APPENDIX H

WILDLIFE TOXICITY AND BIOAVAILABILITY METHODS

UPPER COLUMBIA RIVER

FINAL
Aquatic Baseline Ecological Risk Assessment
Appendix H
Wildlife Toxicity and Bioavailability Methods

Prepared for

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In Association and Consultation with

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July 2026

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ACRONYMS AND ABBREVIATIONS

BERA	baseline ecological risk assessment
COI	chemical of interest
COPC	chemical of potential concern
Eco-SSL	ecological soil screening level
ED20	effective dose with a 20 percent reduction in the response relative to the control (modeled)
EPA	U.S. Environmental Protection Agency
HHRA	human health risk assessment
HPAH	high-molecular-weight polyaromatic hydrocarbon
HQ	hazard quotient
IVBA	in vitro bioaccessibility
OU	operable unit
LOAEL	lowest-observed-adverse-effect level
LOAEL ≥ 20	LOAEL with ≥ 20 percent reduction in the response relative to control
PCB	polychlorinated biphenyl
RBA	relative bioavailability
RFDA	relict floodplain deposition area
RI/FS	Remedial Investigation and Feasibility Study
Site	Upper Columbia River site
TAI	Teck American Incorporated
TEQ	toxic equivalent
TRV	toxicity reference value
UCR	Upper Columbia River
WSDA	windblown sediment deposition area

UNITS OF MEASURE

mg/kg bw/day	milligram(s) per kilogram of body weight per day
ng/kg bw/day	nanogram(s) per kilogram of body weight per day

1 INTRODUCTION

Teck American Incorporated (TAI) conducted evaluations to derive wildlife toxicity reference values (TRVs) and soil relative bioavailability (RBA) factors for use in the baseline ecological risk assessment (BERA) for Operable Unit (OU) 1, OU 2, and the relict floodplain deposition areas (RFDAs) and windblown sediment deposition areas (WSDAs) of the Upper Columbia River (UCR) site (hereafter, the Site[1]). The BERA for these areas is hereafter referred to as the Aquatic BERA. In addition to aquatic-associated receptors of concern, terrestrial receptors of concern are evaluated in the Aquatic BERA, because the data set includes terrestrial soils that may contain metals transported from the river, via either periodic flooding in RFDAs or wind deposition from periodically exposed sediment in certain areas within the river channel in WSDAs (see Sections 2.1 and 3.2.1.1 of Volume 4 for a description of the specific soil samples included as RFDAs and WSDAs). One soil sample from the 2019 Northport Waterfront RI (Ecology 2019) and one sample from the 2014 Soil Study (TAI 2015) were collected from locations below the pre-1973 maximum flood elevation.

TRVs are used to evaluate the potential for adverse effects in birds and mammals based on dietary dose hazard quotient (HQ) calculations. These HQs provide a line of evidence to evaluate risk to terrestrial and aquatic-associated birds and mammals exposed to the chemicals of potential concern (COPCs) identified in the U.S. Environmental Protection Agency (EPA)-approved final COPC Refinement (TAI 2020)[2]. RBA factors are used to calculate daily dietary doses in the Aquatic BERA to adjust total concentrations of metals in sediment and soil to concentrations estimated to be bioavailable for uptake into a receptor's circulatory system.

The objective of this appendix is to present the approach used to derive TRVs and RBA factors used in the Aquatic BERA. The TRVs were derived using approaches developed by TAI that have been reviewed and approved by EPA (Attachment H1 to this appendix).

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[1] As per the June 2, 2006, Settlement Agreement for Implementation of Remedial Investigation and Feasibility Study (RI/FS) at the Upper Columbia River Site (USEPA 2006), the Site consists of the areal extent of hazardous substances contamination within the United States in or adjacent to the UCR, including the Franklin D. Roosevelt Lake, from the U.S.-Canada border to Grand Coulee Dam and all suitable areas in proximity to such contamination necessary for implementation of the response actions (RI/FS) described therein.

[2] The COPC Refinement (TAI 2019) included an addendum that was finalized in January 2020 (TAI 2020). This citation (TAI 2020) is used in the remainder of this appendix to cite the COPC Refinement document.

RBA factors were derived from in vitro bioaccessibility (IVBA) data collected to support the human health risk assessment (HHRA) for the Site.

Section 2 of this appendix provides an overview of how wildlife TRVs were developed, along with the selected TRVs. Section 3 provides an overview of the development of sediment and soil RBA factors and explains why RBA factors were not developed for food (i.e., plants and prey). The detailed TRV derivation methods are presented in Attachments H1 and H2, and the detailed RBA derivation methods are presented in Attachment H3.

2 WILDLIFE TRVs

Dietary dose TRVs were developed to identify the dose resulting in a 20-percent reduction in response relative to the control response for birds and mammals. TRVs are expressed as daily COPC intake rates normalized for body weight of the organism (i.e., mg/kg bw/day) and include separate values for growth, reproduction, and survival endpoints.

Using conservative assumptions, the *Screening-Level Ecological Risk Assessment* (TAI 2010) identified a list of chemicals of interest (COIs) to be carried forward for additional analysis, as well as a list of COIs that were eliminated from further evaluation. The COPC Refinement (TAI 2020) identified COPCs[3] to be evaluated further for both aquatic-associated and terrestrial wildlife receptors. Additionally, the COPC Refinement retained COIs based on uncertainty.[4] The COIs were carried forward to the Aquatic BERA and evaluated alongside COPCs; therefore, the COIs required TRVs for evaluation in the BERA, assuming the necessary data were available. For avian receptors, TRVs needed to be derived for 24 COPCs and COIs, and for mammalian receptors, TRVs needed to be derived for 18 COPCs and COIs (Table H-1).

The wildlife TRV derivation process for five COPCs (i.e., cadmium, copper, lead, manganese, and zinc) is described in the EPA-approved wildlife TRV technical memorandum (Attachment H1). The same approach was used to develop TRVs for the remaining COPCs and COIs, as presented in Attachment H2.

Dietary wildlife TRVs developed for use in the Aquatic BERA are presented in Table H-1. For some COPCs, COIs, and receptor groups, it was not possible to derive a TRV because of a lack of toxicity data; such limitations are shown in Table H-1 and discussed in Attachments H1 and H2.

[3] A COI was considered a COPC for a terrestrial receptor if more than one detected concentration in the soil data set exceeded the ecological soil screening level or other soil screening-level TRV. A COI was considered a COPC for an aquatic-associated receptor if the dietary dose calculated using the 95 percent upper confidence limit of the mean of sediment and prey tissues within the defined exposure area exceeded the dietary dose screening-level TRV.

[4] A COI was retained based on uncertainty for one of the following reasons: COIs were not analyzed; COIs had no benchmark or screening-level TRV; the COI's detection limit exceeded the benchmark or screening-level TRV in more than one sample; or there was a single exceedance of the benchmark or screening-level TRV for a COI in a sample that had at least one other COI exceedance.

3 RELATIVE BIOAVAILABILITY VALUES

RBAs used in the Aquatic BERA for soil and food are summarized in this section and discussed in more detail in Attachment H3.

The amount of a metal absorbed by birds or mammals at the Site is expected to be less than the amount absorbed from exposures during toxicity tests (i.e., metal added to food or water or administered via gavage) used to develop TRVs. Therefore, the use of bioavailability factors allows for a more realistic estimate of the absorption of metals from soil and food items ingested at the Site. In the proceedings of an industry-government workshop on the development of metal cleanup values, Sample et al. (2014) recommended the evaluation of metal bioaccessibility as one component of ecological exposure assessment refinements. For the Site, although IVBA data were generated using a method designed for HHRA purposes, pursuant to Sample et al. (2014), those data are also useful for improving wildlife exposure estimates. Bioaccessibility analyses have been used in ecological risk assessments at other sites, including the Coeur d'Alene Superfund site (USEPA 2001).

3.1 SOIL

Sediment and soil RBA factors for the Aquatic BERA were developed using IVBA data collected to support the UCR HHRA (TAI 2015). IVBA analyses simulate the conditions in an organism's gut to provide an estimate of the fraction of an ingested chemical available for absorption from the gastrointestinal tract. IVBA data, if available, are used in conjunction with regression equations from the literature to calculate RBA factors; if no IVBA data are available, conservative assumptions are used. Attachment H3 provides a comprehensive description of the approach and data set used to develop soil and sediment RBA factors, the basis of the selected values, and how the values are applied. The calculated RBA factors for samples in the Aquatic BERA data set are presented in Tables H3.A-1 and H3.A-2 of Attachment H3.

3.2 FOOD

As described in Attachment H3, there are no Site-specific wildlife food bioaccessibility data. As to developing generic, literature-based bioaccessibility estimates, that approach entails considerable uncertainty because of the lack of literature data for metal bioaccessibility in dietary items relevant to wildlife at the Site, as well as the high variability among bioaccessibility results when data are available. In addition, there are

uncertainties associated with differences among extraction methods for determining bioaccessibility in different species. There is also a lack of validation studies specific to metals biologically incorporated in the diet from which relative bioavailability can be derived. Therefore, the Aquatic BERA assumes an RBA of 100 percent for food items in dietary exposures, which is conservative. Uncertainty associated with this conservative assumption is evaluated as part of the uncertainty analysis for wildlife in the Aquatic BERA.

4 REFERENCES

Ecology (Washington State Department of Ecology). 2019. Draft-Final Remedial Investigation, Northport Waterfront. Prepared for the Washington State Department of Ecology by GeoEngineers, Inc., Spokane, WA.

Sample, B.E., C. Schlekat, D.J. Spurgeon, C. Menzie, J. Rauscher, and B. Adams. 2014. Recommendations to Improve Wildlife Exposure Estimation for Development of Soil Screening and Cleanup Values. *Integr. Environ. Assess. Manag.* 10(3):372–387.

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USEPA. 2001. Final Ecological Risk Assessment Coeur d'Alene Basin Remedial Investigation/Feasibility Study. Prepared by CH2M HILL and URS Corporation for the U.S. Environmental Protection Agency Region 10, Seattle, WA.

USEPA. 2006. Settlement Agreement for Implementation of Remedial Investigation and Feasibility Study at the Upper Columbia River Site. U.S. Environmental Protection Agency. U.S. Environmental Protection Agency, Washington, DC.

TABLES

Table H-1. Dietary TRVs for Wildlife

COPC/COI	Terrestrial COPC or COI	Aquatic-Associated COPC or COI	Units	Growth		Reproduction		Survival		Documentation
				TRV	TRV Type	TRV	TRV Type	TRV	TRV Type	
Birds [a]										
Aluminum	COI	COPC	mg/kg bw/day	150	ED20	none	NA	560	LOAEL ≥ 20	Attachment H2
Antimony	COI	COI	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H2
Arsenic	not a COPC or COI	COPC	mg/kg bw/day	20	LOAEL ≥ 20	40	LOAEL ≥ 20	6.9	ED20	Attachment H2
Barium	COI	COPC	mg/kg bw/day	480	ED20	none	NA	890	LOAEL ≥ 20	Attachment H2
Beryllium	COI	COI	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H2
Cadmium	COPC	COPC	mg/kg bw/day	2.0	ED20	2.3	ED20	7.4	ED20	Attachment H1
Chromium (III)	COPC	COPC	mg/kg bw/day	510	LOAEL ≥ 20	none	NA	none	NA	Attachment H2
Copper	COPC	COPC	mg/kg bw/day	62	ED20	28	ED20	67	ED20	Attachment H1
Iron	COI	COI	mg/kg bw/day	160	LOAEL ≥ 20	none	NA	1,100	ED20	Attachment H2
Lead	COPC	COPC	mg/kg bw/day	29	LOAEL ≥ 20	4.7	geometric mean	11	ED20	Attachment H1
Manganese	not a COPC or COI	COPC	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H1
Methylmercury	COI	COPC	mg/kg bw/day	0.97	ED20	0.012	ED20	0.051	LOAEL ≥ 20	Attachment H2
Molybdenum	COI	COPC	mg/kg bw/day	100	ED20	36	ED20	610	ED20	Attachment H2
Nickel	not a COPC or COI	COPC	mg/kg bw/day	7	ED20	6.71	Eco-SSL	60	ED20	Attachment H2
Selenium	COPC	COPC	mg/kg bw/day	0.29	Eco-SSL	0.55	ED20	0.59	LOAEL ≥ 20	Attachment H2
Thallium	COI	not a COPC or COI	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H2
Vanadium	COPC	COPC	mg/kg bw/day	1.2	ED20	2.1	LOAEL ≥ 20	2.4	ED20	Attachment H2
Zinc	COPC	COPC	mg/kg bw/day	66	Eco-SSL	77	ED20	250	LOAEL ≥ 20	Attachment H1
Bis(2-ethylhexyl)phthalate	not a COPC or COI	COPC	mg/kg bw/day	none	NA	350	LOAEL ≥ 20	none	NA	Attachment H2
Di-n-butyl phthalate	not a COPC or COI	COPC	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H2
HPAHs	not a COPC or COI	COPC	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H2
PCBs	not a COPC or COI	COPC	mg/kg bw/day	none	NA	0.56	ED20	none	NA	Attachment H2
Dioxin/furan TEQ	not a COPC or COI	COPC	ng/kg bw/day	none	NA	none	NA	1,000	LOAEL ≥ 20	Attachment H2
Total TEQ	not a COPC or COI	COPC								
UCR Receptor-Specific Bird TRVs [a]										
Aluminum - mallard	NA	COPC	mg/kg bw/day	500	LOAEL ≥ 20	none	NA	none	NA	Attachment H2
Cadmium - mallard	NA	COPC	mg/kg bw/day	41	ED20	20	LOAEL ≥ 20	39	LOAEL ≥ 20	Attachment H1
Copper - mallard	NA	COPC	mg/kg bw/day	none	NA	none	NA	130	geometric mean	Attachment H2
Methylmercury - American kestrel	COI	NA	mg/kg bw/day	none	NA	0.25	ED20	none	NA	Attachment H2
Methylmercury - mallard	NA	COPC	mg/kg bw/day	none	NA	0.68	ED20	none	NA	Attachment H2
Nickel - mallard	NA	COPC	mg/kg bw/day	87	ED20	none	NA	80	ED20	Attachment H2
Selenium - mallard	NA	COPC	mg/kg bw/day	1.6	ED20	0.56	ED20	4.7	geometric mean	Attachment H2
Zinc - mallard	NA	COPC	mg/kg bw/day	200	ED20	none	NA	330	LOAEL ≥ 20	Attachment H1
Mammals [a]										
Aluminum	COI	COPC	mg/kg bw/day	400	LOAEL ≥ 20	27	ED20	400	LOAEL ≥ 20	Attachment H2
Antimony	COPC	COPC	mg/kg bw/day	none	NA	none	NA	none	NA	Attachment H2
Barium	not a COPC or COI	COPC	mg/kg bw/day	440	ED20	none	NA	200	LOAEL ≥ 20	Attachment H2
Cadmium	COPC	COPC	mg/kg bw/day	4.2	ED20	2.7	ED20	1.5	ED20	Attachment H1
Chromium (III)	COPC	COPC	mg/kg bw/day	110	LOAEL ≥ 20	91	LOAEL ≥ 20	none	NA	Attachment H2
Copper	COPC	COPC	mg/kg bw/day	12	ED20	27	LOAEL ≥ 20	8.7	geometric mean	Attachment H1
Iron	COI	COI	mg/kg bw/day	140	geometric mean	none	NA	870	ED20	Attachment H2
Lead	COPC	COPC	mg/kg bw/day	20	LOAEL ≥ 20	4.7	Eco-SSL	7.6	ED20	Attachment H1

Table H-1. Dietary TRVs for Wildlife

COPC/COI	Terrestrial COPC or COI	Aquatic-Associated COPC or COI	Units	Growth		Reproduction		Survival		Documentation
				TRV	TRV Type	TRV	TRV Type	TRV	TRV Type	
Mammals [a] (continued)										
Manganese	not a COPC or COI	COPC	mg/kg bw/day	71	LOAEL ≥ 20	310	ED20	91	ED20	Attachment H1
Methylmercury	COI	COPC	mg/kg bw/day	0.65	LOAEL ≥ 20	0.23	LOAEL ≥ 20	0.24	ED20	Attachment H2
Molybdenum	COI	COPC	mg/kg bw/day	28	LOAEL ≥ 20	4.5	ED20	none	NA	Attachment H2
Selenium	COPC	COPC	mg/kg bw/day	0.33	ED20	5.0	LOAEL ≥ 20	0.61	LOAEL ≥ 20	Attachment H2
Thallium	COI	not a COPC or COI	mg/kg bw/day	2.6	ED20	none	NA	2.1	ED20	Attachment H2
Zinc	COPC	COPC	mg/kg bw/day	75	Eco-SSL	75	Eco-SSL	190	geometric mean	Attachment H1
PCBs	not a COPC or COI	COPC	mg/kg bw/day	none	NA	0.082	LOAEL ≥ 20	none	NA	Attachment H2
PCB TEQ Dioxin/furan TEQ Total TEQ	not a COPC or COI	COPC	ng/kg bw/day	10	ED20	0.77	ED20	29	LOAEL ≥ 20	Attachment H2
UCR Receptor-Specific Mammal TRVs [a]										
Cadmium - wolf	COPC	NA	mg/kg bw/day	100	LOAEL ≥ 20	none	NA	none	NA	Attachment H2
Copper - mink	NA	COPC	mg/kg bw/day	35	LOAEL ≥ 20	27	LOAEL ≥ 20	35	LOAEL ≥ 20	Attachment H1
PCB TEQ - mink Dioxin/furan TEQ - mink Total TEQ - mink	NA	COPC	ng/kg bw/day	54	LOAEL ≥ 20	0.77	ED20	54	LOAEL ≥ 20	Attachment H2

Notes:

[a] Toxicity reference values (TRVs) for birds and mammals are generic levels applied to all representative receptors in the Baseline Ecological Risk Assessment (BERA) for which receptor-specific data are not available. American kestrel, mallard, mink, and wolf are representative receptors for which receptor-specific data are available.

COI - chemical of interest

COPC - chemical of potential concern

Eco-SSL - ecological soil screening level

ED20 - effective dose with a 20 percent reduction in the response relative to the control (modeled)

HPAH - high-molecular-weight polyaromatic hydrocarbon

LOAEL - lowest-observed-adverse-effect level

NA - not applicable

PCB - polychlorinated biphenyl

TEQ - toxic equivalent

ATTACHMENT H1

APPROVED WILDLIFE TRV MEMO

McCaig Kris SPOK

From: Cerise, Kathy <Cerise.Kathryn@epa.gov>
Sent: Friday, June 7, 2019 1:31 PM
To: Mills Denise SPOK
Cc: McCaig Kris SPOK; Gauthier, Marilyn/PDX
Subject: RE: EPA response to Wildlife TRV responses to comments

[External email]

Denise,

EPA has reviewed the May 22, 2019 revised UCR Wildlife TRV document. The revisions are acceptable and we have no further comments.

Thank you

Kathryn Cerise

Kathryn Cerise
Region 10 Remedial Project Manager
1200 6th Ave,
Seattle, WA 98101
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From: Mills Denise SPOK <Denise.Mills@teck.com>
Sent: Wednesday, May 22, 2019 4:00 PM
To: Cerise, Kathy <Cerise.Kathryn@epa.gov>
Cc: McCaig Kris SPOK <Kris.McCaig@teck.com>; johnt@windwardenv.com; Jennifer Holder <Jennifer.Holder@erm.com>; Kessel Cristy SPOK <Cristy.Kessel@teck.com>
Subject: RE: EPA response to Wildlife TRV responses to comments

Hello Kathy,

Please see the attached files with our response to EPA's comments on the Revised Draft Final Wildlife TRV document and document files that have been updated in response to those comments.

Please contact me or Kris if you have questions.

Thank you,

Denise

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From: Cerise, Kathy <Cerise.Kathryn@epa.gov>
Sent: Thursday, March 28, 2019 3:49 PM
To: McCaig Kris SPOK <Kris.McCaig@teck.com>
Cc: Mills Denise SPOK <Denise.Mills@teck.com>
Subject: EPA response to Wildlife TRV responses to comments

[External email]

Kris,

Attached is EPAs response to TAIs Wildlife TRVs document. Please let me know if you have any questions or concerns.

Thanks

Kathryn Cerise
UCR RPM

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July 8, 2019

File No.: 01-773180-000

Ms. Kathryn Cerise
Project Manager, Office of Environmental Cleanup
U.S. Environmental Protection Agency, Region 10
1200 6th Avenue, Suite 900
Mail Code 12 D12-1
Seattle, WA 98101

VIA ELECTRONIC MAIL ONLY

Subject: Upper Columbia River Remedial Investigation and Feasibility Study – Final Wildlife Toxicity Reference Values for the Baseline Ecological Risk Assessment: Methods and Results for Five Metals (July 2019)

Dear Kathy:

On behalf of Teck American Incorporated and further to your June 7, 2019 email indicating the U.S. Environmental Protection Agency's approval of the above-referenced toxicity reference values document, I am pleased to submit the final document for your records. This document is accessible to registered users via the secure domain of the project website (www.ucr-rifs.com).

Please contact me at (509) 623-4515 if you have questions or require additional information.

Sincerely,

Teck American Incorporated.

Denise Mills
Program Manager, Upper Columbia River

Enclosure: 1) *Final Wildlife Toxicity Reference Values for the Baseline Ecological Risk Assessment: Methods and Results for Five Metals* (July 2019)

cc: Dr. John Toll, Windward, Seattle, WA
Dr. Jennifer Holder, ERM, Carpinteria, CA
Kris McCaig, Teck American Incorporated, Spokane, WA
Cristy Kessel, Teck American Incorporated, Spokane, WA

UPPER COLUMBIA RIVER

FINAL
Wildlife Toxicity Reference Values for the Baseline Ecological Risk Assessment: Methods and Results for Five Metals

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In Association and Consultation with

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July 2019

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ACRONYMS AND ABBREVIATIONS

AWQC	ambient water quality criteria
BERA	baseline ecological risk assessment
BMDS	Benchmark Dose Software
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COI	chemical of interest
COPC	chemical of potential concern
DART	Developmental and Reproductive Toxicology
EC	effect concentration
EC5	concentration that causes a 5 percent effect
EC10	concentration that causes a 10 percent effect
EC20	concentration that causes a 20 percent effect
Eco-SSL	ecological soil screening level
ECOTOX	ECOTOXicology knowledgebase
ED	effect dose
ED20	dose that causes a 20 percent effect
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FIR	food ingestion rate
HQ	hazard quotient
IRIS	Integrated Risk Information System
ITER	International Toxicity Estimates for Risk
LOAEL	lowest-observed-adverse-effect level
LOEC	lowest-observed-effect-concentration
NOAEL	no-observed-adverse-effect level
NOEC	no-observed-effect-concentration
SLERA	screening-level ecological risk assessment

TAI	Teck American Incorporated
TOXLINE	Toxicology Literature Online
TOXNET	Toxicology Data Network
TRAP	Toxicity Relationship Analysis Program
TRV	toxicity reference value
UCR	Upper Columbia River
Windward	Windward Environmental LLC

UNITS OF MEASURE

dw	dry weight
g	gram(s)
kg	kilogram(s)
kg/d	kilogram(s) per day
mg/kg	milligram(s) of metal per kilogram
mg/kg bw/day	milligram(s) of metal per kilogram of body weight per day
ww	wet weight

1 INTRODUCTION

This document presents methods for selecting wildlife toxicity reference values (TRVs) for use in the Upper Columbia River (UCR) baseline ecological risk assessment (BERA). A TRV is a concentration or dose of a substance that, when administered to a test population of organisms in a well-designed experiment (usually conducted under well-controlled laboratory conditions), results in a specified toxic effect on a prescribed number or percentage of the organisms in the exposed test population. A TRV is used in combination with an estimate of the amount and duration of exposure to a substance to determine whether a wildlife receptor may be adversely affected from the exposure. Along with methods for TRV derivation, this document presents the wildlife TRVs selected for cadmium, copper, lead, manganese, and zinc—the five metals that were labeled chemicals[1] of potential concern (COPCs) for the UCR based on preliminary screening assessments (Parametrix et al. 2010a; Windward 2018). The wildlife TRVs identified in this document will be used in the BERA to evaluate whether COPC exposures are sufficient to adversely affect wildlife assessment endpoints. Uncertainties about the strength, relevance, and reliability of the studies used to derive the TRVs are described in this document. This will support the discussion in the BERA about the weight to be placed on the use of hazard quotients for assessing wildlife risk and the weight to be placed on each TRV derived for a particular COPC.

[1] Metals (i.e., the elements) are identified as COPCs for the sake of expediency, but before any conclusive statements about risk from exposure to metals can be made, the fate of those metals must be adequately understood. The fate of metals is affected by several factors, including the chemical compounds they form in the environment, the transformations they undergo as environmental conditions change, the influence that fate has on the nature and extent of interactions between organisms and metal compounds, and how those interactions and toxicity relate to one another. Metals are natural elements that form chemical compounds. To determine the hazards that a particular compound and its elements pose in the environment, it is important to understand the compound's properties and its elemental composition.

2 APPROACH

Teck American Incorporated (TAI) and the U.S. Environmental Protection Agency (EPA) reached agreement on TRV development methods through a series of written communications (USEPA 2016a, 2015b; TAI 2015) and meetings (conference call on August 14, 2015; meeting on January 20, 2016; and conference call on March 27, 2017).[2] Principles upon which TAI and EPA agree include the following:

- TRVs should be based on data from experiments designed to control other factors that could confound data interpretation, such as the presence of other substances, an unhealthy test population, an incorrect feeding regime, or other factors that create a stressful environment.
- TRVs should be predictive of dietary toxicity (i.e., the measured toxic effect should be reproducible). For the UCR BERA, a 20 percent effect level will be used to set TRVs. The uncertainty regarding lower response levels (i.e., in the tails of the dose-response curves) is generally too high to be able to determine if the effect is statistically different from the control.
- Because 20 percent growth reduction, 20 percent reduction in a reproductive endpoint, and 20 percent mortality are not necessarily equivalent effects, it makes sense to derive TRVs for each type of endpoint (growth, survival, and reproduction).
- Experiments that produce a dose- or concentration-response relationship between the substance tested and the test population are better than experiments that do not. A benchmark dose modeling approach is appropriate to estimate a 20 percent effect level for such experiments.
- If a 20 percent effect level cannot be selected from a modeled dose-response curve and a lowest-observed-adverse-effect level (LOAEL) must be used as a selected TRV, then the level of effect associated with the LOAEL must represent a ≥ 20 percent reduction in the response compared to the control.
- Unbounded no-observed-adverse-effect levels (NOAELs) (i.e., NOAELs from experiments that do not also report a LOAEL) should not be used to set TRVs; however, these data are useful in evaluating the range of exposures over which effects were not

[2] The purpose of the conference call on August 14, 2015, with TAI, TAI's consultants, and EPA, was to discuss the wildlife TRV strawman approach. At the meeting on January 20, 2016, Windward (on behalf of TAI) gave a presentation to EPA, the Confederated Tribes of the Colville Reservation, the Spokane Tribe of Indians, and other interested agencies on the status of the TRV development approach, and responded to EPA's written comments provided in December 2015. The purpose of the conference call on March 27, 2017, with TAI, TAI's consultants, and EPA, was to provide a status report on wildlife TRV development and respond to EPA's written comments from June 2016.

observed. Unbounded LOAELs (i.e., LOAELs from experiments that did not also report a NOAEL) are considered acceptable for use in deriving TRVs.

- Metals toxicity data for ruminants should not be used to set TRVs for nonruminant mammals because differences in the ruminant and nonruminant digestive tracts significantly affect the fate of consumed metals[3].

The selection of COPCs for TRV development in this document, the approach for dose modeling, and the rationale for the 20 percent effects level are discussed in the sections below.

2.1 CHEMICALS OF POTENTIAL CONCERN

The selection of COPCs for aquatic and terrestrial UCR receptors is in progress. The first step of the COPC identification process was the screening-level ecological risk assessment (SLERA) (Parametrix et al. 2010b), which included an initial evaluation to determine if there were adequate data for a given chemical of interest (COI) to eliminate it from further evaluation. For aquatic wildlife receptors, a draft refined COPC screen was submitted to EPA as an additional screening step after the SLERA to identify the list of COPCs to be carried forward for further analysis in the BERA (Exponent and HDR 2015). A draft final COPC refinement document, including a screen for both aquatic and terrestrial wildlife receptors, was submitted to EPA for review in July 2018 (Windward 2018).

COPCs identified in the draft final refinement document are listed in Table 2-1. As a preliminary effort to prioritize the TRV search, Windward Environmental LLC (Windward) focused on developing TRVs for the following five COPCs:

- Cadmium
- Copper
- Lead
- Manganese
- Zinc.

The path forward for TRV development for the remaining COPCs identified in Table 2-1 will be determined after TAI and EPA have agreed on the TRV development methods, and after the COPC list has been finalized.

[3] Focal species to represent the herbivorous feeding guild for mammals have not yet been selected; however, the vole was selected as the focal species for the COPC refinement. Metals toxicity data for ruminants will be revisited if a ruminant is selected as a focal species.

2.2 DOSE MODELING APPROACH

Typically, ecological effects thresholds are represented by either published national and regional guidelines or threshold effect screening levels (hereafter referred to as effects thresholds), or NOAEL and LOAEL TRVs derived from toxicological literature. Both NOAELs and LOAELs are commonly used in ecological risk assessments (ERAs) in accordance with EPA guidance (USEPA 1997, 1998).

When data are adequate to define a curve, TRVs may be expressed from a dose-response function wherein the effects threshold is the defined dose resulting in X percent reduction in an endpoint (i.e., effect dose [ED]X) relative to control. TRVs may also be expressed as a concentration response (i.e., effect concentration [EC]X); however, the TRVs developed in this document are expressed as doses rather than concentrations. The approach for determining an EDX involves modeling a dose-response curve for a toxicity dataset to estimate the response at a selected percent reduction. This approach is recommended over the NOAEL/LOAEL approach because NOAELs and LOAELs correspond to inconsistent response levels across studies, endpoints, and chemicals (USEPA 2012b). The EDX modeling approach has been described in recent scientific literature (Mayfield et al. 2013; Allard et al. 2010) and EPA guidance (USEPA 2012b). This approach also has been used in previous EPA Region 10 risk assessments, i.e., for the derivation of TRVs in the Coeur d'Alene BERA (URS and CH2M HILL 2001) and for the evaluation of polychlorinated biphenyls and mink in the Portland Harbor BERA (Windward 2013).

The approach for deriving TRVs described in this document involves modeling toxicity test data to derive an EDX using the Toxicity Relationship Analysis Program (TRAP) software developed by EPA (USEPA 2015c), which is described in more detail in Section 3.5.

2.3 ACCEPTABLE LEVEL OF EFFECT

A 20 percent effect level was selected for deriving modeled dietary toxicity thresholds for wildlife TRVs for the UCR BERA. A 20 percent effect level is consistent with EPA's guidance for a variety of receptors, including wildlife. These guidance examples include ambient water quality criteria (AWQC), ecological soil screening levels (Eco-SSLs), whole-effluent toxicity testing, and ERA, as follows:

- EPA's recent AWQC for ammonia (USEPA 2013) and cadmium (USEPA 2016b) use 20 percent effect concentrations in water (i.e., EC20s [concentrations that cause a 20 percent effect]) to derive chronic criteria for the protection of aquatic organisms; EC20s were also considered acceptable chronic toxicity values in deriving carbaryl AWQC (USEPA 2012a). As noted by EPA (2016b), "The endpoint for chronic exposure is the EC20, which represents a 20 percent effect/inhibition concentration. This is in contrast

to concentrations that cause a low level of reduction in response, such as EC5s or EC10s (concentrations that result in 5 and 10 percent effects, respectively), which are rarely statistically significantly different from the control treatment. EPA selected an EC20 to estimate a low level of effect that would be statistically different from control effects, but not severe enough to cause chronic effects at the population level (USEPA 1999). Reported no-observed-effect-concentrations (NOECs) and lowest-observed-effect-concentrations (LOECs) in water were only used for the derivation of chronic criterion when an EC20 could not be calculated for the genus." This quotation refers to the 1999 updated AWQC for ammonia (USEPA 1999) in which EC20 was first used.

- EPA's guidance for developing Eco-SSLs provides the following hierarchy for compiling toxicity endpoints for plants and soil: EC20 > maximum allowable toxicant concentration > EC10 (USEPA 2005).
- In the Eco-SSLs, EPA used a default effect value of 20 percent of the control to evaluate toxicological studies for the purpose of deriving wildlife TRVs, based on the assumption that "most experimental studies cannot detect smaller changes with acceptable power, and that changes of 20 percent or less will often not result in population level impacts, as least for many endpoints" (USEPA 2005).
- Suter and Tsao (1996) used EC20s to define chronic toxicity values for the development of toxicity benchmarks for aquatic life. The authors noted that the benchmarks were intended to be indices of population production, and were chosen as approximately the mean level of effect on individual response parameters observed at chronic values (defined as the geometric mean of the NOEC and LOEC), and as minimum detectable differences in population characteristics in the field.
- Efroymson et al. (1997) used a 20 percent effect level as the threshold for defining NOECs and LOECs for terrestrial plants. The NOEC was defined as the highest concentration of the chemical that produced a reduction of 20 percent or less in a measured response, and the LOEC was defined as the lowest concentration that resulted in a greater than 20 percent reduction in a measured response. The authors noted that concentrations resulting in statistically significant effects relative to the control were generally associated with greater than 20 percent effects, and that the 20 percent effects level was therefore treated as a conservative approximation of the threshold for regulatory concern.

If toxicity test data met the criteria for modeling using the TRAP software (see Section 3.6 for a discussion of conditions under which data were modeled), the ED20 (dose that causes a 20 percent effect) was the effect level selected from the test's response curve. If toxicity test data were not modeled, then the LOAEL from the study, calculated as the effect relative to the control, was used as the effect level if the reduction in the observed response was at least 20 percent.

3 METHODS

This section describes the approach for deriving TRVs using the seven-step process shown in Figure 3-1. An overview of the process is discussed below, followed by detailed descriptions of each step in Sections 3.1 through 3.7. After literature was compiled for dietary toxicity studies measuring growth, reproduction, and survival, acceptability criteria were applied to eliminate studies that were not considered appropriate for use in TRV derivation. A tiered process was applied to identify preferred studies for TRV selection, as well as secondary studies for inclusion if preferred studies were not available. Based on the tiered process, a subset of acceptable studies was reviewed in detail to compile dose-response datasets. For each of these datasets, either an ED20 (from TRAP modeling) or an effect level with at least a 20 percent reduction in the observed response relative to the control (abbreviated as the LOAEL ≥ 20) was derived. The TRV selected for each chemical, receptor group (i.e., birds and mammals), and endpoint (growth, reproduction, and survival) was the lowest ED20 or LOAEL ≥ 20 from the lowest tier (i.e., preferred studies) within each respective group. Uncertainties in the selected TRVs were evaluated to determine reliability in TRVs and potential bias for use in interpreting the risk estimates in the BERA.

3.1 LITERATURE COMPILATION (STEP 1)

The first step in the TRV derivation process was to conduct a thorough literature search for toxicological studies of the five COPCs using birds or mammals. The following sources were searched for studies related to growth, reproduction, and survival to potentially be used in the selection of TRVs for each COPC and receptor group (i.e., bird or mammal):

- EPA's Eco-SSLs—Includes a list of studies reviewed for use in the derivation of screening-level TRVs for avian and mammalian receptors
- Windward TRV database—Includes all studies reviewed and used in TRV development for EPA Region 10 sites (Portland Harbor and the Lower Duwamish Waterway), as well as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites from other EPA regions[4]

[4] The Windward TRV database for cadmium, copper, lead, manganese, and zinc includes over 150 dietary toxicity studies evaluating the effects on a variety of bird and mammal receptors. These studies were obtained through 2010 using the same general literature search methods described in this section.

- General literature search—A literature search was conducted using the U.S. National Library of Medicine's Toxicology Data Network (TOXNET),[5] the ECOTOXicology knowledgebase (ECOTOX) database, and Google Scholar, to ensure that sources for the UCR TRV derivation included more recent studies not included in EPA's Eco-SSLs or compiled as part of past Windward projects.

For the ECOTOX and TOXNET database searches, the following keywords and Boolean terms were used: (cadmium OR copper OR lead OR manganese OR zinc) AND (bird OR chicken OR duck OR quail OR bobwhite OR mallard OR turkey OR kestrel OR mammal OR rat OR mouse OR mice OR shrew OR rabbit OR mink OR cat OR monkey OR hamster OR pig OR vole OR dog) AND (diet OR gavage). The titles and abstracts retrieved were reviewed, and if any relevant endpoints (i.e., growth, reproduction, and survival) were identified, the paper was obtained for potential inclusion in the TRV derivation process. If papers could not be obtained from an online source, they were requested through the University of Washington's interlibrary loan service.

3.2 STUDY ACCEPTABILITY (STEP 2)

For the second step in the TRV derivation process, the studies compiled in Step 1 were evaluated to determine whether they could be used to derive TRVs for each COPC and receptor group for use in the UCR BERA. EPA's guidance for use of strength, relevance, and reliability in evaluating the weight of evidence in ERAs (USEPA 2016c) was applied in the process of determining whether the studies reviewed were acceptable for TRV derivation, listed by evaluation category:

Strength

- Studies in which effects were reported for relevant endpoints for the control, and at least one dose level, were considered acceptable. Unbounded NOAELs (i.e., dose levels from studies in which no level produced a statistically significant observed effect) were not included. Unbounded LOAELs (i.e., LOAELs from studies that did not report a NOAEL) were considered acceptable.
- Only toxicity studies based on exposure to a single chemical were included as acceptable. This criterion generally excluded the use of field studies.
- Study exposure duration was not a factor in determining study acceptability, although the Eco-SSL derivation procedure did not include studies that were < 3 days in duration.

[5] Within TOXNET, the following databases were searched: 1) Developmental and Reproductive Toxicology (DART), 2) Toxicology Literature Online (TOXLINE), 3) Integrated Risk Information System (IRIS), and 4) International Toxicity Estimates for Risk (ITER).

Relevance

- Only studies that included survival, growth, or reproductive endpoints were used to be consistent with assessment endpoints defined in the UCR Expanded Problem Formulation (Exponent and HDR|HydroQual 2012). Studies that considered only endpoints such as behavior, biochemistry, pathology, population dynamics, or physiology were not included. In addition, studies that used reproductive effect measures that are not directly associated with reproductive success (e.g., egg weight, eggshell thickness, testes weight, sperm count) were not included. Table 3-1 lists specific effect measures from Eco-SSL growth, reproduction, and survival studies that were used, as well as those that were excluded.
- All routes of oral exposure were considered acceptable (e.g., dietary, gavage, drinking water); exposures by intraperitoneal injection, egg injection, inhalation, or any other routes were not considered acceptable. However, studies using dietary or gavage exposures were given preference over those using drinking water exposures in Step 3 of the TRV derivation process. Drinking water studies were included only if the number of studies with dietary or gavage exposures was considered insufficient (see Section 3.3).
- Studies with ruminants (i.e., cows, goats, and sheep) were not included because it was not considered appropriate to apply toxicity data for animals with rumens to monogastric animals. Metal uptake and toxicity in ruminants are influenced by the reducing environment in the rumen, which produces sulfur-reducing micro-organisms. Excess metals become bound in indigestible sulfides in ruminants, which results in differences in how metals are absorbed and eliminated (NRC 2005). A focal species has not yet been selected to represent herbivorous mammals for the BERA, although vole was used in the COPC refinement (Windward 2018). If a ruminant species is selected, the toxicity data for cows, goats, and sheep will be reviewed to ensure that the selected UCR TRVs are protective of ruminants.

Reliability

- Only studies that could be obtained and reviewed were considered acceptable. Primary data must have been included for a study to be acceptable; review or summary articles that mentioned a study and its results were screened out.
- Only controlled toxicity studies that used standardized or peer-reviewed experiment methods were considered acceptable.

Studies that were not considered acceptable for TRV derivation are documented in Appendix A (Tables A-2 to A-11 for studies from the Eco-SSL documents and Table A-12 for additional studies found), along with the rationale for exclusion.

3.3 STUDY SELECTION PROCESS (STEP 3)

The third step of the TRV derivation process was to narrow the list of studies to be reviewed for the extraction of the most relevant toxicity data for TRV derivation. Preferred studies included:

- Studies that administered the dose by diet or gavage, as opposed to drinking water
- Growth studies conducted during a critical life stage (i.e., while a juvenile or during a reproductive period) or long-term, chronic growth studies (i.e., conducted for at least 10 percent of the species' lifespan).

Drinking water was not a preferred exposure route because chemicals are generally taken up more readily from water than from food in a laboratory setting, and exposure to chemicals in the field is generally substantially higher from food than from water (i.e., two to three orders of magnitude). For example, in the SLERA, the daily dose of individual metals from food ingestion (expressed as mg/kg bw/day) was generally at least three orders of magnitude greater than the daily dose from water (Parametrix et al. 2010a).

Growth studies conducted during a noncritical life stage were not preferred because adult receptors in a nonreproductive phase are not considered as susceptible to effects as are juveniles or reproducing adults (i.e., pregnant or lactating females). In addition, short-term growth studies conducted for less than 10 percent of the species' lifespan do not represent chronic exposures and are less preferable than longer-term studies, which have a greater likelihood of representing potential adverse effects at a population level as a result of a change in body weight over time.

A two-tiered process was applied to select studies for data extraction using the study preferences described above. The studies were classified as follows:

- Tier 1
  - Dietary or gavage exposure (including exposure by capsule—identified as "oral" exposure in the Eco-SSL documents)
  - Growth endpoint exposure period during a critical life stage or for at least 10 percent of the species' lifespan (see Tables 3-2 and 3-3 for toxicity test species' critical life stages and lifespans, respectively, used for this determination)[6]

[6] The age of an organism used in a specific study was compared to the critical life stage age presented in Table 3-2. If the EcoSSL did not present the age of the organism but indicated that the organism was a juvenile, then it was assumed that the test had been conducted during a critical life stage.

- Tier 2
  - Drinking water exposure
  - Growth endpoint exposure period during a noncritical life stage or for less than 10 percent of the species' lifespan.

After acceptable studies were selected based on Step 2 (described in Section 3.2), a tier was assigned to each acceptable study. For the Eco-SSL studies, information used to assign the tier was obtained from the Eco-SSL documents (see Appendix A, Tables A-2 to A11); the assigned tiers and rationale are provided in Appendix A (Tables A-13 through A-22). Studies that had been obtained from sources other than the Eco-SSL documents were reviewed to determine the tier based on information provided in the paper, as shown in Table A-12 of Appendix A.

Eco-SSL studies were prioritized for selection, first by tier (Tier 1 ranked higher than Tier 2) and then by LOAEL (ranked from lowest to highest). The top five studies for each chemical/receptor/endpoint based on the study prioritization were selected and reviewed to determine if there were at least five datasets with a LOAEL ≥ 20. Additional studies were then selected as necessary in order of ranking until there were at least five datasets with a LOAEL ≥ 20. Each set of dose-response results from a study was considered a separate dataset in cases where multiple tests were conducted with different species, chemical forms, exposure durations, or effect measures. For example, Sutou et al. (1980) described a specific test conducted with rats that evaluated both the number of live fetuses and the fetal body weights. In this case, the dose responses for live fetuses and the dose responses for fetal body weights were reported as separate datasets. In addition, in some growth studies body weights were recorded separately for males and females of the same species. In cases where results differed between sexes, the dose-response curves for males and females were considered unique datasets.

Additional studies selected for data extraction (in addition to the top-ranked studies with a total of at least five datasets with a LOAEL ≥ 20) were as follows:

- Studies that had comparable data that could be pooled in the generation of ED20s or TRV derivation process (i.e., if data were based on the same effect measure, species, chemical form, and method of dose administration; for growth studies, a similar exposure duration).
- Studies conducted with a species not represented in any of the other selected studies; at least one additional study was reviewed for each new species (selected according to rank by tier and LOAEL value).

- Studies that were not included in the Eco-SSL documents were only selected if they were assigned a tier that was included for review based on the above procedure within each specific chemical, receptor, and endpoint group. For example, if review of Eco-SSL studies for lead/birds/growth resulted in the selection of only Tier 1 studies, then only Tier 1 studies for lead/birds/growth were selected from the non-Eco-SSL group.

The number of studies selected for data extraction and the number of acceptable datasets (i.e., LOAEL ≥ 20) for each chemical, receptor, and endpoint group are summarized in Table 3-4. Details on the rationale for determining whether to select a study for data extraction are provided in Appendix A (Tables A-13 to A-22).

3.4 DATA EXTRACTION AND COMPILATION (STEP 4)

The fourth step in the TRV derivation process involved extracting data from each selected toxicological study and compiling the relevant information needed for TRV derivation. Only studies that were selected based on the tiered process described in Step 3 were used to extract data for the derivation of the TRV.

The doses and their corresponding response levels from each unique dataset were compiled into dose-response datasets for each chemical, receptor, and endpoint (growth, survival, and reproduction). The data extracted from the toxicological studies for each dose-response dataset included the following:

- Species and life stage
- Chemical form
- Endpoint detail (i.e., effect measure)
- Exposure mode and duration
- Concentration in food (mg/kg)
- Dose (mg/kg bw/day) as presented by the study, or as calculated from organism body weight and food ingestion rate (FIR) if no dose was reported
- Organism body weight and FIR for conversion of food concentration to a dose if the study did not report the dose; preferably, body weight and FIR came from the study, but a secondary source was used if either or both were not reported in the study
- Sample size
- Effect observed at each dose or concentration, including the control
- Control-normalized effect, calculated as the dose effect divided by the control effect and multiplied by 100
- Standard error, standard deviation, and/or statistical results.

Doses were taken directly from the study, if reported. Otherwise, doses were calculated based on the chemical concentration of ingested media, the ingestion rate, and the body weight of the test organism, according to the following equation:

$$Dose = (C \times FIR) / BW \qquad \text{Equation 1}$$

Where:

Dose = daily dose of chemical expressed in mg/kg bw/day

C = concentration of chemical in ingested media in mg/kg (dry weight or wet weight)[7]

BW = body weight in kg

FIR = food ingestion rate in kg/day (dry weight or wet weight)[8]

Study-specific ingestion rates and body weights were used when possible for calculating doses. If body weights and ingestion rates were reported in the study, the initial and final values were averaged for animals that began the study as juveniles and ended as adults, and the initial values were used for animals that experienced little growth during the study. When ingestion rates and body weights were not reported in the study, doses were calculated with surrogate data from the scientific literature (Table 3-5).

Concentrations of the target chemical in the basal diet were included in the dose concentrations, when reported. For example, if the concentration of the target chemical in the basal diet was 10 mg/kg, and the amount added to the feed was 100 mg/kg, the amount of chemical in the food was considered to be 110 mg/kg. In cases where the chemical concentration was reported based on the weight of the compound (e.g., cadmium chloride), the weight was converted to that of the element alone (e.g., cadmium) using the molecular weights of the components.

Data extracted from the reviewed toxicological studies, including information used to convert the data to dietary doses, are presented in Appendix B.

[7] The majority of studies used formulated feed as the diet for the laboratory organism; therefore, reported food concentrations were assumed to be based on dry weight unless otherwise noted in the study report.

[8] The wet or dry weight basis of the FIR used in Equation 1 needed to match the basis of the concentration in ingested media (C).

3.5 GENERATION OF ED20s (STEP 5)

The fifth step of the TRV derivation process was to select appropriate datasets for modeling ED20s and to run these datasets through the TRAP program, as discussed in the subsections below.

3.5.1 Selection of Datasets to Model

A subset of the individual and pooled datasets, as identified through the study selection and review process (i.e., Step 4), was modeled to estimate ED20s. Only the datasets that were expected to have the potential to represent the most sensitive dose-response curves for each receptor group (birds or mammals), endpoint (growth, survival, and reproduction), and COPC were considered for modeling, because these datasets had the potential to be used in TRV derivation. In order to be modeled and for the results to be useful for ED20 generation, datasets needed at least two sequential doses with effects less than those for the control, and at least one dose with an effect ≤ 80 percent relative to the control.[9] Effects data were plotted for all acceptable datasets that went through the study review and data compilation process (i.e., selected datasets as shown in Table 3-4). The plots were used to determine which of the individual and pooled study datasets had the potential to represent the most sensitive dose-response curves, and should therefore be modeled. If the points on the graph indicated that the expected ED20 for a specific dataset would be substantially higher than the expected ED20 for any other dataset, then that dataset was not selected for TRAP modeling. Likewise, if it appeared that the ED20 for a specific dataset would be substantially higher than the LOAEL ≥ 20 for a dataset that was not able to be modeled in TRAP, then that dataset was not selected for TRAP modeling.

Pooled datasets were normalized to the control before modeling in TRAP. Similar to modeling individual datasets, pooled datasets were considered for TRAP modeling only if the points on the graph indicated that there was a possibility that the ED20 could be lower than an ED20 or LOAEL ≥ 20 from another dataset. Datasets that could be pooled were evaluated for selection as a TRV only on a combined basis (i.e., a LOAEL ≥ 20 from an individual dataset was not considered for selection if the dataset was included in a pooled dataset).

[9] A minimum of three dose levels (including the control) and associated responses is required by TRAP, although a larger number is preferred. At least one dose with an effect ≤ 80 percent relative to the control (and a second dose with a different effect lower than the control) is needed to ensure that estimating the ED20 does not require extrapolation beyond the range of the empirical data.

3.5.2 TRAP Software

TRAP is a software program developed by the EPA Mid-Continent Ecology Division to model dose-response relationships. TRAP generates model parameters, confidence limits, and variance analysis for biological responses to toxic exposures, based on a chosen analysis type and model shape (USEPA 2015d). TRAP software was used instead of EPA's Benchmark Dose Software (BMDS) (USEPA 2015a) because BMDS requires data that were often not available from the toxicity datasets identified (e.g., standard error). In addition, BMDS generates an array of models that cannot be evaluated easily relative to one another due to the limited number of doses (often fewer than six) in many of the toxicity datasets. In contrast, TRAP requires fewer inputs and generates a smaller array of more generic potential models.

TRAP permits analysis of data using least-squares nonlinear regressions or tolerance distributions. Both of these analysis types can be run using untransformed (raw) data or logarithm (log)-transformed data, and several different models are generated from which the user can select. Least-squares nonlinear regression analysis was used for growth and reproduction datasets (i.e., datasets with continuous data), while maximum likelihood tolerance distribution analysis was used for datasets with survival effect measures (i.e., datasets with dichotomous endpoints). Inputs to TRAP for nonlinear regression analysis include the dose, response values, and "weighting factor" (i.e., standard error). Inputs for the tolerance distribution include the dose, number of organisms that did not respond to treatment (i.e., those surviving treatment), and total number of organisms per dose. Both the nonlinear regression and tolerance distribution analyses generate model parameters, a visual display of the toxicity relationship, confidence limits, variance analysis, and a prediction line for several model types.

3.5.3 Running TRAP Model and Compiling Output

Each dataset selected for modeling was entered into TRAP as raw (i.e., untransformed) or log-transformed data. After initially testing the TRAP output using both raw and log-transformed data, it became apparent that log transformation resulted in better model outputs. Therefore, all datasets were log-transformed prior to running TRAP. The tolerance distribution analysis (used for survival effect measures, including reproduction effect measures of offspring survival) generated three model shapes: triangular distribution, Gaussian distribution, and rectangular distribution. The nonlinear regression analysis (used for reproduction measures other than survival of offspring, growth effect measures, and pooled datasets [i.e., datasets considered comparable as described in Section 3.3] regardless of endpoint because the data were normalized prior to pooling) also generated three model shapes: logistic, threshold sigmoid, and piecewise linear. All model parameters, confidence

limits, variances, and prediction line data were compiled. The three model shape prediction lines for raw or log-transformed data for each dataset were plotted along with the raw data.

3.5.4 Selection of Model and ED20 from TRAP Output

The models for numerous datasets were reviewed, and the log transformation of the data for nonlinear regression and tolerance distribution analyses appeared to be the most appropriate model (compared to untransformed data) based on the fit to empirical data. In addition, log transformation of the data avoided the problem of generating negative values for the ED20s, which occurred for some datasets.[10] For the nonlinear regression analyses, the sigmoid threshold model generally provided the best fit to empirical data. For the tolerance distribution, the Gaussian model generally provided the best fit to empirical data. In some cases, TRAP was unable to model the data, and in a few cases, the models generated had a very poor fit to the empirical data (i.e., the model predictions were very different from the plotted data); as a result, no model was selected. In most cases, however, a model was selected (the threshold sigmoid log model for nonlinear regression[11] and the Gaussian log model for the tolerance distribution), and the ED20 generated from TRAP for that model was recorded. It is noteworthy that in many cases, the ED20s were very similar for all three model shapes. If pooled data from comparable datasets could not be modeled in TRAP, a geometric mean of the LOAELs ≥ 20 and/or ED20s from the comparable datasets was calculated. Appendix C presents the model results for all studies modeled in TRAP.

3.6 TRV SELECTION PROCESS (STEP 6)

The sixth step of the TRV selection process was to select TRVs for use in the BERA. A TRV was selected for each chemical, each receptor type (birds or mammals), and each endpoint type (growth, reproduction, and survival) from the dose-response datasets. The TRVs were selected as the lowest of the following: 1) LOAEL ≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geometric mean from a pooled dataset selected for modeling because the effect concentration had the potential to be lower than other ED20s and/or LOAELs based on visual inspection of the plotted data. If both Tier 1 and 2 studies were reviewed in Step 4, the TRV was selected from the Tier 1 studies. It should be noted that if an

[10] Negative values may be derived using TRAP because the program estimates the control value as the asymptote of the modeled curve; this hypothetical exposure point and other points on the curve may be at values that are less than one. Examples of data that resulted in negative values when data were not log-transformed include DiGiulio and Scanlon (1984) and Leach et al. (1979).

[11] For one of the modeled studies, the sigmoid threshold model produced an unrealistic ED20 whereas the piecewise linear model provided a better fit to the empirical data. In this case, the piecewise linear model rather than the sigmoid threshold model was selected.

individual dose-response dataset was modeled and an ED20 was generated, the ED20 was used to represent that dataset, even if it was higher than the LOAEL ≥ 20 for that specific dataset.

If the selected effect level was based on a LOAEL ≥ 20, the study was reviewed to determine if there was any uncertainty in the results due to the lack of statistical evaluation (Figure 3-2). If it was determined that there was substantial uncertainty in the effect level based on best professional judgement, then the study was excluded from selection as an effect level and the selection process was repeated for the next lowest ED20 or LOAEL ≥ 20 from the lowest tier.

Based on the process described above, and as shown in the first set of boxes in Figure 3-2, an effect level representing either a LOAEL ≥ 20 or an ED20 was selected. Two additional steps were then conducted, as follows (Figure 3-2):

- The Eco-SSL documents were reviewed to determine if there were any studies with unbounded NOAELs for comparable dose-response datasets that were higher than the selected effect level. Two studies were found, but were not usable, as described in Section 4.3. If such studies are found during derivation of TRVs for other metals in the future and the data are considered acceptable with no substantial uncertainties due to lack of statistical evaluation, then data will be combined to see if the pooled dataset can be modeled. If so, the ED20 will be selected as the TRV. If not, a geometric mean will be calculated using the NOAEL and the selected LOAELs ≥ 20.
- If the selected effect level was lower than the Eco-SSL TRV, then the Eco-SSL TRV was selected for use in the BERA so that the BERA would not use a TRV lower than the value used as a screening level.

If a dose-response dataset was available for a specific UCR receptor species, then a receptor-specific TRV was also derived from those data (see Tables 3-6 and 3-7 for the toxicity test species compared to the proposed UCR receptors). The receptor-specific TRVs, rather than the TRVs derived using tests conducted with other species, will be used to characterize risk for the applicable UCR receptors.

3.7 UNCERTAINTY EVALUATION (STEP 7)

A qualitative uncertainty evaluation was conducted to identify factors in individual TRV studies that might affect the level of confidence in the TRV when estimating toxicity to UCR receptors, as well as the potential bias these factors could contribute to the overestimation or underestimation of risk. In addition to uncertainties associated with individual studies, uncertainties associated with the amounts and types of available toxicity data were evaluated. The uncertainties discussed in this section will be incorporated into a weight-of-evidence evaluation for the TRV selected for each COPC and receptor group. The following sections

discuss these two types of uncertainties, as well as the application of these considerations to the selected TRVs.

The BERA will evaluate uncertainty regarding risk conclusions. Section 1 of this wildlife TRV document briefly discusses the issues associated with extrapolating from evidence of possible TRV exceedances to draw conclusions about ecological risk to wildlife. This section describes the part of the BERA wildlife uncertainty evaluation that is associated with the TRV development process.

3.7.1 Individual Study Considerations

A primary and potentially large uncertainty associated with all individual studies is whether the effects observed in a controlled laboratory environment would also be observed in the natural environment. For example, for the egg production endpoint, chickens are allowed to lay eggs indefinitely in the controlled environment, whereas most birds associated with the UCR are expected to lay a limited number of eggs in one or more clutches during a seasonal reproductive period. Therefore, reduced numbers of eggs laid by domesticated species in the laboratory may or may not translate to reduced numbers of eggs laid by wild birds. Another example of the uncertainty in translating laboratory to field effects is that laboratory animals have no alternate feeding options if they have an aversion to contaminated food, whereas animals in the wild may be able to feed on a variety of prey items, thus avoiding contaminated food. The weight reduction endpoint in single-choice laboratory studies is particularly vulnerable to food aversion (i.e., not directly attributable to chemical toxicity), thus over-estimating chemical-specific risk in natural situations where foods of varying degrees of contamination is available.

Individual considerations that vary among studies are described below. The considerations discussed below include the species tested, the type of dose administration, the length of the test if it was a growth study, the egg production endpoint, the chemical form administered, conversion of dietary concentrations to doses, and whether an ED20 could be estimated. The sections for each of these considerations discuss the potential bias in the TRV and the resulting possibility for under- or overestimating risk, as summarized in Table 3-8.

3.7.1.1 Test Species

Metal uptake, absorption, metabolism, and excretion may differ among species, resulting in differences in toxicity associated with the same dose. Therefore, if test species used in the laboratory study are different from UCR receptors, there is greater uncertainty in the TRV. It is not known whether this extrapolation of results from the laboratory species to the species of

concern at the site would contribute to an over- or underestimation of risk because there is no way to determine if the receptor species is more or less sensitive than the tested species.

3.7.1.2 Dose Administration

Dose administration by drinking water increases the uncertainty of an effect level (Section 3.3). Some metals may be more bioavailable for gut uptake when provided in a more soluble form (McGeer et al. 2004); therefore, a toxicity threshold based on drinking water studies may be lower than one based on dietary or gavage studies. No drinking water studies were identified as selected effect levels for any chemical/receptor/endpoint combination because of the availability of dietary and/or gavage studies; therefore, this uncertainty does not apply to the TRVs derived in this document, although it could apply to TRVs derived for other metals in the future. An uncertainty associated with dietary studies is the difficulty in monitoring the quantity of chemical ingested, whereas for gavage studies a measured amount of chemical can be administered (although it may be more difficult to determine the exact quantity for birds because of the potential for regurgitation after dosing). Dietary studies are more representative of the form of exposure in the natural environment than are gavage studies, as well as being more representative of the primary exposure route than are drinking water studies. If drinking water studies are used for a selected TRV, the reliability of the TRV decreases and could contribute to an overestimation of risk, depending on the metal and the form of it used in the toxicity study. Uncertainties in gavage and dietary studies could contribute to an under- or overestimation of risk.

3.7.1.3 Growth Study Exposure

Growth reduction that occurs during a critical life stage or for a long period is more likely to result in ecologically relevant effects (i.e., effects at a population level) than for weight reduction that occurs in adult organisms for a short period. Therefore, there is higher uncertainty associated with the prediction of population-level effects using ED20s and LOAELs ≥ 20 based on Tier 2 growth studies (i.e., tests conducted with organisms in a noncritical life stage and for less than 10 percent of the lifespan) than using those based on Tier 1 studies, potentially contributing to an overestimation of risk.

3.7.1.4 Chemical Form

The form of metal administered in the test was noted. If the form used in a test was not expected to occur as a result of metals mining or smelting activities, then the selected TRV could be biased high or low and could contribute to an underestimation or overestimation of risk. The majority of the toxicity studies evaluated used metal salts. The relative bioavailability of metal salts added to food in toxicity tests compared to metals bound to tissue in wildlife

food is unknown; therefore, effects on the risk estimates are unknown and could be either underestimated or overestimated.

3.7.1.5 Dose Calculation

In most of the studies reviewed, body weight-normalized doses (i.e., expressed in mg/kg bw/day) were not presented; doses were instead calculated by multiplying the concentration in food (mg/kg) by the FIR (kg/day) divided by the body weight (kg). When body weights and FIRs were not measured as part of the study, they were estimated using data from the literature, ideally for the same species, sex, and age as in the study. Such an estimation results in uncertainty in the calculated dose, particularly in cases where data for the same species and/or age are not available. This uncertainty leads to a lower confidence in the TRV derived for the species used in the study. To evaluate the potential magnitude of this uncertainty, two of the effect levels from studies with LOAELs ≥ 20 used to derive TRVs that did not measure body weights or FIRs were recalculated using a range of potential minimum and maximum values, as follows:

- **Copper/mammal/survival LOAEL ≥ 20 of 17 mg/kg bw/day from Allcroft et al. (1961)**. The body weight and FIR of pigs at 15 weeks old (the average age during the study) of 45 kg and 1.5 kg/day, respectively, were used in this calculation; these values were derived from figures showing body weights and FIRs of pigs at different ages from Cai et al. (2009). If body weights of 35 to 55 kg or FIRs of 1.2 to 1.8 kg/day were used in the dose calculation, LOAELs would range from 14 to 22 mg/kg bw/day, respectively.
- **Zinc/bird/growth LOAEL ≥ 20 of 65 mg/kg bw/day from Lu et al. (1990)**. The body weight of leghorn chickens at 2 weeks old (average age at the start of the 1-week study) was estimated to be 70 g, as derived from growth curves for male and female leghorn chickens presented by EPA (1988). The FIR was calculated as a function of body weight using an allometric equation for chickens; also from EPA (1988). If the estimated body weight of chickens was changed to either 40 or 90 g, the respective LOAELs would be 70 or 61 mg/kg bw/day.

As shown above, the uncertainty in the body weights could result in either a high or low bias in the TRV, potentially contributing to an over- or underestimation of risk.

The conversion of a dietary concentration to a body weight-normalized dose assumes that toxicity among different species is a direct function of the FIR and body weight. If this assumption is incorrect, an additional bias may be introduced when applying the dose calculated for the test animals to a UCR receptor of concern, which could contribute to an underestimation or overestimation of risk.

3.7.1.6 Type of Effect Level

In general, TRVs based on ED20s provide a better understanding of predicted effects than LOAEL ≥ 20-based TRVs. An ED20 derived from modeling results in an estimated dose that represents a 20 percent reduction in the measured response compared to the control, taking into consideration the results from the other doses in the study, whereas a LOAEL is dependent upon the number of individuals at each dose level and the variability in responses of the control group (among other issues). The ED20 modeling uses the number of organisms per treatment and standard deviation or standard error, if available, resulting in a better estimate than a point-based LOAEL ≥ 20. In addition, if the measured effect represented by a LOAEL ≥ 20 is substantially greater than a 20 percent reduction in the response, then the TRV based on that LOAEL ≥ 20 could be biased high and could contribute to an underestimation of risk.

3.7.2 Quantity of Available Toxicity Data

In addition to uncertainties associated with the individual dataset used to derive the TRV, the number of species tested, including the overall number of dose-response datasets available for each COPC and receptor group, affect the reliability of the TRV in evaluating risk to UCR receptors.

The lowest ED20 or LOAEL ≥ 20 was selected from the acceptable studies as the TRV, as a protective measure to ensure that the most sensitive tested species and specific effect measure (e.g., litter size vs. offspring survival within the reproduction endpoint) will be covered in the estimation of the TRV. In general, the more species that have been tested, and the broader the range of taxonomic diversity, the more likely the species in the UCR will be represented in the toxicity testing data. Similarly, the greater the number of dose-response datasets, the more likely the representation of a variety of effects within an endpoint, increasing the likelihood that the most sensitive endpoint was measured.

3.7.3 Application of TRV Uncertainty Evaluation

For each selected TRV, the level of confidence in and bias of the TRV was qualitatively evaluated for the individual study used to derive the TRV, based on the considerations described in Section 3.7.1 and Table 3-8. In addition, the numbers of species and dose-response datasets available from the reviewed toxicity literature were noted for each COPC, receptor group, and endpoint.

The uncertainties addressed in this document will be incorporated into the BERA using a weight-of-evidence framework to evaluate the strength, relevance, and reliability of each selected TRV. For example, a hazard quotient (HQ) calculated using a TRV derived from a

long-term test administered by dietary dose will be considered more reliable and relevant than an HQ calculated using a TRV derived from a short-term test administered by gavage. Likewise, an HQ calculated from a TRV based on a LOAEL representing 100 percent mortality compared to the control will be considered a more severe effect than an HQ calculated from a TRV based on an ED20 or a LOAEL representing 20 percent reduction in growth compared to the control derived from a short-term test. The BERA will also include a general discussion of the likelihood that the TRVs represent toxicity thresholds for UCR receptors based on the types of species evaluated in the toxicity tests.

Ideally, a receptor-specific TRV would be developed for each UCR surrogate species identified in the BERA Problem Formulation Plan (Exponent and HDR|HydroQual 2012) using reliable and relevant toxicity data. Because using such TRVs in the risk assessment would not involve interspecies extrapolation, they would result in risk estimates with higher confidence. A few receptor-specific TRVs were derived from the laboratory toxicity tests identified in the literature search that was performed for this wildlife TRV development process; the species associated with these TRVs were mallard, shrew, vole, and mink (Tables 3-6 and 3-7). In most cases, however, receptor-specific toxicity data were not available, and the mammal or bird TRVs were developed based on data for other nonreceptor species (e.g., chickens, rats, mice).

4 RESULTS

This section describes the results of the seven-step TRV derivation process for each COPC for birds and mammals, as described in Sections 3.1 through 3.7 and shown in Figure 3-1.

4.1 LITERATURE SEARCH AND STUDY REVIEW

For Steps 1 and 2 (the literature compilation and study acceptability processes), information on the studies used in the Eco-SSL documents was reviewed to determine whether each growth, reproduction, or survival study was acceptable using the criteria presented in Sections 3.1 and 3.2. Information presented in the Eco-SSL documents was reviewed for over 1,000 study/endpoint combinations (Tables A-2 through A-11 of Appendix A). Approximately 40 percent of the Eco-SSL studies met the acceptability criteria. The acceptability criterion that was most frequently not met in the remaining studies was that there must be an observed effect; most of the studies produced only unbounded NOAELs (Tables A-2 through A-11 of Appendix A).

An additional 61 references that were not included in the Eco-SSL documents were identified in the Windward TRV database or from a directed literature search. Study characteristics for 15 of these 61references met the acceptability criteria; therefore, the data from those studies were included in the TRV derivation process (see Table A-12 of Appendix A). The most common reasons for not using data from the remaining 46 references in the TRV derivation process were 1) only unbounded NOAELs existed, 2) study design concerns, 3) endpoints not being relevant, or 4) the exposure route was via injection.

For Step 3, studies were selected for detailed review based on the tiered process described in Section 3.3, which gave preference to the most relevant studies, i.e., dietary dose administration and long-term growth studies (Table 3-4). Of the 15 COPC/endpoint combinations for deriving bird TRVs, 12 involved the review of only Tier 1 studies, and 1 involved the review of both Tier 1 and Tier 2 studies. For the remaining two COPC/endpoint combinations (reproduction and survival endpoints for manganese), no studies were available for review. Of the 15 COPC/endpoint combinations for deriving mammal TRVs, 11 involved the review of studies from only Tier 1, and 4 involved the review of both Tier 1 and Tier 2 studies (Table 3-4). Four studies identified for review could not be obtained, as noted in Appendix A (one study in Table A-2, and three studies in Table A-4).

Summaries of the data extracted from the toxicological studies for each dose-response dataset (Step 4; see Section 3.4) are presented in Tables 4-1 through 4-5 for cadmium, copper, lead, manganese, and zinc, respectively. Details on the data extracted from the studies are presented in Appendix B.

4.2 TRAP MODELING RESULTS

All dose-response datasets identified through the study selection and review process, as summarized in Table 3-4, were plotted to show the dose vs. effect relative to the control, with separate plots for each chemical, receptor group (bird or mammal), and endpoint (growth, reproduction, and survival). Datasets were selected for TRAP modeling if they were considered most likely to result in the lowest ED20 for a specific chemical/receptor/endpoint combination based on a visual inspection of the plotted dose-response datasets. Figures 4-1 through 4-28 show the dose-response datasets for each COPC evaluated in this document, including the resultant ED20 values for those datasets that could be modeled successfully, as follows:

- Cadmium
  - Birds—Figures 4-1 to 4-3
  - Mammals—Figures 4-4 to 4-6
- Copper
  - Birds—Figures 4-7 to 4-9
  - Mammals—Figures 4-10 to 4-12
- Lead
  - Birds—Figures 4-13 to 4-15
  - Mammals—Figures 4-16 to 4-18
- Manganese
  - Birds—Figure 4-19 (no plots for reproduction or survival)
  - Mammals—Figures 4-20 to 4-22
- Zinc
  - Birds—Figures 4-23 to 4-25
  - Mammals—Figures 4-26 to 4-28

Figures 4-29 to 4-56 show the same data as Figures 4-1 to 4-28, but on a log-transformed basis. Information about the modeling status is presented in Tables 4-1 through 4-5 for

each of the COPCs, including the ED20 values, if derived. For each dataset, the modeling status fell into one the following five categories:

1. Data were modeled as an individual dataset in TRAP to derive the ED20.
2. Data were selected for modeling as an individual or pooled dataset, but an ED20 could not be generated, or the ED20 was not used due to poor model fit.
3. Data did not meet the criteria for modeling (e.g., dataset did not have an effect that was at least 20 percent less than the control, lack of two consecutively lower and different effects less than the control, or consecutively lower effects followed by an increased effect, and a lower tier dataset was available).
4. Data were not selected for modeling because the effect concentration was substantially higher than other ED20s and/or LOAELs based on visual inspection of the plotted data.
5. Data were modeled as a pooled dataset in TRAP to derive the ED20.

For birds, usable ED20s were derived for at least one dataset for the following endpoint/metal combinations: growth, reproduction, and survival for cadmium (Table 4-1); growth, reproduction, and survival for copper (Table 4-2); survival for lead (Table 4-3); and growth and reproduction for zinc (Table 4-5). Seven of the bird ED20s were based on pooled datasets: one for survival and cadmium, two for growth and copper, two for reproduction and copper, one for survival and lead, and one for growth and zinc.

ED20s were not used for the following bird datasets because of poor model fit (see Appendix C for modeled curves):

- Lead and growth (Abduljaleel and Shuhaimi-Othman 2013) (Figure C-12)
- Lead and reproduction pooling group D (Figure C-13)
- Zinc and survival for mallard (Gasaway and Buss 1972) (Figure C-18).

For mammals, ED20s were derived for at least one dataset for the following endpoint and metal combinations: growth, reproduction, and survival for cadmium (Table 4-1); growth for copper (Table 4-2); survival for lead (Table 4-3); reproduction and survival for manganese (Table 4-4); and growth for zinc (Table 4-5). The mammal ED20 for cadmium and growth was based on a pooled dataset. The modeled dose-response curves for ED20s that were selected as TRVs are presented in Appendix C.

ED20s were not used for the following mammal datasets because of poor model fit (see Appendix C for modeled curves):

- Cadmium and survival pooling group C (curve could not be generated)
- Copper and growth (Brandt 1983) (Figure C-23)
- Copper and survival pooling group B (Figure C-25)
- Lead and reproduction (Gupta et al. 1995) (Figure C-27)
- Manganese and growth (Rehnberg et al. 1980) (Figure C-29)
- Zinc and reproduction (Khan et al. 2007) (Figure C-33)
- Zinc and survival pooling group D (curve could not be generated).

4.3 TRV SELECTION AND UNCERTAINTY EVALUATION

This section presents the TRVs selected for each chemical, receptor group, and endpoint as well as the uncertainties associated with these TRVs.

4.3.1 Birds

Effect levels for birds were selected as the lowest of the LOAEL ≥ 20, ED20, or geometric mean from Tier 1 for the growth, reproduction, and survival endpoints for cadmium, copper, lead, and zinc (Table 4-6). Effect levels could not be derived for manganese because of the lack of toxicity data for the reproduction and survival endpoints and because no effects representing a ≥ 20 percent reduction in response compared to the control were observed in any of the three growth studies reviewed. Nine of the 12 selected effect levels for all bird endpoints (not including receptor-specific effect levels) are based on ED20s; two are based on LOAEL ≥ 20, and one is based on a geometric mean. UCR receptor-specific avian TRVs were derived for the mallard growth and reproduction endpoints for cadmium, and the mallard growth and survival endpoints for zinc.

Eco-SSL data (presented in Appendix A) were reviewed to determine if there were any unbounded NOAELs from comparable datasets higher than the selected effect levels (see TRV selection process shown in Figure 3-2). One study for birds was identified (Leeson and Summers 1982), but the NOAEL calculated using the body weight and FIR for a 1-week-old chick from NRC (1994) was an order of magnitude lower than the NOAEL from the Eco-SSL document (calculated using adult body weights and FIRs), resulting in an unbounded NOAEL lower than the selected effect level.

As a final step (Figure 3-2), selected effect levels were compared to Eco-SSLs; one effect level was lower than the Eco-SSL (zinc and growth). Therefore, the Eco-SSL was identified as the TRV for zinc and growth, and the selected effect levels shown in Table 4-6 were identified as TRVs for the remaining chemical and endpoint combinations. TRVs derived for birds are compared to TRV derivation plots from the Eco-SSL documents in Appendix D. A selected TRV could be greater than the LOAELs shown on the Eco-SSL plots that are derived from acceptable studies for one or more of the following reasons: 1) the LOAEL was from a Tier 2 study but Tier 1 data were available; 2) the LOAEL response was less than 20 percent different from the control response; 3) body weight or FIR assumptions were used to calculate the LOAEL dose; 4) an ED20 was used instead of the LOAEL; 5) the LOAEL was part of a pooled dataset; or 6) the LOAEL was not reviewed because of the tiered process.[12] In addition, a number of LOAELs from the Eco-SSL plots were excluded because the studies were not considered acceptable for TRV derivation for one or more of the following reasons: 1) the endpoint was not relevant, 2) the study was conducted with ruminants, 3) no LOAEL was identified, 4) there were concerns with the study design, or 5) there were insufficient data to calculate a response relative to the control. The number of LOAELs presented in Eco-SSL documents that are lower than each selected TRV, along with the rationale for not using these LOAELs, are presented in Appendix A (Table A-23). Based on the rationale, inclusion of these studies would not be expected to result in more reliable TRVs.

4.3.2 Mammals

For mammals, effect levels were selected as the lowest of the LOAEL ≥ 20, ED20, or geometric mean from Tier 1 for growth, reproduction, and survival endpoints for all five metals (Table 4-6). Eight of the selected effect levels (not including receptor-specific effect levels) are based on ED20s, five are based on LOAEL ≥ 20, and two are based on geometric means. Four receptor-specific TRVs were derived for mammals: the cadmium growth endpoint for shrew, and the copper growth, reproduction, and survival endpoints for mink.

[12] For the growth endpoint for copper and birds, although 10 studies were reviewed to obtain at least 5 datasets with a LOAEL ≥ 20, 12 other acceptable studies were not reviewed after following the process described in Section 3.3. Studies that were not reviewed used the same species (chicken and turkey) as those used to derive the TRVs; therefore, it is not expected that inclusion of these additional datasets would substantially affect the selected TRV, as discussed on a conference call with EPA (Bergquist et al. 2019).

The lowest LOAEL ≥ 20 for copper and reproduction was 2.4 mg/kg bw/day, based on a study conducted with pigs in which a dietary copper concentration of 250 mg/kg resulted in a reduced farrowing rate of gilts compared to the control (Cromwell et al. 1993). However, there were no other effects on reproductive endpoints, and the authors stated that "The results indicate that, except for a possible decrease in farrowing rate of gilts, the feeding of 250 ppm of Cu to sows for an extended period of time had no detrimental effect on reproductive performance; in fact, feeding high dietary Cu to sows increased birth and weaning weights of their pigs." The NRC committee (NRC 2005) set maximum tolerable levels for dietary copper at concentrations in food ranging from 250 mg/kg for swine to 2,000 mg/kg for mice, including a consideration of the study by Cromwell et al. (1993). Based on these considerations, the low dose of 2.4 mg/kg bw/day was not selected as the lowest effect level. Instead, the next lowest LOAEL ≥ 20 of 27 mg/kg bw/day from a mink study by Aulerich et al. (1982) was identified as the selected effect level for copper and reproduction (Table 4-2).

Eco-SSL data (presented in Appendix A) were reviewed to determine if there were any unbounded NOAELs from comparable datasets higher than the selected effect levels (see BERA TRV selection process shown in Figure 3-2). One study was identified (Nation et al. 1990), and after reviewing this study, it was found that growth data (i.e., changes in body weight) were not presented in the paper; therefore, effect levels compared to the control could not be calculated.

The final step in deriving TRVs, as shown in Figure 3-2, was to compare selected effect levels to Eco-SSLs; three effect levels were lower than the Eco-SSLs (lead and reproduction, zinc and growth, and zinc and reproduction). Therefore, the Eco-SSLs were identified as the TRVs for these chemical and endpoint combinations, and the selected effect levels shown in Table 4-6 were identified as the TRVs for the remaining combinations (Table 5-1). TRVs derived for mammals are compared to TRV derivation plots from the Eco-SSL documents in Appendix D. A TRV could be greater than the LOAELs shown on the Eco-SSL plots for one or more of the reasons listed for birds in Section 4.3.1. The number of LOAELs presented in Eco-SSL documents that are lower than each selected TRV and the rationale for not using these LOAELs are presented in Appendix A (Table A-23). Based on the rationale, inclusion of these studies would not be expected to result in more reliable TRVs.

4.3.3 Uncertainty Evaluation

For the uncertainty evaluation, each selected effect level was evaluated to determine which considerations could result in a decrease in confidence in the value, and whether

these considerations could result in potential biases in the TRV based on the effect level. The considerations in the selected effect levels for each COPC and receptor group are presented in Tables 4-7 to 4-15.

The most common uncertainty considerations listed in Tables 4-7 to 4-15 as affecting confidence in the selected effect levels were the representation of the UCR species by the species used in the toxicity tests, and the dietary and gavage dose administration methods with their separate types of uncertainty. Of the effect levels that were not specific to UCR species, none for birds and only one for mammals were derived from studies that used UCR receptor species. All the studies used to derive TRVs were conducted using either dietary or gavage dose administration methods. The uncertainties associated with test species and method of dose administration could result in a high or low bias of the TRV.

Another common consideration affecting confidence was the use of secondary sources to estimate the body weight and/or FIR for dose calculations. Secondary sources were used to derive 12 of the 16 bird effect levels and 9 of the 19 mammalian effect levels, including UCR receptor species-specific effect levels. It is not known if the use of test species that are not receptors or the use of an estimated body weight or FIR would result in a high or low bias of the TRVs.

For the growth endpoint for non-UCR receptor species, all of the selected effect levels were based on studies that were conducted during a critical life stage or for more than 10 percent of the species' lifespan. For UCR receptor species (mallard and cadmium), one of the selected effect levels was based on a study that was conducted during a noncritical life stage and for less than 10 percent of the species' lifespan, resulting in a potential low bias of the TRV.

Four of the 16 selected effect levels for birds and 7 of the 19 selected effect levels for mammals were based on LOAELs ≥ 20. The percent reductions in the observed responses compared to the controls ranged from 20 to 71 percent. This factor could result in a potential high bias in the TRV, particularly when the effect level represents a high reduction in the response compared to the control.

TRVs used in ERAs are most commonly expressed as daily doses rather than concentrations in food, although there is uncertainty in the dose-based TRV as a result of the conversion from a food concentration to a dose (Sample et al. 2014). Therefore, for comparison purposes and facilitation of potential qualitative discussions about the uncertainty associated with conversion of concentration to dose, plots showing effects as a function of food concentration are presented in Figures 4-57 to 4-84 for the same datasets as the plots showing effects as a function of dose (Figures 4-1 to 4-28).

5 SUMMARY

Bird and mammal TRVs were derived for use in the BERA for five metals (cadmium, copper, lead, manganese, and zinc) that have been identified as COPCs in the UCR based on preliminary terrestrial and aquatic wildlife screening-level risk assessments. A seven-step process was followed to compile toxicological literature; apply acceptability criteria related to study reliability, relevance, and strength; prioritize studies for review using a tiered process; review studies and compile dose-response results; conduct benchmark dose modeling; select effect levels and TRVs; and conduct an uncertainty evaluation.

Studies were compiled from EPA's Eco-SSL list, the Windward database of studies used in other risk assessments, and a general literature search. Only studies that evaluated growth, reproduction, and survival toxicity endpoints were included. A set of acceptability criteria was applied to the compiled studies to eliminate those that were not considered appropriate for use in TRV derivation.

For dose-response datasets from studies considered acceptable, a tiered process was applied to identify preferred studies for TRV derivation (Tier 1) and secondary studies (Tier 2) for inclusion if preferred studies were not available. Secondary studies included growth studies that were conducted during a noncritical life stage or for less than 10 percent of the species' life stage, as well as studies that administered the dose via drinking water. Based on the tiered process, a subset of acceptable studies was reviewed in detail to compile dose-response data for potential modeling and consideration in deriving the TRVs.

For each of the compiled datasets, either an ED20 (from TRAP modeling) or a LOAEL with at least a 20 percent reduction in the observed response relative to the control (abbreviated as LOAEL ≥ 20) was derived. Datasets were modeled if they were considered most likely to result in the lowest ED20 based on a visual inspection of plotted data, and if criteria for modeling were met. Comparable datasets (i.e., datasets with the same effect measure, species, chemical form, method of dose administration, and similar exposure duration for growth studies) were pooled prior to modeling. If pooled datasets could not be modeled, a geometric mean was calculated from the LOAELs ≥ 20.

The TRV derived for each chemical, receptor group (birds and mammals), and endpoint (growth, reproduction, and survival) was the lowest selected effect level (i.e., ED20, LOAEL ≥ 20, or geometric mean of pooled datasets) from Tier 1 studies, or from Tier 2 studies if Tier 1 studies were not available. Studies from the Eco-SSLs were reviewed to determine if there were any unbounded NOAELs from comparable studies that were

higher than the selected effect levels. In addition, the selected effect levels were compared to the Eco-SSL TRVs to determine if any of the selected effect levels were lower than those from the Eco-SSLs; if so, the Eco-SSL TRV was selected as the TRV.

The TRVs are summarized in Table 5-1. For birds, effect levels were derived for growth, reproduction, and survival endpoints for cadmium, copper, lead, and zinc. TRVs could not be derived for manganese in birds because of the lack of toxicity data for the reproduction and survival endpoints, and because no effects representing a ≥ 20 percent reduction in response compared to the control were observed in any of the three growth studies reviewed. For mammals, TRVs were derived for growth, reproduction, and survival endpoints for all five metals. A review of studies in the Eco-SSL documents found that there were two unbounded NOAELs from comparable datasets that were higher than the selected effect levels, but a review of these papers did not find any usable data that could be pooled with other datasets. One of the selected effect levels for birds and three of the selected effect levels for mammals were lower than the Eco-SSLs; therefore, the Eco-SSL TRVs were selected as TRVs for these receptor/chemical/endpoint combinations.

Uncertainties in the derived effect levels were evaluated to determine potential bias in the final TRVs, and to identify factors influencing confidence in their use in the BERA for estimating and interpreting risk. The most common factors affecting confidence in the TRVs were the use of laboratory species that were not representative of UCR receptors, uncertainties associated with dose administration, the use of secondary sources to estimate the body weight and/or FIR for dose calculations, and the selection of LOAELs rather than ED20s as effect levels. The effects of these factors on the level of confidence and bias in the risk estimates calculated using these TRVs will be discussed in the BERA.

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FIGURES

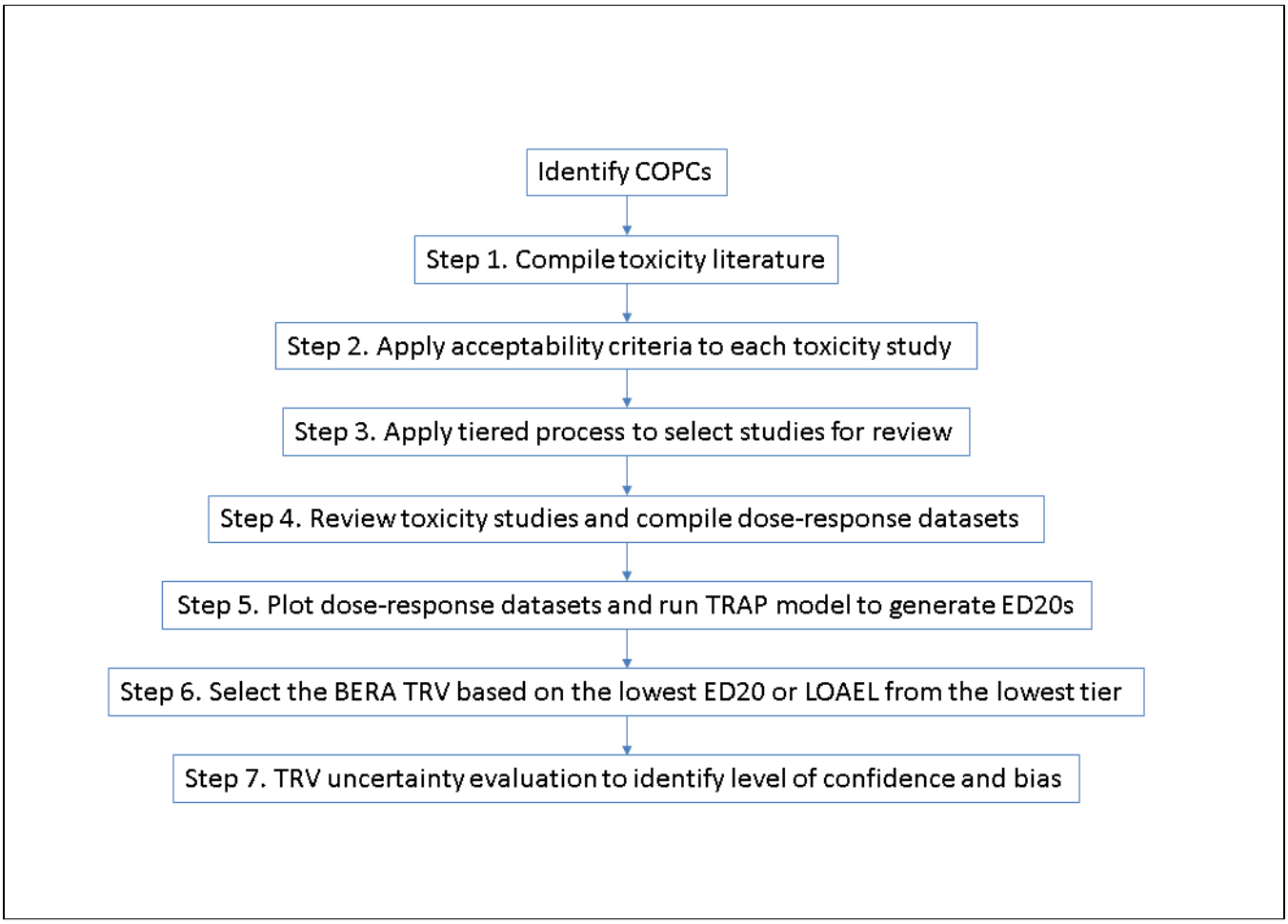
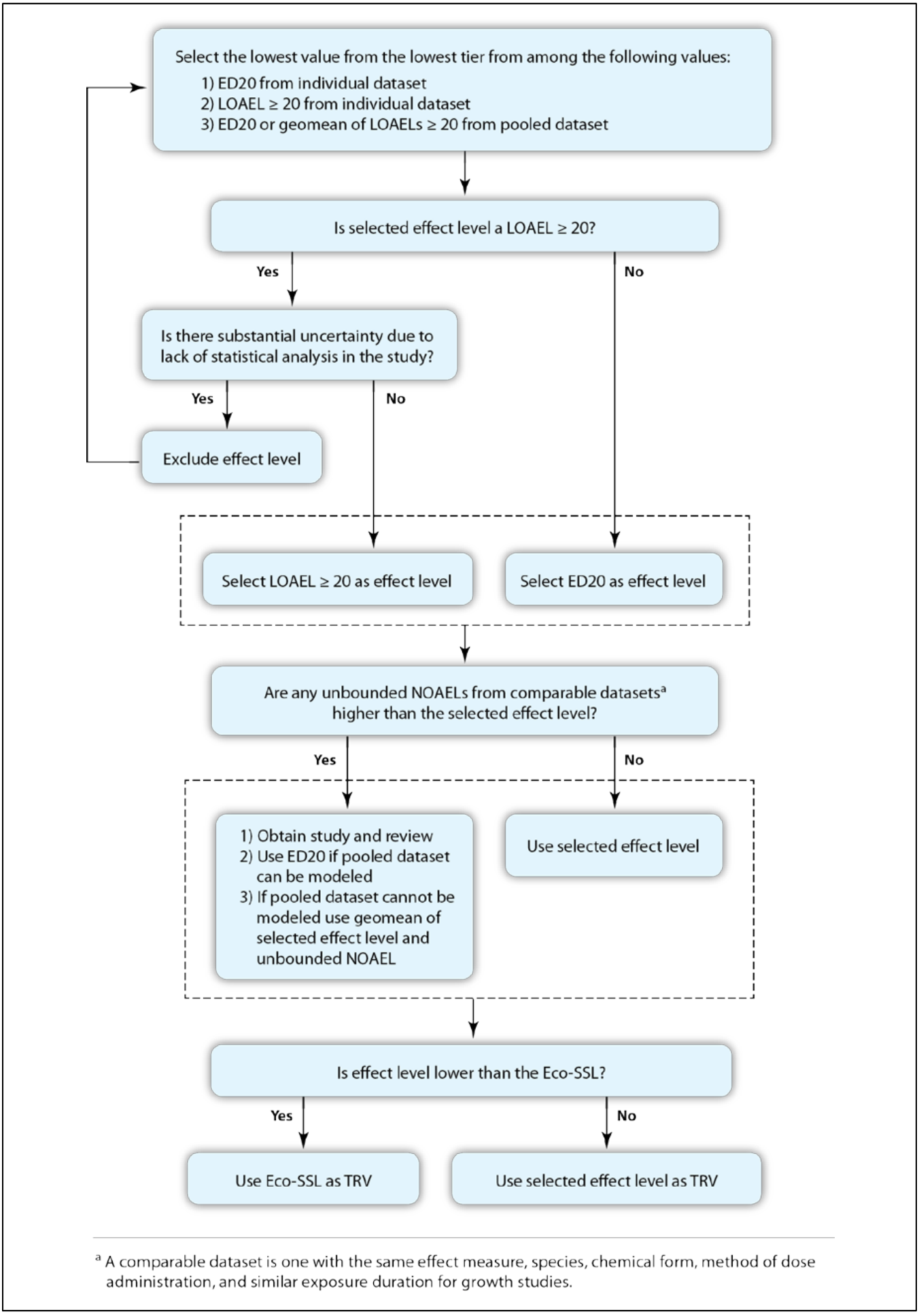
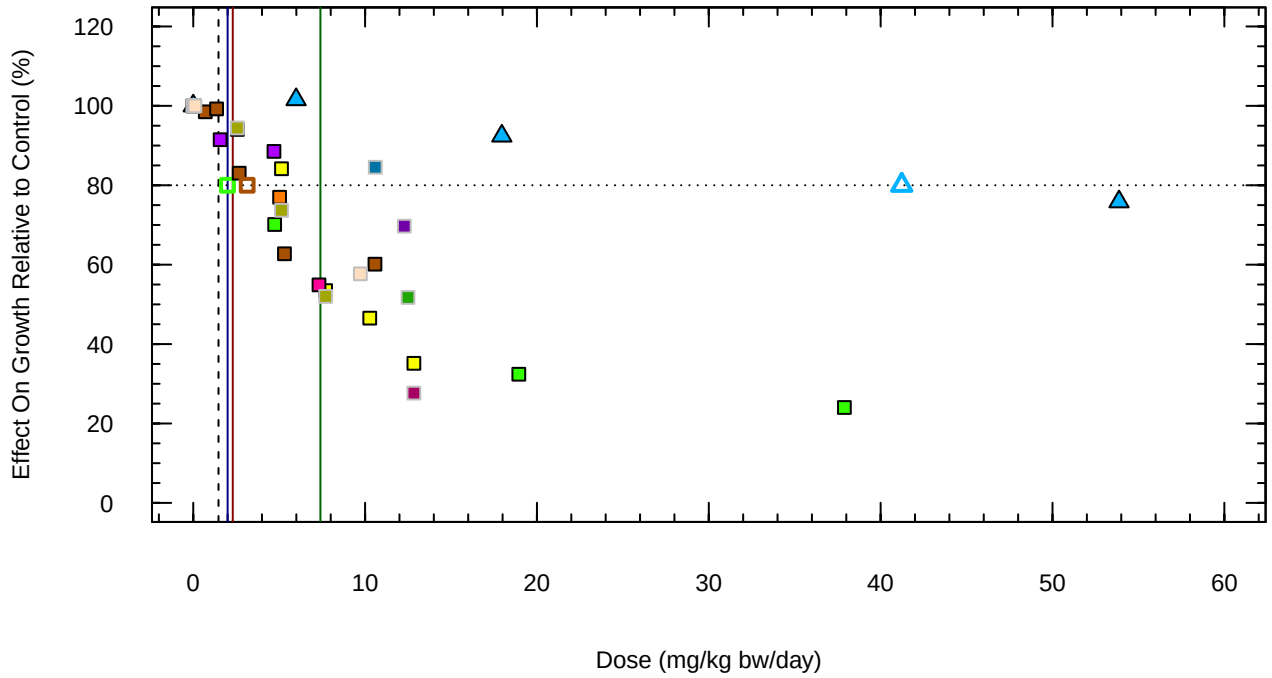


Figure 3-1. Seven-Step Process for Deriving TRVs



[a] A comparable dataset is one with the same effect measure, species, chemical form, method of dose administration, and similar exposure duration for growth studies.

Figure 3-2. Flow Chart for TRV Selection Process



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bafundo et al. 1984	chicken	body weight gain	diet	2 weeks	cadmium chloride	
Bokori et al. 1995a	chicken	body weight	diet	4 weeks	cadmium sulfate	
Bokori et al. 1996	chicken	body weight	diet	39 weeks	cadmium sulfate	
Di Giulio and Scanlon 1984	mallard	body weight	diet	6 weeks	cadmium chloride	
Hill 1974a	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Hill 1974b	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Olgun 2015	Japanese quail	body weight	diet	10 weeks	cadmium sulfate	
Richardson and Fox 1974	Japanese quail	body weight	diet	4 weeks	cadmium chloride	B
Richardson et al. 1974	Japanese quail	body weight	diet	4 weeks	cadmium chloride	B
Richardson et al. 1974	Japanese quail	body weight	diet	6 weeks	cadmium chloride	B
Hill 1979	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Hill 1980	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Rama and Planas 1981	chicken	body weight gain	diet	9 weeks	cadmium sulfate	A
ED20 for Bokori et al. 1995a	chicken	body weight	diet	4 weeks	cadmium sulfate	
ED20 for Di Giulio and Scanlon 1984	mallard	body weight	diet	6 weeks	cadmium chloride	
ED20 for Olgun 2015	Japanese quail	body weight	diet	10 weeks	cadmium sulfate	

Tier 1 Tier 2

Eco−SSL TRV = 1.47 mg/kg bw/day

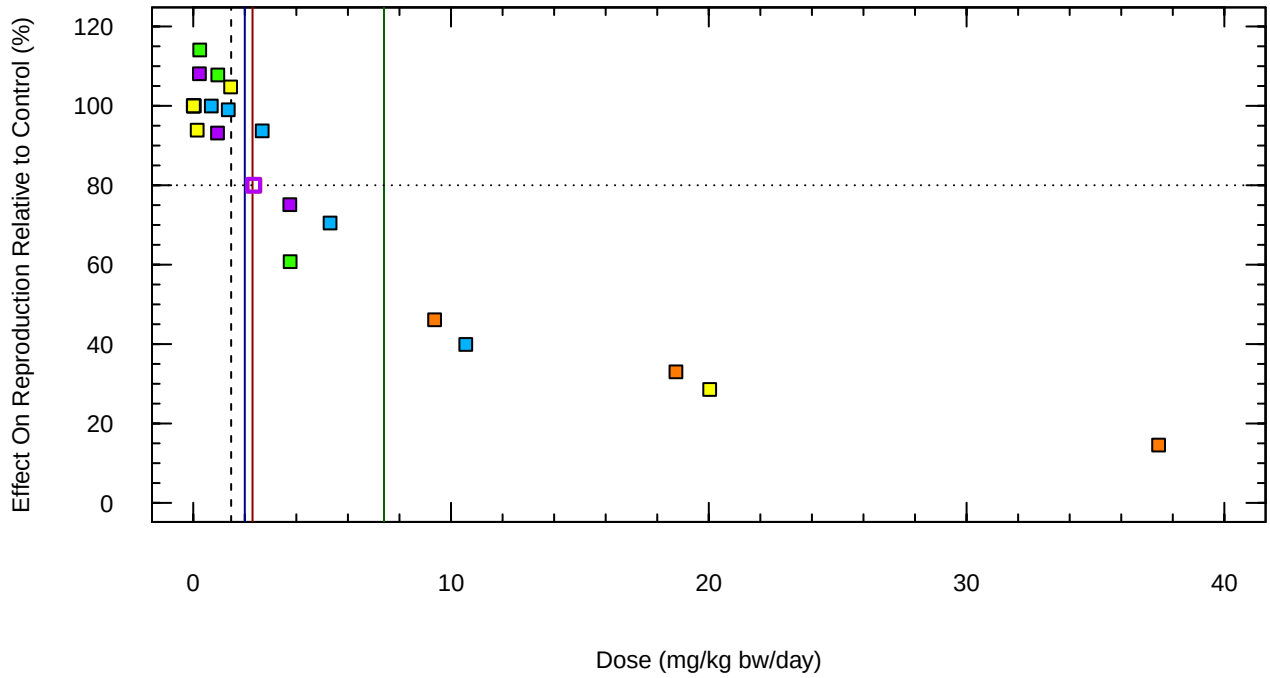
Selected TRV (Growth) = 2 mg/kg bw/day
Selected TRV (Reproduction) = 2.3 mg/kg bw/day
Selected TRV (Survival) = 7.4 mg/kg bw/day

80% effect relative to control

ED20 for Bokori et al. 1995a is 2 mg/kg bw/day
ED20 for Di Giulio and Scanlon 1984 is 41 mg/kg bw/day
ED20 for Olgun 2015 is 3.1 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−1. Dose−Response Data for the Avian Growth Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bokori et al. 1995b	Japanese quail	egg production	diet	5.29 weeks	cadmium sulfate	
Leach et al. 1979	chicken	egg production	diet	48 weeks	cadmium sulfate	
Leach et al. 1979	chicken	egg production	diet	12 weeks	cadmium sulfate	
Olgun 2015	Japanese quail	egg production	diet	10 weeks	cadmium sulfate	
White and Finley 1978	mallard	egg production	diet	4.3−12.8 weeks	cadmium chloride	
ED20 for Bokori et al. 1995b	Japanese quail	egg production	diet	5.29 weeks	cadmium sulfate	
ED20 for Leach et al. 1979	chicken	egg production	diet	12 weeks	cadmium sulfate	

Tier 1

Eco−SSL TRV = 1.47 mg/kg bw/day

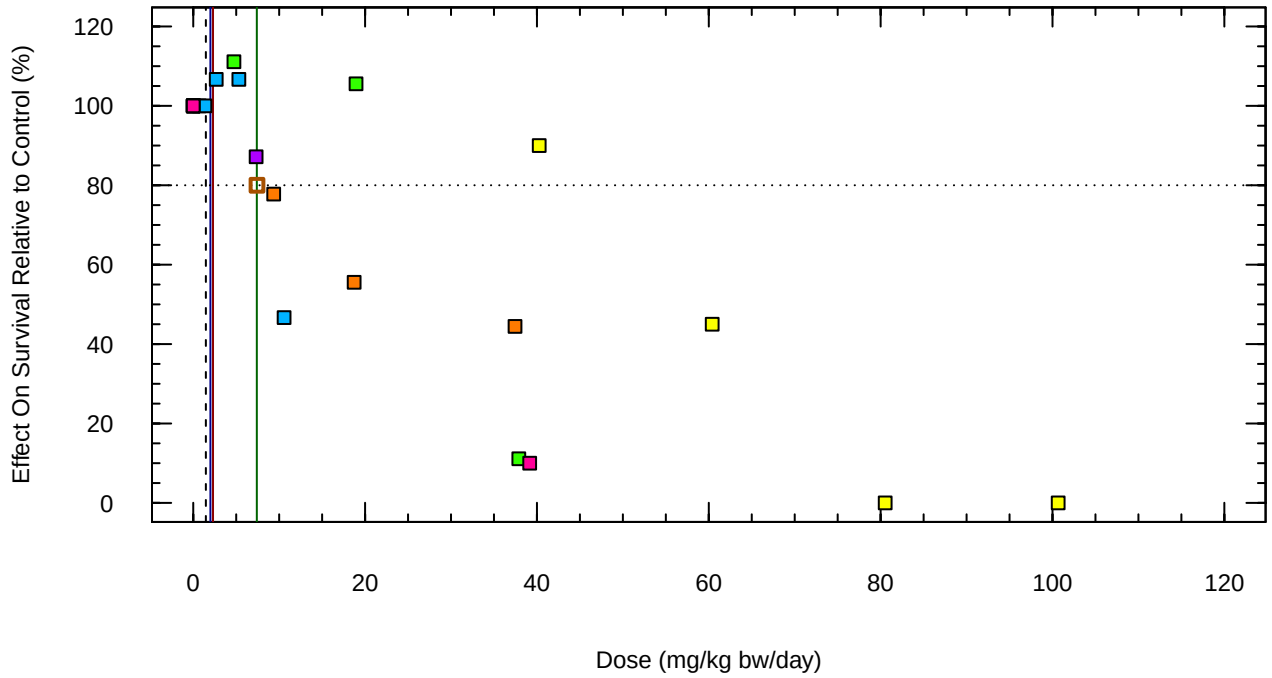
Selected TRV (Growth) = 2 mg/kg bw/day
Selected TRV (Reproduction) = 2.3 mg/kg bw/day
Selected TRV (Survival) = 7.4 mg/kg bw/day

80% effect relative to control

ED20 for Bokori et al. 1995b is 2.4 mg/kg bw/day
ED20 for Leach et al. 1979 is 2.3 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−2. Dose−Response Data for the Avian Reproduction Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bokori et al. 1995b	Japanese quail	survival	diet	5.29 weeks	cadmium sulfate	C
Bokori et al. 1995a	chicken	survival	diet	8 weeks	cadmium sulfate	
Hill 1974b	chicken	survival	diet	2 weeks	cadmium sulfate	
Olgun 2015	Japanese quail	survival	diet	10 weeks	cadmium sulfate	C
Pritzl et al. 1974	chicken	survival	diet	2.86 weeks	cadmium carbonate	
Van Vleet et al. 1981	Pekin duck	survival	diet	4 weeks	cadmium sulfate	
ED20 for pooled dataset C	Japanese quail	survival	diet	5.3−10 weeks	cadmium sulfate	C

Tier 1

Eco−SSL TRV = 1.47 mg/kg bw/day

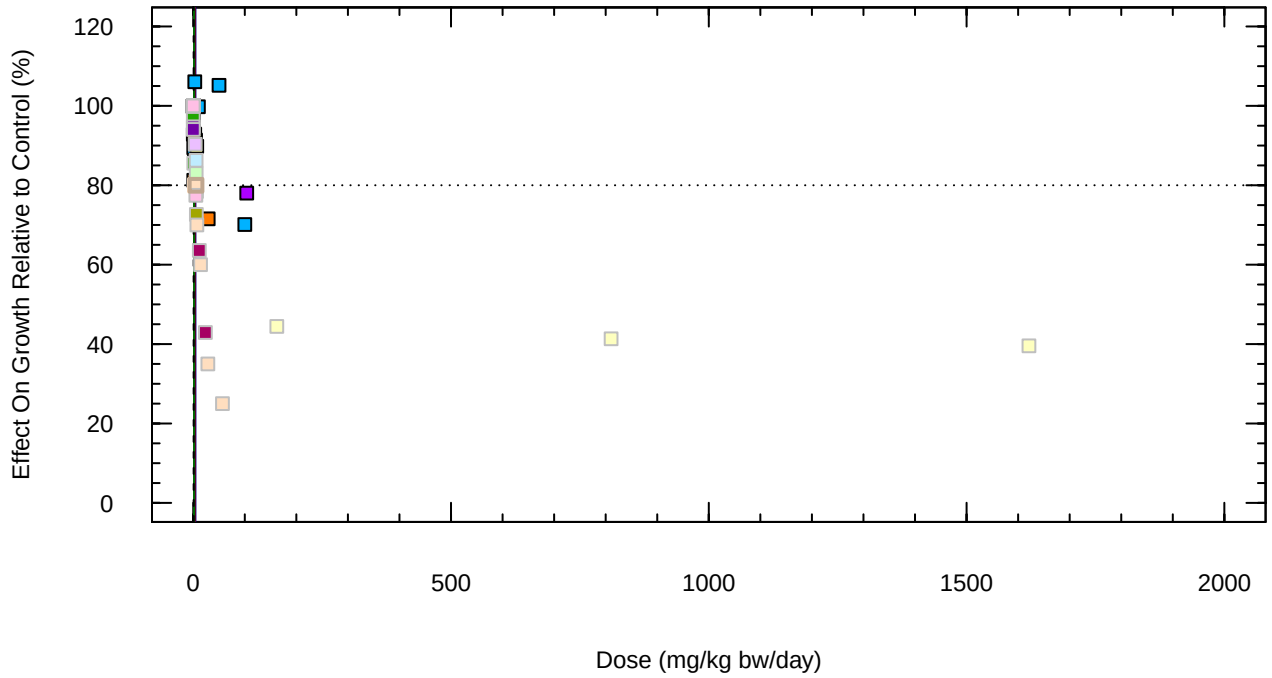
Selected TRV (Growth) = 2 mg/kg bw/day
Selected TRV (Reproduction) = 2.3 mg/kg bw/day
Selected TRV (Survival) = 7.4 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset C is 7.4 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−3. Dose−Response Data for the Avian Survival Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Baranski and Sitarek 1987	rat	body weight	gavage	14 weeks	cadmium chloride	
Cousins et al. 1977	rat	body weight	diet	14 weeks	cadmium chloride	
Dodds−Smith et al. 1992	shrew	body weight	diet	12 weeks	cadmium chloride	
Hamada et al. 1991	dog	body weight	diet	8−9 years	cadmium chloride	
Rajanna et al. 1984	rat	body weight	diet	25.7 weeks	cadmium chloride	
Groten et al. 1991	rat	body weight	diet	8 weeks	cadmium chloride	
Rastogi et al 1977	rat	body weight	gavage	4.27 weeks	cadmium chloride	
Merali and Singhal 1980	rat	body weight	gavage	6.14 weeks	cadmium chloride	
Weigel et al. 1987	rat	body weight	diet	7.86 weeks	cadmium oxide	
Pond et al. 1973	pig	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1979	rat	body weight	diet	2 weeks	cadmium chloride	A
Suzuki and Yoshida 1979	rat	body weight	diet	4 weeks	cadmium chloride	A
Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 1)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 2)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978b	rat	body weight (Exp 1)	diet	2 weeks	cadmium chloride	A
Weber and Reid 1969	mouse	body weight (Exp 1)	diet	3 weeks	cadmium acetate	
Suzuki and Yoshida 1977	rat	body weight (Exp 2)	diet	6.43 weeks	cadmium chloride	A
ED20 for Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
ED20 for pooled dataset A	rat	body weight	diet	2−6.4 weeks	cadmium chloride	A

Tier 1

Eco−SSL TRV = 0.77 mg/kg bw/day

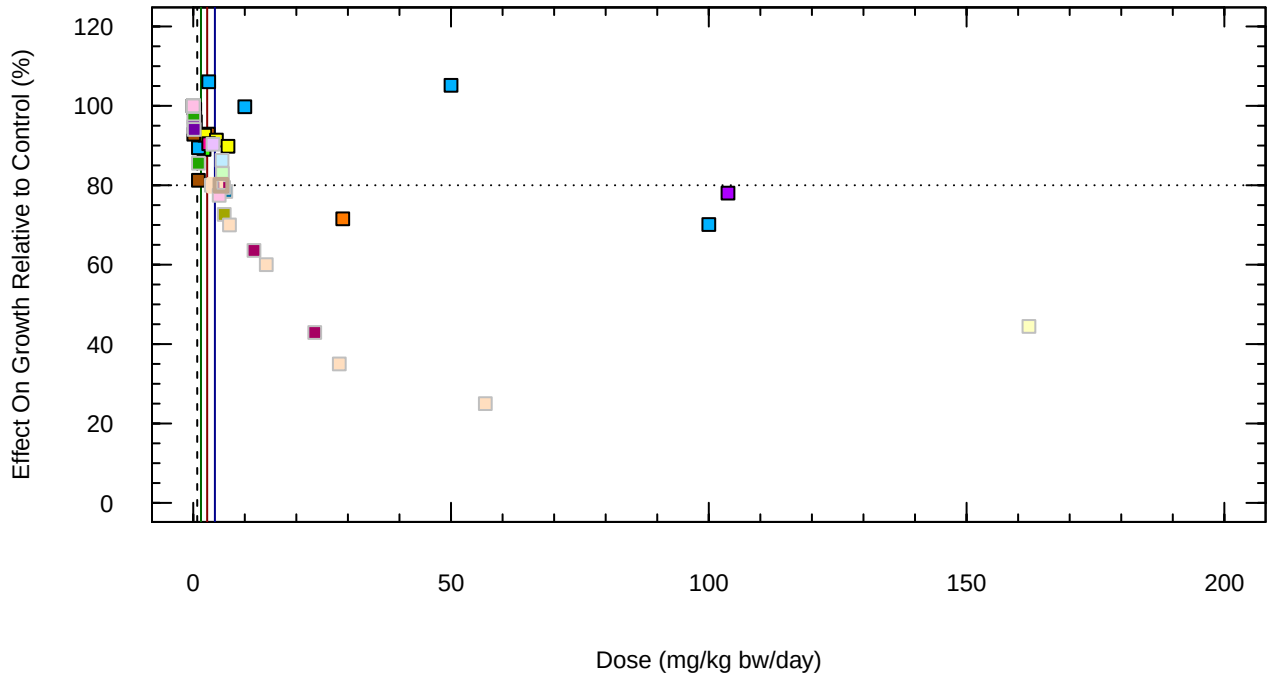
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Wilson et al. 1941 is 4.2 mg/kg bw/day
ED20 for pooled dataset A is 5.4 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−4a. Dose−Response Data for the Mammalian Growth Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Baranski and Sitarek 1987	rat	body weight	gavage	14 weeks	cadmium chloride	
Cousins et al. 1977	rat	body weight	diet	14 weeks	cadmium chloride	
Dodds−Smith et al. 1992	shrew	body weight	diet	12 weeks	cadmium chloride	
Hamada et al. 1991	dog	body weight	diet	8−9 years	cadmium chloride	
Rajanna et al. 1984	rat	body weight	diet	25.7 weeks	cadmium chloride	
Groten et al. 1991	rat	body weight	diet	8 weeks	cadmium chloride	
Rastogi et al 1977	rat	body weight	gavage	4.27 weeks	cadmium chloride	
Merali and Singhal 1980	rat	body weight	gavage	6.14 weeks	cadmium chloride	
Weigel et al. 1987	rat	body weight	diet	7.86 weeks	cadmium oxide	
Pond et al. 1973	pig	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1979	rat	body weight	diet	2 weeks	cadmium chloride	A
Suzuki and Yoshida 1979	rat	body weight	diet	4 weeks	cadmium chloride	A
Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 1)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 2)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978b	rat	body weight (Exp 1)	diet	2 weeks	cadmium chloride	A
Weber and Reid 1969	mouse	body weight (Exp 1)	diet	3 weeks	cadmium acetate	
Suzuki and Yoshida 1977	rat	body weight (Exp 2)	diet	6.43 weeks	cadmium chloride	A
ED20 for Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
ED20 for pooled dataset A	rat	body weight	diet	2−6.4 weeks	cadmium chloride	A

Tier 1

Eco−SSL TRV = 0.77 mg/kg bw/day

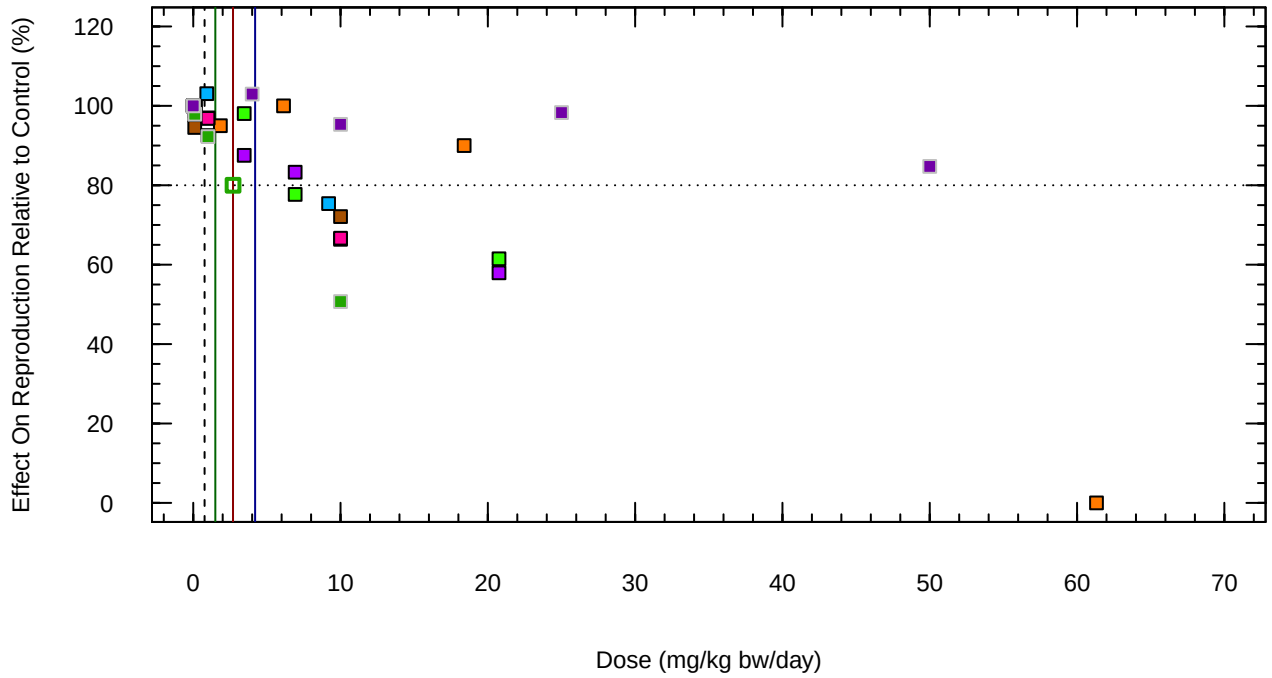
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Wilson et al. 1941 is 4.2 mg/kg bw/day
ED20 for pooled dataset A is 5.4 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−4b. Dose−Response Data for the Mammalian Growth Endpoint for Cadmium (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Machemer and Lorke 1981	rat	pregnancy success	gavage	1.43 weeks	cadmium chloride	
Sawicka−Kapusta et al. 1994	mouse	offspring growth	diet	5 weeks	cadmium chloride	
Sawicka−Kapusta et al. 1994	mouse	offspring survival	diet	5 weeks	cadmium chloride	
Whelton et al. 1988	mouse	offspring growth	diet	36 weeks	cadmium chloride	
Sutou et al. 1980	rat	fetal weight (male)	gavage	9 weeks	cadmium chloride	B
Sutou et al. 1980	rat	fetal weight (female)	gavage	9 weeks	cadmium chloride	B
Sutou et al. 1980	rat	fetal implants	gavage	>9 weeks	cadmium chloride	
Sutou et al. 1980	rat	live fetuses	gavage	>9 weeks	cadmium chloride	
Wardell et al. 1982	rat	litter weight	gavage	1.86 weeks	not specified	
ED20 for Sutou et al. 1980	rat	live fetuses	gavage	>9 weeks	cadmium chloride	

Tier 1

Eco−SSL TRV = 0.77 mg/kg bw/day

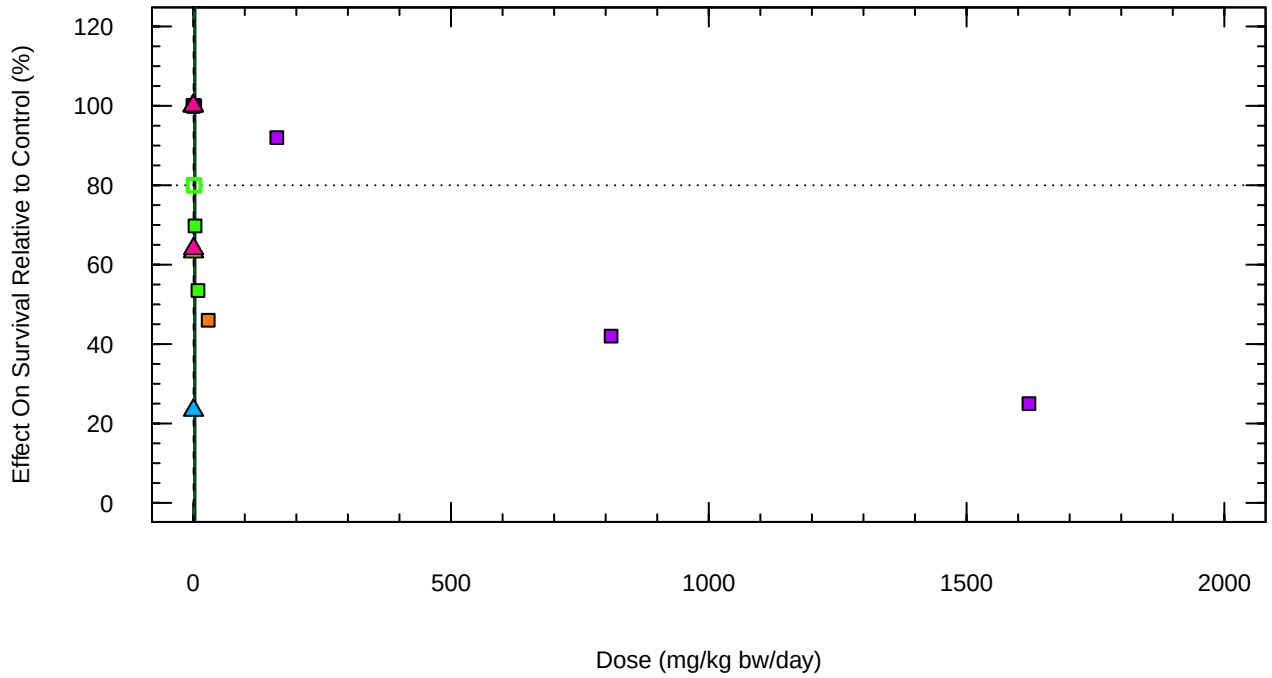
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Sutou et al. 1980 is 2.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−5. Dose−Response Data for the Mammalian Reproduction Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Baranski and Sitarek 1987	rat	survival	gavage	14 weeks	cadmium chloride	
Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	
Weber and Reid 1969	mouse	survival	diet	3 weeks	cadmium acetate	
Schroeder et al. 1963	rat	survival (male)	drinking water	92 weeks	not specified	C
Schroeder et al. 1963	rat	survival (female)	drinking water	92 weeks	not specified	C
Schroeder et al. 1964	mouse	survival (male)	drinking water	78 weeks	not specified	
ED20 for Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	

Tier 1 Tier 2

Eco−SSL TRV = 0.77 mg/kg bw/day

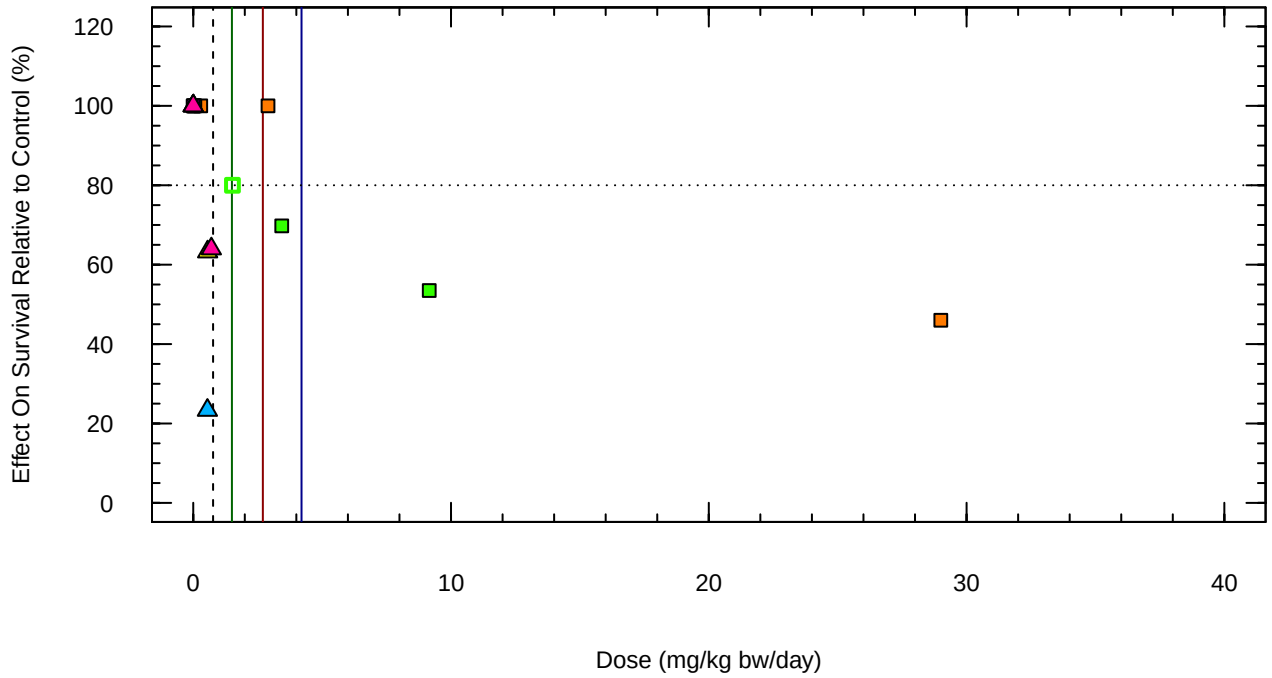
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Swiergosz et al. 1998 is 1.5 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−6a. Dose−Response Data for the Mammalian Survival Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Baranski and Sitarek 1987	rat	survival	gavage	14 weeks	cadmium chloride	
Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	
Weber and Reid 1969	mouse	survival	diet	3 weeks	cadmium acetate	
Schroeder et al. 1963	rat	survival (male)	drinking water	92 weeks	not specified	C
Schroeder et al. 1963	rat	survival (female)	drinking water	92 weeks	not specified	C
Schroeder et al. 1964	mouse	survival (male)	drinking water	78 weeks	not specified	
ED20 for Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	

Tier 1 Tier 2

Eco−SSL TRV = 0.77 mg/kg bw/day

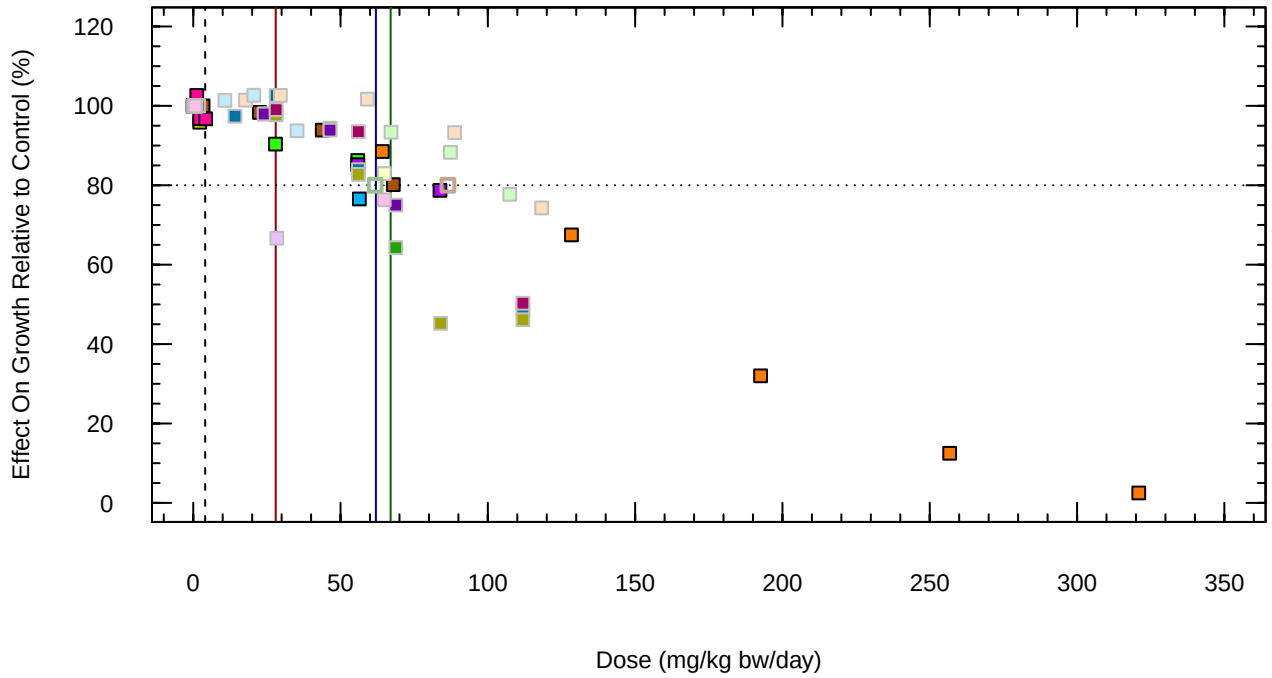
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Swiergosz et al. 1998 is 1.5 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−6b. Dose−Response Data for the Mammalian Survival Endpoint for Cadmium (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill 1974a	chicken	body weight	diet	2 weeks	copper sulfate	C
Jensen and Maurice 1978	chicken	body weight (Exp 1)	diet	4 weeks	copper sulfate	C
Jensen and Maurice 1978	chicken	body weight (Exp 2)	diet	4 weeks	copper sulfate	C
Jensen and Maurice 1979	chicken	body weight (Exp 2)	diet	4 weeks	copper sulfate	C
Kashani et al. 1986	turkey	body weight (Exp 1)	diet	24 weeks	cupric sulfate	
Kashani et al. 1986	turkey	body weight (Exp 2)	diet	24 weeks	cupric sulfate	
Miles et al. 1998	chicken	body weight (Exp 1)	diet	3 weeks	copper sulfate	
Miles et al. 1998	chicken	body weight (Exp 2)	diet	6 weeks	dicopper chloride	
Miles et al. 1998	chicken	body weight (Exp 2)	diet	6 weeks	copper sulfate	
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 1)	diet	4 weeks	copper sulfate	D
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 2)	diet	4 weeks	copper sulfate	D
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 5)	diet	4 weeks	copper sulfate	D
Persia et al. 2004	chicken	body weight (Exp 2)	diet	2.14 weeks	copper chloride	E
Persia et al. 2004	chicken	body weight (Exp 3)	diet	2 weeks	copper chloride	E
Latymer and Cotes 1981	chicken	body weight	diet	3.43 weeks	copper sulfate	C
Smith 1969	chicken	body weight	diet	3.57 weeks	copper sulfate	C
Wang et al. 1987	chicken	body weight gain (Exp 2)	diet	2.86 weeks	copper sulfate	D
Wang et al. 1987	chicken	body weight gain (Exp 1)	diet	2.86 weeks	copper sulfate	D
ED20 for pooled dataset C	chicken	body weight	diet	3.4−4 weeks	copper sulfate	C
ED20 for pooled dataset D	chicken	body weight gain	diet	2.9−4 weeks	copper sulfate	D

Tier 1

Eco−SSL TRV = 4.05 mg/kg bw/day

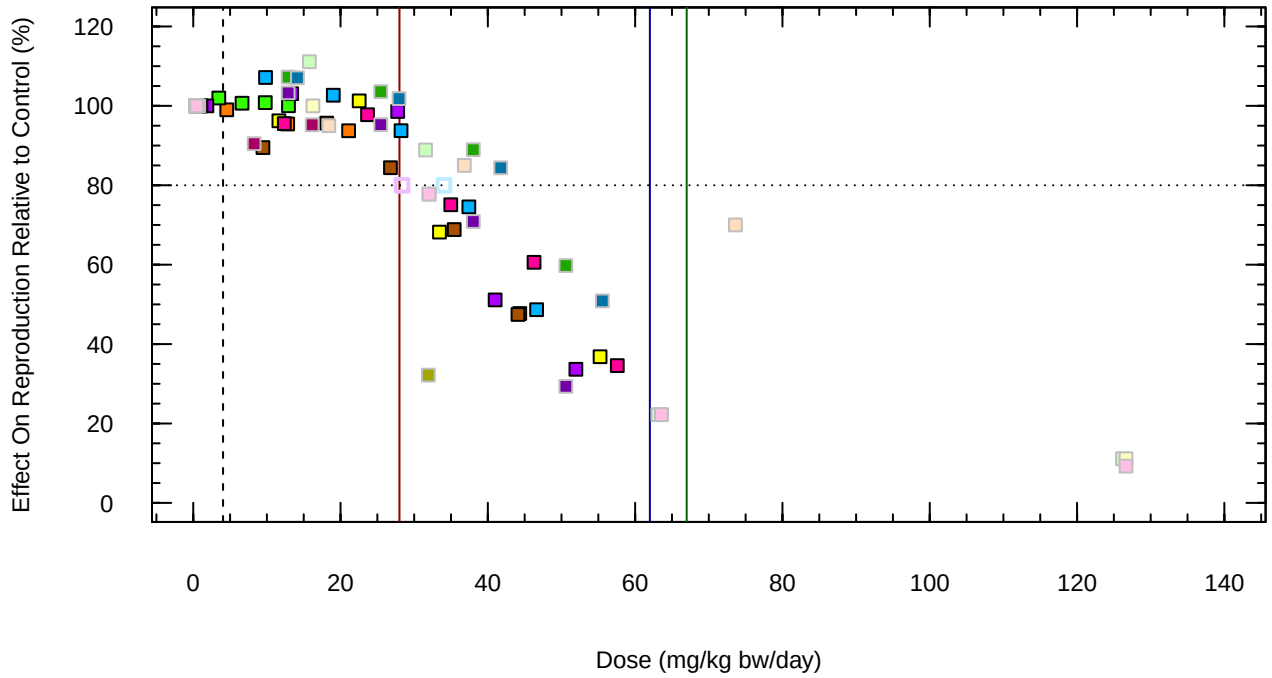
Selected TRV (Growth) = 62 mg/kg bw/day
Selected TRV (Reproduction) = 28 mg/kg bw/day
Selected TRV (Survival) = 67 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset C is 86 mg/kg bw/day
ED20 for pooled dataset D is 62 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−7. Dose−Response Data for the Avian Growth Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Al Ankari et al. 1998	chicken	egg production	diet	12 weeks	copper sulfate/acetate	
Balevi and Coskun 2004	chicken	egg production	diet	4−9 weeks	copper sulfate	A
Chiou et al. 1997	chicken	egg production	diet	4 weeks	copper sulfate	A
Jackson and Stevenson 1981a	chicken	egg production (breed 1)	diet	40 weeks	copper sulfate	B
Jackson and Stevenson 1981a	chicken	egg production (breed 2)	diet	40 weeks	copper sulfate	B
Jackson and Stevenson 1981b	chicken	egg production (breed 1)	diet	48 weeks	copper sulfate	B
Jackson and Stevenson 1981b	chicken	egg production (breed 2)	diet	48 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production (breed 1)	diet	32 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production (breed 2)	diet	32 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production	diet	48 weeks	copper sulfate	B
Harms and Buresh 1986	chicken	egg production (Exp 3)	diet	6 weeks	copper sulfate	A
Lien et al. 2004	chicken	egg production	diet	4 weeks	copper sulfate	A
Stevenson et al. 1983	chicken	egg production	diet	0.714 weeks	copper sulfate	
Pearce et al. 1983	chicken	egg production	diet	6.86 weeks	copper sulfate	A
Stevenson and Jackson 1980a	chicken	egg production	diet	6.86 weeks	copper sulfate	A
Stevenson and Jackson 1980b	chicken	egg production	diet	8 weeks	copper sulfate	A
ED20 for pooled dataset A	chicken	egg production	diet	4−8 weeks	copper sulfate	A
ED20 for pooled dataset B	chicken	egg production	diet	32−48 weeks	copper sulfate	B

Tier 1

Eco−SSL TRV = 4.05 mg/kg bw/day

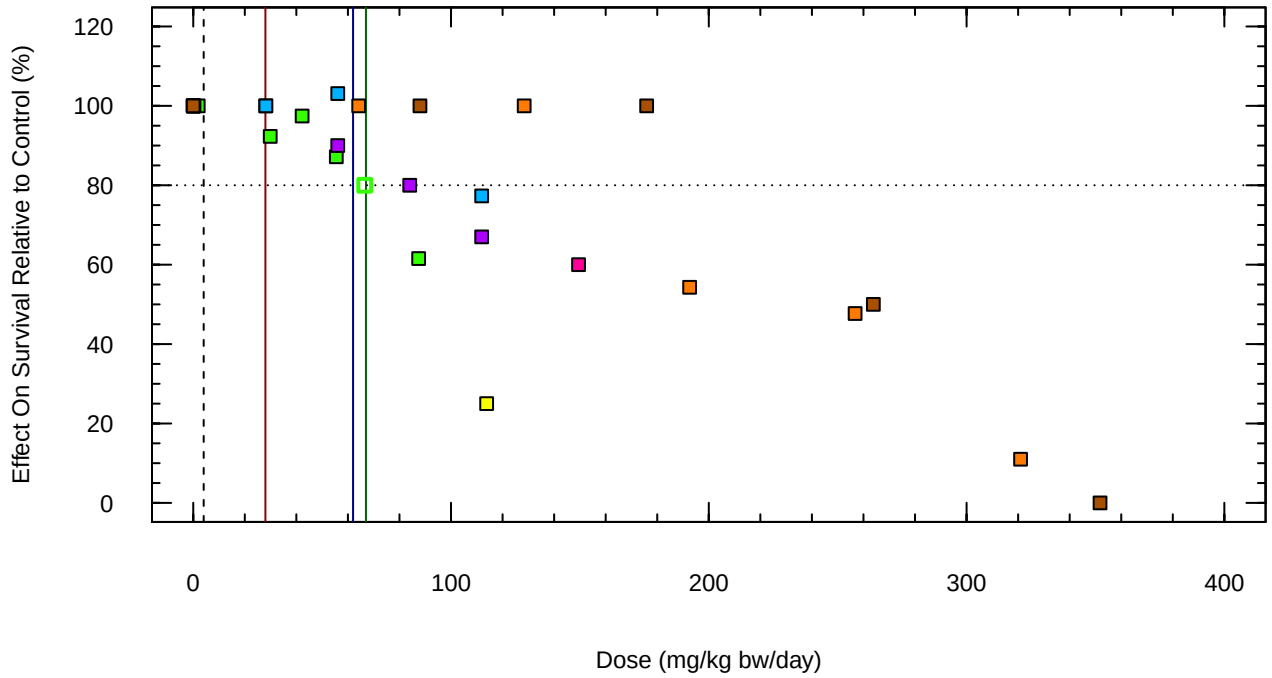
Selected TRV (Growth) = 62 mg/kg bw/day
Selected TRV (Reproduction) = 28 mg/kg bw/day
Selected TRV (Survival) = 67 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset A is 28 mg/kg bw/day
ED20 for pooled dataset B is 34 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−8. Dose−Response Data for the Avian Reproduction Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill 1974a	chicken	survival	diet	2 weeks	copper sulfate	G
Mehring et al. 1960	chicken	survival	diet	10 weeks	copper oxide	
Poupoulis and Jensen 1976	chicken	survival (Exp 2)	diet	4 weeks	copper sulfate	G
Poupoulis and Jensen 1976	chicken	survival (Exp 5)	diet	4 weeks	copper sulfate	G
Van Vleet et al. 1981	Pekin duck	survival	diet	4 weeks	copper sulfate	F
Van Vleet et al. 1981	Pekin duck	survival	diet	2.14 weeks	copper sulfate	F
Vohra and Kratzer 1968	turkey	survival	diet	3 weeks	copper sulfate	
ED20 for Mehring et al. 1960	chicken	survival	diet	10 weeks	copper oxide	

Tier 1

Eco−SSL TRV = 4.05 mg/kg bw/day

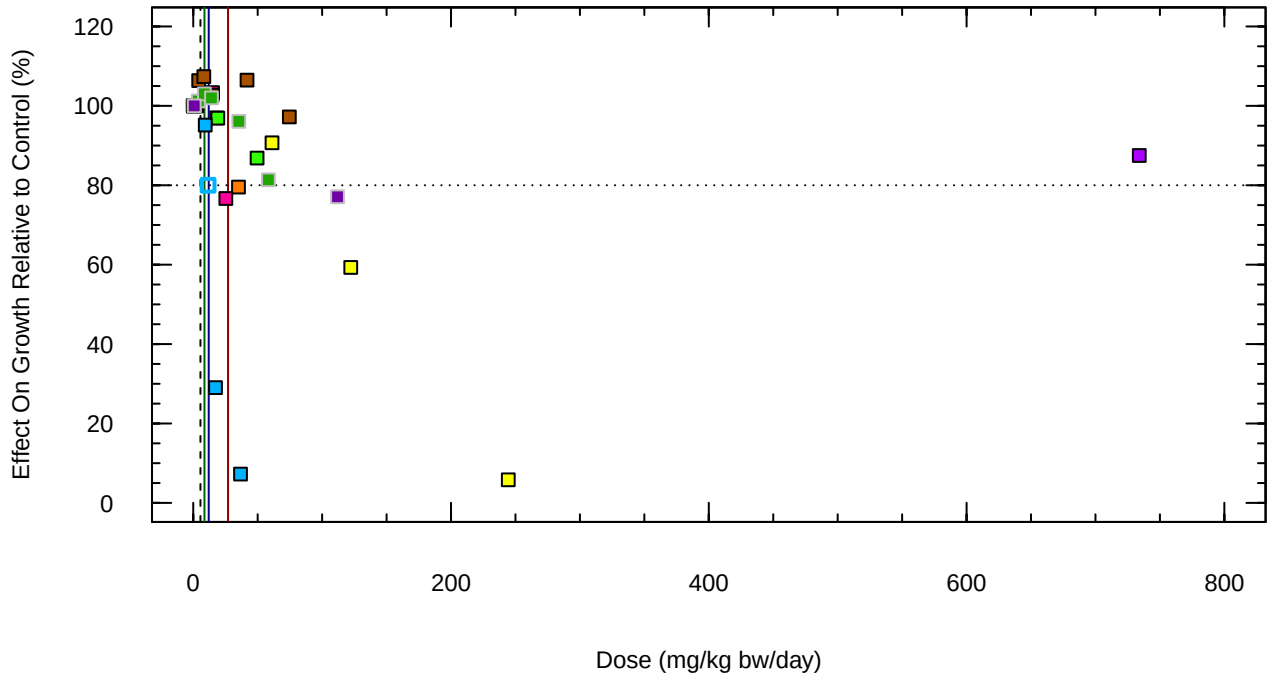
Selected TRV (Growth) = 62 mg/kg bw/day
Selected TRV (Reproduction) = 28 mg/kg bw/day
Selected TRV (Survival) = 67 mg/kg bw/day

80% effect relative to control

ED20 for Mehring et al. 1960 is 67 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−9. Dose−Response Data for the Avian Survival Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Brandt 1983	mink	body weight	diet	~12 weeks	copper sulfate	
Edmonds and Baker 1986	pig	body weight (Exp 3)	diet	4 weeks	copper sulfate	
Petterson et al. 2002	mouse	body weight	diet	3 weeks	copper chloride	
Allcroft et al. 1961	pig	body weight gain	diet	21 weeks	copper sulfate	
Boyden et al. 1938	rat	body weight gain	diet	4 weeks	copper sulfate	
Suttle and Mills 1966	pig	body weight (Exp 2)	diet	5.71 weeks	copper sulfate	
Grobner et al. 1986	rabbit	body weight (Exp 2)	diet	4 weeks	copper sulfate	
Grobner et al. 1986	rabbit	body weight (Exp 2)	diet	4 weeks	copper sulfate	
Llewellyn et al. 1985	rat	body weight	diet	21 weeks	copper acetate	
ED20 for Allcroft et al. 1961	pig	body weight gain	diet	21 weeks	copper sulfate	

Tier 1

Eco−SSL TRV = 5.6 mg/kg bw/day

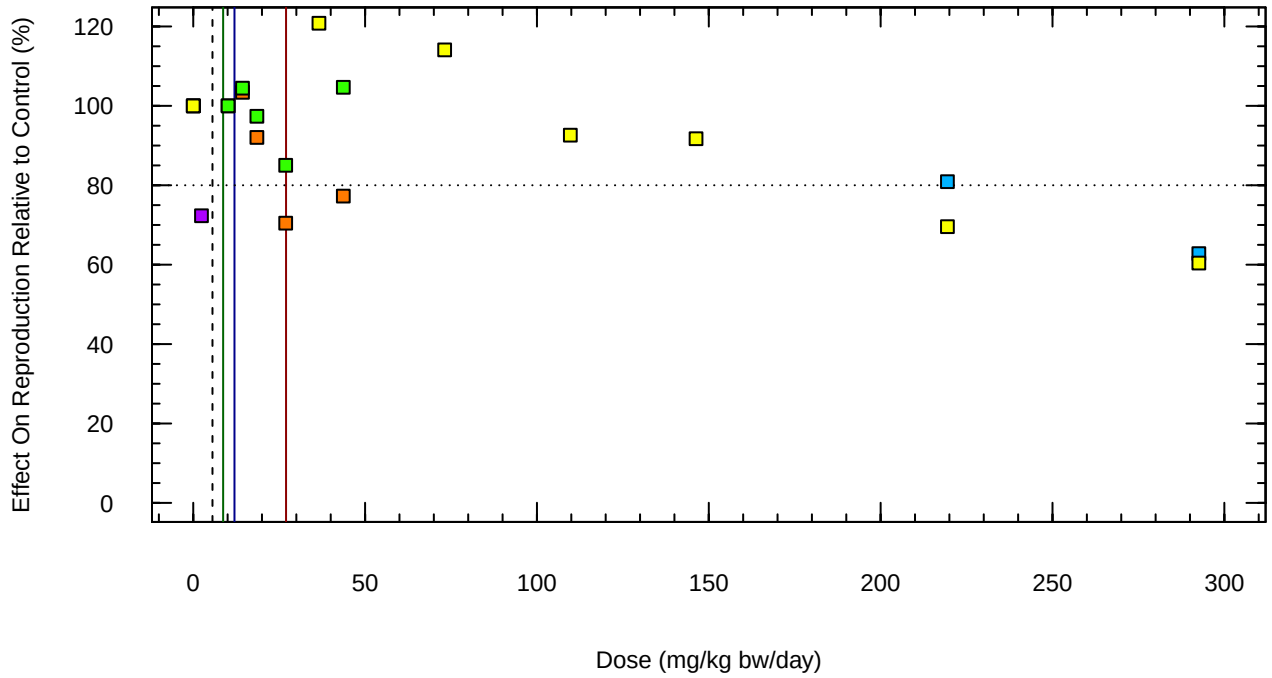
Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

ED20 for Allcroft et al. 1961 is 12 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−10. Dose−Response Data for the Mammalian Growth Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Aulerich et al. 1982	mink	offspring survival	diet	20 weeks	copper sulfate	
Aulerich et al. 1982	mink	offspring growth	diet	20 weeks	copper sulfate	
Cromwell et al. 1993	pig	farrowing success	diet	2.1 years	copper sulfate	
Lecyk 1980	mouse	litter size (breed 1)	diet	7 weeks	copper sulfate	A
Lecyk 1980	mouse	litter size (breed 2)	diet	7 weeks	copper sulfate	A

Tier 1

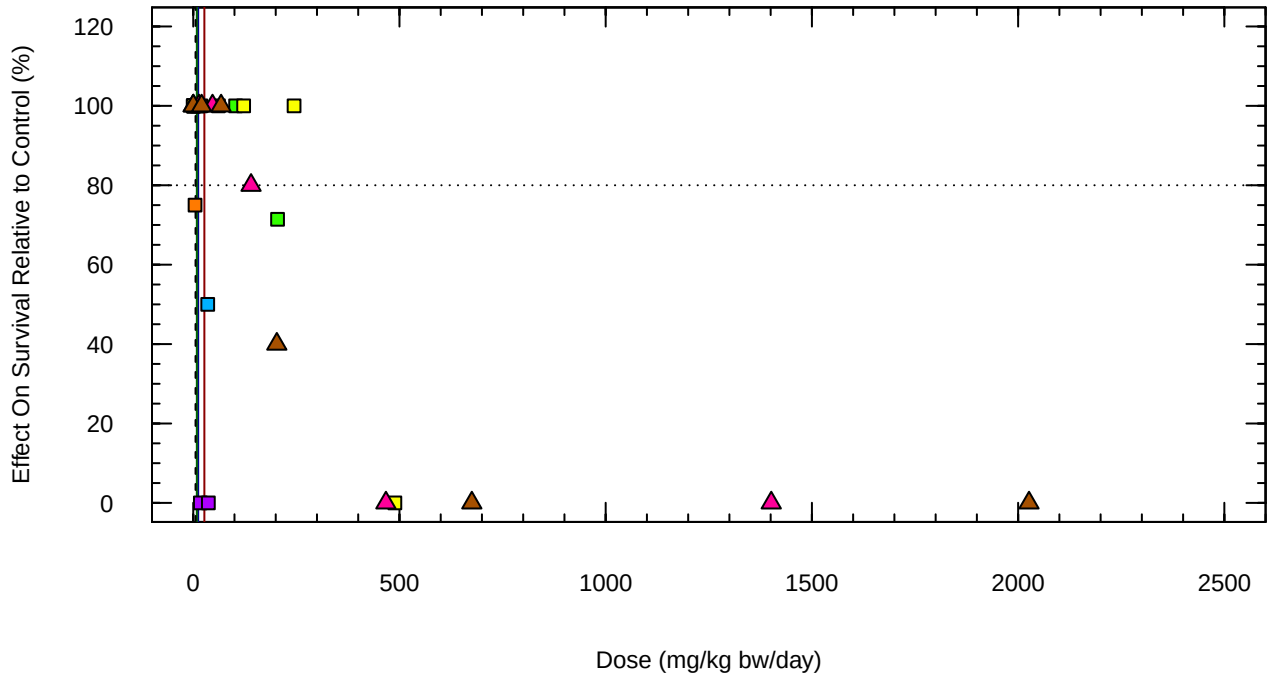
Eco−SSL TRV = 5.6 mg/kg bw/day

Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−11. Dose−Response Data for the Mammalian Reproduction Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Ritchie et al. 1963	pig	survival	diet	15 weeks	copper sulfate	B
Keen et al. 1982	rat	survival	diet	6.71 weeks	copper sulfate	
Allcroft et al. 1961	pig	survival	diet	21 weeks	copper sulfate	B
Brandt 1983	mink	survival	diet	~12 weeks	copper sulfate	
Boyden et al. 1938	rat	survival	diet	4 weeks	copper sulfate	
NTP 1993a	mouse	survival (male)	drinking water	2 weeks	copper sulfate	
NTP 1993a	mouse	survival (female)	drinking water	2 weeks	copper sulfate	
Geomean for pooled dataset B	pig	survival	diet	15−21 weeks	copper sulfate	B

Tier 1 Tier 2

Eco−SSL TRV = 5.6 mg/kg bw/day

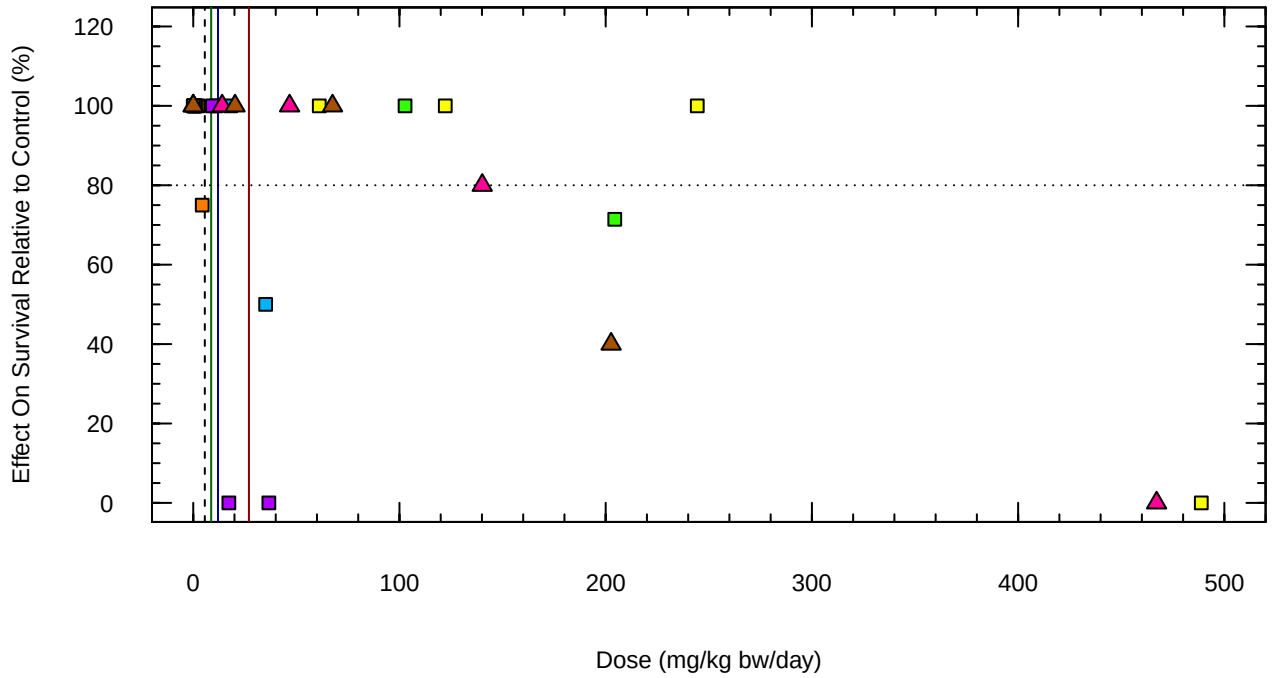
Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset B is 8.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−12a. Dose−Response Data for the Mammalian Survival Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Ritchie et al. 1963	pig	survival	diet	15 weeks	copper sulfate	B
Keen et al. 1982	rat	survival	diet	6.71 weeks	copper sulfate	
Allcroft et al. 1961	pig	survival	diet	21 weeks	copper sulfate	B
Brandt 1983	mink	survival	diet	~12 weeks	copper sulfate	
Boyden et al. 1938	rat	survival	diet	4 weeks	copper sulfate	
NTP 1993a	mouse	survival (male)	drinking water	2 weeks	copper sulfate	
NTP 1993a	mouse	survival (female)	drinking water	2 weeks	copper sulfate	
Geomean for pooled dataset B	pig	survival	diet	15−21 weeks	copper sulfate	B

Tier 1 Tier 2

Eco−SSL TRV = 5.6 mg/kg bw/day

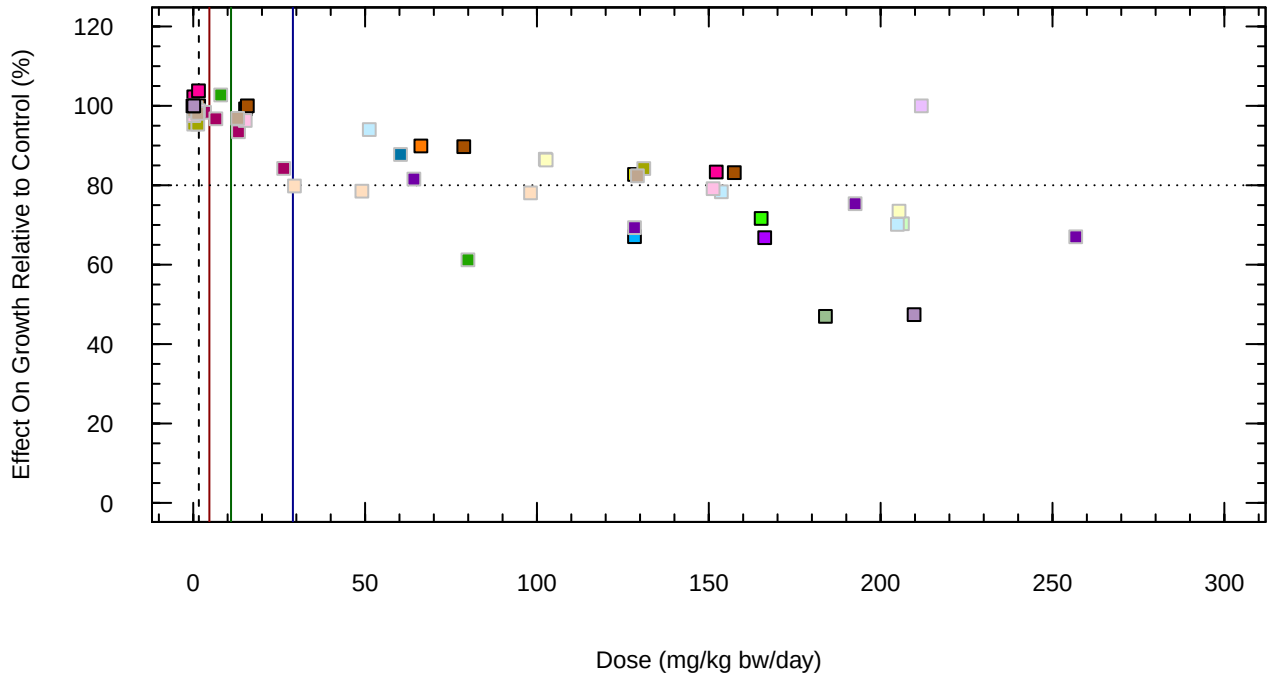
Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset B is 8.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−12b. Dose−Response Data for the Mammalian Survival Endpoint for Copper (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	body weight (breed 2)	diet	21 weeks	lead acetate	
Donaldson 1986	chicken	body weight (Exp 1)	diet	2.9 weeks	lead acetate trihydrate	A
Donaldson 1986	chicken	body weight (Exp 2)	diet	2.9 weeks	lead acetate trihydrate	A
Latta and Donaldson 1986	chicken	body weight gain	diet	2.7 weeks	lead acetate	
Leeming and Donaldson 1984	chicken	body weight gain	diet	2.71 weeks	lead acetate trihydrate	
Morgan et al. 1975	Japanese quail	body weight (Trial 1)	diet	5 weeks	lead acetate	
Morgan et al. 1975	Japanese quail	body weight (Trial 2)	diet	5 weeks	lead acetate	
Damron et al. 1969	chicken	body weight	diet	4 weeks	lead acetate	
Donaldson and McGowan 1989	chicken	body weight	diet	2.9 weeks	lead acetate trihydrate	A
Edens and Melvin 1989	Japanese quail	body weight (breed 1)	diet	21 weeks	lead acetate	
Edens and Melvin 1989	Japanese quail	body weight (female)	diet	15 weeks	lead acetate	
Edens and Garlich 1983	chicken	body weight	diet	10 weeks	lead acetate	
Abduljaleel & Shuhaimi−Othman 2013	chicken	body weight	diet	4 weeks	lead nitrate	
Berg et al. 1980	chicken	body weight (Exp 1)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 1)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 2)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 3)	diet	2 weeks	lead carbonate	C
Edens et al. 1976	Japanese quail	body weight	diet	12 weeks	lead acetate	B
Edens 1985	Japanese quail	body weight	diet	12 weeks	lead acetate	B
Cupo and Donaldson 1988	chicken	body weight	diet	3 weeks	lead acetate	C
Franson and Custer 1982	chicken	body weight	diet	4 weeks	lead acetate	C

Tier 1

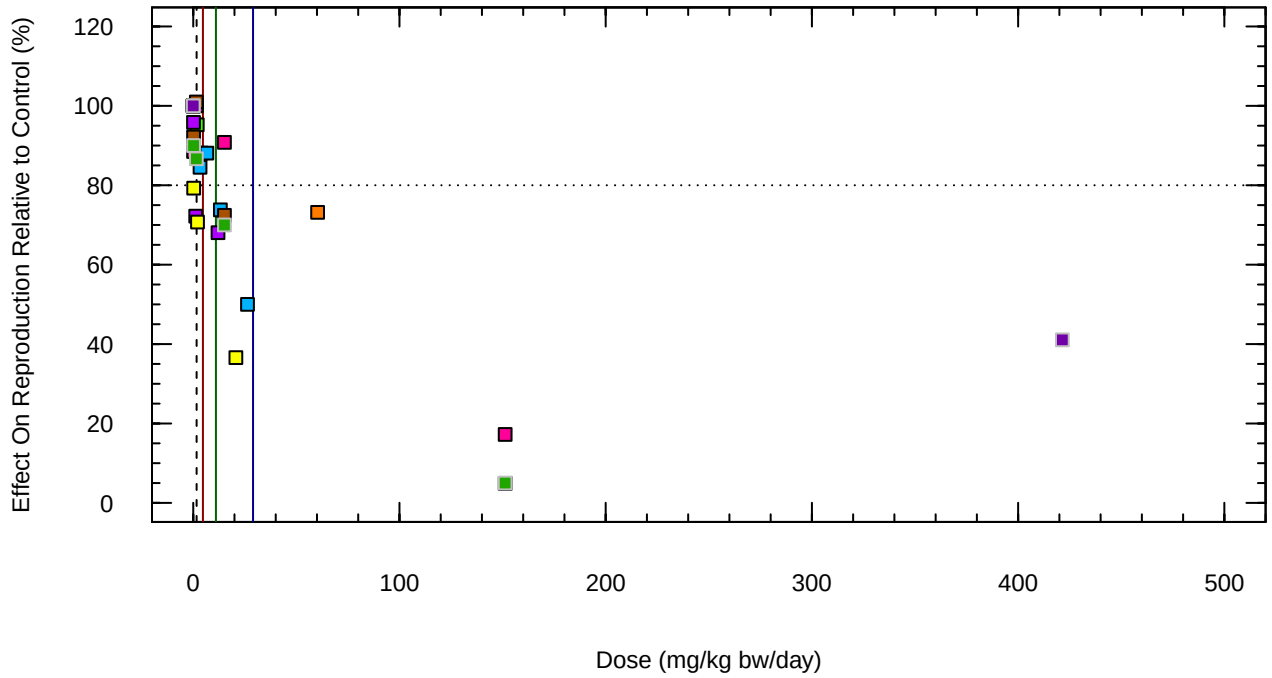
Eco−SSL TRV = 1.63 mg/kg bw/day

Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−13. Dose−Response Data for the Avian Growth Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	egg production	diet	21 weeks	lead acetate	
Edens and Garlich 1983	chicken	egg production (Exp 1)	diet	4 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 2)	diet	5 weeks	lead acetate	D
Edens and Garlich 1983	chicken	egg production (Exp 3)	diet	10 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 4)	diet	5 weeks	lead acetate	D
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Edens et al. 1976	Japanese quail	egg hatchability	diet	12 weeks	lead acetate	
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Stone and Soares 1976	Japanese quail	egg production	diet	3.86 weeks	lead acetate	D
Geomean for pooled dataset D	Japanese quail	egg production	diet	3.9−5 weeks	lead acetate	D

Tier 1

Eco−SSL TRV = 1.63 mg/kg bw/day

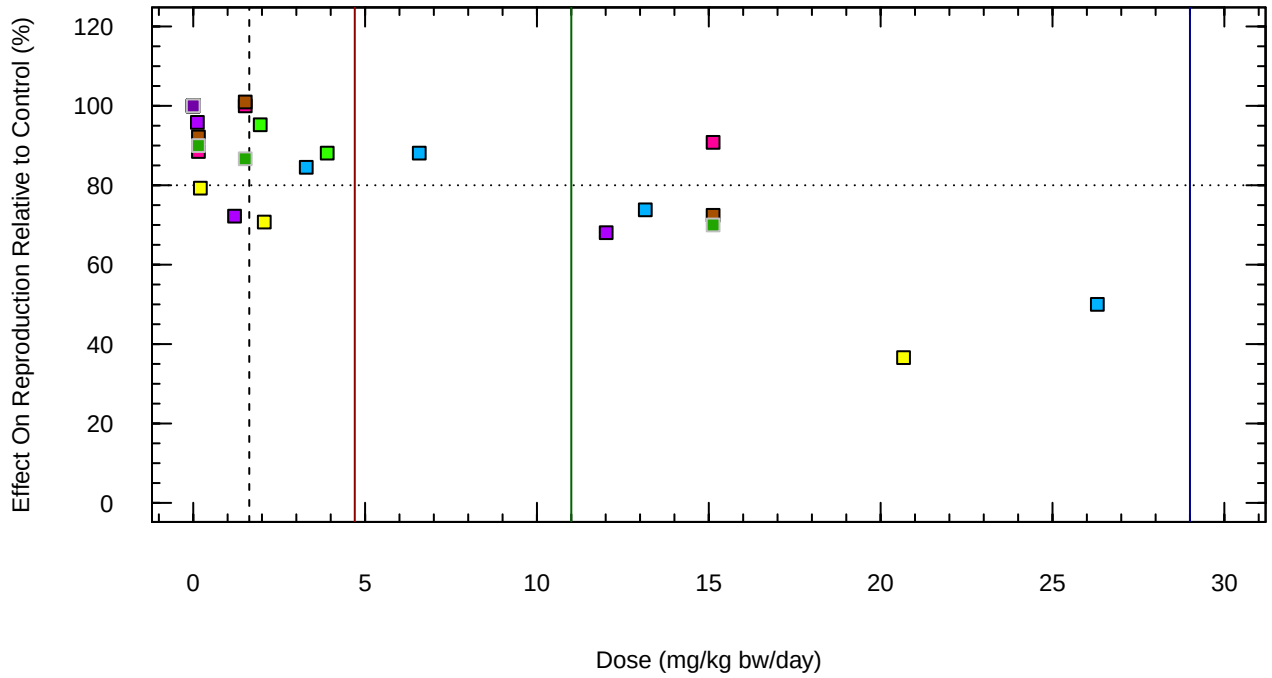
Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset D is 4.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−14a. Dose−Response Data for the Avian Reproduction Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	egg production	diet	21 weeks	lead acetate	
Edens and Garlich 1983	chicken	egg production (Exp 1)	diet	4 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 2)	diet	5 weeks	lead acetate	D
Edens and Garlich 1983	chicken	egg production (Exp 3)	diet	10 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 4)	diet	5 weeks	lead acetate	D
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Edens et al. 1976	Japanese quail	egg hatchability	diet	12 weeks	lead acetate	
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Stone and Soares 1976	Japanese quail	egg production	diet	3.86 weeks	lead acetate	D
Geomean for pooled dataset D	Japanese quail	egg production	diet	3.9−5 weeks	lead acetate	D

Tier 1

Eco−SSL TRV = 1.63 mg/kg bw/day

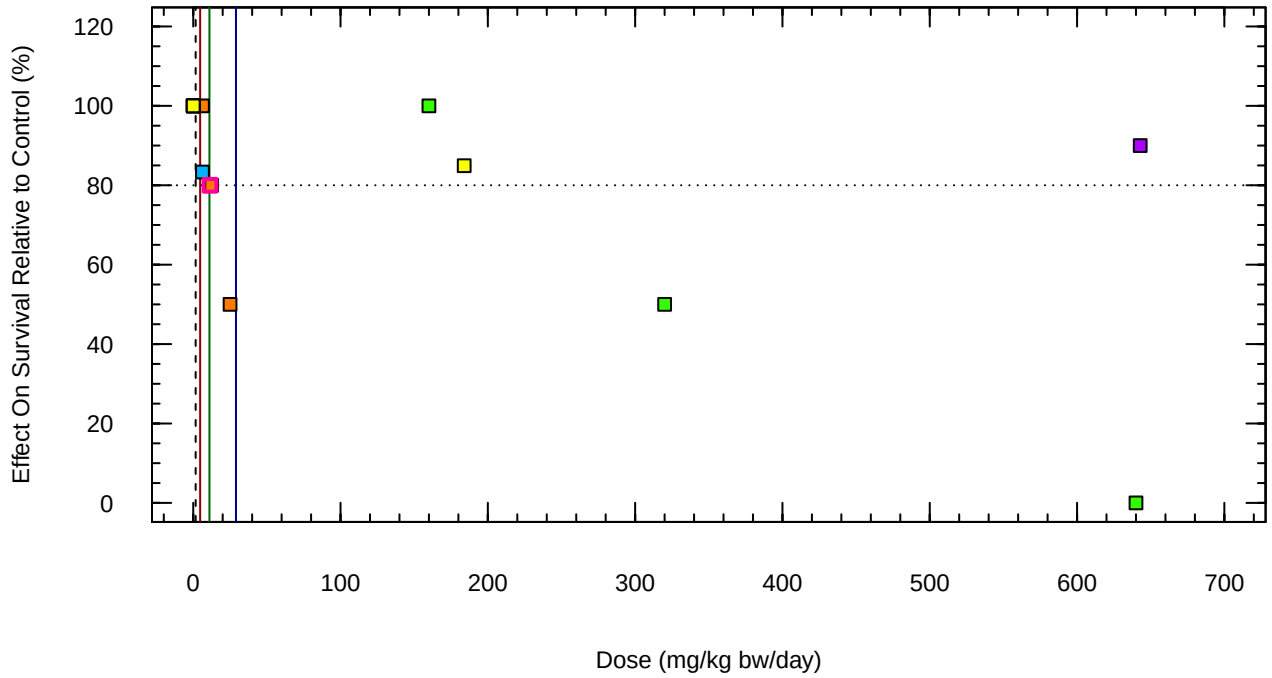
Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset D is 4.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−14b. Dose−Response Data for the Avian Reproduction Endpoint for Lead (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Barthalmus et al. 1977	pigeon	survival	gavage	varied	lead acetate	F
Vengris and Mare 1974	chicken	survival	gavage	5 weeks	lead acetate	
Khan et al. 1993	chicken	survival	gavage	1 weeks	lead acetate	
Anders et al. 1982	pigeon	survival	gavage	5 weeks	lead acetate	F
Cupo and Donaldson 1988	chicken	survival	diet	3 weeks	lead acetate	
ED20 for pooled dataset F	pigeon	survival	gavage	varied	lead acetate	F

Tier 1

Eco−SSL TRV = 1.63 mg/kg bw/day

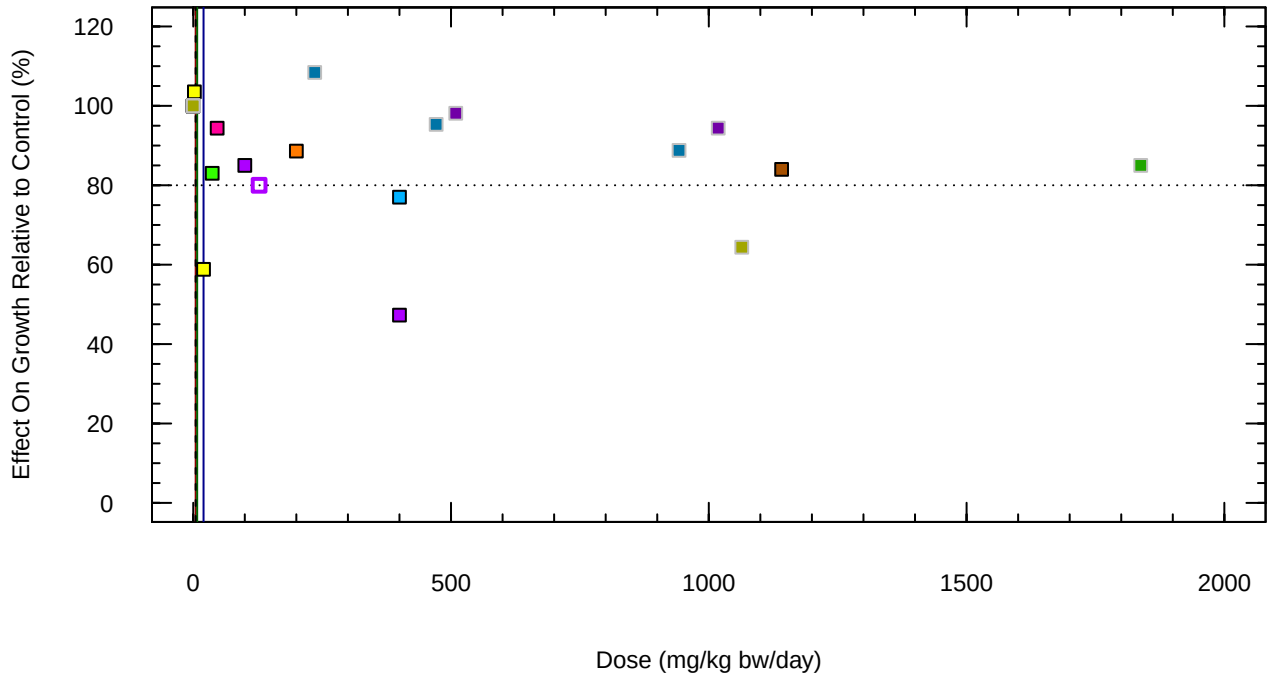
Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset F is 11 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−15. Dose−Response Data for the Avian Survival Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Harry et al. 1985	rat	body weight	gavage	3.71 weeks	lead acetate	A
Hsu et al. 1975	pig	body weight	diet	13 weeks	lead acetate	
Kumar and Desiraju 1990	rat	body weight	gavage	8.43 weeks	lead acetate	
Toews et al. 1983	rat	body weight	gavage	4 weeks	lead acetate	A
Lorenzo et al. 1978	rabbit	% weight gain	gavage	4.29 weeks	lead nitrate	
Al−Omar et al. 2000	mouse	body weight gain	gavage	5 weeks	lead oxide	
Barlow et al. 1977	rat	maternal body weight	diet	3 weeks	lead acetate	
Maker et al. 1973	mouse	body weight	diet	4.29 weeks	lead carbonate	
Mykkanen et al. 1980	rat	weight gain	diet	3 weeks	lead acetate	
Mykkanen et al. 1980	rat	weight gain	diet	3 weeks	lead acetate	
Gerber et al. 1978	rat	body weight	diet	52 weeks	lead acetate	
ED20 for Kumar and Desiraju 1990	rat	body weight	gavage	8.43 weeks	lead acetate	

Tier 1

Eco−SSL TRV = 4.7 mg/kg bw/day

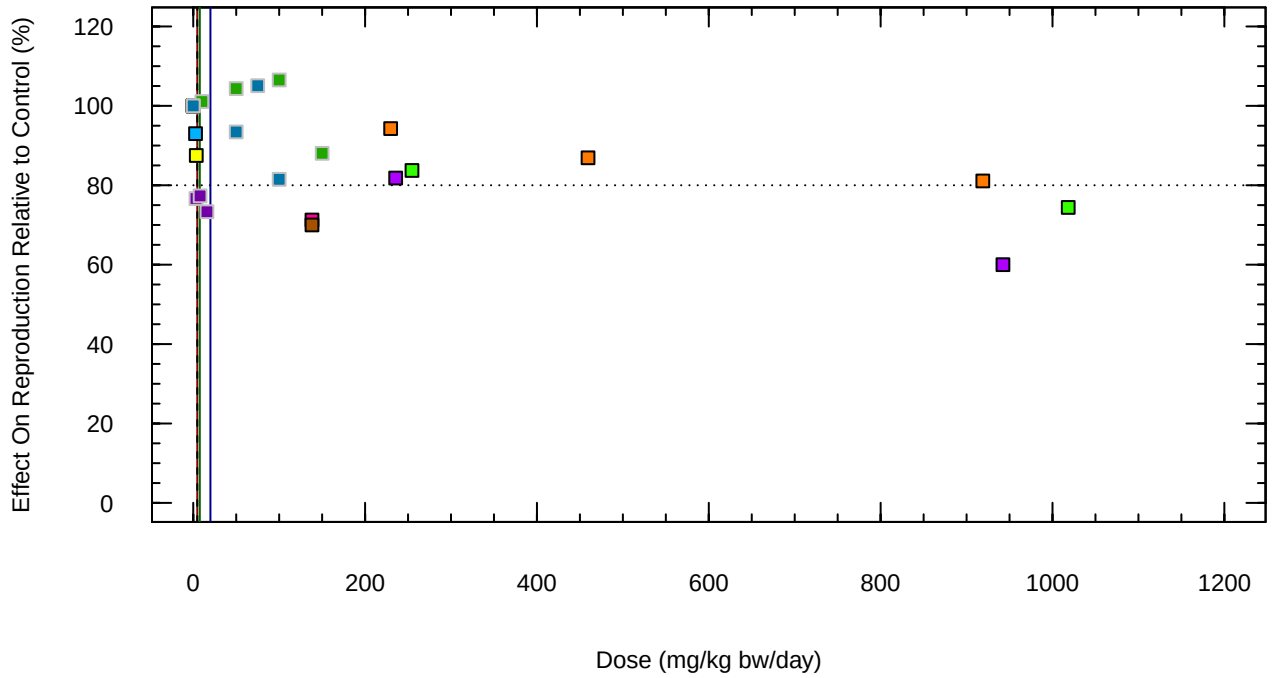
Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 7.6 mg/kg bw/day

80% effect relative to control

ED20 for Kumar and Desiraju 1990 is 130 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−16. Dose−Response Data for the Mammalian Growth Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Jacquet et al. 1977	mouse	embryo weight	diet	2.57 weeks	not specified	
Mykkanen et al. 1980	rat	pup weight (breed 1)	diet	3 weeks	lead acetate	B
Mykkanen et al. 1980	rat	pup weight (breed 2)	diet	3 weeks	lead acetate	B
Schroeder and Mitchener 1971	rat	offspring survival	diet and drinking water	3 generations	soluble lead	
Schroeder and Mitchener 1971	mouse	offspring survival	diet and drinking water	3 generations	soluble lead	
Winneke et al. 1977	rat	litter size	diet	18.6 weeks	lead acetate	
Winneke et al. 1977	rat	pregnancy success	diet	18.6 weeks	lead acetate	
Wardell et al. 1982	rat	fetal mortality (resorptions)	gavage	1.86 weeks	lead acetate	
Gupta et al. 1995	mouse	living embryos per mother	gavage	4 weeks	lead acetate	
Miller et al. 1982	rat	embryo weight	gavage	5.86 weeks	lead acetate	

Tier 1

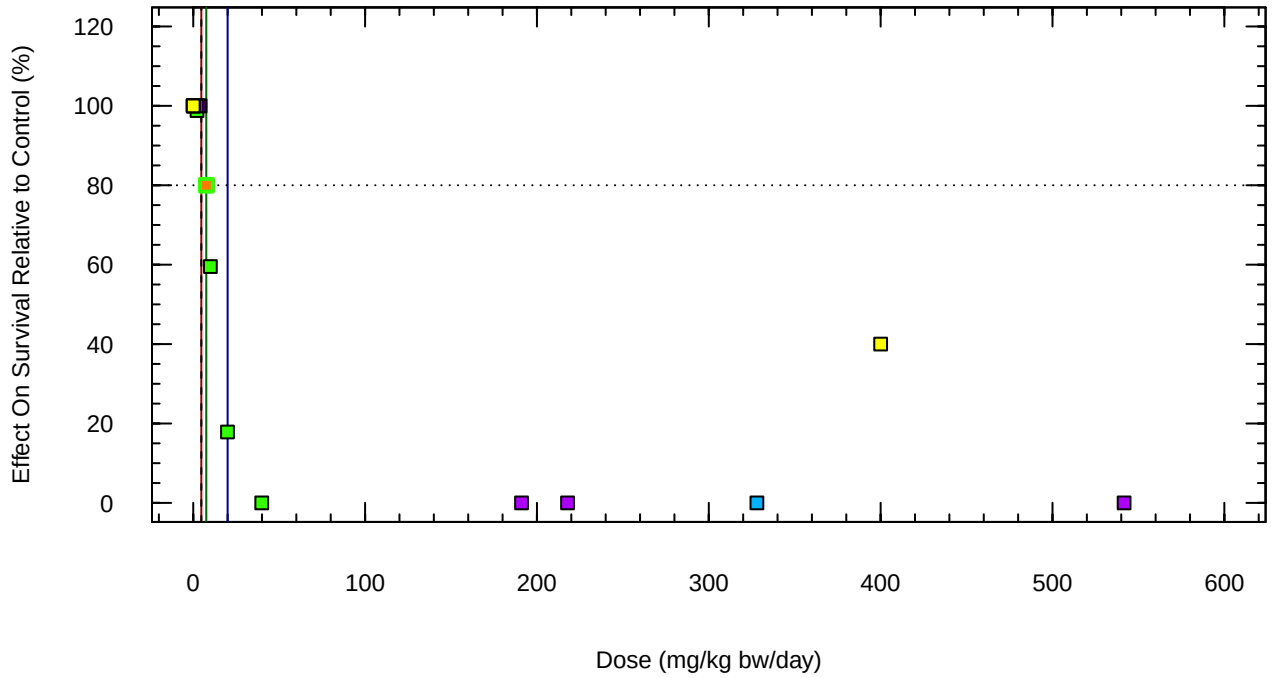
Eco−SSL TRV = 4.7 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 7.6 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−17. Dose−Response Data for the Mammalian Reproduction Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Junaid et al. 1997	mouse	survival	gavage	8.57 weeks	lead acetate	
Lorenzo et al. 1978	rabbit	survival	gavage	4.29 weeks	lead nitrate	
Pankakoski et al. 1994	shrew	survival	diet	0.6 weeks	lead in earthworm prey	
Press 1977	rat	survival	gavage	2.14 weeks	lead acetate	
Kumar and Desiraju 1990	rat	survival	gavage	8.43 weeks	lead acetate	
ED20 for Lorenzo et al. 1978	rabbit	survival	gavage	4.29 weeks	lead nitrate	

Tier 1

Eco−SSL TRV = 4.7 mg/kg bw/day

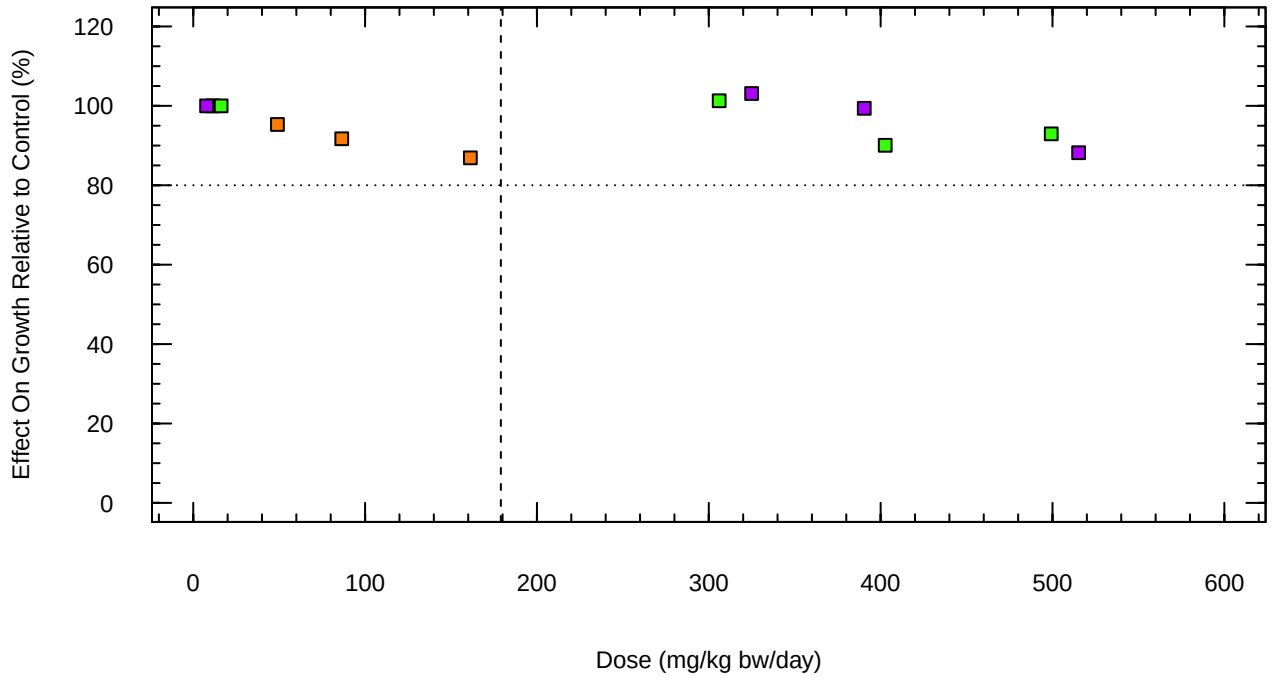
Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 7.6 mg/kg bw/day

80% effect relative to control

ED20 for Lorenzo et al. 1978 is 7.6 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−18. Dose−Response Data for the Mammalian Survival Endpoint for Lead



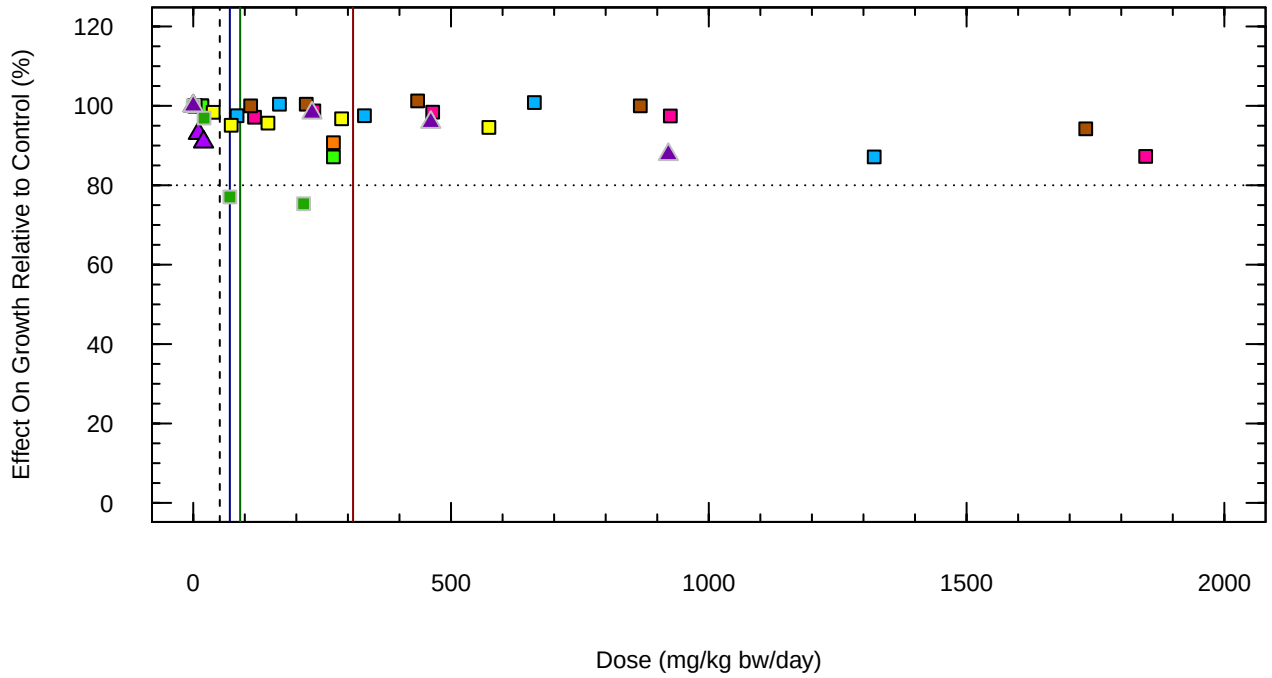
Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Martinez and Diaz 1996	chicken	body weight	diet	6 weeks	manganese oxide	
Southern and Baker 1983	chicken	body weight	diet	2 weeks	manganese chloride	
Vohra and Kratzer 1968	turkey	body weight gain	diet	3 weeks	manganese sulfate	

Tier 1

Eco−SSL TRV = 179 mg/kg bw/day

80% effect relative to control

Figure 4−19. Dose−Response Data for the Avian Growth Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Komura and Sakomoto 1991	mouse	body weight	diet	12.9 weeks	manganese acetate	
Komura and Sakomoto 1991	mouse	body weight	diet	12.9 weeks	manganese chloride	
Lipe et a. 1999	rat	body weight	gavage	4.29 weeks	manganese chloride	
NTP 1993b	rat	body weight (male)	diet	2 weeks	manganese sulfate	
NTP 1993b	rat	body weight (female)	diet	13 weeks	manganese sulfate	
NTP 1993b	mouse	body weight (male)	diet	13 weeks	manganese sulfate	
NTP 1993b	mouse	body weight (female)	diet	13 weeks	manganese sulfate	
Rehnberg et al. 1980	rat	body weight	gavage	2.86 weeks	manganese oxide	
Kontur and Fechter 1985	rat	body weight	drinking water	3 weeks	manganese chloride	

Tier 1 Tier 2

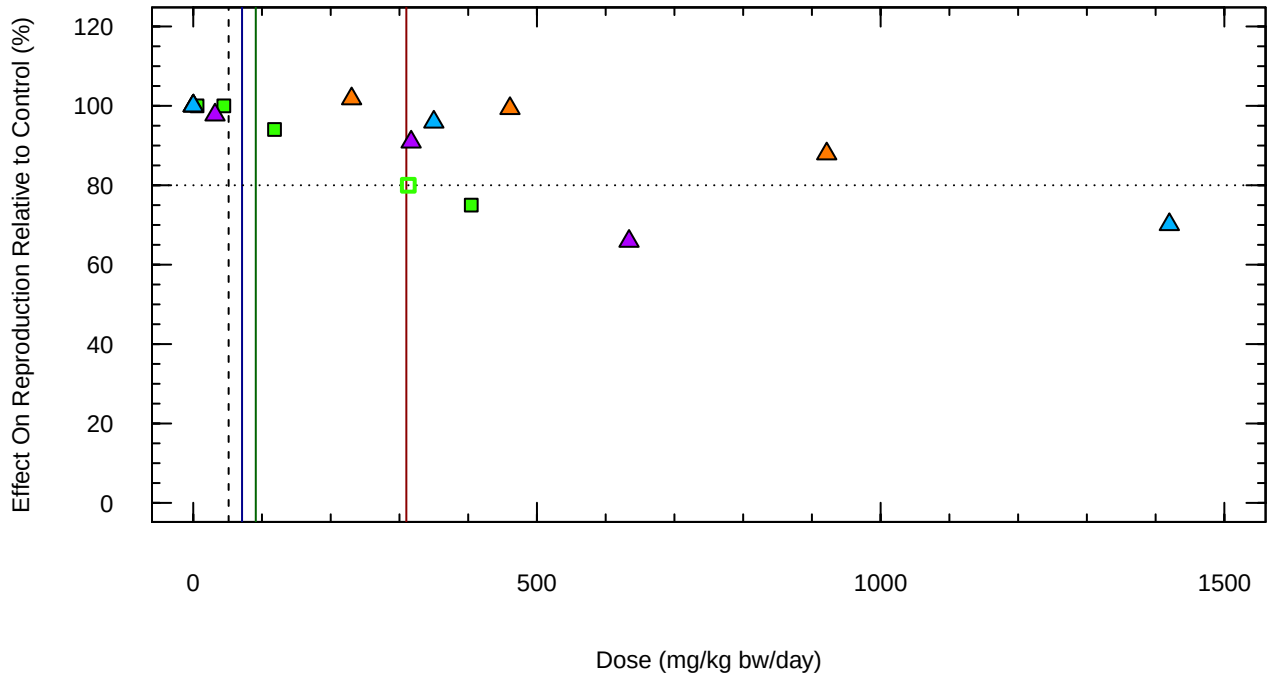
Eco−SSL TRV = 51.5 mg/kg bw/day

Selected TRV (Growth) = 71 mg/kg bw/day
Selected TRV (Reproduction) = 310 mg/kg bw/day
Selected TRV (Survival) = 91 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−20. Dose−Response Data for the Mammalian Growth Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Kontur and Fechter 1985	rat	litter size	drinking water	3 weeks	manganese chloride	
Laskey et al. 1982	rat	pregnancy success	diet	gestation to 32 weeks	manganese oxide	
Leung et al. 1982	rat	offspring body weight	drinking water	3.71 weeks	manganese chloride	A
Pappas et al. 1997	rat	offspring body weight	drinking water	gestation to post−natal day 30	manganese chloride	A
ED20 for Laskey et al. 1982	rat	pregnancy success	diet	gestation to 32 weeks	manganese oxide	

Tier 1 Tier 2

Eco−SSL TRV = 51.5 mg/kg bw/day

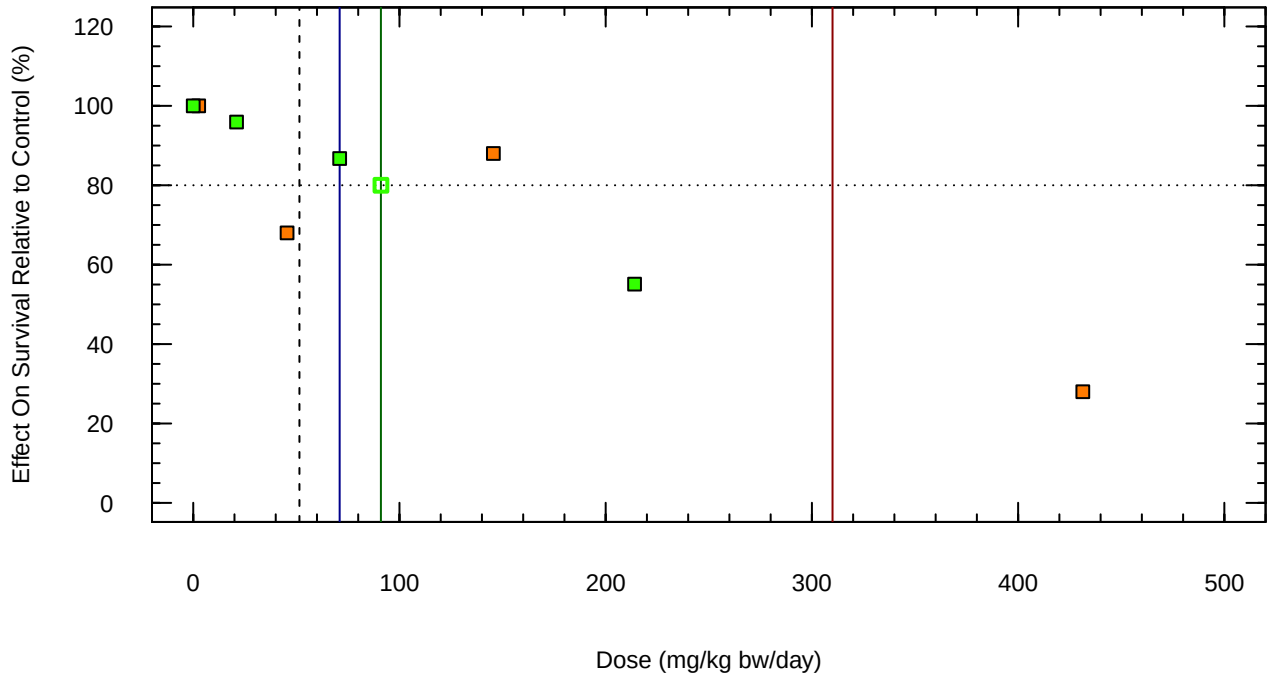
Selected TRV (Growth) = 71 mg/kg bw/day
Selected TRV (Reproduction) = 310 mg/kg bw/day
Selected TRV (Survival) = 91 mg/kg bw/day

80% effect relative to control

ED20 for Laskey et al. 1982 is 310 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−21. Dose−Response Data for the Mammalian Reproduction Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
NTP 1993b	rat	suvival (male)	diet	2 years	manganese sulfate	
Rehnberg et al. 1980	rat	survival	gavage	2.86 weeks	manganese oxide	
ED20 for Rehnberg et al. 1980	rat	survival	gavage	2.86 weeks	manganese oxide	

Tier 1

Eco−SSL TRV = 51.5 mg/kg bw/day

Selected TRV (Growth) = 71 mg/kg bw/day
Selected TRV (Reproduction) = 310 mg/kg bw/day
Selected TRV (Survival) = 91 mg/kg bw/day

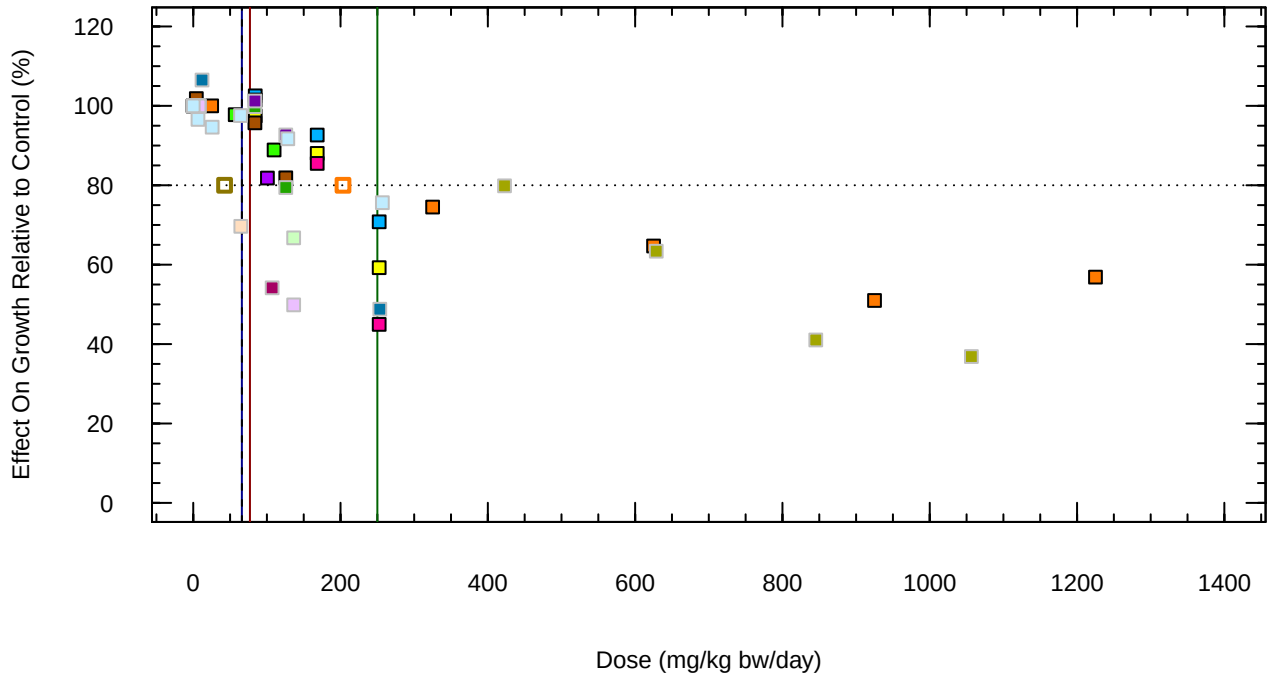
80% effect relative to control

ED20 for Rehnberg et al. 1980 is 91 mg/kg bw/day

* Survival at this dose was not significantly different from the control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−22. Dose−Response Data for the Mammalian Survival Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Gasaway and Buss 1972	mallard	body weight gain	diet	5.71 weeks	zinc carbonate	
Hamilton et al. 1981	Japanese quail	body weight (Exp 2)	diet	2 weeks	zinc carbonate	
Hamilton et al. 1981	Japanese quail	body weight (Exp 5)	diet	2 weeks	zinc carbonate	
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc oxide	D
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc sulfate	C
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc carbonate	B
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc sulfate	C
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc carbonate	B
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc oxide	D
Stahl et al. 1989	chicken	body weight gain	diet	3 weeks	zinc carbonate	
Vohra and Kratzer 1968	turkey	body weight gain	diet	3 weeks	zinc oxide	
Lu and Combs 1988	chicken	body weight gain (Exp 3)	diet	3 weeks	zinc oxide	A
Lu et al. 1990	chicken	body weight gain (Exp 1)	diet	1 weeks	zinc oxide	A
Sandoval et al. 1988	chicken	body weight gain (Exp 2)	diet	3 weeks	zinc sulfate	E
Sandoval et al. 1988	chicken	body weight gain (Exp 2)	diet	3 weeks	zinc gluconate	
Hill 1974a	chicken	body weight gain	diet	2 weeks	zinc sulfate	E
ED20 for Gasaway and Buss 1972	mallard	body weight gain	diet	5.71 weeks	zinc carbonate	
ED20 for pooled dataset A	chicken	body weight gain	diet	1−3 weeks	zinc oxide	A

Tier 1

Eco−SSL TRV = 66.1 mg/kg bw/day

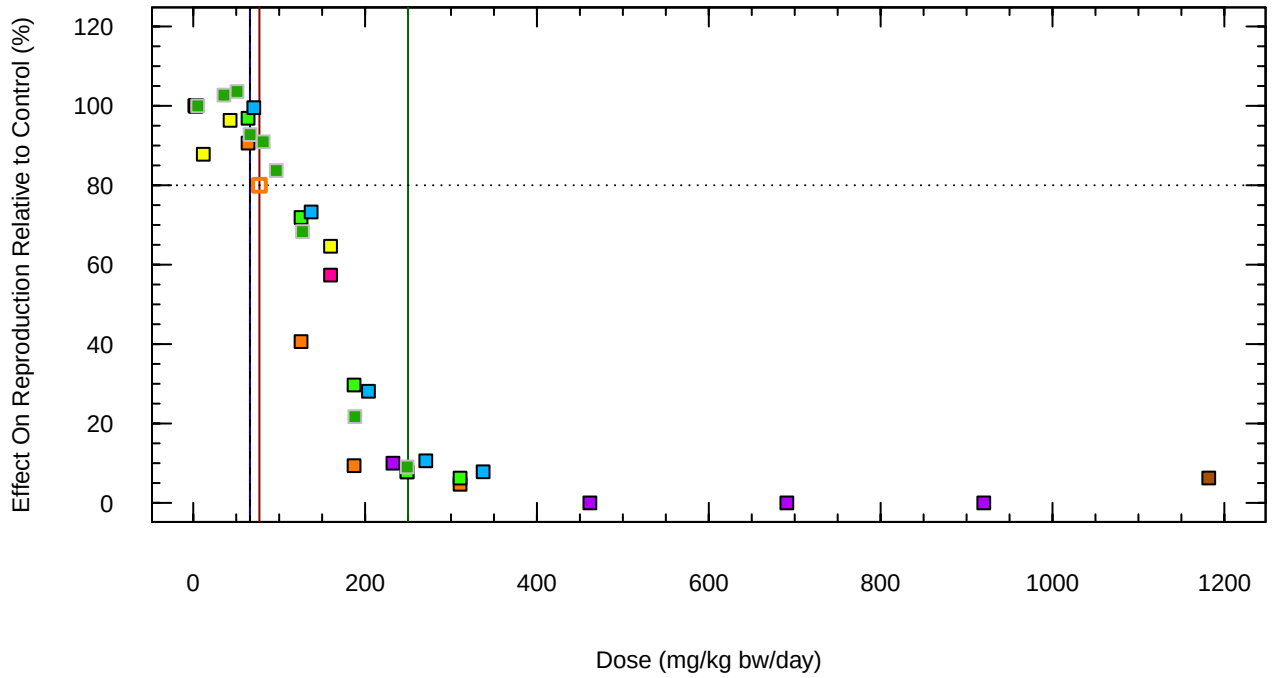
Selected TRV (Growth) = 66 mg/kg bw/day
Selected TRV (Reproduction) = 77 mg/kg bw/day
Selected TRV (Survival) = 250 mg/kg bw/day

80% effect relative to control

ED20 for Gasaway and Buss 1972 is 200 mg/kg bw/day
ED20 for pooled dataset A is 43 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−23. Dose−Response Data for the Avian Growth Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc acetate dihydrate	
Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc oxide	
Jackson et al. 1986	chicken	egg production	diet	3 weeks	zinc oxide	
Jackson et al. 1986	chicken	egg production	diet	20 weeks	zinc oxide	F
Jensen and Maurice 1980	chicken	egg production (Exp 4)	diet	6 weeks	zinc sulfate	G
Jensen and Maurice 1980	chicken	egg production (Exp 3)	diet	6 weeks	zinc sulfate	G
Stepinska et al. 1987	chicken	egg production	diet	0.714 weeks	zinc oxide	
Stevenson et al. 1987	chicken	egg production	diet	20 weeks	zinc oxide	F
ED20 for Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc acetate dihydrate	

Tier 1

Eco−SSL TRV = 66.1 mg/kg bw/day

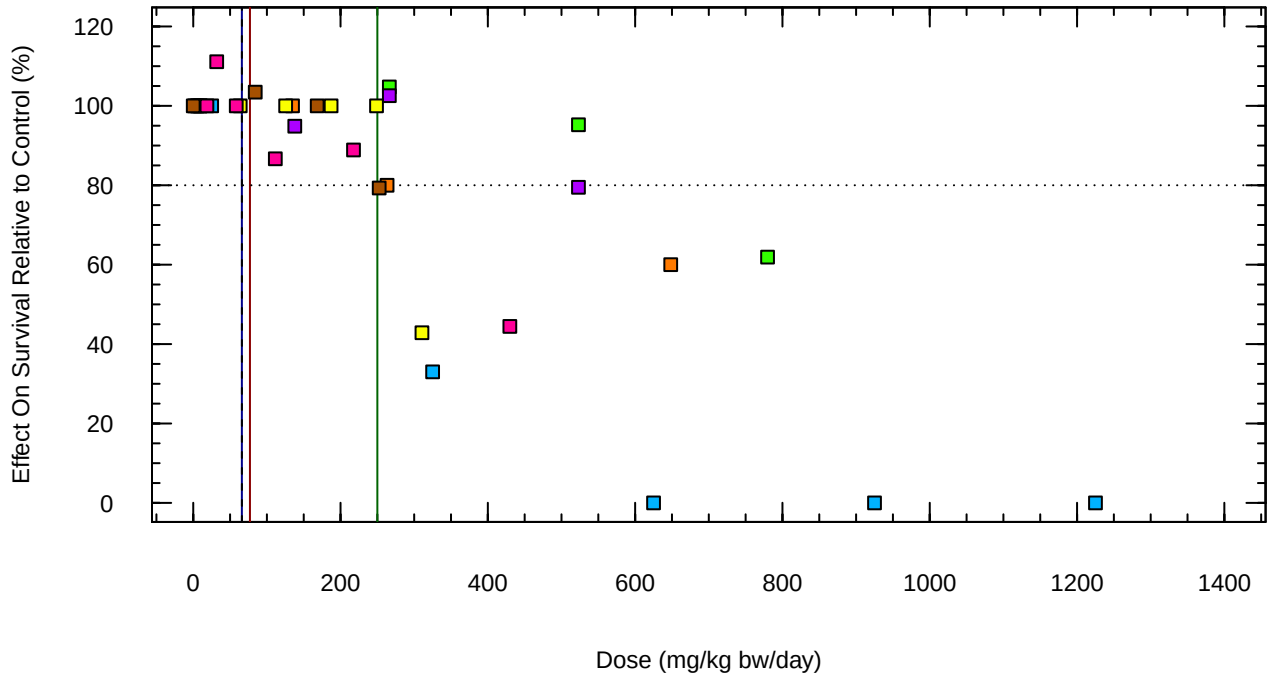
Selected TRV (Growth) = 66 mg/kg bw/day
Selected TRV (Reproduction) = 77 mg/kg bw/day
Selected TRV (Survival) = 250 mg/kg bw/day

80% effect relative to control

ED20 for Gibson et al. 1986 is 77 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−24. Dose−Response Data for the Avian Reproduction Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Blalock and Hill 1988	chicken	survival	diet	2 weeks	zinc oxide	H
Dewar et al. 1983	chicken	survival (Exp 1)	diet	4 weeks	zinc oxide	
Dewar et al. 1983	chicken	survival (Exp 2)	diet	4 weeks	zinc oxide	H
Gasaway and Buss 1972	mallard	survival	diet	8.57 weeks	zinc carbonate	
Gibson et al. 1986	chicken	survival	diet	10 weeks	zinc acetate	
Hamilton et al. 1979	Japanese quail	survival	diet	2 weeks	zinc carbonate	
Roberson and Schaible 1960	chicken	survival (Exp 2)	diet	4 weeks	zinc carbonate	

Tier 1

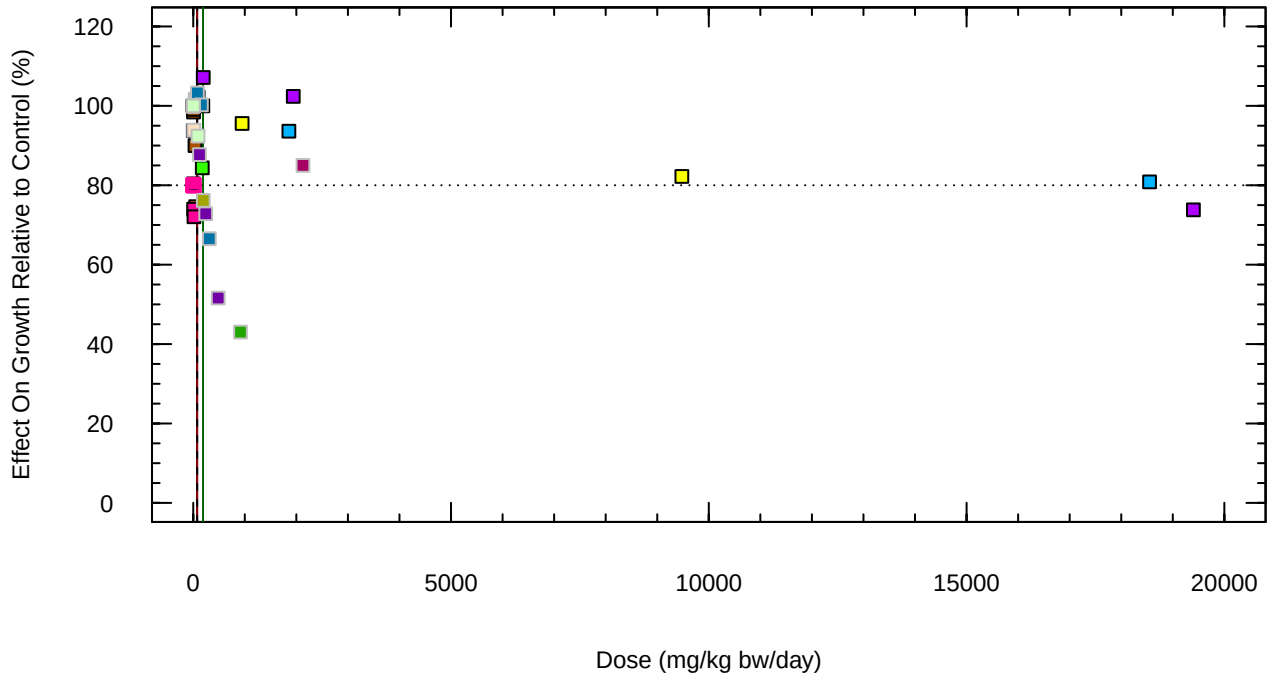
Eco−SSL TRV = 66.1 mg/kg bw/day

Selected TRV (Growth) = 66 mg/kg bw/day
Selected TRV (Reproduction) = 77 mg/kg bw/day
Selected TRV (Survival) = 250 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−25. Dose−Response Data for the Avian Survival Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill et al. 1983	pig	body weight	diet	to 18 months old	zinc oxide	
Hsu et al. 1975	pig	body weight	diet	9−13 weeks	zinc oxide	
Maita et al. 1981	mouse	body weight (female)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	mouse	body weight (male)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	rat	body weight (male)	diet	13 weeks	zinc sulfate	
Khan et al. 2007	rat	male body weight	gavage	14 weeks	zinc chloride	
Subramanian et al. 2000	rat	body weight	diet	6 weeks	zinc oxide	
Settlemire and Matrone 1967	rat	body weight gain	diet	5 weeks	zinc carbonate	
Brink et al. 1959	pig	body weight (Exp 1)	diet	6 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 2)	diet	5 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 3)	diet	6 weeks	not specified	A
Petterson et al. 2002	mouse	body weight	diet	3 weeks	zinc chloride	
Nakamura et al. 1983	rat	body weight	diet	11 weeks	zinc acetate	
Barone et al. 1998	rat	body weight	diet	gestation	not specified	
ED20 for Khan et al. 2007	rat	male body weight	gavage	14 weeks	zinc chloride	

Tier 1

Eco−SSL TRV = 75.4 mg/kg bw/day

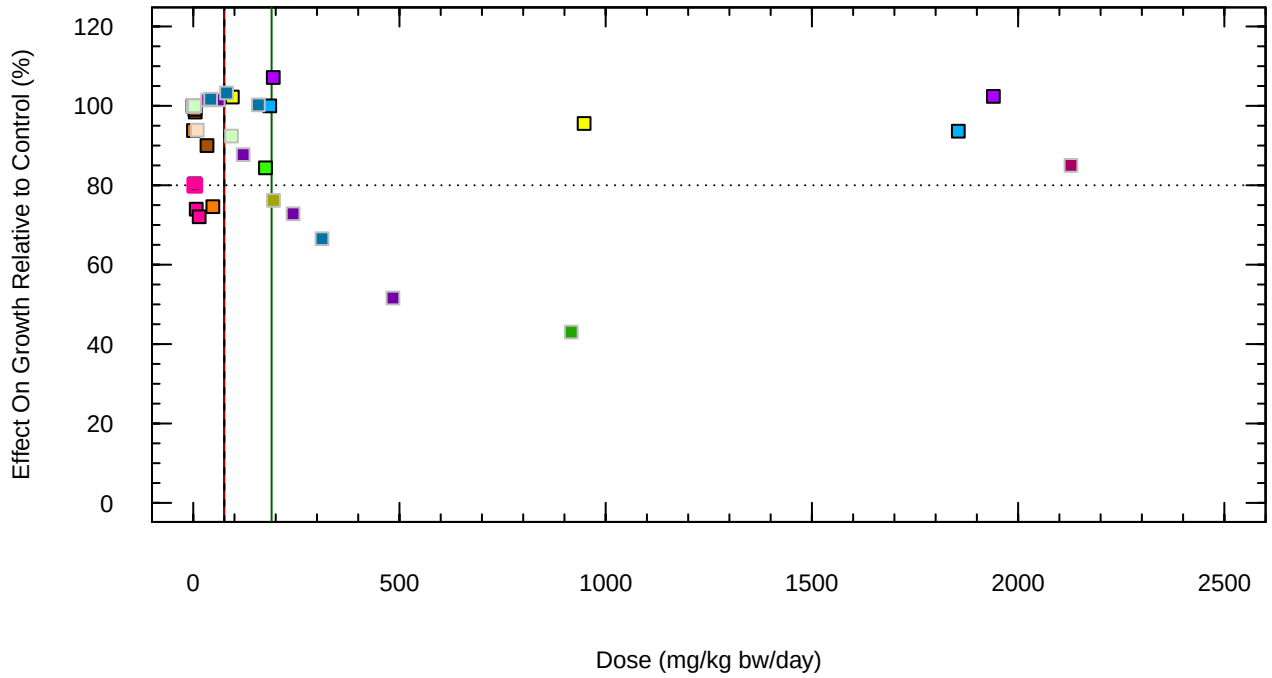
Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

ED20 for Khan et al. 2007 is 3.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−26a. Dose−Response Data for the Mammalian Growth Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill et al. 1983	pig	body weight	diet	to 18 months old	zinc oxide	
Hsu et al. 1975	pig	body weight	diet	9−13 weeks	zinc oxide	
Maita et al. 1981	mouse	body weight (female)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	mouse	body weight (male)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	rat	body weight (male)	diet	13 weeks	zinc sulfate	
Khan et al. 2007	rat	male body weight	gavage	14 weeks	zinc chloride	
Subramanian et al. 2000	rat	body weight	diet	6 weeks	zinc oxide	
Settlemire and Matrone 1967	rat	body weight gain	diet	5 weeks	zinc carbonate	
Brink et al. 1959	pig	body weight (Exp 1)	diet	6 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 2)	diet	5 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 3)	diet	6 weeks	not specified	A
Petterson et al. 2002	mouse	body weight	diet	3 weeks	zinc chloride	
Nakamura et al. 1983	rat	body weight	diet	11 weeks	zinc acetate	
Barone et al. 1998	rat	body weight	diet	gestation	not specified	
ED20 for Khan et al. 2007	rat	male body weight	gavage	14 weeks	zinc chloride	

Tier 1

Eco−SSL TRV = 75.4 mg/kg bw/day

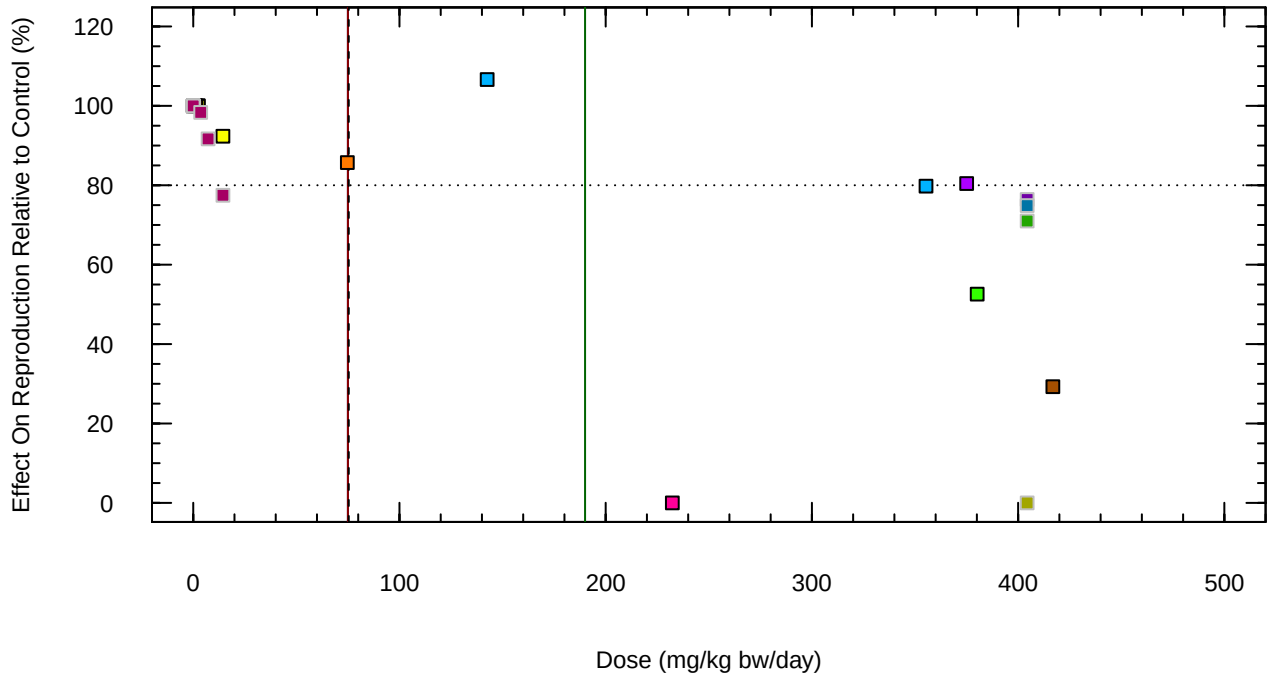
Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

ED20 for Khan et al. 2007 is 3.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−26b. Dose−Response Data for the Mammalian Growth Endpoint for Zinc (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Barone et al. 1998	rat	litter size	diet	gestation	not specified	
Chu and Cox 1972	rat	offspring growth	diet	3 weeks	not specified	
Cox et al. 1969	rat	fetal growth	diet	3.14 weeks	zinc oxide	B
Ketcheson et al. 1969	rat	offspring growth	diet	gestation to 14 days lactation	zinc oxide	
Kumar 1976	rat	fetal survival	diet	2.57 weeks	zinc sulfate	
Newman et al. 2002	rat	offspring survival	diet	gestation to post−natal day 40	zinc acetate dihydrate	
Pal and Pal 1987	rat	normal fetuses	diet	2.57 weeks	zinc sulfate	
Schlicker and Cox 1968	rat	fetal survival	diet	2.14 weeks	zinc oxide	C
Schlicker and Cox 1968	rat	fetal growth	diet	2.14 weeks	zinc oxide	B
Schlicker and Cox 1968	rat	fetal growth	diet	2.57 weeks	zinc oxide	B
Schlicker and Cox 1968	rat	fetal survival	diet	5.14 weeks	zinc oxide	C
Khan et al. 2007	rat	offspring survival	gavage	20 weeks	zinc chloride	

Tier 1

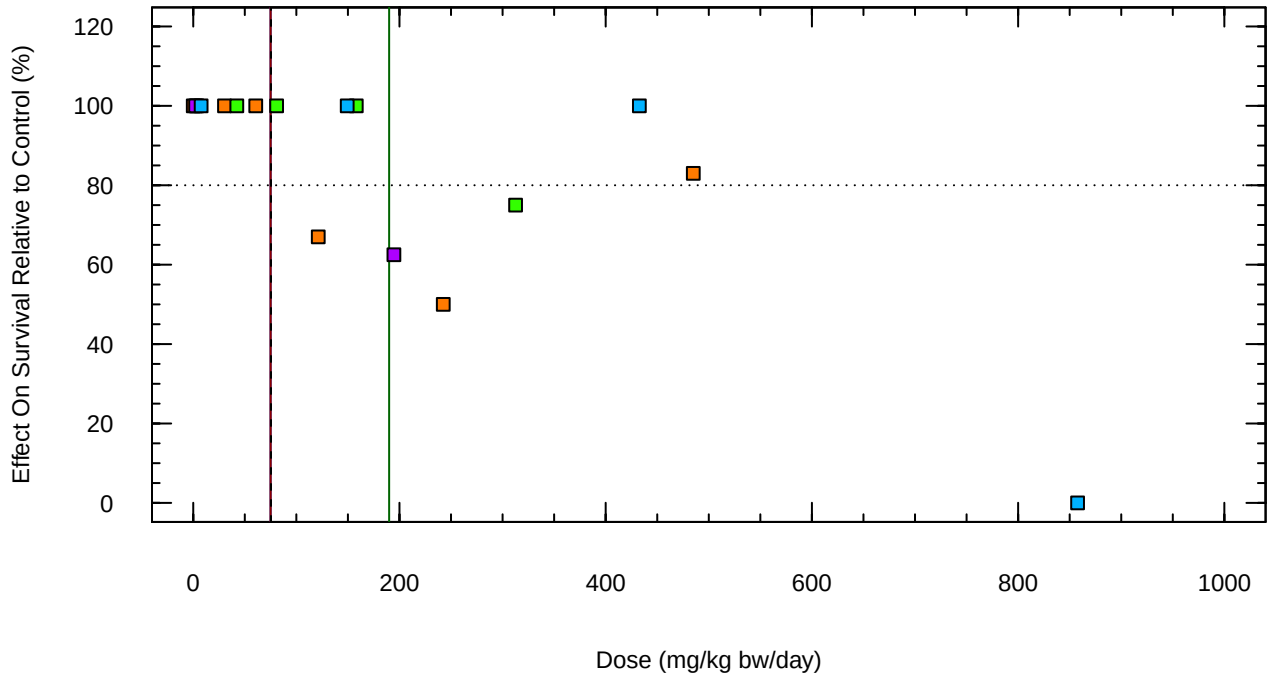
Eco−SSL TRV = 75.4 mg/kg bw/day

Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−27. Dose−Response Data for the Mammalian Reproduction Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Brink et al. 1959	pig	survival (Exp 1)	diet	6 weeks	zinc carbonate	D
Brink et al. 1959	pig	survival (Exp 2)	diet	5 weeks	zinc carbonate	D
Brink et al. 1959	pig	survival (Exp 3)	diet	6 weeks	zinc carbonate	D
Straube et al. 1980	ferret	survival	diet	2−24 weeks	zinc oxide	
Geomean for pooled dataset D	pig	survival	diet	5−6 weeks	zinc carbonate	D

Tier 1

Eco−SSL TRV = 75.4 mg/kg bw/day

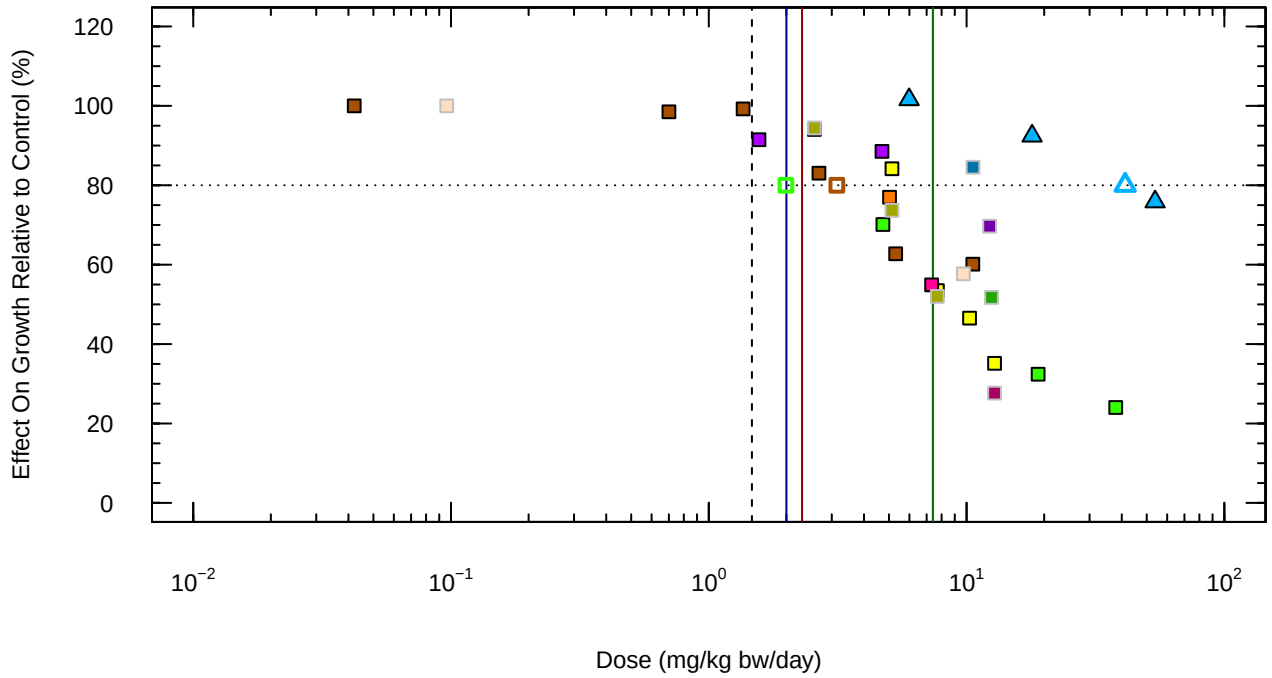
Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset D is 190 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−28. Dose−Response Data for the Mammalian Survival Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bafundo et al. 1984	chicken	body weight gain	diet	2 weeks	cadmium chloride	
Bokori et al. 1995a	chicken	body weight	diet	4 weeks	cadmium sulfate	
Bokori et al. 1996	chicken	body weight	diet	39 weeks	cadmium sulfate	
Di Giulio and Scanlon 1984	mallard	body weight	diet	6 weeks	cadmium chloride	
Hill 1974a	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Hill 1974b	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Olgun 2015	Japanese quail	body weight	diet	10 weeks	cadmium sulfate	
Richardson and Fox 1974	Japanese quail	body weight	diet	4 weeks	cadmium chloride	B
Richardson et al. 1974	Japanese quail	body weight	diet	4 weeks	cadmium chloride	B
Richardson et al. 1974	Japanese quail	body weight	diet	6 weeks	cadmium chloride	B
Hill 1979	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Hill 1980	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Rama and Planas 1981	chicken	body weight gain	diet	9 weeks	cadmium sulfate	A
ED20 for Bokori et al. 1995a	chicken	body weight	diet	4 weeks	cadmium sulfate	
ED20 for Di Giulio and Scanlon 1984	mallard	body weight	diet	6 weeks	cadmium chloride	
ED20 for Olgun 2015	Japanese quail	body weight	diet	10 weeks	cadmium sulfate	

Tier 1 Tier 2

Eco−SSL TRV = 1.47 mg/kg bw/day

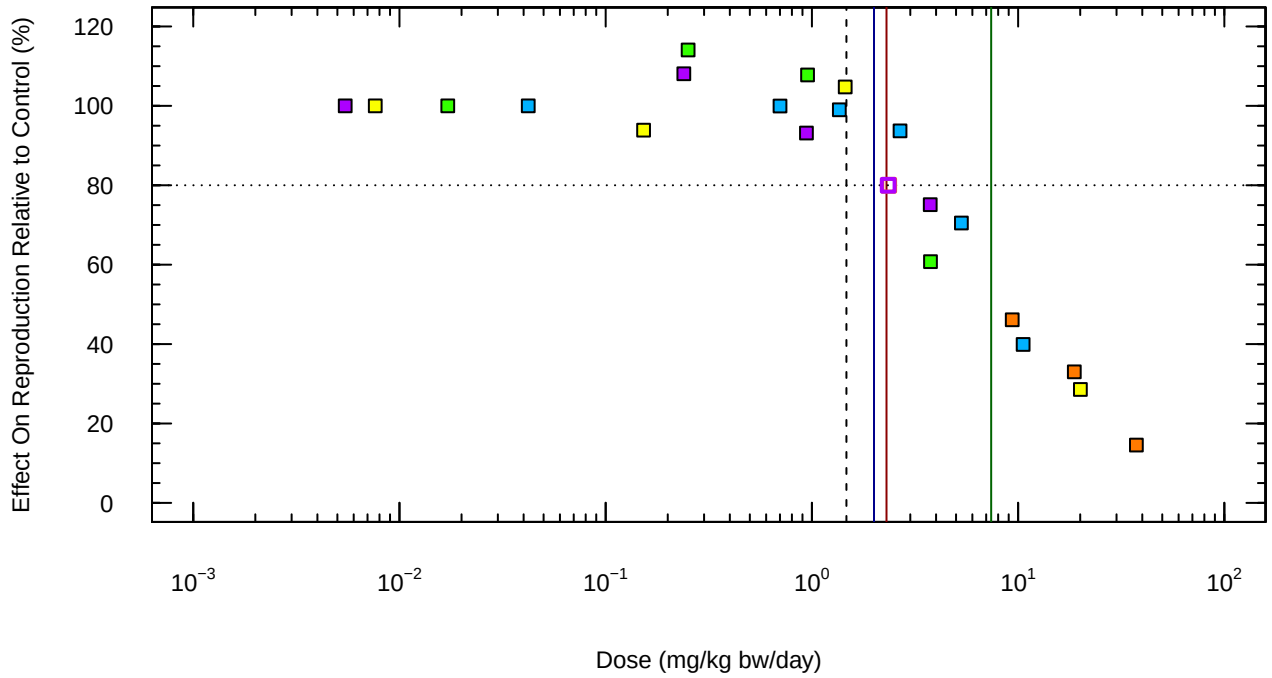
Selected TRV (Growth) = 2 mg/kg bw/day
Selected TRV (Reproduction) = 2.3 mg/kg bw/day
Selected TRV (Survival) = 7.4 mg/kg bw/day

80% effect relative to control

ED20 for Bokori et al. 1995a is 2 mg/kg bw/day
ED20 for Di Giulio and Scanlon 1984 is 41 mg/kg bw/day
ED20 for Olgun 2015 is 3.1 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−29. Dose−Response Data for the Avian Growth Endpoint for Cadmium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bokori et al. 1995b	Japanese quail	egg production	diet	5.29 weeks	cadmium sulfate	
Leach et al. 1979	chicken	egg production	diet	48 weeks	cadmium sulfate	
Leach et al. 1979	chicken	egg production	diet	12 weeks	cadmium sulfate	
Olgun 2015	Japanese quail	egg production	diet	10 weeks	cadmium sulfate	
White and Finley 1978	mallard	egg production	diet	4.3−12.8 weeks	cadmium chloride	
ED20 for Bokori et al. 1995b	Japanese quail	egg production	diet	5.29 weeks	cadmium sulfate	
ED20 for Leach et al. 1979	chicken	egg production	diet	12 weeks	cadmium sulfate	

Tier 1

Eco−SSL TRV = 1.47 mg/kg bw/day

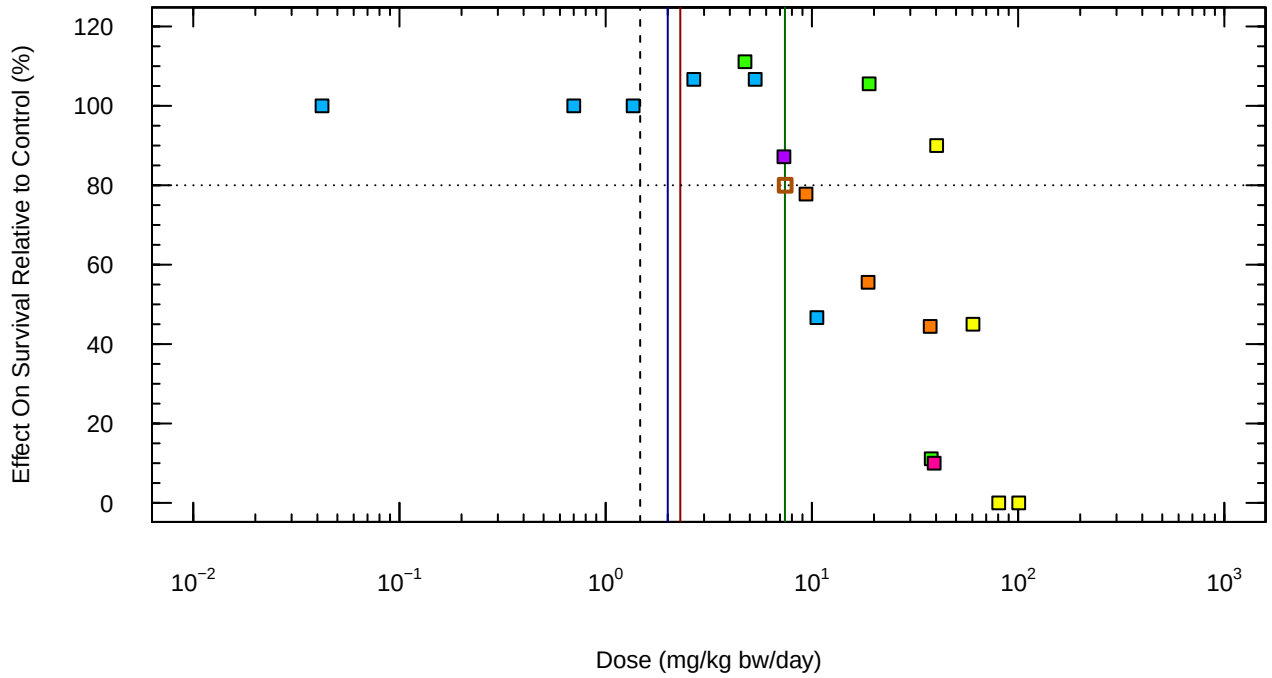
Selected TRV (Growth) = 2 mg/kg bw/day
Selected TRV (Reproduction) = 2.3 mg/kg bw/day
Selected TRV (Survival) = 7.4 mg/kg bw/day

80% effect relative to control

ED20 for Bokori et al. 1995b is 2.4 mg/kg bw/day
ED20 for Leach et al. 1979 is 2.3 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−30. Dose−Response Data for the Avian Reproduction Endpoint for Cadmium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bokori et al. 1995b	Japanese quail	survival	diet	5.29 weeks	cadmium sulfate	C
Bokori et al. 1995a	chicken	survival	diet	8 weeks	cadmium sulfate	
Hill 1974b	chicken	survival	diet	2 weeks	cadmium sulfate	
Olgun 2015	Japanese quail	survival	diet	10 weeks	cadmium sulfate	C
Pritzl et al. 1974	chicken	survival	diet	2.86 weeks	cadmium carbonate	
Van Vleet et al. 1981	Pekin duck	survival	diet	4 weeks	cadmium sulfate	
ED20 for pooled dataset C	Japanese quail	survival	diet	5.3−10 weeks	cadmium sulfate	C

Tier 1

Eco−SSL TRV = 1.47 mg/kg bw/day

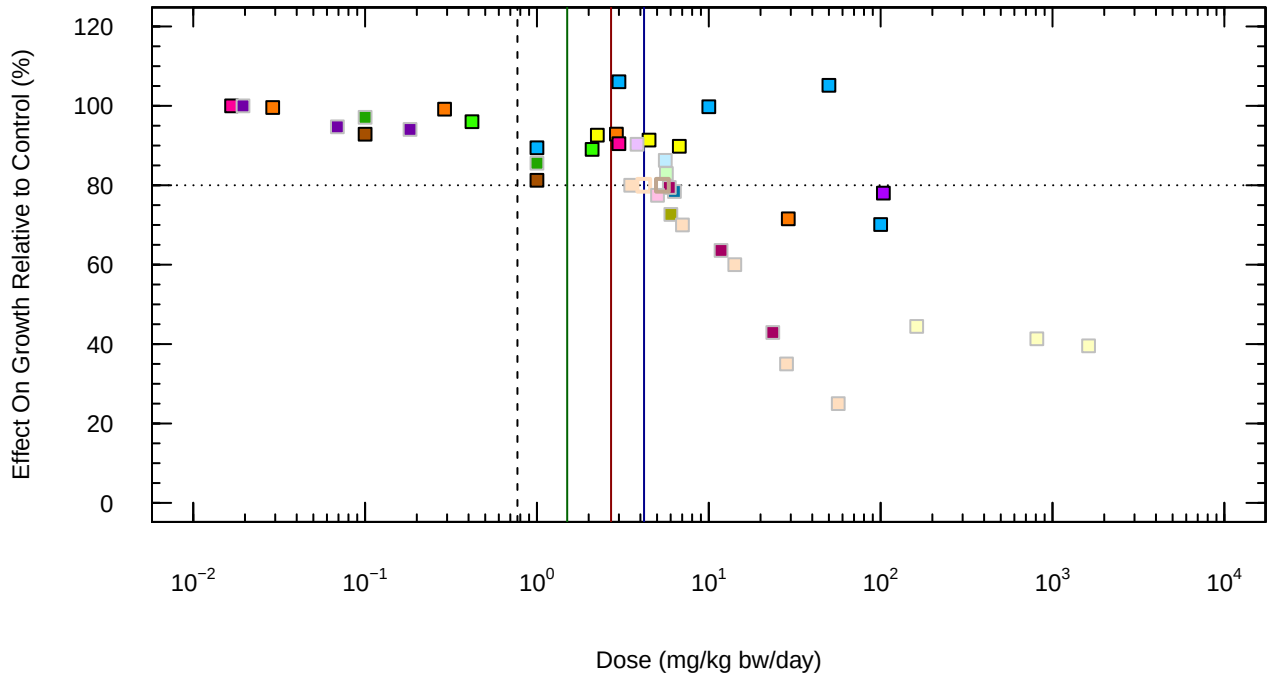
Selected TRV (Growth) = 2 mg/kg bw/day
Selected TRV (Reproduction) = 2.3 mg/kg bw/day
Selected TRV (Survival) = 7.4 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset C is 7.4 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−31. Dose−Response Data for the Avian Survival Endpoint for Cadmium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Baranski and Sitarek 1987	rat	body weight	gavage	14 weeks	cadmium chloride	
Cousins et al. 1977	rat	body weight	diet	14 weeks	cadmium chloride	
Dodds−Smith et al. 1992	shrew	body weight	diet	12 weeks	cadmium chloride	
Hamada et al. 1991	dog	body weight	diet	8−9 years	cadmium chloride	
Rajanna et al. 1984	rat	body weight	diet	25.7 weeks	cadmium chloride	
Groten et al. 1991	rat	body weight	diet	8 weeks	cadmium chloride	
Rastogi et al 1977	rat	body weight	gavage	4.27 weeks	cadmium chloride	
Merali and Singhal 1980	rat	body weight	gavage	6.14 weeks	cadmium chloride	
Weigel et al. 1987	rat	body weight	diet	7.86 weeks	cadmium oxide	
Pond et al. 1973	pig	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1979	rat	body weight	diet	2 weeks	cadmium chloride	A
Suzuki and Yoshida 1979	rat	body weight	diet	4 weeks	cadmium chloride	A
Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 1)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 2)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978b	rat	body weight (Exp 1)	diet	2 weeks	cadmium chloride	A
Weber and Reid 1969	mouse	body weight (Exp 1)	diet	3 weeks	cadmium acetate	
Suzuki and Yoshida 1977	rat	body weight (Exp 2)	diet	6.43 weeks	cadmium chloride	A
ED20 for Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
ED20 for pooled dataset A	rat	body weight	diet	2−6.4 weeks	cadmium chloride	A

Tier 1

Eco−SSL TRV = 0.77 mg/kg bw/day

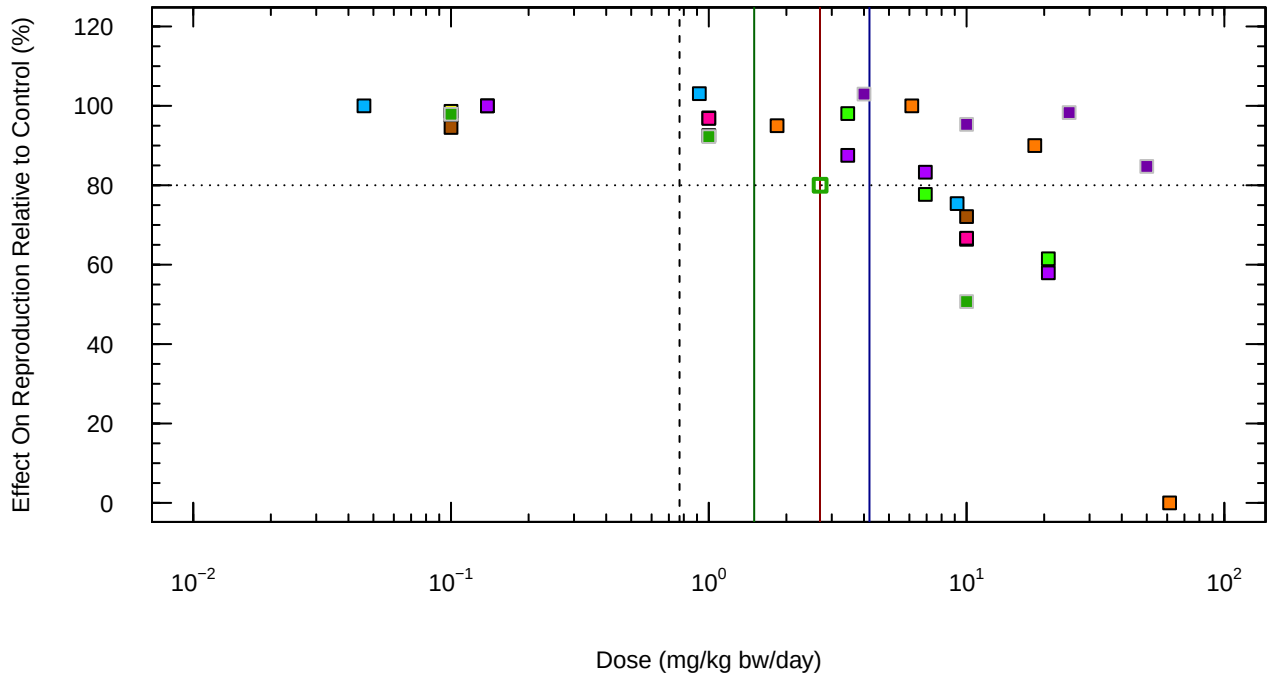
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Wilson et al. 1941 is 4.2 mg/kg bw/day
ED20 for pooled dataset A is 5.4 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−32. Dose−Response Data for the Mammalian Growth Endpoint for Cadmium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Machemer and Lorke 1981	rat	pregnancy success	gavage	1.43 weeks	cadmium chloride	
Sawicka−Kapusta et al. 1994	mouse	offspring growth	diet	5 weeks	cadmium chloride	
Sawicka−Kapusta et al. 1994	mouse	offspring survival	diet	5 weeks	cadmium chloride	
Whelton et al. 1988	mouse	offspring growth	diet	36 weeks	cadmium chloride	
Sutou et al. 1980	rat	fetal weight (male)	gavage	9 weeks	cadmium chloride	B
Sutou et al. 1980	rat	fetal weight (female)	gavage	9 weeks	cadmium chloride	B
Sutou et al. 1980	rat	fetal implants	gavage	>9 weeks	cadmium chloride	
Sutou et al. 1980	rat	live fetuses	gavage	>9 weeks	cadmium chloride	
Wardell et al. 1982	rat	litter weight	gavage	1.86 weeks	not specified	
ED20 for Sutou et al. 1980	rat	live fetuses	gavage	>9 weeks	cadmium chloride	

Tier 1

Eco−SSL TRV = 0.77 mg/kg bw/day

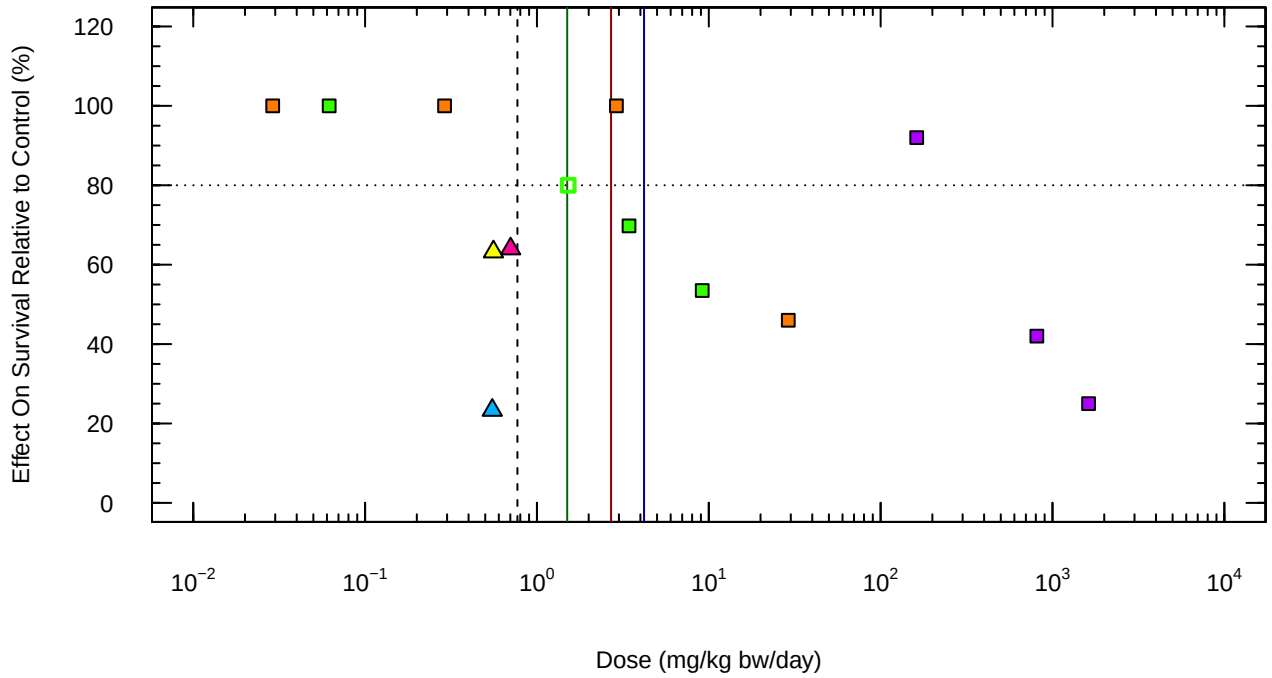
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Sutou et al. 1980 is 2.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−33. Dose−Response Data for the Mammalian Reproduction Endpoint for Cadmium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Baranski and Sitarek 1987	rat	survival	gavage	14 weeks	cadmium chloride	
Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	
Weber and Reid 1969	mouse	survival	diet	3 weeks	cadmium acetate	
Schroeder et al. 1963	rat	survival (male)	drinking water	92 weeks	not specified	C
Schroeder et al. 1963	rat	survival (female)	drinking water	92 weeks	not specified	C
Schroeder et al. 1964	mouse	survival (male)	drinking water	78 weeks	not specified	
ED20 for Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	

Tier 1 Tier 2

Eco−SSL TRV = 0.77 mg/kg bw/day

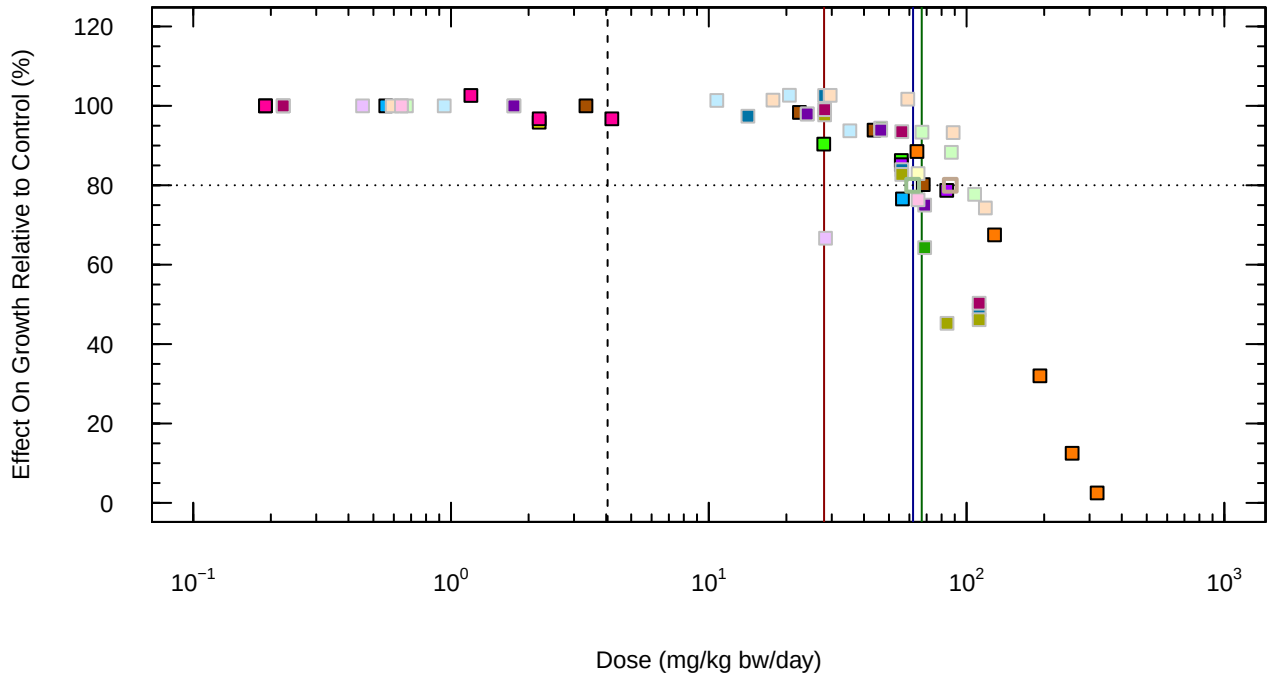
Selected TRV (Growth) = 4.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.7 mg/kg bw/day
Selected TRV (Survival) = 1.5 mg/kg bw/day

80% effect relative to control

ED20 for Swiergosz et al. 1998 is 1.5 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−34. Dose−Response Data for the Mammalian Survival Endpoint for Cadmium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill 1974a	chicken	body weight	diet	2 weeks	copper sulfate	C
Jensen and Maurice 1978	chicken	body weight (Exp 1)	diet	4 weeks	copper sulfate	C
Jensen and Maurice 1978	chicken	body weight (Exp 2)	diet	4 weeks	copper sulfate	C
Jensen and Maurice 1979	chicken	body weight (Exp 2)	diet	4 weeks	copper sulfate	C
Kashani et al. 1986	turkey	body weight (Exp 1)	diet	24 weeks	cupric sulfate	
Kashani et al. 1986	turkey	body weight (Exp 2)	diet	24 weeks	cupric sulfate	
Miles et al. 1998	chicken	body weight (Exp 1)	diet	3 weeks	copper sulfate	
Miles et al. 1998	chicken	body weight (Exp 2)	diet	6 weeks	dicopper chloride	
Miles et al. 1998	chicken	body weight (Exp 2)	diet	6 weeks	copper sulfate	
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 1)	diet	4 weeks	copper sulfate	D
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 2)	diet	4 weeks	copper sulfate	D
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 5)	diet	4 weeks	copper sulfate	D
Persia et al. 2004	chicken	body weight (Exp 2)	diet	2.14 weeks	copper chloride	E
Persia et al. 2004	chicken	body weight (Exp 3)	diet	2 weeks	copper chloride	E
Latymer and Cotes 1981	chicken	body weight	diet	3.43 weeks	copper sulfate	C
Smith 1969	chicken	body weight	diet	3.57 weeks	copper sulfate	C
Wang et al. 1987	chicken	body weight gain (Exp 2)	diet	2.86 weeks	copper sulfate	D
Wang et al. 1987	chicken	body weight gain (Exp 1)	diet	2.86 weeks	copper sulfate	D
ED20 for pooled dataset C	chicken	body weight	diet	3.4−4 weeks	copper sulfate	C
ED20 for pooled dataset D	chicken	body weight gain	diet	2.9−4 weeks	copper sulfate	D

Tier 1

Eco−SSL TRV = 4.05 mg/kg bw/day

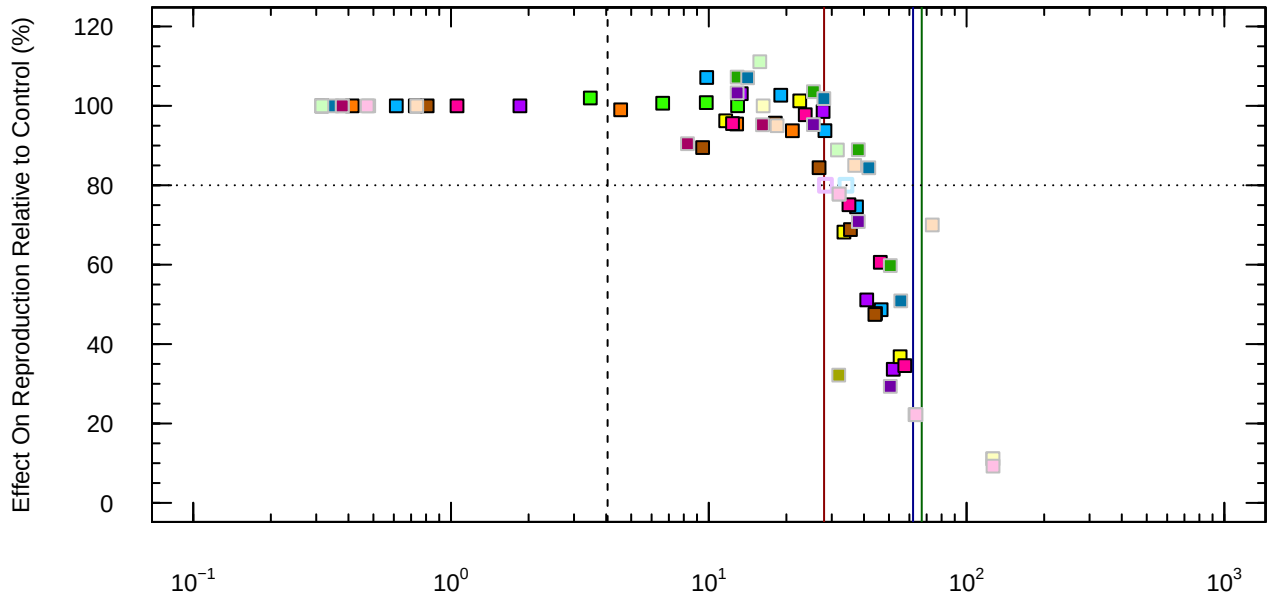
Selected TRV (Growth) = 62 mg/kg bw/day
Selected TRV (Reproduction) = 28 mg/kg bw/day
Selected TRV (Survival) = 67 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset C is 86 mg/kg bw/day
ED20 for pooled dataset D is 62 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−35. Dose−Response Data for the Avian Growth Endpoint for Copper, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Al Ankari et al. 1998	chicken	egg production	diet	12 weeks	copper sulfate/acetate	
Balevi and Coskun 2004	chicken	egg production	diet	4−9 weeks	copper sulfate	A
Chiou et al. 1997	chicken	egg production	diet	4 weeks	copper sulfate	A
Jackson and Stevenson 1981a	chicken	egg production (breed 1)	diet	40 weeks	copper sulfate	B
Jackson and Stevenson 1981a	chicken	egg production (breed 2)	diet	40 weeks	copper sulfate	B
Jackson and Stevenson 1981b	chicken	egg production (breed 1)	diet	48 weeks	copper sulfate	B
Jackson and Stevenson 1981b	chicken	egg production (breed 2)	diet	48 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production (breed 1)	diet	32 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production (breed 2)	diet	32 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production	diet	48 weeks	copper sulfate	B
Harms and Buresh 1986	chicken	egg production (Exp 3)	diet	6 weeks	copper sulfate	A
Lien et al. 2004	chicken	egg production	diet	4 weeks	copper sulfate	A
Stevenson et al. 1983	chicken	egg production	diet	0.714 weeks	copper sulfate	
Pearce et al. 1983	chicken	egg production	diet	6.86 weeks	copper sulfate	A
Stevenson and Jackson 1980a	chicken	egg production	diet	6.86 weeks	copper sulfate	A
Stevenson and Jackson 1980b	chicken	egg production	diet	8 weeks	copper sulfate	A
ED20 for pooled dataset A	chicken	egg production	diet	4−8 weeks	copper sulfate	A
ED20 for pooled dataset B	chicken	egg production	diet	32−48 weeks	copper sulfate	B

Tier 1

Eco−SSL TRV = 4.05 mg/kg bw/day

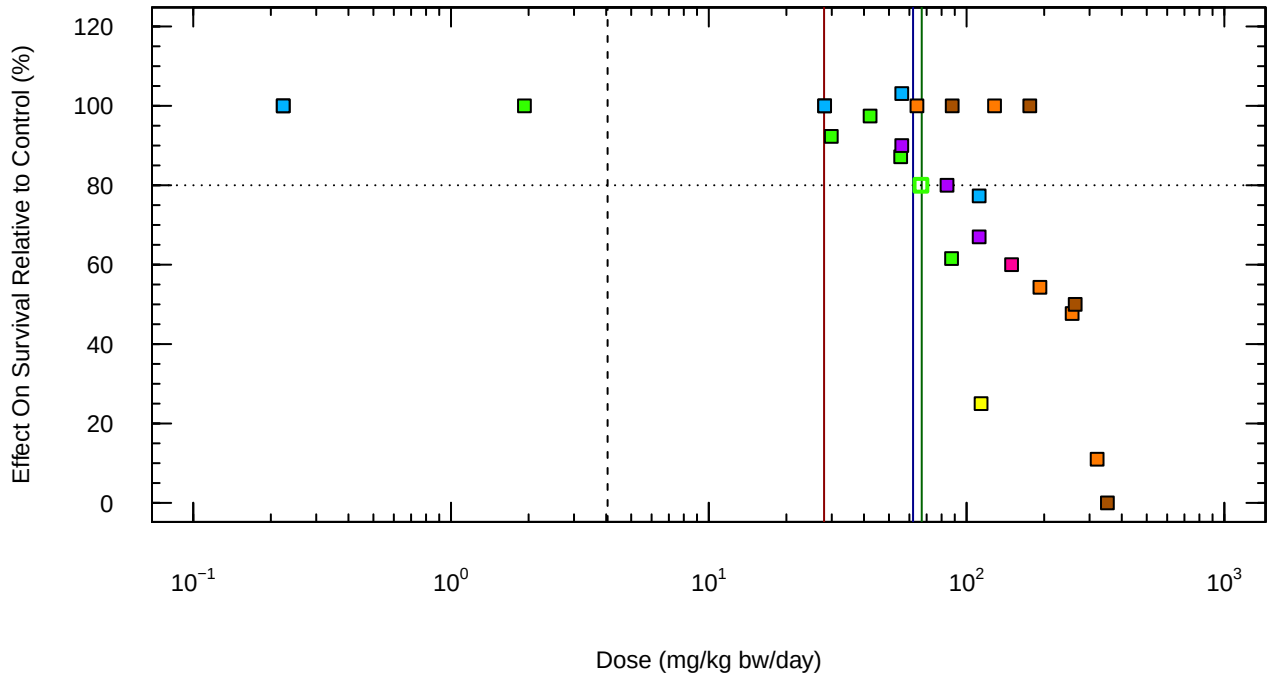
Selected TRV (Growth) = 62 mg/kg bw/day
Selected TRV (Reproduction) = 28 mg/kg bw/day
Selected TRV (Survival) = 67 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset A is 28 mg/kg bw/day
ED20 for pooled dataset B is 34 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−36. Dose−Response Data for the Avian Reproduction Endpoint for Copper, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill 1974a	chicken	survival	diet	2 weeks	copper sulfate	G
Mehring et al. 1960	chicken	survival	diet	10 weeks	copper oxide	
Poupoulis and Jensen 1976	chicken	survival (Exp 2)	diet	4 weeks	copper sulfate	G
Poupoulis and Jensen 1976	chicken	survival (Exp 5)	diet	4 weeks	copper sulfate	G
Van Vleet et al. 1981	Pekin duck	survival	diet	4 weeks	copper sulfate	F
Van Vleet et al. 1981	Pekin duck	survival	diet	2.14 weeks	copper sulfate	F
Vohra and Kratzer 1968	turkey	survival	diet	3 weeks	copper sulfate	
ED20 for Mehring et al. 1960	chicken	survival	diet	10 weeks	copper oxide	

Tier 1

Eco−SSL TRV = 4.05 mg/kg bw/day

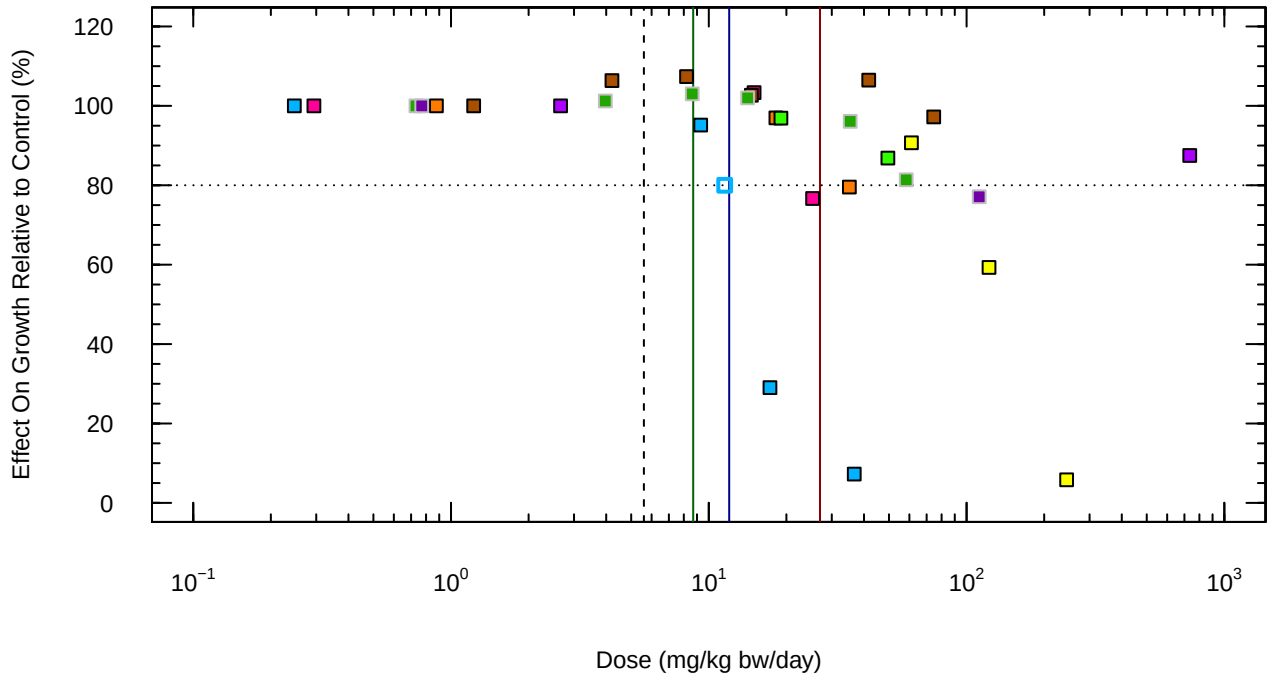
Selected TRV (Growth) = 62 mg/kg bw/day
Selected TRV (Reproduction) = 28 mg/kg bw/day
Selected TRV (Survival) = 67 mg/kg bw/day

80% effect relative to control

ED20 for Mehring et al. 1960 is 67 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−37. Dose−Response Data for the Avian Survival Endpoint for Copper, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Brandt 1983	mink	body weight	diet	~12 weeks	copper sulfate	
Edmonds and Baker 1986	pig	body weight (Exp 3)	diet	4 weeks	copper sulfate	
Petterson et al. 2002	mouse	body weight	diet	3 weeks	copper chloride	
Allcroft et al. 1961	pig	body weight gain	diet	21 weeks	copper sulfate	
Boyden et al. 1938	rat	body weight gain	diet	4 weeks	copper sulfate	
Suttle and Mills 1966	pig	body weight (Exp 2)	diet	5.71 weeks	copper sulfate	
Grobner et al. 1986	rabbit	body weight (Exp 2)	diet	4 weeks	copper sulfate	
Grobner et al. 1986	rabbit	body weight (Exp 2)	diet	4 weeks	copper sulfate	
Llewellyn et al. 1985	rat	body weight	diet	21 weeks	copper acetate	
ED20 for Allcroft et al. 1961	pig	body weight gain	diet	21 weeks	copper sulfate	

Tier 1

Eco−SSL TRV = 5.6 mg/kg bw/day

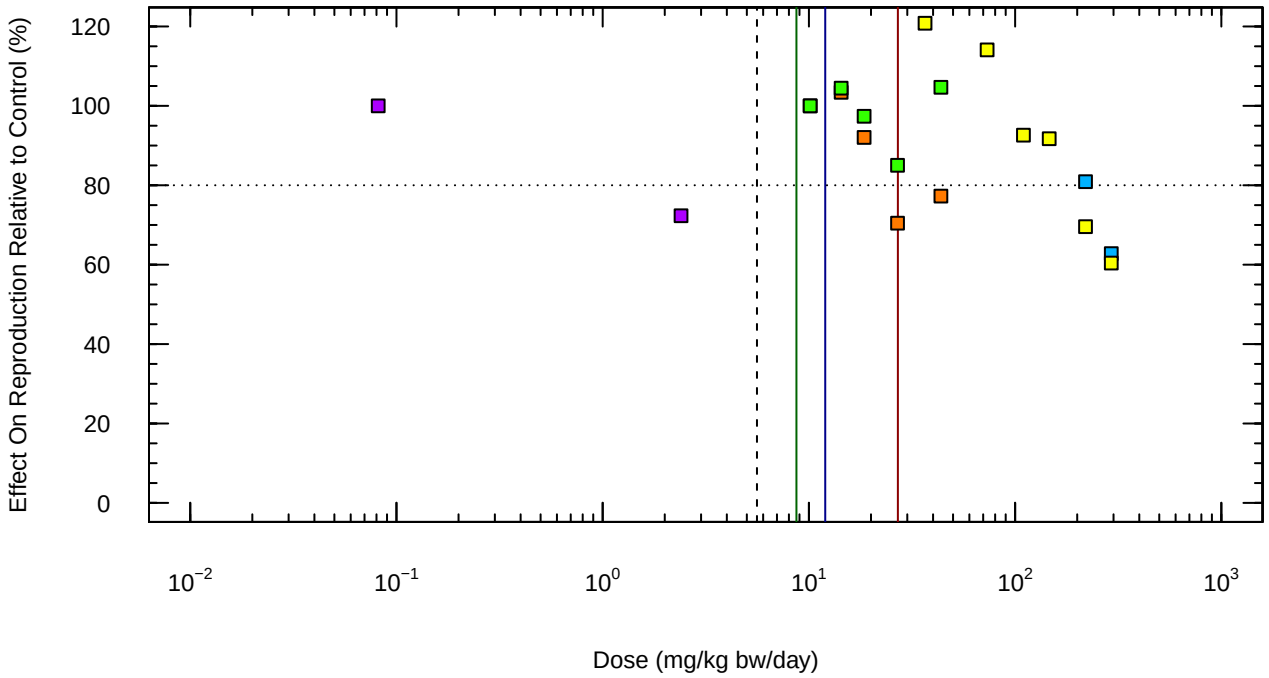
Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

ED20 for Allcroft et al. 1961 is 12 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−38. Dose−Response Data for the Mammalian Growth Endpoint for Copper, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Aulerich et al. 1982	mink	offspring survival	diet	20 weeks	copper sulfate	
Aulerich et al. 1982	mink	offspring growth	diet	20 weeks	copper sulfate	
Cromwell et al. 1993	pig	farrowing success	diet	2.1 years	copper sulfate	
Lecyk 1980	mouse	litter size (breed 1)	diet	7 weeks	copper sulfate	A
Lecyk 1980	mouse	litter size (breed 2)	diet	7 weeks	copper sulfate	A

Tier 1

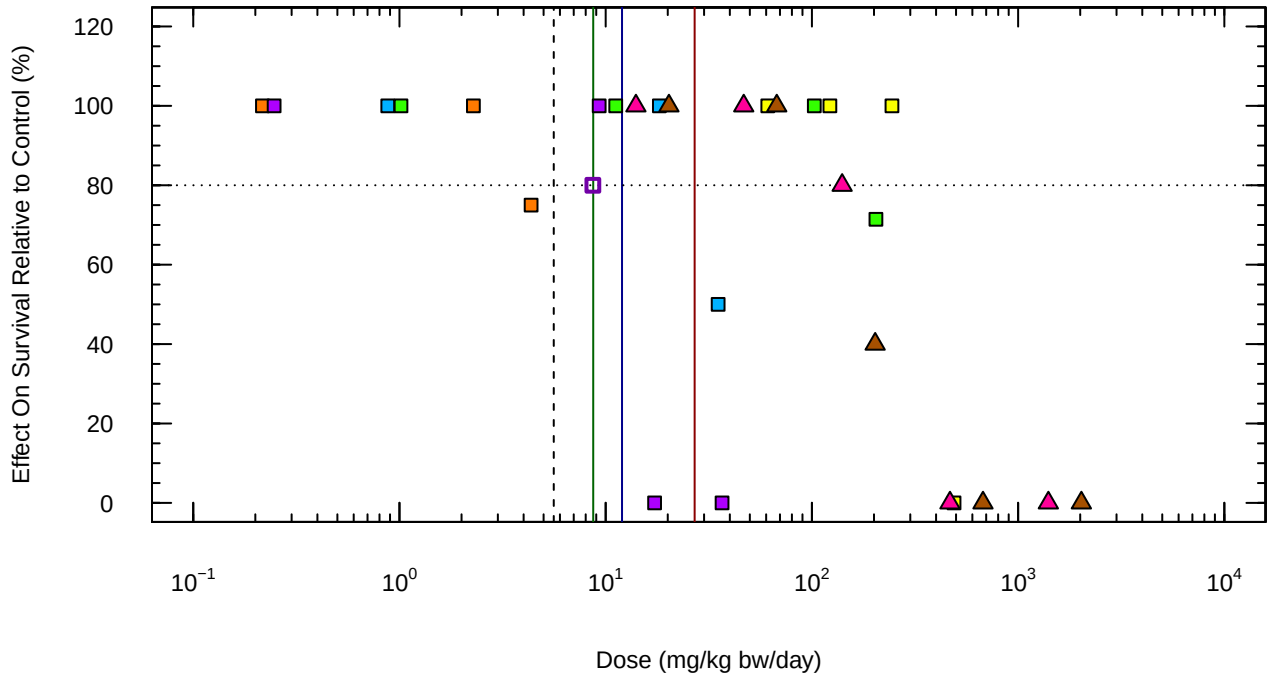
Eco−SSL TRV = 5.6 mg/kg bw/day

Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−39. Dose−Response Data for the Mammalian Reproduction Endpoint for Copper, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Ritchie et al. 1963	pig	survival	diet	15 weeks	copper sulfate	B
Keen et al. 1982	rat	survival	diet	6.71 weeks	copper sulfate	
Allcroft et al. 1961	pig	survival	diet	21 weeks	copper sulfate	B
Brandt 1983	mink	survival	diet	~12 weeks	copper sulfate	
Boyden et al. 1938	rat	survival	diet	4 weeks	copper sulfate	
NTP 1993a	mouse	survival (male)	drinking water	2 weeks	copper sulfate	
NTP 1993a	mouse	survival (female)	drinking water	2 weeks	copper sulfate	
Geomean for pooled dataset B	pig	survival	diet	15−21 weeks	copper sulfate	B

Tier 1 Tier 2

Eco−SSL TRV = 5.6 mg/kg bw/day

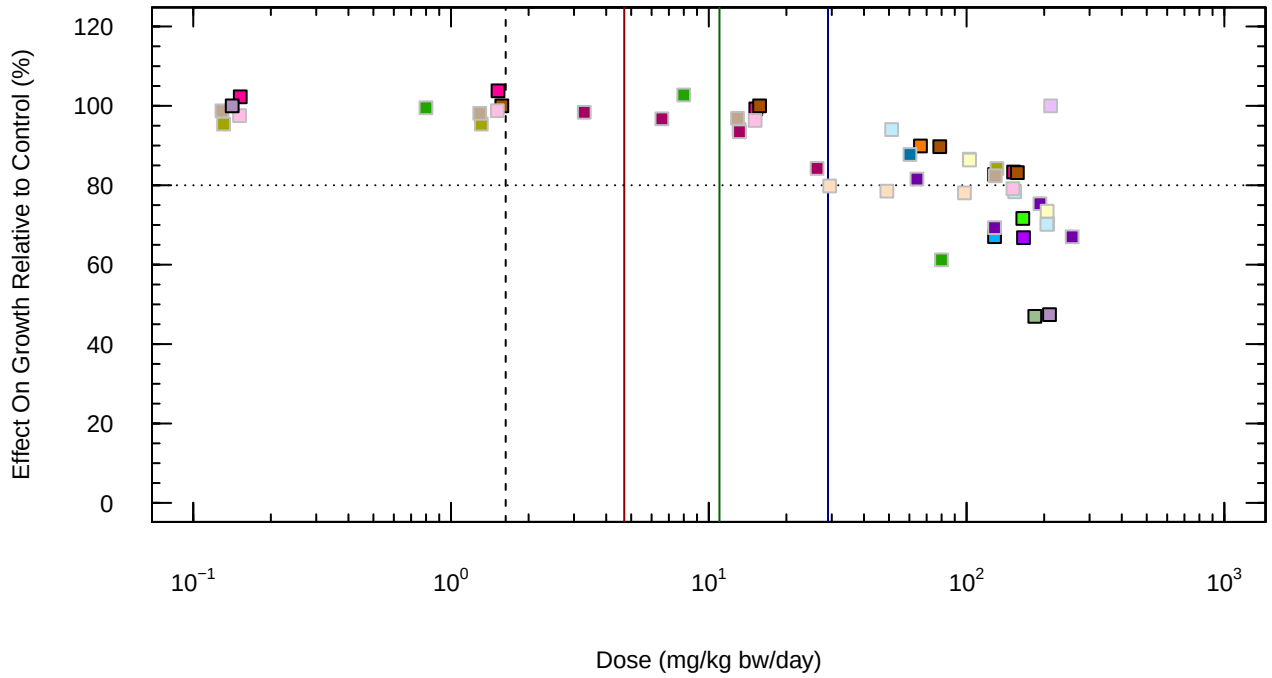
Selected TRV (Growth) = 12 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day
Selected TRV (Survival) = 8.7 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset B is 8.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−40. Dose−Response Data for the Mammalian Survival Endpoint for Copper, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	body weight (breed 2)	diet	21 weeks	lead acetate	
Donaldson 1986	chicken	body weight (Exp 1)	diet	2.9 weeks	lead acetate trihydrate	A
Donaldson 1986	chicken	body weight (Exp 2)	diet	2.9 weeks	lead acetate trihydrate	A
Latta and Donaldson 1986	chicken	body weight gain	diet	2.7 weeks	lead acetate	
Leeming and Donaldson 1984	chicken	body weight gain	diet	2.71 weeks	lead acetate trihydrate	
Morgan et al. 1975	Japanese quail	body weight (Trial 1)	diet	5 weeks	lead acetate	
Morgan et al. 1975	Japanese quail	body weight (Trial 2)	diet	5 weeks	lead acetate	
Damron et al. 1969	chicken	body weight	diet	4 weeks	lead acetate	
Donaldson and McGowan 1989	chicken	body weight	diet	2.9 weeks	lead acetate trihydrate	A
Edens and Melvin 1989	Japanese quail	body weight (breed 1)	diet	21 weeks	lead acetate	
Edens and Melvin 1989	Japanese quail	body weight (female)	diet	15 weeks	lead acetate	
Edens and Garlich 1983	chicken	body weight	diet	10 weeks	lead acetate	
Abduljaleel & Shuhaimi−Othman 2013	chicken	body weight	diet	4 weeks	lead nitrate	
Berg et al. 1980	chicken	body weight (Exp 1)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 1)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 2)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 3)	diet	2 weeks	lead carbonate	C
Edens et al. 1976	Japanese quail	body weight	diet	12 weeks	lead acetate	B
Edens 1985	Japanese quail	body weight	diet	12 weeks	lead acetate	B
Cupo and Donaldson 1988	chicken	body weight	diet	3 weeks	lead acetate	C
Franson and Custer 1982	chicken	body weight	diet	4 weeks	lead acetate	C

Tier 1

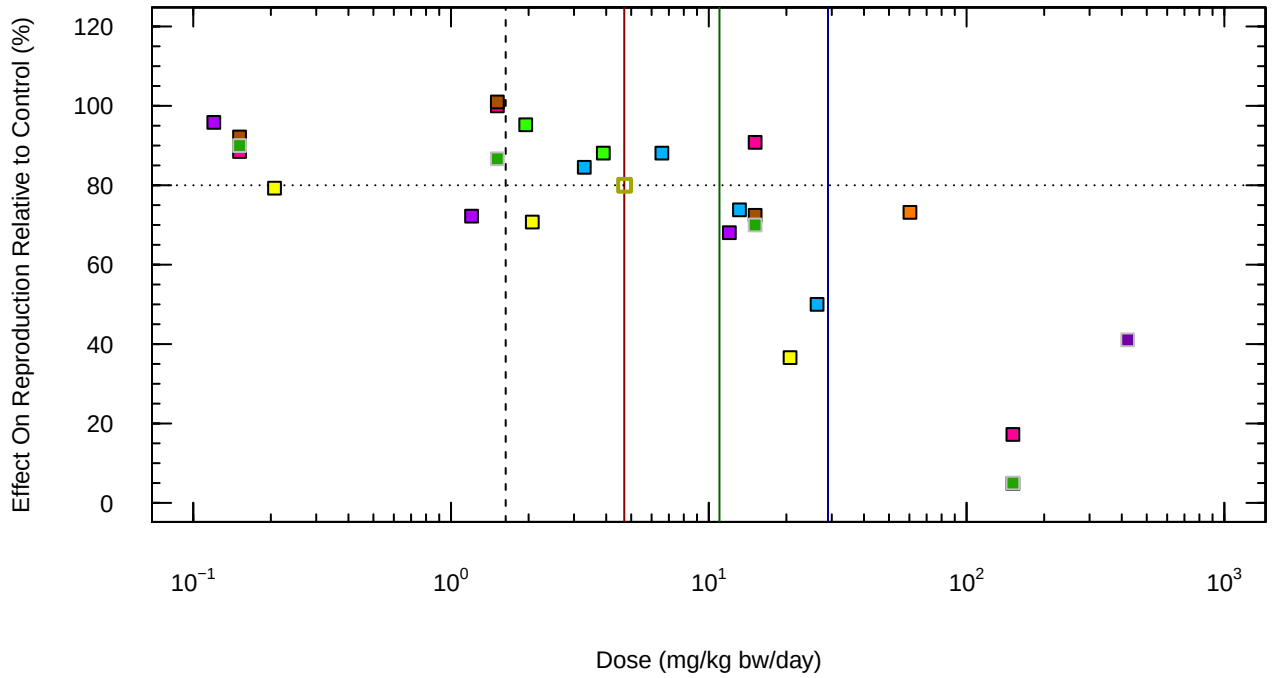
Eco−SSL TRV = 1.63 mg/kg bw/day

Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−41. Dose−Response Data for the Avian Growth Endpoint for Lead, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	egg production	diet	21 weeks	lead acetate	
Edens and Garlich 1983	chicken	egg production (Exp 1)	diet	4 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 2)	diet	5 weeks	lead acetate	D
Edens and Garlich 1983	chicken	egg production (Exp 3)	diet	10 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 4)	diet	5 weeks	lead acetate	D
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Edens et al. 1976	Japanese quail	egg hatchability	diet	12 weeks	lead acetate	
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Stone and Soares 1976	Japanese quail	egg production	diet	3.86 weeks	lead acetate	D
Geomean for pooled dataset D	Japanese quail	egg production	diet	3.9−5 weeks	lead acetate	D

Tier 1

Eco−SSL TRV = 1.63 mg/kg bw/day

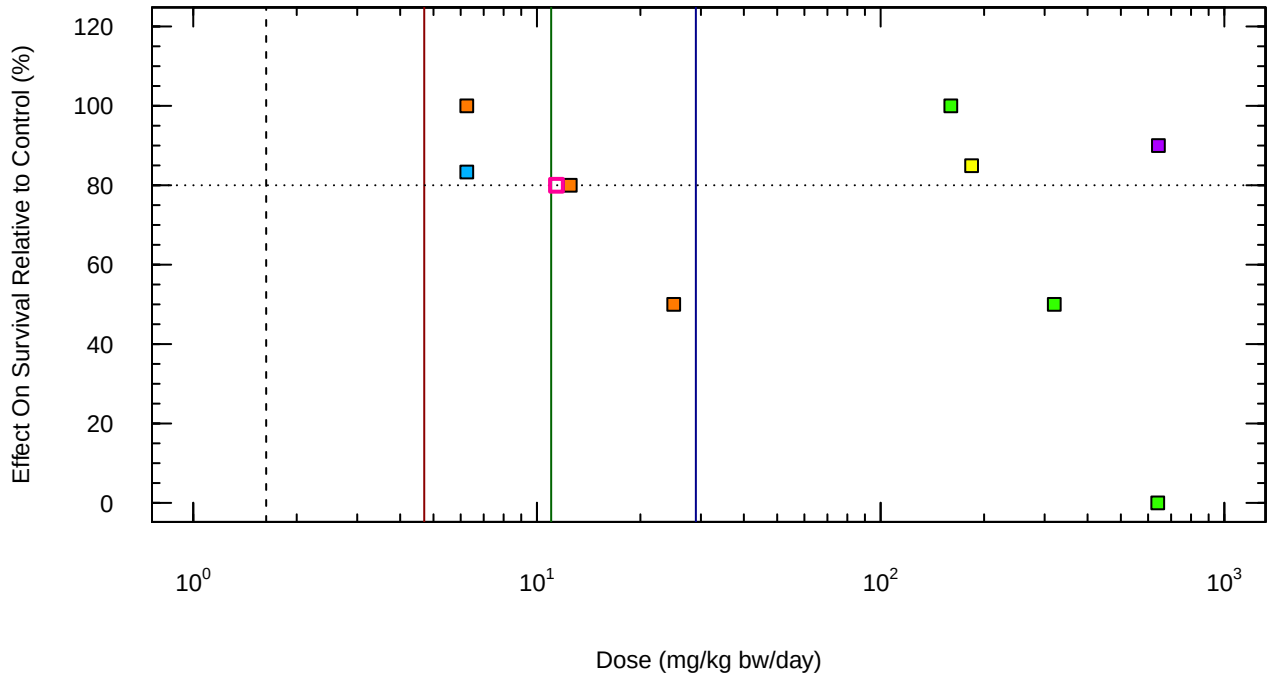
Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset D is 4.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−42. Dose−Response Data for the Avian Reproduction Endpoint for Lead, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Barthalmus et al. 1977	pigeon	survival	gavage	varied	lead acetate	F
Vengris and Mare 1974	chicken	survival	gavage	5 weeks	lead acetate	
Khan et al. 1993	chicken	survival	gavage	1 weeks	lead acetate	
Anders et al. 1982	pigeon	survival	gavage	5 weeks	lead acetate	F
Cupo and Donaldson 1988	chicken	survival	diet	3 weeks	lead acetate	
ED20 for pooled dataset F	pigeon	survival	gavage	varied	lead acetate	F

Tier 1

Eco−SSL TRV = 1.63 mg/kg bw/day

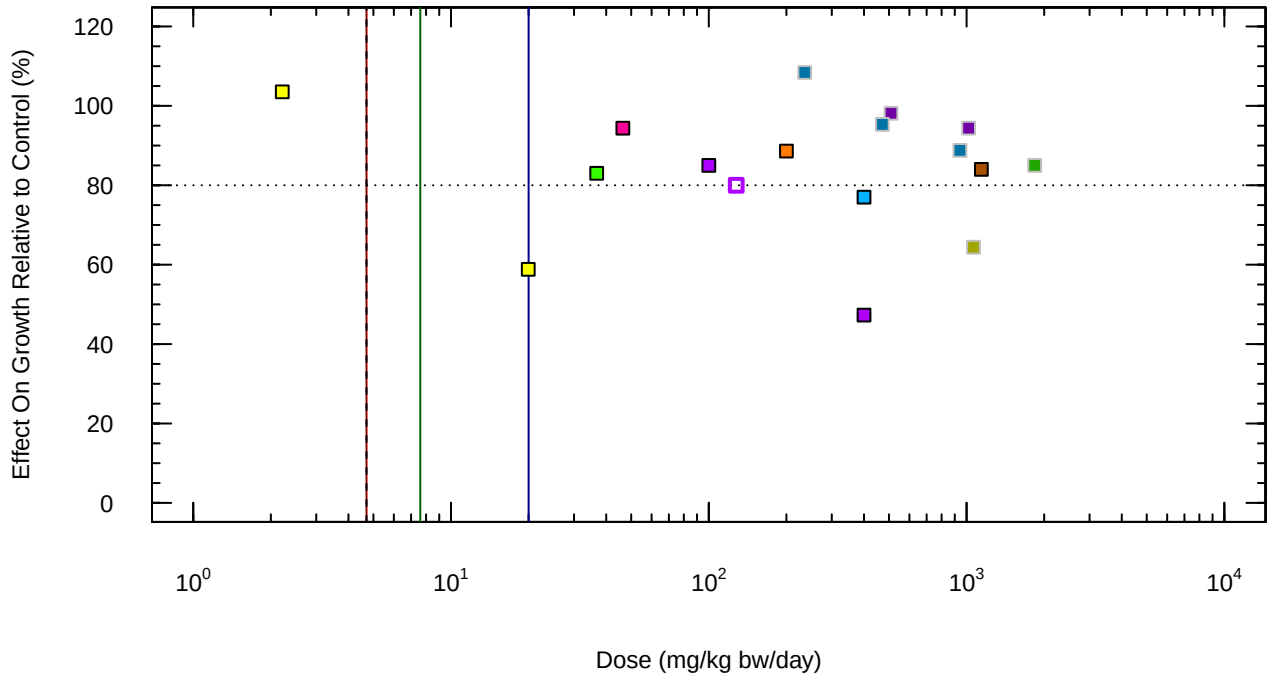
Selected TRV (Growth) = 29 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 11 mg/kg bw/day

80% effect relative to control

ED20 for pooled dataset F is 11 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−43. Dose−Response Data for the Avian Survival Endpoint for Lead, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Harry et al. 1985	rat	body weight	gavage	3.71 weeks	lead acetate	A
Hsu et al. 1975	pig	body weight	diet	13 weeks	lead acetate	
Kumar and Desiraju 1990	rat	body weight	gavage	8.43 weeks	lead acetate	
Toews et al. 1983	rat	body weight	gavage	4 weeks	lead acetate	A
Lorenzo et al. 1978	rabbit	% weight gain	gavage	4.29 weeks	lead nitrate	
Al−Omar et al. 2000	mouse	body weight gain	gavage	5 weeks	lead oxide	
Barlow et al. 1977	rat	maternal body weight	diet	3 weeks	lead acetate	
Maker et al. 1973	mouse	body weight	diet	4.29 weeks	lead carbonate	
Mykkanen et al. 1980	rat	weight gain	diet	3 weeks	lead acetate	
Mykkanen et al. 1980	rat	weight gain	diet	3 weeks	lead acetate	
Gerber et al. 1978	rat	body weight	diet	52 weeks	lead acetate	
ED20 for Kumar and Desiraju 1990	rat	body weight	gavage	8.43 weeks	lead acetate	

Tier 1

Eco−SSL TRV = 4.7 mg/kg bw/day

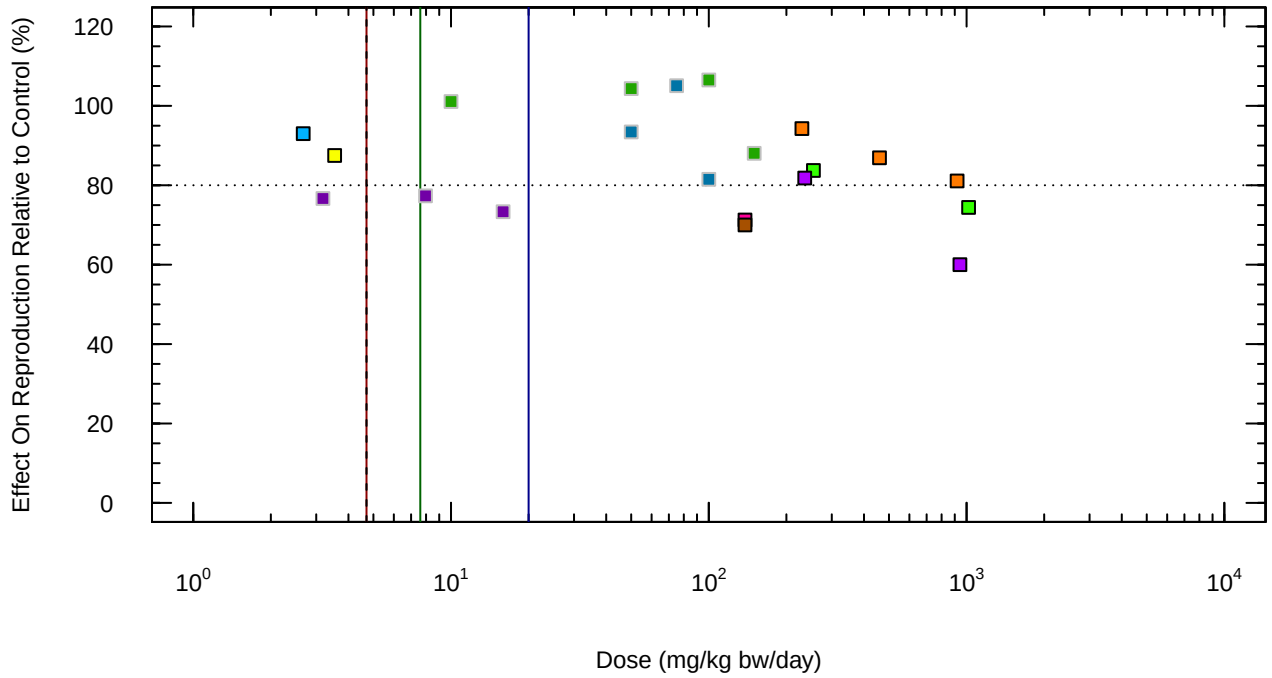
Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 7.6 mg/kg bw/day

80% effect relative to control

ED20 for Kumar and Desiraju 1990 is 130 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−44. Dose−Response Data for the Mammalian Growth Endpoint for Lead, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Jacquet et al. 1977	mouse	embryo weight	diet	2.57 weeks	not specified	
Mykkanen et al. 1980	rat	pup weight (breed 1)	diet	3 weeks	lead acetate	B
Mykkanen et al. 1980	rat	pup weight (breed 2)	diet	3 weeks	lead acetate	B
Schroeder and Mitchener 1971	rat	offspring survival	diet and drinking water	3 generations	soluble lead	
Schroeder and Mitchener 1971	mouse	offspring survival	diet and drinking water	3 generations	soluble lead	
Winneke et al. 1977	rat	litter size	diet	18.6 weeks	lead acetate	
Winneke et al. 1977	rat	pregnancy success	diet	18.6 weeks	lead acetate	
Wardell et al. 1982	rat	fetal mortality (resorptions)	gavage	1.86 weeks	lead acetate	
Gupta et al. 1995	mouse	living embryos per mother	gavage	4 weeks	lead acetate	
Miller et al. 1982	rat	embryo weight	gavage	5.86 weeks	lead acetate	

Tier 1

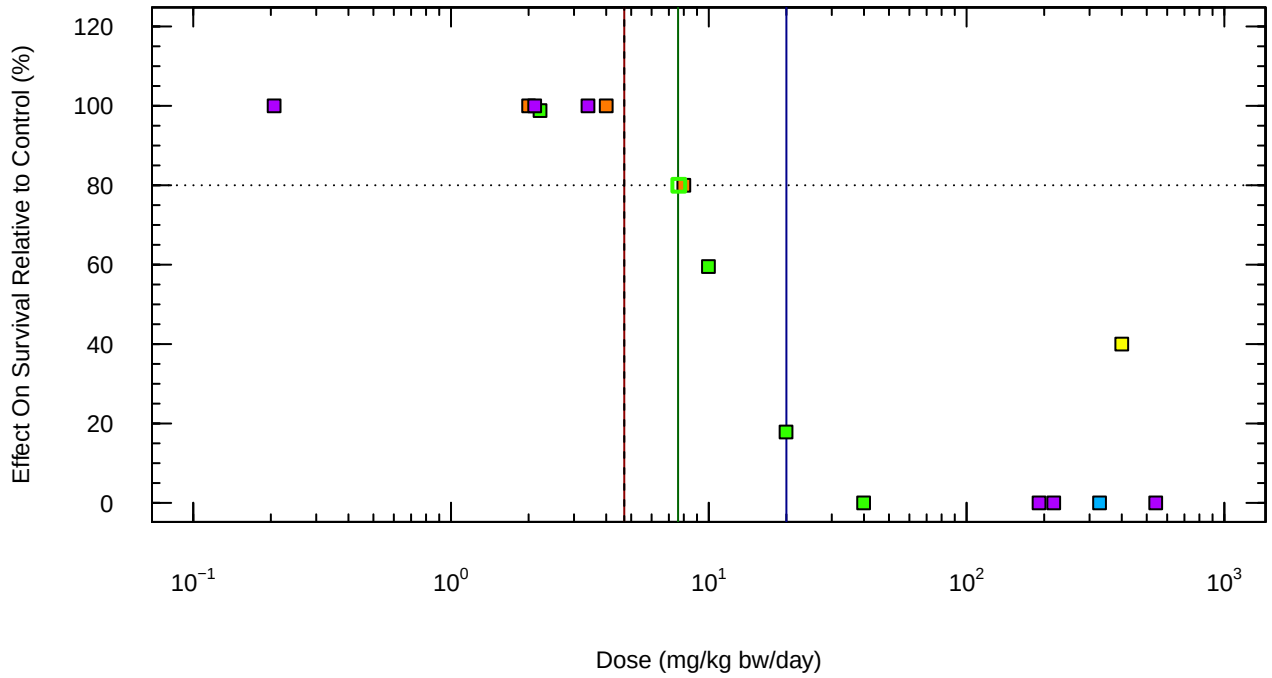
Eco−SSL TRV = 4.7 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 7.6 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−45. Dose−Response Data for the Mammalian Reproduction Endpoint for Lead, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Junaid et al. 1997	mouse	survival	gavage	8.57 weeks	lead acetate	
Lorenzo et al. 1978	rabbit	survival	gavage	4.29 weeks	lead nitrate	
Pankakoski et al. 1994	shrew	survival	diet	0.6 weeks	lead in earthworm prey	
Press 1977	rat	survival	gavage	2.14 weeks	lead acetate	
Kumar and Desiraju 1990	rat	survival	gavage	8.43 weeks	lead acetate	
ED20 for Lorenzo et al. 1978	rabbit	survival	gavage	4.29 weeks	lead nitrate	

Tier 1

Eco−SSL TRV = 4.7 mg/kg bw/day

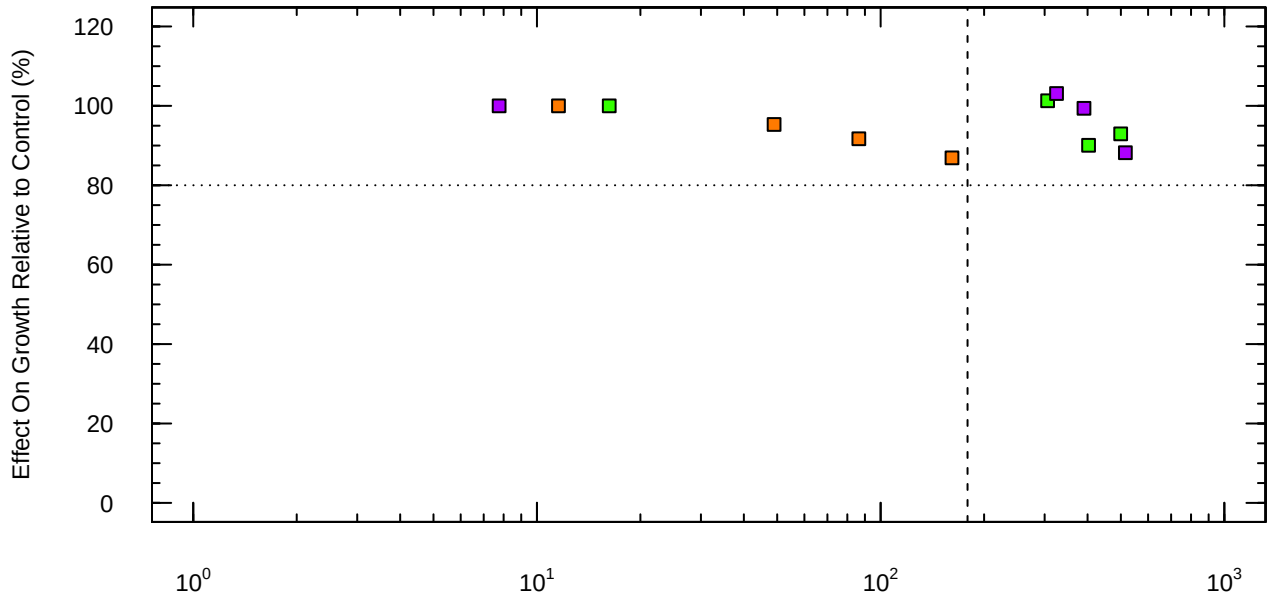
Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 4.7 mg/kg bw/day
Selected TRV (Survival) = 7.6 mg/kg bw/day

80% effect relative to control

ED20 for Lorenzo et al. 1978 is 7.6 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−46. Dose−Response Data for the Mammalian Survival Endpoint for Lead, Log−Transformed



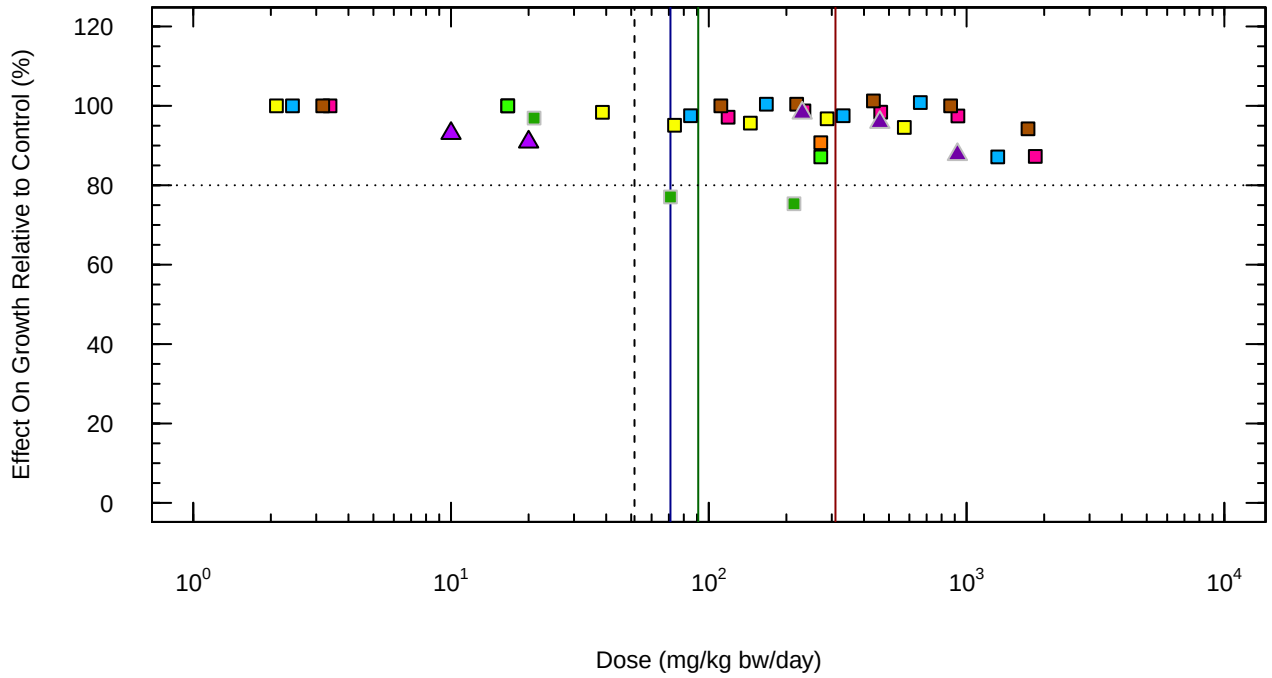
Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Martinez and Diaz 1996	chicken	body weight	diet	6 weeks	manganese oxide	
Southern and Baker 1983	chicken	body weight	diet	2 weeks	manganese chloride	
Vohra and Kratzer 1968	turkey	body weight gain	diet	3 weeks	manganese sulfate	

Tier 1

Eco−SSL TRV = 179 mg/kg bw/day

80% effect relative to control

Figure 4−47. Dose−Response Data for the Avian Growth Endpoint for Manganese, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Komura and Sakomoto 1991	mouse	body weight	diet	12.9 weeks	manganese acetate	
Komura and Sakomoto 1991	mouse	body weight	diet	12.9 weeks	manganese chloride	
Lipe et a. 1999	rat	body weight	gavage	4.29 weeks	manganese chloride	
NTP 1993b	rat	body weight (male)	diet	2 weeks	manganese sulfate	
NTP 1993b	rat	body weight (female)	diet	13 weeks	manganese sulfate	
NTP 1993b	mouse	body weight (male)	diet	13 weeks	manganese sulfate	
NTP 1993b	mouse	body weight (female)	diet	13 weeks	manganese sulfate	
Rehnberg et al. 1980	rat	body weight	gavage	2.86 weeks	manganese oxide	
Kontur and Fechter 1985	rat	body weight	drinking water	3 weeks	manganese chloride	

Tier 1 Tier 2

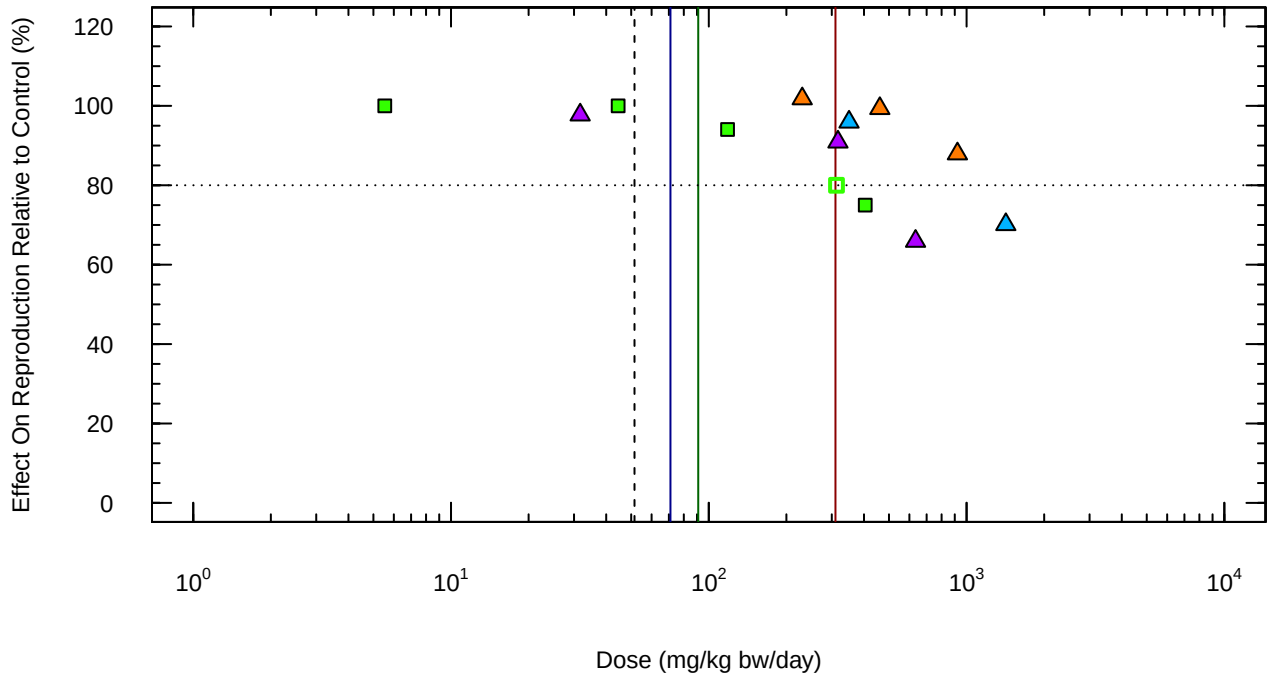
Eco−SSL TRV = 51.5 mg/kg bw/day

Selected TRV (Growth) = 71 mg/kg bw/day
Selected TRV (Reproduction) = 310 mg/kg bw/day
Selected TRV (Survival) = 91 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−48. Dose−Response Data for the Mammalian Growth Endpoint for Manganese, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Kontur and Fechter 1985	rat	litter size	drinking water	3 weeks	manganese chloride	
Laskey et al. 1982	rat	pregnancy success	diet	gestation to 32 weeks	manganese oxide	
Leung et al. 1982	rat	offspring body weight	drinking water	3.71 weeks	manganese chloride	A
Pappas et al. 1997	rat	offspring body weight	drinking water	gestation to post−natal day 30	manganese chloride	A
ED20 for Laskey et al. 1982	rat	pregnancy success	diet	gestation to 32 weeks	manganese oxide	

Tier 1 Tier 2

Eco−SSL TRV = 51.5 mg/kg bw/day

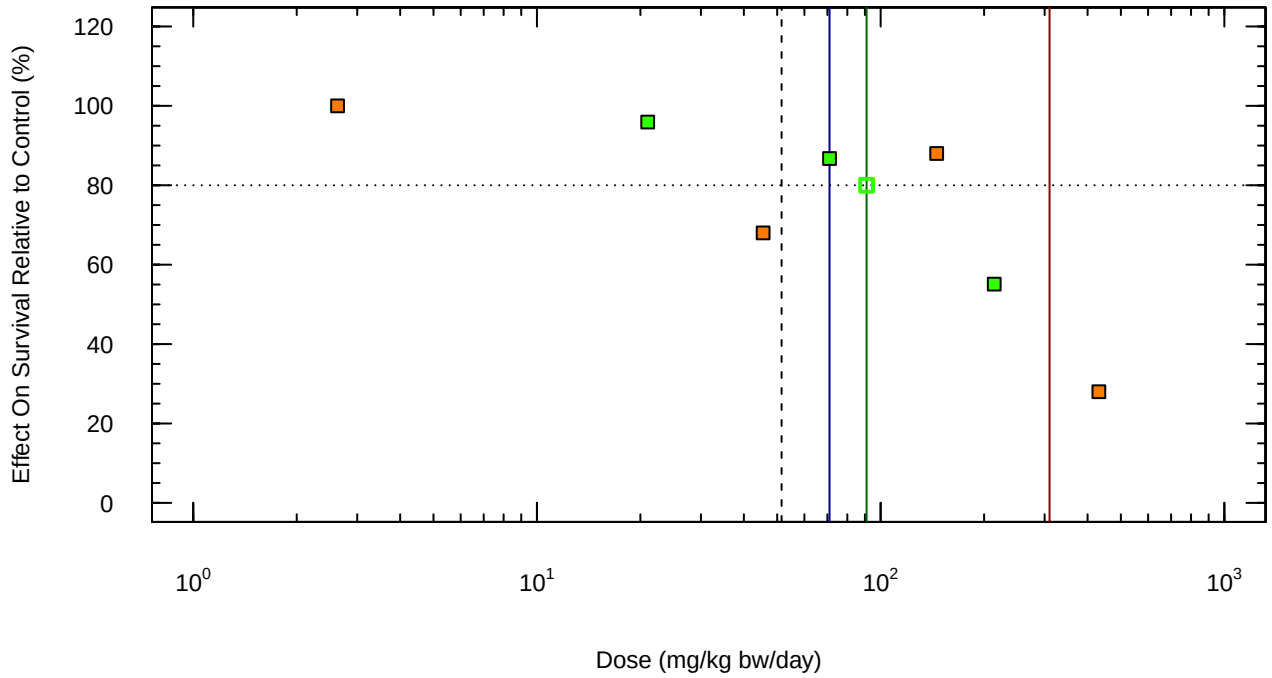
Selected TRV (Growth) = 71 mg/kg bw/day
Selected TRV (Reproduction) = 310 mg/kg bw/day
Selected TRV (Survival) = 91 mg/kg bw/day

80% effect relative to control

ED20 for Laskey et al. 1982 is 310 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−49. Dose−Response Data for the Mammalian Reproduction Endpoint for Manganese, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
NTP 1993b	rat	suvival (male)	diet	2 years	manganese sulfate	
Rehnberg et al. 1980	rat	survival	gavage	2.86 weeks	manganese oxide	
ED20 for Rehnberg et al. 1980	rat	survival	gavage	2.86 weeks	manganese oxide	

Tier 1

Eco−SSL TRV = 51.5 mg/kg bw/day

Selected TRV (Growth) = 71 mg/kg bw/day
Selected TRV (Reproduction) = 310 mg/kg bw/day
Selected TRV (Survival) = 91 mg/kg bw/day

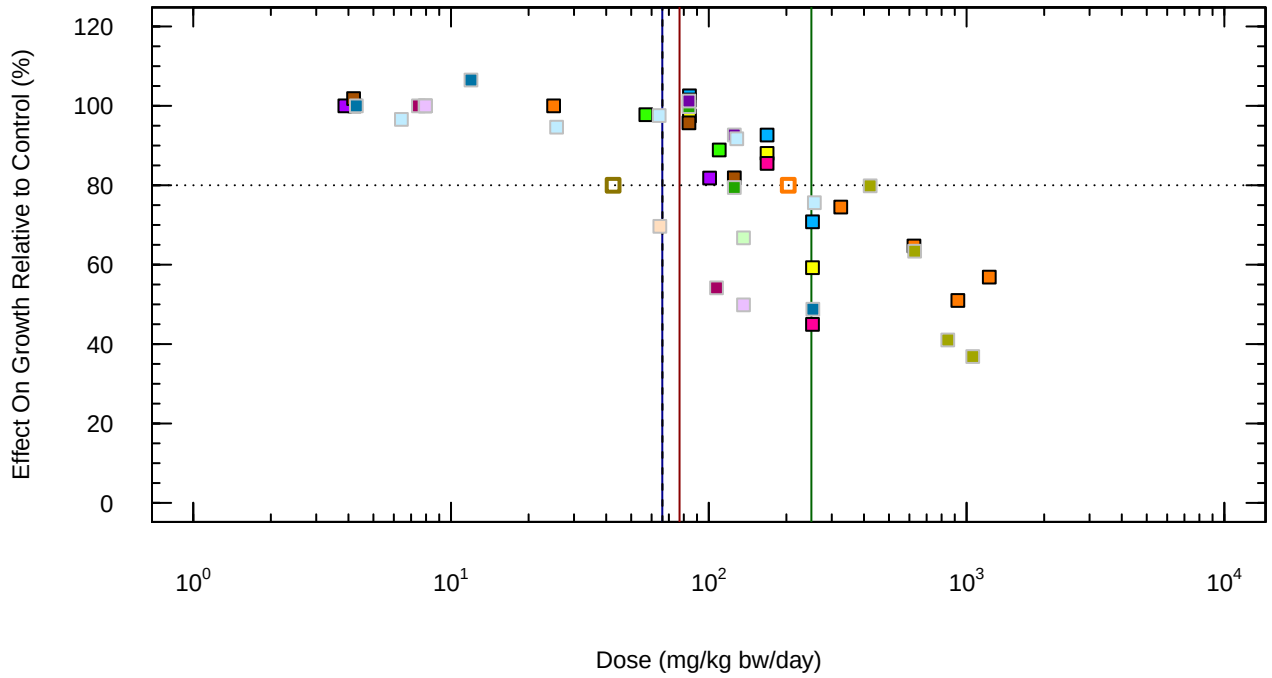
80% effect relative to control

ED20 for Rehnberg et al. 1980 is 91 mg/kg bw/day

* Survival at this dose was not significantly different from the control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−50. Dose−Response Data for the Mammalian Survival Endpoint for Manganese, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Gasaway and Buss 1972	mallard	body weight gain	diet	5.71 weeks	zinc carbonate	
Hamilton et al. 1981	Japanese quail	body weight (Exp 2)	diet	2 weeks	zinc carbonate	
Hamilton et al. 1981	Japanese quail	body weight (Exp 5)	diet	2 weeks	zinc carbonate	
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc oxide	D
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc sulfate	C
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc carbonate	B
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc sulfate	C
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc carbonate	B
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc oxide	D
Stahl et al. 1989	chicken	body weight gain	diet	3 weeks	zinc carbonate	
Vohra and Kratzer 1968	turkey	body weight gain	diet	3 weeks	zinc oxide	
Lu and Combs 1988	chicken	body weight gain (Exp 3)	diet	3 weeks	zinc oxide	A
Lu et al. 1990	chicken	body weight gain (Exp 1)	diet	1 weeks	zinc oxide	A
Sandoval et al. 1988	chicken	body weight gain (Exp 2)	diet	3 weeks	zinc sulfate	E
Sandoval et al. 1988	chicken	body weight gain (Exp 2)	diet	3 weeks	zinc gluconate	
Hill 1974a	chicken	body weight gain	diet	2 weeks	zinc sulfate	E
ED20 for Gasaway and Buss 1972	mallard	body weight gain	diet	5.71 weeks	zinc carbonate	
ED20 for pooled dataset A	chicken	body weight gain	diet	1−3 weeks	zinc oxide	A

Tier 1

Eco−SSL TRV = 66.1 mg/kg bw/day

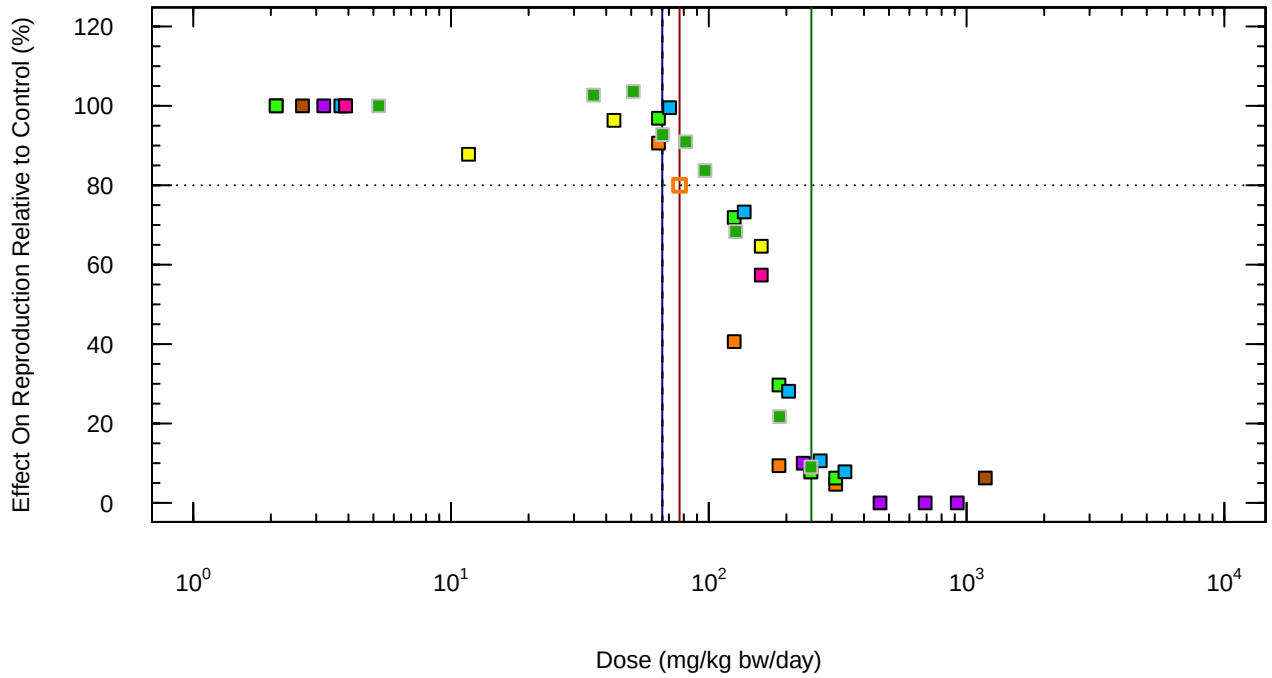
Selected TRV (Growth) = 66 mg/kg bw/day
Selected TRV (Reproduction) = 77 mg/kg bw/day
Selected TRV (Survival) = 250 mg/kg bw/day

80% effect relative to control

ED20 for Gasaway and Buss 1972 is 200 mg/kg bw/day
ED20 for pooled dataset A is 43 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−51. Dose−Response Data for the Avian Growth Endpoint for Zinc, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc acetate dihydrate	
Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc oxide	
Jackson et al. 1986	chicken	egg production	diet	3 weeks	zinc oxide	
Jackson et al. 1986	chicken	egg production	diet	20 weeks	zinc oxide	F
Jensen and Maurice 1980	chicken	egg production (Exp 4)	diet	6 weeks	zinc sulfate	G
Jensen and Maurice 1980	chicken	egg production (Exp 3)	diet	6 weeks	zinc sulfate	G
Stepinska et al. 1987	chicken	egg production	diet	0.714 weeks	zinc oxide	
Stevenson et al. 1987	chicken	egg production	diet	20 weeks	zinc oxide	F
ED20 for Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc acetate dihydrate	

Tier 1

Eco−SSL TRV = 66.1 mg/kg bw/day

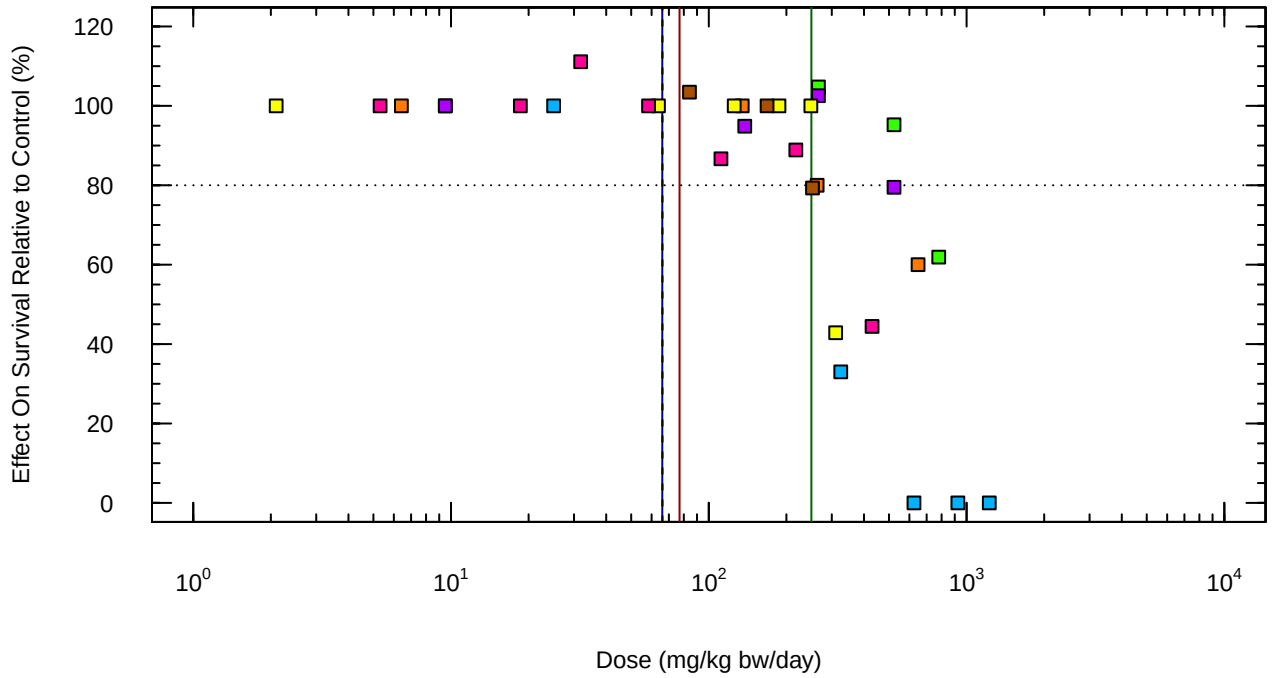
Selected TRV (Growth) = 66 mg/kg bw/day
Selected TRV (Reproduction) = 77 mg/kg bw/day
Selected TRV (Survival) = 250 mg/kg bw/day

80% effect relative to control

ED20 for Gibson et al. 1986 is 77 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−52. Dose−Response Data for the Avian Reproduction Endpoint for Zinc, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Blalock and Hill 1988	chicken	survival	diet	2 weeks	zinc oxide	H
Dewar et al. 1983	chicken	survival (Exp 1)	diet	4 weeks	zinc oxide	
Dewar et al. 1983	chicken	survival (Exp 2)	diet	4 weeks	zinc oxide	H
Gasaway and Buss 1972	mallard	survival	diet	8.57 weeks	zinc carbonate	
Gibson et al. 1986	chicken	survival	diet	10 weeks	zinc acetate	
Hamilton et al. 1979	Japanese quail	survival	diet	2 weeks	zinc carbonate	
Roberson and Schaible 1960	chicken	survival (Exp 2)	diet	4 weeks	zinc carbonate	

Tier 1

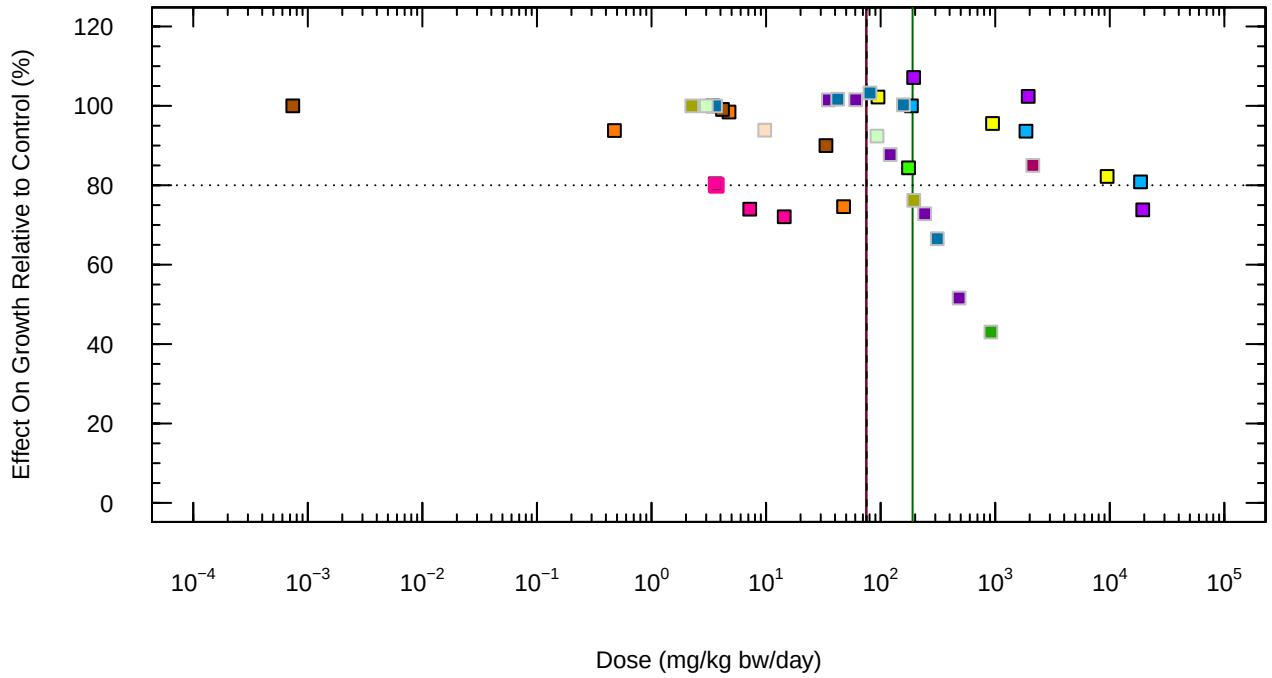
Eco−SSL TRV = 66.1 mg/kg bw/day

Selected TRV (Growth) = 66 mg/kg bw/day
Selected TRV (Reproduction) = 77 mg/kg bw/day
Selected TRV (Survival) = 250 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−53. Dose−Response Data for the Avian Survival Endpoint for Zinc, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill et al. 1983	pig	body weight	diet	to 18 months old	zinc oxide	
Hsu et al. 1975	pig	body weight	diet	9−13 weeks	zinc oxide	
Maita et al. 1981	mouse	body weight (female)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	mouse	body weight (male)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	rat	body weight (male)	diet	13 weeks	zinc sulfate	
Khan et al. 2007	rat	male body weight	gavage	14 weeks	zinc chloride	
Subramanian et al. 2000	rat	body weight	diet	6 weeks	zinc oxide	
Settlemire and Matrone 1967	rat	body weight gain	diet	5 weeks	zinc carbonate	
Brink et al. 1959	pig	body weight (Exp 1)	diet	6 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 2)	diet	5 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 3)	diet	6 weeks	not specified	A
Petterson et al. 2002	mouse	body weight	diet	3 weeks	zinc chloride	
Nakamura et al. 1983	rat	body weight	diet	11 weeks	zinc acetate	
Barone et al. 1998	rat	body weight	diet	gestation	not specified	
ED20 for Khan et al. 2007	rat	male body weight	gavage	14 weeks	zinc chloride	

Tier 1

Eco−SSL TRV = 75.4 mg/kg bw/day

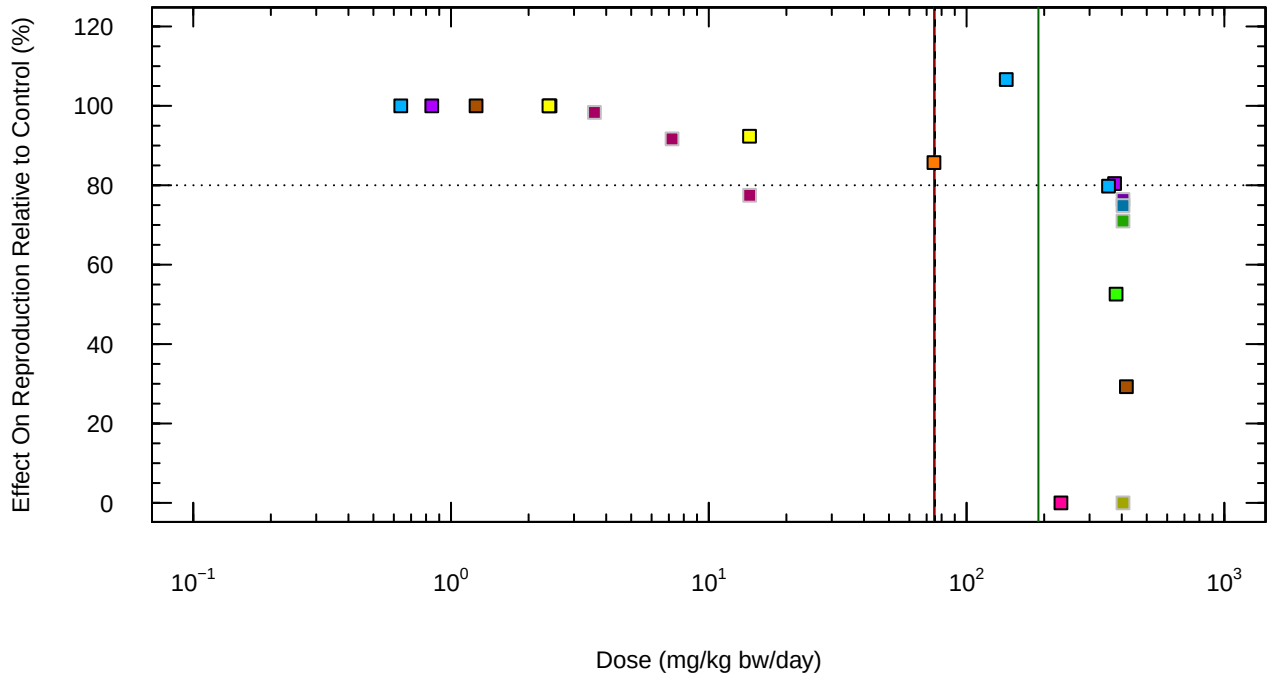
Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

ED20 for Khan et al. 2007 is 3.7 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−54. Dose−Response Data for the Mammalian Growth Endpoint for Zinc, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Barone et al. 1998	rat	litter size	diet	gestation	not specified	
Chu and Cox 1972	rat	offspring growth	diet	3 weeks	not specified	
Cox et al. 1969	rat	fetal growth	diet	3.14 weeks	zinc oxide	B
Ketcheson et al. 1969	rat	offspring growth	diet	gestation to 14 days lactation	zinc oxide	
Kumar 1976	rat	fetal survival	diet	2.57 weeks	zinc sulfate	
Newman et al. 2002	rat	offspring survival	diet	gestation to post−natal day 40	zinc acetate dihydrate	
Pal and Pal 1987	rat	normal fetuses	diet	2.57 weeks	zinc sulfate	
Schlicker and Cox 1968	rat	fetal survival	diet	2.14 weeks	zinc oxide	C
Schlicker and Cox 1968	rat	fetal growth	diet	2.14 weeks	zinc oxide	B
Schlicker and Cox 1968	rat	fetal growth	diet	2.57 weeks	zinc oxide	B
Schlicker and Cox 1968	rat	fetal survival	diet	5.14 weeks	zinc oxide	C
Khan et al. 2007	rat	offspring survival	gavage	20 weeks	zinc chloride	

Tier 1

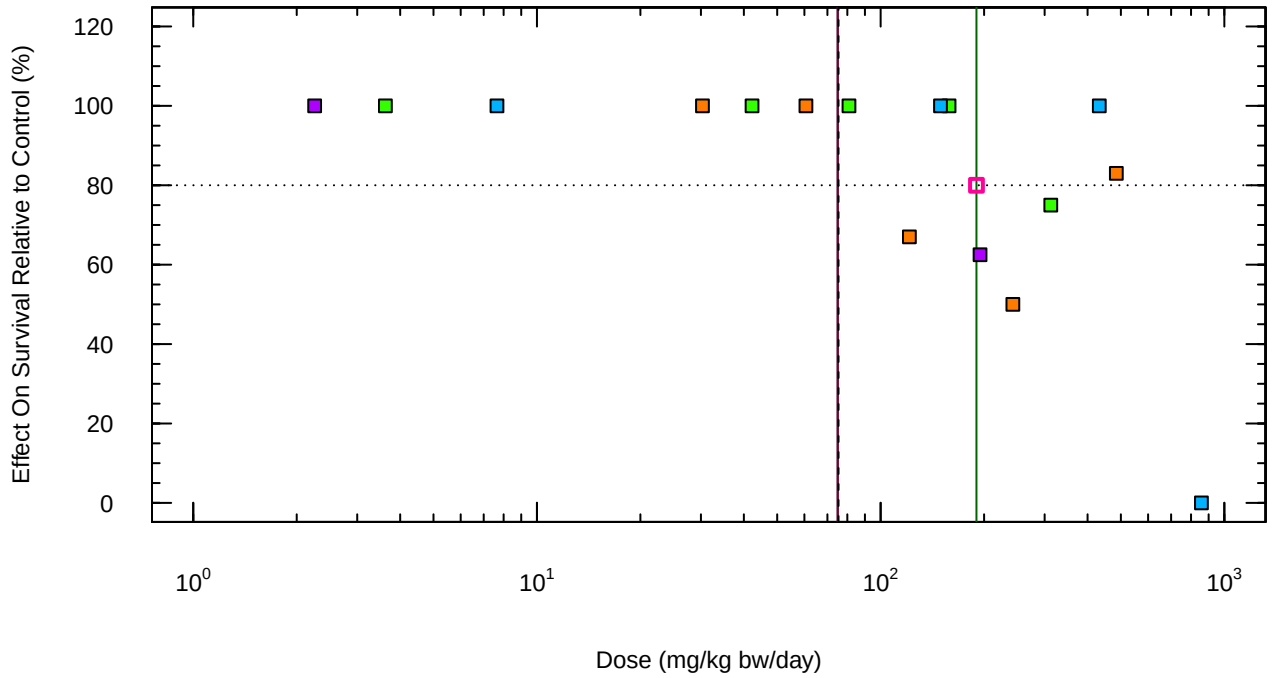
Eco−SSL TRV = 75.4 mg/kg bw/day

Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

Figure 4−55. Dose−Response Data for the Mammalian Reproduction Endpoint for Zinc, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Brink et al. 1959	pig	survival (Exp 1)	diet	6 weeks	zinc carbonate	D
Brink et al. 1959	pig	survival (Exp 2)	diet	5 weeks	zinc carbonate	D
Brink et al. 1959	pig	survival (Exp 3)	diet	6 weeks	zinc carbonate	D
Straube et al. 1980	ferret	survival	diet	2−24 weeks	zinc oxide	
Geomean for pooled dataset D	pig	survival	diet	5−6 weeks	zinc carbonate	D

Tier 1

Eco−SSL TRV = 75.4 mg/kg bw/day

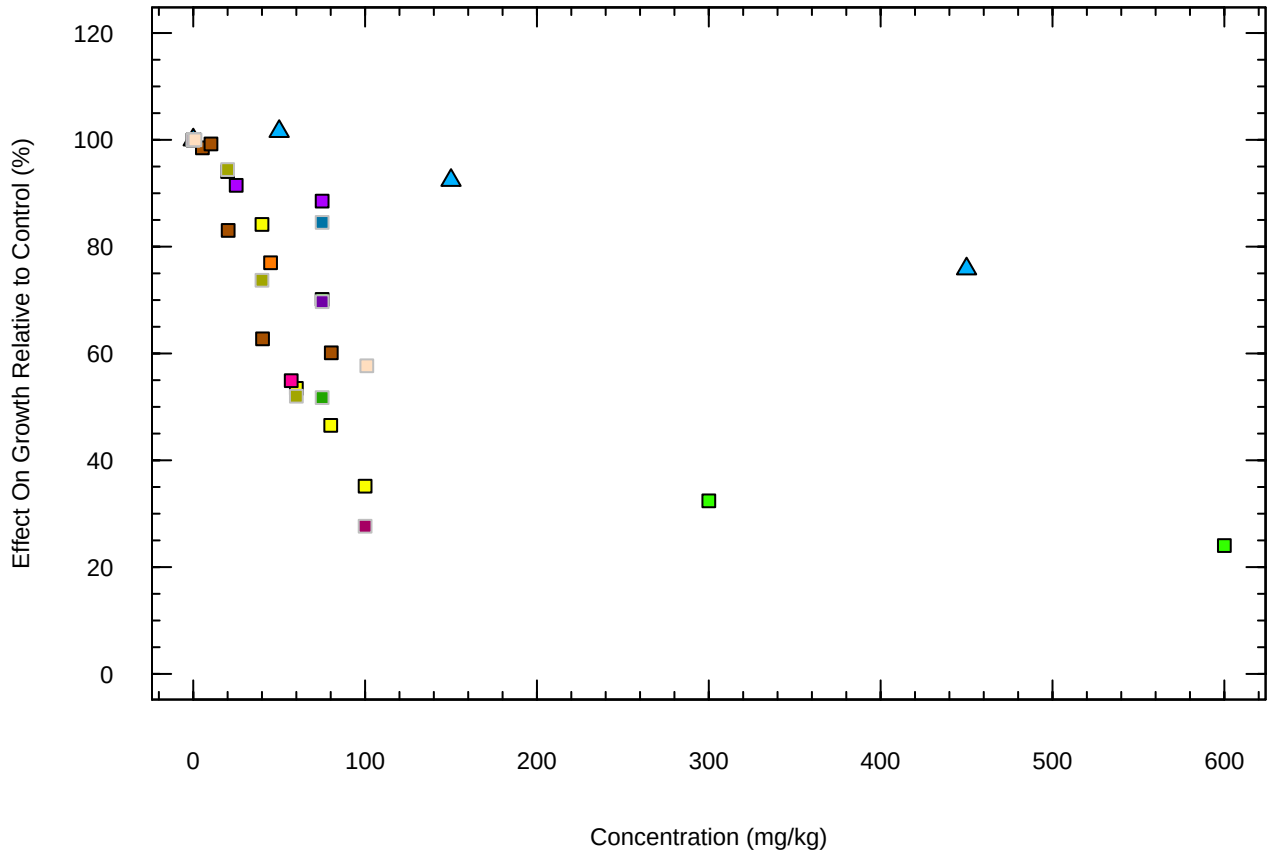
Selected TRV (Growth) = 75 mg/kg bw/day
Selected TRV (Reproduction) = 75 mg/kg bw/day
Selected TRV (Survival) = 190 mg/kg bw/day

80% effect relative to control

Geomean for pooled dataset D is 190 mg/kg bw/day

Note: All selected TRVs for this metal and receptor are shown for comparison across growth, reproduction, and survival endpoints. The relative weight of each TRV for use in the risk assessment will be discussed in a weight−of−evidence evaluation.

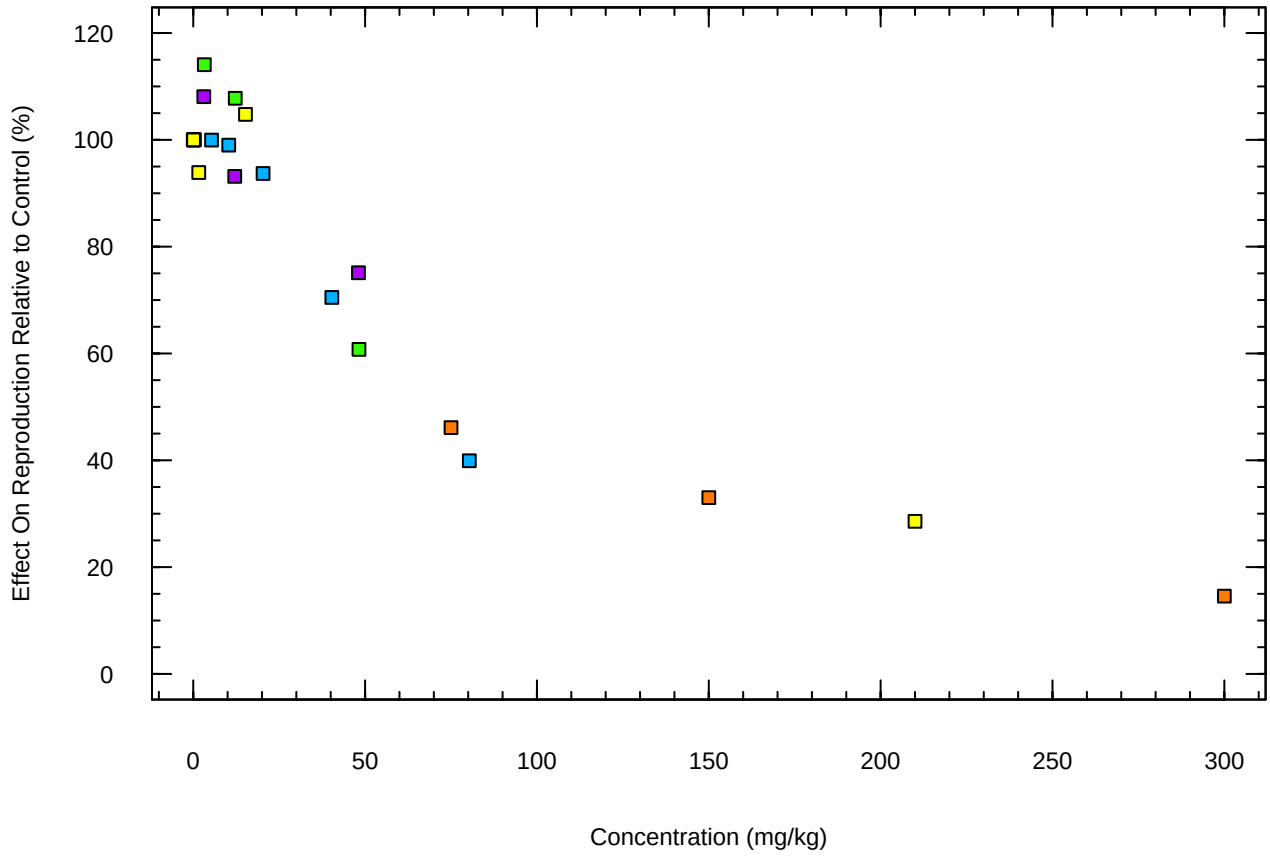
Figure 4−56. Dose−Response Data for the Mammalian Survival Endpoint for Zinc, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bafundo et al. 1984	chicken	body weight gain	diet	2 weeks	cadmium chloride	
Bokori et al. 1995a	chicken	body weight	diet	4 weeks	cadmium sulfate	
Bokori et al. 1996	chicken	body weight	diet	39 weeks	cadmium sulfate	
Di Giulio and Scanlon 1984	mallard	body weight	diet	6 weeks	cadmium chloride	
Hill 1974a	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Hill 1974b	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Olgun 2015	Japanese quail	body weight	diet	10 weeks	cadmium sulfate	
Richardson and Fox 1974	Japanese quail	body weight	diet	4 weeks	cadmium chloride	B
Richardson et al. 1974	Japanese quail	body weight	diet	4 weeks	cadmium chloride	B
Richardson et al. 1974	Japanese quail	body weight	diet	6 weeks	cadmium chloride	B
Hill 1979	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Hill 1980	chicken	body weight gain	diet	2 weeks	cadmium sulfate	A
Rama and Planas 1981	chicken	body weight gain	diet	9 weeks	cadmium sulfate	A

Tier 1 Tier 2

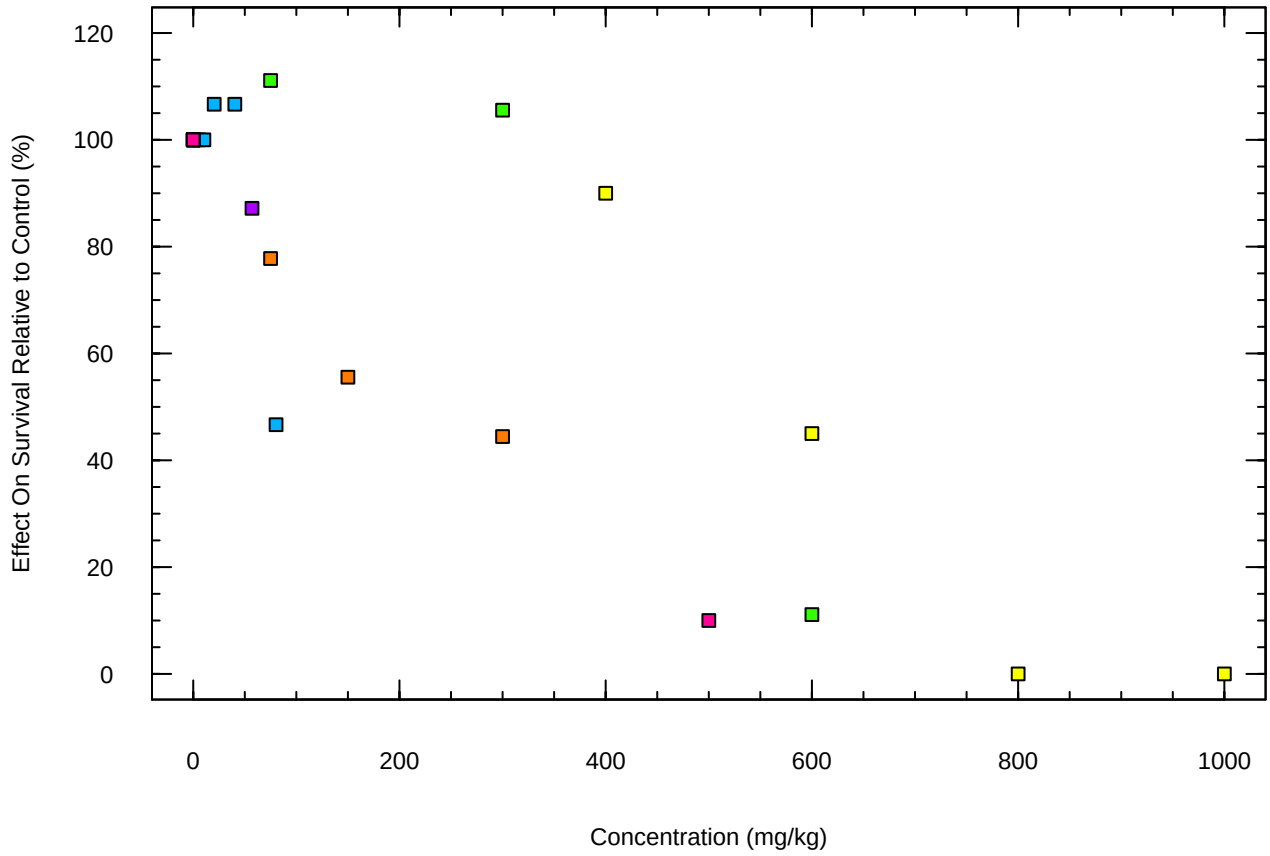
Figure 4−57. Concentration−Response Data for the Avian Growth Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bokori et al. 1995b	Japanese quail	egg production	diet	5.29 weeks	cadmium sulfate	
Leach et al. 1979	chicken	egg production	diet	48 weeks	cadmium sulfate	
Leach et al. 1979	chicken	egg production	diet	12 weeks	cadmium sulfate	
Olgun 2015	Japanese quail	egg production	diet	10 weeks	cadmium sulfate	
White and Finley 1978	mallard	egg production	diet	4.3−12.8 weeks	cadmium chloride	

Tier 1

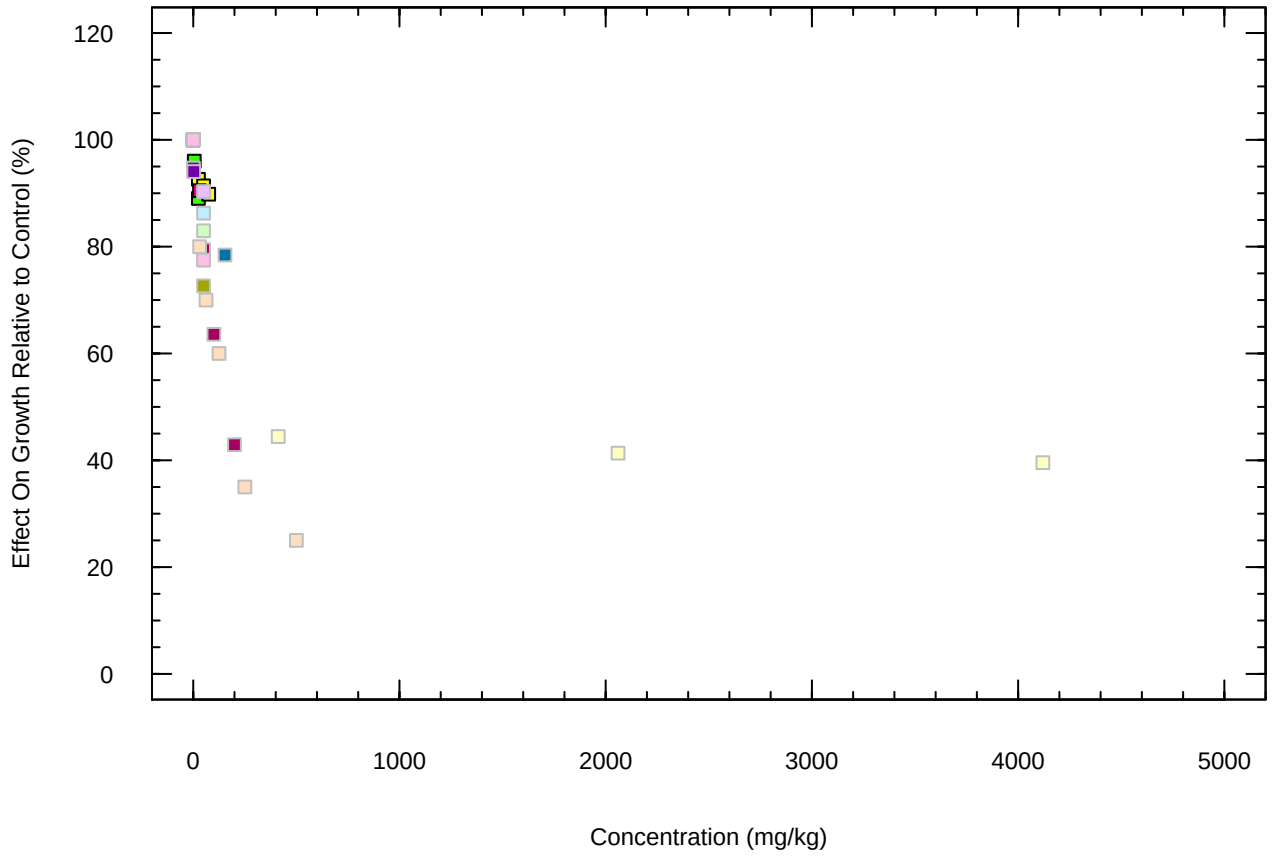
Figure 4−58. Concentration−Response Data for the Avian Reproduction Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Bokori et al. 1995b	Japanese quail	survival	diet	5.29 weeks	cadmium sulfate	C
Bokori et al. 1995a	chicken	survival	diet	8 weeks	cadmium sulfate	
Hill 1974b	chicken	survival	diet	2 weeks	cadmium sulfate	
Olgun 2015	Japanese quail	survival	diet	10 weeks	cadmium sulfate	C
Pritzl et al. 1974	chicken	survival	diet	2.86 weeks	cadmium carbonate	
Van Vleet et al. 1981	Pekin duck	survival	diet	4 weeks	cadmium sulfate	

Tier 1

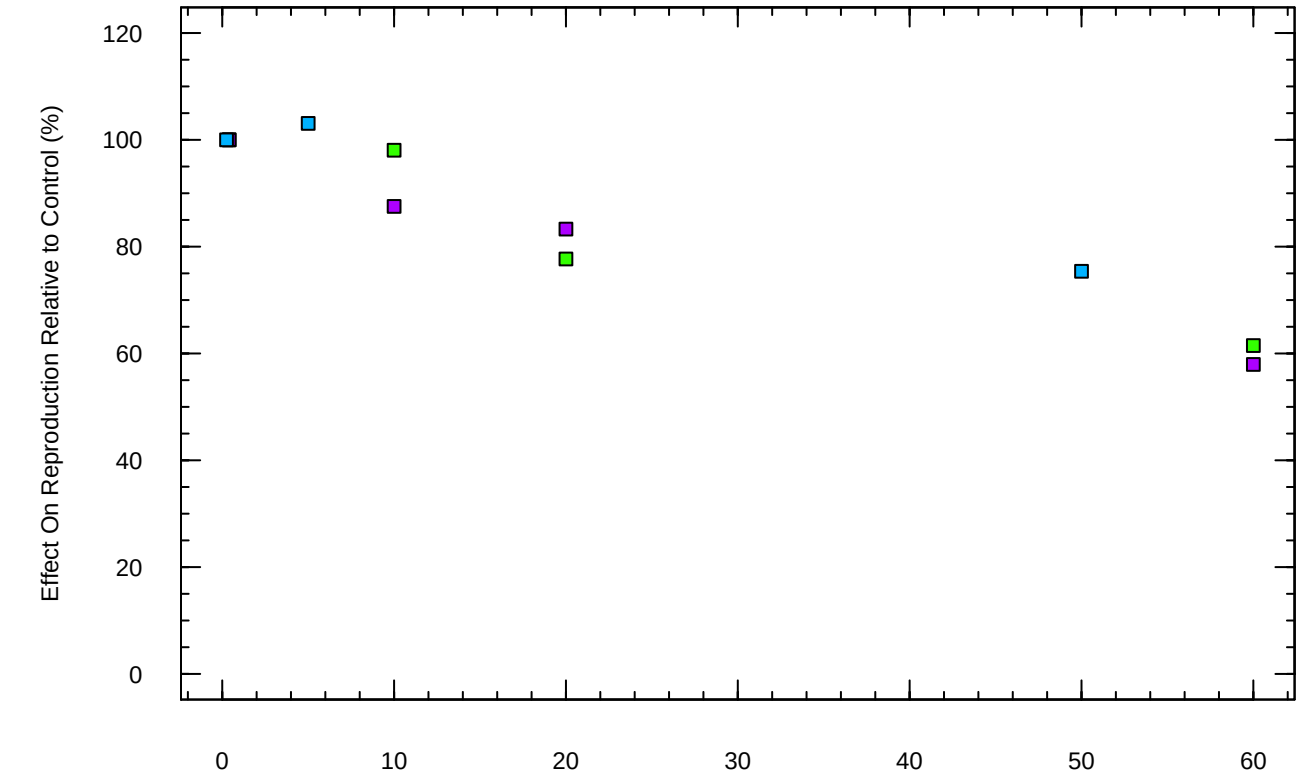
Figure 4−59. Concentration−Response Data for the Avian Survival Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Cousins et al. 1977	rat	body weight	diet	14 weeks	cadmium chloride	
Rajanna et al. 1984	rat	body weight	diet	25.7 weeks	cadmium chloride	
Groten et al. 1991	rat	body weight	diet	8 weeks	cadmium chloride	
Weigel et al. 1987	rat	body weight	diet	7.86 weeks	cadmium oxide	
Pond et al. 1973	pig	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1979	rat	body weight	diet	2 weeks	cadmium chloride	A
Suzuki and Yoshida 1979	rat	body weight	diet	4 weeks	cadmium chloride	A
Wilson et al. 1941	rat	body weight	diet	7.14 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 1)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978a	rat	body weight (Exp 2)	diet	25.7 weeks	cadmium chloride	
Suzuki and Yoshida 1978b	rat	body weight (Exp 1)	diet	2 weeks	cadmium chloride	A
Weber and Reid 1969	mouse	body weight (Exp 1)	diet	3 weeks	cadmium acetate	
Suzuki and Yoshida 1977	rat	body weight (Exp 2)	diet	6.43 weeks	cadmium chloride	A

Tier 1

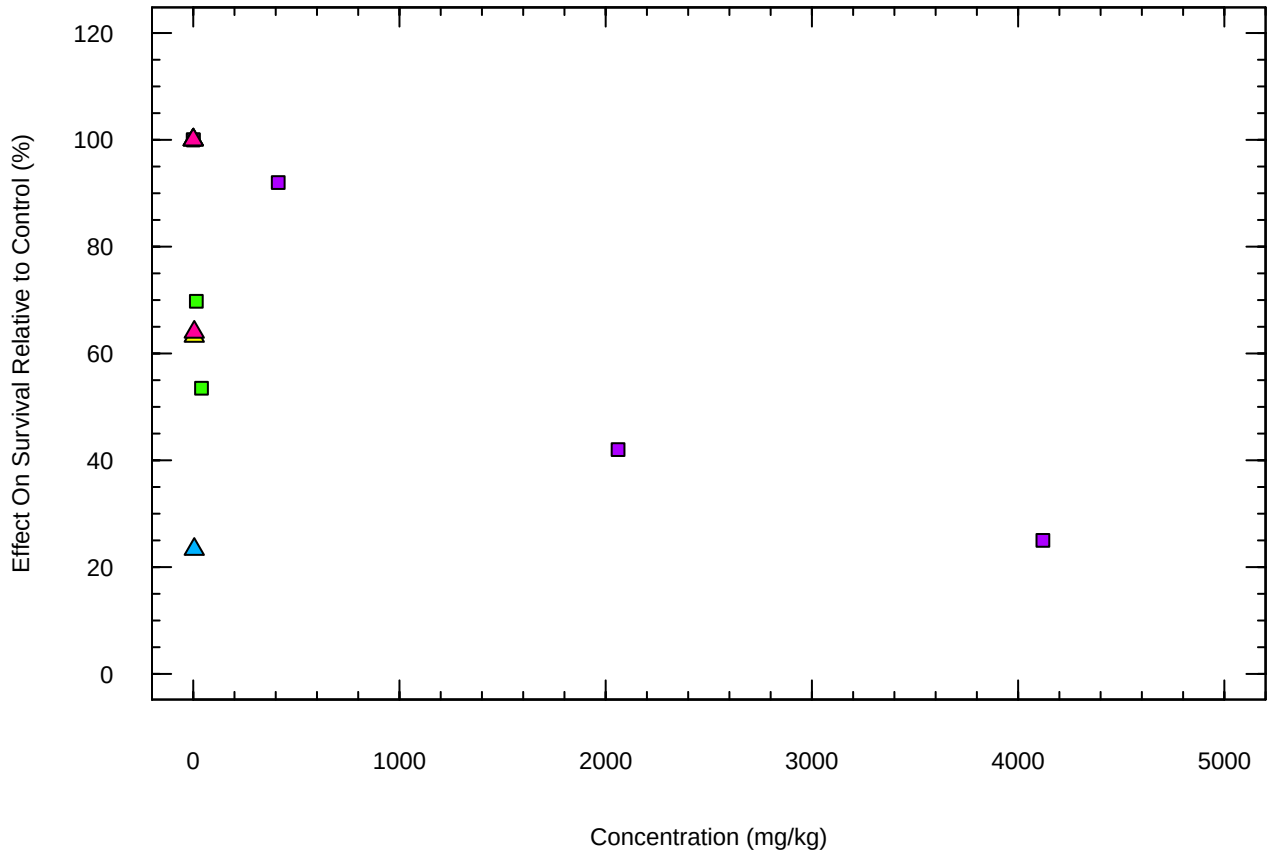
Figure 4−60. Concentration−Response Data for the Mammalian Growth Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Sawicka−Kapusta et al. 1994	mouse	offspring growth	diet	5 weeks	cadmium chloride	
Sawicka−Kapusta et al. 1994	mouse	offspring survival	diet	5 weeks	cadmium chloride	
Whelton et al. 1988	mouse	offspring growth	diet	36 weeks	cadmium chloride	

Tier 1

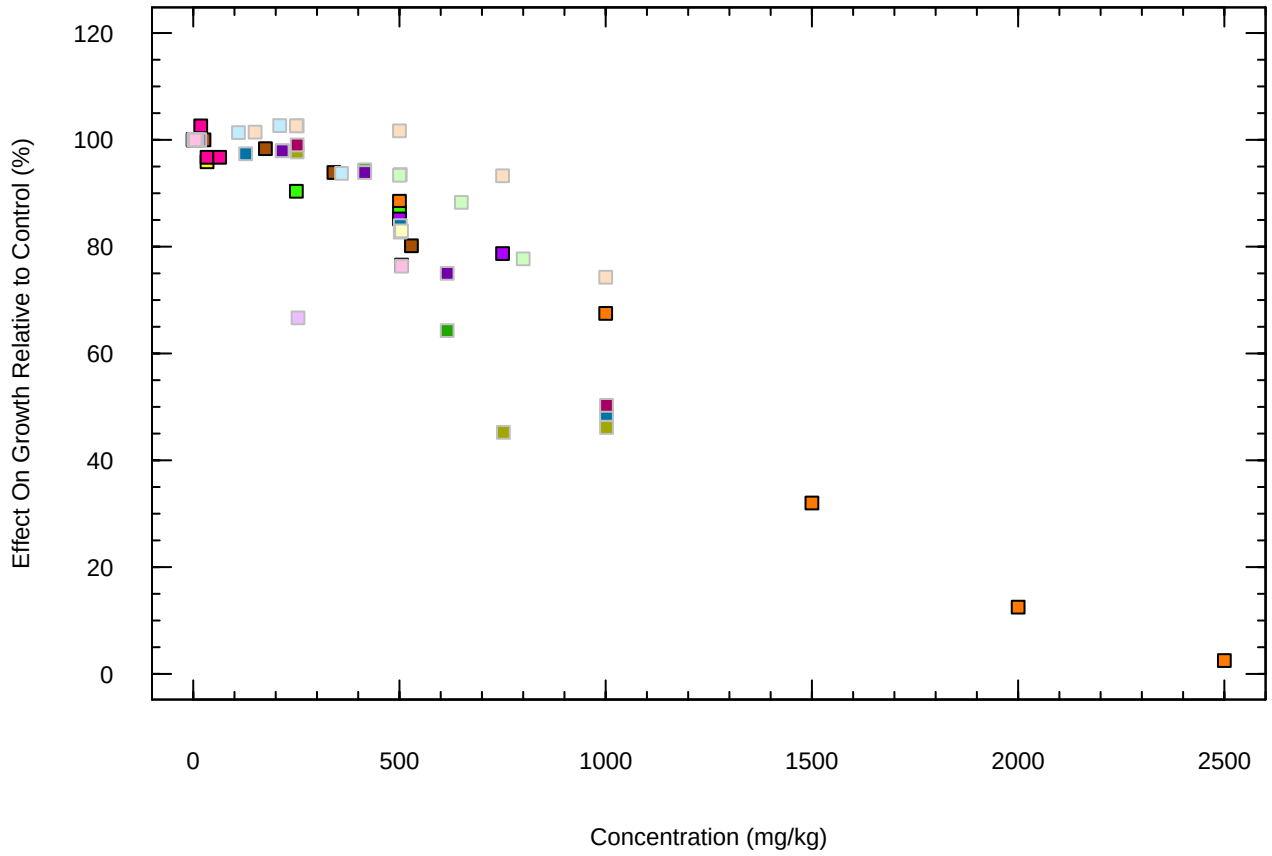
Figure 4−61. Concentration−Response Data for the Mammalian Reproduction Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Swiergosz et al. 1998	vole	survival	diet	24 weeks	cadmium chloride	
Weber and Reid 1969	mouse	survival	diet	3 weeks	cadmium acetate	
Schroeder et al. 1963	rat	survival (male)	drinking water	92 weeks	not specified	C
Schroeder et al. 1963	rat	survival (female)	drinking water	92 weeks	not specified	C
Schroeder et al. 1964	mouse	survival (male)	drinking water	78 weeks	not specified	

Tier 1 Tier 2

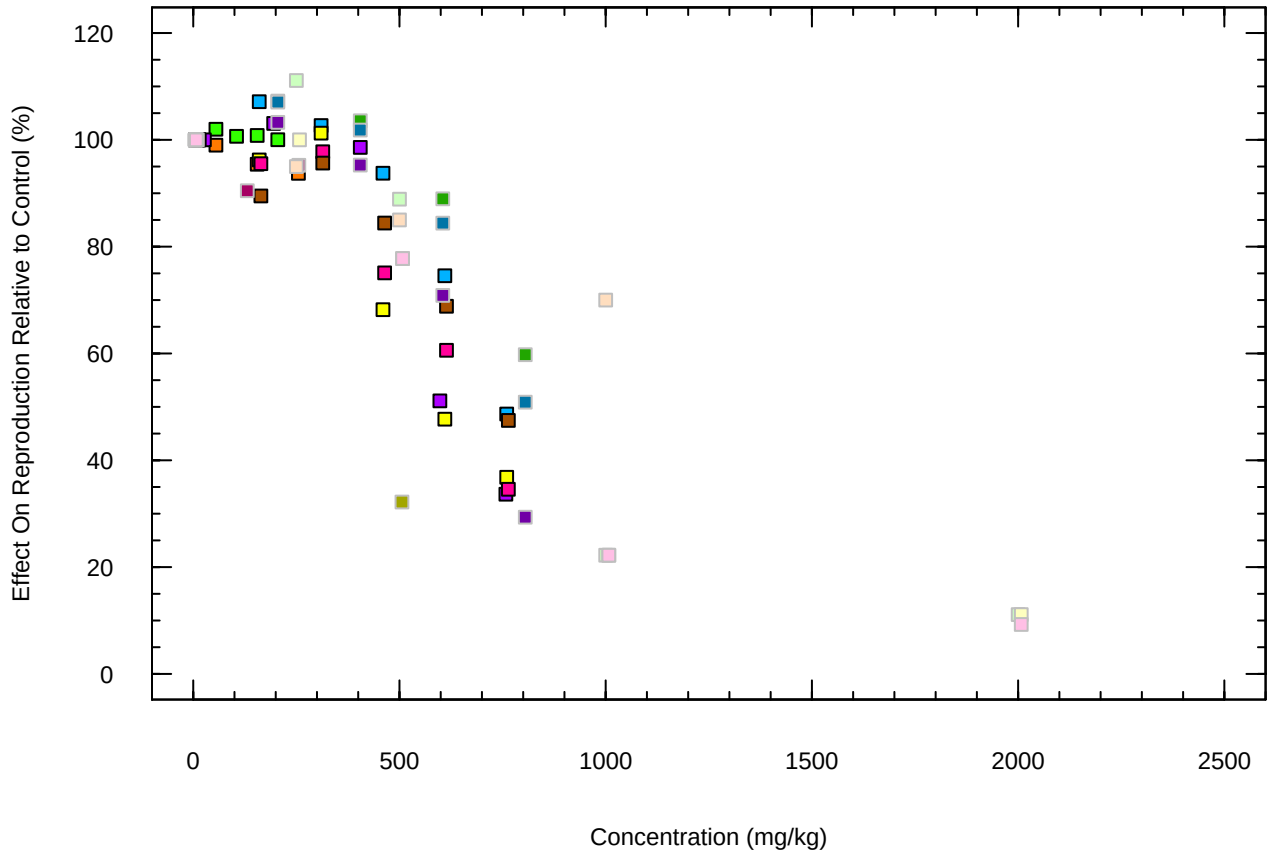
Figure 4−62. Concentration−Response Data for the Mammalian Survival Endpoint for Cadmium



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill 1974a	chicken	body weight	diet	2 weeks	copper sulfate	C
Jensen and Maurice 1978	chicken	body weight (Exp 1)	diet	4 weeks	copper sulfate	C
Jensen and Maurice 1978	chicken	body weight (Exp 2)	diet	4 weeks	copper sulfate	C
Jensen and Maurice 1979	chicken	body weight (Exp 2)	diet	4 weeks	copper sulfate	C
Kashani et al. 1986	turkey	body weight (Exp 1)	diet	24 weeks	cupric sulfate	
Kashani et al. 1986	turkey	body weight (Exp 2)	diet	24 weeks	cupric sulfate	
Miles et al. 1998	chicken	body weight (Exp 1)	diet	3 weeks	copper sulfate	
Miles et al. 1998	chicken	body weight (Exp 2)	diet	6 weeks	dicopper chloride	
Miles et al. 1998	chicken	body weight (Exp 2)	diet	6 weeks	copper sulfate	
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 1)	diet	4 weeks	copper sulfate	D
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 2)	diet	4 weeks	copper sulfate	D
Poupoulis and Jensen 1976	chicken	body weight gain (Exp 5)	diet	4 weeks	copper sulfate	D
Persia et al. 2004	chicken	body weight (Exp 2)	diet	2.14 weeks	copper chloride	E
Persia et al. 2004	chicken	body weight (Exp 3)	diet	2 weeks	copper chloride	E
Latymer and Cotes 1981	chicken	body weight	diet	3.43 weeks	copper sulfate	C
Smith 1969	chicken	body weight	diet	3.57 weeks	copper sulfate	C
Wang et al. 1987	chicken	body weight gain (Exp 2)	diet	2.86 weeks	copper sulfate	D
Wang et al. 1987	chicken	body weight gain (Exp 1)	diet	2.86 weeks	copper sulfate	D

Tier 1

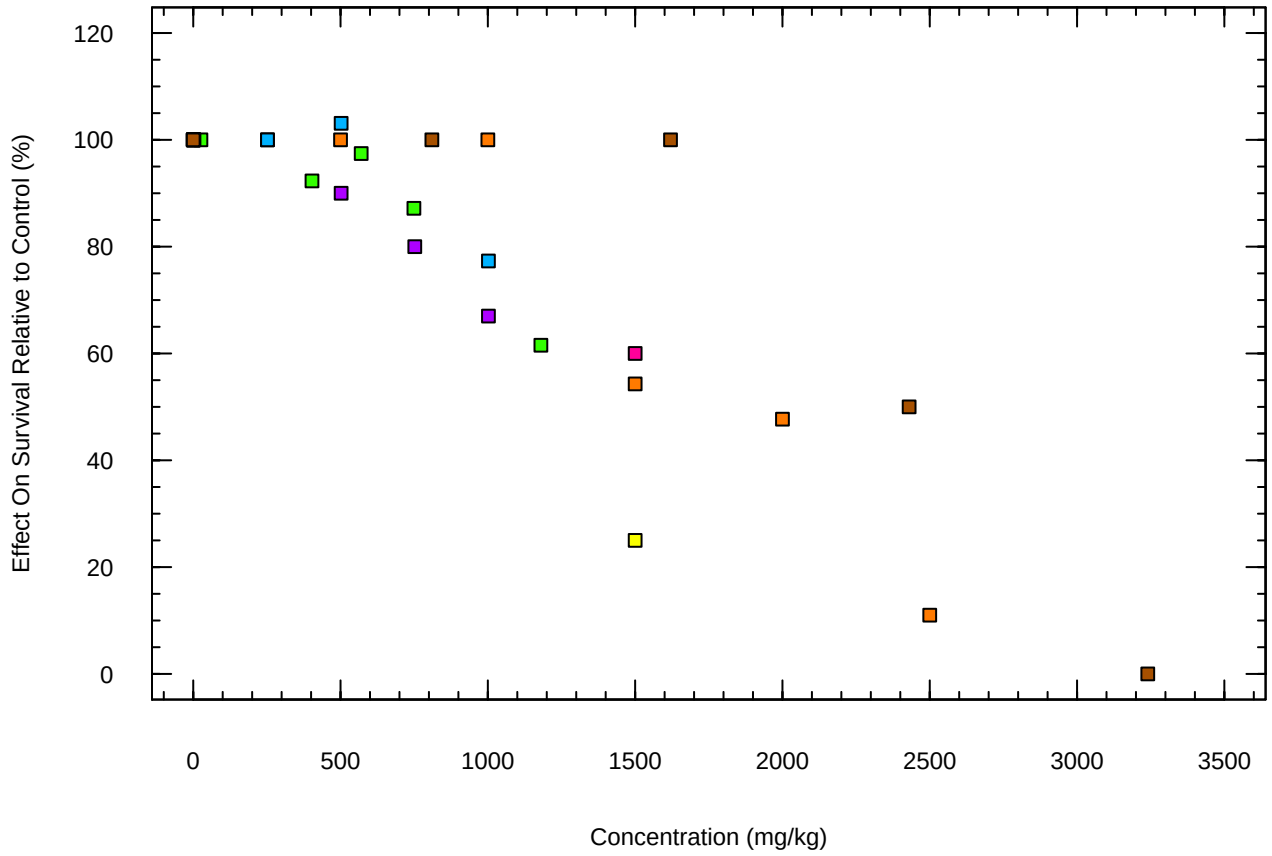
Figure 4−63. Concentration−Response Data for the Avian Growth Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Al Ankari et al. 1998	chicken	egg production	diet	12 weeks	copper sulfate/acetate	
Balevi and Coskun 2004	chicken	egg production	diet	4−9 weeks	copper sulfate	A
Chiou et al. 1997	chicken	egg production	diet	4 weeks	copper sulfate	A
Jackson and Stevenson 1981a	chicken	egg production (breed 1)	diet	40 weeks	copper sulfate	B
Jackson and Stevenson 1981a	chicken	egg production (breed 2)	diet	40 weeks	copper sulfate	B
Jackson and Stevenson 1981b	chicken	egg production (breed 1)	diet	48 weeks	copper sulfate	B
Jackson and Stevenson 1981b	chicken	egg production (breed 2)	diet	48 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production (breed 1)	diet	32 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production (breed 2)	diet	32 weeks	copper sulfate	B
Jackson et al. 1979	chicken	egg production	diet	48 weeks	copper sulfate	B
Harms and Buresh 1986	chicken	egg production (Exp 3)	diet	6 weeks	copper sulfate	A
Lien et al. 2004	chicken	egg production	diet	4 weeks	copper sulfate	A
Stevenson et al. 1983	chicken	egg production	diet	0.714 weeks	copper sulfate	
Pearce et al. 1983	chicken	egg production	diet	6.86 weeks	copper sulfate	A
Stevenson and Jackson 1980a	chicken	egg production	diet	6.86 weeks	copper sulfate	A
Stevenson and Jackson 1980b	chicken	egg production	diet	8 weeks	copper sulfate	A

Tier 1

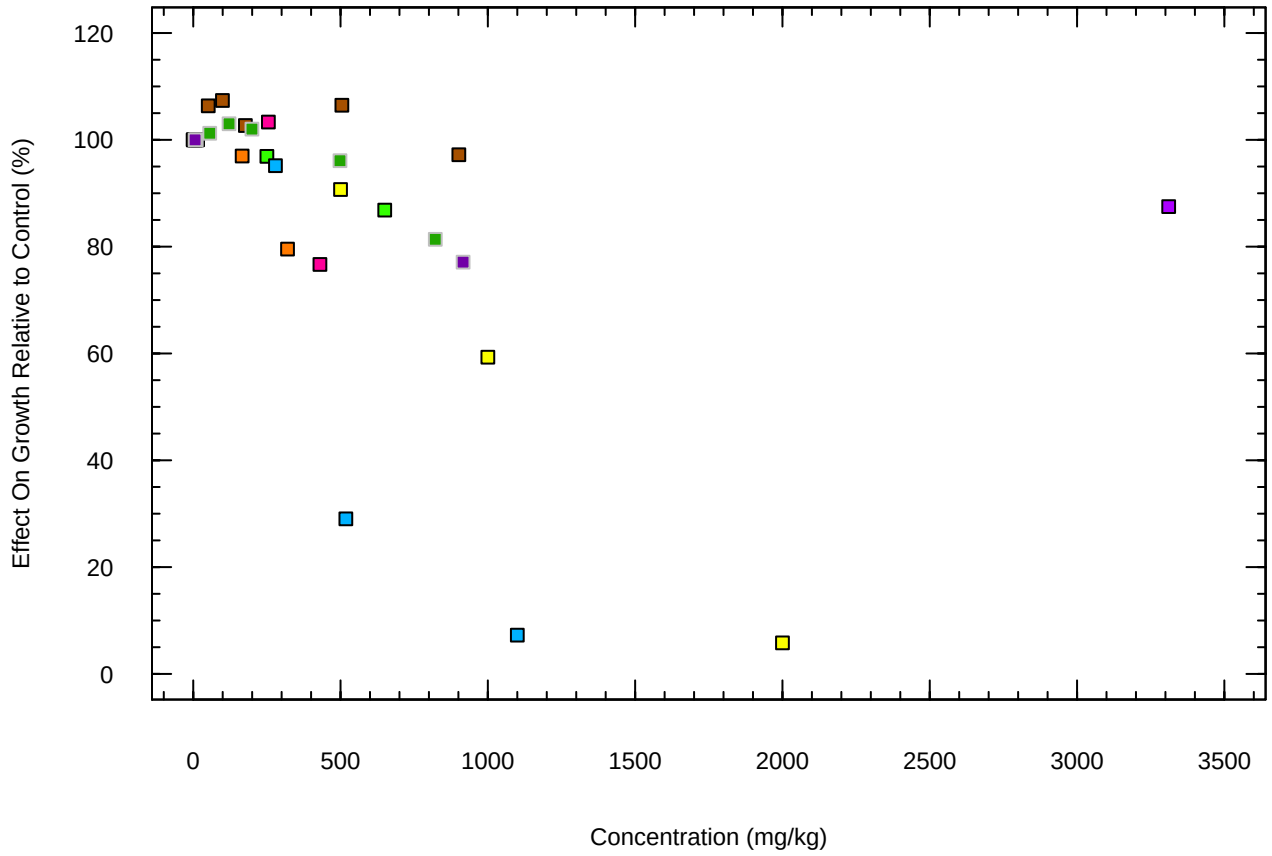
Figure 4−64. Concentration−Response Data for the Avian Reproduction Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill 1974a	chicken	survival	diet	2 weeks	copper sulfate	G
Mehring et al. 1960	chicken	survival	diet	10 weeks	copper oxide	
Poupoulis and Jensen 1976	chicken	survival (Exp 2)	diet	4 weeks	copper sulfate	G
Poupoulis and Jensen 1976	chicken	survival (Exp 5)	diet	4 weeks	copper sulfate	G
Van Vleet et al. 1981	Pekin duck	survival	diet	4 weeks	copper sulfate	F
Van Vleet et al. 1981	Pekin duck	survival	diet	2.14 weeks	copper sulfate	F
Vohra and Kratzer 1968	turkey	survival	diet	3 weeks	copper sulfate	

Tier 1

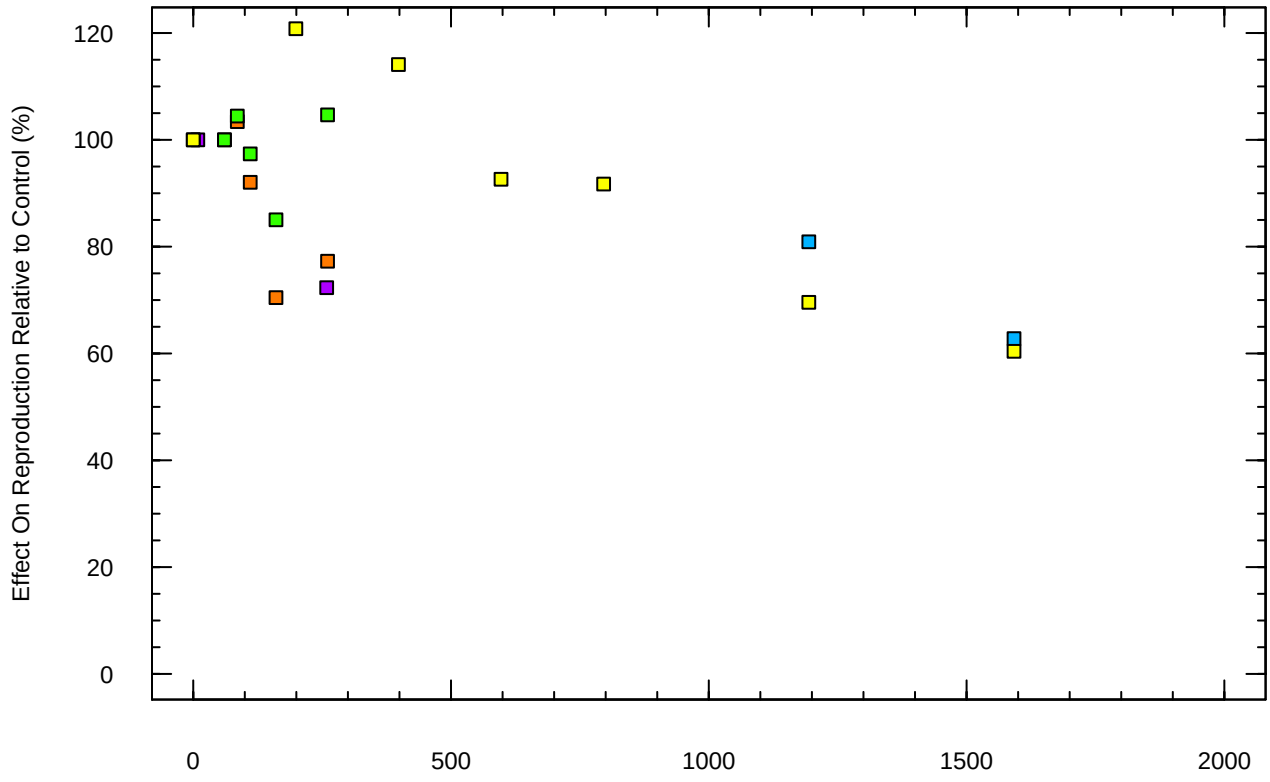
Figure 4−65. Concentration−Response Data for the Avian Survival Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Brandt 1983	mink	body weight	diet	~12 weeks	copper sulfate	
Edmonds and Baker 1986	pig	body weight (Exp 3)	diet	4 weeks	copper sulfate	
Petterson et al. 2002	mouse	body weight	diet	3 weeks	copper chloride	
Allcroft et al. 1961	pig	body weight gain	diet	21 weeks	copper sulfate	
Boyden et al. 1938	rat	body weight gain	diet	4 weeks	copper sulfate	
Suttle and Mills 1966	pig	body weight (Exp 2)	diet	5.71 weeks	copper sulfate	
Grobner et al. 1986	rabbit	body weight (Exp 2)	diet	4 weeks	copper sulfate	
Grobner et al. 1986	rabbit	body weight (Exp 2)	diet	4 weeks	copper sulfate	
Llewellyn et al. 1985	rat	body weight	diet	21 weeks	copper acetate	

Tier 1

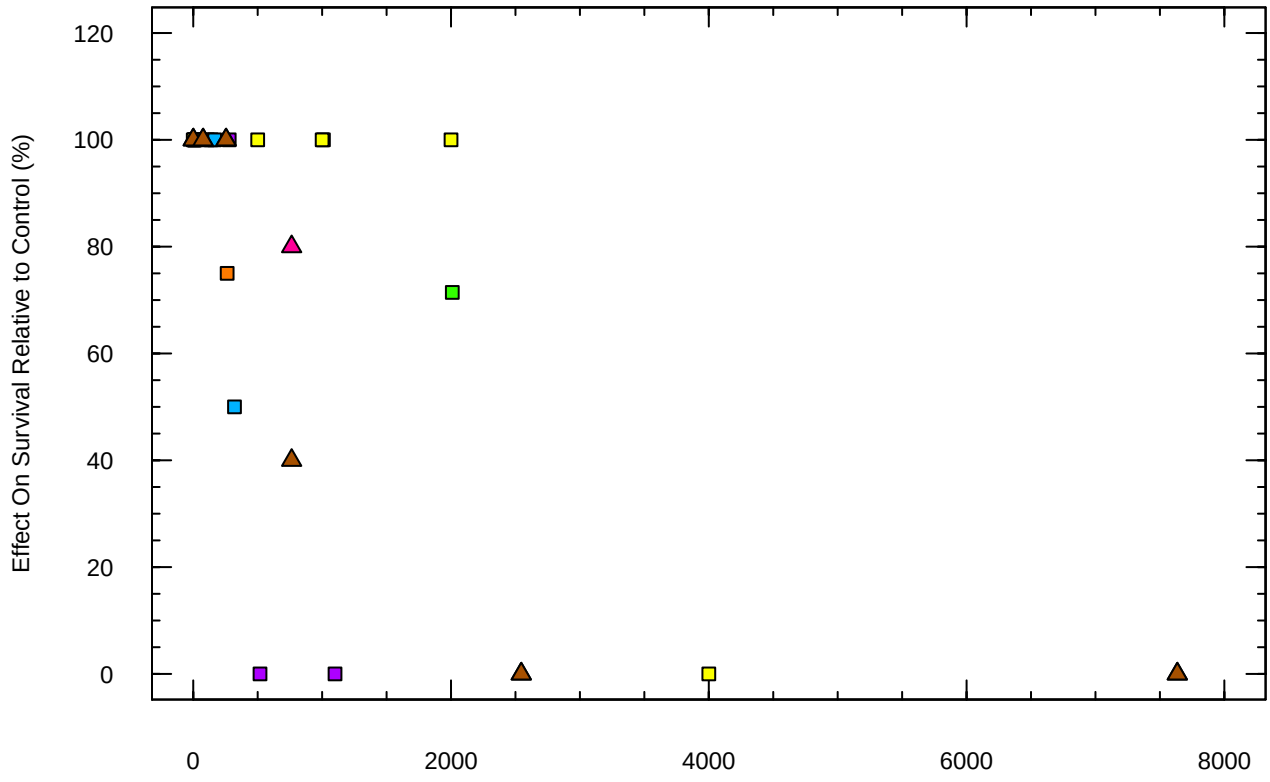
Figure 4−66. Concentration−Response Data for the Mammalian Growth Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Aulerich et al. 1982	mink	offspring survival	diet	20 weeks	copper sulfate	
Aulerich et al. 1982	mink	offspring growth	diet	20 weeks	copper sulfate	
Cromwell et al. 1993	pig	farrowing success	diet	2.1 years	copper sulfate	
Lecyk 1980	mouse	litter size (breed 1)	diet	7 weeks	copper sulfate	A
Lecyk 1980	mouse	litter size (breed 2)	diet	7 weeks	copper sulfate	A

Tier 1

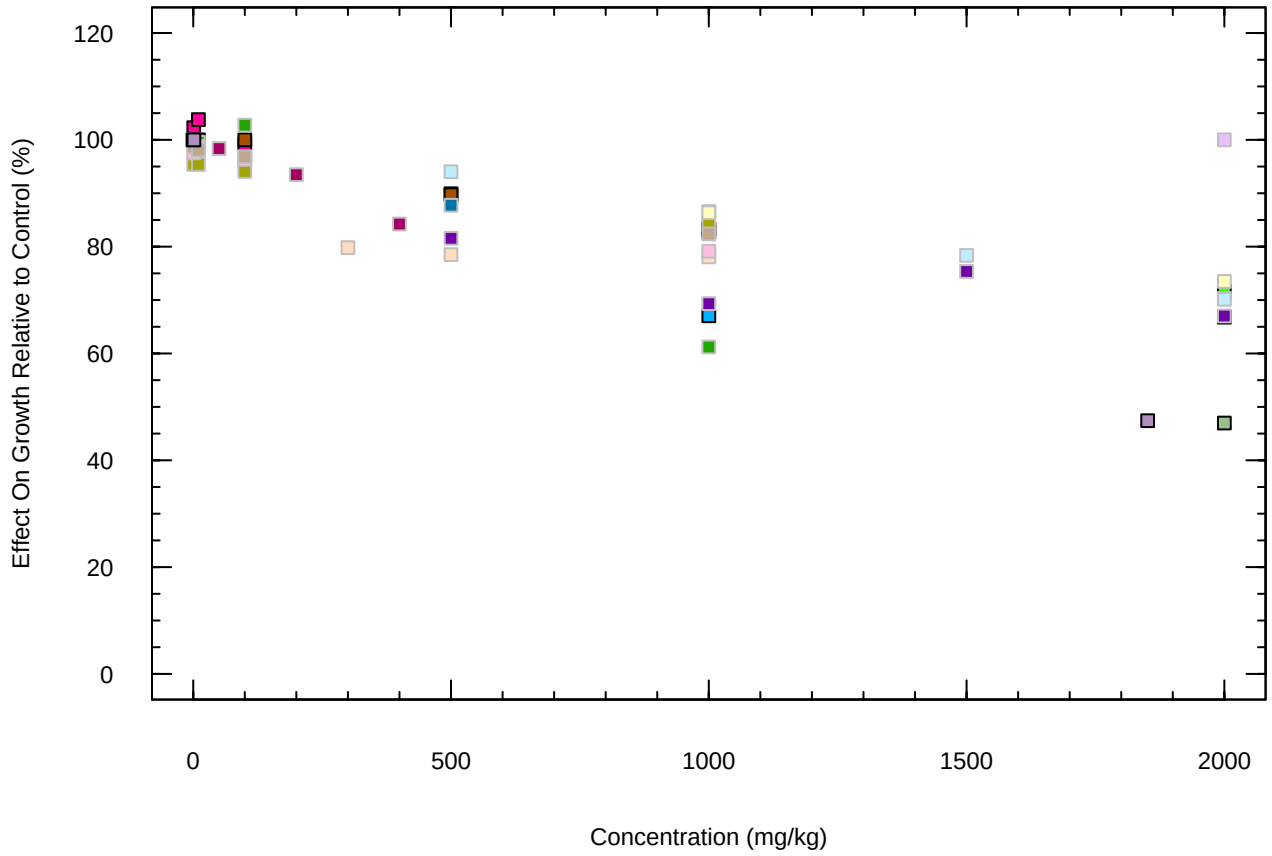
Figure 4−67. Concentration−Response Data for the Mammalian Reproduction Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Ritchie et al. 1963	pig	survival	diet	15 weeks	copper sulfate	B
Keen et al. 1982	rat	survival	diet	6.71 weeks	copper sulfate	
Allcroft et al. 1961	pig	survival	diet	21 weeks	copper sulfate	B
Brandt 1983	mink	survival	diet	~12 weeks	copper sulfate	
Boyden et al. 1938	rat	survival	diet	4 weeks	copper sulfate	
NTP 1993a	mouse	survival (male)	drinking water	2 weeks	copper sulfate	
NTP 1993a	mouse	survival (female)	drinking water	2 weeks	copper sulfate	

Tier 1 Tier 2

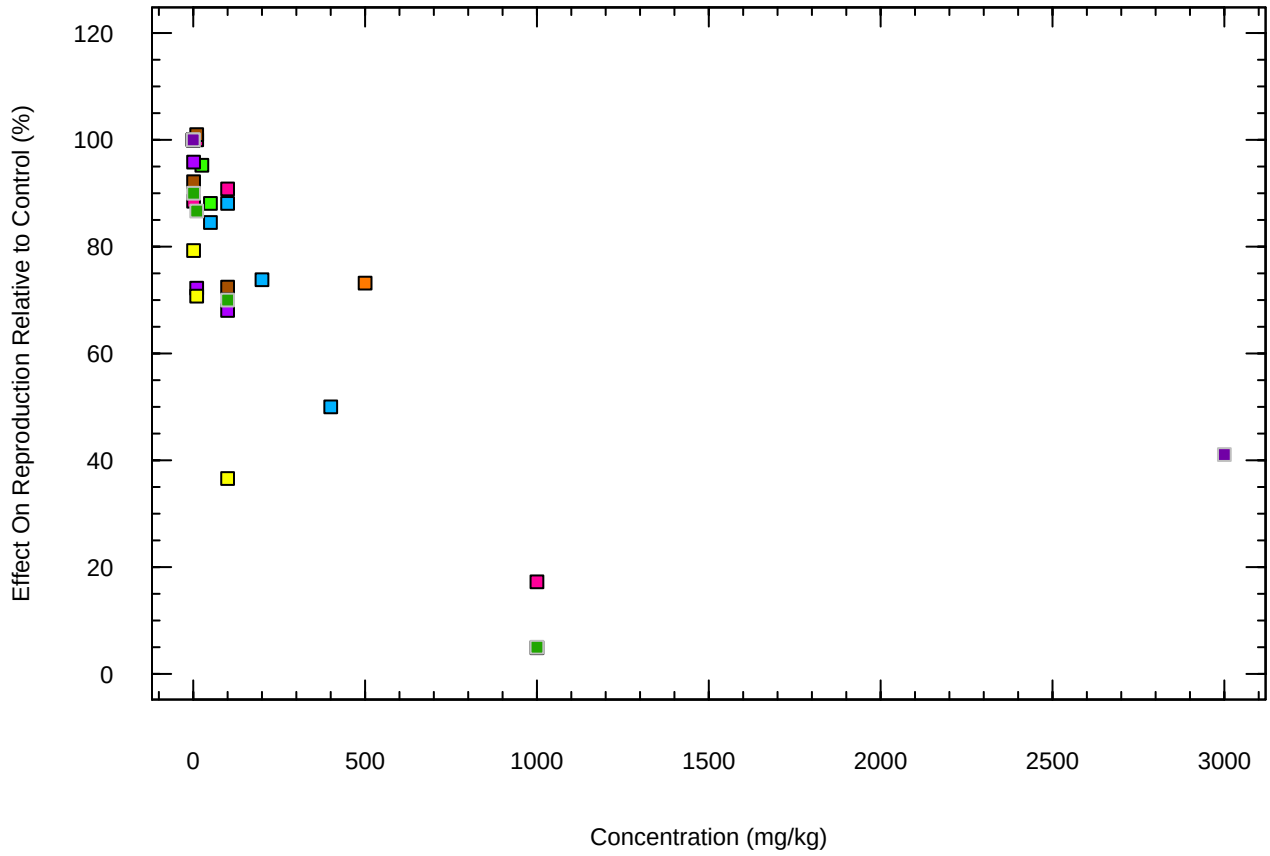
Figure 4−68. Concentration−Response Data for the Mammalian Survival Endpoint for Copper



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	body weight (breed 2)	diet	21 weeks	lead acetate	
Donaldson 1986	chicken	body weight (Exp 1)	diet	2.9 weeks	lead acetate trihydrate	A
Donaldson 1986	chicken	body weight (Exp 2)	diet	2.9 weeks	lead acetate trihydrate	A
Latta and Donaldson 1986	chicken	body weight gain	diet	2.7 weeks	lead acetate	
Leeming and Donaldson 1984	chicken	body weight gain	diet	2.71 weeks	lead acetate trihydrate	
Morgan et al. 1975	Japanese quail	body weight (Trial 1)	diet	5 weeks	lead acetate	
Morgan et al. 1975	Japanese quail	body weight (Trial 2)	diet	5 weeks	lead acetate	
Damron et al. 1969	chicken	body weight	diet	4 weeks	lead acetate	
Donaldson and McGowan 1989	chicken	body weight	diet	2.9 weeks	lead acetate trihydrate	A
Edens and Melvin 1989	Japanese quail	body weight (breed 1)	diet	21 weeks	lead acetate	
Edens and Melvin 1989	Japanese quail	body weight (female)	diet	15 weeks	lead acetate	
Edens and Garlich 1983	chicken	body weight	diet	10 weeks	lead acetate	
Abduljaleel & Shuhaimi−Othman 2013	chicken	body weight	diet	4 weeks	lead nitrate	
Berg et al. 1980	chicken	body weight (Exp 1)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 1)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 2)	diet	2 weeks	lead carbonate	C
Berg et al. 1980	chicken	body weight (Exp 3)	diet	2 weeks	lead carbonate	C
Edens et al. 1976	Japanese quail	body weight	diet	12 weeks	lead acetate	B
Edens 1985	Japanese quail	body weight	diet	12 weeks	lead acetate	B
Cupo and Donaldson 1988	chicken	body weight	diet	3 weeks	lead acetate	C
Franson and Custer 1982	chicken	body weight	diet	4 weeks	lead acetate	C

Tier 1

Figure 4−69. Concentration−Response Data for the Avian Growth Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Edens and Melvin 1989	Japanese quail	egg production	diet	21 weeks	lead acetate	
Edens and Garlich 1983	chicken	egg production (Exp 1)	diet	4 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 2)	diet	5 weeks	lead acetate	D
Edens and Garlich 1983	chicken	egg production (Exp 3)	diet	10 weeks	lead acetate	
Edens and Garlich 1983	Japanese quail	egg production (Exp 4)	diet	5 weeks	lead acetate	D
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Edens et al. 1976	Japanese quail	egg hatchability	diet	12 weeks	lead acetate	
Edens et al. 1976	Japanese quail	egg production	diet	12 weeks	lead acetate	E
Stone and Soares 1976	Japanese quail	egg production	diet	3.86 weeks	lead acetate	D

Tier 1

Figure 4−70. Concentration−Response Data for the Avian Reproduction Endpoint for Lead

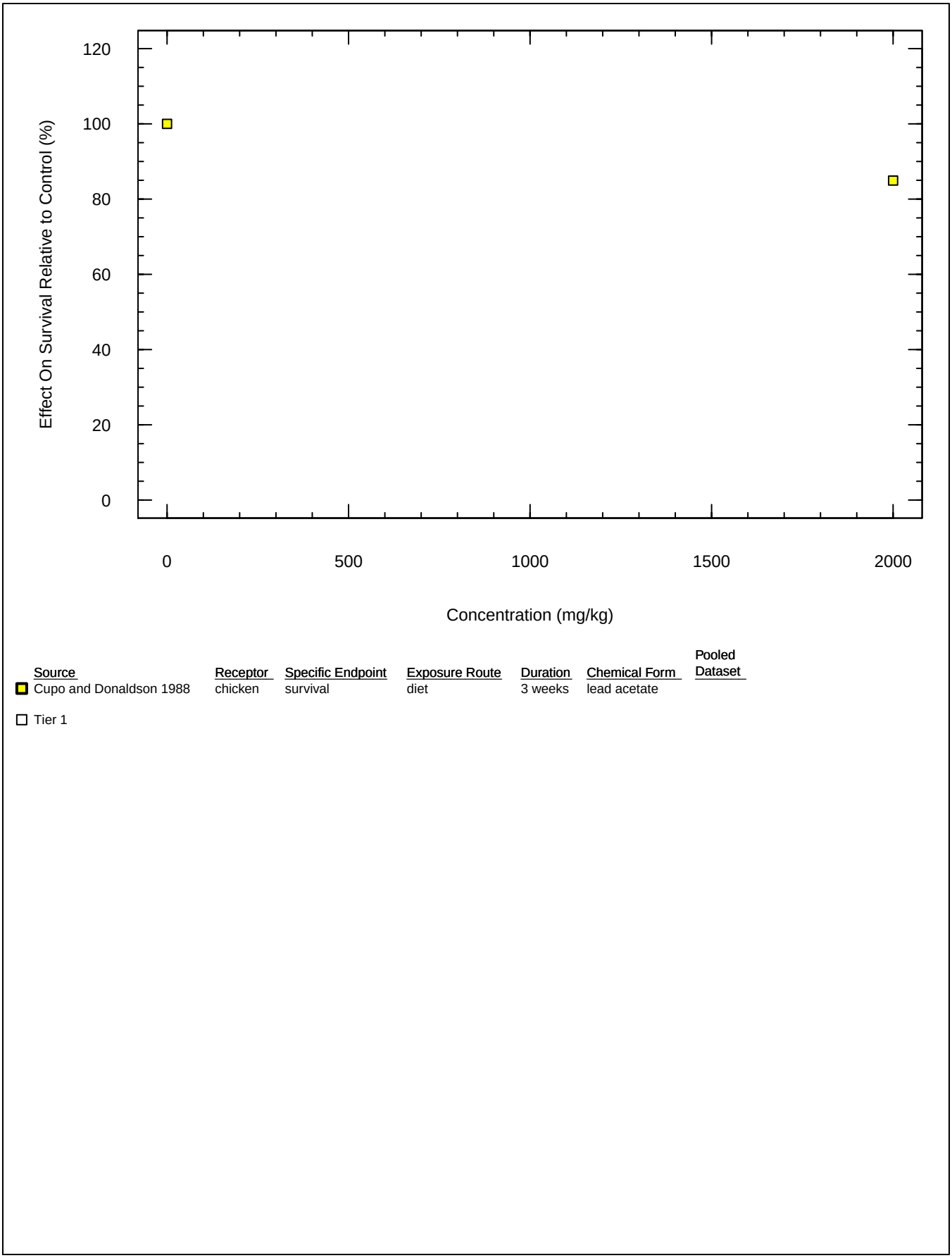
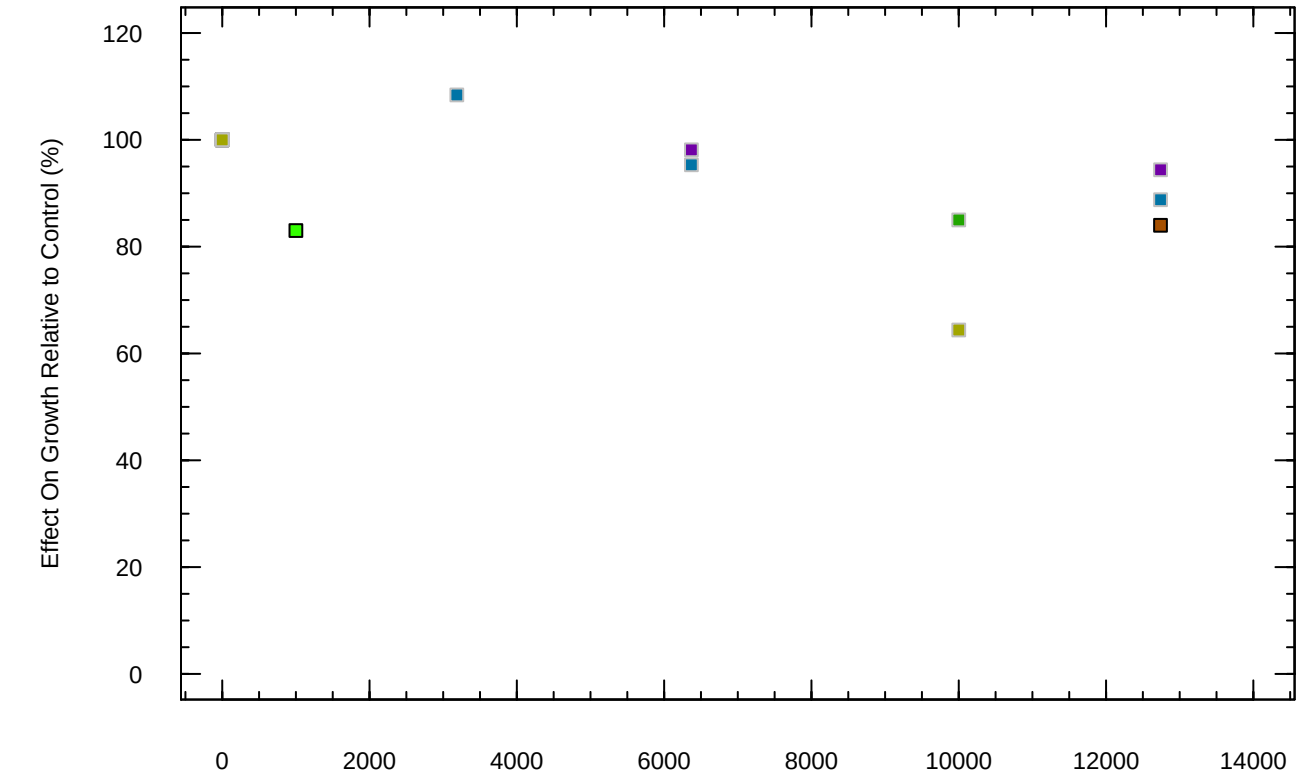


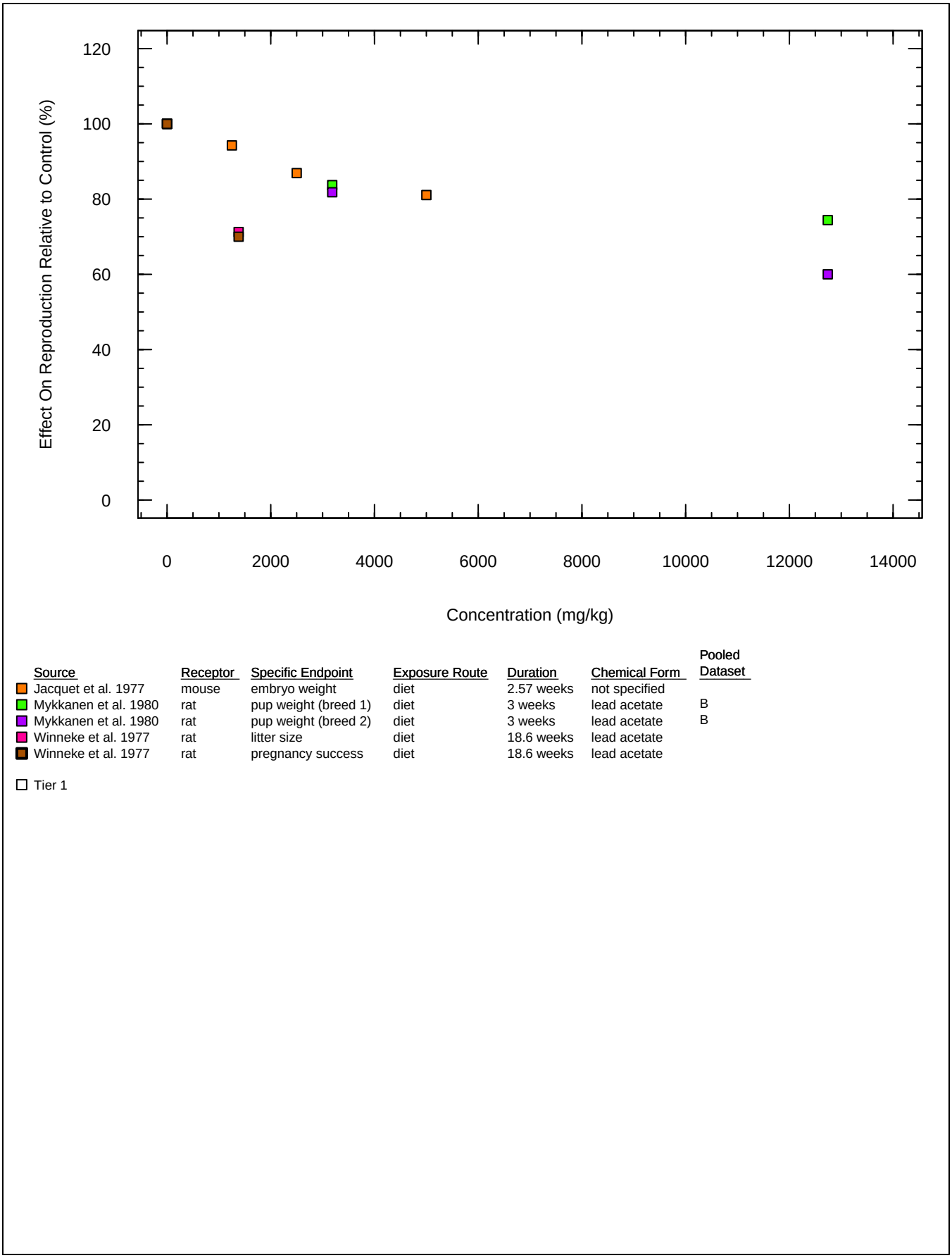
Figure 4−71. Concentration−Response Data for the Avian Survival Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hsu et al. 1975	pig	body weight	diet	13 weeks	lead acetate	
Barlow et al. 1977	rat	maternal body weight	diet	3 weeks	lead acetate	
Maker et al. 1973	mouse	body weight	diet	4.29 weeks	lead carbonate	
Mykkanen et al. 1980	rat	weight gain	diet	3 weeks	lead acetate	
Mykkanen et al. 1980	rat	weight gain	diet	3 weeks	lead acetate	
Gerber et al. 1978	rat	body weight	diet	52 weeks	lead acetate	

Tier 1

Figure 4−72. Concentration−Response Data for the Mammalian Growth Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Jacquet et al. 1977	mouse	embryo weight	diet	2.57 weeks	not specified	
Mykkanen et al. 1980	rat	pup weight (breed 1)	diet	3 weeks	lead acetate	B
Mykkanen et al. 1980	rat	pup weight (breed 2)	diet	3 weeks	lead acetate	B
Winneke et al. 1977	rat	litter size	diet	18.6 weeks	lead acetate	
Winneke et al. 1977	rat	pregnancy success	diet	18.6 weeks	lead acetate	

Tier 1

Figure 4−73. Concentration−Response Data for the Mammalian Reproduction Endpoint for Lead

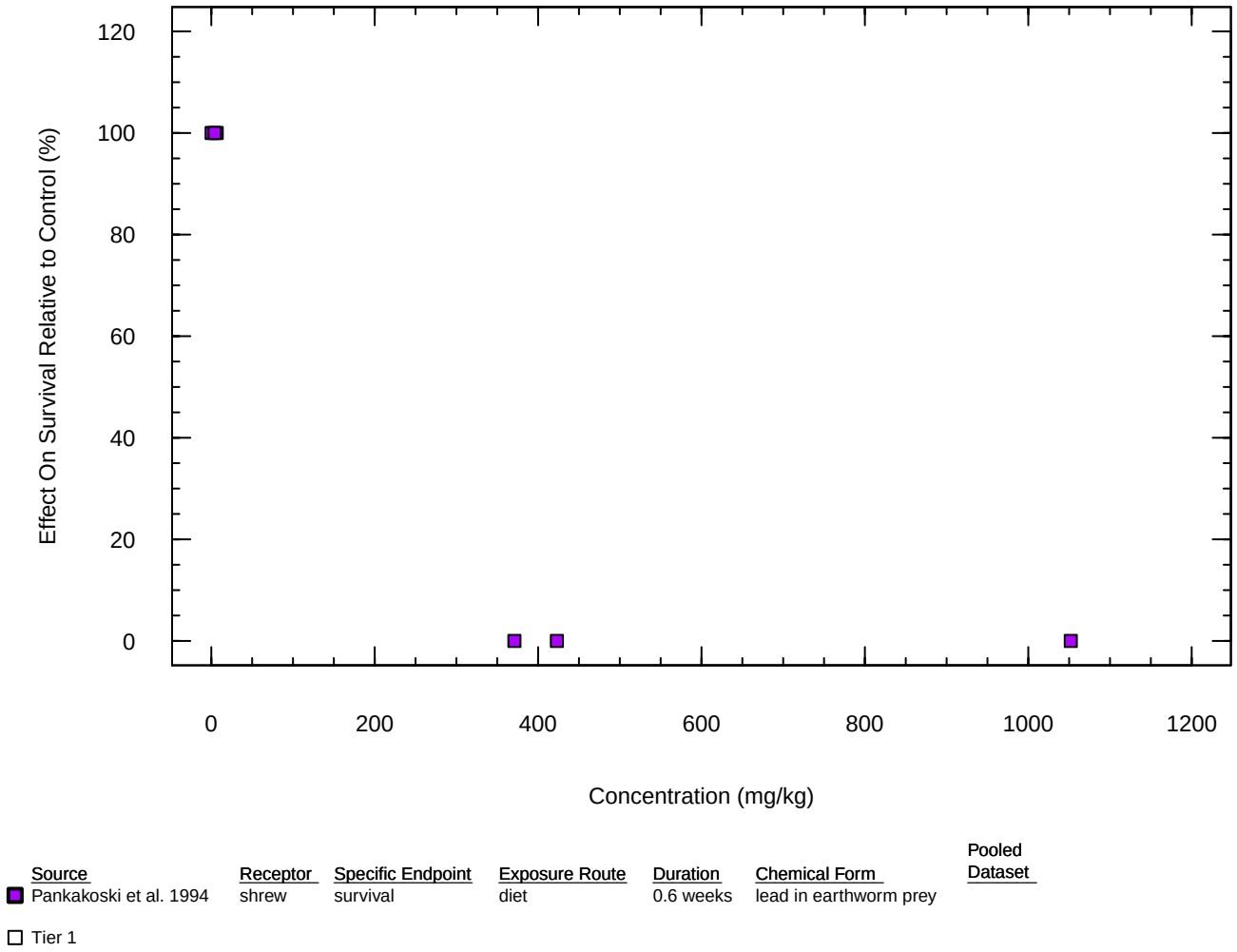
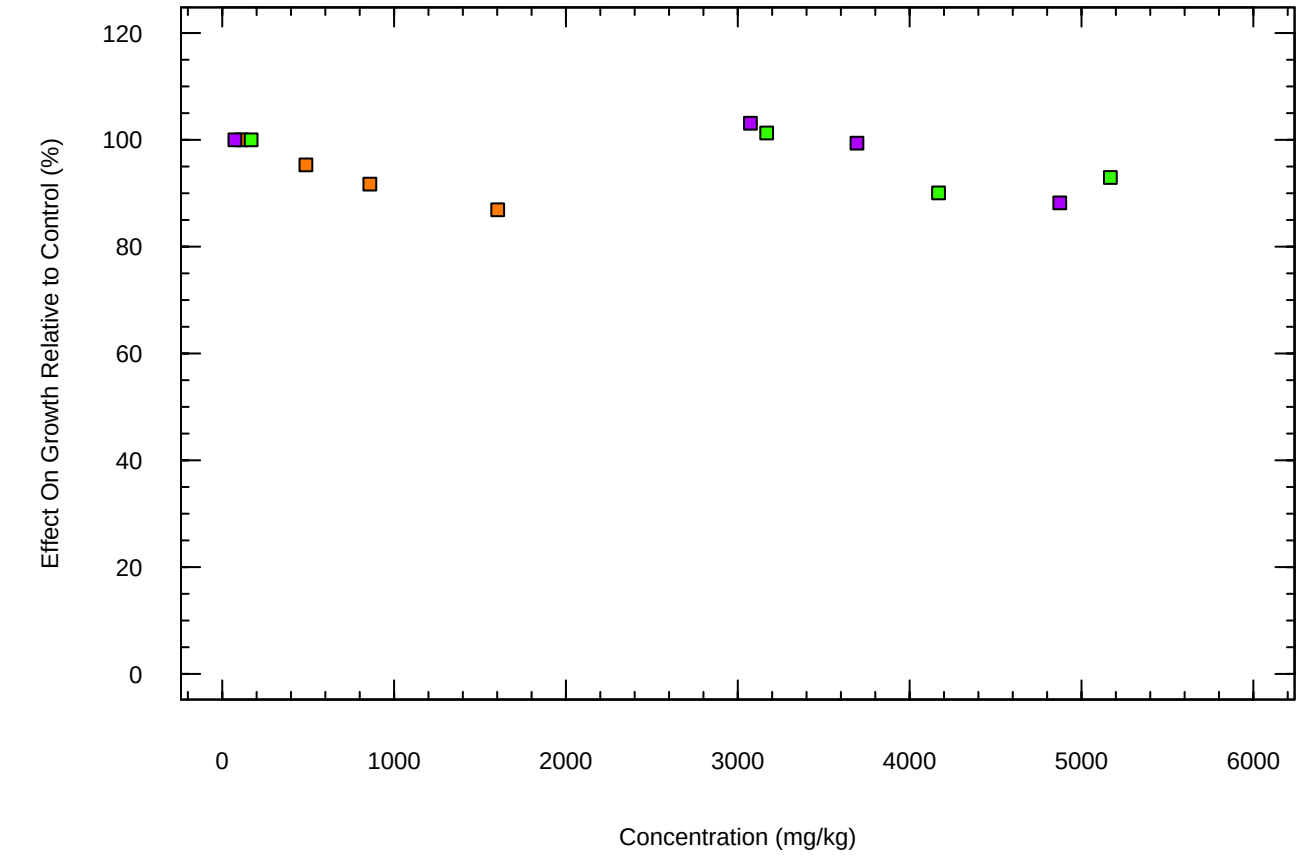


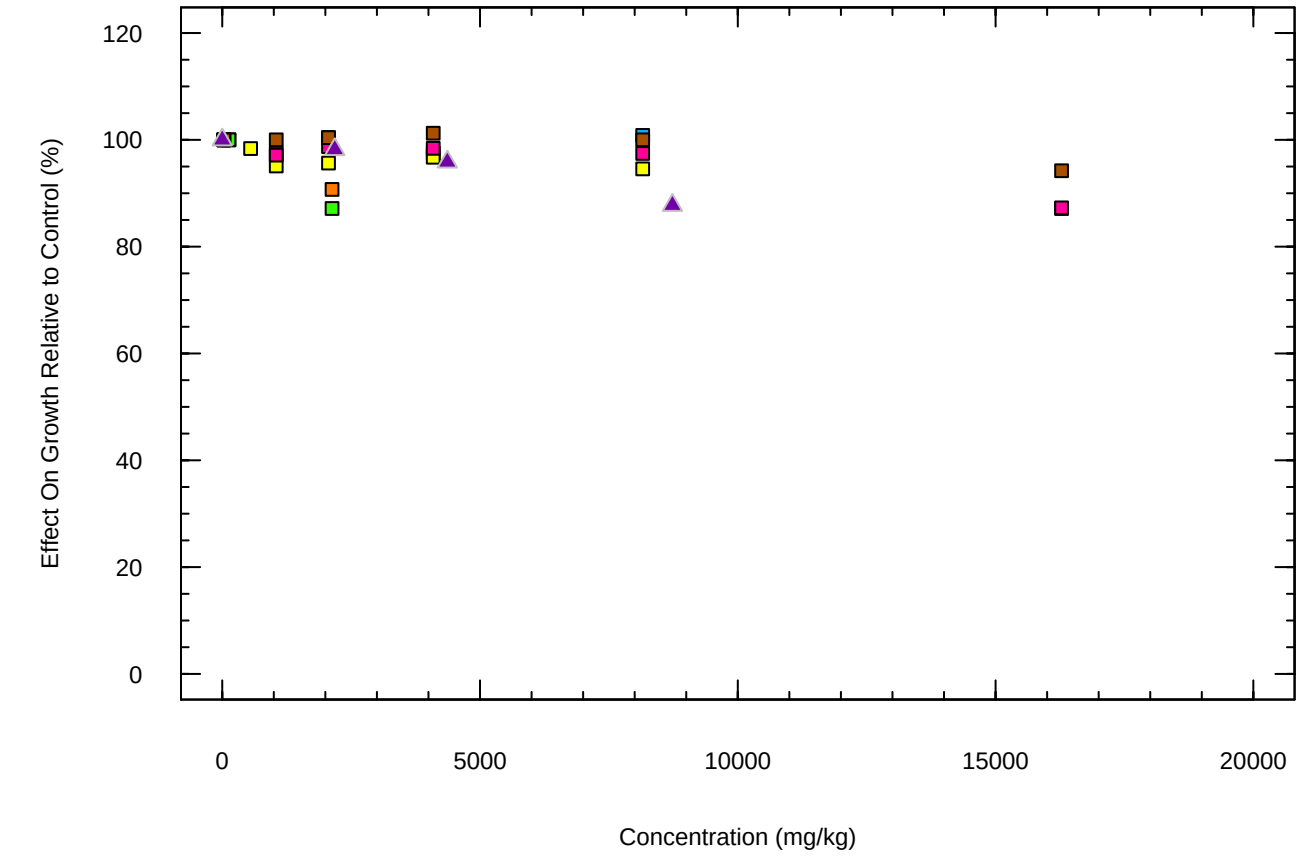
Figure 4−74. Concentration−Response Data for the Mammalian Survival Endpoint for Lead



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Martinez and Diaz 1996	chicken	body weight	diet	6 weeks	manganese oxide	
Southern and Baker 1983	chicken	body weight	diet	2 weeks	manganese chloride	
Vohra and Kratzer 1968	turkey	body weight gain	diet	3 weeks	manganese sulfate	

Tier 1

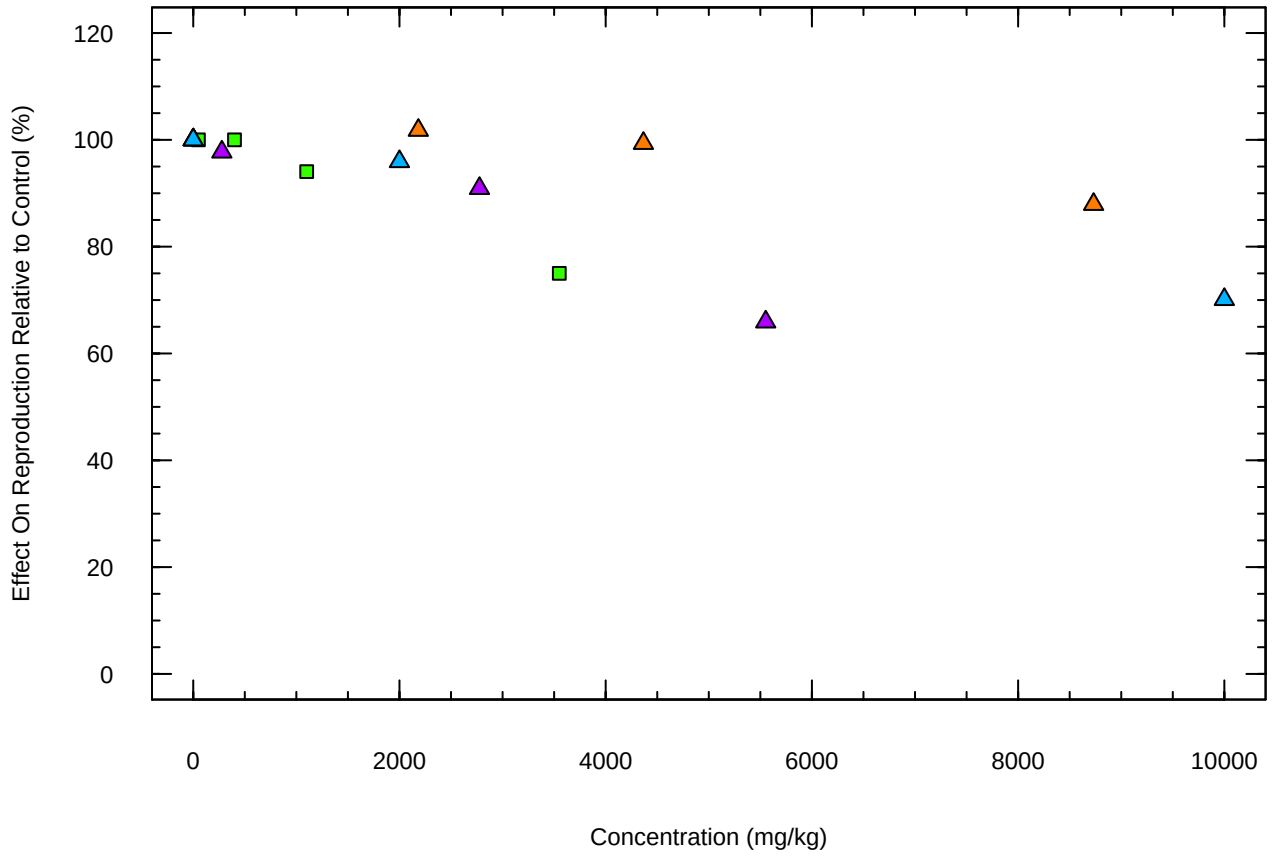
Figure 4−75. Concentration−Response Data for the Avian Growth Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Komura and Sakomoto 1991	mouse	body weight	diet	12.9 weeks	manganese acetate	
Komura and Sakomoto 1991	mouse	body weight	diet	12.9 weeks	manganese chloride	
NTP 1993b	rat	body weight (male)	diet	2 weeks	manganese sulfate	
NTP 1993b	rat	body weight (female)	diet	13 weeks	manganese sulfate	
NTP 1993b	mouse	body weight (male)	diet	13 weeks	manganese sulfate	
NTP 1993b	mouse	body weight (female)	diet	13 weeks	manganese sulfate	
Kontur and Fechter 1985	rat	body weight	drinking water	3 weeks	manganese chloride	

Tier 1 Tier 2

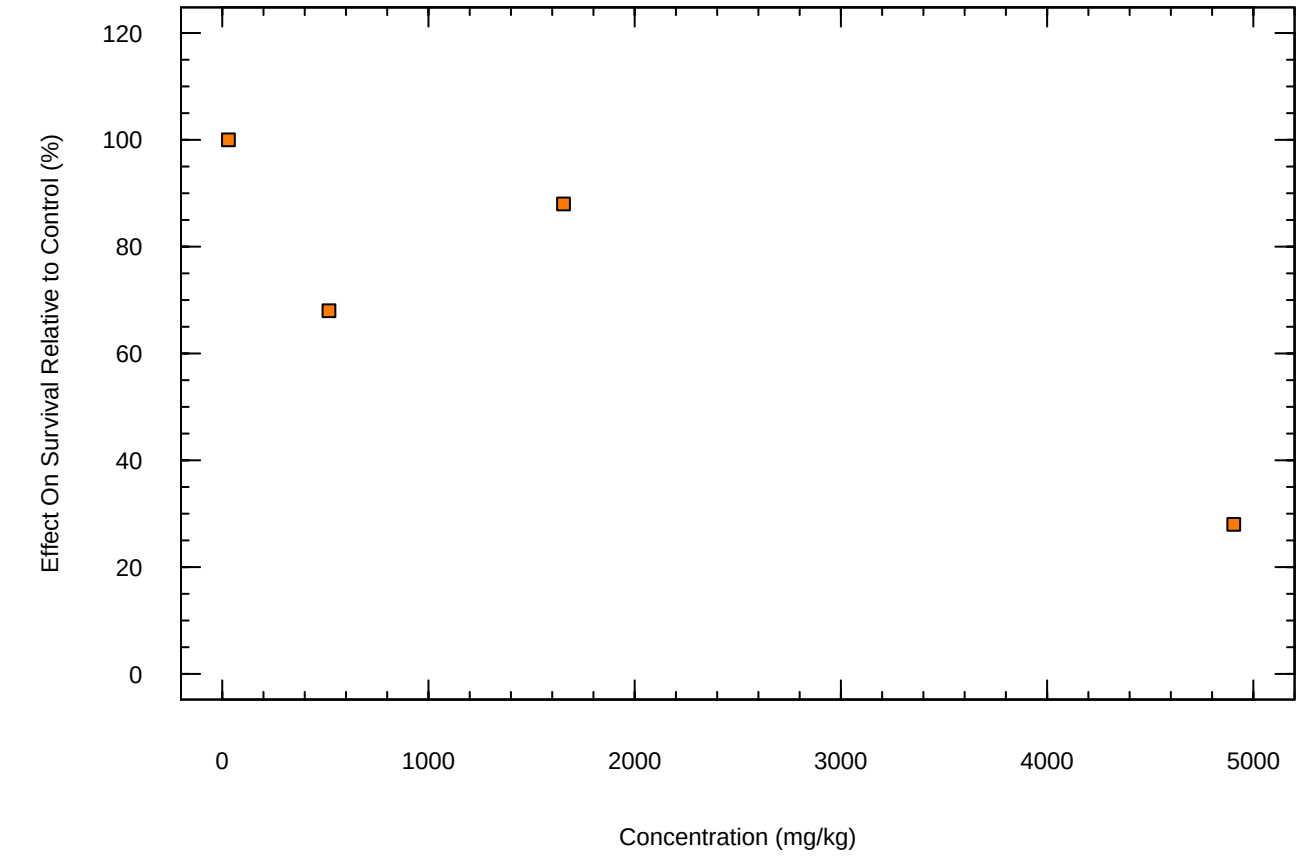
Figure 4−76. Concentration−Response Data for the Mammalian Growth Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Kontur and Fechter 1985	rat	litter size	drinking water	3 weeks	manganese chloride	
Laskey et al. 1982	rat	pregnancy success	diet	gestation to 32 weeks	manganese oxide	
Leung et al. 1982	rat	offspring body weight	drinking water	3.71 weeks	manganese chloride	A
Pappas et al. 1997	rat	offspring body weight	drinking water	gestation to post−natal day 30	manganese chloride	A

Tier 1 Tier 2

Figure 4−77. Concentration−Response Data for the Mammalian Reproduction Endpoint for Manganese

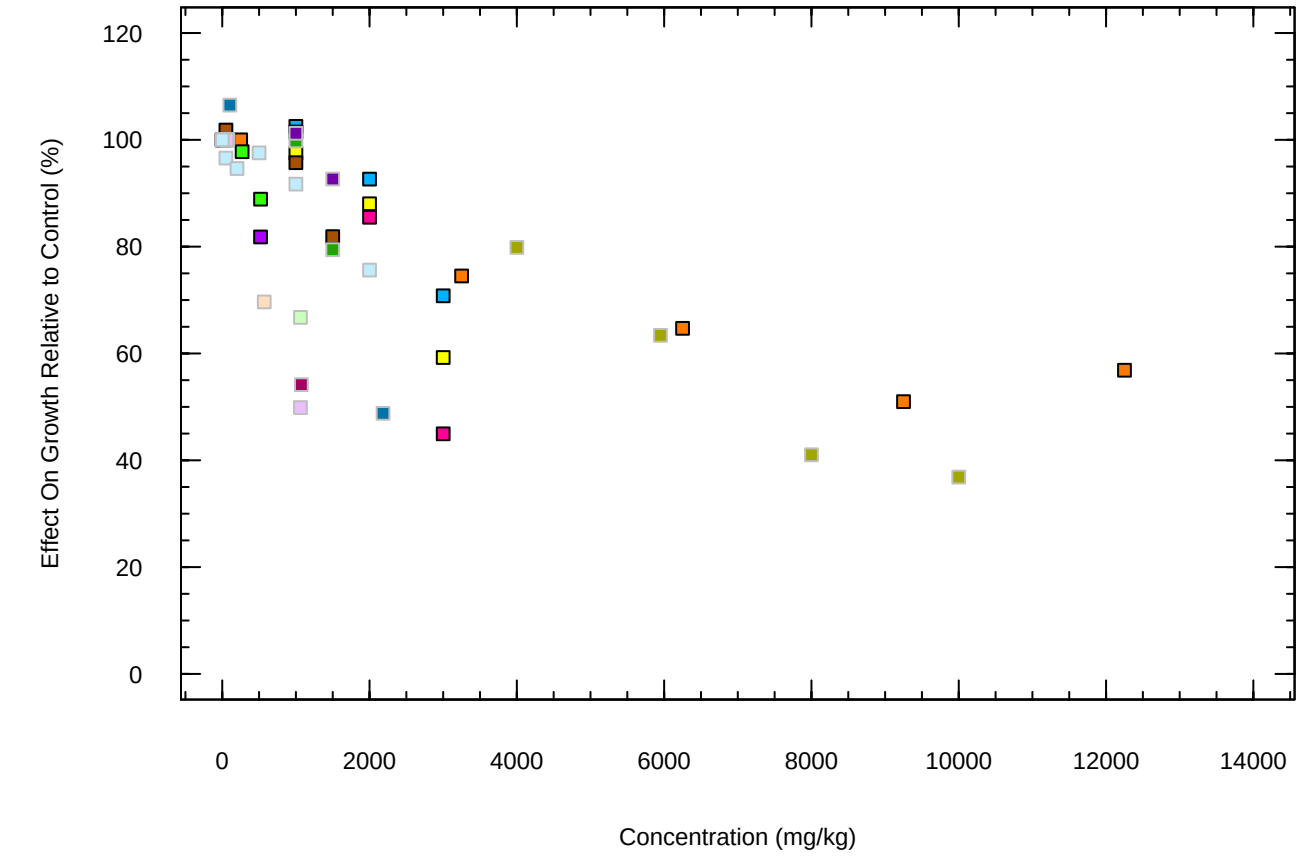


Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
NTP 1993b	rat	suvival (male)	diet	2 years	manganese sulfate	

Tier 1

* Survival at this dose was not significantly different from the control

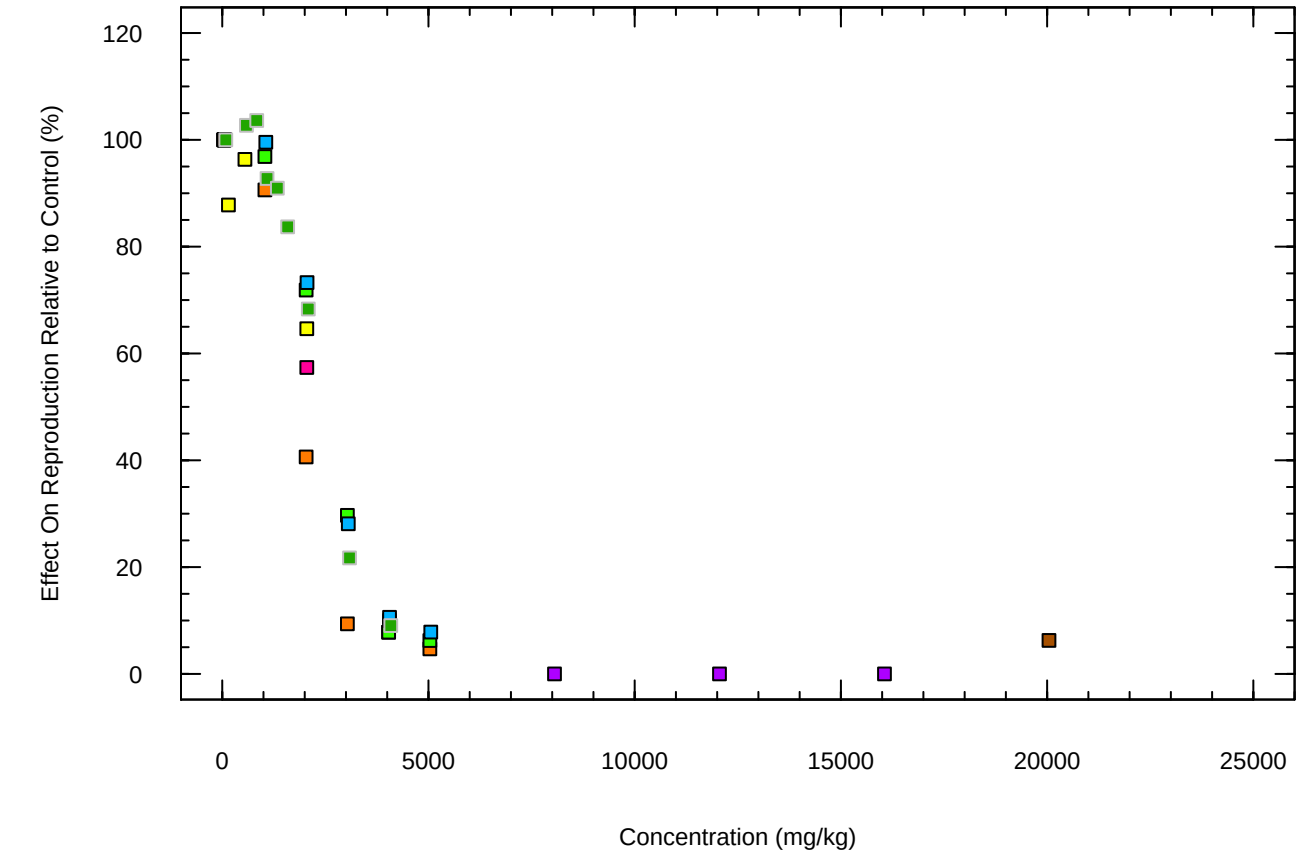
Figure 4−78. Concentration−Response Data for the Mammalian Survival Endpoint for Manganese



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Gasaway and Buss 1972	mallard	body weight gain	diet	5.71 weeks	zinc carbonate	
Hamilton et al. 1981	Japanese quail	body weight (Exp 2)	diet	2 weeks	zinc carbonate	
Hamilton et al. 1981	Japanese quail	body weight (Exp 5)	diet	2 weeks	zinc carbonate	
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc oxide	D
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc sulfate	C
Roberson and Schaible 1960	chicken	body weight (Exp 2)	diet	4 weeks	zinc carbonate	B
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc sulfate	C
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc carbonate	B
Roberson and Schaible 1960	chicken	body weight (Exp 3)	diet	4 weeks	zinc oxide	D
Stahl et al. 1989	chicken	body weight gain	diet	3 weeks	zinc carbonate	
Vohra and Kratzer 1968	turkey	body weight gain	diet	3 weeks	zinc oxide	
Lu and Combs 1988	chicken	body weight gain (Exp 3)	diet	3 weeks	zinc oxide	A
Lu et al. 1990	chicken	body weight gain (Exp 1)	diet	1 weeks	zinc oxide	A
Sandoval et al. 1988	chicken	body weight gain (Exp 2)	diet	3 weeks	zinc sulfate	E
Sandoval et al. 1988	chicken	body weight gain (Exp 2)	diet	3 weeks	zinc gluconate	
Hill 1974a	chicken	body weight gain	diet	2 weeks	zinc sulfate	E

Tier 1

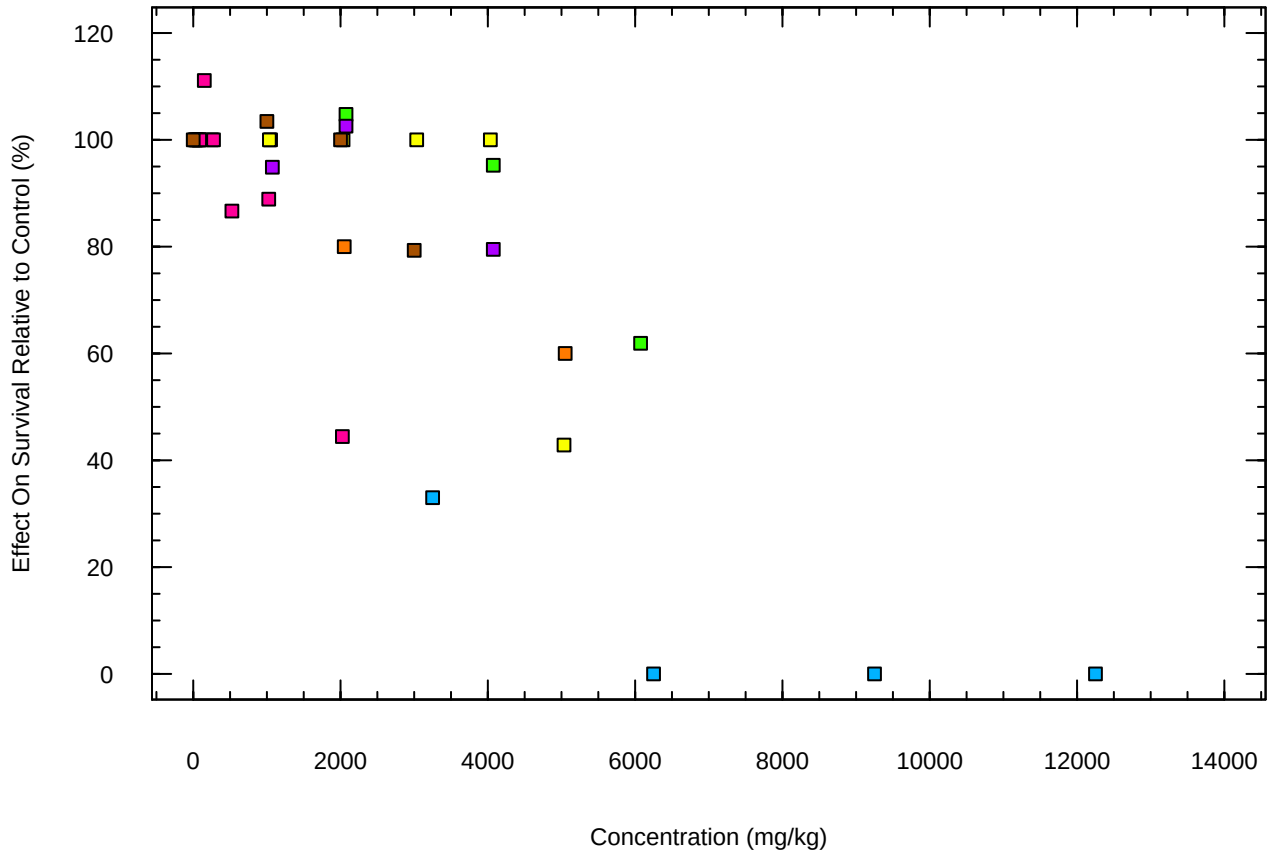
Figure 4−79. Concentration−Response Data for the Avian Growth Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc acetate dihydrate	
Gibson et al. 1986	chicken	egg production	diet	10 weeks	zinc oxide	
Jackson et al. 1986	chicken	egg production	diet	3 weeks	zinc oxide	
Jackson et al. 1986	chicken	egg production	diet	20 weeks	zinc oxide	F
Jensen and Maurice 1980	chicken	egg production (Exp 4)	diet	6 weeks	zinc sulfate	G
Jensen and Maurice 1980	chicken	egg production (Exp 3)	diet	6 weeks	zinc sulfate	G
Stepinska et al. 1987	chicken	egg production	diet	0.714 weeks	zinc oxide	
Stevenson et al. 1987	chicken	egg production	diet	20 weeks	zinc oxide	F

Tier 1

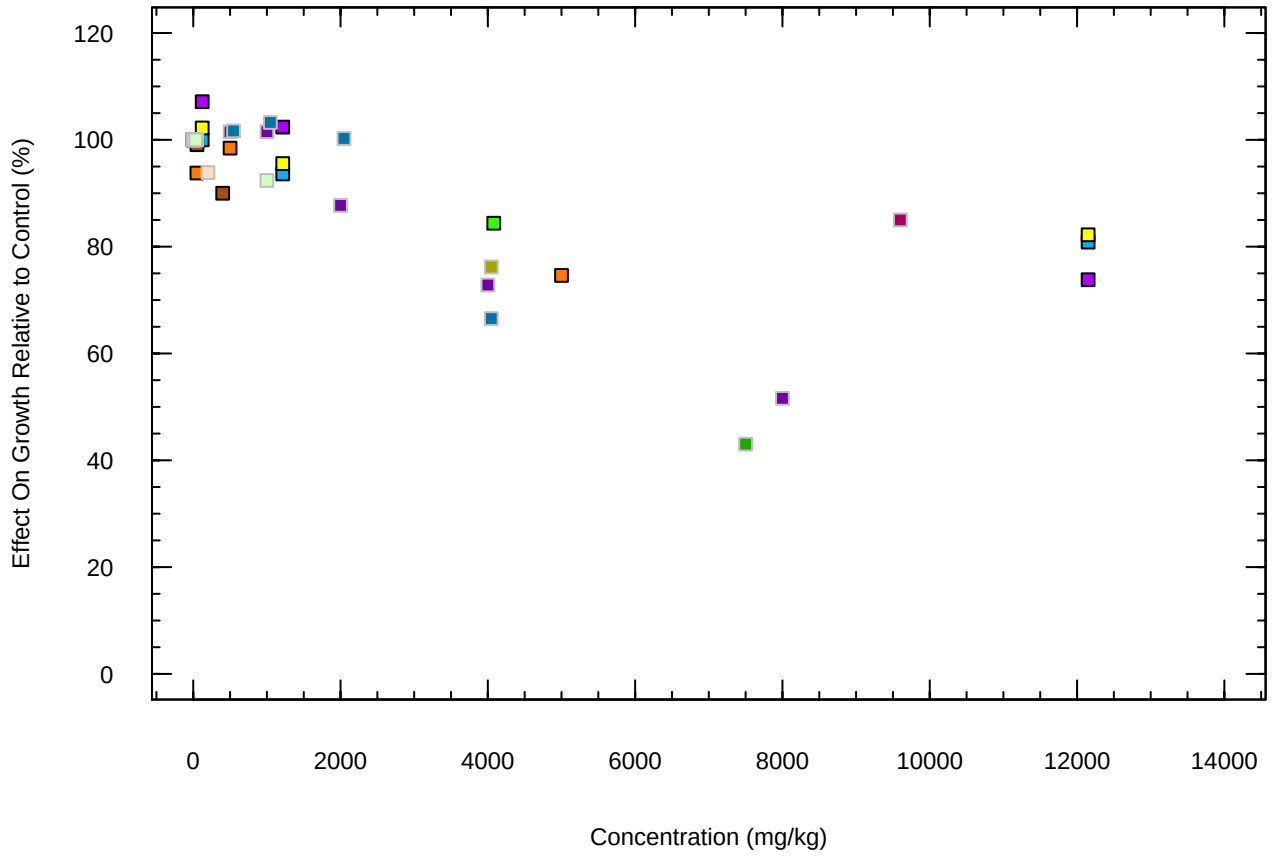
Figure 4−80. Concentration−Response Data for the Avian Reproduction Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Blalock and Hill 1988	chicken	survival	diet	2 weeks	zinc oxide	H
Dewar et al. 1983	chicken	survival (Exp 1)	diet	4 weeks	zinc oxide	
Dewar et al. 1983	chicken	survival (Exp 2)	diet	4 weeks	zinc oxide	H
Gasaway and Buss 1972	mallard	survival	diet	8.57 weeks	zinc carbonate	
Gibson et al. 1986	chicken	survival	diet	10 weeks	zinc acetate	
Hamilton et al. 1979	Japanese quail	survival	diet	2 weeks	zinc carbonate	
Roberson and Schaible 1960	chicken	survival (Exp 2)	diet	4 weeks	zinc carbonate	

Tier 1

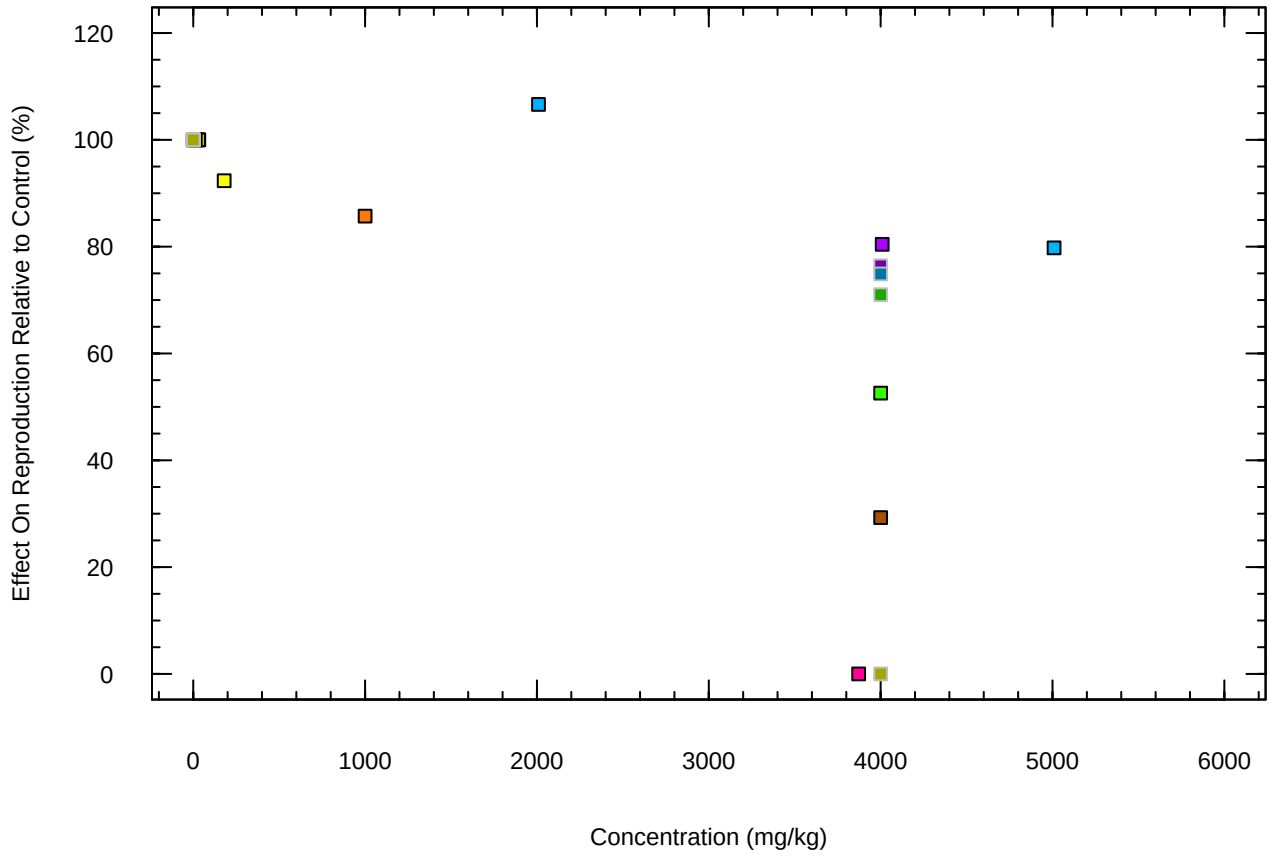
Figure 4−81. Concentration−Response Data for the Avian Survival Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Hill et al. 1983	pig	body weight	diet	to 18 months old	zinc oxide	
Hsu et al. 1975	pig	body weight	diet	9−13 weeks	zinc oxide	
Maita et al. 1981	mouse	body weight (female)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	mouse	body weight (male)	diet	13 weeks	zinc sulfate	
Maita et al. 1981	rat	body weight (male)	diet	13 weeks	zinc sulfate	
Subramanian et al. 2000	rat	body weight	diet	6 weeks	zinc oxide	
Settlemire and Matrone 1967	rat	body weight gain	diet	5 weeks	zinc carbonate	
Brink et al. 1959	pig	body weight (Exp 1)	diet	6 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 2)	diet	5 weeks	not specified	A
Brink et al. 1959	pig	body weight (Exp 3)	diet	6 weeks	not specified	A
Petterson et al. 2002	mouse	body weight	diet	3 weeks	zinc chloride	
Nakamura et al. 1983	rat	body weight	diet	11 weeks	zinc acetate	
Barone et al. 1998	rat	body weight	diet	gestation	not specified	

Tier 1

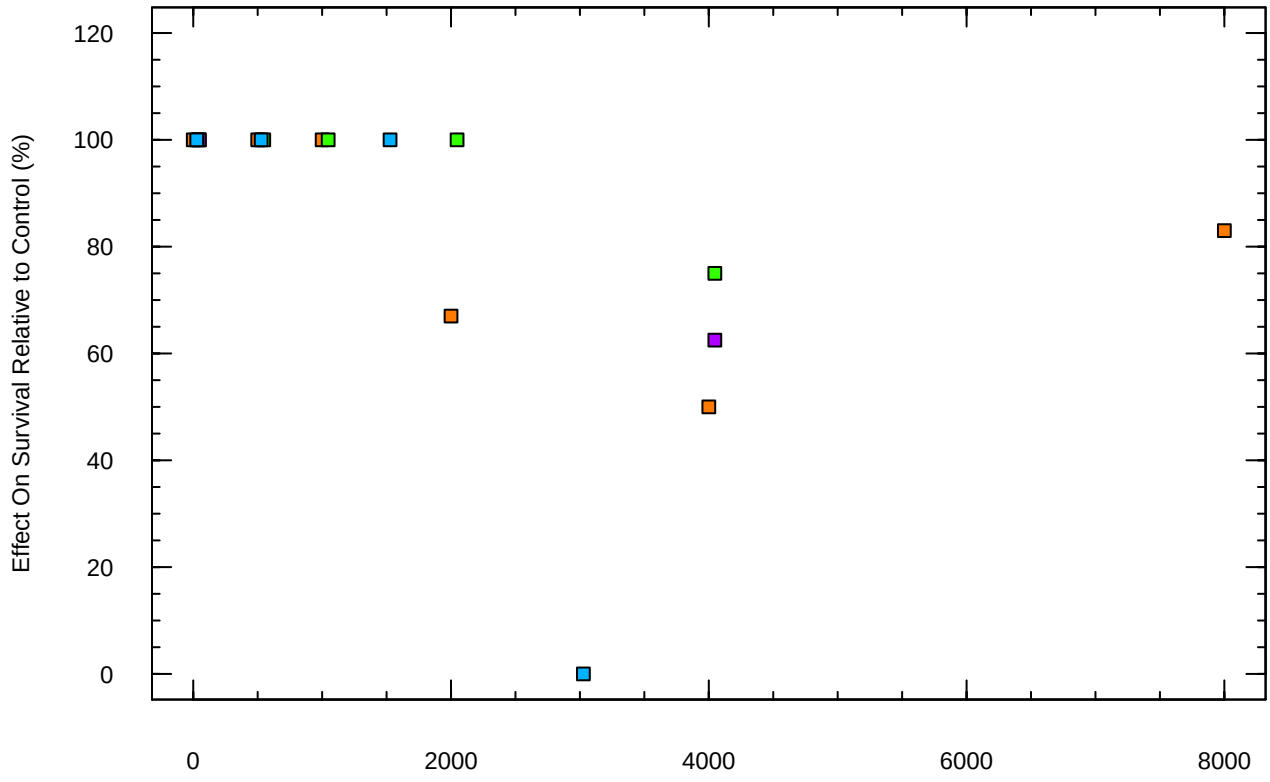
Figure 4−82. Concentration−Response Data for the Mammalian Growth Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Barone et al. 1998	rat	litter size	diet	gestation	not specified	
Chu and Cox 1972	rat	offspring growth	diet	3 weeks	not specified	
Cox et al. 1969	rat	fetal growth	diet	3.14 weeks	zinc oxide	B
Ketcheson et al. 1969	rat	offspring growth	diet	gestation to 14 days lactation	zinc oxide	
Kumar 1976	rat	fetal survival	diet	2.57 weeks	zinc sulfate	
Newman et al. 2002	rat	offspring survival	diet	gestation to post−natal day 40	zinc acetate dihydrate	
Pal and Pal 1987	rat	normal fetuses	diet	2.57 weeks	zinc sulfate	
Schlicker and Cox 1968	rat	fetal survival	diet	2.14 weeks	zinc oxide	C
Schlicker and Cox 1968	rat	fetal growth	diet	2.14 weeks	zinc oxide	B
Schlicker and Cox 1968	rat	fetal growth	diet	2.57 weeks	zinc oxide	B
Schlicker and Cox 1968	rat	fetal survival	diet	5.14 weeks	zinc oxide	C

Tier 1

Figure 4−83. Concentration−Response Data for the Mammalian Reproduction Endpoint for Zinc



Source	Receptor	Specific Endpoint	Exposure Route	Duration	Chemical Form	Pooled Dataset
Brink et al. 1959	pig	survival (Exp 1)	diet	6 weeks	zinc carbonate	D
Brink et al. 1959	pig	survival (Exp 2)	diet	5 weeks	zinc carbonate	D
Brink et al. 1959	pig	survival (Exp 3)	diet	6 weeks	zinc carbonate	D
Straube et al. 1980	ferret	survival	diet	2−24 weeks	zinc oxide	

Tier 1

Figure 4−84. Concentration−Response Data for the Mammalian Survival Endpoint for Zinc

TABLES

Table 2-1. Preliminary COPCs Selected for UCR Birds and Mammals

	Aquatic Wildlife		Terrestrial Wildlife	
Chemical[a]	Birds	Mammals	Birds	Mammals
Aluminum	✓	✓	ns	ns
Antimony	ns	✓	ns	✓
Arsenic	X	X	X	X
Barium	✓	✓	ns	X
Beryllium	ns	X	ns	X
Cadmium	✓	✓	✓	✓
Chromium	✓	✓	✓	✓
Cobalt	X	X	X	X
Copper	✓	✓	✓	✓
Iron	ns	ns	ns	ns
Lead	✓	✓	✓	✓
Manganese	✓	✓	X	X
Mercury	✓	✓	ns	ns
Molybdenum	✓	✓	ns	ns
Nickel	X	X	X	X
Selenium	✓	✓	✓	✓
Silver	X	X	X	X
Vanadium	✓	X	✓	X
Zinc	✓	✓	✓	✓

Notes:

Shaded cells indicate chemicals selected as (chemicals of potential concern) COPCs.

[a] COPCs for terrestrial and aquatic wildlife are based on comparison of doses based on upper confidence limits to no-observed-adverse-effect levels.

✓ - selected

X - not selected

ns - not screened

Table 3-1. Use of Effect Measures from Eco-SSL Documents for TRV Development

Effect Type	Effect Measure	Effect Measure Definition	Used for TRV Development?
Bird and Mammal Growth			
GRO	BDWT	body weight	yes
GRO	GGRO	general growth	yes
DVP	GDPV	general development	no[a]
MPH	GMPH	general morphology	no
MPH	MUSC	muscle changes	no
MPH	Other	NA	no
Bird and Mammal Survival			
MOR	LFSP	lifespan	yes
MOR	MORT	mortality	yes
MOR	SURV	survival	yes
Bird Reproduction			
REP	ALWT	albumin weight	no
REP	EGPN	egg production	yes
REP	EGWT	egg weight	no
REP	ESQU	eggshell quality	no
REP	ESTH	eggshell thickness	no
REP	ORWT	organ weight changes	no
REP	PROG	progeny counts/numbers	yes
REP	RHIS	reproductive organ histology	no
REP	SPCV	sperm cell viability	no
REP	TEDG	testes degeneration	no
REP	TEWT	testes weight	no
REP	TPRD	total production	yes
Mammal Reproduction			
REP	DEYO	death of young	yes
REP	FERT	fertility	yes
REP	GREP	general reproductive effect	yes[b]
REP	ODVP	offpsring development	no
REP	ORWT	organ weight changes	no
REP	Other	NA	no[c]
REP	PRFM	pregnant females in a population	no
REP	PROG	progeny counts/numbers	yes
REP	PRWT	progeny weight	yes
REP	RBEH	reproductive behavior	no
REP	RHIS	reproductive organ histology	no
REP	RPRD	reproductive capacity	no
REP	RSEM	resorbed embryos	yes
REP	RSUC	reproductive success	yes
REP	SPCL	sperm cell counts	no
REP	SPCV	sperm cell viability	no
REP	TEDG	testes degeneration	no
REP	TEWT	testes weight	no

Notes:

[a] Not used because response site was the eye.

[b] This endpoint was used with the exception of Baranski and Sitarek (1987) because the specific endpoint was oestrous duration.

[c] Not used because response site was the seminal vesicle.

DVP - development

Eco-SSL - ecological soil screening level

GRO - growth

MOR - mortality

MPH - morphology

NA - not applicable

REP - reproduction

TRV - toxicity reference value

Table 3-2. Juvenile Life Stages for Bird and Mammal Test Species

Test Species	Age at End of Juvenile Life Stage	Basis	Source
Birds			
Bobwhite quail	9 weeks	juvenal plumage fully developed	Brennan et al. 2014
Chicken	3 months	age at first egg	Podisi et al. 2011
Japanese quail	8 weeks	end of first juvenal plumage; sexual maturity	Ipek et al. 2004; Lyon 1962
Mallard	10 weeks	fledging (i.e., independent stage)	Drilling et al. 2002
Turkey	7.5 months	juvenile plumage fully developed; cessation of parental care	McRoberts et al. 2014
Wood duck	10 weeks	most birds flyng and juvenile plumage almost complete	Hepp and Bellrose 2013
Mammals			
Cat	240 days	sexual maturity	USEPA 1988
Dog	240 days	sexual maturity	USEPA 1988
Guinea pig	10 weeks	sexual maturity	USEPA 1988
Hamster	60 days	sexual maturity	USEPA 1988
Mink	300 days	sexual maturity	USEPA 1988
Mouse	50 days	sexual maturity	USEPA 1988
Pig	150 days	sexual maturity	USEPA 1988
Rabbit	4.5 months	sexual maturity	USEPA 1988
Rat	56 days	sexual maturity	USEPA 1988
Shrew	50 days	sexual maturity	George et al. 1986
Vole	40 days	sexual maturity	USEPA 1988

Table 3-3. Lifespans for Bird and Mammal Test Species

Test Species	Lifespan (years)
Mammals	
Cat	15
Dog	15
Guinea pig	6
Hamster	2.5
Mink	9
Mouse	2
Pig	2[a]
Rabbit	6
Rat	2
Shrew	1.04
Vole	0.25
Birds	
Bobwhite quail	6.5
Chicken	8[a]
Japanese quail	3
Mallard	1.8[a]
Turkey	1.6[a]
Wood duck	4[b]

Notes:

All values based on information provided by USEPA (2007) except where noted.

[a] Derived in agreement with EPA based on review of a variety of sources; for birds preference was given to data from the British Trust for Ornithology website (www.bto.org/about-birds/birdfacts) and the Cornell Lab of Ornithology (www.birdsna.org).

[b] Based on information provided by the National Wildlife Federation (2018)

Table 3-4. Number of Wildlife Studies Reviewed and Usable Dose-Response Datasets

		Number of Studies Reviewed[a]			Number of Usable Datasets[a]		
Receptor Group	Endpoint	Tier 1[b]	Tier 2[c]	Total	Tier 1[b]	Tier 2[c]	Total
Cadmium							
Bird	growth	12	1	13	10	1	11
Bird	reproduction	4	0	4	5	0	5
Bird	survival	6	0	6	5	0	5
Mammal	growth	16	0	16	9	0	9
Mammal	reproduction	5	0	5	8	0	8
Mammal	survival	3	2	5	3	3	6
Copper							
Bird	growth	10	0	10	12	0	12
Bird	reproduction	10	0	10	13	0	13
Bird	survival	5	0	5	7	0	7
Mammal	growth	8	0	8	5	0	5
Mammal	reproduction	3	0	3	4	0	4
Mammal	survival	5	1	6	5	2	7
Lead							
Bird	growth	14	0	14	12	0	12
Bird	reproduction	4	0	4	8	0	8
Bird	survival	5	0	5	2	0	2
Mammal	growth	10	0	10	4	0	4
Mammal	reproduction	7	0	7	5	0	5
Mammal	survival	5	0	5	5	0	5
Manganese							
Bird	growth	3	0	3	0	0	0
Bird	reproduction	0	0	0	0	0	0
Bird	survival	0	0	0	0	0	0
Mammal	growth	3	2	5	1	0	1
Mammal	reproduction	1	3	4	1	2	3
Mammal	survival	2	0	2	2	0	2
Zinc							
Bird	growth	9	0	9	12	0	12
Bird	reproduction	5	0	5	8	0	8
Bird	survival	6	0	6	7	0	7
Mammal	growth	10	0	10	7	0	7
Mammal	reproduction	9	0	9	9	0	9
Mammal	survival	2	0	2	4	0	4

Notes:

[a] Number of studies and usable datasets includes those reviewed for the purposes of pooling and for inclusion of unique receptors. The number of usable datasets may be higher than the number of unique studies because some studies included multiple experiments and/or measurements.

[b] Tier 1 includes growth studies with exposure during the critical lifestage or with a duration of at least 10 percent of the lifespan, and all survival and reproduction studies regardless of exposure duration. The exposure route for all Tier 1 data is diet or gavage.

[c] Tier 2 includes studies with drinking water exposure or studies for the growth endpoint if exposure was not during the critical lifestage or if the study duration was less than 10 percent of the lifespan.

Table 3-5. Source of Body Weights and Food Ingestion Rates for Dose Calculations

Test Organism[a]	BW[b] (kg)	BW Source	FIR (kg/d dw)[c]	FIR (kg/d ww)	Receptor Type for FIR Application	FIR Source
Mammals						
Mink	NA	NA	based on sex		mink	Bleavins and Aulerich 1981
Mouse[d]	based on sex and age	USEPA 1988	$0.056*(BW^{0.6611})$	NA	lab mammals	USEPA 1988
Pig[e]	based on age	Cai et al. 2009	based on age	NA	pig	Cai et al. 2009
Rabbit	based on sex and age	USEPA 1988	NA	NA	NA	NA
Rat[d]	based on sex and age	USEPA 1988	$0.056*(BW^{0.6611})$	NA	lab mammals	USEPA 1988
Shrew	NA	NA	NA	$1.13*((BW*1000)^{0.622})/1000$	insectivores	Nagy 2001
Birds						
Chicken (broiler)	based on age and sex	NRC 1994	based on age and sex	NA	chicken (broiler)	NRC 1994
Chicken[f]	based on age and sex	USEPA 1988	$0.075*(BW^{0.8449})$	NA	chicken	USEPA 1988
Duck, mallard	1.082	Dunning 1993	BW/10	NA	duck (mallard)	Heinz et al. 1987
Duck, Pekin	based on sex and age	NRC 1994	(0.638*((BW*1000)0.685))/1000	$(2.065*((BW*1000)^{0.689}))/1000$	birds	Nagy 2001
Quail, Japanese	based on age	based on age[g]	(0.638*((BW*1000)0.685))/1000	$(2.065*((BW*1000)^{0.689}))/1000$	birds	Nagy 2001
Turkey	based on age and sex	NRC 1994	based on age and sex	NA	turkey	NRC 1994

Notes:

[a] Organisms are not listed in this table if body weights (BWs) and food ingestion rates (FIRs) from the study were available.

[b] When possible, growth curves based on organism age were used to estimate BW.

[c] If wet weight or dry weight basis was not reported, FIRs were assumed to be reported on a dry weight basis (based on typical feed type for laboratory mammals, chickens, and turkeys).

[d] When a secondary source for drinking water ingestion was needed for mouse and rat, the equation from Calder and Braun (1983) was used: $0.099*(BW^{0.9})$

[e] When both a BW and a FIR were needed for pigs, values were taken from Cai et al. (2009). If only a FIR was needed, the equation for omnivores from Nagy (2001) was used.

[f] Used for chickens other than broiler

[g] Narinc et al. (2010) or Vos et al. (1971) was used, depending on age.

NA - not applicable (no secondary source needed)

Table 3-6. UCR Avian Receptors and Toxicity Test Species

UCR Receptors	Chicken	Mallard Duck	Other Duck	Kestrel	Pigeon	Quail	Turkey
Aquatic							
Belted kingfisher							
Canada goose							
Great blue heron							
Mallard duck		*					
Spotted sandpiper							
Tree swallow							
Terrestrial							
American kestrel				*			
American robin							
Bald eagle							
Blue grouse							
Red-tailed hawk							
Tree swallow							

Green shading with asterisk indicates species match for receptor-specific toxicity reference value.

Blank cells indicate there was no match between the UCR receptor and the receptor species used in toxicity tests.

Table 3-7. UCR Mammalian Receptors and Toxicity Test Species

UCR Receptors	Dog	Ferret	Mink	Mouse	Pig	Rabbit	Rat	Shrew	Vole
Aquatic									
Little brown bat									
Mink			*						
Muskrat									
River otter									
Shrew								*	
Terrestrial									
Little brown bat									
Meadow vole									*
Mink			*						
Raccoon									
Red fox									
Shrew								*	

Notes:

Green shading with asterisk indicates species match for receptor-specific toxicity reference value.

Blank cells indicate there was no match between the UCR receptor and the receptor species used in toxicity tests.

Table 3-8. Potential Bias Associated with Uncertainty Considerations

Consideration	Potential Bias in TRV	Potential Effect on Risk Estimate
Test species is not a UCR receptor	high or low	possible under- or overestimation because it is not known how sensitive the UCR receptor would be compared to the test species
Dose administration	high or low	possible overestimation for drinking water studies because chemicals are expected to be more bioavailable than when administered by diet or gavage; possible under- or overestimation of risk based on uncertainties in administration by diet or gavage
Growth study conducted during a non-critical life stage and for less than 10% of species' lifespan	low	possible overestimation because of uncertainty that growth effects during a noncritical life stage for a relatively short time period would result in ecologically relevant effects
Chemical form	high or low	possible under- or overestimation if chemical form used in the toxicity test is more or less toxic or bioavailable than the form present in dietary items of UCR wildlife
Dose calculated with estimated body weight and/or food ingestion rate	high or low	possible under- or overestimation because it is not known if estimated body weights and/or food ingestion rates are biased high or low
LOAEL ≥ 20 rather than ED20	high	possible underestimation because the value represents a level at which adverse effects are expected to be higher than 20% of the control

Notes:

Potential bias was based on whether the uncertainties in the toxicity reference value (TRV) derivation may have resulted in higher or lower estimates of the TRV than might otherwise have been derived, as discussed in Section 3.7

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

Table 4-1. Summary of Cadmium Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Bird Growth												
Bafundo et al. 1984	5.0	LOAEL ≥ 20	77.0	chicken	1 week	cadmium chloride	body weight gain	diet	2	1	none	3
Bokori et al. 1995b	**2.0**	**ED20**	**70.1**	**chicken**	**21 days**	**cadmium sulfate**	**body weight**	**diet**	**4**	**1**	**none**	**1**
Bokori et al. 1996	NA	NA	NA	chicken	chick to adult	cadmium sulfate	body weight	diet	39	1	none	3
DiGiulio and Scanlon 1984	*41*	*ED20*	*75.9*	*mallard duck*	*11 months*	*cadmium chloride*	*body weight*	*diet*	*6*	*2*	*none*	*1*
Hill 1974a	7.7	LOAEL ≥ 20	53.5	chicken	1 day	cadmium sulfate	body weight gain	diet	2	1	A	4
Hill 1974b	7.3	LOAEL ≥ 20	54.9	chicken	1 day	cadmium sulfate	body weight gain	diet	2	1	A	4
Hill 1979	5.1	LOAEL ≥ 20	73.7	chicken	1 day	cadmium sulfate	body weight gain	diet	2	1	A	4
Hill 1980	13	LOAEL ≥ 20	27.6	chicken	1 day	cadmium sulfate	body weight gain	diet	2	1	A	4
Rama and Planas 1981	9.7	LOAEL ≥ 20	57.7	chicken	1 day	cadmium sulfate	body weight gain	diet	9	1	A	4
Olgun 2015	3.1	ED20	62.7	Japanese quail	21 weeks	cadmium sulfate	body weight gain	diet	10	1	none	1
Richardson and Fox 1974	12	LOAEL ≥ 20	51.7	Japanese quail	1 day	cadmium chloride	body weight	diet	4	1	B	4
Richardson et al. 1974	12	LOAEL ≥ 20	69.7	Japanese quail	1 day	cadmium chloride	body weight	diet	4	1	B	4
Richardson et al. 1974	NA	NA	NA	Japanese quail	1 day	cadmium chloride	male body weight	diet	6	1	B	4
Bird Reproduction												
Bokori et al. 1995a	2.4	ED20	46.1	Japanese quail	adult	cadmium sulfate	egg production	diet	5.3	1	none	1
Leach et al. 1979	3.8	LOAEL ≥ 20	60.8	chicken	adult	cadmium sulfate	egg production	diet	48	1	none	3
Leach et al. 1979	**2.3**	**ED20**	**75.1**	**chicken**	**adult**	**cadmium sulfate**	**egg production**	**diet**	**12**	**1**	**none**	**1**
Olgun 2015	5.3	LOAEL ≥ 20	70.5	Japanese quail	22 weeks	cadmium sulfate	egg production	diet	10	1	none	4
White and Finley 1978	*20*	*LOAEL ≥ 20*	*28.6*	*mallard duck*	*adult*	*cadmium chloride*	*egg production*	*diet*	*4.3-12.9*	*1*	*none*	*3*
Bird Survival												
Pooled dataset:	**7.4**	**ED20**	**NA**	**Japanese quail**	**23 weeks to adult**	**cadmium sulfate**	**survival**	**diet**	**5.3 - 10**	**1**	**C**	5
Bokori et al. 1995a	9.4	LOAEL ≥ 20	77.8	Japanese quail	adult	cadmium sulfate	survival	diet	5.3	1	C	5
Olgun 2015	10.6	LOAEL ≥ 20	46.7	Japanese quail	23 weeks	cadmium sulfate	survival	diet	10	1	C	5
Bokori et al. 1995b	42	LOAEL ≥ 20	11.1	chicken	21 days	cadmium sulfate	survival	diet	8	1	none	3
Hill 1974b	NA	NA	NA	chicken	1 day	cadmium sulfate	survival	diet	2	1	none	3
Pritzl et al. 1974	65	LOAEL ≥ 20	45.0	chicken	2 week	cadmium carbonate	survival	diet	2.9	1	none	4
Van Vleet et al. 1981	130	LOAEL ≥ 20	10.0	Pekin duck	1 day	cadmium sulfate	survival	diet	4	1	none	4
Mammal Growth												
Baranski and Sitarek 1987	29	LOAEL ≥ 20	71.5	rat	3 months	cadmium chloride	body weight	gavage	14	1	none	4
Cousins et al. 1977	NA	NA	NA	rat	juvenile	cadmium chloride	body weight	diet	14	1	none	3
Dodds-Smith et al. 1992	*104*	*LOAEL ≥ 20*	*78.0*	*shrew*	*weanling*	*cadmium chloride*	*body weight*	*diet*	*12*	*1*	*none*	*3*
Groten et al. 1991	NA	NA	NA	rat	5 weeks	cadmium chloride	body weight	diet	8	1	none	3
Hamada et al. 1991	100	LOAEL ≥ 20	70.1	dog	6 to 8 months	cadmium chloride	body weight	diet	8-9 years	1	none	3
Merali and Singhal 1980	NA	NA	NA	rat	1 day	cadmium chloride	body weight	gavage	6.1	1	none	3
Pond et al. 1973	6.3	LOAEL ≥ 20	78.4	pig	weanling	cadmium chloride	body weight	diet	7.1	1	none	3
Rajanna et al. 1984	NA	NA	NA	rat	6 weeks	cadmium chloride	body weight	diet	25.7	1	none	3
Rastogi et al 1977	NA	NA	NA	rat	1 day	cadmium chloride	body weight	gavage	4.3	1	none	3
Pooled dataset:	5.4	ED20	NA	rat	juvenile	cadmium chloride	body weight	diet	2.0 - 6.4	1	A	5
Suzuki and Yoshida 1977	5.0	LOAEL ≥ 20	77.5	rat	juvenile	cadmium chloride	body weight	diet	6.4	1	A	5
Suzuki and Yoshida 1978a	NA	NA	NA	rat	juvenile	cadmium chloride	body weight	diet	2	1	A	5
Suzuki and Yoshida 1979	6.0	LOAEL ≥ 20	72.7	rat	juvenile	cadmium chloride	body weight	diet	2	1	A	5
Suzuki and Yoshida 1979	5.9	LOAEL ≥ 20	79.4	rat	juvenile	cadmium chloride	body weight	diet	4	1	A	5
Suzuki and Yoshida 1978b	NA	NA	NA	rat	juvenile	cadmium chloride	body weight	diet	25.7	1	none	3
Suzuki and Yoshida 1978b	NA	NA	NA	rat	juvenile	cadmium chloride	body weight	diet	25.7	1	none	3
Weber and Reid 1969	160	LOAEL ≥ 20	44.4	mouse	weanling	cadmium acetate	body weight	diet	3	1	none	4
Weigel et al. 1987	NA	NA	NA	rat	weanling	cadmium oxide	body weight	diet	7.9	1	none	3
Wilson et al. 1941	**4.2**	**ED20**	**80.0**	**rat**	**juvenile**	**cadmium chloride**	**body weight**	**diet**	**7.1**	**1**	**none**	**1**
Mammal Reproduction												
Machemer and Lorke 1981	61	LOAEL ≥ 20	0.0	rat	adult	cadmium chloride	pregancy success	gavage	1.4	1	none	4
Sawicka-Kapusta et al. 1994	6.9	LOAEL ≥ 20	77.7	mouse	15 days pregnant	cadmium chloride	offspring growth	diet	5	1	none	4
Sawicka-Kapusta et al. 1994	21	LOAEL ≥ 20	57.9	mouse	15 days pregnant	cadmium chloride	offspring survival	diet	5	1	none	4
Sutou et al. 1980	10	LOAEL ≥ 20	66.4	rat	4 weeks	cadmium chloride	male fetal body weight	gavage	9	1	B	4
Sutou et al. 1980	10	LOAEL ≥ 20	66.7	rat	4 weeks	cadmium chloride	female fetal body weight	gavage	9	1	B	4
Sutou et al. 1980	10	LOAEL ≥ 20	72.1	rat	4 weeks	cadmium chloride	fetal implants	gavage	>9	1	none	4
Sutou et al. 1980	**2.7**	**ED20**	**50.7**	**rat**	**4 weeks**	**cadmium chloride**	**live fetuses**	**gavage**	**>9**	**1**	**none**	**1**
Wardell et al. 1982	NA	NA	NA	rat	adult	not specified	litter weight	gavage	1.9	1	none	3
Whelton et al. 1988	9.2	LOAEL ≥ 20	75.4	mouse	adult	cadmium chloride	offspring growth	diet	36	1	none	3

Table 4-1. Summary of Cadmium Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Mammal Survival												
Baranski and Sitarek 1987	29	LOAEL ≥ 20	46.0	rat	adult	cadmium chloride	survival	gavage	14	1	none	3
Schroeder et al. 1963	0.55	LOAEL ≥ 20	23.3	rat	weaning	not specified	male survival	drinking water	92	2	C	2
Schroeder et al. 1963	0.56	LOAEL ≥ 20	63.2	rat	weaning	not specified	female survival	drinking water	92	2	C	2
Schroeder et al. 1964	0.70	LOAEL ≥ 20	64.0	mouse	weaning	not specified	male survival	drinking water	78	2	none	3
Swiergosz et al. 1998	***1.5***	***ED20***	***69.8***	***vole***	***adult***	***cadmium chloride***	***survival***	***diet***	***24***	***1***	***none***	***1***
Weber and Reid 1969	810	LOAEL ≥ 20	42.0	mouse	adult	cadmium acetate	survival	diet	3	1	none	4

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following: 1) LOAEL ≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geomean from a pooled dataset that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific toxicity reference value (TRV) dataset.

Bold and italics together indicate data were used to derive both the selected TRV and the receptor-specific TRV.

Yellow highlights indicate pooled datasets modeled in the toxicity relationship analysis program (TRAP).

[a] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual dataset to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled dataset but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual dataset (e.g., no effect with a ≥20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier dataset is available).
4. Not selected for modeling because the effect concentration for the individual or pooled dataset is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled dataset.

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable because the effect level is an ED20 or reduction in response was <20 percent relative to the control

Table 4-2. Summary of Copper Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Bird Growth												
Pooled dataset C:	86	ED20	NA	chicken	1 day/chick	copper sulfate	body weight	diet	2 to 4	1	C	5
Hill 1974a	130	LOAEL ≥ 20	67.5	chicken	1 day	copper sulfate	body weight	diet	2	1	C	5
Jensen and Maurice 1978	NA	NA	NA	chicken	chick	copper sulfate	body weight	diet	4	1	C	5
Jensen and Maurice 1978	84	LOAEL ≥ 20	78.7	chicken	chick	copper sulfate	body weight	diet	4	1	C	5
Jensen and Maurice 1979	56	LOAEL ≥ 20	76.5	chicken	1 day	copper sulfate	body weight	diet	4	1	C	5
Latymer and Cotes 1981	28	LOAEL ≥ 20	66.7	chicken	1 day	copper sulfate	body weight	diet	3.4	1	C	5
Smith 1969	NA	NA	NA	chicken	1 day	copper sulfate	body weight	diet	3.6	1	C	5
Kashani et al. 1986	NA	NA	NA	turkey	1 day	cupric sulfate pentahydrate	body weight	diet	24	1	none	3
Kashani et al. 1986	NA	NA	NA	turkey	1 day	cupric sulfate pentahydrate	body weight	diet	24	1	none	3
Miles et al. 1998	NA	NA	NA	chicken	1 day	cupric sulfate pentahydrate	body weight	diet	3	1	none	3
Miles et al. 1998	69	LOAEL ≥ 20	64.3	chicken	1 day	dicopper chloride trihydroxide	body weight	diet	6	1	none	4
Miles et al. 1998	69	LOAEL ≥ 20	75.0	chicken	1 day	cupric sulfate pentahydrate	body weight	diet	6	1	none	4
Persia et al. 2004	120	LOAEL ≥ 20	74.3	chicken	8 days	copper chloride	body weight	diet	2.1	1	E	4
Persia et al. 2004	67	LOAEL ≥ 20	77.7	chicken	8 days	copper chloride	body weight	diet	2	1	E	4
Pooled dataset D:	**62**	**ED20**	**NA**	**chicken**	**1 day**	**copper sulfate**	**body weight gain**	**diet**	**2.9 to 4**	**1**	**D**	5
Poupoulis and Jensen 1976	110	LOAEL ≥ 20	48.6	chicken	1 day	copper sulfate	body weight gain	diet	4	1	D	5
Poupoulis and Jensen 1976	84	LOAEL ≥ 20	45.2	chicken	1 day	copper sulfate	body weight gain	diet	4	1	D	5
Poupoulis and Jensen 1976	110	LOAEL ≥ 20	50.3	chicken	1 day	copper sulfate	body weight gain	diet	4	1	D	5
Wang et al. 1987	NA	NA	NA	chicken	1 day	copper sulfate	body weight gain	diet	2.9	1	D	5
Wang et al. 1987	65	LOAEL ≥ 20	76.3	chicken	1 day	copper sulfate	body weight gain	diet	2.9	1	D	5
Bird Reproduction												
Al Ankari et al. 1998	NA	NA	NA	chicken	25 weeks	copper sulfate/acetate	egg production	diet	12	1	none	3
Pooled dataset A:	**28**	**ED20**	**NA**	**chicken**	**24 to 68 weeks**	**copper sulfate**	**egg production**	**diet**	**4 to 8**	**1**	**A**	5
Chiou et al. 1997	41	LOAEL ≥ 20	51.4	chicken	28 weeks	copper sulfate	egg production	diet	4	1	A	5
Harms and Buresh 1986	32	LOAEL ≥ 20	32.2	chicken	68 weeks	copper sulfate	egg production	diet	6	1	A	5
Pearce et al. 1983	63	LOAEL ≥ 20	22.2	chicken	26 weeks	copper sulfate	egg production	diet	6.9	1	A	5
Stevenson and Jackson 1980b	32	LOAEL ≥ 20	77.8	chicken	24 weeks	copper sulfate	egg production	diet	8	1	A	5
Stevenson and Jackson 1980a	32	LOAEL ≥ 20	77.8	chicken	24 weeks	copper sulfate pentahydrate	egg production	diet	6.9	1	A	5
Pooled dataset B:	34	ED20	NA	chicken	24 to 27 weeks	copper sulfate	egg production	diet	32 to 48	1	B	5
Jackson et al. 1979	51	LOAEL ≥ 20	59.8	chicken	24 weeks	copper sulfate	egg production	diet	32	1	B	5
Jackson et al. 1979	38	LOAEL ≥ 20	70.9	chicken	24 weeks	copper sulfate	egg production	diet	32	1	B	5
Jackson et al. 1979	56	LOAEL ≥ 20	50.9	chicken	24 weeks	copper sulfate	egg production	diet	48	1	B	5
Jackson and Stevenson 1981a	37	LOAEL ≥ 20	74.6	chicken	27 weeks	copper sulfate	egg production	diet	40	1	B	5
Jackson and Stevenson 1981a	33	LOAEL ≥ 20	68.2	chicken	27 weeks	copper sulfate	egg production	diet	40	1	B	5
Jackson and Stevenson 1981b	35	LOAEL ≥ 20	75.1	chicken	26 weeks	copper sulfate	egg production	diet	48	1	B	5
Jackson and Stevenson 1981b	35	LOAEL ≥ 20	68.8	chicken	26 weeks	copper sulfate	egg production	diet	48	1	B	5
Stevenson et al. 1983	74	LOAEL ≥ 20	70.0	chicken	27 weeks	copper sulfate	egg production	diet	0.7	1	none	4
Bird Survival												
Mehring et al. 1960	**67**	**ED20**	**61.5**	**chicken**	**1 day**	**copper oxide**	**survival**	**diet**	**10**	**1**	**none**	**1**
Hill 1974a	190	LOAEL ≥ 20	54.3	chicken	1 day	copper sulfate	survival	diet	2	1	G	4
Poupoulis and Jensen 1976	84	LOAEL ≥ 20	80.0	chicken	chick	copper sulfate	survival	diet	4	1	G	4
Poupoulis and Jensen 1976	110	LOAEL ≥ 20	77.3	chicken	1 day	copper sulfate	survival	diet	4	1	G	4
Van Vleet et al. 1981	110	LOAEL ≥ 20	25.0	Pekin duck	duckling	copper sulfate	survival	diet	4	1	F	4
Van Vleet et al. 1981	150	LOAEL ≥ 20	60.0	Pekin duck	duckling	copper sulfate	survival	diet	2.1	1	F	4
Vohra and Kratzer 1968	260	LOAEL ≥ 20	50.0	turkey	juvenile	copper sulfate	survival	diet	3	1	none	4
Mammal Growth												
Allcroft et al. 1961	**12**	**ED20**	**29.0**	**pig**	**8 to 10 weeks**	**copper sulfate**	**body weight gain**	**diet**	**21**	**1**	**none**	**1**
Boyden et al. 1938	120	LOAEL ≥ 20	59.3	rat	4 weeks	copper sulfate	body weight gain	diet	4	1	none	4
Brandt 1983	*35*	*LOAEL ≥ 20*	*79.5*	*mink*	*90 days*	*copper sulfate*	*body weight*	*diet*	*from 90 days after birth to pelting*[c]	*1*	*none*	*2*
Edmonds and Baker 1986	NA	NA	NA	pig	4 weeks	copper sulfate	body weight	diet	4	1	none	3

Table 4-2. Summary of Copper Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Grobner et al. 1986	NA	NA	NA	rabbit	weanling	copper sulfate	body weight	diet	4	1	none	3
Mammal Growth (continued)												
Grobner et al. 1986	NA	NA	NA	rabbit	weanling	copper sulfate	body weight	diet	4	1	none	3
Llewellyn et al. 1985	110	LOAEL ≥ 20	77.1	rat	weanling	copper acetate	body weight	diet	21	1	none	3
Pettersen et al. 2002	NA	NA	NA	mouse	4.5 weeks	copper chloride	body weight	diet	3	1	none	3
Suttle and Mills 1966	25	LOAEL ≥ 20	76.7	pig	weanling	copper sulfate	body weight	diet	5.7	1	none	3
Mammal Reproduction												
Aulerich et al. 1982	***27***	***LOAEL ≥ 20***	***70.5***	***mink***	***kit***	***copper sulfate***	***kit survival***	***diet***	***20***	***1***	***none***	***3***
Aulerich et al. 1982	NA	NA	NA	mink	kit	copper sulfate	kit body weight	diet	20	1	none	3
Cromwell et al. 1993[d]	2.4	LOAEL ≥ 20	72.3	pig	multigenerational	copper sulfate	farrowing success	diet	2.1 years	1	none	3
Lecyk 1980	290	LOAEL ≥ 20	62.8	mouse	adult	copper sulfate	litter size (breed 1)	diet	7	1	A	4
Lecyk 1980	220	LOAEL ≥ 20	69.6	mouse	adult	copper sulfate	litter size (breed 2)	diet	7	1	A	4
Mammal Survival												
Pooled dataset:	**8.7**	**geometric mean**	**NA**	**pig**	**7 to 10 weeks**	**copper sulfate**	**survival**	**diet**	**15 to 21**	**1**	**B**	2
Allcroft et al. 1961	17	LOAEL ≥ 20	0.0	pig	8 to10 weeks	copper sulfate	survival	diet	21	1	B	2
Ritchie et al. 1963	4.3	LOAEL ≥ 20	75.0	pig	7 weeks	copper sulfate	survival	diet	15	1	B	2
Boyden et al. 1938	490	LOAEL ≥ 20	0.0	rat	4 weeks	copper sulfate	survival	diet	4	1	none	3
Brandt 1983	*35*	*LOAEL ≥ 20*	*50.0*	*mink*	*90 days*	*copper sulfate*	*survival*	*diet*	*from 90 days after birth to pelting*	*1*	*none*	*3*
NTP 1993a	140	LOAEL ≥ 20	80.0	mouse	6 weeks	copper sulfate	male survival	drinking water	2	2	none	4
NTP 1993a	200	LOAEL ≥ 20	40.0	mouse	6 weeks	copper sulfate	female survival	drinking water	2	2	none	4
Keen et al. 1982	200	LOAEL ≥ 20	71.4	rat	juvenile	copper sulfate	survival	diet	6.7	1	none	3

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following: 1) LOAEL ≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geomean from a pooled dataset that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific toxicity reference value (TRV) dataset.

Yellow and blue highlights indicate pooled datasets modeled in the toxicity relationship analysis program (TRAP).

[a] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual dataset to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled dataset but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual dataset (e.g., no effect with a ≥20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier dataset is available).
4. Not selected for modeling because the effect concentration for the individual or pooled dataset is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled dataset.

[c] The exposure duration was not provided in the paper; 12 weeks was used as an estimate based on general mink pelting information.

[d] This study resulted in the lowest LOAEL ≥ 20 for mammal reproduction, but was not selected as the lowest effect level for reasons described in Section 4.3.2.

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL≥20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable because the effect level is an ED20 or reduction in response was <20 percent relative to the control.

Table 4-3. Summary of Lead Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Bird Growth												
Abduljaleel and Shuhaimi-Othman 2013	**29**	**LOAEL ≥ 20**	**79.8**	**chicken**	**1 day**	**lead nitrate**	**body weight**	**diet**	**4**	**1**	**none**	**2**
Berg et al. 1980	NA	NA	NA	chicken	1 day	lead carbonate	body weight	diet	2	1	C	4
Berg et al. 1980	150	LOAEL ≥ 20	78.4	chicken	1 day	lead carbonate	body weight	diet	2	1	C	4
Berg et al. 1980	200	LOAEL ≥ 20	73.5	chicken	1 day	lead carbonate	body weight	diet	2	1	C	4
Berg et al. 1980	200	LOAEL ≥ 20	70.3	chicken	1 day	lead carbonate	body weight	diet	2	1	C	4
Cupo and Donaldson 1988	180	LOAEL ≥ 20	47.0	chicken	1 day	lead acetate	body weight	diet	3	1	C	4
Franson and Custer 1982	210	LOAEL ≥ 20	47.4	chicken	1 day	lead acetate	body weight	diet	4	1	C	4
Damron et al. 1969	80	LOAEL ≥ 20	61.2	chicken	4 weeks	lead acetate	body weight	diet	4	1	none	3
Donaldson 1986	170	LOAEL ≥ 20	71.6	chicken	1 day	lead acetate trihydrate	body weight	diet	2.9	1	A	4
Donaldson 1986	170	LOAEL ≥ 20	66.8	chicken	1 day	lead acetate trihydrate	body weight	diet	2.9	1	A	4
Donaldson and McGowan 1989	130	LOAEL ≥ 20	69.3	chicken	1 day	lead acetate trihydrate	body weight	diet	2.9	1	A	4
Edens 1985	NA	NA	NA	Japanese quail	1 day	lead acetate	body weight	diet	12	1	B	4
Edens et al. 1976	150	LOAEL ≥ 20	79.1	Japanese quail	1 day	lead acetate	body weight	diet	12	1	B	4
Edens and Garlich 1983	NA	NA	NA	chicken	producing eggs for about 15 weeks	lead acetate	body weight	diet	10	1	none	3
Edens and Melvin 1989	NA	NA	NA	Japanese quail	1 day	lead acetate	body weight (breed 1)	diet	21	1	none	3
Edens and Melvin 1989	NA	NA	NA	Japanese quail	1 day	lead acetate	body weight (breed 2)	diet	21	1	none	3
Edens and Melvin 1989	NA	NA	NA	Japanese quail	1 day	lead acetate	female body weight (breed 1)	diet	15	1	none	3
Latta and Donaldson 1986	130	LOAEL ≥ 20	67.1	chicken	1 day	lead acetate	body weight gain	diet	2.7	1	none	3
Leeming and Donaldson 1984	NA	NA	NA	chicken	1 day	lead acetate trihydrate	body weight gain	diet	2.7	1	none	3
Morgan et al. 1975	NA	NA	NA	Japanese quail	6 days	lead acetate	body weight (trial 1)	diet	5	1	none	3
Morgan et al. 1975	NA	NA	NA	Japanese quail	hatchling	lead acetate	body weight (trial 2)	diet	5	1	none	3
Bird Reproduction												
Edens et al. 1976	15	LOAEL ≥ 20	72.4	Japanese quail	1 day	lead acetate	egg hatchability	diet	12	1	none	4
Edens et al. 1976	15	LOAEL ≥ 20	70.0	Japanese quail	1 day	lead acetate	egg production	diet	12	1	E	4
Edens et al. 1976	500	LOAEL ≥ 20	17.2	Japanese quail	1 day	lead acetate	egg production	diet	12	1	E	4
Pooling group:	**4.7**	**geometric mean**	**NA**	**Japanese quail**	**1 day to adult**	**lead acetate**	**egg production**	**diet**	**3.8 - 5**	**1**	**D**	2
Edens and Garlich 1983	1.2	LOAEL ≥ 20	72.2	Japanese quail	6 weeks	lead acetate	egg production	diet	5	1	D	2
Edens and Garlich 1983	0.21	LOAEL ≥ 20	79.3	Japanese quail	1 day	lead acetate	egg production	diet	5	1	D	2
Stone and Soares 1976	420	LOAEL ≥ 20	41.1	Japanese quail	adult	lead acetate	egg production	diet	3.9	1	D	2
Edens and Garlich 1983	NA	NA	NA	chicken	at ~78% egg production	lead acetate	egg production	diet	4	1	none	3
Edens and Garlich 1983	13	LOAEL ≥ 20	73.8	chicken	producing eggs for 15 weeks	lead acetate	egg production	diet	10	1	none	4
Edens and Melvin 1989	200	LOAEL ≥ 20	73.2	Japanese quail	1 day	lead acetate	egg production	diet	21	1	none	3
Bird Survival												
Pooling group:	**11**	**ED20**	**NA**	**pigeon**	**adult**	**lead acetate**	**survival**	**gavage**	**varied**	**1**	**F**	5
Anders et al. 1982	NA	NA	NA	pigeon	adult	lead acetate	survival	gavage	5	1	F	5
Barthalmus et al. 1977	13	LOAEL ≥ 20	80.0	pigeon	adult	lead acetate	survival	gavage	varied	1	F	5
Cupo and Donaldson 1988	NA	NA	NA	chicken	1 day	lead acetate	survival	diet	3	1	none	3
Khan et al. 1993	NA	NA	NA	chicken	1 day	lead acetate	survival	gavage	1	1	none	3
Vengris and Mare 1974	320	LOAEL ≥ 20	50.0	chicken	6 weeks	lead acetate	survival	gavage	5	1	none	4
Mammal Growth												
Al-Omar et al. 2000	NA	NA	NA	mouse	adult	lead oxide	body weight gain	gavage	5	1	none	3
Barlow et al. 1977	NA	NA	NA	rat	adult	lead acetate	body weight	diet	3	1	none	3
Gerber et al. 1978	1100	LOAEL ≥ 20	64.4	rat	infant	lead acetate	body weight	diet	52	1	none	3
Harry et al. 1985	NA	NA	NA	rat	2 days	lead acetate	body weight	gavage	3.7	1	A	4
Toews et al. 1983	400	LOAEL ≥ 20	77.0	rat	pup	lead acetate	body weight	gavage	4	1	A	4
Hsu et al. 1975	NA	NA	NA	pig	4 weeks	lead acetate	body weight	diet	13	1	none	3
Lorenzo et al. 1978	**20**	**LOAEL ≥ 20**	**58.8**	**rabbit**	**1 day**	**lead nitrate**	**body weight gain**	**gavage**	**4.3**	**1**	**none**	**3**
Maker et al. 1973	NA	NA	NA	mouse	adult	lead carbonate	body weight	diet	4.3	1	none	3
Mykkanen et al. 1980	NA	NA	NA	rat	adult	lead acetate	body weight gain	diet	3	1	none	3
Mykkanen et al. 1980	NA	NA	NA	rat	adult	lead acetate	body weight gain	diet	3	1	none	3
Kumar and Desiraju 1990	130	ED20	47.3	rat	2 days	lead acetate	body weight	gavage	8.4	1	none	1
Mammal Reproduction												
Gupta et al. 1995	**3.2**	**LOAEL ≥ 20**	**76.7**	**mouse**	**adult**	**lead acetate**	**number living embryos**	**gavage**	**4**	**1**	**none**	**2**
Jacquet et al. 1977	NA	NA	NA	mouse	adult	not specified	embryo weight	diet	2.6	1	none	3
Miller et al. 1982	NA	NA	NA	rat	adult	lead acetate	embryo weight	gavage	5.9	1	none	3

Table 4-3. Summary of Lead Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Mammal Reproduction (continued)												
Mykkanen et al. 1980	1000	LOAEL ≥ 20	74.4	rat	adult	lead acetate	offspring weight (breed 1)	diet	3	1	B	4
Mykkanen et al. 1980	940	LOAEL ≥ 20	60.0	rat	adult	lead acetate	offspring weight (breed 2)	diet	3	1	B	4
Schroeder and Mitchener 1971	NA	NA	NA	rat	multigenerational	soluble lead	offspring survival	diet and drinking water	3 generations	1	none	3
Schroeder and Mitchener 1971	NA	NA	NA	mouse	multigenerational	soluble lead	offspring survival	diet and drinking water	3 generations	1	none	3
Wardell et al. 1982	NA	NA	NA	rat	adult	lead acetate	fetal mortality	gavage	1.9	1	none	3
Winneke et al. 1977	140	LOAEL ≥ 20	71.3	rat	adult	lead acetate	litter size	diet	18.6	1	none	3
Winneke et al. 1977	140	LOAEL ≥ 20	70.0	rat	adult	lead acetate	number pregnant	diet	18.6	1	none	3
Mammal Survival												
Junaid et al. 1997	8.0	LOAEL ≥ 20	80.0	mouse	adult	lead acetate	survival	gavage	8.6	1	none	3
Lorenzo et al. 1978	**7.6**	**ED20**	**59.5**	**rabbit**	**1 day**	**lead nitrate**	**survival**	**gavage**	**4.3**	**1**	**none**	**1**
Pankakoski et al. 1994	190[c]	LOAEL ≥ 20	0.0	shrew	juvenile	lead in earthworm prey	survival	diet	0.6	1	none	3
Press 1977	330	LOAEL ≥ 20	0.0	rat	1 day	lead acetate	survival	gavage	2.1	1	none	3
Kumar and Desiraju 1990	400	LOAEL ≥ 20	40.0	rat	2 days	lead acetate	survival	gavage	8.4	1	none	3

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following: 1) LOAEL ≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geomean from a pooled dataset that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Bold and italics together indicate data were used to derive both the selected toxicity reference value (TRV) and the receptor-specific TRV.

Yellow highlights indicate pooled datasets modeled in the toxicity relationship analysis program (TRAP).

[a] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual dataset to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled dataset but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual dataset (e.g., no effect with a ≥20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier dataset is available).
4. Not selected for modeling because the effect concentration for the individual or pooled dataset is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled dataset.

[c] Not selected as a receptor-specific TRV because the LOAEL is based on 100 percent mortality.

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL≥20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable because the effect level is an ED20 or reduction in response was <20 percent relative to the control.

Table 4-4. Summary of Manganese Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Bird Growth												
Martinez and Diaz 1996	NA	NA	NA	chicken	1 day	manganese oxide	body weight	diet	6	1	none	3
Southern and Baker 1983	NA	NA	NA	chicken	8 days	manganese chloride	body weight	diet	2	1	none	3
Vohra and Kratzer 1968	NA	NA	NA	turkey	juvenile	manganese sulfate	body weight gain	diet	3	1	none	3
Mammal Growth												
Komura and Sakomoto 1991	NA	NA	NA	mouse	6 weeks	manganese acetate	body weight	diet	12.9	1	none	3
Komura and Sakomoto 1991	NA	NA	NA	mouse	6 weeks	manganese chloride	body weight	diet	12.9	1	none	3
Lipe et al. 1999	NA	NA	NA	rat	90 days	manganese chloride	body weight	gavage	4.3	2	none	3
NTP 1993b	NA	NA	NA	rat	50 days	manganese sulfate	male body weight	diet	2	1	none	3
NTP 1993b	NA	NA	NA	rat	50 days	manganese sulfate	female body weight	diet	13	1	none	3
NTP 1993b	NA	NA	NA	mouse	63 days	manganese sulfate	male body weight	diet	13	1	none	3
NTP 1993b	NA	NA	NA	mouse	63 days	manganese sulfate	female body weight	diet	13	1	none	3
Rehnberg et al. 1980	**71**	**LOAEL ≥ 20**	**77.1**	**rat**	**1 day**	**manganese oxide**	**body weight**	**gavage**	**2.9**	**1**	**none**	**2**
Kontur and Fechter 1985	NA	NA	NA	rat	adult	manganese chloride	body weight	drinking water	3	2	none	3
Mammal Reproduction												
Kontur and Fechter 1985	NA	NA	NA	rat	adult	manganese chloride	litter size	drinking water	3	2	none	3
Laskey et al. 1982	**310**	**ED20**	**75.0**	**rat**	**adult**	**manganese oxide**	**% pregnant**	**diet**	**gestation to 224 days**	**1**	**none**	**1**
Leung et al. 1982	630	LOAEL ≥ 20	65.9	rat	adult	manganese chloride	offspring weight	drinking water	3.7	2	none	3
Pappas et al. 1997	1400	LOAEL ≥ 20	70.1	rat	adult	manganese chloride	offspring weight	drinking water	gestation to post-natal day 30	2	none	3
Mammal Survival												
NTP 1993b	430[c]	LOAEL ≥ 20	28.0	rat	41 days	manganese sulfate	male suvival	diet	2 years	1	none	4
Rehnberg et al. 1980	**91**	**ED20**	**55.1**	**rat**	**1 day**	**manganese oxide**	**survival**	**gavage**	**2.9**	**1**	**none**	**1**

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following: 1) LOAEL≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geomean from a pooled dataset that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

[a] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in the toxicity relationship analysis program (TRAP). Not all pooling groups were run in TRAP.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual dataset to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled dataset but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual dataset (e.g., no effect with a≥20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier dataset is available).
4. Not selected for modeling because the effect concentration for the individual or pooled dataset is substantially higher than other ED20s and/or LOAELs.

[c] Effect doses of 46 and 150 mg/kg bw/day from this study also resulted in a≥20% reduction in response compared to the control, but the results were not significantly different from the control, so they were not selected as the LOAEL ≥ 20.

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL≥20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable because the reduction in response was <20 percent relative to the control

Table 4-5. Summary of Zinc Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Bird Growth												
Gasaway and Buss 1972	*200*	*ED20*	*74.5*	*mallard duck*	*7 weeks*	*zinc carbonate*	*body weight gain*	*diet*	*5.7*	*1*	*none*	*1*
Hamilton et al. 1981	NA	NA	NA	Japanese quail	hatchling	zinc carbonate	body weight (Exp. 2)	diet	2	1	none	3
Hamilton et al. 1981	NA	NA	NA	Japanese quail	hatchling	zinc carbonate	body weight (Exp. 5)	diet	2	1	none	3
Pooled dataset A:	**43**	**ED20**	**NA**	**chicken**	**14 to 20 days**	**zinc oxide**	**body weight gain**	**diet**	**1 to 3**	**1**	**A**	5
Lu and Combs 1988	110	LOAEL ≥ 20	54.2	chicken	20 days	zinc oxide	body weight gain	diet	3	1	A	5
Lu et al. 1990	65	LOAEL ≥ 20	69.7	chicken	2 weeks	zinc oxide	body weight gain	diet	1	1	A	5
Roberson and Schaible 1960	250	LOAEL ≥ 20	45.0	chicken	1 day	zinc carbonate	body weight (Exp. 2)	diet	4	1	B	4
Roberson and Schaible 1960	130	LOAEL ≥ 20	79.4	chicken	1 day	zinc carbonate	body weight (Exp. 3)	diet	4	1	B	4
Roberson and Schaible 1960	250	LOAEL ≥ 20	59.2	chicken	1 day	zinc sulfate	body weight (Exp. 2)	diet	4	1	C	4
Roberson and Schaible 1960	NA	NA	NA	chicken	1 day	zinc sulfate	body weight (Exp. 3)	diet	4	1	C	4
Roberson and Schaible 1960	250	LOAEL ≥ 20	70.8	chicken	1 day	zinc oxide	body weight (Exp. 2)	diet	4	1	D	4
Roberson and Schaible 1960	NA	NA	NA	chicken	1 day	zinc oxide	body weight (Exp. 3)	diet	4	1	D	4
Sandoval et al. 1988	140	LOAEL ≥ 20	66.8	chicken	1 day	zinc sulfate	body weight gain	diet	3	1	E	4
Hill 1974a	260	LOAEL ≥ 20	75.6	chicken	1 day	zinc sulfate	body weight gain	diet	2	1	E	4
Sandoval et al. 1988	140	LOAEL ≥ 20	49.9	chicken	1 day	zinc gluconate	body weight gain	diet	3	1	none	3
Stahl et al. 1989	250	LOAEL ≥ 20	48.8	chicken	hatchling	zinc carbonate	body weight gain	diet	3	1	none	3
Vohra and Kratzer 1968	420	LOAEL ≥ 20	79.9	turkey	chick	zinc oxide	body weight gain	diet	3	1	none	4
Bird Reproduction												
Gibson et al. 1986	**77**	**ED20**	**40.6**	**chicken**	**30 weeks**	**zinc acetate dihydrate**	**egg production**	**diet**	**10**	**1**	**none**	**1**
Gibson et al. 1986	130	LOAEL ≥ 20	71.9	chicken	30 weeks	zinc oxide	egg production	diet	10	1	none	4
Jackson et al. 1986	230	LOAEL ≥ 20	10.0	chicken	40 weeks	zinc oxide	egg production	diet	3	1	none	4
Stepinska et al. 1987	1200	LOAEL ≥ 20	6.27	chicken	71 weeks	zinc oxide	egg production	diet	0.7	1	none	3
Jensen and Maurice 1980	160	LOAEL ≥ 20	57.4	chicken	adult	zinc sulfate	egg production (Exp. 3)	diet	6	1	G	4
Jensen and Maurice 1980	160	LOAEL ≥ 20	64.6	chicken	adult	zinc sulfate	egg production (Exp. 4)	diet	6	1	G	4
Jackson et al. 1986	140	LOAEL ≥ 20	73.3	chicken	40 weeks	zinc oxide	egg production	diet	20	1	F	4
Stevenson et al. 1987	130	LOAEL ≥ 20	68.3	chicken	28 weeks	zinc oxide	egg production	diet	20	1	F	4
Bird Survival												
Blalock and Hill 1988	260	LOAEL ≥ 20	80	chicken	1 day	zinc oxide	survival	diet	2	1	H	4
Dewar et al. 1983	520	LOAEL ≥ 20	79.5	chicken	1 day	zinc oxide	survival (Exp. 2)	diet	4	1	H	4
Dewar et al. 1983	780	LOAEL ≥ 20	61.9	chicken	15 days	zinc oxide	survival (Exp. 1)	diet	4	1	none	4
Gasaway and Buss 1972	*330*	*LOAEL ≥ 20*	*33*	*mallard duck*	*7 weeks*	*zinc carbonate*	*survival*	*diet*	*8.6*	*1*	*none*	*2*
Gibson et al. 1986	310	LOAEL ≥ 20	42.9	chicken	30 weeks	zinc acetate	survival	diet	10	1	none	3
Hamilton et al. 1979	430	LOAEL ≥ 20	44.4	Japanese quail	1 day	zinc carbonate	survival	diet	2	1	none	4
Roberson and Schaible 1960	**250**	**LOAEL ≥ 20**	**79.3**	**chicken**	**1 day**	**zinc carbonate**	**survival**	**diet**	**4**	**1**	**none**	**3**
Mammal Growth												
Barone et al. 1998	NA	NA	NA	rat	adult	not specified	body weight	diet	Day 11 of gestation to day before expected delivery	1	none	3
Brink et al. 1959	240	LOAEL ≥ 20	72.8	pig	weanling	not specified	body weight (Exp. 1)	diet	6	1	A	4
Brink et al. 1959	310	LOAEL ≥ 20	66.5	pig	weanling	not specified	body weight (Exp. 2)	diet	5	1	A	4
Brink et al. 1959	200	LOAEL ≥ 20	76.2	pig	weanling	not specified	body weight (Exp. 3)	diet	6	1	A	4
Hill et al. 1983	47	LOAEL ≥ 20	74.6	pig	30 kg	zinc oxide	body weight	diet	30 kg to 18 months old	1	none	4
Hsu et al. 1975	NA	NA	NA	pig	4 weeks	zinc oxide	body weight	diet	9 to13	1	none	3
Khan et al. 2007	**3.7**	**ED20**	**74.0**	**rat**	**adult**	**zinc chloride**	**male body weight**	**gavage**	**14**	**1**	**none**	**1**
Maita et al. 1981	19000	LOAEL ≥ 20	73.8	mouse	5 weeks	zinc sulfate	female body weight	diet	13	1	none	3
Maita et al. 1981	NA	NA	NA	mouse	5 weeks	zinc sulfate	male body weight	diet	13	1	none	3
Maita et al. 1981	NA	NA	NA	rat	5 weeks	zinc sulfate	male body weight	diet	13	1	none	3
Nakamura et al. 1983	NA	NA	NA	rat	not specified	zinc acetate	body weight	diet	11	1	none	3
Pettersen et al. 2002	NA	NA	NA	mouse	4.5 weeks	zinc chloride	body weight	diet	3	1	none	3
Settlemire and Matrone 1967	920	LOAEL ≥ 20	43.0	rat	4 to 6 weeks	zinc carbonate	body weight gain	diet	5	1	none	3
Subramanian et al. 2000	NA	NA	NA	rat	adult	zinc oxide	body weight	diet	6	1	none	3
Mammal Reproduction												
Barone et al. 1998	NA	NA	NA	rat	adult	not specified	litter size	diet	gestation	1	none	3
Chu and Cox 1972	380	LOAEL ≥ 20	52.6	rat	adult	not specified	offspring growth	diet	3	1	none	3
Ketcheson et al. 1969	360	LOAEL ≥ 20	78.9	rat	adult	zinc oxide	offspring growth	diet	gestation to 14 days lactation	1	none	3
Khan et al. 2007	**14**	**LOAEL ≥ 20**	**77.5**	**rat**	**adult**	**zinc chloride**	**offspring survival**	**gavage**	**20**	**1**	**none**	**2**

Table 4-5. Summary of Zinc Dose-Response Datasets

Source	Effect Dose (mg/kg bw/day)	Type of Effect Level	LOAEL Percent Effect Relative to Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Mammal Reproduction (continued)												
Kumar 1976	NA	NA	NA	rat	100 days	zinc sulfate	fetal survival	diet	2.6	1	none	3
Newman et al. 2002	230	LOAEL ≥ 20	0.0	rat	adult	zinc acetate dihydrate	offspring survival	diet	gestation day 5 to post-natal day 40	1	none	3
Pal and Pal 1987	420	LOAEL ≥ 20	29.3	rat	120 to 130 days	zinc sulfate	number of normal fetuses	diet	2.6	1	none	3
Cox et al. 1969	NA	NA	NA	rat	adult	zinc oxide	fetal growth	diet	3.1	1	B	4
Schlicker and Cox 1968	400	LOAEL ≥ 20	76.4	rat	adult	zinc oxide	fetal growth	diet	2.1	1	B	4
Schlicker and Cox 1968	400	LOAEL ≥ 20	74.9	rat	adult	zinc oxide	fetal growth	diet	2.6	1	B	4
Schlicker and Cox 1968	400	LOAEL ≥ 20	71.0	rat	adult	zinc oxide	fetal survival	diet	2.1	1	C	4
Schlicker and Cox 1968	400	LOAEL ≥ 20	0.0	rat	adult	zinc oxide	fetal survival	diet	5.1	1	C	4
Mammal Survival												
Straube et al. 1980	860	LOAEL ≥ 20	0.0	ferret	adult	zinc oxide	survival	diet	2 to 24	1	none	3
Pooled dataset	**190**	**geometric mean**	**NA**	**pig**	**weanling**	**zinc carbonate**	**survival**	**diet**	**5 to 6**	**1**	**D**	2
Brink et al. 1959	120	LOAEL ≥ 20	67.0	pig	weanling	zinc carbonate	survival	diet	6	1	D	2
Brink et al. 1959	310	LOAEL ≥ 20	75.0	pig	weanling	zinc carbonate	survival	diet	5	1	D	2
Brink et al. 1959	190	LOAEL ≥ 20	62.5	pig	weanling	zinc carbonate	survival	diet	6	1	D	2

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following: 1) LOAEL ≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geomean from a pooled dataset that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific toxicity reference value (TRV) dataset.

Yellow highlights indicate pooled datasets modeled in the toxicity relationship analysis program (TRAP).

[a] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual dataset to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled dataset but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual dataset (e.g., no effect with a ≥20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier dataset is available).
4. Not selected for modeling because the effect concentration for the individual or pooled dataset is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled dataset.

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable because the effect level is an ED20 or reduction in response was <20 percent relative to the control

Table 4-6. Summary of Selected Effect Levels

		Growth					Reproduction					Survival				
Metal	Eco-SSL	Selected Effect Level (mg/kg bw/day)	Effect Level Type	LOAEL Effect Level (%)	Tier	Citation	Selected Effect Level (mg/kg bw/day)	Effect Level Type	LOAEL Effect Level (%)	Tier	Citation	Selected Effect Level (mg/kg bw/day)	Effect Level Type	LOAEL Effect Level (%)	Tier	Citation
Bird TRVs																
Cadmium	1.47	2.0	ED20	NA	1	Bokori et al. 1995b	2.3	ED20	NA	1	Leach et al. 1979	7.4	ED20	NA	1	Bokori et al. 1995a, Olgun 2015 (pooled)
Copper	4.05	62	ED20	NA	1	Poupoulis and Jenson 1976, Wang et al. 1987 (pooled)	28	ED20	NA	1	Chiou et al. 1997, Harms and Buresh 1986, Pearce et al. 1983, Stevenson and Jackson 1980a, Stevenson and Jackson 1980b (pooled)	67	ED20	NA	1	Mehring et al. 1960
Lead	1.63	29	LOAEL≥20	20	1	Abduljaleel and Shuhaimi-Othman 2013	4.7	geomean	NA	1	Edens and Garlich 1983, Stone and Soares 1976 (pooled)	11	ED20	NA	1	Anders et al. 1982, Barthalmus et al. 1977 (pooled)
Manganese	179	none	NA		NA	NA	none	NA	NA	NA	NA	none	NA	NA	NA	NA
Zinc	66.1	43	ED20	NA	1	Lu and Combs 1988, Lu et al. 1990 (pooled)	77	ED20	NA	1	Gibson et al. 1986	250	LOAEL≥20	21	1	Roberson and Schaible 1960
UCR Receptor-Specific Bird TRVs																
Cadmium - mallard	1.47	41	ED20	NA	2	DiGiulio and Scanlon 1985	20	LOAEL≥20	71	1	White and Finley 1978	none	NA	NA	NA	NA
Zinc - mallard	66.1	200	ED20	NA	1	Gasaway and Buss 1972	none	NA	NA	NA	NA	330	LOAEL≥20	67	1	Gasaway and Buss 1972
Mammal TRVs																
Cadmium	0.77	4.2	ED20	NA	1	Wilson et al. 1941	2.7	ED20	NA	1	Sutou et al. 1980b	1.5	ED20	NA	1	Swiergosz et al. 1998
Copper	5.6	12	ED20	NA	1	Allcroft et al. 1961	27	LOAEL≥20	30	1	Aulerich et al. 1982	8.7	geometric mean	NA	1	Allcroft et al. 1961, Ritchie et al. 1963 (pooled)
Lead	4.7	20	LOAEL≥20	41	1	Lorenzo et al. 1978	3.2	LOAEL≥20	23	1	Gupta et al. 1995	7.6	ED20	NA	1	Lorenzo et al. 1978
Manganese	51.5	71	LOAEL≥20	23	1	Rehnberg et al. 1980	310	ED20	NA	1	Laskey et al. 1982	91	ED20	NA	1	Rehnberg et al. 1980
Zinc	75.4	3.7	ED20	NA	1	Khan et al. 2007	14	LOAEL≥20	23	1	Khan et al. 2007	190	geometric mean	NA	1	Brink et al. 1959 (pooled)
UCR Receptor-Specific Mammal TRVs																
Cadmium - shrew	0.77	104	LOAEL≥20	22	1	Dodds-Smith et al. 1982	none	NA	NA	NA	NA	none	NA	NA	NA	NA
Copper - mink	5.6	35	LOAEL≥20	21	1	Brandt 1983	27	LOAEL≥20	30	1	Aulerich et al. 1982	35	LOAEL≥20	50	1	Brandt 1983

Notes:

Green shading indicates selected effect levels, which were derived from the ED20 or the lowest LOAEL ≥ 20 from the lowest tier study reviewed, with the exception of the copper mammal reproduction effect level which was based on the second lowest LOAEL ≥ 20 as discussed in Section 4.3.

Eco-SSL – ecological soil screening level

ED20 – effective dose with a 20% reduction in the response relative to the control (modeled)

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable

TRV - toxicity reference value

Table 4-7. Uncertainty Considerations for Avian Selected Effect Levels for Cadmium

	Growth	Growth - Mallard [a]	Reproduction	Reproduction - Mallard [a]	Survival
Selected Effect Level Details					
Dose (mg/kg bw/day)	2.0	41	2.3	20	7.4
Reference	Bokori et al. 1995a	DiGiulio and Scanlon 1985	Leach et al. 1979	White and Finley 1978	pooled dataset[b]
Receptor used in study	chicken	mallard duck	chicken	mallard duck	Japanese quail
Considerations in Study Used to Derive Selected Effect Level					
Is species a UCR receptor?	no	yes	no	yes	no
Dose administration	diet	diet	diet	diet	diet
Growth study exposure	critical lifestage	non-critical lifestage, <10% of lifespan	NA	NA	NA
Chemical form	cadmium sulfate	cadmium chloride	cadmium sulfate	cadmium chloride	cadmium sulfate
Source of BW and FIR	BW – study; FIR – secondary source	BW and FIR – study	BW and FIR – secondary source	BW and FIR – study	BW – study and secondary sources; FIR – secondary sources
Type of effect level	ED20	ED20	ED20	LOAEL ≥ 20 (71% reduction in response relative to the control)	ED20
Level of Confidence and Bias					
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) estimated FIR (unknown)	dose administration (unknown) exposure life stage and duration (unknown)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)	dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)
Considerations Associated with Available Literature					
Number of species with LOAEL ≥ 20 or ED20	three (chicken, Japanese quail, mallard)	NA	three (chicken, Japanese quail, mallard)	NA	three (chicken, mallard, Pekin duck)
Number of dose-response datasets evaluated	12 - Tier 1, 1 - Tier 2	1 - Tier 1	5 - Tier 1	1 - Tier 1	6 - Tier 1

Notes:

[a] Effect levels for the growth and reproduction endpoints from mallard studies are receptor-specific and will be used to evaluate risk to mallards in the UCR.

[b] Pooled datasets included Bokori et al. 1995a and Olgun 2015

BW – body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA – not applicable

Table 4-8. Uncertainty Considerations for Mammalian Selected Effect Levels for Cadmium

	Growth	Growth - Shrew[a]	Reproduction	Survival[b]
Selected Effect Level Details				
Dose (mg/kg bw/day)	4.2	104	2.7	1.5
Reference	Wilson et al. 1941	Dodds-Smith et al. 1992	Sutou et al. 1980	Swiergosz et al. 1998
Receptor used in study	rat	shrew	rat	vole
Considerations in Study Used to Derive Selected Effect Level				
Is species a UCR receptor?	no	yes	no	no
Dose administration	diet	diet	gavage	diet
Growth study exposure	critical lifestage	critical lifestage	NA	NA
Chemical form	cadmium chloride	cadmium chloride	cadmium chloride	cadmium chloride
Source of BW and FIR	BW – study; FIR – secondary source	NA (doses reported in the study)	NA (doses reported in the paper)	BW – study; FIR – secondary source
Type of effect level	ED20	LOAEL ≥ 20 (22% reduction in response relative to the control)	ED20	ED20
Level of Confidence and Bias				
Considerations decreasing the level of confidence in effect level (potential bias)	Not a UCR receptor (unknown) Dose administration) estimated FIR (unknown)	dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown)	dose administration (unknown) estimated FIR (unknown)
Considerations Associated with Available Literature				
Number of species with LOAEL ≥ 20 or ED20	five (dog, mouse, pig, rat, shrew)	NA	two (mouse, rat)	three (mouse, rat, vole)
Number of dose-response datasets evaluated	18 - Tier 1	1 - Tier 1	9 - Tier 1	3 - Tier 1, 3 - Tier 2

Notes:

[a] Effect level for the growth endpoint from the shrew study is receptor-specific and will be used to evaluate risk to shrews in the UCR.

[b] The selected survival effect level is receptor-specific for vole.

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-9. Uncertainty Considerations for Avian Selected Effect Levels for Copper

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	62	28	67
Reference	pooled dataset[a]	pooled dataset[b]	Mehring et al. 1960
Receptor used in study	chicken	chicken	chicken
Considerations in Study Used to Derive Selected Effect Level			
Is species a UCR receptor?	no	no	no
Dose administration	diet	diet	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	copper sulfate	copper sulfate	copper oxide
Source of BW and FIR	BW and FIR – secondary sources	BW and FIR – study and secondary sources	BW – study; FIR – secondary source
Type of effect level	ED20	ED20	ED20
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)	not a UCR receptor (unknown) dose administration (unknown)) egg production endpoint (low) estimated BW and FIR (unknown)	not a UCR receptor (unknown) dose administration (unknown)) estimated FIR (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	two (chicken, turkey)	one (chicken)	three (chicken, Pekin duck, turkey)
Number of dose-response datasets evaluated	18 - Tier 1	14 - Tier 1	7 - Tier 1

Notes:

[a] Pooled datasets included Poupoulis and Jensen 1976 (3 datasets), and Wang et al. 1987 (2 datasets)

[b] Pooled datasets included Chiou et al. (1997), Harms and Buresh (1986), Lien et al. (2004), Pearce et al. (1983), and Stevenson and Jackson (1980a,b) (2 datasets)

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-10. Uncertainty Considerations for Mammalian Selected Effect Levels for Copper

	Growth	Growth - Mink[a]	Reproduction[b]	Survival	Survival - Mink[a]
Selected Effect Level Details					
Dose (mg/kg bw/day)	12	35	27	8.7	35
Reference	Allcroft et al. 1961	Brandt 1983	Aulerich et al. 1982	Ritchie et al. 1963 and Allcroft et al. 1961 (pooled dataset)	Brandt 1983
Receptor used in study	pig	mink	mink	pig	mink
Considerations in Study Used to Derive Selected Effect Level					
Is species a UCR receptor?	no	yes	yes	no	yes
Dose administration	diet	diet	diet	diet	diet
Growth study exposure	critical lifestage	critical lifestage	NA	NA	NA
Chemical form	copper sulfate	copper sulfate	copper sulfate	copper sulfate	copper sulfate
Source of BW and FIR	BW and FIR – secondary sources	BW – study; FIR – secondary source	BW – study; FIR – secondary source	BW – study and secondary source; FIR – secondary source	BW – study; FIR – secondary source
Type of effect level	ED20	LOAEL ≥ 20 (21% reduction in response relative to the control)	LOAEL ≥ 20 (30% reduction in response relative to the control)	geometric mean	LOAEL ≥ 20 (50% reduction in response relative to the control)
Level of Confidence and Bias					
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)	Dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	estimated FIR (unknown) dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)	dose administration (unknown) estimated BW and FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature					
Number of species with LOAEL ≥ 20 or ED20	five (mink, mouse, pig, rabbit, rat)	NA	NA	four (mink, mouse, pig, rat)	NA
Number of dose-response datasets evaluated	9 - Tier 1	1 - Tier 1	1 - Tier 1	5 -Tier 1, 2 - Tier 2	1 - Tier 1

Notes:

[a] Effect levels for the growth and survival endpoints from mink studies are receptor-specific and will be used only to evaluate risk to mink in the UCR.

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-11. Uncertainty Considerations for Avian Selected Effect Levels for Lead

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	29	4.7	11
Reference	Abduljaleel and Shuhaimi-Othman 2013	pooled dataset[a]	pooled dataset[b]
Receptor used in study	chicken	Japanese quail	pigeon
Considerations in Study Used to Derive Selected Effect Level			
Is species a UCR receptor?	no	no	no
Dose administration	diet	diet	gavage
Growth study exposure	critical lifestage	NA	NA
Chemical form	lead nitrate	lead acetate	lead acetate
Source of BW and FIR	BW and FIR – secondary sources	BW and FIR – study and secondary sources	NA (doses reported in the paper)
Type of effect level	LOAEL ≥ 20 (20% reduction in response relative to the control)	geometric mean	ED20
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)	not a UCR receptor (unknown) dose administration (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	two (chicken, Japanese quail)	two (chicken, Japanese quail)	two (chicken, pigeon)
Number of dose-response datasets evaluated	20 - Tier 1	9 - Tier 1	5 - Tier 1

Notes:

[a] Pooled datasets included Edens and Garlich 1983 (2 datasets) and Stone and Soares 1976

[b] Pooled datasets included Anders et al. 1982 and Barthalmus et al. 1977

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-12. Uncertainty Considerations for Mammalian Selected Effect Levels for Lead

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	20	3.2	7.6
Reference	Lorenzo et al. 1978	Gupta et al. 1995	Lorenzo et al. 1978
Receptor used in study	rabbit	mouse	rabbit
Considerations in Study Used to Derive Selected Effect Level			
Is species a UCR receptor?	no	no	no
Dose administration	gavage	gavage	gavage
Growth study exposure	critical lifestage	NA	NA
Chemical form	lead nitrate	lead acetate	lead nitrate
Source of BW and FIR	NA (doses reported in paper)	NA (doses reported in paper)	NA (doses reported in paper)
Type of effect level	LOAEL ≥ 20 (41% reduction in response relative to the control)	LOAEL ≥ 20 (23% reduction in response relative to the control)	ED20
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	four (mouse, pig, rat, rabbit)	two (mouse, rat)	four (mouse, rabbit, rat, shrew)
Number of dose-response datasets evaluated	11 - Tier 1	10 - Tier 1	5 - Tier 1

Notes:

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-13. Uncertainty Considerations for Mammalian Selected Effect Levels for Manganese

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	71	310	91
Reference	Rehnberg et al. 1980	Laskey et al. 1982	Rehnberg et al. 1980
Receptor used in study	rat	rat	rat
Considerations in Study Used to Derive Selected Effect Level			
Is species a UCR receptor?	no	no	no
Dose administration	gavage	diet	gavage
Growth study exposure	critical lifestage	NA	NA
Chemical form	manganese oxide	manganese oxide	manganese oxide
Source of BW and FIR	NA (doses provided in the paper)	BW - study; FIR - secondary source	NA (doses provided in the paper)
Type of effect level	LOAEL ≥ 20 (23% reduction in response relative to the control)	ED20	ED20
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) short-term growth study (low) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown) dose administration (unknown) estimated FIR (unknown)	not a UCR receptor (unknown) dose administration (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	two (mouse, rat)	one (rat)	one (rat)
Number of dose-response datasets evaluated	8 - Tier 1, 1 - Tier 2	1 - Tier 1, 3 - Tier 2	2 - Tier 1

Notes:

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-14. Uncertainty Considerations for Avian Selected Effect Levels for Zinc

	Growth	Growth - Mallard[a]	Reproduction	Survival	Survival - Mallard[a]
Selected Effect Level Details					
Dose (mg/kg bw/day)	43	200	77	250	330
Reference	pooled dataset[b]	Gasaway and Buss 1972	Gibson et al. 1986	Roberson and Schaible 1960	Gasaway and Buss 1972
Receptor used in study	chicken	mallard duck	chicken	chicken	mallard duck
Considerations in Study Used to Derive Selected Effect Level					
Is species a UCR receptor?	no	yes	no	no	yes
Dose administration	diet	diet	diet	diet	diet
Growth study exposure	critical lifestage	critical lifestage	NA	NA	NA
Chemical form	zinc oxide	zinc carbonate	zinc acetate dihydrate	zinc carbonate	zinc carbonate
Source of BW and FIR	BW and FIR – secondary sources	BW and FIR – secondary sources	BW and FIR – study	BW - study; FIR - secondary source	BW and FIR – secondary sources
Type of effect level	ED20	ED20	ED20	LOAEL ≥ 20 (21% reduction in response relative to the control)	LOAEL ≥ 20 (67% reduction in response relative to the control)
Level of Confidence and Bias					
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown)	dose administration (unknown) estimated BW and FIR (unknown)	not a UCR receptor (unknown) dose administration (unknown) egg production endpoint (low)	not a UCR receptor (unknown) dose administration (unknown) estimated BW and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	dose administration (unknown) estimated BW and FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature					
Number of species with LOAEL ≥ 20 or ED20	four (chicken, Japanese quail, mallard, turkey)	NA	one (chicken)	three (chicken, Japanese quail, mallard)	NA
Number of dose-response datasets evaluated	16 - Tier 1	1 - Tier 1	8 - Tier 1	7 - Tier 1	1 - Tier 1

Notes:

[a] Effect levels for growth and survival endpoints from mallard studies are receptor-specific and will be used to evaluate risk to mallard in the UCR.

[b] Pooled datasets included Lu and Combs 1988 and Lu et al. 1990

BW – body weight

ED20 – effect dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 4-15. Uncertainty Considerations for Mammalian Selected Effect Levels for Zinc

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	3.7	14	190
Reference	Khan et al. 2007	Khan et al. 2007	Brink et al. 1959 (pooled dataset)
Receptor used in study	rat	rat	pig
Considerations in Study Used to Derive Selected Effect Level			
Is species a UCR receptor?	no	no	no
Dose administration	gavage	gavage	diet
Growth study exposure	>10% of lifespan	NA	NA
Chemical form	zinc chloride	zinc chloride	zinc carbonate
Source of BW and FIR	NA (doses reported in the paper)	NA (doses reported in the paper)	BW and FIR – study
Type of effect level	ED20	LOAEL ≥ 20 (23% reduction in response relative to the control)	geomean
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias)	not a UCR receptor (unknown) dose administration (unknown)	not a UCR receptor (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	not a UCR receptor (unknown)dose administration (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	three (mouse, pig, rat)	one (rat)	two (ferret, pig)
Number of dose-response datasets evaluated	14 - Tier 1	12 - Tier 1	4 - Tier 1

Notes:

BW – body weight

ED20 – effective dose with 20% reduction in observed response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with a 20% or more reduction in response compared to the control

NA – not applicable

Table 5-1. Summary of TRVs for Birds and Mammals

Metal	Growth		Reproduction		Survival	
	TRV (mg/kg bw/day)	TRV Type	TRV (mg/kg bw/day)	TRV Type	TRV (mg/kg bw/day)	TRV Type
Bird TRVs						
Cadmium	2.0	ED20	2.3	ED20	7.4	ED20
Copper	62	ED20	28	ED20	67	ED20
Lead	29	LOAEL ≥ 20	4.7	geometric mean	11	ED20
Manganese	none	NA	none	NA	none	NA
Zinc	66[a]	Eco-SSL	77	ED20	250	LOAEL ≥ 20
UCR Receptor-Specific Bird TRVs						
Cadmium - mallard	41	ED20	20	LOAEL ≥ 20	none	NA
Zinc - mallard	200	ED20	none	NA	330	LOAEL ≥ 20
Mammal TRVs						
Cadmium	4.2	ED20	2.7	ED20	1.5	ED20
Copper	12	ED20	27	LOAEL ≥ 20	8.7	geometric mean
Lead	20	LOAEL ≥ 20	4.7[a]	Eco-SSL	7.6	ED20
Manganese	71	LOAEL ≥ 20	310	ED20	91	ED20
Zinc	75[a]	Eco-SSL	75[a]	Eco-SSL	190	geometric mean
UCR Receptor-Specific Mammal TRVs						
Cadmium - shrew	104	LOAEL ≥ 20	none	NA	none	NA
Copper - mink	35	LOAEL ≥ 20	27	LOAEL ≥ 20	35	LOAEL ≥ 20

Notes:

Green shading indicates selected toxicity reference values (TRVs). TRVs were derived from the lowest value from the lowest tier from among the following values: 1) ED20 from individual dataset; 2) LOAEL ≥ 20 from individual dataset; or 3) ED20 or geometric mean of LOAELs ≥ 20 from pooled dataset. One exception is that the copper mammal reproduction TRV was based on the second lowest LOAEL ≥ 20 as discussed in Section 4.3.

[a] The selected TRV is the ecological soil screening level (Eco-SSL) because the lowest effect level is less than the Eco-SSL.

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA - not applicable

APPENDIX A

STUDIES CONSIDERED IN THE TRV DERIVATION PROCESS

APPENDIX A-1

TABLES

Table A-1. Acronyms Used in the Eco-SSL Documents

Acronym	Definition
AD	adult
ALWT	albumin weight
B	both
BDWT	body weight changes
BO	bone
DEYO	death of young
DR	drinking water
DVP	development
EG	egg response site
EGG	egg effect type
EGPN	egg production
EGWT	egg weight
EM	embryo
ESQU	egg quality
ESTH	eggshell thickness
EY	eye
FD	food
F	female
FM	femur
FERT	fertility
GDPV	general development
GE	gestation
GGRO	general growth
GMPH	general morphology
GRO	growth
GREP	general reproduction
GV	gavage
IM	immature
JV	juvenile
LB	laying bird
LC	lactation
LFSP	lifespan
M	male
M	measured
MA	mature
MOR	mortality effect type
MORT	mortality effect measure
MPH	morphology
MT	multiple tissues/organs
MU	muscle
MUSC	muscle changes
NR	not reported
OD	oviduct
ODVP	offspring development
OR	oral
ORWT	organ weight changes
OV	ovary
PG	prostate gland
PRFM	pregnant females in a population
PROG	progeny numbers/counts
PRWT	progeny weight
RBEH	reproductive behavior
REP	reproduction
RHIS	reproductive organ histology
RPRD	reproductive capacity
RSEM	resorbed embryos
RSUC	reproductive success

Table A-1. Acronyms Used in the Eco-SSL Documents

Acronym	Definition
RT	Reproductive tissue
SL	spleen
SM	sexually mature
SM	sperm
SPCL	sperm cell counts
SPCV	sperm cell viability
SURV	survival
SV	seminal vesicle
TA	tail
TB	tibia
TE	testes
TEDG	testes degeneration
TEWT	testes weight
TPRD	total production
U	unmeasured
UX	unmeasured by verified
WI	wings
WO	whole organism
YO	young

Table A-2. Cadmium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Reproduction																			
44	Leach et al. 1978[b]	398	chicken (*Gallus domesticus*)	2	U	FD	12	week	8	month	LB	F	REP	EGPN	WO	0.593	2.37	82	yes
45	Leach et al. 1978[b]	398	chicken (*Gallus domesticus*)	3	U	FD	12	month	6	month	LB	F	REP	PROG	WO	0.593	2.37	82	yes
46	Bokori et al. 1996	375	chicken (*Gallus domesticus*)	1	U	FD	39	week	14	day	IM	M	REP	TEWT	TE	0.799	2.40	85	no (ENR)
47	White and Finley 1978	396	mallard (*Anas platyrhychos*)	1	M	FD	90	day	1	year	AD	F	REP	Other	NR	1.53	21.1	83	yes
48	White et al. 1978	399	mallard (*Anas platyrhychos*)	1	M	FD	90	day	1	year	AD	B	REP	TEWT	TE	1.53	21.1	87	no (ENR)
49	Di Giulio and Scanlon 1985	389	mallard (*Anas platyrhychos*)	1	U	FD	42	day	32	week	JV	M	REP	TEWT	TE	4.20		73	no (ENR, UN)
50	Sell 1975	807	chicken (*Gallus domesticus*)	1	U	FD	23	day	16	month	LB	F	REP	PROG	WO		2.40	79	no (SDC)
51	Bokori et al. 1995	378	chicken (*Gallus domesticus*)	2	U	FD	5	week	21	day	JV	M	REP	TEDG	TE		3.71	79	no (ENR)
52	Bokori et al. 1995	379	Japanese quail (*Coturnix japonica*)	1	U	FD	37	day	NR	NR	LB	F	REP	PROG	WO		7.65	79	yes
53	Richardson et al. 1974	371	Japanese quail (*Coturnix japonica*)	1	U	FD	6	week	1	day	JV	M	REP	TEWT	TE		10.4	79	no (ENR)
Growth																			
54	Jacobs et al. 1978	400	Japanese quail (*Coturnix japonica*)	6	U	FD	7	day	7	day	JV	B	GRO	BDWT	WO	0.125		69	no (UN)
55	Stoewsand et al 1986	356	Japanese quail (*Coturnix japonica*)	2	M	FD	63	day	1	day	JV	B	GRO	BDWT	WO	0.260		75	no (UN)
56	Lefevre et al. 1982	392	chicken (*Gallus domesticus*)	3	U	FD	5	week	1	day	JV	NR	GRO	BDWT	WO	0.708	7.08	82	yes
57	Leach et al. 1978[b]	398	chicken (*Gallus domesticus*)	4	U	FD	6	week	1	day	JV	M	GRO	BDWT	WO	0.826	3.30	81	no (UN[c])
58	Cain et al. 1983	366	mallard (*Anas platyrhychos*)	4	M	FD	12	week	1	day	JV	B	GRO	BDWT	WO	0.858		82	no (UN)
59	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO	1.25		76	no (UN)
60	Bokori et al. 1996	375	chicken (*Gallus domesticus*)	3	U	FD	4	week	14	day	JV	M	GRO	BDWT	WO	1.55	4.66	83	yes
61	Hill 1979	397	chicken (*Gallus domesticus*)	4	U	FD	2	week	1	day	JV	F	GRO	BDWT	WO	1.72	3.44	82	yes
62	Hill 1974	92	chicken (*Gallus domesticus*)	6	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO	1.72	3.44	82	yes
63	Di Giulio and Scanlon 1985	389	mallard (*Anas platyrhychos*)	3	U	FD	42	day	32	week	JV	M	GRO	BDWT	WO	4.20		78	no (UN)
64	Blalock and Hill 1988	386	chicken (*Gallus domesticus*)	4	U	FD	2	week	1	day	JV	NR	GRO	BDWT	WO	4.24		68	no (UN)
65	Mayack et al. 1981	393	wood duck (*Aix sponsa*)	4	M	FD	12	week	1	week	JV	B	GRO	BDWT	WO	5.76		73	no (UN)
66	Hill 1979	397	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	F	GRO	BDWT	WO	6.44		74	no (UN)
67	Di Giulio and Scanlon 1984	183	mallard (*Anas platyrhychos*)	4	U	FD	42	day	11	month	JV	M	GRO	BDWT	WO	12.5	37.6	84	yes
68	Fadil and Magid 1996	5265	chicken (*Gallus domesticus*)	3	U	DR	30	day	1	day	JV	NR	GRO	BDWT	WO		1.05	71	yes
69	Hill 1990	8125	chicken (*Gallus domesticus*)	2	U	FD	18	day	1	day	JV	F	GRO	BDWT	WO		4.26	76	no (SNF[d])
70	Bafundo et al. 1984	8500	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO		4.80	76	yes
71	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO		4.90	76	yes
72	Bokori et al. 1995	378	chicken (*Gallus domesticus*)	4	U	FD	1	week	21	day	JV	M	GRO	BDWT	WO		5.63	77	yes
73	Pritzl et al. 1974	403	chicken (*Gallus domesticus*)	5	U	FD	20	day	2	week	JV	M	GRO	BDWT	WO		9.57	77	yes
74	Freeland and Cousins 1973	7011	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	M	GRO	BDWT	WO		9.75	77	yes
75	Richardson et al. 1974	371	Japanese quail (*Coturnix japonica*)	2	U	FD	4	week	1	day	JV	B	GRO	BDWT	WO		12.2	77	yes
76	Richardson and Fox 1974	402	Japanese quail (*Coturnix japonica*)	2	U	FD	4	week	1	day	JV	B	GRO	BDWT	WO		12.8	77	yes
77	Rama and Planas 1981	6468	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	NR	GRO	BDWT	WO		13.0	77	yes
78	Hill 1980	395	chicken (*Gallus domesticus*)	2	U	FD	1	week	1	day	JV	F	GRO	BDWT	WO		13.8	69	yes
79	Spivey et al. 1971	7101	Japanese quail (*Coturnix japonica*)	2	U	FD	2	week	1	day	JV	NR	GRO	BDWT	WO		14.7	77	yes
Survival																			
80	Bokori et al. 1996	375	chicken (*Gallus domesticus*)	3	U	FD	12	week	14	day	JV	M	MOR	MORT	WO	3.00		78	no (UN)
81	Blalock and Hill 1988	386	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	NR	MOR	MORT	WO	4.24		69	no (UN)
82	Mayack et al. 1981	393	wood duck (*Aix sponsa*)	4	M	FD	12	week	1	week	JV	B	MOR	MORT	WO	5.78		74	no (UN)
83	Hill 1974	92	chicken (*Gallus domesticus*)	6	U	FD	5	week	1	day	JV	B	MOR	MORT	WO	8.59		77	no (UN)
84	Pritzl et al. 1974	403	chicken (*Gallus domesticus*)	5	U	FD	20	day	2	week	JV	M	MOR	MORT	WO	9.57	14.3	84	yes
85	Richardson et al. 1974	371	Japanese quail (*Coturnix japonica*)	2	U	FD	4	week	1	day	JV	B	MOR	MORT	WO	10.5		69	no (UN)
86	Van Vleet et al. 1981	80	duck (*Anas* sp.)	3	U	FD	15	day	NR	NR	JV	M	MOR	MORT	WO	13.4		77	no (UN)
87	Spivey et al. 1971	7101	Japanese quail (*Coturnix japonica*)	2	U	FD	2	week	1	day	JV	NR	MOR	MORT	WO	14.2		69	no (UN)
88	Bokori et al. 1995	379	Japanese quail (*Coturnix japonica*)	4	U	FD	37	day	NR	NR	SM	F	MOR	MORT	WO	15.3	30.6	84	yes
89	White and Finley 1978	396	mallard (*Anas platyrhynchos*)	4	M	FD	90	day	1	year	AD	B	MOR	MORT	WO	16.9		80	no (UN)

Table A-2. Cadmium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Survival (continued)																			
90	White et al 1978	399	mallard (*Anas platyrhynchos*)	4	M	FD	90	day	1	year	AD	B	MOR	MORT	WO	21.1		84	no (UN)
91	Bokori et al. 1995	378	chicken (*Gallus domesticus*)	4	U	FD	4	week	21	day	JV	M	MOR	MORT	WO	22.3	44.6	84	yes
92	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	B	MOR	MORT	WO		4.90	77	yes
93	Van Vleet et al. 1981	80	duck (*Anas* sp.)	2	U	FD	28	day	NR	NR	JV	M	MOR	MORT	WO		66.9	77	yes

Notes:

Not all studies presented in the cadmium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2005a) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Rationale for study unacceptability is in parentheses

[b] As reported in the Eco-SSL. The correct publication year for this paper is 1979.

[c] Dose/response dataset was reviewed and determined to be an unbounded no-observed-adverse-effect level (NOAEL) (differs from the Eco-SSL document).

[d] The citation for this paper was not presented in the Eco-SSL document and the paper was not found through an online search.

ENR - endpoint not relevant

LOAEL - lowest-observed-adverse-effect level

SDC - study design concern

SNF - data not found

UN - unbounded NOAEL

Table A-3. Cadmium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Reproduction																			
163	Wills et al. 1981	646	rat (*Rattus norvegicus*)	3	U	FD	64	week	NR	NR	GE	B	REP	PROG	WO	0.0069		74	no (UN)
164	Webster 1988	525	mouse (*Mus musculus*)	4	U	DR	60	day	8	week	GE	F	REP	PRWT	WO	0.0939	15.6	76	yes
165	Sorell and Braziano 1990	822	rat (*Rattus norvegicus*)	4	U	DR	14	day	NR	NR	GE	F	REP	PRWT	WO	0.651	4.88	78	yes
166	Combs et al. 1983	643	rat (*Rattus norvegicus*)	5	U	FD	57	day	NR	NR	JV	M	REP	TEWT	TE	0.890		70	no (UN)
167	Sutou, et al. 1980	443	rat (*Rattus norvegicus*)	4	U	GV	6	week	5	week	GE	F	REP	Other	WO	1.00	10.0	85	no (DNU)
168	Sutou et al. 1980	647	rat (*Rattus norvegicus*)	4	U	GV	6	week	5	week	GE	F	REP	RSEM	WO	1.00	10.0	90	yes
169	Sawicka-Kapusta et al. 1994	694	mouse (*Mus musculus*)	4	U	FD	6	day	NR	NR	GE	F	REP	DEYO	WO	1.14	2.28	84	yes
170	Ahokas et al. 1980	669	rat (*Rattus norvegicus*)	4	U	DR	21	day	NR	NR	GE	F	REP	PRWT	WO	1.57	4.50	79	yes
171	Loeser and Lorke 1977	754	rat (*Rattus norvegicus*)	5	U	FD	3	month	NR	NR	JV	B	REP	SPCL	SM	2.53		70	no (ENR, UN)
172	Baranski and Sitarek 1987	809	rat (*Rattus norvegicus*)	5	U	GV	7	week	3	month	JV	F	REP	GREP	WO	4.00	40.0	85	no (ENR)
173	Baranski et al. 1983	641	rat (*Rattus norvegicus*)	4	U	GV	8	week	3	month	GE	F	REP	RSEM	WO	4.00		72	no (UN)
174	Zielinska-Psuja et al. 1979	569	rat (*Rattus norvegicus*)	3	U	FD	3	month	NR	NR	JV	M	REP	TEWT	TE	5.40	54.0	83	no (ENR)
175	Sasser et al. 1985	9321	rat (*Rattus norvegicus*)	4	U	DR	21	day	5	month	GE	F	REP	PRWT	WO	6.00	10.0	81	yes
176	Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	5	U	GV	9	day	4	month	GE	F	REP	FERT	WO	6.13	18.4	92	yes
177	Kotsonis and Klassen 1978	778	rat (*Rattus norvegicus*)	4	U	DR	24	week	70	day	JV	M	REP	PRFM	WO	6.44		66	no (UN)
178	Zenick et al. 1982	661	rat (*Rattus norvegicus*)	4	U	DR	11	week	100	day	JV	M	REP	SPCL	SM	7.41		67	no (ENR, UN)
179	Caflisch 1994	607	rat (*Rattus norvegicus*)	3	U	DR	40	day	NR	NR	AD	M	REP	TEWT	TE	11.4		74	no (ENR, UN)
180	Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	4	U	FD	9	day	4	month	GE	F	REP	FERT	WO	12.5		74	no (UN)
181	Desi et al. 1998	592	rat (*Rattus norvegicus*)	4	U	GV	16	day	12	week	GE	F	REP	PRWT	WO	13.9		77	no (UN)
182	Cornwall et al. 1984	651	rat (*Rattus norvegicus*)	2	U	GV	13	day	NR	NR	GE	F	REP	RSEM	WO	25.0		79	no (UN)
183	Seidenberg et al. 1986	113	mouse (*Mus musculus*)	2	U	GV	4	day	NR	NR	GE	F	REP	PRWT	WO	41.1		80	no (UN)
184	Wardell et al. 1982	748	rat (*Rattus norvegicus*)	5	U	GV	12	day	NR	NR	GE	F	REP	RSEM	WO	50.0	75	92	yes
185	Simmons et al. 1984	652	rat (*Rattus norvegicus*)	4	U	GV	13	day	NR	NR	GE	F	REP	RSEM	WO	50.0		77	no (UN)
186	Whelton et al. 1988	625	mouse (*Mus musculus*)	3	U	FD	252	day	68	day	GE	F	REP	PROG	WO		0.661	79	yes
187	Webster 1978	824	mouse (*Mus musculus*)	4	U	DR	19	day	NR	NR	GE	F	REP	PRWT	WO		1.42	80	yes
188	Schroeder and Mitchener 1971	66	mouse (*Mus musculus*)	2	U	DR	6	month	21	day	JV	F	REP	DEYO	WO		1.45	67	yes
189	Swiergosz et al. 1998	506	bank vole (*Clethrionomys glareolus*)	3	U	FD	6	month	5	month	JV	M	REP	SPCL	TE		1.87	79	no (ENR)
190	Hastings et al. 1978	571	rat (*Rattus norvegicus*)	2	U	DR	111	day	NR	NR	GE	F	REP	PRWT	WO		2.14	68	yes
191	Steibert et al. 1984	543	rat (*Rattus norvegicus*)	2	U	DR	170	day	NR	NR	GE	F	REP	PRWT	WO		3.93	75	yes
192	Mallol et al. 1984	550	rat (*Rattus norvegicus*)	2	U	DR	25	day	2	week	JV	B	REP	TEWT	TE		4.61	73	no (ENR)
193	Webster 1979	823	mouse (*Mus musculus*)	2	U	DR	19	day	NR	NR	GE	F	REP	PRWT	WO		5.59	74	yes
194	Steibert et al. 1984	544	rat (*Rattus norvegicus*)	2	U	DR	170	day	7	week	JV	F	REP	PRWT	WO		5.82	74	yes
195	Gupta et al. 1993	608	rat (*Rattus norvegicus*)	2	U	DR	28	day	NR	NR	GE	F	REP	PRWT	WO		6.30	73	yes
196	Saxena et.al. 1989	2857	rat (*Rattus norvegicus*)	2	U	DR	120	day	NR	NR	JV	M	REP	SPCL	TE		7.28	69	no (ENR)
197	Pond and Walker 1975	3731	rat (*Rattus norvegicus*)	2	U	FD	21	day	12	week	GE	F	REP	PRWT	WO		236	80	yes
Growth																			
198	Wills et al. 1981	646	rat (*Rattus norvegicus*)	3	U	FD	64	week	NR	NR	JV	B	GRO	BDWT	WO	0.00690		72	no (UN)
199	Vreman et al. 1988	471	cattle (*Bos taurus*)	2	M	FD	330	day	NR	NR	JV	M	GRO	BDWT	WO	0.00792		69	no (RU, UN)
200	Vreman et al. 1988	471	cattle (*Bos taurus*)	2	M	FD	328	day	NR	NR	JV	M	GRO	BDWT	WO	0.00884		69	no (RU, UN)
201	Vreman et al. 1988	471	cattle (*Bos taurus*)	2	M	FD	330	day	NR	NR	JV	M	GRO	BDWT	WO	0.0187		69	no (RU, UN)
202	Lind et al. 1997	685	mouse (*Mus musculus*)	2	M	FD	5	week	NR	NR	JV	F	GRO	BDWT	WO	0.0584		74	no (UN)
203	King et al. 1992	488	pig (*Sus scrofa*)	5	M	FD	128	day	NR	NR	JV	F	GRO	BDWT	WO	0.0793		74	no (UN)
204	Merali and Singhal 1980	639	rat (*Rattus norvegicus*)	3	U	GV	7	day	1	day	JV	M	GRO	BDWT	WO	0.100	1.0	88	yes
205	Rastogi et al. 1977	753	rat (*Rattus norvegicus*)	3	U	GV	30	day	1	day	JV	NR	GRO	BDWT	WO	0.100	1.0	83	yes
206	Williams et al. 1978	483	vole (*Microtus pennsylvanicus*)	2	U	FD	40	day	NR	NR	JV	NR	GRO	BDWT	WO	0.179		69	no (UN)
207	Ahokas et al. 1980	669	rat (*Rattus norvegicus*)	4	U	DR	21	day	NR	NR	GE	F	GRO	BDWT	WO	0.207	1.57	75	yes

Table A-3. Cadmium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Growth (continued)																			
208	Cousins et al. 1977	670	rat (*Rattus norvegicus*)	3	U	FD	14	week	NR	NR	JV	M	GRO	BDWT	WO	0.268	1.34	82	yes
209	Koo and Winslow 1983	12092	rat (*Rattus norvegicus*)	3	U	FD	11	week	NR	NR	JV	M	GRO	BDWT	WO	0.323		72	no (UN)
210	Baranski and Sitarek 1987	809	rat (*Rattus norvegicus*)	5	U	GV	12	week	3	month	JV	F	GRO	BDWT	WO	0.400	4.0	83	yes
211	Doyle et al. 1974	3703	sheep (*Ovis aires*)	5	U	FD	163	day	4	month	JV	M	GRO	BDWT	WO	0.448	0.909	80	no (RU)
212	Williams et al. 1978	483	vole (*Microtus pennsylvanicus*)	3	U	FD	40	day	NR	NR	JV	NR	GRO	BDWT	WO	0.478		69	no (UN)
213	Williams et al. 1978	483	vole (*Microtus pennsylvanicus*)	2	U	FD	40	day	NR	NR	JV	NR	GRO	BDWT	WO	0.579		69	no (UN)
214	Ogoshi et al. 1989	720	rat (*Rattus norvegicus*)	3	U	DR	4	week	21	day	JV	F	GRO	BDWT	WO	0.581	1.16	77	yes
215	Schroeder et al. 1963	14446	rat (*Rattus norvegicus*)	2	U	DR	32	day	28	day	JV	B	GRO	BDWT	WO	0.593		66	no (UN)
216	Perry et al. 1977	3730	rat (*Rattus norvegicus*)	7	U	DR	24	month	21	day	JV	F	GRO	BDWT	WO	0.645	1.61	74	yes
217	Yuhas et al. 1979	776	rat (*Rattus norvegicus*)	4	U	DR	2	week	35	day	JV	M	GRO	BDWT	WO	0.770	7.70	72	yes
218	Combs et al. 1983	643	rat (*Rattus norvegicus*)	5	U	FD	57	day	NR	NR	JV	M	GRO	BDWT	WO	0.890		69	no (UN)
219	Combs et al. 1983	643	rat (*Rattus norvegicus*)	5	U	FD	57	day	NR	NR	JV	M	GRO	BDWT	WO	0.890		69	no (UN)
220	Sutou, et al. 1980	443	rat (*Rattus norvegicus*)	4	U	GV	6	week	5	week	GE	F	GRO	BDWT	WO	1.00	10.0	83	yes
221	Takashima et al. 1980	563	rat (*Rattus norvegicus*)	4	U	FD	19	month	NR	NR	JV	M	MPH	GMPH	BO	1.04	5.18	81	no (ENR)
222	Bhattacharyya et al. 1988	626	mouse (*Mus musculus*)	3	U	FD	252	day	68	day	GE	F	GRO	BDWT	WO	1.08	10.8	82	no (CNR)
223	Loeser and Lorke 1977	446	dog (*Canis familiaris*)	5	U	FD	3	month	4-6	month	JV	B	GRO	BDWT	WO	1.36		68	no (UN)
224	Sugawara and Sugawara 1983	21111	rat (*Rattus norvegicus*)	2	U	DR	36	day	27	day	JV	F	GRO	BDWT	WO	1.78		72	no (UN)
225	Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	5	U	GV	9	day	2	month	GE	F	GRO	BDWT	WO	1.84	6.13	88	yes
226	Mitra et al. 1995	783	rat (*Rattus norvegicus*)	2	M	FD	6	week	1	month	JV	NR	GRO	BDWT	WO	1.85		76	no (UN)
227	Mangler et al. 1988	521	rat (*Rattus norvegicus*)	2	U	DR	18	month	28	day	JV	F	GRO	BDWT	WO	2.22		73	no (UN)
228	Loeser and Lorke 1977	754	rat (*Rattus norvegicus*)	5	U	FD	3	month	NR	NR	JV	B	GRO	BDWT	WO	2.53		68	no (UN)
229	Yuyama 1982	710	rat (*Rattus norvegicus*)	4	U	FD	2	week	5	week	JV	M	GRO	BDWT	WO	2.65	10.6	82	yes
230	Washko and Cousins 1977	770	rat (*Rattus norvegicus*)	2	U	DR	8	week	NR	NR	JV	M	GRO	BDWT	WO	2.78		72	no (UN)
231	Lee et al. 1994	733	rat (*Rattus norvegicus*)	4	U	GV	8	week	60	day	JV	M	GRO	BDWT	WO	3.00	10.0	88	yes
232	Mitsumori et al. 1998	591	rat (*Rattus norvegicus*)	5	U	FD	4	day	5	week	JV	F	GRO	BDWT	WO	3.08	15.4	82	yes
233	Steibert et al. 1984	543	rat (*Rattus norvegicus*)	2	U	DR	170	day	NR	month	AD	F	GRO	BDWT	WO	3.73		73	no (UN)
234	Cousins et al. 1973	502	pig (*Sus scrofa*)	5	U	FD	6	week	55	day	JV	M	GRO	BDWT	WO	4.05	12.1	84	yes
235	Chetty et al. 1980	650	rat (*Rattus norvegicus*)	4	U	FD	4	week	NR	NR	JV	M	GRO	BDWT	WO	4.36	8.71	83	yes
236	Koller and Roan 1977	814	mouse (*Mus musculus*)	4	U	DR	70	day	28	day	JV	NR	GRO	BDWT	WO	4.44	44.4	76	yes
237	Watanabe et al. 1986	632	mouse (*Mus musculus*)	6	M	FD	2	year	7	week	AD	F	GRO	BDWT	WO	4.97		74	no (UN)
238	Swiergosz et al. 1998	506	bank vole (*Clethrionomys glareolus*)	3	U	FD	6	month	5	month	JV	M	GRO	BDWT	WO	4.99		68	no (UN)
239	Zielinska-Psuja et al. 1979	569	rat (*Rattus norvegicus*)	3	U	FD	3	month	NR	NR	JV	M	GRO	BDWT	WO	5.40	54.0	81	yes
240	Sugawara and Sugawara 1983	21111	rat (*Rattus norvegicus*)	2	U	DR	330	day	27	day	JV	F	GRO	BDWT	WO	5.54		72	no (UN)
241	Gustafson and Mercer 1984	551	rat (*Rattus norvegicus*)	7	U	FD	21	day	NR	NR	JV	M	GRO	BDWT	WO	6.06	15.2	83	yes
242	Blakely 1984	547	mouse (*Mus musculus*)	4	U	DR	3	week	6	week	JV	F	GRO	BDWT	WO	7.23		71	no (UN)
243	Zenick et al. 1982	661	rat (*Rattus norvegicus*)	4	U	DR	80	day	100	day	JV	M	GRO	BDWT	WO	7.38		72	no (UN)
244	Weber and Reid 1969	677	mouse (*Mus musculus*)	4	U	FD	3	week	NR	NR	JV	B	GRO	BDWT	WO	8.53		69	no (UN)
245	Ogoshi et al. 1989	720	rat (*Rattus norvegicus*)	6	U	DR	4	week	24	week	AD	NR	GRO	BDWT	WO	8.54	17.1	77	yes
246	Tanaka et al. 1995	690	rat (*Rattus norvegicus*)	3	M	FD	5	month	3	week	JV	M	GRO	BDWT	WO	8.61		73	no (UN)
247	Wlostowski et al. 2000	25891	bank vole (*Clethrionomys glareolus*)	3	UX	FD	6	week	1	month	JV	M	GRO	BDWT	WO	10.5		82	no (UN)
248	Watanabe et al. 1986	632	mouse (*Mus musculus*)	5	M	FD	2	year	10	week	GE	F	GRO	BDWT	WO	11.8		74	no (UN)
249	Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	4	U	FD	9	day	4	month	GE	F	GRO	BDWT	WO	12.5		72	no (UN)
250	Kodama et al. 1989	507	dog (*Canis familiaris*)	6	U	FD	250	week	8	month	JV	B	MPH	GMPH	BO	12.5		68	no (ENR, UN)
251	Wlostowski and Krasowska 1999	25890	bank vole (*Clethrionomys glareolus*)	3	UX	FD	6	week	1	month	JV	M	GRO	BDWT	WO	12.6		83	no (UN)
252	Ogoshi et al. 1989	720	rat (*Rattus norvegicus*)	3	U	DR	4	week	2	year	AD	NR	MPH	GMPH	FM	16.9		67	no (ENR, UN)
253	King et al. 1992	488	pig (*Sus scrofa*)	3	M	FD	132	day	NR	NR	JV	F	GRO	BDWT	WO	21.3		74	no (UN)

Table A-3. Cadmium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Growth (continued)																			
254	Nation et al. 1990	617	rat (*Rattus norvegicus*)	2	U	FD	61	day	50	day	JV	M	GRO	BDWT	WO	31.3		68	no (UN)
255	Exon et al. 1979	3847	mouse (*Mus musculus*)	5	U	DR	6	week	NR	NR	JV	M	GRO	BDWT	WO	43.0	85.9	73	yes
256	Hamada et al. 1991	465	dog (*Canis familiaris*)	6	U	FD	9	year	6-8	month	JV	B	GRO	BDWT	WO	50.0	100	87	yes
257	Weigel et al. 1987	629	rat (*Rattus norvegicus*)	3	M	FD	6	week	NR	NR	JV	M	GRO	BDWT	WO		0.0744	76	yes
258	Bakry et al. 1992	772	rat (*Rattus norvegicus*)	2	U	GV	2	week	NR	NR	JV	B	MPH	GMPH	WO		0.143	84	no (ENR)
259	Smith et al. 1985	636	rat (*Rattus norvegicus*)	2	U	GV	14	day	5	day	JV	M	DVP	GDPV	EY		1.00	84	no (ENR)
260	Rajanna et al. 1984	637	rat (*Rattus norvegicus*)	4	U	FD	180	day	6	week	JV	M	GRO	BDWT	WO		1.97	77	yes
261	Groten et al. 1991	615	rat (*Rattus norvegicus*)	2	M	FD	7	day	5	week	JV	B	GRO	BDWT	WO		3.01	82	yes
262	Wilson et al. 1940[b]	825	rat (*Rattus norvegicus*)	6	U	FD	25	day	NR	NR	JV	M	GRO	BDWT	WO		3.21	77	yes
263	Osuna and Edds 1980[c]	494	pig (*Sus scrofa*)	2	M	FD	4	week	NR	NR	JV	M	GRO	BDWT	WO		3.43	83	no (UN[d])
264	Pond et al. 1973	583	pig (*Sus scrofa*)	2	U	FD	50	day	NR	NR	JV	NR	GRO	BDWT	WO		3.88	78	yes
265	Suzuki and Yoshida 1978	572	rat (*Rattus norvegicus*)	2	U	FD	14	day	NR	NR	JV	M	GRO	BDWT	WO		4.06	78	yes
266	Suzuki and Yoshida 1979	780	rat (*Rattus norvegicus*)	4	U	FD	28	day	NR	NR	JV	M	GRO	BDWT	WO		4.58	77	yes
267	Suzuki and Yoshida 1978	768	rat (*Rattus norvegicus*)	2	U	FD	9	day	NR	NR	JV	M	GRO	BDWT	WO		5.08	77	yes
268	Suzuki and Yoshida 1979	780	rat (*Rattus norvegicus*)	2	U	FD	14	day	NR	NR	JV	M	GRO	BDWT	WO		5.18	77	yes
269	Meyer et al. 1982	662	rat (*Rattus norvegicus*)	3	U	FD	30	day	NR	NR	JV	M	GRO	BDWT	WO		5.44	78	yes
270	Lynch et al. 1976	3711	cattle (*Bos taurus*)	2	U	OR	63	day	NR	NR	JV	M	GRO	BDWT	WO		5.74	79	no (RU)
271	Steibert et al. 1984	544	rat (*Rattus norvegicus*)	2	U	DR	170	day	7	week	JV	F	GRO	BDWT	WO		5.82	72	yes
272	Ando et al. 1978	801	rat (*Rattus norvegicus*)	2	U	GV	2	month	64	day	JV	F	MPH	GMPH	BO		6.13	84	no (ENR)
273	Freundt and Irbahim 1990	2640	rat (*Rattus norvegicus*)	2	U	DR	5	week	NR	NR	AD	F	GRO	BDWT	WO		6.89	72	yes
274	Nakamura et al. 1983	638	rat (*Rattus norvegicus*)	2	U	FD	11	week	NR	NR	NR	F	GRO	BDWT	WO		9.54	78	yes
275	Banis et al. 1969	3733	rat (*Rattus norvegicus*)	2	U	FD	30	day	NR	NR	JV	M	GRO	BDWT	WO		9.70	77	yes
276	Iguchi and Sano 1982	556	rat (*Rattus norvegicus*)	3	U	FD	8	week	NR	NR	YO	M	MPH	GMPH	TB		10.0	77	no (ENR)
277	Banis et al. 1969	3733	rat (*Rattus norvegicus*)	2	U	FD	3	week	5	week	JV	B	GRO	BDWT	WO		10.4	77	yes
278	Eakin et al. 1980	659	rat (*Rattus norvegicus*)	2	U	FD	16	week	NR	NR	JV	M	GRO	BDWT	WO		13.2	72	yes
279	Kajikawa et al. 1981	667	rat (*Rattus norvegicus*)	2	U	DR	91	week	NR	NR	JV	M	GRO	BDWT	WO		14.7	72	yes
280	Pond and Walker 1975	3731	rat (*Rattus norvegicus*)	2	U	FD	21	day	12	week	GE	F	GRO	BDWT	WO		16.8	78	yes
281	Suzuki and Yoshida 1977	574	rat (*Rattus norvegicus*)	2	U	FD	10	day	NR	NR	JV	M	GRO	BDWT	WO		20.7	77	yes
282	Van Vleet et al. 1981	149	pig (*Sus scrofa*)	2	U	FD	2	week	NR	NR	JV	M	GRO	BDWT	WO		75.8	77	yes
283	Dodds-Smith et al. 1992	440	shrew (*Sorex araneus*)	2	U	FD	12	week	NR	NR	JV	B	GRO	BDWT	WO		103	77	yes
284	Weber and Reid 1969	677	mouse (*Mus musculus*)	4	U	FD	3	week	NR	NR	JV	B	GRO	BDWT	WO		571	78	yes
Survival																			
285	Wills et al. 1981	646	rat (*Rattus norvegicus*)	3	U	FD	64	week	NR	NR	JV	B	MOR	MORT	WO	0.00690		73	no (UN)
286	Loeser and Lorke 1977	446	dog (*Canis familiaris*)	5	U	FD	3	month	4-6	month	JV	B	MOR	MORT	WO	1.36		78	no (UN)
287	Swiergosz et al. 1998	506	bank vole (*Clethrionomys glareolus*)	3	U	FD	6	month	5	month	JV	M	MOR	MORT	WO	1.87	4.99	84	yes
288	Mangler et al. 1988	521	rat (*Rattus norvegicus*)	2	U	DR	18	month	28	day	JV	F	MOR	MORT	WO	2.22		74	no (UN)
289	Loeser and Lorke 1977	754	rat (*Rattus norvegicus*)	5	U	FD	3	month	NR	NR	JV	B	MOR	MORT	WO	2.53		69	no (UN)
290	Groten et al. 1991	615	rat (*Rattus norvegicus*)	2	M	FD	56	day	5	week	JV	B	MOR	MORT	WO	2.61		83	no (UN)
291	Baranski and Sitarek 1987	809	rat (*Rattus norvegicus*)	5	U	GV	13	week	3	month	JV	F	MOR	MORT	WO	4.00	40.0	84	yes
292	Baranski et al. 1983	641	rat (*Rattus norvegicus*)	4	U	GV	8	week	3	month	GE	F	MOR	SURV	WO	4.00		76	no (UN)
293	Whelton et al. 1988	625	Mouse (*Mus musculus*)	3	U	FD	252	day	68	day	GE	F	MOR	MORT	WO	6.61		78	no (UN)
294	Sutou, et al. 1980	443	rat (*Rattus norvegicus*)	4	U	GV	6	week	5	week	JV	B	MOR	MORT	WO	10.0		85	no (UN)
295	Sasser et al. 1985	9321	rat (*Rattus norvegicus*)	4	U	DR	21	day	5	month	GE	F	MOR	MORT	WO	10.0		74	no (UN)
296	Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	4	U	FD	9	day	4	month	GE	F	MOR	MORT	WO	12.5		73	no (UN)
297	Van Vleet et al. 1981	149	pig (*Sus scrofa*)	2	U	FD	10	week	NR	NR	JV	M	MOR	MORT	WO	21.3		77	no (UN)
298	Seidenberg et al. 1986	113	mouse (*Mus musculus*)	2	U	GV	4	day	NR	NR	GE	F	MOR	MORT	WO	41.1		79	no (UN)

Table A-3. Cadmium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Survival (continued)																			
299	Cousins et al. 1973	502	pig (*Sus scrofa*)	5	U	FD	6	week	55	day	JV	M	MOR	MORT	WO	67.3		70	no (UN)
300	Dodds-Smith et al. 1992	440	shrew (*Sorex araneus*)	2	U	FD	12	week	NR	NR	JV	B	MOR	MORT	WO	103		78	no (UN)
301	Weber and Reid 1969	677	mouse (*Mus musculus*)	4	U	FD	3	week	NR	NR	JV	B	MOR	MORT	WO	571	2160	83	yes
302	Schroeder et al. 1963	14446	rat (*Rattus norvegicus*)	2	U	DR	6	month	28	day	JV	M	MOR	SURV	WO		0.551	67	yes
303	Schroeder et al. 1964	14447	mouse (*Mus musculus*)	2	U	DR	18	month	21	day	JV	B	MOR	SURV	WO		0.620	73	yes
304	Lynch et al. 1976	3711	cattle (*Bos taurus*)	2	U	OR	63	day	NR	NR	JV	M	MOR	SURV	WO		5.74	80	no (RU)

Notes:
Not all studies presented in the cadmium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).
See Eco-SSL document (USEPA 2005a) for the full reference list for studies cited in this table.
Abbreviations from the Eco-SSL document are defined in Table A-1.
Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Rationale for study unacceptability is in parentheses
[b] As reported in the Eco-SSL. The correct publication year for this paper is 1941.
[c] As reported in the Eco-SSL. The correct publication year for this paper is 1982.
[d] Dose/response dataset was reviewed and determined to be an unbounded no-observed-adverse-effect level (NOAEL) (differs from the Eco-SSL document).
CNR - control group not relevant
DNU - data not usable
ENR - endpoint not relevant
LOAEL - lowest-observed-adverse-effect level
RU - ruminant study
UN - unbounded NOAEL

Table A-4. Copper Data for Birds as Presented in Eco-SSL Document, Inculding Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Reproduction																			
189	Ankari et al. 1998	2006	chicken (*Gallus domesticus*)	4	U	FD	84	day	25	week	LB	F	REP	EGPN	WO	4.05	12.1	80	yes
190	Harms and Buresh 1986	2117	chicken (*Gallus domesticus*)	3	U	FD	6	week	64	week	LB	F	REP	EGPN	WO	13.9	19.5	85	yes
191	Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	6	U	FD	280	day	18	week	LB	F	EGG	EGWT	EG	15.6	23.3	86	no (ENR)
192	Stevenson et al. 1983	6170	chicken (*Gallus domesticus*)	4	U	GV	5	day	27	week	LB	F	REP	PROG	WO	16.7	34.0	89	yes
193	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	LB	F	REP	EGPN	WO	17.0	25.5	86	yes
194	Stevenson et al. 1983	6170	chicken (*Gallus domesticus*)	4	U	FD	5	day	27	week	LB	F	REP	PROG	WO	18.0	28.0	86	yes
195	Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	6	U	FD	280	day	18	week	LB	F	EGG	EGWT	EG	19.4	29.0	86	no (ENR)
196	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	LB	F	REP	EGPN	WO	20.5	30.7	86	yes
197	Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	5	U	FD	336	day	17	week	LB	F	REP	EGPN	WO	21.6		71	no (UN)
198	Griminger 1977	2112	chicken (*Gallus domesticus*)	5	U	FD	2	week	7	month	LB	F	EGG	ESTH	EG	22.4	44.8	85	no (ENR)
199	Pearce et al. 1983	2294	chicken (*Gallus domesticus*)	5	U	FD	12	day	26	week	LB	F	REP	EGPN	WO	22.5	45.0	85	yes
200	Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	5	U	FD	232	day	17	week	LB	F	REP	EGPN	WO	23.2	29.9	86	yes
201	Stevenson and Jackson 1981	2291	chicken (*Gallus domesticus*)	2	M	FD	6	week	24	week	LB	F	REP	EGPN	WO	23.9		76	no (UN)
202	Stevenson and Jackson 1980	2292	chicken (*Gallus domesticus*)	5	U	FD	6	day	24	week	LB	F	REP	EGPN	WO	27.2	54.4	85	yes
203	Chiou et al. 1997	2050	chicken (*Gallus domesticus*)	5	M	FD	4	week	28	week	LB	F	REP	EGPN	WO	27.5	40.6	91	yes
204	Jackson 1977	2157	chicken (*Gallus domesticus*)	6	U	FD	35	day	NR	NR	LB	F	REP	PROG	WO	29.1	47.5	86	yes
205	Jackson and Stevenson 1981	2291	chicken (*Gallus domesticus*)	2	M	FD	6	week	24	week	LB	F	REP	EGPN	WO	30.4		76	no (SDC, UN)
206	Chiou et al. 1998	2049	chicken (*Gallus domesticus*)	4	U	FD	4	week	38	week	LB	F	REP	EGPN	WO	33.4	40.1	86	no (SDC)
207	Jackson and Stevenson 1981	2291	chicken (*Gallus domesticus*)	2	M	FD	6	week	24	week	LB	F	REP	EGPN	WO	35.2		76	no (SDC, UN)
208	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	LB	F	REP	ORWT	OV	40.0	50.0	86	no (ENR)
209	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	LB	F	REP	EGPN	WO	43.3		71	no (UN)
210	Shivanandappa et al. 1983	3727	chicken (*Gallus domesticus*)	6	U	OR	3	week	25	week	JV	M	REP	SPCV	TE	239	318	87	no (ENR)
211	Kadirvel and Kothandaraman 1978	11876	chicken (*Gallus domesticus*)	2	U	FD	28	week	12	week	LB	F	EGG	EGWT	WO		19.7	80	no (ENR)
212	Stevenson and Jackson 1980	2293	chicken (*Gallus domesticus*)	4	U	FD	8	week	24	week	LB	F	REP	EGPN	WO		22.6	79	yes
213	Shivanandappa et al. 1983	3727	chicken (*Gallus domesticus*)	5	U	OR	3	week	25	week	JV	M	REP	SPCV	TE		536	81	no (ENR)
Growth																			
214	Hoda and Maha 1995	2007	chicken (*Gallus domesticus*)	3	U	FD	6	week	1	day	JV	M	GRO	BDWT	WO	1.92		78	no (UN)
215	Kashani et al. 1986	2171	turkey (*Melagris gallopavo*)	4	U	FD	8	week	1	day	JV	M	GRO	BDWT	WO	2.34	4.68	83	yes
216	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	2	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	2.70		76	no (UN)
217	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO	2.75		76	no (UN)
218	Guenthner et al. 1978	2114	turkey (*Melagris gallopavo*)	2	U	FD	24	week	1	day	JV	M	GRO	BDWT	WO	2.97		68	no (UN)
219	McGhee et al. 1965	14453	chicken (*Gallus domesticus*)	5	U	FD	4	week	NR	NR	JV	NR	GRO	BDWT	WO	3.83	7.67	83	no (SDC)
220	King 1975	2177	duck (*Anas platyrhynchos*)	2	U	FD	56	day	8	day	JV	B	GRO	BDWT	WO	4.15		76	no (UN)
221	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	4	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	4.43		76	no (UN)
222	King 1972	2178	chicken (*Gallus domesticus*)	2	U	FD	9	week	1	day	JV	B	GRO	BDWT	WO	4.65		67	no (UN)
223	Kayongo-Male and Palmer 1998	5149	turkey (*Melagris gallopavo*)	3	U	FD	4	week	NR	NR	JV	NR	GRO	BDWT	WO	4.75		68	no (UN)
224	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	2	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	5.43		76	no (UN)
225	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	3	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	5.56		76	no (UN)
226	Waibel et al. 1964	14405	turkey (*Melagris gallopavo*)	3	U	FD	3	week	7	day	JV	NR	GRO	BDWT	WO	5.82	46.6	75	yes
227	Hoda and Maha 1995	2007	chicken (*Gallus domesticus*)	3	U	FD	6	week	1	day	JV	NR	GRO	BDWT	WO	6.28		78	no (UN)
228	Hoda and Maha 1995	2007	chicken (*Gallus domesticus*)	3	U	FD	6	week	1	day	JV	NR	GRO	BDWT	WO	7.55		78	no (UN)
229	Hill 1974	92	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	B	GRO	BDWT	WI	7.63		76	no (UN)
230	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	2	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	8.19		76	no (UN)
231	Ko et al. 1985	2181	chicken (*Gallus domesticus*)	4	U	FD	3	week	3	day	JV	M	GRO	BDWT	WO	8.40		69	no (UN)
232	Ekperigin and Vohra 1981	6474	chicken (*Gallus domesticus*)	4	U	FD	7	day	6	day	JV	NR	GRO	BDWT	WO	8.59	42.9	80	yes
233	Ekperigin and Vohra 1981	6474	chicken (*Gallus domesticus*)	3	U	FD	7	day	7	day	JV	NR	GRO	BDWT	WO	8.59	42.9	80	yes
234	Gill et al. 1995	2107	chicken (*Gallus domesticus*)	4	U	FD	3	week	4	week	JV	M	GRO	BDWT	WO	9.52	19.0	84	no (SNF)
235	Skrivan et al. 2000	25969	chicken (*Gallus domesticus*)	2	M	FD	38	day	1	day	JV	B	GRO	BDWT	WO	9.72		82	no (UN)
236	Foster 1999	18769	duck (*Anas platyrhynchos*)	5	M	DR	14	day	4	day	JV	NR	GRO	BDWT	WO	10.2	51.6	82	no (SNF)
237	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	3	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	11.1		76	no (UN)
238	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	2	U	FD	42	day	21	day	JV	M	GRO	BDWT	WO	11.5		67	no (UN)
239	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	5	U	FD	35	day	1	day	JV	M	GRO	BDWT	WO	11.9		76	no (UN)
240	Nam et al. 1984	2226	chicken (*Gallus domesticus*)	3	U	FD	4	week	3	day	JV	NR	GRO	BDWT	WO	12.2	24.3	83	no (UN[c])

Table A-4. Copper Data for Birds as Presented in Eco-SSL Document, Inculding Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Growth (continued)																			
241	Foster 1999	18769	duck (*Anas platyrhynchos*)	2	M	DR	14	day	4	day	JV	NR	GRO	BDWT	WO	12.6		78	no (SNF)
242	Chiou et al. 1999	2048	chicken (*Gallus domesticus*)	4	U	FD	3	week	3	week	JV	NR	GRO	BDWT	WO	13.3	26.6	84	yes
243	Jenkins et al. 1970	2162	chicken (*Gallus domesticus*)	2	M	FD	6	week	1	day	JV	B	GRO	BDWT	WO	13.4		73	no (UN)
244	Marron et al. 2001	25968	chicken (*Gallus domesticus*)	2	U	FD	21	day	7	day	JV	M	GRO	BDWT	WO	14.2		68	no (UN)
245	Hill 1990	5734	chicken (*Gallus domesticus*)	5	U	FD	19	day	1	day	JV	F	GRO	BDWT	WO	14.2		76	no (UN)
246	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3	28.7	82	yes
247	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	5	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3	28.7	82	yes
248	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3	28.7	82	yes
249	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	5	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3	28.7	82	yes
250	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3	28.7	82	yes
251	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	2	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3		67	no (UN)
252	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	2	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	14.3		67	no (UN)
253	Bakalli et al. 1995	3717	chicken (*Gallus domesticus*)	2	U	FD	41	day	1	day	JV	M	GRO	BDWT	WO	14.3		76	no (UN)
254	Funk and Baker 1991	2099	chicken (*Gallus domesticus*)	3	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	15.7	25.8	84	yes
255	Miles et al. 1998	2221	chicken (*Gallus domesticus*)	4	U	FD	42	day	1	day	JV	B	GRO	BDWT	WO	16.5	24.7	84	yes
256	Stevenson and Jackson 1980	2292	chicken (*Gallus domesticus*)	5	U	FD	6	day	24	week	SM	F	GRO	BDWT	WO	16.7	33.4	83	yes
257	Miles et al. 1998	2221	chicken (*Gallus domesticus*)	4	U	FD	42	day	1	day	JV	B	GRO	BDWT	WO	17.2	25.8	84	yes
258	Pesti and Bakalli 1996	2244	chicken (*Gallus domesticus*)	4	U	FD	42	day	1	day	JV	M	GRO	BDWT	WO	17.5		76	no (UN)
259	Smith 1969	2284	chicken (*Gallus domesticus*)	4	U	FD	25	day	1	day	JV	M	GRO	BDWT	WO	17.8	31.1	83	yes
260	Wang et al. 1987	2319	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO	17.8	35.5	82	yes
261	Stevenson et al. 1983	6170	chicken (*Gallus domesticus*)	4	U	FD	5	day	27	week	SM	F	GRO	BDWT	WO	18.0	28.0	80	yes
262	Jensen and Maurice 1978	2164	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	NR	GRO	BDWT	WO	18.2		68	no (UN)
263	Ward et al. 1995	6788	turkey (*Melagris gallopavo*)	2	M	FD	10	day	5	day	JV	M	GRO	BDWT	WO	18.3		74	no (UN)
264	Jensen and Maurice 1978	2164	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	NR	GRO	BDWT	WO	18.3		68	no (UN)
265	Jensen and Maurice 1978	2164	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	NR	GRO	BDWT	WO	18.4		68	no (UN)
266	Jensen and Maurice 1978[d]	2166	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	18.5	37.1	83	yes
267	Jensen and Maurice 1978	2164	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	NR	GRO	BDWT	WO	18.6		68	no (UN)
268	Funk and Baker 1991	2099	chicken (*Gallus domesticus*)	5	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	19.6	30.5	84	yes
269	Kadirvel and Kothandaraman 1978	11876	chicken (*Gallus domesticus*)	2	U	FD	28	week	12	week	SM	F	GRO	BDWT	WO	19.7		69	no (UN)
270	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	GRO	BDWT	WO	20.5	30.7	84	yes
271	Pimentel et al. 1992	5617	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	B	GRO	BDWT	WO	20.9		68	no (UN)
272	Robbins and Baker 1980	2267	chicken (*Gallus domesticus*)	3	U	FD	14	day	8	day	JV	NR	GRO	BDWT	WO	21.3	42.7	83	yes
273	Ekperigin and Vohra 1981	6474	chicken (*Gallus domesticus*)	5	U	FD	7	day	9	day	JV	NR	GRO	BDWT	WO	21.5	42.9	82	yes
274	Ekperigin and Vohra 1981	6474	chicken (*Gallus domesticus*)	2	U	FD	8	day	9	day	JV	NR	GRO	BDWT	WO	21.5		76	no (UN)
275	Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	5	U	FD	336	day	17	week	SM	F	GRO	BDWT	WO	21.6		68	no (UN)
276	Wideman et al. 1996	2325	chicken (*Gallus domesticus*)	5	M	FD	2	week	1	day	JV	M	GRO	BDWT	WO	21.7		76	no (UN)
277	Miles et al. 1998	2221	chicken (*Gallus domesticus*)	4	M	FD	21	day	1	day	JV	B	GRO	BDWT	WO	21.9	34.0	89	yes
278	Griminger 1977	2112	chicken (*Gallus domesticus*)	5	U	FD	2	week	7	month	SM	F	GRO	BDWT	WO	22.4	44.8	83	yes
279	Kassim and Suwanpradit 1996	2172	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO	22.7	34.1	83	yes
280	Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	6	U	FD	280	day	18	week	SM	F	GRO	BDWT	WO	23.0	30.7	84	yes
281	Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	5	U	FD	232	day	17	week	SM	F	GRO	BDWT	WO	23.2	29.9	84	yes
282	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	GRO	BDWT	WO	23.3	31.0	84	yes
283	Stevenson and Jackson 1981	2291	chicken (*Gallus domesticus*)	2	M	FD	6	week	24	week	SM	F	GRO	BDWT	WO	23.9		74	no (UN)
284	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	24.7		67	no (UN)
285	Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	6	U	FD	280	day	18	week	SM	F	GRO	BDWT	WO	26.4	35.2	84	yes
286	Ward et al. 1995	6788	turkey (*Melagris gallopavo*)	2	M	DR	10	day	5	day	JV	M	GRO	BDWT	WO	26.6		69	no (UN)
287	Ledoux et al. 1989	5812	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO	26.9	40.4	78	yes
288	Chiou et al. 1997	2050	chicken (*Gallus domesticus*)	5	M	FD	28	day	28	week	SM	F	GRO	BDWT	WO	27.9	35.3	89	yes
289	Hill 1989	7091	chicken (*Gallus domesticus*)	4	U	FD	19	day	NR	NR	JV	NR	GRO	BDWT	WO	28.4		70	no (UN)
290	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	28.7	57.4	82	yes
291	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	28.7		67	no (UN)
292	Miles et al. 1998	2221	chicken (*Gallus domesticus*)	4	M	FD	21	day	1	day	JV	B	GRO	BDWT	WO	29.5		83	no (UN)
293	Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	3	U	FD	21	day	NR	NR	JV	B	GRO	BDWT	WO	29.7	59.3	82	yes

Table A-4. Copper Data for Birds as Presented in Eco-SSL Document, Inculding Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Growth (continued)																			
294	Hill 1990	5734	chicken (*Gallus domesticus*)	4	U	FD	19	day	1	day	JV	F	GRO	BDWT	WO	30.4		76	no (UN)
295	Stevenson and Jackson 1981	2291	chicken (*Gallus domesticus*)	2	M	FD	6	week	24	week	SM	F	GRO	BDWT	WO	30.7		74	no (UN)
296	Mehring et al. 1960	22	chicken (*Gallus domesticus*)	5	M	FD	10	week	1	day	JV	B	GRO	BDWT	WO	33.0	43.3	88	yes
297	Jensen et al. 1991	2163	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO	34.1		68	no (UN)
298	Harms and Buresh 1986	2118	turkey (*Melagris gallopavo*)	3	U	FD	21	day	1	day	JV	B	GRO	BDWT	WO	34.6	51.9	84	yes
299	Funk and Baker 1991	2099	chicken (*Gallus domesticus*)	5	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	35.2	63.9	83	yes
300	Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	35.5		67	no (UN)
301	Hill 1990	5734	chicken (*Gallus domesticus*)	2	U	FD	19	day	1	day	JV	F	GRO	BDWT	WO	35.5		76	no (UN)
302	Funk and Baker 1991	2099	chicken (*Gallus domesticus*)	3	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	36.3		78	no (UN)
303	Jensen and Maurice 1979	2166	chicken (*Gallus domesticus*)	2	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	36.6		77	no (UN)
304	Davis et al. 1996	1278	chicken (*Gallus domesticus*)	2	U	FD	21	day	14	day	JV	M	GRO	BDWT	WO	37.1		69	no (UN)
305	Chiou et al. 1998	2049	chicken (*Gallus domesticus*)	4	U	FD	4	week	38	week	SM	F	GRO	BDWT	WO	40.1		69	no (UN)
306	Southern and Baker 1983	6368	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	41.0		68	no (UN)
307	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	GRO	BDWT	WO	43.3		69	no (UN)
308	Kassim and Suwanpradit 1996	2172	chicken (*Gallus domesticus*)	4	U	FD	3	week	3	week	JV	M	GRO	BDWT	WO	49.5	74.2	83	yes
309	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	GRO	BDWT	WO	50.0		69	no (UN)
310	Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	3	U	FD	21	day	NR	NR	JV	B	GRO	BDWT	WO	50.1		76	no (UN)
311	Jackson 1977	2157	chicken (*Gallus domesticus*)	6	U	FD	35	day	1	year	SM	F	GRO	BDWT	WO	50.9	55.9	84	yes
312	Foster 1999	18769	duck (*Anas platyrhynchos*)	4	M	FD	35	day	3	day	JV	NR	GRO	BDWT	WO	56.8	109	89	no (SNF)
313	Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	5	U	FD	21	day	NR	NR	JV	B	GRO	BDWT	WO	60.0	120	82	yes
314	Stevenson et al. 1983	6170	chicken (*Gallus domesticus*)	4	U	GV	5	day	27	week	SM	F	GRO	BDWT	WO	65.4		68	no (UN)
315	Yannakopoulos et al. 1990	2333	Japanese quail (*Coturnix japonica*)	4	U	FD	34	day	7	day	JV	B	GRO	BDWT	WO	82.0		78	no (UN)
316	Leeson and Summers 1982	2196	chicken (*Gallus domesticus*)	4	U	FD	21	day	1	day	JV	M	GRO	BDWT	WO	103		68	no (UN)
317	Foster 1999	18769	duck (*Anas platyrhynchos*)	2	M	FD	35	day	3	day	JV	NR	GRO	BDWT	WO	143		78	no (SNF)
318	Ko et al. 1985	2181	chicken (*Gallus domesticus*)	4	U	FD	3	week	3	day	JV	M	GRO	BDWT	WO		2.69	78	no (SNF)
319	Kashani et al. 1986	2171	turkey (*Melagris gallopavo*)	2	U	FD	8	week	1	day	JV	M	GRO	BDWT	WO		4.88	77	yes
320	Harms and Eberst 1974	9234	turkey (*Melagris gallopavo*)	2	U	FD	3	week	1	day	JV	NR	GRO	GGRO	WO		10.3	77	no (UN[c])
321	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO		14.3	76	yes
322	Jensen and Maurice 1978	2165	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO		17.5	77	yes
323	Latymer and Coates 1981	2191	chicken (*Gallus domesticus*)	2	U	FD	24	day	1	day	JV	B	GRO	BDWT	WO		21.3	77	yes
324	Stevenson and Jackson 1980	2293	chicken (*Gallus domesticus*)	4	U	FD	8	week	24	week	SM	F	GRO	BDWT	WO		22.6	77	yes
325	Ledoux et al. 1987	2194	chicken (*Gallus domesticus*)	3	UX	FD	21	day	1	day	JV	F	GRO	BDWT	WO		22.7	82	no (DNU)
326	Robbins and Baker 1980	2266	chicken (*Gallus domesticus*)	3	U	FD	8	day	8	day	JV	M	GRO	BDWT	WO		26.4	77	yes
327	Robbins and Baker 1980	2266	chicken (*Gallus domesticus*)	3	U	FD	8	day	8	day	JV	M	GRO	BDWT	WO		26.4	77	yes
328	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	5	week	1	day	JV	B	GRO	BDWT	WO		28.7	76	yes
329	Christmas and Harms 1979	2052	turkey (*Melagris gallopavo*)	3	U	FD	21	day	1	day	JV	B	GRO	BDWT	WO		31.4	78	yes
330	Jensen and Maurice 1978	2165	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO		34.9	77	yes
331	Stevenson and Jackson 1981	2291	chicken (*Gallus domesticus*)	2	M	FD	6	week	24	week	SM	F	GRO	BDWT	WO		35.2	83	yes
332	Ekperigin and Vohra 1981	2084	chicken (*Gallus domesticus*)	3	U	FD	1	week	12	day	JV	B	GRO	BDWT	WO		35.5	76	yes
333	Wang et al. 1987	2319	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO		35.5	76	yes
334	Hill 1974	92	chicken (*Gallus domesticus*)	6	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO		42.9	76	yes
335	Robbins and Baker 1980	2267	chicken (*Gallus domesticus*)	2	U	FD	12	day	8	day	JV	NR	GRO	BDWT	WO		50.1	77	yes
336	Robbins and Baker 1980	2266	chicken (*Gallus domesticus*)	2	U	FD	8	day	8	day	JV	M	GRO	BDWT	WO		55.2	77	yes
337	Robbins and Baker 1980	2267	chicken (*Gallus domesticus*)	2	U	FD	8	day	8	day	JV	NR	GRO	BDWT	WO		57.2	77	yes
338	Robbins and Baker 1980	2267	chicken (*Gallus domesticus*)	2	U	FD	12	day	8	day	JV	NR	GRO	BDWT	WO		59.0	77	yes
339	Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	4	U	FD	21	day	NR	NR	JV	B	GRO	BDWT	WO		60.0	76	yes
340	Foster 1999	18769	duck (*Anas platyrhynchos*)	2	M	FD	35	day	3	day	JV	NR	GRO	BDWT	WO		75.5	83	no (SNF)
341	Hill 1979	1370	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	NR	GRO	BDWT	WO		85.9	76	yes
342	Jensen 1975	1403	chicken (*Gallus domesticus*)	2	U	FD	14	day	1	day	JV	NR	GRO	BDWT	WO		92.9	78	yes
343	Hill 1980	395	chicken (*Gallus domesticus*)	2	U	FD	1	week	1	day	JV	F	GRO	BDWT	WO		138	70	yes

Table A-4. Copper Data for Birds as Presented in Eco-SSL Document, Inculding Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Survival																			
344	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	2	week	NR	NR	JV	B	MOR	MORT	WO	2.75		70	no (UN)
345	Wood and Worden 1973	36216	chicken (*Gallus domesticus*)	2	U	FD	49	day	2	day	JV	B	MOR	MORT	WO	3.55		77	no (UN)
346	Wood and Worden 1973	36216	duck (*Anas platyrhynchos*)	2	U	FD	49	day	2	day	JV	B	MOR	MORT	WO	6.69		77	no (UN)
347	Hill 1974	92	chicken (*Gallus domesticus*)	2	U	FD	5	week	1	day	JV	B	MOR	MORT	WO	7.63		68	no (UN)
348	McGhee et al. 1965	14453	chicken (*Gallus domesticus*)	5	U	FD	4	week	NR	NR	JV	NR	MOR	MORT	WO	8.14	16.3	84	no (SDC)
349	Ko et al. 1985	2181	chicken (*Gallus domesticus*)	4	U	FD	3	week	3	day	JV	M	MOR	MORT	WO	8.40		79	no (UN)
350	Skrivan et al. 2000	25969	chicken (*Gallus domesticus*)	2	M	FD	38	day	1	day	JV	B	MOR	MORT	WO	9.72		74	no (UN)
351	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	11.7		68	no (UN)
352	Jenkins et al. 1970	2162	chicken (*Gallus domesticus*)	2	M	FD	6	week	1	day	JV	B	MOR	MORT	WO	13.4		83	no (UN)
353	Marron et al. 2001	25968	chicken (*Gallus domesticus*)	2	U	FD	21	day	7	day	JV	M	MOR	MORT	WO	14.2		78	no (UN)
354	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	5	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	14.3	28.7	83	yes
355	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	14.3	28.7	83	yes
356	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	2	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	14.3		77	no (UN)
357	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	2	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	14.3		77	no (UN)
358	Wood and Worden 1973	36216	duck (*Anas platyrhynchos*)	2	U	FD	16	day	2	day	JV	B	MOR	MORT	WO	18.1		77	no (UN)
359	Ward et al. 1995	6788	turkey (*Melagris gallopavo*)	2	M	FD	10	day	5	day	JV	M	MOR	MORT	WO	18.3		84	no (UN)
360	Ankari et al. 1998	2006	chicken (*Gallus domesticus*)	4	U	FD	84	day	25	week	SM	F	MOR	MORT	WO	19.9		73	no (UN)
361	Latymer and Coates 1981	2191	chicken (*Gallus domesticus*)	2	U	FD	24	day	1	day	JV	B	MOR	MORT	WO	21.3		69	no (UN)
362	Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	5	U	FD	336	day	17	week	SM	F	MOR	MORT	WO	21.6		79	no (UN)
363	Ward et al. 1995	6788	turkey (*Melagris gallopavo*)	2	M	DR	10	day	5	day	JV	M	MOR	MORT	WO	26.6		79	no (UN)
364	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	28.7	57.4	83	yes
365	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	5	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	28.7	57.4	83	yes
366	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	5	week	1	day	JV	M	MOR	MORT	WO	28.7		70	no (UN)
367	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	28.7		77	no (UN)
368	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	28.7		77	no (UN)
369	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	28.7		77	no (UN)
370	Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	28.7		77	no (UN)
371	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	MOR	MORT	WO	29.7		79	no (UN)
372	Miles et al. 1998	2221	chicken (*Gallus domesticus*)	4	U	FD	42	day	1	day	JV	B	MOR	MORT	WO	29.7		79	no (UN)
373	Miles et al. 1998	2221	chicken (*Gallus domesticus*)	4	U	FD	42	day	1	day	JV	B	MOR	MORT	WO	30.8		70	no (UN)
374	Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	6	U	FD	280	day	18	week	SM	F	MOR	MORT	WO	31.6		79	no (UN)
375	Mehring et al. 1960	22	chicken (*Gallus domesticus*)	5	M	FD	10	week	1	day	JV	B	MOR	MORT	WO	33.0	43.3	89	yes
376	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	MOR	MORT	WO	35.2		79	no (UN)
377	Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	6	U	FD	280	day	18	week	SM	F	MOR	MORT	WO	35.4		79	no (UN)
378	Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	5	U	FD	232	day	17	week	SM	F	MOR	MORT	WO	35.5		79	no (UN)
379	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	MOR	MORT	WO	43.3		79	no (UN)
380	Waibel et al. 1964	14405	turkey (*Melagris gallopavo*)	3	U	FD	3	week	7	day	JV	NR	MOR	SURV	WO	46.6		72	no (UN)
381	Christmas and Harms 1979	2052	turkey (*Melagris gallopavo*)	3	U	FD	21	day	1	day	JV	B	MOR	MORT	WO	48.3		79	no (UN)
382	Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	6	U	FD	336	day	26	week	SM	F	MOR	MORT	WO	50.0		79	no (UN)
383	Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	5	U	FD	21	day	NR	NR	JV	B	MOR	MORT	WO	60.0	120	83	yes
384	Jackson 1977	2157	chicken (*Gallus domesticus*)	6	U	FD	35	day	NR	NR	SM	F	MOR	MORT	WO	62.7		78	no (UN)
385	Hill 1974	92	chicken (*Gallus domesticus*)	6	U	FD	5	week	1	day	JV	F	MOR	MORT	WO	81.6	122	83	yes
386	Hill 1979	1370	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	B	MOR	MORT	WO	85.9		77	no (UN)
387	Jensen 1975	1403	chicken (*Gallus domesticus*)	2	U	FD	14	day	1	day	JV	NR	MOR	MORT	WO	92.9		79	no (UN)
388	Van Vleet et al. 1981	80	duck (*Anas platyrhynchos*)	2	U	FD	15	day	1	day	JV	M	MOR	MORT	WO	201		77	no (UN)
389	Ko et al. 1985	2181	chicken (*Gallus domesticus*)	4	U	FD	3	week	3	day	JV	M	MOR	MORT	WO		2.69	79	no (SNF)
390	Foster 1999	18769	duck (*Anas platyrhynchos*)	2	M	DR	4	day	4	day	JV	NR	MOR	MORT	WO		78.5	77	no (SNF)

Table A-4. Copper Data for Birds as Presented in Eco-SSL Document, Inculding Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Survival (continued)																			
391	Shivanandappa et al. 1983	3727	chicken (*Gallus domesticus*)	6	U	OR	3	week	25	week	JV	M	MOR	MORT	WO		79.6	80	no (CNR)
392	Van Vleet et al. 1981	80	duck (*Anas platyrhynchos*)	2	U	FD	15	day	1	day	JV	M	MOR	MORT	WO		201	77	yes
393	Shivanandappa et al. 1983	3727	chicken (*Gallus domesticus*)	5	U	OR	4	day	25	week	JV	M	MOR	MORT	WO		536	80	no (CNR)

Notes:

Not all studies presented in the copper ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007a) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) values that are equal and from the same reference represent different experimental designs.

[b] Rationale for study unacceptability is in parentheses

[c] Dose/response dataset was reviewed and determined to be an unbounded NOAEL (differs from the Eco-SSL document).

[d] As reported in the Eco-SSL. The correct publication year for this paper is 1979.

CNR - control group data not reported

DNU - data not usable (insufficient data)

ENR - endpoint not relevant

SDC - study design concern

SNF - study not found

UN - unbounded NOAEL

Table A-5. Copper Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Reproduction																			
156	Aulerich et al. 1982	2013	mink (*Mustela vision*)	5	U	FD	357	day	NR	month	JV	F	REP	PROG	WO	3.40	6.79	85	yes
157	Thacker 1991	2304	pig (*Sus scrofa*)	2	U	FD	7	day	NR	NR	GE	F	REP	PROG	WO	6.51		79	no (UN)
158	Webster 1979	823	mouse (*Mus musculus*)	4	U	FD	19	day	4	month	GE	F	REP	PRWT	WO	50.7		79	no (UN)
159	Lecyk 1980	2193	mouse (*Mus musculus*)	7	U	FD	49	day	NR	NR	GE	B	REP	PROG	WO	90.9	136	84	yes
160	Lecyk 1980	2193	mouse (*Mus musculus*)	7	U	FD	49	day	NR	NR	GE	B	REP	PROG	WO	90.9	136	84	yes
161	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	FD	13	week	6	week	JV	M	REP	SPCL	SM	107		80	no (ENR, UN)
162	NTP 1993a	2127	rat (*Rattus norvegicus*)	4	U	FD	92	day	6	week	JV	M	REP	SPCL	SM	304		70	no (ENR, UN)
163	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	FD	13	week	6	week	JV	M	REP	SPCL	SM	358		76	no (ENR, UN)
164	NTP 1993a	2127	mouse (*Mus musculus*)	4	U	FD	92	day	6	week	JV	M	REP	SPCL	SM	48300		70	no (ENR, UN)
165	Cromwell et al. 1993	2062	pig (*Sus scrofa*)	2	U	FD	783	day	10	month	GE	F	REP	RSUC	WO		5.51	80	yes
166	Bataineh et al. 1998	1717	rat (*Rattus norvegicus*)	2	U	DR	12	week	NR	NR	AD	M	REP	TEWT	TE		41.2	67	no (ENR)
Growth																			
167	Engle and Spears 2001	25940	cattle (*Bos taurus*)	2	U	FD	239	day	NR	NR	JV	M	GRO	BDWT	WO	0.812		69	no (RU, UN)
168	Engle et al. 2000	25935	cattle (*Bos taurus*)	2	U	FD	154	day	NR	NR	JV	M	GRO	BDWT	WO	0.852		69	no (RU, UN)
169	Bailey et al. 2001	25941	cattle (*Bos taurus*)	3	M	FD	112	day	NR	NR	JV	NR	GRO	BDWT	WO	1.33		73	no (RU, UN)
170	Arthur 1965	2012	guinea pig (*Cavia porcellus*)	3	U	FD	8	week	NR	NR	JV	B	GRO	BDWT	WO	1.48		70	no (UN)
171	Uthus 2001	36349	rat (*Rattus norvegicus*)	2	U	FD	62	day	NR	NR	JV	M	GRO	BDWT	WO	2.07		77	no (UN)
172	Miranda et al. 1981	36240	rat (*Rattus norvegicus*)	2	M	FD	5	week	NR	NR	JV	M	GRO	BDWT	WO	3.60		81	no (UN)
173	Bassuny 1991	2020	rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	week	35	day	JV	M	GRO	BDWT	WO	4.25		78	no (UN)
174	Ward et al. 1991	1888	pig (*Sus scrofa*)	2	M	FD	144	day	31	day	JV	B	GRO	BDWT	WO	4.37		74	no (UN)
175	King 1975	2179	rabbit (*Oryctolagus cuniculus*)	2	U	FD	8	week	5	week	JV	B	GRO	BDWT	WO	5.43		76	no (UN)
176	Cromwell et al. 1993	2062	pig (*Sus scrofa*)	2	U	FD	783	day	10.3	month	GE	F	GRO	BDWT	WO	5.51		69	no (UN)
177	Allcroft et al. 1961	14387	pig (*Sus scrofa*)	4	M	FD	4	week	8-10	week	JV	B	GRO	BDWT	WO	5.60	9.34	88	yes
178	Gershbein et al. 1983	136	rat (*Rattus norvegicus*)	2	U	FD	80	day	44	day	JV	M	GRO	BDWT	WO	5.89		68	no (UN)
179	Anugwa et al. 1984	2010	rabbit (*Oryctolagus cuniculus*)	3	M	FD	8	week	8	week	JV	B	GRO	BDWT	WO	6.67		74	no (UN)
180	Apgar et al. 1995	25922	pig (*Sus scrofa*)	4	M	FD	5	week	31	day	JV	B	GRO	BDWT	WO	6.90		74	no (UN)
181	Cromwell et al. 1998	25930	pig (*Sus scrofa*)	4	U	FD	28	day	26-32	day	JV	B	GRO	BDWT	WO	7.19		69	no (UN)
182	Omole 1977	12977	rabbit (*Oryctolagus cuniculus*)	4	U	FD	8	week	6	week	JV	B	GRO	BDWT	WO	7.34		69	no (UN)
183	Cromwell et al. 1998	25930	pig (*Sus scrofa*)	2	U	FD	28	day	26-32	day	JV	B	GRO	BDWT	WO	7.36		69	no (UN)
184	Cromwell et al. 1998	25930	pig (*Sus scrofa*)	2	M	FD	28	day	29	day	JV	B	GRO	BDWT	WO	7.37		74	no (UN)
185	Kline et al. 1971	20975	pig (*Sus scrofa*)	4	M	FD	88	day	69	day	JV	NR	GRO	BDWT	WO	7.63		73	no (UN)
186	Gipp et al. 1973	14396	pig (*Sus scrofa*)	2	U	FD	12	week	NR	NR	JV	F	GRO	BDWT	WO	7.66		68	no (UN)
187	Cromwell et al. 1989	2061	pig (*Sus scrofa*)	3	U	FD	28	day	28	day	JV	B	GRO	BDWT	WO	7.68		69	no (UN)
188	Luo and Dove 1996	25929	pig (*Sus scrofa*)	2	U	FD	15	day	26	day	JV	M	GRO	BDWT	WO	7.72		69	no (UN)
189	Myres and Bowland 1973	12809	pig (*Sus scrofa*)	2	U	FD	10	week	70	day	JV	B	GRO	BDWT	WO	7.84		69	no (UN)
190	Ritchie et al. 1963	14402	pig (*Sus scrofa*)	2	U	FD	15	week	7	week	JV	NR	GRO	BDWT	WO	8.08		68	no (UN)
191	Cromwell et al. 1998	25930	pig (*Sus scrofa*)	2	M	FD	28	day	30	day	JV	B	GRO	BDWT	WO	8.21		74	no (UN)
192	Braude and Ryder 1973	2034	pig (*Sus scrofa*)	4	M	FD	112	day	9	week	JV	NR	GRO	BDWT	WO	8.29		73	no (UN)
193	Allcroft et al. 1961	14387	pig (*Sus scrofa*)	4	M	FD	19	week	8-10	week	JV	B	GRO	BDWT	WO	8.43		73	no (UN)
194	Prince et al 1979	2253	pig (*Sus scrofa*)	2	U	FD	59	day	64	day	JV	NR	GRO	BDWT	WO	8.44		68	no (UN)
195	Cromwell et al. 1998	25930	pig (*Sus scrofa*)	3	M	FD	28	day	29	day	JV	B	GRO	BDWT	WO	8.50		74	no (UN)
196	Cromwell et al. 1998	25930	pig (*Sus scrofa*)	4	M	FD	28	day	30	day	JV	B	GRO	BDWT	WO	8.68		74	no (UN)
197	Cromwell et al 1989	2061	pig (*Sus scrofa*)	3	U	FD	28	day	28	day	JV	B	GRO	BDWT	WO	9.60		69	no (UN)
198	Gipp et al. 1974	14397	pig (*Sus scrofa*)	2	U	FD	35	day	3	week	JV	B	GRO	BDWT	WO	9.93		69	no (UN)
199	Brandt 1983	2033	mink (*Mustela vision*)	3	M	FD	4	month	90	day	JV	M	GRO	BDWT	WO	10.2	19.6	88	yes
200	Edmonds and Baker 1986	2075	pig (*Sus scrofa*)	3	U	FD	28	day	4	week	JV	NR	GRO	BDWT	WO	10.3	26.9	84	yes
201	Radecki et al. 1992	2255	pig (*Sus scrofa*)	2	U	FD	14	day	21	day	JV	B	GRO	BDWT	WO	12.0		68	no (UN)
202	Aulerich et al. 1982	2013	mink (*Mustela vision*)	5	U	FD	20	week	NR	month	JV	B	GRO	BDWT	WO	12.4		68	no (UN)
203	Felsman et al. 1973	3760	cattle (*Bos taurus*)	4	U	FD	98	day	6	week	JV	M	GRO	BDWT	WO	12.7		68	no (RU, UN)
204	Smith et al. 1975	3756	horse - Shetland pony (*Equus caballus*)	4	M	FD	84	day	NR	NR	JV	NR	GRO	BDWT	WO	13.8		74	no (UN)
205	Suttle and Mills 1966	3757	pig (*Sus scrofa*)	3	U	FD	14	day	NR	NR	JV	F	GRO	BDWT	WO	16.2	27.6	84	yes
206	Cromwell et al. 1989	2061	pig (*Sus scrofa*)	5	U	FD	33	day	28	day	JV	B	GRO	BDWT	WO	16.4		69	no (UN)
207	Apgar and Kornegay 1996	25928	pig (*Sus scrofa*)	2	M	FD	14	day	NR	NR	JV	M	GRO	BDWT	WO	16.5		77	no (UN)
208	Cromwell et al. 1989	2061	pig (*Sus scrofa*)	4	U	FD	28	day	28	day	JV	B	GRO	BDWT	WO	16.7		69	no (UN)

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Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Growth (continued)																			
209	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	DR	15	day	6	week	JV	B	GRO	BDWT	WO	17.2	51.6	79	yes
210	Lalich et al. 1965	2189	rat (*Rattus norvegicus*)	2	U	FD	42	day	NR	NR	JV	M	GRO	BDWT	WO	17.5		68	no (UN)
211	Cromwell et al. 1989	2061	pig (*Sus scrofa*)	4	U	FD	28	day	28	day	JV	B	GRO	BDWT	WO	17.8		69	no (UN)
212	Felsman et al. 1973	3760	cattle (*Bos taurus*)	4	U	FD	98	day	6	week	JV	M	GRO	BDWT	WO	22.9		68	no (RU, UN)
213	Grobner et al. 1986	2113	rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	day	28	day	JV	NR	GRO	BDWT	WO	27.7	45.7	89	yes
214	Onifade and Abu 1998	2237	rabbit (*Oryctolagus cuniculus*)	4	U	FD	70	day	7	week	JV	NR	GRO	BDWT	WO	28.4		77	no (UN)
215	Bush et al. 1995	2043	mink (*Mustela vision*)	3	M	FD	132	day	10	week	JV	B	GRO	BDWT	WO	33.4		82	no (UN)
216	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	DR	8	day	6	week	JV	B	GRO	BDWT	WO	33.8	101	78	yes
217	King 1975	2179	rabbit (*Oryctolagus cuniculus*)	2	U	FD	6	week	5	week	JV	B	GRO	BDWT	WO	37.1		67	no (UN)
218	White et al. 1985	2324	rat (*Rattus norvegicus*)	2	U	FD	50	day	21	day	JV	M	GRO	BDWT	WO	43.1		68	no (UN)
219	DeVries et al. 1986	10891	rat (*Rattus norvegicus*)	2	U	DR	11	month	3	week	JV	F	GRO	BDWT	WO	45.8		73	no (UN)
220	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	FD	13	week	6	week	JV	B	GRO	BDWT	WO	49.8	99.6	84	no (DNU[c])
221	Komulainen 1983	12079	rat (*Rattus norvegicus*)	4	U	DR	1	week	4	week	JV	M	GRO	BDWT	WO	50.0	64.0	82	yes
222	Grobner et al. 1986	2113	rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	day	28	day	JV	NR	GRO	BDWT	WO	59.0		74	no (UN)
223	Myers et al. 1993	2225	rat (*Rattus norvegicus*)	2	U	DR	6	week	NR	month	JV	M	GRO	BDWT	WO	73.4		67	no (UN)
224	Tatum et al. 2000	36389	rat (*Rattus norvegicus*)	2	U	FD	6	week	NR	NR	JV	F	GRO	BDWT	WO	75.7		68	no (UN)
225	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	FD	15	day	6	week	JV	B	GRO	BDWT	WO	82.5	165	84	yes
226	Keen et al. 1982	11928	rat (*Rattus norvegicus*)	4	U	FD	7	week	NR	NR	JV	F	GRO	BDWT	WO	91.7	183	83	yes
227	NTP 1993a	2127	rat (*Rattus norvegicus*)	6	U	FD	92	day	6	week	JV	M	GRO	BDWT	WO	146	293	83	yes
228	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	FD	13	week	6	week	JV	B	GRO	BDWT	WO	179	358	84	no (DNU)
229	Dodds-Smith et al. 1992	440	common shrew (*Sorex araneus*)	2	U	FD	12	week	NR	NR	JV	B	GRO	BDWT	WO	229		77	no (UN)
230	NTP 1993a	2127	rat (*Rattus norvegicus*)	5	U	DR	2	week	6	week	JV	M	GRO	BDWT	WO	259	400	78	yes
231	Pettersen et al. 2002	36374	mouse (*Mus musculus*)	3	U	FD	3	week	4	week	JV	B	GRO	BDWT	WO	494	988	83	yes
232	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	FD	15	day	6	week	JV	B	GRO	BDWT	WO	690		69	no (UN)
233	NTP 1993a	2127	rat (*Rattus norvegicus*)	6	U	FD	15	day	6	week	JV	M	GRO	BDWT	WO	812	1738	83	yes
234	NTP 1993a	2127	mouse (*Mus musculus*)	5	U	DR	2	week	6	week	JV	M	GRO	BDWT	WO	1427	3395	78	yes
235	NTP 1993a	2127	mouse (*Mus musculus*)	6	U	FD	92	day	6	week	JV	M	GRO	BDWT	WO	2113	4670	83	yes
236	NTP 1993a	2127	mouse (*Mus musculus*)	6	U	FD	15	day	6	week	JV	F	GRO	BDWT	WO	19500	47500	83	yes
237	Solaiman et al. 2001	36748	goat (*Capra hircus*)	3	U	GV	9	week	7-8	month	JV	F	GRO	BDWT	WO		1.47	80	no (RU)
238	Ortolani et al. 2003	36759	sheep (*Ovis aries*)	2	U	DR	35	day	6	month	JV	M	GRO	BDWT	WO		3.00	76	no (RU)
239	Freundt and Ibrahim 1990	2640	rat (*Rattus norvegicus*)	2	U	DR	91	day	NR	NR	JV	F	GRO	BDWT	WO		5.78	72	yes
240	DeGoey et al. 1971	2064	pig (*Sus scrofa*)	2	U	FD	98	day	NR	NR	JV	B	GRO	BDWT	WO		7.46	78	no (UN[d])
241	DeGoey et al. 1971	2064	pig (*Sus scrofa*)	2	U	FD	23	day	NR	NR	JV	NR	MPH	MUSC	MU		15.5	77	no (ENR)
242	Boyden 1938	14653	rat (*Rattus norvegicus*)	5	U	FD	4	week	28	day	JV	B	GRO	BDWT	WO		23.5	77	yes
243	Rana and Kumar 1980	2256	rat (*Rattus norvegicus*)	2	U	GV	20	day	90	day	JV	M	GRO	BDWT	WO		39.8	84	yes
244	Kumar et al. 1987	2186	rat (*Rattus norvegicus*)	2	U	GV	45	day	90	day	JV	M	GRO	BDWT	WO		39.8	84	yes
245	Llewellyn et al. 1985	2203	rat (*Rattus norvegicus*)	2	U	FD	21	week	NR	NR	JV	M	GRO	BDWT	WO		106	71	yes
246	Fuentealba et al. 2000	36364	rat (*Rattus norvegicus*)	2	U	FD	12	week	21	day	JV	B	GRO	BDWT	WO		122	76	yes
247	Haywood 1985	2121	rat (*Rattus norvegicus*)	5	U	FD	15	week	NR	NR	JV	M	GRO	BDWT	WO		274	71	yes
248	Haywood and Loughran 1985	2124	rat (*Rattus norvegicus*)	5	U	FD	6	week	NR	month	JV	M	GRO	BDWT	WO		285	77	yes

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Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Survival																			
249	Bassuny 1991	2020	rabbit (*Oryctolagus cuniculus*)	5	U	FD	7	week	35	day	JV	M	MOR	MORT	WO	4.25		79	no (UN)
250	Cromwell et al. 1993	2062	pig (*Sus scrofa*)	2	U	FD	783	day	10.3	month	GE	F	MOR	MORT	WO	5.51		70	no (UN)
251	Allcroft et al. 1961	14387	pig (*Sus scrofa*)	4	M	FD	4	week	8-10	week	JV	B	MOR	MORT	WO	5.60	9.34	89	yes
252	Brandt 1983	2033	mink (*Mustela vision*)	3	M	FD	4	month	90	day	JV	M	MOR	MORT	WO	10.2	19.6	89	yes
253	Jenkins 1989	48117	cattle (*Bos taurus*)	5	U	FD	6	week	3	day	JV	M	MOR	MORT	WO	16.3	32.5	77	no (RU)
254	Boyden 1938	14653	rat (*Rattus norvegicus*)	5	U	FD	1	week	28	day	JV	B	MOR	MORT	WO	23.3	35.0	84	yes
255	Edmonds and Baker 1986	2075	pig (*Sus scrofa*)	3	U	FD	28	day	4	week	JV	NR	MOR	MORT	WO	25.9		79	no (UN)
256	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	DR	15	day	6	week	JV	B	MOR	MORT	WO	33.3	111	78	yes
257	Bush et al. 1995	2043	mink (*Mustela vision*)	3	M	FD	132	day	10	week	JV	B	MOR	MORT	WO	33.4		83	no (UN)
258	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	DR	15	day	6	week	JV	F	MOR	MORT	WO	33.8	101	80	yes
259	Grobner et al. 1986	2113	rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	day	28	day	JV	NR	MOR	MORT	WO	45.5		75	no (UN)
260	Grobner et al. 1986	2113	rabbit (*Oryctolagus cuniculus*)	6	M	FD	28	day	28	day	JV	NR	MOR	MORT	WO	59.0		75	no (UN)
261	Keen et al. 1982	11928	rat (*Rattus norvegicus*)	4	U	FD	7	week	NR	NR	JV	F	MOR	MORT	WO	91.7	183	84	yes
262	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	FD	13	week	6	week	JV	B	MOR	MORT	WO	107		79	no (UN)
263	Dodds-Smith et al. 1992	440	common shrew (*Sorex araneus*)	2	U	FD	12	week	NR	NR	JV	B	MOR	MORT	WO	229		78	no (UN)
264	NTP 1993a	2127	rat (*Rattus norvegicus*)	5	U	DR	2	week	6	week	JV	M	MOR	MORT	WO	259	400	79	yes
265	NTP 1993a	2126	rat (*Rattus norvegicus*)	6	U	FD	15	day	6	week	JV	B	MOR	MORT	WO	307		79	no (UN)
266	Haywood 1985	2121	rat (*Rattus norvegicus*)	5	U	FD	2	week	NR	NR	JV	M	MOR	MORT	WO	457	548	78	no (DNR)
267	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	FD	15	day	6	week	JV	B	MOR	MORT	WO	690		70	no (UN)
268	NTP 1993a	2126	mouse (*Mus musculus*)	6	U	FD	13	week	6	week	JV	B	MOR	MORT	WO	760		79	no (UN)
269	NTP 1993a	2127	rat (*Rattus norvegicus*)	6	U	FD	92	day	6	week	JV	B	MOR	MORT	WO	798		78	no (UN)
270	NTP 1993a	2127	mouse (*Mus musculus*)	5	U	DR	2	week	6	week	JV	B	MOR	MORT	WO	1427	3395	79	yes
271	NTP 1993a	2127	rat (*Rattus norvegicus*)	6	U	FD	15	day	6	week	JV	M	MOR	MORT	WO	4160		78	no (UN)
272	NTP 1993a	2127	mouse (*Mus musculus*)	6	U	FD	15	day	6	week	JV	B	MOR	MORT	WO	47519		78	no (UN)
273	NTP 1993a	2127	mouse (*Mus musculus*)	6	U	FD	92	day	6	week	JV	B	MOR	MORT	WO	48270		78	no (UN)
274	Gopinath et al. 1974	36202	sheep (*Ovis aries*)	2	U	DR	10	week	6	month	JV	F	MOR	MORT	WO		5.09	77	no (RU)
275	Ishmael et al. 1971	2155	sheep (*Ovis aries*)	2	U	OR	31	day	6	month	JV	F	MOR	MORT	WO		7.57	75	no (RU)
276	Ritchie et al. 1963	14402	pig (*Sus scrofa*)	2	U	FD	15	week	7	week	JV	NR	MOR	MORT	WO		8.08	78	yes
277	DeGoey et al. 1971	2064	pig (*Sus scrofa*)	2	U	FD	23	day	NR	NR	JV	NR	MOR	MORT	WO		15.5	78	no (UN[c])
278	McNatt et al. 1971	2216	rat (*Rattus norvegicus*)	2	U	DR	3	week	4-11	month	JV	M	MOR	MORT	WO		114	68	yes

Notes:

Not all studies presented in the copper ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007a) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) values that are equal and from the same reference represent different experimental designs.

[b] Rationale for study unacceptability is in parentheses

[c] Dose/response dataset was reviewed and determined to be an unbounded NOAEL (differs from the Eco-SSL document).

DNR - data not relevant

DNU - data not used; data are the same as reported in NTP 1993a

ENR - endpoint not relevant

RU - ruminant study

UN - unbounded NOAEL

Table A-6. Lead Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Reproduction																			
50	Edens and Garlich 1983	2608	Japanese quail (*Coturnix japonica*)	4	U	FD	5	week	6	week	LB	F	REP	PROG	WO	0.194	1.94	77	yes
51	Edens and Garlich 1983	2608	chicken (*Gallus domesticus*)	3	U	FD	4	week	NR	NR	LB	F	REP	PROG	WO	1.63	3.26	79	yes
52	Meluzzi et al. 1996	2771	chicken (*Gallus domesticus*)	4	U	FD	30	day	22	week	LB	F	EGG	ALWT	EG	2.69	4.04	81	no (ENR)
53	Haegele et al. 1974	2668	chicken (*Gallus domesticus*)	2	U	FD	76	day	NR	NR	SM	F	EGG	ESTH	EG	5.63		71	no (ENR, UN)
54	Pattec 1984	2809	American kestrel (*Falco sparverius)*	3	M	FD	6	month	1-6	year	AD	F	REP	RSUC	WO	12.0		90	no (UN)
55	Morgan et al. 1975	2779	Japanese quail (*Coturnix japonica*)	5	U	FD	5	week	6	day	JV	M	REP	TEWT	TE	12.6	126	78	no (ENR)
56	Morgan et al. 1975	2779	Japanese quail (*Coturnix japonica*)	5	U	FD	5	week	1	day	JV	M	REP	TEWT	TE	67.4	135	80	no (ENR)
57	Stone and Soares 1976	2898	Japanese quail (*Coturnix japonica*)	3	U	FD	32	day	NR	NR	AD	F	REP	PROG	WO	125		67	no (UN)
58	Edens et al. 1976	2606	Japanese quail (*Coturnix japonica*)	5	U	FD	12	week	0	day	LB	B	REP	EGPN	EG		0.110	77	yes
59	Edens and Garlich 1983	2608	Japanese quail (*Coturnix japonica*)	4	U	FD	12	week	NR	NR	LB	F	REP	PROG	WO		0.194	75	yes
60	Edens and Garlich 1983	2608	chicken (*Gallus domesticus*)	5	U	FD	10	week	NR	NR	LB	F	REP	PROG	WO		3.26	75	yes
61	Kendall and Scanlon 1981	2734	ringed rurtle dove (*Streptopelia risoria*)	2	U	DR	11	week	NR	NR	AD	M	REP	TEWT	TE		11.8	68	no (ENR)
62	Edens and Melvin 1989	2609	Japanese quail (*Coturnix japonica*)	2	U	FD	1	week	14	week	JV	F	REP	TPRD	WO		93.1	75	yes
63	Stone and Soares 1976	2898	Japanese quail (*Coturnix japonica*)	2	U	FD	27	day	NR	NR	AD	F	REP	PROG	WO		377	74	yes
Growth																			
64	Edens and Garlich 1983	2608	Japanese quail (*Coturnix japonica*)	3	U	FD	5	week	1	day	JV	F	GRO	BDWT	WO	1.56	15.6	77	yes
65	Stone and Fox 1984	6291	Japanese quail (*Coturnix japonica*)	3	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO	2.77		72	no (UN)
66	Stone et al. 1977	2897	Japanese quail (*Coturnix japonica*)	2	U	FD	2	week	1	day	JV	NR	GRO	BDWT	WO	4.64		70	no (UN)
67	Edens and Melvin 1989	2609	Japanese quail (*Coturnix japonica*)	3	U	FD	4	week	0	day	JV	F	GRO	BDWT	WO	5.93	59.3	76	yes
68	Damron et al. 1969	14768	chicken (*Gallus domesticus*)	4	U	FD	4	week	4	week	JV	NR	GRO	BDWT	WO	6.1	61.4	76	yes
69	Damron et al. 1969	14768	chicken (*Gallus domesticus*)	4	U	FD	4	week	4	week	JV	NR	GRO	BDWT	WO	7.10	71.0	76	yes
70	Edens et al. 1976	2606	Japanese quail (*Coturnix japonica*)	5	U	FD	12	week	0	day	JV	F	GRO	BDWT	WO	11.1	111	79	yes
71	Edens 1985	2605	Japanese quail (*Coturnix japonica*)	5	U	FD	12	week	1	week	JV	F	GRO	BDWT	WO	11.2	112	76	yes
72	Morgan et al. 1975	2779	Japanese quail (*Coturnix japonica*)	5	U	FD	2	week	6	day	JV	NR	GRO	BDWT	WO	12.6	126	76	yes
73	Morgan et al. 1975	2779	Japanese quail (*Coturnix japonica*)	5	U	FD	1	week	1	day	JV	NR	GRO	BDWT	WO	13.5	67.4	76	yes
74	Howell and Hill 1978	1387	chicken (*Gallus domesticus*)	2	U	FD	21	day	1	day	JV	B	GRO	BDWT	WO	14.2		67	no (UN)
75	Jeng et al. 1979	2718	duck (*Ana platyrhynchos*)	3	U	GV	3	month	24	week	MA	F	GRO	BDWT	WO	20.0		87	no (UN)
76	Hoffman et al. 1985	2696	American kestrel *(Falco sparverius*)	4	U	GV	10	day	1	day	JV	NR	GRO	BDWT	WO	25.0	125	88	no (ICF)
77	Howell and Hill 1978	1387	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	B	GRO	BDWT	WO	28.4		67	no (UN)
78	Stone et al. 1981	6463	Japanese quail (*Coturnix japonica*)	5	U	FD	14	day	1	day	JV	B	GRO	BDWT	WO	34.5		77	no (UN)
79	Custer et al. 1984	2581	American kestrel (*Falco sparverius*)	4	M	FD	60	day	1-2	year	AD	B	GRO	BDWT	WO	54.3		68	no (UN)
80	Berg et al. 1980	2534	chicken (*Gallus domesticus*)	5	U	FD	2	week	1	day	JV	M	GRO	BDWT	WO	61.3	123	83	yes
81	Frederick 1976	2638	mallard (*Anas platyrhynchos*)	4	U	FD	8	day	9	day	JV	NR	GRO	BDWT	WO	66.9		67	no (UN)
82	Donaldson and McGowan 1989	1285	chicken (*Gallus domesticus*)	5	U	FD	20	day	1	day	JV	M	GRO	BDWT	WO		38.2	72	yes
83	Latta and Donaldson 1986	2744	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO		53.1	71	yes
84	Stone and Soares 1976	2898	Japanese quail (*Coturnix japonica*)	3	U	FD	32	day	NR	NR	AD	F	GRO	BDWT	WO		64.3	72	yes
85	Leeming and Donaldson 1984	2748	chicken (*Gallus domesticus*)	2	U	FD	19	day	1	day	JV	M	GRO	BDWT	WO		76.3	71	yes
86	Berg et al. 1980	2534	chicken (*Gallus domesticus*)	3	U	FD	2	week	1	day	JV	M	GRO	BDWT	WO		124	77	yes
87	Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	4	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO		152	71	yes
88	Donaldson 1986	2600	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	M	GRO	BDWT	WO		163	72	yes
89	Khan et al. 1993	5507	chicken (*Gallus domesticus*)	2	U	OR	4	week	NR	NR	JV	B	GRO	BDWT	WO		200	74	yes
90	Cupo and Donaldson 1987	2579	chicken (*Gallus domesticus*)	2	U	FD	7	day	1	day	JV	M	GRO	BDWT	WO		262	72	yes
91	Berg et al. 1980	2534	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	M	GRO	BDWT	WO		270	77	yes
92	Franson and Custer 1982	2635	chicken (*Gallus domesticus*)	2	U	FD	7	day	1	day	IM	NR	GRO	BDWT	WO		273	72	yes
93	Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO		282	71	yes

Table A-6. Lead Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Survival																			
94	Finley et al. 1976	2624	mallard (*Anas platyrhynchos)*	4	M	FD	12	week	1	year	AD	M	MOR	MORT	WO	2.47		80	no (UN)
95	Barthalmus et al. 1977	2526	pigeon (*Columba livia*)	4	U	GV	40	day	NR	NR	AD	M	MOR	MORT	WO	12.5	25.0	82	yes
96	Howell and Hill 1978	1387	chicken (*Gallus domesticus*)	2	U	FD	21	day	1	day	JV	B	MOR	MORT	WO	14.2		77	no (UN)
97	Howell and Hill 1978	1387	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	B	MOR	MORT	WO	28.4		77	no (UN)
98	Custer et al. 1984	2581	American kestrel (*Falco sparverius*)	4	M	FD	60	day	1-2	year	AD	B	MOR	MORT	WO	54.3		78	no (UN)
99	Frederick 1976	2638	mallard (*Anas platyrhynchos*)	4	U	FD	8	day	9	day	JV	NR	MOR	MORT	WO	66.9		77	no (UN)
100	Hoffman et al. 1985	2696	American kestrel (*Falco sparverius*)	4	U	GV	10	day	1	day	JV	NR	MOR	SURV	WO	125	625	89	no (ICF)
101	Vengris and Mare 1974	14384	chicken (*Gallus domesticus*)	7	U	GV	35	day	6	week	JV	B	MOR	MORT	WO	160	320	86	yes
102	Donaldson and McGowan 1989	1285	chicken (*Gallus domesticus*)	5	U	FD	20	day	1	day	JV	M	MOR	MORT	WO	163		66	no (UN)
103	Johnsen and Damron 1982	2724	goose (*Anser cygnides*)	5	U	FD	12	week	26	week	JV	NR	MOR	MORT	WO	196		73	no (UN)
104	Anders et al. 1982	2513	pigeon (*Columba livia*)	2	U	GV	4	week	NR	NR	AD	M	MOR	MORT	WO		6.3	73	yes
105	Cupo and Donaldson 1987	2579	chicken (*Gallus domesticus*)	2	U	FD	21	day	1	day	JV	M	MOR	MORT	WO		194	73	yes
106	Khan et al. 1993	1415	chicken (*Gallus domesticus*)	2	U	GV	7	day	43	day	JV	F	MOR	MORT	WO		400	80	yes

Notes:

Not all studies presented in the lead ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2005b) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Rationale for study unacceptability is in parentheses

ENR - endpoint not relevant

LOAEL - lowest-observed-adverse-effect level

NOAEL - no-observed-adverse-effect level

ICF - irrelevant chemical form

UN - unbounded NOAEL

Table A-7. Lead Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Reproduction																			
121	Grant et al. 1980	2658	rat (*Rattus norvegicus*)	5	U	DR	62	day	21	day	GE	F	REP	PRWT	WO	0.710	7.00	77	yes
122	Dilts and Ahokas 1979	2593	rat (*Rattus norvegicus*)	6	U	DR	21	day	NR	NR	GE	F	REP	PRWT	WO	1.00	5.00	74	yes
123	Gandley et al. 1999	2642	rat (*Rattus norvegicus*)	3	U	DR	35	day	NR	NR	AD	M	REP	RSUC	WO	2.60	26.0	72	yes
124	Grant et al. 1980	2658	rat (*Rattus norvegicus*)	4	U	DR	62	day	21	day	GE	B	REP	PRWT	WO	3.00	6.0	79	yes
125	Carson et al. 1973	3830	sheep (*Ovis aries*)	3	U	FD	27	week	NR	NR	GE	F	REP	RSUC	WO	4.50		68	no (RU, UN)
126	Dilts and Ahokas 1980	2592	rat (*Rattus norvegicus*)	6	U	DR	21	day	NR	NR	GE	F	REP	PRWT	WO	5.00	10.0	76	yes
127	Sierra and Tiffany-Castiglioni 1992	2876	guinea pig (*Cavia porcellus*)	3	U	DR	40	day	NR	NR	GE	F	REP	PRWT	WO	5.50		73	no (UN)
128	Jessup and Shott 1969	11831	rat (*Rattus norvegicus*)	5	U	FD	92	week	21	day	JV	M	REP	TEWT	TE	7.50	74.9	78	no (ENR)
129	Kimmel et al. 1980	2737	rat (*Rattus norvegicus*)	4	U	DR	23.8	day	21	day	LC	F	REP	Other	WO	8.90		76	no (UN)
130	Kimmel et al. 1980	2737	rat (*Rattus norvegicus*)	5	U	DR	23.8	day	21	day	GE	F	REP	Other	WO	9.10	45.0	73	yes
131	McMurry et al. 1995	2770	cotton rat (*Sigmodon hispidus*)	3	U	DR	7	week	NR	NR	AD	M	REP	RHIS	RT	12.4	170	67	no (ENR)
132	Barratt et al. 1989	2524	rat (*Rattus norvegicus*)	4	U	GV	9	week	10	week	JV	M	REP	SPCV	TE	18.0	180	85	no (ENR)
133	Zenick et al. 1979	2943	rat (*Rattus norvegicus*)	3	U	DR	100	day	21	day	GE	F	REP	PRWT	WO	25.4		68	no (UN)
134	Cerklewski 1980	10607	rat (*Rattus norvegicus*)	2	U	FD	35	day	70	day	LC	F	REP	PRWT	WO	27.5		66	no (UN)
135	Chowdhury et al. 1984	3721	rat (*Rattus norvegicus*)	4	U	DR	60	day	NR	NR	SM	M	REP	TEWT	TE	31.6	63.2	71	no (ENR)
136	Bull et al. 1978	14812	rat (*Rattus norvegicus*)	4	U	DR	56	day	70	day	LC	F	REP	PROG	WO	32.5		69	no (UN)
137	Winder et al. 1984	2934	rat (*Rattus norvegicus*)	3	U	DR	31	day	NR	day	LC	F	REP	PRWT	WO	33.3	111	72	yes
138	Miller et al. 1982	2775	rat (*Rattus norvegicus*)	4	U	GV	41	day	NR	NR	GE	F	REP	PRWT	WO	41.0	54.6	87	yes
139	Wolfe et al. 1996	2502	rat (*Rattus norvegicus*)	5	U	DR	1	week	94	day	JV	M	REP	SPCL	SM	47.3	82.0	84	no (ENR)
140	Sourgens et al. 1987	2889	rat (*Rattus norvegicus*)	4	U	DR	30	day	NR	NR	SM	M	REP	Other	SV	56.0	285	73	no (ENR)
141	Carpenter 1982	2565	hamster (*Mesocricetus auratus*)	2	U	DR	51	day	15	week	GE	F	REP	PROG	WO	64.8		69	no (UN)
142	Carpenter 1982	2565	hamster (*Mesocricetus auratus*)	2	U	DR	14	day	11	week	GE	F	REP	PROG	WO	64.9		67	no (UN)
143	Ronis et al. 1998	2847	rat (*Rattus norvegicus*)	4	U	DR	37	day	NR	NR	GE	F	REP	PRWT	WO	90.1	270	74	yes
144	Wardell et al. 1982	748	rat (*Rattus norvegicus*)	5	U	GV	12	day	NR	NR	GE	F	REP	RSEM	EM	100	150	87	yes
145	Hamilton and O'Flaherty 1994	2670	rat (*Rattus norvegicus*)	3	U	DR	68	day	25	day	GE	F	REP	PRWT	WO	115		72	no (UN)
146	Hamilton et al. 1994	2671	rat (*Rattus norvegicus*)	4	U	DR	77	day	25	day	GE	F	REP	PRWT	WO	116		68	no (UN)
147	Fox et al. 1977	2633	rat (*Rattus norvegicus*)	2	U	DR	21	day	NR	NR	LC	F	REP	PRWT	WO	120		68	no (UN)
148	Eyden et al. 1978	2618	mouse (*Mus musculus*)	3	U	FD	8	week	2	month	GE	M	REP	SPCV	TE	144	1440	78	no (ENR)
149	Maker et al. 1973	2758	mouse (*Mus musculus*)	7	U	FD	30	day	NR	NR	LC	F	REP	PRWT	WO	202	506	79	yes
150	Maker et al. 1973	2758	mouse (*Mus musculus*)	7	U	FD	30	day	NR	NR	LC	F	REP	PRWT	WO	202	506	79	yes
151	Cramer et al. 1980	14816	rat (*Rattus norvegicus*)	4	U	DR	21	day	NR	NR	GE	F	REP	DEYO	WO	276	552	74	yes
152	Nathan et al. 1992	2785	rat (*Rattus norvegicus*)	5	U	DR	10	week	NR	NR	AD	M	REP	TEWT	MT	294	587	71	no (ENR)
153	Brady et al. 1975	14795	rat (*Rattus norvegicus*)	2	U	GV	102	day	30	day	GE	F	REP	PRWT	WO	441		69	no (UN)
154	Wenda-Rozewicka et al. 1996	2928	rat (*Rattus norvegicus*)	2	U	DR	9	month	NR	NR	SM	M	REP	RHIS	TE	600		66	no (ENR, UN)
155	Barrett and Livesey 1983	10239	rat (*Rattus norvegicus*)	4	U	FD	4	day	NR	NR	LC	F	REP	PRWT	WO	601	1500	86	no (ICF)
156	Piasekand Kostial 1987	2817	rat (*Rattus norvegicus*)	4	U	DR	13	week	NR	NR	JV	M	REP	FERT	WO	639		66	no (UN)
157	Junaid et al. 1997	2725	mouse (*Mus musculus*)	4	U	GV	60	day	NR	NR	AD	F	REP	RPRD	OV		2.00	77	no (ENR)
158	Morris et al. 1938	15125	rat (*Rattus norvegicus*)	3	U	FD	339	day	26-27	day	JV	B	REP	PRWT	WO		2.49	74	no (UN[b])
159	Schroeder and Mitchener 1971	66	rat (*Rattus norvegicus*)	2	U	DR	9	month	21	day	JV	F	REP	DEYO	WO		2.94	67	yes
160	Schroeder and Mitchener 1971	66	mouse (*Mus musculus*)	2	U	DR	6	month	21	day	JV	F	REP	DEYO	WO		3.62	67	yes
161	Gupta et al. 1995	2666	mouse (*Mus musculus*)	4	U	GV	52	day	2	month	GE	F	REP	PROG	EM		5.50	81	yes
162	Saxena et al. 1989	2857	rat (*Rattus norvegicus*)	2	U	DR	120	day	1	day	GE	M	REP	SPCL	TE		6.76	69	no (ENR)
163	Cernochova and Kamarad 1992	2568	mouse (*Mus musculus*)	2	U	DR	5	week	NR	NR	AD	M	REP	TEDG	TE		16.6	66	no (ENR)
164	Al-Omar et al. 2000	20974	mouse (*Mus musculus*)	2	M	GV	2	week	NR	NR	JV	M	REP	SPCL	SM		46.4	86	no (ENR)
165	Winneke et al. 1977	3935	rat (*Rattus norvegicus*)	2	U	FD	102	day	NR	NR	GE	F	REP	PROG	WO		49.6	78	yes
166	Batra et al. 1998	2528	rat (*Rattus norvegicus*)	2	U	GV	3	month	8	week	SM	M	REP	TEDG	TE		50.0	81	no (ENR)
167	Hayashi 1983	3864	rat (*Rattus norvegicus*)	2	U	DR	18	day	NR	NR	GE	F	REP	PRWT	WO		55.5	68	yes
168	Kempinas et al. 1988	2733	rat (*Rattus norvegicus*)	3	U	DR	90	day	NR	NR	AD	M	REP	SPCL	SM		61.2	69	no (ENR)
169	Donald et al. 1981	2598	mouse (*Mus musculus*)	2	U	DR	23	day	NR	NR	GE	F	REP	PRWT	WO		78.6	69	yes
170	Donald et al. 1986	2599	mouse (*Mus musculus*)	2	U	DR	62	day	NR	NR	GE	F	REP	PRWT	WO		99.8	69	yes
171	Talcott and Koller 1983	2906	mouse (*Mus musculus*)	2	U	DR	18	week	6-8	week	LC	F	REP	PRWT	WO		137	69	yes
172	Johansson and Wide 1986	2723	mouse (*Mus musculus*)	2	U	DR	12	week	9	week	SM	M	REP	PRFM	WO		139	74	no (ENR)

Table A-7. Lead Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Reproduction (continued)																			
173	Jacquet et al. 1997	2713	mouse (*Mus musculus*)	4	U	FD	18	day	NR	NR	GE	F	REP	PRWT	WO		154	72	yes
174	Wolfe et al. 1996	2502	rat (*Rattus norvegicus*)	2	M	DR	4	week	99	day	JV	M	REP	SPCL	SM		171	78	no (ENR)
175	Blanusa et al. 1989	14750	rat (*Rattus norvegicus*)	5	U	DR	6	week	4	month	GE	F	REP	RHIS	WO		175	69	no (ENR)
176	Cramer et al. 1980	14816	rat (*Rattus norvegicus*)	2	U	DR	22	day	NR	NR	GE	F	REP	PRWT	WO		178	69	yes
177	Sokol et al. 1985	2888	rat (*Rattus norvegicus*)	3	U	DR	30	day	52	day	JV	M	REP	GREP	PG		198	71	yes
178	Hallen et al. 1995	2669	rat (*Rattus norvegicus*)	2	U	DR	13	week	NR	NR	GE	F	REP	PRWT	WO		200	73	yes
179	Rabe et al. 1985	13216	rat (*Rattus norvegicus*)	2	U	DR	21	day	80	day	JV	F	REP	PRWT	WO		218	70	yes
180	Mykkanen et al. 1980	2783	rat (*Rattus norvegicus*)	4	U	FD	3	week	NR	NR	LC	F	REP	PRWT	WO		221	73	yes
181	Hsu 1980[c]	2704	rat (*Rattus norvegicus*)	2	U	FD	1	week	19	week	LC	F	REP	PRWT	WO		222	73	yes
182	Mykkanen et al. 1980	2783	rat (*Rattus norvegicus*)	4	U	FD	3	week	NR	NR	LC	F	REP	PRWT	WO		230	73	yes
183	Alfano and Petit 1982	2511	rat (*Rattus norvegicus*)	3	U	FD	25	day	NR	NR	LC	F	REP	PRWT	WO		258	78	yes
184	Yu et al. 1996	3939	rat (*Rattus norvegicus*)	2	U	DR	21	day	NR	NR	LC	F	REP	PRWT	WO		330	68	yes
185	Sokol 1989	2887	rat (*Rattus norvegicus*)	2	U	DR	30	day	52	day	JV	M	REP	SPCL	SM		354	69	no (ENR)
186	Ronis et al. 1998	2845	rat (*Rattus norvegicus*)	2	U	DR	17	day	NR	NR	GE	F	REP	PRWT	WO		360	68	yes
187	Ronis et al. 1998	2845	rat (*Rattus norvegicus*)	2	U	DR	24	day	NR	NR	LC	F	REP	PRWT	WO		360	68	yes
188	Ronis et al. 1996	2846	rat (*Rattus norvegicus*)	2	U	DR	12	day	NR	NR	GE	F	REP	PRWT	WO		362	69	yes
189	Sokol 1989	2887	rat (*Rattus norvegicus*)	2	U	DR	30	day	27	day	JV	M	REP	SPCL	SM		364	69	no (ENR)
190	Pinon-Lataillade et al. 1995	2821	mouse (*Mus musculus*)	2	U	DR	44	day	NR	NR	GE	F	REP	PRWT	WO		381	68	yes
191	Draski et al. 1989	3719	mouse (*Mus musculus*)	2	U	DR	14	day	NR	NR	LC	F	REP	PRWT	WO		381	68	yes
192	Ronis et al. 1996	2846	rat (*Rattus norvegicus*)	2	U	DR	50	day	24	day	JV	F	REP	RBEH	WO		381	69	no (ENR)
193	Rasile et al. 1995	2836	mouse (*Mus musculus*)	2	U	DR	45	day	50-100	day	GE	F	REP	ODVP	WO		404	69	no (ENR)
194	Thoreux-Manlay et al. 1995	2909	rat (*Rattus norvegicus*)	2	U	DR	22	day	NR	NR	GE	F	REP	PRWT	WO		420	68	yes
195	Donald et al. 1987	2597	mouse (*Mus musculus*)	2	U	DR	48	day	NR	NR	GE	F	REP	PRWT	WO		437	70	yes
196	Marchlewicz et al. 1993	2760	rat (*Rattus norvegicus*)	2	U	DR	9	month	3	month	SM	M	REP	SPCL	TE		579	69	no (ENR)
197	Piasecka et al. 1995	2816	rat (*Rattus norvegicus*)	2	U	DR	9	month	NR	NR	SM	M	REP	TEDG	TE		600	69	no (ENR)
198	Piasek et al. 1988	14751	rat (*Rattus norvegicus*)	2	U	DR	3	week	14	week	LC	F	REP	PRWT	WO		635	69	yes
199	Jacquet 1977	2711	mouse (*Mus musculus*)	2	U	FD	7	day	NR	NR	GE	F	REP	RSUC	EM		646	73	yes
200	Selvin-Testa et al. 1997	2869	rat (*Rattus norvegicus*)	2	U	DR	126	day	1	day	GE	F	REP	PROG	WO		651	66	yes
201	Piasek and Kostial 1991	2818	rat (*Rattus norvegicus*)	2	U	DR	20	week	10	week	GE	F	REP	PRWT	WO		750	73	yes
202	Epstein et al. 1991	2614	mouse (*Mus musculus*)	2	U	DR	4	day	NR	NR	LC	F	REP	PRWT	WO		762	68	yes
203	Holtzman et al. 1981	2698	rat (*Rattus norvegicus*)	2	U	FD	2	week	NR	NR	LC	F	REP	PRWT	WO		828	78	yes
204	Holtzman et al. 1978	2699	rat (*Rattus norvegicus*)	2	U	FD	7	day	NR	NR	LC	F	REP	PRWT	WO		833	78	yes
205	Barlow et al. 1977	2523	rat (*Rattus norvegicus*)	2	U	FD	21	day	NR	NR	LC	F	REP	PRWT	WO		991	74	yes
206	Gulati et al. 1985	2837	mouse (*Mus musculus*)	4	M	DR	18	week	11	week	JV	F	REP	TEWT	WO		1370	75	no (ENR)
207	McConnell and Berry 1979	2767	rat (*Rattus norvegicus*)	2	U	FD	30	day	NR	NR	LC	F	REP	PRWT	WO		1770	73	yes
208	Sharma and Kanwar 1985	2871	mouse (*Mus musculus*)	2	U	DR	14	week	NR	NR	GE	B	REP	PROG	WO		1990	70	yes
209	Goldstein et al. 1974	14824	rat (*Rattus norvegicus*)	2	U	FD	16	day	NR	NR	LC	F	REP	PROG	WO		2570	78	no (DNU)
210	Holtzman et al. 1980	14827	rat (*Rattus norvegicus*)	2	U	FD	7	day	NR	NR	LC	F	REP	PRWT	WO		2570	78	yes
211	Krigman et al. 1974	2741	rat (*Rattus norvegicus*)	2	U	FD	25	day	NR	NR	LC	F	REP	PRWT	WO		2570	78	yes
212	Pentschew and Garro 1966	2811	rat (*Rattus norvegicus*)	M[d]	FD[d]	27[d]	d[d]	NR[d]	NR[d]	LC[d]	F[d]	C[d]	REP	PROG	WO		2840	78	yes
213	Sharma and Kanwar 1985	2871	mouse (*Mus musculus*)	2	U	DR	14	week	21	day	JV	B	REP	PROG	WO		3630	70	yes
214	Michaelson and Sauerhoff 1974	2774	rat (*Rattus norvegicus*)	2	U	FD	17	day	NR	NR	LC	F	REP	PRWT	WO		6170	74	yes
Growth																			
215	Willoughby et al. 1972	14386	horse (*Equus caballus*)	2	U	FD	15	week	20 to	week	JV	M	GRO	BDWT	WO	0.150		68	no (UN)
216	Fox et al. 1982	2634	rat (*Rattus norvegicus*)	2	U	FD	21	day	0	day	JV	F	GRO	BDWT	WO	0.500		67	no (UN)
217	Dilts and Ahokas 1979	2593	rat (*Rattus norvegicus*)	6	U	DR	21	day	NR	NR	GE	F	GRO	BDWT	WO	1.00	5.00	72	yes
218	Kimmel et al. 1980	2737	rat (*Rattus norvegicus*)	5	U	DR	7	day	50	day	AD	F	GRO	BDWT	WO	1.27	13.0	73	yes
219	Lynch et al. 1975	14380	cattle (*Bos taurus*)	4	U	OR	7	week	1	week	JV	M	GRO	BDWT	WO	1.99		75	no (RU, UN)
220	Wiebe and Barr 1988	2930	rat (*Rattus norvegicus*)	3	U	DR	14	day	21	day	JV	F	GRO	BDWT	WO	2.40		72	no (UN)
221	Schroeder et al. 1963	14446	rat (*Rattus norvegicus*)	2	U	DR	332	day	28	day	JV	B	GRO	BDWT	WO	2.98		66	no (UN)
222	Kimmel et al. 1980	2737	rat (*Rattus norvegicus*)	4	U	DR	7	week	21	day	GE	F	GRO	BDWT	WO	4.70	8.90	80	yes
223	Horwitt and Cowgill 1937	3873	dog (*Canis familiaris*)	3	M	FD	7	month	NR	NR	JV	NR	GRO	BDWT	WO	4.71		68	no (UN)

Table A-7. Lead Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Growth (continued)																			
224	Zheng et al. 1996	2944	rat (*Rattus norvegicus*)	3	U	DR	30	day	22-24	day	JV	M	GRO	BDWT	WO	5.64	28.2	71	yes
225	Hammond et al. 1989	2675	rat (*Rattus norvegicus*)	4	U	DR	23	day	22	day	JV	F	GRO	BDWT	WO	5.80	29.0	73	yes
226	Lynch et al. 1976	3711	cattle (*Bos taurus*)	3	U	OR	84	day	NR	NR	JV	M	GRO	BDWT	WO	7.79		80	no (RU, UN)
227	Rader et al. 1981	2830	rat (*Rattus norvegicus*)	2	U	OR	6	week	NR	NR	AD	M	GRO	BDWT	WO	9.10		67	no (UN)
228	Nehru et al. 1997	2788	rat (*Rattus norvegicus*)	2	U	GV	8	week	NR	NR	JV	F	GRO	BDWT	WO	10.0		78	no (UN)
229	Gruber et al. 1997	2660	rat (*Rattus norvegicus*)	3	U	DR	6	month	NR	NR	AD	M	GRO	BDWT	WO	10.6	532	69	yes
230	Lorenzo et al. 1978	2751	rabbit (*Oryctolagus cuniculus*)	3	U	GV	10	day	1	day	JV	F	GRO	BDWT	WO	10.7	50.4	78	yes
231	El-Gazzar et al. 1978	21143	rat (*Rattus norvegicus*)	2	U	DR	140	day	21	day	JV	M	GRO	BDWT	WO	10.7		67	no (UN)
232	Rader et al. 1981	2830	rat (*Rattus norvegicus*)	2	U	DR	6	week	NR	NR	JV	M	GRO	BDWT	WO	15.1		71	no (UN)
233	Mahaffey et al. 1977	14580	rat (*Rattus norvegicus*)	2	UX	FD	10	week	NR	NR	JV	M	GRO	BDWT	WO	15.4		79	no (UN)
234	Rader et al. 1981	2830	rat (*Rattus norvegicus*)	2	U	OR	6	week	NR	NR	AD	M	GRO	BDWT	WO	15.5		74	no (UN)
235	Rader et al. 1981	2829	rat (*Rattus norvegicus*)	2	U	DR	7	week	NR	NR	JV	M	GRO	BDWT	WO	16.1		71	no (UN)
236	Gerber et al. 1978	14822	mouse (*Mus musculus*)	3	U	DR	14	day	0	day	JV	NR	GRO	BDWT	WO	16.3	163	71	yes
237	Barratt et al. 1989	2524	rat (*Rattus norvegicus*)	4	U	GV	9	week	10	week	JV	M	GRO	BDWT	WO	18.0	180	83	yes
238	Morris et al. 1938	15125	rat (*Rattus norvegicus*)	3	U	FD	339	day	26-27	day	JV	B	GRO	BDWT	WO	18.3		72	no (UN)
239	Tafelski and Lamperti 1975	2905	rat (*Rattus norvegicus*)	4	U	GV	29	day	NR	NR	SM	F	GRO	BDWT	WO	18.9		71	no (UN)
240	Mahaffey et al. 1973	2756	rat (*Rattus norvegicus*)	7	U	DR	10	week	NR	NR	JV	M	GRO	BDWT	WO	24.3		71	no (UN)
241	Bull et al. 1978	14812	rat (*Rattus norvegicus*)	4	U	DR	56	day	70	day	LC	F	GRO	BDWT	WO	32.5		67	no (UN)
242	Fick et al. 1976	3704	sheep (*Ovis aries*)	5	U	FD	84	day	NR	NR	JV	M	GRO	BDWT	WO	32.7		66	no (RU, UN)
243	Bankowska and Hine 1985	14852	rat (*Rattus norvegicus*)	2	U	DR	10	week	NR	NR	JV	M	GRO	BDWT	WO	38.5		67	no (UN)
244	Logner et al. 1984	3889	cattle (*Bos taurus*)	4	U	FD	7	week	16	week	JV	M	GRO	BDWT	WO	43.0		72	no (RU, UN)
245	Agodi et al. 1990	2507	rat (*Rattus norvegicus*)	2	U	GV	28	day	2	day	JV	B	GRO	BDWT	WO	50.0		79	no (UN)
246	Wolfe et al. 1996	2502	rat (*Rattus norvegicus*)	5	M	DR	4	week	94	day	JV	M	GRO	BDWT	WO	71.5	178	82	yes
247	Gelman and Michaelson 1979	14821	rat (*Rattus norvegicus*)	4	U	GV	12	day	2	day	JV	B	GRO	BDWT	WO	75.0	225	85	yes
248	Rudra Pal et al. 1975	2806	rat (*Rattus norvegicus*)	2	U	FD	4	week	NR	NR	JV	M	GRO	BDWT	WO	100		67	no (UN)
249	Goyer et al. 1970	14799	rat (*Rattus norvegicus*)	6	U	DR	10	week	NR	NR	JV	M	GRO	BDWT	WO	120	383	71	yes
250	Eyden et al. 1978	2618	mouse (*Mus musculus*)	3	U	FD	4	week	3	month	JV	B	GRO	BDWT	WO	136	1360	76	yes
251	Talcott and Koller 1983	2906	mouse (*Mus musculus*)	2	U	DR	18	week	6-8	week	LC	F	GRO	BDWT	WO	137		67	no (UN)
252	Johansson and Wide 1986	2723	mouse (*Mus musculus*)	2	U	DR	12	week	NR	NR	GE	M	GRO	BDWT	WO	139		72	no (UN)
253	Sokol et al. 1985	2888	rat (*Rattus norvegicus*)	3	U	DR	30	day	52	day	JV	M	GRO	BDWT	WO	169	508	74	yes
254	Wolfe et al. 1996	2502	rat (*Rattus norvegicus*)	2	M	DR	4	week	99	day	JV	B	GRO	BDWT	WO	171		76	no (UN)
255	Kishi et al. 1983	12025	rat (*Rattus norvegicus*)	4	U	GV	18	day	3	day	JV	M	GRO	BDWT	WO	180		79	no (UN)
256	Wadi and Ahmad 1999	2924	mouse (*Mus musculus*)	3	U	DR	6	week	7	week	SM	M	GRO	BDWT	WO	187	373	69	yes
257	Petrusz et al. 1979	2815	rat (*Rattus norvegicus*)	4	U	GV	18	day	2	day	JV	B	GRO	BDWT	WO	200		70	no (UN)
258	Yagminas et al. 1990	3937	rat (*Rattus norvegicus*)	2	U	GV	91	day	NR	NR	JV	M	GRO	BDWT	WO	200		79	no (UN)
259	Rabe et al. 1985	13216	rat (*Rattus norvegicus*)	2	U	DR	21	day	80	day	JV	F	GRO	BDWT	WO	218		68	no (UN)
260	Mykkanen et al. 1980	2783	rat (*Rattus norvegicus*)	4	U	FD	1	week	NR	NR	LC	F	GRO	BDWT	WO	230	460	77	yes
261	Sourgens et al. 1987	2889	rat (*Rattus norvegicus*)	4	U	DR	30	day	NR	NR	JV	M	GRO	BDWT	WO	285		67	no (UN)
262	Exon et al. 1979	3847	mouse (*Mus musculus*)	5	U	DR	10	week	NR	NR	JV	M	GRO	BDWT	WO	362		67	no (UN)
263	Sokol 1989	2887	rat (*Rattus norvegicus*)	2	U	DR	30	day	52	day	JV	M	GRO	BDWT	WO	364		67	no (UN)
264	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	4	U	GV	14	day	14	day	JV	NR	GRO	BDWT	WO	400	800	85	no (ID)
265	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	5	U	GV	14	day	20	day	JV	NR	GRO	BDWT	WO	400	800	85	no (ID)
266	Gerber et al. 1978	14822	rat (*Rattus norvegicus*)	2	U	FD	14	month	0	day	JV	NR	GRO	BDWT	WO	431		70	no (UN)
267	Brady et al. 1975	14795	rat (*Rattus norvegicus*)	2	U	GV	102	day	30	day	LC	F	GRO	BDWT	WO	441		67	no (UN)
268	Stewart et al. 1998	2896	mouse (*Mus musculus*)	4	U	GV	12	day	6	day	JV	M	GRO	BDWT	WO	534		79	no (UN)
269	Maker et al. 1973	2758	mouse (*Mus musculus*)	7	U	FD	30	day	NR	NR	LC	F	GRO	BDWT	WO	632	1260	77	yes
270	Selvin-Testa et al. 1997	2869	rat (*Rattus norvegicus*)	2	U	DR	126	day	1	day	GE	F	GRO	BDWT	WO	651		66	no (UN)
271	Piasek and Kostial 1991	2818	rat (*Rattus norvegicus*)	2	U	DR	20	week	10	week	GE	F	GRO	BDWT	WO	750		71	no (UN)
272	Maker et al. 1973	2758	mouse (*Mus musculus*)	7	U	FD	28	day	NR	NR	LC	F	GRO	BDWT	WO	1260	2530	77	no (DNF)
273	Barrett and Livesey 1983	10239	rat (*Rattus norvegicus*)	4	U	FD	18	day	NR	NR	LC	F	GRO	BDWT	WO	1500		71	no (UN)
274	Schroeder et al. 1970	252	rat (*Rattus norvegicus*)	2	U	DR	9	day	21	day	JV	M	GRO	BDWT	WO		3.30	72	yes
275	Kelliher et al. 1973	14377	cattle (*Bos taurus*)	2	U	FD	283	day	7	month	JV	M	GRO	BDWT	WO		15.0	76	no (RU)

Table A-7. Lead Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Growth (continued)																			
276	Hamilton and O'Flaherty 1994	2670	rat (*Rattus norvegicus*)	3	U	DR	92	day	25	day	GE	F	MPH	GMPH	TB		28.7	70	no (ENR)
277	Hamilton et al. 1994	2671	rat (*Rattus norvegicus*)	4	U	DR	7	day	25	day	GE	F	GRO	BDWT	WO		29.0	66	yes
278	Hammond and Succop 1995	2678	rat (*Rattus norvegicus*)	2	U	DR	5	day	26	day	JV	F	GRO	BDWT	WO		29.0	66	yes
279	Hammond et al. 1993	2677	rat (*Rattus norvegicus*)	2	U	DR	26	day	22	day	JV	F	GRO	BDWT	WO		29.5	70	yes
280	Hammond et al. 1993	2677	rat (*Rattus norvegicus*)	2	U	DR	14	day	26	day	JV	F	MPH	Other	TA		29.9	69	no (ENR)
281	Minnema and Hammond 1994	2776	rat (*Rattus norvegicus*)	2	U	DR	10	day	26	day	JV	F	GRO	BDWT	WO		30.4	67	yes
282	Al-Omar et al. 2000	20974	mouse (*Mus musculus*)	2	M	GV	3	week	NR	NR	JV	M	GRO	BDWT	WO		46.4	84	yes
283	White 1977	2929	dog (*Canis familiaris*)	2	U	OR	5	week	<1	year	JV	NR	GRO	BDWT	WO		50.0	84	no (DNU)
284	Pankakoski et al. 1994	2807	shrew (*Sorex araneus*)	4	M	FD	31	day	NR	NR	JV	B	GRO	BDWT	WO		61.5	76	no (SDC)
285	Shailesh Kumar and Desiraju 1990	2870	rat (*Rattus norvegicus*)	3	U	GV	58	day	2	day	JV	B	GRO	BDWT	WO		100	79	yes
286	Hsu et al. 1975	14376	pig (*Sus scrofa*)	2	U	FD	13	week	4	week	JV	NR	GRO	BDWT	WO		173	73	yes
287	Harry et al. 1985	2680	rat (*Rattus norvegicus*)	2	U	GV	29	day	2	day	JV	F	GRO	BDWT	WO		200	79	yes
288	Lessler and Wright 1976	2750	rat (*Rattus norvegicus*)	2	U	FD	5	week	NR	NR	MA	NR	GRO	BDWT	WO		272	72	yes
289	Press 1975[e]	2827	rat (*Rattus norvegicus*)	2	U	GV	6	day	1	day	JV	B	GRO	BDWT	WO		328	79	no (ID)
290	Sokol 1989	2887	rat (*Rattus norvegicus*)	2	U	DR	30	day	27	day	JV	M	GRO	BDWT	WO		354	67	yes
291	Ronis et al. 1996	2846	rat (*Rattus norvegicus*)	2	U	DR	50	day	24	day	JV	M	GRO	BDWT	WO		371	67	yes
292	Toews et al. 1983	2911	rat (*Rattus norvegicus*)	2	U	GV	28	day	2	day	JV	M	GRO	BDWT	WO		400	79	yes
293	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	4	U	GV	14	day	18	day	JV	NR	GRO	BDWT	WO		400	79	no (ID)
294	Rasile et al. 1995	2836	mouse (*Mus musculus*)	2	U	DR	45	day	50-100	day	GE	F	GRO	BDWT	WO		404	67	yes
295	Mykkanen et al. 1980	2783	rat (*Rattus norvegicus*)	4	U	FD	1	week	NR	NR	LC	F	GRO	BDWT	WO		442	71	yes
296	Piasek et al. 1988	14751	rat (*Rattus norvegicus*)	2	U	DR	6	week	14	week	LC	F	GRO	BDWT	WO		638	67	yes
297	Gulati et al. 1985	2837	mouse (*Mus musculus*)	4	M	DR	10	week	11	week	JV	F	GRO	BDWT	WO		748	73	yes
298	Barlow et al. 1977	2523	rat (*Rattus norvegicus*)	2	U	FD	21	day	NR	NR	LC	F	GRO	BDWT	WO		991	72	yes
299	Brashear et al. 1978	2546	rat (*Rattus norvegicus*)	2	U	GV	18	day	2	day	JV	B	GRO	BDWT	WO		1000	79	no (ID)
300	Gerber et al. 1978	14822	rat (*Rattus norvegicus*)	2	U	FD	2	week	0	day	JV	NR	GRO	BDWT	WO		1430	72	yes
301	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	4	U	GV	14	day	24	day	JV	NR	GRO	BDWT	WO		1600	79	no (ID)
302	Holtzman et al. 1981	2698	rat (*Rattus norvegicus*)	2	U	FD	2	week	60-80	day	JV	M	GRO	BDWT	WO		2390	69	yes
303	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	3	U	GV	14	day	16	day	JV	NR	GRO	BDWT	WO		2400	79	no (ID)
304	Holtzman et al. 1980	14827	rat (*Rattus norvegicus*)	2	U	FD	14	day	60	day	JV	M	GRO	BDWT	WO		2650	77	yes
305	Schroeder and Mitchener 1975	1858	mouse (*Mus musculus*)	2	U	DR	669	day	19-20	day	JV	B	MOR	LFSP	WO	3.50		68	no (UN)
306	Junaid et al. 1997	2725	mouse (*Mus musculus*)	4	U	GV	60	day	NR	NR	AD	F	MOR	MORT	WO	4.00	8.00	82	yes
307	Lynch et al. 1976	3711	cattle (*Bos taurus*)	3	U	OR	84	day	NR	NR	JV	M	MOR	SURV	WO	7.79		85	no (RU, UN)
308	Lorenzo et al. 1978	2751	rabbit (*Oryctolagus cuniculus*)	5	U	GV	30	day	1	day	JV	F	MOR	MORT	WO	10.7	50.4	84	yes
309	Azar et al. 1973	3747	rat (*Rattus norvegicus*)	5	M	FD	2	year	NR	NR	NR	M	MOR	MORT	WO	10.9	42.4	81	no (SDC)
310	Logner et al. 1984	3889	cattle (*Bos taurus*)	4	U	FD	10	day	74	day	JV	M	MOR	MORT	WO	16.0	43.0	88	no (RU)
311	Azar et al. 1973	3747	dog (*Canis familiaris*)	5	M	FD	2	year	NR	NR	NR	B	MOR	MORT	WO	24.7		68	no (UN)
312	Jessup 1967	2720	rabbit (*Oryctolagus cuniculus*)	3	U	FD	10	day	NR	NR	GE	F	MOR	MORT	WO	29.2		72	no (UN)
313	Lassen and Buck 1979	3709	pig (*Sus scrofa*)	5	U	DR	13	week	6	week	JV	NR	MOR	MORT	WO	30.2		68	no (UN)
314	Bankowska and Hine 1985	14852	rat (*Rattus norvegicus*)	2	U	DR	4	week	NR	NR	JV	M	MOR	MORT	WO	40.3		68	no (UN)
315	Al-Omar et al. 2000	20974	mouse (*Mus musculus*)	2	M	GV	5	week	NR	NR	JV	M	MOR	MORT	WO	46.4		85	no (UN)
316	Carpenter 1982	2565	hamster (*Mesocricetus auratus*)	2	U	DR	51	day	15	week	GE	F	MOR	MORT	WO	64.8		68	no (UN)
317	Carpenter 1982	2565	hamster (*Mesocricetus auratus*)	2	U	DR	14	day	11	week	GE	F	MOR	MORT	WO	64.9		68	no (UN)
318	Jessup and Shott 1969	11831	rat (*Rattus norvegicus*)	5	U	FD	92	week	21	day	JV	M	MOR	SURV	WO	74.9		73	no (UN)
319	Jessup 1969	2721	rat (*Rattus norvegicus*)	4	U	FD	8	week	NR	NR	GE	B	MOR	SURV	WO	78.9		73	no (UN)
320	Azar et al. 1973	3747	rat (*Rattus norvegicus*)	3	M	FD	2	year	NR	NR	NR	M	MOR	MORT	WO	87.5	163	83	no (SDC)
321	Wolfe et al. 1996	2502	rat (*Rattus norvegicus*)	5	U	DR	24	week	94	day	JV	B	MOR	MORT	WO	104		77	no (UN)
322	Lessler and Wright 1976	2750	rat (*Rattus norvegicus*)	2	U	FD	24	week	NR	NR	YO	M	MOR	MORT	WO	170		73	no (UN)
323	Lessler and Wright 1976	2750	rat (*Rattus norvegicus*)	2	U	FD	8	week	NR	NR	MA	M	MOR	MORT	WO	170		66	no (UN)

Table A-7. Lead Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[a]
Survival																			
324	Petrusz et al. 1979	2815	rat (*Rattus norvegicus*)	4	U	GV	18	day	2	day	JV	B	MOR	MORT	WO	200		80	no (UN)
325	Ogilvie and Martin 1981	2799	mouse (*Mus musculus*)	2	U	DR	10	month	NR	NR	AD	M	MOR	MORT	WO	379		68	no (UN)
326	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	5	U	GV	14	day	20	day	JV	NR	MOR	MORT	WO	400	800	86	yes
327	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	4	U	GV	14	day	24	day	JV	NR	MOR	MORT	WO	400	800	86	yes
328	Rasile et al. 1995	2836	mouse (*Mus musculus*)	2	U	DR	98	day	50-100	day	GE	F	MOR	MORT	WO	404		68	no (UN)
329	Piasekand Kostial 1987	2817	rat (*Rattus norvegicus*)	4	U	DR	18	week	NR	NR	JV	M	MOR	MORT	WO	639		72	no (UN)
330	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	4	U	GV	14	day	24	day	JV	NR	MOR	MORT	WO	2000	2400	86	yes
331	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	3	U	GV	14	day	14	day	JV	NR	MOR	MORT	WO	3200		80	no (UN)
332	Kanisawa and Schroeder 1969	3701	rat (*Rattus norvegicus*)	2	U	DR	727	day	30	day	JV	F	MOR	LFSP	WO		0.569	67	yes
333	Zmudski et al. 1983	3940	cattle (*Bos taurus*)	4	U	DR	21	day	10	week	JV	M	MOR	MORT	WO		2.70	72	no (RU)
334	Schroeder et al. 1963	14446	rat (*Rattus norvegicus*)	2	U	DR	6	month	28	day	JV	B	MOR	SURV	WO		2.87	67	yes
335	Schroeder et al. 1964	14447	mouse (*Mus musculus*)	2	U	DR	21	month	21	day	JV	M	MOR	SURV	WO		3.10	73	yes
336	Wells et al. 1986	14803	cattle (*Bos taurus*)	2	U	DR	8	day	3	month	JV	M	MOR	MORT	WO		20.0	72	no (RU)
337	Pankakoski et al. 1994	2807	shrew (*Sorex araneus*)	4	M	FD	31	day	NR	NR	JV	B	MOR	MORT	WO		61.5	77	yes
338	Press 1975[e]	2827	rat (*Rattus norvegicus*)	2	U	GV	14	day	1	day	JV	B	MOR	MORT	WO		328	80	yes
339	Shailesh Kumar and Desiraju 1990	2870	rat (*Rattus norvegicus*)	2	U	GV	58	day	2	day	JV	B	MOR	MORT	WO		400	84	yes
340	Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	4	U	GV	14	day	16	day	JV	NR	MOR	MORT	WO		400	80	yes
341	Eyden et al. 1978	2618	mouse (*Mus musculus*)	6	U	FD	115	day	NR	NR	AD	B	MOR	SURV	WO		635	72	yes
342	Gulati et al. 1985	2837	mouse (*Mus musculus*)	4	M	DR	18	week	11	week	JV	B	MOR	MORT	WO		670	74	yes
343	Lamb et al. 1997	2505	mouse (*Mus musculus*)	4	U	DR	105	day	6	week	JV	B	MOR	MORT	WO		670	72	yes

Notes:
Not all studies presented in the lead ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).
See Eco-SSL document (USEPA 2005b) for the full reference list for studies cited in this table.
Abbreviations from the Eco-SSL document are defined in Table A-1.
Blank cells are shown as reported in the Eco-SSL document; no description was provided.
[a] Rationale for study unacceptability is in parentheses
[b] Dose/response dataset was reviewed and determined to be an unbounded no-observed-adverse-effect level (NOAEL) (differs from the Eco-SSL document).
[c] As reported in the Eco-SSL. The correct publication year for this study is 1981.
[d] As reported in the Eco-SSL. These entries appear to be off by one column.
[e] As reported in the Eco-SSL. The correct publication year for this study is 1977.
DNF - data not found
DNU - data not used because insufficient information was reported.
ENR - endpoint not relevant
ICF - irrelevant chemical form
ID - insufficient data
LOAEL - lowest-observed-adverse-effect level
RU - ruminant study
SDC - study design concern
UN - unbounded NOAEL

Table A-8. Manganese Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Reproduction																			
15	Sazzad et al. 11994	5474	chicken (*Gallus domesticus*)	2	U	FD	12	week	23	week	LB	F	REP	PROG	WO	191		70	no (UN)
16	Sazzad et al. 11994	5474	chicken (*Gallus domesticus*)	2	U	FD	12	week	23	week	LB	F	REP	PROG	WO	202		70	no (UN)
17	Laskey and Edens 1985	8426	Japanese quail (*Coturnix japonica*)	2	U	FD	75	day	1	day	JV	M	REP	TEWT	TE	575		81	no (ENR, UN)
Growth																			
18	Spulkamy et al. 11976	6772	chicken (*Gallus domesticus*)	5	U	FD	7	week	1	week	JV	M	GRO	BDWT	WO	23.1		69	no (UN)
19	Settle et al. 11969	7191	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	B	GRO	BDWT	WO	24.3		68	no (UN)
20	Wedekind and Baker 1990	5728	chicken (*Gallus domesticus*)	3	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	50.2		67	no (UN)
21	Halpin et al. 11986	6054	chicken (*Gallus domesticus*)	3	U	GV	14	day	8	day	JV	M	GRO	BDWT	WO	67.0		71	no (UN)
22	Henry et al. 1986	6087	chicken (*Gallus domesticus*)	2	U	FD	21	day	1	day	JV	M	GRO	BDWT	WO	71.8		68	no (UN)
23	Baker and Halpin 1991	5700	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	87.7		68	no (UN)
24	De Rosa et al. 11980	44196	chicken (*Gallus domesticus*)	2	U	FD	1	week	2	week	JV	B	GRO	BDWT	WO	97.6		71	no (UN)
25	Brown and Southern 1985	6215	chicken (*Gallus domesticus*)	2	U	FD	14	day	4	day	JV	M	GRO	BDWT	WO	110		77	no (UN)
26	Black et al. 1985	6195	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO	197		69	no (UN)
27	Black et al. 11984	6305	chicken (*Gallus domesticus*)	4	U	FD	21	day	1	day	JV	M	GRO	BDWT	WO	202		74	no (UN)
28	Wong-Valle et al. 11989	5788	chicken (*Gallus domesticus*)	4	U	FD	21	day	1	day	JV	M	GRO	BDWT	WO	213		67	no (UN)
29	Wong-Valle et al. 11989	5788	chicken (*Gallus domesticus*)	4	U	FD	21	day	1	day	JV	M	GRO	BDWT	WO	213		67	no (UN)
30	Martinez and Diaz 1996	5345	chicken (*Gallus domesticus*)	4	U	FD	14	day	1	day	JV	M	GRO	BDWT	WO	215	431	84	yes
31	Southern and Baker 1983	6382	chicken (*Gallus domesticus*)	3	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	252		68	no (UN)
32	Southern and Baker 1983	6363	chicken (*Gallus domesticus*)	4	U	FD	14	day	7	day	JV	M	GRO	BDWT	WO	261	348	83	yes
33	Vohra and Kratzer 1968	14404	turkey (*Meleagris gallopavo*)	9	U	FD	21	day	NR	NR	JV	B	GRO	BDWT	WO	302	356	82	yes
34	Southern and Baker 1983	6363	chicken (*Gallus domesticus*)	4	U	FD	14	day	7	day	JV	M	GRO	BDWT	WO	435		68	no (UN)
35	Southern and Baker 1983	6363	chicken (*Gallus domesticus*)	4	U	FD	14	day	7	day	JV	M	GRO	BDWT	WO	437		68	no (UN)
36	Southern and Baker 1983	6363	chicken (*Gallus domesticus*)	4	U	FD	14	day	7	day	JV	M	GRO	BDWT	WO	439		68	no (UN)
37	Laskey and Edens 1985	8426	Japanese quail (*Coturnix japonica*)	2	U	FD	75	day	1	day	JV	M	GRO	BDWT	WO	575		81	no (UN)
38	Leeson and Summers 1982	2196	chicken (*Gallus domesticus*)	5	U	FD	21	day	1	day	JV	M	GRO	BDWT	WO	1120		68	no (UN)
Survival																			
39	Black et al. 1984	6252	chicken (*Gallus domesticus*)	4	U	FD	26	day	4	day	JV	B	MOR	MORT	WO	216		72	no (UN)
40	Vohra and Kratzer 1968	14404	turkey (*Meleagris gallopavo*)	9	U	FD	21	day	NR	NR	JV	B	MOR	MORT	WO	356		68	no (UN)

Notes:

Not all studies presented in the manganese ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007b) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) values that are equal and from the same reference represent different experimental designs.

[b] Rationale for study unacceptability is in parentheses
ENR - endpoint not relevant
UN - unbounded NOAEL

Table A-9. Manganese Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Reproduction																			
61	Grummer et al. 1950	14464	pig (*Sus scrofa*)	2	U	FD	124	day	9	week	GE	F	REP	PROG	WO	2.83		71	no (UN)
62	Rehnberg et al. 1980	57	rat (*Rattus norvegicus*)	4	U	GV	20	day	1	day	JV	B	REP	RHIS	TE	21.0	71.0	90	no (ENR)
63	USDA 1973	35143	rat (*Rattus norvegicus*)	5	U	GV	9	day	NR	NR	GE	F	REP	PROG	WO	78.3		77	no (UN)
64	USDA 1973	35143	rabbit (*Oryctolagus cuniculus*)	5	U	GV	12	day	NR	NR	GE	F	REP	PROG	WO	112		77	no (UN)
65	USDA 1973	35143	mouse (*Mus musculus*)	5	U	GV	9	day	NR	NR	GE	F	REP	PROG	WO	125		77	no (UN)
66	USDA 1973	35143	hamster (*Mesocricetus auratus*)	5	U	GV	4	day	NR	NR	GE	F	REP	PROG	WO	136		77	no (UN)
67	Pappas et al. 1997	33496	rat (*Rattus norvegicus*)	3	U	DR	30	day	NR	NR	GE	F	REP	PRWT	WO	153	620	82	yes
68	Kontur and Fechter 1985	34752	rat (*Rattus norvegicus*)	4	U	DR	21	day	NR	NR	GE	F	REP	PRWT	WO	276	415	81	yes
69	Laskey et al. 1982	56	rat (*Rattus norvegicus*)	4	U	FD	43	day	NR	NR	GE	F	REP	PRWT	WO	291		78	yes
70	Leung et al. 1982	34895	rat (*Rattus norvegicus*)	3	U	DR	26	day	NR	NR	GE	F	REP	PRWT	WO	1069	2139	79	yes
71	Becker and McCollum 1938	14459	rat (*Rattus norvegicus*)	5	U	FD	730	day	NR	NR	JV	M	REP	TEDG	TE	1996		77	no (ENR, UN)
72	Bataineh et al. 1998	1717	rat (*Rattus norvegicus*)	2	U	DR	12	week	NR	NR	AD	M	REP	TEWT	TE		26.4	67	no (ENR)
73	Laskey et al 1985	34755	rat (*Rattus norvegicus*)	2	U	GV	21	day	0	day	JV	M	REP	TEWT	TE		71.0	86	no (ENR)
Growth																			
74	Ivan and Grieve 1975	34990	cattle (*Bos taurus*)	2	U	FD	10	week	22-28	week	JV	M	GRO	BDWT	WO	1.30		68	no (RU, UN)
75	Mohamed et al. 1986	36002	water buffalo (*Bubalus carabanensis*)	3	M	FD	90	day	13-19	month	JV	M	GRO	BDWT	WO	1.86		73	no (UN)
76	Svajgr et al. 1969	34656	pig (*Sus scrofa*)	2	U	FD	84	day	NR	NR	JV	B	GRO	BDWT	WO	2.74		69	no (UN)
77	Grummer et al. 1950	14464	pig (*Sus scrofa*)	2	U	FD	124	day	NR	NR	JV	B	GRO	BDWT	WO	2.83		69	no (UN)
78	Gershbein et al. 1983	136	rat (*Rattus norvegicus*)	2	U	FD	80	day	44	day	JV	M	GRO	BDWT	WO	5.89		68	no (UN)
79	Bhoot et al. 1981	35470	cattle (*Bos taurus*)	3	U	FD	66	day	1	year	JV	F	GRO	BDWT	WO	7.05		71	no (RU, UN)
80	Lee and Johnson 1988	34504	rat (*Rattus norvegicus*)	3	U	FD	2	week	NR	NR	JV	B	GRO	BDWT	WO	7.37		68	no (UN)
81	Kontur and Fechter 1985	36045	rat (*Rattus norvegicus*)	3	U	GV	21	day	1	day	JV	B	GRO	BDWT	WO	13.8		75	no (UN)
82	Leibholz et al. 1962	14468	pig (*Sus scrofa*)	4	U	FD	10	week	2	week	JV	B	GRO	BDWT	WO	14.4	144	81	no (UN[c])
83	Lipe et al. 1999	33403	rat (*Rattus norvegicus*)	3	U	GV	30	day	30	day	JV	M	GRO	BDWT	WO	20.0		75	no (UN)
84	Deskin et al. 1981	34921	rat (*Rattus norvegicus*)	4	U	GV	24	day	1	day	JV	M	GRO	BDWT	WO	20.0		75	no (UN)
85	Rehnberg et al. 1980	57	rat (*Rattus norvegicus*)	4	U	GV	5	day	1	day	JV	B	GRO	BDWT	WO	21.0	71.0	88	yes
86	Cunningham et al. 1966	14461	cattle (*Bos taurus*)	4	U	FD	84	day	10	week	JV	M	GRO	BDWT	WO	21.7	65.0	84	no (RU)
87	Black et al. 1985	35824	sheep (*Ovis aries*)	5	U	FD	84	day	NR	NR	JV	M	GRO	BDWT	WO	59.4	119	84	no (RU)
88	Laskey et al. 1985	34755	rat (*Rattus norvegicus*)	2	U	GV	21	day	0	day	JV	M	GRO	BDWT	WO	71.0		84	no (UN)
89	Cunningham et al. 1966	14461	cattle (*Bos taurus*)	4	U	FD	100	day	10	week	JV	M	GRO	BDWT	WO	73.8		69	no (RU, UN)
90	USDA 1973	35143	rat (*Rattus norvegicus*)	5	U	GV	9	day	NR	month	GE	F	GRO	BDWT	WO	78.3		75	no (UN)
91	Leibholz et al. 1962	14468	pig (*Sus scrofa*)	6	U	FD	6	week	2	week	JV	B	GRO	BDWT	WO	86.3		68	no (UN)
92	Nachtman et al. 1986	34669	rat (*Rattus norvegicus*)	2	U	DR	65	week	6	week	JV	M	GRO	BDWT	WO	102		72	no (UN)
93	Black et al. 1985	35824	sheep (*Ovis aries*)	4	U	FD	84	day	NR	NR	JV	M	GRO	BDWT	WO	112	223	84	no (RU)
94	USDA 1973	35143	rabbit (*Oryctolagus cuniculus*)	5	U	GV	12	day	NR	NR	GE	F	GRO	BDWT	WO	112		75	no (UN)
95	USDA 1973	35143	mouse (*Mus musculus*)	5	U	GV	9	day	NR	NR	GE	F	GRO	BDWT	WO	125		75	no (UN)
96	USDA 1973	35143	hamster (*Mesocricetus auratus*)	5	U	GV	4	day	NR	NR	GE	F	GRO	BDWT	WO	136		75	no (UN)
97	Kontur and Fechter 1985	34752	rat (*Rattus norvegicus*)	4	U	DR	21	day	NR	NR	GE	F	GRO	BDWT	WO	162	271	79	yes
98	Komura and Sakamoto 1991	33786	mouse (*Mus musculus*)	2	U	FD	100	day	6	week	JV	M	GRO	BDWT	WO	262		69	no (UN)
99	Komura and Sakamoto 1991	33786	mouse (*Mus musculus*)	2	U	FD	100	day	6	week	JV	M	GRO	BDWT	WO	270		69	no (UN)
100	Johnson and Kies 1987	34574	rat (*Rattus norvegicus*)	3	U	FD	56	day	NR	NR	JV	M	GRO	BDWT	WO	394		68	no (UN)
101	Gaillard et al. 1996	33511	rat (*Rattus norvegicus*)	2	U	DR	11	week	3	week	JV	M	GRO	BDWT	WO	554		73	no (UN)
102	Lipe et al. 1999	33403	rat (*Rattus norvegicus*)	3	U	GV	24	day	90	day	AD	M	GRO	BDWT	WO		10.0	80	yes
103	Komura and Sakamoto 1991	33786	mouse (*Mus musculus*)	2	U	FD	30	day	6	week	JV	M	GRO	BDWT	WO		284	73	yes
104	Komura and Sakamoto 1991	33786	mouse (*Mus musculus*)	2	U	FD	30	day	6	week	JV	M	GRO	BDWT	WO		284	78	yes

Table A-9. Manganese Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Survival																			
105	Rehnberg et al. 1980	57	rat (*Rattus norvegicus*)	4	U	GV	17	day	1	day	JV	B	MOR	SURV	WO	21.0	71.0	89	yes
106	USDA 1973	35143	rat (*Rattus norvegicus*)	5	U	GV	9	day	NR	NR	GE	F	MOR	SURV	WO	78.3		76	no (UN)
107	USDA 1973	35143	rabbit (*Oryctolagus cuniculus*)	5	U	GV	12	day	NR	NR	GE	F	MOR	SURV	WO	112		85	no (UN)
108	USDA 1973	35143	mouse (*Mus musculus*)	5	U	GV	9	day	NR	NR	GE	F	MOR	SURV	WO	125		85	no (UN)
109	USDA 1973	35143	hamster (*Mesocricetus auratus*)	5	U	GV	4	day	NR	NR	GE	F	MOR	SURV	WO	136		80	no (UN)

Notes:

Not all studies presented in the manganese ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007b) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) values that are equal and from the same reference represent different experimental designs.

[b] Rationale for study unacceptability is in parentheses

[c] Dose/response dataset was reviewed and determined to be an unbounded NOAEL (differs from the Eco-SSL document).

ENR - endpoint not relevant

RU - ruminant study

UN - unbounded NOAEL

Table A-10. Zinc Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Reproduction																			
75	Kaya et al. 2001	48543	chicken (*Gallus domesticus*)	5	U	FD	12	week	NR	NR	LB	F	REP	PROG	WO	13.8		75	no (UN)
76	Schisler and Kienholz 1967	8798	chicken (*Gallus domesticus*)	2	U	FD	14	week	48	week	LB	F	REP	PROG	WO	14.4		70	no (UN)
77	Jensen and Maurice 1980	9749	chicken (*Gallus domesticus*)	3	U	FD	6	week	NR	NR	LB	F	REP	PROG	WO	24.7	98.8	82	yes
78	Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	6	U	FD	140	day	40	week	LB	F	REP	PROG	WO	55	105	81	yes
79	Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	6	U	FD	10	week	30	week	JV	F	REP	PROG	WO	57.3	66.5	81	yes
80	Stevenson et al. 1987	8184	chicken (*Gallus domesticus*)	9	U	FD	140	day	28	week	JV	F	REP	PROG	WO	63.9	76.7	81	yes
81	Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	6	U	FD	10	week	30	week	LB	F	REP	PROG	WO	64.1	123	81	yes
82	Stevenson et al. 1987	8184	chicken (*Gallus domesticus*)	9	U	FD	140	day	28	week	LB	F	REP	PROG	WO	67.8	84.8	81	yes
83	Stahl et al. 1990	5764	chicken (*Gallus domesticus*)	4	U	FD	12	week	56	week	LB	F	REP	PROG	WO	106		71	no (UN)
84	Gasaway and Buss 1972	9261	mallard duck (*Anas platyrhynchos*)	4	U	FD	60	day	7	week	JV	M	REP	TEWT	TE		31.2	79	no (ENR)
85	Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	5	U	FD	1	week	40	week	SM	F	REP	PROG	WO		88	75	yes
86	Jensen and Maurice 1980	9749	chicken (*Gallus domesticus*)	2	U	FD	6	week	NR	NR	LB	F	REP	PROG	WO		101	79	yes
87	Stepinska et al. 1987	5770	chicken (*Gallus domesticus*)	2	U	FD	5	day	71	week	LB	F	REP	PROG	WO		205	75	yes
88	Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	5	U	FD	1	week	40	week	LB	F	REP	PROG	WO		367	75	no (DNF)
89	Berry and Brake 1985	6144	chicken (*Gallus domesticus*)	2	U	FD	4	day	60	week	LB	F	REP	RHIS	OD		988	73	no (ENR)
90	Berry and Brake 1990	7089	chicken (*Gallus domesticus*)	2	U	FD	49	day	66	week	LB	F	REP	RHIS	OD		988	73	no (ENR)
Growth																			
91	Schisler and Kienholz 1967	8798	chicken (*Gallus domesticus*)	2	U	FD	14	week	48	week	JV	F	GRO	BDWT	WO	14.4		68	no (UN)
92	Baker and Halpin 1988	5917	chicken (*Gallus domesticus*)	2	M	FD	14	day	8	day	JV	M	GRO	BDWT	WO	15.0		73	no (UN)
93	Mohanna and Nys 1999	5090	chicken (*Gallus domesticus*)	2	U	FD	16	day	5	day	JV	NR	GRO	BDWT	WO	16.1		68	no (UN)
94	Hamilton et al. 1979	6655	Japanese quail (*Coturnix japonica*)	2	U	FD	14	day	0	day	JV	B	GRO	BDWT	WO	21.5		80	no (UN)
95	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	B	GRO	BDWT	WO	28.7		76	no (UN)
96	Stahl et al. 1989	5820	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	B	GRO	BDWT	WO	35.4		68	no (UN)
97	Hill 1990	5734	chicken (*Gallus domesticus*)	2	U	FD	19	day	1	day	JV	F	GRO	BDWT	WO	36.6		76	no (UN)
98	Hamilton et al. 1981	6403	Japanese quail (*Coturnix japonica*)	3	U	FD	14	day	1	day	JV	B	GRO	BDWT	WO	43.3	86.6	83	yes
99	Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	6	U	FD	140	day	40	week	SM	F	GRO	BDWT	WO	55.0	105	79	yes
100	Harland et al. 1975	6887	Japanese quail (*Coturnix japonica*)	2	U	FD	1	week	1	day	JV	B	GRO	BDWT	WO	55.1		77	no (UN)
101	Berg and Martinson 1972	93	chicken (*Gallus domesticus*)	7	U	FD	2	week	1	day	JV	NR	GRO	BDWT	WO	55.3	111	78	yes
102	Lefevre et al. 1982	392	chicken (*Gallus domesticus*)	2	U	FD	5	week	1	day	JV	NR	GRO	BDWT	WO	63.2		76	no (UN)
103	Sandoval et al. 1998	7245	chicken (*Gallus domesticus*)	4	U	FD	3	week	1	day	JV	M	GRO	BDWT	WO	70.6	106	84	yes
104	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	M	GRO	BDWT	WO	74.3	111	83	yes
105	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	M	GRO	BDWT	WO	74.7	112	83	yes
106	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	M	GRO	BDWT	WO	75.0	150	79	yes
107	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	M	GRO	BDWT	WO	75.7	114	83	yes
108	Hill 1974	92	chicken (*Gallus domesticus*)	5	U	FD	2	week	1	day	JV	B	GRO	BDWT	WO	85.9	172	82	yes
109	Hamilton et al. 1979	6655	Japanese quail (*Coturnix japonica*)	6	U	FD	14	day	8	day	JV	B	GRO	BDWT	WO	86.8	174	86	yes
110	Henry et al. 1987	6039	chicken (*Gallus domesticus*)	4	U	FD	1	week	1	day	JV	M	GRO	BDWT	WO	92.3	185	83	yes
111	Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	6	U	FD	10	week	30	week	JV	F	GRO	BDWT	WO	96.9	145	79	yes
112	Stevenson et al. 1987	8184	chicken (*Gallus domesticus*)	9	U	FD	140	day	28	week	JV	F	GRO	BDWT	WO	99.1	149	79	yes
113	Sandoval et al. 1999	5067	chicken (*Gallus domesticus*)	2	U	FD	7	day	14	day	JV	M	GRO	BDWT	WO	103		68	no (UN)
114	Sandoval et al. 1999	5067	chicken (*Gallus domesticus*)	2	U	FD	7	day	14	day	JV	M	GRO	BDWT	WO	103		68	no (UN)
115	Stahl et al. 1990	5764	chicken (*Gallus domesticus*)	3	U	FD	44	week	24	week	LB	F	GRO	BDWT	WO	129		69	no (UN)
116	Stevenson et al. 1987	8184	chicken (*Gallus domesticus*)	9	U	FD	140	day	28	week	LB	F	GRO	BDWT	WO	129	194	79	yes
117	Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	F	GRO	BDWT	WO	142		67	no (UN)
118	Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	B	GRO	BDWT	WO	143	286	79	yes
119	Vohra and Kratzer 1968	14404	turkey (*Meleagris gallopavo*)	7	U	FD	21	day	NR	NR	JV	B	GRO	BDWT	WO	148	297	77	yes
120	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	M	GRO	BDWT	WO	155	232	83	yes
121	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	M	GRO	BDWT	WO	158	237	83	yes
122	Southern and Baker 1983	6368	chicken (*Gallus domesticus*)	3	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO	177	354	83	yes
123	Oh et al. 1979	6627	chicken (*Gallus domesticus*)	6	U	FD	4	week	1	day	JV	NR	GRO	BDWT	WO	252	503	79	yes
124	Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	5	U	FD	1	week	40	week	SM	F	GRO	BDWT	WO	367	480	79	yes
125	Lu and Combs 1988	5903	chicken (*Gallus domesticus*)	2	U	FD	15	day	1	day	JV	NR	GRO	BDWT	WO		21.6	72	no (SDC)

Table A-10. Zinc Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Growth (continued)																			
126	Stahl et al. 1989	5820	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	B	GRO	BDWT	WO		31.0	77	yes
127	Lu and Combs 1988	5866	chicken (*Gallus domesticus*)	2	U	FD	6	day	20	day	JV	NR	GRO	BDWT	WO		39.0	73	yes
128	Lu et al. 1990	8008	chicken (*Gallus domesticus*)	2	U	FD	7	day	14	day	JV	B	GRO	BDWT	WO		65.7	72	yes
129	Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	5	U	FD	21	day	40	week	SM	F	GRO	BDWT	WO		88	73	yes
130	Jensen and Maurice 1980	9749	chicken (*Gallus domesticus*)	2	U	FD	6	week	NR	NR	SM	F	GRO	BDWT	WO		101	77	yes
131	Gasaway and Buss 1972	9261	mallard duck (*Anas platyrhynchos*)	4	U	FD	10	day	7	week	JV	B	GRO	BDWT	WO		126	77	yes
132	Pimentel et al. 1992	5617	chicken (*Gallus domesticus*)	2	M	FD	3	week	1	day	JV	B	GRO	BDWT	WO		132	77	yes
133	Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	4	U	FD	4	week	2	week	JV	B	GRO	BDWT	WO		143	72	yes
134	Berg and Martinson 1972	93	chicken (*Gallus domesticus*)	2	U	FD	2	week	1	day	JV	NR	GRO	BDWT	WO		252	72	yes
135	Bafundo et al. 1984	6273	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO		190	76	yes
136	Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	2	U	FD	14	day	8	day	JV	M	GRO	BDWT	WO		284	76	yes
137	Bartov 1996	5373	chicken (*Gallus domesticus*)	4	U	FD	2	week	1	week	JV	F	GRO	BDWT	WO		315	73	yes
138	Rama and Planas 1981	6435	chicken (*Gallus domesticus*)	2	U	FD	9	week	1	day	JV	NR	GRO	BDWT	WO		433	70	yes
139	Dean et al. 1991	5681	chicken (*Gallus domesticus*)	2	M	FD	1	week	1	day	JV	M	GRO	BDWT	WO		757	78	yes
140	Bartov et al. 1994	7956	chicken (*Gallus domesticus*)	3	U	FD	2	week	1	week	JV	F	GRO	BDWT	WO		914	73	yes
141	Palafox and Ho-A 1980	6545	chicken (*Gallus domesticus*)	2	U	FD	5	day	38	week	JV	F	GRO	BDWT	WO		988	71	yes
142	Bartov 1996	5373	chicken (*Gallus domesticus*)	4	U	FD	2	week	1	week	JV	F	GRO	BDWT	WO		1370	73	yes
Survival																			
143	Hamilton et al. 1979	6655	Japanese quail (*Coturnix japonica*)	2	U	FD	14	day	0	day	JV	B	MOR	MORT	WO	21.5		81	no (UN)
144	Stahl et al. 1989	5820	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	B	MOR	MORT	WO	31.0		78	no (UN)
145	Stahl et al. 1989	5820	chicken (*Gallus domesticus*)	2	U	FD	20	day	1	day	JV	B	MOR	MORT	WO	35.4		78	no (UN)
146	Harland et al. 1975	6887	Japanese quail (*Coturnix japonica*)	2	U	FD	1	week	1	day	JV	B	MOR	MORT	WO	55.1		78	no (UN)
147	Lefevre et al. 1982	392	chicken (*Gallus domesticus*)	2	U	FD	5	week	1	day	JV	NR	MOR	MORT	WO	63.2		79	no (UN)
148	Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	6	U	FD	10	week	30	week	JV	F	MOR	MORT	WO	68.8	87.1	80	yes
149	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	10	U	FD	4	week	1	week	JV	M	MOR	SURV	WO	75.6		73	no (UN)
150	Hamilton et al. 1981	6403	Japanese quail (*Coturnix japonica*)	3	U	FD	14	day	1	day	JV	B	MOR	MORT	WO	89.5		78	no (UN)
151	Blalock and Hill 1988	5868	chicken (*Gallus domesticus*)	3	U	FD	12	day	1	day	JV	F	MOR	MORT	WO	109	219	79	yes
152	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	M	MOR	SURV	WO	115		78	no (UN)
153	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	M	MOR	SURV	WO	120		77	no (UN)
154	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	3	U	FD	4	week	1	day	JV	M	MOR	SURV	WO	121		78	no (UN)
155	Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	B	MOR	MORT	WO	143	286	80	yes
156	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	M	MOR	SURV	WO	159	239	84	yes
157	Hill 1974	92	chicken (*Gallus domesticus*)	5	U	FD	5	week	1	day	JV	B	MOR	MORT	WO	172		68	no (UN)
158	Hamilton et al. 1979	6655	Japanese quail (*Coturnix japonica*)	6	U	FD	14	day	0	day	JV	B	MOR	MORT	WO	183	366	87	yes
159	Oh et al. 1979	6627	chicken (*Gallus domesticus*)	6	U	FD	4	week	1	day	JV	NR	MOR	MORT	WO	252	503	80	yes
160	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	M	MOR	SURV	WO	255		78	no (UN)
161	Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	4	U	FD	4	week	1	day	JV	M	MOR	SURV	WO	272		78	no (UN)
162	Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	3	U	FD	4	day	18	month	AD	F	MOR	MORT	WO	319		69	no (UN)
163	Hill 1974	1369	chicken (*Gallus domesticus*)	2	U	FD	3	week	1	day	JV	B	MOR	MORT	WO	320		77	no (UN)
164	Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	4	U	FD	4	week	2	week	JV	B	MOR	MORT	WO	327	491	79	yes
165	Vohra and Kratzer 1968	14404	turkey (*Meleagris gallopavo*)	7	U	FD	21	day	NR	NR	JV	B	MOR	MORT	WO	741		72	no (UN)
166	Gasaway and Buss 1972	9261	mallard duck (*Anas platyrhynchos*)	4	U	FD	30	day	7	week	JV	B	MOR	MORT	WO		126	78	yes
167	Van Vleet et al. 1981	80	duck (*Anas platyrhynchos*)	2	U	FD	15	day	1	day	JV	M	MOR	MORT	WO		401	77	yes
168	Van Vleet et al. 1981	80	duck (*Anas platyrhynchos*)	2	U	FD	15	day	1	day	JV	M	MOR	MORT	WO		803	77	yes

Notes:

Not all studies presented in the zinc ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007c) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) values that are equal and from the same reference represent different experimental designs.

[b] Rationale for study unacceptability is in parentheses
DNF - data not found
ENR - endpoint not relevant
UN - unbounded NOAEL

Table A-11. Zinc Data for Mammals as Presented in Eco-SSL document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Reproduction																			
87	Hill et. al. 1983	45143	pig (*Sus scrofa*)	3	U	FD	12	month	7-8	month	GE	F	REP	ODVP	WO	8.23	82.3	79	no (ENR)
88	Seidenberg et al. 1986	113	mouse (*Mus musculus*)	2	U	GV	4	day	NR	NR	GE	F	REP	PRWT	NR	8.89		82	no (UN)
89	Alaoui et al. 1985	36854	rat (*Rattus norvegicus*)	2	U	FD	5	week	NR	NR	JV	M	REP	ORWT	TE	9.64		71	no (ENR, UN)
90	Cerklewski 1979	37008	rat (*Rattus norvegicus*)	2	U	FD	37	day	105	day	LC	F	REP	PRWT	WO	14.4		80	no (UN)
91	Food and Drug Res. Lab 1973	42289	mouse (*Mus musculus*)	3	U	GV	10	day	NR	NR	GE	F	REP	PRFM	WO	30.0		77	no (ENR, UN)
92	Khera and Shah 1979	21134	rat (*Rattus norvegicus*)	2	U	FD	4	day	NR	NR	GE	F	REP	PRWT	WO	34.0		69	no (UN)
93	Miller et al. 1989	14685	cattle (*Bos taurus*)	3	U	FD	14	week	NR	NR	LC	F	REP	PRWT	WO	37.9	75.9	86	no (RU)
94	Amemiya et al. 1986	21069	rat (*Rattus norvegicus*)	2	U	FD	21	day	NR	NR	GE	F	REP	PRWT	WO	41.2		74	no (UN)
95	Evenson et al. 1993	14660	rat (*Rattus norvegicus*)	2	U	FD	8	week	3	week	JV	M	REP	TEWT	TE	42.1		70	no (ENR, UN)
96	Food and Drug Res. Lab 1973	42289	rat (*Rattus norvegicus*)	4	U	GV	10	day	NR	NR	GE	F	REP	PRFM	WO	42.5		77	no (ENR, UN)
97	Food and Drug Res. Lab 1974	42292	rabbit (*Oryctolagus cuniculus*)	5	U	GV	13	day	NR	NR	GE	F	REP	PRFM	WO	60.0		77	no (ENR, UN)
98	Food and Drug Res. Lab 1973	42289	hamster (*Mesocricetus auratus*)	3	U	GV	5	day	NR	NR	GE	F	REP	PRFM	WO	88.0		77	no (ENR, UN)
99	Shrader et al. 1978	21138	rat (*Rattus norvegicus*)	2	U	FD	21	day	NR	NR	GE	F	REP	PRWT	WO	89.6		73	no (UN)
100	Hirsch and Hurley 1978	21139	rat (*Rattus norvegicus*)	2	U	FD	12	day	NR	NR	GE	F	REP	PRWT	WO	89.6		75	no (UN)
101	Hill et al. 1983	35659	pig (*Sus scrofa*)	3	U	FD	20	week	NR	NR	LC	F	REP	RHIS	WO	97.8		70	no (ENR, UN)
102	Webster 1979	823	mouse (*Mus musculus*)	4	U	FD	19	day	4	month	GE	F	REP	PRWT	WO	101		79	no (UN)
103	Anderson et al. 1993	139	mouse (*Mus musculus*)	2	U	FD	13	week	12	week	JV	M	REP	PRWT	WO	110		74	no (UN)
104	Schlicker and Cox 1968	25	rat (*Rattus norvegicus*)	2	U	FD	36	day	NR	NR	GE	F	REP	PRWT	WO	167		73	no (UN)
105	Ketcheson et al. 1969	37837	rat (*Rattus norvegicus*)	3	U	FD	14	day	NR	NR	LC	F	REP	PRWT	WO	181	452	81	yes
106	Maita et al. 1981	43680	rat (*Rattus norvegicus*)	4	U	FD	13	week	5	week	JV	M	REP	ORWT	TE	234	2514	82	no (ENR)
107	Chu and Cox 1970	42767	rat (*Rattus norvegicus*)	2	U	FD	21	day	NR	NR	LC	F	REP	GREP	WO	347		74	no (UN)
108	Maita et al. 1981	43680	mouse (*Mus musculus*)	4	U	FD	13	week	5	week	JV	M	REP	ORWT	TE	458	4927	82	no (ENR)
109	Maita et al. 1981	43680	mouse (*Mus musculus*)	4	U	FD	13	week	5	week	JV	F	REP	ORWT	OV	479	4878	82	no (ENR)
110	Bui et al. 1998	21045	rat (*Rattus norvegicus*)	2	M	GV	7	day	NR	NR	GE	F	REP	PRWT	WO	975		80	no (UN)
111	Maita et al. 1981	43680	rat (*Rattus norvegicus*)	4	U	FD	13	week	5	week	JV	F	REP	ORWT	OV	2486		71	no (ENR, UN)
112	Kumar 1976	43587	rat (*Rattus norvegicus*)	2	U	FD	17	day	100	day	GE	F	REP	RSEM	WO		12.2	78	yes
113	Barone et al. 1998	21042	rat (*Rattus norvegicus*)	2	U	FD	10	day	NR	NR	GE	F	REP	PROG	WO		81.1	73	yes
114	Newman et al. 2002	48540	rat (*Rattus norvegicus*)	2	U	FD	16	day	NR	NR	GE	F	REP	PROG	WO		232	81	yes
115	Pal and Pal 1987	14664	rat (*Rattus norvegicus*)	2	U	FD	18	day	120-130	day	GE	F	REP	GREP	WO		326	78	yes
116	Chu and Cox 1972	42670	rat (*Rattus norvegicus*)	2	U	FD	14	day	NR	NR	LC	F	REP	PRWT	WO		326	72	yes
117	Cox et al. 1969	42838	rat (*Rattus norvegicus*)	2	U	FD	22	day	NR	NR	GE	F	REP	PRWT	WO		353	74	yes
118	Schlicker and Cox 1968	25	rat (*Rattus norvegicus*)	2	U	FD	18	day	NR	NR	GE	F	REP	PRWT	WO		424	74	yes
Growth																			
119	Attia et al. 1987	36003	water buffalo (*Bubalus bubalis*)	5	U	FD	90	day	7-9	month	JV	M	GRO	BDWT	WO	4.33		69	no (UN)
120	Huerta et al. 2002	25973	cattle (*Bos taurus*)	2	U	FD	50	day	18	month	JV	F	GRO	BDWT	WO	4.78		68	no (RU, UN)
121	Huerta et al. 2002	25973	cattle (*Bos taurus*)	2	U	FD	50	day	18	month	JV	F	GRO	BDWT	WO	4.78		68	no (RU, UN)
122	Alaoui et al. 1985	36854	rat (*Rattus norvegicus*)	2	U	FD	5	week	NR	NR	JV	M	GRO	BDWT	WO	9.64		69	no (UN)
123	Hill et al. 1983	45143	pig (*Sus scrofa*)	3	U	FD	8	month	7-8	month	GE	F	GRO	GGRO	WO	10.3	103	77	yes
124	Weigarnd and Kirchgessner 1978	41855	rat (*Rattus norvegicus*)	4	U	FD	12	day	NR	NR	JV	M	GRO	BDWT	WO	11.7		68	no (UN)
125	Eisemann et al. 1979	43242	pig (*Sus scrofa*)	2	M	FD	16	week	6-8	week	JV	B	GRO	BDWT	WO	13.5		69	no (UN)
126	Cerklewski 1979	37008	rat (*Rattus norvegicus*)	2	U	FD	37	day	105	day	LC	F	GRO	BDWT	WO	14.4		78	no (UN)
127	Elliot and Walker 1968	38623	pig (*Sus scrofa*)	2	U	FD	4	week	NR	NR	JV	B	GRO	BDWT	WO	14.9		68	no (UN)
128	Cerklewski and Forbes 1976	2627	rat (*Rattus norvegicus*)	2	U	FD	7	week	NR	NR	JV	M	GRO	BDWT	WO	15.7		69	no (UN)
129	Wapnir and Lee 1993	39821	rat (*Rattus norvegicus*)	2	U	FD	3	week	NR	NR	JV	M	GRO	BDWT	WO	15.7		68	no (UN)
130	Agarwal et al. 1986	21084	rat (*Rattus norvegicus*)	2	U	FD	14	day	9-10	week	SM	M	GRO	BDWT	WO	18.0		72	no (UN)
131	Brandt 1983	2033	mink (*Mustela vison*)	3	M	FD	4	month	90	day	JV	M	GRO	BDWT	WO	20.2		82	no (UN)
132	Shankar et al. 1986	46830	rat (*Rattus norvegicus*)	2	U	FD	120	day	40	day	JV	F	GRO	BDWT	WO	28.9		73	no (UN)

Table A-11. Zinc Data for Mammals as Presented in Eco-SSL document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Growth (continued)																			
133	Food and Drug Res. Lab 1973	42289	mouse (*Mus musculus*)	3	U	GV	10	day	NR	NR	GE	F	GRO	BDWT	WO	30.0		75	no (UN)
134	Reeves and Newman 1997	21067	rat (*Rattus norvegicus*)	2	U	FD	7	week	3	week	JV	M	GRO	BDWT	WO	30.4		79	no (UN)
135	Gaynor et al. 1988	47892	cattle (*Bos taurus*)	2	M	FD	4	week	NR	NR	LC	F	GRO	BDWT	WO	30.6		74	no (RU, UN)
136	Gaynor et al. 1988	47892	cattle (*Bos taurus*)	2	M	FD	5	week	NR	NR	LC	F	GRO	BDWT	WO	33.2		74	no (RU, UN)
137	Khera and Shah 1979	21134	rat (*Rattus norvegicus*)	2	U	FD	4	day	NR	NR	GE	F	GRO	BDWT	WO	34		67	no (UN)
138	Evenson et al. 1993	14660	rat (*Rattus norvegicus*)	2	U	FD	8	week	3	week	JV	F	GRO	BDWT	WO	42.1		68	no (UN)
139	Food and Drug Res. Lab 1973	42289	rat (*Rattus norvegicus*)	4	U	GV	10	day	NR	NR	GE	F	GRO	BDWT	WO	42.5		75	no (UN)
140	Brink et al. 1959	14525	pig (*Sus scrofa*)	6	U	FD	42	day	NR	NR	JV	NR	GRO	BDWT	WO	43.5	87.1	84	yes
141	Miller et al. 1989	14685	cattle (*Bos taurus*)	3	U	FD	14	week	NR	NR	LC	F	GRO	BDWT	WO	63.7		69	no (RU, UN)
142	Reeves et al. 1994	37015	rat (*Rattus norvegicus*)	2	U	FD	2	week	NR	NR	JV	M	GRO	BDWT	WO	56		75	no (UN)
143	Food and Drug Res. Lab 1974	42292	rabbit (*Oryctolagus cuniculus*)	5	U	GV	12	day	NR	NR	GE	F	GRO	BDWT	WO	60.0		75	no (UN)
144	Food and Drug Res. Lab 1973	42289	hamster (*Mesocricetus auratus*)	3	U	GV	5	day	NR	NR	GE	F	GRO	BDWT	WO	88.0		75	no (UN)
145	Bui et al. 1998	21045	rat (*Rattus norvegicus*)	2	M	GV	7	day	NR	NR	GE	F	GRO	BDWT	WO	97.5		69	no (UN)
146	Van Vleet et al. 1981	149	pig (*Sus scrofa*)	2	U	FD	10	week	NR	NR	JV	M	GRO	BDWT	WO	99.1		73	no (UN)
147	Schell and Kornegay 1996	42234	pig (*Sus scrofa*)	4	M	FD	2	week	23	day	JV	B	GRO	BDWT	WO	103		69	no (UN)
148	Schell and Kornegay 1996	42234	pig (*Sus scrofa*)	4	M	FD	23	day	23	day	JV	B	GRO	BDWT	WO	106		74	no (UN)
149	Anderson et al. 1993	139	mouse (*Mus musculus*)	2	U	FD	13	week	12	week	JV	M	GRO	BDWT	WO	110		81	no (UN)
150	Maita et al. 1981	43680	rat (*Rattus norvegicus*)	4	U	FD	13	week	5	week	JV	M	GRO	BDWT	WO	234	2514	80	yes
151	Bentley and Grubb 1991	40436	rabbit (*Oryctolagus cuniculus*)	3	U	FD	22	week	NR	NR	JV	B	GRO	BDWT	WO	282		68	no (UN)
152	Llewellyn et al. 1985	2203	golden hamster (*Mesocricetus auratus*)	2	U	FD	18	week	NR	NR	JV	M	GRO	BDWT	WO	295		67	no (UN)
153	Maita et al. 1981	43680	mouse (*Mus musculus*)	4	U	FD	13	week	5	week	JV	M	GRO	BDWT	WO	458	4927	80	yes
154	Ketcheson et al. 1969	37837	rat (*Rattus norvegicus*)	3	U	FD	14	day	NR	NR	LC	F	GRO	BDWT	WO	470		73	no (UN)
155	Maita et al. 1981	43680	mouse (*Mus musculus*)	4	U	FD	13	week	5	week	JV	F	GRO	BDWT	WO	479	4878	80	yes
156	O'Neil-Cutting et al. 1981	14656	rat (*Rattus norvegicus*)	2	U	FD	18	week	NR	NR	JV	M	GRO	BDWT	WO	597		77	no (UN)
157	Zhang et al. 1995	39356	mouse (*Mus musculus*)	2	M	FD	10	day	8	week	JV	F	GRO	BDWT	WO	825		68	no (UN)
158	Zhang et al. 1995	39356	mouse (*Mus musculus*)	2	M	FD	10	day	8	week	JV	F	GRO	BDWT	WO	845		73	no (UN)
159	Zhang et al. 1995	39356	mouse (*Mus musculus*)	2	M	FD	10	day	8	week	JV	F	GRO	BDWT	WO	846		68	no (UN)
160	Pettersen et al. 2002	36374	mouse (*Mus musculus*)	3	U	FD	3	week	4	week	JV	B	GRO	BDWT	WO	1419	2838	83	yes
161	Urabe and Hayakawa 1990	40997	rat (*Rattus norvegicus*)	2	U	FD	42	day	NR	NR	JV	M	GRO	BDWT	WO	1684		78	no (UN)
162	Maita et al. 1981	43680	rat (*Rattus norvegicus*)	4	U	FD	13	week	5	week	JV	F	GRO	BDWT	WO	2486		69	no (UN)
163	Nakamura et al. 1983	638	rat (*Rattus norvegicus*)	2	U	FD	11	week	NR	NR	JV	F	GRO	BDWT	WO		8.71	73	yes
164	Rosa et al. 1986	47007	sheep (*Ovis aries*)	2	U	FD	56	day	NR	NR	SM	M	GRO	BDWT	WO		16.1	71	no (RU)
165	Subramanian et al. 2000	21011	rat (*Rattus norvegicus*)	2	U	FD	6	week	NR	NR	JV	M	GRO	BDWT	WO		28.2	73	yes
166	Davies et al. 1977	14527	sheep (*Ovis aries*)	2	M	FD	26	day	1	week	JV	M	GRO	BDWT	WO		75.7	81	no (RU)
167	Barone et al. 1998	21042	rat (*Rattus norvegicus*)	2	U	FD	10	day	NR	NR	GE	F	GRO	BDWT	WO		81.1	71	yes
168	Hsu et al. 1975	14376	pig (*Sus scrofa*)	2	U	FD	13	week	4	week	JV	NR	GRO	BDWT	WO		89.1	73	yes
169	Schlicker and Cox 1968	25	rat (*Rattus norvegicus*)	2	U	FD	18	day	NR	NR	GE	F	GRO	BDWT	WO		424	68	yes
170	Settlemire and Matrone 1967	38015	rat (*Rattus norvegicus*)	2	U	FD	5	week	4-6	week	JV	M	GRO	BDWT	WO		667	76	yes
171	Ogiso et al. 1974	42961	rat (*Rattus norvegicus*)	2	U	FD	15	day	NR	NR	JV	M	GRO	BDWT	WO		956	77	yes
172	Scott and Magee 1979	43264	rat (*Rattus norvegicus*)	2	U	FD	1	week	NR	NR	JV	M	GRO	BDWT	WO		968	77	yes

Table A-11. Zinc Data for Mammals as Presented in Eco-SSL document, Including Study Acceptability Determination

Result #	Reference	Ref No.	Test Organism	No. of Conc. or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose[a] (mg/kg bw/day)	LOAEL Dose[a] (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation?[b]
Survival																			
173	Seidenberg et al. 1986	113	mouse (*Mus musculus*)	2	U	GV	4	day	NR	NR	GE	F	MOR	MORT	WO	8.89		85	no (UN)
174	Van der Schee et al. 1980	21171	sheep (*Ovis aries*)	3	M	FD	98	day	NR	NR	JV	M	MOR	MORT	WO	12.0		83	no (RU, UN)
175	Food and Drug Res. Lab 1973	42289	mouse (*Mus musculus*)	3	U	GV	10	day	NR	NR	GE	F	MOR	SURV	WO	30.0		76	no (UN)
176	Food and Drug Res. Lab 1973	42289	rat (*Rattus norvegicus*)	4	U	GV	10	day	NR	NR	GE	F	MOR	SURV	WO	42.5		76	no (UN)
177	Brink et al. 1959	14525	pig (*Sus scrofa*)	6	U	FD	42	day	NR	NR	JV	NR	MOR	MORT	WO	43.5	87.1	85	yes
178	Food and Drug Res. Lab 1974	42292	rabbit (*Oryctolagus cuniculus*)	5	U	GV	13	day	NR	NR	GE	F	MOR	MORT	WO	60.0		76	no (UN)
179	Ott et al. 1966	14535	sheep (*Ovis aries*)	8	U	FD	6	week	NR	NR	JV	NR	MOR	MORT	WO	82.9	99.5	80	no (RU)
180	Willoughby et al. 1972	14385	horse (*Equus caballus*)	2	M	FD	9	week	3-4	week	JV	F	MOR	MORT	WO	83.7		78	no (UN)
181	Food and Drug Res. Lab 1973	42289	hamster (*Mesocricetus auratus*)	3	U	GV	5	day	NR	NR	GE	F	MOR	SURV	WO	88.0		76	no (UN)
182	Aulerich et al. 1991	46274	mink (*Mustela vison*)	4	M	FD	144	day	>1	year	AD	M	MOR	MORT	WO	165		80	no (UN)
183	Aulerich et al. 1991	46274	mink (*Mustela vison*)	4	M	FD	144	day	10-12	week	JV	M	MOR	MORT	WO	297		84	no (UN)
184	Aulerich et al. 1991	46274	mink (*Mustela vison*)	4	M	FD	144	day	10-12	week	JV	F	MOR	MORT	WO	324		84	no (UN)
185	Aulerich et al. 1991	46274	mink (*Mustela vison*)	4	M	FD	114	day	>1	year	AD	F	MOR	MORT	WO	327		80	no (UN)
186	Maita et al. 1981	43680	mouse (*Mus musculus*)	4	U	FD	13	week	5	week	JV	M	MOR	MORT	WO	458	4927	81	no (UN[c])
187	Maita et al. 1981	43680	rat (*Rattus norvegicus*)	4	U	FD	13	week	5	week	JV	F	MOR	MORT	WO	2486		70	no (UN)
188	Maita et al. 1981	43680	rat (*Rattus norvegicus*)	4	U	FD	13	week	5	week	JV	M	MOR	MORT	WO	2514		79	no (UN)
189	Maita et al. 1981	43680	mouse (*Mus musculus*)	4	U	FD	13	week	5	week	JV	F	MOR	MORT	WO	4878		79	no (UN)
190	Van Vleet et al. 1981	149	pig (*Sus scrofa*)	2	U	FD	10	week	NR	NR	JV	M	MOR	MORT	WO		99.1	78	no (UN[c])

Notes:

Not all studies presented in the zinc ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007c) for the full reference list for studies cited in this table.

Abbreviations from the Eco-SSL document are defined in Table A-1.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Lowest-observed-adverse-effect level (LOAEL) and no-observed-adverse-effect level (NOAEL) values that are equal and from the same reference represent different experimental designs.

[b] Rationale for study unacceptability is in parentheses

[c] Dose/response dataset was reviewed and determined to be an unbounded NOAEL (differs from the Eco-SSL document).

ENR - endpoint not relevant

RU - ruminant study

UN - unbounded NOAEL

Table A-12. Wildlife TRV References Not Included in Eco-SSL Documents

Receptor	Test Organism	Reference	Information Used to Determine Tier	Tier
Cadmium				
Growth				
Bird	chicken (*Gallus domesticus*)	Abduljaleel and Shuhaimi-Othman 2013	UN	NT
Bird	duck (*Anas platyrhynchos*)	Lucia et al. 2010	FD	2
Bird	Japanese quail (*Coturnix japonica*)	Olgun 2015	FD	1
Mammal	bank vole (*Clethrionomys glareolus*)	Bonda et al. 2004	UN	NT
Mammal	mouse (*Mus musculus*)	Seidenberg et al. 1986[a]	UN	NT
Mammal	horse *(Equus caballus*)	Willoughby et al. 1972	UN	NT
Reproduction				
Bird	Japanese quail (*Coturnix japonica*)	Olgun 2015	FD	1
Mammal	rat (*Rattus norvegicus*)	Aprioku et al. 2014	DR	2
Mammal	rat (*Rattus norvegicus*)	Nagymajtenyi et al. 1997	UN	NT
Survival				
Bird	Japanese quail (*Coturnix japonica*)	Olgun 2015	FD	1
Mammal	rat (*Rattus norvegicus*)	Borzelleca et al. 1989	UN	NT
Copper				
Growth				
Bird	duck (*Anas platyrhynchos*)	Attia et al. 2012	SDC	NT
Bird	chicken (*Gallus domesticus*)	Cinar et al. 2014	UN	NT
Bird	chicken (*Gallus domesticus*)	Dozier et al. 2003	UN	NT
Bird	chicken (*Gallus domesticus*)	Norvell et al. 1975	UN	NT
Bird	chicken (*Gallus domesticus*)	Payvastegan et al. 2013	UN	NT
Bird	chicken (*Gallus domesticus*)	Persia et al. 2004	FD	1
Bird	chicken (*Gallus domesticus*)	Yenice et al. 2015	SDC	NT
Mammal	sheep (*Ovis aries*)	Haywood et al. 2004	RU	NT
Mammal	vole (*Microtus pennsylvanicus*)	Miska-Schramm et al. 2014	DR	2
Mammal	rat, mouse (*Rattus norvegicus, Mus musculus*)	NTP 1993b	DR	2
Mammal	pig (*Sus scrofa)*	Shelton et al. 2011	SDC	NT
Mammal	mink (*Mustela vision*)	Wu et al. 2014	UN	NT
Reproduction				
Bird	chicken (*Gallus domesticus*)	Balevi and Coskun 2004	UN	NT
Bird	chicken (*Gallus domesticus*)	Lien et al. 2004	UN	NT
Bird	chicken (*Gallus domesticus*)	Stefanello et al. 2014	SDC	NT
Mammal	rat (*Rattus norvegicus*)	Chung et al. 2009	UN, ENR	NT
Survival				
Mammal	mouse (*Mus musculus*)	Pocino et al. 1991	ENR	NT

Table A-12. Wildlife TRV References Not Included in Eco-SSL Documents

Receptor	Test Organism	Reference	Information Used to Determine Tier	Tier
Lead				
Growth				
Bird	chicken (*Gallus domesticus*)	Abduljaleel and Shuhaimi-Othman 2013	FD	1
Bird	herring gull (*Larus argentatus*)	Burger 1990	ENR	NT
Bird	common tern (*Sterna hirundo)*	Burger and Gochfeld 1985	INJ	NT
Bird	herring gull (*Larus argentatus*)	Burger and Gochfeld 1993	INJ	NT
Bird	herring gull (*Larus argentatus*)	Burger and Gochfeld 1994	INJ	NT
Bird	herring gull (*Larus argentatus*)	Burger and Gochfeld 1995	ENR	NT
Bird	common tern (*Sterna hirundo)*	Gochfeld and Berger 1988	ENR	NT
Bird	ringed turtle dove (*Streptopelia risoria*)	Kendall and Scanlon 1982[a]	UN	NT
Bird	American kestrel (*Falco sparverius*)	Pattee 1984[a]	UN	NT
Bird	Great tit (*Parus major*)	Ruuskanen et al. 2014	SDC	NT
Mammal	rat (*Rattus norvegicus*)	Angell and Weiss 1982	DR	2
Mammal	rat (*Rattus norvegicus*)	Fowler et al. 1980	UN	NT
Mammal	rat (*Rattus norvegicus*)	Hackett et al. 1982	INJ	NT
Mammal	rat (*Rattus norvegicus*)	Hammond et al. 1990	DR	2
Mammal	shrew, vole (*Sorex araneus, Microtus pennsylvanicus*)	Ma 1989	SDC	NT
Mammal	rat (*Rattus norvegicus*)	Overmann 1977	UN	NT
Mammal	rat (*Rattus norvegicus*)	Reiter et al. 1975	UN	NT
Mammal	horse *(Equus caballus*)	Willoughby et al. 1972	SDC	NT
Mammal	mouse (*Mus musculus*)	Wise 1981	FD	2
Mammal	rat (*Rattus norvegicus*)	Zenick et al. 1979[a]	UN	NT
Reproduction				
Mammal	mink (*Mustela vision*)	Bursian et al 2013	SDC	NT
Mammal	mouse (*Mus musculus*)	Iavicoli et al. 2006	UN	NT
Mammal	mouse (*Mus musculus*)	Odenbro and Kihlstrom 1977	ENR	NT
Survival				
Bird	common tern (*Sterna hirundo)*	Burger and Gochfeld 1988	INJ	NT
Manganese				
Growth				
Mammal	rat (*Rattus norvegicus*)	Dorman et al. 2000	UN	NT
Mammal	rat (*Rattus norvegicus*)	Foster et al. 2015	UN	NT
Mammal	rat, mouse (*Rattus norvegicus, Mus musculus*)	NTP 1993	FD	1
Mammal	mink (*Mustela vision*)	Zhang et al. 2014	UN	NT
Reproduction				
Mammal	dog (*Canis lupus familiaris*)	Bao et al. 2014	UN	NT
Mammal	mouse (*Mus musculus*)	Gray and Laskey 1980	UN	NT
Survival				
Mammal	rat (*Rattus norvegicus*)	NTP 1993	FD	1

Table A-12. Wildlife TRV References Not Included in Eco-SSL Documents

Receptor	Test Organism	Reference	Information Used to Determine Tier	Tier
Zinc				
Growth				
Bird	chicken (*Gallus domesticus*)	Persia et al. 2004	UN	NT
Mammal	mouse (*Mus musculus*)	Aughey et al. 1977	UN	2
Mammal	pig (*Sus scrofa)*	Davin et al. 2013	UN, SDC	NT
Mammal	rat (*Rattus norvegicus*)	Khan et al. 2007	FD	1
Mammal	rat (*Rattus norvegicus*)	Llobet et al. 1988	DR	2
Mammal	ferret (*Mustela putorius furo)*	Straube et al. 1980	NDR	NT
Mammal	horse *(Equus caballus*)	Willoughby et al. 1972	SDC	NT
Reproduction				
Bird	duck (*Anas platyrhynchos*)	Chen et al. 2017	UN	NT
Bird	chicken (*Gallus domesticus*)	Stefanello et al. 2014	ENR	NT
Mammal	rat (*Rattus norvegicus*)	Khan et al. 2007	FD	1
Mammal	rat (*Rattus norvegicus*)	Sutton and Nelson 1937	SDC	NT
Survival				
Bird	chicken (*Gallus domesticus*)	Dozier et al. 2003	UN	NT
Mammal	ferret (*Mustela putorius furo)*	Straube et al. 1980	FD	1

Notes:
[a] Listed in ecological soil screening level (Eco-SSL) for different endpoint.
DR - drinking water exposure
ENR - endpoint not relevant
INJ - injection study
FD - dietary/food exposure
NT - no tier applied because study was not acceptable for toxicity reference value (TRV) derivation
NDR - no data reported in study
RU - ruminant study
SDC - study design concern
UN - unbounded no-observed-adverse-effect level (NOAEL)

Table A-13. Tier Determination and Results of Study Selection Process for Acceptable Cadmium Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Leach et al. 1978[b]	398	chicken (*Gallus domesticus*)	2.37	NA	NA	no	1	1	T	2
Bokori et al. 1995	379	Japanese quail (*Coturnix japonica*)	7.65	NA	NA	no	1	2	T	1
White and Finley 1978	396	mallard (*Anas platyrhychos*)	21.1	NA	NA	no	1	3	T	1
Growth										
Hill 1979	397	chicken (*Gallus domesticus*)	3.44	yes	no	no	1	1	T	1
Hill 1974	92	chicken (*Gallus domesticus*)	3.44	yes	no	no	1	2	T	1
Hill 1990	8125	chicken (*Gallus domesticus*)	4.26	yes	no	no	1	na[c]	na	na
Bokori et al. 1996	375	chicken (*Gallus domesticus*)	4.66	yes	no	no	1	3	T	0
Bafundo et al. 1984	8500	chicken (*Gallus domesticus*)	4.80	yes	no	no	1	4	T	1
Hill 1974	1369	chicken (*Gallus domesticus*)	4.90	yes	no	no	1	5	T	1
Bokori et al. 1995	378	chicken (*Gallus domesticus*)	5.63	yes	no	no	1	6	A	1
Lefevre et al. 1982	392	chicken (*Gallus domesticus*)	7.08	yes	no	no	1	7	NR	NA
Pritzl et al. 1974	403	chicken (*Gallus domesticus*)	9.57	yes	no	no	1	8	NR	NA
Freeland and Cousins 1973	7011	chicken (*Gallus domesticus*)	9.75	yes	no	no	1	9	NR	NA
Richardson et al. 1974	371	Japanese quail (*Coturnix japonica*)	12.2	yes	no	no	1	10	S	1
Richardson and Fox 1974	402	Japanese quail (*Coturnix japonica*)	12.8	yes	no	no	1	11	P	1
Rama and Planas 1981	6468	chicken (*Gallus domesticus*)	13.0	yes	no	no	1	12	P	1
Hill 1980	395	chicken (*Gallus domesticus*)	13.8	yes	no	no	1	13	P	1
Spivey et al. 1971	7101	Japanese quail (*Coturnix japonica*)	14.7	yes	no	no	1	14	NR	NA
Fadil and Magid 1996	5265	chicken (*Gallus domesticus*)	1.05	yes	no	yes	2	15	NR	NA
Di Giulio and Scanlon 1984[d]	183	mallard (*Anas platyrhychos*)	37.6	no	no	no	2	16	S	1
Survival										
Hill 1974	1369	chicken (*Gallus domesticus*)	4.90	NA	NA	no	1	1	T	0
Pritzl et al. 1974	403	chicken (*Gallus domesticus*)	14.3	NA	NA	no	1	2	T	1
Bokori et al. 1995	379	Japanese quail (*Coturnix japonica*)	30.6	NA	NA	no	1	3	T	1
Bokori et al. 1995	378	chicken (*Gallus domesticus*)	44.6	NA	NA	no	1	4	T	1
Van Vleet et al. 1981	80	duck (*Anas* sp.)	66.9	NA	NA	no	1	5	T	1

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2005a) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), A = additional studies reviewed if five datasets were not available from the top five studies, P = studies included for pooling with a comparable study, S = studies included for receptors not represented in the other studies reviewed, and NR = not reviewed because five usable datasets were available in higher

[b] As reported in the Eco-SSL. The correct publication year for this paper is 1979.

[c] The full citation for this paper was not presented in the Eco-SSL and the paper could not be found through an online search.

na - not available

NA - not applicable

NR - not reviewed

Table A-14. Tier Determination and Results of Study Selection Process for Acceptable Cadmium Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Whelton et al. 1988	625	mouse (*Mus musculus*)	0.661	NA	NA	no	1	1	T	1
Sawicka-Kapusta et al. 1994	694	mouse (*Mus musculus*)	2.28	NA	NA	no	1	2	T	2
Sutou et al. 1980	647	rat (*Rattus norvegicus*)	10.0	NA	NA	no	1	3	T	4
Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	18.4	NA	NA	no	1	4	T	1
Wardell et al. 1982	748	rat (*Rattus norvegicus*)	75	NA	NA	no	1	5	T	0
Pond and Walker 1975	3731	rat (*Rattus norvegicus*)	236	NA	NA	no	1	7	NR	NR
Webster 1978	824	mouse (*Mus musculus*)	1.42	NA	NA	yes	2	8	NR	NR
Schroeder and Mitchener 1971	66	mouse (*Mus musculus*)	1.45	NA	NA	yes	2	9	NR	NR
Hastings et al. 1978	571	rat (*Rattus norvegicus*)	2.14	NA	NA	yes	2	10	NR	NR
Steibert et al. 1984	543	rat (*Rattus norvegicus*)	3.93	NA	NA	yes	2	11	NR	NR
Ahokas et al. 1980	669	rat (*Rattus norvegicus*)	4.50	NA	NA	yes	2	12	NR	NR
Sorell and Braziano 1990	822	rat (*Rattus norvegicus*)	4.88	NA	NA	yes	2	13	NR	NR
Webster 1979	823	mouse (*Mus musculus*)	5.59	NA	NA	yes	2	14	NR	NR
Steibert et al. 1984	544	rat (*Rattus norvegicus*)	5.82	NA	NA	yes	2	15	NR	NR
Gupta et al. 1993	608	rat (*Rattus norvegicus*)	6.30	NA	NA	yes	2	16	NR	NR
Sasser et al. 1985	9321	rat (*Rattus norvegicus*)	10.0	NA	NA	yes	2	17	NR	NR
Webster 1988	525	mouse (*Mus musculus*)	15.6	NA	NA	yes	2	18	NR	NR
Growth										
Weigel et al. 1987	629	rat (*Rattus norvegicus*)	0.0744	yes	no	no	1	1	T	0
Merali and Singhal 1980	639	rat (*Rattus norvegicus*)	1.0	yes	no	no	1	2	T	0
Rastogi et al. 1977	753	rat (*Rattus norvegicus*)	1.0	yes	no	no	1	3	T	0
Cousins et al. 1977	670	rat (*Rattus norvegicus*)	1.34	yes	yes	no	1	4	T	0
Rajanna et al. 1984	637	rat (*Rattus norvegicus*)	1.97	yes	yes	no	1	5	T	0
Groten et al. 1991	615	rat (*Rattus norvegicus*)	3.01	yes	no	no	1	6	A	0
Wilson et al. 1940[b]	825	rat (*Rattus norvegicus*)	3.21	yes	no	no	1	7	A	1
Pond et al. 1973	583	pig (*Sus scrofa*)	3.88	yes	no	no	1	8	A	1
Baranski and Sitarek 1987	809	rat (*Rattus norvegicus*)	4.0	no	yes	no	1	9	A	1
Suzuki and Yoshida 1978	572	rat (*Rattus norvegicus*)	4.06	yes	no	no	1	10	A	0
Suzuki and Yoshida 1979	780	rat (*Rattus norvegicus*)	4.58	yes	no	no	1	11	A	2
Suzuki and Yoshida 1978	768	rat (*Rattus norvegicus*)	5.08	yes	no	no	1	12	A	0
Meyer et al. 1982	662	rat (*Rattus norvegicus*)	5.44	yes	no	no	1	13	NR	NR
Machemer and Lorke 1981	560	rat (*Rattus norvegicus*)	6.13	yes	no	no	1	14	NR	NR
Chetty et al. 1980	650	rat (*Rattus norvegicus*)	8.71	yes	no	no	1	15	NR	NR
Nakamura et al. 1983	638	rat (*Rattus norvegicus*)	9.54	yes	yes	no	1	16	NR	NR
Banis et al. 1969	3733	rat (*Rattus norvegicus*)	9.70	yes	no	no	1	17	NR	NR
Sutou, et al. 1980	443	rat (*Rattus norvegicus*)	10.0	yes	no	no	1	18	NR	NR
Banis et al. 1969	3733	rat (*Rattus norvegicus*)	10.4	yes	no	no	1	19	NR	NR
Yuyama 1982	710	rat (*Rattus norvegicus*)	10.6	yes	no	no	1	20	NR	NR
Cousins et al. 1973	502	pig (*Sus scrofa*)	12.1	yes	no	no	1	21	NR	NR
Eakin et al. 1980	659	rat (*Rattus norvegicus*)	13.2	yes	yes	no	1	22	NR	NR
Gustafson and Mercer 1984	551	rat (*Rattus norvegicus*)	15.2	yes	no	no	1	23	NR	NR
Mitsumori et al. 1998	591	rat (*Rattus norvegicus*)	15.4	yes	no	no	1	24	NR	NR
Suzuki and Yoshida 1977	574	rat (*Rattus norvegicus*)	20.7	yes	no	no	1	25	P	1
Zielinska-Psuja et al. 1979	569	rat (*Rattus norvegicus*)	54.0	yes	yes	no	1	26	NR	NR
Van Vleet et al. 1981	149	pig (*Sus scrofa*)	75.8	yes	no	no	1	27	NR	NR
Hamada et al. 1991	465	dog (*Canis familiaris*)	100	yes	no	no	1	28	S	1
Dodds-Smith et al. 1992	440	shrew (*Sorex araneus*)	103	yes	no	no	1	29	S	1
Weber and Reid 1969	677	mouse (*Mus musculus*)	571	yes	no	no	1	30	S	1
Ogoshi et al. 1989	720	rat (*Rattus norvegicus*)	1.16	yes	na	yes	2	31	NR	NR
Ahokas et al. 1980	669	rat (*Rattus norvegicus*)	1.57	yes	na	yes	2	32	NR	NR
Perry et al. 1977	3730	rat (*Rattus norvegicus*)	1.61	yes	na	yes	2	33	NR	NR
Steibert et al. 1984	544	rat (*Rattus norvegicus*)	5.82	yes	na	yes	2	34	NR	NR
Freundt and Irbahim 1990	2640	rat (*Rattus norvegicus*)	6.89	yes	na	yes	2	35	NR	NR
Yuhas et al. 1979	776	rat (*Rattus norvegicus*)	7.70	yes	na	yes	2	36	NR	NR
Lee et al. 1994	733	rat (*Rattus norvegicus*)	10.0	no	no	no	2	37	NR	NR
Kajikawa et al. 1981	667	rat (*Rattus norvegicus*)	14.7	yes	no	yes	2	38	NR	NR
Pond and Walker 1975	3731	rat (*Rattus norvegicus*)	16.8	no	no	no	2	39	NR	NR
Ogoshi et al. 1989	720	rat (*Rattus norvegicus*)	17.1	no	na	yes	2	40	NR	NR
Koller and Roan 1977	814	mouse (*Mus musculus*)	44.4	yes	na	yes	2	41	NR	NR
Exon et al. 1979	3847	mouse (*Mus musculus*)	85.9	yes	na	yes	2	42	NR	NR
Survival										
Swiergosz et al. 1998	506	bank vole (*Clethrionomys glareolus*)	4.99	NA	NA	no	1	1	T	1
Baranski and Sitarek 1987	809	rat (*Rattus norvegicus*)	40.0	NA	NA	no	1	2	T	1
Weber and Reid 1969	677	mouse (*Mus musculus*)	2160	NA	NA	no	1	3	T	1
Schroeder et al. 1963	14446	rat (*Rattus norvegicus*)	0.551	NA	NA	yes	2	4	T	2
Schroeder et al. 1964	14447	mouse (*Mus musculus*)	0.620	NA	NA	yes	2	5	T	1

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2005a) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), A = additional studies reviewed if five datasets were not available from the top five studies, P = studies included for pooling with a comparable study, S = studies included for receptors not represented in the other studies reviewed, and NR = not reviewed because five usable datasets were available in higher ranked studies.

[b] As reported in the Eco-SSL. The correct publication year for this paper is 1941.

NA - not applicable

na - not available

NR - not reviewed

Table A-15. Tier Determination and Results of Study Selection Process for Acceptable Copper Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Ankari et al. 1998	2006	chicken (*Gallus domesticus*)	12.1	NA	NA	no	1	1	T	0
Harms and Buresh 1986	2117	chicken (*Gallus domesticus*)	19.5	NA	NA	no	1	2	T	1
Stevenson and Jackson 1980	2293	chicken (*Gallus domesticus*)	22.6	NA	NA	no	1	3	T	1
Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	25.5	NA	NA	no	1	4	T	2
Stevenson et al. 1983	6170	chicken (*Gallus domesticus*)	28.0	NA	NA	no	1	5	T	2
Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	29.9	NA	NA	no	1	6	P	3
Chiou et al. 1997	2050	chicken (*Gallus domesticus*)	40.6	NA	NA	no	1	7	P	1
Pearce et al. 1983	2294	chicken (*Gallus domesticus*)	45.0	NA	NA	no	1	8	P	1
Jackson 1977	2157	chicken (*Gallus domesticus*)	47.5	NA	NA	no	1	9	NR	NR
Stevenson and Jackson 1980	2292	chicken (*Gallus domesticus*)	54.4	NA	NA	no	1	10	P	1
Growth										
Kashani et al. 1986	2171	turkey (*Melagris gallopavo*)	4.68	yes	no	no	1	1	T	0
Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	14.3	yes	no	no	1	2	T	3
Jensen and Maurice 1978	2165	chicken (*Gallus domesticus*)	17.5	yes	no	no	1	3	T	1
Latymer and Coates 1981	2191	chicken (*Gallus domesticus*)	21.3	yes	no	no	1	4	T	1
Miles et al. 1998	2221	chicken (*Gallus domesticus*)	24.7	yes	no	no	1	5	T	2
Funk and Baker 1991	2099	chicken (*Gallus domesticus*)	25.8	yes	no	no	1	6	NR	NR
Robbins and Baker 1980	2266	chicken (*Gallus domesticus*)	26.4	yes	no	no	1	7	NR	NR
Chiou et al. 1999	2048	chicken (*Gallus domesticus*)	26.6	yes	no	no	1	8	NR	NR
Hill 1974	1369	chicken (*Gallus domesticus*)	28.7	yes	no	no	1	9	P	1
Smith 1969	2284	chicken (*Gallus domesticus*)	31.1	yes	no	no	1	10	P	0[b]
Christmas and Harms 1979	2052	turkey (*Melagris gallopavo*)	31.4	yes	no	no	1	11	NR	NR
Kassim and Suwanpradit 1996	2172	chicken (*Gallus domesticus*)	34.1	yes	no	no	1	12	NR	NR
Wang et al. 1987	2319	chicken (*Gallus domesticus*)	35.5	yes	no	no	1	13	P	1
Ekperigin and Vohra 1981	2084	chicken (*Gallus domesticus*)	35.5	yes	no	no	1	14	NR	NR
Jensen and Maurice 1978[c]	2166	chicken (*Gallus domesticus*)	37.1	yes	no	no	1	15	P	1
Ledoux et al. 1989	5812	chicken (*Gallus domesticus*)	40.4	yes	no	no	1	16	NR	NR
Robbins and Baker 1980	2267	chicken (*Gallus domesticus*)	42.7	yes	no	no	1	17	NR	NR
Ekperigin and Vohra 1981	6474	chicken (*Gallus domesticus*)	42.9	yes	no	no	1	18	NR	NR
Hill 1974	92	chicken (*Gallus domesticus*)	42.9	yes	no	no	1	19	NR	NR
Mehring et al. 1960	22	chicken (*Gallus domesticus*)	43.3	yes	no	no	1	20	NR	NR
Waibel et al. 1964	14405	turkey (*Melagris gallopavo*)	46.6	yes	no	no	1	21	NR	NR
Robbins and Baker 1980	2267	chicken (*Gallus domesticus*)	50.1	yes	no	no	1	22	NR	NR
Harms and Buresh 1986	2118	turkey (*Melagris gallopavo*)	51.9	yes	no	no	1	23	NR	NR
Robbins and Baker 1980	2266	chicken (*Gallus domesticus*)	55.2	yes	no	no	1	24	NR	NR
Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	59.3	yes	no	no	1	25	NR	NR
Hill 1979	1370	chicken (*Gallus domesticus*)	85.9	yes	no	no	1	26	NR	NR
Jensen 1975	1403	chicken (*Gallus domesticus*)	92.9	yes	no	no	1	27	NR	NR
Hill 1980	395	chicken (*Gallus domesticus*)	138	yes	no	no	1	28	NR	NR
Stevenson and Jackson 1980	2293	chicken (*Gallus domesticus*)	22.6	no	no	no	2	29	NR	NR
Stevenson et al. 1983	6170	chicken (*Gallus domesticus*)	28.0	no	no	no	2	30	NR	NR
Jackson et al. 1979	2160	chicken (*Gallus domesticus*)	29.9	no	no	no	2	31	NR	NR
Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	30.7	no	yes	no	2	32	NR	NR
Jackson and Stevenson 1981	2158	chicken (*Gallus domesticus*)	30.7	no	yes	no	2	33	NR	NR
Jackson and Stevenson 1981	2159	chicken (*Gallus domesticus*)	31.0	no	no	no	2	34	NR	NR
Stevenson and Jackson 1980	2292	chicken (*Gallus domesticus*)	33.4	no	no	no	2	35	NR	NR
Stevenson and Jackson 1981	2291	chicken (*Gallus domesticus*)	35.2	no	no	no	2	36	NR	NR
Chiou et al. 1997	2050	chicken (*Gallus domesticus*)	35.3	no	no	no	2	37	NR	NR
Griminger 1977	2112	chicken (*Gallus domesticus*)	44.8	no	no	no	2	38	NR	NR
Jackson 1977	2157	chicken (*Gallus domesticus*)	55.9	no	no	no	2	39	NR	NR
Survival										
Poupoulis and Jensen 1976	2250	chicken (*Gallus domesticus*)	28.7	NA	NA	no	1	1	T	2
Mehring et al. 1960	22	chicken (*Gallus domesticus*)	43.3	NA	NA	no	1	2	T	1
Vohra and Kratzer 1968	14404	turkey (*Melagris gallopavo*)	120	NA	NA	no	1	3	T	1
Hill 1974	92	chicken (*Gallus domesticus*)	122	NA	NA	no	1	4	T	1
Van Vleet et al. 1981	80	duck (*Anas platyrhynchos*)	201	NA	NA	no	1	5	S	2

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2007a) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), P = studies included for pooling with a comparable study, S = studies included for receptors not represented in the other studies reviewed, and NR = not reviewed because five usable datasets were available in higher ranked studies.

[b] Zero is based on using data as an individual study because there is no LOAEL ≥ 20, but data could still be used for pooling.

[c] As reported in the Eco-SSL. The correct publication year for this paper is 1979.

NA - not applicable

NR - not reviewed

Table A-16. Tier Determination and Results of Study Selection Process for Acceptable Copper Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Cromwell et al. 1993	2062	pig (*Sus scrofa*)	5.51	NA	NA	no	1	1	T	1
Aulerich et al. 1982	2013	mink (*Mustela vision*)	6.79	NA	NA	no	1	2	T	1
Lecyk 1980	2193	mouse (*Mus musculus*)	136	NA	NA	no	1	3	T	2
Growth										
Allcroft et al. 1961	14387	pig (*Sus scrofa*)	9.34	yes	no	no	1	1	T	1
Brandt 1983	2033	mink (*Mustela vision*)	19.6	yes	no	no	1	2	T	1
Boyden 1938	14653	rat (*Rattus norvegicus*)	23.5	yes	no	no	1	3	T	1
Edmonds and Baker 1986	2075	pig (*Sus scrofa*)	26.9	yes	no	no	1	4	T	0
Suttle and Mills 1966	3757	pig (*Sus scrofa*)	27.6	yes	no	no	1	5	T	1
Grobner et al. 1986	2113	rabbit (*Oryctolagus cuniculus*)	45.7	yes	no	no	1	6	A	0
Llewellyn et al. 1985	2203	rat (*Rattus norvegicus*)	106	yes	yes	no	1	7	A	1
Fuentealba et al. 2000	36364	rat (*Rattus norvegicus*)	122	yes	yes	no	1	8	NR	NR
NTP 1993a	2126	rat (*Rattus norvegicus*)	165	yes	no	no	1	9	NR	NR
Keen et al. 1982	11928	rat (*Rattus norvegicus*)	183	yes	no	no	1	10	NR	NR
Haywood 1985	2121	rat (*Rattus norvegicus*)	274	yes	yes	no	1	11	NR	NR
Haywood and Loughran 1985	2124	rat (*Rattus norvegicus*)	285	yes	no	no	1	12	NR	NR
NTP 1993a	2127	rat (*Rattus norvegicus*)	293	yes	yes	no	1	13	NR	NR
Pettersen et al. 2002	36374	mouse (*Mus musculus*)	988	yes	no	no	1	14	S	0
NTP 1993a	2127	rat (*Rattus norvegicus*)	1738	yes	no	no	1	15	NR	NR
NTP 1993a	2127	mouse (*Mus musculus*)	4670	yes	no	no	1	16	NR	NR
NTP 1993a	2127	mouse (*Mus musculus*)	47500	yes	no	no	1	17	NR	NR
Rana and Kumar 1980	2256	rat (*Rattus norvegicus*)	39.8	no	no	no	2	18	NR	NR
Kumar et al. 1987	2186	rat (*Rattus norvegicus*)	39.8	no	no	no	2	19	NR	NR
NTP 1993a	2126	rat (*Rattus norvegicus*)	51.6	yes	no	yes	2	20	NR	NR
Komulainen 1983	12079	rat (*Rattus norvegicus*)	64.0	yes	no	yes	2	21	NR	NR
NTP 1993a	2126	mouse (*Mus musculus*)	101	yes	no	yes	2	22	NR	NR
NTP 1993a	2127	rat (*Rattus norvegicus*)	400	yes	no	yes	2	23	NR	NR
NTP 1993a	2127	mouse (*Mus musculus*)	3395	yes	no	yes	2	24	NR	NR
Freundt and Ibrahim 1990	2640	rat (*Rattus norvegicus*)	5.78	no	yes	yes	2	25	NR	NR
Survival										
Ritchie et al. 1963	14402	pig (*Sus scrofa*)	8.08	NA	NA	no	1	1	T	1
Allcroft et al. 1961	14387	pig (*Sus scrofa*)	9.34	NA	NA	no	1	2	T	1
Brandt 1983	2033	mink (*Mustela vision*)	19.6	NA	NA	no	1	3	T	1
Boyden 1938	14653	rat (*Rattus norvegicus*)	35.0	NA	NA	no	1	4	T	1
Keen et al. 1982	11928	rat (*Rattus norvegicus*)	183	NA	NA	no	1	5	T	1
NTP 1993a	2127	rat (*Rattus norvegicus*)	400	NA	NA	yes	2	6	NR	NR
NTP 1993a	2126	mouse (*Mus musculus*)	101	NA	NA	yes	2	7	S	2
NTP 1993a	2126	rat (*Rattus norvegicus*)	111	NA	NA	yes	2	8	NR	NR
McNatt et al. 1971	2216	rat (*Rattus norvegicus*)	114	NA	NA	yes	2	9	NR	NR
NTP 1993a	2127	mouse (*Mus musculus*)	3395	NA	NA	yes	2	10	NR	NR

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2007a) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), A = additional studies reviewed if five datasets were not available from the top five studies, S = studies included for receptors not represented in the other studies reviewed, and NR = not reviewed because five usable datasets were available in higher ranked studies.

NA - not applicable

NR - not reviewed

Table A-17. Tier Determination and Results of Study Selection Process for Acceptable Lead Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Edens et al. 1976	2606	Japanese quail (*Coturnix japonica*)	0.110	NA	NA	no	1	1	T	3
Edens and Garlich 1983	2608	Japanese quail (*Coturnix japonica*)	0.194	NA	NA	no	1	2	T	3
Edens and Melvin 1989	2609	Japanese quail (*Coturnix japonica*)	93.1	NA	NA	no	1	3	T	1
Stone and Soares 1976	2898	Japanese quail (*Coturnix japonica*)	377	NA	NA	no	1	4	T	1
Growth										
Edens and Garlich 1983	2608	Japanese quail (*Coturnix japonica*)	15.6	yes	no	no	1	1	T	0
Donaldson and McGowan 1989	1285	chicken (*Gallus domesticus*)	38.2	yes	no	no	1	2	T	1
Latta and Donaldson 1986	2744	chicken (*Gallus domesticus*)	53.1	yes	no	no	1	3	T	1
Edens and Melvin 1989	2609	Japanese quail (*Coturnix japonica*)	59.3	yes	no	no	1	4	T	0
Damron et al. 1969	14768	chicken (*Gallus domesticus*)	61.4	yes	no	no	1	5	T	1
Morgan et al. 1975	2779	Japanese quail (*Coturnix japonica*)	67.4	yes	no	no	1	6	A	0
Leeming and Donaldson 1984	2748	chicken (*Gallus domesticus*)	76.3	yes	no	no	1	7	A	0
Edens et al. 1976	2606	Japanese quail (*Coturnix japonica*)	111	yes	no	no	1	8	A	1
Edens 1985	2605	Japanese quail (*Coturnix japonica*)	112	yes	no	no	1	9	A	0
Berg et al. 1980	2534	chicken (*Gallus domesticus*)	123	yes	no	no	1	10	A	3
Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	152	yes	no	no	1	11	NR	NR
Donaldson 1986	2600	chicken (*Gallus domesticus*)	163	yes	no	no	1	12	P	2
Khan et al. 1993	5507	chicken (*Gallus domesticus*)	200	yes	no	no	1	13	NR	NR
Cupo and Donaldson 1987	2579	chicken (*Gallus domesticus*)	262	yes	no	no	1	14	P	1
Berg et al. 1980	2534	chicken (*Gallus domesticus*)	270	yes	no	no	1	15	NR	NR
Franson and Custer 1982	2635	chicken (*Gallus domesticus*)	273	yes	no	no	1	16	P	1
Stone and Soares 1976	2898	Japanese quail (*Coturnix japonica*)	64.3	no	no	no	2	17	NR	NR
Survival										
Anders et al. 1982	2513	pigeon (*Columba livia*)	6.3	NA	NA	no	1	1	T	0
Barthalmus et al. 1977	2526	pigeon (*Columba livia*)	25.0	NA	NA	no	1	2	T	1
Cupo and Donaldson 1987	2579	chicken (*Gallus domesticus*)	194	NA	NA	no	1	3	T	0
Vengris and Mare 1974	14384	chicken (*Gallus domesticus*)	320	NA	NA	no	1	4	T	1
Khan et al. 1993	1415	chicken (*Gallus domesticus*)	400	NA	NA	no	1	5	T	0

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2005b) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), A = additional studies reviewed if five datasets were not available from the top five studies, P = studies included for pooling with a comparable study, and NR = not reviewed because five usable datasets were available in higher ranked studies.

NA - not applicable

NR - not reviewed

Table A-18. Tier Determination and Results of Study Selection Process for Acceptable Lead Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Schroeder and Mitchener 1971	66	rat (*Rattus norvegicus*), mouse (Mus muscul	2.94	NA	NA	no[b]	1	1	T	0
Gupta et al. 1995	2666	mouse (*Mus musculus*)	5.50	NA	NA	no	1	2	T	1
Winneke et al. 1977	3935	rat (*Rattus norvegicus*)	49.6	NA	NA	no	1	3	T	2
Miller et al. 1982	2775	rat (*Rattus norvegicus*)	54.6	NA	NA	no	1	4	T	0
Wardell et al. 1982	748	rat (*Rattus norvegicus*)	150	NA	NA	no	1	5	T	0
Jacquet et al. 1997	2713	mouse (*Mus musculus*)	154	NA	NA	no	1	6	A	0
Mykkanen et al. 1980	2783	rat (*Rattus norvegicus*)	221	NA	NA	no	1	7	A	2
Hsu 1980	2704	rat (*Rattus norvegicus*)	222	NA	NA	no	1	8	NR	NR
Alfano and Petit 1982	2511	rat (*Rattus norvegicus*)	258	NA	NA	no	1	9	NR	NR
Maker et al. 1973	2758	mouse (*Mus musculus*)	506	NA	NA	no	1	10	NR	NR
Maker et al. 1973	2758	mouse (*Mus musculus*)	506	NA	NA	no	1	11	NR	NR
Jacquet 1977	2711	mouse (*Mus musculus*)	646	NA	NA	no	1	11	NR	NR
Holtzman et al. 1981	2698	rat (*Rattus norvegicus*)	828	NA	NA	no	1	12	NR	NR
Holtzman et al. 1978	2699	rat (*Rattus norvegicus*)	833	NA	NA	no	1	13	NR	NR
Barlow et al. 1977	2523	rat (*Rattus norvegicus*)	991	NA	NA	no	1	14	NR	NR
Barrett and Livesey 1983	10239	rat (*Rattus norvegicus*)	1500	NA	NA	no	1	15	NR	NR
McConnell and Berry 1979	2767	rat (*Rattus norvegicus*)	1770	NA	NA	no	1	15	NR	NR
Krigman et al. 1974	2741	rat (*Rattus norvegicus*)	2570	NA	NA	no	1	16	NR	NR
Goldstein et al. 1974	14824	rat (*Rattus norvegicus*)	2570	NA	NA	no	1	17	NR	NR
Holtzman et al. 1980	14827	rat (*Rattus norvegicus*)	2570	NA	NA	no	1	17	NR	NR
Pentschew and Garro 1966	2811	rat (*Rattus norvegicus*)	2840	NA	NA	no	1	18	NR	NR
Michaelson and Sauerhoff 1974	2774	rat (*Rattus norvegicus*)	6170	NA	NA	no	1	19	NR	NR
Dilts and Ahokas 1979	2593	rat (*Rattus norvegicus*)	5.00	NA	NA	yes	2	20	NR	NR
Grant et al. 1980	2658	rat (*Rattus norvegicus*)	6.0	NA	NA	yes	2	21	NR	NR
Dilts and Ahokas 1980	2592	rat (*Rattus norvegicus*)	10.0	NA	NA	yes	2	22	NR	NR
Gandley et al. 1999	2642	rat (*Rattus norvegicus*)	26.0	NA	NA	yes	2	23	NR	NR
Kimmel et al. 1980	2737	rat (*Rattus norvegicus*)	45.0	NA	NA	yes	2	24	NR	NR
Hayashi 1983	3864	rat (*Rattus norvegicus*)	55.5	NA	NA	yes	2	25	NR	NR
Donald et al. 1981	2598	mouse (*Mus musculus*)	78.6	NA	NA	yes	2	26	NR	NR
Donald et al. 1986	2599	mouse (*Mus musculus*)	99.8	NA	NA	yes	2	27	NR	NR
Winder et al. 1984	2934	rat (*Rattus norvegicus*)	111	NA	NA	yes	2	28	NR	NR
Talcott and Koller 1983	2906	mouse (*Mus musculus*)	137	NA	NA	yes	2	29	NR	NR
Cramer et al. 1980	14816	rat (*Rattus norvegicus*)	178	NA	NA	yes	2	30	NR	NR
Sokol et al. 1985	2888	rat (*Rattus norvegicus*)	198	NA	NA	yes	2	31	NR	NR
Hallen et al. 1995	2669	rat (*Rattus norvegicus*)	200	NA	NA	yes	2	32	NR	NR
Rabe et al. 1985	13216	rat (*Rattus norvegicus*)	218	NA	NA	yes	2	33	NR	NR
Ronis et al. 1998	2847	rat (*Rattus norvegicus*)	270	NA	NA	yes	2	34	NR	NR
Yu et al. 1996	3939	rat (*Rattus norvegicus*)	330	NA	NA	yes	2	35	NR	NR
Ronis et al. 1998	2845	rat (*Rattus norvegicus*)	360	NA	NA	yes	2	36	NR	NR
Ronis et al. 1998	2845	rat (*Rattus norvegicus*)	360	NA	NA	yes	2	40	NR	NR
Ronis et al. 1996	2846	rat (*Rattus norvegicus*)	362	NA	NA	yes	2	37	NR	NR
Pinon-Lataillade et al. 1995	2821	mouse (*Mus musculus*)	381	NA	NA	yes	2	38	NR	NR
Draski et al. 1989	3719	mouse (*Mus musculus*)	381	NA	NA	yes	2	39	NR	NR
Thoreux-Manlay et al. 1995	2909	rat (*Rattus norvegicus*)	420	NA	NA	yes	2	40	NR	NR
Donald et al. 1987	2597	mouse (*Mus musculus*)	437	NA	NA	yes	2	41	NR	NR

Table A-18. Tier Determination and Results of Study Selection Process for Acceptable Lead Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction (continued)										
Cramer et al. 1980	14816	rat (*Rattus norvegicus*)	552	NA	NA	yes	2	42	NR	NR
Piasek et al. 1988	14751	rat (*Rattus norvegicus*)	635	NA	NA	yes	2	43	NR	NR
Selvin-Testa et al. 1997	2869	rat (*Rattus norvegicus*)	651	NA	NA	yes	2	44	NR	NR
Piasek and Kostial 1991	2818	rat (*Rattus norvegicus*)	750	NA	NA	yes	2	45	NR	NR
Epstein et al. 1991	2614	mouse (*Mus musculus*)	762	NA	NA	yes	2	46	NR	NR
Sharma and Kanwar 1985	2871	mouse (*Mus musculus*)	1990	NA	NA	yes	2	47	NR	NR
Sharma and Kanwar 1985	2871	mouse (*Mus musculus*)	3630	NA	NA	yes	2	52	NR	NR
Growth[c]										
Al-Omar et al. 2000	20974	mouse (*Mus musculus*)	46.4	yes	no	no	1	1	T	0
Lorenzo et al. 1978	2751	rabbit (*Oryctolagus cuniculus*)	50.4	yes	no	no	1	2	T	1
Kumar and Desiraju 1990	2870	rat (*Rattus norvegicus*)	100	yes	no	no	1	3	T	1
Hsu et al. 1975	14376	pig (*Sus scrofa*)	173	yes	yes	no	1	4	T	0
Harry et al. 1985	2680	rat (*Rattus norvegicus*)	200	yes	no	no	1	5	T	0
Toews et al. 1983	2911	rat (*Rattus norvegicus*)	400	yes	no	no	1	6	A	1
Mykkanen et al. 1980	2783	rat (*Rattus norvegicus*)	442	yes	no	no	1	7	A	0
Barlow et al. 1977	2523	rat (*Rattus norvegicus*)	991	yes	no	no	1	8	A	0
Maker et al. 1973	2758	mouse (*Mus musculus*)	1260	yes	no	no	1	9	A	0
Gerber et al. 1978	14822	rat (*Rattus norvegicus*)	1430	yes	no	no	1	10	A	1
Eyden et al. 1978	2618	mouse (*Mus musculus*)	1360	no	no	no	2	11	NR	NR
Holtzman et al. 1981	2698	rat (*Rattus norvegicus*)	2390	no	no	no	2	12	NR	NR
Holtzman et al. 1980	14827	rat (*Rattus norvegicus*)	2650	no	no	no	2	13	NR	NR
Barratt et al. 1989	2524	rat (*Rattus norvegicus*)	180	no	no	no	2	14	NR	NR
Lessler and Wright 1976	2750	rat (*Rattus norvegicus*)	272	no	no	no	2	15	NR	NR
Schroeder et al. 1970	252	rat (*Rattus norvegicus*)	3.30	yes	no	yes	2	16	NR	NR
Dilts and Ahokas 1979	2593	rat (*Rattus norvegicus*)	5.00	yes	no	yes	2	17	NR	NR
Kimmel et al. 1980	2737	rat (*Rattus norvegicus*)	8.90	yes	no	yes	2	18	NR	NR
Zheng et al. 1996	2944	rat (*Rattus norvegicus*)	28.2	yes	no	yes	2	19	NR	NR
Hammond et al. 1989	2675	rat (*Rattus norvegicus*)	29.0	yes	no	yes	2	20	NR	NR
Hamilton et al. 1994	2671	rat (*Rattus norvegicus*)	29.0	yes	no	yes	2	21	NR	NR
Hammond and Succop 1995	2678	rat (*Rattus norvegicus*)	29.0	yes	no	yes	2	22	NR	NR
Hammond et al. 1993	2677	rat (*Rattus norvegicus*)	29.5	yes	no	yes	2	23	NR	NR
Minnema and Hammond 1994	2776	rat (*Rattus norvegicus*)	30.4	yes	no	yes	2	24	NR	NR
Gerber et al. 1978	14822	mouse (*Mus musculus*)	163	yes	no	yes	2	25	NR	NR
Wolfe et al. 1996	2502	rat (*Rattus norvegicus*)	178	no	no	yes	2	26	NR	NR
Goyer et al. 1970	14799	rat (*Rattus norvegicus*)	383	yes	no	yes	2	27	NR	NR
Sokol 1989	2887	rat (*Rattus norvegicus*)	354	yes	no	yes	2	28	NR	NR
Ronis et al. 1996	2846	rat (*Rattus norvegicus*)	371	yes	no	yes	2	29	NR	NR
Wadi and Ahmad 1999	2924	mouse (*Mus musculus*)	373	yes	no	yes	2	30	NR	NR
Rasile et al. 1995	2836	mouse (*Mus musculus*)	404	yes	no	yes	2	31	NR	NR
Sokol et al. 1985	2888	rat (*Rattus norvegicus*)	508	yes	no	yes	2	32	NR	NR
Gruber et al. 1997	2660	rat (*Rattus norvegicus*)	532	yes	yes	yes	2	33	NR	NR
Piasek et al. 1988	14751	rat (*Rattus norvegicus*)	638	no	no	yes	2	34	NR	NR
Gulati et al. 1985	2837	mouse (*Mus musculus*)	748	no	no	yes	2	35	NR	NR

Table A-18. Tier Determination and Results of Study Selection Process for Acceptable Lead Studies for Mammals from the Eco-SSL Document

Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Results of Study Selection Process: Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Survival										
Junaid et al. 1997	2725	mouse (*Mus musculus*)	8.00	NA	NA	no	1	1	T	1
Lorenzo et al. 1978	2751	rabbit (*Oryctolagus cuniculus*)	50.4	NA	NA	no	1	2	T	1
Pankakoski et al. 1994	2807	shrew (*Sorex araneus*)	61.5	NA	NA	no	1	3	T	1
Press 1975[d]	2827	rat (*Rattus norvegicus*)	328	NA	NA	no	1	4	T	1
Kumar and Desiraju 1990	2870	rat (*Rattus norvegicus*)	400	NA	NA	no	1	5	T	1
Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	400	NA	NA	no	1	6	NR	NR
Eyden et al. 1978	2618	mouse (*Mus musculus*)	635	NA	NA	no	1	7	NR	NR
Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	800	NA	NA	no	1	8	NR	NR
Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	800	NA	NA	no	1	9	NR	NR
Holtzman et al. 1982	2697	rat (*Rattus norvegicus*)	2400	NA	NA	no	1	10	NR	NR
Kanisawa and Schroeder 1969	3701	rat (*Rattus norvegicus*)	0.569	NA	NA	yes	2	11	NR	NR
Schroeder et al. 1963	14446	rat (*Rattus norvegicus*)	2.87	NA	NA	yes	2	12	NR	NR
Schroeder et al. 1964	14447	mouse (*Mus musculus*)	3.10	NA	NA	yes	2	13	NR	NR
Gulati et al. 1985	2837	mouse (*Mus musculus*)	670	NA	NA	yes	2	14	NR	NR
Lamb et al. 1997	2505	mouse (*Mus musculus*)	670	NA	NA	yes	2	15	NR	NR

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2005b) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), A = additional studies reviewed if five datasets were not available from the top five studies, and NR = not reviewed because five usable datasets were available in higher ranked studies.

[b] The Eco-SSL reported drinking water exposure for this study. The actual exposure method was diet and drinking water so the study was classified as Tier 1.

[c] Four usable growth datasets were available from the ten Tier 1 studies reviewed. Because of the large number of Tier 1 studies reviewed for growth, Tier 2 studies were not included.

[d] As reported in the Eco-SSL. The correct publication year for this paper is 1977.

NA - not applicable

NR - not reviewed

Table A-19. Tier Determination and Results of Study Selection Process for Acceptable Manganese Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Growth										
Southern and Baker 1983	6363	chicken (*Gallus domesticus*)	348	yes	no	no	1	1	T	0
Vohra and Kratzer 1968	14404	turkey (*Meleagris gallopavo*)	356	yes	no	no	1	2	T	0
Martinez and Diaz 1996	5345	chicken (*Gallus domesticus*)	431	yes	no	no	1	3	T	0

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2007b) for the full reference list for studies cited in this table.

[a] T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL)

Table A-20. Tier Determination and Results of Study Selection Process for Acceptable Manganese Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Laskey et al. 1982[b]	56	Rat (*Rattus norvegicus*)		NA	NA	no	1	1	T	1
Kontur and Fechter 1985	34752	rat (*Rattus norvegicus*)	415	NA	NA	yes	2	2	T	0
Pappas et al. 1997	33496	rat (*Rattus norvegicus*)	620	NA	NA	yes	2	3	T	1
Leung et al. 1982	34895	rat (*Rattus norvegicus*)	2139	NA	NA	yes	2	4	T	1
Growth										
Rehnberg et al. 1980	57	rat (*Rattus norvegicus*)	71.0	yes	no	no	1	1	T	1
Komura and Sakamoto 1991	33786	mouse (*Mus musculus*)	284	yes	no	no	1	2	T	0
Lipe et al. 1999	33403	rat (*Rattus norvegicus*)	10.0	no	no	no	2	3	T	0
Kontur and Fechter 1985	34752	rat (*Rattus norvegicus*)	271	no	no	yes	2	4	T	0
Survival										
Rehnberg et al. 1980	57	rat (*Rattus norvegicus*)	71.0	NA	NA	no	1	1	T	1

Notes:

Blank cells are shown as reported in the ecological soil screening level (Eco-SSL) document; no description was provided.

See Eco-SSL document (USEPA 2007b) for the full reference list for studies cited in this table.

[a] T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL)

[b] No LOAEL was reported in the Eco-SSL for this study. Paper was reviewed and found to have an effect.

NA - not applicable

Table A-21. Tier Determination and Results of Study Selection Process for Acceptable Zinc Studies for Birds from the Eco-SSL Document

Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	> 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	66.5	NA	NA	no	1	1	T	2
Stevenson et al. 1987	8184	chicken (*Gallus domesticus*)	76.7	NA	NA	no	1	2	T	1
Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	88	NA	NA	no	1	3	T	2
Jensen and Maurice 1980	9749	chicken (*Gallus domesticus*)	98.8	NA	NA	no	1	4	T	2
Stepinska et al. 1987	5770	chicken (*Gallus domesticus*)	205	NA	NA	no	1	5	T	1
Growth										
Stahl et al. 1989	5820	chicken (*Gallus domesticus*)	31.0	yes	no	no	1	1	T	1
Lu and Combs 1988	5866	chicken (*Gallus domesticus*)	39.0	yes	no	no	1	2	T	1
Lu et al. 1990	8008	chicken (*Gallus domesticus*)	65.7	yes	no	no	1	3	T	1
Hamilton et al. 1981	6403	Japanese quail (*Coturnix japonica*)	86.6	yes	no	no	1	4	T	0
Sandoval et al. 1998	7245	chicken (*Gallus domesticus*)	106	yes	no	no	1	5	T	2
Berg and Martinson 1972	93	chicken (*Gallus domesticus*)	111	yes	no	no	1	6	NR	NR
Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	111	yes	no	no	1	7	P	4
Gasaway and Buss 1972	9261	mallard duck (*Anas platyrhynchos*)	126	yes	no	no	1	8	S	1
Pimentel et al. 1992	5617	chicken (*Gallus domesticus*)	132	yes	no	no	1	9	NR	NR
Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	143	yes	no	no	1	10	NR	NR
Hill 1974	92	chicken (*Gallus domesticus*)	172	yes	no	no	1	11	P	1
Hamilton et al. 1979	6655	Japanese quail (*Coturnix japonica*)	174	yes	no	no	1	12	NR	NR
Henry et al. 1987	6039	chicken (*Gallus domesticus*)	185	yes	no	no	1	13	NR	NR
Bafundo et al. 1984	6273	chicken (*Gallus domesticus*)	190	yes	no	no	1	14	NR	NR
Vohra and Kratzer 1968	14404	turkey (*Meleagris gallopavo*)	297	yes	no	no	1	15	S	1
Bartov 1996	5373	chicken (*Gallus domesticus*)	315	yes	no	no	1	16	NR	NR
Southern and Baker 1983	6368	chicken (*Gallus domesticus*)	354	yes	no	no	1	17	NR	NR
Rama and Planas 1981	6435	chicken (*Gallus domesticus*)	433	yes	no	no	1	18	NR	NR
Oh et al. 1979	6627	chicken (*Gallus domesticus*)	503	yes	no	no	1	19	NR	NR
Dean et al. 1991	5681	chicken (*Gallus domesticus*)	757	yes	no	no	1	20	NR	NR
Bartov et al. 1994	7956	chicken (*Gallus domesticus*)	914	yes	no	no	1	21	NR	NR
Jackson et al. 1986	6133	chicken (*Gallus domesticus*)	88	no	no	no	2	22	NR	NR
Jensen and Maurice 1980	9749	chicken (*Gallus domesticus*)	101	no	no	no	2	23	NR	NR
Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	145	no	no	no	2	24	NR	NR
Stevenson et al. 1987	8184	chicken (*Gallus domesticus*)	149	no	no	no	2	25	NR	NR
Bafundo et al. 1984	2517	chicken (*Gallus domesticus*)	284	no	no	no	2	26	NR	NR
Palafox and Ho-A 1980	6545	chicken (*Gallus domesticus*)	988	no	no	no	2	27	NR	NR
Survival										
Gibson et al. 1986	6048	chicken (*Gallus domesticus*)	87.1	NA	NA	no	1	1	T	1
Gasaway and Buss 1972	9261	mallard duck (*Anas platyrhynchos*)	126	NA	NA	no	1	2	T	1
Blalock and Hill 1988	5868	chicken (*Gallus domesticus*)	219	NA	NA	no	1	3	T	1
Roberson and Schaible 1960	14538	chicken (*Gallus domesticus*)	239	NA	NA	no	1	4	T	1
Dewar et al. 1983	37018	chicken (*Gallus domesticus*)	286	NA	NA	no	1	5	T	2
Hamilton et al. 1979	6655	Japanese quail (*Coturnix japonica*)	366	NA	NA	no	1	6	S	1
Van Vleet et al. 1981	80	duck (*Anas platyrhynchos*)	401	NA	NA	no	1	7	NR	NR
Oh et al. 1979	6627	chicken (*Gallus domesticus*)	503	NA	NA	no	1	8	NR	NR

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2007c) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), P = studies included for pooling with a comparable study, S = studies included for receptors not represented in the other studies reviewed, and NR = not reviewed because five usable datasets were available in higher ranked studies.

NA - not applicable

NR - not reviewed

Table A-22. Tier Determination and Results of Study Selection Process for Acceptable Zinc Studies for Mammals from the Eco-SSL Document

Reference	Ref No.	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection[a]	No. of Usable Datasets
Reproduction										
Kumar 1976	43587	rat (*Rattus norvegicus*)	12.2	NA	NA	no	1	1	T	0
Barone et al. 1998	21042	rat (*Rattus norvegicus*)	81.1	NA	NA	no	1	2	T	0
Newman et al. 2002	48540	rat (*Rattus norvegicus*)	232	NA	NA	no	1	3	T	1
Pal and Pal 1987	14664	rat (*Rattus norvegicus*)	326	NA	NA	no	1	4	T	1
Chu and Cox 1972	42670	rat (*Rattus norvegicus*)	326	NA	NA	no	1	5	T	1
Cox et al. 1969	42838	rat (*Rattus norvegicus*)	353	NA	NA	no	1	6	A	0
Schlicker and Cox 1968	25	rat (*Rattus norvegicus*)	424	NA	NA	no	1	7	A	4
Ketcheson et al. 1969	37837	rat (*Rattus norvegicus*)	452	NA	NA	no	1	8	NR	NR
Growth										
Nakamura et al. 1983	638	rat (*Rattus norvegicus*)	8.71	yes	yes	no	1	1	T	0
Subramanian et al. 2000	21011	rat (*Rattus norvegicus*)	28.2	yes	no	no	1	2	T	0
Barone et al. 1998	21042	rat (*Rattus norvegicus*)	81.1	yes	no	no	1	3	T	0
Brink et al. 1959	14525	pig (*Sus scrofa*)	87.1	yes	no	no	1	4	T	3
Hsu et al. 1975	14376	pig (*Sus scrofa*)	89.1	yes	yes	no	1	5	T	0
Hill et al. 1983	45143	pig (*Sus scrofa*)	103	yes	yes	no	1	6	A	1
Schlicker and Cox 1968	25	rat (*Rattus norvegicus*)	424	yes	no	no	1	7	A	0
Settlemire and Matrone 1967	38015	rat (*Rattus norvegicus*)	667	yes	no	no	1	8	A	1
Ogiso et al. 1974	42961	rat (*Rattus norvegicus*)	956	yes	no	no	1	9	NR	NR
Scott and Magee 1979	43264	rat (*Rattus norvegicus*)	968	yes	no	no	1	10	NR	NR
Maita et al. 1981	43680	rat (*Rattus norvegicus*)	2514	yes	yes	no	1	11	NR	NR
Pettersen et al. 2002	36374	mouse (*Mus musculus*)	2838	yes	no	no	1	12	S	0
Maita et al. 1981	43680	mouse (*Mus musculus*)	4878	yes	yes	no	1	13	S	1
Survival										
Brink et al. 1959	14525	pig (*Sus scrofa*)	87.1	NA	NA	no	1	1	T	3

Notes:

See ecological soil screening level (Eco-SSL) document (USEPA 2007c) for the full reference list for studies cited in this table.

[a] Study selection abbreviations are defined as follows: T = top five study based on tier and lowest-observed-adverse-effect level (LOAEL), A = additional studies reviewed if five datasets were not available from the top five studies, S = studies included for receptors not represented in the other studies reviewed, and NR = not reviewed because five usable datasets were available in higher ranked studies.

NA - not applicable

NR - not reviewed

Table A-23. Number of LOAELs in Eco-SSL Documents Less than the Selected UCR TRVs

							Number of Eco-SSL LOAELs < Selected TRV[a]														
							Acceptable Datasets Reviewed Based on Tiered Process							Acceptable Datasets Not Reviewed Based on Tiered Process[b]		Unacceptable Datasets					
Chemical	Receptor	Endpoint	Selected TRV	Total No. of LOAELs	Total No. LOAELs < Selected TRV	% LOAELs < Selected TRV	Tier 2 Study	Different Body Weight and Food Ingestion Rate Used	Effect Not <80% Relative to the Control	ED20 Calculated	Part of Pooled Dataset	No LOAEL Based on Study Review	Dose Converted from Weight of Salt to Weight of Metal	Tier 2 Study	Based on LOAEL Ranking	Endpoint not Relevant	Ruminant Study	NOAEL	Concerns with Study Design	Insufficient Data	Study Could Not Be Obtained
Cadmium	Birds	Growth	2.0	18	1	6%	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	Birds	Reproduction	2.3	9	0	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	Birds	Survival	7.4	5	1	20%	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Copper	Birds	Growth	62	70	62	89%	0	5	16	0	0	0	0	8	26	0	0	2	1	1	3
Copper	Birds	Reproduction	28	20	6	30%	0	2	1	0	1	0	0	0	0	2	0	0	0	0	0
Copper	Birds	Survival	67	13	7	54%	0	2	2	1	0	0	0	0	0	0	0	0	1	0	1
Lead	Birds	Growth	29	22	1	5%	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Lead	Birds	Reproduction	4.7	11	6	55%	0	0	4	0	1	0	0	0	0	1	0	0	0	0	0
Lead	Birds	Survival	11	6	1	17%	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Manganese	Birds	Growth	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Birds	Reproduction	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Birds	Survival	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	Birds	Growth	66	39	4	10%	0	1	0	0	2	0	0	0	0	0	0	0	1	0	0
Zinc	Birds	Reproduction	77	13	3	23%	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0
Zinc	Birds	Survival	250	10	4	40%	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0
Cadmium	Mammals	Growth	4.2	52	17	33%	0	1	8	1	0	0	0	3	0	2	1	1	0	0	0
Cadmium	Mammals	Reproduction	2.7	23	6	26%	0	0	2	0	0	0	0	3	0	1	0	0	0	0	0
Cadmium	Mammals	Survival	1.5	6	2	33%	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper	Mammals	Growth	12	31	5	16%	0	0	0	1	0	0	0	1	0	0	2	1	0	0	0
Copper	Mammals	Reproduction	27	5	2	40%	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Copper	Mammals	Survival	8.7	15	3	20%	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
Lead	Mammals	Growth	20	51	5	10%	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0
Lead	Mammals	Reproduction	4.7	80	4	5%	0	0	2	0	0	0	0	0	0	1	0	1	0	0	0
Lead	Mammals	Survival	7.6	20	4	20%	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0
Manganese	Mammals	Growth	71	9	2	22%	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Manganese	Mammals	Reproduction	310	6	3	50%	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Manganese	Mammals	Survival	91	1	1	100%	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Zinc	Mammals	Growth	75	16	3	19%	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0
Zinc	Mammals	Reproduction	75	13	1	8%	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Zinc	Mammals	Survival	190	4	3	75%	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0

Notes:

[a] There may be more than one reason why a lowest observed adverse effect level (LOAEL) is less than the selected toxicity reference value (TRV). In such cases the primary reason is shown (e.g., the body weight and food ingestion rate may be different, but the primary reason is that the effect at the LOAEL selected in the Eco-SSL document is not <80% relative to the control).

[b] See Section 3.3 of the main document for a desciption of the process by which studies were selected for review.

Eco-SSL - ecological soil screening level
ED20 - dose that causes a 20 percent effect
NA - not applicable
NOAEL - no observed apparent effect level

APPENDIX A-2

REFERENCES

NOTE:

See Eco-SSL document (USEPA 2007c) for the full reference list for studies in all tables in this appendix except Table A-12.

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APPENDIX B

DATA EXTRACTED FROM TOXICOLOGICAL STUDY REVIEWS

This appendix presents data extracted from acceptable papers reviewed for use in the derivation of wildlife toxicity reference values (TRVs) for cadmium, copper, lead, manganese, and zinc for use in the Upper Columbia River baseline ecological risk assessment. Tables B-2, B-4, B-6, B-8, and B-10 present bird data for each of the five metals, respectively, and Tables B-3, B-5, B-7, B-9, and B-11 present mammal data for each of the five metals respectively.

The following information and data in the tables were extracted directly from each of the papers:

- Chemical form
- Receptor
- Lifestage
- Endpoint
- Exposure mode (i.e., food, gavage, or drinking water)
- Exposure duration
- Dose in mg/kg bw/day, if provided in the paper
- Concentration in food in mg/kg, if provided in the paper[1]
- Effect (e.g., final body weight, percent of animals surviving)

If body-weight-normalized daily doses were not provided in the paper, then the doses were calculated using the following equation, as indicated in column labeled "Dose Notes":

$$Dose = (C \times IR) / BW \qquad \text{Equation 1}$$

Where:

Dose = daily dose of chemical expressed in mg/kg bw/day

C = concentration of chemical in food in mg/kg (dry weight or wet weight)[2] or drinking water in mg/L

BW = body weight in kg

[1] Concentrations of the target chemical in the basal diet were included, when reported. For example, if the concentration of the target chemical in the basal diet was 10 mg/kg, and the amount added to the feed was 100 mg/kg, the amount of chemical in the food was considered to be 110 mg/kg. In cases where the chemical concentration was reported based on the weight of the compound (e.g., cadmium chloride), the weight was converted to that of the element alone (e.g., cadmium) using the molecular weights of the components.

[2] The majority of studies used formulated feed as the diet for the laboratory organism; therefore, reported food concentrations were assumed to be based on dry weight unless otherwise noted in the study report.

IR = food ingestion rate in kg/day (dry weight or wet weight)[3] or drinking water ingestion rate in L/day

If a receptor's body weight and/or food or drinking water ingestion rate were not provided in the paper, the source is indicated in column labeled "BW Source" and/or column labeled "IR Source." The effect relative to the control was calculated using the data in the "Effect" columns as the effect at each dose relative to the effect at the control level. The reported lowest-observed-adverse-effect level (LOAEL) in column B is the dose for the lowest effect that was statistically significant as reported in the study. The LOAEL ≥ 20 is the lowest effect with a response that was at least 20% different from the control, as calculated in the "Effect Relative to Control (%)" columns.

[3] The wet or dry weight basis of the IR used in Equation 1 needed to match the basis of the concentration in ingested media (C).

APPENDIX B-1

TABLES

Table B-1. Acronyms, Abbreviations, and Units of Measure

Acronym/Abbreviation	Definition
BW	body weight
DW	drinking water
ED20	modeled concentration resulting in a 20% effect relative to the control
Exp.	experiment
FD	food (diet)
FIR	food ingestion rate
GV	gavage
LOAEL	lowest-observed-adverse-effect level
LOAEL ≥ 20	LOAEL representing a ≥ 20 percent reduction in the response compared to the control
NA	not applicable
no stats	statistical analyses not reported
NR	not reported
-	no data
Unit of Measure	**Definition**
dw	dry weight
g	gram(s)
kg	kilogram(s)
kg/day	kilogram(s) per day
L/day	liter(s) per day
lbs	pounds
mg/kg	milligram(s) per kilogram
mg/kg bw/day	milligram per kilogram of body weight per day
ww	wet weight

Table B-2. Cadmium TRV Data for Birds

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Bafundo et al. 1984	no stats	5	cadmium chloride	chicken	1 week	body weight gain	FD	2.0	0	5.03	-	-	-	-	calculated from BW and FIR
Bokori et al. 1995b	no stats	19	cadmium sulfate	chicken	21 days	body weight	FD	4.0	0	4.74	18.9	37.9	-	-	calculated from BW and FIR
Bokori et al. 1996	no stats	NA	cadmium sulfate	chicken	chick to adult	body weight	FD	39.0	0	1.57	4.7	-	-	-	calculated from BW and FIR
Di Giulio and Scanlon 1984	54	54	cadmium chloride	mallard	11 months	body weight	FD	6.0	0	5.99	18	53.9	-	-	calculated from BW and FIR
Hill 1974a	5.1	7.7	cadmium sulfate	chicken	1 day	body weight gain	FD	2.0	0	2.57	5.14	7.7	10.3	12.8	calculated from BW and FIR
Hill 1974b	7.3	7.3	cadmium sulfate	chicken	1 day	body weight gain	FD	2.0	0	7.32	-	-	-	-	calculated from BW and FIR
Hill 1979	no stats	5.1	cadmium sulfate	chicken	1 day	body weight gain	FD	2.0	0	2.57	5.14	7.7	-	-	calculated from BW and FIR
Hill 1980	13	13	cadmium sulfate	chicken	1 day	body weight gain	FD	2.0	0	12.8	-	-	-	-	calculated from BW and FIR
Olgun 2015	no stats	5.3	cadmium sulfate	Japanese quail	21 weeks	body weight	FD	10.0	0.0421	0.7	1.36	2.67	5.31	10.6	calculated from BW and FIR
Richardson and Fox 1974	12	12	cadmium chloride	Japanese quail	1 day	body weight	FD	4.0	0	12.5	-	-	-	-	calculated from BW and FIR
Rama and Planas 1981	no stats	10	cadmium sulfate	chicken	1 day	body weight gain	FD	9.0	0.0963	9.72	-	-	-	-	calculated from BW and FIR
Richardson et al. 1974	12	12	cadmium chloride	Japanese quail	1 day	body weight	FD	4.0	0	12.3	-	-	-	-	calculated from BW and FIR
Richardson et al. 1974	11	NA	cadmium chloride	Japanese quail	1 day	body weight	FD	6.0	0	10.6	-	-	-	-	calculated from BW and FIR
Reproduction															
Bokori et al. 1995b	no stats	9.4	cadmium sulfate	Japanese quail	adult	egg production	FD	5.3	0	9.36	18.7	37.4	-	-	calculated from BW and FIR
Leach et al. 1979	3.8	3.8	cadmium sulfate	chicken	adult	egg production	FD	48.0	0.0171	0.251	0.953	3.76	-	-	calculated from BW and FIR
Leach et al. 1979	0.24	3.7	cadmium sulfate	chicken	adult	egg production	FD	12.0	0.0055	0.239	0.941	3.75	-	-	calculated from BW and FIR
Olgun 2015	no stats	5.3	cadmium sulfate	Japanese quail	22 weeks	egg production	FD	10.0	0.0421	0.7	1.36	2.67	5.31	10.6	calculated from BW and FIR
White and Finley 1978	20	20	cadmium chloride	mallard	adult	egg production	FD	4.3 - 12.8	0.0076	0.153	1.45	20	-	-	calculated from BW and FIR
Survival															
Bokori et al. 1995b	no stats	9.4	cadmium sulfate	Japanese quail	adult	survival	FD	5.3	0	9.36	18.7	37.4	0	0	calculated from BW and FIR
Bokori et al. 1995a	no stats	38	cadmium sulfate	chicken	21 days	survival	FD	8.0	0	4.74	18.9	37.9	0	0	calculated from BW and FIR
Hill 1974b	7.3	NA	cadmium sulfate	chicken	1 day	survival	FD	2.0	0	7.32	0	0	0	0	calculated from BW and FIR
Olgun 2015	no stats	11	cadmium sulfate	Japanese quail	23 weeks	survival	FD	10.0	0.0421	0.7	1.36	2.67	5.31	10.6	calculated from BW and FIR
Pritzl et al. 1974	no stats	60	cadmium carbonate	chicken	2 weeks	survival	FD	2.9	0	40.3	60.4	80.5	101	0	calculated from BW and FIR
Van Vleet et al. 1981	no stats	39	cadmium sulfate	Pekin duck	1 day	survival	FD	4.0	0	39.2	0	0	0	0	calculated from BW and FIR

Table B-2. Cadmium TRV Data for Birds

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight Basis
Growth															
Bafundo et al. 1984	0.36	0.36	-	-	-	-	NRC 1994	0.0402	0.0402	-	-	-	-	NRC 1994	dw
Bokori et al. 1995b	1.52	1.52	1.52	1.52	-	-	present study	0.0961	0.0961	0.0961	0.0961	0.0961	-	NRC 1994	dw
Bokori et al. 1996	3.2	3.2	3.2	-	-	-	present study	0.2	0.2	0.2	-	-	-	USEPA 1988	dw
Di Giulio and Scanlon 1984	1.12	1.12	1.12	1.12	-	-	present study	0.134	0.134	0.134	0.134	-	-	present study	NA
Hill 1974a	0.148	0.148	0.148	0.148	0.148	0.148	NRC 1994	0.019	0.019	0.019	0.019	0.019	0.019	NRC 1994	dw
Hill 1974b	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Hill 1979	0.148	0.148	0.148	0.148	-	-	NRC 1994	0.019	0.019	0.019	0.019	-	-	NRC 1994	dw
Hill 1980	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Olgun 2015	0.15	0.15	0.15	0.15	0.15	0.15	Vos et al. 1971	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	Nagy 2001	dw
Richardson and Fox 1974	0.075	0.075	-	-	-	-	Narinc et al. 2010	0.0125	0.0125	-	-	-	-	Nagy 2001	dw
Rama and Planas 1981	0.2	0.2	-	-	-	-	USEPA 1988	0.0193	0.0193	-	-	-	-	USEPA 1988	dw
Richardson et al. 1974	0.075	0.075	-	-	-	-	Narinc et al. 2010	0.0123	0.0123	-	-	-	-	Nagy 2001	dw
Richardson et al. 1974	0.12	0.12	-	-	-	-	Narinc et al. 2010	0.0169	0.0169	-	-	-	-	Nagy 2001	dw
Reproduction															
Bokori et al. 1995b	0.178	0.178	0.178	0.178	-	-	present study	0.0222	0.0222	0.0222	0.0222	-	-	Nagy 2001	dw
Leach et al. 1979	0.78	0.78	0.78	0.78	-	-	USEPA 1988	0.0608	0.0608	0.0608	0.0608	-	-	USEPA 1988	dw
Leach et al. 1979	0.78	0.78	0.78	0.78	-	-	USEPA 1988	0.0608	0.0608	0.0608	0.0608	-	-	USEPA 1988	dw
Olgun 2015	0.15	0.15	0.15	0.15	0.15	0.15	Vos et al. 1971	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	Nagy 2001	dw
White and Finley 1978	1.15	1.15	1.15	1.15	-	-	present study	0.11	0.11	0.11	0.11	-	-	present study	NA
Survival															
Bokori et al. 1995b	0.178	0.178	0.178	0.178	-	-	present study	0.0222	0.0222	0.0222	0.0222	-	-	Nagy 2001	dw
Bokori et al. 1995a	1.52	1.52	1.52	1.52	-	-	present study	0.0961	0.0961	0.0961	0.0961	-	-	NRC 1994	dw
Hill 1974b	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Olgun 2015	0.15	0.15	0.15	0.15	0.15	0.15	Vos et al. 1971	0.0197	0.0197	0.0197	0.0197	0.0197	0.0197	Nagy 2001	dw
Pritzl et al. 1974	0.15	0.15	0.15	0.15	0.15	-	USEPA 1988	0.0151	0.0151	0.0151	0.0151	0.0151	-	USEPA 1988	dw
Van Vleet et al. 1981	0.78	0.78	-	-	-	-	NRC 1994	0.0611	0.0611	-	-	-	-	Nagy 2001	dw

Table B-2. Cadmium TRV Data for Birds

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Bafundo et al. 1984	0	45	-	-	-	-	dw	265	204	-	-	-	-
Bokori et al. 1995b	0	75	300	600	-	-	dw	1.47	1.03	0.476	0.353	-	-
Bokori et al. 1996	0	25	75	-	-	-	dw	6.1	5.58	5.4	-	-	-
Di Giulio and Scanlon 1984	0	50	150	450	-	-	NA	1.2	1.22	1.11	0.911	-	-
Hill 1974a	0	20	40	60	80	100	dw	0.202	0.19	0.17	0.108	0.094	0.071
Hill 1974b	0	57	-	-	-	-	dw	0.224	0.123	-	-	-	-
Hill 1979	0	20	40	60	-	-	dw	100	94.4	73.7	52	-	-
Hill 1980	0	100	-	-	-	-	dw	0.217	0.06	-	-	-	-
Olgun 2015	0.32	5.32	10.3	20.3	40.3	80.3	dw	0.153	0.15	0.152	0.127	0.0958	0.0918
Richardson and Fox 1974	0	75	-	-	-	-	dw	0.0891	0.0461	-	-	-	-
Rama and Planas 1981	1	101	-	-	-	-	dw	0.65	0.375	-	-	-	-
Richardson et al. 1974	0	75	-	-	-	-	dw	0.0825	0.0575	-	-	-	-
Richardson et al. 1974	0	75	-	-	-	-	dw	0.097	0.082	-	-	-	-
Reproduction													
Bokori et al. 1995b	0	75	150	300	-	-	dw	206	95	68	30	-	-
Leach et al. 1979	0.22	3.22	12.2	48.2	-	-	dw	60.4	68.9	65.1	36.7	-	-
Leach et al. 1979	0.07	3.07	12.1	48.1	-	-	dw	64.3	69.5	59.9	48.3	-	-
Olgun 2015	0.32	5.32	10.3	20.3	40.3	80.3	dw	94.7	94.7	93.8	88.8	66.8	37.8
White and Finley 1978	0.08	1.6	15.2	210	-	-	NA	3.5	3.29	3.67	1	-	-
Survival													
Bokori et al. 1995b	0	75	150	300	-	-	dw	90	70	50	40	-	-
Bokori et al. 1995a	0	75	300	600	-	-	dw	90	100	95	10	-	-
Hill 1974b	0	57	-	-	-	-	dw	97.5	85	-	-	-	-
Olgun 2015	0.32	5.32	10.3	20.3	40.3	80.3	dw	93.8	93.8	93.8	100	100	43.8
Pritzl et al. 1974	0	400	600	800	1000	-	dw	100	90	45	0	0	-
Van Vleet et al. 1981	0	500	-	-	-	-	dw	100	10	-	-	-	-

Table B-2. Cadmium TRV Data for Birds

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Bafundo et al. 1984	weight gain (g)	100	77	-	-	-	-
Bokori et al. 1995b	body weight after 4 weeks (week 6) (kg)	100	70	32	24	-	-
Bokori et al. 1996	average final body weight at week 41 (kg)	100	91	89	-	-	-
Di Giulio and Scanlon 1984	average final body weight (kg)	100	102	92	76	-	-
Hill 1974a	2 wk weight gain (kg)	100	94	84	53	47	35
Hill 1974b	weight gain (kg)	100	55	-	-	-	-
Hill 1979	average 2 week gain as percent of control (g)	100	94	74	52	-	-
Hill 1980	average 2 week gain (kg)	100	28	-	-	-	-
Olgun 2015	body weight (kg) (using body weight change and estimated initial body weight of 0.15 kg from Vos et al. 1971)	100	99	99	83	63	60
Richardson and Fox 1974	average final body weight (kg)	100	52	-	-	-	-
Rama and Planas 1981	average weight gain (kg)	100	58	-	-	-	-
Richardson et al. 1974	average male/female final weight (kg)	100	70	-	-	-	-
Richardson et al. 1974	average male final weight (kg)	100	85	-	-	-	-
Reproduction							
Bokori et al. 1995b	total eggs laid per group	100	46	33	15	-	-
Leach et al. 1979	egg production after 48 weeks	100	114	108	61	-	-
Leach et al. 1979	egg production after 12 weeks	100	108	93	75	-	-
Olgun 2015	egg production (eggs/100 birds per day)	100	100	99	94	70	40
White and Finley 1978	average number of eggs laid per hen	100	94	105	29	-	-
Survival							
Bokori et al. 1995b	% survival	100	78	56	44	-	-
Bokori et al. 1995a	% survival at week 8	100	111	106	11	-	-
Hill 1974b	% survival	100	87	-	-	-	-
Olgun 2015	% survival	100	100	100	107	107	47
Pritzl et al. 1974	% survival	100	90	45	0	0	-
Van Vleet et al. 1981	% survival after day 11	100	10	-	-	-	-

Notes:
Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.
[a] LOAEL determined by study based on statistical analyses.
[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-3. Cadmium TRV Data for Mammals

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Baranski and Sitarek 1987	0.29	29	cadmium chloride	rat	3 months	body weight	GV	14.0	0	0.029	0.29	2.9	29	-	doses presented in paper
Cousins et al. 1977	2.1	NA	cadmium chloride	rat	juvenile	body weight	FD	14.0	0	0.419	2.09	-	-	-	calculated from BW and FIR
Dodds-Smith et al. 1992	104	104	cadmium chloride	shrew	weanling	body weight	FD	12.0	0	104	-	-	-	-	calculated from BW and FIR
Groten et al. 1991	3.0	NA	cadmium chloride	rat	5 weeks	body weight	FD	8.0	0.0167	3	-	-	-	-	calculated from BW and FIR
Hamada et al. 1991	no stats	100	cadmium chloride	dog	6-8 months	body weight	FD	8-9 years	0	1	3	10	50	100	doses presented in paper
Merali and Singhal 1980	1.0	NA	cadmium chloride	rat	1 day	body weight	GV	6.1	0	0.1	1	-	-	-	doses presented in paper
Pond et al. 1973	6.3	6.3	cadmium chloride	pig	weanling	body weight	FD	7.1	0	6.31	-	-	-	-	calculated from BW and FIR
Rajanna et al. 1984	no stats	NA	cadmium chloride	rat	6 weeks	body weight	FD	25.7	0	2.25	4.49	6.74	-	-	calculated from BW and FIR
Rastogi et al 1977	1.0	NA	cadmium chloride	rat	1 day	body weight	GV	4.3	0	0.1	1	-	-	-	doses presented in paper
Weigel et al. 1987	0.07	NA	cadmium oxide	rat	weanling	body weight	FD	7.9	0.0195	0.069	0.183	-	-	-	calculated from BW and FIR
Suzuki and Yoshida 1977	no stats	5.0	cadmium chloride	rat	juvenile assumed (growing rats)	body weight (Exp. 2)	FD	6.4	0	5.03	-	-	-	-	calculated from BW and FIR
Suzuki and Yoshida 1978a	no stats	NA	cadmium chloride	rat	juvenile assumed (growing rats)	body weight (Exp. 1)	FD	25.7	0	5.67	-	-	-	-	calculated from BW and FIR
Suzuki and Yoshida 1978a	no stats	NA	cadmium chloride	rat	juvenile assumed (growing rats)	body weight (Exp. 2)	FD	25.7	0	3.82	-	-	-	-	calculated from BW and FIR
Suzuki and Yoshida 1978b	no stats	NA	cadmium chloride	rat	juvenile assumed (growing rats)	body weight (Exp. 1)	FD	2.0	0	5.58	-	-	-	-	calculated from BW and FIR
Suzuki and Yoshida 1979	6.0	6.0	cadmium chloride	rat	juvenile assumed (growing rats)	body weight	FD	2.0	0	6.02	-	-	-	-	calculated from BW and FIR
Suzuki and Yoshida 1979	5.9	5.9	cadmium chloride	rat	juvenile assumed (growing rats)	body weight	FD	4.0	0	5.89	11.8	23.6	-	-	calculated from BW and FIR
Weber and Reid 1969	162	162	cadmium acetate	mouse	weanling	body weight (Exp. 1)	FD	3.0	0	162	810	1620	-	-	calculated from BW and FIR
Wilson et al. 1941	no stats	3.5	cadmium chloride	rat	juvenile assumed (50 g)	body weight	FD	7.1	0	3.51	7.02	14.2	28.3	56.7	calculated from BW and FIR
Reproduction															
Machemer and Lorke 1981	61	61	cadmium chloride	rat	adult	pregnancy success	GV	1.4	0	1.84	6.13	18.4	61.3	-	doses presented in paper
Sawicka-Kapusta et al. 1994	6.9	6.9	cadmium chloride	mouse	15 days pregnant	offspring growth	FD	5.0	0.138	3.46	6.92	20.8	-	-	calculated from BW and FIR
Sawicka-Kapusta et al. 1994	no stats	21	cadmium chloride	mouse	15 days pregnant	offspring survival	FD	5.0	0.138	3.46	6.92	20.8	-	-	calculated from BW and FIR
Sutou et al. 1980	10	10	cadmium chloride	rat	4 weeks	fetal body weight (male)	GV	9.0	0	0.1	1	10	-	-	doses presented in paper
Sutou et al. 1980	10	10	cadmium chloride	rat	4 weeks	fetal body weight (female)	GV	9.0	0	0.1	1	10	-	-	doses presented in paper
Sutou et al. 1980	10	10	cadmium chloride	rat	4 weeks	fetal implants	GV	>9	0	0.1	1	10	-	-	doses presented in paper
Sutou et al. 1980	10	10	cadmium chloride	rat	4 weeks	live fetuses	GV	>9	0	0.1	1	10	-	-	doses presented in paper
Wardell et al. 1982	50	NA	NR	rat	adult	litter weight	GV	1.9	0	4	10	25	50	-	doses presented in paper
Whelton et al. 1988	no stats	9.2	cadmium chloride	mouse	adult	offspring growth	FD	36.0	0.0459	0.919	9.19	-	-	-	calculated from BW and FIR
Survival															
Baranski and Sitarek 1987	29	29	cadmium chloride	rat	adult	survival	GV	14.0	0	0.029	0.29	2.9	29	-	doses presented in paper
Schroeder et al. 1963	0.56	0.56	NR	rat	weanling	survival (female)	DW	92.0	0	0.558	-	-	-	-	calculated from BW and FIR
Schroeder et al. 1964	0.70	0.70	NR	mouse	weanling	survival (male)	DW	78.0	0	0.703	-	-	-	-	calculated from BW and FIR
Schroeder et al. 1963	0.55	0.55	NR	rat	weanling	survival (male)	DW	92.0	0	0.55	-	-	-	-	calculated from BW and FIR
Swiergosz et al. 1998	no stats	3.4	cadmium chloride	vole	adult	survival	FD	24.0	0.0618	3.43	9.16	-	-	-	calculated from BW and FIR
Weber and Reid 1969	no stats	810	cadmium acetate	mouse	adult	survival	FD	3.0	0	162	810	1620	-	-	calculated from BW and FIR

Table B-3. Cadmium TRV Data for Mammals

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight Basis
Growth															
Baranski and Sitarek 1987	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Cousins et al. 1977	0.256	0.256	0.256	-	-	-	present study	0.0214	0.0214	0.0214	-	-	-	present study	dw
Dodds-Smith et al. 1992	0.0086	0.00704	-	-	-	-	present study	-	-	-	-	-	-	NA (dose presented)	NA
Groten et al. 1991	0.19	0.19	-	-	-	-	present study	0.0187	0.0187	-	-	-	-	USEPA 1988	dw
Hamada et al. 1991	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Merali and Singhal 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Pond et al. 1973	24.7	24.7	-	-	-	-	present study	1.01	1.01	-	-	-	-	present study	dw
Rajanna et al. 1984	0.248	0.248	0.248	0.248	-	-	present study	0.0223	0.0223	0.0223	0.0223	-	-	USEPA 1988	dw
Rastogi et al 1977	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Weigel et al. 1987	0.184	0.184	0.184	-	-	-	present study	0.015	0.015	0.015	-	-	-	present study	dw
Suzuki and Yoshida 1977	0.178	0.178	-	-	-	-	present study	0.0179	0.0179	-	-	-	-	USEPA 1988	dw
Suzuki and Yoshida 1978a	0.399	0.399	-	-	-	-	present study	0.0142	0.0142	-	-	-	-	USEPA 1988	dw
Suzuki and Yoshida 1978a	0.348	0.348	-	-	-	-	present study	0.0305	0.0305	-	-	-	-	USEPA 1988	dw
Suzuki and Yoshida 1978b	0.131	0.131	-	-	-	-	present study	0.0146	0.0146	-	-	-	-	USEPA 1988	dw
Suzuki and Yoshida 1979	0.142	0.142	-	-	-	-	present study	0.0171	0.0171	-	-	-	-	USEPA 1988	dw
Suzuki and Yoshida 1979	0.175	0.175	0.175	0.175	-	-	present study	0.0207	0.0207	0.0207	0.0207	-	-	USEPA 1988	dw
Weber and Reid 1969	0.0153	0.0153	0.0153	0.0153	-	-	present study	0.006	0.006	0.006	0.006	-	-	present study	dw
Wilson et al. 1941	0.125	0.125	0.125	0.125	0.125	0.125	present study	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	USEPA 1988	dw
Reproduction															
Machemer and Lorke 1981	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Sawicka-Kapusta et al. 1994	0.00464	0.00464	0.00464	0.00464	-	-	present study	0.00161	0.00161	0.00161	0.00161	-	-	USEPA 1988	dw
Sawicka-Kapusta et al. 1994	0.00464	0.00464	0.00464	0.00464	-	-	present study	0.00161	0.00161	0.00161	0.00161	-	-	USEPA 1988	dw
Sutou et al. 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Sutou et al. 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Sutou et al. 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Sutou et al. 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Wardell et al. 1982	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Whelton et al. 1988	0.03	0.03	0.03	-	-	-	USEPA 1988	0.00551	0.00551	0.00551	-	-	-	USEPA 1988	dw
Survival															
Baranski and Sitarek 1987	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Schroeder et al. 1963	0.3	0.3	-	-	-	-	USEPA 1988	0.0335	0.0335	-	-	-	-	Calder and Braun 1983	NA
Schroeder et al. 1964	0.03	0.03	-	-	-	-	USEPA 1988	0.00422	0.00422	-	-	-	-	Calder and Braun 1983	NA
Schroeder et al. 1963	0.35	0.35	-	-	-	-	USEPA 1988	0.0385	0.0385	-	-	-	-	Calder and Braun 1983	NA
Swiergosz et al. 1998	0.035	0.035	0.035	-	-	-	present study	0.00801	0.00801	0.00801	-	-	-	Nagy 2001	dw
Weber and Reid 1969	0.0153	0.0153	0.0153	0.0153	-	-	present study	0.006	0.006	0.006	0.006	-	-	present study	dw

Table B-3. Cadmium TRV Data for Mammals

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Baranski and Sitarek 1987	-	-	-	-	-	-	NA	239	238	237	222	171	-
Cousins et al. 1977	0	5	25	-	-	-	dw	0.401	0.385	0.357	-	-	-
Dodds-Smith et al. 1992	-	-	-	-	-	-	NA	0.0091	0.0071	-	-	-	-
Groten et al. 1991	0.17	30.5	0	-	-	-	dw	0.315	0.285	-	-	-	-
Hamada et al. 1991	-	-	-	-	-	-	NA	11.1	9.95	11.8	11.1	11.7	7.8
Merali and Singhal 1980	-	-	-	-	-	-	NA	0.173	0.168	0.148	-	-	-
Pond et al. 1973	0	154	-	-	-	-	dw	36.4	28.6	-	-	-	-
Rajanna et al. 1984	0	25	50	75	-	-	dw	0.496	0.459	0.453	0.445	-	-
Rastogi et al 1977	-	-	-	-	-	-	NA	0.112	0.104	0.091	-	-	-
Weigel et al. 1987	0.24	0.85	2.25	-	-	-	dw	0.303	0.287	0.285	-	-	-
Suzuki and Yoshida 1977	0	50	-	-	-	-	dw	0.355	0.275	-	-	-	-
Suzuki and Yoshida 1978a	0	50	-	-	-	-	dw	0.698	0.579	-	-	-	-
Suzuki and Yoshida 1978a	0	50	-	-	-	-	dw	0.595	0.537	-	-	-	-
Suzuki and Yoshida 1978b	0	50	-	-	-	-	dw	0.161	0.139	-	-	-	-
Suzuki and Yoshida 1979	0	50	-	-	-	-	dw	0.185	0.134	-	-	-	-
Suzuki and Yoshida 1979	0	50	100	200	-	-	dw	0.251	0.199	0.159	0.108	-	-
Weber and Reid 1969	0	412	2060	4120	-	-	dw	0.0225	0.01	0.0093	0.0089	-	-
Wilson et al. 1941	0	31	62	125	250	500	dw	0.2	0.16	0.14	0.12	0.07	0.05
Reproduction													
Machemer and Lorke 1981	-	-	-	-	-	-	NA	20	19	20	18	0	-
Sawicka-Kapusta et al. 1994	0.4	10	20	60	-	-	dw	0.00771	0.00756	0.00599	0.00474	-	-
Sawicka-Kapusta et al. 1994	0.4	10	20	60	-	-	dw	73	63.9	60.8	42.3	-	-
Sutou et al. 1980	-	-	-	-	-	-	NA	0.00363	0.00358	0.00352	0.00241	-	-
Sutou et al. 1980	-	-	-	-	-	-	NA	0.00348	0.0034	0.00337	0.00232	-	-
Sutou et al. 1980	-	-	-	-	-	-	NA	14.7	13.9	13.6	10.6	-	-
Sutou et al. 1980	-	-	-	-	-	-	NA	14.2	13.9	13.1	7.2	-	-
Wardell et al. 1982	-	-	-	-	-	-	NA	0.00236	0.00243	0.00225	0.00232	0.002	-
Whelton et al. 1988	0.25	5	50	-	-	-	dw	13	13.4	9.8	-	-	-
Survival													
Baranski and Sitarek 1987	-	-	-	-	-	-	NA	100	100	100	100	46	-
Schroeder et al. 1963	0	5	-	-	-	-	NA	86.5	54.7	-	-	-	-
Schroeder et al. 1964	0	5	-	-	-	-	NA	50	32	-	-	-	-
Schroeder et al. 1963	0	5	-	-	-	-	NA	90.4	21.1	-	-	-	-
Swiergosz et al. 1998	0.27	15	40	-	-	0	NA	86	60	46	-	-	-
Weber and Reid 1969	0	412	2060	4120	-	-	dw	100	92	42	25	-	-

Table B-3. Cadmium TRV Data for Mammals

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Baranski and Sitarek 1987	body weight at 14 weeks (g)	100	100	99	93	72	-
Cousins et al. 1977	average final body weight (kg)	100	96	89	-	-	-
Dodds-Smith et al. 1992	final male weight (kg)	100	78	-	-	-	-
Groten et al. 1991	body weight (kg)	100	90	-	-	-	-
Hamada et al. 1991	final weight (kg)	100	89	106	100	105	70
Merali and Singhal 1980	estimated body weight at day 43 (kg)	100	97	86	-	-	-
Pond et al. 1973	body weight (kg) calculated from weight gain	100	78	-	-	-	-
Rajanna et al. 1984	body weight using initial weight and average weight gain (kg) at 180 days	100	93	91	90	-	-
Rastogi et al 1977	body weight (kg)	100	93	81	-	-	-
Weigel et al. 1987	body weight (kg) at 8 weeks of exposure	100	95	94	-	-	-
Suzuki and Yoshida 1977	final body weight (kg) (estimated from figure 2 + initial body weight)	100	77	-	-	-	-
Suzuki and Yoshida 1978a	body weight (kg) calculated from weight gain	100	83	-	-	-	-
Suzuki and Yoshida 1978a	body weight (kg) calculated from weight gain	100	90	-	-	-	-
Suzuki and Yoshida 1978b	body weight (kg) calculated from weight gain	100	86	-	-	-	-
Suzuki and Yoshida 1979	body weight (kg) calculated from weight gain	100	73	-	-	-	-
Suzuki and Yoshida 1979	body weight (kg) calculated from weight gain	100	79	64	43	-	-
Weber and Reid 1969	body weight (kg) at week 3	100	44	41	40	-	-
Wilson et al. 1941	body weight (kg)	100	80	70	60	35	25
Reproduction							
Machemer and Lorke 1981	number pregnant	100	95	100	90	0	-
Sawicka-Kapusta et al. 1994	final weight (kg)	100	98	78	61	-	-
Sawicka-Kapusta et al. 1994	% survival	100	88	83	58	-	-
Sutou et al. 1980	male fetal body weight (kg)	100	99	97	66	-	-
Sutou et al. 1980	female fetal body weight (kg)	100	98	97	67	-	-
Sutou et al. 1980	number fetal implants	100	95	93	72	-	-
Sutou et al. 1980	number live fetuses	100	98	92	51	-	-
Wardell et al. 1982	average litter weight (kg)	100	103	95	98	85	-
Whelton et al. 1988	pup growth (g per pup)	100	103	75	-	-	-
Survival							
Baranski and Sitarek 1987	% survival	100	100	100	100	46	-
Schroeder et al. 1963	% survival	100	63	-	-	-	-
Schroeder et al. 1964	% survival at 18 months	100	64	-	-	-	-
Schroeder et al. 1963	% survival	100	23	-	-	-	-
Swiergosz et al. 1998	survival (reported as absolute percent values)	100	70	53	-	-	-
Weber and Reid 1969	% survival	100	92	42	25	-	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-4. Copper TRV Data for Birds

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	Notes
Growth															
Hill 1974a	64	128	copper sulfate	chicken	1 day	body weight	FD	2.0	0	64.2	128	193	257	321	calculated from BW and FIR
Jensen and Maurice 1978	28	NA	copper sulfate	chicken	chick	body weight (Exp. 1)	FD	4.0	0	27.9	55.8	-	-	-	calculated from BW and FIR
Jensen and Maurice 1978	56	84	copper sulfate	chicken	chick	body weight (Exp. 2)	FD	4.0	0	55.8	83.8	-	-	-	calculated from BW and FIR
Jensen and Maurice 1979	56	56	copper sulfate	chicken	1 day	body weight (Exp. 2)	FD	4.0	0.558	56.4	-	-	-	-	calculated from BW and FIR
Kashani et al. 1986	2.2	NA	cupric sulfate	turkey	1 day	body weight (Exp. 1)	FD	24.0	0.191	2.2	-	-	-	-	calculated from BW and FIR
Kashani et al. 1986	2.2	NA	cupric sulfate	turkey	1 day	body weight (Exp. 2)	FD	24.0	0.191	1.19	2.2	4.21	-	-	calculated from BW and FIR
Latymer and Cotes 1981	28	28	copper sulfate	chicken	1 day	body weight	FD	3.4	0.454	28.4	-	-	-	-	calculated from BW and FIR
Miles et al. 1998	68	NA	copper sulfate	chicken	1 day	body weight (Exp. 1)	FD	3.0	3.34	22.5	43.8	67.9	-	-	calculated from BW and FIR
Miles et al. 1998	no stats	69	dicopper chloride	chicken	1 day	body weight (Exp. 2)	FD	6.0	1.75	24.1	46.4	68.8	-	-	calculated from BW and FIR
Miles et al. 1998	no stats	69	copper sulfate	chicken	1 day	body weight (Exp. 2)	FD	6.0	1.75	24.1	46.4	68.8	-	-	calculated from BW and FIR
Persia et al. 2004	89	118	copper chloride	chicken	8 days	body weight (Exp. 2)	FD	2.1	0.591	17.7	29.6	59.1	88.7	118	calculated from BW and FIR
Persia et al. 2004	67	107	copper chloride	chicken	8 days	body weight (Exp. 3)	FD	2.0	0.671	67.1	87.3	107	-	-	calculated from BW and FIR
Poupoulis and Jensen 1976	56	112	copper sulfate	chicken	1 day	body weight gain (Exp. 1)	FD	4.0	0.223	14.2	28.1	56.1	112	-	calculated from BW and FIR
Poupoulis and Jensen 1976	56	84	copper sulfate	chicken	1 day	body weight gain (Exp. 2)	FD	4.0	0.223	28.1	56.1	84	112	-	calculated from BW and FIR
Poupoulis and Jensen 1976	112	112	copper sulfate	chicken	1 day	body weight gain (Exp. 5)	FD	4.0	0.223	28.1	56.1	112	-	-	calculated from BW and FIR
Smith 1969	no stats	NA	copper sulfate	chicken	1 day	body weight	FD	3.6	0.941	10.7	20.5	35.2	-	-	calculated from BW and FIR
Wang et al. 1987	65	NA	copper sulfate	chicken	1 day	body weight gain (Exp. 2)	FD	2.9	0.642	64.8	-	-	-	-	calculated from BW and FIR
Wang et al. 1987	not clear	65	copper sulfate	chicken	1 day	body weight gain (Exp. 1)	FD	2.9	0.642	64.8	-	-	-	-	calculated from BW and FIR
Reproduction															
Al Ankari et al. 1998	13	NA	copper sulfate/acetate	chicken	25 weeks	egg production	FD	12.0	0.414	4.55	12.8	21.1	-	-	calculated from BW and FIR
Chiou et al. 1997	41	41	copper sulfate	chicken	28 weeks	egg production	FD	4.0	1.85	13.4	27.8	41	52	-	calculated from BW and FIR
Harms and Buresh 1986	32	32	copper sulfate	chicken	68 weeks	egg production (Exp. 3)	FD	6.0	0.378	31.9	-	-	-	-	calculated from BW and FIR
Jackson and Stevenson 1981a	not clear	37	copper sulfate	chicken	27 weeks	egg production (breed 1)	FD	40.0	0.613	9.81	19	28.2	37.4	46.6	calculated from BW and FIR
Jackson and Stevenson 1981a	not clear	33	copper sulfate	chicken	27 weeks	egg production (breed 2)	FD	40.0	0.727	11.6	22.5	33.4	44.3	55.2	calculated from BW and FIR
Jackson and Stevenson 1981b	not clear	35	copper sulfate	chicken	26 weeks	egg production (breed 1)	FD	48.0	1.06	12.4	23.7	35	46.3	57.6	calculated from BW and FIR
Jackson and Stevenson 1981b	not clear	35	copper sulfate	chicken	26 weeks	egg production (breed 2)	FD	48.0	0.808	9.46	18.1	26.8	35.4	44.1	calculated from BW and FIR
Jackson et al. 1979	not clear	51	copper sulfate	chicken	24 weeks	egg production (breed 1)	FD	32.0	0.314	12.9	25.5	38	50.6	-	calculated from BW and FIR
Jackson et al. 1979	not clear	38	copper sulfate	chicken	24 weeks	egg production (breed 2)	FD	32.0	0.314	12.9	25.5	38	50.6	-	calculated from BW and FIR
Jackson et al. 1979	not clear	56	copper sulfate	chicken	24 weeks	egg production	FD	48.0	0.345	14.1	27.9	41.7	55.5	-	calculated from BW and FIR
Pearce et al. 1983	not clear	63	copper sulfate	chicken	26 weeks	egg production	FD	6.9	0.315	15.8	31.5	63.1	126	-	calculated from BW and FIR
Stevenson and Jackson 1980a	not clear	32	copper sulfate	chicken	24 weeks	egg production	FD	8.0	0.473	32	63.6	127	-	-	calculated from BW and FIR
Stevenson et al. 1983	not clear	74	copper sulfate	chicken	27 weeks	egg production	FD	0.7	0.736	18.4	36.8	73.6	-	-	calculated from BW and FIR
Stevenson and Jackson 1980b	not clear	32	copper sulfate	chicken	24 weeks	egg production	FD	6.9	0.479	16.3	32	63.6	127	-	calculated from BW and FIR
Survival															
Hill 1974	193	193	copper sulfate	chicken	1 day	survival	FD	2.0	0	64.2	128	193	257	321	calculated from BW and FIR
Mehring et al. 1960	no stats	87	copper oxide	chicken	1 day	survival	FD	10.0	1.93	29.9	42.2	55.5	87.4	-	calculated from BW and FIR
Poupoulis and Jensen 1976	no stats	84	copper sulfate	chicken	chick	survival (Exp. 2)	FD	4.0	0.223	28.1	56.1	84	112	-	calculated from BW and FIR
Poupoulis and Jensen 1976	no stats	112	copper sulfate	chicken	1 day	survival (Exp. 5)	FD	4.0	0.223	28.1	56.1	112	-	-	calculated from BW and FIR
Van Vleet et al. 1981	no stats	114	copper sulfate	Pekin duck	duckling	survival	FD	4.0	0	114	-	-	-	-	calculated from BW and FIR
Van Vleet et al. 1981	no stats	149	copper sulfate	Pekin duck	duckling	survival	FD	2.1	0	149	-	-	-	-	calculated from BW and FIR
Vohra and Kratzer 1968	176	264	copper sulfate	turkey	juvenile	survival	FD	3.0	0	87.9	176	264	352	-	calculated from BW and FIR

Table B-4. Copper TRV Data for Birds

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight Basis
Growth															
Hill 1974a	0.148	0.148	0.148	0.148	0.148	0.148	NRC 1994	0.019	0.019	0.019	0.019	0.019	0.019	NRC 1994	dw
Jensen and Maurice 1978	0.36	0.36	0.36	-	-	-	NRC 1994	0.0402	0.0402	0.0402	-	-	-	NRC 1994	dw
Jensen and Maurice 1978	0.36	0.36	0.36	-	-	-	NRC 1994	0.0402	0.0402	0.0402	-	-	-	NRC 1994	dw
Jensen and Maurice 1979	0.36	0.36	-	-	-	-	NRC 1994	0.0402	0.0402	-	-	-	-	NRC 1994	dw
Kashani et al. 1986	2.13	2.13	-	-	-	-	NRC 1994	0.14	0.14	-	-	-	-	NRC 1994	dw
Kashani et al. 1986	2.13	2.13	2.13	2.13	-	-	NRC 1994	0.14	0.14	0.14	0.14	-	-	NRC 1994	dw
Latymer and Cotes 1981	0.36	0.36	-	-	-	-	NRC 1994	0.0402	0.0402	-	-	-	-	NRC 1994	dw
Miles et al. 1998	0.148	0.148	0.148	0.148	-	-	NRC 1994	0.019	0.019	0.019	0.019	-	-	NRC 1994	dw
Miles et al. 1998	0.36	0.36	0.36	0.36	-	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	-	-	NRC 1994	dw
Miles et al. 1998	0.36	0.36	0.36	0.36	-	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	-	-	NRC 1994	dw
Persia et al. 2004	0.292	0.292	0.292	0.292	0.292	0.292	present study	0.0345	0.0345	0.0345	0.0345	0.0345	0.0345	present study	dw
Persia et al. 2004	0.408	0.408	0.408	0.408	-	-	present study	0.0548	0.0548	0.0548	0.0548	-	-	present study	dw
Poupoulis and Jensen 1976	0.36	0.36	0.36	0.36	0.36	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	0.0402	-	NRC 1994	dw
Poupoulis and Jensen 1976	0.36	0.36	0.36	0.36	0.36	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	0.0402	-	NRC 1994	dw
Poupoulis and Jensen 1976	0.36	0.36	0.36	0.36	-	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	-	-	NRC 1994	dw
Smith 1969	0.178	0.178	0.178	0.178	-	-	present study	0.0175	0.0175	0.0175	0.0175	-	-	USEPA 1988	dw
Wang et al. 1987	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Wang et al. 1987	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Reproduction															
Al Ankari et al. 1998	1.51	1.51	1.51	1.51	-	-	present study	0.125	0.125	0.125	0.125	-	-	present study	NA
Chiou et al. 1997	1.46	1.46	1.46	1.46	1.46	-	present study	0.1	0.1	0.1	0.1	0.1	-	present study	NA
Harms and Buresh 1986	3.2	3.2	-	-	-	-	NRC 1994	0.202	0.202	-	-	-	-	NRC 1994	dw
Jackson and Stevenson 1981a	2	2	2	2	2	2	present study	0.123	0.123	0.123	0.123	0.123	0.123	present study	NA
Jackson and Stevenson 1981a	1.63	1.63	1.63	1.63	1.63	1.63	present study	0.118	0.118	0.118	0.118	0.118	0.118	present study	NA
Jackson and Stevenson 1981b	1.62	1.62	1.62	1.62	1.62	1.62	present study	0.122	0.122	0.122	0.122	0.122	0.122	present study	NA
Jackson and Stevenson 1981b	2.13	2.13	2.13	2.13	2.13	2.13	present study	0.123	0.123	0.123	0.123	0.123	0.123	present study	NA
Jackson et al. 1979	1.85	1.85	1.85	1.85	1.85	-	present study	0.117	0.117	0.117	0.117	0.117	-	present study	NA
Jackson et al. 1979	1.85	1.85	1.85	1.85	1.85	-	present study	0.117	0.117	0.117	0.117	0.117	-	present study	NA
Jackson et al. 1979	1.71	1.71	1.71	1.71	1.71	-	present study	0.118	0.118	0.118	0.118	0.118	-	USEPA 1988	dw
Pearce et al. 1983	3.2	3.2	3.2	3.2	3.2	-	NRC 1994	0.202	0.202	0.202	0.202	0.202	-	NRC 1994	dw
Stevenson and Jackson 1980a	3.2	3.2	3.2	3.2	-	-	NRC 1994	0.202	0.202	0.202	0.202	-	-	NRC 1994	dw
Stevenson et al. 1983	1.44	1.44	1.44	1.44	-	-	present study	0.106	0.106	0.106	0.106	-	-	present study	NA
Stevenson and Jackson 1980b	3.2	3.2	3.2	3.2	3.2	-	NRC 1994	0.202	0.202	0.202	0.202	0.202	-	NRC 1994	dw
Survival															
Hill 1974	0.148	0.148	0.148	0.148	0.148	0.148	NRC 1994	0.019	0.019	0.019	0.019	0.019	0.019	NRC 1994	dw
Mehring et al. 1960	1.08	1.08	1.08	1.08	1.08	-	present study	0.0801	0.0801	0.0801	0.0801	0.0801	-	USEPA 1988	dw
Poupoulis and Jensen 1976	0.36	0.36	0.36	0.36	0.36	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	0.0402	-	NRC 1994	dw
Poupoulis and Jensen 1976	0.36	0.36	0.36	0.36	-	-	NRC 1994	0.0402	0.0402	0.0402	0.0402	-	-	NRC 1994	dw
Van Vleet et al. 1981	0.862	0.862	-	-	-	-	NRC 1994	0.0654	0.0654	-	-	-	-	Nagy 2001	dw
Van Vleet et al. 1981	0.363	0.363	-	-	-	-	NRC 1994	0.0362	0.0362	-	-	-	-	Nagy 2001	dw
Vohra and Kratzer 1968	0.25	0.25	0.25	0.25	0.25	-	NRC 1994	0.0271	0.0271	0.0271	0.0271	0.0271	-	NRC 1994	dw

Table B-4. Copper TRV Data for Birds

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Hill 1974a	0	500	1000	1500	2000	2500	dw	0.2	0.177	0.135	0.064	0.025	0.005
Jensen and Maurice 1978	0	250	500	-	-	-	dw	0.654	0.591	0.564	-	-	-
Jensen and Maurice 1978	0	500	750	-	-	-	dw	0.695	0.592	0.547	-	-	-
Jensen and Maurice 1979	5	505	-	-	-	-	dw	0.678	0.519	-	-	-	-
Kashani et al. 1986	2.9	33.4	-	-	-	-	dw	2.92	2.8	-	-	-	-
Kashani et al. 1986	2.9	18.2	33.4	64	-	-	dw	3.06	3.14	2.96	2.96	-	-
Latymer and Cotes 1981	4.06	254	-	-	-	-	dw	0.372	0.248	-	-	-	-
Miles et al. 1998	26	175	341	529	-	-	dw	0.605	0.595	0.568	0.485	-	-
Miles et al. 1998	15.7	216	416	616	-	-	dw	1.96	1.92	1.85	1.26	-	-
Miles et al. 1998	15.7	216	416	616	-	-	dw	1.96	1.92	1.84	1.47	-	-
Persia et al. 2004	5	150	250	500	750	1000	dw	0.416	0.422	0.427	0.423	0.388	0.309
Persia et al. 2004	5	500	650	800	-	-	dw	0.709	0.662	0.626	0.551	-	-
Poupoulis and Jensen 1976	2	127	252	502	1000	-	dw	0.498	0.485	0.511	0.418	0.242	-
Poupoulis and Jensen 1976	2	252	502	752	1000	-	dw	0.44	0.43	0.364	0.199	0.203	-
Poupoulis and Jensen 1976	2	252	502	1000	-	-	dw	0.523	0.518	0.489	0.263	-	-
Smith 1969	9.6	110	210	360	-	-	dw	0.32	0.324	0.329	0.3	-	-
Wang et al. 1987	5	505	-	-	-	-	dw	0.475	0.394	-	-	-	-
Wang et al. 1987	5	505	-	-	-	-	dw	0.541	0.413	-	-	-	-
Reproduction													
Al Ankari et al. 1998	5	55	155	255	-	-	dw	24.1	23.8	23	22.6	-	-
Chiou et al. 1997	27	195	405	598	758	-	dw	84.7	87.3	83.5	43.3	28.5	-
Harms and Buresh 1986	6	506	-	-	-	-	dw	78.3	25.2	-	-	-	-
Jackson and Stevenson 1981a	10	160	310	460	610	760	dw	224	240	230	210	167	109
Jackson and Stevenson 1981a	10	160	310	460	610	760	dw	239	230	242	163	114	88
Jackson and Stevenson 1981b	14	164	314	464	614	764	dw	269	257	263	202	163	93
Jackson and Stevenson 1981b	14	164	314	464	614	764	dw	276	247	264	233	190	131
Jackson et al. 1979	5	205	405	605	805	-	dw	185	198	191	164	110	-
Jackson et al. 1979	5	205	405	605	805	-	dw	186	193	178	132	54.7	-
Jackson et al. 1979	5	205	405	605	805	-	dw	262	280	266	221	133	-
Pearce et al. 1983	5	250	500	1000	2000	-	dw	0.9	1	0.8	0.2	0.1	-
Stevenson and Jackson 1980a	7.5	508	1010	2010	-	-	dw	5.4	4.2	1.2	0.5	-	-
Stevenson et al. 1983	10	250	500	1000	-	-	dw	1	0.95	0.85	0.7	-	-
Stevenson and Jackson 1980b	7.6	258	508	1010	2010	-	dw	0.9	0.9	0.7	0.2	0.1	-
Survival													
Hill 1974	0	500	1000	1500	2000	2500	dw	100	100	100	54.3	47.7	11
Mehring et al. 1960	26	403	570	749	1180	-	dw	97.5	90	95	85	60	-
Poupoulis and Jensen 1976	2	252	502	752	1000	-	dw	100	100	90	80	67	-
Poupoulis and Jensen 1976	2	252	502	1000	0	-	dw	97	97	100	75	-	-
Van Vleet et al. 1981	0	1500	-	-	-	-	dw	100	25	-	-	-	-
Van Vleet et al. 1981	0	1500	-	-	-	-	dw	100	60	-	-	-	-
Vohra and Kratzer 1968	0	810	1620	2430	3240	-	dw	100	100	100	50	0	-

Table B-4. Copper TRV Data for Birds

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Hill 1974a	weight gain (kg)	100	89	68	32	13	3
Jensen and Maurice 1978	final weight (kg)	100	90	86	-	-	-
Jensen and Maurice 1978	final weight (kg)	100	85	79	-	-	-
Jensen and Maurice 1979	final weight (kg)	100	77	-	-	-	-
Kashani et al. 1986	weight at 8 weeks (kg)	100	96	-	-	-	-
Kashani et al. 1986	weight at 8 weeks (kg)	100	103	97	97	-	-
Latymer and Cotes 1981	mean body weight (kg)	100	67	-	-	-	-
Miles et al. 1998	body weight (kg)	100	98	94	80	-	-
Miles et al. 1998	average M/F body weight (kg)	100	98	94	64	-	-
Miles et al. 1998	average M/F body weight (kg)	100	98	94	75	-	-
Persia et al. 2004	final bw calculated from initial bw and weight gain (kg)	100	101	103	102	93	74
Persia et al. 2004	final bw calculated from initial bw and weight gain (kg)	100	93	88	78	-	-
Poupoulis and Jensen 1976	weight gain during 4 weeks (kg)	100	97	103	84	49	-
Poupoulis and Jensen 1976	weight gain during 4 weeks (kg)	100	98	83	45	46	-
Poupoulis and Jensen 1976	weight gain during 4 weeks (kg)	100	99	93	50	-	-
Smith 1969	average of initial weight plus weight gained for two experimental groups (kg)	100	101	103	94	-	-
Wang et al. 1987	average weight gain (kg)	100	83	-	-	-	-
Wang et al. 1987	average weight gain (kg)	100	76	-	-	-	-
Reproduction							
Al Ankari et al. 1998	number of eggs per 28 days	100	99	95	94	-	-
Chiou et al. 1997	egg production (%)	100	103	99	51	34	-
Harms and Buresh 1986	% hen producing eggs/day	100	32	-	-	-	-
Jackson and Stevenson 1981a	number of eggs	100	107	103	94	75	49
Jackson and Stevenson 1981a	number of eggs	100	96	101	68	48	37
Jackson and Stevenson 1981b	number of eggs	100	96	98	75	61	35
Jackson and Stevenson 1981b	number of eggs	100	89	96	84	69	47
Jackson et al. 1979	eggs produced	100	107	104	89	60	-
Jackson et al. 1979	eggs produced	100	103	95	71	29	-
Jackson et al. 1979	egss produced	100	107	102	84	51	-
Pearce et al. 1983	average daily number of eggs laid/ bird (48 days)	100	111	89	22	11	-
Stevenson and Jackson 1980a	number of eggs	100	78	22	9	-	-
Stevenson et al. 1983	number of eggs/bird	100	95	85	70	-	-
Stevenson and Jackson 1980b	daily egg number at day 48	100	100	78	22	11	-
Survival							
Hill 1974	% survival (birds not inoculated)	100	100	100	54	48	11
Mehring et al. 1960	% survival; control is based on the average of the two control groups	100	92	97	87	62	-
Poupoulis and Jensen 1976	% survival	100	100	90	80	67	-
Poupoulis and Jensen 1976	% survival	100	100	103	77	-	-
Van Vleet et al. 1981	% survival	100	25	-	-	-	-
Van Vleet et al. 1981	% survival	100	60	-	-	-	-
Vohra and Kratzer 1968	% survival	100	100	100	50	0	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-5. Copper TRV Data for Mammals

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)									
									Control	1	2	3	4	5	6	Notes	Control	Dose 1
Growth																		
Allcroft et al. 1961	17	17	copper sulfate	pig	8-10 weeks	body weight gain	FD	21.0	0.247	9.3	17.3	36.7	-	-	-	calculated from BW and FIR	45	45
Boyden et al. 1938	no stats	122	copper sulfate	rat	4 weeks	body weight gain	FD	4.0	0	61.1	122	-	-	-	-	calculated from BW and FIR	0.1	0.1
Brandt 1983	35	35	copper sulfate	mink	90 days	body weight	FD	~12	0.878	18.2	35.1	-	-	-	-	calculated from BW and FIR	1.98	1.98
Edmonds and Baker 1986	no stats	NA	copper sulfate	pig	4 weeks	body weight (Exp. 3)	FD	4.0	0	19	49.5	-	-	-	-	calculated from BW and FIR	9.05	9.05
Grobner et al. 1986	no stats	NA	copper sulfate	rabbit	weanling	body weight (Exp. 2)	FD	4.0	1.22	4.21	8.2	14.6	41.7	74.6	-	calculated from BW and FIR	1.25	1.25
Grobner et al. 1986	no stats	NA	copper sulfate	rabbit	weanling	body weight (Exp. 2)	FD	4.0	0.731	3.97	8.62	14.1	35.4	58.3	-	calculated from BW and FIR	1.26	1.26
Llewellyn et al. 1985	112	112	copper acetate	rat	weanling	body weight	FD	21.0	0.77	112	-	-	-	-	-	calculated from BW and FIR	0.1	0.1
Petterson et al. 2002	no stats	NA	copper chloride	mouse	4.5 weeks	body weight	FD	3.0	2.66	367	734	-	-	-	-	calculated from BW and FIR	0.0173	0.0173
Suttle and Mills 1966	no stats	25	copper sulfate	pig	weanling	body weight (Exp. 2)	FD	5.7	0.294	15	25.3	-	-	-	-	calculated from BW and FIR	23.5	23.5
Reproduction																		
Aulerich et al. 1982	no stats	27	copper sulfate	mink	kit	offspring survival	FD	20.0	10.1	14.3	18.5	26.9	43.7	-	-	calculated from BW and FIR	1.05	1.05
Aulerich et al. 1982	27	NA	copper sulfate	mink	kit	offspring growth	FD	20.0	10.1	14.3	18.5	26.9	43.7	-	-	calculated from BW and FIR	1.05	1.05
Cromwell et al. 1993	2	2	copper sulfate	pig	multigenerational	farrowing success	FD	2.1 years	0.0815	2.4	-	-	-	-	-	calculated from BW and FIR	152	152
Lecyk 1980	no stats	293	copper sulfate	mouse	sexually mature	litter size (breed 1)	FD	7.0	0	36.6	73.1	110	146	219	293	calculated from BW and FIR	0.03	0.03
Lecyk 1980	no stats	219	copper sulfate	mouse	sexually mature	litter size (breed 2)	FD	7.0	0	36.6	73.1	110	146	219	293	calculated from BW and FIR	0.03	0.03
Survival																		
Ritchie et al. 1963	no stats	4	copper sulfate	pig	7 weeks	survival	FD	15.0	0.217	2.28	4.35	-	-	-	-	calculated from BW and FIR	25.2	25.2
Keen et al. 1982	no stats	204	copper sulfate	rat	juvenile	survival	FD	6.7	1.02	11.2	103	204	-	-	-	calculated from BW and FIR	0.172	0.172
Allcroft et al. 1961	no stats	17	copper sulfate	pig	8-10 weeks	survival	FD	21.0	0.247	9.3	17.3	36.7	-	-	-	calculated from BW and FIR	45	45
Brandt 1983	no stats	35	copper sulfate	mink	90 days	survival	FD	~12	0.878	18.2	35.1	-	-	-	-	calculated from BW and FIR	1.98	1.98
Boyden et al. 1938	no stats	489	copper sulfate	rat	4 weeks	survival	FD	4.0	0	61.1	122	244	489	-	-	calculated from BW and FIR	0.1	0.1
NTP 1993a	no stats	140	copper sulfate	mouse	6 weeks	survival (male)	DW	2.0	0	14	46.7	140	467	1400	-	calculated from BW and FIR	0.0262	0.0262
NTP 1993a	no stats	203	copper sulfate	mouse	6 weeks	survival (female)	DW	2.0	0	20.3	67.5	203	675	2030	-	calculated from BW and FIR	0.0211	0.0211

Table B-5. Copper TRV Data for Mammals

	Body Weight (kg)						Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)								
Source	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source	Wet or Dry Weight Basis
Growth															
Allcroft et al. 1961	45	45	-	-	-	Cai et al. 2009	1.5	1.5	1.5	1.5	-	-	-	Cai et al. 2009	dw
Boyden et al. 1938	0.1	0.1	-	-	-	USEPA 1988	0.0122	0.0122	0.0122	0.0122	-	-	-	USEPA 1988	dw
Brandt 1983	1.98	-	-	-	-	present study	0.217	0.217	0.217	-	-	-	-	Bleavins and Aulerich 1981	dw
Edmonds and Baker 1986	9.05	-	-	-	-	present study	0.689	0.689	0.689	-	-	-	-	present study	dw
Grobner et al. 1986	1.25	1.25	1.25	1.25	-	present study	0.104	0.104	0.104	0.104	0.104	0.104	-	present study, daily intake for control (Table 6)	dw
Grobner et al. 1986	1.26	1.26	1.26	1.26	-	present study	0.0891	0.0891	0.0891	0.0891	0.0891	0.0891	-	present study, daily intake for control (Table 6)	dw
Llewellyn et al. 1985	-	-	-	-	-	USEPA 1988	0.0122	0.0122	-	-	-	-	-	USEPA 1988	dw
Petterson et al. 2002	0.0173	-	-	-	-	present study	0.00382	0.00382	0.00382	-	-	-	-	USEPA 1988	dw
Suttle and Mills 1966	23.5	-	-	-	-	present study	1.38	1.38	1.38	-	-	-	-	present study	dw
Reproduction															
Aulerich et al. 1982	1.05	1.05	1.05	-	-	present study	0.176	0.176	0.176	0.176	0.176	-	-	Bleavins and Aulerich 1981	ww
Aulerich et al. 1982	1.05	1.05	1.05	-	-	present study	0.176	0.176	0.176	0.176	0.176	-	-	Bleavins and Aulerich 1981	ww
Cromwell et al. 1993	-	-	-	-	-	present study	1.41	1.41	-	-	-	-	-	Nagy 2001	dw
Lecyk 1980	0.03	0.03	0.03	0.03	0.03	USEPA 1988	0.00551	0.00551	0.00551	0.00551	0.00551	0.00551	0.00551	USEPA 1988	dw
Lecyk 1980	0.03	0.03	0.03	0.03	0.03	USEPA 1988	0.00551	0.00551	0.00551	0.00551	0.00551	0.00551	0.00551	USEPA 1988	dw
Survival															
Ritchie et al. 1963	25.2	-	-	-	-	present study	0.416	0.416	0.416	-	-	-	-	Nagy 2001	dw
Keen et al. 1982	0.172	0.172	-	-	-	present study	0.0175	0.0175	0.0175	0.0175	-	-	-	USEPA 1988	dw
Allcroft et al. 1961	45	45	-	-	-	Cai et al. 2009	1.5	1.5	1.5	1.5	-	-	-	Cai et al. 2009	dw
Brandt 1983	1.98	-	-	-	-	present study	0.217	0.217	0.217	-	-	-	-	Bleavins and Aulerich 1981	dw
Boyden et al. 1938	0.1	0.1	0.1	-	-	USEPA 1988	0.0122	0.0122	0.0122	0.0122	0.0122	-	-	USEPA 1988	dw
NTP 1993a	0.0262	0.0262	0.0262	0.0262	-	present study	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	-	present study	NA
NTP 1993a	0.0211	0.0211	0.0211	0.0211	-	present study	0.0056	0.0056	0.0056	0.0056	0.0056	0.0056	-	present study	NA

Table B-5. Copper TRV Data for Mammals

	Concentration in Food (mg/kg)								Effect						
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6
Growth															
Allcroft et al. 1961	7.4	279	518	1100	-	-	-	dw	1.24	1.18	0.36	0.09	-	-	-
Boyden et al. 1938	0	500	1000	2000	-	-	-	dw	86	78	51	5	-	-	-
Brandt 1983	8	166	320	-	-	-	-	dw	1.98	1.92	1.58	-	-	-	-
Edmonds and Baker 1986	0	250	650	-	-	-	-	dw	18.1	17.5	15.7	-	-	-	-
Grobner et al. 1986	14.8	50.9	99.1	177	505	902	-	dw	2.51	2.67	2.69	2.57	2.67	2.44	-
Grobner et al. 1986	10.3	55.9	122	199	498	822	-	dw	2.51	2.54	2.59	2.56	2.41	2.04	-
Llewellyn et al. 1985	6.3	916	-	-	-	-	-	dw	100	77.1	-	-	-	-	-
Petterson et al. 2002	12	1660	3310	-	-	-	-	dw	20	-	17.5	-	-	-	-
Suttle and Mills 1966	5	255	430	-	-	-	-	dw	30	31	23	-	-	-	-
Reproduction															
Aulerich et al. 1982	60.5	85.5	111	161	261	-	-	ww	88	91	81	62	68	-	-
Aulerich et al. 1982	60.5	85.5	111	161	261	-	-	ww	0.137	0.143	0.133	0.116	0.143	-	-
Cromwell et al. 1993	8.8	259	-	-	-	-	-	dw	88.9	64.3	-	-	-	-	-
Lecyk 1980	0	199	398	597	796	1190	1590	dw	3.09	4.6	4.5	4.42	4.2	2.5	1.94
Lecyk 1980	0	199	398	597	796	1190	1590	dw	4.47	5.4	5.1	4.14	4.1	3.11	2.7
Survival															
Ritchie et al. 1963	13.1	138	263	-	-	-	-	dw	100	100	75	-	-	-	-
Keen et al. 1982	10	110	1010	2010	-	-	-	dw	100	100	100	71.4	-	-	-
Allcroft et al. 1961	7.4	279	518	1100	-	-	-	dw	100	100	0	0	-	-	-
Brandt 1983	8	166	320	-	-	-	-	ww	100	100	50	-	-	-	-
Boyden et al. 1938	0	500	1000	2000	4000	-	-	dw	100	100	100	100	0	-	-
NTP 1993a	0	76.4	255	764	2550	7640	-	NA	100	100	100	80	0	0	-
NTP 1993a	0	76.4	255	764	2550	7640	-	NA	100	100	100	40	0	0	-

Table B-5. Copper TRV Data for Mammals

	Effect (continued)	Effect Relative to Control (%)						
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6
Growth								
Allcroft et al. 1961	daily weight gain (lbs)	100	95	29	7	-	-	-
Boyden et al. 1938	avgerage growth in four weeks (g)	100	91	59	6	0	-	-
Brandt 1983	average final body weight (kg)	100	97	80	-	-	-	-
Edmonds and Baker 1986	final body weight using initial body weight and daily weight gain (kg)	100	97	87	-	-	-	-
Grobner et al. 1986	final body weight (based on initial body weight and average daily gain) (kg)	100	106	107	103	106	97	-
Grobner et al. 1986	final body weight (based on initial body weight and average daily gain) (kg)	100	101	103	102	96	81	-
Llewellyn et al. 1985	final body weight relative to control (g)	100	77	-	-	-	-	-
Petterson et al. 2002	body weight (g)	100	-	88	-	-	-	-
Suttle and Mills 1966	final body weight (kg)	100	103	77	-	-	-	-
Reproduction								
Aulerich et al. 1982	% kit survival	100	103	92	70	77	-	-
Aulerich et al. 1982	average kit weight at 4 weeks	100	104	97	85	105	-	-
Cromwell et al. 1993	% gilts to farrow	100	72	-	-	-	-	-
Lecyk 1980	litter size	100	149	146	143	136	81	63
Lecyk 1980	litter size	100	121	114	93	92	70	60
Survival								
Ritchie et al. 1963	% survival	100	100	75	-	-	-	-
Keen et al. 1982	% survival	100	100	100	71	-	-	-
Allcroft et al. 1961	% survival	100	100	0	0	-	-	-
Brandt 1983	% survival	100	100	50	-	-	-	-
Boyden et al. 1938	% survival	100	100	100	100	0	-	-
NTP 1993a	% survival	100	100	100	80	0	0	-
NTP 1993a	% survival	100	100	100	40	0	0	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-6. Lead TRV Data for Birds

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Abduljaleel & Shuhaimi-Othman 2013	29	29	lead nitrate	chicken	1 day old chicks	body weight	FD	4.0	0	29.4	49.1	98.1	-	-	calculated from BW and FIR
Berg et al. 1980	206	206	lead carbonate	chicken	1 day	body weight (Exp. 1)	FD	2.0	0	206	-	-	-	-	calculated from BW and FIR
Berg et al. 1980	no stats	NA	lead carbonate	chicken	1 day	body weight (Exp. 1)	FD	2.0	0	212	-	-	-	-	calculated from BW and FIR
Berg et al. 1980	102	154	lead carbonate	chicken	1 day	body weight (Exp. 2)	FD	2.0	0	51.2	102	154	205	-	calculated from BW and FIR
Berg et al. 1980	103	205	lead carbonate	chicken	1 day	body weight (Exp. 3)	FD	2.0	0	103	205	-	-	12.8	calculated from BW and FIR
Cupo and Donaldson 1988	1102	184	lead acetate	chicken	1 day	body weight	FD	3.0	0	184	-	-	-	-	calculated from BW and FIR
Damron et al. 1969	80	80	lead acetate	chicken	4 weeks	body weight	FD	4.0	0	0.799	7.99	79.9	-	-	calculated from BW and FIR
Donaldson 1986	165	165	lead acetate trihydrate	chicken	1 day	body weight (Exp. 1)	FD	2.9	0	165	-	-	-	-	calculated from BW and FIR
Donaldson 1986	166	166	lead acetate trihydrate	chicken	1 day	body weight (Exp. 2)	FD	2.9	0	166	-	-	-	10.6	calculated from BW and FIR
Donaldson and McGowan 1989	64	128	lead acetate trihydrate	chicken	1 day	body weight	FD	2.9	0	64.2	128	193	257	-	calculated from BW and FIR
Edens 1985	129	NA	lead acetate	Japanese quail	1 day	body weight	FD	12.0	0	0.129	1.29	12.9	129	-	calculated from BW and FIR
Edens and Garlich 1983	26	NA	lead acetate	chicken	producing eggs for ~15 weeks	body weight	FD	10.0	0	3.29	6.58	13.2	26.3	-	calculated from BW and FIR
Edens and Melvin 1989	66	NA	lead acetate	Japanese quail	1 day	body weight (breed 2)	FD	21.0	0	66.2	-	-	-	-	calculated from BW and FIR
Edens and Melvin 1989	60	NA	lead acetate	Japanese quail	1 day	body weight (breed 1)	FD	21.0	0	60.3	-	-	-	-	calculated from BW and FIR
Edens and Melvin 1989	131	NA	lead acetate	Japanese quail	1 day	body weight (female)	FD	15.0	0	0.131	1.31	13.1	131	-	calculated from BW and FIR
Edens et al. 1976	151	151	lead acetate	Japanese quail	1 day	body weight	FD	12.0	0	0.151	1.51	15.1	151	-	calculated from BW and FIR
Franson and Custer 1982	210	210	lead acetate	chicken	1 day	body weight	FD	4.0	0.142	210	-	-	-	-	calculated from BW and FIR
Latta and Donaldson 1986	128	128	lead acetate	chicken	1 day	body weight gain	FD	2.7	0	128	-	-	-	-	calculated from BW and FIR
Leeming and Donaldson 1984	128	NA	lead acetate trihydrate	chicken	1 day	body weight gain	FD	2.7	0	128	-	-	-	-	calculated from BW and FIR
Morgan et al. 1975	152	NA	lead acetate	Japanese quail	6 days	body weight (Trial 1)	FD	5.0	0	0.152	1.52	15.2	152	-	calculated from BW and FIR
Morgan et al. 1975	79	NA	lead acetate	Japanese quail	hatchling	body weight (Trial 2)	FD	5.0	0	1.57	15.7	78.7	157	-	calculated from BW and FIR
Reproduction															
Edens and Garlich 1983	4	NA	lead acetate	chicken	78% egg production	egg production (Exp. 1)	FD	4.0	0	1.95	3.9	-	-	-	calculated from BW and FIR
Edens and Garlich 1983	1.2	1.2	lead acetate	Japanese quail	6 weeks	egg production (Exp. 2)	FD	5.0	0	0.12	1.2	12	-	-	calculated from BW and FIR
Edens and Garlich 1983	3.3	13	lead acetate	chicken	producing eggs for ~15 weeks	egg production (Exp. 3)	FD	10.0	0	3.29	6.58	13.2	26.3	-	calculated from BW and FIR
Edens and Garlich 1983	0.21	0.21	lead acetate	Japanese quail	1 day	egg production (Exp. 4)	FD	5.0	0	0.207	2.07	20.7	-	-	calculated from BW and FIR
Edens and Melvin 1989	no stats	199	lead acetate	Japanese quail	1 day	egg production	FD	21.0	0	60.3	-	-	-	-	calculated from BW and FIR
Edens et al. 1976	not clear	499	lead acetate	Japanese quail	1 day	egg production	FD	12.0	0	0.151	1.51	15.1	151	-	calculated from BW and FIR
Edens et al. 1976	15.1	15.1	lead acetate	Japanese quail	1 day	egg hatchability	FD	12.0	0	0.151	1.51	15.1	151	-	calculated from BW and FIR
Edens et al. 1976	15.1	15.1	lead acetate	Japanese quail	1 day	egg production	FD	12.0	0	0.151	1.51	15.1	151	-	calculated from BW and FIR
Stone and Soares 1976	421.4	421	lead acetate	Japanese quail	adult	egg production	FD	3.9	0	421	-	-	-	-	calculated from BW and FIR
Survival															
Anders et al. 1982	no stats	NA	lead acetate	pigeon	adult	survival	GV	5.0	0	6.25	-	-	-	-	doses presented in paper
Barthalmus et al. 1977	no stats	13	lead acetate	pigeon	adult	survival	GV	varied	0	6.25	12.5	25	-	-	doses presented in paper
Cupo and Donaldson 1988	no stats	NA	lead acetate	chicken	1 day	survival	FD	3.0	0	184	-	-	-	-	calculated from BW and FIR
Khan et al. 1993	no stats	NA	lead acetate	chicken	1 day	survival	GV	1.0	0	643	-	-	-	-	doses presented in paper
Vengris and Mare 1974	no stats	320	lead acetate	chicken	6 weeks	survival	GV	5.0	0	160	320	640	-	-	doses presented in paper

Table B-6. Lead TRV Data for Birds

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight Basis
Growth															
Abduljaleel & Shuhaimi-Othman 2013	0.587	0.587	0.587	0.587	0	-	NRC 1994	0.0576	0.0576	0.0576	0.0576	-	-	NRC 1994	dw
Berg et al. 1980	0.128	0.128	-	-	-	-	present study	0.0132	0.0132	-	-	-	-	USEPA 1988	dw
Berg et al. 1980	0.108	0.108	-	-	-	-	present study	0.0114	0.0114	-	-	-	-	USEPA 1988	dw
Berg et al. 1980	0.134	0.134	0.134	0.134	0.134	-	present study	0.0137	0.0137	0.0137	0.0137	0.0137	-	USEPA 1988	dw
Berg et al. 1980	0.132	0.132	0.132	-	-	-	present study	0.0136	0.0136	0.0136	-	-	-	USEPA 1988	dw
Cupo and Donaldson 1988	0.269	0.269	-	-	-	-	present study	0.0247	0.0247	-	-	-	-	USEPA 1988	dw
Damron et al. 1969	1.91	1.91	1.91	1.91	-	-	NRC 1994	0.153	0.153	0.153	0.153	0	-	NRC 1994	dw
Donaldson 1986	0.536	0.536	-	-	-	-	present study	0.0443	0.0443	-	-	-	-	USEPA 1988	dw
Donaldson 1986	0.515	0.515	-	-	-	-	present study	0.0428	0.0428	-	-	-	-	USEPA 1988	dw
Donaldson and McGowan 1989	0.148	0.148	0.148	0.148	0.148	-	NRC 1994	0.019	0.019	0.019	0.019	0.019	-	NRC 1994	dw
Edens 1985	0.159	0.159	0.159	0.159	0.159	-	present study	0.0205	0.0205	0.0205	0.0205	0.0205	-	Nagy 2001	dw
Edens and Garlich 1983	1.84	1.84	1.84	1.84	1.84	-	present study	0.121	0.121	0.121	0.121	0.121	-	present study	dw
Edens and Melvin 1989	0.147	0.147	-	-	-	-	present study	0.0195	0.0195	-	-	-	-	Nagy 2001	dw
Edens and Melvin 1989	0.198	0.198	-	-	-	-	present study	0.0239	0.0239	-	-	-	-	Nagy 2001	dw
Edens and Melvin 1989	0.152	0.152	0.152	0.152	0.152	-	present study	0.0199	0.0199	0.0199	0.0199	0.0199	-	Nagy 2001	dw
Edens et al. 1976	0.0965	0.0965	0.0965	0.0965	0.0965	-	present study	0.0146	0.0146	0.0146	0.0146	0.0146	-	Nagy 2001	dw
Franson and Custer 1982	0.07	0.07	-	-	-	-	USEPA 1988	0.00793	0.00793	-	-	-	-	USEPA 1988	dw
Latta and Donaldson 1986	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Leeming and Donaldson 1984	0.148	0.148	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	NRC 1994	dw
Morgan et al. 1975	0.0947	0.0947	0.0947	0.0947	0.0947	-	present study	0.0144	0.0144	0.0144	0.0144	0.0144	-	Nagy 2001	dw
Morgan et al. 1975	0.085	0.085	0.085	0.085	0.085	-	present study	0.0134	0.0134	0.0134	0.0134	0.0134	-	Nagy 2001	dw
Reproduction															
Edens and Garlich 1983	0.78	0.78	0.78	-	-	-	USEPA 1988	0.0608	0.0608	0.0608	-	-	-	USEPA 1988	dw
Edens and Garlich 1983	0.2	0.2	0.2	0.2	-	-	Narinc et al. 2010	0.0241	0.0241	0.0241	0.0241	-	-	Nagy 2001	dw
Edens and Garlich 1983	1.84	1.84	1.84	1.84	1.84	-	present study	0.121	0.121	0.121	0.121	0.121	-	present study	dw
Edens and Garlich 1983	0.15	0.15	0.15	0.15	-	-	present study	0.031	0.031	0.031	0.031	-	-	present study	dw
Edens and Melvin 1989	0.198	0.198	-	-	-	-	present study	0.0239	0.0239	-	-	-	-	Nagy 2001	dw
Edens et al. 1976	0.0965	0.0965	0.0965	0.0965	0.0965	-	present study	0.0146	0.0146	0.0146	0.0146	0.0146	-	Nagy 2001	dw
Edens et al. 1976	0.0965	0.0965	0.0965	0.0965	0.0965	-	present study	0.0146	0.0146	0.0146	0.0146	0.0146	-	Nagy 2001	dw
Edens et al. 1976	0.0965	0.0965	0.0965	0.0965	0.0965	-	present study	0.0146	0.0146	0.0146	0.0146	0.0146	-	Nagy 2001	dw
Stone and Soares 1976	0.122	0.122	-	-	-	-	present study	0.0171	0.0171	-	-	-	-	Nagy 2001	dw
Survival															
Anders et al. 1982	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	-
Barthalmus et al. 1977	0.445	0.445	0.445	0.445	-	-	present study	-	-	-	-	-	-	NA (dose presented)	-
Cupo and Donaldson 1988	0.269	0.269	-	-	-	-	present study	0.0247	0.0247	-	-	-	-	USEPA 1988	dw
Khan et al. 1993	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	-
Vengris and Mare 1974	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	-

Table B-6. Lead TRV Data for Birds

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Abduljaleel & Shuhaimi-Othman 2013	0	300	500	1000	-	-	dw	0.628	0.502	0.493	0.491	-	-
Berg et al. 1980	0	2000	-	-	-	-	dw	0.128	0.09	-	-	-	-
Berg et al. 1980	0	2000	-	-	-	-	dw	0.108	0.108	-	-	-	-
Berg et al. 1980	0	500	1000	1500	2000	-	dw	0.134	0.126	0.116	0.105	0.094	-
Berg et al. 1980	0	1000	2000	-	-	-	dw	0.132	0.114	0.097	-	-	-
Cupo and Donaldson 1988	0	2000	-	-	-	-	dw	0.496	0.233	-	-	-	-
Damron et al. 1969	0	10	100	1000	0	-	dw	0.838	0.834	0.861	0.513	-	-
Donaldson 1986	0	2000	-	-	-	-	dw	0.536	0.384	-	-	-	-
Donaldson 1986	0	2000	-	-	-	-	dw	0.515	0.344	-	-	-	-
Donaldson and McGowan 1989	0	500	1000	1500	2000	-	dw	0.564	0.46	0.391	0.425	0.378	-
Edens 1985	0	1	10	100	1000	-	dw	0.159	0.157	0.156	0.154	0.131	-
Edens and Garlich 1983	0	50	100	200	400	-	dw	1.84	1.81	1.78	1.72	1.55	-
Edens and Melvin 1989	0	500	-	-	-	-	dw	0.198	0.178	-	-	-	-
Edens and Melvin 1989	0	500	-	-	-	-	dw	0.147	0.129	-	-	-	-
Edens and Melvin 1989	0	1	10	100	1000	-	dw	0.152	0.145	0.145	0.143	0.128	-
Edens et al. 1976	0	1	10	100	1000	-	dw	0.163	0.159	0.161	0.157	0.129	-
Franson and Custer 1982	1.25	1850	-	-	-	-	dw	0.34	0.161	-	-	-	-
Latta and Donaldson 1986	0	1000	-	-	-	-	dw	0.343	0.23	-	-	-	-
Leeming and Donaldson 1984	0	1000	-	-	-	-	dw	0.463	0.383	-	-	-	-
Morgan et al. 1975	0	1	10	100	1000	-	dw	0.132	0.135	0.137	0.131	0.11	-
Morgan et al. 1975	0	10	100	500	1000	-	dw	0.107	0.107	0.107	0.096	0.089	-
Reproduction													
Edens and Garlich 1983	0	25	50	-	-	-	dw	84	80	74	-	-	-
Edens and Garlich 1983	0	1	10	100	0	-	dw	72	69	52	49	-	-
Edens and Garlich 1983	0	50	100	200	400	-	dw	84	71	74	62	42	-
Edens and Garlich 1983	0	1	10	100	-	-	dw	82	65	58	30	-	-
Edens and Melvin 1989	0	500	-	-	-	-	dw	82	60	-	-	-	-
Edens et al. 1976	0	1	10	100	1000	-	dw	87	77	87	79	15	-
Edens et al. 1976	0	1	10	100	1000	-	dw	81.6	75.2	82.4	59.1	4	-
Edens et al. 1976	0	1	10	100	1000	-	dw	6	5.4	5.2	4.2	0.3	-
Stone and Soares 1976	0	3000	-	-	-	-	dw	0.56	0.23	-	-	-	-
Survival													
Anders et al. 1982	-	-	-	-	-	-	NA (dose presented)	100	83.3	-	-	-	-
Barthalmus et al. 1977	-	-	-	-	-	-	NA (dose presented)	100	100	80	50	-	-
Cupo and Donaldson 1988	0	2000	-	-	-	-	dw	96.2	81.7	-	-	-	-
Khan et al. 1993	-	-	-	-	-	-	NA (dose presented)	100	90	-	-	-	-
Vengris and Mare 1974	-	-	-	-	-	-	NA (dose presented)	100	100	50	0	-	-

Table B-6. Lead TRV Data for Birds

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Abduljaleel & Shuhaimi-Othman 2013	mean body weight gain (kg)	100	80	79	78	-	-
Berg et al. 1980	mean body weight gain (kg)	100	70	-	-	-	-
Berg et al. 1980	mean body weight gain (kg)	100	100	-	-	-	-
Berg et al. 1980	mean body weight gain (kg)	100	94	87	78	70	-
Berg et al. 1980	mean body weight gain (kg)	100	86	73	-	-	-
Cupo and Donaldson 1988	average final body weight (kg)	100	47	-	-	-	-
Damron et al. 1969	final body weight (kg)	100	100	103	61	-	-
Donaldson 1986	chick weight (kg) after 20 days of control, adequate dietary riboflavin	100	72	-	-	-	-
Donaldson 1986	chick weight (kg) after 20 days of control, adequate dietary riboflavin	100	67	-	-	-	-
Donaldson and McGowan 1989	final body weight (kg)	100	82	69	75	67	-
Edens 1985	average final body weight (kg) female	100	99	98	97	82	-
Edens and Garlich 1983	average final body weight (kg) Exp. 3	100	98	97	93	84	-
Edens and Melvin 1989	average final body weight (kg)	100	90	-	-	-	-
Edens and Melvin 1989	average final body weight (kg)	100	88	-	-	-	-
Edens and Melvin 1989	average final body weight Fatty (kg)	100	95	95	94	84	-
Edens et al. 1976	final body weight of females (kg)	100	98	99	96	79	-
Franson and Custer 1982	final weight (kg)	100	47	-	-	-	-
Latta and Donaldson 1986	body weight gain of 100% dietary Met (kg), males	100	67	-	-	-	-
Leeming and Donaldson 1984	body weight gain of 100% dietary Met (kg), males	100	83	-	-	-	-
Morgan et al. 1975	final body weight (kg) at 6 weeks	100	102	104	99	83	-
Morgan et al. 1975	final body weight (kg) at 5 weeks	100	100	100	90	83	-
Reproduction							
Edens and Garlich 1983	hen-day egg production	100	95	88	-	-	-
Edens and Garlich 1983	hen-day egg production	100	96	72	68	-	-
Edens and Garlich 1983	hen-day egg production	100	85	88	74	50	-
Edens and Garlich 1983	hen-day egg production	100	79	71	37	-	-
Edens and Melvin 1989	% hen-day egg production	100	73	-	-	-	-
Edens et al. 1976	% hens producing eggs	100	89	100	91	17	-
Edens et al. 1976	% hatch of setable eggs	100	92	101	72	5	-
Edens et al. 1976	setable eggs/hen/week	100	90	87	70	5	-
Stone and Soares 1976	eggs/hen/day	100	41	-	-	-	-
Survival							
Anders et al. 1982	% survival	100	83	-	-	-	-
Barthalmus et al. 1977	% survival	100	100	80	50	-	-
Cupo and Donaldson 1988	% survival	100	85	-	-	-	-
Khan et al. 1993	% survival	100	90	-	-	-	-
Vengris and Mare 1974	% survival	100	100	50	0	-	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-7. Lead TRV Data for Mammals

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Al-Omar et al. 2000	46	NA	lead oxide	mouse	adult	body weight gain	GV	5.0	0	46.4	-	-	-	-	doses presented in paper
Barlow et al. 1977	1141	NA	lead acetate	rat	adult	maternal body weight	FD	3.0	0	1140	-	-	-	-	calculated from BW and FIR
Gerber et al. 1978	1064	1064	lead acetate	rat	infant	body weight	FD	52.0	0	1060	-	-	-	-	calculated from BW and FIR
Harry et al. 1985	200	NA	lead acetate	rat	2 days	body weight	GV	3.7	0	200	-	-	-	-	doses presented in paper
Hsu et al. 1975	37	NA	lead acetate	pig	4 weeks	body weight	FD	13.0	0	36.7	-	-	-	-	calculated from BW and FIR
Lorenzo et al. 1978	no stats	20	lead nitrate	rabbit	1 day	% weight gain	GV	4.3	0	2.21	9.97	19.9	39.9	0	converted Pb(NO3)2 to Pb, divided by BW
Maker et al. 1973	no stats	NA	lead carbonate	mouse	adult	body weight	FD	4.3	0	1840	-	-	-	-	calculated from BW and FIR
Mykkanen et al. 1980	no stats	NA	lead acetate	rat	adult	weight gain	FD	3.0	0	509	1020	-	-	-	calculated from BW and FIR
Mykkanen et al. 1980	no stats	NA	lead acetate	rat	adult	weight gain	FD	3.0	0	236	471	942	-	-	calculated from BW and FIR
Kumar and Desiraju 1990	100	400	lead acetate	rat	2 days	body weight	GV	8.4	0	100	400	-	-	-	doses presented in paper
Toews et al. 1983	400	400	lead acetate	rat	pup	body weight	GV	4.0	0	400	-	-	-	-	doses presented in paper
Reproduction															
Gupta et al. 1995	3	3.2	lead acetate	mouse	adult	living embryos per mother	GV	4.0	0	3.19	7.96	15.9	-	-	doses presented in paper
Jacquet et al. 1977	919	NA	not specified	mouse	sexually mature	embryo weight	FD	2.6	0	230	459	919	-	-	calculated from BW and FIR
Miller et al. 1982	no stats	NA	lead acetate	rat	adult	embryo weight	GV	5.9	0	50	75	100	-	-	doses presented in paper
Mykkanen et al. 1980	no effect	1018	lead acetate	rat	adult	pup weight (breed 1)	FD	3.0	0	255	1020	-	-	-	calculated from BW and FIR
Mykkanen et al. 1980	236	942	lead acetate	rat	adult	pup weight (breed 2)	FD	3.0	0	236	942	-	-	-	calculated from BW and FIR
Schroeder and Mitchener 1971	2.7	NA	soluble lead	rat	multigenerational	offspring survival	FD, DW	3 generations	0	2.67	-	-	-	-	dose in food + dose in water (based on Calder and Braun 1983)
Schroeder and Mitchener 1971	3.5	NA	soluble lead	mouse	multigenerational	offspring survival	FD, DW	3 generations	0	3.54	-	-	-	-	dose in food + dose in water (based on Calder and Braun 1983)
Wardell et al. 1982	150	NA	lead acetate	rat	adult	fetal mortality (resorptions)	GV	1.9	0	10	50	100	150	-	doses presented in paper
Winneke et al. 1977	138	138	lead acetate	rat	adult	litter size	FD	18.6	0	138	-	-	-	-	calculated from BW and FIR
Winneke et al. 1977	138	138	lead acetate	rat	adult	pregnancy success	FD	18.6	0	138	-	-	-	-	calculated from BW and FIR
Survival															
Junaid et al. 1997	no stats	8.0	lead acetate	mouse	adult	survival	GV	8.6	0	2	4	8	-	-	doses presented in paper
Lorenzo et al. 1978	no stats	10	lead nitrate	rabbit	1 day	survival	GV	4.3	0	2.21	9.97	19.9	39.9	-	dose in Pb(NO3)2 to Pb divided by BW
Pankakoski et al. 1994	191	191	lead in earthworm prey	shrew	juvenile (< 5 months)	survival	FD	0.6	0.206	3.4	2.11	191	218	542	calculated from BW and FIR
Press 1977	no stats	328	lead acetate	rat	1 day	survival	GV	2.1	0	328	-	-	-	-	doses presented in paper
Kumar and Desiraju 1990	no stats	400	lead acetate	rat	2 days	survival	GV	8.4	0	400	-	-	-	-	doses presented in paper

Table B-7. Lead TRV Data for Mammals

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight
Growth															
Al-Omar et al. 2000	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Barlow et al. 1977	0.25	0.25	-	-	-	-	present study	0.0224	0.0224	-	-	-	-	USEPA 1988	dw
Gerber et al. 1978	0.151	0.151	-	-	-	-	present study	0.016	0.016	-	-	-	-	USEPA 1988	dw
Harry et al. 1985	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Hsu et al. 1975	35.4	35.4	-	-	-	-	present study	1.3	1.3	-	-	-	-	present Study	NA
Lorenzo et al. 1978	0.282	0.282	0.282	0.282	0.282	-	USEPA 1988	-	-	-	-	-	-	NA (dose presented)	NA
Maker et al. 1973	0.03	0.03	-	-	-	-	USEPA 1988	0.00551	0.00551	-	-	-	-	USEPA 1988	dw
Mykkanen et al. 1980	0.35	0.35	0.35	-	-	-	USEPA 1988	0.028	0.028	0.028	-	-	-	USEPA 1988	dw
Mykkanen et al. 1980	0.44	0.44	0.44	0.44	-	-	USEPA 1988	0.0325	0.0325	0.0325	0.0325	-	-	USEPA 1988	dw
Kumar and Desiraju 1990	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Toews et al. 1983	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Reproduction															
Gupta et al. 1995	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Jacquet et al. 1977	0.03	0.03	0.03	0.03	-	-	USEPA 1988	0.00551	0.00551	0.00551	0.00551	-	-	USEPA 1988	dw
Miller et al. 1982	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Mykkanen et al. 1980	0.35	0.35	0.35	-	-	-	USEPA 1988	0.028	0.028	0.028	-	-	-	USEPA 1988	dw
Mykkanen et al. 1980	0.44	0.44	0.44	-	-	-	USEPA 1988	0.0325	0.0325	0.0325	-	-	-	USEPA 1988	dw
Schroeder and Mitchener 1971	0.48	0.48	-	-	-	-	USEPA 1988	0.0345	-	-	-	-	-	USEPA 1988	dw
Schroeder and Mitchener 1971	0.03	0.03	-	-	-	-	USEPA 1988	0.00551	-	-	-	-	-	USEPA 1988	dw
Wardell et al. 1982	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Winneke et al. 1977	0.18	0.18	-	-	-	-	present study	0.018	0.018	-	-	-	0	USEPA 1988	dw
Winneke et al. 1977	0.18	0.18	-	-	-	-	present study	0.018	0.018	-	-	-	-	USEPA 1988	dw
Survival															
Junaid et al. 1997	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Lorenzo et al. 1978	0.282	0.282	0.282	0.282	0.282	-	USEPA 1988	-	-	-	-	-	-	NA (dose presented)	NA
Pankakoski et al. 1994	0.008	0.008	0.008	0.008	0.008	0.008	present study	0.00412	0.00412	0.00412	0.00412	0.00412	0.00412	Nagy 2001	ww
Press 1977	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Kumar and Desiraju 1990	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA

Table B-7. Lead TRV Data for Mammals

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Al-Omar et al. 2000	-	-	-	-	-	-	NA (dose presented)	0.0484	0.0456	-	-	-	-
Barlow et al. 1977	0	12700	-	-	-	-	dw	0.25	0.21	-	-	-	-
Gerber et al. 1978	0	10000	-	-	-	-	dw	0.264	0.17	-	-	-	-
Harry et al. 1985	-	-	-	-	-	-	NA (dose presented)	0.079	0.07	-	-	-	-
Hsu et al. 1975	0	1000	-	-	-	-	dw	59.5	49.4	-	-	-	-
Lorenzo et al. 1978	-	-	-	-	-	-	NA (dose presented)	850	880	-	500	-	-
Maker et al. 1973	0	10000	-	-	-	-	dw	100	85	-	-	-	-
Mykkanen et al. 1980	0	6370	12700	-	-	-	dw	107	105	101	-	-	-
Mykkanen et al. 1980	0	3190	6370	12700	-	-	dw	107	116	102	95	-	-
Kumar and Desiraju 1990	-	-	-	-	-	-	NA (dose presented)	0.148	0.126	0.07	-	-	-
Toews et al. 1983	-	-	-	-	-	-	NA (dose presented)	0.08	0.0616	-	-	-	-
Reproduction													
Gupta et al. 1995	-	-	-	-	-	-	NA (dose presented)	7.5	5.75	5.8	5.5	-	-
Jacquet et al. 1977	0	1250	2500	5000	0	0	dw	0.000978	0.000922	0.00085	0.000793	-	-
Miller et al. 1982	-	-	-	-	-	-	NA (dose presented)	3.35	3.13	3.52	2.73	-	-
Mykkanen et al. 1980	0	3190	12700	-	-	-	dw	0.043	0.036	0.032	-	-	-
Mykkanen et al. 1980	0	3190	12700	-	-	-	dw	0.055	0.045	0.033	-	-	-
Schroeder and Mitchener 1971	-	-	-	-	-	-	dw	100	93	-	-	-	-
Schroeder and Mitchener 1971	-	-	-	-	-	-	NA	100	87.5	-	-	-	-
Wardell et al. 1982	-	-	-	-	-	-	NA (dose presented)	92	93	96	98	81	-
Winneke et al. 1977	0	1380	-	-	-	-	dw	8	5.7	-	-	-	-
Winneke et al. 1977	0	1380	-	-	-	-	dw	20	14	-	-	-	-
Survival													
Junaid et al. 1997	-	-	-	-	-	-	NA	100	100	100	80	-	-
Lorenzo et al. 1978	-	-	-	-	-	-	NA	84	83	50	15	0	-
Pankakoski et al. 1994	0.4	6.6	4.1	371	423	1050	ww	100	100	100	0	0	0
Press 1977	-	-	-	-	-	-	NA	100	0	-	-	-	-
Kumar and Desiraju 1990	-	-	-	-	-	-	NA	100	40	-	-	-	-

Table B-7. Lead TRV Data for Mammals

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Al-Omar et al. 2000	final body weight using initial body weight (25 g) and weight gain	100	94	-	-	-	-
Barlow et al. 1977	average final mother weight (kg)	100	84	-	-	-	-
Gerber et al. 1978	body weight (kg)	330	213	-	-	-	-
Harry et al. 1985	average male/female weight at day 29 (kg)	100	89	-	-	-	-
Hsu et al. 1975	final body weight (kg) (calculated from initial bw and daily weight gain)	100	83	-	-	-	-
Lorenzo et al. 1978	avgerage % weight gain	100	104	-	59	-	-
Maker et al. 1973	average weight as % of control	100	85	-	-	-	-
Mykkanen et al. 1980	weight gain (as a % of delivery weight)	100	98	94	-	-	-
Mykkanen et al. 1980	weight gain (as a % of delivery weight)	100	108	95	89	-	-
Kumar and Desiraju 1990	body weight at 60 days old (kg)	100	85	47	-	-	-
Toews et al. 1983	body weight on day 30 (kg)	100	77	-	-	-	-
Reproduction							
Gupta et al. 1995	living embryos per mother	100	77	77	73	-	-
Jacquet et al. 1977	average final weight of embryo (kg)	100	94	87	81	-	-
Miller et al. 1982	embryo weight (g)	100	93	105	81	-	-
Mykkanen et al. 1980	average final pup weight (kg)	100	84	74	-	-	-
Mykkanen et al. 1980	average final pup weight (kg)	100	82	60	-	-	-
Schroeder and Mitchener 1971	percent survival: F1 generation	100	93	-	-	-	-
Schroeder and Mitchener 1971	percent survival: F1 generation	100	88	-	-	-	-
Wardell et al. 1982	% survival (no resportions)	100	101	104	107	88	-
Winneke et al. 1977	litter size	100	71	-	-	-	-
Winneke et al. 1977	number of pregnant rats	100	70	-	-	-	-
Survival							
Junaid et al. 1997	% survival	100	100	100	80	-	-
Lorenzo et al. 1978	mortality determined at 30 days of age	100	99	60	18	0	-
Pankakoski et al. 1994	% survival	100	100	100	0	0	0
Press 1977	% survival	100	0	-	-	-	-
Kumar and Desiraju 1990	% survival	100	40	-	-	-	-

Notes:
selected to match the basis of the food concentration.
Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.
[a] LOAEL determined by study based on statistical analyses.
[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-8. Manganese TRV Data for Birds

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Martinez and Diaz 1996	161	NA	manganese oxide	chicken	1 day	body weight	FD	6.0	11.5	49	86.4	161	-	-	calculated from BW and FIR
Southern and Baker 1983	403	NA	manganese chloride	chicken	8 days	body weight	FD	2.0	16.2	306	403	499	-	-	calculated from BW and FIR
Vohra and Kratzer 1968	515	NA	manganese sulfate	turkey	juvenile	body weight gain	FD	3.0	7.76	325	390	515	-	-	calculated from BW and FIR

Table B-8. Manganese TRV Data for Birds

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight Basis
Growth															
Martinez and Diaz 1996	0.795	0.795	0.795	0.795	-	-	present study	0.0799	0.0799	0.0799	0.0799	-	-	present Study	NA
Southern and Baker 1983	0.196	0.196	0.196	0.196	-	-	present study	0.0189	0.0189	0.0189	0.0189	-	-	USEPA 1988	dw
Vohra and Kratzer 1968	0.5	0.5	0.5	0.5	-	-	NRC 1994	0.0529	0.0529	0.0529	0.0529	-	-	NRC 1994	dw

Table B-8. Manganese TRV Data for Birds

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Martinez and Diaz 1996	115	487	859	1600	-	-	dw	2.02	1.92	1.85	1.75	-	-
Southern and Baker 1983	168	3170	4170	5170	-	-	dw	0.312	0.316	0.281	0.29	-	-
Vohra and Kratzer 1968	73.4	3070	3690	4870	-	-	dw	0.322	0.332	0.32	0.284	-	-

Table B-8. Manganese TRV Data for Birds

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Martinez and Diaz 1996	final body weight on day 42 (kg)	100	95	92	87	-	-
Southern and Baker 1983	final body weight (kg)	100	101	90	93	-	-
Vohra and Kratzer 1968	average weight gain (kg)	100	103	99	88	-	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-9. Manganese TRV Data for Mammals

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	Notes
Growth															
Komura and Sakomoto 1991	no stats	NA	manganese acetate	mouse	6 weeks	body weight	FD	12.9	16.6	272	-	-	-	-	calculated from BW and FIR
Komura and Sakomoto 1991	no stats	NA	manganese chloride	mouse	6 weeks	body weight	FD	12.9	16.6	272	-	-	-	-	calculated from BW and FIR
Kontur and Fechter 1985	no stats	NA	manganese chloride	rat	adult (gestation day 1)	body weight	DW	3.0	0	230	461	922	-	-	calculated from BW and FIR
Lipe et a. 1999	10	NA	manganese chloride	rat	90 days	body weight	GV	4.3	0	10	20	-	-	-	doses presented in paper
NTP 1993b	1321	NA	manganese sulfate	rat	50 days	body weight (male)	FD	2.0	2.43	85	167	332	662	1320	calculated from BW and FIR
NTP 1993b	74	NA	manganese sulfate	rat	50 days	body weight (female)	FD	13.0	2.1	38.7	73.6	145	288	573	calculated from BW and FIR
NTP 1993b	1847	NA	manganese sulfate	mouse	63 days	body weight (male)	FD	13.0	3.39	119	234	464	925	1850	calculated from BW and FIR
NTP 1993b	1731	NA	manganese sulfate	mouse	63 days	body weight (female)	FD	13.0	3.18	111	219	435	867	1730	calculated from BW and FIR
Rehnberg et al. 1980	71	71	manganese oxide	rat	1 day	body weight	GV	2.9	0	21	71	214	-	-	doses presented in paper
Reproduction															
Kontur and Fechter 1985	922	NA	manganese chloride	rat	adult (gestation day 1)	litter size	DW	3.0	0	230	461	922	-	-	calculated from BW and FIR
Laskey et al. 1982	404	404	manganese oxide	rat	pregnant	pregnancy success	FD	gestation to 32 weeks	5.53	44.5	118	404	-	-	calculated from BW and FIR
Leung et al. 1982	no stats	634	manganese chloride	rat	adult	offspring body weight	DW	3.7	0	31.7	317	634	-	-	calculated from BW and FIR
Pappas et al. 1997	1420	1420	manganese chloride	rat	pregnant	offspring body weight	DW	gestation to post-natal day 30	0	350	1420	-	-	-	doses presented in paper
Survival															
NTP 1993b	431	45.5	manganese sulfate	rat	41 days	suvival (male)	FD	2 years	2.63	45.5	146	431	-	-	calculated from BW and FIR
Rehnberg et al. 1980	71	214	manganese oxide	rat	1 day	survival	GV	2.9	0	21	71	214	-	-	doses presented in paper

Table B-9. Manganese TRV Data for Mammals

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight Basis
Growth															
Komura and Sakomoto 1991	0.0282	0.0282	0.0282	0.0282	0.0282	-	present study	0.0036	0.0036	-	-	-	-	present study	NA
Komura and Sakomoto 1991	0.0282	0.0282	0.0282	0.0282	0.0282	-	present study	0.0036	0.0036	-	-	-	-	present study	NA
Kontur and Fechter 1985	0.371	0.371	0.371	0.371	-	-	present study	0.0392	0.0392	0.0392	0.0392	-	-	present study	NA
Lipe et a. 1999	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
NTP 1993b	0.212	0.212	0.212	0.212	0.212	0.212	present study	0.0172	0.0172	0.0172	0.0172	0.0172	0.0172	present study	NA
NTP 1993b	0.142	0.142	0.142	0.142	0.142	0.142	present study	0.00995	0.00995	0.00995	0.00995	0.00995	0.00995	present study	NA
NTP 1993b	0.0282	0.0282	0.0282	0.0282	0.0282	0.0282	present study	0.0032	0.0032	0.0032	0.0032	0.0032	0.0032	present study	NA
NTP 1993b	0.0221	0.0221	0.0221	0.0221	0.0221	0.0221	present study	0.00235	0.00235	0.00235	0.00235	0.00235	0.00235	present study	NA
Rehnberg et al. 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Reproduction															
Kontur and Fechter 1985	0.371	0.371	0.371	0.371	-	-	present study	0.0392	0.0392	0.0392	0.0392	-	-	present study	NA
Laskey et al. 1982	0.134	0.132	0.146	0.123	-	-	present study	0.0148	0.0147	0.0157	0.014	-	-	USEPA 1988	dw
Leung et al. 1982	0.24	0.24	0.24	0.24	-	-	USEPA 1988	0.0274	0.0274	0.0274	0.0274	-	-	Calder and Braun 1983	NA
Pappas et al. 1997	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA
Survival															
NTP 1993b	0.264	0.264	0.264	0.264	-	-	present study	0.0232	0.0232	0.0232	0.0232	-	-	USEPA 1988	dw
Rehnberg et al. 1980	-	-	-	-	-	-	NA (dose presented)	-	-	-	-	-	-	NA (dose presented)	NA

Table B-9. Manganese TRV Data for Mammals

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Komura and Sakomoto 1991	130	2130	-	-	-	-	dw	0.0395	0.0358	-	-	-	-
Komura and Sakomoto 1991	130	2130	-	-	-	-	dw	0.0395	0.0344	-	-	-	-
Kontur and Fechter 1985	0	2180	4370	8730	-	-	NA	0.442	0.434	0.424	0.388	-	-
Lipe et a. 1999	-	-	-	-	-	-	NA	0.462	0.43	0.42	-	-	-
NTP 1993b	29.9	1050	2060	4090	8150	16300	dw	0.241	0.235	0.242	0.235	0.243	0.21
NTP 1993b	29.9	550	1050	2060	4090	8150	dw	0.184	0.181	0.175	0.176	0.178	0.174
NTP 1993b	29.9	1050	2060	4090	8150	16300	dw	0.0314	0.0305	0.031	0.0309	0.0306	0.0274
NTP 1993b	29.9	1050	2060	4090	8150	16300	dw	0.0242	0.0242	0.0243	0.0245	0.0242	0.0228
Rehnberg et al. 1980	-	-	-	-	-	-	NA	0.0584	0.0566	0.045	0.044	-	-
Reproduction													
Kontur and Fechter 1985	0	2180	4370	8730	-	-	NA (dose presented)	0.00613	0.00624	0.00609	0.00539	-	-
Laskey et al. 1982	50	400	1100	3550	-	-	dw	84	84	79	63	-	-
Leung et al. 1982	0	278	2780	5550	-	-	NA	0.22	0.215	0.2	0.145	-	-
Pappas et al. 1997	0	2000	10000	-	-	-	NA (dose presented)	0.113	0.109	0.0793	-	-	-
Survival													
NTP 1993b	29.9	517	1650	4900	-	-	dw	0.357	0.243	0.314	0.1	-	-
Rehnberg et al. 1980	-	-	-	-	-	-	NA	98	94	85	54	-	-

Table B-9. Manganese TRV Data for Mammals

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Komura and Sakomoto 1991	body weight on day 60 (kg)	100	91	-	-	-	-
Komura and Sakomoto 1991	body weight on day 60 (kg)	100	87	-	-	-	-
Kontur and Fechter 1985	final maternal body weight (kg)	100	98	96	88	-	-
Lipe et a. 1999	average final weight (kg)	100	93	91	-	-	-
NTP 1993b	male final body weight (kg)	100	98	100	98	101	87
NTP 1993b	female final body weight (kg)	100	98	95	96	97	95
NTP 1993b	male final body weight (kg)	100	97	99	98	97	87
NTP 1993b	female final body weight	100	100	100	101	100	94
Rehnberg et al. 1980	average final weight (kg)	100	97	77	75	-	-
Reproduction							
Kontur and Fechter 1985	average littler weight (kg)	100	102	99	88	-	-
Laskey et al. 1982	percent pregnant	100	100	94	75	-	-
Leung et al. 1982	average final pup weight (kg)	100	98	91	66	-	-
Pappas et al. 1997	pup body weight at PND 32 (kg)	100	96	70	-	-	-
Survival							
NTP 1993b	proportion of males surviving to study termination	100	68	88	28	-	-
Rehnberg et al. 1980	% survival	100	96	87	55	-	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-10. Zn TRV Data for Birds

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)									
									Control	1	2	3	4	5	6	7	8	Notes
Growth																		
Gasaway and Buss 1972	no stats	325	zinc carbonate	mallard	7 weeks	body weight gain	FD	5.7	25	325	625	925	1230	-	-	-	-	calculated from BW and FIR
Hamilton et al. 1981	110	NA	zinc carbonate	Japanese quail	hatchling	body weight (Exp. 2)	FD	2.0	4.22	57	110	-	-	-	-	-	-	calculated from BW and FIR
Hamilton et al. 1981	101	NA	zinc carbonate	Japanese quail	hatchling	body weight (Exp. 5)	FD	2.0	3.87	101	-	-	-	-	-	-	-	calculated from BW and FIR
Hill 1974a	257	257	zinc sulfate	chicken	1 day	body weight gain	FD	2.0	0	6.42	25.7	64.2	128	257	-	-	-	calculated from BW and FIR
Lu and Combs 1988	107	107	zinc oxide	chicken	20 days	body weight gain (Exp. 3)	FD	3.0	7.47	107	-	-	-	-	-	-	-	calculated from BW and FIR
Lu et al. 1990	65	65	zinc oxide	chicken	2 weeks	body weight gain (Exp. 1)	FD	1.0	7.93	64.6	-	-	-	-	-	-	-	calculated from BW and FIR
Roberson and Schaible 1960	252	252	zinc oxide	chicken	1 day	body weight (Exp. 2)	FD	4.0	0	84.2	168	252	-	-	-	-	-	calculated from BW and FIR
Roberson and Schaible 1960	168	252	zinc sulfate	chicken	1 day	body weight (Exp. 2)	FD	4.0	0	84.2	168	252	-	-	-	-	-	calculated from BW and FIR
Roberson and Schaible 1960	168	252	zinc carbonate	chicken	1 day	body weight (Exp. 2)	FD	4.0	0	84.2	168	252	-	-	-	-	-	calculated from BW and FIR
Roberson and Schaible 1960	126	NA	zinc sulfate	chicken	1 day	body weight (Exp. 3)	FD	4.0	0	4.19	83.7	126	-	-	-	-	-	calculated from BW and FIR
Roberson and Schaible 1960	126	126	zinc carbonate	chicken	1 day	body weight (Exp. 3)	FD	4.0	0	83.7	126	-	-	-	-	-	-	calculated from BW and FIR
Roberson and Schaible 1960	126	NA	zinc oxide	chicken	1 day	body weight (Exp. 3)	FD	4.0	0	83.7	126	-	-	-	-	-	-	calculated from BW and FIR
Sandoval et al. 1988	136	136	zinc sulfate	chicken	1 day	body weight gain (Exp. 2)	FD	3.0	7.96	136	-	-	-	-	-	-	-	calculated from BW and FIR
Sandoval et al. 1988	136	136	zinc gluconate	chicken	1 day	body weight gain (Exp. 2)	FD	3.0	7.96	136	-	-	-	-	-	-	-	calculated from BW and FIR
Stahl et al. 1989	253	253	zinc carbonate	chicken	hatchling	body weight gain	FD	3.0	4.29	12	253	-	-	-	-	-	-	calculated from BW and FIR
Vohra and Kratzer 1968	423	423	zinc oxide	turkey	chick	body weight gain	FD	3.0	0	423	629	845	1060	-	-	-	-	calculated from BW and FIR
Reproduction																		
Gibson et al. 1986	no stats	125	zinc acetate dihydrate	chicken	30 weeks	egg production	FD	10.0	2.1	63.8	125	187	249	311	-	-	-	calculated from BW and FIR
Gibson et al. 1986	no stats	125	zinc oxide	chicken	30 weeks	egg production	FD	10.0	2.1	63.8	125	187	249	311	-	-	-	calculated from BW and FIR
Jackson et al. 1986	232	232	zinc oxide	chicken	40 weeks	egg production	FD	3.0	3.21	232	462	691	920	0	-	-	-	calculated from BW and FIR
Jackson et al. 1986	no stats	137	zinc oxide	chicken	40 weeks	egg production	FD	20.0	3.74	70.5	137	204	271	337	-	-	-	calculated from BW and FIR
Jensen and Maurice 1980	160	160	zinc sulfate	chicken	adult	egg production (Exp. 4)	FD	6.0	3.9	11.7	42.9	160	-	-	-	-	-	calculated from BW and FIR
Jensen and Maurice 1980	160	160	zinc sulfate	chicken	adult	egg production (Exp. 3)	FD	6.0	3.9	160	-	-	-	-	-	-	-	calculated from BW and FIR
Stepinska et al. 1987	no stats	1182	zinc oxide	chicken	71 weeks	egg production	FD	0.7	2.65	1180	-	-	-	-	-	-	-	calculated from BW and FIR
Stevenson et al. 1987	no stats	127	zinc oxide	chicken	28 weeks	egg production	FD	20.0	5.24	35.7	51	66.2	81.4	96.7	127	188	249	calculated from BW and FIR
Survival																		
Blalock and Hill 1988	no stats	263	zinc oxide	chicken	1 day	survival	FD	2.0	6.42	135	263	648	-	-	-	-	-	calculated from BW and FIR
Dewar et al. 1983	no stats	780	zinc oxide	chicken	15 days	survival (Exp. 1)	FD	4.0	9.5	266	523	780	-	-	-	-	-	calculated from BW and FIR
Dewar et al. 1983	no stats	523	zinc oxide	chicken	1 day	survival (Exp. 2)	FD	4.0	9.5	138	266	523	-	-	-	-	-	calculated from BW and FIR
Gasaway and Buss 1972	no stats	325	zinc carbonate	mallard	7 weeks	survival	FD	8.6	25	325	625	925	1230	-	-	-	-	calculated from BW and FIR
Gibson et al. 1986	no stats	311	zinc acetate	chicken	30 weeks	survival	FD	10.0	2.1	63.8	125	187	249	311	-	-	-	calculated from BW and FIR
Hamilton et al. 1979	no stats	430	zinc carbonate	Japanese quail	1 day	survival	FD	2.0	5.31	18.6	31.8	58.4	111	218	430	-	-	calculated from BW and FIR
Roberson and Schaible 1960	no stats	252	zinc carbonate	chicken	1 day	survival (Exp. 2)	FD	4.0	0	84.2	168	252	-	-	-	-	-	calculated from BW and FIR

Table B-10. Zn TRV Data for Birds

	Body Weight (kg)										Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)										
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Source	Wet or Dry Weight Basis
Growth																					
Gasaway and Buss 1972	1.08	1.08	1.08	1.08	1.08	-	-	-	-	Dunning 1983	0.108	0.108	0.108	0.108	0.108	-	-	-	-	Heinz et al. 1987	dw
Hamilton et al. 1981	0.0335	0.0335	0.0335	-	-	-	-	-	-	present study	0.00707	0.00707	0.00707	-	-	-	-	-	-	Nagy 2001	dw
Hamilton et al. 1981	0.044	0.044	0.044	-	-	-	-	-	-	present study	0.00852	0.00852	-	-	-	-	-	-	-	Nagy 2001	dw
Hill 1974a	0.148	0.148	0.148	0.148	0.148	0.148	-	-	-	NRC 1994	0.019	0.019	0.019	0.019	0.019	0.019	-	-	-	NRC 1994	dw
Lu and Combs 1988	0.16	0.16	-	-	-	-	-	-	-	USEPA 1988	0.0159	0.0159	-	-	-	-	-	-	-	USEPA 1988	dw
Lu et al. 1990	0.07	0.07	-	-	-	-	-	-	-	USEPA 1988	0.00793	0.00793	-	-	-	-	-	-	-	USEPA 1988	dw
Roberson and Schaible 1960	0.476	0.476	0.476	0.476	-	-	-	-	-	present study	0.0401	0.0401	0.0401	0.0401	-	-	-	-	-	USEPA 1988	dw
Roberson and Schaible 1960	0.476	0.476	0.476	0.476	-	-	-	-	-	present study	0.0401	0.0401	0.0401	0.0401	-	-	-	-	-	USEPA 1988	dw
Roberson and Schaible 1960	0.476	0.476	0.476	0.476	-	-	-	-	-	present study	0.0401	0.0401	0.0401	0.0401	-	-	-	-	-	USEPA 1988	dw
Roberson and Schaible 1960	0.491	0.491	0.491	0.491	-	-	-	-	-	present study	0.0411	0.0411	0.0411	0.0411	-	-	-	-	-	USEPA 1988	dw
Roberson and Schaible 1960	0.491	0.491	0.491	-	-	-	-	-	-	present study	0.0411	0.0411	0.0411	-	-	-	-	-	-	USEPA 1988	dw
Roberson and Schaible 1960	0.491	0.491	0.491	-	-	-	-	-	-	present study	0.0411	0.0411	0.0411	-	-	-	-	-	-	USEPA 1988	dw
Sandoval et al. 1988	0.148	0.148	-	-	-	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	-	-	-	NRC 1994	dw
Sandoval et al. 1988	0.148	0.148	-	-	-	-	-	-	-	NRC 1994	0.019	0.019	-	-	-	-	-	-	-	NRC 1994	dw
Stahl et al. 1989	0.06	0.06	0.06	-	-	-	-	-	-	USEPA 1988	0.00696	0.00696	0.00696	-	-	-	-	-	-	USEPA 1988	dw
Vohra and Kratzer 1968	0.48	0.48	0.48	0.48	0.48	-	-	-	-	NRC 1994	0.0507	0.0507	0.0507	0.0507	0.0507	-	-	-	-	NRC 1994	dw
Reproduction																					
Gibson et al. 1986	1.95	1.95	1.95	1.95	1.95	1.95	-	-	-	present study	0.12	0.12	0.12	0.12	0.12	0.12	-	-	-	present study	NA
Gibson et al. 1986	1.95	1.95	1.95	1.95	1.95	1.95	-	-	-	present study	0.12	0.12	0.12	0.12	0.12	0.12	-	-	-	present study	NA
Jackson et al. 1986	1.88	1.88	1.88	1.88	1.88	-	-	-	-	present study	0.108	0.108	0.108	0.108	0.108	-	-	-	-	present study	NA
Jackson et al. 1986	1.85	1.85	1.85	1.85	1.85	1.85	-	-	-	present study	0.123	0.123	0.123	0.123	0.123	0.123	-	-	-	present study	NA
Jensen and Maurice 1980	0.78	0.78	0.78	0.78	-	-	-	-	-	USEPA 1988	0.0608	0.0608	0.0608	0.0608	-	-	-	-	-	USEPA 1988	dw
Jensen and Maurice 1980	0.78	0.78	-	-	-	-	-	-	-	USEPA 1988	0.0608	0.0608	-	-	-	-	-	-	-	USEPA 1988	dw
Stepinska et al. 1987	2.17	2.17	-	-	-	-	-	-	-	present study	0.128	0.128	-	-	-	-	-	-	-	present study	NA
Stevenson et al. 1987	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	present study	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	0.103	present study	NA
Survival																					
Blalock and Hill 1988	0.148	0.148	0.148	0.148	-	-	-	-	-	NRC 1994	0.019	0.019	0.019	0.019	-	-	-	-	-	NRC 1994	dw
Dewar et al. 1983	0.148	0.148	0.148	0.148	-	-	-	-	-	NRC 1994	0.019	0.019	0.019	0.019	-	-	-	-	-	NRC 1994	dw
Dewar et al. 1983	0.148	0.148	0.148	0.148	-	-	-	-	-	NRC 1994	0.019	0.019	0.019	0.019	-	-	-	-	-	NRC 1994	dw
Gasaway and Buss 1972	1.08	1.08	1.08	1.08	1.08	-	-	-	-	Dunning 1983	0.108	0.108	0.108	0.108	0.108	-	-	-	-	Heinz et al. 1987	dw
Gibson et al. 1986	1.95	1.95	1.95	1.95	1.95	1.95	-	-	-	present study	0.12	0.12	0.12	0.12	0.12	0.12	-	-	-	present study	NA
Hamilton et al. 1979	0.0329	0.0329	0.0329	0.0329	0.0329	0.0329	0.0329	-	-	Narinc et al. 2010	0.00698	0.00698	0.00698	0.00698	0.00698	0.00698	0.00698	-	-	Nagy 2001	dw
Roberson and Schaible 1960	0.476	0.476	0.476	0.476	-	-	-	-	-	present study	0.0401	0.0401	0.0401	0.0401	-	-	-	-	-	USEPA 1988	dw

Table B-10. Zn TRV Data for Birds

	Concentration in Food (mg/kg)										Effect								
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8
Growth																			
Gasaway and Buss 1972	250	3250	6250	9250	12300	-	-	-	-	dw	102	76	66	52	58	-	-	-	-
Hamilton et al. 1981	20	270	520	-	-	-	-	-	-	dw	0.045	0.044	0.04	-	-	-	-	-	-
Hamilton et al. 1981	20	520	-	-	-	-	-	-	-	dw	0.044	0.036	-	-	-	-	-	-	-
Hill 1974a	0	50	200	500	1000	2000	-	-	-	dw	0.205	0.198	0.194	0.2	0.188	0.155	-	-	-
Lu and Combs 1988	75	1080	-	-	-	-	-	-	-	dw	96	52	-	-	-	-	-	-	-
Lu et al. 1990	70	570	-	-	-	-	-	-	-	dw	65.9	45.9	-	-	-	-	-	-	-
Roberson and Schaible 1960	0	1000	2000	3000	-	-	-	-	-	dw	0.476	0.488	0.441	0.337	-	-	-	-	-
Roberson and Schaible 1960	0	1000	2000	3000	-	-	-	-	-	dw	0.476	0.464	0.419	0.282	-	-	-	-	-
Roberson and Schaible 1960	0	1000	2000	3000	-	-	-	-	-	dw	0.476	0.483	0.407	0.214	-	-	-	-	-
Roberson and Schaible 1960	0	50	1000	1500	-	-	-	-	-	dw	0.491	0.5	0.47	0.402	-	-	-	-	-
Roberson and Schaible 1960	0	1000	1500	-	-	-	-	-	-	dw	0.491	0.49	0.39	-	-	-	-	-	-
Roberson and Schaible 1960	0	1000	1500	-	-	-	-	-	-	dw	0.491	0.497	0.455	-	-	-	-	-	-
Sandoval et al. 1988	62	1060	-	-	-	-	-	-	-	dw	0.0391	0.0261	-	-	-	-	-	-	-
Sandoval et al. 1988	62	1060	-	-	-	-	-	-	-	dw	0.0391	0.0195	-	-	-	-	-	-	-
Stahl et al. 1989	37	103	2180	-	-	-	-	-	-	dw	0.123	0.131	0.06	-	-	-	-	-	-
Vohra and Kratzer 1968	0	4000	5950	8000	10000	-	-	-	-	dw	0.407	0.325	0.258	0.167	0.15	-	-	-	-
Reproduction																			
Gibson et al. 1986	34	1030	2030	3030	4030	5030	-	-	-	dw	6.4	5.8	2.6	0.6	0.5	0.3	-	-	-
Gibson et al. 1986	34	1030	2030	3030	4030	5030	-	-	-	dw	6.4	6.2	4.6	1.9	0.5	0.4	-	-	-
Jackson et al. 1986	56	4060	8060	12100	16100	20100	-	-	-	dw	6	0.6	0	0	0	-	-	-	-
Jackson et al. 1986	56	1060	2060	3060	4060	5060	6060	-	-	dw	21.7	21.6	15.9	6.1	2.3	1.7	-	-	-
Jensen and Maurice 1980	50	150	550	2050	-	-	-	-	-	dw	82	72	79	53	-	-	-	-	-
Jensen and Maurice 1980	50	2050	-	-	-	-	-	-	-	dw	61	35	-	-	-	-	-	-	-
Stepinska et al. 1987	45	20000	-	-	-	-	-	-	-	dw	59	3.7	-	-	-	-	-	-	-
Stevenson et al. 1987	86	586	836	1090	1340	1590	2090	3090	4090	dw	111	114	115	103	101	92.5	75.5	24	10
Survival																			
Blalock and Hill 1988	50	1050	2050	5050	-	-	-	-	-	dw	100	100	80	60	-	-	-	-	-
Dewar et al. 1983	74	2070	4070	6070	-	-	-	-	-	dw	95.5	100	90.9	59.1	-	-	-	-	-
Dewar et al. 1983	74	1070	2070	4070	-	-	-	-	-	dw	0.975	0.925	1	0.775	-	-	-	-	-
Gasaway and Buss 1972	250	3250	6250	9250	12300	-	-	-	-	dw	100	33	0	0	0	-	-	-	-
Gibson et al. 1986	34	1030	2030	3030	4030	5030	-	-	-	dw	100	100	100	100	100	42.9	-	-	-
Hamilton et al. 1979	25	87.5	150	275	525	1030	2030	-	-	dw	90	90	100	90	78	80	40	-	-
Roberson and Schaible 1960	0	1000	2000	3000	-	-	-	-	-	dw	96.7	100	96.7	76.7	-	-	-	-	-

Table B-10. Zn TRV Data for Birds

	Effect (continued)	Effect Relative to Control (%)								
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8
Growth										
Gasaway and Buss 1972	average percent of original weight at day 40	100	75	65	51	57	-	-	-	-
Hamilton et al. 1981	body weight at 14 days (kg)	100	98	89	-	-	-	-	-	-
Hamilton et al. 1981	body weight at 14 days (kg)	100	82	-	-	-	-	-	-	-
Hill 1974a	average body weight gain (kg)	100	97	95	98	92	76	-	-	-
Lu and Combs 1988	average weight gain/chick (g)	100	54	-	-	-	-	-	-	-
Lu et al. 1990	% body weight gain	100	70	-	-	-	-	-	-	-
Roberson and Schaible 1960	average final body weight (kg)	100	103	93	71	-	-	-	-	-
Roberson and Schaible 1960	average final body weight (kg)	100	97	88	59	-	-	-	-	-
Roberson and Schaible 1960	average final body weight (kg)	100	101	86	45	-	-	-	-	-
Roberson and Schaible 1960	average final body weight (kg)	100	102	96	82	-	-	-	-	-
Roberson and Schaible 1960	average final body weight (kg)	100	100	79	-	-	-	-	-	-
Roberson and Schaible 1960	average final body weight (kg)	100	101	93	-	-	-	-	-	-
Sandoval et al. 1988	average daily body weight gain (kg)	100	67	-	-	-	-	-	-	-
Sandoval et al. 1988	average daily body weight gain (kg)	100	50	-	-	-	-	-	-	-
Stahl et al. 1989	weight gain (kg)	100	107	49	-	-	-	-	-	-
Vohra and Kratzer 1968	average weight gain (kg), Experiment 2 (no EDTA supplement)	100	80	63	41	37	-	-	-	-
Reproduction										
Gibson et al. 1986	egg production (#)	100	91	41	9	8	5	-	-	-
Gibson et al. 1986	egg production (#)	100	97	72	30	8	6	-	-	-
Jackson et al. 1986	egg production (#) at 3 weeks	100	10	0	0	0	-	-	-	-
Jackson et al. 1986	egg production (#) at 20 weeks	100	100	73	28	11	8	-	-	-
Jensen and Maurice 1980	egg production % (Exp. 4)	100	88	96	65	-	-	-	-	-
Jensen and Maurice 1980	egg production % (Exp. 3)	100	57	-	-	-	-	-	-	-
Stepinska et al. 1987	egg production (%)	100	6	-	-	-	-	-	-	-
Stevenson et al. 1987	egg number (140 days)	100	103	104	93	91	84	68	22	9
Survival										
Blalock and Hill 1988	Cumulative survival (%)	100	100	80	60	-	-	-	-	-
Dewar et al. 1983	% survival at 6 weeks	100	105	95	62	-	-	-	-	-
Dewar et al. 1983	% survival at 4 weeks	100	95	103	79	-	-	-	-	-
Gasaway and Buss 1972	% survival at 60 days	100	33	0	0	0	-	-	-	-
Gibson et al. 1986	% survival	100	100	100	100	100	43	-	-	-
Hamilton et al. 1979	% survival at 2 weeks	100	100	111	100	87	89	44	-	-
Roberson and Schaible 1960	% survival	100	103	100	79	-	-	-	-	-

Notes:

Concentrations in food were assumed to be reported on a dry weight basis unless clearly stated otherwise in the study. The wet or dry weight basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.

[a] LOAEL determined by study based on statistical analyses.

[b] If reported, the basal diet concentration is included in the control diet concentration.

Table B-11. Zinc TRV Data for Mammals

Source	Reported LOAEL[a]	LOAEL ≥ 20	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Barone et al. 1998	93	NA	not specified	rat	adult (200-250 g)	body weight	FD	Day 11 of gestation to day before expected delivery	3.01	92.8	-	-	-	-	calculated from BW and FIR
Brink et al. 1959	no stats	242	not specified	pig	weanling	body weight (Exp. 1)	FD	6.0	0	35	60.5	121	242	484	calculated from BW and FIR
Brink et al. 1959	no stats	312	not specified	pig	weanling	body weight (Exp. 2)	FD	5.0	3.62	42.2	80.8	158	312	0	calculated from BW and FIR
Brink et al. 1959	no stats	195	not specified	pig	weanling	body weight (Exp. 3)	FD	6.0	2.25	195	-	-	-	-	calculated from BW and FIR
Hill et al. 1983	47	47	zinc oxide	pig	30 kg BW	body weight	FD	from 30 kg body weight to 18 months old	0	0.475	4.75	47.5	-	-	calculated from BW and FIR
Hsu et al. 1975	no stats	NA	zinc oxide	pig	4 weeks	body weight	FD	9-13	3.43	175	-	-	-	-	calculated from BW and FIR
Khan et al. 2007	7.2	7.2	zinc chloride	rat	adult	male body weight	GV	14.0	0	3.6	7.2	14.4	-	-	doses presented in paper
Maita et al. 1981	19400	19400	zinc sulfate	mouse	5 weeks	body weight (female)	FD	13.0	0	194	1940	19400	-	-	doses presented in paper
Maita et al. 1981	18549	NA	zinc sulfate	mouse	5 weeks	body weight (male)	FD	13.0	0	185	1850	18500	-	-	doses presented in paper
Maita et al. 1981	9477	NA	zinc sulfate	rat	5 weeks	body weight (male)	FD	13.0	0	94.8	948	9480	-	-	doses presented in paper
Nakamura et al. 1983	9.7	NA	zinc acetate	rat	not reported (148 g)	body weight	FD	11.0	0	9.72	-	-	-	-	calculated from BW and FIR
Petterson et al. 2002	no stats	NA	zinc chloride	mouse	4.5 weeks	body weight	FD	3.0	0	1060	2130	-	-	-	calculated from BW and FIR
Settlemire and Matrone 1967	917	917	zinc carbonate	rat	4-6 weeks	body weight gain	FD	5.0	0	917	-	-	-	-	calculated from BW and FIR
Subramanian et al. 2000	33	NA	zinc oxide	rat	adult	body weight	FD	6.0	0.000739	4.16	33.3	-	-	-	calculated from BW and FIR
Reproduction															
Barone et al. 1998	75	NA	not specified	rat	adult	litter size	FD	gestation	2.42	74.7	-	-	-	-	calculated from BW and FIR
Chu and Cox 1972	380	380	not specified	rat	adult	offspring growth	FD	3.0	0	380	-	-	-	-	calculated from BW and FIR
Cox et al. 1969	375	NA	zinc oxide	rat	adult	fetal growth	FD	3.1	0.842	375	-	-	-	-	calculated from BW and FIR
Ketcheson et al. 1969	355	355	zinc oxide	rat	adult	offspring growth	FD	gestation to 14 days lactation	0.638	143	355	-	-	-	calculated from BW and FIR
Khan et al. 2007	14.4	14	zinc chloride	rat	adult (female)	offspring survival	GV	20.0	0	3.6	7.2	14.4	-	-	doses presented in paper
Kumar 1976	14	NA	zinc sulfate	rat	100 days	fetal survival	FD	2.6	2.4	14.4	-	-	-	-	calculated from BW and FIR
Newman et al. 2002	no stats	232	zinc acetate dihydrate	rat	adult	offspring survival	FD	gestational day 5 to post-natal day 40	0	232	-	-	-	-	calculated from BW and FIR
Pal and Pal 1987	no stats	417	zinc sulfate	rat	120-130 days	normal fetuses	FD	2.6	1.25	417	-	-	-	-	calculated from BW and FIR
Schlicker and Cox 1968	no stats	404	zinc oxide	rat	adult	fetal survival	FD	2.1	0	404	-	-	-	-	calculated from BW and FIR
Schlicker and Cox 1968	404	404	zinc oxide	rat	adult	fetal growth	FD	2.1	0	404	-	-	-	-	calculated from BW and FIR
Schlicker and Cox 1968	404	404	zinc oxide	rat	adult	fetal growth	FD	2.6	0	404	-	-	-	-	calculated from BW and FIR
Schlicker and Cox 1968	no stats	404	zinc oxide	rat	adult	fetal survival	FD	5.1	0	404	-	-	-	-	doses presented in paper
Survival															
Brink et al. 1959	no stats	121	zinc carbonate	pig	6	survival (Exp. 1)	FD	2 years	0	30.3	60.6	121	242	485	calculated from BW and FIR
Brink et al. 1959	no stats	313	zinc carbonate	pig	5	survival (Exp. 2)	FD	2 years	3.62	42.2	80.9	158	313	-	calculated from BW and FIR
Brink et al. 1959	no stats	195	zinc carbonate	pig	6	survival (Exp. 3)	FD	2 years	2.26	195	-	-	-	-	calculated from BW and FIR
Straube et al. 1980	no stats	858	zinc oxide	ferret	2-24	survival	FD	2 years	7.65	149	433	858	-	-	calculated from BW and FIR

Table B-11. Zinc TRV Data for Mammals

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source	Wet or Dry Weight
Growth															
Barone et al. 1998	0.225	0.225	-	-	-	-	present study	0.0209	0.0209	-	-	-	-	USEPA 1988	dw
Brink et al. 1959	28.1	28.1	32.6	32.6	32.6	32.6	present study	1.97	1.97	1.97	1.97	1.97	1.97	present study	NA
Brink et al. 1959	23.7	23.7	23.7	23.7	23.7	-	present study	1.83	1.83	1.83	1.83	1.83	0	present study	NA
Brink et al. 1959	30.5	30.5	-	-	-	-	present study	1.46	1.47	-	-	-	-	present study	NA
Hill et al. 1983	141	141	141	141	-	-	present study	1.34	1.34	1.34	1.34	-	-	Nagy 2001	dw
Hsu et al. 1975	29.7	29.7	-	-	-	-	present study	1.28	1.28	-	-	-	-	present study	NA
Khan et al. 2007	-	-	-	-	-	-	NA (dose provided in paper)	-	-	-	-	-	-	NA (dose provided in paper)	NA
Maita et al. 1981	0.033	0.033	0.033	0.033	-	-	present study	0.00587	0.00587	0.00587	0.00587	-	-	USEPA 1988	dw
Maita et al. 1981	0.0375	0.0375	0.0375	0.0375	-	-	present study	0.00639	0.00639	0.00639	0.00639	-	-	USEPA 1988	dw
Maita et al. 1981	0.29	0.29	0.29	0.29	-	-	present study	0.0247	0.0247	0.0247	0.0247	-	-	USEPA 1988	dw
Nakamura et al. 1983	0.165	0.165	-	-	-	-	present study	0.008	0.008	-	-	-	-	present study	dw
Petterson et al. 2002	0.0173	0.0173	0.0173	-	-	-	present study	0.00382	0.00382	0.00382	-	-	-	USEPA 1988	dw
Settlemire and Matrone 1967	0.1	0.1	-	-	-	-	USEPA 1988	0.0122	0.0122	-	-	-	-	USEPA 1988	dw
Subramanian et al. 2000	0.18	0.18	0.18	-	-	-	present study	0.015	0.015	0.015	-	-	-	present study	dw
Reproduction															
Barone et al. 1998	0.427	0.427	-	-	-	-	present study	0.0319	0.0319	-	-	-	-	USEPA 1988	dw
Chu and Cox 1972	0.21	0.21	-	-	-	-	USEPA 1988	0.02	0.02	-	-	-	-	USEPA 1988	dw
Cox et al. 1969	0.22	0.22	-	-	-	-	present study	0.0206	0.0206	-	-	-	-	USEPA 1988	dw
Ketcheson et al. 1969	0.277	0.277	0.277	-	-	-	present study	0.0197	0.0197	0.0197	0	-	-	present study	NA
Khan et al. 2007	-	-	-	-	-	-	NA (dose provided in paper)	-	-	-	-	-	-	NA (dose provided in paper)	NA
Kumar 1976	0.35	0.35	-	-	-	-	USEPA 1988	0.028	0.028	-	-	-	-	EPA 1988	dw
Newman et al. 2002	0.2	0.2	-	-	-	-	present study	0.012	0.012	-	-	-	-	present study	NA
Pal and Pal 1987	0.16	0.16	-	-	-	-	USEPA 1988	0.0167	0.0167	-	-	-	-	USEPA 1988	dw
Schlicker and Cox 1968	0.175	0.175	-	-	0	0	present study	0.0177	0.0177	-	-	-	-	USEPA 1988	dw
Schlicker and Cox 1968	0.175	0.175	-	-	-	-	present study	0.0177	0.0177	-	-	-	-	USEPA 1988	dw
Schlicker and Cox 1968	0.175	0.175	-	-	-	-	present study	0.0177	0.0177	-	-	-	-	USEPA 1988	dw
Schlicker and Cox 1968	0.175	0.175	-	-	-	-	present study	0.0177	0.0177	-	-	-	-	USEPA 1988	dw
Survival															
Brink et al. 1959	32.6	32.6	32.6	32.6	32.6	32.6	present study	1.97	1.97	1.97	1.97	1.97	1.97	present study	NA
Brink et al. 1959	23.7	23.7	23.7	23.7	23.7	-	present study	1.83	1.83	1.83	1.83	1.83	-	present study	NA
Brink et al. 1959	30.5	30.5	-	-	-	-	present study	1.47	1.47	-	-	-	-	present study	NA
Straube et al. 1980	0.6	0.6	0.6	0.6	-	-	present study	0.17	0.17	0.17	0.17	-	-	present study	NA

Table B-11. Zinc TRV Data for Mammals

	Concentration in Food (mg/kg)							Effect					
Source	Control[b]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth													
Barone et al. 1998	32.4	1000	-	-	-	-	dw	0.427	0.395	-	-	-	-
Brink et al. 1959	0	500	1000	2000	4000	8000	dw	85	86.3	86.3	74.6	61.9	43.9
Brink et al. 1959	46.9	547	1050	2050	4050	0	dw	74.6	75.8	77	74.8	49.6	-
Brink et al. 1959	46.9	4050	-	-	-	-	dw	93.6	71.3	-	-	-	-
Hill et al. 1983	0	50	500	5000	-	-	dw	193	181	190	144	-	-
Hsu et al. 1975	80	4080	-	-	-	-	dw	59.5	50.2	-	-	-	-
Khan et al. 2007	-	-	-	-	-	-	NA	223	179	165	161	-	-
Maita et al. 1981	0	122	1220	12200	-	-	dw	0.042	0.045	0.043	0.031	-	-
Maita et al. 1981	0	122	1220	12200	-	-	dw	0.047	0.047	0.044	0.038	-	-
Maita et al. 1981	0	122	1220	12200	-	-	dw	0.45	0.46	0.43	0.37	-	-
Nakamura et al. 1983	0	200	-	-	-	-	dw	0.196	0.184	-	-	-	-
Petterson et al. 2002	0	4800	9600	-	-	-	dw	20	-	17	-	-	-
Settlemire and Matrone 1967	0	7500	-	-	-	-	dw	0.172	0.074	-	-	-	-
Subramanian et al. 2000	0.00888	50	400	-	-	-	dw	0.22	0.218	0.198	-	-	-
Reproduction													
Barone et al. 1998	32.4	1000	-	-	-	-	dw	14.7	12.6	-	-	-	-
Chu and Cox 1972	0	4000	-	-	-	-	dw	0.0194	0.0102	-	-	-	-
Cox et al. 1969	9	4010	-	-	-	-	dw	0.546	0.439	-	-	-	-
Ketcheson et al. 1969	9	2010	5010	-	-	-	dw	8.89	9.47	7.09	-	-	-
Khan et al. 2007	-	-	-	-	-	-	NA	96.1	94.5	88.1	74.4	-	-
Kumar 1976	30	180	-	-	-	-	dw	2	9.5	-	-	-	-
Newman et al. 2002	0	3870	-	-	-	-	dw	100	0	-	-	-	-
Pal and Pal 1987	12	4000	-	-	-	-	dw	82	24	-	-	-	-
Schlicker and Cox 1968	0	4000	-	-	-	-	dw	0	29	-	-	-	-
Schlicker and Cox 1968	0	4000	-	-	-	-	dw	0.0212	0.0162	-	-	-	-
Schlicker and Cox 1968	0	4000	-	-	-	-	dw	0.132	0.0987	-	-	-	-
Schlicker and Cox 1968	0	4000	-	-	-	-	dw	0	100	-	-	-	-
Survival													
Brink et al. 1959	0	500	1000	2000	4000	8000	dw	100	100	100	67	50	83
Brink et al. 1959	46.9	547	1050	2050	4050	-	dw	100	100	100	100	75	-
Brink et al. 1959	46.9	4050	-	-	-	-	dw	100	62.5	-	-	-	-
Straube et al. 1980	27	527	1530	3030	-	-	ww	100	100	100	0	-	-

Table B-11. Zinc TRV Data for Mammals

	Effect (continued)	Effect Relative to Control (%)					
Source	Description	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth							
Barone et al. 1998	body weight of dams	100	92	-	-	-	-
Brink et al. 1959	final body weight (lbs) using initial and average daily gain	100	101	102	88	73	52
Brink et al. 1959	final body weight (lbs) using initial and average daily gain	100	102	103	100	67	-
Brink et al. 1959	average daily gain (kg)	100	76	-	-	-	-
Hill et al. 1983	average final (18 months) weight (kg)	100	94	98	75	-	-
Hsu et al. 1975	final body weight based on intial plus average weight gain/day (low Ca)	100	84	-	-	-	-
Khan et al. 2007	male body weight gain (g)	100	80	74	72	-	-
Maita et al. 1981	final weight (kg)	100	107	102	74	-	-
Maita et al. 1981	final weight (kg)	100	100	94	81	-	-
Maita et al. 1981	final weight (kg)	100	102	96	82	-	-
Nakamura et al. 1983	body weight at 11 weeks (kg)	100	94	-	-	-	-
Petterson et al. 2002	final body weight (g)	100	-	85	-	-	-
Settlemire and Matrone 1967	body weight gain (kg)	100	43	-	-	-	-
Subramanian et al. 2000	body weight (kg)	100	99	90	-	-	-
Reproduction							
Barone et al. 1998	litter size	100	86	-	-	-	-
Chu and Cox 1972	offspring body weight gain at 21 days (kg)	100	53	-	-	-	-
Cox et al. 1969	fetal bw at 22 days (g)	100	80	-	-	-	-
Ketcheson et al. 1969	14-day old body weight (dry weight) (g)	100	107	80	-	-	-
Khan et al. 2007	4-day survival index	100	98	92	77	-	-
Kumar 1976	% resorptions	100	92	-	-	-	-
Newman et al. 2002	% of pups surviving	100	0	-	-	-	-
Pal and Pal 1987	no. normal fetuses	100	29	-	-	-	-
Schlicker and Cox 1968	% resorption at 15 days	100	71	-	-	-	-
Schlicker and Cox 1968	fetal body weight at 15 days (g)	100	76	-	-	-	-
Schlicker and Cox 1968	fetal body weight at 18 days (g)	100	75	-	-	-	-
Schlicker and Cox 1968	% resorption at 15 + 16 days	100	0	-	-	-	-
Survival							
Brink et al. 1959	% survival	100	100	100	67	50	83
Brink et al. 1959	% survival	100	100	100	100	75	-
Brink et al. 1959	% survival	100	63	-	-	-	-
Straube et al. 1980	% survival	100	100	100	0	-	-

Notes:
selected to match the basis of the food concentration.
Lowest-observed-adverse-effect levels (LOAELs) are reported in mg/kg bw/day.
[a] LOAEL determined by study based on statistical analyses.
[b] If reported, the basal diet concentration is included in the control diet concentration.

APPENDIX B-2

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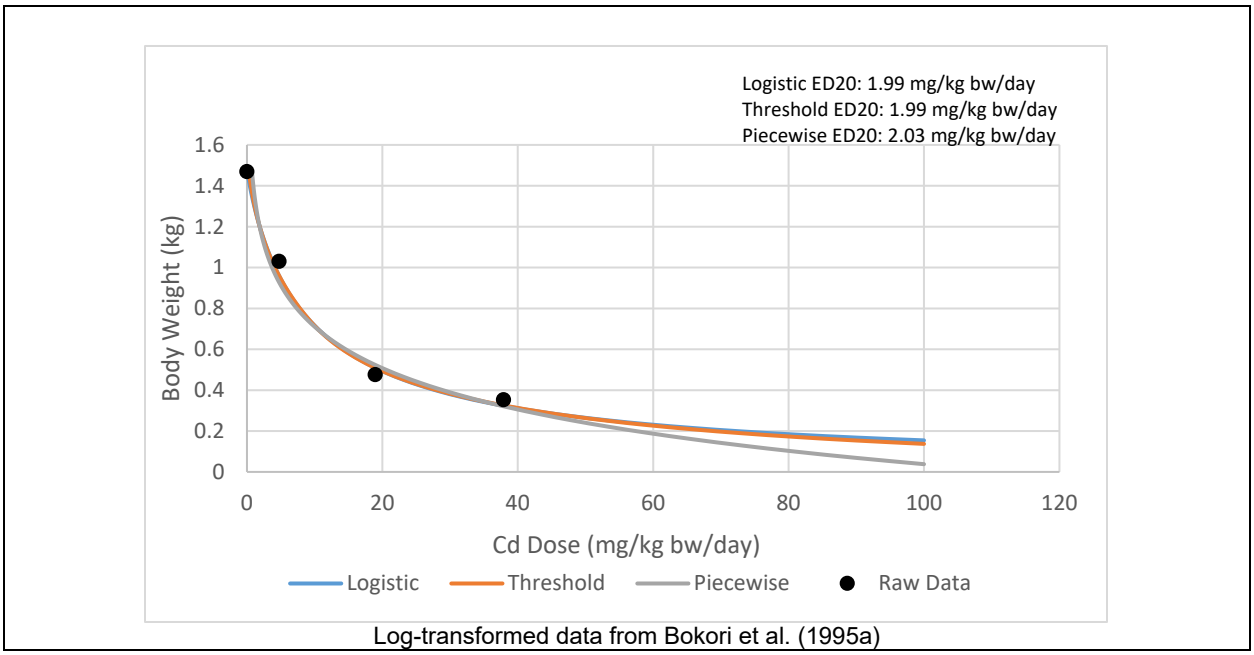
APPENDIX C

MODELED DOSE-RESPONSE CURVES

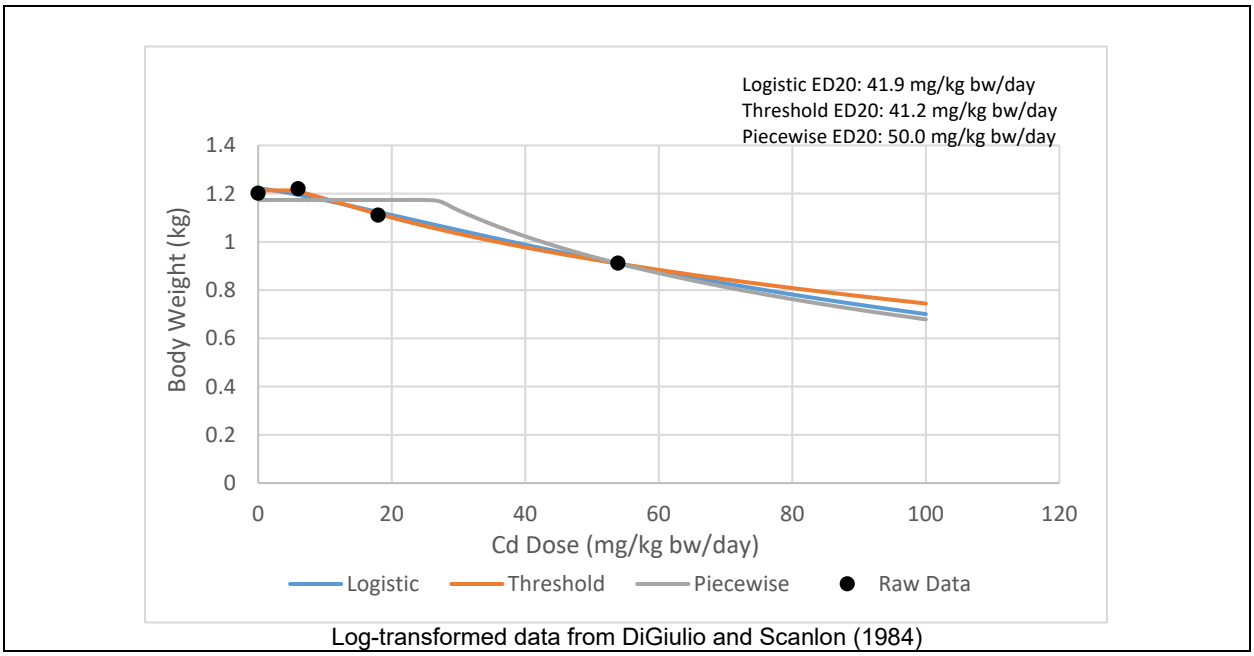
APPENDIX C-1

MODELED DOSE-RESPONSE CURVES FOR BIRD TRV DERIVATION



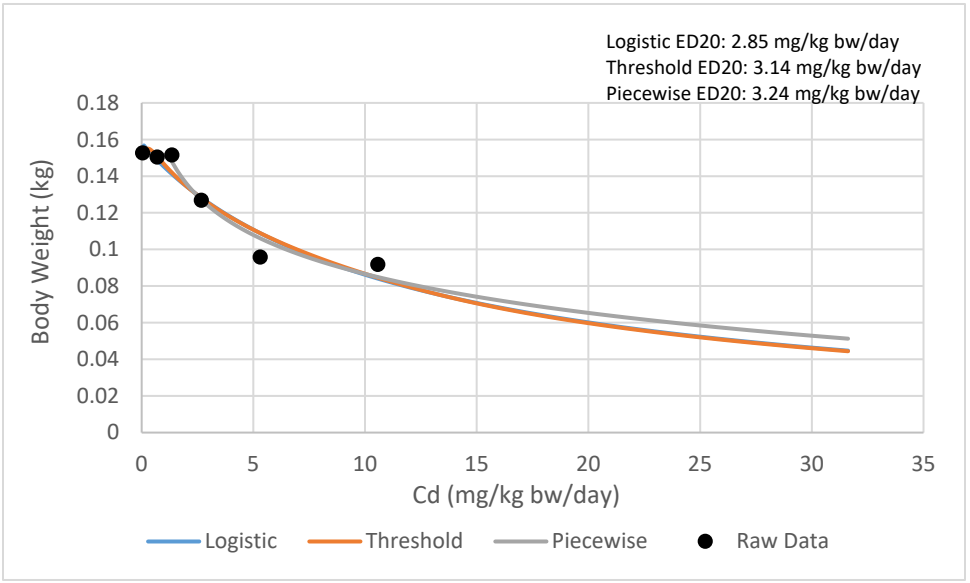
Log-transformed data from Bokori et al. (1995a)

Figure C-1. Dose-Response Curves for Avian Growth Endpoint for Cadmium



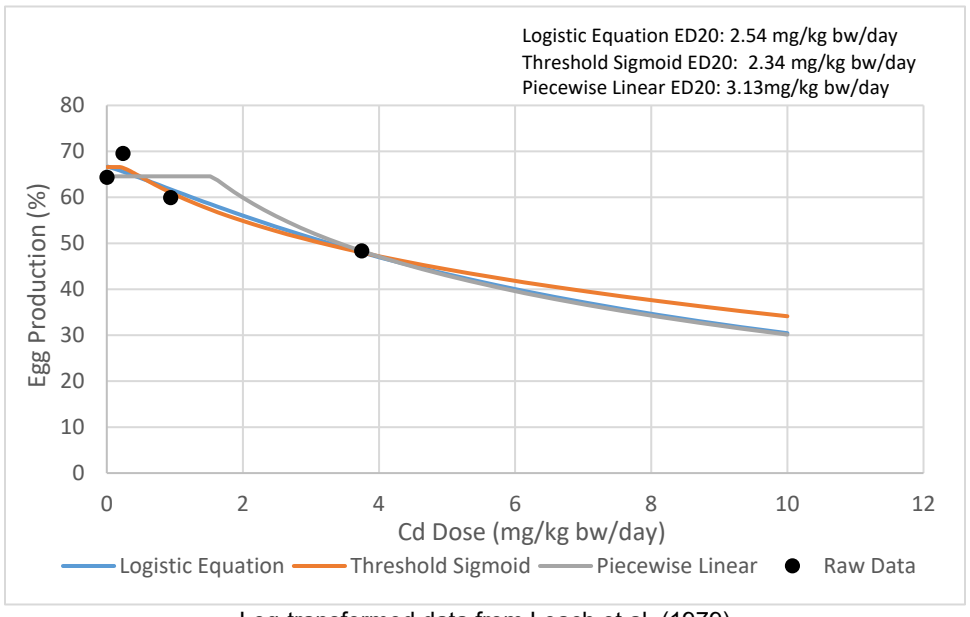
Log-transformed data from DiGiulio and Scanlon (1984)

Figure C-2. Dose-Response Curves for Avian Growth Endpoint for Cadmium



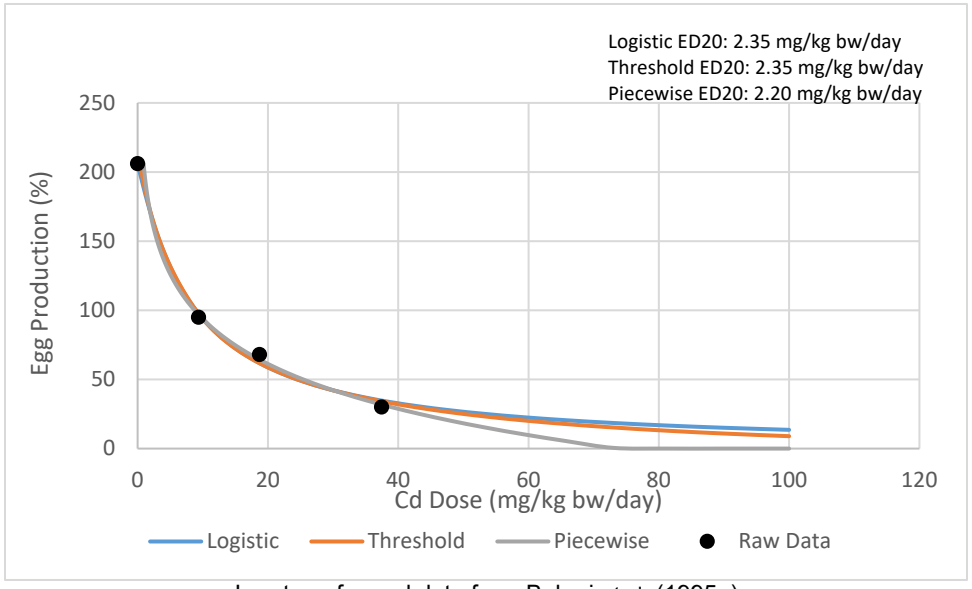
Log-transformed data from Olgun (2015)

Figure C-3. Dose-Response Curves for Avian Growth Endpoint for Cadmium



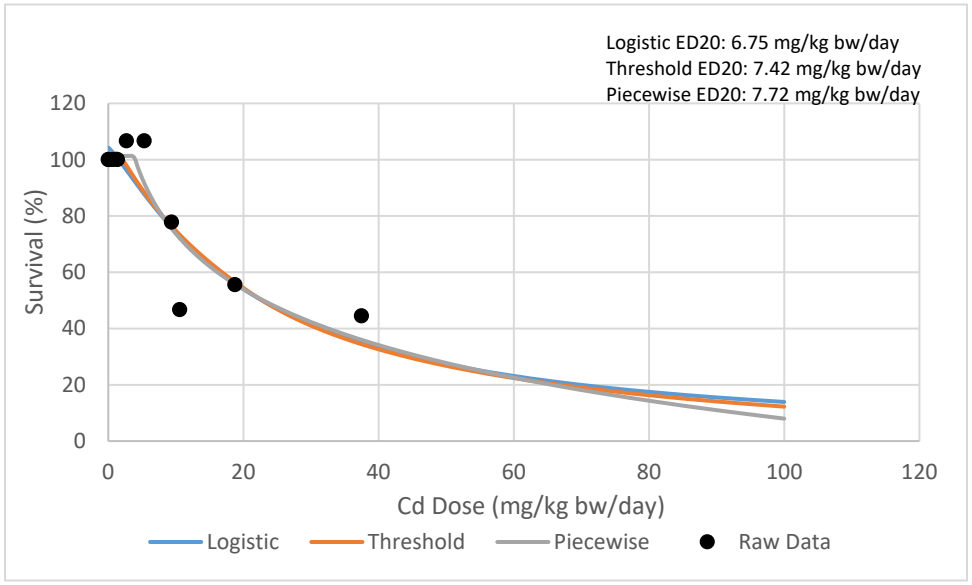
Log-transformed data from Leach et al. (1979)

Figure C-4. Dose-Response Curves for Avian Reproduction Endpoint for Cadmium



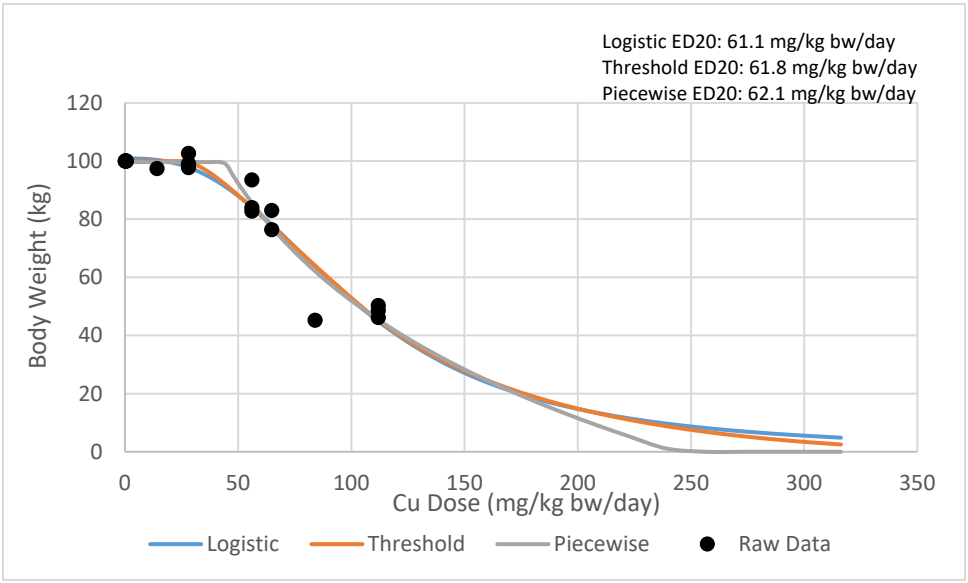
Log-transformed data from Bokori et al. (1995a)

Figure C-5. Dose-Response Curves for Avian Reproduction Endpoint for Cadmium



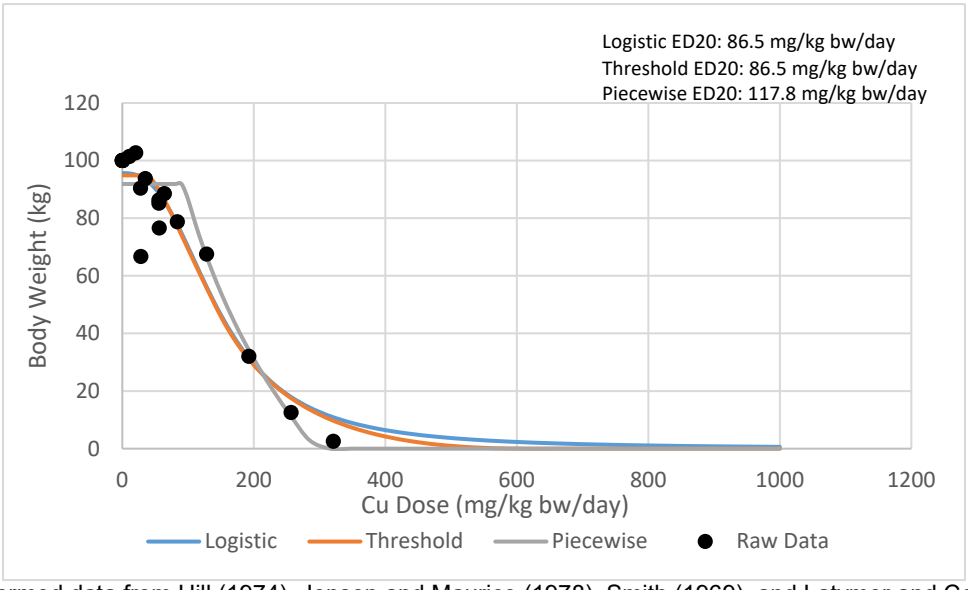
Log-transformed data from pooled group C: Bokori et al. (1995b) and Olgun (2015)

Figure C-6. Dose-Response Curves for Avian Survival Endpoint for Cadmium



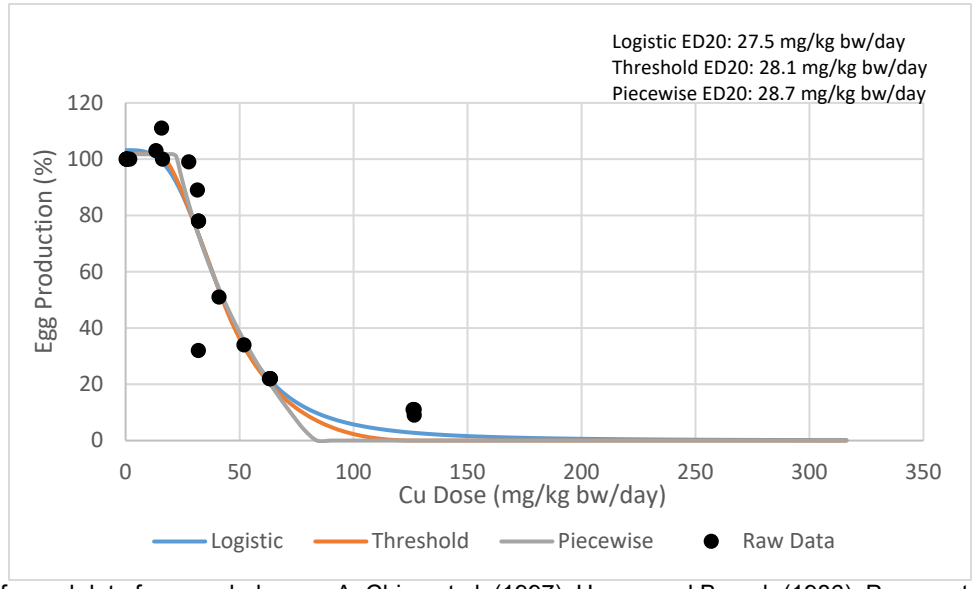
Log-transformed data from pooled group D: Poupoulis and Jensen (1976) and Wang et al. (1987)

Figure C-7. Dose-Response Curves for Avian Growth Endpoint for Copper



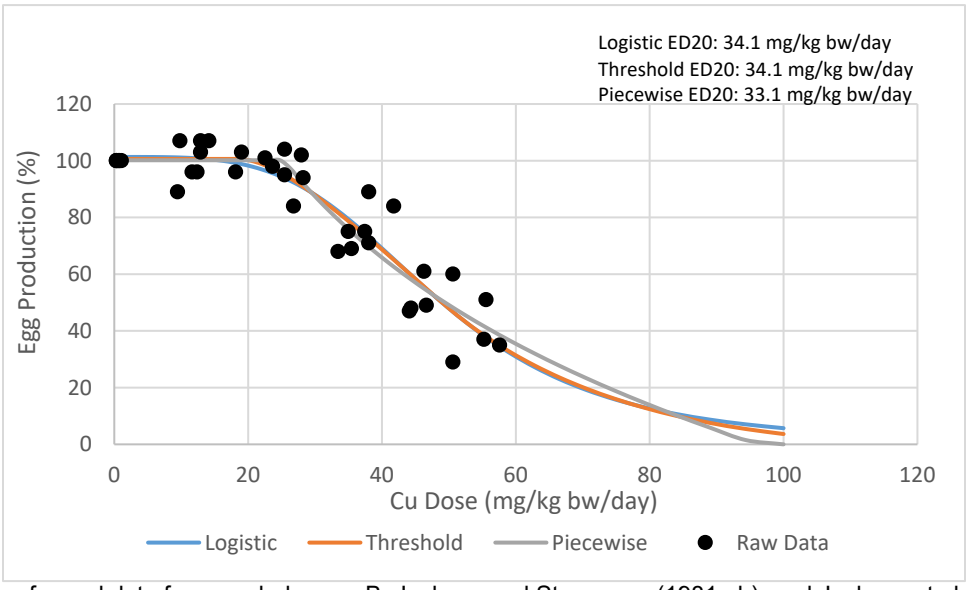
Log-transformed data from Hill (1974), Jensen and Maurice (1978), Smith (1969), and Latymer and Cotes (1981)

Figure C-8. Dose-Response Curves for Avian Growth Endpoint for Copper



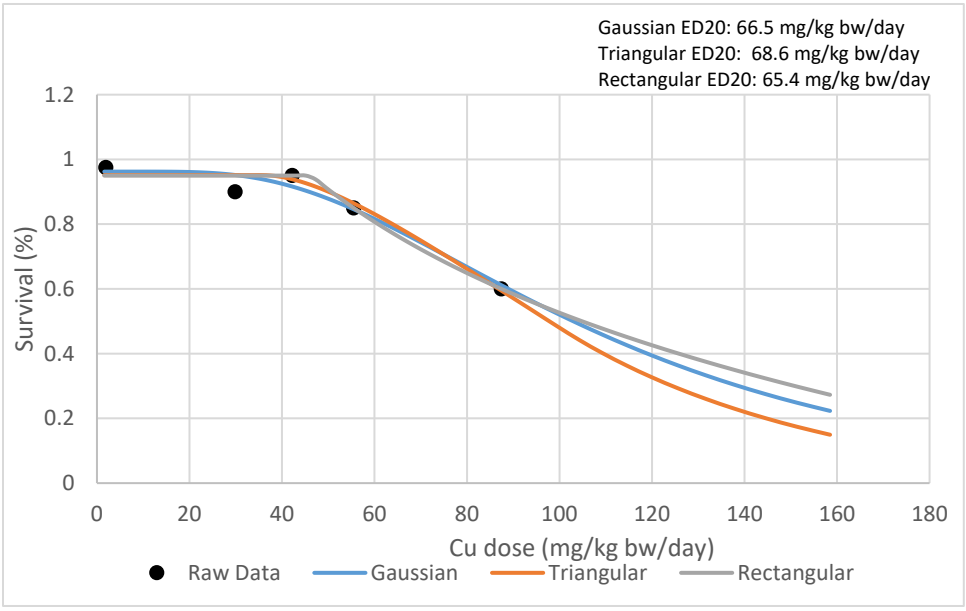
Log-transformed data from pooled group A: Chiou et al. (1997), Harms and Buresh (1986), Pearce et al. (1983), and Stevenson and Jackson (1980a, b)

Figure C-9. Dose-Response Curves for Avian Reproduction Endpoint for Copper



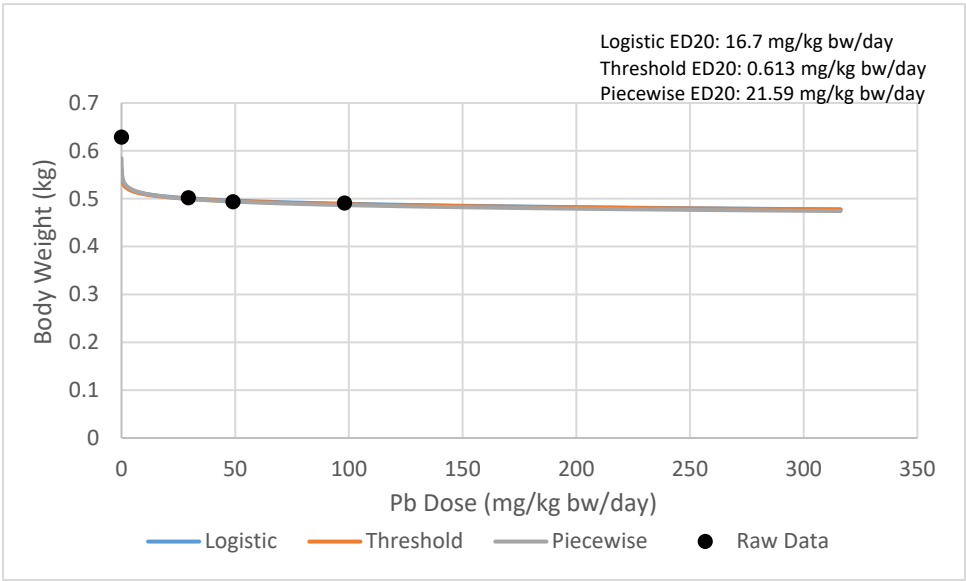
Log-transformed data from pooled group B: Jackson and Stevenson (1981a,b), and Jackson et al. (1979)

Figure C-10. Dose-Response Curves for Avian Reproduction Endpoint for Copper



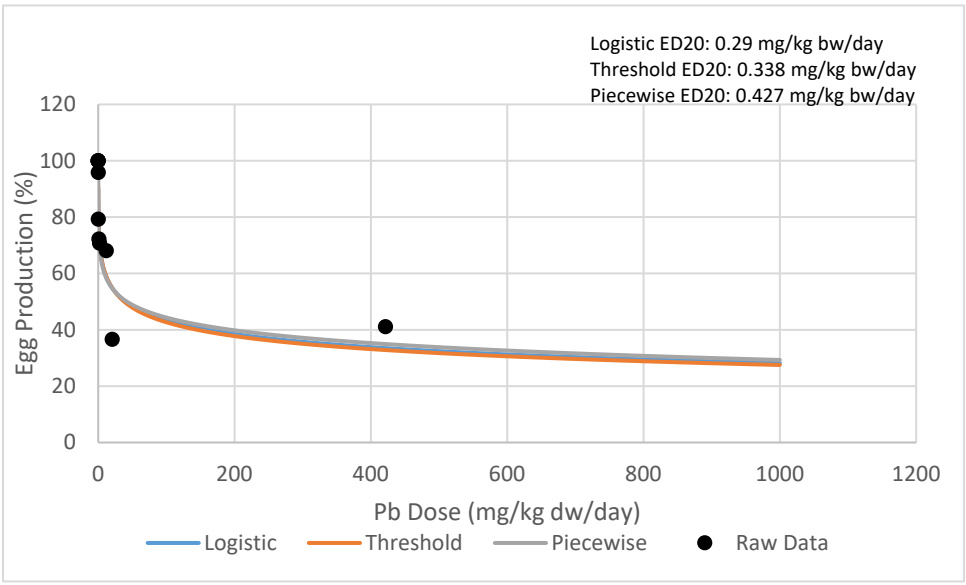
Log-transformed data from Mehring et al. (1960)

Figure C-11. Dose-Response Curves for Avian Survival Endpoint for Copper



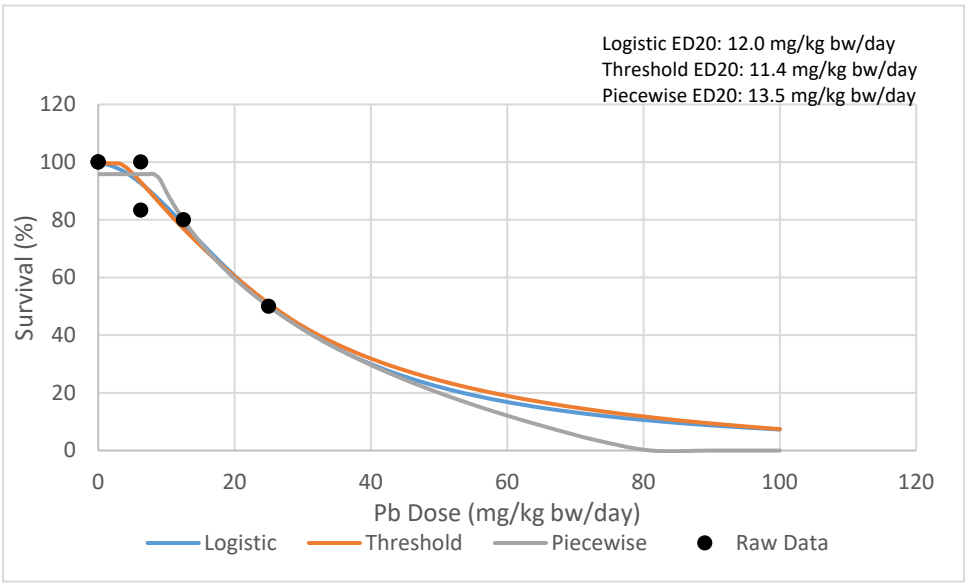
Log-transformed data from Abduljaleel and Shuhaimi-Othman (2013)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-12. Dose-Response Curves for Avian Growth Endpoint for Lead



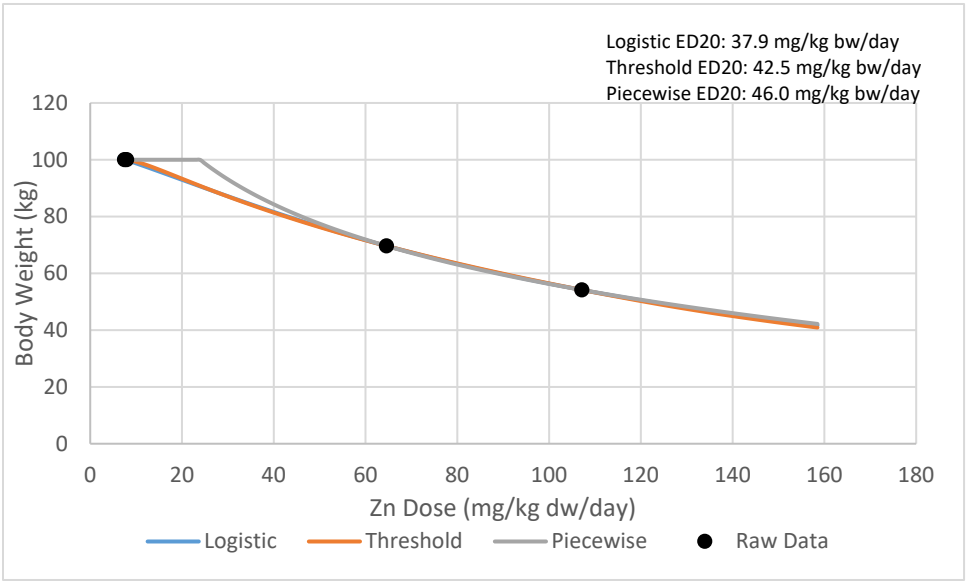
Log-transformed data from pooled group D: Edens and Garlich (1983), Stone and Soares (1976)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-13. Dose-Response Curves for Avian Reproduction Endpoint for Lead



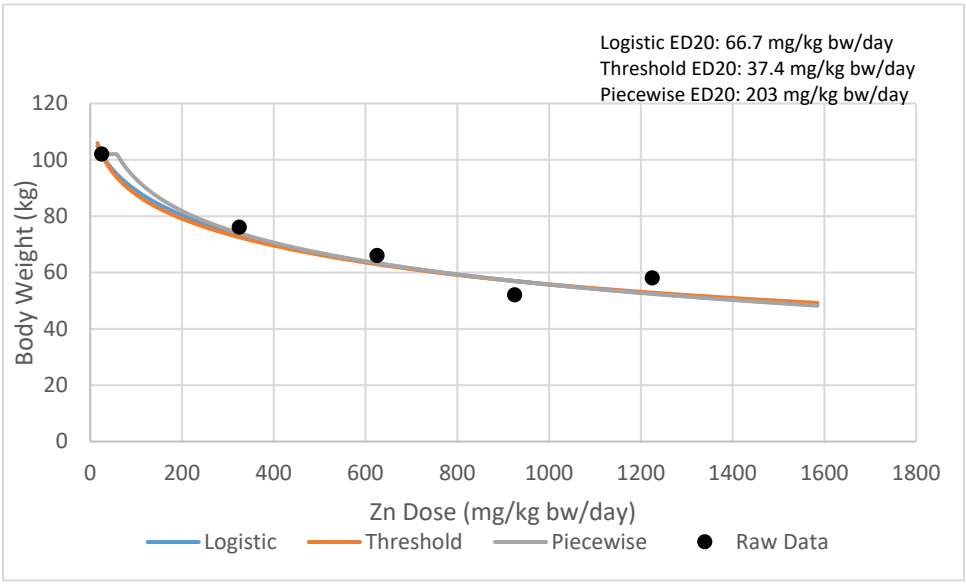
Log-transformed data from pooled group F: Barthalmus et al. (1977) and Anders et al. (1982)

Figure C-14. Dose-Response Curves for Avian Survival Endpoint for Lead



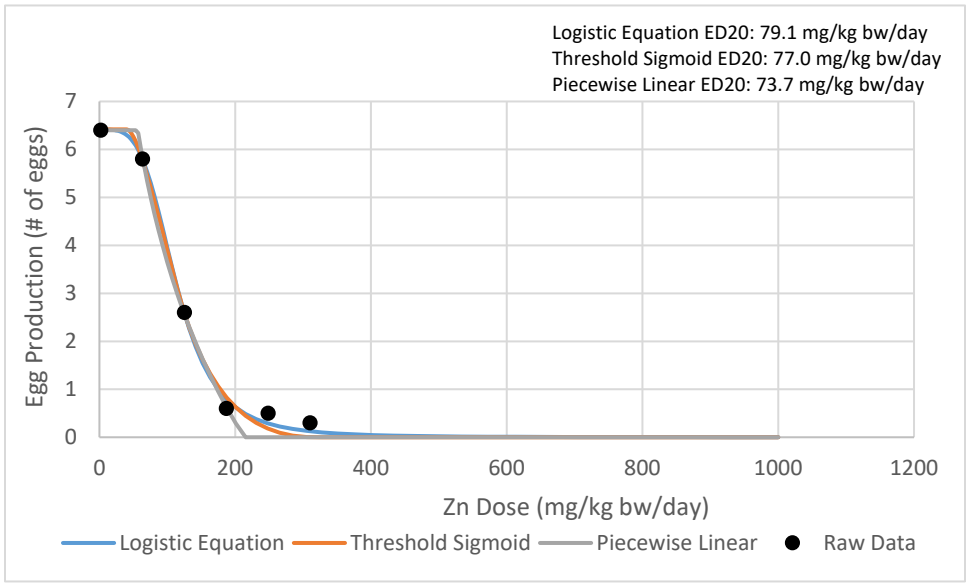
Log-transformed data from pooled group A: Lu and Combs (1988), Lu et al. (1990)

Figure C-15. Dose-Response Curves for Avian Growth Endpoint for Zinc



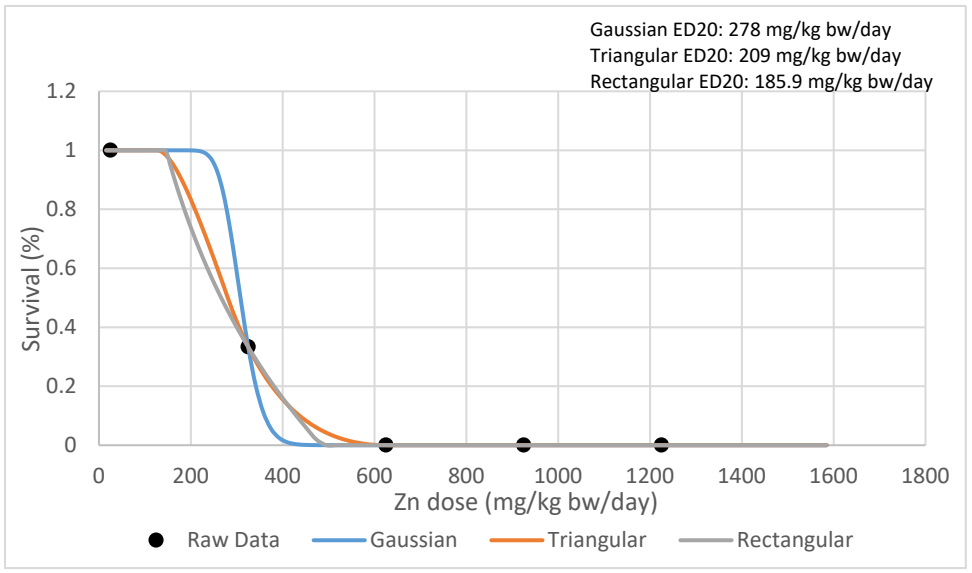
Log-transformed data from Gasaway and Buss (1972)

Figure C-16. Dose-Response Curves For Avian Growth Endpoint For Zinc



Log-transformed data from Gibson et al. (1986)

Figure C-17. Dose-Response Curves for Avian Reproduction Endpoint for Zinc

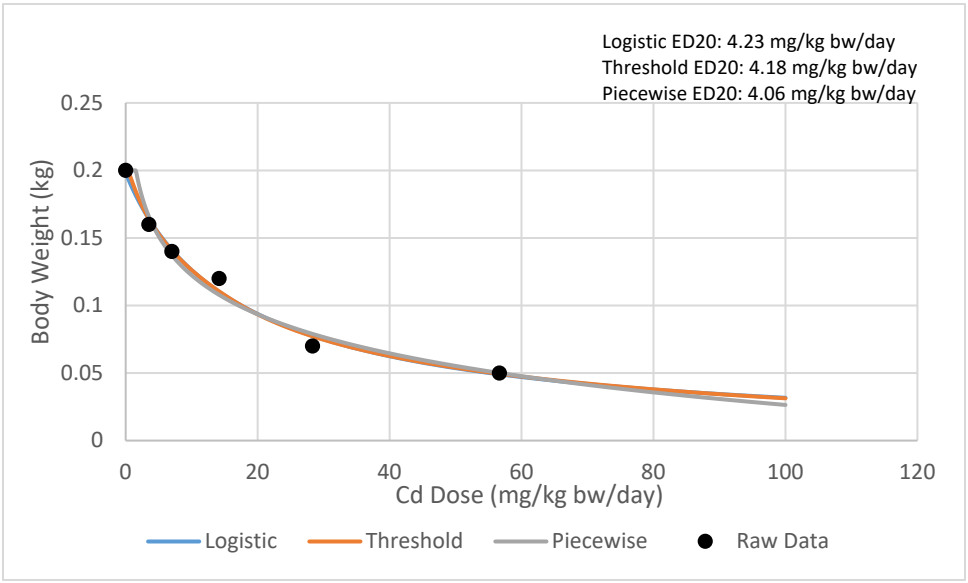


Log-transformed data from Gasaway and Buss (1972)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-18. Dose-Response Curves For Avian Survival Endpoint For Zinc

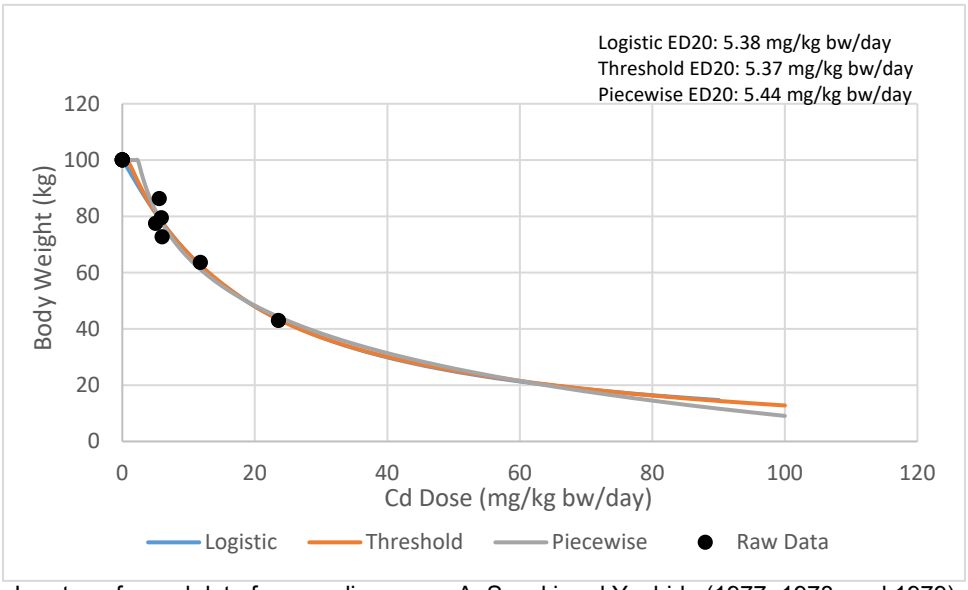
APPENDIX C -2

MODELED DOSE-RESPONSE CURVES FOR MAMMALIAN TRV DERIVATION



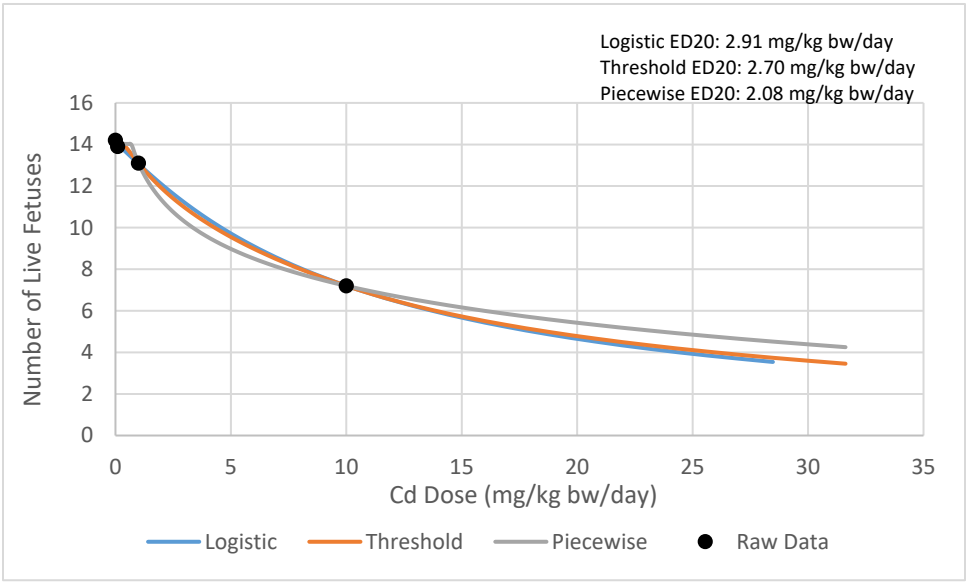
Log-transformed data from Wilson et al. (1941)

Figure C-19. Dose-Response Curves for Mammalian Growth Endpoint for Cadmium



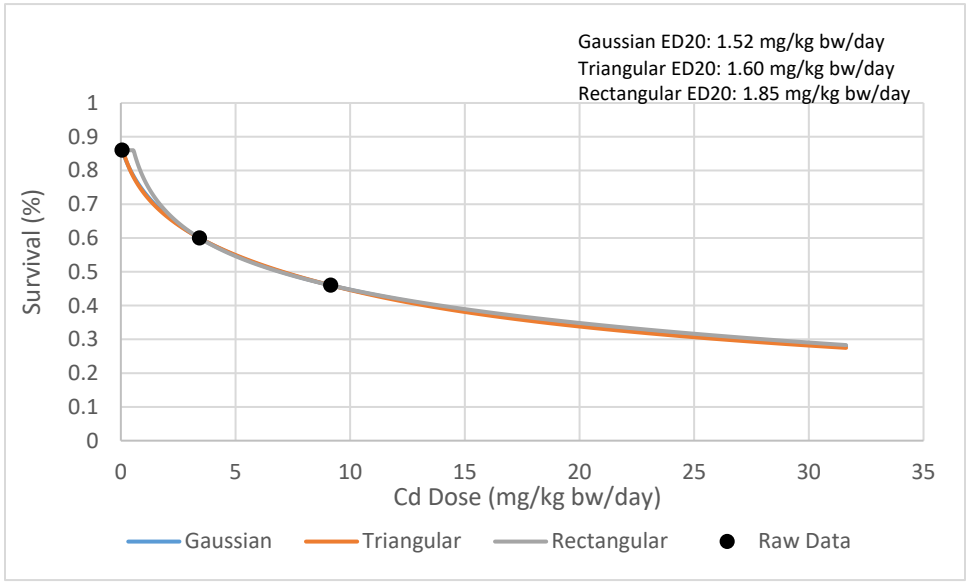
Log-transformed data from pooling group A: Suzuki and Yoshida (1977, 1978, and 1979)

Figure C-20. Dose-Response Curves for Mammalian Growth Endpoint for Cadmium



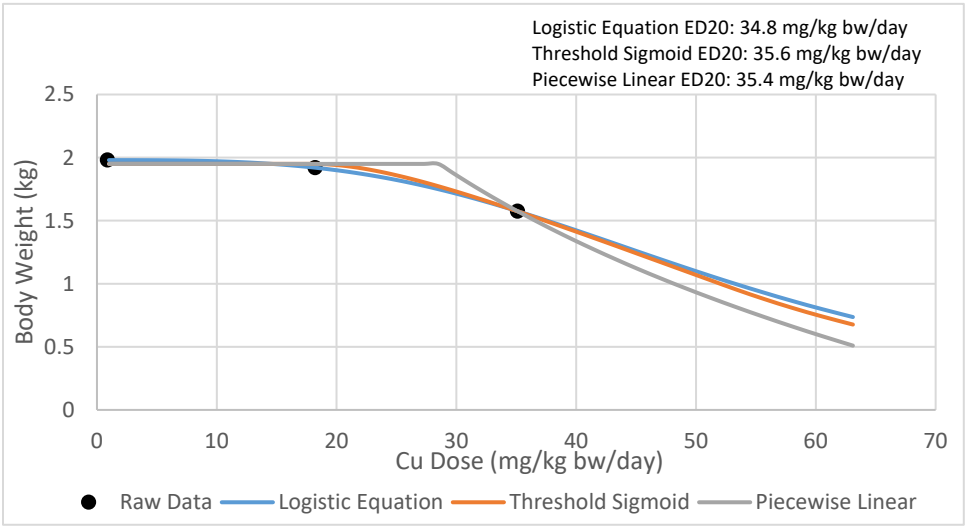
Log-transformed data from Sutou et al. (1980)

Figure C-21. Dose-Response Curves for Mammalian Reproduction Endpoint for Cadmium



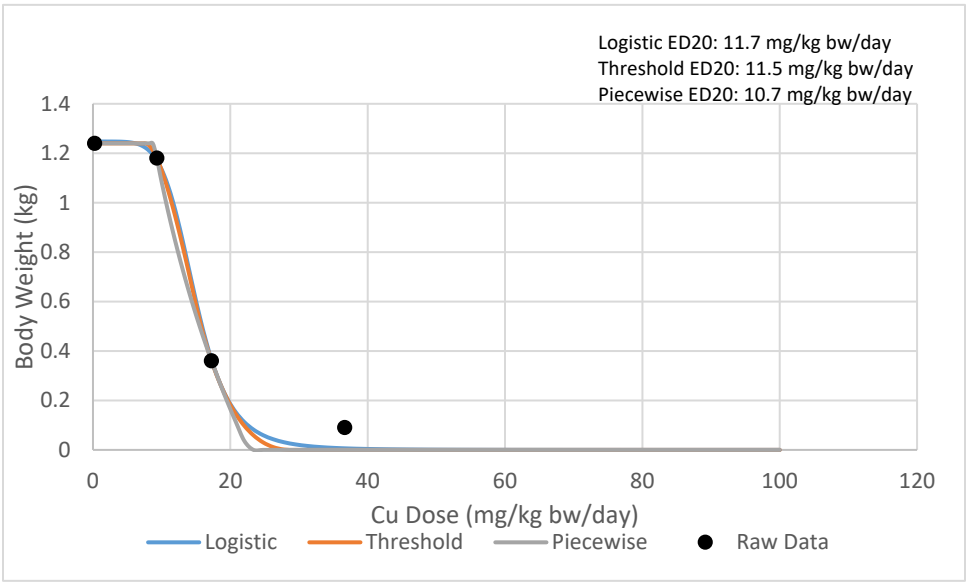
Log-transformed data from Swiergosz et al. (1998)

Figure C-22. Dose-Response Curves for Mammalian Survival Endpoint for Cadmium



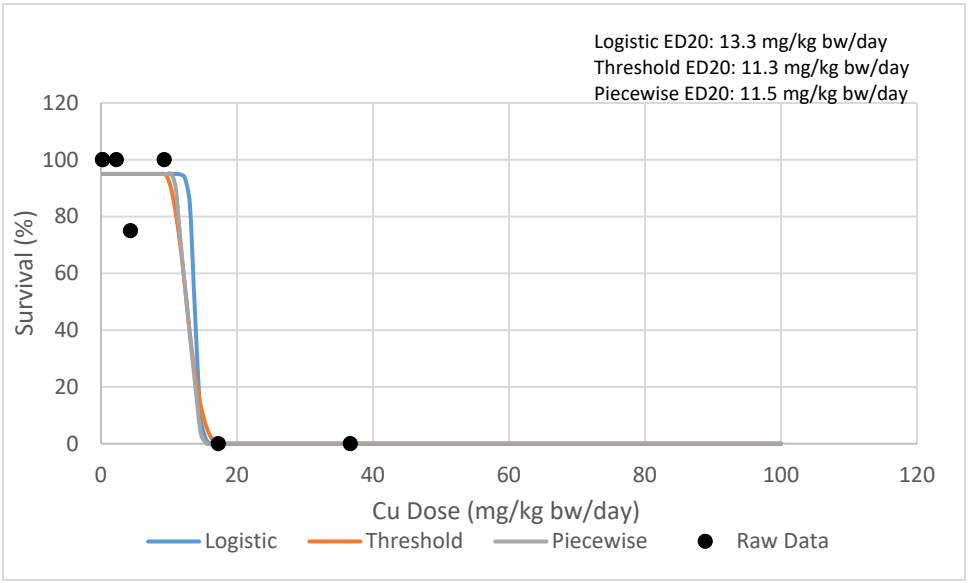
Log-transformed data from Brandt (1983)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-23. Dose-Response Curves for Mammalian Endpoint for Copper



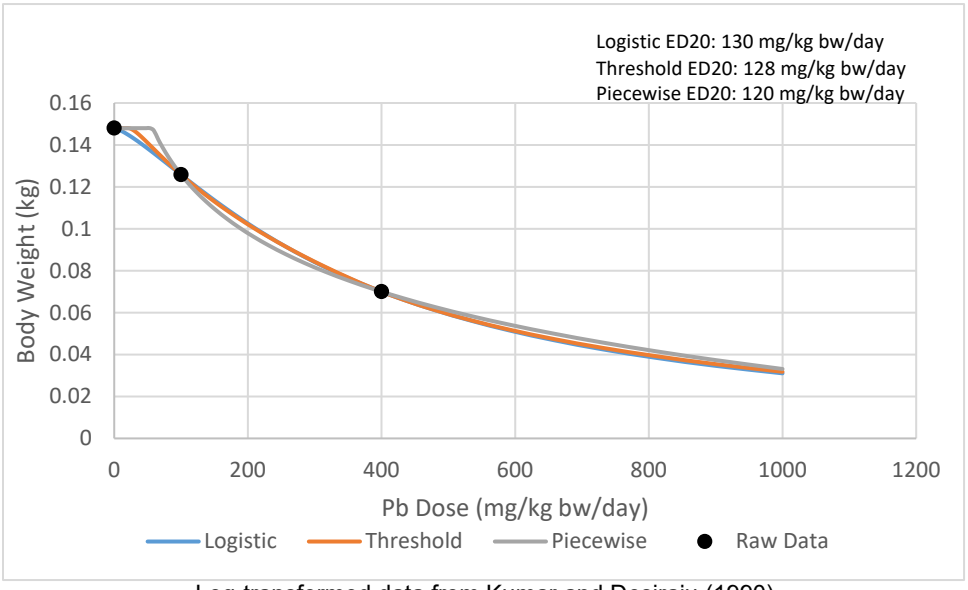
Log-transformed data from Allcroft et al. (1961)

Figure C-24. Dose-Response Curves for Mammalian Growth Endpoint for Copper



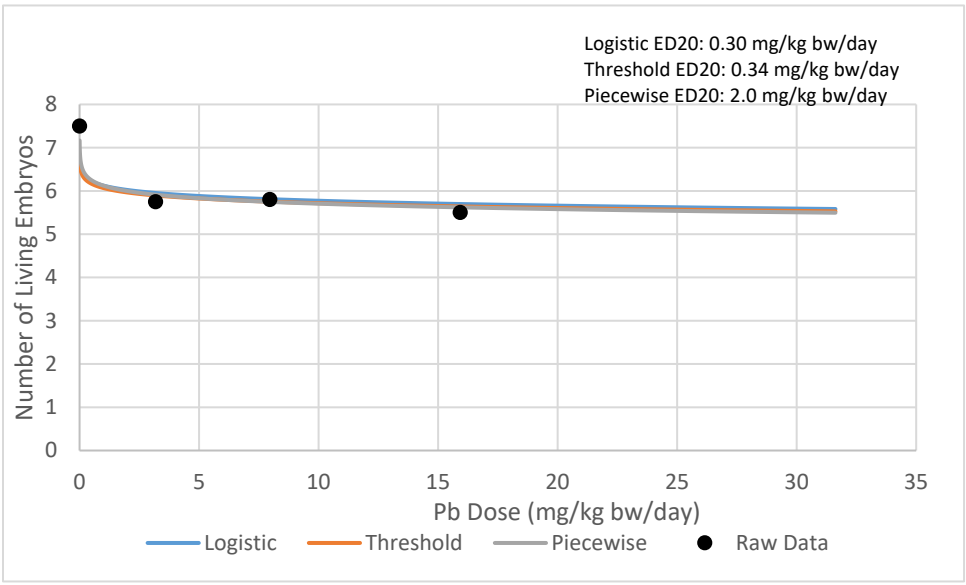
Log-transformed data from pooling group B: Allcroft et al. (1961) and Rtichie et al. (1963)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-25. Dose-Response Curves for Mammalian Survival Endpoint for Copper



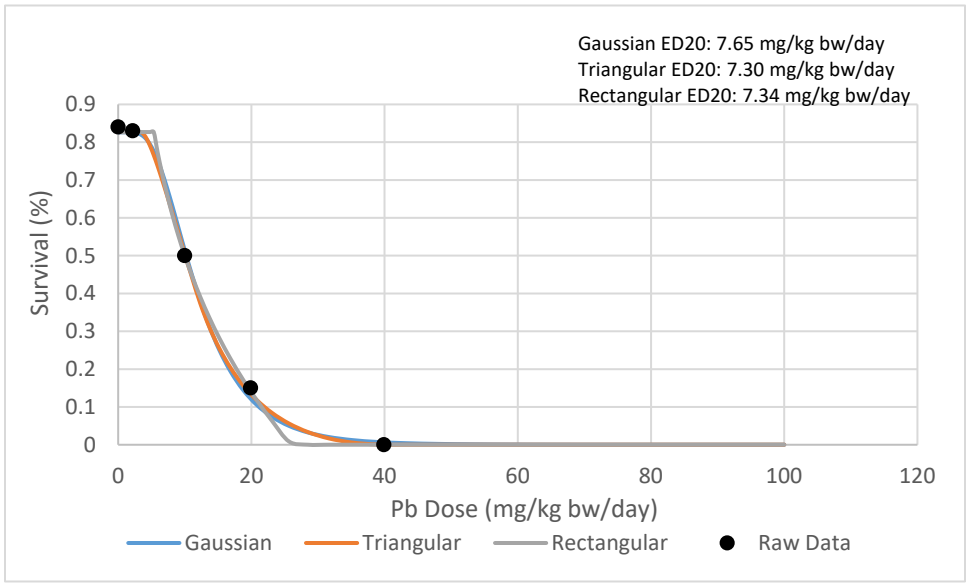
Log-transformed data from Kumar and Desiraju (1990)

Figure C-26. Dose-Response Curves for Mammalian Growth Endpoint for Lead



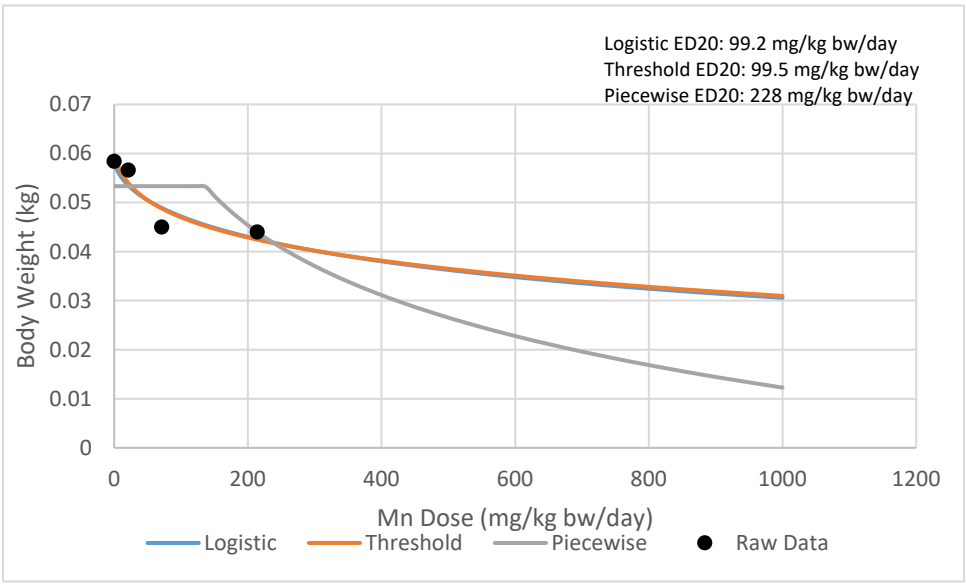
Log-transformed data from Gupta et al. (1995)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-27. Dose-Response Curves for Mammalian Reproduction Endpoint for Lead



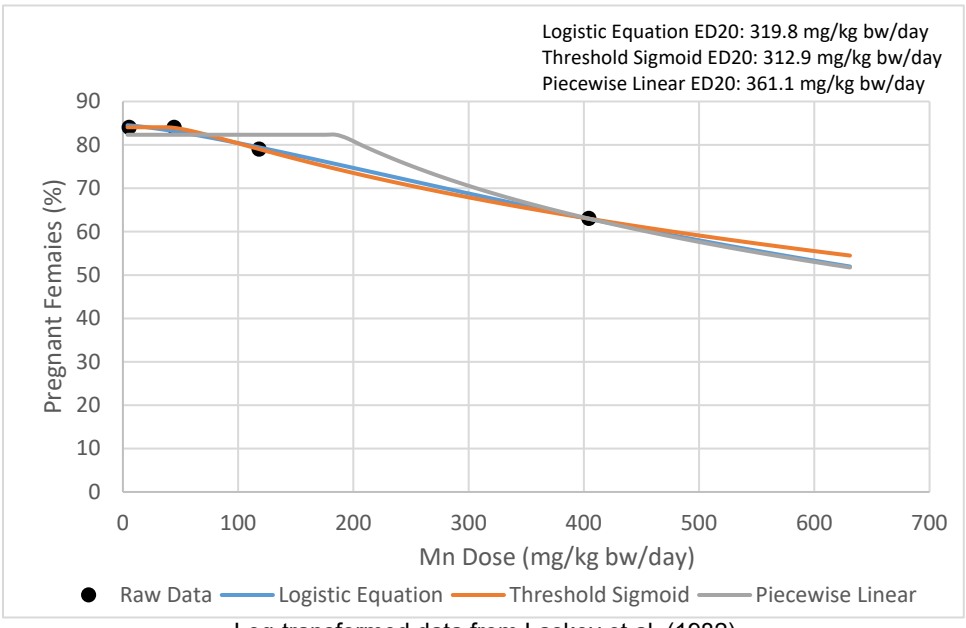
Log-transformed data from Lorenzo et al. (1978)

Figure C-28. Dose-Response Curves for Mammalian Survival Endpoint for Lead



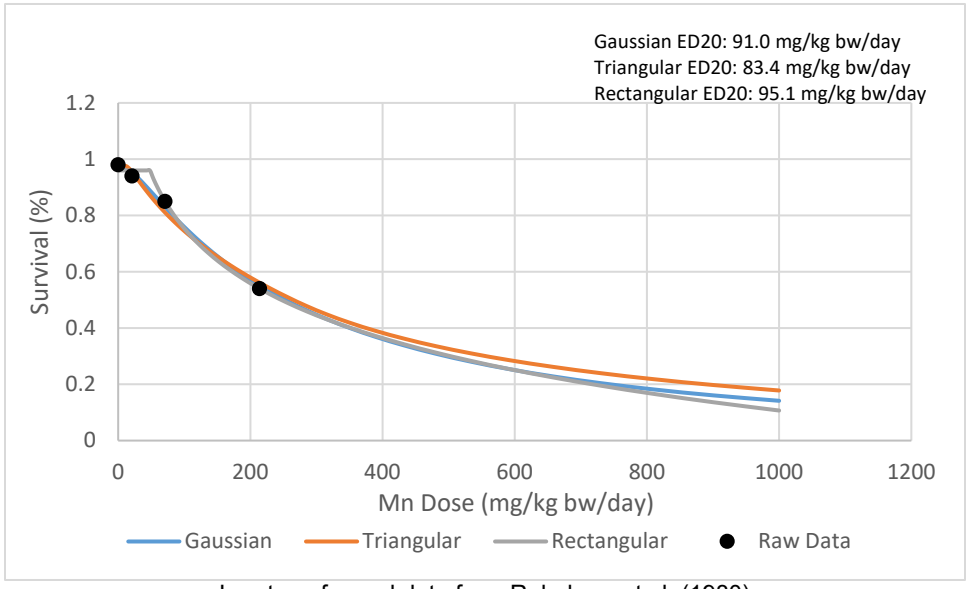
Log-transformed data from Rehnberg et al. (1980)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-29. Dose-Response Curves for Mammalian Growth Endpoint for Manganese



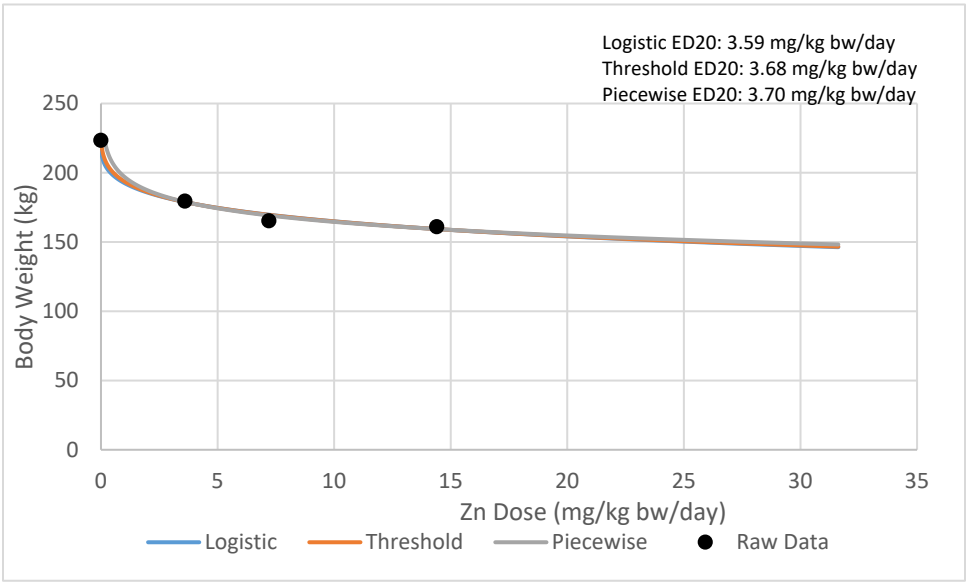
Log-transformed data from Laskey et al. (1982)

Figure C-30. Dose-Response Curves for Mammalian Reproduction Endpoint for Manganese



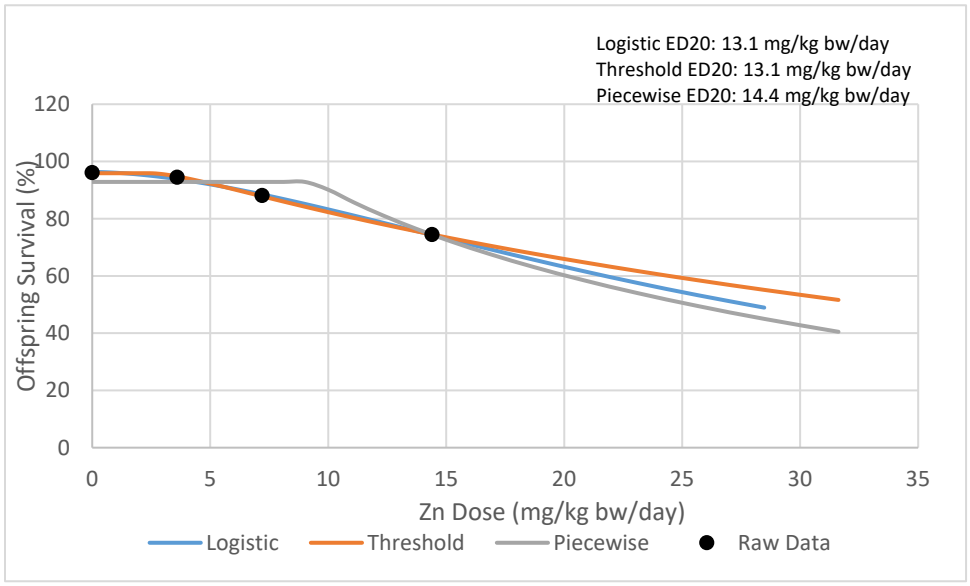
Log-transformed data from Rehnberg et al. (1980)

Figure C-31. Dose-Response Curves for Mammalian Survival Endpoint for Manganese



Log-transformed data from Khan et al. (2007)

Figure C-32. Dose-Response Curves for Mammalian Growth Endpoint for Zinc



Log-transformed data from Khan et al. (2007)
Note: Fit was poor for all three models, so an ED20 was not used for TRV derivation.

Figure C-33. Dose-response Curves for Mammalian Reproduction Endpoint for Zinc

APPENDIX C-3

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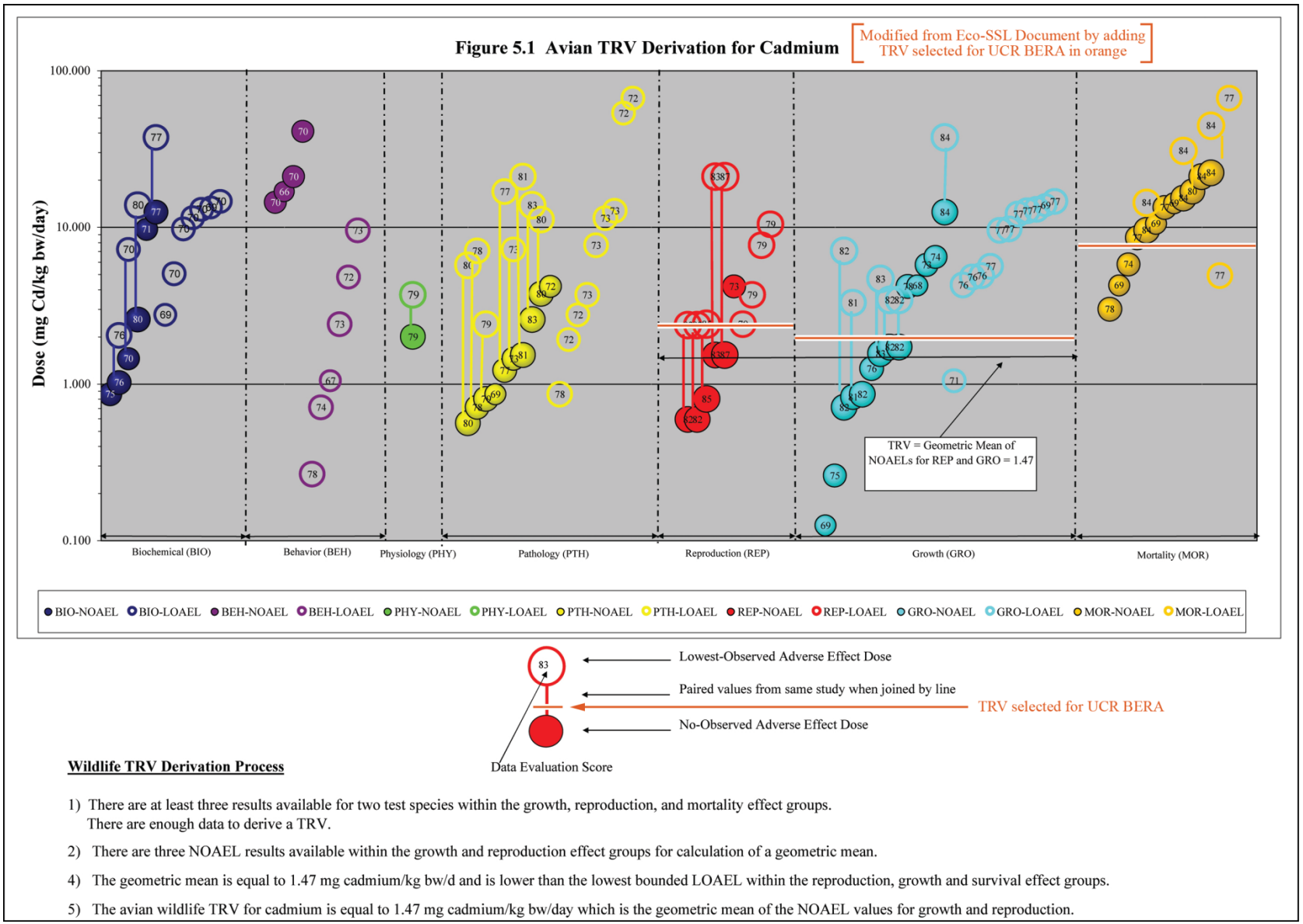
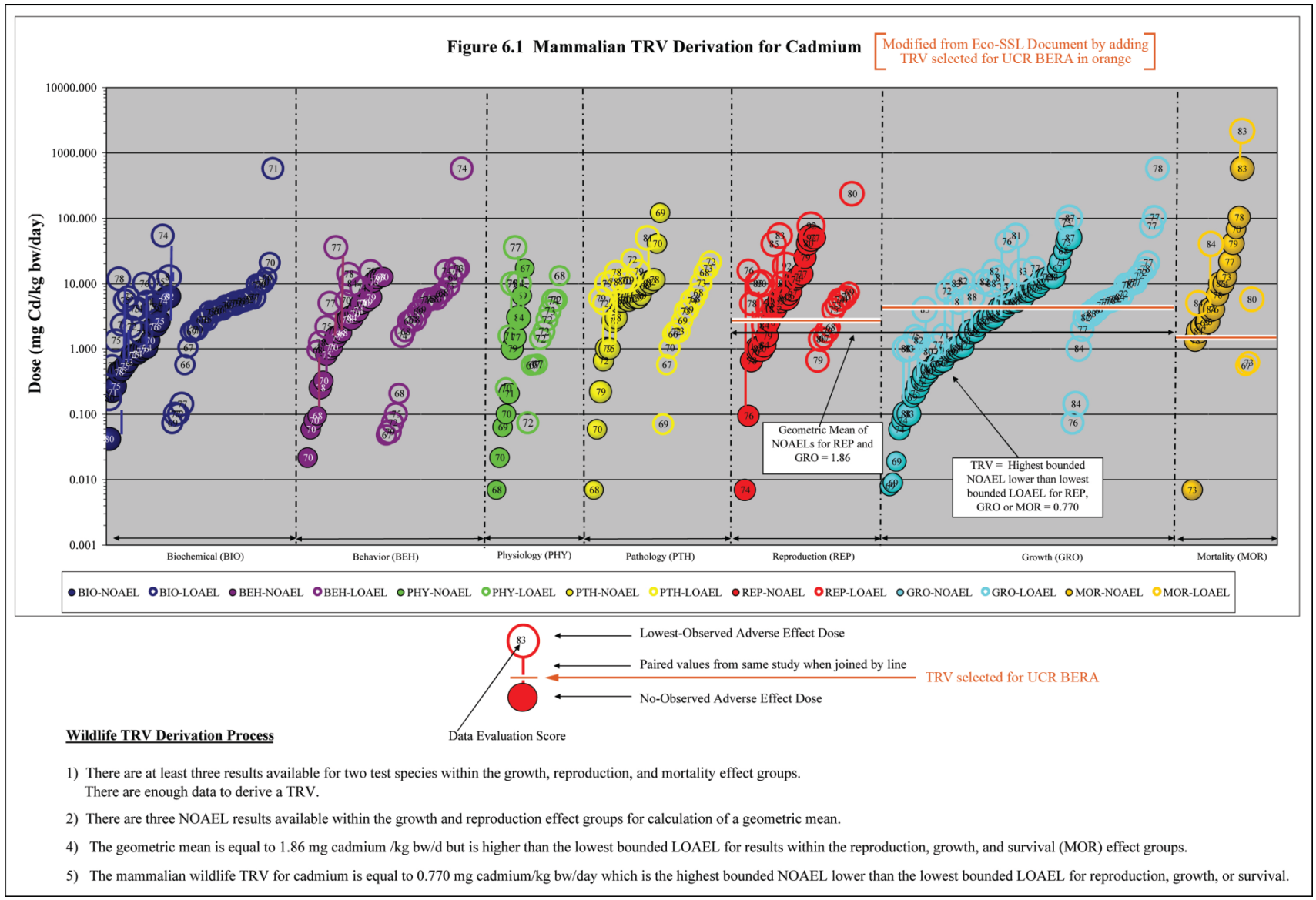
APPENDIX D

ECO-SSL TRV DERIVATION PLOTS COMPARED TO SELECTED TRVS



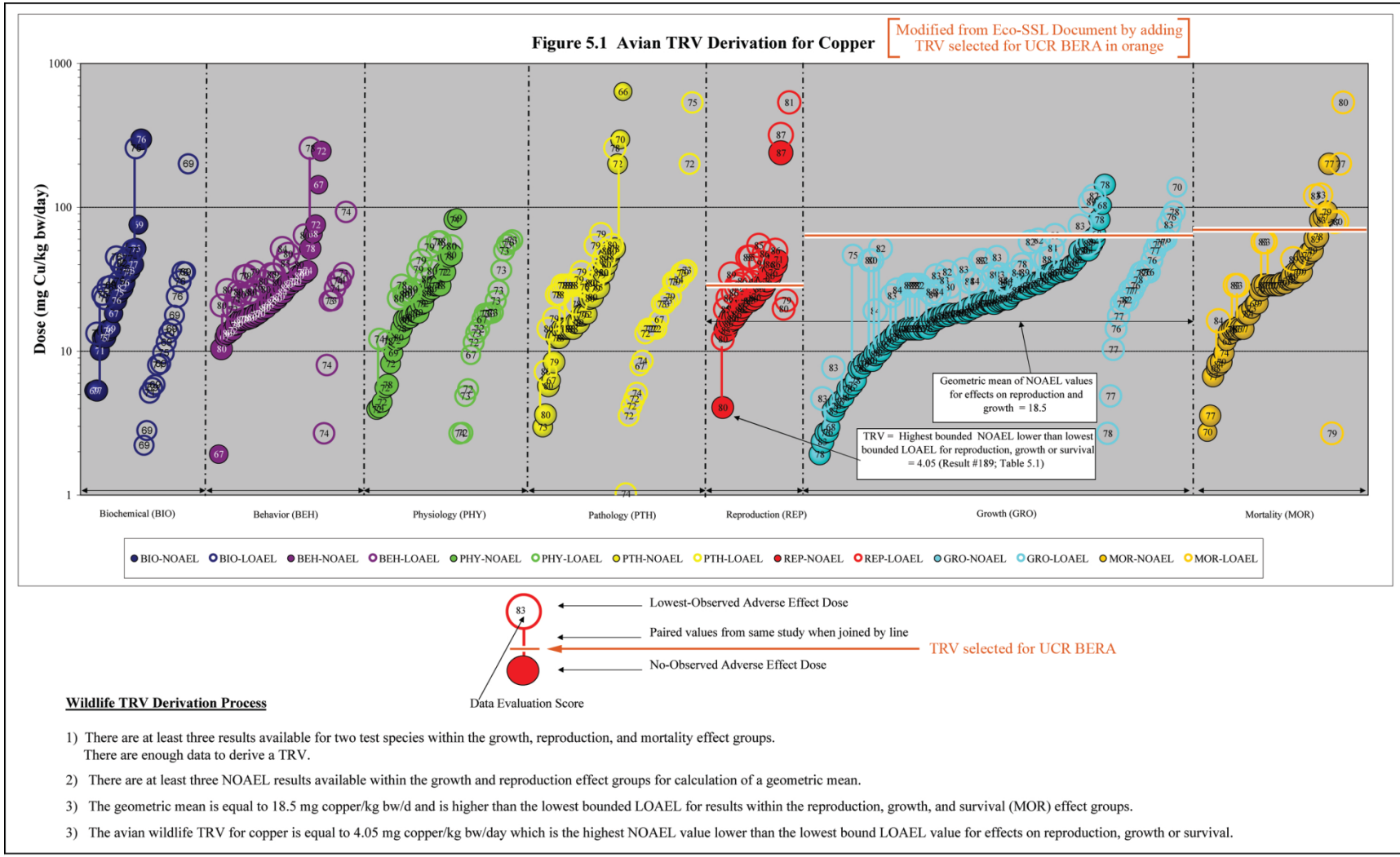
Selected BERA wildlife TRVs for comparative purposes (in mg Cd/kg bw/day): Growth = 2.0, Reproduction = 2.3; Survival = 7.4

Figure D-1. Avian TRV Derivation for Cadmium as Presented in Figure 5.1 of USEPA's 2005 Eco-SSL Document



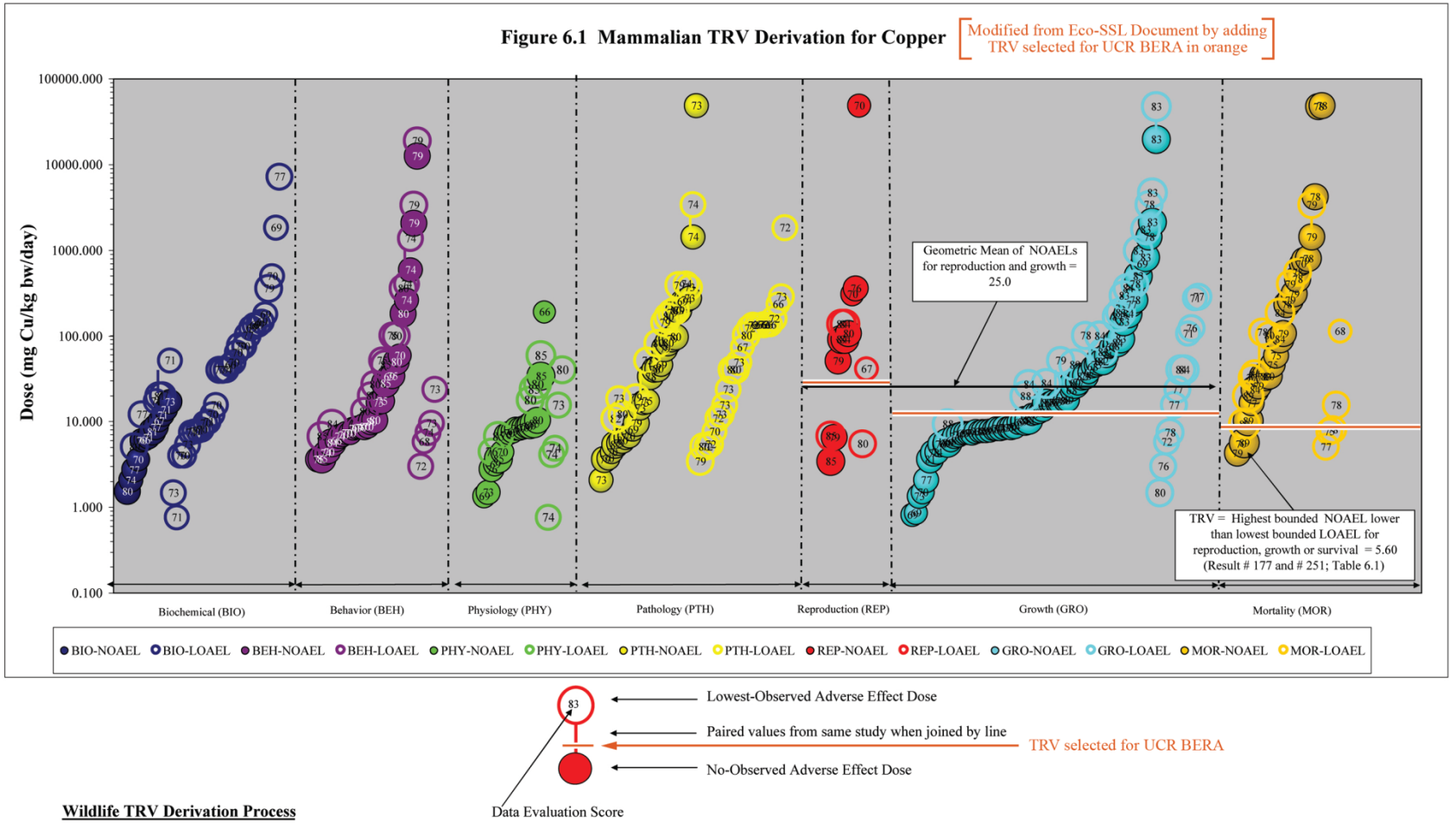
Selected BERA wildlife TRVs for comparative purposes (in mg Cd/kg bw/day): Growth = 4.2; Reproduction = 2.7; Survival = 1.5

Figure D-2. Mammal TRV Derivation for Cadmium as Presented in Figure 6.1 of USEPA's 2005 Eco-SSL Document



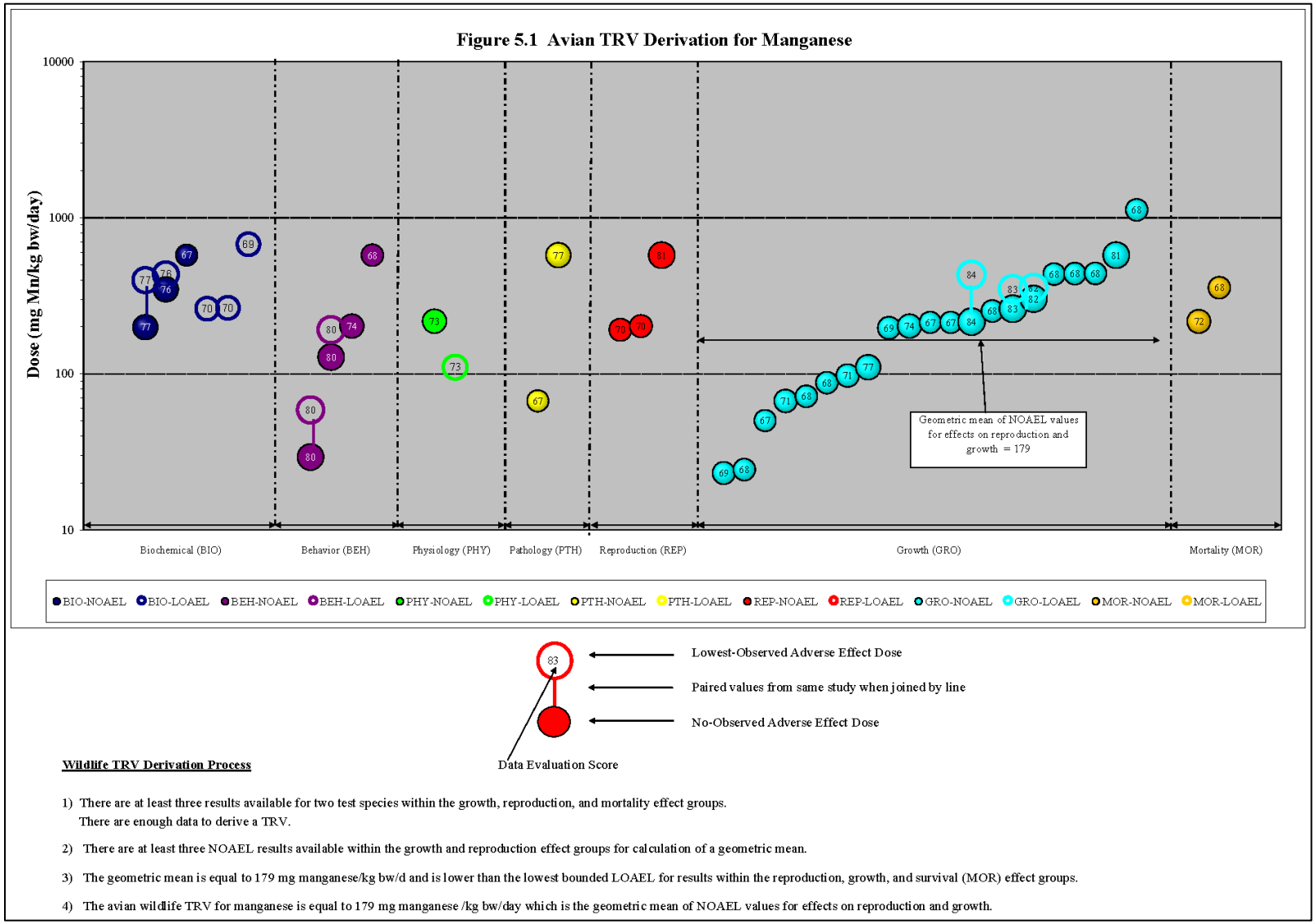
Selected BERA wildlife TRVs for comparative purposes (in mg Cu/kg bw/day): Growth = 62; Reproduction = 28; Survival = 67

Figure D-3. Avian TRV Derivation for Copper as Presented in Figure 5.1 of USEPA's 2007 Eco-SSL Document



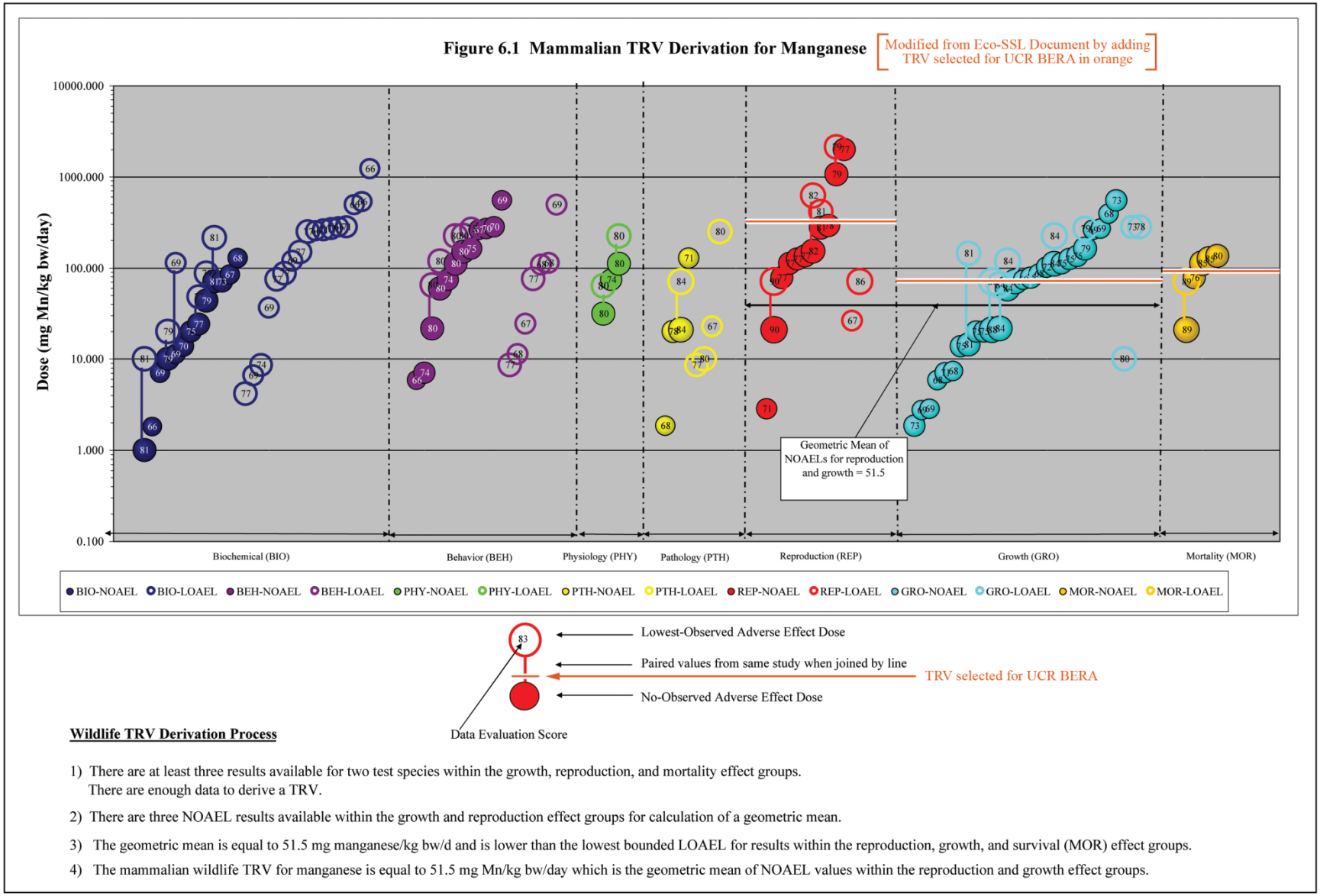
Selected BERA wildlife TRVs for comparative purposes (in mg Cu/kg bw/day): Growth = 12; Reproduction = 27; Survival = 8.7

Figure D-4. Mammal TRV Derivation for Copper as Presented in Figure 6.1 of USEPA's 2007 Eco-SSL Document



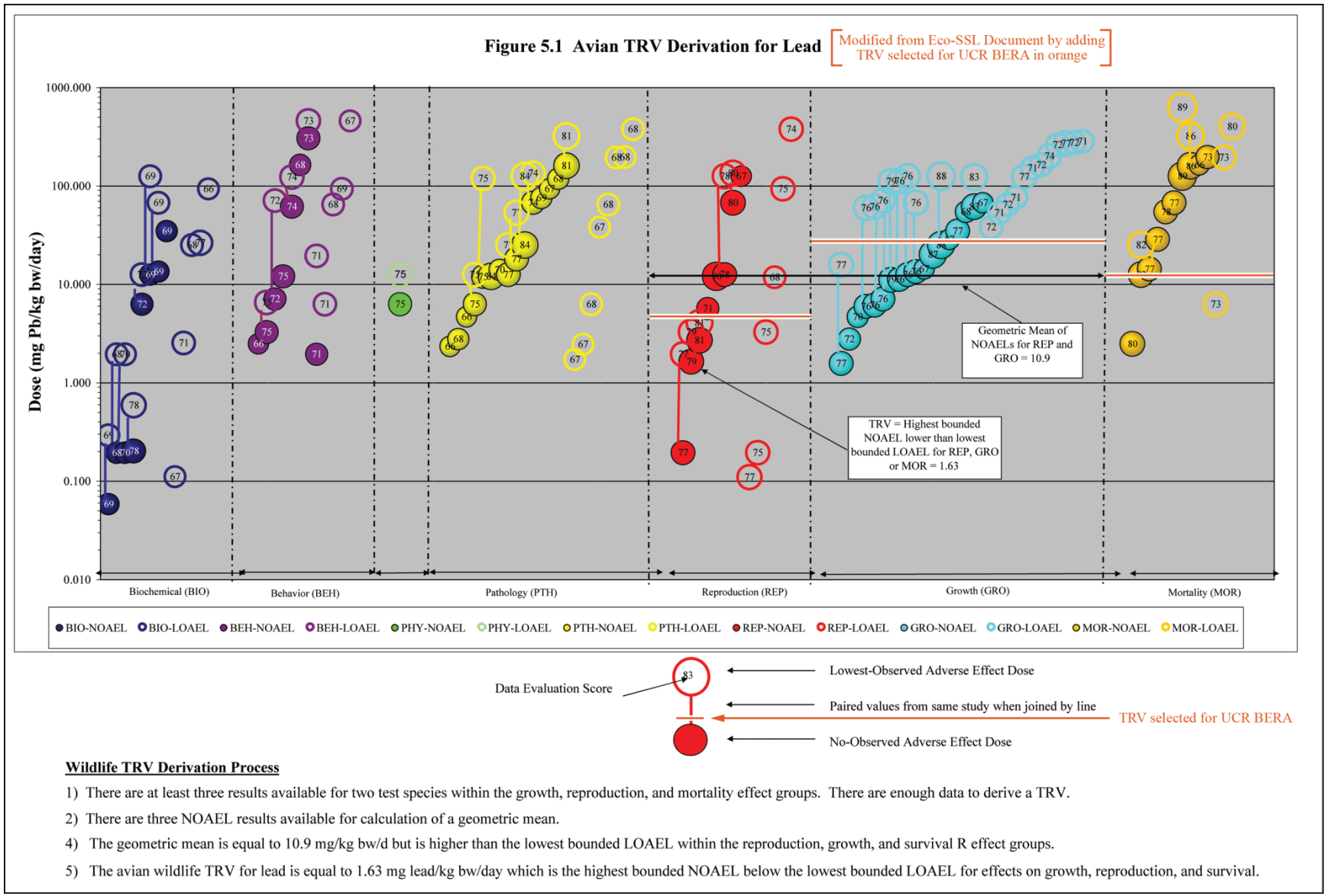
No avian TRVs were identified for manganese.

Figure D-5. Avian TRV Derivation for Manganese as Presented in Figure 5.1 of USEPA's 2007 Eco-SSL Document



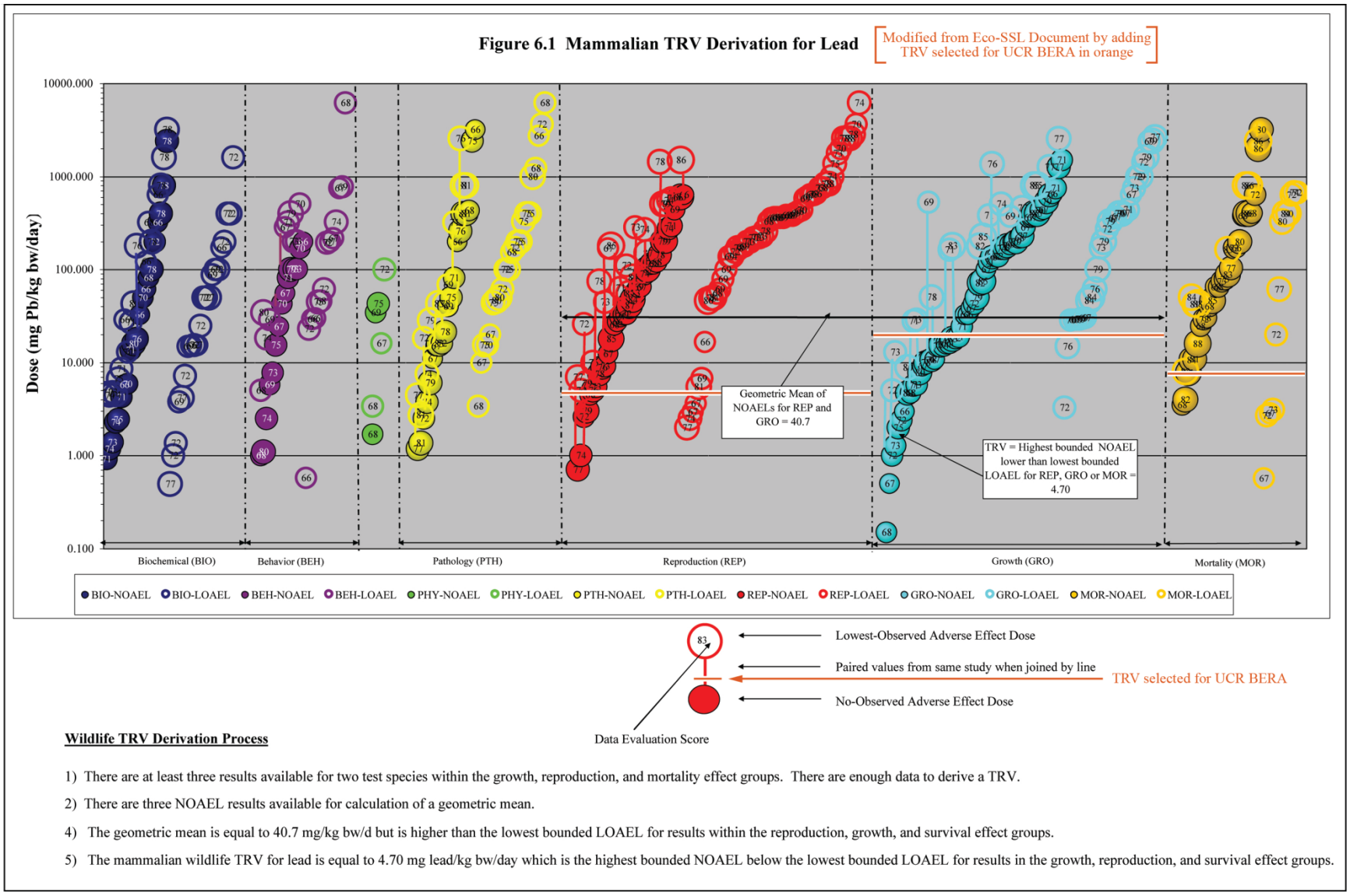
Selected BERA wildlife TRVs for comparative purposes (in mg Mn/kg bw/day): Growth = 71; Reproduction = 310; Survival = 91

Figure D-6. Mammal TRV Derivation for Manganese as Presented in Figure 6.1 of USEPA's 2007 Eco-SSL Document



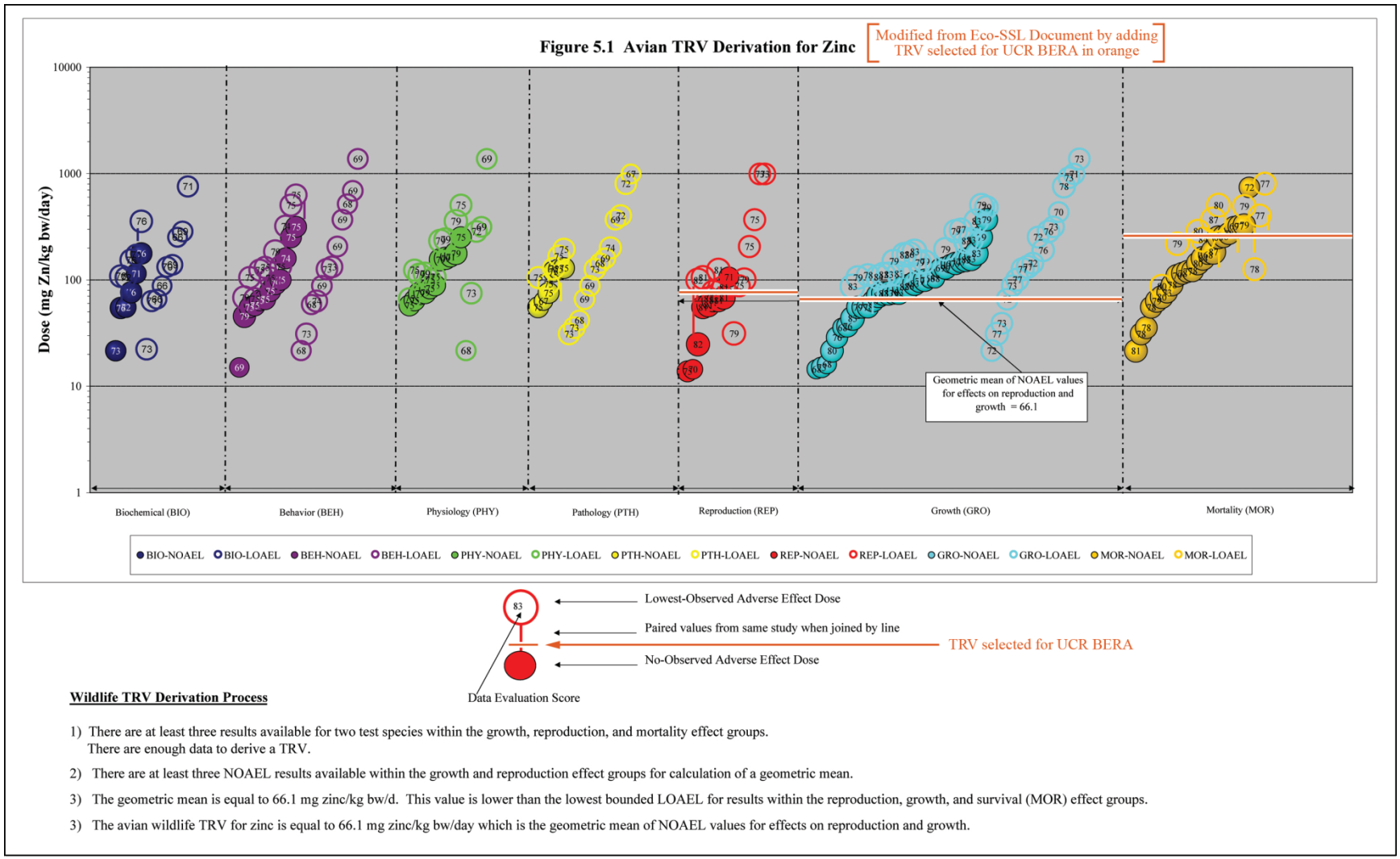
Selected BERA wildlife TRVs for comparative purposes (in mg Pb/kg bw/day): Growth = 29; Reproduction = 4.7; Survival = 11

Figure D-7. Avian TRV Derivation for Lead as Presented in Figure 5.1 of USEPA's 2005 Eco-SSL Document



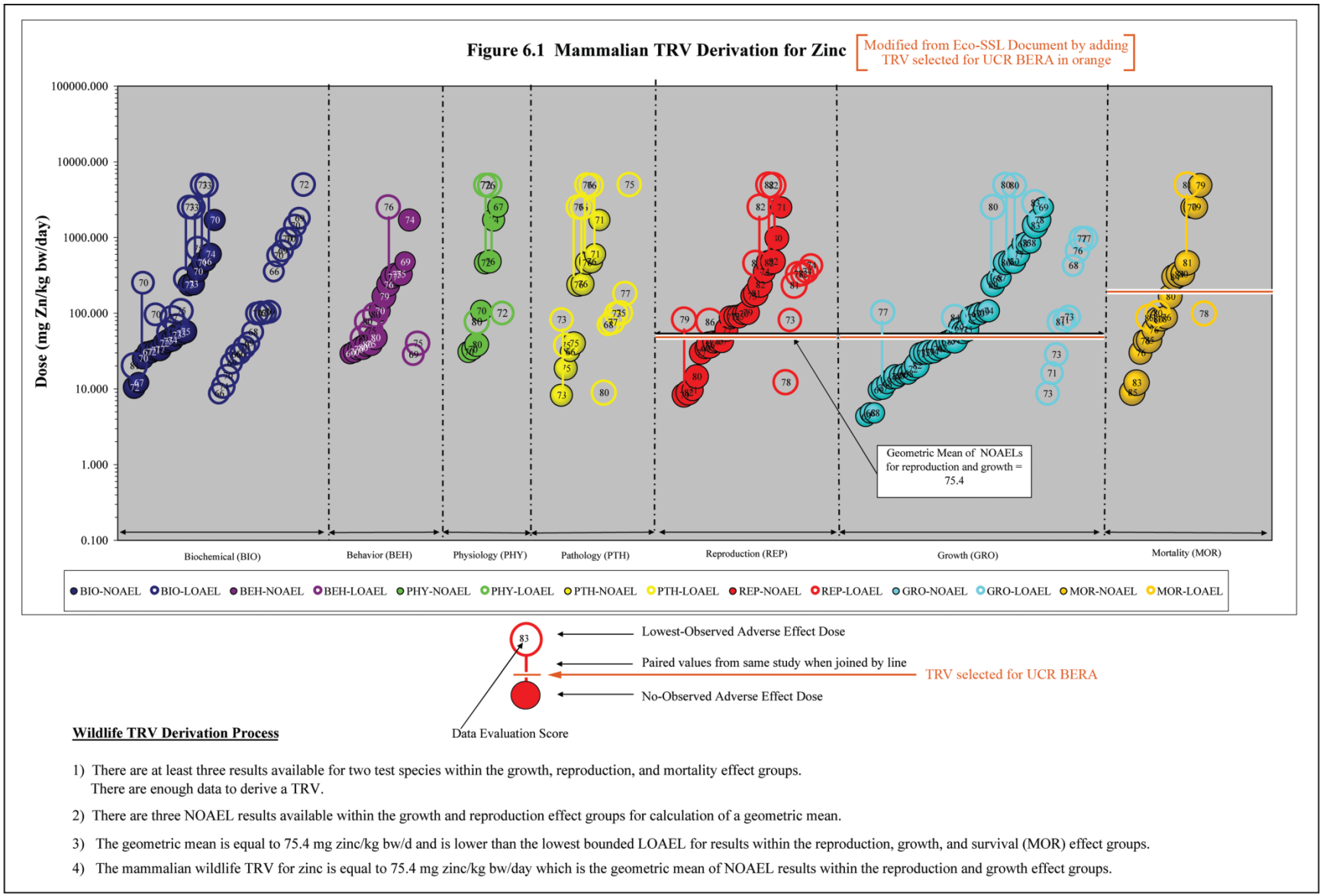
Selected BERA wildlife TRVs for comparative purposes (in mg Pb/kg bw/day): Growth = 20; Reproduction = 4.7; Survival = 7.6

Figure D-8. Mammal TRV Derivation for Lead as Presented in Figure 6.1 of USEPA's 2005 Eco-SSL Document



Selected BERA wildlife TRVs for comparative purposes (in mg Zn/kg bw/day): Growth = 66; Reproduction = 77; Survival = 250

Figure D-9. Avian TRV Derivation for Zinc as Presented in Figure 5.1 of USEPA's 2007 Eco-SSL Document



Selected BERA wildlife TRVs for comparative purposes (in mg Zn/kg bw/day): Growth = 75; Reproduction = 75; Survival = 190

Figure D-10. Mammal TRV Derivation for Zinc as Presented in Figure 6.1 of USEPA's 2007 Eco-SSL Document

ATTACHMENT H2

SUPPLEMENTAL WILDLIFE TRV DEVELOPMENT MEMO

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MEMORANDUM

To: Teck American Incorporated

From: Windward Environmental LLC

Subject: Additional Wildlife Toxicity Reference Values for the Upper Columbia River Aquatic BERA

Date: October 2025

INTRODUCTION

The chemicals of potential concern (COPCs) to be addressed in the Upper Columbia River (UCR) baseline ecological risk assessment (BERA) were identified in the *Final Chemicals of Potential Concern Refinement for Aquatic and Terrestrial Receptors* (TAI 2019, 2020).[1] An initial set of wildlife toxicity reference values (TRVs) for five metal COPCs, along with derivation methods, was presented in the *Final Wildlife Toxicity Reference Values for the Baseline Ecological Risk Assessment: Methods and Results for Five Metals* (Attachment H1). This document presents additional wildlife TRVs derived for the remaining COPCs identified for aquatic and terrestrial birds and mammals evaluated in the Aquatic BERA.[2] Methods used to derive the additional TRVs presented herein are consistent with the methods presented in the initial TRV document (Attachment H1).

The initial set of TRVs was derived for the following COPCs for both birds and mammals:

- Cadmium
- Copper
- Lead
- Manganese

[1] The COPC Refinement (TAI 2019) included an addendum that was finalized in January 2020 (TAI 2020).

[2] The Aquatic BERA addresses aquatic-associated wildlife associated with areas below full pool reservoir elevation, as well as terrestrial wildlife associated with relict floodplain areas located above full pool reservoir elevation but below the Columbia River's pre-1973 maximum flood extent.

- Zinc

This memorandum addresses TRV derivation for the remaining COPCs identified for either aquatic or terrestrial wildlife:

- Aluminum (birds and mammals)
- Antimony (mammals only)
- Arsenic (birds only)
- Barium (birds and mammals)
- Chromium (birds and mammals)
- Mercury (birds and mammals)
- Molybdenum (birds and mammals)
- Nickel (birds only)
- Selenium (birds and mammals)
- Vanadium (birds only)
- Bis(2-ethylhexyl) phthalate (BEHP) (birds only)
- Di-n-butyl phthalate (DNP) (birds only)
- High-molecular-weight polycyclic aromatic hydrocarbons (HPAHs) (birds only)
- Polychlorinated biphenyls (PCBs) (birds and mammals)[3]
- Dioxins/furans (birds and mammals)[4]

In addition, this memorandum addresses TRV derivation for other chemicals identified as chemicals of interest (COIs) for either aquatic or terrestrial wildlife, based on the lack of screening-level benchmarks:

- Antimony (birds only)
- Beryllium (birds only)
- Iron (birds and mammals)
- Thallium (birds and mammals)

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[3] PCBs were identified as a COPC based on both total PCB congeners and PCB toxic equivalents (TEQs) (TAI 2019, 2020). PCB TEQs were calculated using the toxic equivalency factors (TEFs) for the 12 coplanar PCBs for birds or mammals, as appropriate, from Van den Berg et al. (2006), Van den Berg et al. (1998), and the U.S. Environmental Protection Agency (EPA) (2010).

[4] Dioxins/furans were identified as a COPC based on dioxin/furan TEQs, which were calculated using TEFs for each of the dioxin/furan congeners for birds or mammals, as appropriate, from Van den Berg et al. (2006) and Van den Berg et al. (1998). Total TEQ (calculated as the sum of PCB TEQ and dioxin/furan TEQ) is also a COPC.

This memorandum also includes a refinement to the selection of representative receptor-specific TRVs presented in the initial wildlife TRV document. Instead of identifying a TRV as receptor specific based on a similar common name, per the initial document, this refinement identifies TRVs as receptor specific only when the genus and species of the test animal matches that of the representative receptor used for dietary modeling in the Aquatic BERA. This refinement results in fewer instances of the identification and use of receptor-specific TRVs, creating a more conservative approach because the receptor-specific TRV for a particular metal and endpoint is always equal to or higher than its respective generic TRV.

METHODS

The seven-step process presented in the initial wildlife TRV document (Attachment H1) was used to derive the wildlife TRVs presented in this document (Figure H2-1). Detailed descriptions of each step are presented in Sections 3.1 through 3.7 of the initial wildlife TRV document. A summary of the process is provided herein.

After toxicity literature were compiled for dietary toxicity studies measuring growth, reproduction, and survival (Step 1), acceptability criteria were applied to eliminate studies that were not considered appropriate for use in TRV derivation (Step 2). A tiered process was applied to identify preferred studies for TRV selection (i.e., Tier 1 studies), as well as secondary studies for inclusion if preferred studies were not available (i.e., Tier 2 studies) (Step 3). Based on the tiered process, a subset of acceptable studies was reviewed in detail to compile dose-response datasets (Step 4). For each of these datasets, either an ED20 (dose that causes a 20% effect) was modeled using EPA's Toxicity Relationship Analysis Program (TRAP), or an effect level was derived from the dose with at least a 20% reduction in the observed response relative to the control (abbreviated as the lowest-observed-adverse-effect level [LOAEL] ≥ 20) (Step 5).

To select a TRV for each chemical, receptor group (birds and mammals), and endpoint (growth, reproduction, and survival) (Step 6), a lowest effect level was identified from the lowest tier of studies: 1) LOAEL ≥ 20 from an individual dataset, 2) ED20 from an individual dataset, or 3) ED20 or geometric mean from a pooled dataset (Figure H2-2). If, based on best professional judgement, it was determined that there was substantial uncertainty in the effect level, then the study was excluded from selection as an effect level (Figure H2-2).

Two additional steps were conducted prior to selecting the lowest effect level as a TRV (Figure H2-2):

- The ecological soil screening level (Eco-SSL) documents were reviewed to determine if there were any studies with unbounded no-observed-adverse-effect levels (NOAELs) for comparable dose-response datasets that were higher than the selected effect level.
- If the selected effect level was lower than the TRV used to derive the Eco-SSL, then the Eco-SSL TRV was selected for use as the Aquatic BERA TRV, on the

grounds that the Aquatic BERA TRV should not be lower than the TRV used to derive the Eco-SSL issued by EPA's Superfund program.

If a dose-response dataset was available for a specific representative aquatic or terrestrial receptor species evaluated in the Aquatic BERA, then a receptor-specific TRV was also derived from those data. Receptor-specific TRVs were used only if the genus and species of the test animal matched that of the representative receptor.

The final step (Step 7) involved the evaluation of uncertainties in the selected TRVs to determine TRV reliability and potential bias. Based on the results of Step 6—which involved selecting the lowest LOAEL, ED20, or geomean of all datasets evaluated for a particular receptor/chemical/endpoint—the derivation process resulted in an overall conservative bias for the selected TRVs. Potential bias related to other uncertainties is discussed in the uncertainty evaluation of this memorandum.

Modifications to the methods shown in Figure H2-2 were applied to derive TRVs for PCBs for both birds and mammals. Steps 1 through 3 were modified to include only reproduction studies with mink and chickens. Mink are known to be extremely sensitive to PCBs, and the effects of dietary PCBs on this species' reproduction have been extensively studied (Aulerich and Ringer 1977; Aulerich et al. 1985; Bleavins et al. 1980; Brunström et al. 2001; Folland et al. 2016; Jensen et al. 1977; Kihlstrom et al. 1992; Wren et al. 1987; Basu et al. 2007). Consequently, the mammalian PCB TRV is likely biased low for mammalian receptors that are not mink. EPA has used mink reproduction studies to derive TRVs for Region 5 (Chapman 2003), as well as to derive TRVs for other ecological risk assessments in Region 10 (e.g., Portland Harbor and Lower Duwamish Waterway). Similarly, chickens are known to be among the bird species most sensitive to PCBs, and the most significant effects have been associated with the reproduction endpoint (Chapman 2003). Consequently, the avian PCB TRV is likely biased low for avian receptors other than chickens.

RESULTS

Literature Search and Study Review

Results from the literature compilation and study acceptability processes are presented in Annex A. Tables H2.A-2 through H2.A-10 in Annex A present the study acceptability results for chemicals and receptors included in the Eco-SSL documents. As a result of the literature search for chemicals with Eco-SSLs, additional references were identified, as listed in Table H2.A-11. As a result of the literature search for chemicals without Eco-SSLs, a number of references were not used for TRV derivation because they reported unbounded NOAELs; these references are listed in Table H2.A-12. Unbounded NOAELs from the Eco-SSL documents are reported in Tables H2.A-2 through H2.A-10.

Table H2-1 summarizes the results from the application of the tiered process, including the number of papers reviewed, number of usable datasets, and assignment of tiers. Detailed information on the tier determination results for each chemical and receptor

included in the Eco-SSL documents is presented in Tables H2.A-13 through H2.A-20. Tables H2-2 through H2-17 present toxicity data summaries for each chemical. Annex B presents the details of data extracted from the studies.

The following points should be noted for a subset of the chemicals:

- **Antimony**: One of the studies included in the derivation of the Eco-SSL TRV (Schroeder et al. 1970) was not used to derive a UCR TRV because of uncertainties in the study. Lynch et al. (1999) found that the Schroeder et al. (1970) study contained numerous shortcomings, irregularities, and inconsistencies, and that it therefore should not be used as an indication of antimony toxicity.
- **Arsenic**: Receptors may be exposed to both inorganic and organic forms of arsenic. Inorganic forms are generally more toxic than organic forms (Eisler 1988). All studies included in the TRV derivation for the growth and reproduction endpoints for birds used inorganic arsenic.
- **Chromium**: The hexavalent form of chromium is considered the most toxic. It is generally produced by industrial processes such as electroplating, stainless steel production, leather tanning, textile manufacturing, and wood preservation (NIH 2018). Because UCR sources are not expected to contain hexavalent chromium, only studies using trivalent chromium were used for TRV derivation. Likewise, studies using the yeast chromium form (i.e., a form found in brewer's yeast, which is a nutritional supplement) were not included in the TRV derivation.
- **Mercury**: Methylmercury is the form of mercury most toxic to wildlife (Evers 2018). Only studies with methylmercury were included in the review of toxicity studies for TRV derivation.
- **HPAH**: One of the two relevant studies found for the potential derivation of an HPAH TRV for birds (Trust et al. 1994) showed a statistically significant effect relative to the control. This gavage study (Trust et al. 1994) used a synthetic polycyclic aromatic hydrocarbon (7,12-dimethylbenz[a]anthracene), which is in the same class as benzo(a)pyrene and could be used as a surrogate for HPAHs. However, the body weight at this dose was 89% of the control (i.e., not at least 20% less than the control) and therefore was not used as a LOAEL ≥ 20.
- **DNP and BEHP**: No acceptable studies were found for the derivation of a DNP TRV for birds. For BEHP, there was high uncertainty associated with the selected TRV, because egg production was not reported in the control group (Ishida et al. 1982). The authors noted that egg production ceased completely in the two dosed groups, but data were not presented to determine percent egg production relative to the control; therefore, it was assumed that the effect was at least 20% greater than in the control. It is possible that the cessation of egg laying could have been due to reduced food consumption caused by the unpalatability of the dosed food used by Ishida et al. (1982); this was the case in Wood and Bitman

(1984) for 2-ethylhexanol. Therefore, any use of the BEHP TRV should occur with acknowledgement of its high uncertainty.

- **PCBs:** PCB TRVs are based on Aroclor or Clophen mixtures, whereas data from the UCR site are based on congener sums for sediment, water, and tissue (fish, crayfish, and mussels). The TRVs are derived from studies using Aroclor 1248 for birds and Clophen A50 for mammals. Compared to other common PCB mixtures for which data are available, Aroclor 1248 and Clophen A50 contain the greatest percentages of the PCB congeners 126 and/or 81, which are the congeners most toxic to birds and/or mammals. Therefore, although there is uncertainty in the application of these TRVs to the PCB congener mixtures that may be present in the UCR, these TRVs are conservative because they are derived from studies using the most toxic mixtures.
- **Dioxin/furan TEQ, PCB TEQ, and total TEQ**: The dioxin/furan TRVs for birds and mammals were derived from studies using 2,3,7,8-tetrachlorodibenzodioxin (TCDD). These TRVs were used to evaluate risks from exposure to calculated dioxin/furan TEQs and PCB TEQs, since the TEFs used to calculate the TEQs were based on toxicity relative to 2,3,7,8-TCDD. Total TEQ is the sum of dioxin/furan TEQ and PCB TEQ. It is noted that birds have been classified into groups (high, moderate, and low) based on their sensitivity to dioxins (Farmahin et al. 2013). Avian sensitivity to the toxic effects of dioxin-like compounds may vary up to 1,000-fold among bird species; this sensitivity is associated with differences in the structural characteristics of the aryl hydrocarbon receptor (Farmahin et al. 2013; Cohen-Barnhouse et al. 2011; Head et al. 2008). The dioxin/furan TRV for birds is based on a study that used chickens, a species in the highly sensitive group. If there are hazard quotients > 1 for dioxin/furan TEQ, PCB TEQ, or total TEQ for a particular UCR receptor, the BERA should consider the sensitivity of that species relative to the sensitivity of chickens to determine if the TRV could be biased low in that case.

TRAP Modeling Results

All dose-response datasets identified through the study selection and review process, as summarized in Table H2-1, were plotted to show the dose vs. effect relative to the control, with separate plots for each chemical, receptor group (bird or mammal), and endpoint (growth, reproduction, and survival).[5] Figures H2-3 through H2-60 show the dose-response datasets for each chemical evaluated in this memorandum, including the resultant ED20 values for those datasets that could be modeled successfully.

[5] Plots are not shown for BEHP because results relative to the control are not available for Ishida et al. (1982), as discussed in this memorandum.

Figures H2-61 through H2-118 show the same data as Figures H2-3 through H2-60, but on a log-transformed basis.[6]

For each dataset, the modeling status fell into one the following five categories:

1. Data were modeled as an individual dataset in TRAP to derive the ED20.
2. Data were selected for modeling as an individual or pooled dataset, but an ED20 could not be generated, or the ED20 was not used due to poor model fit.
3. Data did not meet the criteria for modeling (i.e., dataset did not have an effect that was at least 20% less than the control; did not have two consecutively lower and different effects less than the control; or had consecutively lower effects followed by an increased effect, and a lower tier dataset was available).
4. Data were not selected for modeling because the effect concentration was substantially higher than other ED20s and/or LOAELs based on visual inspection of the plotted data.
5. Data were modeled as a pooled dataset in TRAP to derive the ED20.

Information about the modeling status of each dataset is presented in Tables H2-2 through H2-17 for each of the chemicals and includes ED20 values, if derived. For those studies that could be modeled in TRAP, dose-response curves and modeled ED20s are presented in Annex C. A summary of dose-response model parameters and dose-response effect values is also presented in Annex D.

TRV Selection and Uncertainty Evaluation

The effect level selected was the lowest value among the LOAEL ≥ 20, ED20, or geometric mean from the lowest tier for the growth, reproduction, and survival endpoints. A summary of selected effect levels is presented in Table H2-18.

Following the selection of effect levels, Eco-SSL data (presented in Annex A) were reviewed to determine if there were any unbounded NOAELs from comparable datasets higher than the selected effect levels (see TRV selection process shown in Figure H2-2). No such NOAELs were identified.

As a final step (Figure H2-2), selected effect levels were compared to Eco-SSL TRVs. Two effect levels were less than their respective Eco-SSL TRVs; therefore, the values from these Eco-SSL documents were identified as the TRVs:

- The Eco-SSL TRV of 0.29 mg/kg body weight (bw)/day was selected as the TRV for selenium/birds/growth, rather than the effect level of 0.28 mg/kg bw/day.

[6] Plots are also shown on a concentration-response basis in Figures H2-119 through H2-171, representing concentrations in food rather than dietary doses. These figures are presented for informational purposes only, to be consistent with the same types of plots presented in the initial wildlife TRV document (Attachment H1).

- The Eco-SSL TRV of 6.71 mg/kg bw/day was selected as the TRV for nickel/birds/reproduction, rather than the effect level of 0.54 mg/kg bw/day reported by Arpasova et al. (2007). All studies used to derive the Eco-SSL were Tier 1 studies, whereas the effect level was identified as being from a Tier 2 study, because the dose was administered via drinking water.

All other TRVs were equivalent to the effect levels shown in Table H2-18. Table H2-19 presents the final additional TRVs identified based on all the steps shown in Figure H2-2. TRVs were derived for at least one endpoint for all chemicals, with the exceptions of antimony/birds, beryllium/birds, thallium/birds, HPAHs/birds, DNP/birds, and antimony/mammals, for which TRVs could not be derived because no toxicity studies were found or none of the studies showed at least a 20% reduction in the observed response relative to the control. The selected TRVs are compared to TRV derivation plots from the Eco-SSL documents in Annex E.

As noted in the introduction to this memorandum, the criteria for identifying a TRV as receptor specific were refined from the initial wildlife TRV document (Attachment H1) so that a TRV was identified as receptor specific only when the genus and species of the test animal (rather than the common name) matches that of the representative receptor used in the Aquatic BERA. Based on this refinement for the chemicals addressed in this document, receptor-specific TRVs were derived for mallard (aluminum, methylmercury, nickel, and selenium), kestrel (methylmercury), and mink (dioxin/furan) (Table H2-19). In addition, updates were made to receptor-specific TRVs reported in the initial wildlife TRV document as follows:

- The cadmium/survival and copper/survival TRVs for Pekin duck were added as receptor-specific TRVs for mallard, because the two species have the same genus and species (*Anas platyrhynchos)* (Table H-20).
- The shrew-specific TRV for cadmium/growth was removed because the test species (*Sorex araneus*) is not the same as the representative receptor species (*S. cinereus* and *S. palustris*).

The LOAELs presented in Eco-SSL documents that are lower than each selected TRV, along with the rationale for not using these LOAELs, are presented in Annex A (Table H2.A-21). Based on the rationale presented therein, inclusion of these studies would not be expected to result in more reliable TRVs.

For the uncertainty evaluation, each selected effect level was evaluated to determine which considerations could result in decreased confidence in the value, and whether these considerations could result in potential biases in the TRV based on the effect level (Tables H2-21 through H2-43; in addition, Table H2-44 presents uncertainty considerations for updated receptor-specific TRVs). Some of the most common factors affecting confidence in the TRVs were:

- The use of laboratory species that are representative receptors used in the Aquatic BERA[7]
- The form of dose administration, which could affect uptake by the test organism
- The use of a highly soluble form of a metal that may be more bioaccessible than the forms found in sediment and tissue samples from the UCR
- The use of secondary sources to estimate the body weight and/or food ingestion rate (FIR) for dose calculations
- The selection of a LOAEL ≥ 20 rather than an ED20, particularly if the reduction in response relative to the control was substantially greater than 20%
- Data available for only a small number of species and/or datasets

An additional factor affecting the level of confidence in a smaller number of TRVs were:

- The derivation of TRVs from Tier 2 datasets may have had the potential for unknown bias in the values, because the datasets were from growth studies conducted during a non-critical life stage for less than 10% of the species' lifespans, or were from drinking water studies.
- There was high uncertainty associated with the BEHP/bird TRV, because egg production was not reported in the control group (Ishida et al. 1982).
- For arsenic/bird/survival, there were no datasets for inorganic arsenic, which is the more toxic form of arsenic, resulting in a potential high bias in the TRV.

Confidence levels associated with the modeled ED20s as reported by TRAP are presented in Annex D for datasets with five or more data points. TRAP error estimates were assumed to be unreliable for datasets with fewer than five data points, or if there was a warning message indicating a large standard error for one or more of the model parameters (see Table H2.D-1 in Annex D).

SUMMARY

Additional TRVs were derived for bird and mammal COPCs that were not included in the initial wildlife TRV document (Attachment H1). Additional TRVs were also derived for bird or mammal COIs that are discussed in the uncertainty section of the Aquatic BERA if they are also COPCs for aquatic birds or mammals. Methods for deriving the additional TRVs were consistent with those presented in the initial wildlife TRV document. The following points summarize the results of the TRV derivation process for the additional COPCs or COIs:

[7] Potential interspecies differences in toxicity may be due to factors such as metabolism or toxicokinetics.

- TRVs were derived for at least one endpoint for the following chemicals for both birds and mammals: aluminum, barium, chromium (trivalent), iron, methylmercury, molybdenum, selenium, PCBs, and dioxins/furans.
- TRVs were derived for at least one endpoint for the following additional chemicals for either birds or mammals: arsenic (birds), nickel (birds), vanadium (birds), BEHP (birds), and thallium (mammals).
- TRVs were not derived for HPAHs (birds) or antimony (mammals) because none of the studies showed at least a 20% reduction in the observed response relative to the control.
- TRVs were not derived for antimony (birds), beryllium (birds), DNP (birds), or thallium (birds), because no acceptable studies were found during the literature search.
- Common uncertainties identified among many of the TRVs include:
  - The use of laboratory species that are not representative receptors assessed in the Aquatic BERA
  - The form of dose administration, which could affect uptake by the test organism
  - The use of a highly soluble form of the metal that is probably more bioaccessible than the forms found in UCR site soil, sediments, and tissue
  - The use of secondary sources to estimate the body weight and/or FIR for dose calculations
  - The selection of a LOAEL ≥ 20 rather than an ED20, particularly if the reduction in response relative to the control was substantially greater than 20%
  - Data available for only a small number of species and/or datasets.

Additional uncertainty is associated with TRVs derived from Tier 2 datasets.

This memorandum also includes an update to some of the receptor-specific TRVs presented in the initial wildlife TRV document (Attachment H1). A summary of all bird and mammal TRVs derived for use in the Aquatic BERA is presented in Table H2-45.

REFERENCES (INCLUDING ANNEX REFERENCES)

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Figures

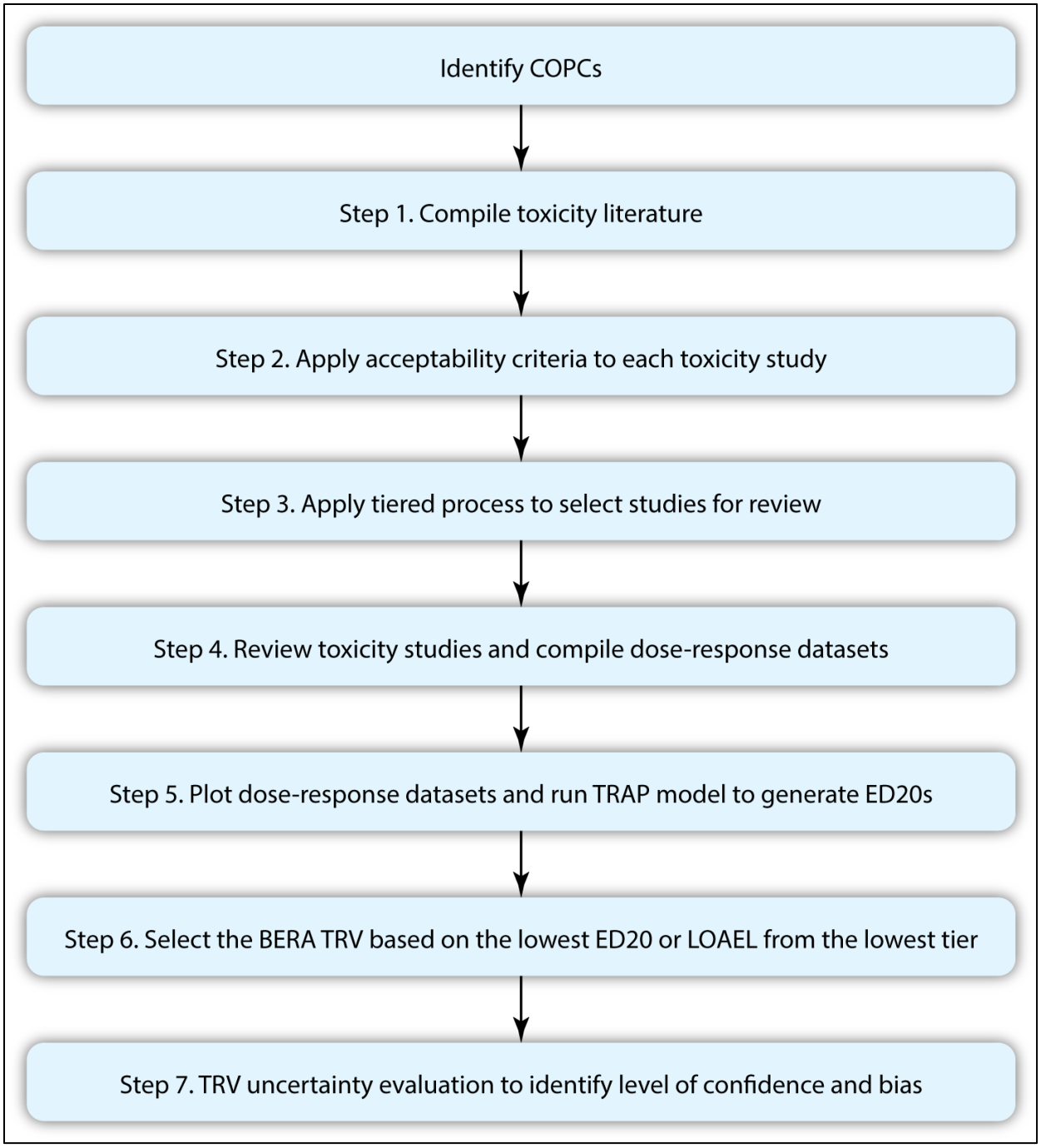


Figure H2-1. Seven-Step Process for Deriving TRVs

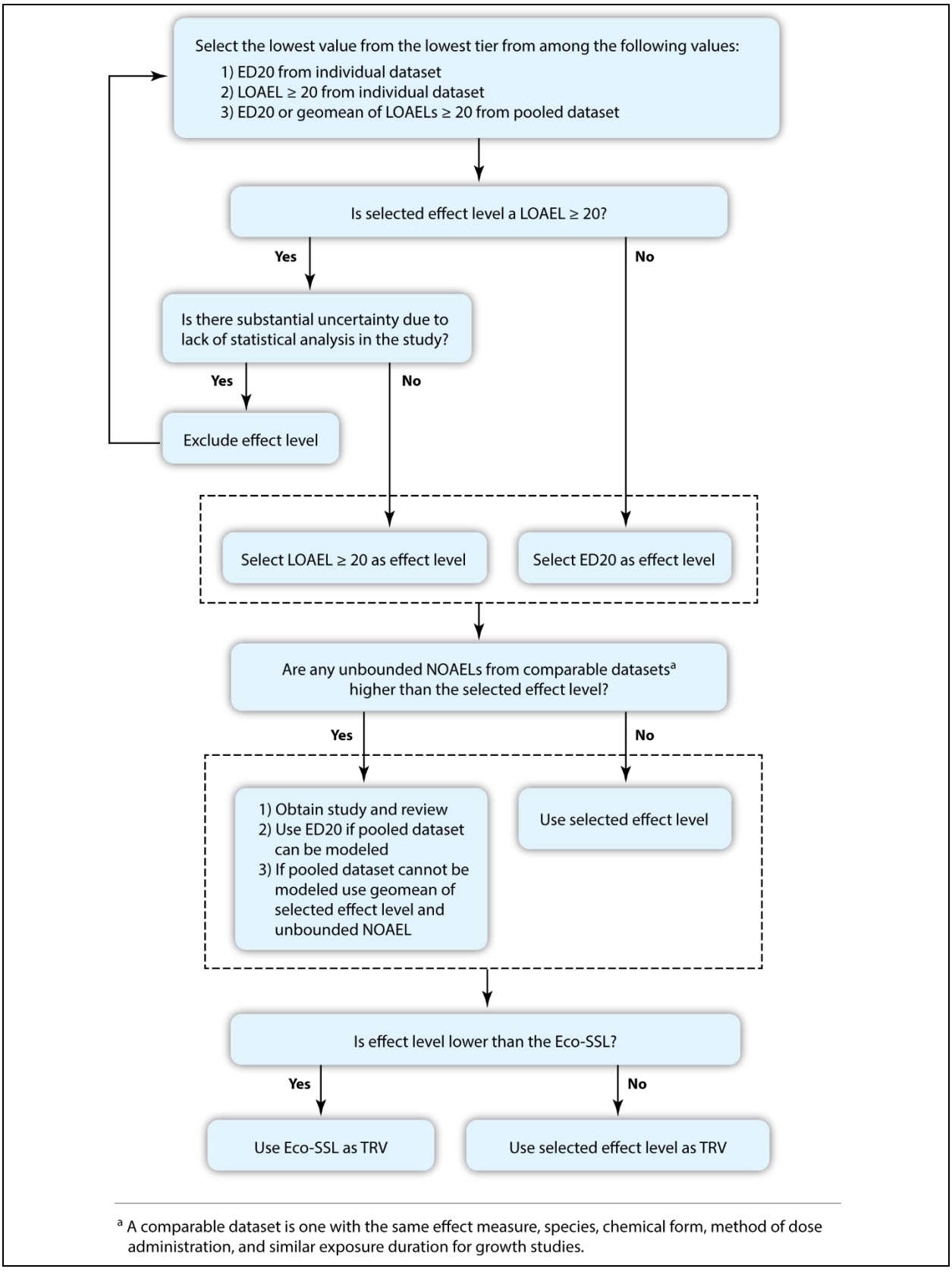
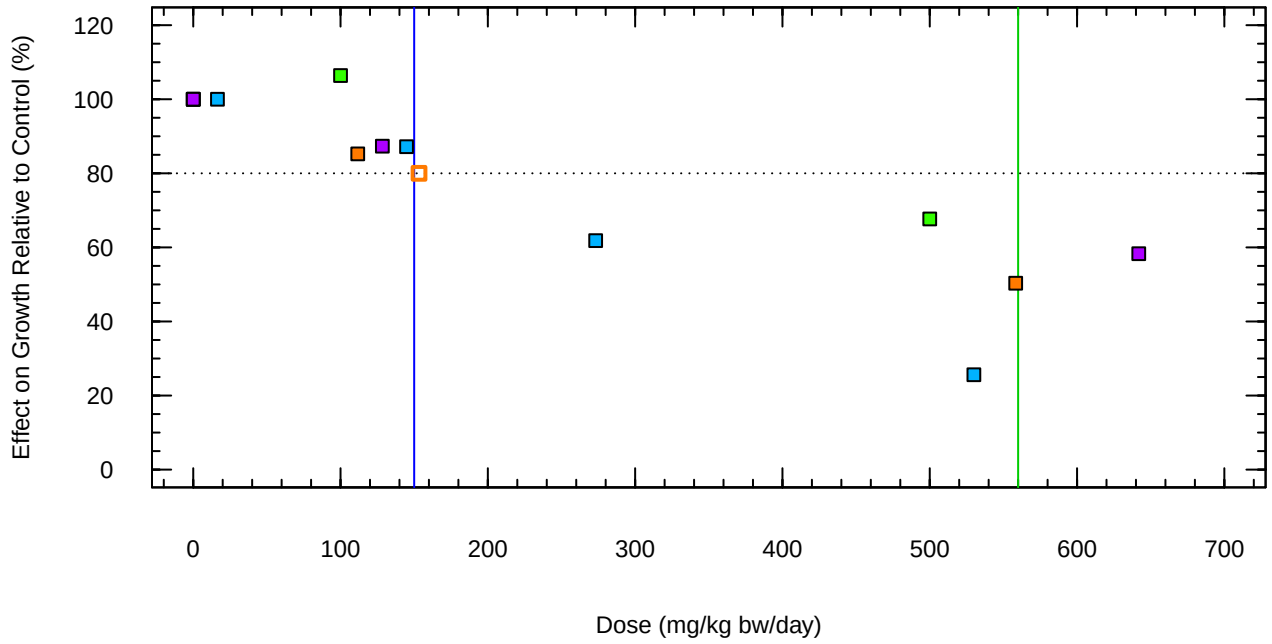


Figure H2-2. Flow Chart for Aquatic BERA TRV Selection Process



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Capdevielle and Scanes 1995a	chicken	body weight	diet	2	aluminum sulfate		
Capdevielle and Scanes 1995b	mallard	body weight	diet	2.1	aluminum sulfate		
Capdevielle et al. 1996	chicken	body weight	diet	1.5	aluminum sulfate	A	
Elliot and Edwards 1991	chicken	body weight	diet	2.3	aluminum sulfate	A	
ED20 for Capdevielle and Scanes 1995a	chicken	body weight	diet	2	aluminum sulfate		150

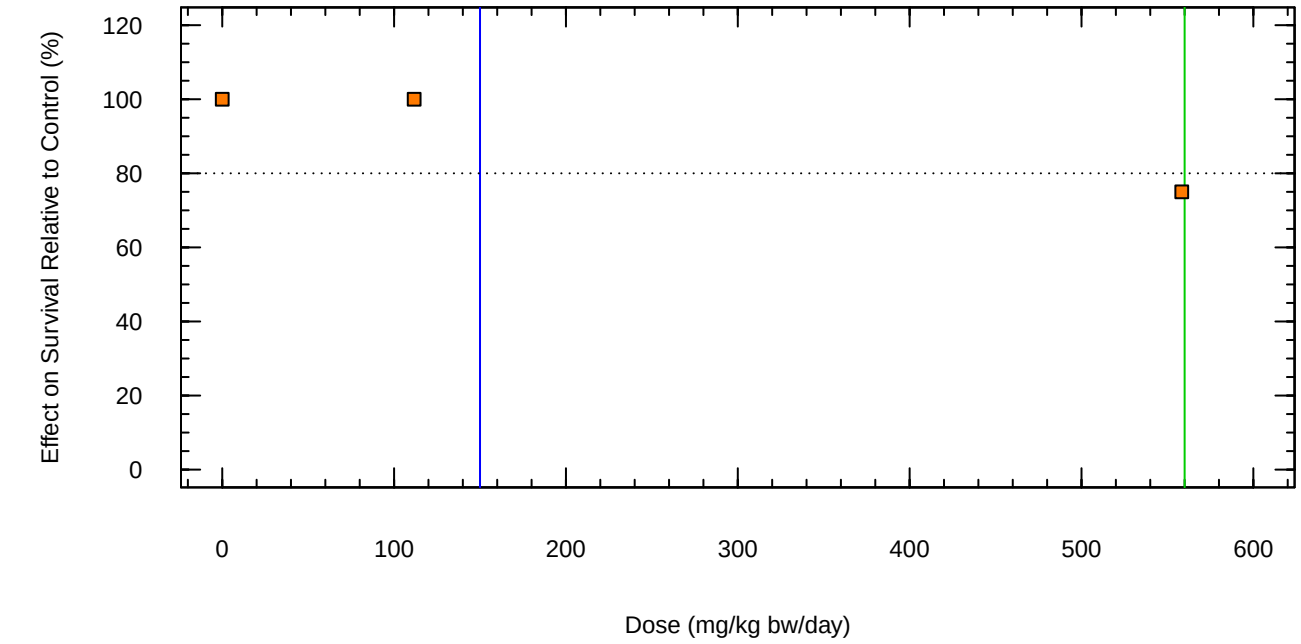
Tier 1

Selected TRV (Growth) = 150 mg/kg bw/day
Selected TRV (Survival) = 560 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−3. Dose−Response Data for the Avian Growth Endpoint for Aluminum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Capdevielle and Scanes 1995a	chicken	survival	diet	2	aluminum sulfate

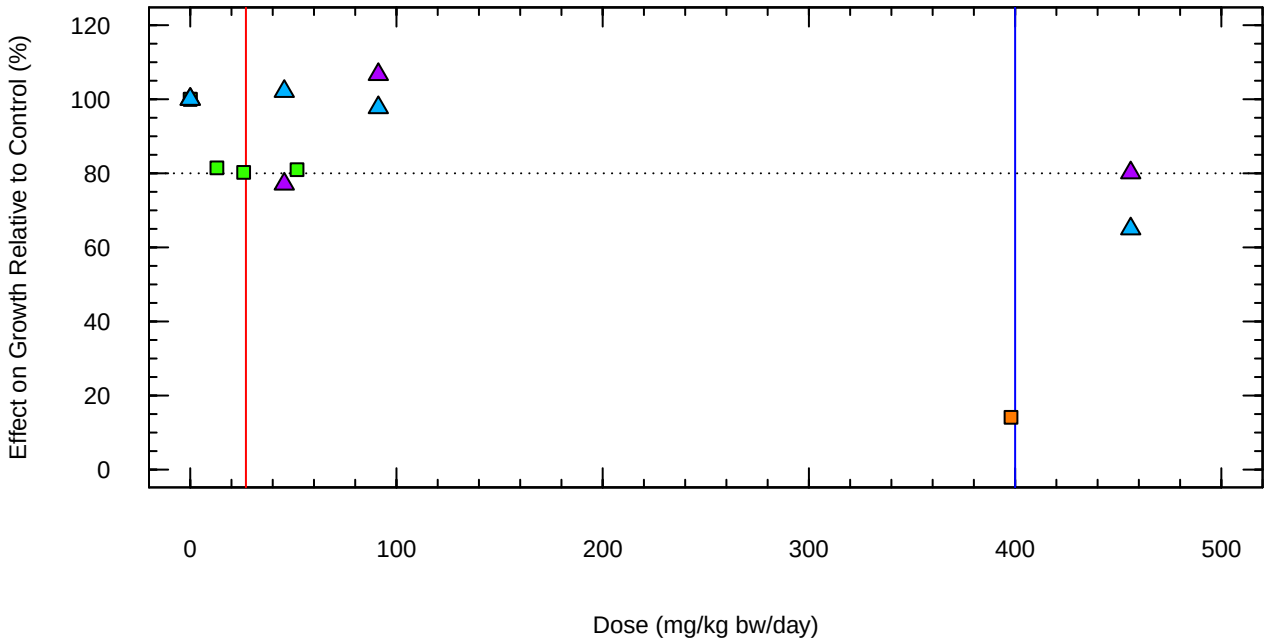
Tier 1

Selected TRV (Growth) = 150 mg/kg bw/day
Selected TRV (Survival) = 560 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−4. Dose−Response Data for the Avian Survival Endpoint for Aluminum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Belles et al. 1999	mouse	body weight gain	gavage	1.5	aluminum nitrate nonahydrate
Paternain et al. 1988	rat	body weight gain	gavage	1.3	aluminum nitrate nonahydrate
Domingo et al. 1987a	rat	body weight	drinking water	14	aluminum nitrate nonahydrate
Domingo et al. 1987a	rat	body weight	drinking water	14	aluminum nitrate nonahydrate

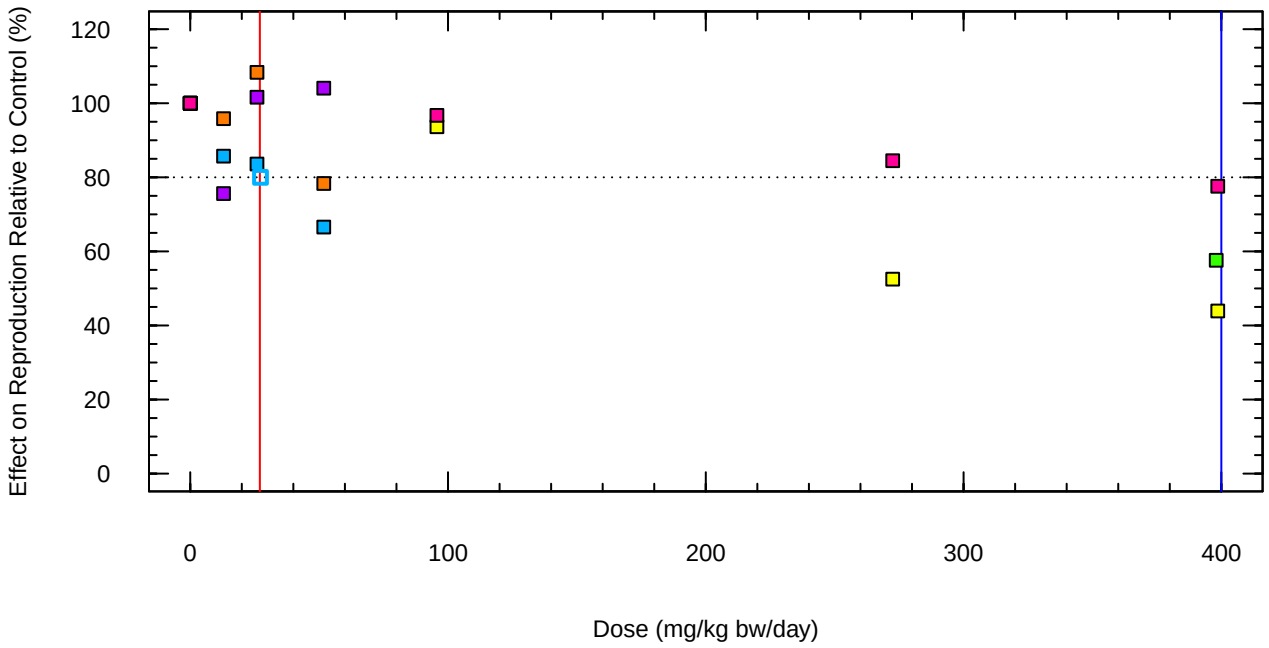
Tier 1 Tier 2

Selected TRV (Growth and Survival) = 400 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−5. Dose−Response Data for the Mammalian Growth Endpoint for Aluminum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Domingo et al. 1987b	rat	pup survival	gavage	unclear	aluminum nitrate nonahydrate	
Belles et al. 1999	mouse	fetal body weight	gavage	1.5	aluminum nitrate nonahydrate	
Paternain et al. 1988	rat	fetal survival	gavage	1.3	aluminum nitrate nonahydrate	
Paternain et al. 1988	rat	fetal body weight	gavage	1.3	aluminum nitrate nonahydrate	
Bernuzzi et al. 1989	rat	postnatal survival	diet	2.6	aluminum chloride	
Bernuzzi et al. 1989	rat	pup body weight	diet	2.6	aluminum chloride	
ED20 for Paternain et al. 1988	rat	fetal body weight	gavage	1.3	aluminum nitrate nonahydrate	27

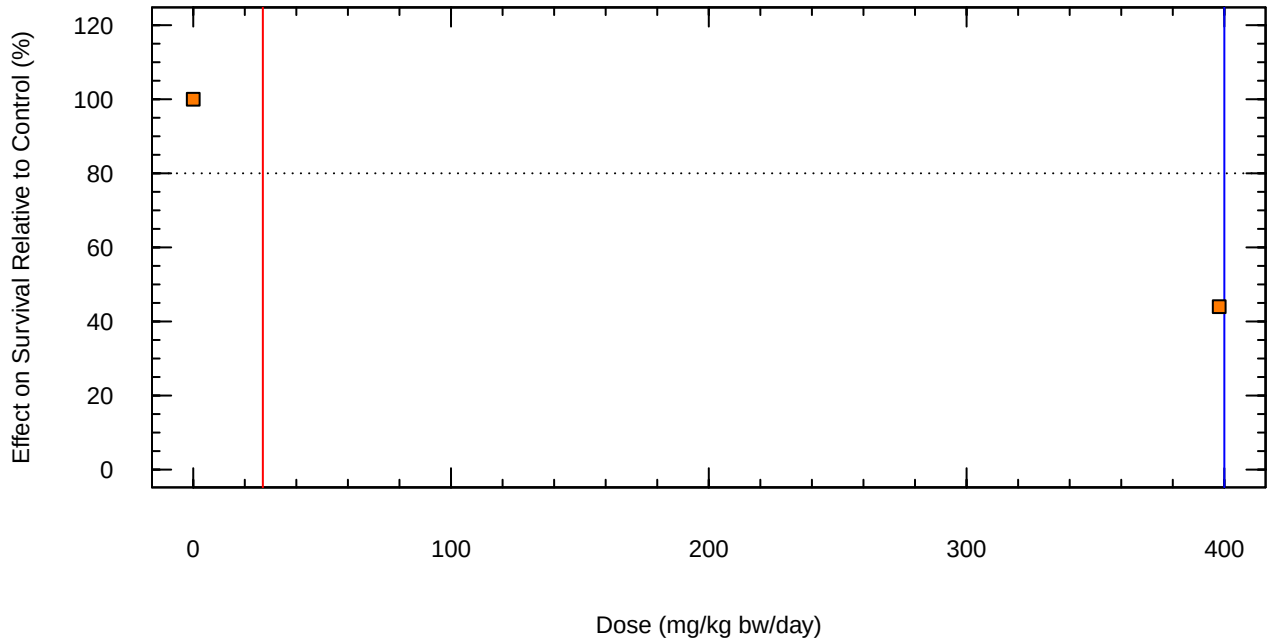
Tier 1

Selected TRV (Growth and Survival) = 400 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−6. Dose−Response Data for the Mammalian Reproduction Endpoint for Aluminum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Belles et al. 1999	mouse	survival	gavage	1.5	aluminum nitrate nonahydrate

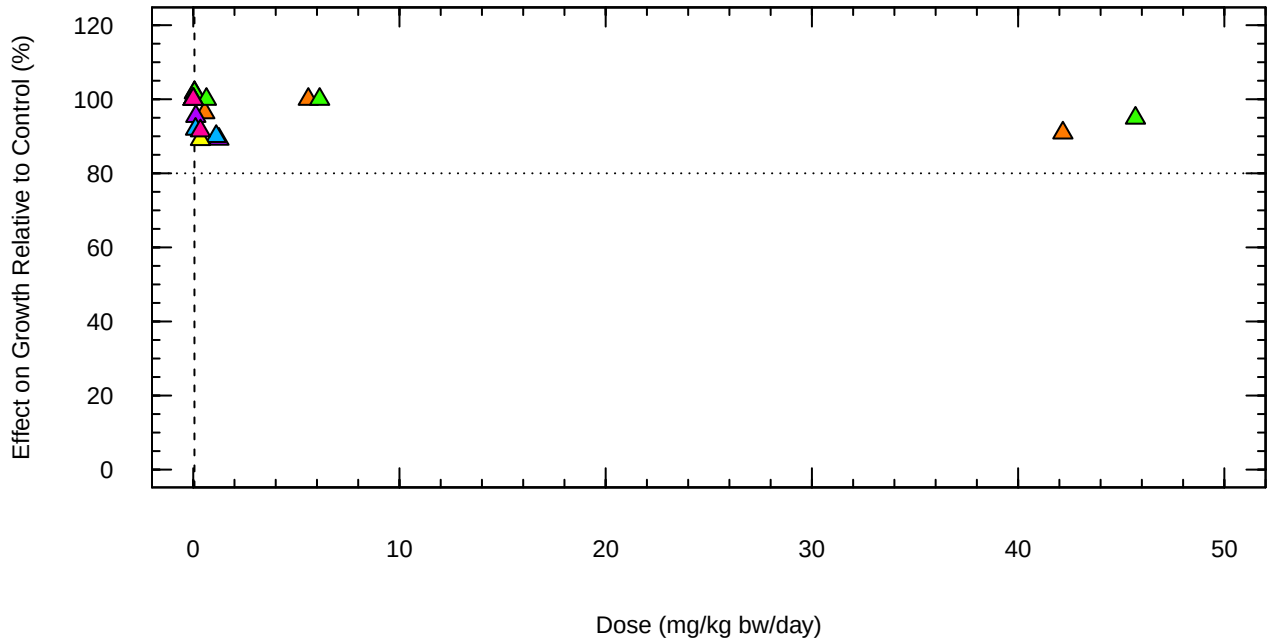
Tier 1

Selected TRV (Growth and Survival) = 400 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−7. Dose−Response Data for the Mammalian Survival Endpoint for Aluminum



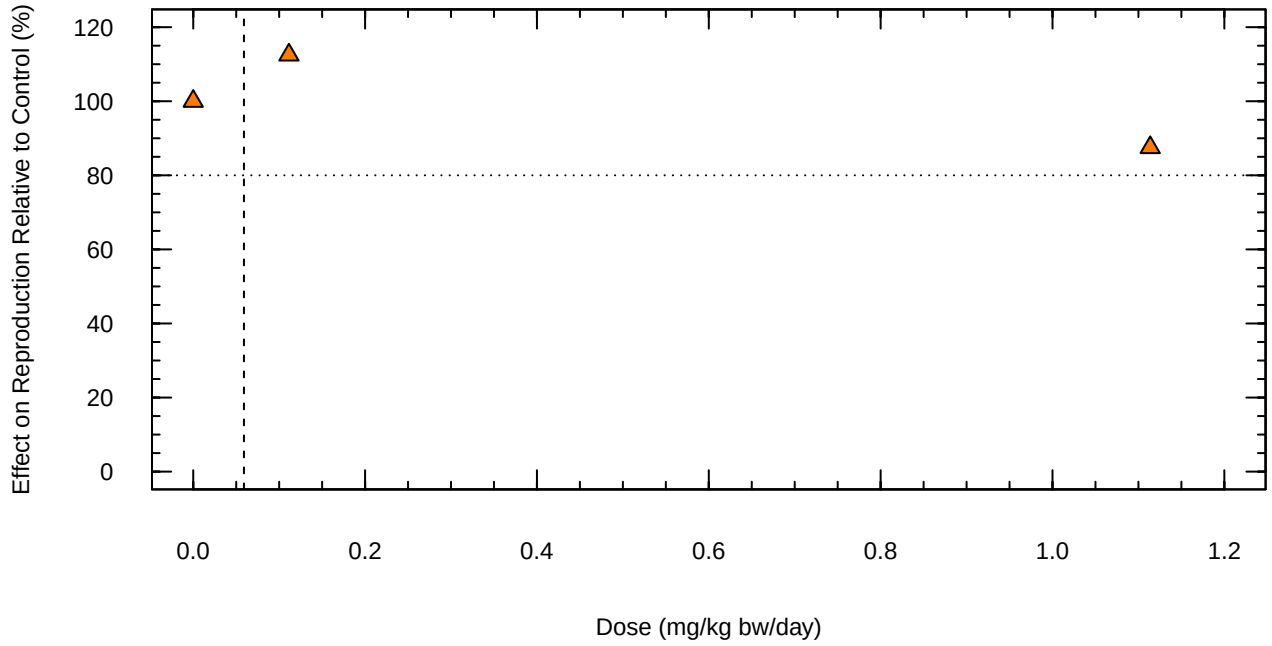
Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Poon et al. 1998	rat	body weight (male)	drinking water	13	potassium antimony tartrate
Poon et al. 1998	rat	body weight (female)	drinking water	13	potassium antimony tartrate
Rossi et al. 1987	rat	body weight	drinking water	8.6	antimony trichloride
Rossi et al. 1987	rat	body weight	drinking water	6.3	antimony trichloride
Shroeder et al. 1968	mouse	body weight (male)	drinking water	80	antimony potassium tartrate
Shroeder et al. 1968	mouse	body weight (female)	drinking water	80	antimony potassium tartrate

△ Tier 2

- - - Eco−SSL TRV = 0.059 mg/kg bw/day

····· 80% effect relative to control

Figure H2−8. Dose−Response Data for the Mammalian Growth Endpoint for Antimony



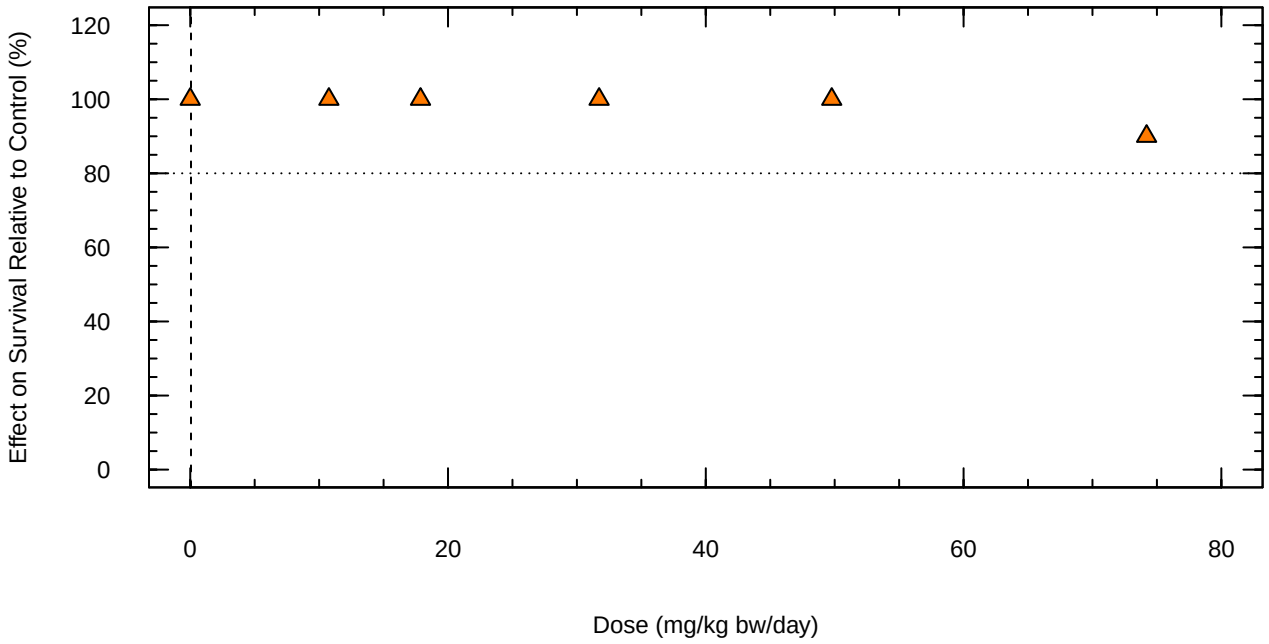
Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Rossi et al. 1987	rat	pups per litter	drinking water	6.3	antimony trichloride

△ Tier 2

- - - Eco−SSL TRV = 0.059 mg/kg bw/day

····· 80% effect relative to control

Figure H2−9. Dose−Response Data for the Mammalian Reproduction Endpoint for Antimony



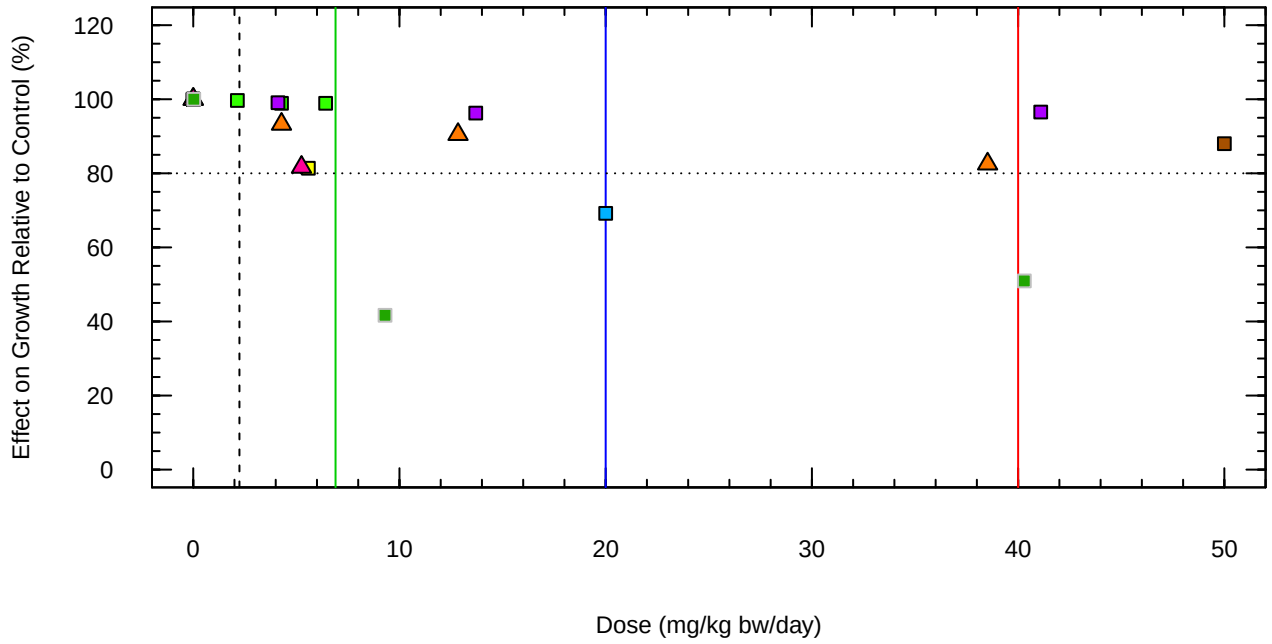
Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
▲ Dieter et al. 1991	mouse	survival	drinking water	2	antimony potassium tartrate

△ Tier 2

- - - Eco−SSL TRV = 0.059 mg/kg bw/day

····· 80% effect relative to control

Figure H2−10. Dose−Response Data for the Mammalian Survival Endpoint for Antimony



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Albert et al. 2008a	zebra finch	body weight	gavage	2	monomethylarsonic acid
Albert et al. 2008b	zebra finch	body weight	gavage	3	monomethylarsonic acid
Camardese et al. 1990	mallard	body weight	diet	10	sodium arsenate
Hoffman et al. 1992	mallard	body weight	diet	4	sodium arsenate
Howell and Hill 1978	chicken	body weight gain	diet	3	arsenic trichloride
Naraharisetti et al. 2009	chicken	body weight	drinking water	4	sodium arsenite
Sattar et al. 2016	chicken	body weight	gavage	4	disodium hydrogen arsenate
Stanley et al. 1994	mallard	body weight gain	diet	11.6−24.7	sodium arsenate

Tier 1 Tier 2

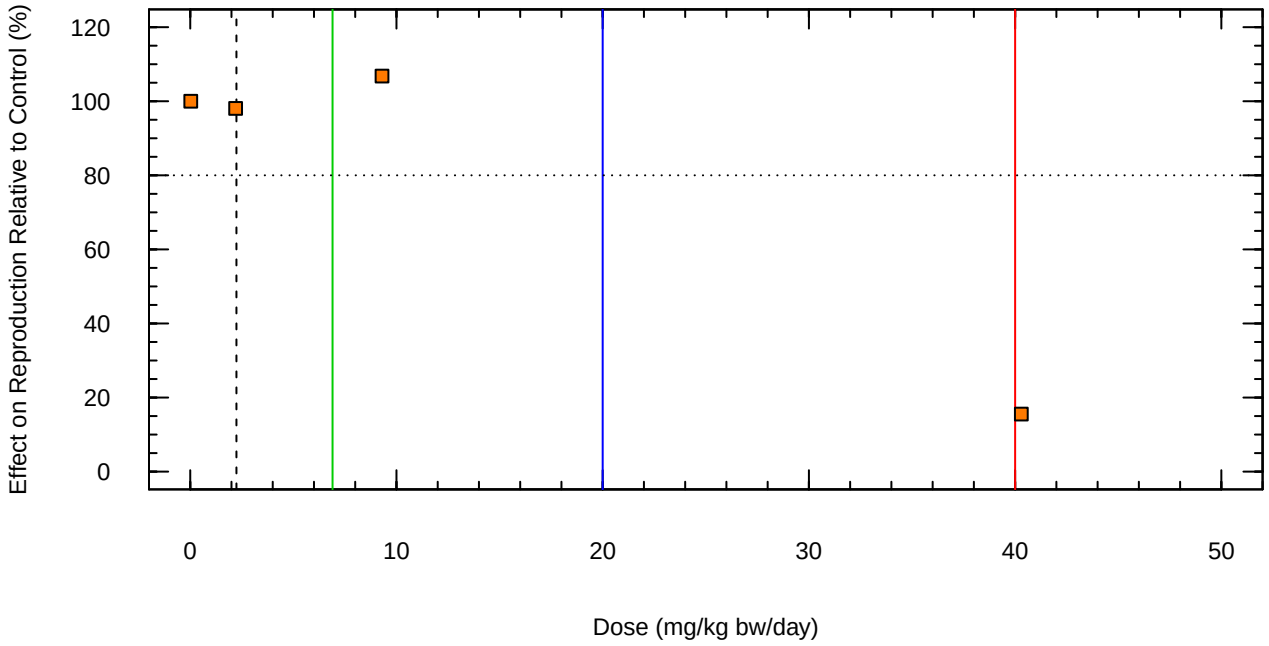
Eco−SSL TRV = 2.24 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 40 mg/kg bw/day
Selected TRV (Survival) = 6.9 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−11. Dose−Response Data for the Avian Growth Endpoint for Arsenic



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Stanley et al. 1994	mallard	duckling survival	diet	11.6−24.7	sodium arsenate

Tier 1

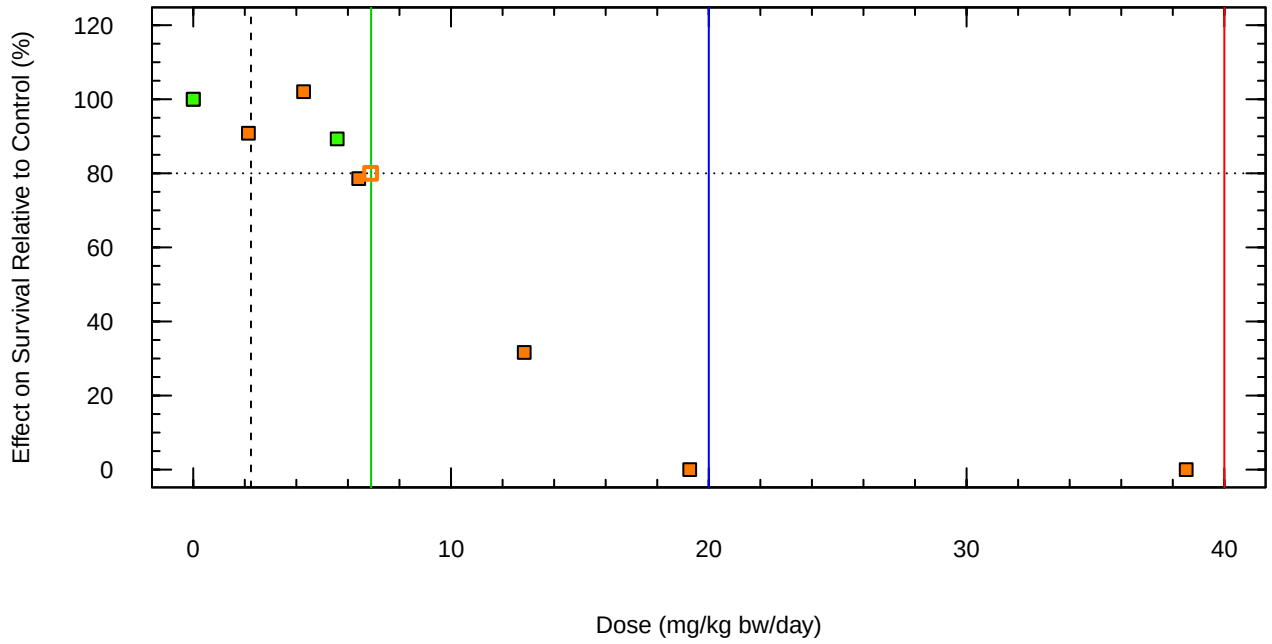
Eco−SSL TRV = 2.24 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 40 mg/kg bw/day
Selected TRV (Survival) = 6.9 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−12. Dose−Response Data for the Avian Reproduction Endpoint for Arsenic



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Albert et al. 2008b	zebra finch	survival	gavage	3	monomethylarsonic acid	
Howell and Hill 1978	chicken	survival	diet	3	arsenic trichloride	
ED20 for Albert et al. 2008b	zebra finch	survival	gavage	3	monomethylarsonic acid	6.9

Tier 1

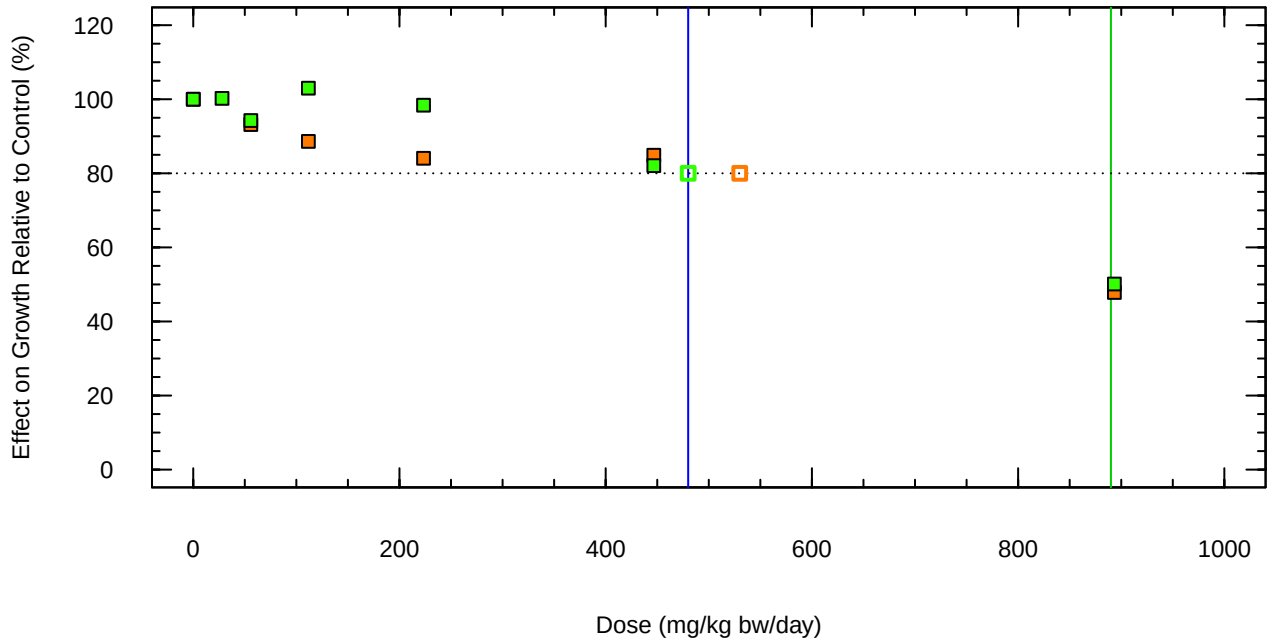
Eco−SSL TRV = 2.24 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 40 mg/kg bw/day
Selected TRV (Survival) = 6.9 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−13. Dose−Response Data for the Avian Survival Endpoint for Arsenic



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Johnson et al. 1960	chicken	body weight gain	diet	4	barium hydroxide	
Johnson et al. 1960	chicken	body weight gain	diet	4	barium acetate	
ED20 for Johnson et al. 1960	chicken	body weight gain	diet	4	barium hydroxide	530
ED20 for Johnson et al. 1960	chicken	body weight gain	diet	4	barium acetate	480

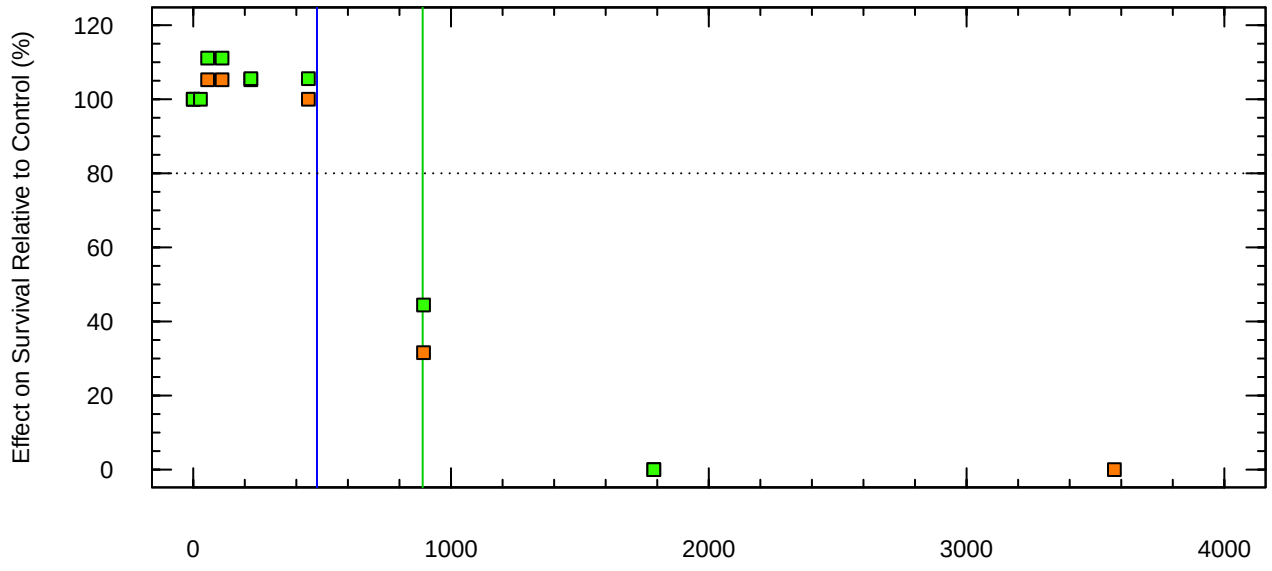
Tier 1

Selected TRV (Growth) = 480 mg/kg bw/day
Selected TRV (Survival) = 890 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−14. Dose−Response Data for the Avian Growth Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Johnson et al. 1960	chicken	survival	diet	4	barium hydroxide
Johnson et al. 1960	chicken	survival	diet	4	barium acetate

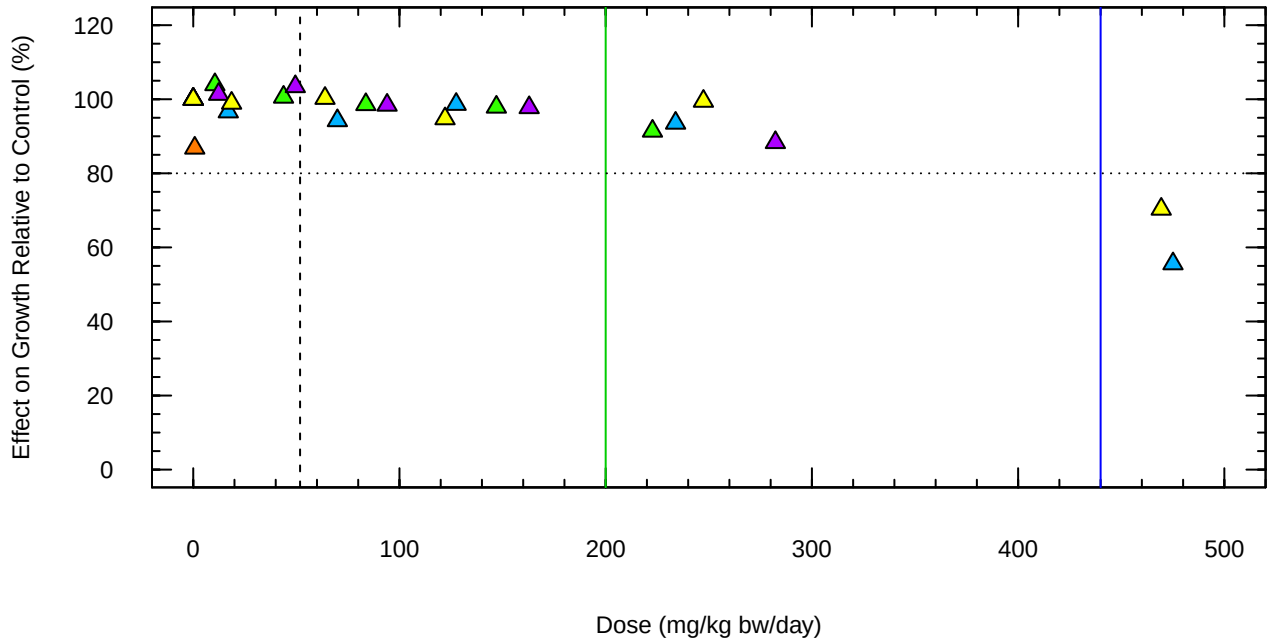
Tier 1

Selected TRV (Growth) = 480 mg/kg bw/day
Selected TRV (Survival) = 890 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−15. Dose−Response Data for the Avian Survival Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Schroeder and Mitchener 1975	mouse	body weight (female)	drinking water	104	barium acetate	
Dietz et al. 1992	rat	body weight (female)	drinking water	13	barium chloride dihydrate	B
Dietz et al. 1992	rat	body weight (male)	drinking water	13	barium chloride dihydrate	B
Dietz et al. 1992	mouse	body weight (female)	drinking water	13	barium chloride dihydrate	A
Dietz et al. 1992	mouse	body weight (male)	drinking water	13	barium chloride dihydrate	A

△ Tier 2

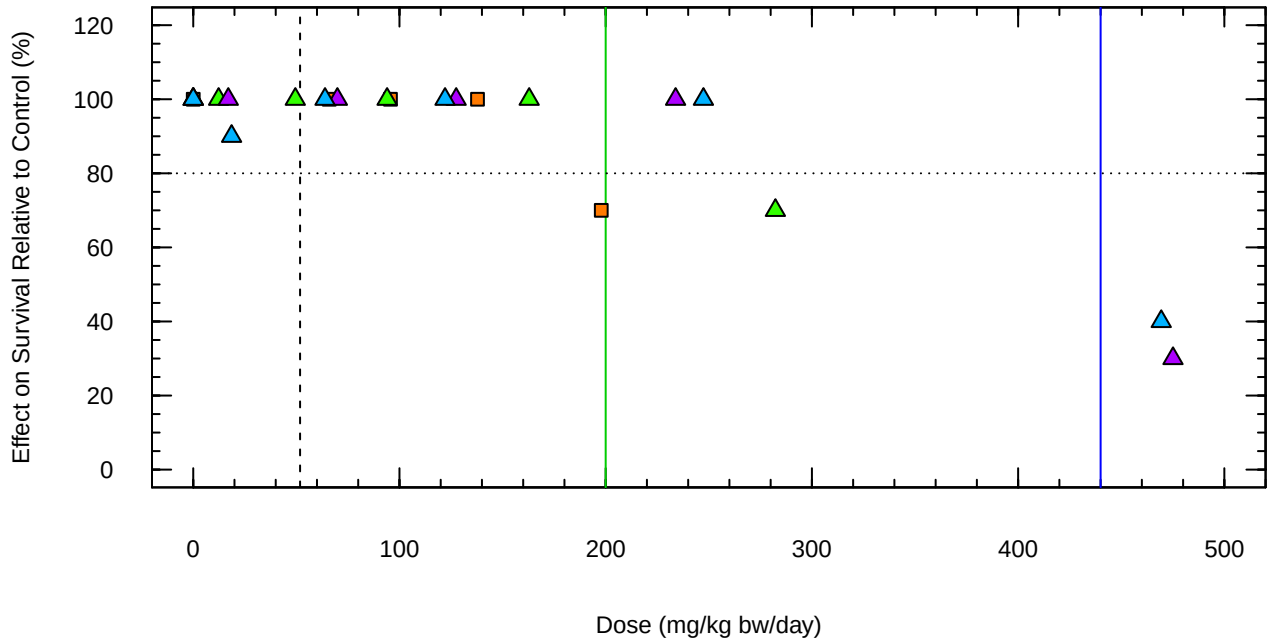
- - - Eco−SSL TRV = 51.8 mg/kg bw/day

Selected TRV (Growth) = 440 mg/kg bw/day
Selected TRV (Survival) = 200 mg/kg bw/day

····· 80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−16. Dose−Response Data for the Mammalian Growth Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Borzelleca et al. 1988	rat	survival (female)	gavage	1.4	barium chloride	
Dietz et al. 1992	rat	survival (male)	drinking water	13	barium chloride dihydrate	
Dietz et al. 1992	mouse	survival (female)	drinking water	13	barium chloride dihydrate	C
Dietz et al. 1992	mouse	survival (male)	drinking water	13	barium chloride dihydrate	C

Tier 1 Tier 2

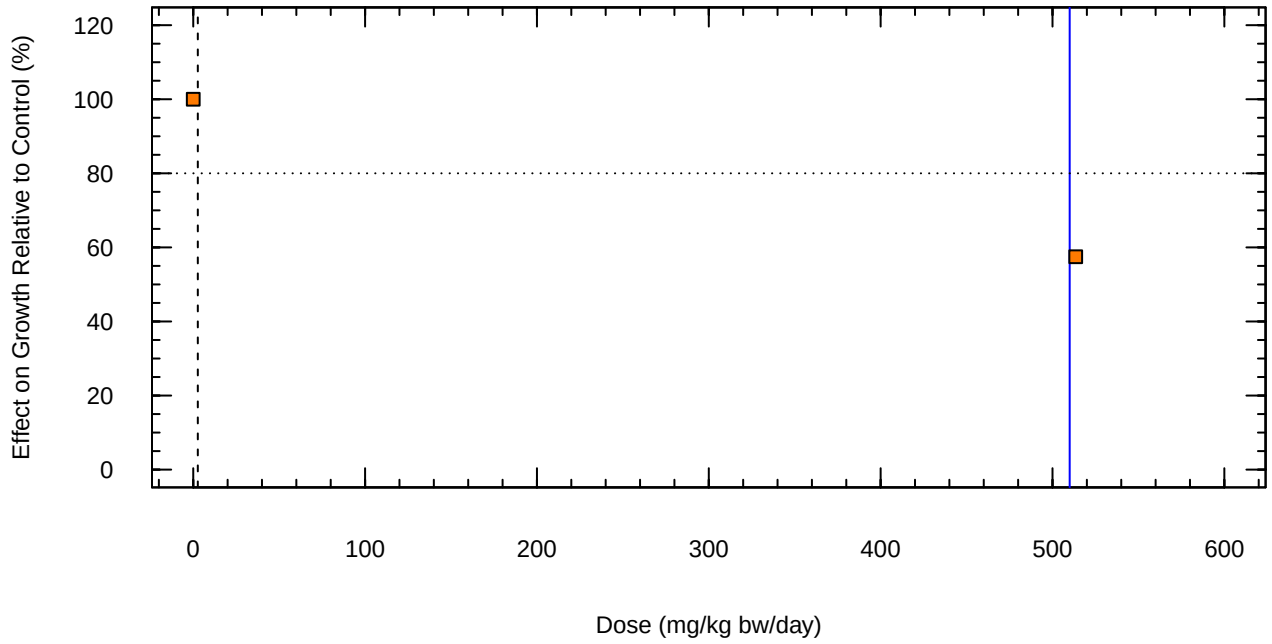
Eco−SSL TRV = 51.8 mg/kg bw/day

Selected TRV (Growth) = 440 mg/kg bw/day
Selected TRV (Survival) = 200 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−17. Dose−Response Data for the Mammalian Survival Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Chung et al. 1985	chicken	body weight	diet	2	chromium sulfate (chromium [III])

Tier 1

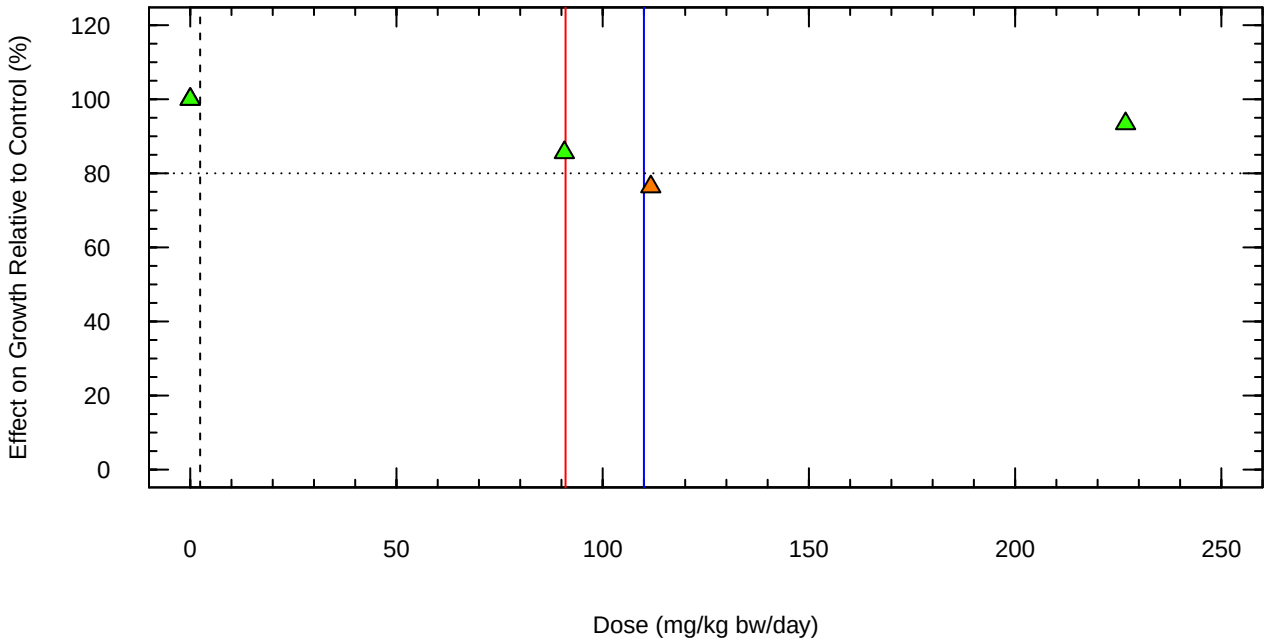
Eco−SSL TRV = 2.66 mg/kg bw/day

Selected TRV (Growth) = 510 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−18. Dose−Response Data for the Avian Growth Endpoint for Chromium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Bataineh et al. 1997	rat	body weight (male)	drinking water	12	chromium chloride (chromium [III])
Elbetieha and Al−Hamood 1997	mouse	body weight	drinking water	12	chromium chloride (chromium [III])

Tier 2

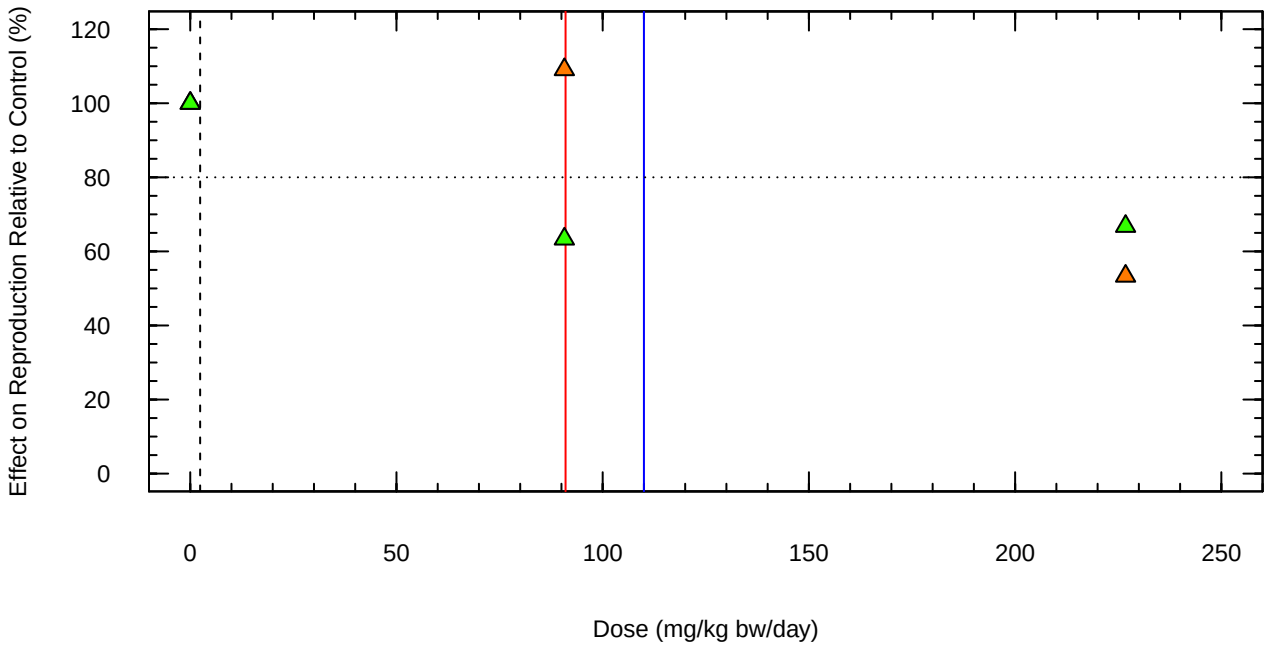
Eco−SSL TRV = 2.4 mg/kg bw/day

Selected TRV (Growth) = 110 mg/kg bw/day
Selected TRV (Reproduction) = 91 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−19. Dose−Response Data for the Mammalian Growth Endpoint for Chromium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Elbetieha and Al−Hamood 1997	mouse	pregnancy success	drinking water	12	chromium chloride (chromium [III])
Elbetieha and Al−Hamood 1997	mouse	viability of fetuses	drinking water	12	chromium chloride (chromium [III])

△ Tier 2

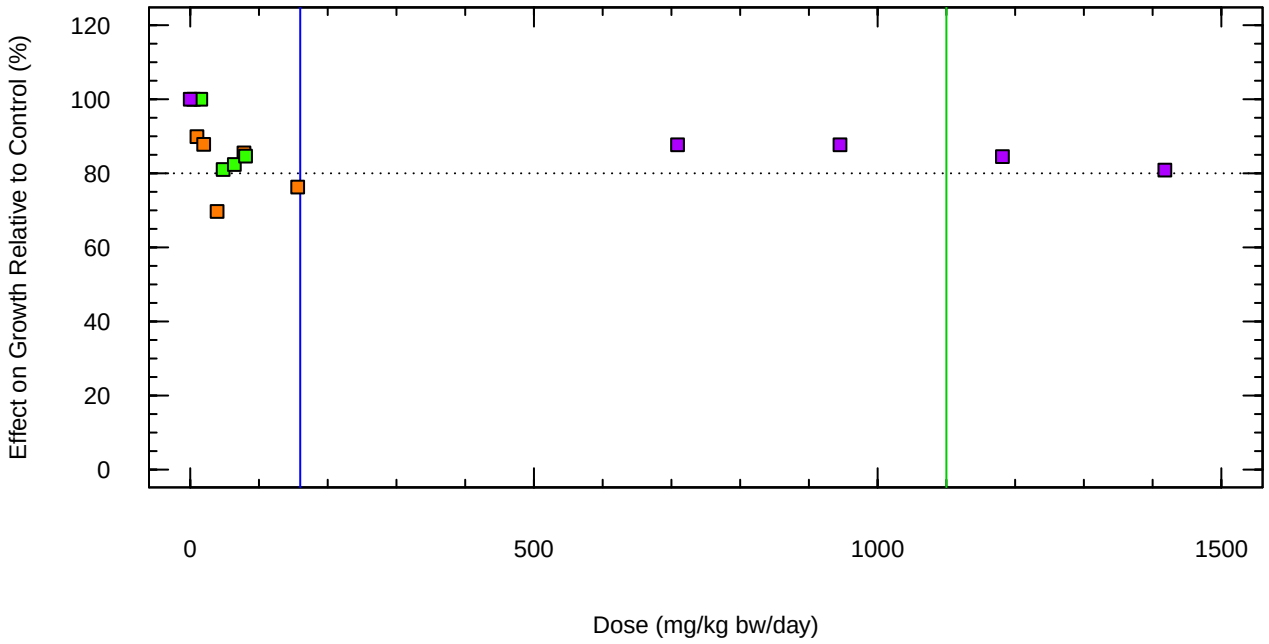
- - - Eco−SSL TRV = 2.4 mg/kg bw/day

Selected TRV (Growth) = 110 mg/kg bw/day
Selected TRV (Reproduction) = 91 mg/kg bw/day

····· 80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−20. Dose−Response Data for the Mammalian Reproduction Endpoint for Chromium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
McGhee et al. 1965	chicken	body weight	diet	4	iron sulfate
Cao et al. 1996	chicken	body weight	diet	3	iron sulfate
Pescatore and Harter−Dennis 1989	chicken	body weight	gavage	single dose	iron sulfate

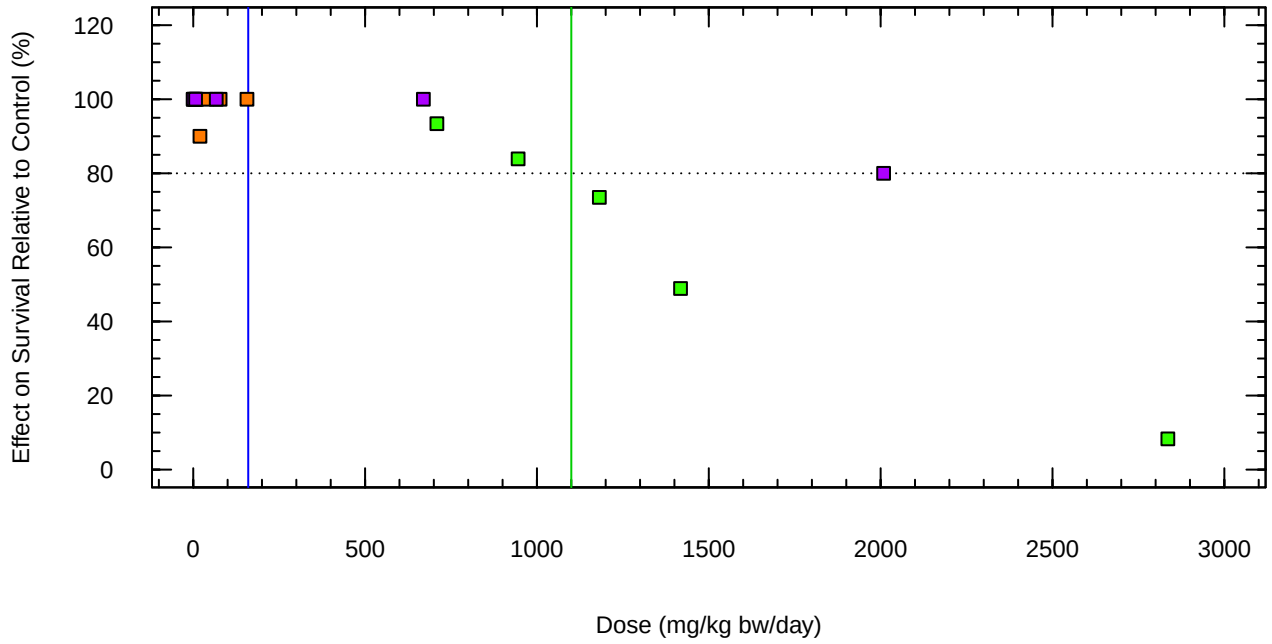
Tier 1

Selected TRV (Growth) = 160 mg/kg bw/day
Selected TRV (Survival) = 1100 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−21. Dose−Response Data for the Avian Growth Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
McGhee et al. 1965	chicken	survival	diet	4	iron sulfate	
Pescatore and Harter−Dennis 1989	chicken	survival	gavage	single dose	iron sulfate	A
Wallner−Pendleton et al. 1986	chicken	survival	gavage	single dose	iron sulfate	A

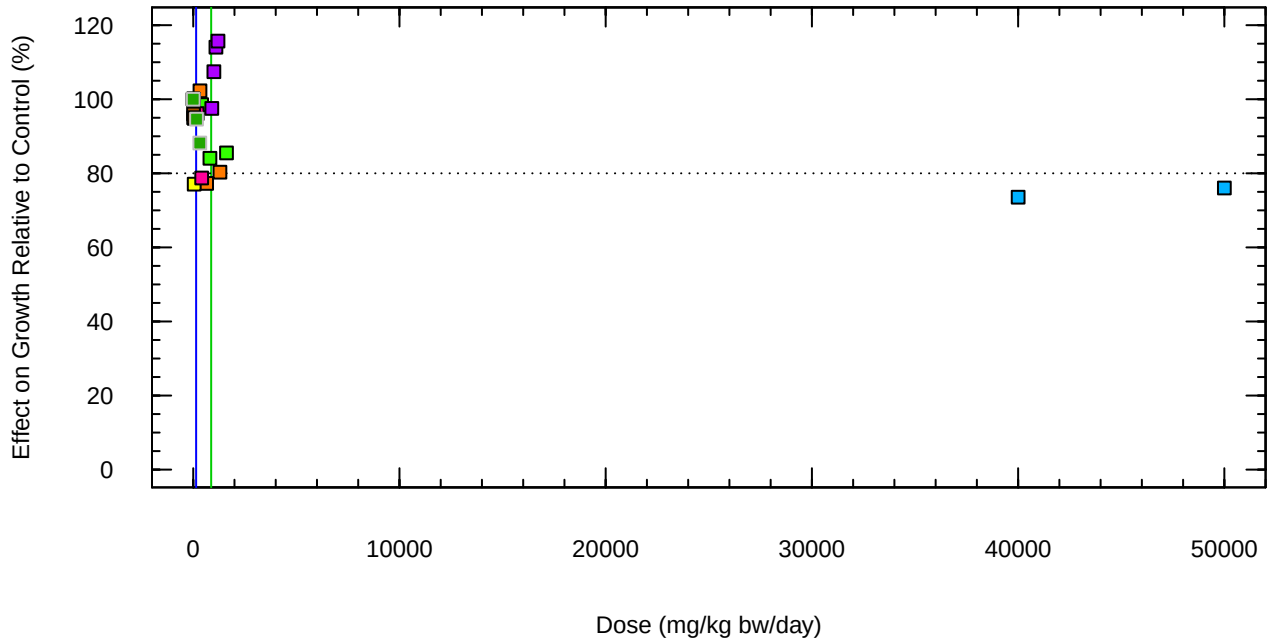
Tier 1

Selected TRV (Growth) = 160 mg/kg bw/day
Selected TRV (Survival) = 1100 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−22. Dose−Response Data for the Avian Survival Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Plummer et al. 1997	rat (male)	body weight	diet	32	carbonyl iron	
Plummer et al. 1997	rat (female)	body weight	diet	32	carbonyl iron	
Whittaker et al. 2002	rat	body weight	gavage	single dose	iron sulfate	
Whittaker et al. 2002	rat	body weight	gavage	single dose	carbonyl iron	
Banis et al. 1969	rat	body weight	diet	4	iron sulfate	A
Storey and Greger 1987	rat	body weight	diet	3	iron sulfate	A
Prince et al. 1979	pig	body weight	diet	16	ferrous sulfide	
Zhu et al. 2016	rat	body weight	diet	13	carbonyl iron	

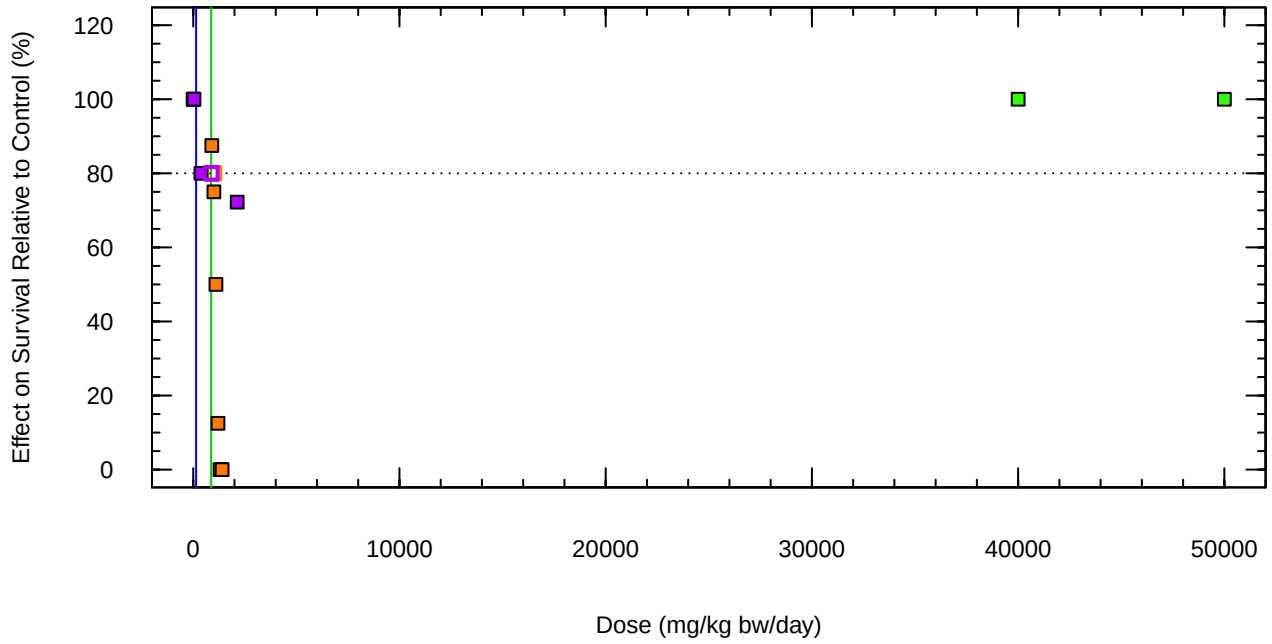
Tier 1

Selected TRV (Growth) = 140 mg/kg bw/day
Selected TRV (Survival) = 870 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−23. Dose−Response Data for the Mammalian Growth Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Whittaker et al. 2002	rat	survival	gavage	single dose	iron sulfate	
Whittaker et al. 2002	rat	survival	gavage	single dose	carbonyl iron	
Whittaker et al. 1996	rat	survival	diet	12	carbonyl iron	
ED20 for Whittaker et al. 2002	rat	survival	gavage	single dose	iron sulfate	1000
ED20 for Whittaker et al. 1996	rat	survival	diet	12	carbonyl iron	870

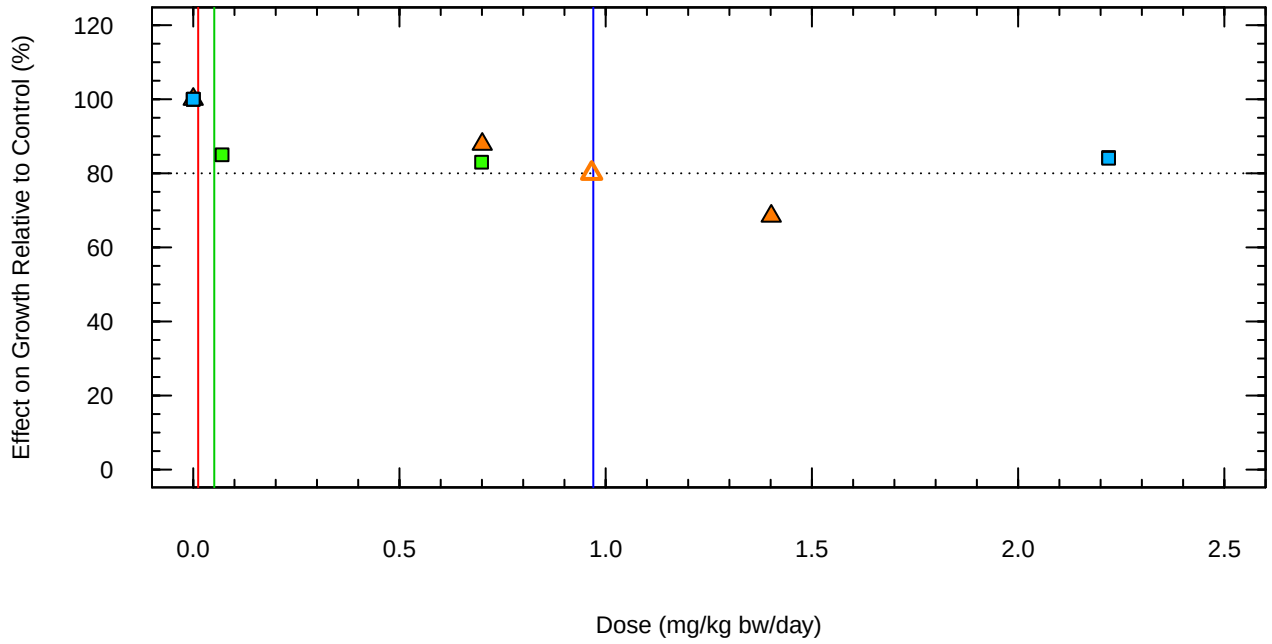
Tier 1

Selected TRV (Growth) = 140 mg/kg bw/day
Selected TRV (Survival) = 870 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−24. Dose−Response Data for the Mammalian Survival Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Scott et al. 1977	chicken	body weight	diet	8	methylmercury chloride		
Spalding et al. 2000	egret	weight index	diet	14	methylmercury chloride		
Sell and Horani 1976	chicken	body weight gain (Exp 1)	diet	4	methylmercury chloride	A	
Sell and Horani 1976	chicken	body weight gain (Exp 2)	diet	3.6	methylmercury chloride	A	
ED20 for Scott et al. 1977	chicken	body weight	diet	8	methylmercury chloride		0.97

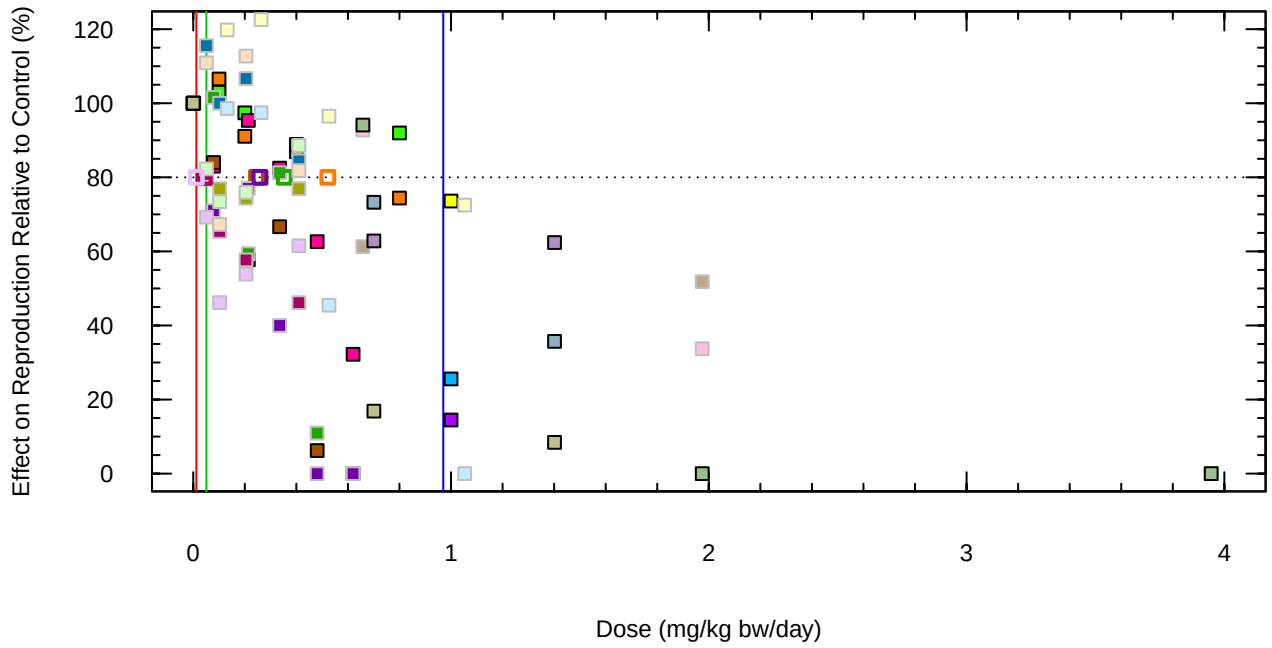
Tier 1 Tier 2

Selected TRV (Growth) = 0.97 mg/kg bw/day
Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−25. Dose−Response Data for the Avian Growth Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	
Heinz et al. 2010	mallard	duckling body weight	diet	3.7	methylmercury chloride		
Heinz and Hoffman 1998	mallard	# of ducklings per hen	diet	up to 11	methylmercury chloride	B	
Heinz and Hoffman 1998	mallard	% hatchability	diet	up to 11	methylmercury chloride		
Heinz and Hoffman 1998	mallard	duckling survival	diet	up to 11	methylmercury chloride		
Albers et al. 2007	kestrel	egg production	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		
Varian−Ramos et al. 2014	finch	% hatchability	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % hatchability	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % chicks fledged	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		
Eskeland and Nafstad 1978	quail	chick survival	diet	6	methylmercury chloride		
Eskeland and Nafstad 1978	quail	hatch success	diet	6	methylmercury chloride		
El−Begearmi et al. 1977	quail	% egg fertility	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	egg production	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	% hatchability	diet	16	methylmercury hydroxide		
Scott et al. 1977	chicken	egg fertility	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg production	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg hatchability	diet	8	methylmercury chloride		
ED20 for Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	0.52
ED20 for Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		0.25
ED20 for Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		0.35
ED20 for Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		0.26
ED20 for Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		0.047
ED20 for Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		0.043
ED20 for Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		0.012

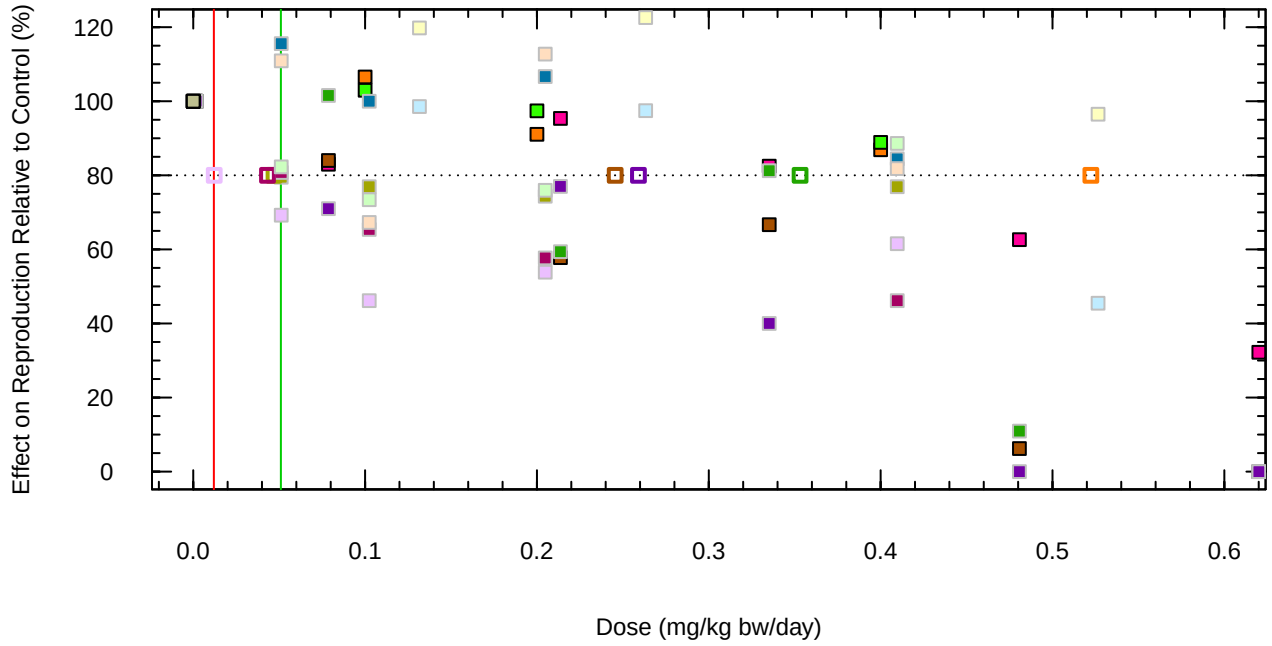
Tier 1

Selected TRV (Growth) = 0.97 mg/kg bw/day
Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−26a. Dose−Response Data for the Avian Reproduction Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	
Heinz et al. 2010	mallard	duckling body weight	diet	3.7	methylmercury chloride		
Heinz and Hoffman 1998	mallard	# of ducklings per hen	diet	up to 11	methylmercury chloride	B	
Heinz and Hoffman 1998	mallard	% hatchability	diet	up to 11	methylmercury chloride		
Heinz and Hoffman 1998	mallard	duckling survival	diet	up to 11	methylmercury chloride		
Albers et al. 2007	kestrel	egg production	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		
Varian−Ramos et al. 2014	finch	% hatchability	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % hatchability	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % chicks fledged	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		
Eskeland and Nafstad 1978	quail	chick survival	diet	6	methylmercury chloride		
Eskeland and Nafstad 1978	quail	hatch success	diet	6	methylmercury chloride		
El−Begearmi et al. 1977	quail	% egg fertility	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	egg production	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	% hatchability	diet	16	methylmercury hydroxide		
Scott et al. 1977	chicken	egg fertility	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg production	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg hatchability	diet	8	methylmercury chloride		
ED20 for Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	0.52
ED20 for Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		0.25
ED20 for Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		0.35
ED20 for Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		0.26
ED20 for Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		0.047
ED20 for Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		0.043
ED20 for Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		0.012

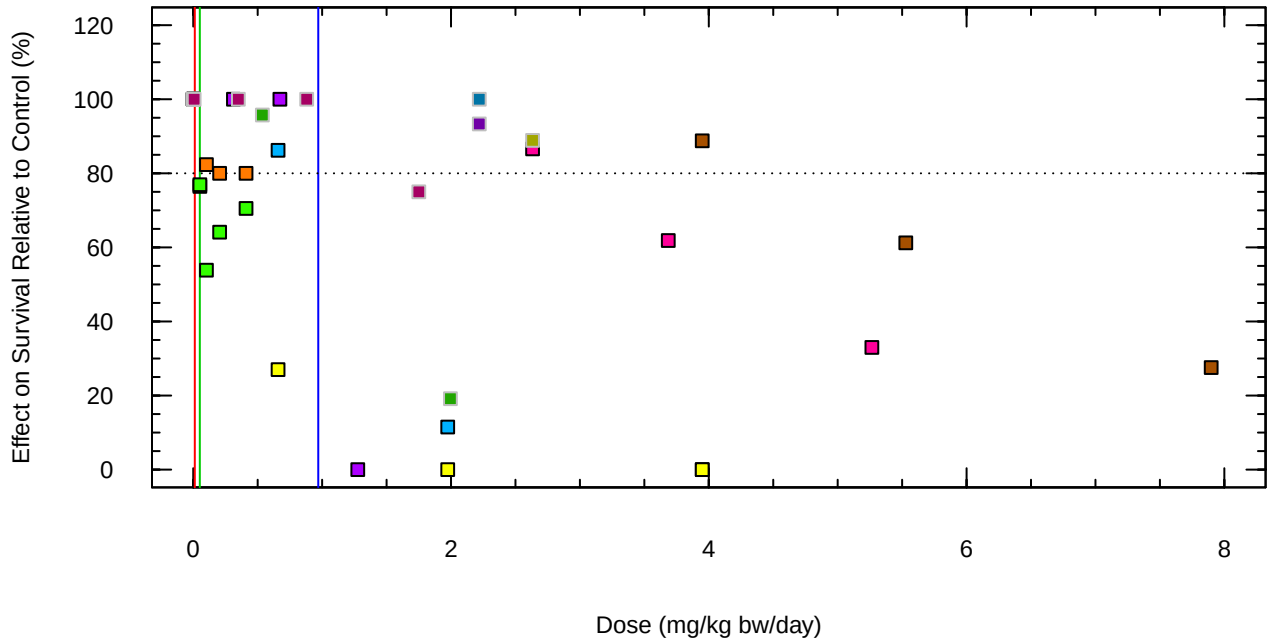
Tier 1

Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day
Selected TRV (Growth) = 0.97 mg/kg bw/day (not shown on plot because of truncated X−axis)

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−26b. Dose−Response Data for the Avian Reproduction Endpoint for Methylmercury (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Varian−Ramos et al. 2014	finch	survival	diet	52	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	F1 survival	diet	unclear	methylmercury cysteine	
Bennet et al. 2009	kestrel	survival	diet	5−7	methylmercury chloride	
El−Begearmi et al. 1977	quail	survival (female)	diet	16	methylmercury hydroxide	C
El−Begearmi et al. 1977	quail	survival (male)	diet	16	methylmercury hydroxide	C
Hill and Soares 1987	quail	survival	diet	0.71	methylmercury chloride	
Hill and Soares 1987	quail	survival	diet	0.71	methylmercury chloride	
Spann et al. 1986	quail	survival	diet	6	methylmercury chloride	
Sell and Horani 1976	chicken	survival (Exp 1)	diet	4	methylmercury chloride	
Sell and Horani 1976	chicken	survival (Exp 2)	diet	3.6	methylmercury chloride	
Sell and Horani 1976	quail	survival (Exp 2)	diet	3.3	methylmercury chloride	
Scheuhammer 1988	finch	survival	diet	11	methylmercury chloride	

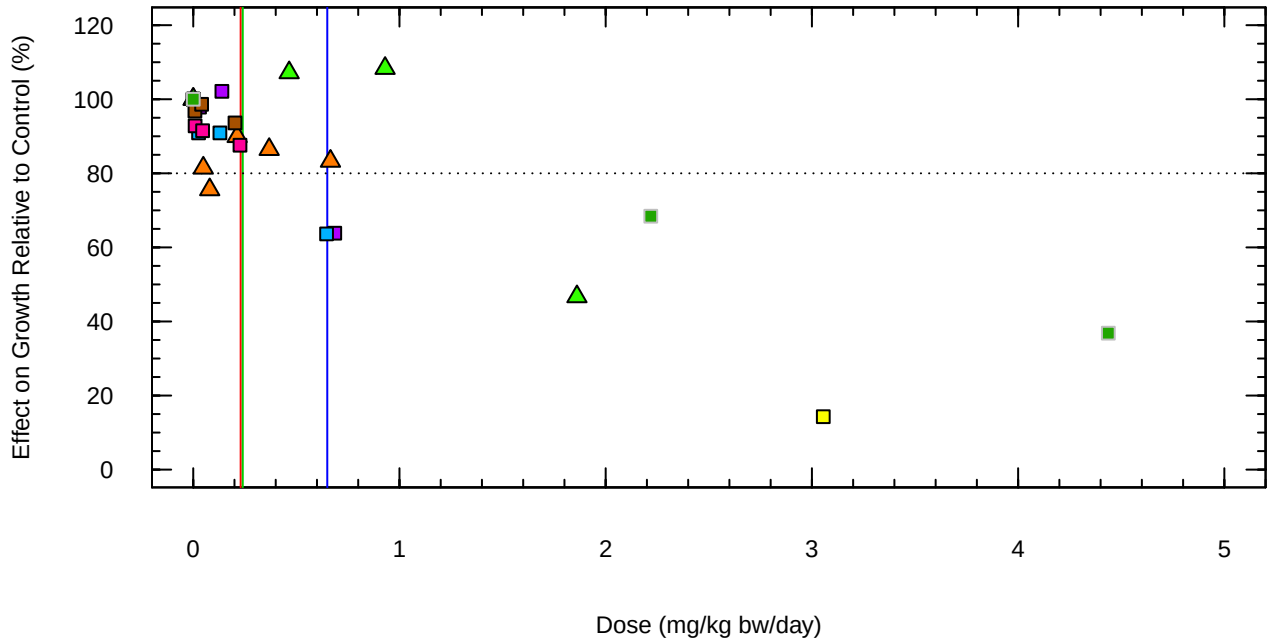
Tier 1

Selected TRV (Growth) = 0.97 mg/kg bw/day
Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−27. Dose−Response Data for the Avian Survival Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Wobeser et al. 1976	mink	body weight	diet	13	methylmercury chloride	
Gandhi et al. 2013	rat	body weight gain	gavage	3	methylmercury chloride	
Mitsumori et al. 1990	mouse	body weight	diet	104	methylmercury chloride	
Mitsumori et al. 1983	rat	body weight	diet	130	methylmercury chloride	D
Stillings et al. 1974	rat	body weight gain	diet	4	methylmercury chloride	
Verschuuren et al. 1976a	rat	F2 body weight gain	diet	12	methylmercury chloride	
Verschuuren et al. 1976b	rat	body weight	diet	104	methylmercury chloride	D
Friedman et al. 1978	rat	body weight	diet	10	methylmercury chloride	

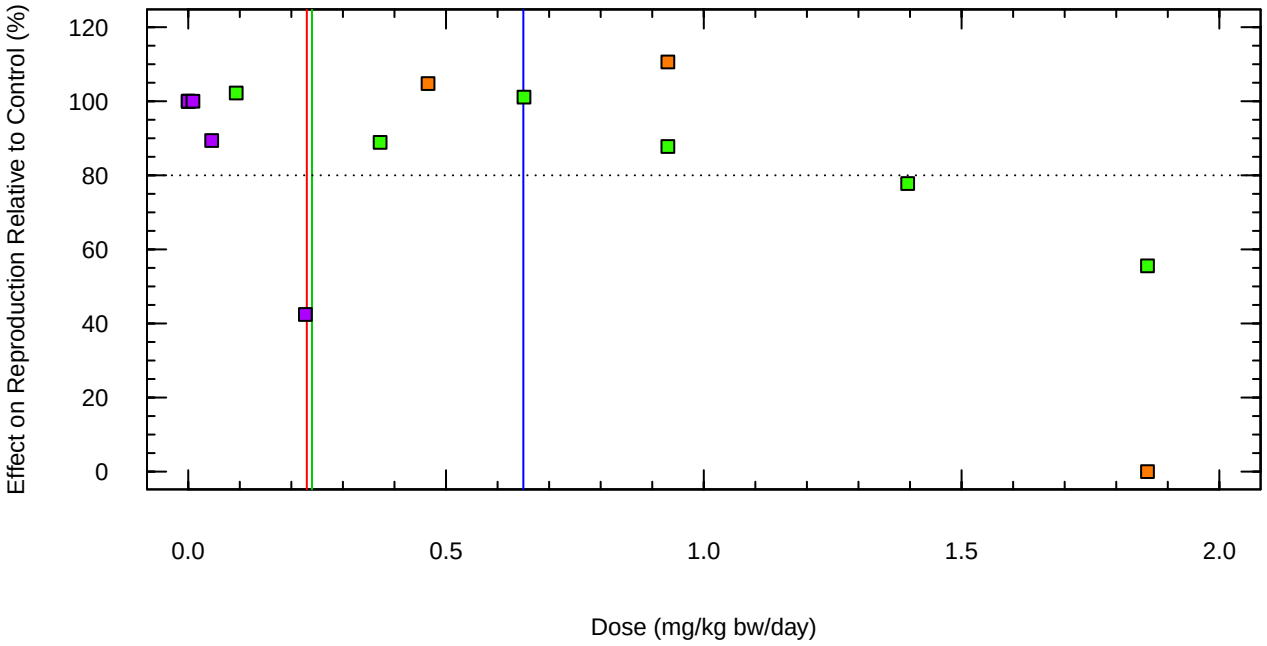
Tier 1 Tier 2

Selected TRV (Growth) = 0.65 mg/kg bw/day
Selected TRV (Reproduction) = 0.23 mg/kg bw/day
Selected TRV (Survival) = 0.24 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−28. Dose−Response Data for the Mammalian Growth Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Gandhi et al. 2013	rat	fetal survival	gavage	3	methylmercury chloride
Tonk et al. 2010	rat	litter survival	gavage	variable	methylmercury chloride
Verschuuren et al. 1976a	rat	F1 viability index	diet	12	methylmercury chloride

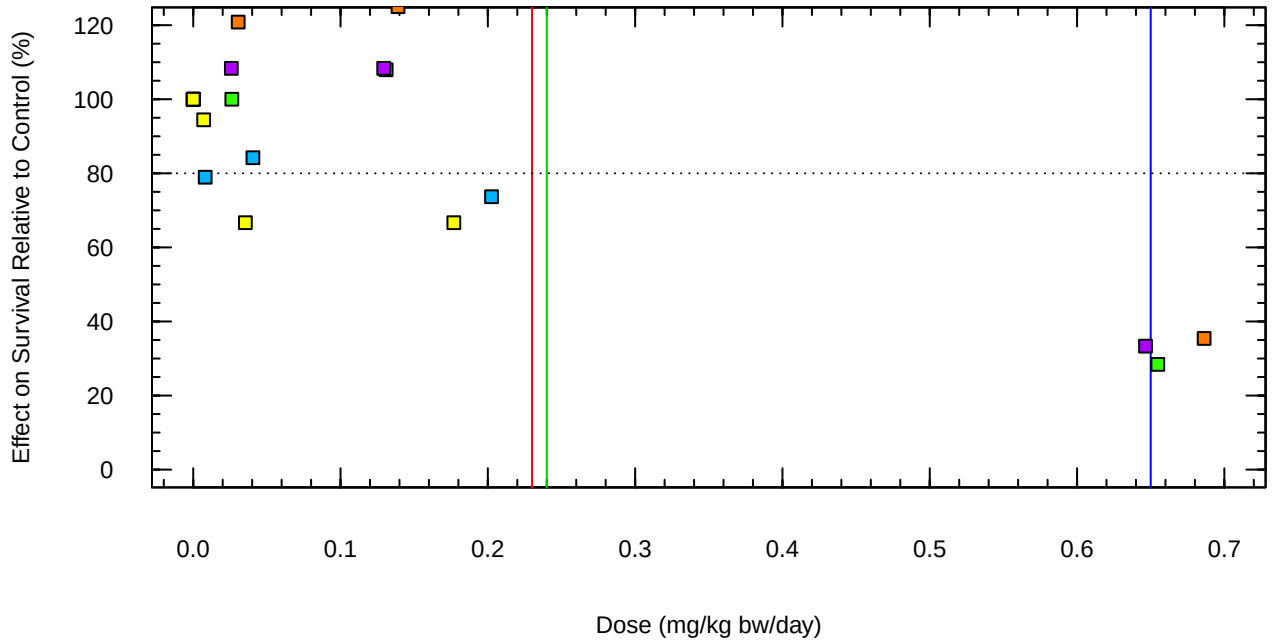
Tier 1

Selected TRV (Growth) = 0.65 mg/kg bw/day
Selected TRV (Reproduction) = 0.23 mg/kg bw/day
Selected TRV (Survival) = 0.24 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−29. Dose−Response Data for the Mammalian Reproduction Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Mitsumori et al. 1990	mouse	survival	diet	104	methylmercury chloride	
Mitsumori et al. 1983	rat	survival	diet	130	methylmercury chloride	E
Mitsumori et al. 1983	rat	survival	diet	130	methylmercury chloride	E
Verschuuren et al. 1976b	rat	survival (female)	diet	104	methylmercury chloride	E
Verschuuren et al. 1976b	rat	survival (male)	diet	104	methylmercury chloride	E

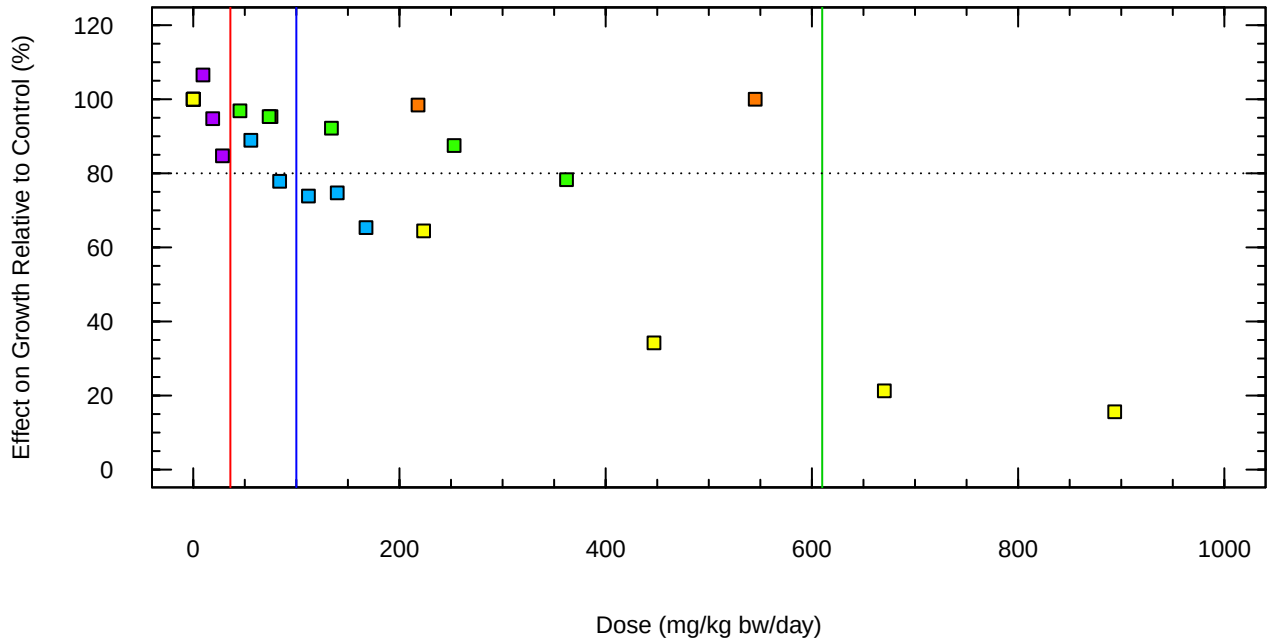
Tier 1

Selected TRV (Growth) = 0.65 mg/kg bw/day
Selected TRV (Reproduction) = 0.23 mg/kg bw/day
Selected TRV (Survival) = 0.24 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−30. Dose−Response Data for the Mammalian Survival Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Stafford et al. 2015	bobwhite quail	body weight gain	diet	4.3	molydenum disulfide	
Stafford et al. 2015	bobwhite quail	body weight gain	diet	4.3	sodium molybdate	
Kratzer 1952	chicken	weight gain	diet	3.3	sodium molybdate	
Davies et al. 1960	chicken	body weight (Exp 1b)	diet	4	sodium molybdate	A
Davies et al. 1960	chicken	body weight (Exp 1c)	diet	4	sodium molybdate	A

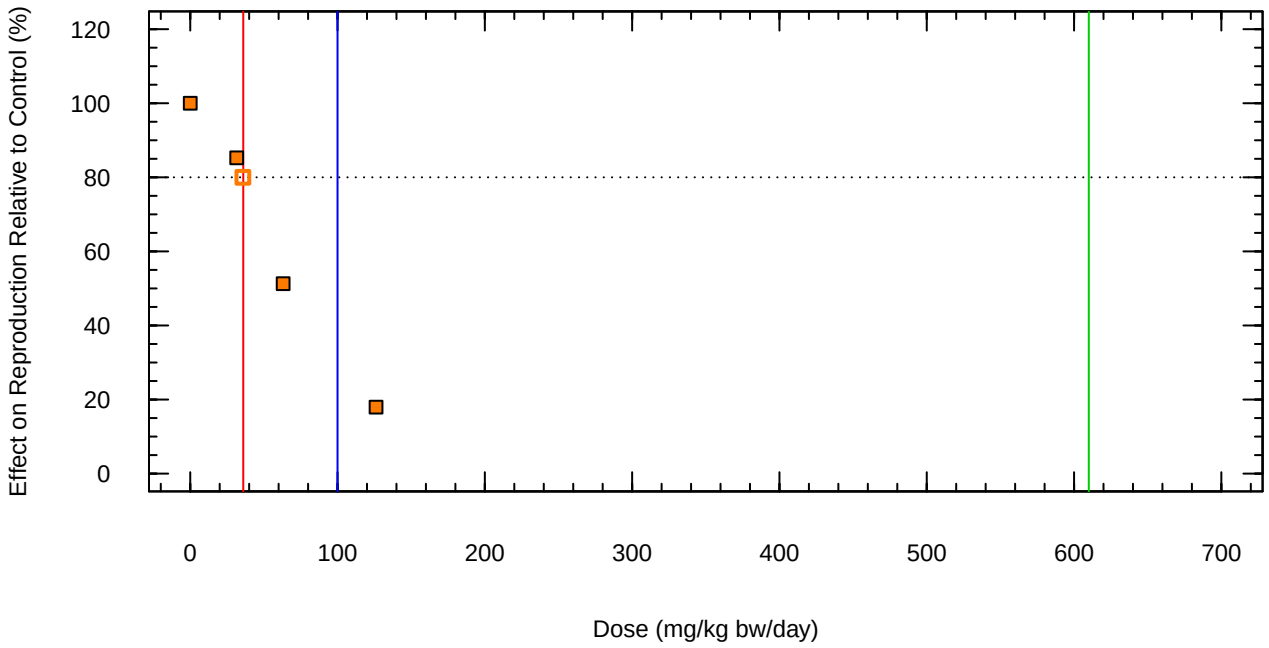
Tier 1

Selected TRV (Growth) = 100 mg/kg bw/day
Selected TRV (Reproduction) = 36 mg/kg bw/day
Selected TRV (Survival) = 610 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−31. Dose−Response Data for the Avian Growth Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Lepore and Miller 1965	chicken	egg production	diet	3	sodium molybdate	
ED20 for Lepore and Miller 1965	chicken	egg production	diet	3	sodium molybdate	36

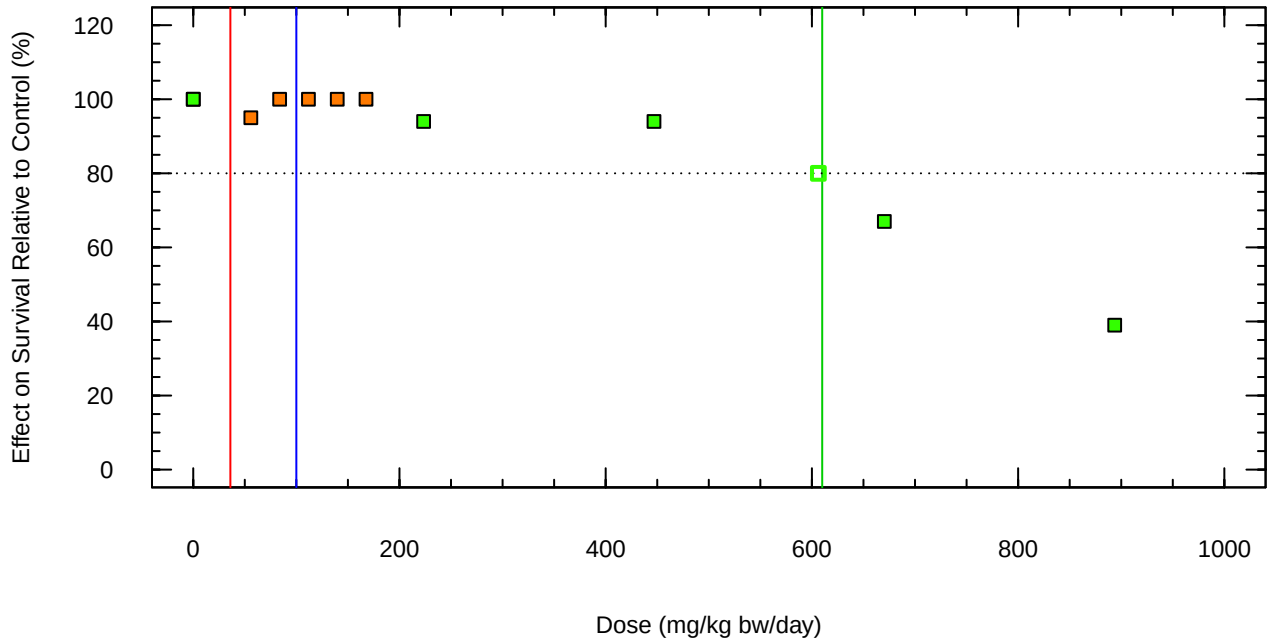
Tier 1

Selected TRV (Growth) = 100 mg/kg bw/day
Selected TRV (Reproduction) = 36 mg/kg bw/day
Selected TRV (Survival) = 610 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−32. Dose−Response Data for the Avian Reproduction Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Davies et al. 1960	chicken	survival (Exp 1b)	diet	4	sodium molybdate	
Davies et al. 1960	chicken	survival (Exp 1c)	diet	4	sodium molybdate	
ED20 for Davies et al. 1960	chicken	survival (Exp 1c)	diet	4	sodium molybdate	610

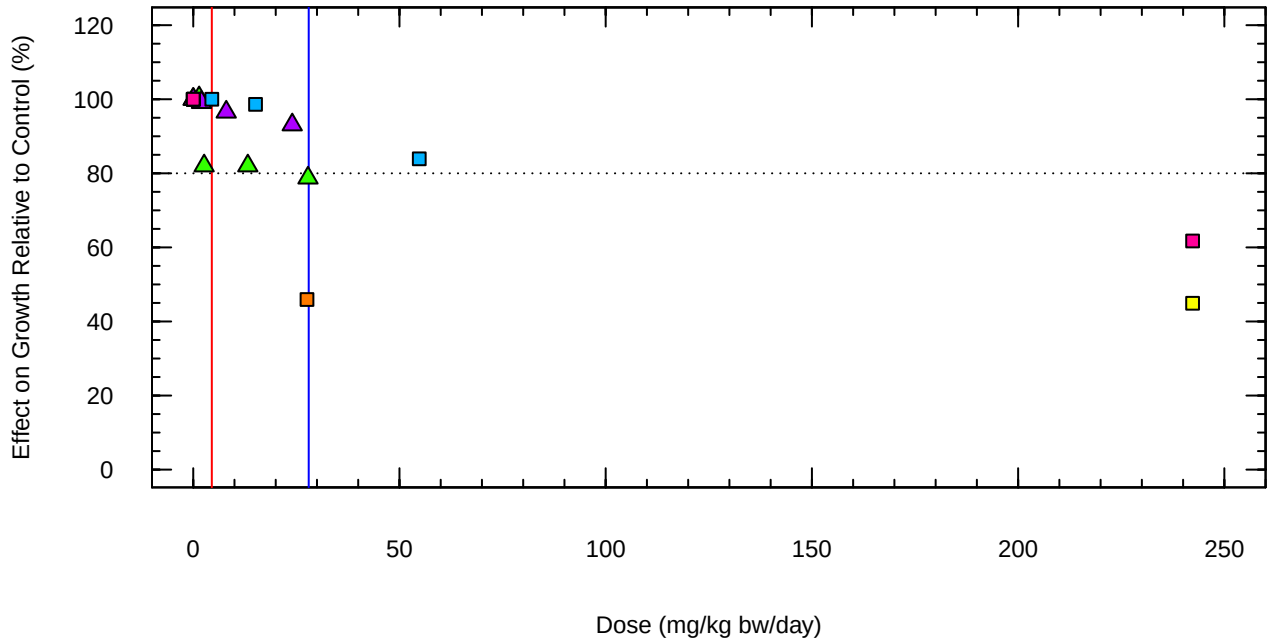
Tier 1

Selected TRV (Growth) = 100 mg/kg bw/day
Selected TRV (Reproduction) = 36 mg/kg bw/day
Selected TRV (Survival) = 610 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−33. Dose−Response Data for the Avian Survival Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Brinkman and Miller 1961	rat	body weight gain	diet	6	sodium molybdate	
Fungwe et al. 1990	rat	body weight gain	drinking water	9	sodium molybdate	
Lyubimov et al. 2004	rat	body weight	gavage	8	ammonium tetrathiomolybdate	
Murray et al. 2013	rat	body weight	diet	12	sodium molybdate dihydrate	
Bandyopadhyay et al. 1981	rat	body weight gain	oral	4	ammonium molybdate	A
Bandyopadhyay et al.1981	rat	body weight gain	oral	4	ammonium molybdate	A

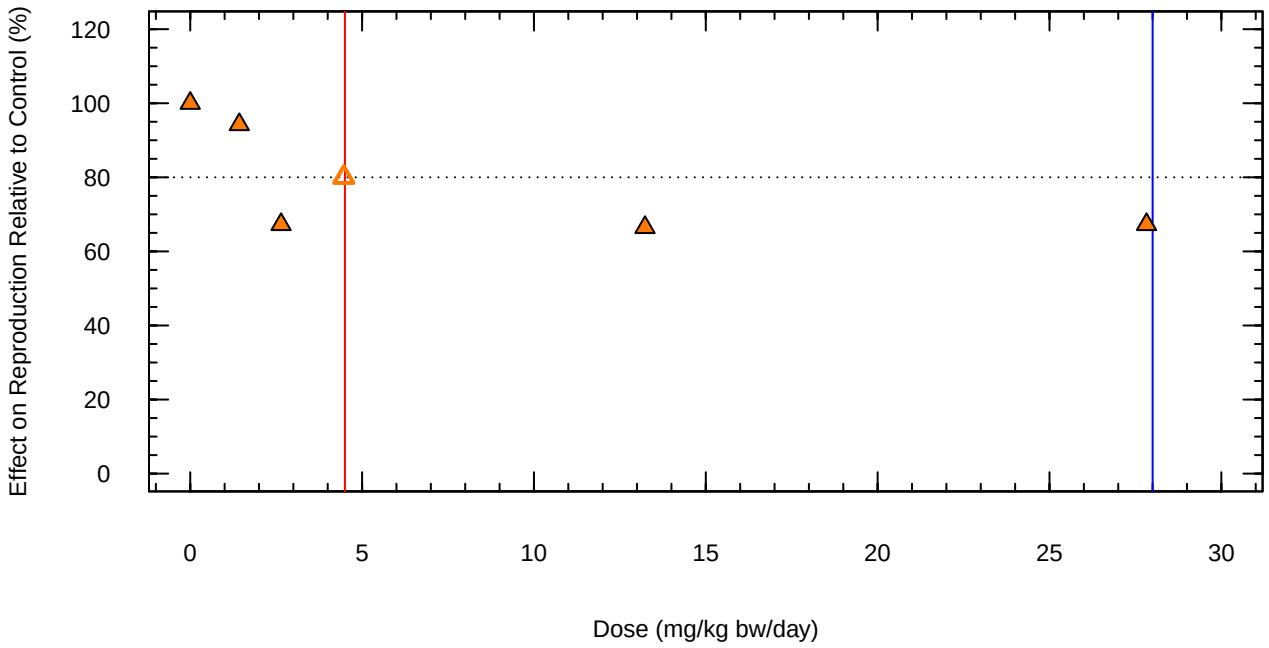
Tier 1 Tier 2

Selected TRV (Growth) = 28 mg/kg bw/day
Selected TRV (Reproduction) = 4.5 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−34. Dose−Response Data for the Mammalian Growth Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Fungwe et al. 1990	rat	litter weight	drinking water	9	sodium molybdate	
ED20 for Fungwe et al. 1990	rat	litter weight	drinking water	9	sodium molybdate	4.5

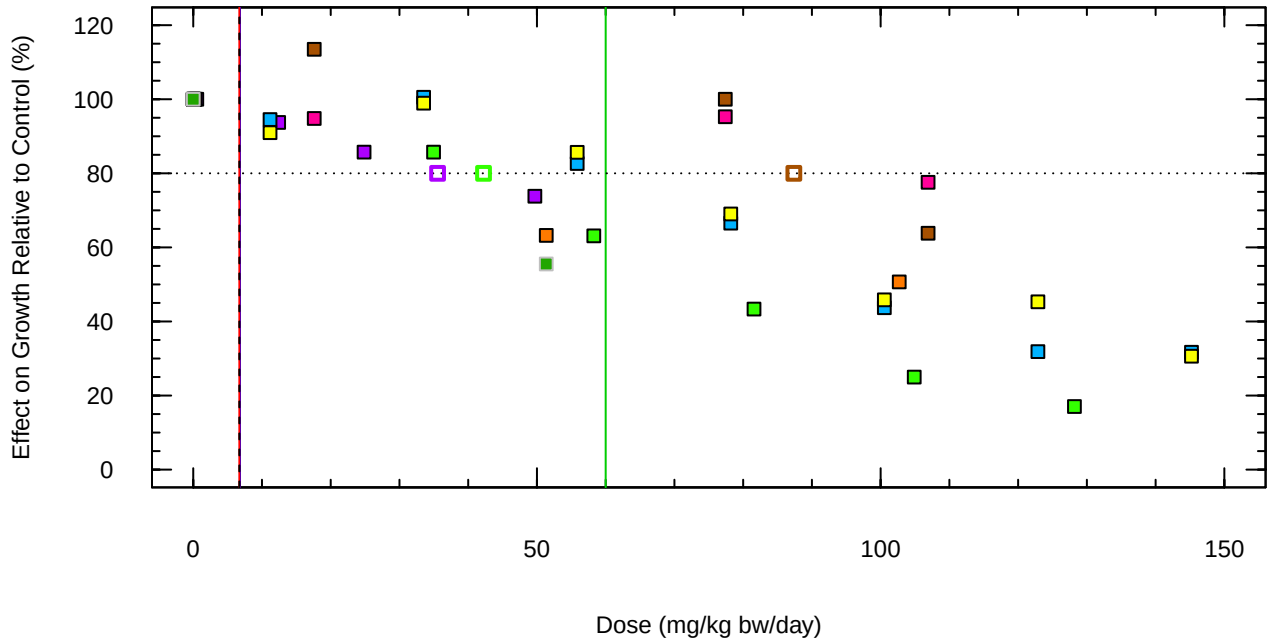
Tier 2

Selected TRV (Growth) = 28 mg/kg bw/day
Selected TRV (Reproduction) = 4.5 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−35. Dose−Response Data for the Mammalian Reproduction Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Hill 1979	chicken	body weight gain	diet	2	nickel chloride	A	
Ling and Leach 1979	chicken	body weight	diet	3	nickel chloride		
Martinez and Diaz 1996	chicken	body weight	diet	6	nickel chloride		
Weber and Reid 1968	chicken	body weight	diet	4	nickel sulfate		
Weber and Reid 1968	chicken	body weight	diet	4	nickel acetate		
Cain and Pafford 1981	mallard	body weight (female)	diet	8.6	nickel sulfate		
Cain and Pafford 1981	mallard	body weight (male)	diet	4	nickel sulfate		
Hill 1985	chicken	body weight gain	diet	2.7	nickel chloride	A	
ED20 for Ling and Leach 1979	chicken	body weight	diet	3	nickel chloride		42
ED20 for Martinez and Diaz 1996	chicken	body weight	diet	6	nickel chloride		36
ED20 for Cain and Pafford 1981	mallard	body weight (male)	diet	4	nickel sulfate		87

Tier 1

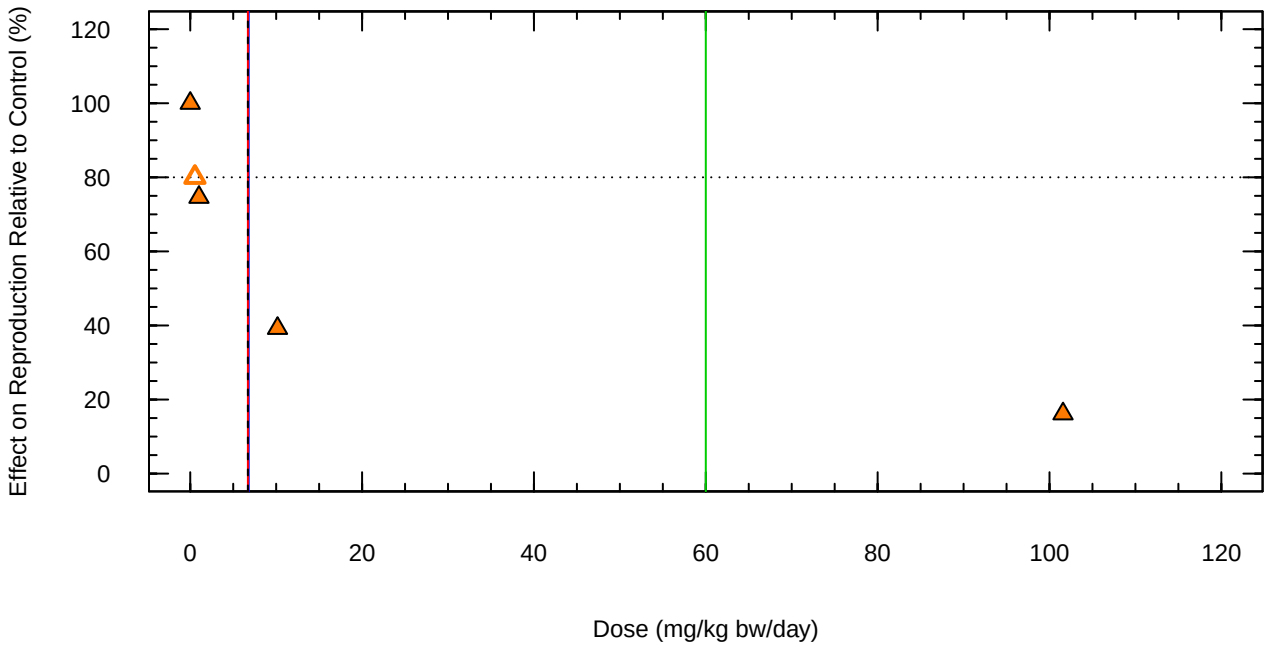
Eco−SSL TRV = 6.71 mg/kg bw/day

Selected TRV (Growth) = 6.8 mg/kg bw/day
Selected TRV (Reproduction) = 6.71 mg/kg bw/day
Selected TRV (Survival) = 60 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−36. Dose−Response Data for the Avian Growth Endpoint for Nickel



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Arpasova et al. 2007	chicken	egg production	drinking water	4	nickel chloride	
ED20 for Arpasova et al. 2007	chicken	egg production	drinking water	4	nickel chloride	0.54

Tier 2

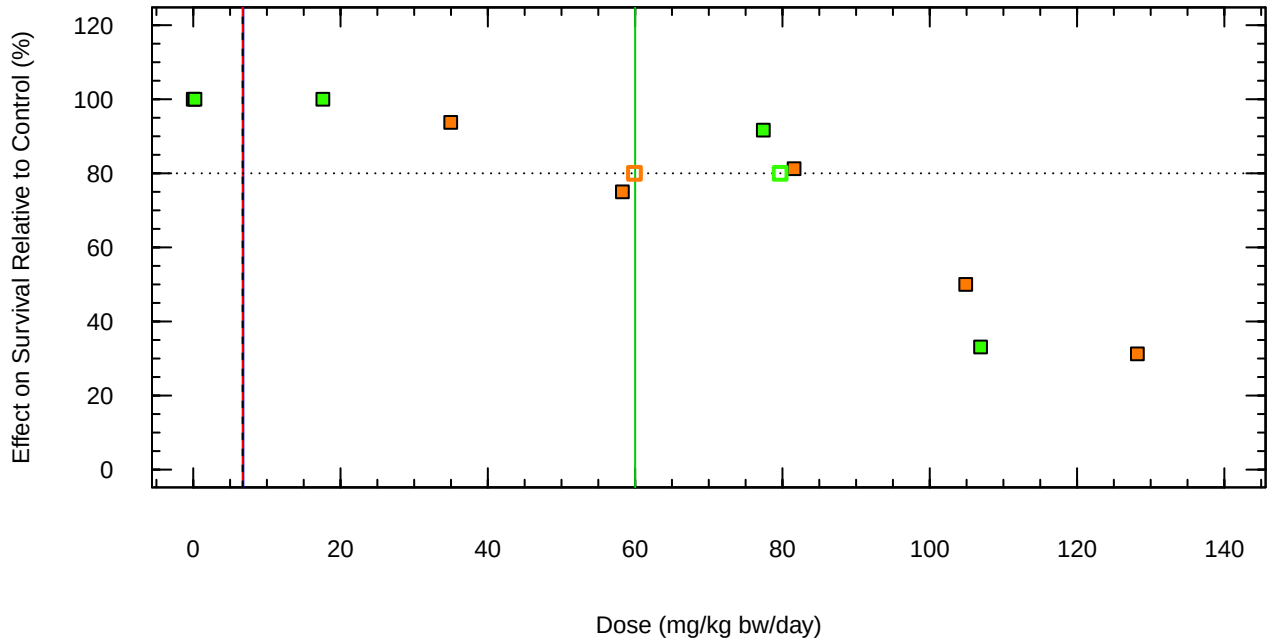
Eco−SSL TRV = 6.71 mg/kg bw/day

Selected TRV (Growth) = 6.8 mg/kg bw/day
Selected TRV (Reproduction) = 6.71 mg/kg bw/day
Selected TRV (Survival) = 60 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−37. Dose−Response Data for the Avian Reproduction Endpoint for Nickel



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Ling and Leach 1979	chicken	survival	diet	3	nickel chloride	
Cain and Pafford 1981	mallard	survival	diet	12.9	nickel sulfate	
ED20 for Ling and Leach 1979	chicken	survival	diet	3	nickel chloride	60
ED20 for Cain and Pafford 1981	mallard	survival	diet	12.9	nickel sulfate	80

Tier 1

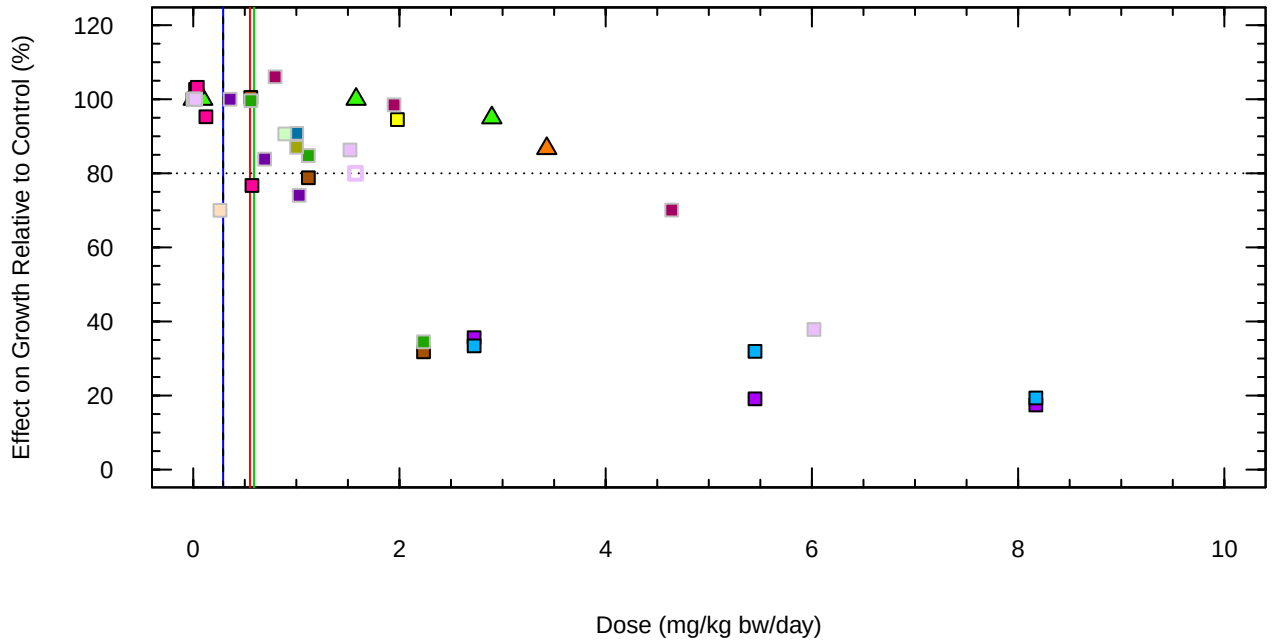
Eco−SSL TRV = 6.71 mg/kg bw/day

Selected TRV (Growth) = 6.8 mg/kg bw/day
Selected TRV (Reproduction) = 6.71 mg/kg bw/day
Selected TRV (Survival) = 60 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−38. Dose−Response Data for the Avian Survival Endpoint for Nickel



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Gad and El−Twab 2009	quail	body weight	gavage	4	sodium selenite		
Santolo et al. 2010	quail	body weight gain	diet	4	seleno−L−methionine		
El−Begearmi and Combs 1982	chicken	body weight (brewer's yeast diet)	diet	4	sodium selenite	A	
El−Begearmi and Combs 1982	chicken	body weight (corn−soy diet)	diet	4	sodium selenite	A	
Heinz and Fitzgerald 1993a	mallard	body weight	diet	21	seleno−DL−methionine	D	
Jensen 1986	chicken	body weight	diet	3	sodium selenite	A	
Hill 1979a	chicken	body weight gain (Exp 1)	diet	4−5	selenium dioxide	B	
Hill 1979a	chicken	body weight gain (Exp 2)	diet	4−5	selenium dioxide	B	
Echevarria et al. 1988	chicken	body weight gain	diet	3	sodium selenite	C	
Stowesand et al. 1977	quail	body weight	diet	10	sodium selenite		
Stowesand et al. 1977	quail	body weight	diet	10	seleniferous wheat		
O'Toole and Raisbeck 1997	mallard	body weight	diet	21	seleno−L−methionine	D	
Dafalla and Adam 1986	chicken	body weight	diet	4	sodium selenite	A	
Sell and Horani 1976	chicken	body weight gain	diet	4	sodium selenite	C	
Hoffman et al. 1992	mallard	body weight	diet	4	seleno−DL−methionine		
ED20 for Hoffman et al. 1992	mallard	body weight	diet	4	seleno−DL−methionine		1.6

Tier 1 Tier 2

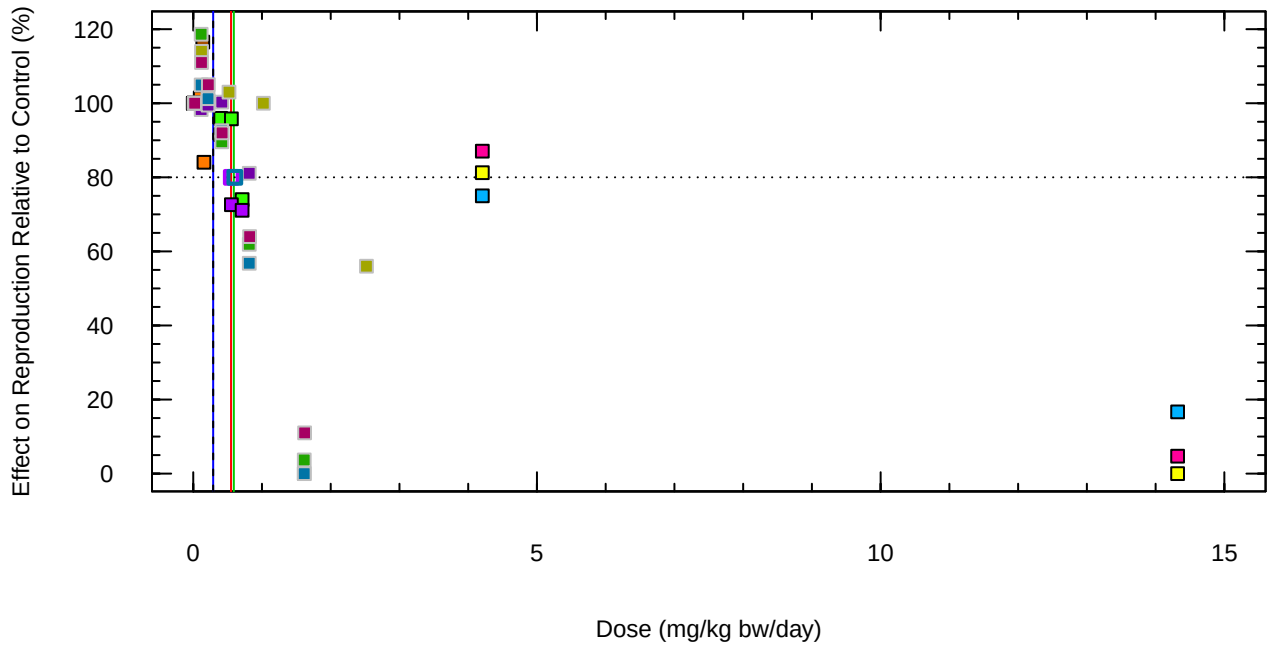
Eco−SSL TRV = 0.29 mg/kg bw/day

Selected TRV (Growth) = 0.29 mg/kg bw/day
Selected TRV (Reproduction) = 0.55 mg/kg bw/day
Selected TRV (Survival) = 0.59 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−39. Dose−Response Data for the Avian Growth Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Kääntee and Kurbela 1980	chicken	egg production	diet	4	sodium selenite		
Ort and Latshaw 1978	chicken	egg production (Exp 2)	diet	16	sodium selenite		
Ort and Latshaw 1978	chicken	hatchability (Exp 2)	diet	16	sodium selenite		
Wiemeyer and Hoffman 1996	owl	% pairs with hatchlings	diet	12	seleno−DL−methionine		
Wiemeyer and Hoffman 1996	owl	# of pairs with 5−day−old young	diet	12	seleno−DL−methionine		
Wiemeyer and Hoffman 1996	owl	% hatch of eggs incubated	diet	12	seleno−DL−methionine		
Stone and Soares 1976	quail	egg production (Exp 1 and 3)	diet	3.9−4.6	sodium selenite		
Heinz et al. 1989	mallard	% hatch of fertile eggs	diet	>14	selenomethionine	E	
Heinz et al. 1989	mallard	duckling survival	diet	>14	selenomethionine		
Heinz et al. 1989	mallard	# of ducklings	diet	>14	selenomethionine		
Hoffman and Heinz 1988	mallard	hatching success	diet	NR	sodium selenite		
Hoffman and Heinz 1988	mallard	hatching success	diet	NR	seleno−methionine	E	
ED20 for Ort and Latshaw 1978	chicken	hatchability (Exp 2)	diet	16	sodium selenite		0.55
ED20 for Heinz et al. 1989	mallard	# of ducklings	diet	>14	selenomethionine		0.60

Tier 1

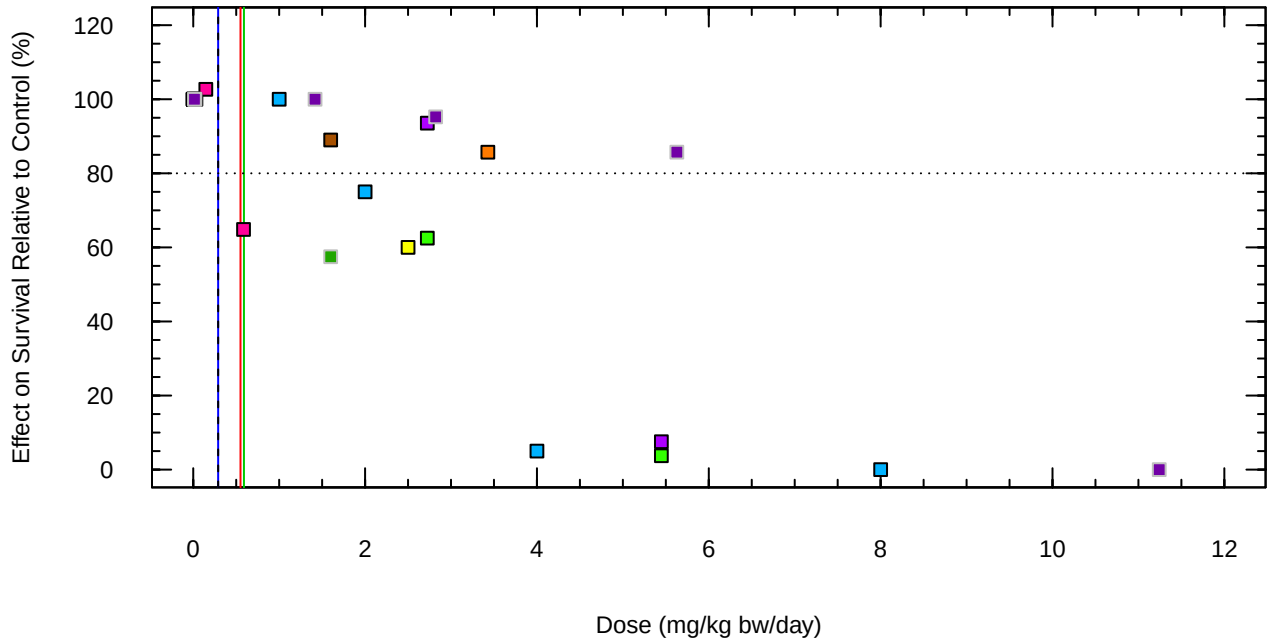
Eco−SSL TRV = 0.29 mg/kg bw/day

Selected TRV (Growth) = 0.29 mg/kg bw/day
Selected TRV (Reproduction) = 0.55 mg/kg bw/day
Selected TRV (Survival) = 0.59 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−40. Dose−Response Data for the Avian Reproduction Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Gad and El−Twab 2009	quail	survival	gavage	4	sodium selenite	
El−Begearmi and Combs 1982	chicken	survival (brewer's yeast diet)	diet	4	sodium selenite	G
El−Begearmi and Combs 1982	chicken	survival (corn−soy diet)	diet	4	sodium selenite	G
Heinz and Fitzgerald 1993b	mallard	survival	diet	16	seleno−DL−methionine	I
Khan et al. 1993	chicken	survival	gavage	0.86	sodium selenite	
Arnold et al. 1973	chicken	survival	diet	64	sodium selenite	
El−Begearmi et al. 1977	quail	survival (males)	diet	16	sodium selenite	H
El−Begearmi et al. 1977	quail	survival (females)	diet	16	sodium selenite	H
Albers et al. 1996	mallard	survival	diet	16	seleno−DL−methionine	I

Tier 1

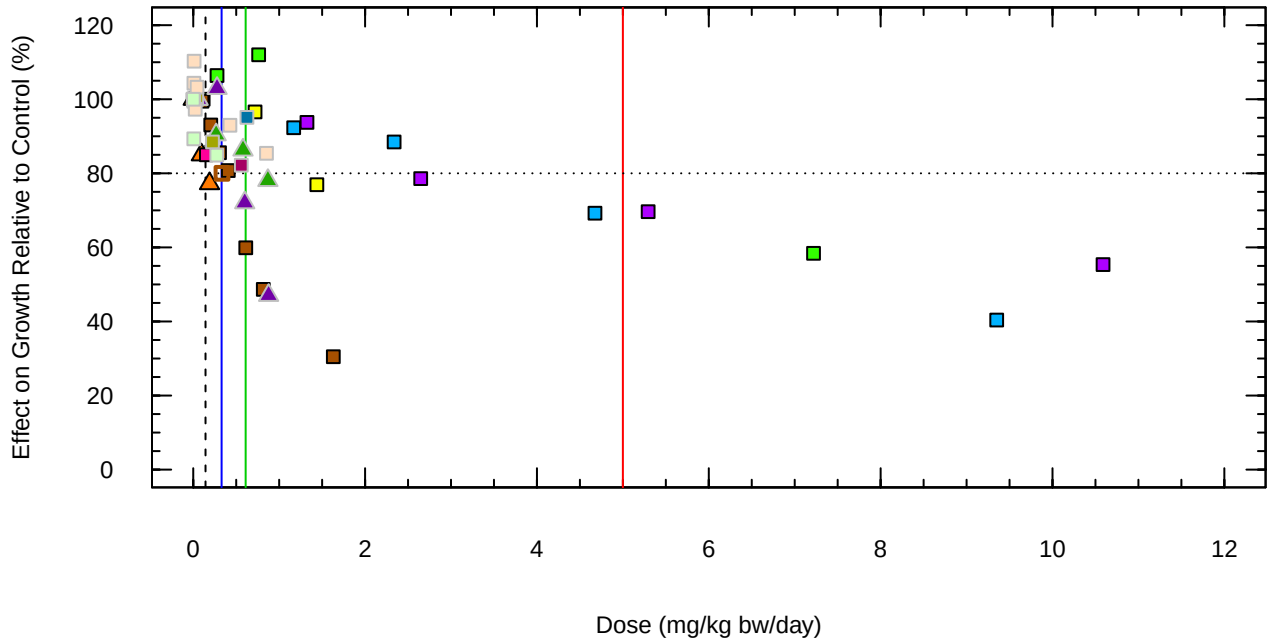
Eco−SSL TRV = 0.29 mg/kg bw/day

Selected TRV (Growth) = 0.29 mg/kg bw/day
Selected TRV (Reproduction) = 0.55 mg/kg bw/day
Selected TRV (Survival) = 0.59 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−41. Dose−Response Data for the Avian Survival Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Kaur and Parshad 1994	rat	body weight	diet	5.1	sodium selenite		
Spallholz et al. 1973	mouse	body weight gain	diet	5	sodium selenite		
Julius et al. 1983	hamster	body weight (male, Exp 1)	diet	3	sodium selenite	A	
Julius et al. 1983	hamster	body weight (female, Exp 1)	diet	3	sodium selenite	A	
Julius et al. 1983	hamster	body weight (male, Exp 2)	diet	3	sodium selenite	A	
Behne et al. 1992	rat	body weight	diet	14.3	L−selenomethionine		
Mahan and Moxon 1984	pig	body weight	diet	5.3	sodium selenite		
Goehring et al. 1984	rat	body weight gain	diet	4	seleniferous grain		
Goehring et al. 1984	rat	body weight gain	diet	4	sodium selenite		
Baker et al. 1989	pig	body weight	diet	3.7	sodium selenate		
Boylan et al. 1990	mouse	body weight	diet	26	sodium selenite		
Wahlstrom et al. 1956	pig	body weight	diet	14	sodium selenite		
Birt et al. 1983	hamster	body weight	diet	25	sodium selenite		
Birt et al. 1986	hamster	body weight	diet	64	sodium selenite		
ED20 for Mahan and Moxon 1984	pig	body weight	diet	5.3	sodium selenite		0.33

Tier 1 Tier 2

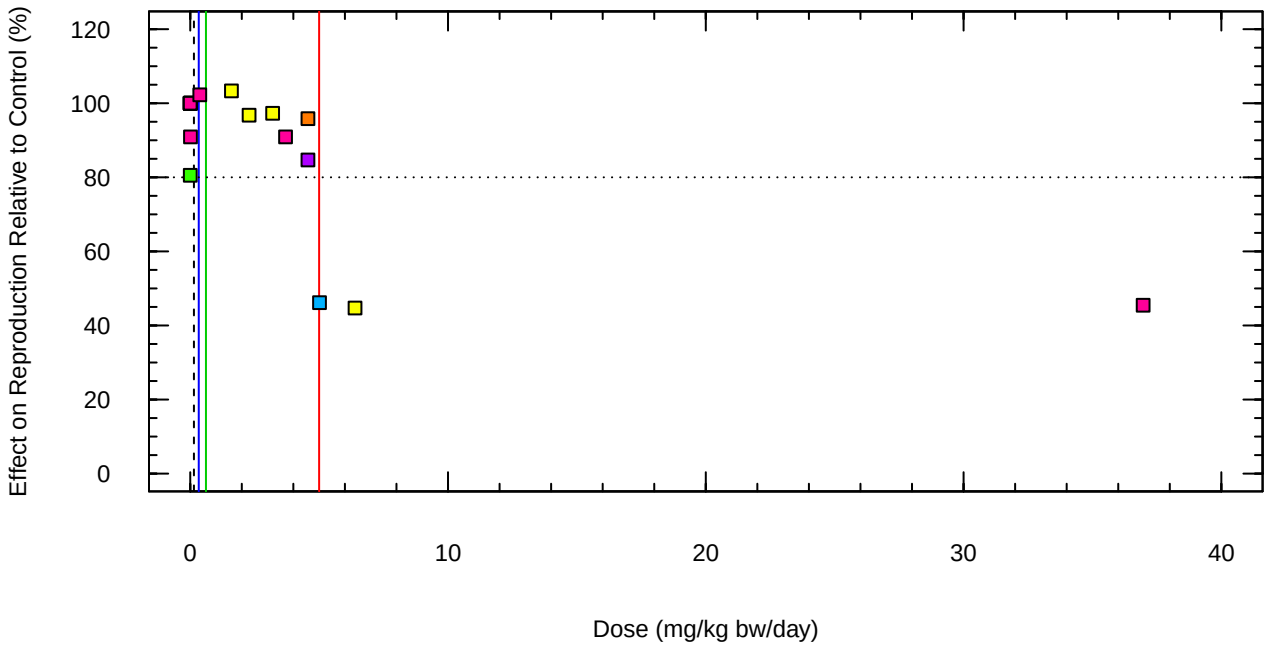
Eco−SSL TRV = 0.143 mg/kg bw/day

Selected TRV (Growth) = 0.33 mg/kg bw/day
Selected TRV (Reproduction) = 5 mg/kg bw/day
Selected TRV (Survival) = 0.61 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−42. Dose−Response Data for the Mammalian Growth Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Chernoff and Kavlock 1982	mouse	% pregnant	gavage	0.71	sodium selenite
Wahlstrom and Olson 1959	pig	# of live piglets	diet	34	sodium selenite
Gray and Kavlock 1984	mouse	# of live offspring	gavage	0.71	sodium selenite
Seidenberg et al. 1986	mouse	# of litters born	gavage	0.71	sodium selenate
Hardin et al. 1987	mouse	% viable litters	gavage	1.1	sodium selenite
Webster 1979	mouse	% with litters	diet	2.7	sodium selenite

Tier 1

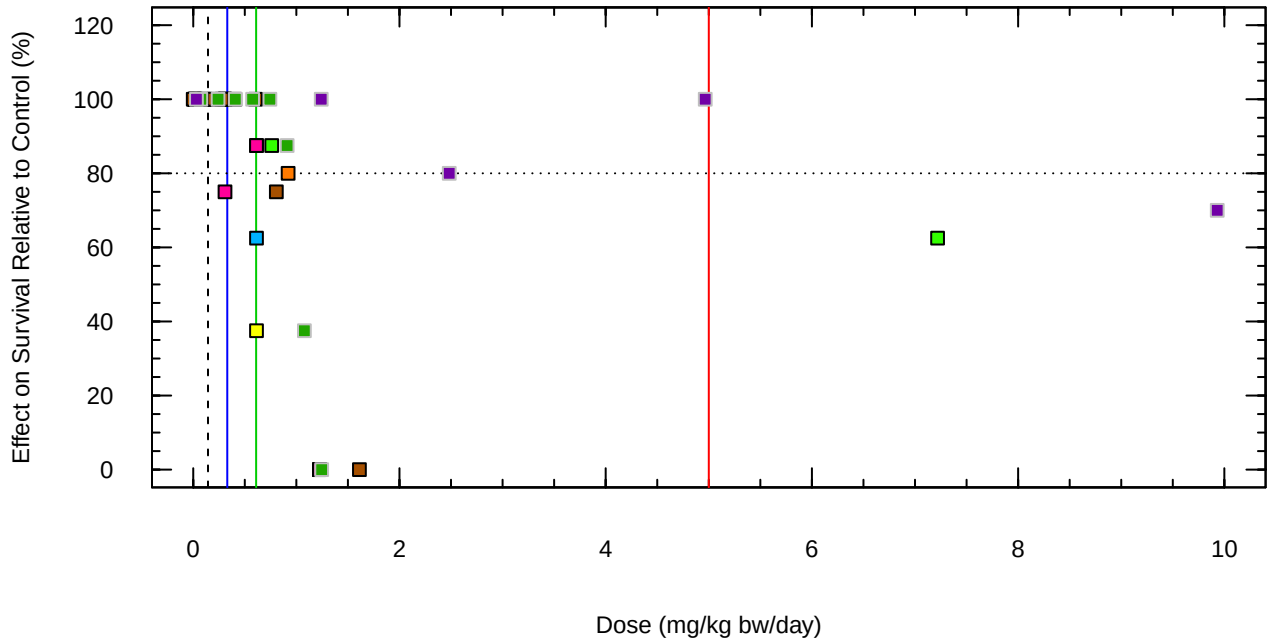
Eco−SSL TRV = 0.143 mg/kg bw/day

Selected TRV (Growth) = 0.33 mg/kg bw/day
Selected TRV (Reproduction) = 5 mg/kg bw/day
Selected TRV (Survival) = 0.61 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−43. Dose−Response Data for the Mammalian Reproduction Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Palmer et al. 1982	rat	survival	diet	4	seleniferous corn	B
Spallholz et al. 1973	mouse	survival	diet	5	sodium selenite	
McAdam and Levander 1987	rat	survival	diet	6	D−selenomethionine	B
McAdam and Levander 1987	rat	survival	diet	6	L−selenomethionine	B
McAdam and Levander 1987	rat	survival	diet	6	sodium selenite	
McAdam and Levander 1987	rat	survival	diet	6	sodium selenate	
Moxon and Mahan 1981	pig	survival	diet	5.3	sodium selenite	
Halverson et al. 1966	rat	survival	diet	6	seleniferous wheat	B
Julius et al. 1983	hamster	survival	diet	3	sodium selenite	

Tier 1

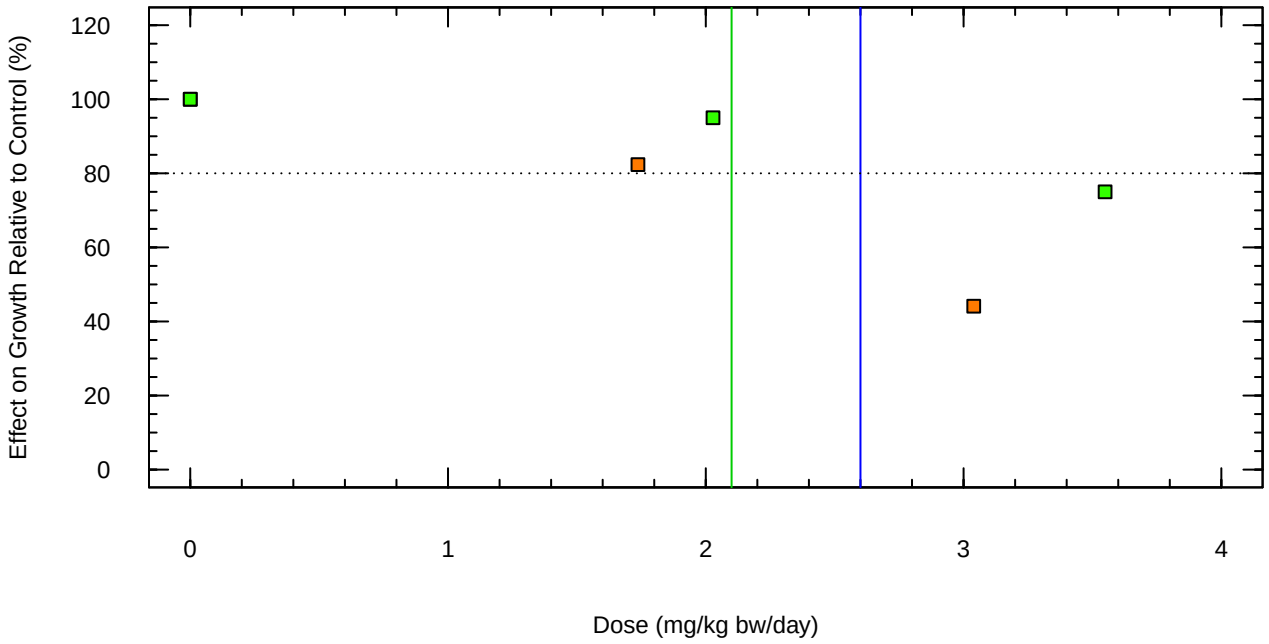
Eco−SSL TRV = 0.143 mg/kg bw/day

Selected TRV (Growth) = 0.33 mg/kg bw/day
Selected TRV (Reproduction) = 5 mg/kg bw/day
Selected TRV (Survival) = 0.61 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−44. Dose−Response Data for the Mammalian Survival Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Downs et al. 1960	rat (male)	body weight	diet	15	thallic oxide	A
Downs et al. 1960	rat (female)	body weight	diet	15	thallic oxide	A

Tier 1

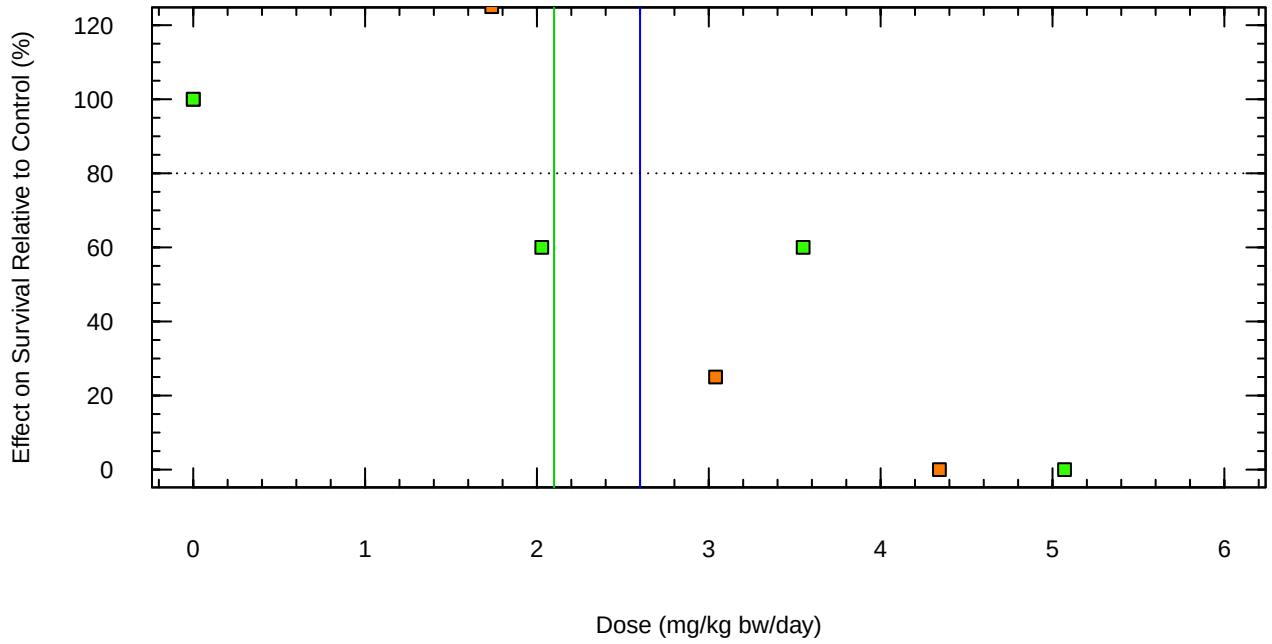
Selected TRV (Growth) = 2.6 mg/kg bw/day

Selected TRV (Survival) = 2.1 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−45. Dose−Response Data for the Mammalian Growth Endpoint for Thallium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Downs et al. 1960	rat (male)	survival	diet	15	thallic oxide	B
Downs et al. 1960	rat (female)	survival	diet	15	thallic oxide	B

Tier 1

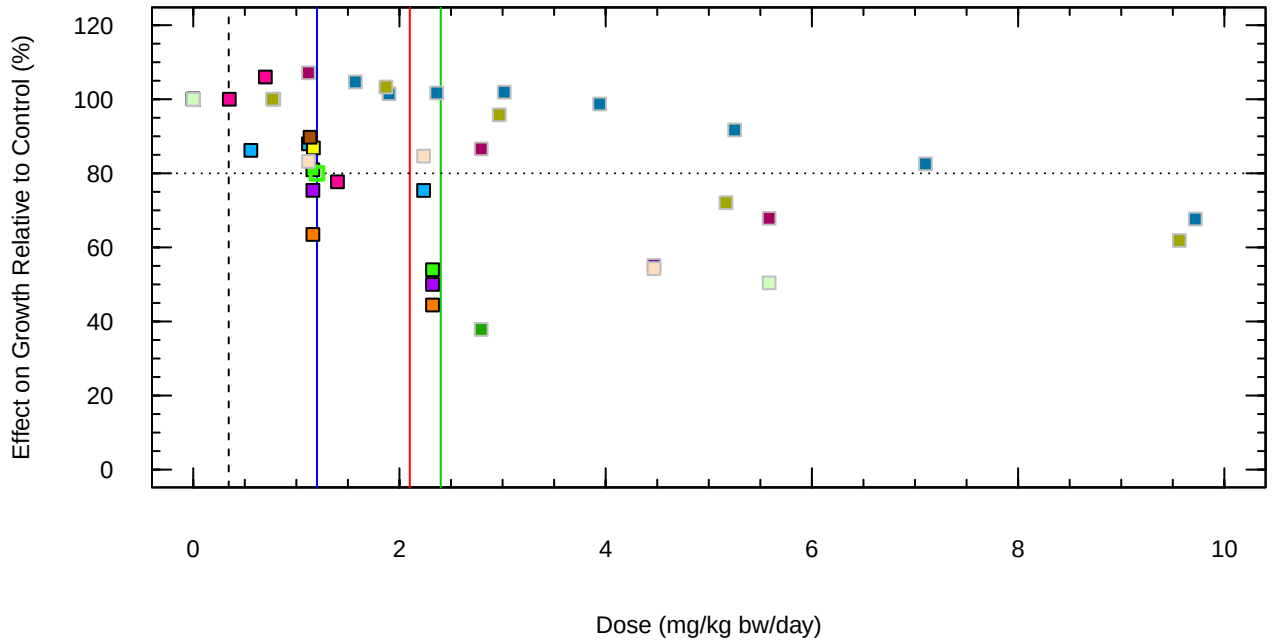
Selected TRV (Growth) = 2.6 mg/kg bw/day

Selected TRV (Survival) = 2.1 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−46. Dose−Response Data for the Mammalian Survival Endpoint for Thallium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Berg and Lawrence 1971	chicken	body weight	diet	2	ammonium metavanadate	A	
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl dichloride	E	
Cervantes and Jensen 1986	chicken	body weight	diet	4	ammonium metavanadate	A	
Hill 1974	chicken	body weight gain	diet	2	sodium metavanadate	B	
Hill 1979a	chicken	body weight gain	diet	2	sodium metavanadate	B	
Summers and Moran 1972	chicken	body weight gain	diet	3	NR		
Hill 1990b	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Hill 1990a	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Qureshi et al. 1999	chicken	body weight	diet	3	ammonium metavanadate	A	
Blalock and Hill 1987	chicken	body weight	diet	3	vanadyl chloride	E	
Hill 1994	chicken	body weight	diet	2.9	ammonium metavanadate	A	
ED20 for Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		1.2

Tier 1

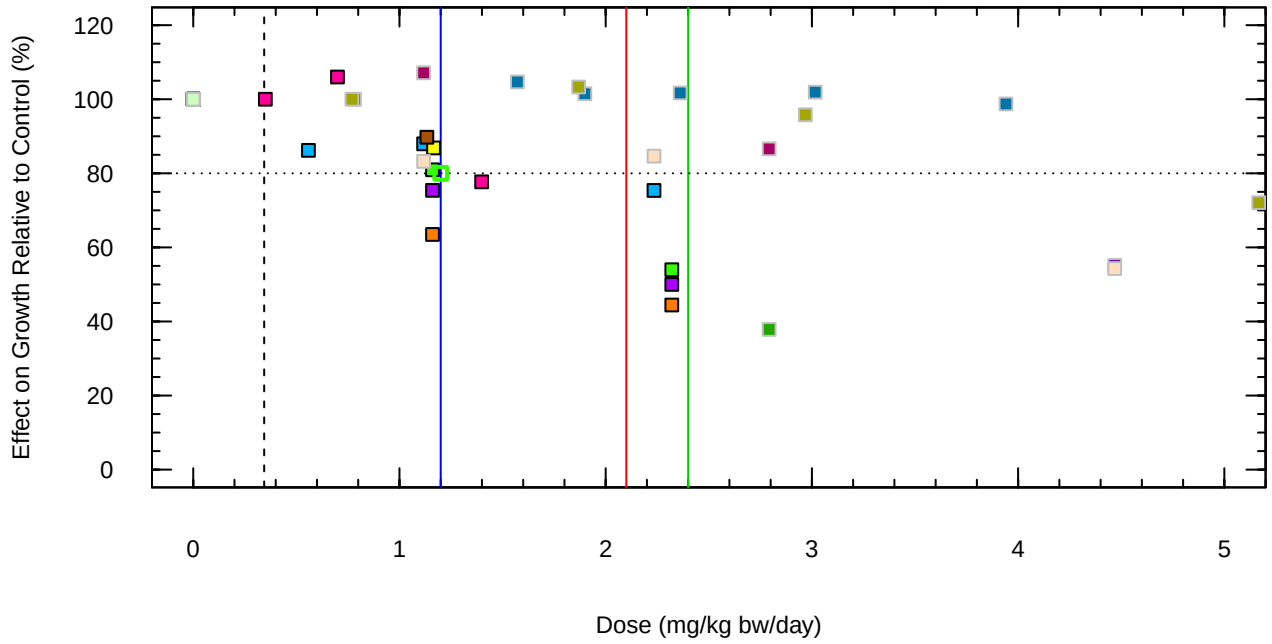
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−47a. Dose−Response Data for the Avian Growth Endpoint for Vanadium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Berg and Lawrence 1971	chicken	body weight	diet	2	ammonium metavanadate	A	
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl dichloride	E	
Cervantes and Jensen 1986	chicken	body weight	diet	4	ammonium metavanadate	A	
Hill 1974	chicken	body weight gain	diet	2	sodium metavanadate	B	
Hill 1979a	chicken	body weight gain	diet	2	sodium metavanadate	B	
Summers and Moran 1972	chicken	body weight gain	diet	3	NR		
Hill 1990b	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Hill 1990a	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Qureshi et al. 1999	chicken	body weight	diet	3	ammonium metavanadate	A	
Blalock and Hill 1987	chicken	body weight	diet	3	vanadyl chloride	E	
Hill 1994	chicken	body weight	diet	2.9	ammonium metavanadate	A	
ED20 for Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		1.2

Tier 1

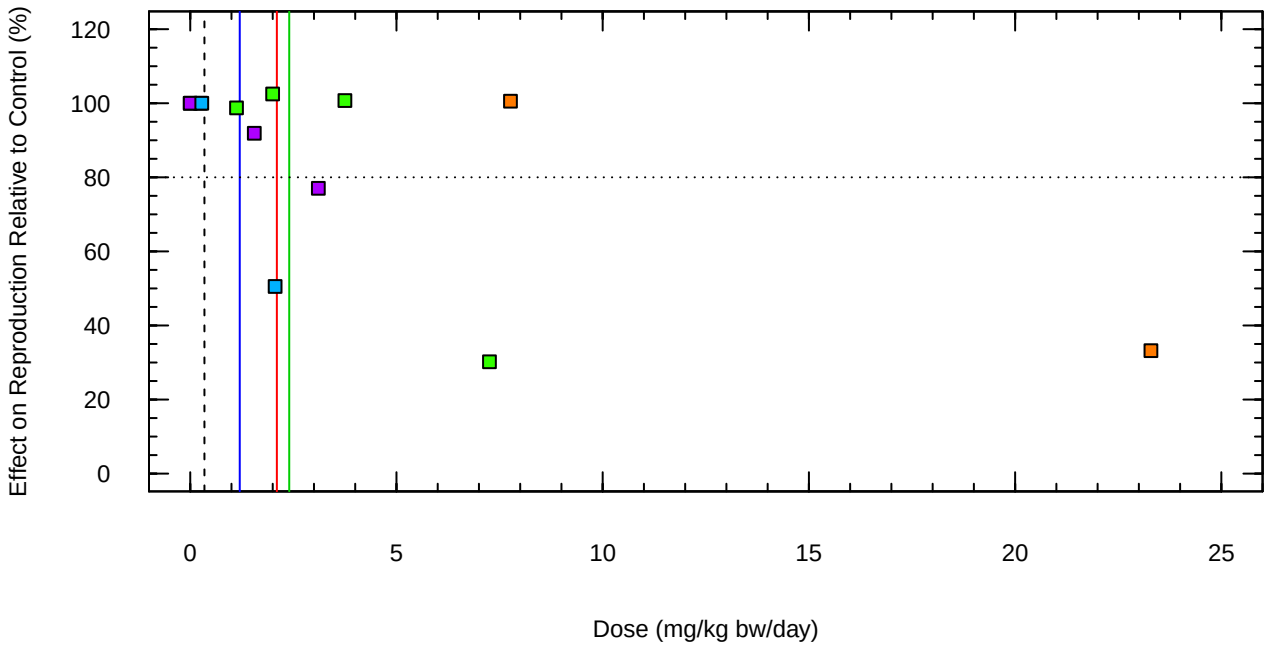
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−47b. Dose−Response Data for the Avian Growth Endpoint for Vanadium (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Hafez and Kratzer 1976b	chicken	egg production	diet	NR	ammonium metavanadate	C
Kubena and Phillips 1982	chicken	egg production	diet	20	calcium orthovanadate	
Ousterhout and Berg 1980	chicken	egg production	diet	4	ammonium metavanadate	C
Toussant and Latshaw 1994	chicken	egg production	diet	4	ammonium metavanadate	C

Tier 1

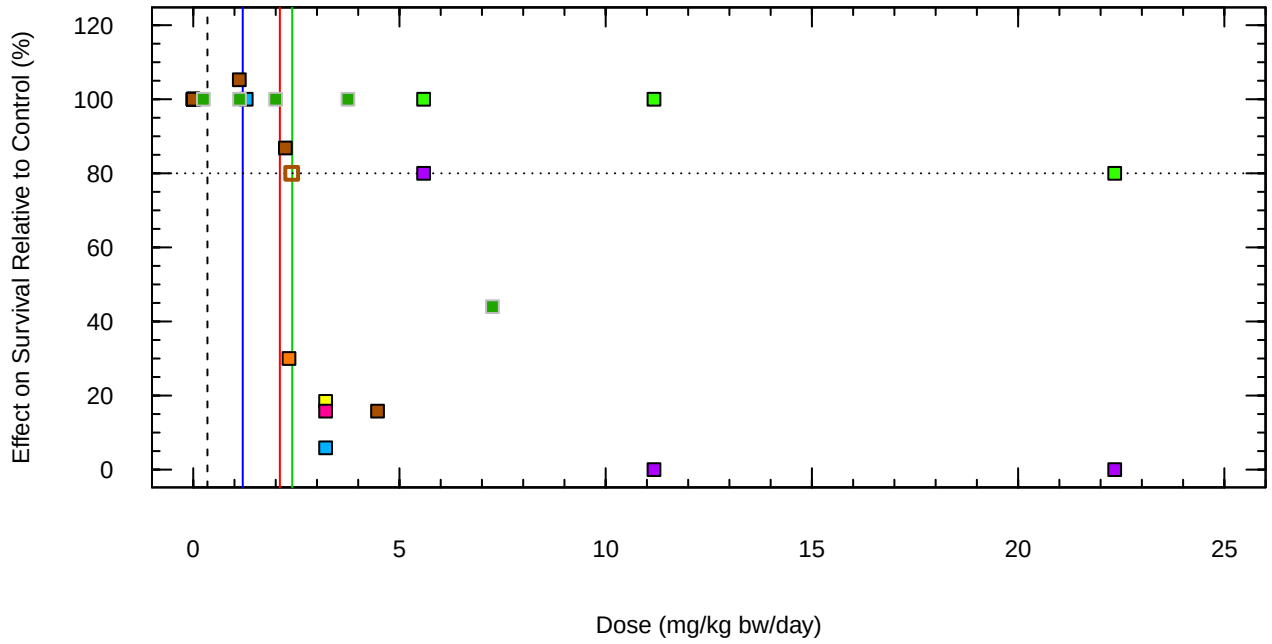
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−48. Dose−Response Data for the Avian Reproduction Endpoint for Vanadium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Berg and Lawrence 1971	chicken	survival	diet	2	ammonium metavanadate	D	
Hafez and Kratzer 1976a	chicken	survival (Exp 1)	diet	4	ammonium metavanadate	D	
Hafez and Kratzer 1976a	chicken	survival (Exp 2)	diet	4	ammonium metavanadate	D	
Hathcock et al. 1964	chicken	survival (Exp 1)	diet	2	ammonium metavanadate	D	
Hathcock et al. 1964	chicken	survival (Exp 2)	diet	2	ammonium metavanadate	D	
Hathcock et al. 1964	chicken	survival	diet	2	vanadyl sulfate		
Blalock and Hill 1987	chicken	survival	diet	3	vanadyl chloride		
Kubena and Phillips 1982	chicken	survival	diet	20	calcium orthovanadate		
ED20 for Blalock and Hill 1987	chicken	survival	diet	3	vanadyl chloride		2.4

Tier 1

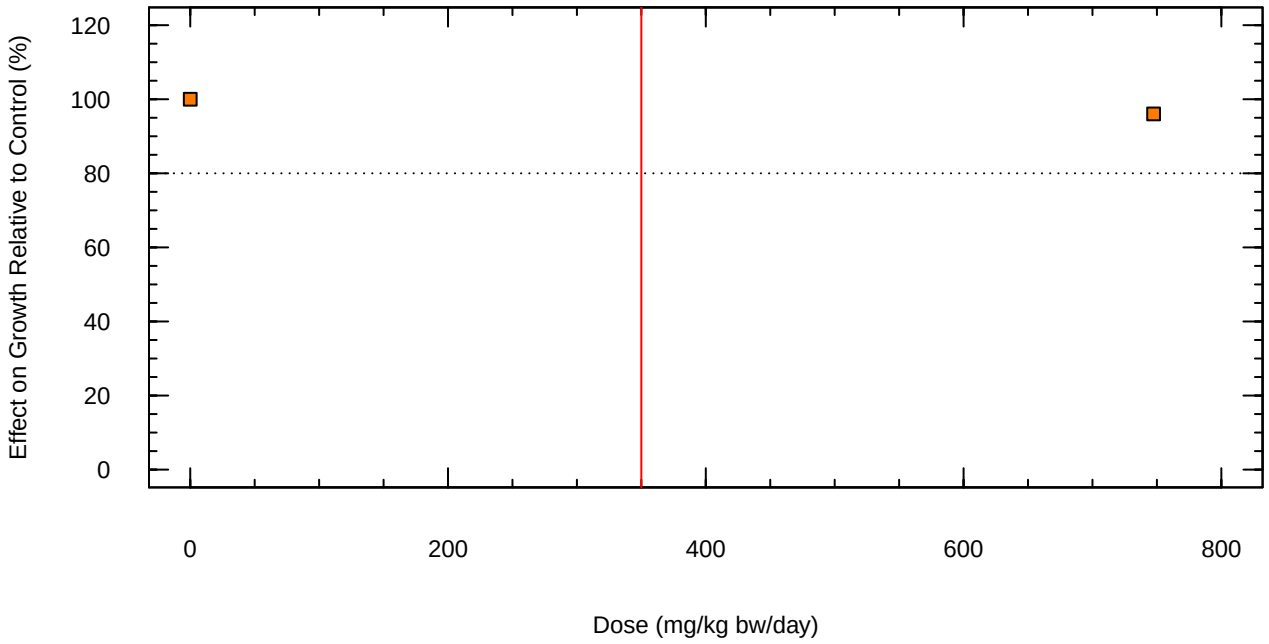
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−49. Dose−Response Data for the Avian Survival Endpoint for Vanadium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Wood and Bitman 1984	chicken	body weight	diet	4	bis(2−ethylhexyl)phthalate

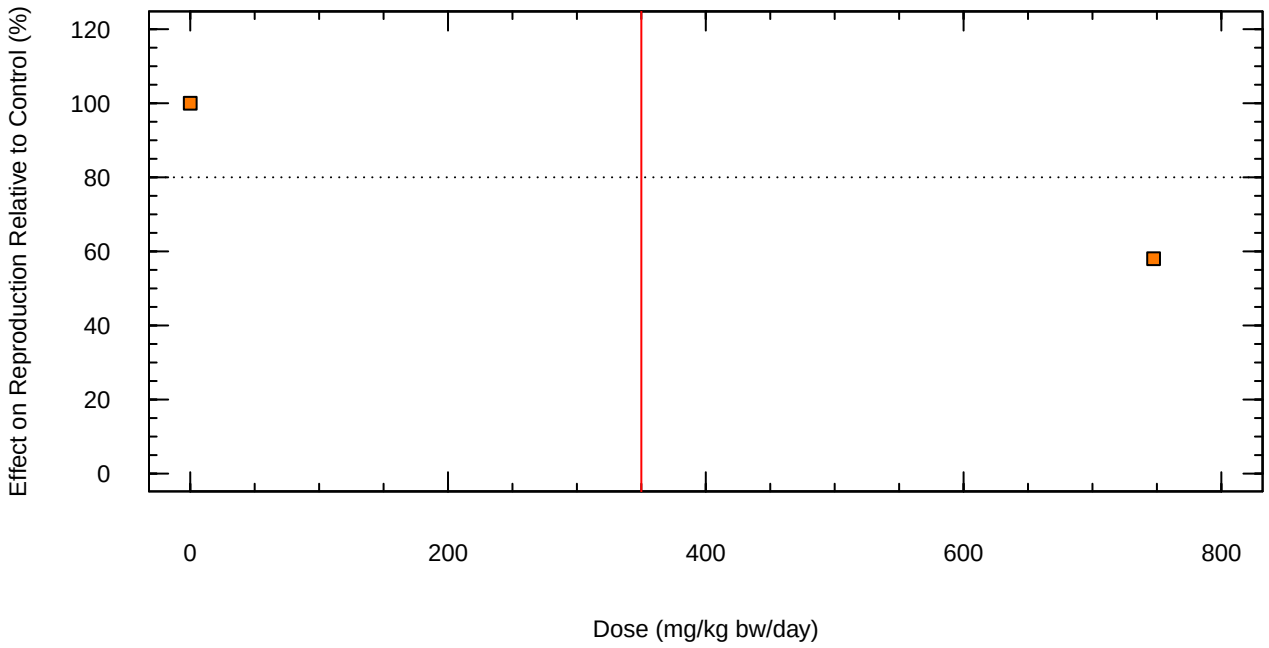
Tier 1

Selected TRV (Reproduction) = 350 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−50. Dose−Response Data for the Avian Growth Endpoint for Bis(2−ethylhexyl)phthalate



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Wood and Bitman 1984	chicken	egg production	diet	4	bis(2−ethylhexyl)phthalate

Tier 1

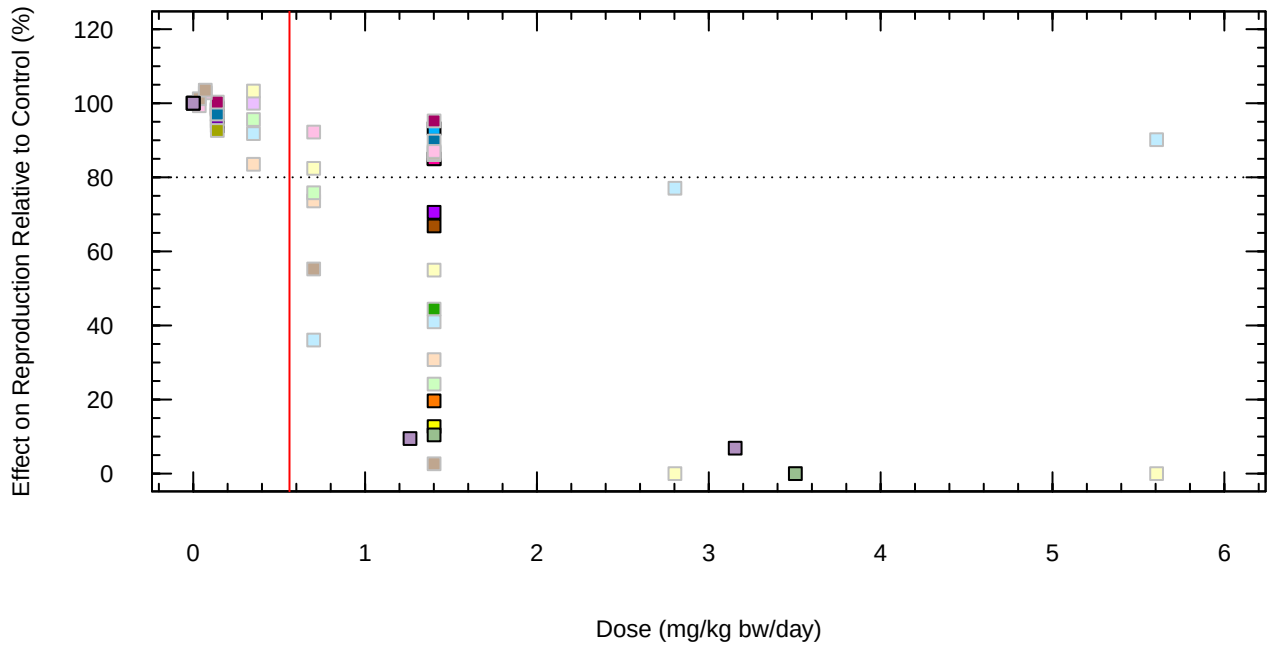
Selected TRV (Reproduction) = 350 mg/kg bw/day

80% effect relative to control

Note: The LOAEL from Ishida et al. (1982) for egg production after dietary exposure of chickens for 33 weeks is 350 mg/kg bw/day; this value was selected as the TRV, but could not be plotted on this figure because egg production was not reported in the control group.

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−51. Dose−Response Data for the Avian Reproduction Endpoint for Bis(2−ethylhexyl)phthalate



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1242	A
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1248	B
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1254	
Lillie et al. 1975	chicken	hatchability	diet	8	Aroclor 1242	A
Lillie et al. 1975	chicken	hatchability	diet	8	Aroclor 1248	B
Platanow and Reinhart 1973	chicken	hatchability	diet	14	Aroclor 1254	
Britton and Huston 1973	chicken	egg production	diet	6	Aroclor 1242	
Britton and Huston 1973	chicken	hatchability	diet	6	Aroclor 1242	A
Scott 1977	chicken	egg production	diet	8	Aroclor 1248	
Scott 1977	chicken	hatchability	diet	8	Aroclor 1248	B
Briggs and Harris 1973	chicken	hatchability (leghorn)	diet	6	Aroclor 1242	A
Briggs and Harris 1973	chicken	hatchability (broiler)	diet	6	Aroclor 1242	A

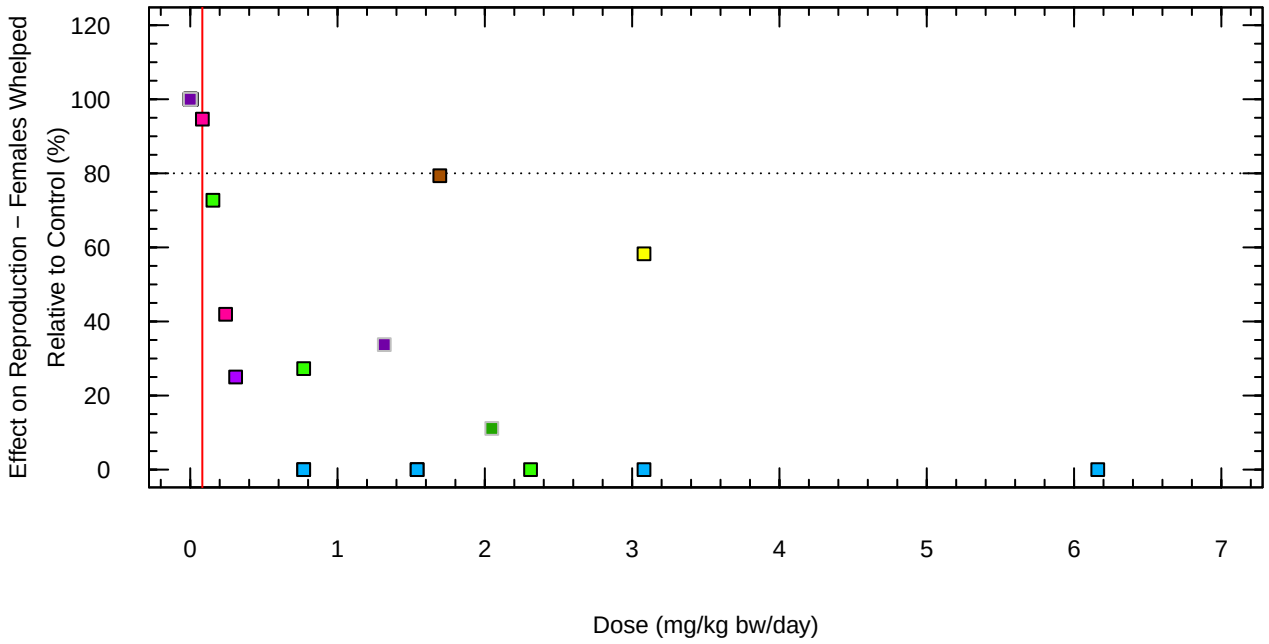
Tier 1

Selected TRV (Reproduction) = 0.56 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−52. Dose−Response Data for the Avian Reproduction Endpoint for Polychlorinated Biphenyls



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Bleavins et al. 1980	mink	females whelped	diet	35	Aroclor 1242	
Bleavins et al. 1980	mink	females whelped	diet	35	Aroclor 1016	
Brunström et al. 2001	mink	females whelped	diet	24	Clophen A50	B
Jensen et al. 1977	mink	females whelped	diet	9.4	NR	
Kihlstrom et al. 1992	mink	females whelped	diet	12	Clophen A50	B
Kihlstrom et al. 1992	mink	females whelped	diet	12	Aroclor 1254	A

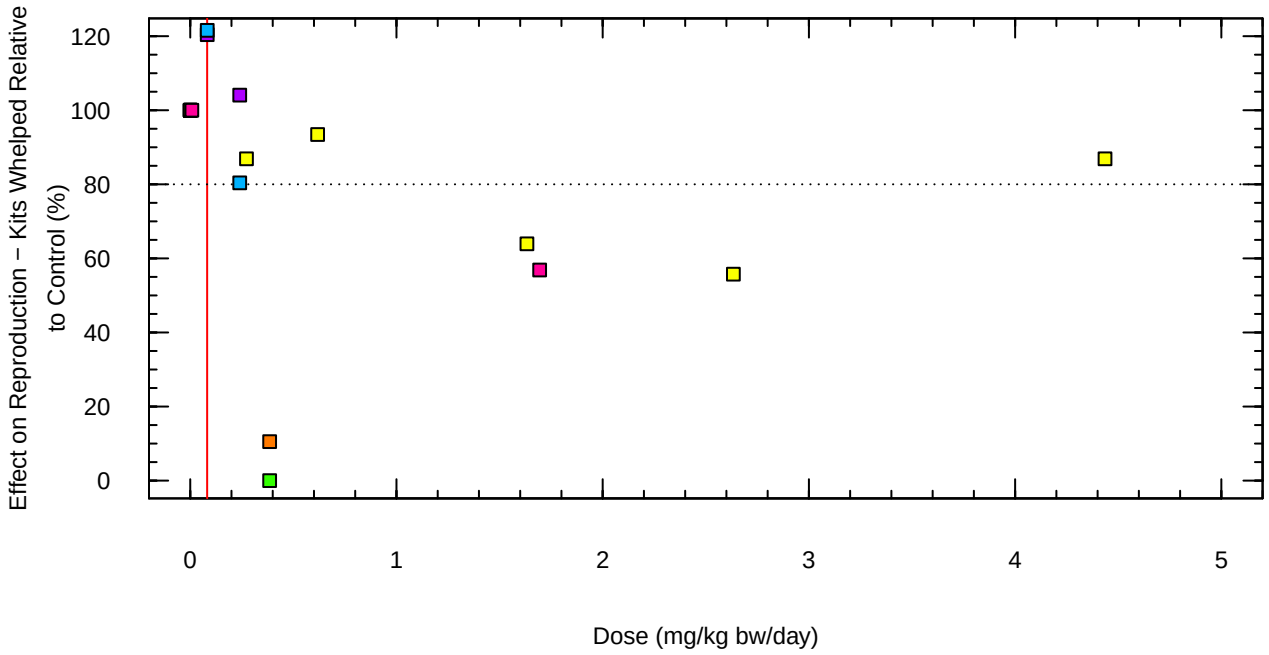
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−53. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls (Females Whelped)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Aulerich et al. 1985	mink	kits whelped	diet	~12	Aroclor 1254
Aulerich et al. 1985	mink	kits whelped	diet	~12	Aroclor 1254
Brunström et al. 2001	mink	kits whelped	diet	72	Clophen A50
Brunström et al. 2001	mink	kits whelped	diet	24	Clophen A50
Folland et al. 2016	mink	kits whelped	diet	16	Aroclor 1268
Jensen et al. 1977	mink	kits whelped	diet	9.4	NR

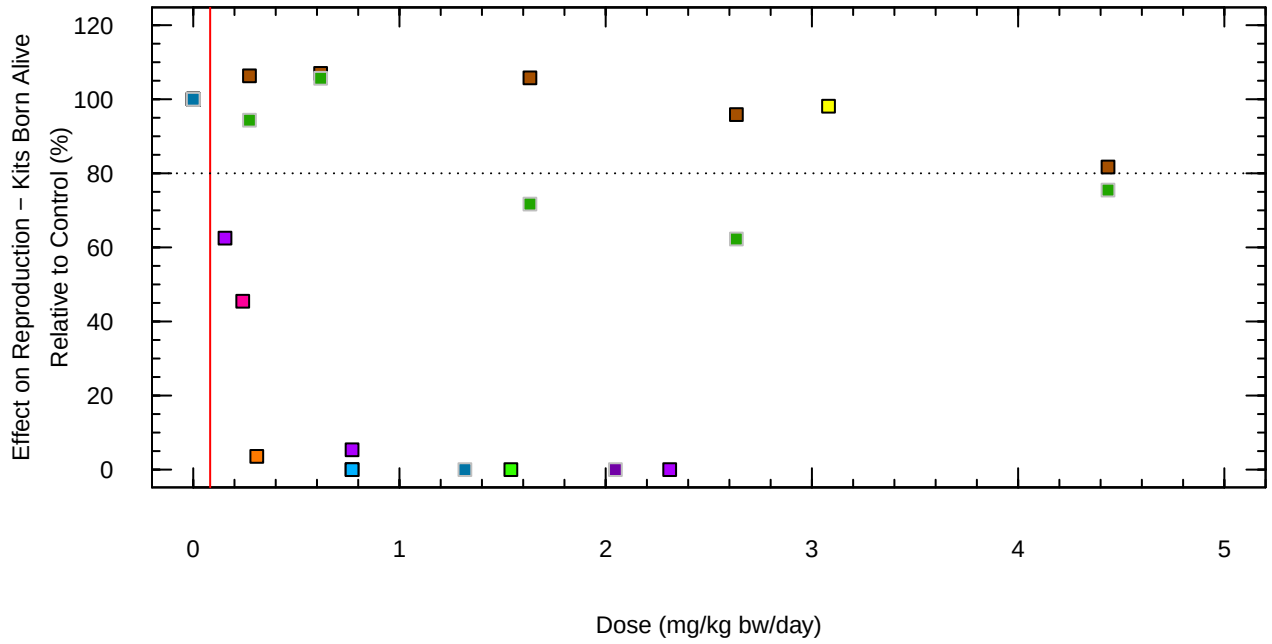
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−54. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls (Kits Whelped)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Bleavins et al. 1980	mink	kits born alive	diet	35	Aroclor 1242	
Bleavins et al. 1980	mink	kits born alive	diet	35	Aroclor 1016	
Brunström et al. 2001	mink	kits born alive	diet	24	Clophen A50	E
Folland et al. 2016	mink	kits born alive	diet	16	Aroclor 1268	
Folland et al. 2016	mink	kits born alive	diet	16	Aroclor 1268	
Kihlstrom et al. 1992	mink	kits born alive	diet	12	Clophen A50	E
Kihlstrom et al. 1992	mink	kits born alive	diet	12	Aroclor 1254	

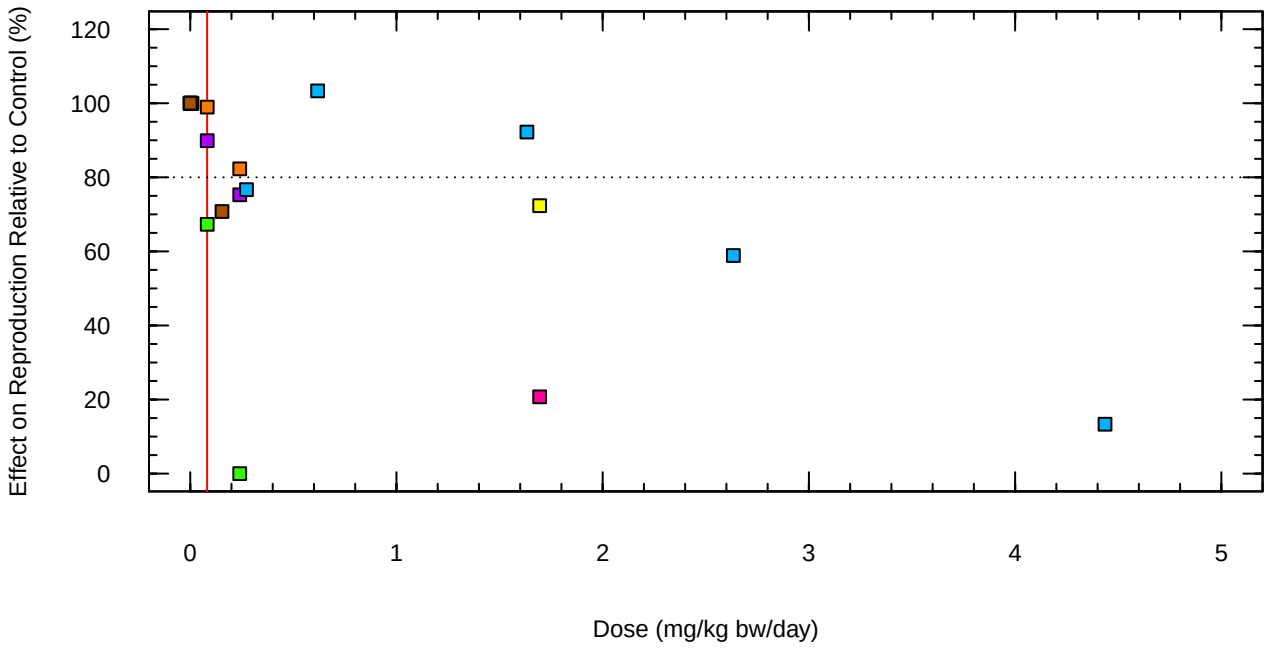
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−55. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls (Kits Born Alive)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Brunström et al. 2001	mink	kit birth weight	diet	72	Clophen A50
Brunström et al. 2001	mink	kit growth	diet	72	Clophen A50
Brunström et al. 2001	mink	kit birth weight	diet	24	Clophen A50
Folland et al. 2016	mink	kit survival to 6 weeks	diet	16	Aroclor 1268
Jensen et al. 1977	mink	kit weight of young	diet	9.4	NR
Jensen et al. 1977	mink	kit survival after 5 days	diet	9.4	NR
Wren et al. 1987	mink	kit weight at 5 weeks	diet	24	Aroclor 1254

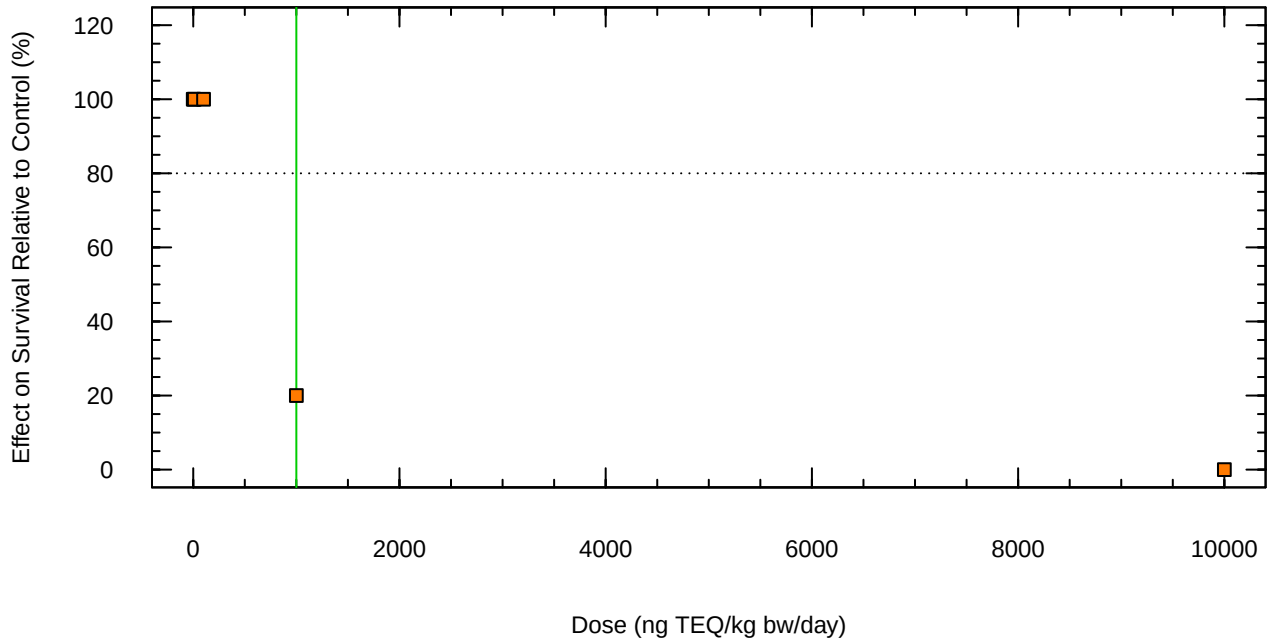
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−56. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Schwetz et al. 1973	chicken	survival	oral intubation	3	2,3,7,8−TCDD

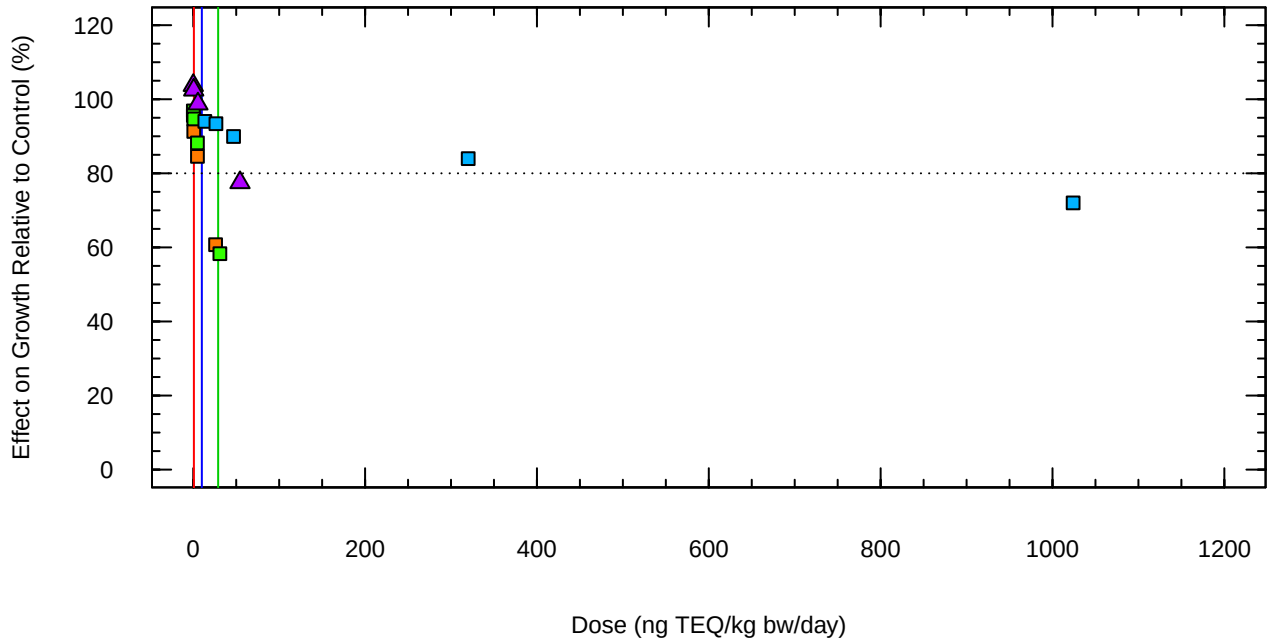
Tier 1

Selected TRV (Survival) = 1000 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−57. Dose−Response Data for the Avian Survival Endpoint for Dioxins/Furans



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
DeCaprio et al. 1986	guinea pig	body weight (male)	diet	12.9	2,3,7,8−TCDD	A
DeCaprio et al. 1986	guinea pig	body weight (female)	diet	12.9	2,3,7,8−TCDD	A
Hochstein et al. 1998	mink	body weight	diet	17.9	2,3,7,8−TCDD	
Van Birgelen et al. 1995	rat	body weight	diet	13	2,3,7,8−TCDD	

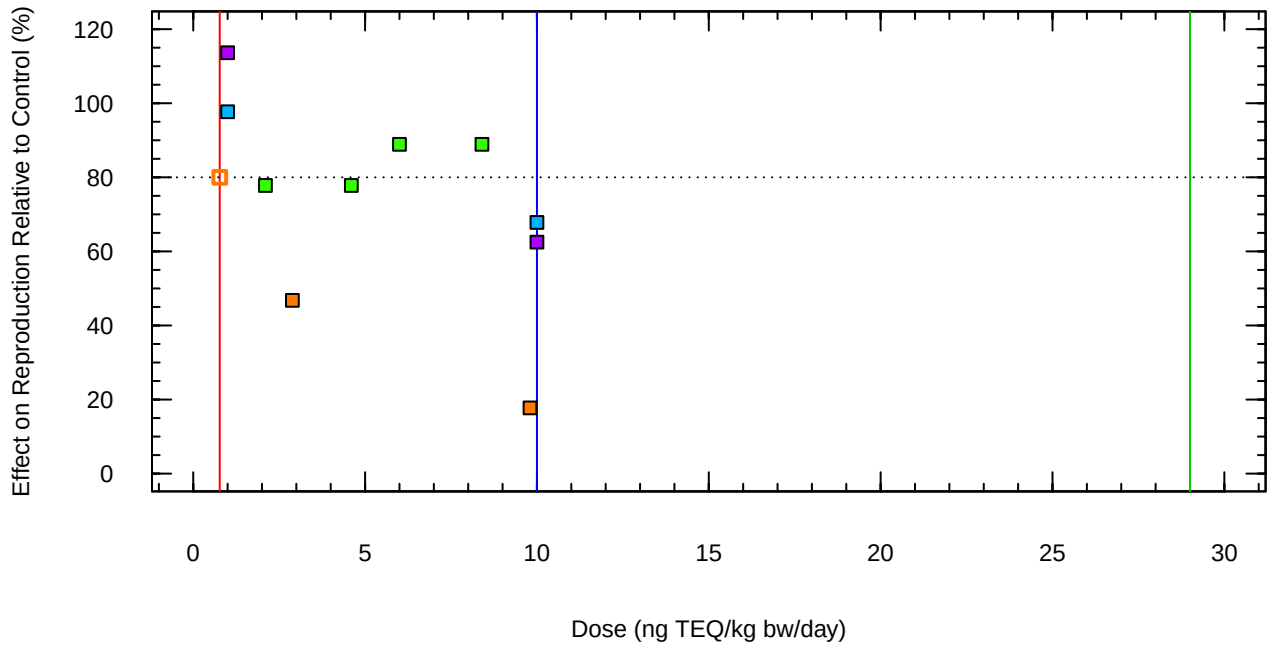
Tier 1 Tier 2

Selected TRV (Growth) = 10 ng TEQ/kg bw/day
Selected TRV (Reproduction) = 0.77 ng TEQ/kg bw/day
Selected TRV (Survival) = 29 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−58. Dose−Response Data for the Mammalian Growth Endpoint for Dioxins/Furans



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Hochstein et al. 2001	mink	kit survival	diet	18.7−18.8	2,3,7,8−TCDD	B	
Moore et al. 2012	mink	females whelping	diet	20.4−25.1	2,3,7,8−TCDD		
Murray et al. 1979	rat	females with litter	diet	12.9	2,3,7,8−TCDD		
Murray et al. 1979	rat	postnatal survival	diet	12.9	2,3,7,8−TCDD		
ED20 for Hochstein et al. 2001	mink	kit survival	diet	18.7−18.8	2,3,7,8−TCDD	B	0.77

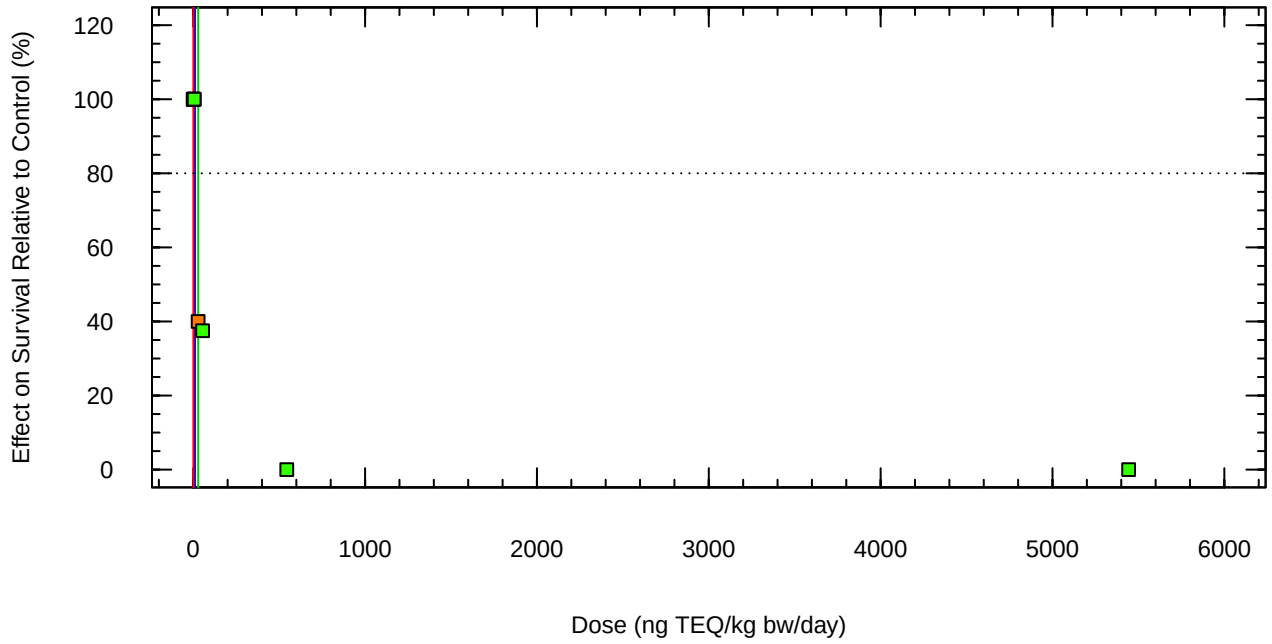
Tier 1

Selected TRV (Growth) = 10 ng TEQ/kg bw/day
Selected TRV (Reproduction) = 0.77 ng TEQ/kg bw/day
Selected TRV (Survival) = 29 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−59. Dose−Response Data for the Mammalian Reproduction Endpoint for Dioxins/Furans



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
DeCaprio et al. 1986	guinea pig	survival	diet	12.9	2,3,7,8−TCDD
Hochstein et al. 1998	mink	survival	diet	17.9	2,3,7,8−TCDD

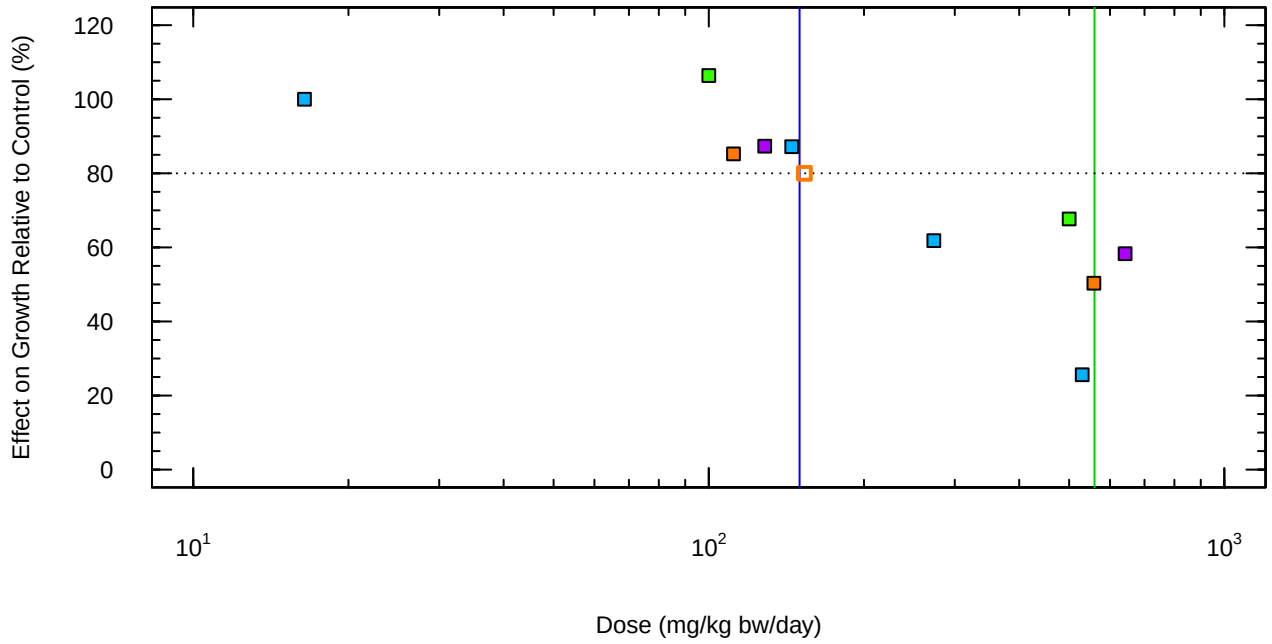
Tier 1

Selected TRV (Growth) = 10 ng TEQ/kg bw/day
Selected TRV (Reproduction) = 0.77 ng TEQ/kg bw/day
Selected TRV (Survival) = 29 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−60. Dose−Response Data for the Mammalian Survival Endpoint for Dioxins/Furans



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Capdevielle and Scanes 1995a	chicken	body weight	diet	2	aluminum sulfate		
Capdevielle and Scanes 1995b	mallard	body weight	diet	2.1	aluminum sulfate		
Capdevielle et al. 1996	chicken	body weight	diet	1.5	aluminum sulfate	A	
Elliot and Edwards 1991	chicken	body weight	diet	2.3	aluminum sulfate	A	
ED20 for Capdevielle and Scanes 1995a	chicken	body weight	diet	2	aluminum sulfate		150

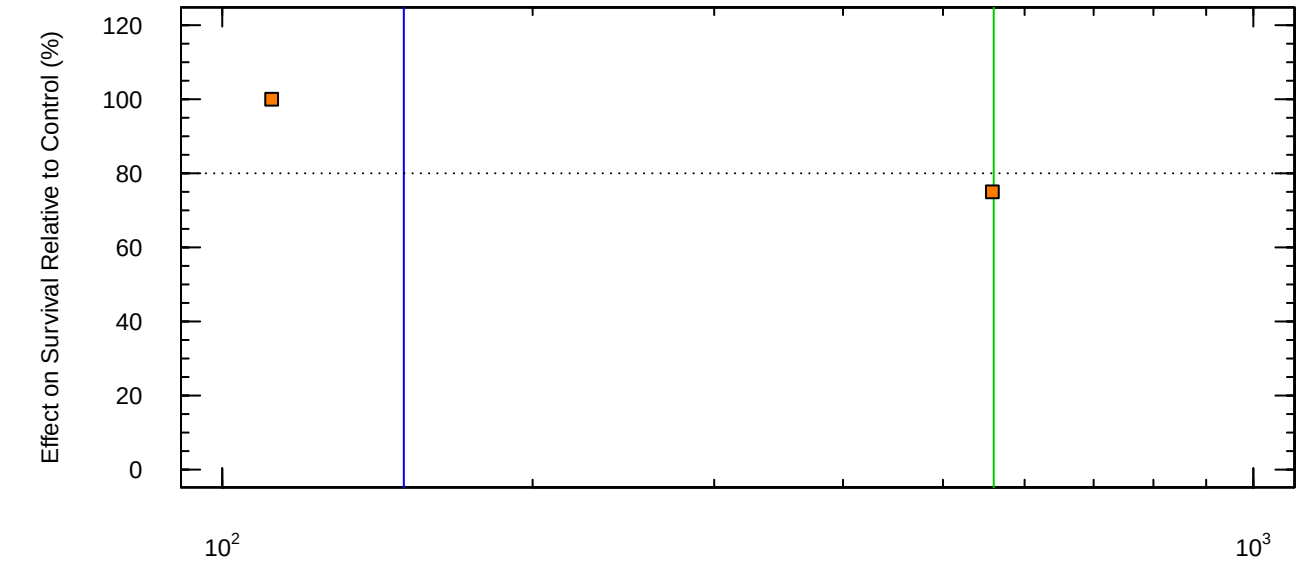
Tier 1

Selected TRV (Growth) = 150 mg/kg bw/day
Selected TRV (Survival) = 560 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−61. Dose−Response Data for the Avian Growth Endpoint for Aluminum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Capdevielle and Scanes 1995a	chicken	survival	diet	2	aluminum sulfate

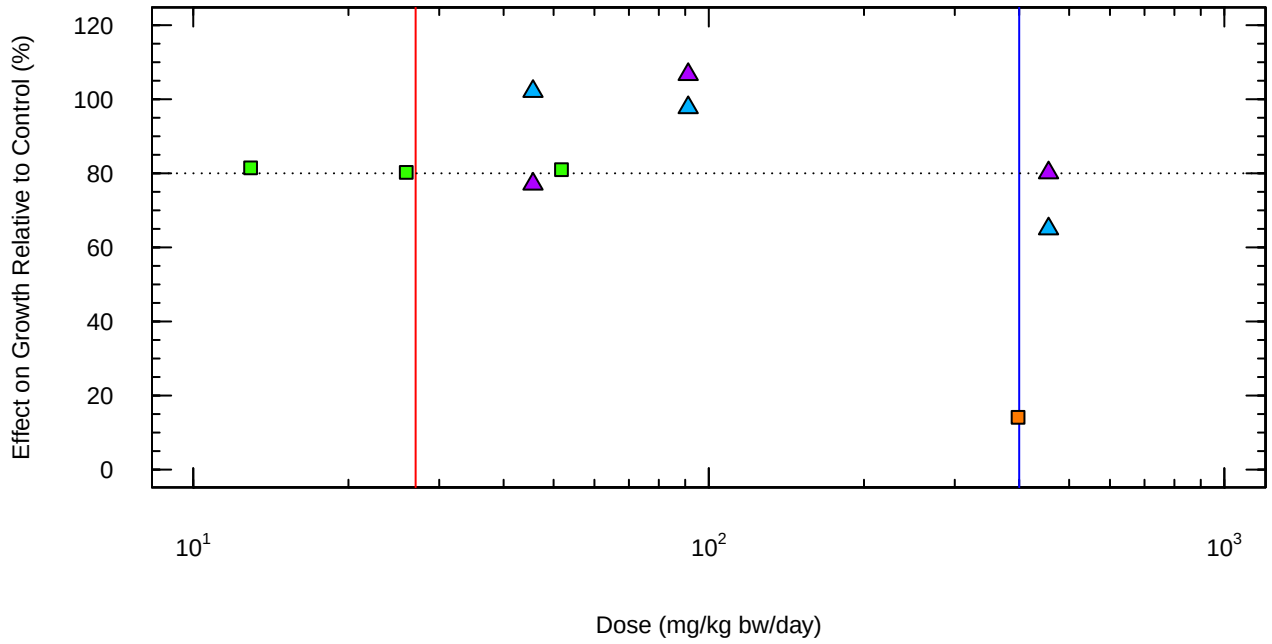
Tier 1

Selected TRV (Growth) = 150 mg/kg bw/day
Selected TRV (Survival) = 560 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−62. Dose−Response Data for the Avian Survival Endpoint for Aluminum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Belles et al. 1999	mouse	body weight gain	gavage	1.5	aluminum nitrate nonahydrate
Paternain et al. 1988	rat	body weight gain	gavage	1.3	aluminum nitrate nonahydrate
Domingo et al. 1987a	rat	body weight	drinking water	14	aluminum nitrate nonahydrate
Domingo et al. 1987a	rat	body weight	drinking water	14	aluminum nitrate nonahydrate

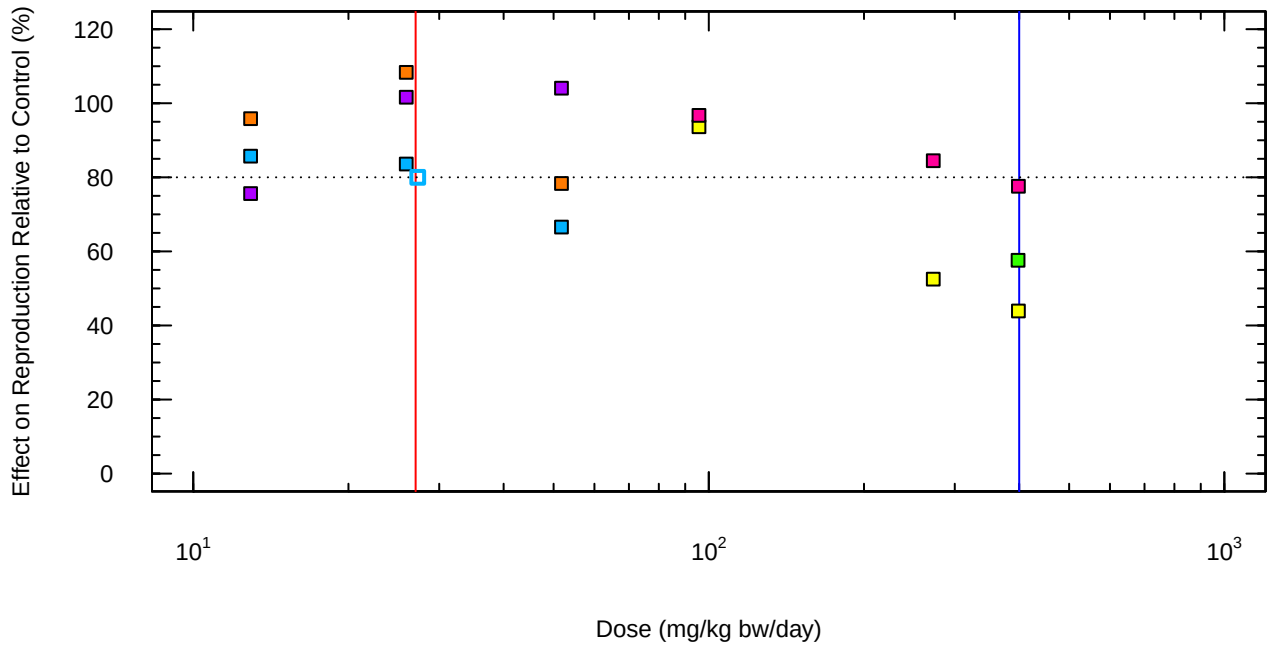
Tier 1 Tier 2

Selected TRV (Growth and Survival) = 400 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−63. Dose−Response Data for the Mammalian Growth Endpoint for Aluminum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Domingo et al. 1987b	rat	pup survival	gavage	unclear	aluminum nitrate nonahydrate	
Belles et al. 1999	mouse	fetal body weight	gavage	1.5	aluminum nitrate nonahydrate	
Paternain et al. 1988	rat	fetal survival	gavage	1.3	aluminum nitrate nonahydrate	
Paternain et al. 1988	rat	fetal body weight	gavage	1.3	aluminum nitrate nonahydrate	
Bernuzzi et al. 1989	rat	postnatal survival	diet	2.6	aluminum chloride	
Bernuzzi et al. 1989	rat	pup body weight	diet	2.6	aluminum chloride	
ED20 for Paternain et al. 1988	rat	fetal body weight	gavage	1.3	aluminum nitrate nonahydrate	27

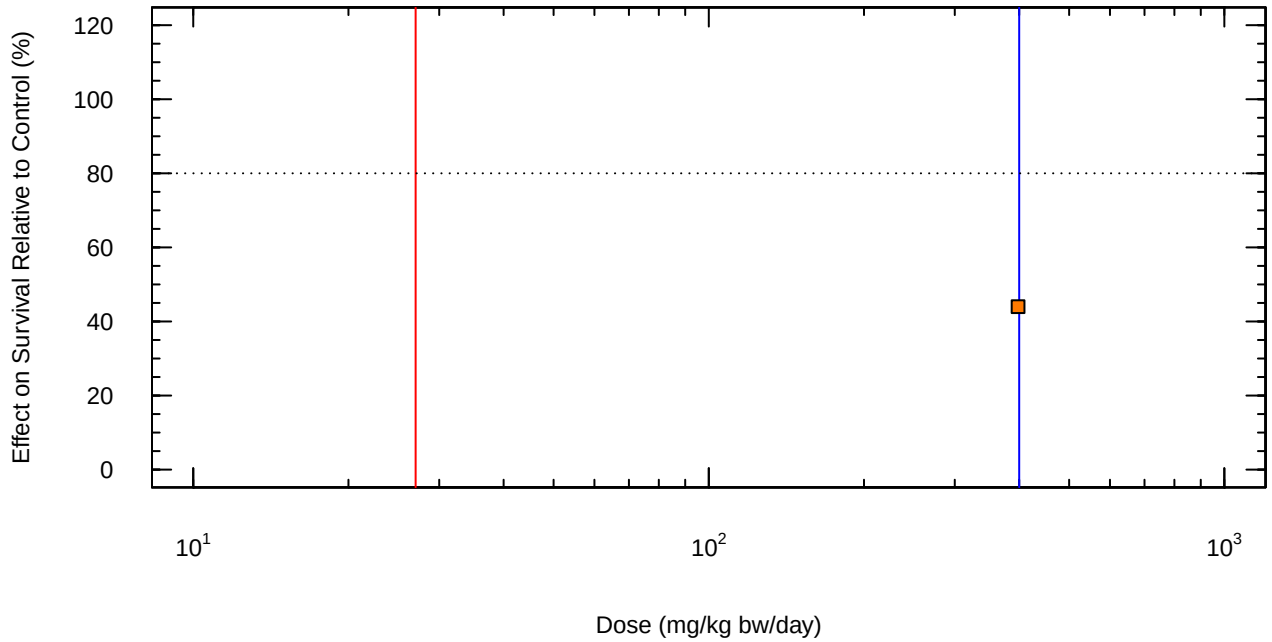
Tier 1

Selected TRV (Growth and Survival) = 400 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−64. Dose−Response Data for the Mammalian Reproduction Endpoint for Aluminum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Belles et al. 1999	mouse	survival	gavage	1.5	aluminum nitrate nonahydrate

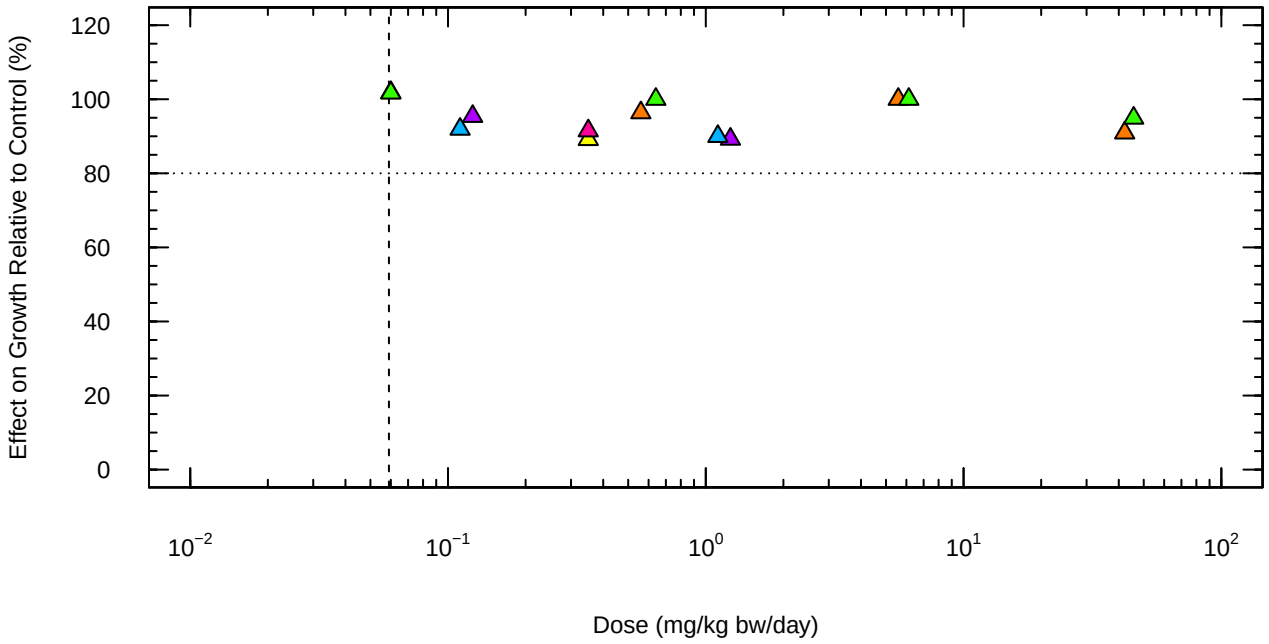
Tier 1

Selected TRV (Growth and Survival) = 400 mg/kg bw/day
Selected TRV (Reproduction) = 27 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−65. Dose−Response Data for the Mammalian Survival Endpoint for Aluminum, Log−Transformed



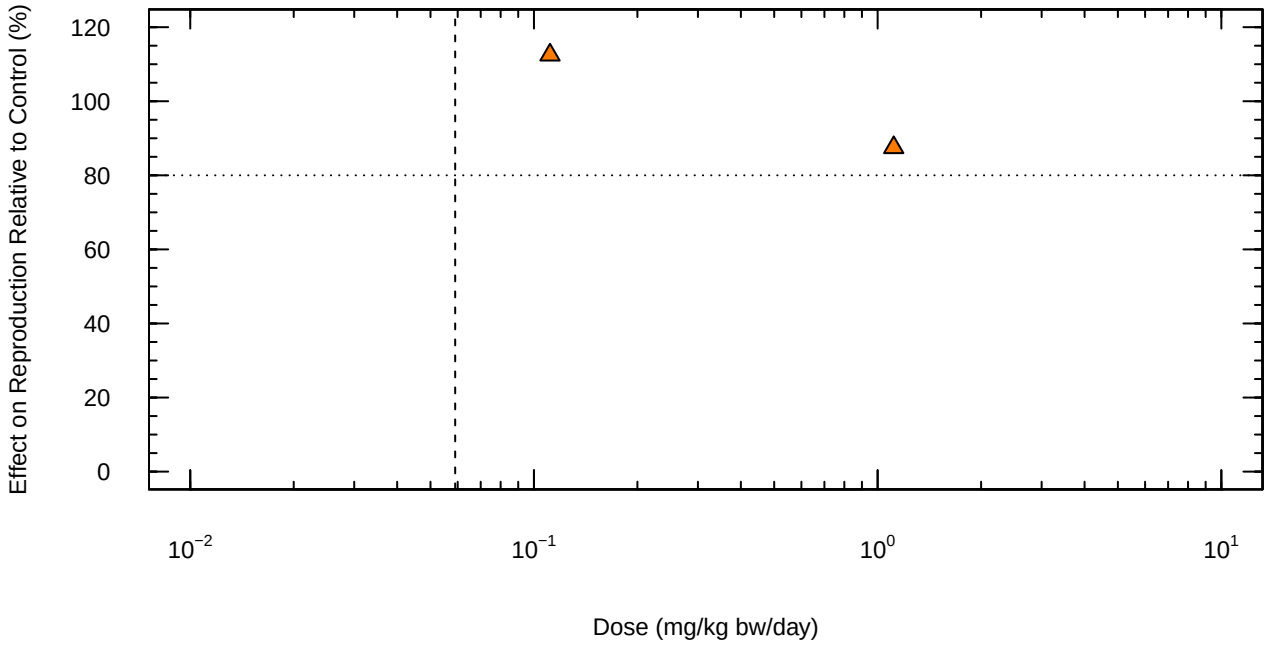
Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Poon et al. 1998	rat	body weight (male)	drinking water	13	potassium antimony tartrate
Poon et al. 1998	rat	body weight (female)	drinking water	13	potassium antimony tartrate
Rossi et al. 1987	rat	body weight	drinking water	8.6	antimony trichloride
Rossi et al. 1987	rat	body weight	drinking water	6.3	antimony trichloride
Shroeder et al. 1968	mouse	body weight (male)	drinking water	80	antimony potassium tartrate
Shroeder et al. 1968	mouse	body weight (female)	drinking water	80	antimony potassium tartrate

△ Tier 2

- - - Eco−SSL TRV = 0.059 mg/kg bw/day

····· 80% effect relative to control

Figure H2−66. Dose−Response Data for the Mammalian Growth Endpoint for Antimony, Log−Transformed



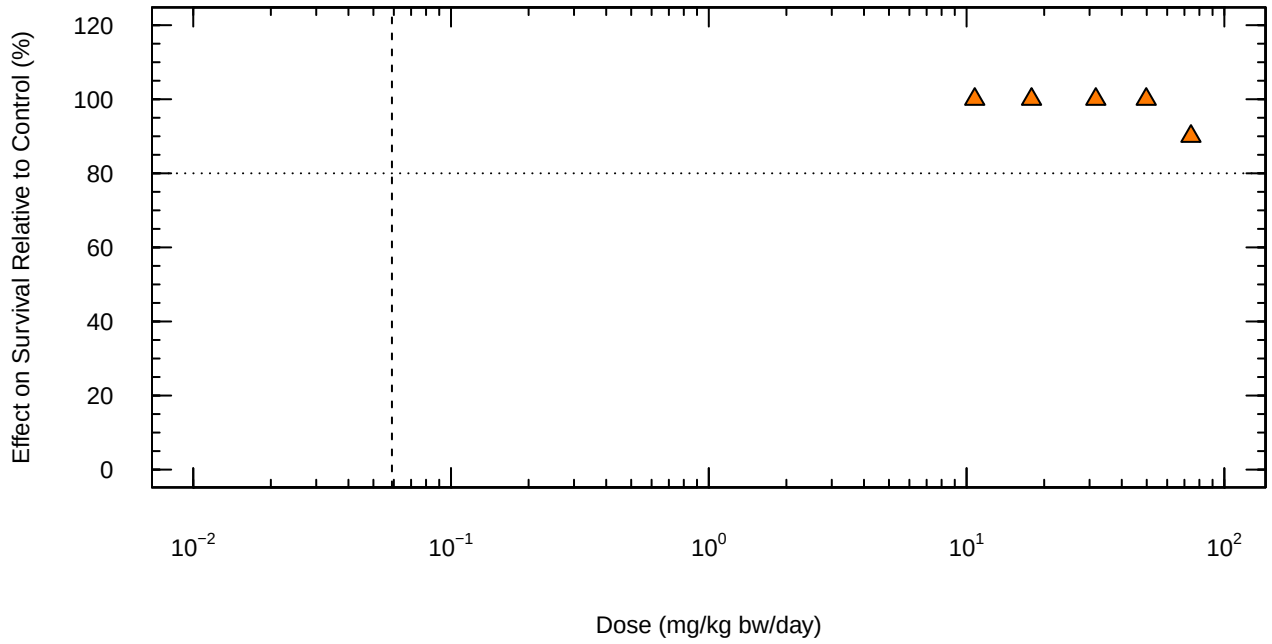
Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Rossi et al. 1987	rat	pups per litter	drinking water	6.3	antimony trichloride

Tier 2

Eco−SSL TRV = 0.059 mg/kg bw/day

80% effect relative to control

Figure H2−67. Dose−Response Data for the Mammalian Reproduction Endpoint for Antimony, Log−Transformed



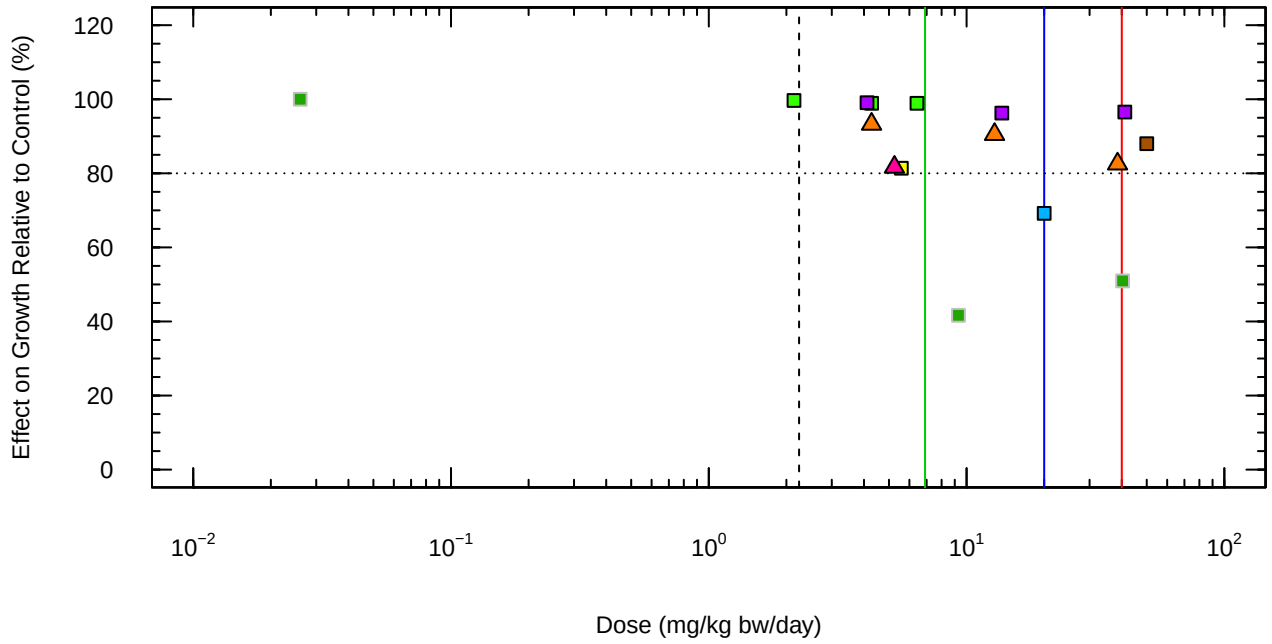
Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Dieter et al. 1991	mouse	survival	drinking water	2	antimony potassium tartrate

Tier 2

Eco−SSL TRV = 0.059 mg/kg bw/day

80% effect relative to control

Figure H2−68. Dose−Response Data for the Mammalian Survival Endpoint for Antimony, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Albert et al. 2008a	zebra finch	body weight	gavage	2	monomethylarsonic acid
Albert et al. 2008b	zebra finch	body weight	gavage	3	monomethylarsonic acid
Camardese et al. 1990	mallard	body weight	diet	10	sodium arsenate
Hoffman et al. 1992	mallard	body weight	diet	4	sodium arsenate
Howell and Hill 1978	chicken	body weight gain	diet	3	arsenic trichloride
Naraharisetti et al. 2009	chicken	body weight	drinking water	4	sodium arsenite
Sattar et al. 2016	chicken	body weight	gavage	4	disodium hydrogen arsenate
Stanley et al. 1994	mallard	body weight gain	diet	11.6−24.7	sodium arsenate

Tier 1 Tier 2

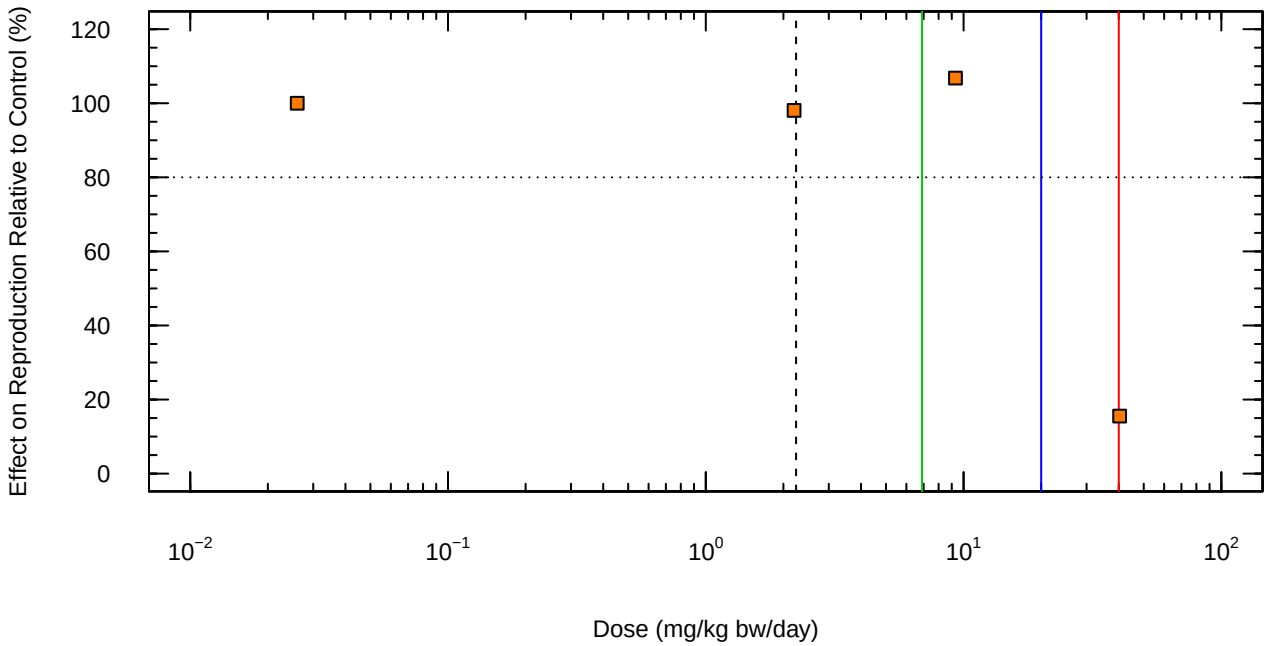
Eco−SSL TRV = 2.24 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 40 mg/kg bw/day
Selected TRV (Survival) = 6.9 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−69. Dose−Response Data for the Avian Growth Endpoint for Arsenic, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Stanley et al. 1994	mallard	duckling survival	diet	11.6−24.7	sodium arsenate

Tier 1

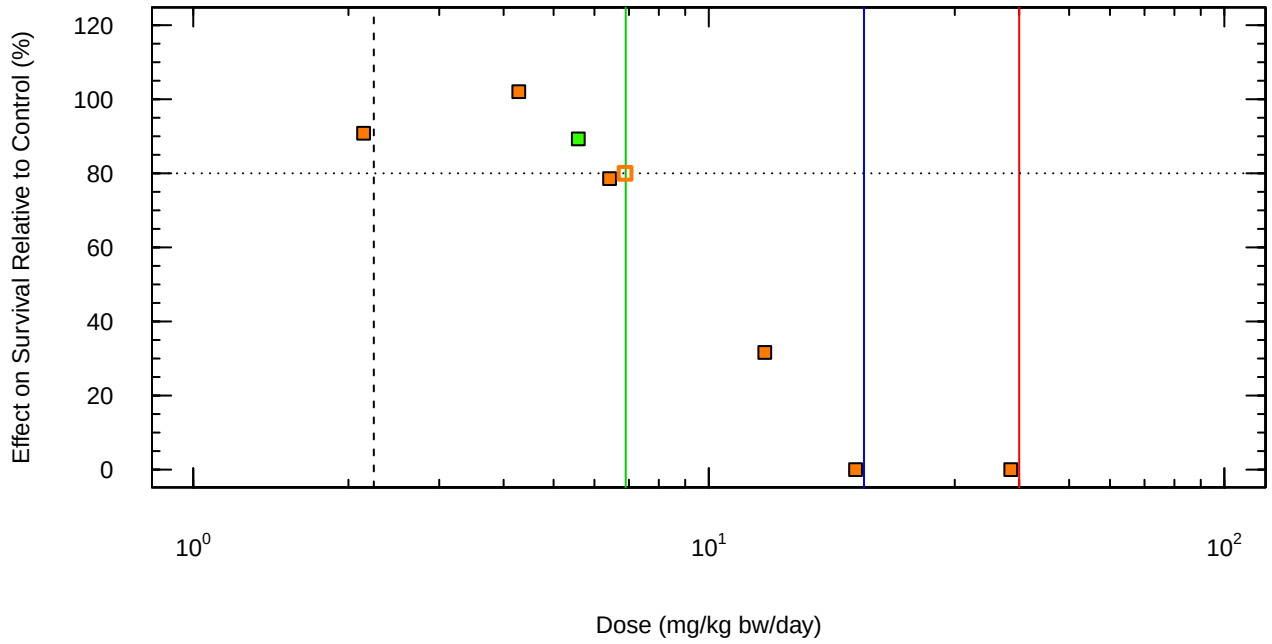
Eco−SSL TRV = 2.24 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 40 mg/kg bw/day
Selected TRV (Survival) = 6.9 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−70. Dose−Response Data for the Avian Reproduction Endpoint for Arsenic, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Albert et al. 2008b	zebra finch	survival	gavage	3	monomethylarsonic acid	
Howell and Hill 1978	chicken	survival	diet	3	arsenic trichloride	
ED20 for Albert et al. 2008b	zebra finch	survival	gavage	3	monomethylarsonic acid	6.9

Tier 1

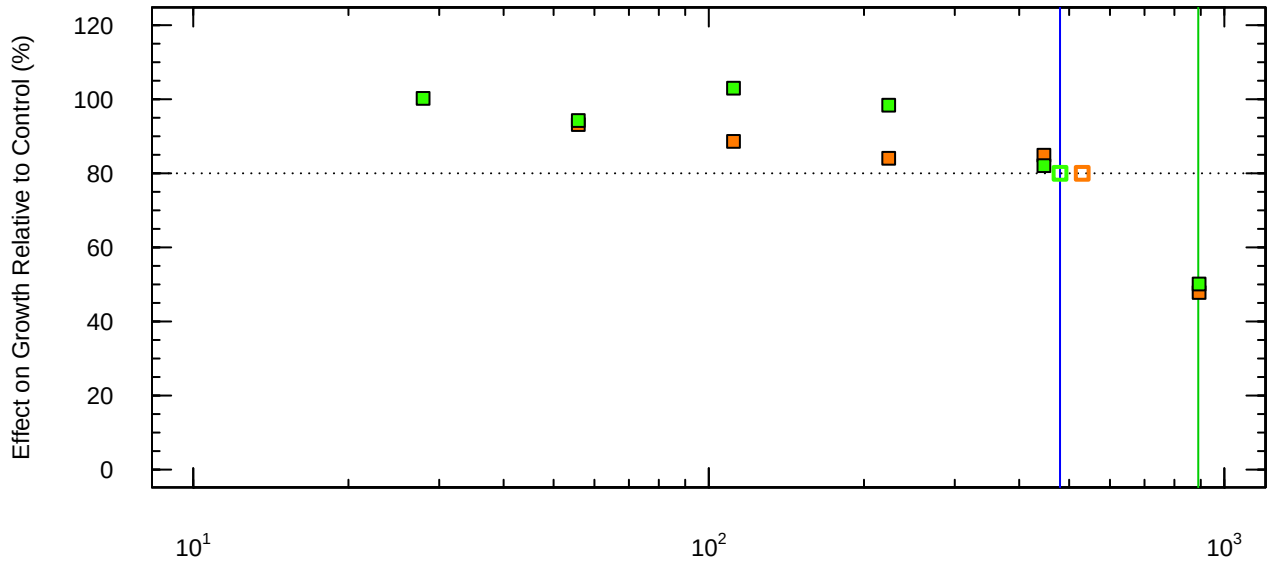
Eco−SSL TRV = 2.24 mg/kg bw/day

Selected TRV (Growth) = 20 mg/kg bw/day
Selected TRV (Reproduction) = 40 mg/kg bw/day
Selected TRV (Survival) = 6.9 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−71. Dose−Response Data for the Avian Survival Endpoint for Arsenic, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Johnson et al. 1960	chicken	body weight gain	diet	4	barium hydroxide	
Johnson et al. 1960	chicken	body weight gain	diet	4	barium acetate	
ED20 for Johnson et al. 1960	chicken	body weight gain	diet	4	barium hydroxide	530
ED20 for Johnson et al. 1960	chicken	body weight gain	diet	4	barium acetate	480

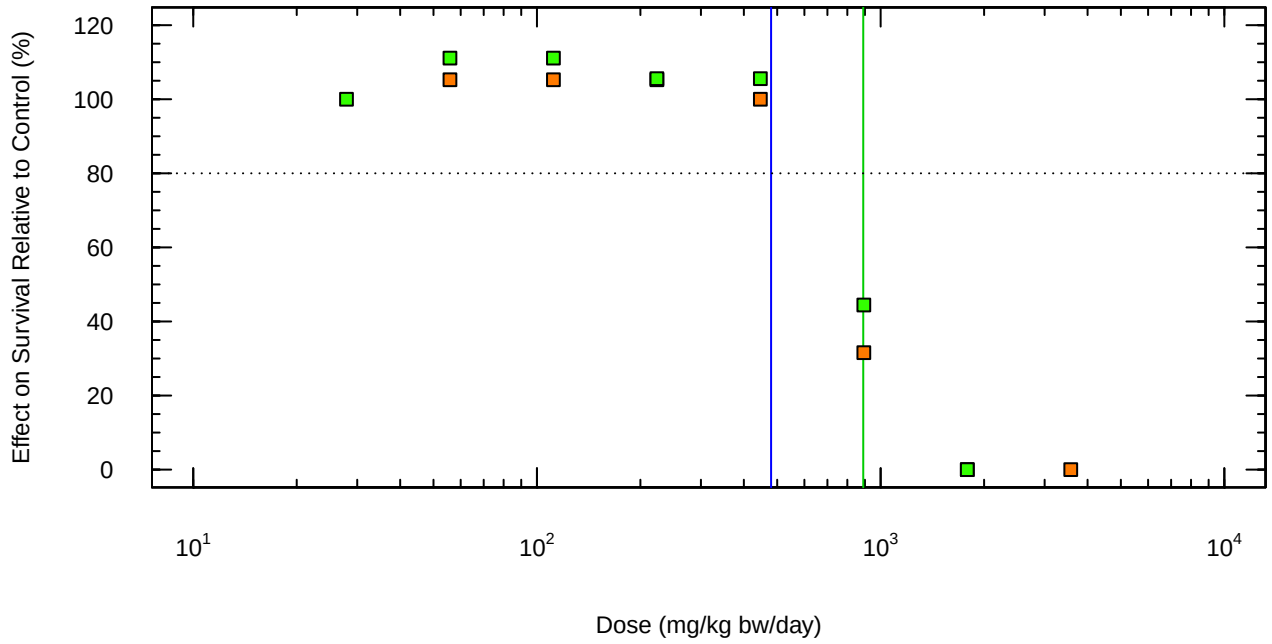
Tier 1

Selected TRV (Growth) = 480 mg/kg bw/day
Selected TRV (Survival) = 890 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−72. Dose−Response Data for the Avian Growth Endpoint for Barium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Johnson et al. 1960	chicken	survival	diet	4	barium hydroxide
Johnson et al. 1960	chicken	survival	diet	4	barium acetate

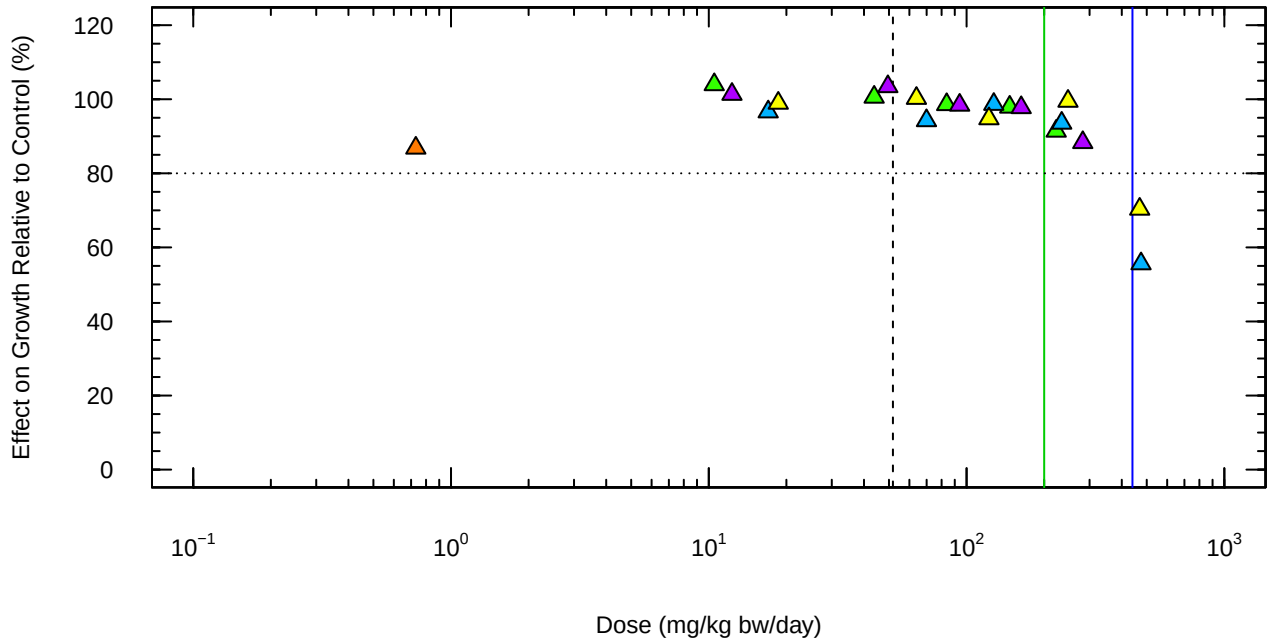
Tier 1

Selected TRV (Growth) = 480 mg/kg bw/day
Selected TRV (Survival) = 890 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−73. Dose−Response Data for the Avian Survival Endpoint for Barium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Schroeder and Mitchener 1975	mouse	body weight (female)	drinking water	104	barium acetate	
Dietz et al. 1992	rat	body weight (female)	drinking water	13	barium chloride dihydrate	B
Dietz et al. 1992	rat	body weight (male)	drinking water	13	barium chloride dihydrate	B
Dietz et al. 1992	mouse	body weight (female)	drinking water	13	barium chloride dihydrate	A
Dietz et al. 1992	mouse	body weight (male)	drinking water	13	barium chloride dihydrate	A

△ Tier 2

- - - Eco−SSL TRV = 51.8 mg/kg bw/day

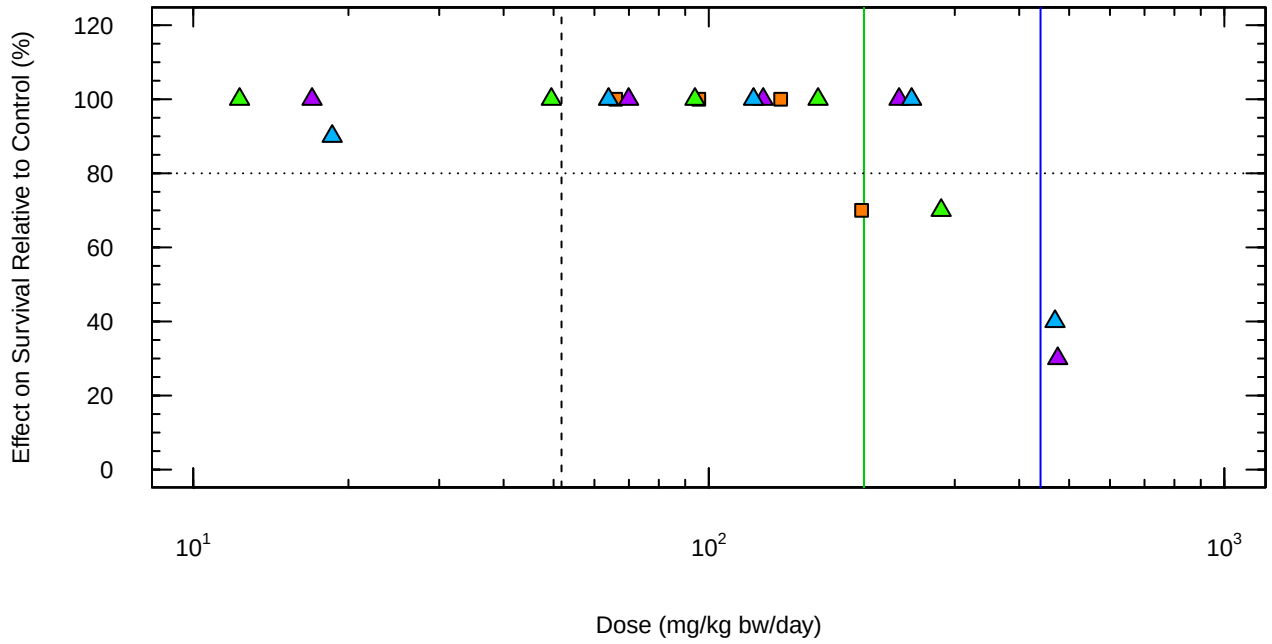
—— Selected TRV (Growth) = 440 mg/kg bw/day

—— Selected TRV (Survival) = 200 mg/kg bw/day

····· 80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−74. Dose−Response Data for the Mammalian Growth Endpoint for Barium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Borzelleca et al. 1988	rat	survival (female)	gavage	1.4	barium chloride	
Dietz et al. 1992	rat	survival (male)	drinking water	13	barium chloride dihydrate	
Dietz et al. 1992	mouse	survival (female)	drinking water	13	barium chloride dihydrate	C
Dietz et al. 1992	mouse	survival (male)	drinking water	13	barium chloride dihydrate	C

Tier 1 Tier 2

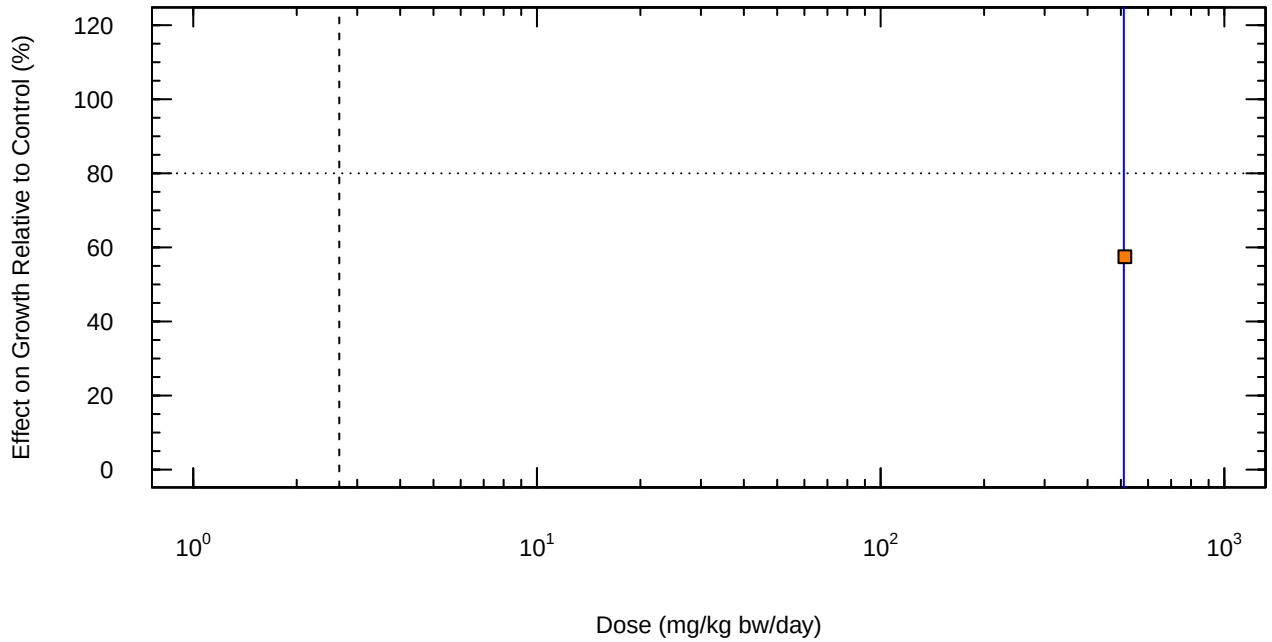
Eco−SSL TRV = 51.8 mg/kg bw/day

Selected TRV (Growth) = 440 mg/kg bw/day
Selected TRV (Survival) = 200 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−75. Dose−Response Data for the Mammalian Survival Endpoint for Barium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Chung et al. 1985	chicken	body weight	diet	2	chromium sulfate (chromium [III])

Tier 1

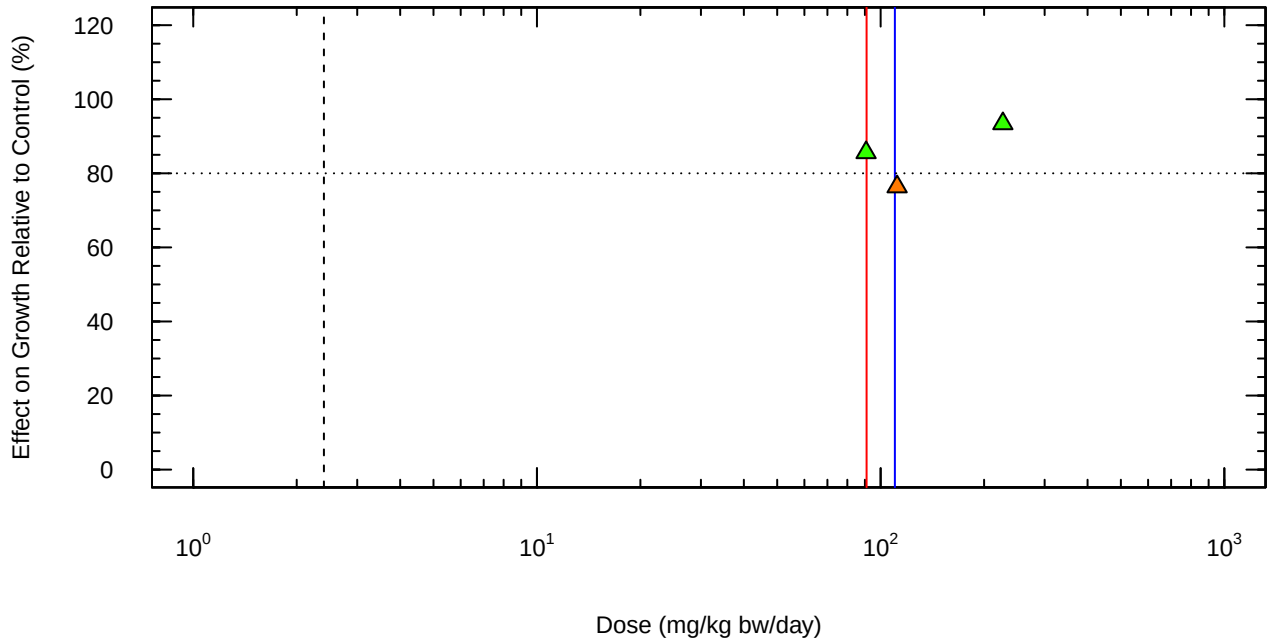
Eco−SSL TRV = 2.66 mg/kg bw/day

Selected TRV (Growth) = 510 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−76. Dose−Response Data for the Avian Growth Endpoint for Chromium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Bataineh et al. 1997	rat	body weight (male)	drinking water	12	chromium chloride (chromium [III])
Elbetieha and Al−Hamood 1997	mouse	body weight	drinking water	12	chromium chloride (chromium [III])

Tier 2

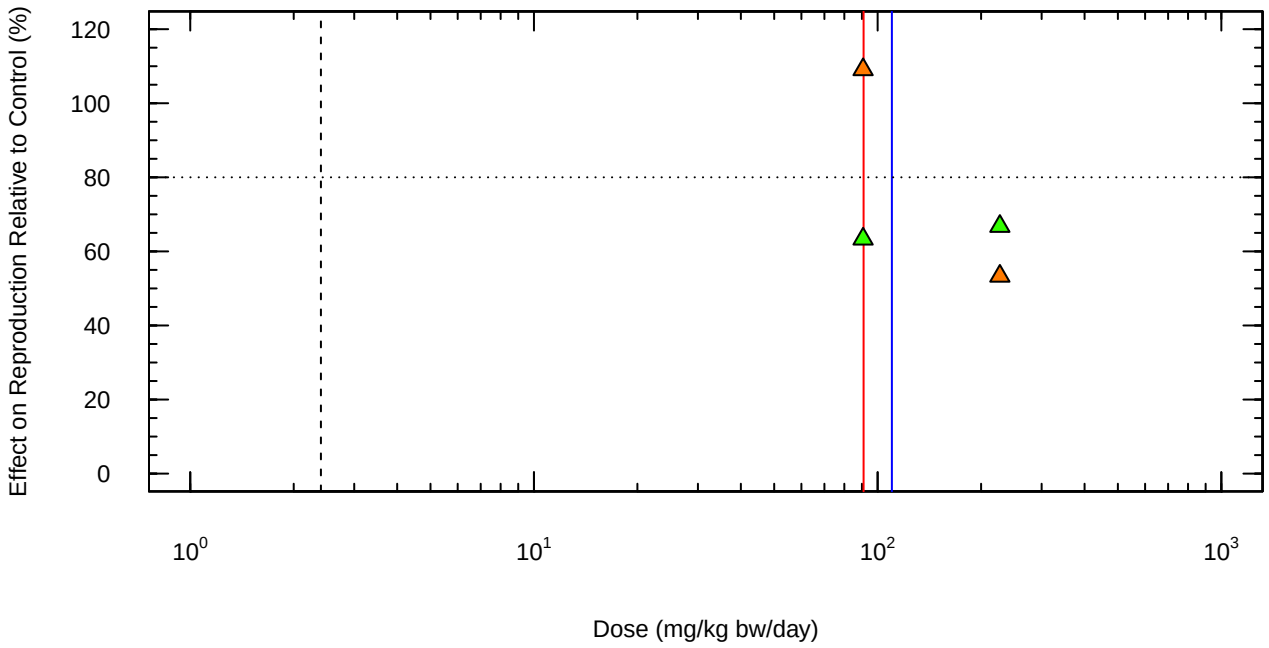
Eco−SSL TRV = 2.4 mg/kg bw/day

Selected TRV (Growth) = 110 mg/kg bw/day
Selected TRV (Reproduction) = 91 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−77. Dose−Response Data for the Mammalian Growth Endpoint for Chromium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Elbetieha and Al−Hamood 1997	mouse	pregnancy success	drinking water	12	chromium chloride (chromium [III])
Elbetieha and Al−Hamood 1997	mouse	viability of fetuses	drinking water	12	chromium chloride (chromium [III])

△ Tier 2

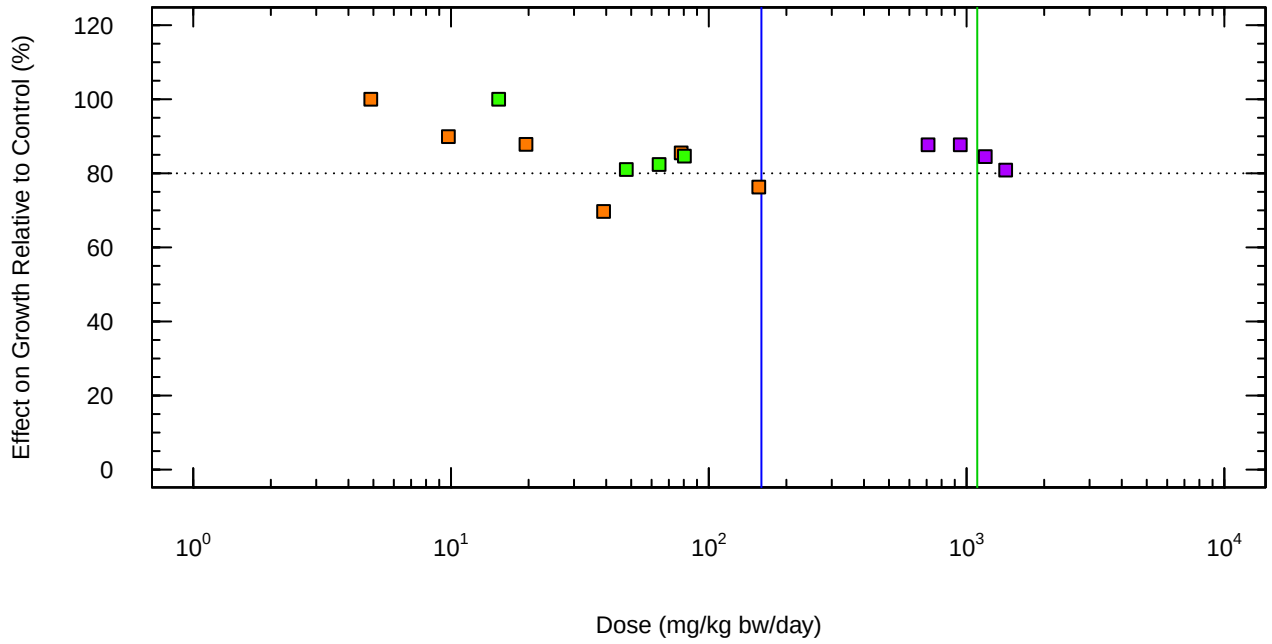
- - - Eco−SSL TRV = 2.4 mg/kg bw/day

Selected TRV (Growth) = 110 mg/kg bw/day
Selected TRV (Reproduction) = 91 mg/kg bw/day

····· 80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−78. Dose−Response Data for the Mammalian Reproduction Endpoint for Chromium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
McGhee et al. 1965	chicken	body weight	diet	4	iron sulfate
Cao et al. 1996	chicken	body weight	diet	3	iron sulfate
Pescatore and Harter−Dennis 1989	chicken	body weight	gavage	single dose	iron sulfate

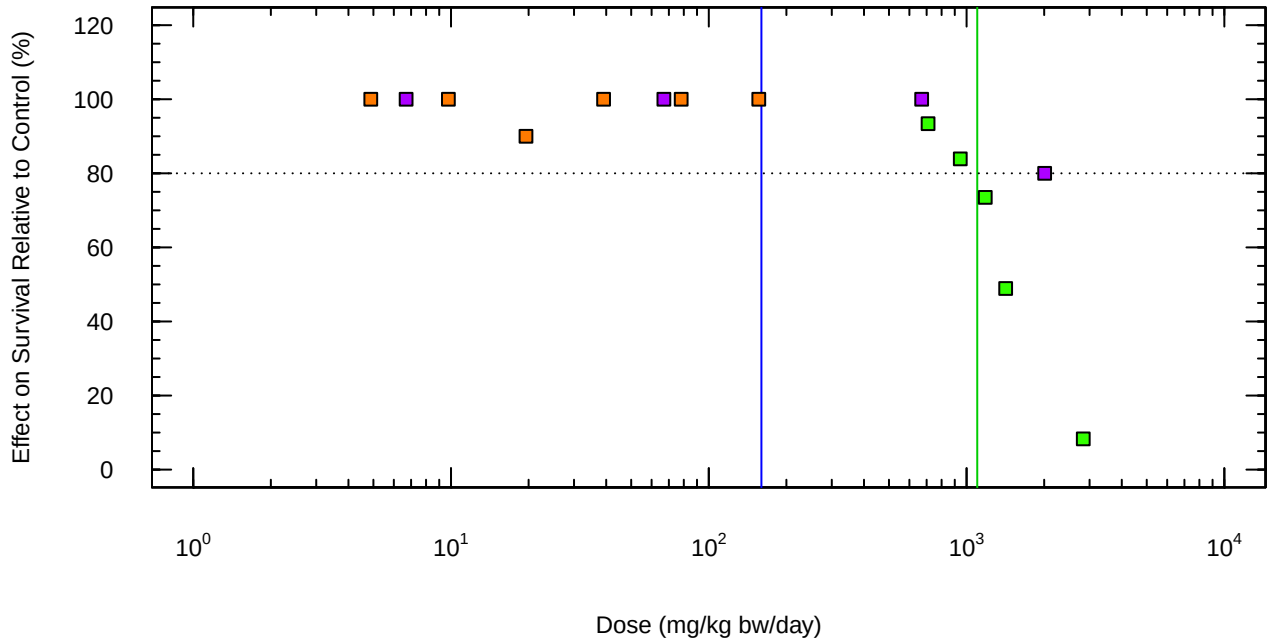
Tier 1

Selected TRV (Growth) = 160 mg/kg bw/day
Selected TRV (Survival) = 1100 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−79. Dose−Response Data for the Avian Growth Endpoint for Iron, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
McGhee et al. 1965	chicken	survival	diet	4	iron sulfate	
Pescatore and Harter−Dennis 1989	chicken	survival	gavage	single dose	iron sulfate	A
Wallner−Pendleton et al. 1986	chicken	survival	gavage	single dose	iron sulfate	A

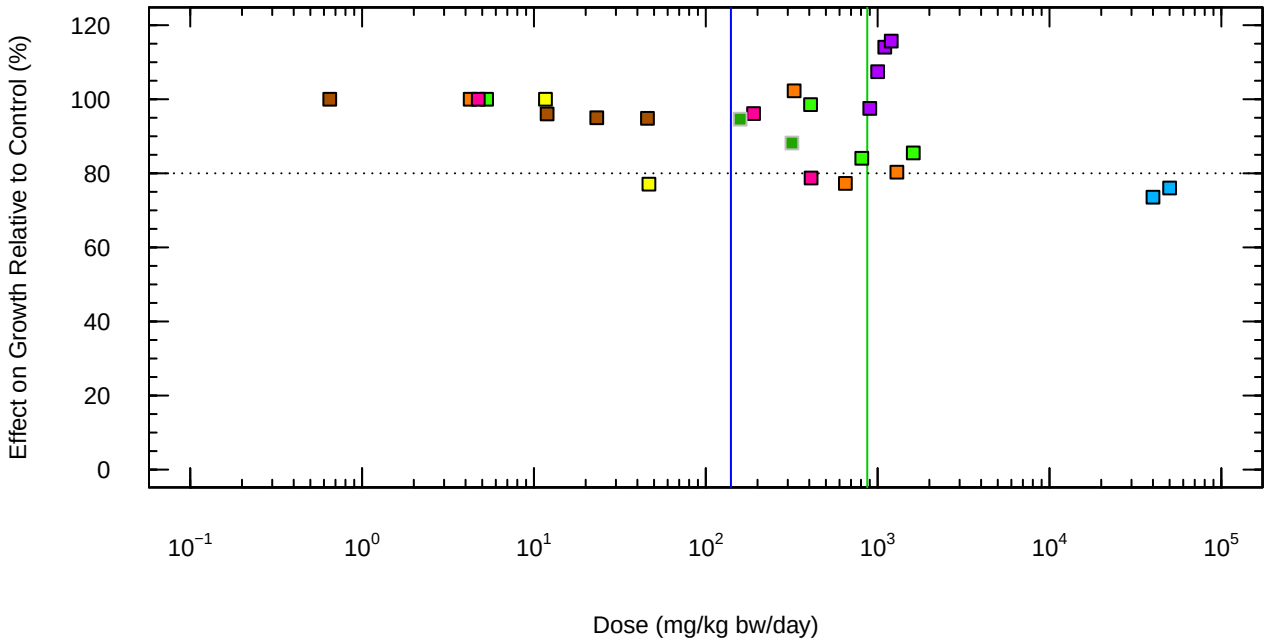
Tier 1

Selected TRV (Growth) = 160 mg/kg bw/day
Selected TRV (Survival) = 1100 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−80. Dose−Response Data for the Avian Survival Endpoint for Iron, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Plummer et al. 1997	rat (male)	body weight	diet	32	carbonyl iron	
Plummer et al. 1997	rat (female)	body weight	diet	32	carbonyl iron	
Whittaker et al. 2002	rat	body weight	gavage	single dose	iron sulfate	
Whittaker et al. 2002	rat	body weight	gavage	single dose	carbonyl iron	
Banis et al. 1969	rat	body weight	diet	4	iron sulfate	A
Storey and Greger 1987	rat	body weight	diet	3	iron sulfate	A
Prince et al. 1979	pig	body weight	diet	16	ferrous sulfide	
Zhu et al. 2016	rat	body weight	diet	13	carbonyl iron	

Tier 1

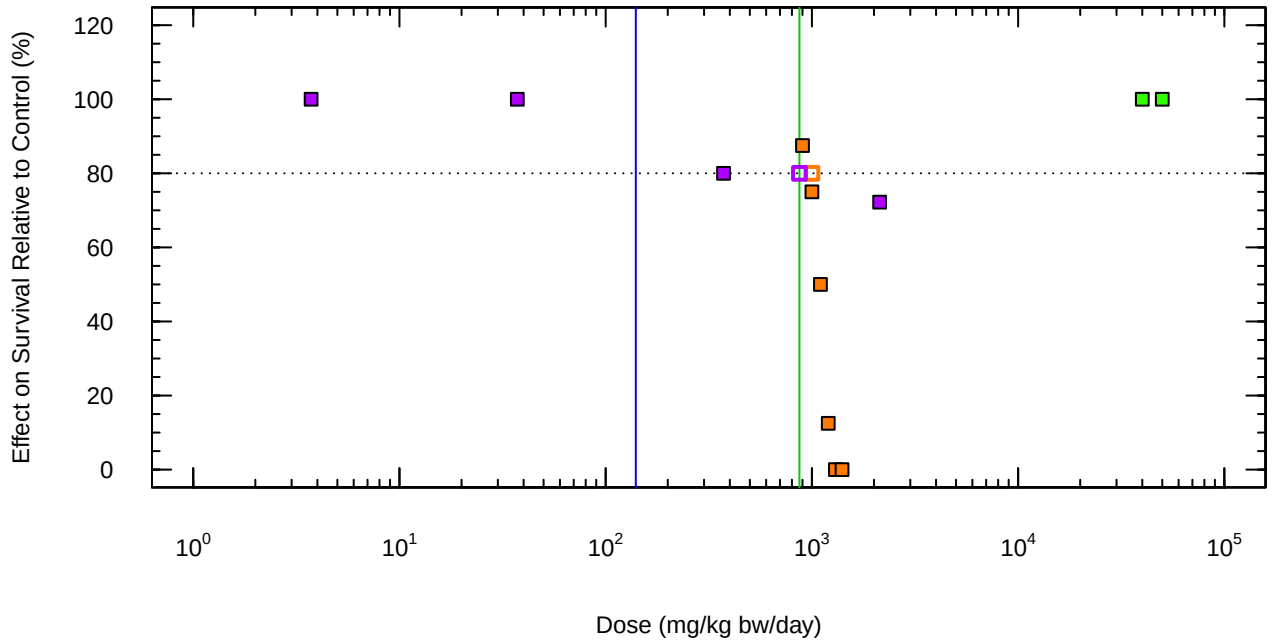
Selected TRV (Growth) = 140 mg/kg bw/day

Selected TRV (Survival) = 870 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−81. Dose−Response Data for the Mammalian Growth Endpoint for Iron, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Whittaker et al. 2002	rat	survival	gavage	single dose	iron sulfate	
Whittaker et al. 2002	rat	survival	gavage	single dose	carbonyl iron	
Whittaker et al. 1996	rat	survival	diet	12	carbonyl iron	
ED20 for Whittaker et al. 2002	rat	survival	gavage	single dose	iron sulfate	1000
ED20 for Whittaker et al. 1996	rat	survival	diet	12	carbonyl iron	870

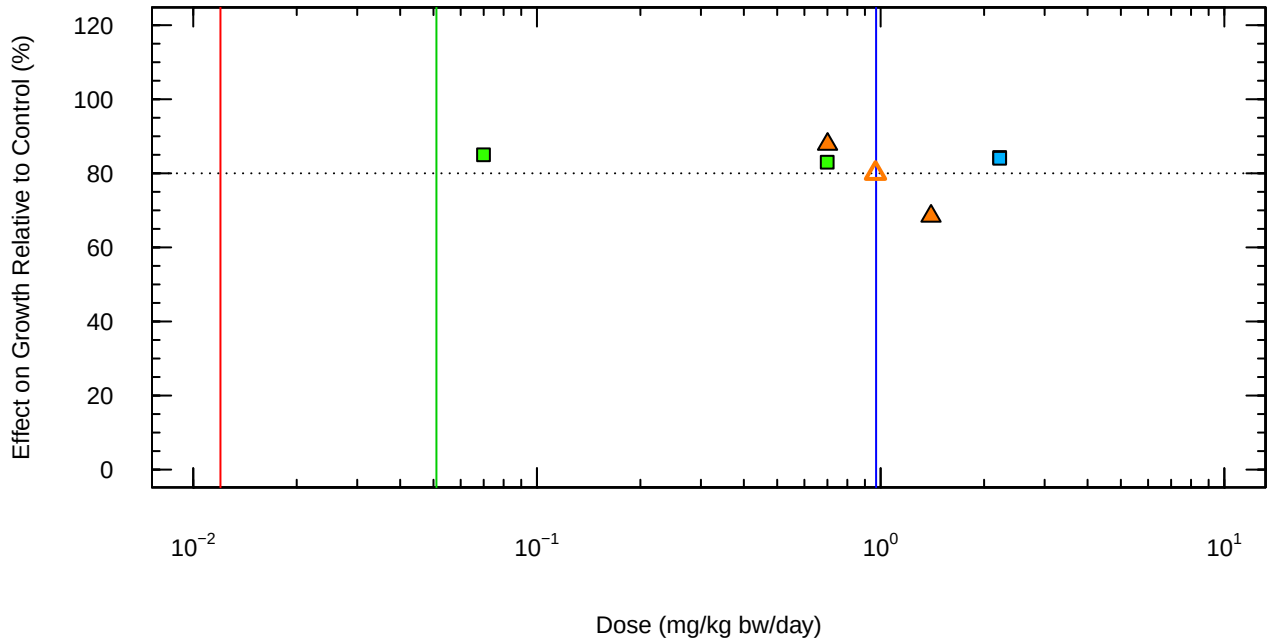
Tier 1

Selected TRV (Growth) = 140 mg/kg bw/day
Selected TRV (Survival) = 870 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−82. Dose−Response Data for the Mammalian Survival Endpoint for Iron, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Scott et al. 1977	chicken	body weight	diet	8	methylmercury chloride		
Spalding et al. 2000	egret	weight index	diet	14	methylmercury chloride		
Sell and Horani 1976	chicken	body weight gain (Exp 1)	diet	4	methylmercury chloride	A	
Sell and Horani 1976	chicken	body weight gain (Exp 2)	diet	3.6	methylmercury chloride	A	
ED20 for Scott et al. 1977	chicken	body weight	diet	8	methylmercury chloride		0.97

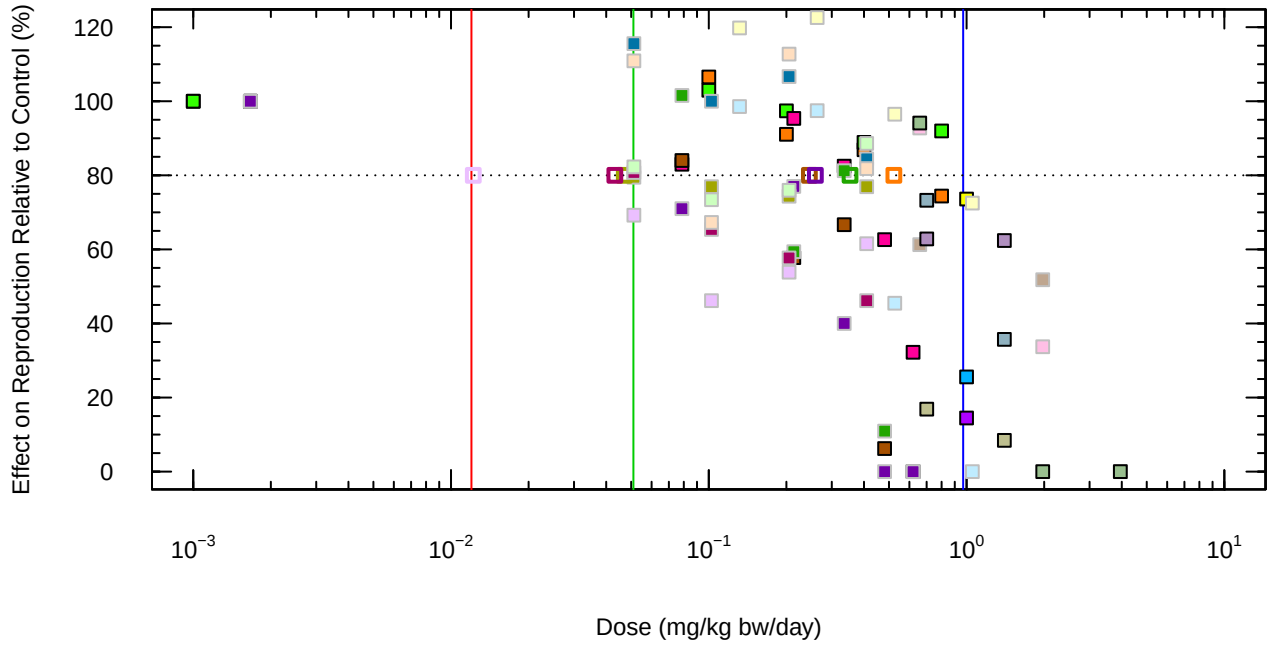
Tier 1 Tier 2

Selected TRV (Growth) = 0.97 mg/kg bw/day
Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−83. Dose−Response Data for the Avian Growth Endpoint for Methylmercury, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	
Heinz et al. 2010	mallard	duckling body weight	diet	3.7	methylmercury chloride		
Heinz and Hoffman 1998	mallard	# of ducklings per hen	diet	up to 11	methylmercury chloride	B	
Heinz and Hoffman 1998	mallard	% hatchability	diet	up to 11	methylmercury chloride		
Heinz and Hoffman 1998	mallard	duckling survival	diet	up to 11	methylmercury chloride		
Albers et al. 2007	kestrel	egg production	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		
Varian−Ramos et al. 2014	finch	% hatchability	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % hatchability	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % chicks fledged	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		
Eskeland and Nafstad 1978	quail	chick survival	diet	6	methylmercury chloride		
Eskeland and Nafstad 1978	quail	hatch success	diet	6	methylmercury chloride		
El−Begearmi et al. 1977	quail	% egg fertility	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	egg production	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	% hatchability	diet	16	methylmercury hydroxide		
Scott et al. 1977	chicken	egg fertility	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg production	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg hatchability	diet	8	methylmercury chloride		
ED20 for Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	0.52
ED20 for Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		0.25
ED20 for Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		0.35
ED20 for Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		0.26
ED20 for Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		0.047
ED20 for Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		0.043
ED20 for Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		0.012

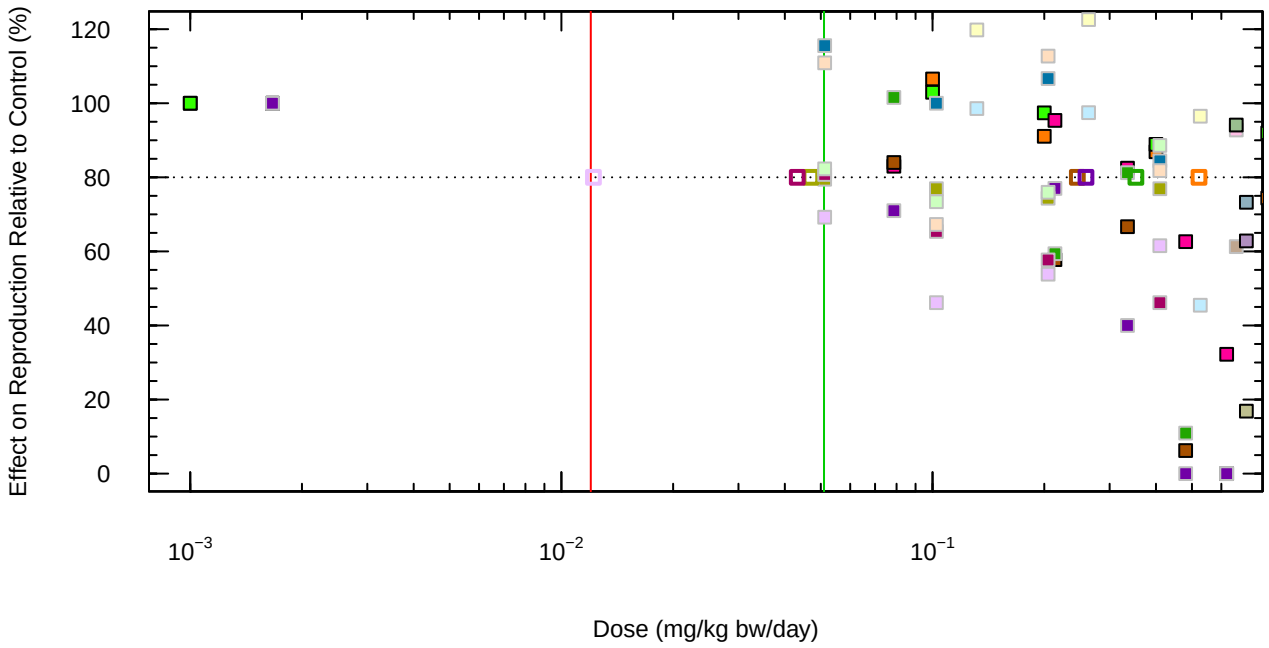
Tier 1

Selected TRV (Growth) = 0.97 mg/kg bw/day
Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−84a. Dose−Response Data for the Avian Reproduction Endpoint for Methylmercury, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	
Heinz et al. 2010	mallard	duckling body weight	diet	3.7	methylmercury chloride		
Heinz and Hoffman 1998	mallard	# of ducklings per hen	diet	up to 11	methylmercury chloride	B	
Heinz and Hoffman 1998	mallard	% hatchability	diet	up to 11	methylmercury chloride		
Heinz and Hoffman 1998	mallard	duckling survival	diet	up to 11	methylmercury chloride		
Albers et al. 2007	kestrel	egg production	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		
Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		
Varian−Ramos et al. 2014	finch	% hatchability	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % hatchability	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 % chicks fledged	diet	unclear	methylmercury cysteine		
Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		
Eskeland and Nafstad 1978	quail	chick survival	diet	6	methylmercury chloride		
Eskeland and Nafstad 1978	quail	hatch success	diet	6	methylmercury chloride		
El−Begearmi et al. 1977	quail	% egg fertility	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	egg production	diet	16	methylmercury hydroxide		
El−Begearmi et al. 1977	quail	% hatchability	diet	16	methylmercury hydroxide		
Scott et al. 1977	chicken	egg fertility	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg production	diet	8	methylmercury chloride		
Scott et al. 1977	chicken	egg hatchability	diet	8	methylmercury chloride		
ED20 for Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B	0.52
ED20 for Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride		0.25
ED20 for Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride		0.35
ED20 for Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride		0.26
ED20 for Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine		0.047
ED20 for Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine		0.043
ED20 for Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine		0.012

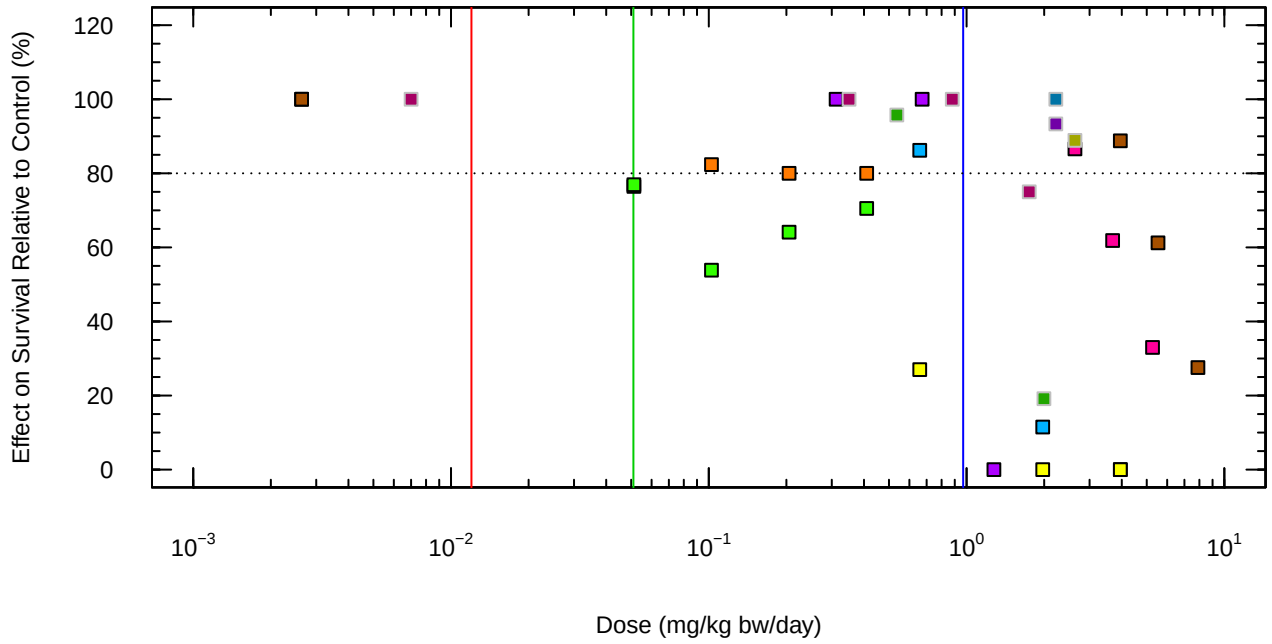
Tier 1

Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day
Selected TRV (Growth) = 0.97 mg/kg bw/day (not shown on plot because of truncated X−axis)

····· 80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−84b. Dose−Response Data for the Avian Reproduction Endpoint for Methylmercury, Log−Transformed (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Varian−Ramos et al. 2014	finch	survival	diet	52	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	F1 survival	diet	unclear	methylmercury cysteine	
Bennet et al. 2009	kestrel	survival	diet	5−7	methylmercury chloride	
El−Begearmi et al. 1977	quail	survival (female)	diet	16	methylmercury hydroxide	C
El−Begearmi et al. 1977	quail	survival (male)	diet	16	methylmercury hydroxide	C
Hill and Soares 1987	quail	survival	diet	0.71	methylmercury chloride	
Hill and Soares 1987	quail	survival	diet	0.71	methylmercury chloride	
Spann et al. 1986	quail	survival	diet	6	methylmercury chloride	
Sell and Horani 1976	chicken	survival (Exp 1)	diet	4	methylmercury chloride	
Sell and Horani 1976	chicken	survival (Exp 2)	diet	3.6	methylmercury chloride	
Sell and Horani 1976	quail	survival (Exp 2)	diet	3.3	methylmercury chloride	
Scheuhammer 1988	finch	survival	diet	11	methylmercury chloride	

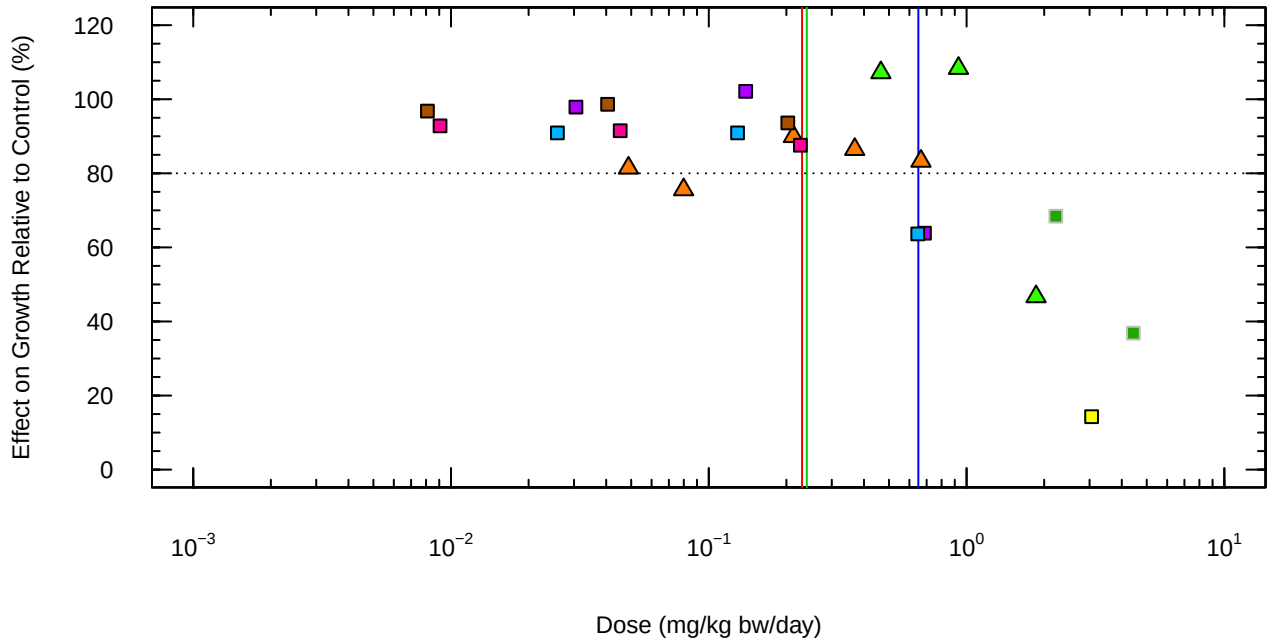
Tier 1

Selected TRV (Growth) = 0.97 mg/kg bw/day
Selected TRV (Reproduction) = 0.012 mg/kg bw/day
Selected TRV (Survival) = 0.051 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−85. Dose−Response Data for the Avian Survival Endpoint for Methylmercury, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Wobeser et al. 1976	mink	body weight	diet	13	methylmercury chloride	
Gandhi et al. 2013	rat	body weight gain	gavage	3	methylmercury chloride	
Mitsumori et al. 1990	mouse	body weight	diet	104	methylmercury chloride	
Mitsumori et al. 1983	rat	body weight	diet	130	methylmercury chloride	D
Stillings et al. 1974	rat	body weight gain	diet	4	methylmercury chloride	
Verschuuren et al. 1976a	rat	F2 body weight gain	diet	12	methylmercury chloride	
Verschuuren et al. 1976b	rat	body weight	diet	104	methylmercury chloride	D
Friedman et al. 1978	rat	body weight	diet	10	methylmercury chloride	

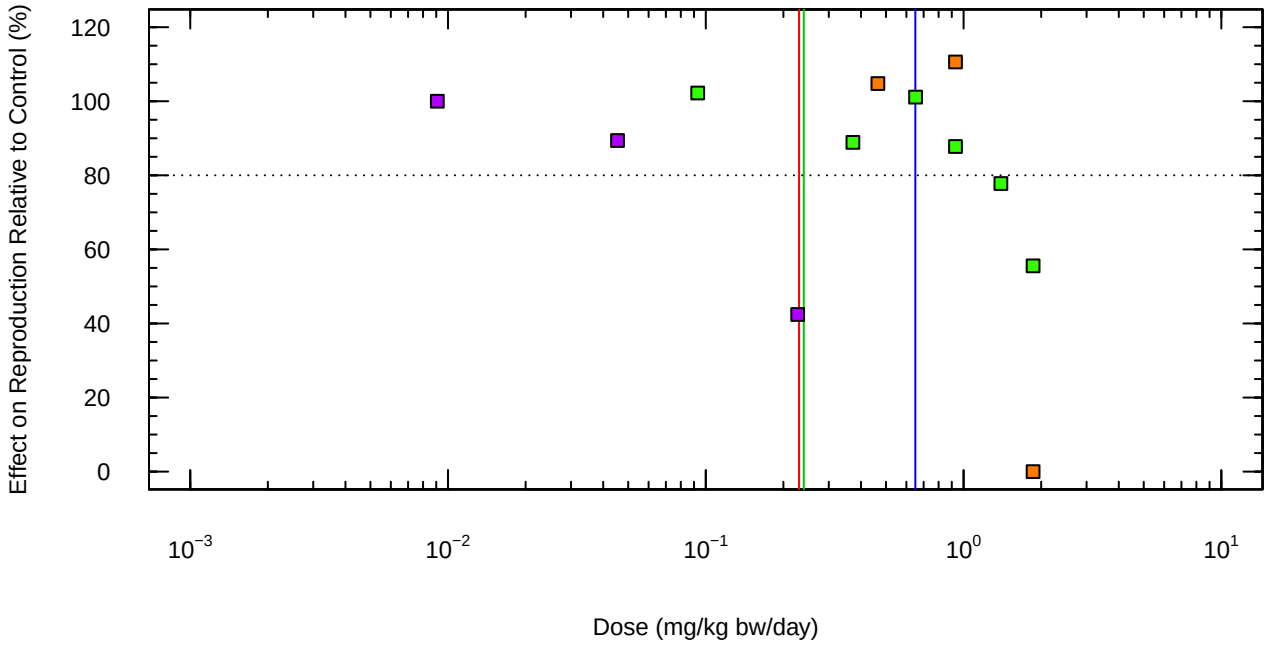
Tier 1 Tier 2

Selected TRV (Growth) = 0.65 mg/kg bw/day
Selected TRV (Reproduction) = 0.23 mg/kg bw/day
Selected TRV (Survival) = 0.24 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−86. Dose−Response Data for the Mammalian Growth Endpoint for Methylmercury, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Gandhi et al. 2013	rat	fetal survival	gavage	3	methylmercury chloride
Tonk et al. 2010	rat	litter survival	gavage	variable	methylmercury chloride
Verschuuren et al. 1976a	rat	F1 viability index	diet	12	methylmercury chloride

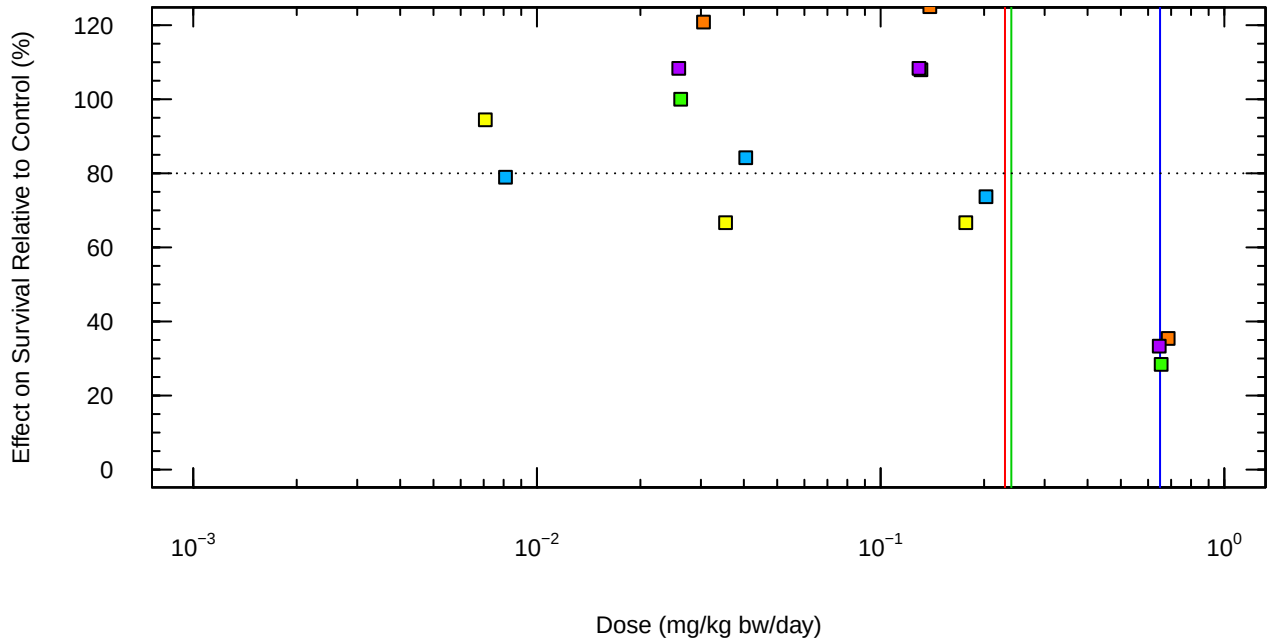
Tier 1

Selected TRV (Growth) = 0.65 mg/kg bw/day
Selected TRV (Reproduction) = 0.23 mg/kg bw/day
Selected TRV (Survival) = 0.24 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−87. Dose−Response Data for the Mammalian Reproduction Endpoint for Methylmercury, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Mitsumori et al. 1990	mouse	survival	diet	104	methylmercury chloride	
Mitsumori et al. 1983	rat	survival	diet	130	methylmercury chloride	E
Mitsumori et al. 1983	rat	survival	diet	130	methylmercury chloride	E
Verschuuren et al. 1976b	rat	survival (female)	diet	104	methylmercury chloride	E
Verschuuren et al. 1976b	rat	survival (male)	diet	104	methylmercury chloride	E

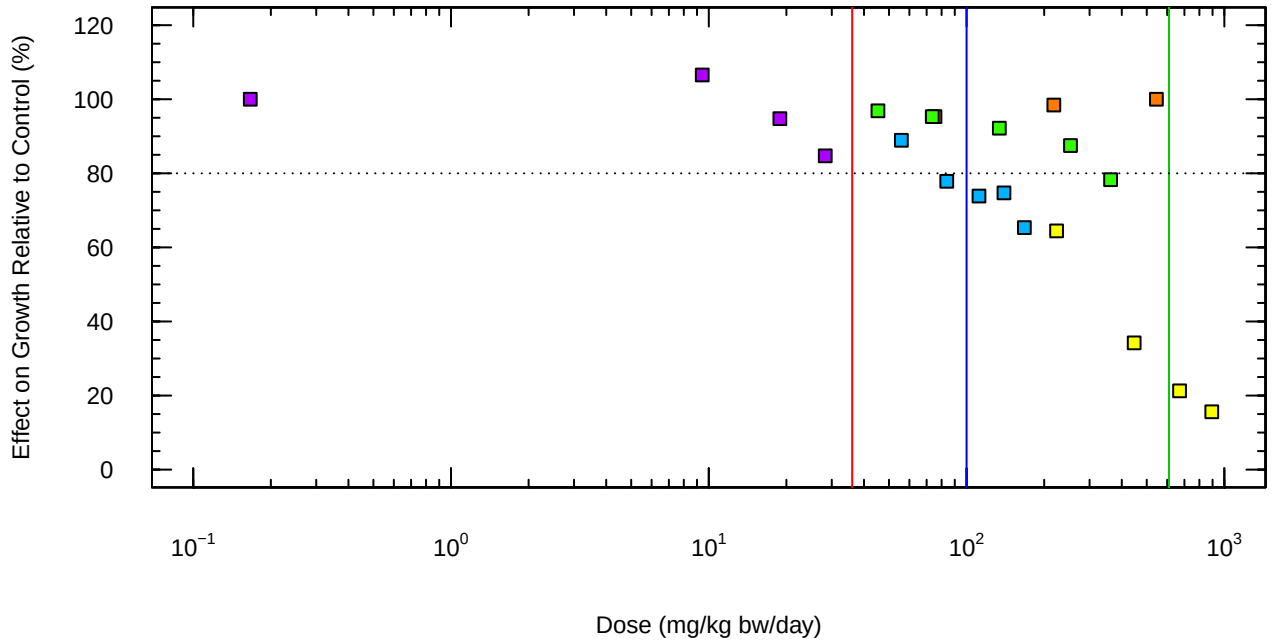
Tier 1

Selected TRV (Growth) = 0.65 mg/kg bw/day
Selected TRV (Reproduction) = 0.23 mg/kg bw/day
Selected TRV (Survival) = 0.24 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−88. Dose−Response Data for the Mammalian Survival Endpoint for Methylmercury, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Stafford et al. 2015	bobwhite quail	body weight gain	diet	4.3	molydenum disulfide	
Stafford et al. 2015	bobwhite quail	body weight gain	diet	4.3	sodium molybdate	
Kratzer 1952	chicken	weight gain	diet	3.3	sodium molybdate	
Davies et al. 1960	chicken	body weight (Exp 1b)	diet	4	sodium molybdate	A
Davies et al. 1960	chicken	body weight (Exp 1c)	diet	4	sodium molybdate	A

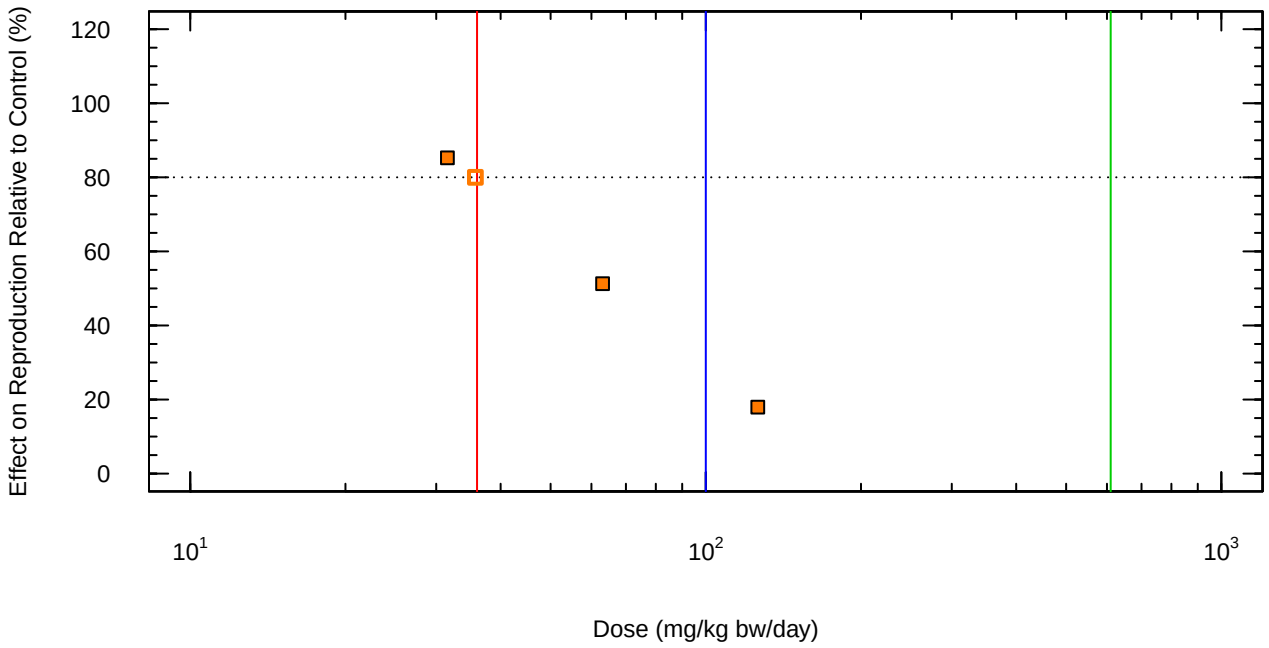
Tier 1

Selected TRV (Growth) = 100 mg/kg bw/day
Selected TRV (Reproduction) = 36 mg/kg bw/day
Selected TRV (Survival) = 610 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−89. Dose−Response Data for the Avian Growth Endpoint for Molybdenum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Lepore and Miller 1965	chicken	egg production	diet	3	sodium molybdate	
ED20 for Lepore and Miller 1965	chicken	egg production	diet	3	sodium molybdate	36

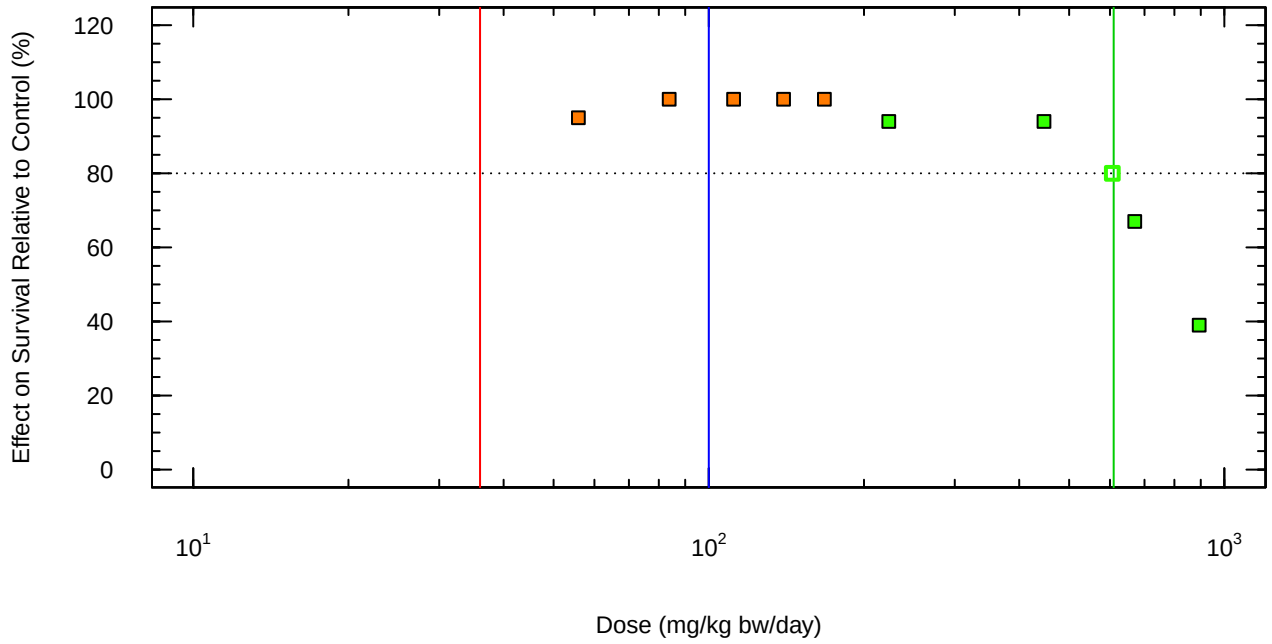
Tier 1

Selected TRV (Growth) = 100 mg/kg bw/day
Selected TRV (Reproduction) = 36 mg/kg bw/day
Selected TRV (Survival) = 610 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−90. Dose−Response Data for the Avian Reproduction Endpoint for Molybdenum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Davies et al. 1960	chicken	survival (Exp 1b)	diet	4	sodium molybdate	
Davies et al. 1960	chicken	survival (Exp 1c)	diet	4	sodium molybdate	
ED20 for Davies et al. 1960	chicken	survival (Exp 1c)	diet	4	sodium molybdate	610

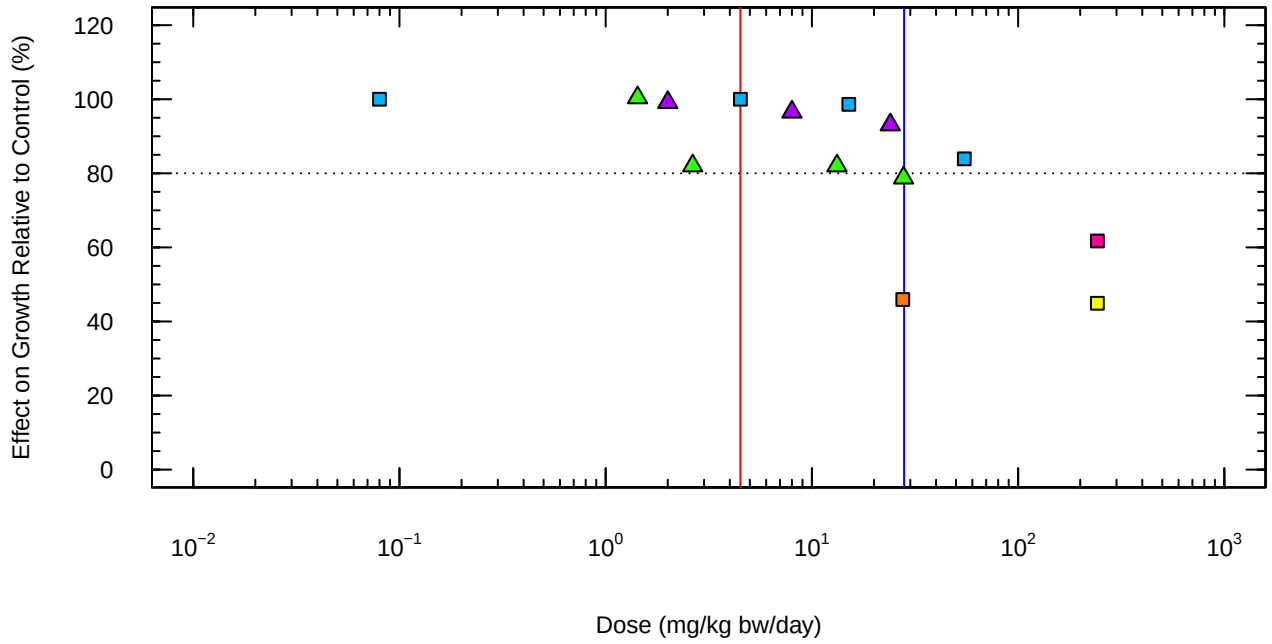
Tier 1

Selected TRV (Growth) = 100 mg/kg bw/day
Selected TRV (Reproduction) = 36 mg/kg bw/day
Selected TRV (Survival) = 610 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−91. Dose−Response Data for the Avian Survival Endpoint for Molybdenum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Brinkman and Miller 1961	rat	body weight gain	diet	6	sodium molybdate	
Fungwe et al. 1990	rat	body weight gain	drinking water	9	sodium molybdate	
Lyubimov et al. 2004	rat	body weight	gavage	8	ammonium tetrathiomolybdate	
Murray et al. 2013	rat	body weight	diet	12	sodium molybdate dihydrate	
Bandyopadhyay et al. 1981	rat	body weight gain	oral	4	ammonium molybdate	A
Bandyopadhyay et al.1981	rat	body weight gain	oral	4	ammonium molybdate	A

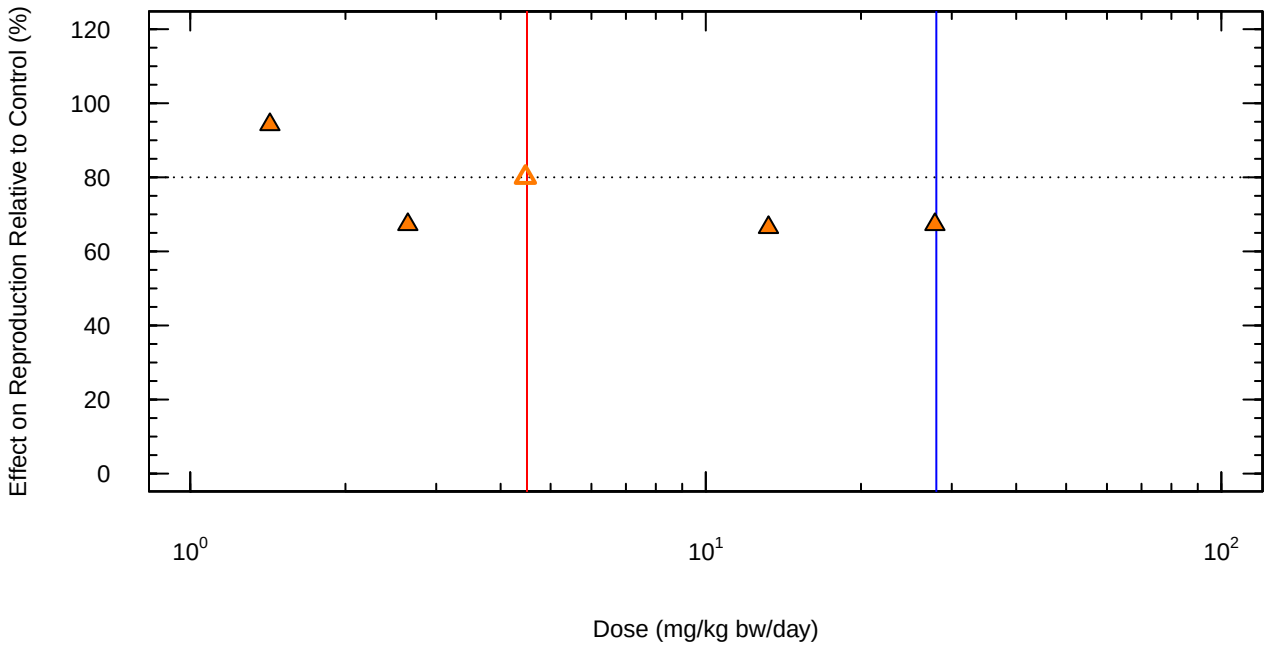
Tier 1 Tier 2

Selected TRV (Growth) = 28 mg/kg bw/day
Selected TRV (Reproduction) = 4.5 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−92. Dose−Response Data for the Mammalian Growth Endpoint for Molybdenum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Fungwe et al. 1990	rat	litter weight	drinking water	9	sodium molybdate	
ED20 for Fungwe et al. 1990	rat	litter weight	drinking water	9	sodium molybdate	4.5

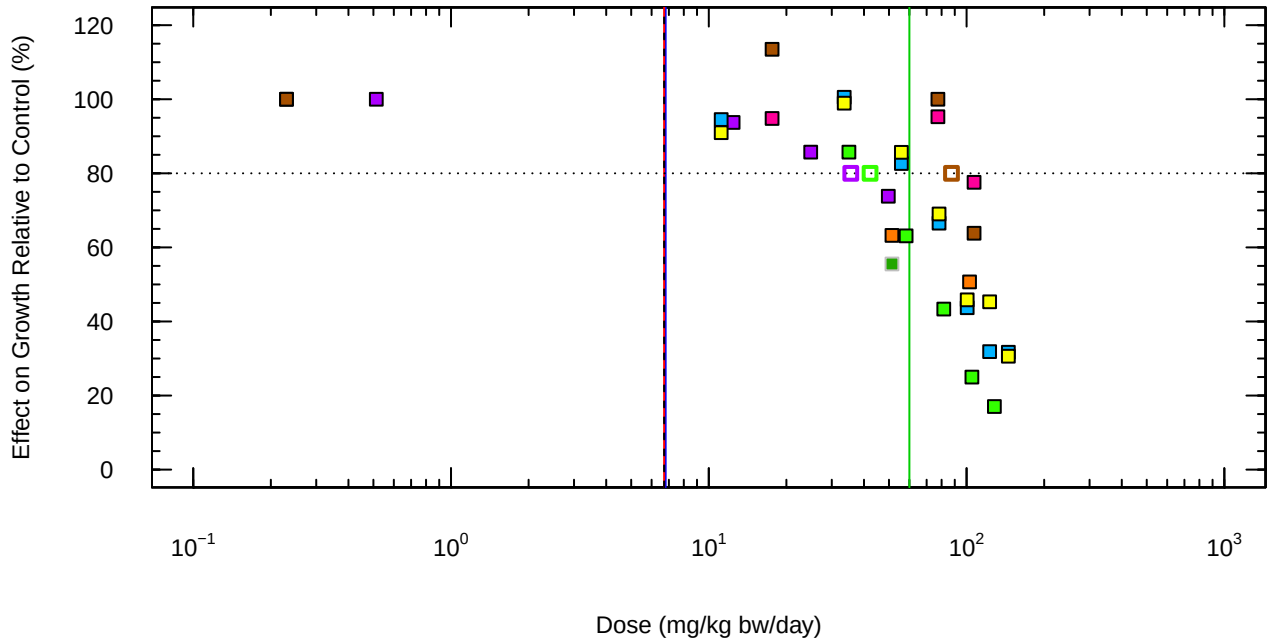
Tier 2

Selected TRV (Growth) = 28 mg/kg bw/day
Selected TRV (Reproduction) = 4.5 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−93. Dose−Response Data for the Mammalian Reproduction Endpoint for Molybdenum, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Hill 1979	chicken	body weight gain	diet	2	nickel chloride	A	
Ling and Leach 1979	chicken	body weight	diet	3	nickel chloride		
Martinez and Diaz 1996	chicken	body weight	diet	6	nickel chloride		
Weber and Reid 1968	chicken	body weight	diet	4	nickel sulfate		
Weber and Reid 1968	chicken	body weight	diet	4	nickel acetate		
Cain and Pafford 1981	mallard	body weight (female)	diet	8.6	nickel sulfate		
Cain and Pafford 1981	mallard	body weight (male)	diet	4	nickel sulfate		
Hill 1985	chicken	body weight gain	diet	2.7	nickel chloride	A	
ED20 for Ling and Leach 1979	chicken	body weight	diet	3	nickel chloride		42
ED20 for Martinez and Diaz 1996	chicken	body weight	diet	6	nickel chloride		36
ED20 for Cain and Pafford 1981	mallard	body weight (male)	diet	4	nickel sulfate		87

Tier 1

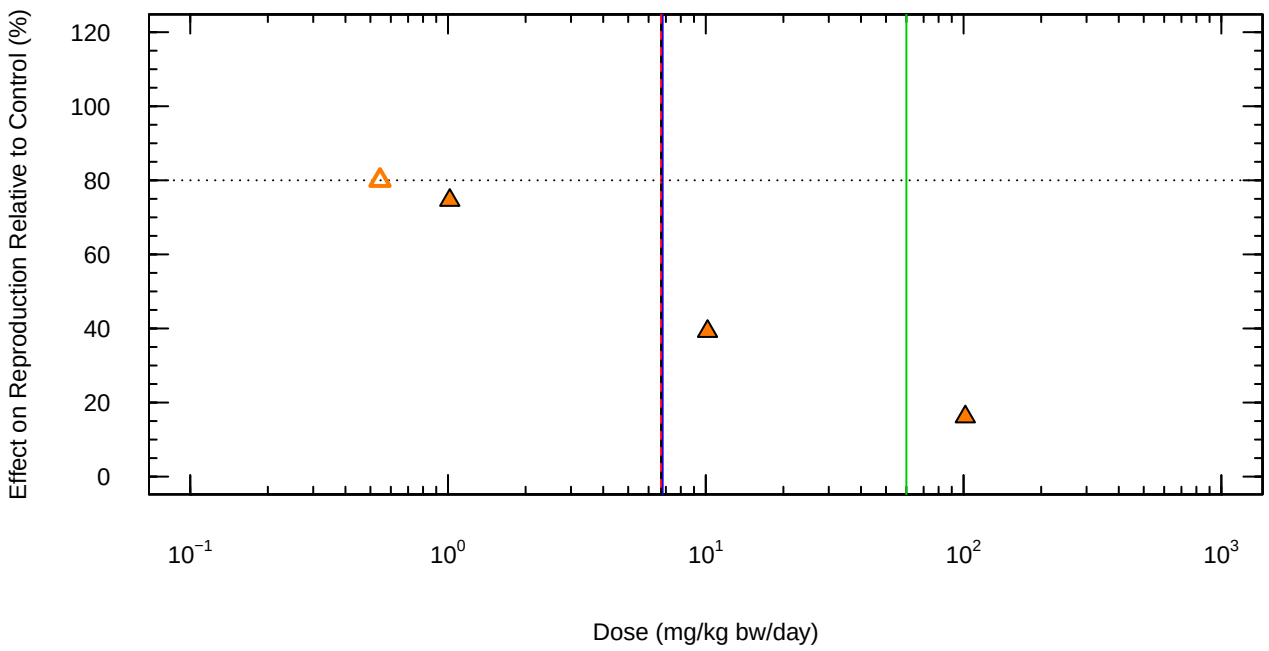
Eco−SSL TRV = 6.71 mg/kg bw/day

Selected TRV (Growth) = 6.8 mg/kg bw/day
Selected TRV (Reproduction) = 6.71 mg/kg bw/day
Selected TRV (Survival) = 60 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−94. Dose−Response Data for the Avian Growth Endpoint for Nickel, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Arpasova et al. 2007	chicken	egg production	drinking water	4	nickel chloride	
ED20 for Arpasova et al. 2007	chicken	egg production	drinking water	4	nickel chloride	0.54

Tier 2

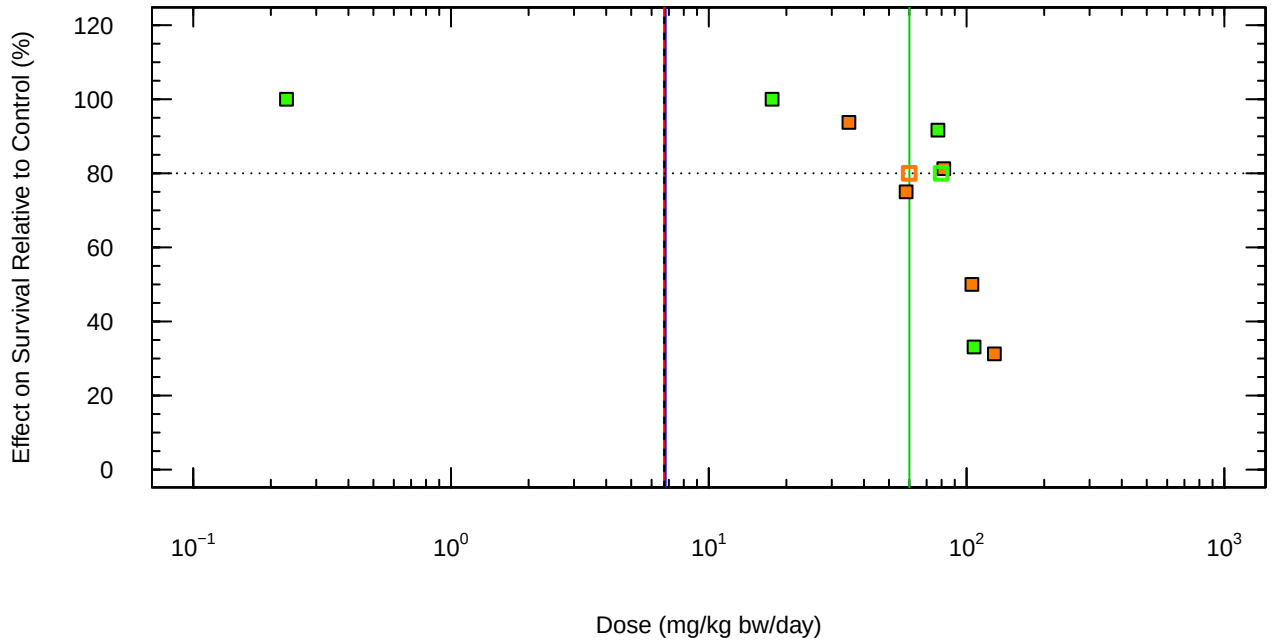
Eco−SSL TRV = 6.71 mg/kg bw/day

Selected TRV (Growth) = 6.8 mg/kg bw/day
Selected TRV (Reproduction) = 6.71 mg/kg bw/day
Selected TRV (Survival) = 60 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−95. Dose−Response Data for the Avian Reproduction Endpoint for Nickel, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	ED20 or Geomean (mg/kg bw/day)
Ling and Leach 1979	chicken	survival	diet	3	nickel chloride	
Cain and Pafford 1981	mallard	survival	diet	12.9	nickel sulfate	
ED20 for Ling and Leach 1979	chicken	survival	diet	3	nickel chloride	60
ED20 for Cain and Pafford 1981	mallard	survival	diet	12.9	nickel sulfate	80

Tier 1

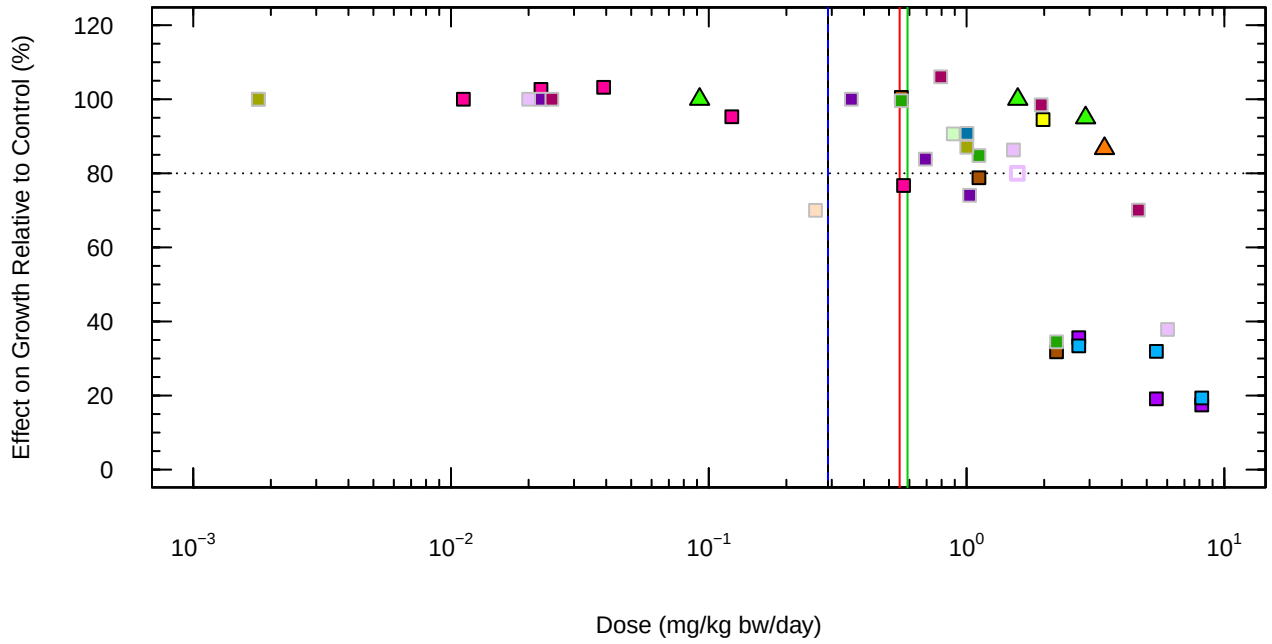
Eco−SSL TRV = 6.71 mg/kg bw/day

Selected TRV (Growth) = 6.8 mg/kg bw/day
Selected TRV (Reproduction) = 6.71 mg/kg bw/day
Selected TRV (Survival) = 60 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−96. Dose−Response Data for the Avian Survival Endpoint for Nickel, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Gad and El−Twab 2009	quail	body weight	gavage	4	sodium selenite		
Santolo et al. 2010	quail	body weight gain	diet	4	seleno−L−methionine		
El−Begearmi and Combs 1982	chicken	body weight (brewer's yeast diet)	diet	4	sodium selenite	A	
El−Begearmi and Combs 1982	chicken	body weight (corn−soy diet)	diet	4	sodium selenite	A	
Heinz and Fitzgerald 1993a	mallard	body weight	diet	21	seleno−DL−methionine	D	
Jensen 1986	chicken	body weight	diet	3	sodium selenite	A	
Hill 1979a	chicken	body weight gain (Exp 1)	diet	4−5	selenium dioxide	B	
Hill 1979a	chicken	body weight gain (Exp 2)	diet	4−5	selenium dioxide	B	
Echevarria et al. 1988	chicken	body weight gain	diet	3	sodium selenite	C	
Stowesand et al. 1977	quail	body weight	diet	10	sodium selenite		
Stowesand et al. 1977	quail	body weight	diet	10	seleniferous wheat		
O'Toole and Raisbeck 1997	mallard	body weight	diet	21	seleno−L−methionine	D	
Dafalla and Adam 1986	chicken	body weight	diet	4	sodium selenite	A	
Sell and Horani 1976	chicken	body weight gain	diet	4	sodium selenite	C	
Hoffman et al. 1992	mallard	body weight	diet	4	seleno−DL−methionine		
ED20 for Hoffman et al. 1992	mallard	body weight	diet	4	seleno−DL−methionine		1.6

Tier 1 Tier 2

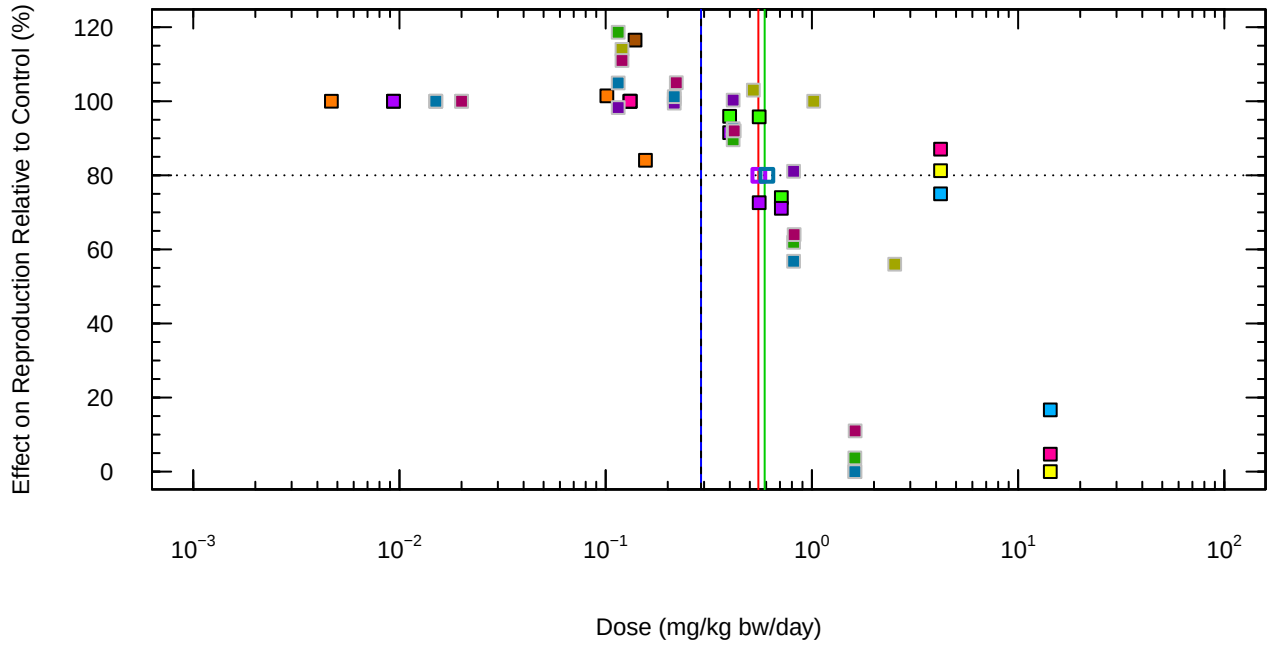
Eco−SSL TRV = 0.29 mg/kg bw/day

Selected TRV (Growth) = 0.29 mg/kg bw/day
Selected TRV (Reproduction) = 0.55 mg/kg bw/day
Selected TRV (Survival) = 0.59 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−97. Dose−Response Data for the Avian Growth Endpoint for Selenium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Kääntee and Kurbela 1980	chicken	egg production	diet	4	sodium selenite		
Ort and Latshaw 1978	chicken	egg production (Exp 2)	diet	16	sodium selenite		
Ort and Latshaw 1978	chicken	hatchability (Exp 2)	diet	16	sodium selenite		
Wiemeyer and Hoffman 1996	owl	% pairs with hatchlings	diet	12	seleno−DL−methionine		
Wiemeyer and Hoffman 1996	owl	# of pairs with 5−day−old young	diet	12	seleno−DL−methionine		
Wiemeyer and Hoffman 1996	owl	% hatch of eggs incubated	diet	12	seleno−DL−methionine		
Stone and Soares 1976	quail	egg production (Exp 1 and 3)	diet	3.9−4.6	sodium selenite		
Heinz et al. 1989	mallard	% hatch of fertile eggs	diet	>14	selenomethionine	E	
Heinz et al. 1989	mallard	duckling survival	diet	>14	selenomethionine		
Heinz et al. 1989	mallard	# of ducklings	diet	>14	selenomethionine		
Hoffman and Heinz 1988	mallard	hatching success	diet	NR	sodium selenite		
Hoffman and Heinz 1988	mallard	hatching success	diet	NR	seleno−methionine	E	
ED20 for Ort and Latshaw 1978	chicken	hatchability (Exp 2)	diet	16	sodium selenite		0.55
ED20 for Heinz et al. 1989	mallard	# of ducklings	diet	>14	selenomethionine		0.60

Tier 1

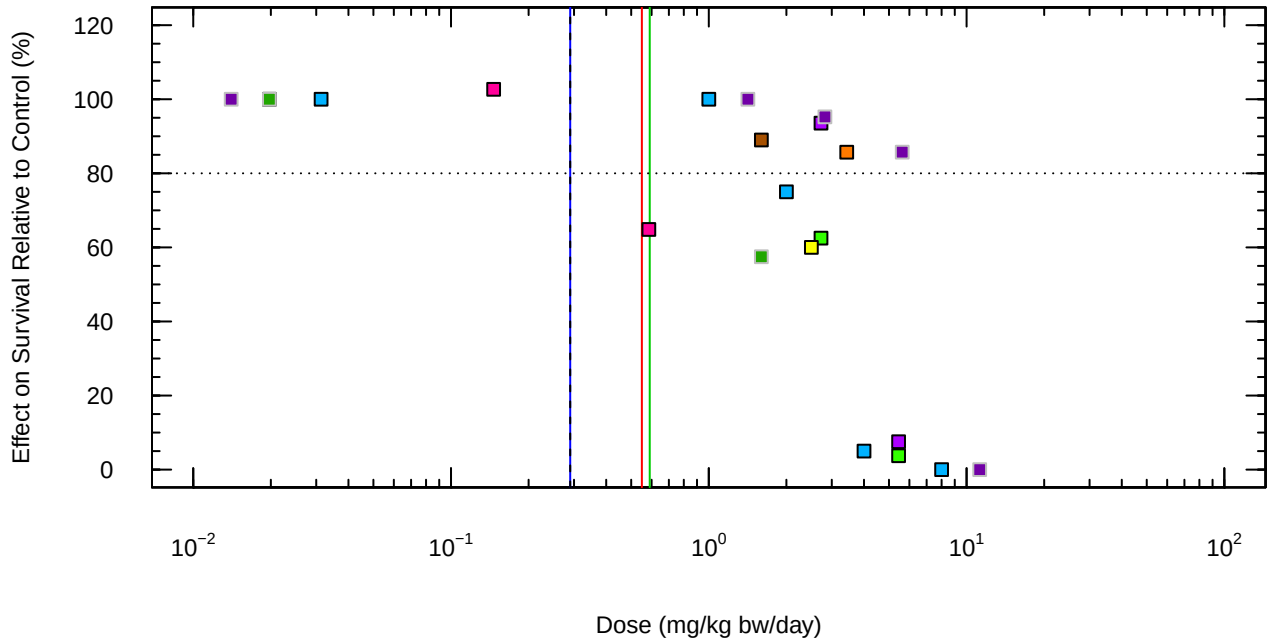
Eco−SSL TRV = 0.29 mg/kg bw/day

Selected TRV (Growth) = 0.29 mg/kg bw/day
Selected TRV (Reproduction) = 0.55 mg/kg bw/day
Selected TRV (Survival) = 0.59 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−98. Dose−Response Data for the Avian Reproduction Endpoint for Selenium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Gad and El−Twab 2009	quail	survival	gavage	4	sodium selenite	
El−Begearmi and Combs 1982	chicken	survival (brewer's yeast diet)	diet	4	sodium selenite	G
El−Begearmi and Combs 1982	chicken	survival (corn−soy diet)	diet	4	sodium selenite	G
Heinz and Fitzgerald 1993b	mallard	survival	diet	16	seleno−DL−methionine	I
Khan et al. 1993	chicken	survival	gavage	0.86	sodium selenite	
Arnold et al. 1973	chicken	survival	diet	64	sodium selenite	
El−Begearmi et al. 1977	quail	survival (males)	diet	16	sodium selenite	H
El−Begearmi et al. 1977	quail	survival (females)	diet	16	sodium selenite	H
Albers et al. 1996	mallard	survival	diet	16	seleno−DL−methionine	I

Tier 1

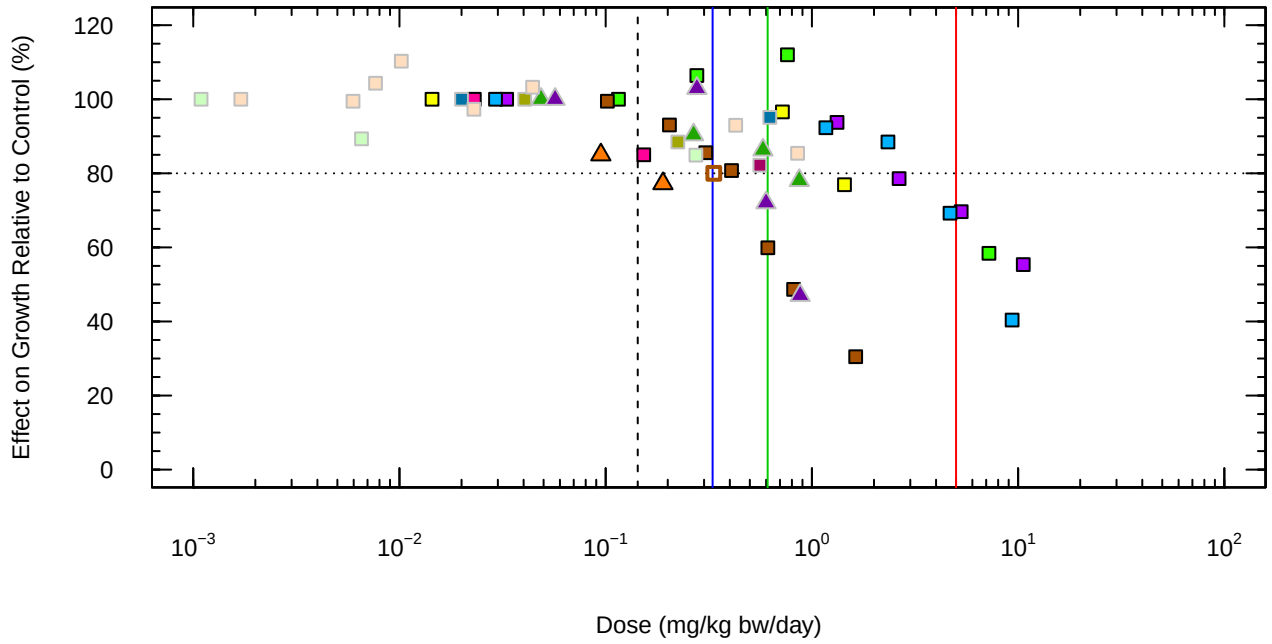
Eco−SSL TRV = 0.29 mg/kg bw/day

Selected TRV (Growth) = 0.29 mg/kg bw/day
Selected TRV (Reproduction) = 0.55 mg/kg bw/day
Selected TRV (Survival) = 0.59 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−99. Dose−Response Data for the Avian Survival Endpoint for Selenium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Kaur and Parshad 1994	rat	body weight	diet	5.1	sodium selenite		
Spallholz et al. 1973	mouse	body weight gain	diet	5	sodium selenite		
Julius et al. 1983	hamster	body weight (male, Exp 1)	diet	3	sodium selenite	A	
Julius et al. 1983	hamster	body weight (female, Exp 1)	diet	3	sodium selenite	A	
Julius et al. 1983	hamster	body weight (male, Exp 2)	diet	3	sodium selenite	A	
Behne et al. 1992	rat	body weight	diet	14.3	L−selenomethionine		
Mahan and Moxon 1984	pig	body weight	diet	5.3	sodium selenite		
Goehring et al. 1984	rat	body weight gain	diet	4	seleniferous grain		
Goehring et al. 1984	rat	body weight gain	diet	4	sodium selenite		
Baker et al. 1989	pig	body weight	diet	3.7	sodium selenate		
Boylan et al. 1990	mouse	body weight	diet	26	sodium selenite		
Wahlstrom et al. 1956	pig	body weight	diet	14	sodium selenite		
Birt et al. 1983	hamster	body weight	diet	25	sodium selenite		
Birt et al. 1986	hamster	body weight	diet	64	sodium selenite		
ED20 for Mahan and Moxon 1984	pig	body weight	diet	5.3	sodium selenite		0.33

Tier 1 Tier 2

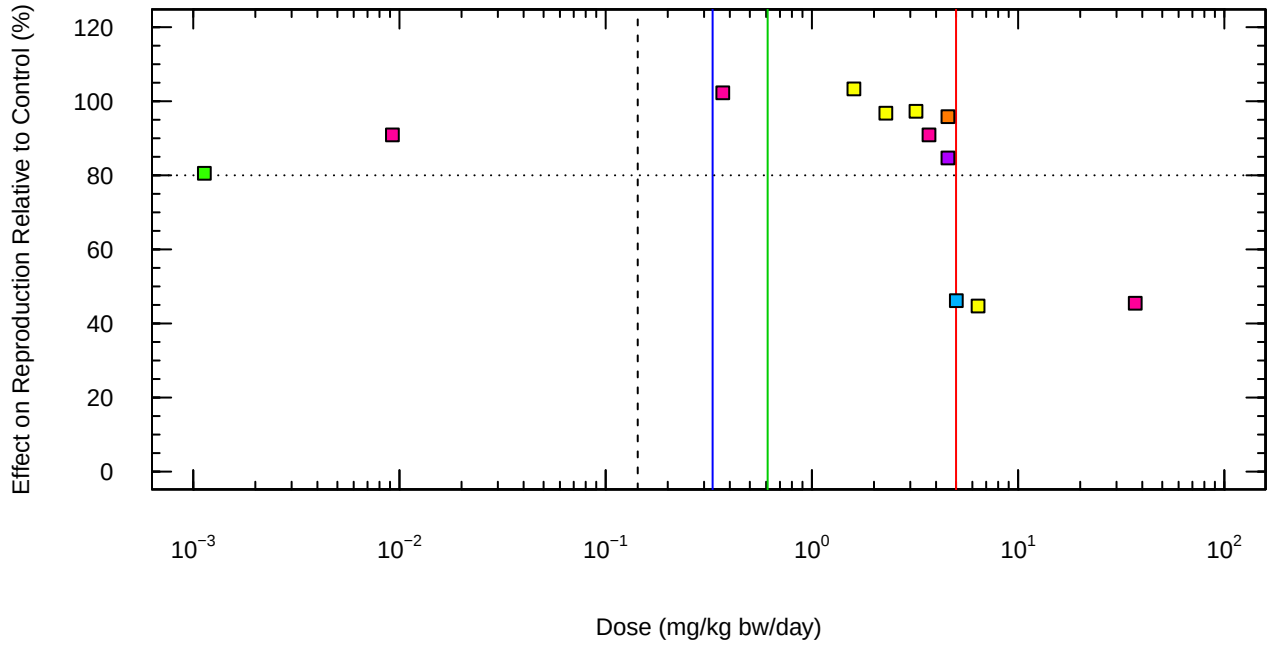
Eco−SSL TRV = 0.143 mg/kg bw/day

Selected TRV (Growth) = 0.33 mg/kg bw/day
Selected TRV (Reproduction) = 5 mg/kg bw/day
Selected TRV (Survival) = 0.61 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−100. Dose−Response Data for the Mammalian Growth Endpoint for Selenium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Chernoff and Kavlock 1982	mouse	% pregnant	gavage	0.71	sodium selenite
Wahlstrom and Olson 1959	pig	# of live piglets	diet	34	sodium selenite
Gray and Kavlock 1984	mouse	# of live offspring	gavage	0.71	sodium selenite
Seidenberg et al. 1986	mouse	# of litters born	gavage	0.71	sodium selenate
Hardin et al. 1987	mouse	% viable litters	gavage	1.1	sodium selenite
Webster 1979	mouse	% with litters	diet	2.7	sodium selenite

Tier 1

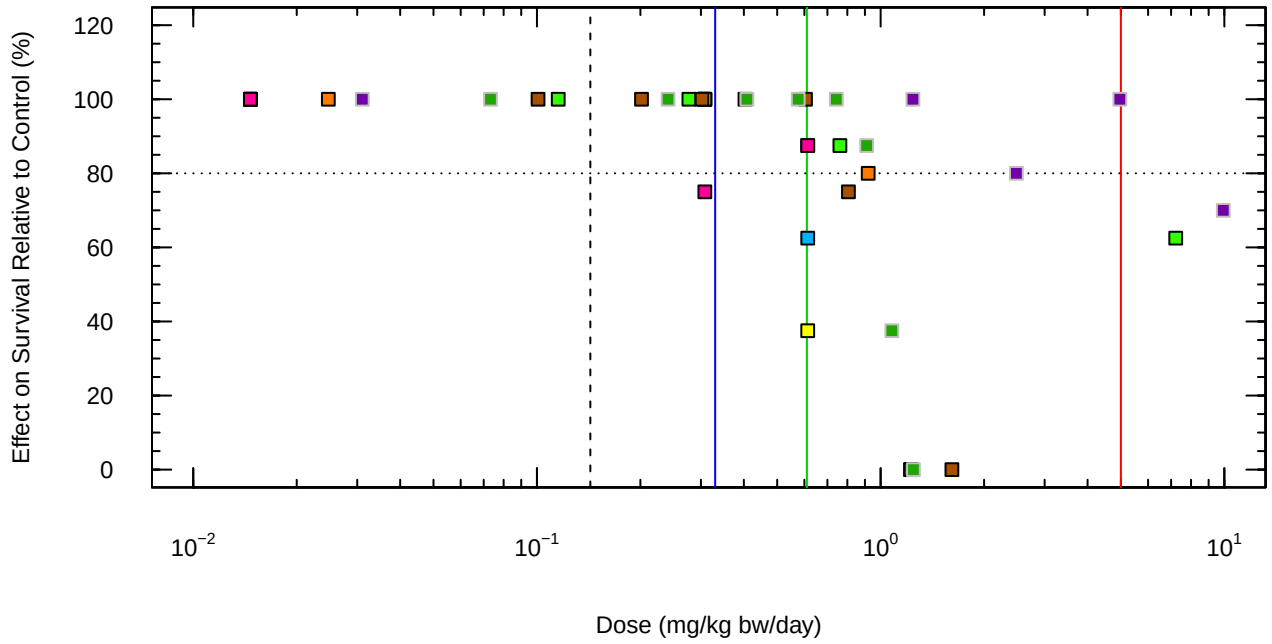
Eco−SSL TRV = 0.143 mg/kg bw/day

Selected TRV (Growth) = 0.33 mg/kg bw/day
Selected TRV (Reproduction) = 5 mg/kg bw/day
Selected TRV (Survival) = 0.61 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−101. Dose−Response Data for the Mammalian Reproduction Endpoint for Selenium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Palmer et al. 1982	rat	survival	diet	4	seleniferous corn	B
Spallholz et al. 1973	mouse	survival	diet	5	sodium selenite	
McAdam and Levander 1987	rat	survival	diet	6	D−selenomethionine	B
McAdam and Levander 1987	rat	survival	diet	6	L−selenomethionine	B
McAdam and Levander 1987	rat	survival	diet	6	sodium selenite	
McAdam and Levander 1987	rat	survival	diet	6	sodium selenate	
Moxon and Mahan 1981	pig	survival	diet	5.3	sodium selenite	
Halverson et al. 1966	rat	survival	diet	6	seleniferous wheat	B
Julius et al. 1983	hamster	survival	diet	3	sodium selenite	

Tier 1

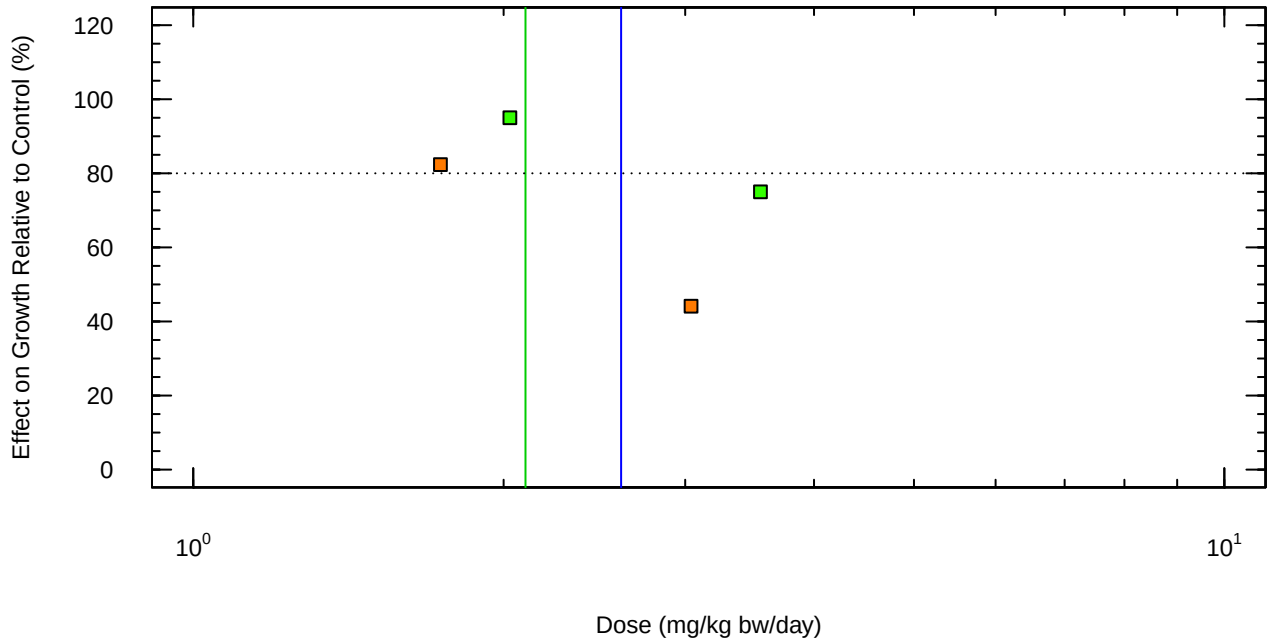
Eco−SSL TRV = 0.143 mg/kg bw/day

Selected TRV (Growth) = 0.33 mg/kg bw/day
Selected TRV (Reproduction) = 5 mg/kg bw/day
Selected TRV (Survival) = 0.61 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−102. Dose−Response Data for the Mammalian Survival Endpoint for Selenium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Downs et al. 1960	rat (male)	body weight	diet	15	thallic oxide	A
Downs et al. 1960	rat (female)	body weight	diet	15	thallic oxide	A

Tier 1

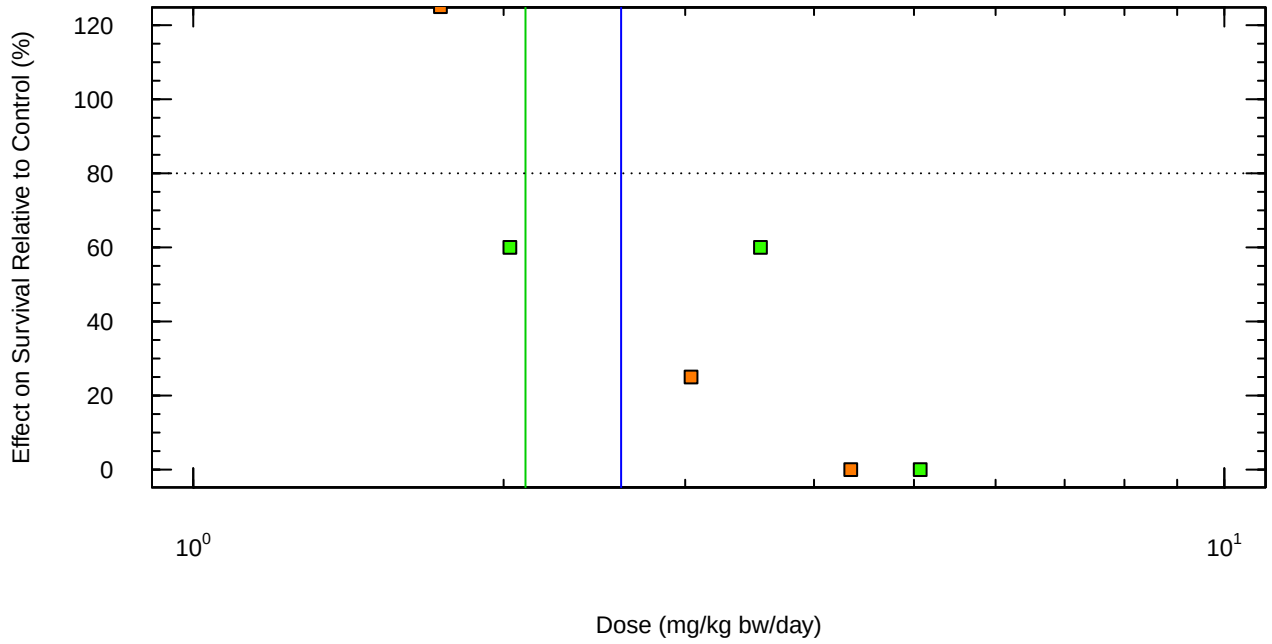
Selected TRV (Growth) = 2.6 mg/kg bw/day

Selected TRV (Survival) = 2.1 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−103. Dose−Response Data for the Mammalian Growth Endpoint for Thallium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Downs et al. 1960	rat (male)	survival	diet	15	thallic oxide	B
Downs et al. 1960	rat (female)	survival	diet	15	thallic oxide	B

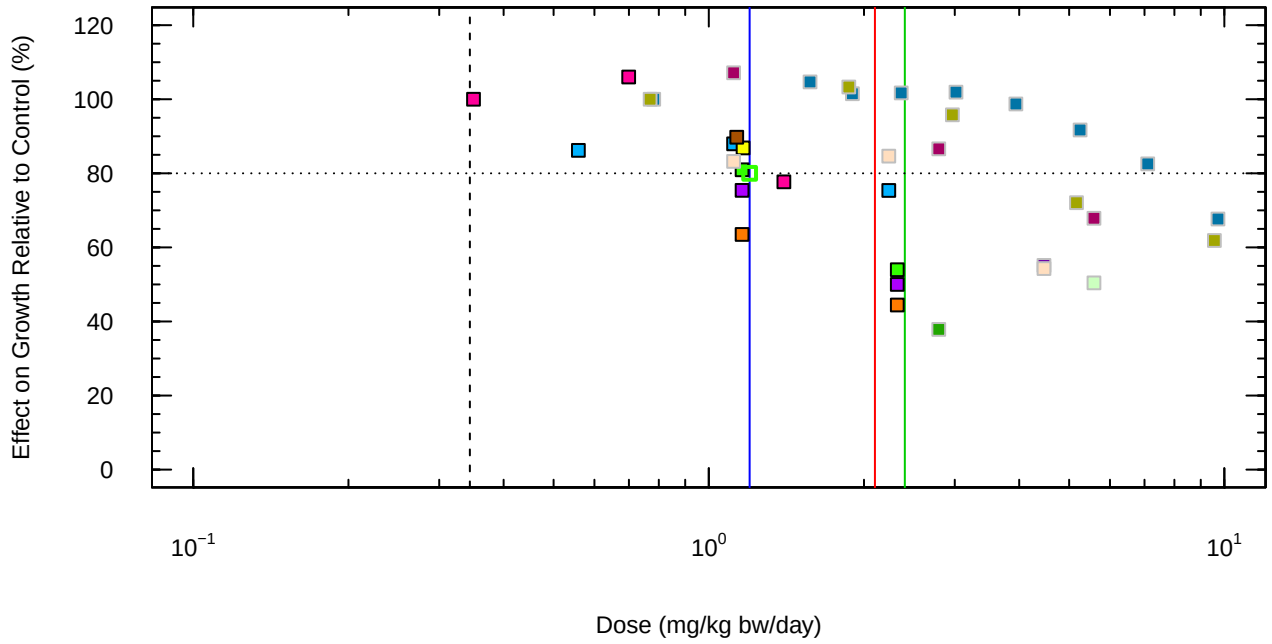
Tier 1

Selected TRV (Growth) = 2.6 mg/kg bw/day
Selected TRV (Survival) = 2.1 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−104. Dose−Response Data for the Mammalian Survival Endpoint for Thallium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Berg and Lawrence 1971	chicken	body weight	diet	2	ammonium metavanadate	A	
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl dichloride	E	
Cervantes and Jensen 1986	chicken	body weight	diet	4	ammonium metavanadate	A	
Hill 1974	chicken	body weight gain	diet	2	sodium metavanadate	B	
Hill 1979a	chicken	body weight gain	diet	2	sodium metavanadate	B	
Summers and Moran 1972	chicken	body weight gain	diet	3	NR		
Hill 1990b	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Hill 1990a	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Qureshi et al. 1999	chicken	body weight	diet	3	ammonium metavanadate	A	
Blalock and Hill 1987	chicken	body weight	diet	3	vanadyl chloride	E	
Hill 1994	chicken	body weight	diet	2.9	ammonium metavanadate	A	
ED20 for Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		1.2

Tier 1

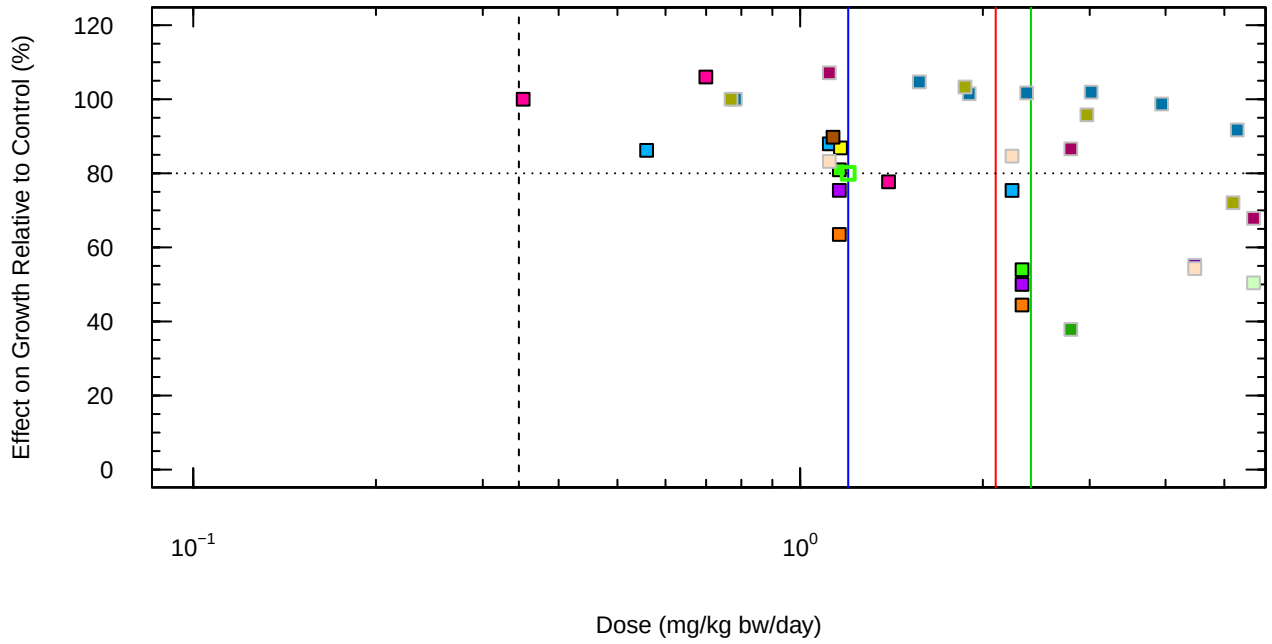
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−105a. Dose−Response Data for the Avian Growth Endpoint for Vanadium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Berg and Lawrence 1971	chicken	body weight	diet	2	ammonium metavanadate	A	
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl dichloride	E	
Cervantes and Jensen 1986	chicken	body weight	diet	4	ammonium metavanadate	A	
Hill 1974	chicken	body weight gain	diet	2	sodium metavanadate	B	
Hill 1979a	chicken	body weight gain	diet	2	sodium metavanadate	B	
Summers and Moran 1972	chicken	body weight gain	diet	3	NR		
Hill 1990b	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Hill 1990a	chicken	body weight gain	diet	2.7	sodium metavanadate	B	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A	
Qureshi et al. 1999	chicken	body weight	diet	3	ammonium metavanadate	A	
Blalock and Hill 1987	chicken	body weight	diet	3	vanadyl chloride	E	
Hill 1994	chicken	body weight	diet	2.9	ammonium metavanadate	A	
ED20 for Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate		1.2

Tier 1

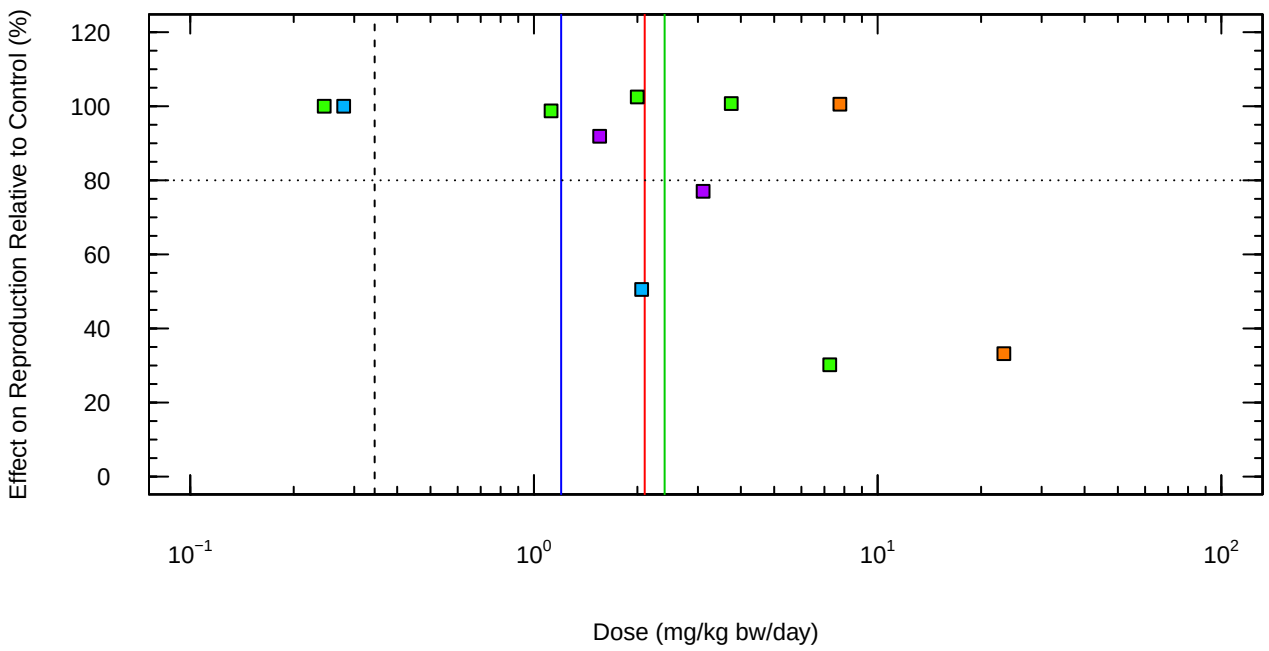
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−105b. Dose−Response Data for the Avian Growth Endpoint for Vanadium, Log−Transformed (Truncated X−Axis)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Hafez and Kratzer 1976b	chicken	egg production	diet	NR	ammonium metavanadate	C
Kubena and Phillips 1982	chicken	egg production	diet	20	calcium orthovanadate	
Ousterhout and Berg 1980	chicken	egg production	diet	4	ammonium metavanadate	C
Toussant and Latshaw 1994	chicken	egg production	diet	4	ammonium metavanadate	C

Tier 1

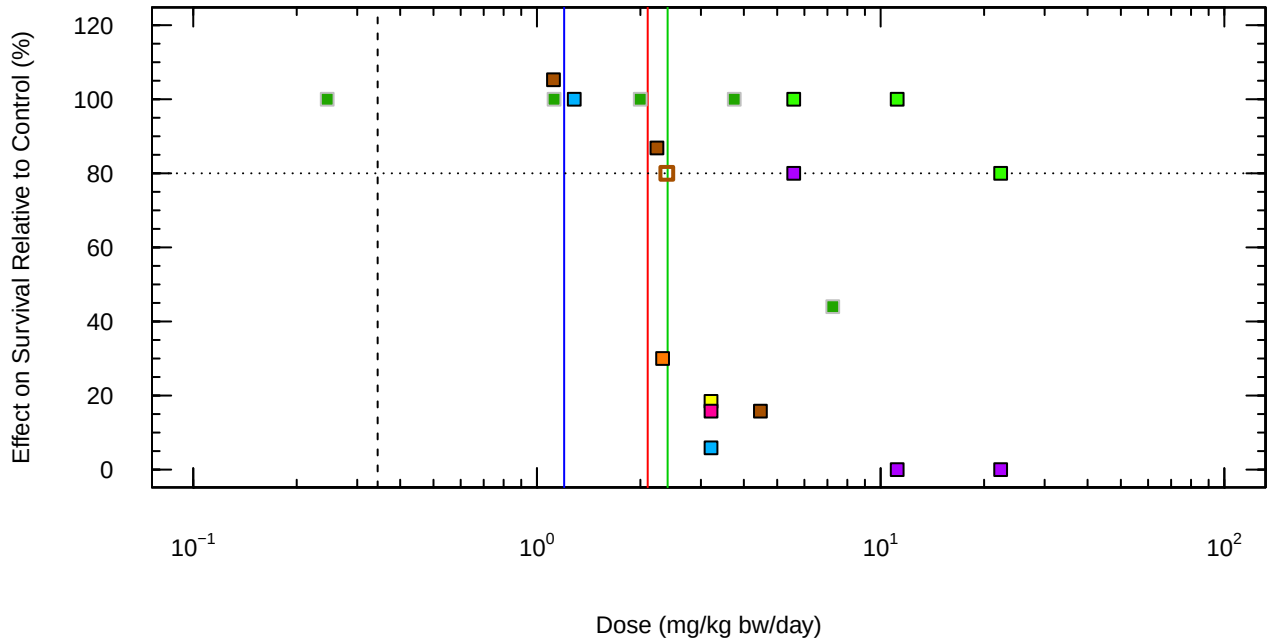
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−106. Dose−Response Data for the Avian Reproduction Endpoint for Vanadium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Berg and Lawrence 1971	chicken	survival	diet	2	ammonium metavanadate	D	
Hafez and Kratzer 1976a	chicken	survival (Exp 1)	diet	4	ammonium metavanadate	D	
Hafez and Kratzer 1976a	chicken	survival (Exp 2)	diet	4	ammonium metavanadate	D	
Hathcock et al. 1964	chicken	survival (Exp 1)	diet	2	ammonium metavanadate	D	
Hathcock et al. 1964	chicken	survival (Exp 2)	diet	2	ammonium metavanadate	D	
Hathcock et al. 1964	chicken	survival	diet	2	vanadyl sulfate		
Blalock and Hill 1987	chicken	survival	diet	3	vanadyl chloride		
Kubena and Phillips 1982	chicken	survival	diet	20	calcium orthovanadate		
ED20 for Blalock and Hill 1987	chicken	survival	diet	3	vanadyl chloride		2.4

Tier 1

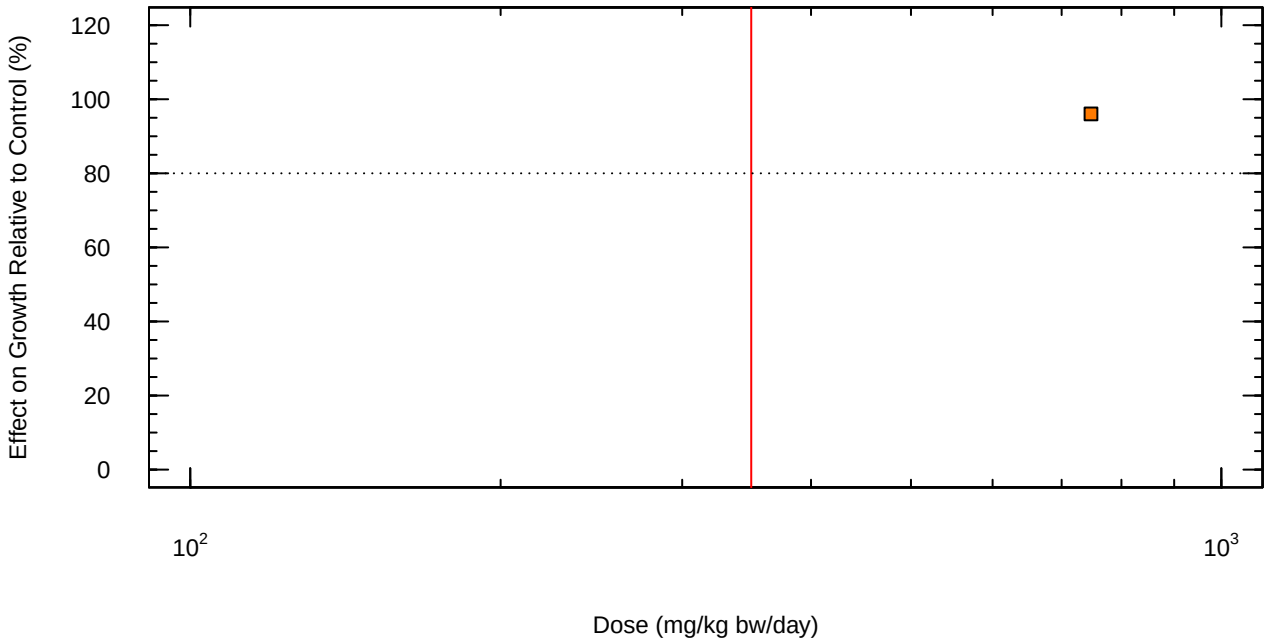
Eco−SSL TRV = 0.344 mg/kg bw/day

Selected TRV (Growth) = 1.2 mg/kg bw/day
Selected TRV (Reproduction) = 2.1 mg/kg bw/day
Selected TRV (Survival) = 2.4 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−107. Dose−Response Data for the Avian Survival Endpoint for Vanadium, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Wood and Bitman 1984	chicken	body weight	diet	4	bis(2−ethylhexyl)phthalate

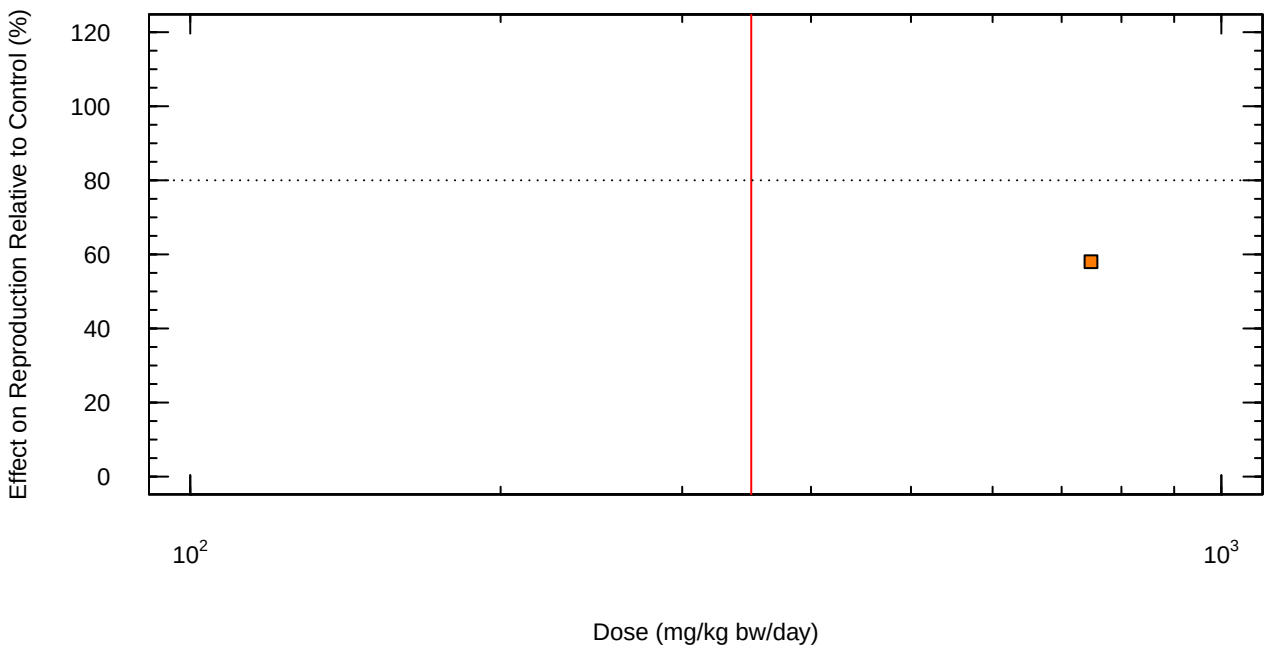
Tier 1

Selected TRV (Reproduction) = 350 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−108. Dose−Response Data for the Avian Growth Endpoint for Bis(2−Ethylhexyl)phthalate, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Wood and Bitman 1984	chicken	egg production	diet	4	bis(2−ethylhexyl)phthalate

Tier 1

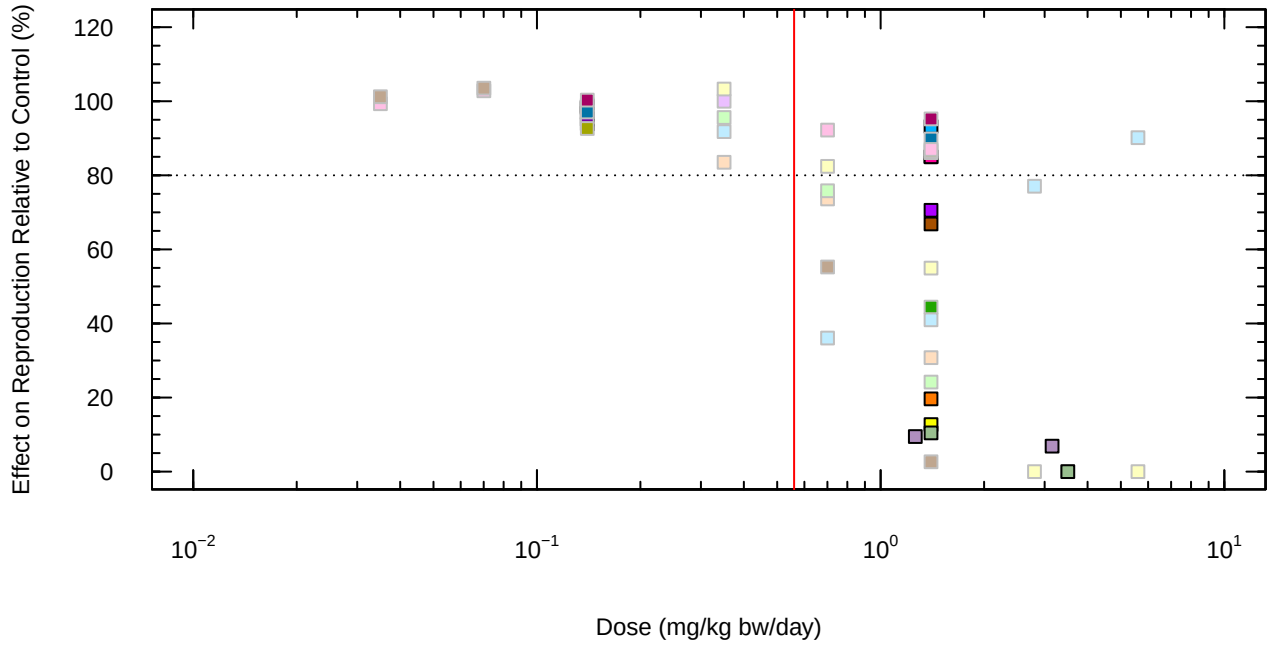
Selected TRV (Reproduction) = 350 mg/kg bw/day

80% effect relative to control

Note: The LOAEL from Ishida et al. (1982) for egg production after dietary exposure of chickens for 33 weeks is 350 mg/kg bw/day; this value was selected as the TRV, but could not be plotted on this figure because egg production was not reported in the control group.

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−109. Dose−Response Data for the Avian Reproduction Endpoint for Bis(2−Ethylhexyl)phthalate, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1242	A
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1248	B
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1254	
Lillie et al. 1975	chicken	hatchability	diet	8	Aroclor 1242	A
Lillie et al. 1975	chicken	hatchability	diet	8	Aroclor 1248	B
Platanow and Reinhart 1973	chicken	hatchability	diet	14	Aroclor 1254	
Britton and Huston 1973	chicken	egg production	diet	6	Aroclor 1242	
Britton and Huston 1973	chicken	hatchability	diet	6	Aroclor 1242	A
Scott 1977	chicken	egg production	diet	8	Aroclor 1248	
Scott 1977	chicken	hatchability	diet	8	Aroclor 1248	B
Briggs and Harris 1973	chicken	hatchability (leghorn)	diet	6	Aroclor 1242	A
Briggs and Harris 1973	chicken	hatchability (broiler)	diet	6	Aroclor 1242	A

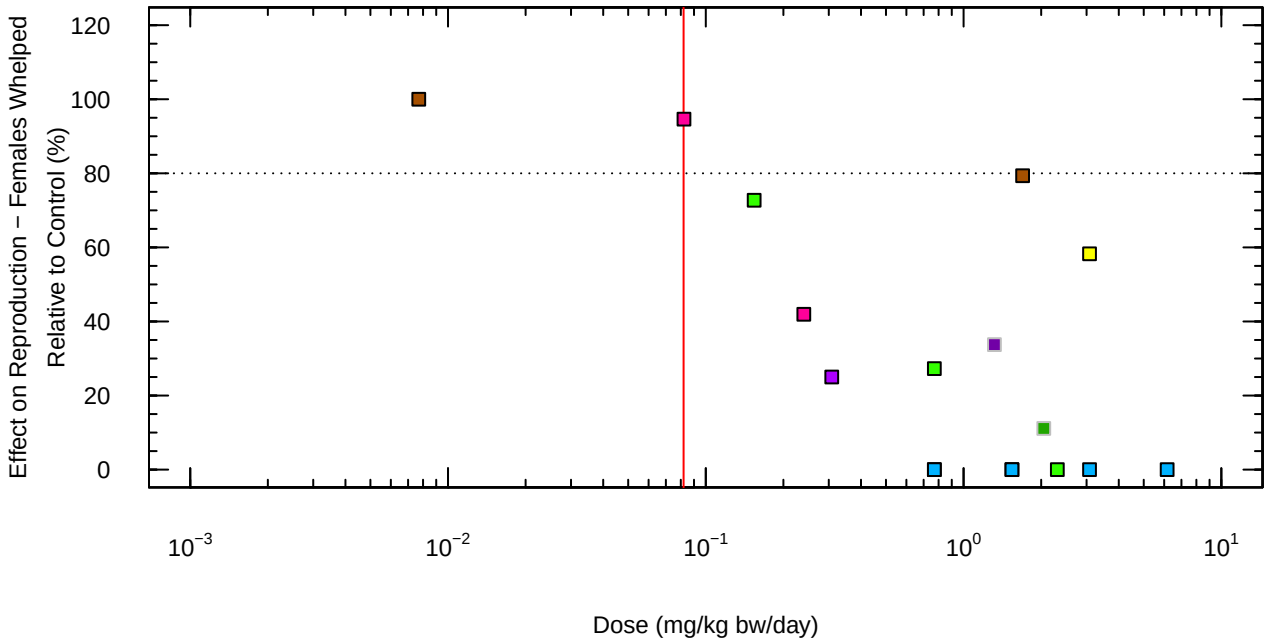
Tier 1

Selected TRV (Reproduction) = 0.56 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−110. Dose−Response Data for the Avian Reproduction Endpoint for Polychlorinated Biphenyls, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Bleavins et al. 1980	mink	females whelped	diet	35	Aroclor 1242	
Bleavins et al. 1980	mink	females whelped	diet	35	Aroclor 1016	
Brunström et al. 2001	mink	females whelped	diet	24	Clophen A50	B
Jensen et al. 1977	mink	females whelped	diet	9.4	NR	
Kihlstrom et al. 1992	mink	females whelped	diet	12	Clophen A50	B
Kihlstrom et al. 1992	mink	females whelped	diet	12	Aroclor 1254	A

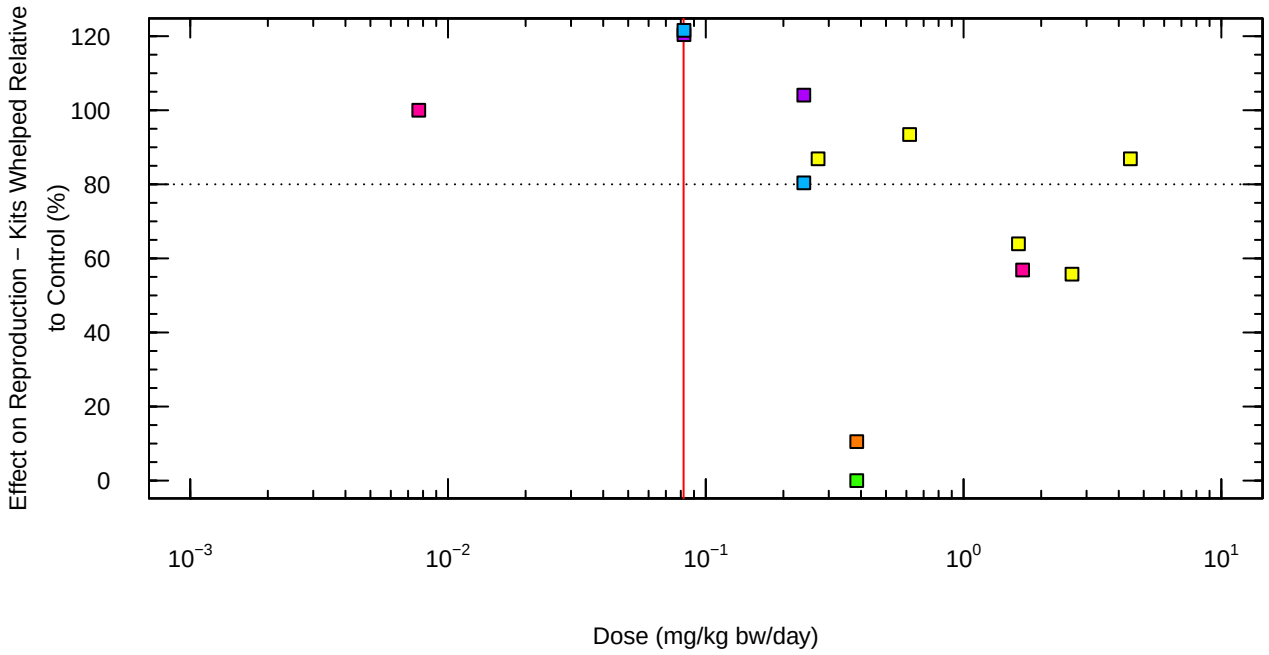
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−111. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls, Log−Transformed (Females Whelped)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Aulerich et al. 1985	mink	kits whelped	diet	~12	Aroclor 1254
Aulerich et al. 1985	mink	kits whelped	diet	~12	Aroclor 1254
Brunström et al. 2001	mink	kits whelped	diet	72	Clophen A50
Brunström et al. 2001	mink	kits whelped	diet	24	Clophen A50
Folland et al. 2016	mink	kits whelped	diet	16	Aroclor 1268
Jensen et al. 1977	mink	kits whelped	diet	9.4	NR

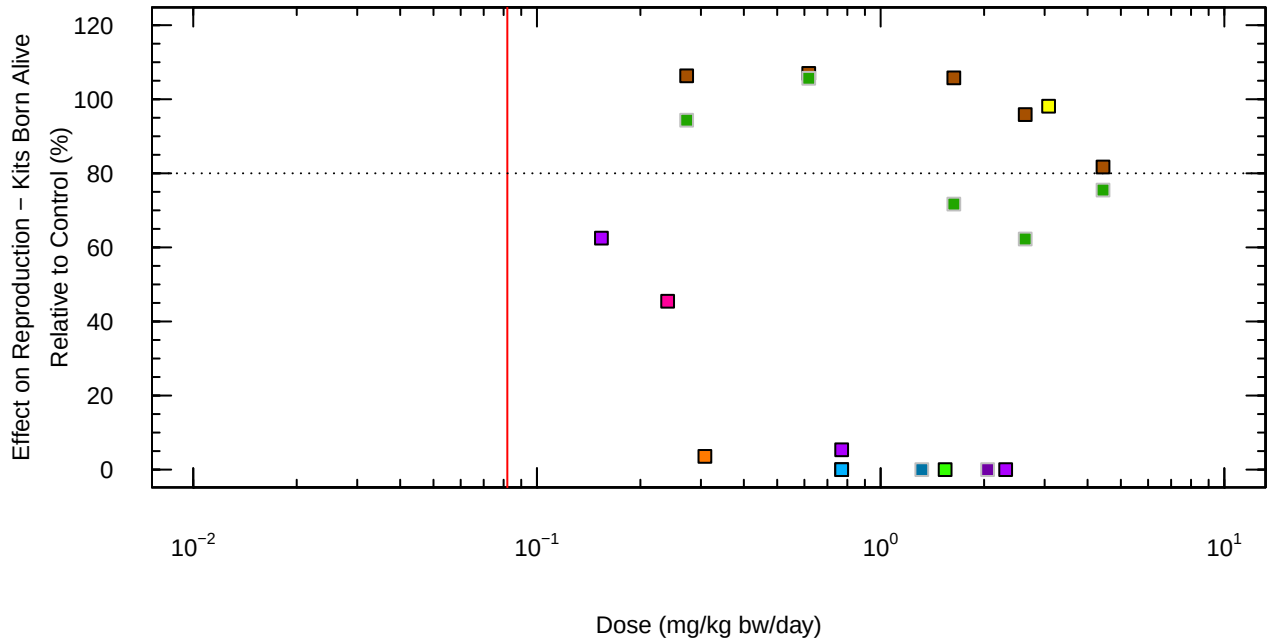
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−112. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls, Log−Transformed (Kits Whelped)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Bleavins et al. 1980	mink	kits born alive	diet	35	Aroclor 1242	
Bleavins et al. 1980	mink	kits born alive	diet	35	Aroclor 1016	
Brunström et al. 2001	mink	kits born alive	diet	24	Clophen A50	E
Folland et al. 2016	mink	kits born alive	diet	16	Aroclor 1268	
Folland et al. 2016	mink	kits born alive	diet	16	Aroclor 1268	
Kihlstrom et al. 1992	mink	kits born alive	diet	12	Clophen A50	E
Kihlstrom et al. 1992	mink	kits born alive	diet	12	Aroclor 1254	

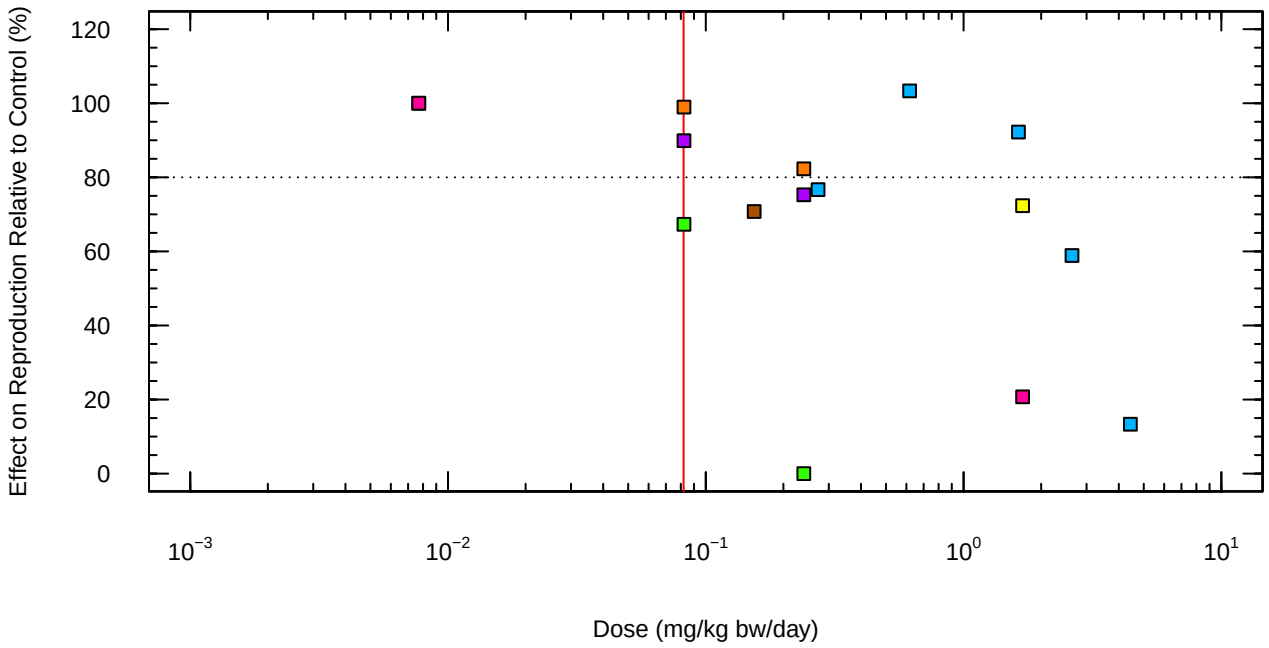
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−113. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls, Log−Transformed (Kits Born Alive)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Brunström et al. 2001	mink	kit birth weight	diet	72	Clophen A50
Brunström et al. 2001	mink	kit growth	diet	72	Clophen A50
Brunström et al. 2001	mink	kit birth weight	diet	24	Clophen A50
Folland et al. 2016	mink	kit survival to 6 weeks	diet	16	Aroclor 1268
Jensen et al. 1977	mink	kit weight of young	diet	9.4	NR
Jensen et al. 1977	mink	kit survival after 5 days	diet	9.4	NR
Wren et al. 1987	mink	kit weight at 5 weeks	diet	24	Aroclor 1254

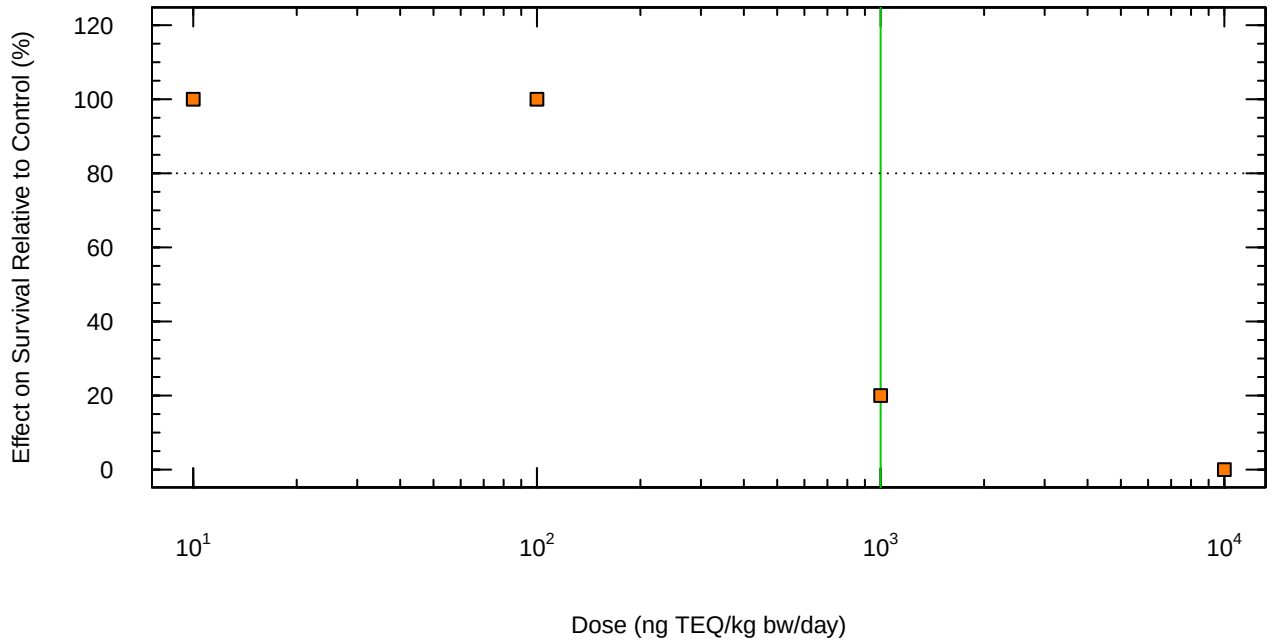
Tier 1

Selected TRV (Reproduction) = 0.082 mg/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−114. Dose−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Schwetz et al. 1973	chicken	survival	oral intubation	3	2,3,7,8−TCDD

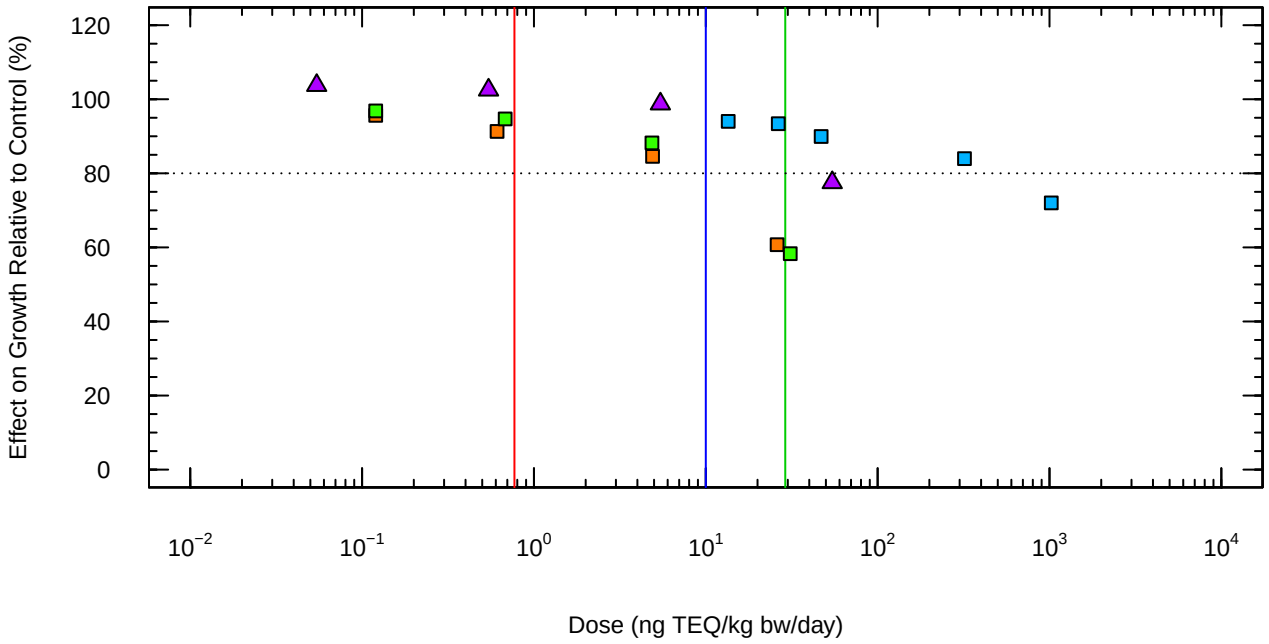
Tier 1

Selected TRV (Survival) = 1000 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−115. Dose−Response Data for the Avian Survival Endpoint for Dioxins/Furans, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
DeCaprio et al. 1986	guinea pig	body weight (male)	diet	12.9	2,3,7,8−TCDD	A
DeCaprio et al. 1986	guinea pig	body weight (female)	diet	12.9	2,3,7,8−TCDD	A
Hochstein et al. 1998	mink	body weight	diet	17.9	2,3,7,8−TCDD	
Van Birgelen et al. 1995	rat	body weight	diet	13	2,3,7,8−TCDD	

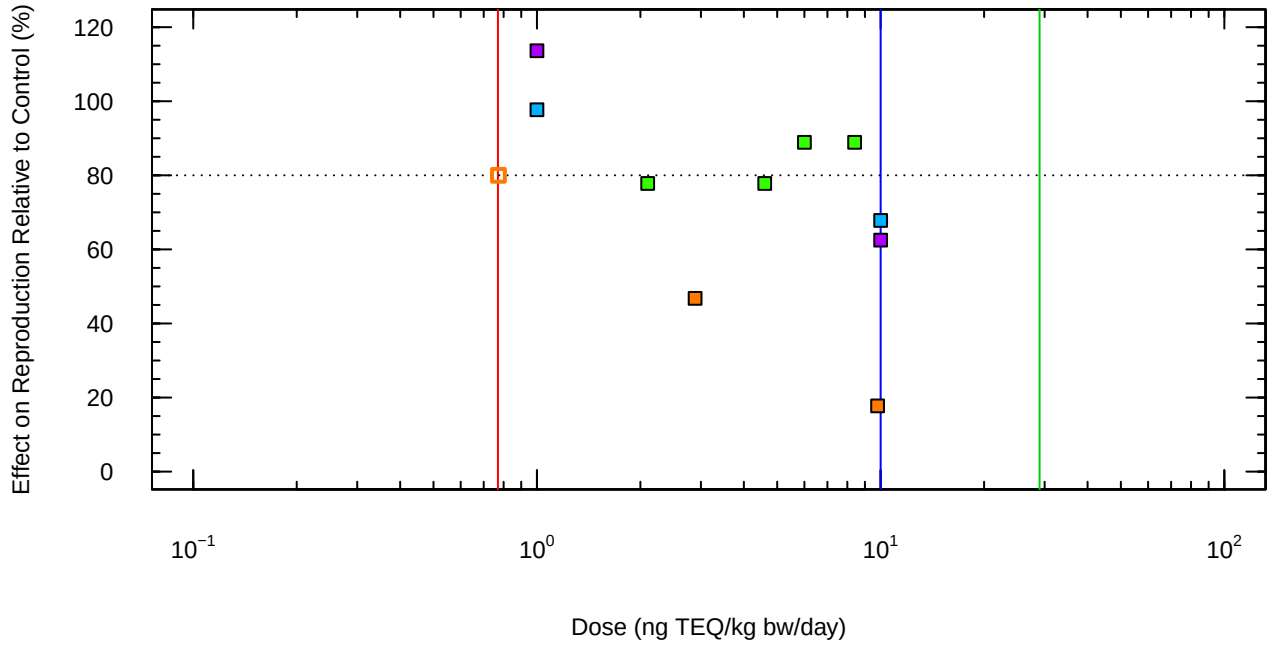
Tier 1 Tier 2

Selected TRV (Growth) = 10 ng TEQ/kg bw/day
Selected TRV (Reproduction) = 0.77 ng TEQ/kg bw/day
Selected TRV (Survival) = 29 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−116. Dose−Response Data for the Mammalian Growth Endpoint for Dioxins/Furans, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group	ED20 or Geomean (mg/kg bw/day)
Hochstein et al. 2001	mink	kit survival	diet	18.7−18.8	2,3,7,8−TCDD	B	
Moore et al. 2012	mink	females whelping	diet	20.4−25.1	2,3,7,8−TCDD		
Murray et al. 1979	rat	females with litter	diet	12.9	2,3,7,8−TCDD		
Murray et al. 1979	rat	postnatal survival	diet	12.9	2,3,7,8−TCDD		
ED20 for Hochstein et al. 2001	mink	kit survival	diet	18.7−18.8	2,3,7,8−TCDD	B	0.77

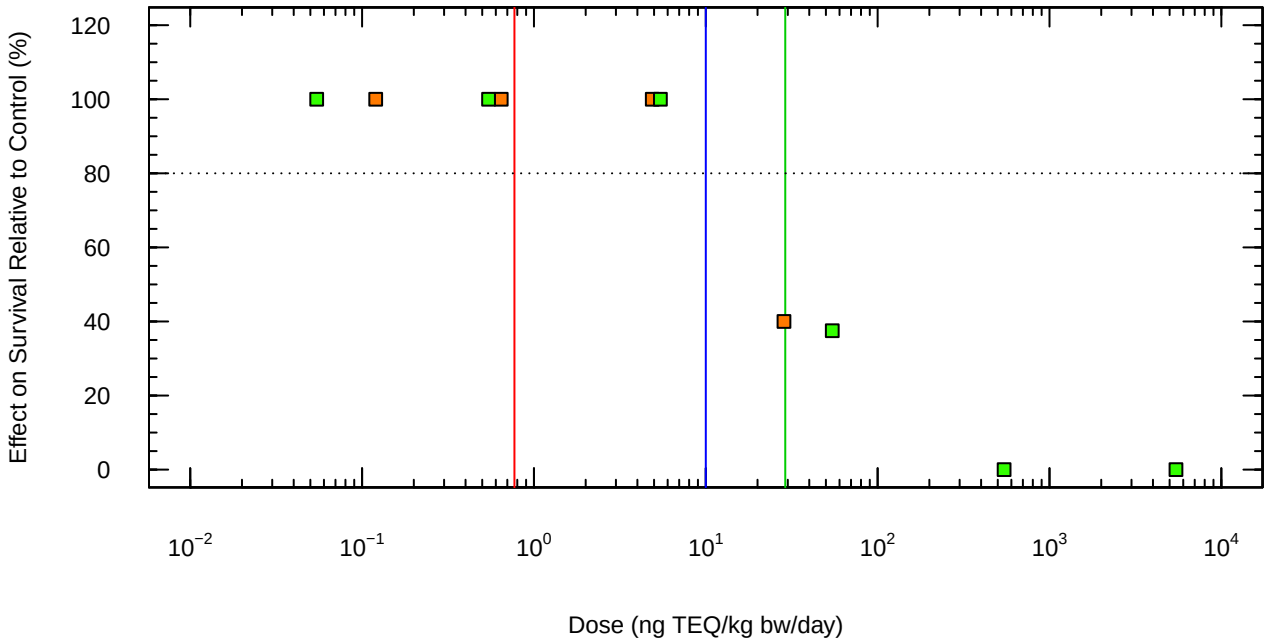
Tier 1

Selected TRV (Growth) = 10 ng TEQ/kg bw/day
Selected TRV (Reproduction) = 0.77 ng TEQ/kg bw/day
Selected TRV (Survival) = 29 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

Figure H2−117. Dose−Response Data for the Mammalian Reproduction Endpoint for Dioxins/Furans, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
DeCaprio et al. 1986	guinea pig	survival	diet	12.9	2,3,7,8−TCDD
Hochstein et al. 1998	mink	survival	diet	17.9	2,3,7,8−TCDD

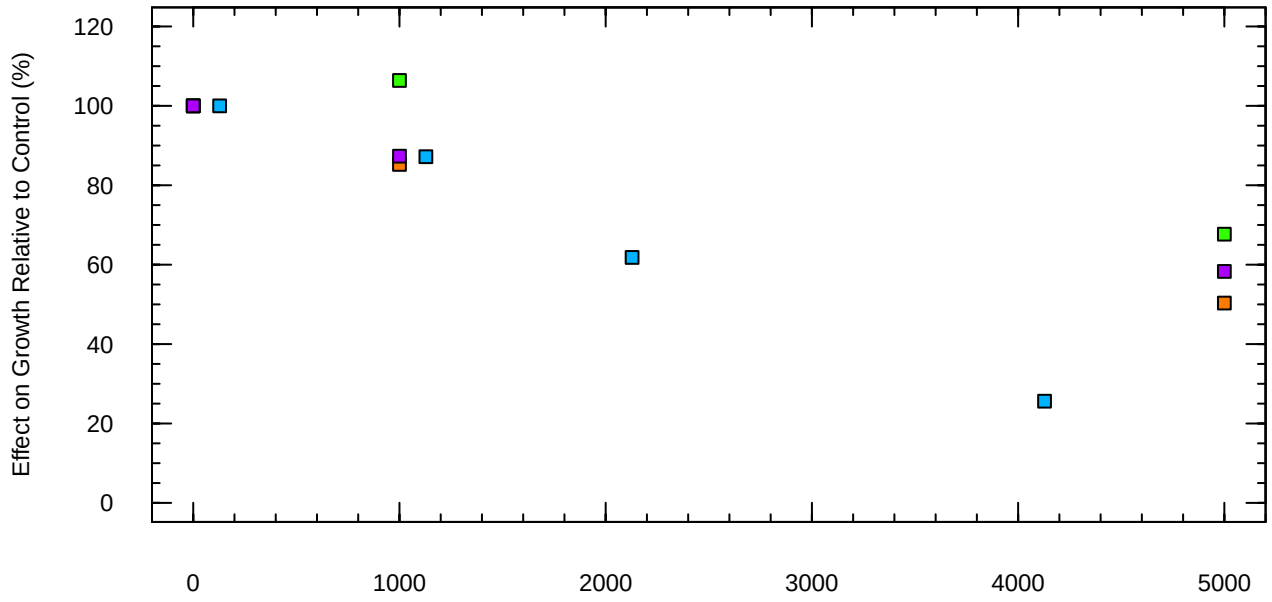
Tier 1

Selected TRV (Growth) = 10 ng TEQ/kg bw/day
Selected TRV (Reproduction) = 0.77 ng TEQ/kg bw/day
Selected TRV (Survival) = 29 ng TEQ/kg bw/day

80% effect relative to control

Note: All selected toxicity reference values (TRVs) for this chemical and receptor are shown for comparison across growth, reproduction, and survival endpoints.

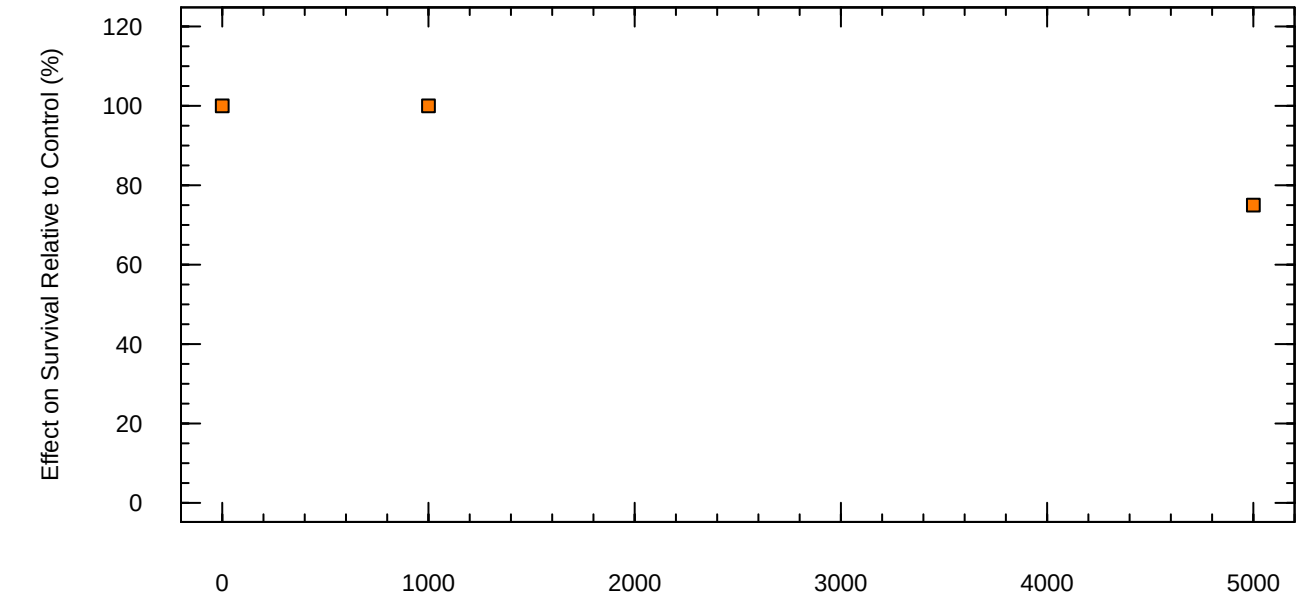
Figure H2−118. Dose−Response Data for the Mammalian Survival Endpoint for Dioxins/Furans, Log−Transformed



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Capdevielle and Scanes 1995a	chicken	body weight	diet	2	aluminum sulfate	
Capdevielle and Scanes 1995b	mallard	body weight	diet	2.1	aluminum sulfate	
Capdevielle et al. 1996	chicken	body weight	diet	1.5	aluminum sulfate	A
Elliot and Edwards 1991	chicken	body weight	diet	2.3	aluminum sulfate	A

☐ Tier 1

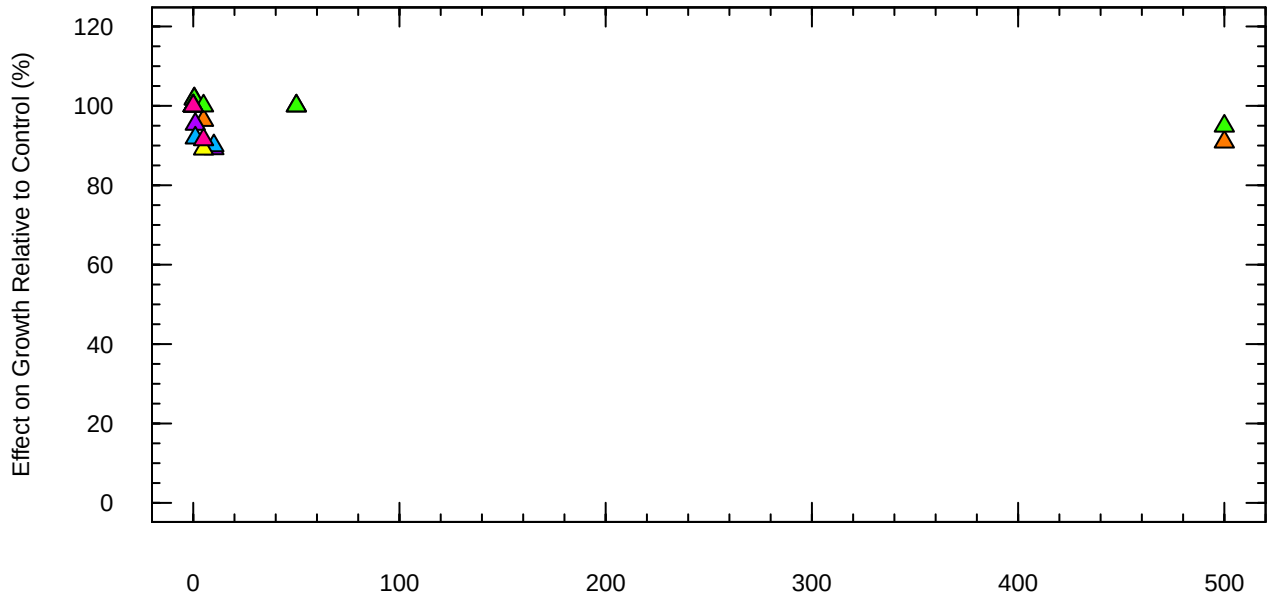
Figure H2−119. Concentration−Response Data for the Avian Growth Endpoint for Aluminum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Capdevielle and Scanes 1995a	chicken	survival	diet	2	aluminum sulfate

Tier 1

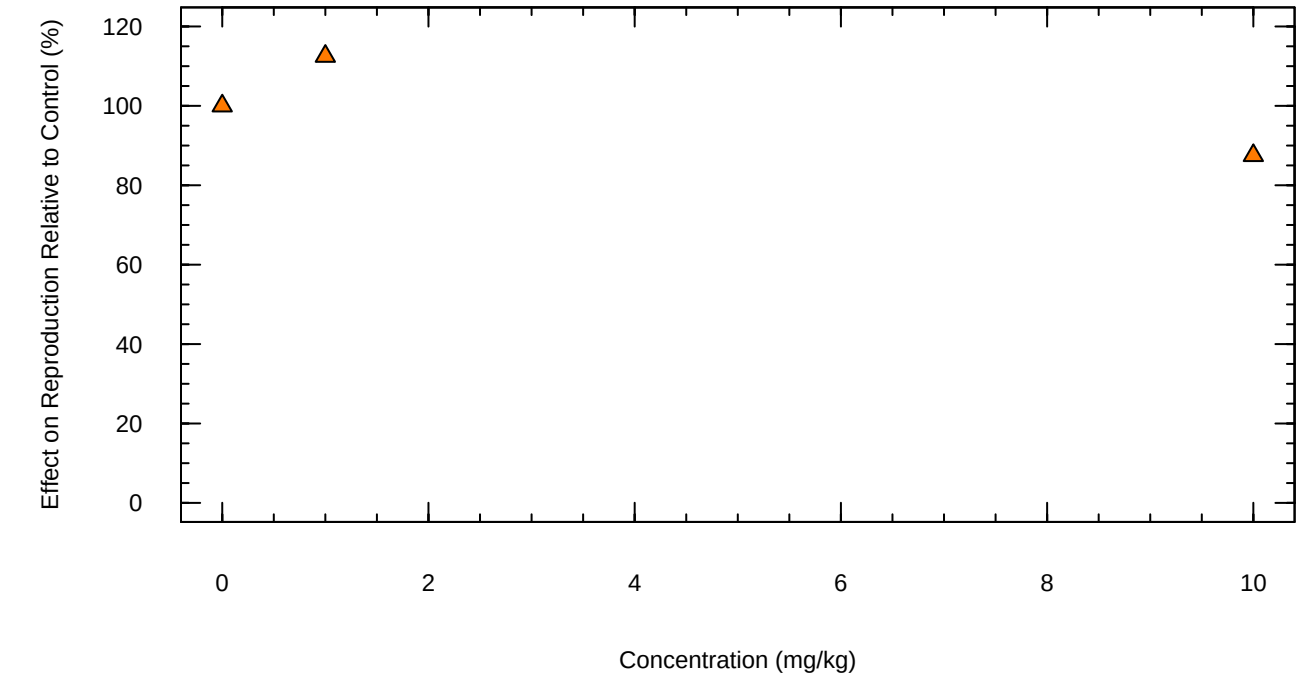
Figure H2−120. Concentration−Response Data for the Avian Survival Endpoint for Aluminum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Poon et al. 1998	rat	body weight (male)	drinking water	13	potassium antimony tartrate
Poon et al. 1998	rat	body weight (female)	drinking water	13	potassium antimony tartrate
Rossi et al. 1987	rat	body weight	drinking water	8.6	antimony trichloride
Rossi et al. 1987	rat	body weight	drinking water	6.3	antimony trichloride
Shroeder et al. 1968	mouse	body weight (male)	drinking water	80	antimony potassium tartrate
Shroeder et al. 1968	mouse	body weight (female)	drinking water	80	antimony potassium tartrate

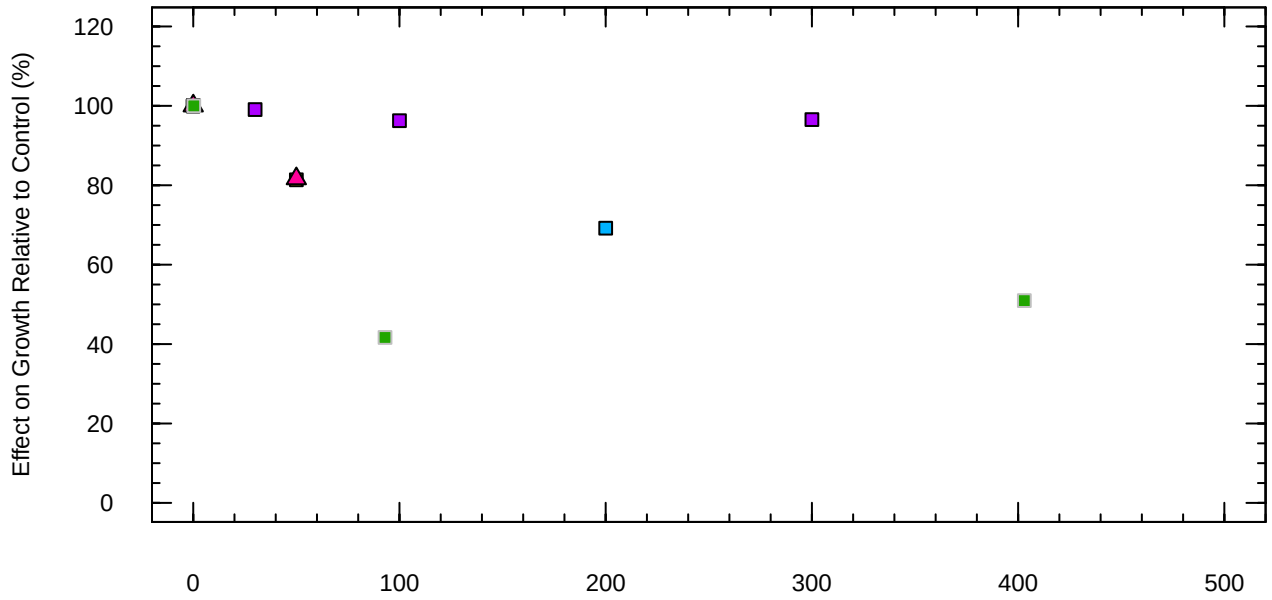
△ Tier 2

Figure H2−121. Concentration−Response Data for the Mammalian Growth Endpoint for Antimony



	Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
▲	Rossi et al. 1987	rat	pups per litter	drinking water	6.3	antimony trichloride
△	Tier 2					

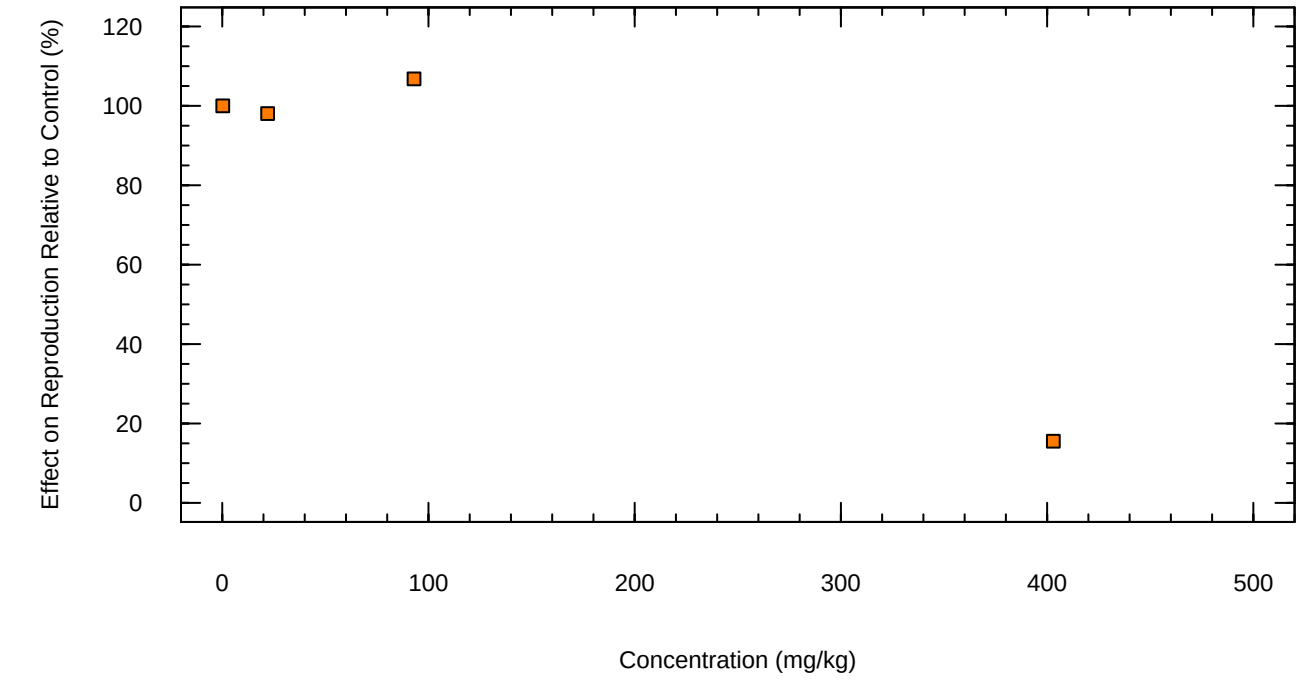
Figure H2−122. Concentration−Response Data for the Mammalian Reproduction Endpoint for Antimony



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Camardese et al. 1990	mallard	body weight	diet	10	sodium arsenate
Hoffman et al. 1992	mallard	body weight	diet	4	sodium arsenate
Howell and Hill 1978	chicken	body weight gain	diet	3	arsenic trichloride
Naraharisetti et al. 2009	chicken	body weight	drinking water	4	sodium arsenite
Stanley et al. 1994	mallard	body weight gain	diet	11.6−24.7	sodium arsenate

□ Tier 1 △ Tier 2

Figure H2−123. Concentration−Response Data for the Avian Growth Endpoint for Arsenic



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Stanley et al. 1994	mallard	duckling survival	diet	11.6−24.7	sodium arsenate

Tier 1

Figure H2−124. Concentration−Response Data for the Avian Reproduction Endpoint for Arsenic

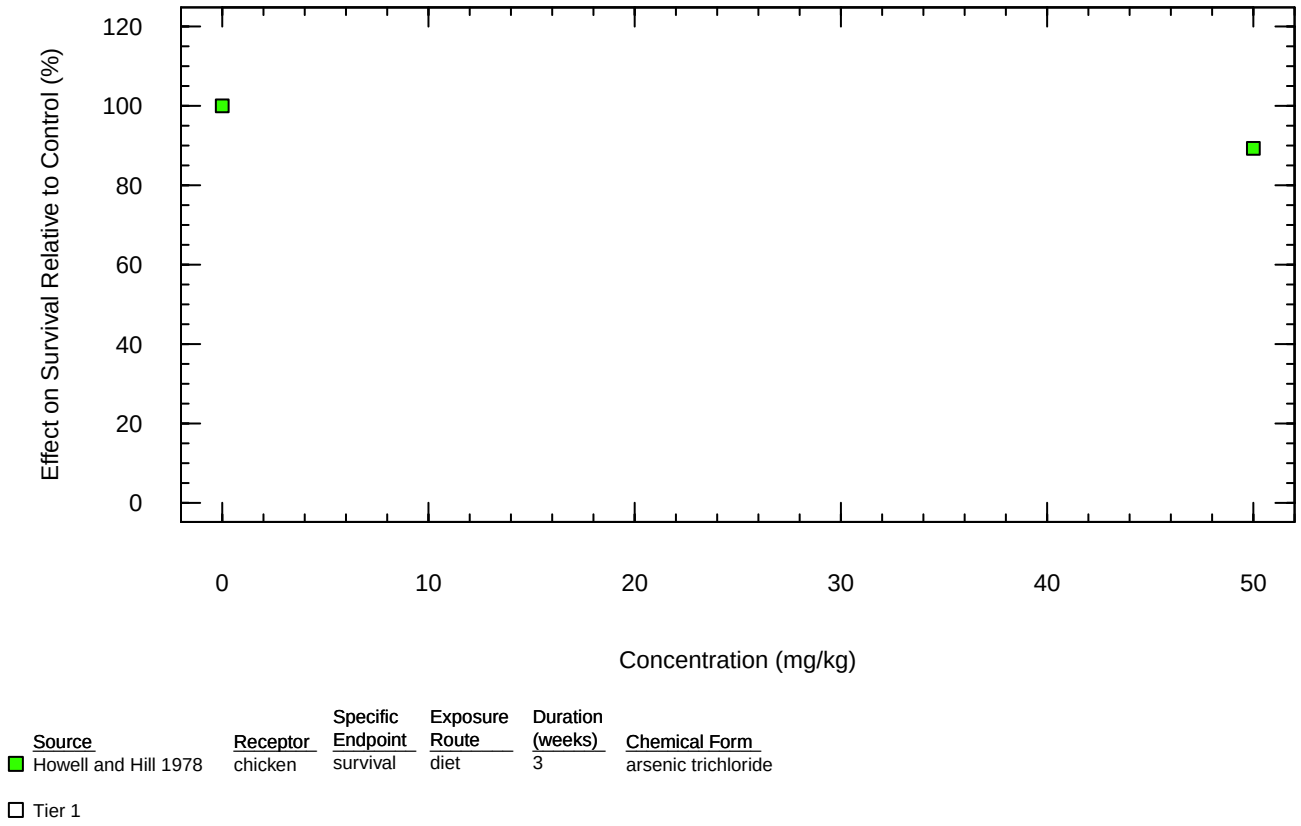
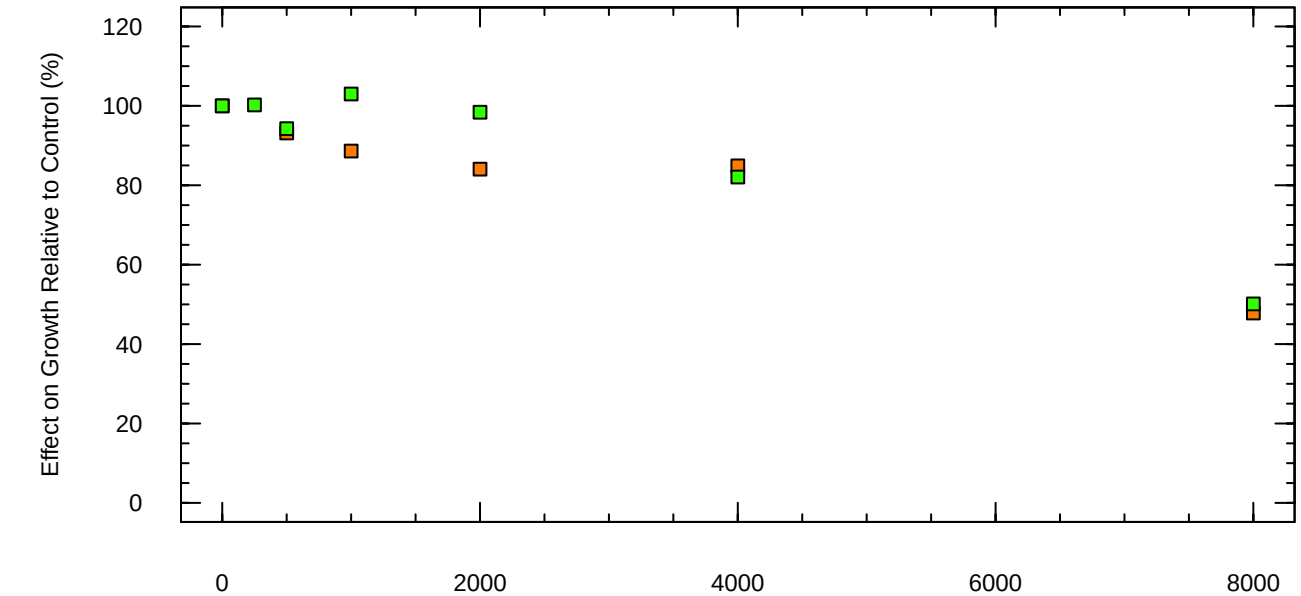


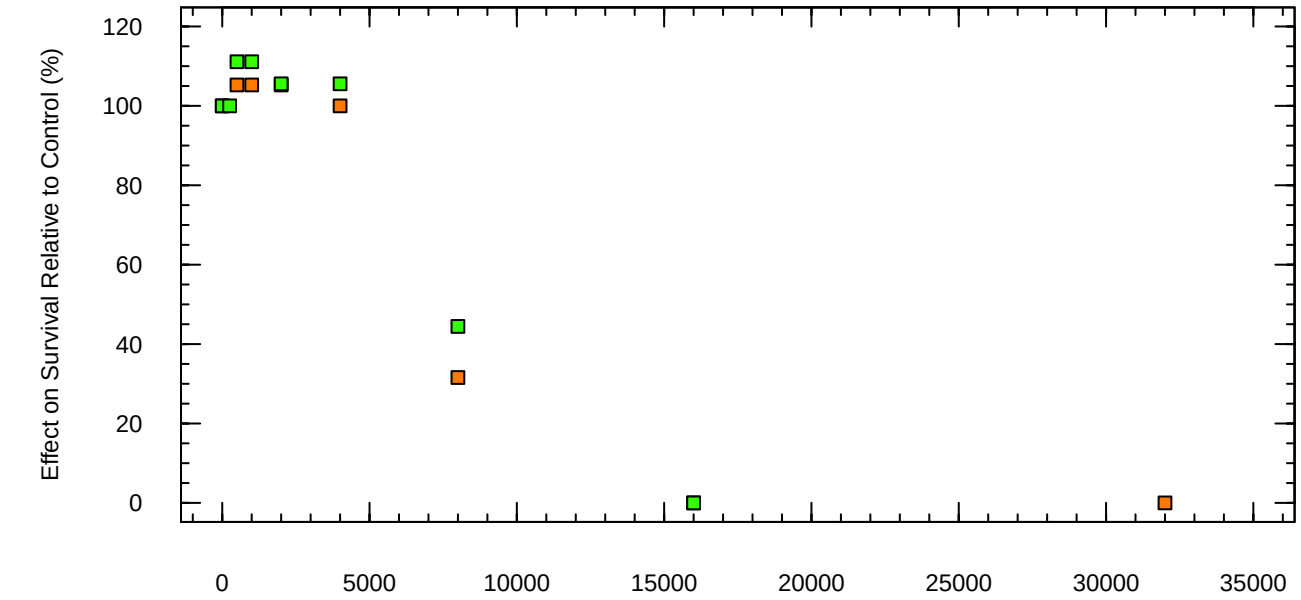
Figure H2−125. Concentration−Response Data for the Avian Survival Endpoint for Arsenic



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Johnson et al. 1960	chicken	body weight gain	diet	4	barium hydroxide
Johnson et al. 1960	chicken	body weight gain	diet	4	barium acetate

Tier 1

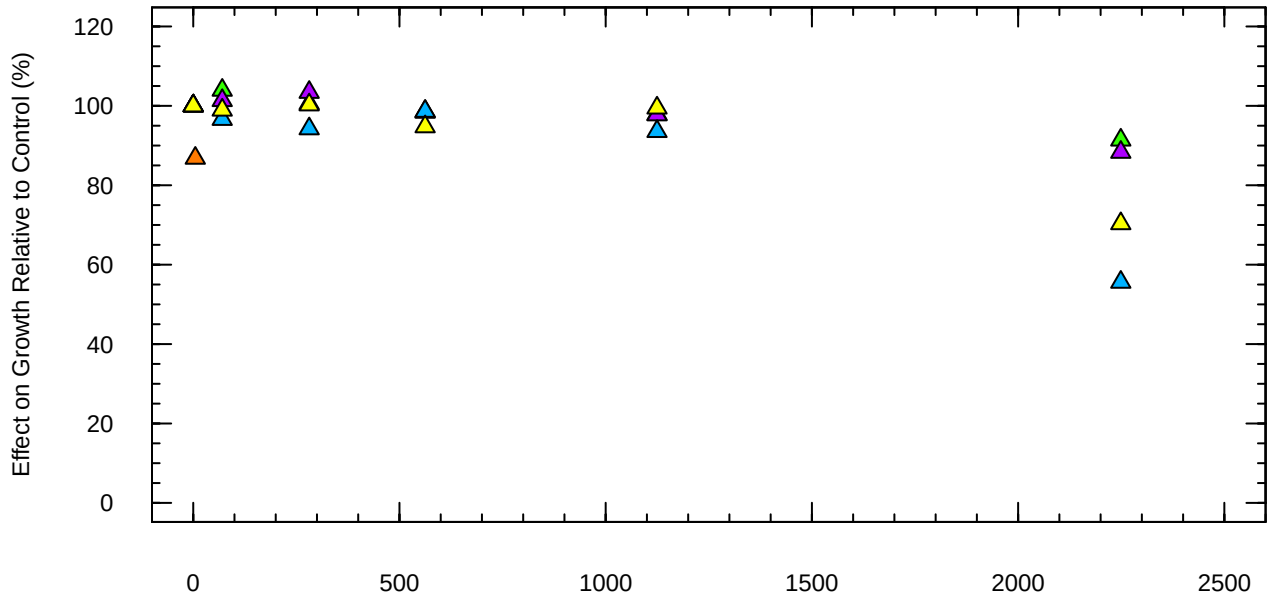
Figure H2−126. Concentration−Response Data for the Avian Growth Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Johnson et al. 1960	chicken	survival	diet	4	barium hydroxide
Johnson et al. 1960	chicken	survival	diet	4	barium acetate

Tier 1

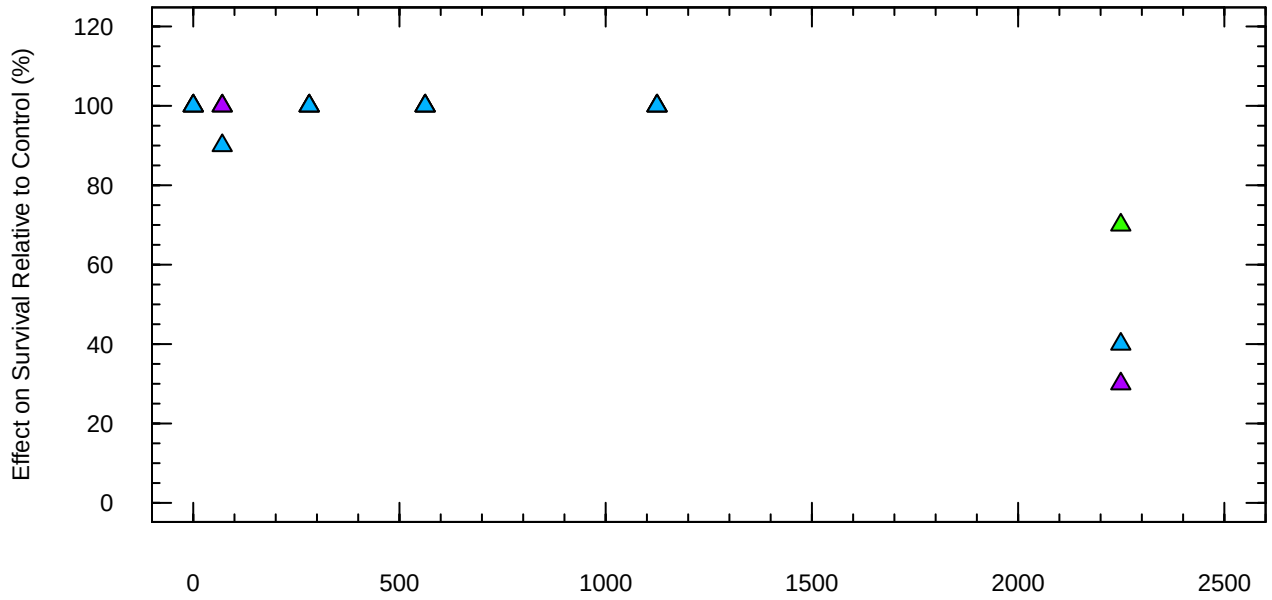
Figure H2−127. Concentration−Response Data for the Avian Survival Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Schroeder and Mitchener 1975	mouse	body weight (female)	drinking water	104	barium acetate	
Dietz et al. 1992	rat	body weight (female)	drinking water	13	barium chloride dihydrate	B
Dietz et al. 1992	rat	body weight (male)	drinking water	13	barium chloride dihydrate	B
Dietz et al. 1992	mouse	body weight (female)	drinking water	13	barium chloride dihydrate	A
Dietz et al. 1992	mouse	body weight (male)	drinking water	13	barium chloride dihydrate	A

△ Tier 2

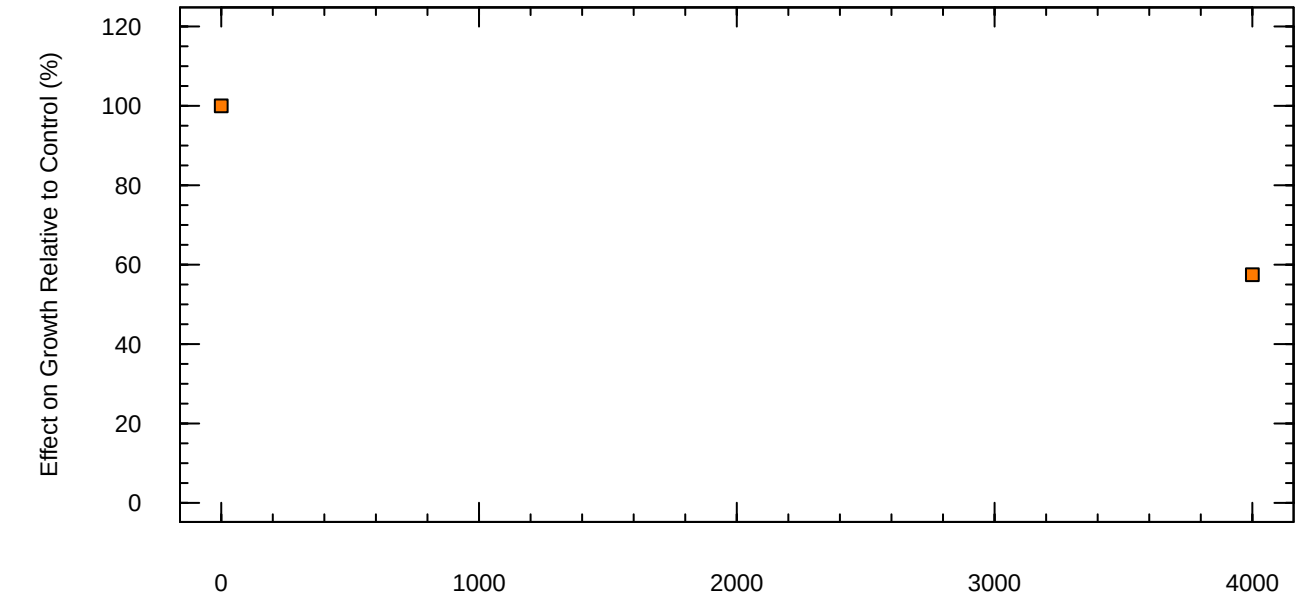
Figure H2−128. Concentration−Response Data for the Mammalian Growth Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Dietz et al. 1992	rat	survival (male)	drinking water	13	barium chloride dihydrate	
Dietz et al. 1992	mouse	survival (female)	drinking water	13	barium chloride dihydrate	C
Dietz et al. 1992	mouse	survival (male)	drinking water	13	barium chloride dihydrate	C

△ Tier 2

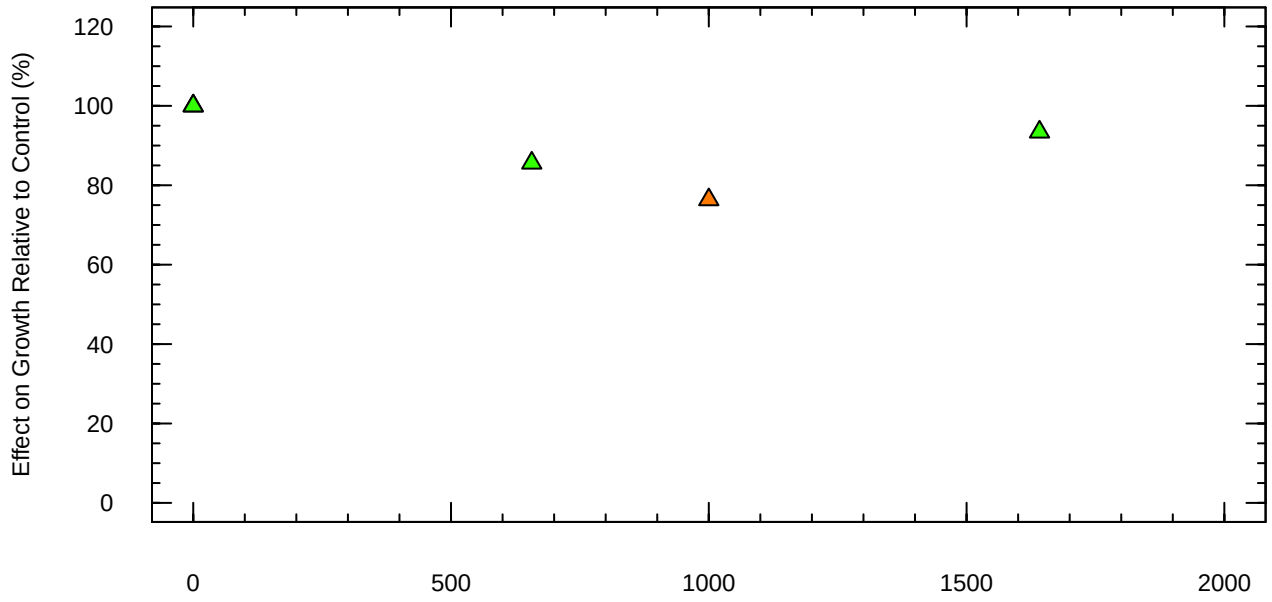
Figure H2−129. Concentration−Response Data for the Mammalian Survival Endpoint for Barium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Chung et al. 1985	chicken	body weight	diet	2	chromium sulfate (chromium [III])

Tier 1

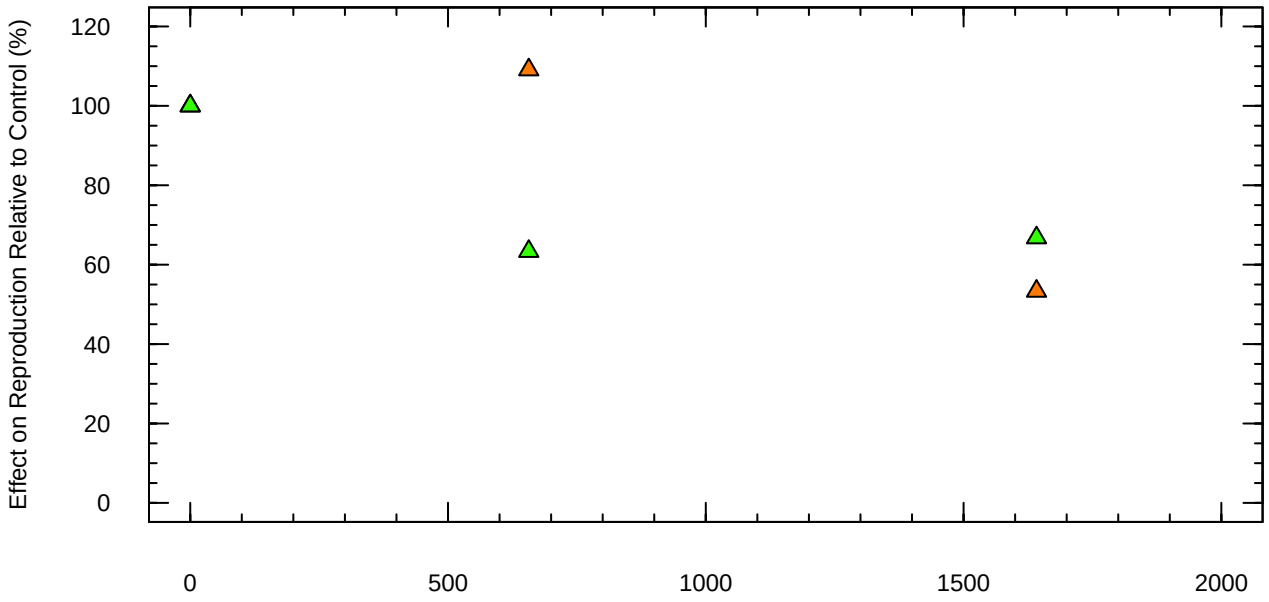
Figure H2−130. Concentration−Response Data for the Avian Growth Endpoint for Chromium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Bataineh et al. 1997	rat	body weight (male)	drinking water	12	chromium chloride (chromium [III])
Elbetieha and Al−Hamood 1997	mouse	body weight	drinking water	12	chromium chloride (chromium [III])

△ Tier 2

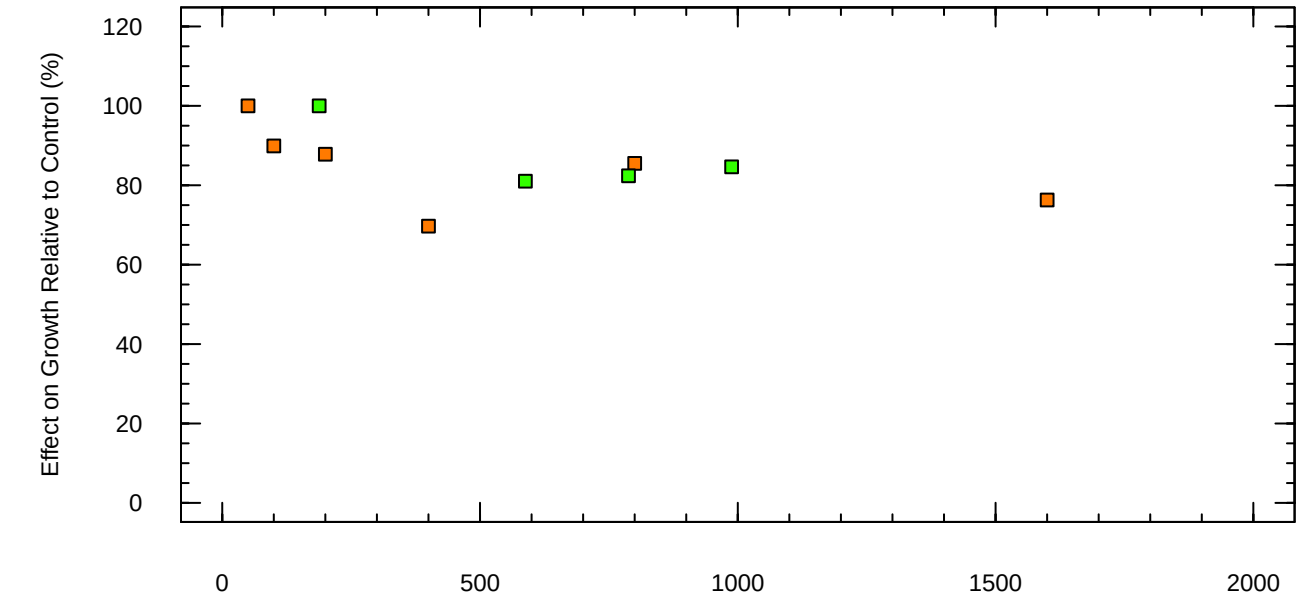
Figure H2−131. Concentration−Response Data for the Mammalian Growth Endpoint for Chromium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Elbetieha and Al−Hamood 1997	mouse	pregnancy success	drinking water	12	chromium chloride (chromium [III])
Elbetieha and Al−Hamood 1997	mouse	viability of fetuses	drinking water	12	chromium chloride (chromium [III])

△ Tier 2

Figure H2−132. Concentration−Response Data for the Mammalian Reproduction Endpoint for Chromium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
McGhee et al. 1965	chicken	body weight	diet	4	iron sulfate
Cao et al. 1996	chicken	body weight	diet	3	iron sulfate

Tier 1

Figure H2−133. Concentration−Response Data for the Avian Growth Endpoint for Iron

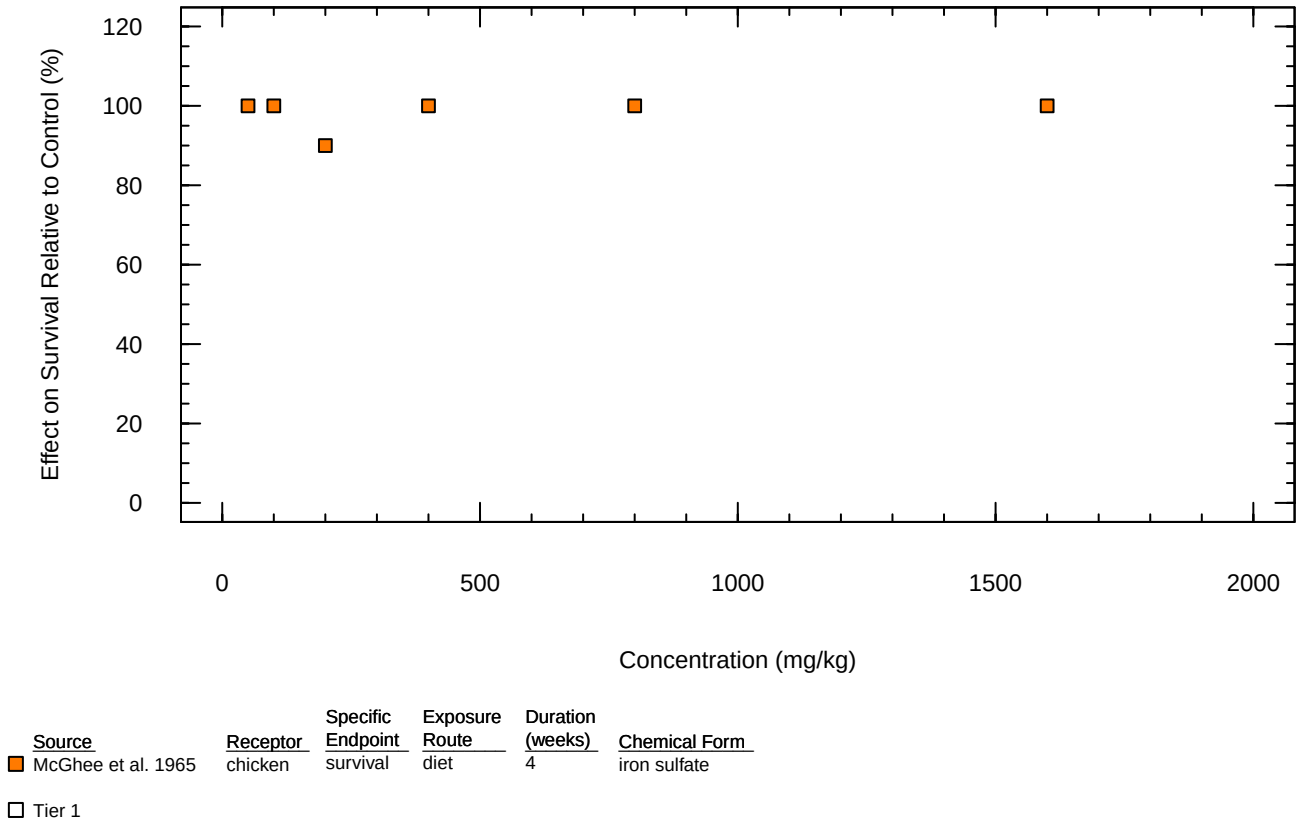
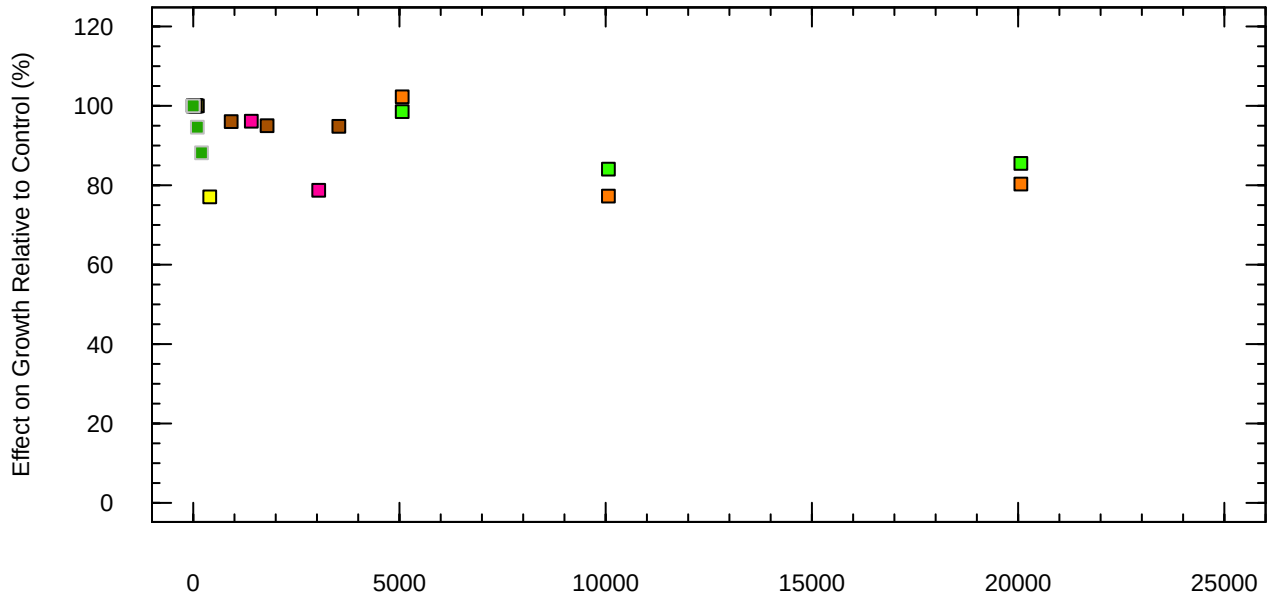


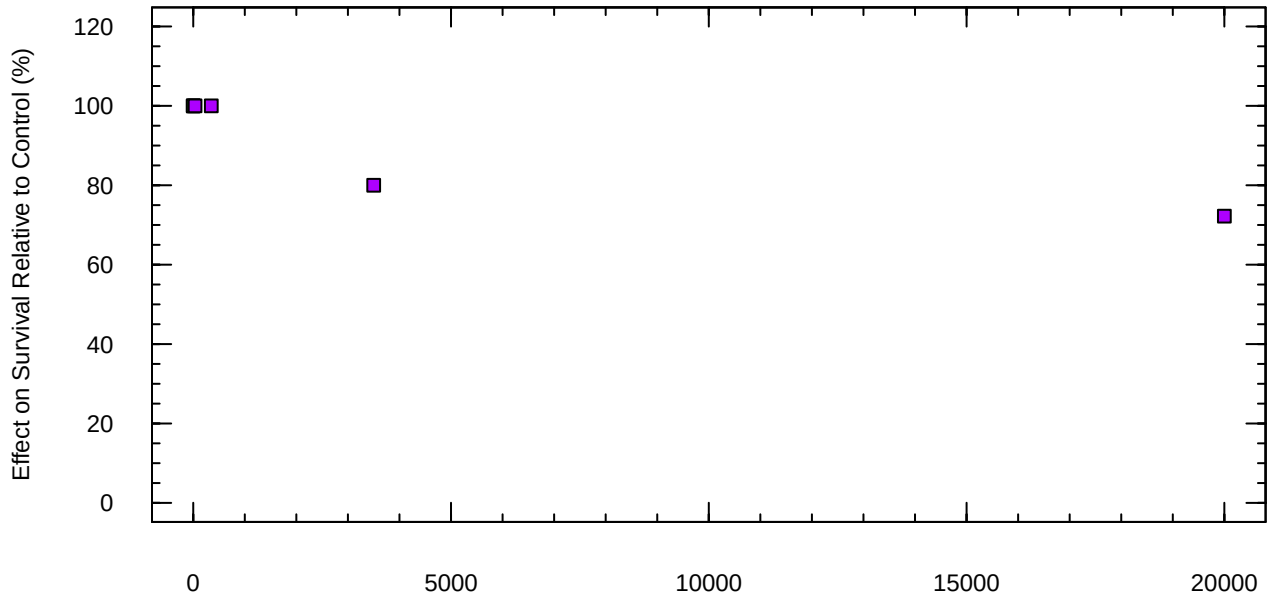
Figure H2−134. Concentration−Response Data for the Avian Survival Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Plummer et al. 1997	rat (male)	body weight	diet	32	carbonyl iron	
Plummer et al. 1997	rat (female)	body weight	diet	32	carbonyl iron	
Whittaker et al. 2002	rat	body weight	gavage	single dose	iron sulfate	
Whittaker et al. 2002	rat	body weight	gavage	single dose	carbonyl iron	
Banis et al. 1969	rat	body weight	diet	4	iron sulfate	A
Storey and Greger 1987	rat	body weight	diet	3	iron sulfate	A
Prince et al. 1979	pig	body weight	diet	16	ferrous sulfide	
Zhu et al. 2016	rat	body weight	diet	13	carbonyl iron	

Tier 1

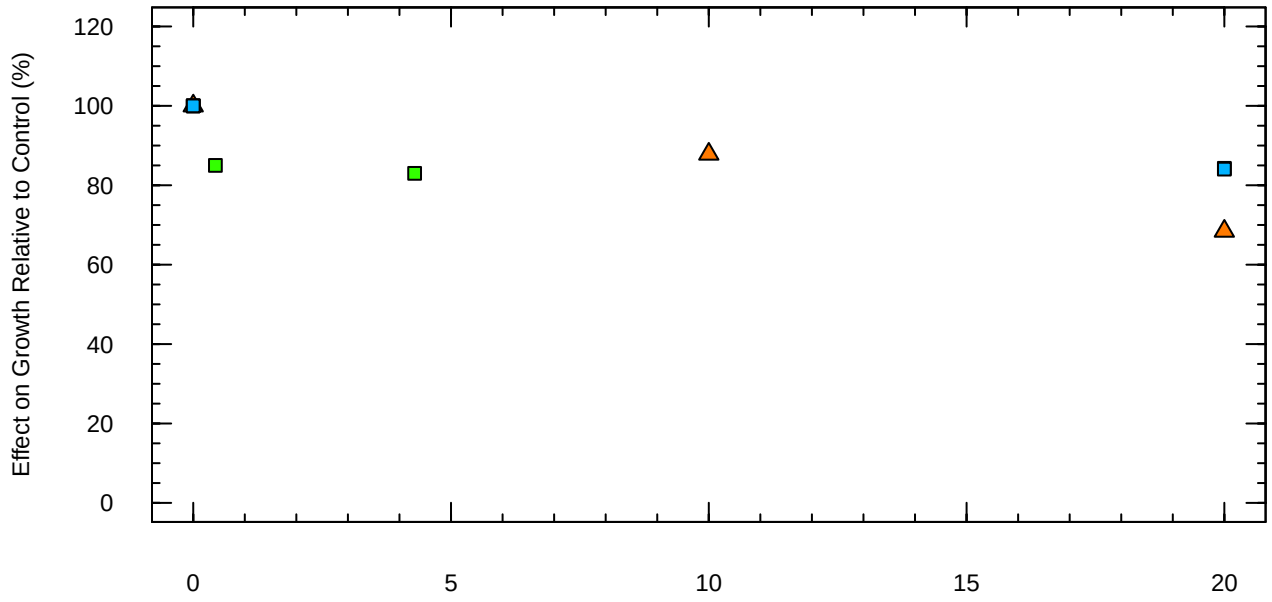
Figure H2−135. Concentration−Response Data for the Mammalian Growth Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Whittaker et al. 2002	rat	survival	gavage	single dose	iron sulfate
Whittaker et al. 2002	rat	survival	gavage	single dose	carbonyl iron
Whittaker et al. 1996	rat	survival	diet	12	carbonyl iron

Tier 1

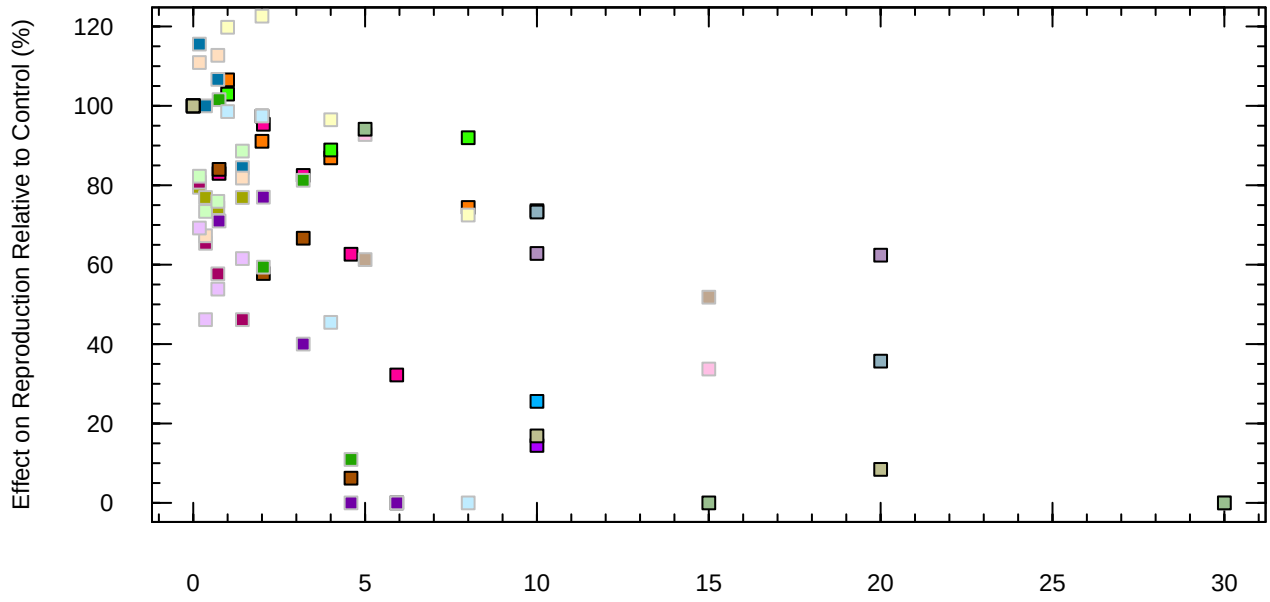
Figure H2−136. Concentration−Response Data for the Mammalian Survival Endpoint for Iron



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Scott et al. 1977	chicken	body weight	diet	8	methylmercury chloride	
Spalding et al. 2000	egret	weight index	diet	14	methylmercury chloride	
Sell and Horani 1976	chicken	body weight gain (Exp 1)	diet	4	methylmercury chloride	A
Sell and Horani 1976	chicken	body weight gain (Exp 2)	diet	3.6	methylmercury chloride	A

Tier 1 Tier 2

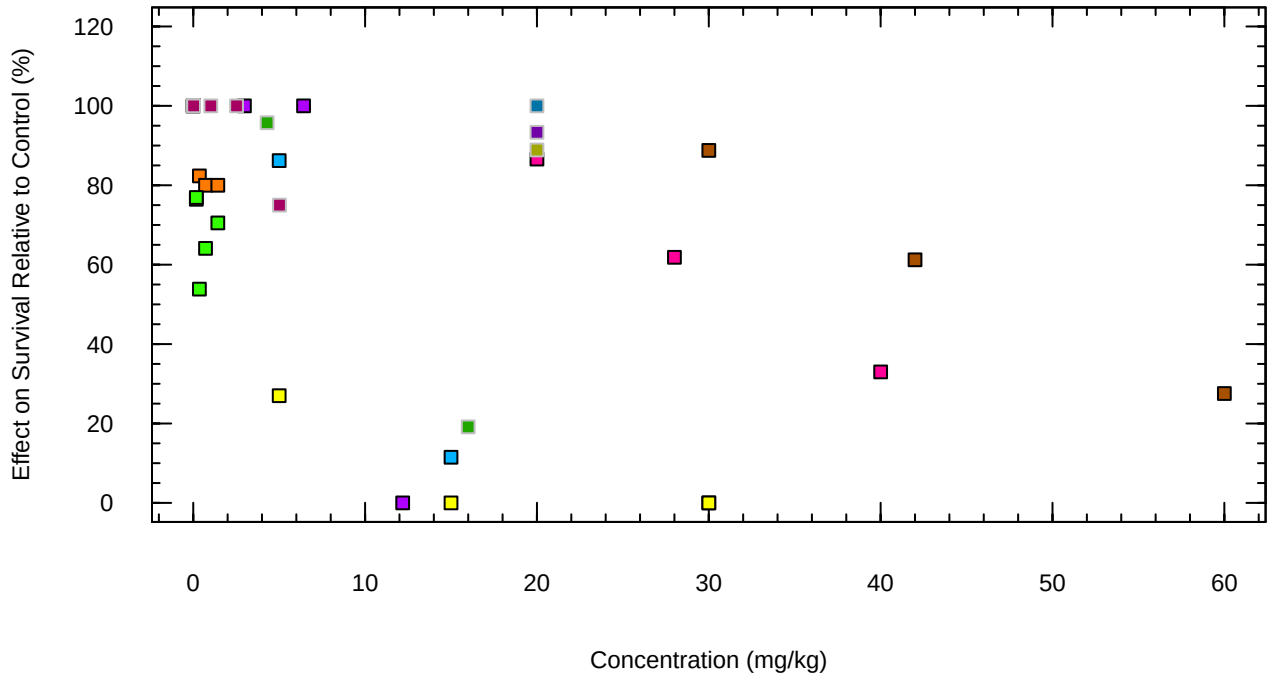
Figure H2−137. Concentration−Response Data for the Avian Growth Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Heinz et al. 2010	mallard	# of ducklings per hen	diet	3.7	methylmercury chloride	B
Heinz et al. 2010	mallard	duckling body weight	diet	3.7	methylmercury chloride	
Heinz and Hoffman 1998	mallard	# of ducklings per hen	diet	up to 11	methylmercury chloride	B
Heinz and Hoffman 1998	mallard	% hatchability	diet	up to 11	methylmercury chloride	
Heinz and Hoffman 1998	mallard	duckling survival	diet	up to 11	methylmercury chloride	
Albers et al. 2007	kestrel	egg production	diet	at least 11	methylmercury chloride	
Albers et al. 2007	kestrel	# of eggs hatched	diet	at least 11	methylmercury chloride	
Albers et al. 2007	kestrel	% eggs hatched	diet	at least 11	methylmercury chloride	
Albers et al. 2007	kestrel	% fledged	diet	at least 11	methylmercury chloride	
Varian−Ramos et al. 2014	finch	% hatchability	diet	52	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	% chicks fledged	diet	52	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	# of offspring	diet	52	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	F1 % hatchability	diet	unclear	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	F1 % chicks fledged	diet	unclear	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	F1 # of offspring	diet	unclear	methylmercury cysteine	
Eskeland and Nafstad 1978	quail	chick survival	diet	6	methylmercury chloride	
Eskeland and Nafstad 1978	quail	hatch success	diet	6	methylmercury chloride	
El−Begearmi et al. 1977	quail	% egg fertility	diet	16	methylmercury hydroxide	
El−Begearmi et al. 1977	quail	egg production	diet	16	methylmercury hydroxide	
El−Begearmi et al. 1977	quail	% hatchability	diet	16	methylmercury hydroxide	
Scott et al. 1977	chicken	egg fertility	diet	8	methylmercury chloride	
Scott et al. 1977	chicken	egg production	diet	8	methylmercury chloride	
Scott et al. 1977	chicken	egg hatchability	diet	8	methylmercury chloride	

Tier 1

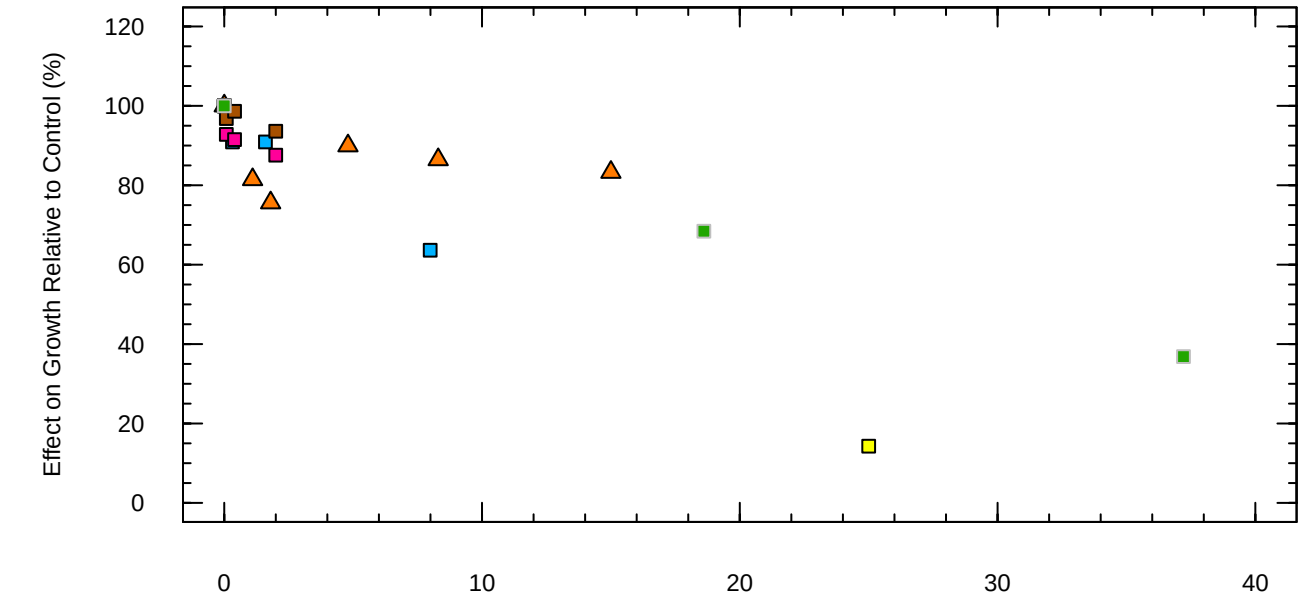
Figure H2−138. Concentration−Response Data for the Avian Reproduction Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Varian−Ramos et al. 2014	finch	survival	diet	52	methylmercury cysteine	
Varian−Ramos et al. 2014	finch	F1 survival	diet	unclear	methylmercury cysteine	
Bennet et al. 2009	kestrel	survival	diet	5−7	methylmercury chloride	
El−Begearmi et al. 1977	quail	survival (female)	diet	16	methylmercury hydroxide	C
El−Begearmi et al. 1977	quail	survival (male)	diet	16	methylmercury hydroxide	C
Hill and Soares 1987	quail	survival	diet	0.71	methylmercury chloride	
Hill and Soares 1987	quail	survival	diet	0.71	methylmercury chloride	
Spann et al. 1986	quail	survival	diet	6	methylmercury chloride	
Sell and Horani 1976	chicken	survival (Exp 1)	diet	4	methylmercury chloride	
Sell and Horani 1976	chicken	survival (Exp 2)	diet	3.6	methylmercury chloride	
Sell and Horani 1976	quail	survival (Exp 2)	diet	3.3	methylmercury chloride	
Scheuhammer 1988	finch	survival	diet	11	methylmercury chloride	

Tier 1

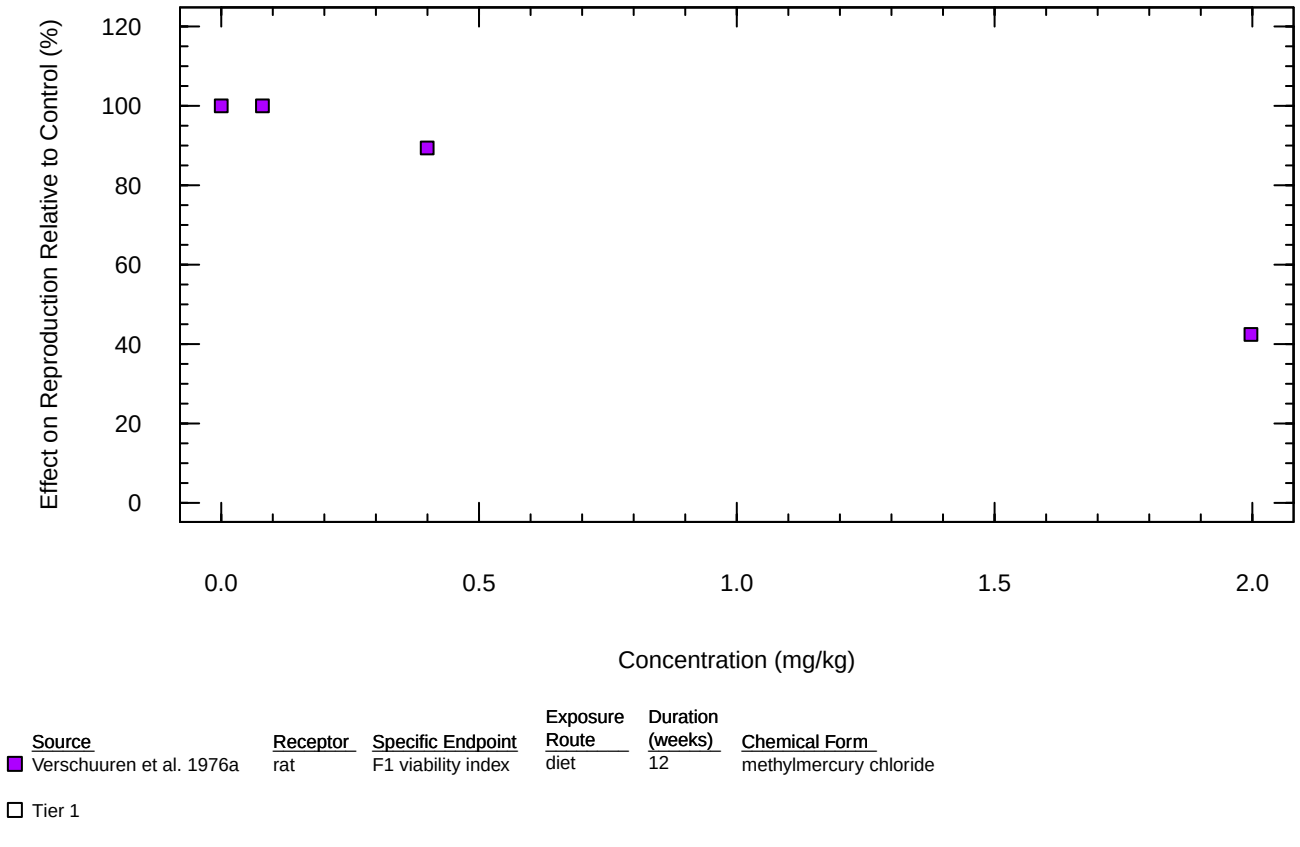
Figure H2−139. Concentration−Response Data for the Avian Survival Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Wobeser et al. 1976	mink	body weight	diet	13	methylmercury chloride	
Mitsumori et al. 1983	rat	body weight	diet	130	methylmercury chloride	D
Stillings et al. 1974	rat	body weight gain	diet	4	methylmercury chloride	
Verschuuren et al. 1976a	rat	F2 body weight gain	diet	12	methylmercury chloride	
Verschuuren et al. 1976b	rat	body weight	diet	104	methylmercury chloride	D
Friedman et al. 1978	rat	body weight	diet	10	methlymercury chloride	

Tier 1 Tier 2

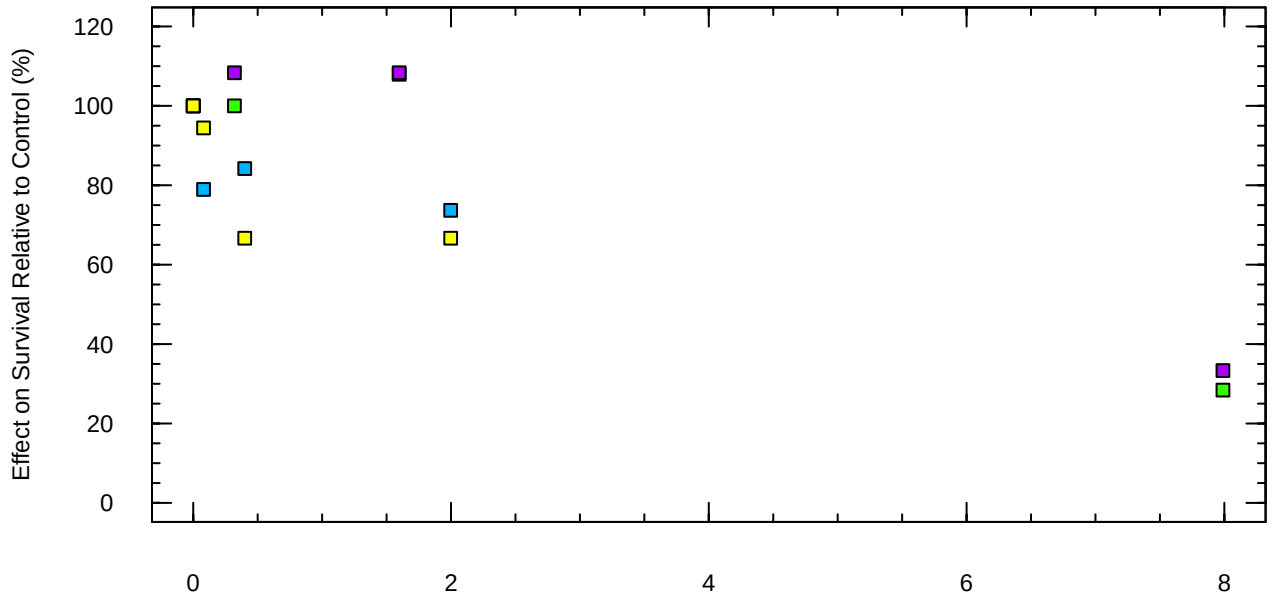
Figure H2−140. Concentration−Response Data for the Mammalian Growth Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Verschuuren et al. 1976a	rat	F1 viability index	diet	12	methylmercury chloride

Tier 1

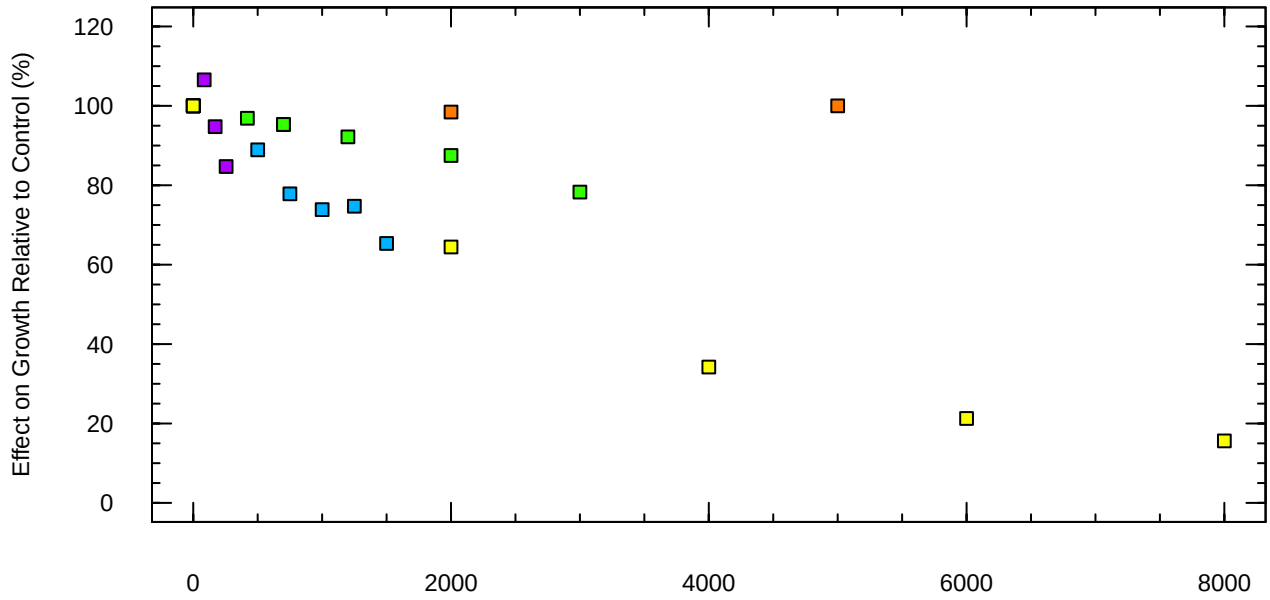
Figure H2−141. Concentration−Response Data for the Mammalian Reproduction Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Mitsumori et al. 1983	rat	survival	diet	130	methylmercury chloride	E
Mitsumori et al. 1983	rat	survival	diet	130	methylmercury chloride	E
Verschuuren et al. 1976b	rat	survival (female)	diet	104	methylmercury chloride	E
Verschuuren et al. 1976b	rat	survival (male)	diet	104	methylmercury chloride	E

Tier 1

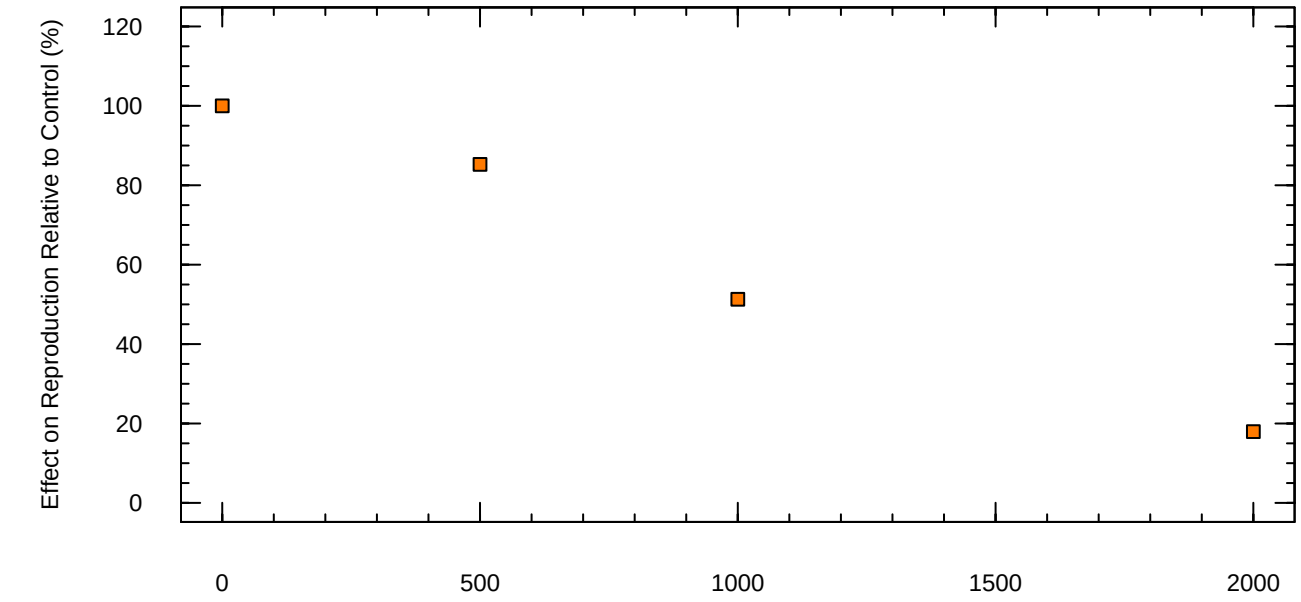
Figure H2−142. Concentration−Response Data for the Mammalian Survival Endpoint for Methylmercury



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Stafford et al. 2015	bobwhite quail	body weight gain	diet	4.3	molydenum disulfide	
Stafford et al. 2015	bobwhite quail	body weight gain	diet	4.3	sodium molybdate	
Kratzer 1952	chicken	weight gain	diet	3.3	sodium molybdate	
Davies et al. 1960	chicken	body weight (Exp 1b)	diet	4	sodium molybdate	A
Davies et al. 1960	chicken	body weight (Exp 1c)	diet	4	sodium molybdate	A

Tier 1

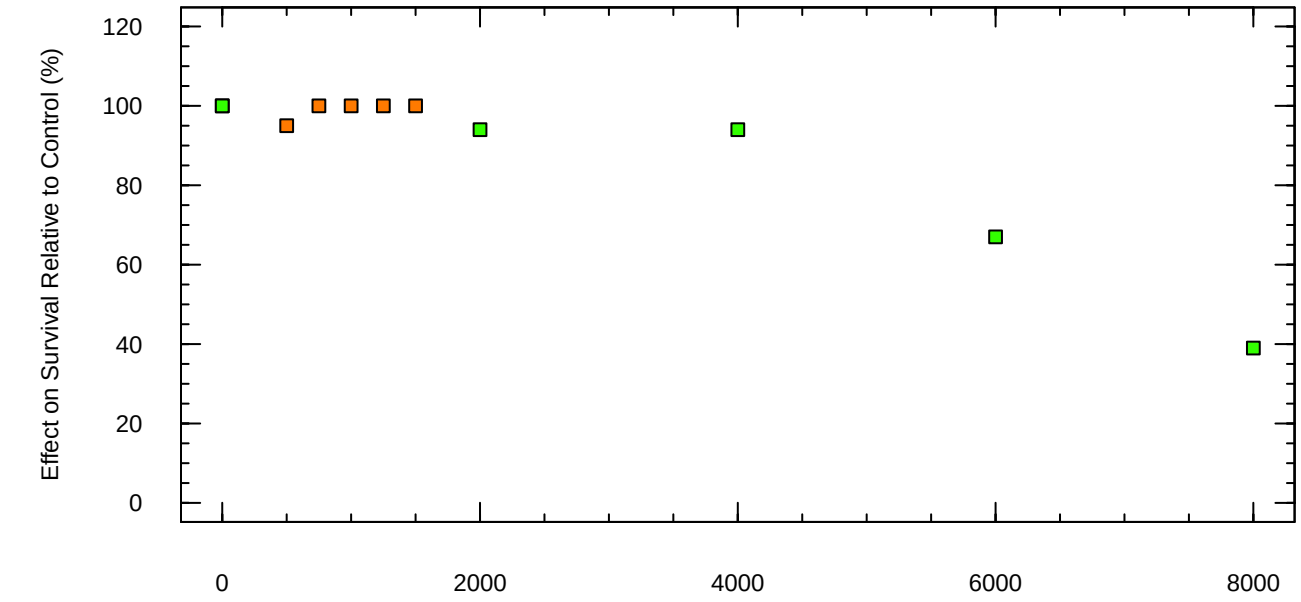
Figure H2−143. Concentration−Response Data for the Avian Growth Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Lepore and Miller 1965	chicken	egg production	diet	3	sodium molybdate

Tier 1

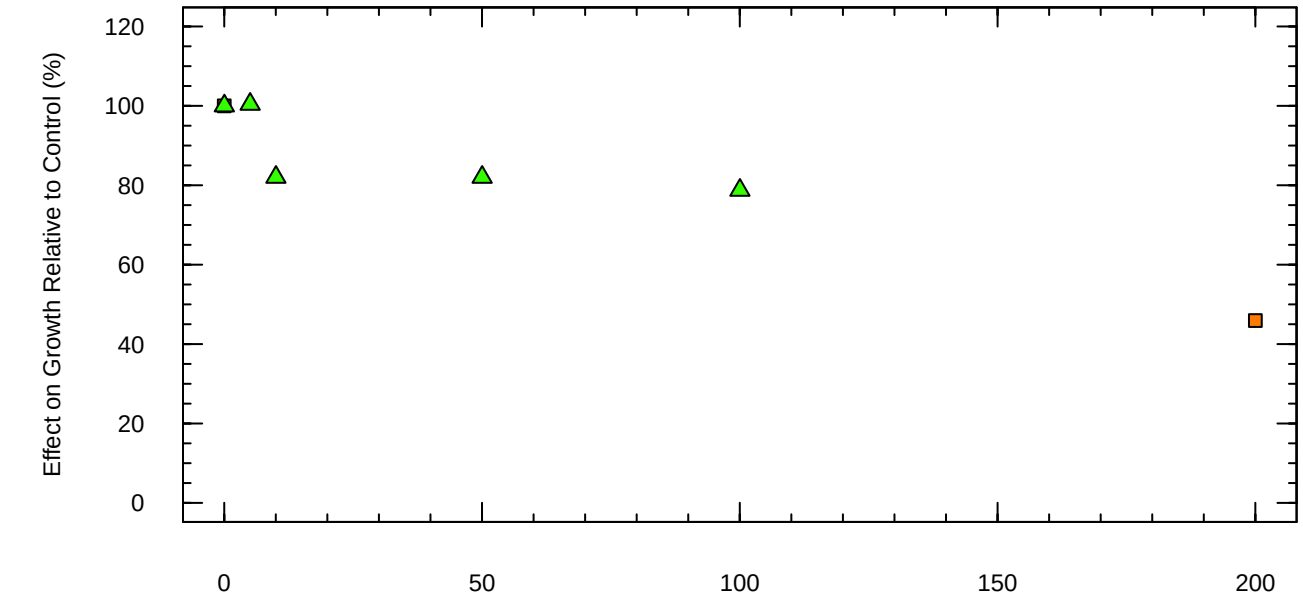
Figure H2−144. Concentration−Response Data for the Avian Reproduction Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Davies et al. 1960	chicken	survival (Exp 1b)	diet	4	sodium molybdate
Davies et al. 1960	chicken	survival (Exp 1c)	diet	4	sodium molybdate

Tier 1

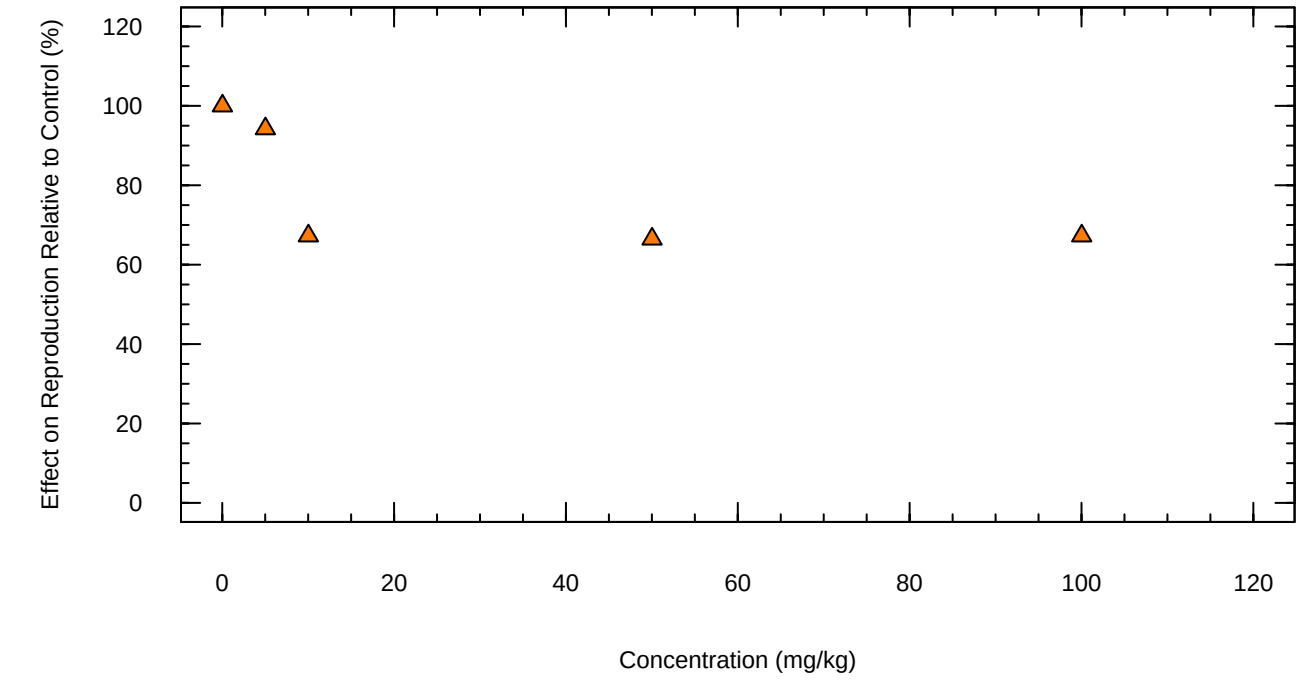
Figure H2−145. Concentration−Response Data for the Avian Survival Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Brinkman and Miller 1961	rat	body weight gain	diet	6	sodium molybdate
Fungwe et al. 1990	rat	body weight gain	drinking water	9	sodium molybdate

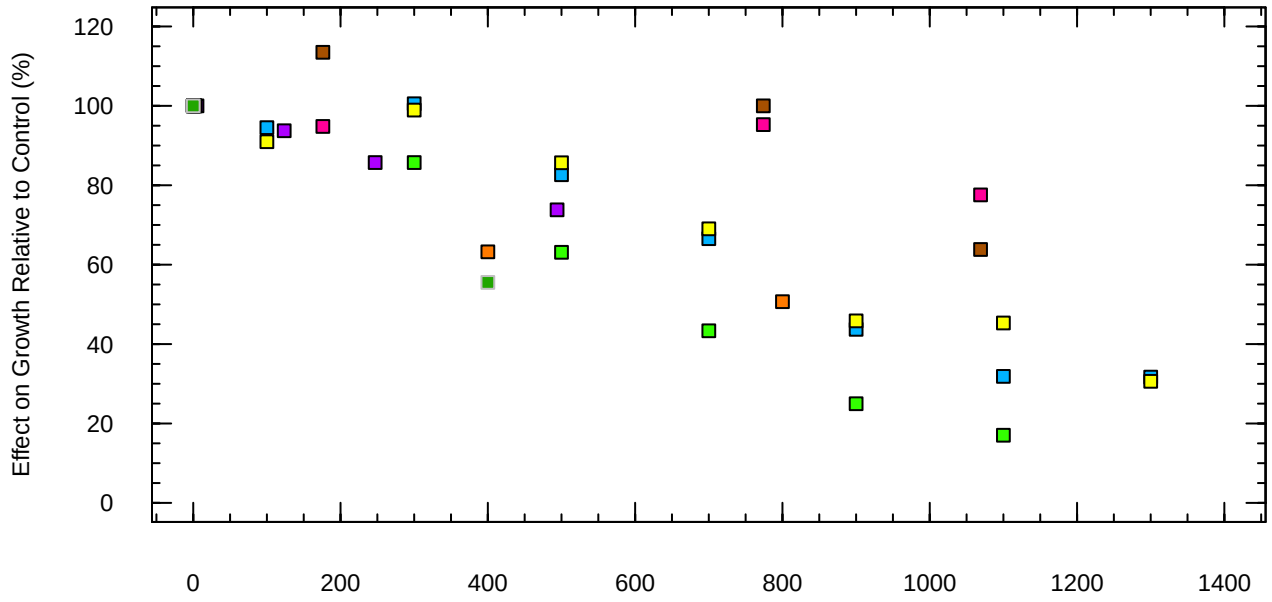
Tier 1 Tier 2

Figure H2−146. Concentration−Response Data for the Mammalian Growth Endpoint for Molybdenum



	Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
▲	Fungwe et al. 1990	rat	litter weight	drinking water	9	sodium molybdate
△	Tier 2					

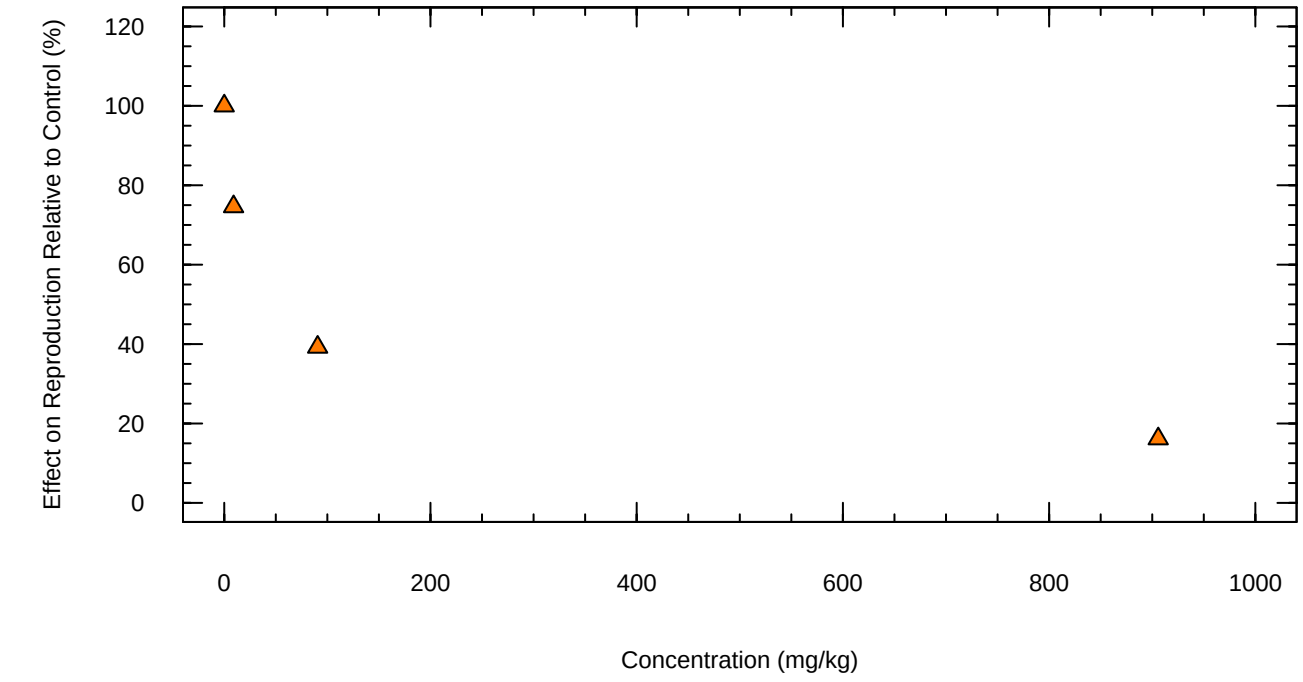
Figure H2−147. Concentration−Response Data for the Mammalian Reproduction Endpoint for Molybdenum



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Hill 1979	chicken	body weight gain	diet	2	nickel chloride	A
Ling and Leach 1979	chicken	body weight	diet	3	nickel chloride	
Martinez and Diaz 1996	chicken	body weight	diet	6	nickel chloride	
Weber and Reid 1968	chicken	body weight	diet	4	nickel sulfate	
Weber and Reid 1968	chicken	body weight	diet	4	nickel acetate	
Cain and Pafford 1981	mallard	body weight (female)	diet	8.6	nickel sulfate	
Cain and Pafford 1981	mallard	body weight (male)	diet	4	nickel sulfate	
Hill 1985	chicken	body weight gain	diet	2.7	nickel chloride	A

Tier 1

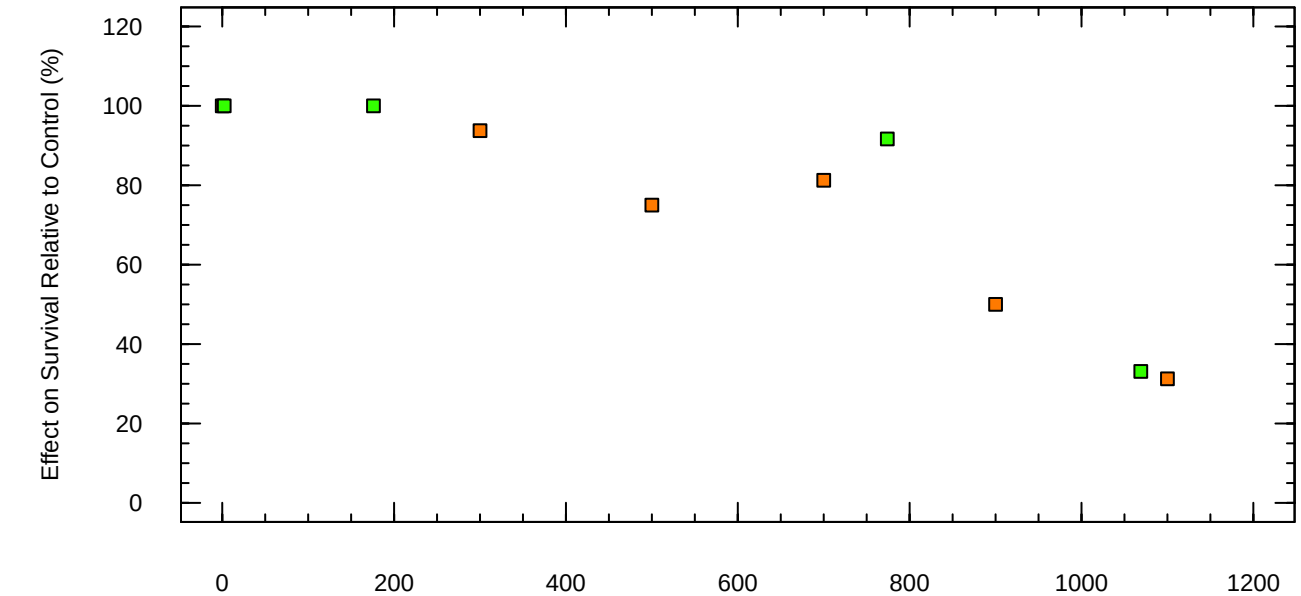
Figure H2−148. Concentration−Response Data for the Avian Growth Endpoint for Nickel



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Arpasova et al. 2007	chicken	egg production	drinking water	4	nickel chloride

△ Tier 2

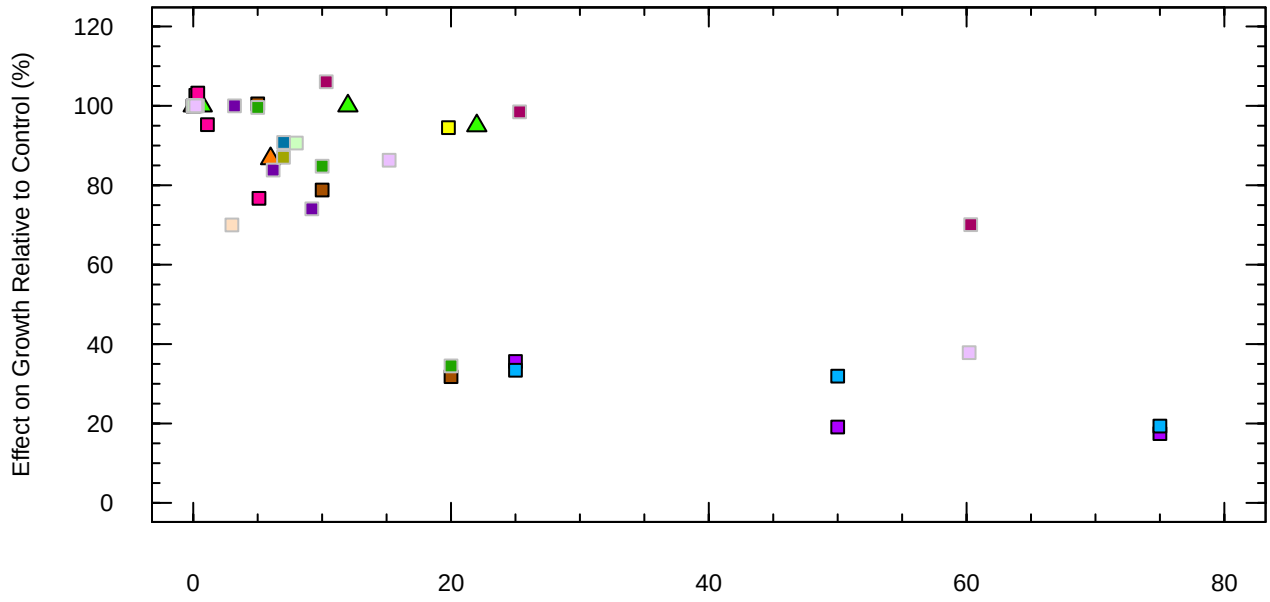
Figure H2−149. Concentration−Response Data for the Avian Reproduction Endpoint for Nickel



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Ling and Leach 1979	chicken	survival	diet	3	nickel chloride
Cain and Pafford 1981	mallard	survival	diet	12.9	nickel sulfate

Tier 1

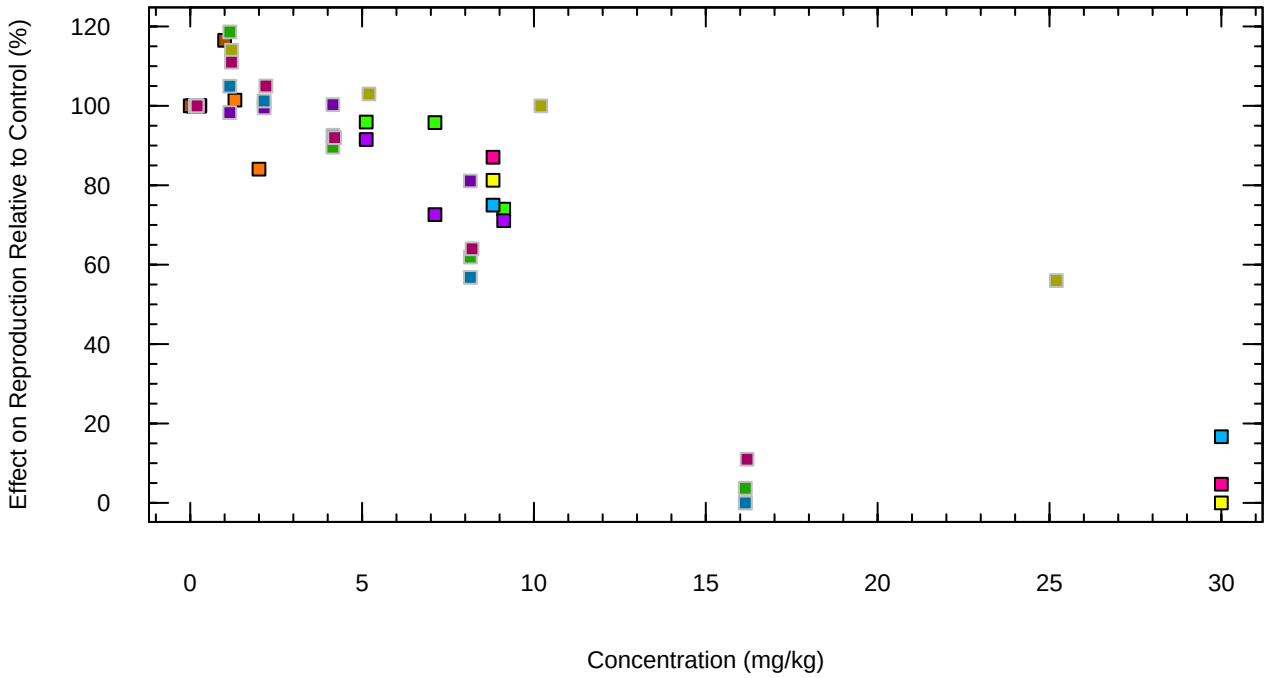
Figure H2−150. Concentration−Response Data for the Avian Survival Endpoint for Nickel



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Gad and El−Twab 2009	quail	body weight	gavage	4	sodium selenite	
Santolo et al. 2010	quail	body weight gain	diet	4	seleno−L−methionine	
El−Begearmi and Combs 1982	chicken	body weight (brewer's yeast diet)	diet	4	sodium selenite	A
El−Begearmi and Combs 1982	chicken	body weight (corn−soy diet)	diet	4	sodium selenite	A
Heinz and Fitzgerald 1993a	mallard	body weight	diet	21	seleno−DL−methionine	D
Jensen 1986	chicken	body weight	diet	3	sodium selenite	A
Hill 1979a	chicken	body weight gain (Exp 1)	diet	4−5	selenium dioxide	B
Hill 1979a	chicken	body weight gain (Exp 2)	diet	4−5	selenium dioxide	B
Echevarria et al. 1988	chicken	body weight gain	diet	3	sodium selenite	C
Stowesand et al. 1977	quail	body weight	diet	10	sodium selenite	
Stowesand et al. 1977	quail	body weight	diet	10	seleniferous wheat	
O'Toole and Raisbeck 1997	mallard	body weight	diet	21	seleno−L−methionine	D
Dafalla and Adam 1986	chicken	body weight	diet	4	sodium selenite	A
Sell and Horani 1976	chicken	body weight gain	diet	4	sodium selenite	C
Hoffman et al. 1992	mallard	body weight	diet	4	seleno−DL−methionine	

Tier 1 Tier 2

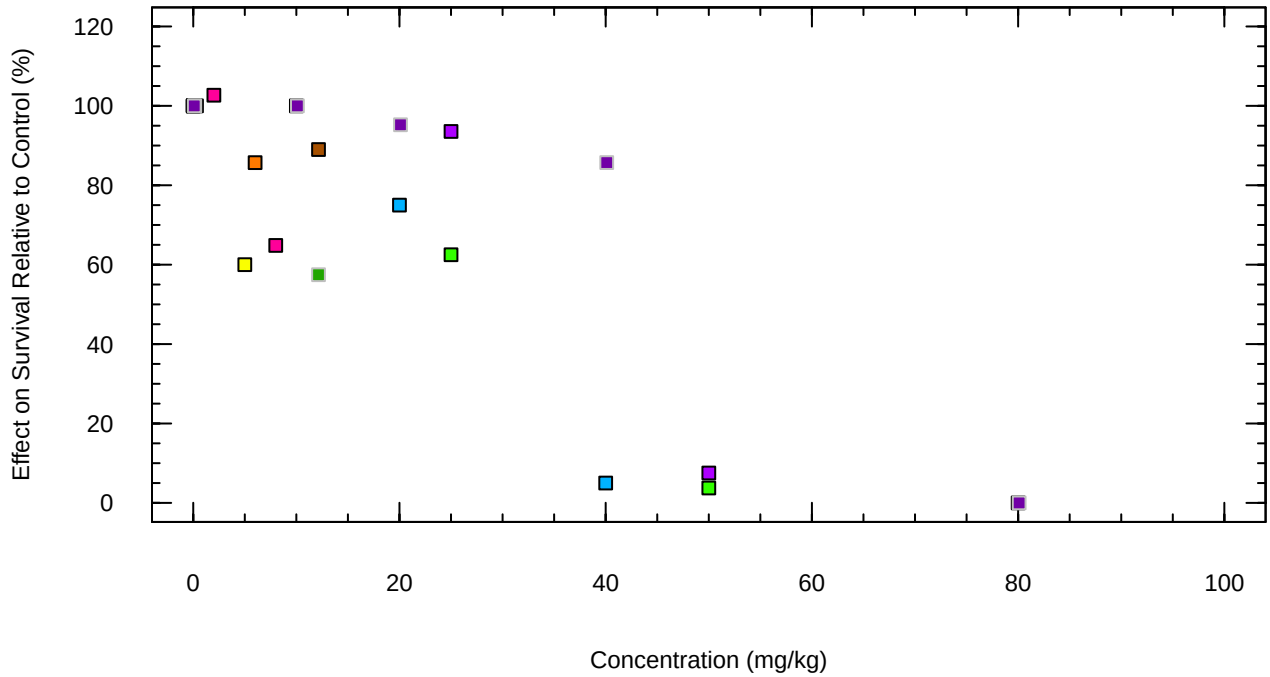
Figure H2−151. Concentration−Response Data for the Avian Growth Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Käántee and Kurbela 1980	chicken	egg production	diet	4	sodium selenite	
Ort and Latshaw 1978	chicken	egg production (Exp 2)	diet	16	sodium selenite	
Ort and Latshaw 1978	chicken	hatchability (Exp 2)	diet	16	sodium selenite	
Wiemeyer and Hoffman 1996	owl	% pairs with hatchlings	diet	12	seleno−DL−methionine	
Wiemeyer and Hoffman 1996	owl	# of pairs with 5−day−old young	diet	12	seleno−DL−methionine	
Wiemeyer and Hoffman 1996	owl	% hatch of eggs incubated	diet	12	seleno−DL−methionine	
Stone and Soares 1976	quail	egg production (Exp 1 and 3)	diet	3.9−4.6	sodium selenite	
Heinz et al. 1989	mallard	% hatch of fertile eggs	diet	>14	selenomethionine	E
Heinz et al. 1989	mallard	duckling survival	diet	>14	selenomethionine	
Heinz et al. 1989	mallard	# of ducklings	diet	>14	selenomethionine	
Hoffman and Heinz 1988	mallard	hatching success	diet	NR	sodium selenite	
Hoffman and Heinz 1988	mallard	hatching success	diet	NR	seleno−methionine	E

Tier 1

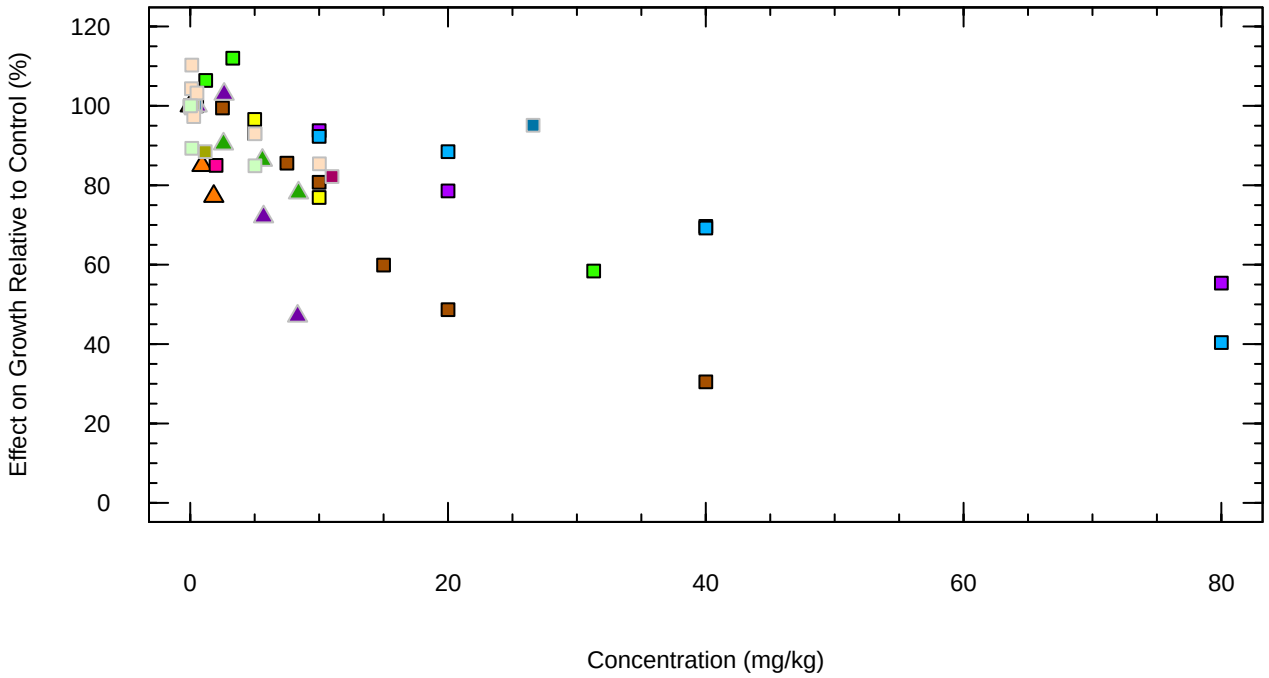
Figure H2−152. Concentration−Response Data for the Avian Reproduction Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Gad and El−Twab 2009	quail	survival	gavage	4	sodium selenite	
El−Begearmi and Combs 1982	chicken	survival (brewer's yeast diet)	diet	4	sodium selenite	G
El−Begearmi and Combs 1982	chicken	survival (corn−soy diet)	diet	4	sodium selenite	G
Heinz and Fitzgerald 1993b	mallard	survival	diet	16	seleno−DL−methionine	I
Khan et al. 1993	chicken	survival	gavage	0.86	sodium selenite	
Arnold et al. 1973	chicken	survival	diet	64	sodium selenite	
El−Begearmi et al. 1977	quail	survival (males)	diet	16	sodium selenite	H
El−Begearmi et al. 1977	quail	survival (females)	diet	16	sodium selenite	H
Albers et al. 1996	mallard	survival	diet	16	seleno−DL−methionine	I

Tier 1

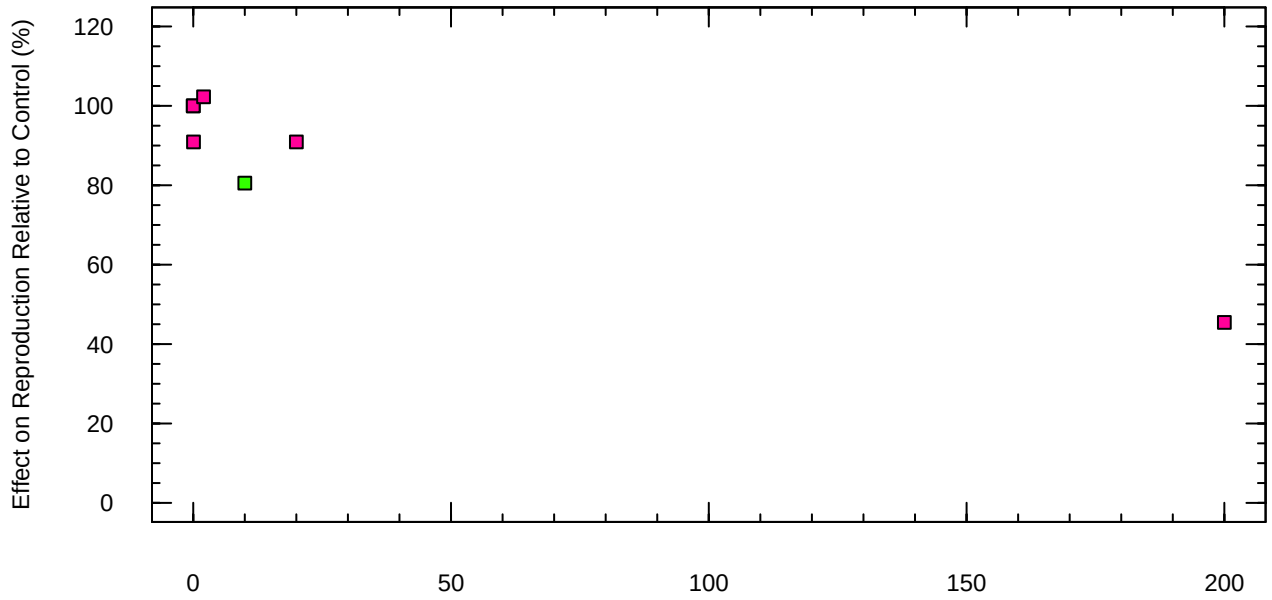
Figure H2−153. Concentration−Response Data for the Avian Survival Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Kaur and Parshad 1994	rat	body weight	diet	5.1	sodium selenite	
Spallholz et al. 1973	mouse	body weight gain	diet	5	sodium selenite	
Julius et al. 1983	hamster	body weight (male, Exp 1)	diet	3	sodium selenite	A
Julius et al. 1983	hamster	body weight (female, Exp 1)	diet	3	sodium selenite	A
Julius et al. 1983	hamster	body weight (male, Exp 2)	diet	3	sodium selenite	A
Behne et al. 1992	rat	body weight	diet	14.3	L−selenomethionine	
Mahan and Moxon 1984	pig	body weight	diet	5.3	sodium selenite	
Goehring et al. 1984	rat	body weight gain	diet	4	seleniferous grain	
Goehring et al. 1984	rat	body weight gain	diet	4	sodium selenite	
Baker et al. 1989	pig	body weight	diet	3.7	sodium selenate	
Boylan et al. 1990	mouse	body weight	diet	26	sodium selenite	
Wahlstrom et al. 1956	pig	body weight	diet	14	sodium selenite	
Birt et al. 1983	hamster	body weight	diet	25	sodium selenite	
Birt et al. 1986	hamster	body weight	diet	64	sodium selenite	

Tier 1 Tier 2

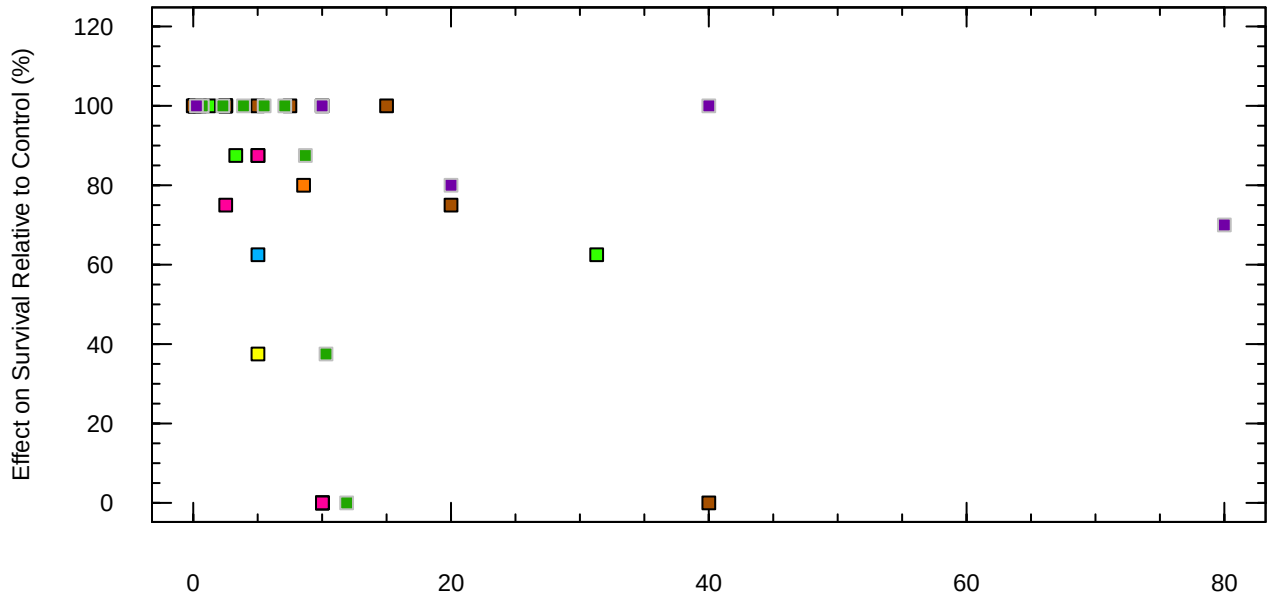
Figure H2−154. Concentration−Response Data for the Mammalian Growth Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Wahlstrom and Olson 1959	pig	# of live piglets	diet	34	sodium selenite
Webster 1979	mouse	% with litters	diet	2.7	sodium selenite

Tier 1

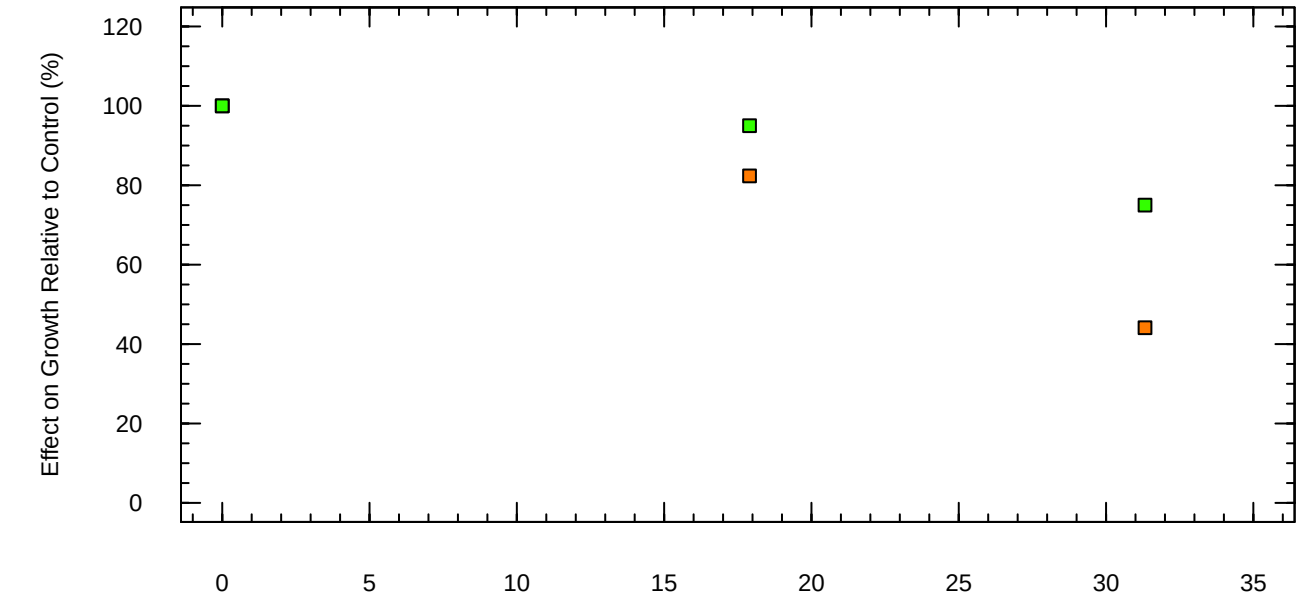
Figure H2−155. Concentration−Response Data for the Mammalian Reproduction Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Palmer et al. 1982	rat	survival	diet	4	seleniferous corn	B
Spallholz et al. 1973	mouse	survival	diet	5	sodium selenite	
McAdam and Levander 1987	rat	survival	diet	6	D−selenomethionine	B
McAdam and Levander 1987	rat	survival	diet	6	L−selenomethionine	B
McAdam and Levander 1987	rat	survival	diet	6	sodium selenite	
McAdam and Levander 1987	rat	survival	diet	6	sodium selenate	
Moxon and Mahan 1981	pig	survival	diet	5.3	sodium selenite	
Halverson et al. 1966	rat	survival	diet	6	seleniferous wheat	B
Julius et al. 1983	hamster	survival	diet	3	sodium selenite	

Tier 1

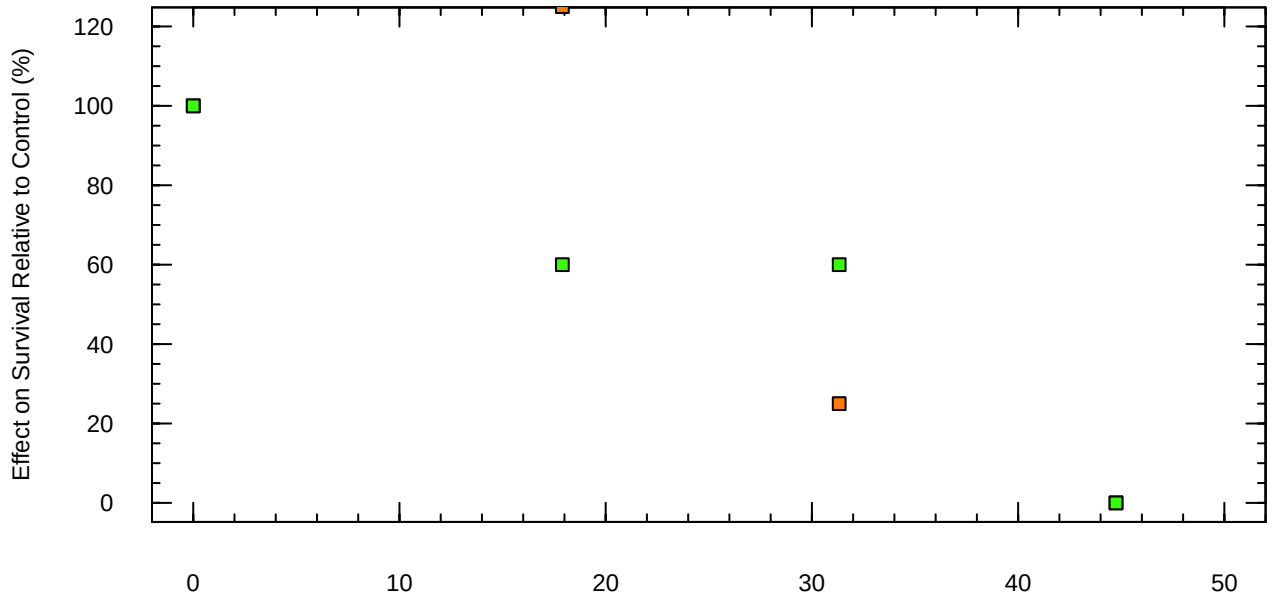
Figure H2−156. Concentration−Response Data for the Mammalian Survival Endpoint for Selenium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Downs et al. 1960	rat (male)	body weight	diet	15	thallic oxide	A
Downs et al. 1960	rat (female)	body weight	diet	15	thallic oxide	A

Tier 1

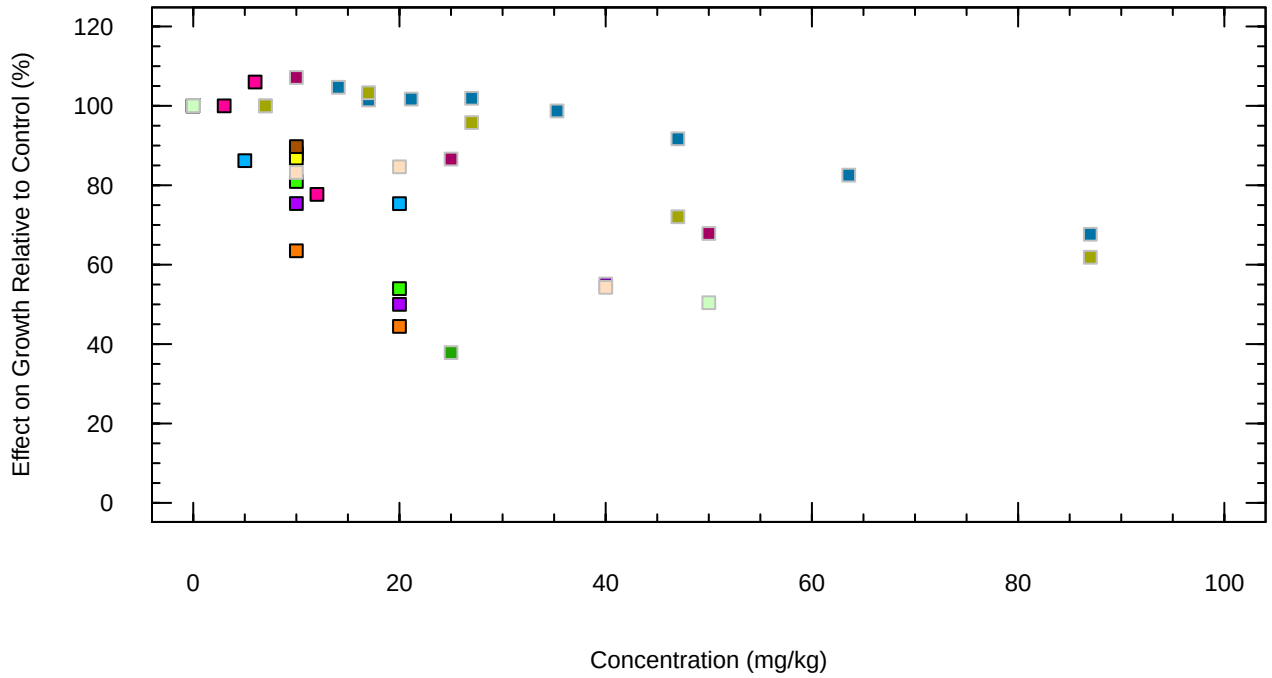
Figure H2−157. Concentration−Response Data for the Mammalian Growth Endpoint for Thallium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Downs et al. 1960	rat (male)	survival	diet	15	thallic oxide	B
Downs et al. 1960	rat (female)	survival	diet	15	thallic oxide	B

Tier 1

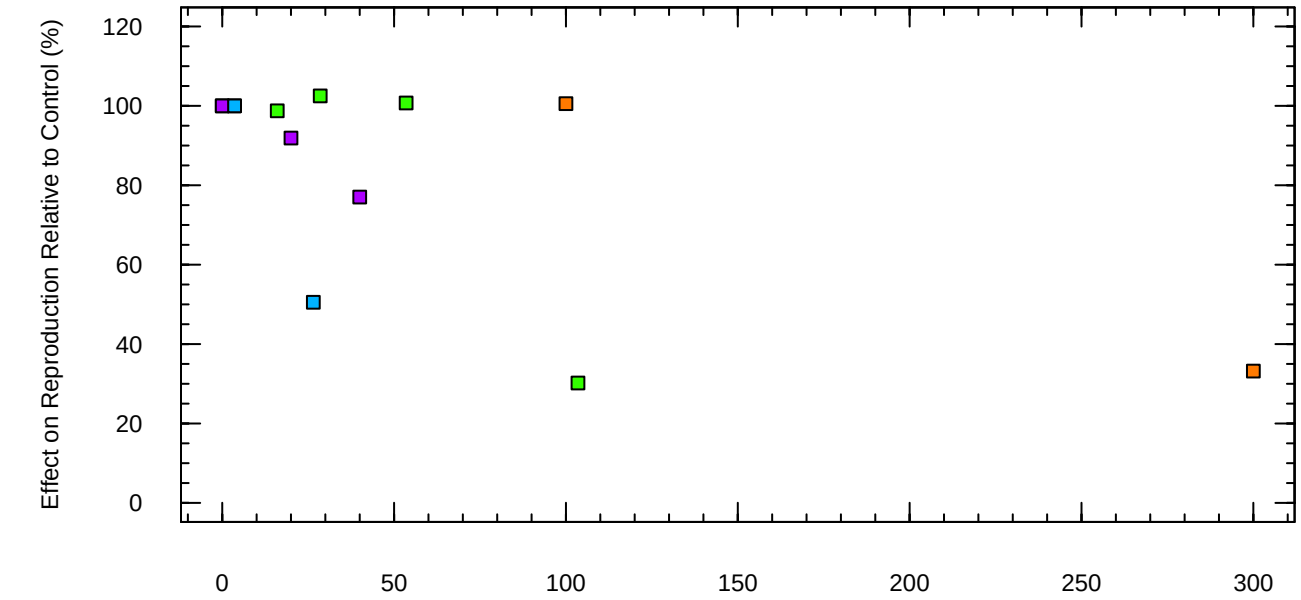
Figure H2−158. Concentration−Response Data for the Mammalian Survival Endpoint for Thallium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Berg and Lawrence 1971	chicken	body weight	diet	2	ammonium metavanadate	A
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl sulfate	
Berg and Lawrence 1971	chicken	body weight	diet	2	vanadyl dichloride	E
Cervantes and Jensen 1986	chicken	body weight	diet	4	ammonium metavanadate	A
Hill 1974	chicken	body weight gain	diet	2	sodium metavanadate	B
Hill 1979a	chicken	body weight gain	diet	2	sodium metavanadate	B
Summers and Moran 1972	chicken	body weight gain	diet	3	NR	
Hill 1990b	chicken	body weight gain	diet	2.7	sodium metavanadate	B
Hill 1990a	chicken	body weight gain	diet	2.7	sodium metavanadate	B
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A
Nelson et al. 1962	chicken	body weight	diet	4	ammonium metavanadate	A
Qureshi et al. 1999	chicken	body weight	diet	3	ammonium metavanadate	A
Blalock and Hill 1987	chicken	body weight	diet	3	vanadyl chloride	E
Hill 1994	chicken	body weight	diet	2.9	ammonium metavanadate	A

Tier 1

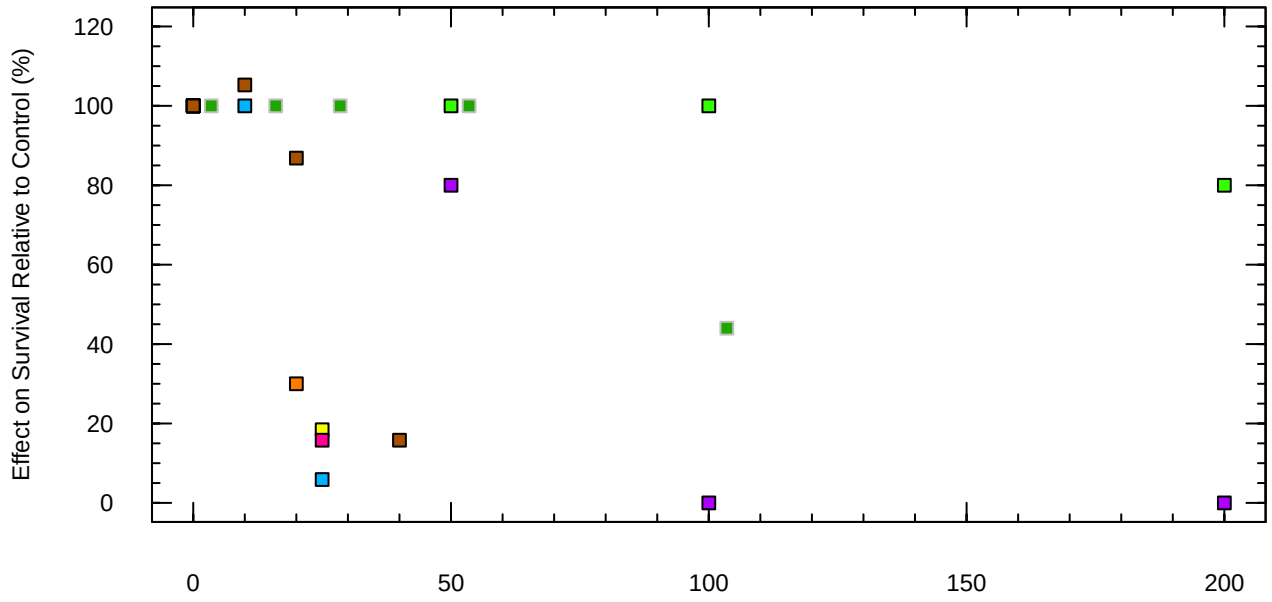
Figure H2−159. Concentration−Response Data for the Avian Growth Endpoint for Vanadium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Hafez and Kratzer 1976b	chicken	egg production	diet	NR	ammonium metavanadate	C
Kubena and Phillips 1982	chicken	egg production	diet	20	calcium orthovanadate	
Ousterhout and Berg 1980	chicken	egg production	diet	4	ammonium metavanadate	C
Toussant and Latshaw 1994	chicken	egg production	diet	4	ammonium metavanadate	C

Tier 1

Figure H2−160. Concentration−Response Data for the Avian Reproduction Endpoint for Vanadium



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Berg and Lawrence 1971	chicken	survival	diet	2	ammonium metavanadate	D
Hafez and Kratzer 1976a	chicken	survival (Exp 1)	diet	4	ammonium metavanadate	D
Hafez and Kratzer 1976a	chicken	survival (Exp 2)	diet	4	ammonium metavanadate	D
Hathcock et al. 1964	chicken	survival (Exp 1)	diet	2	ammonium metavanadate	D
Hathcock et al. 1964	chicken	survival (Exp 2)	diet	2	ammonium metavanadate	D
Hathcock et al. 1964	chicken	survival	diet	2	vanadyl sulfate	
Blalock and Hill 1987	chicken	survival	diet	3	vanadyl chloride	
Kubena and Phillips 1982	chicken	survival	diet	20	calcium orthovanadate	

Tier 1

Figure H2−161. Concentration−Response Data for the Avian Survival Endpoint for Vanadium

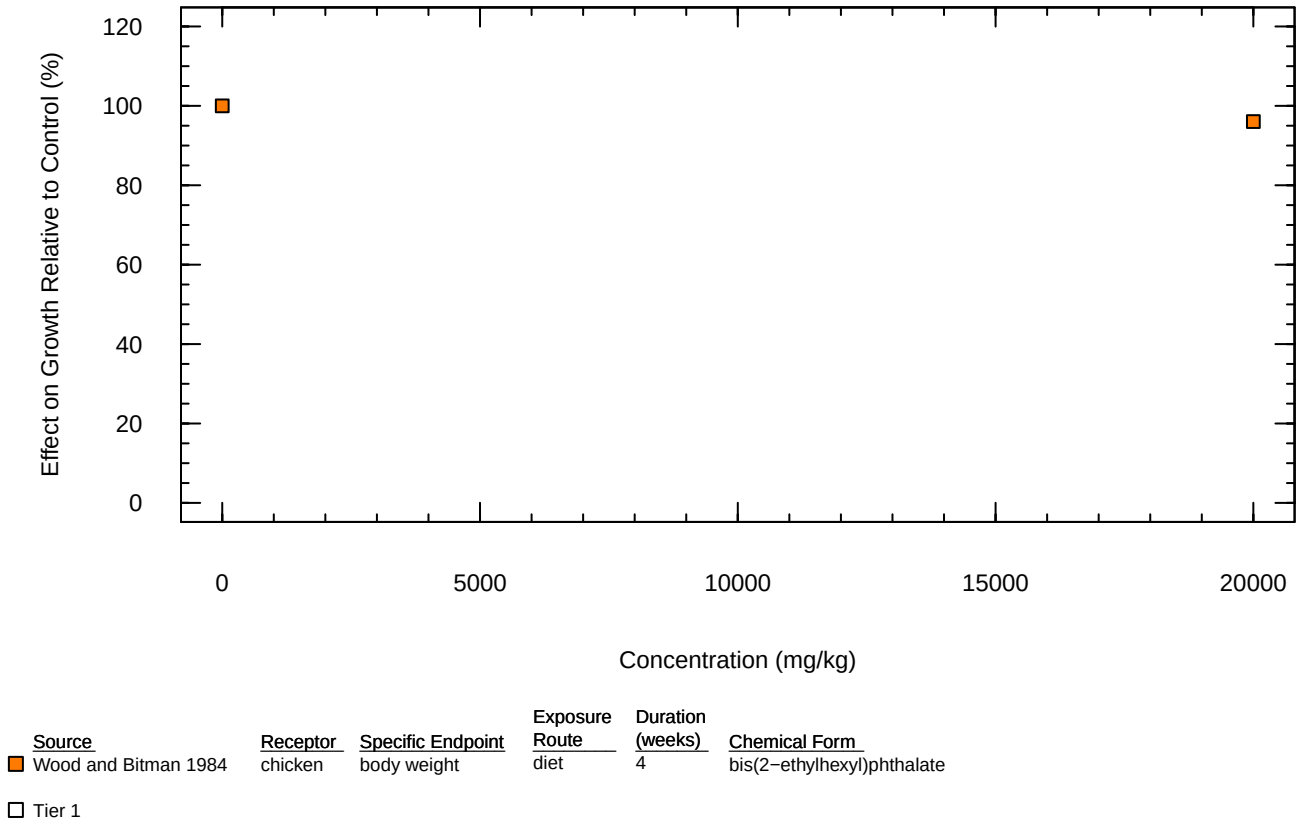
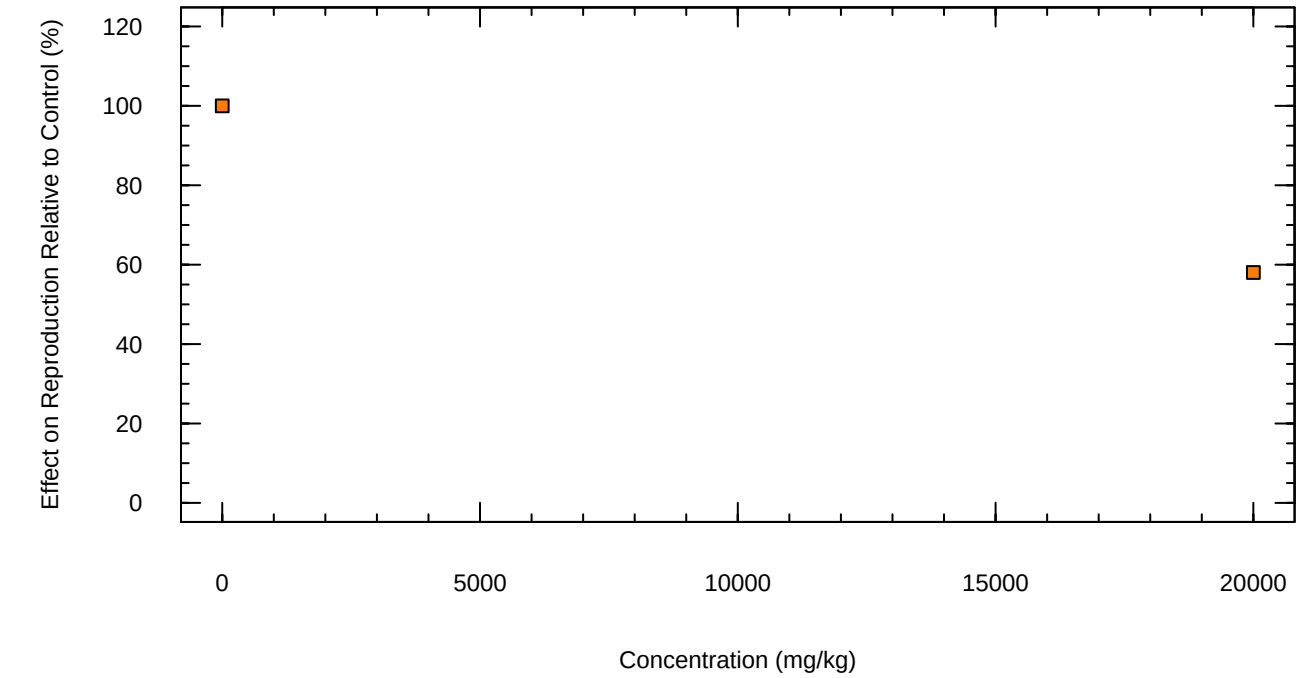


Figure H2−162. Concentration−Response Data for the Avian Growth Endpoint for Bis(2−ethylhexyl)phthalate

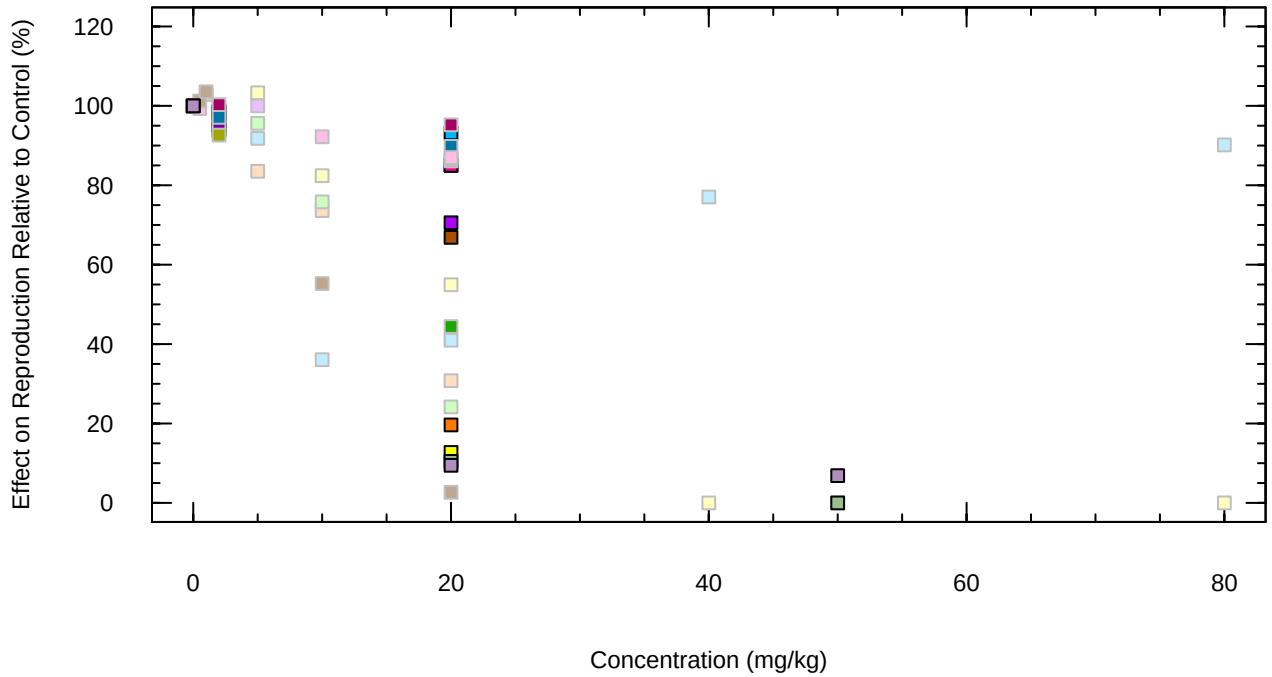


Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Wood and Bitman 1984	chicken	egg production	diet	4	bis(2−ethylhexyl)phthalate

Tier 1

Note: The LOAEL from Ishida et al. (1982) for egg production after dietary exposure of chickens for 33 weeks is 350 mg/kg bw/day; this value was selected as the TRV, but could not be plotted on this figure because egg production was not reported in the control group.

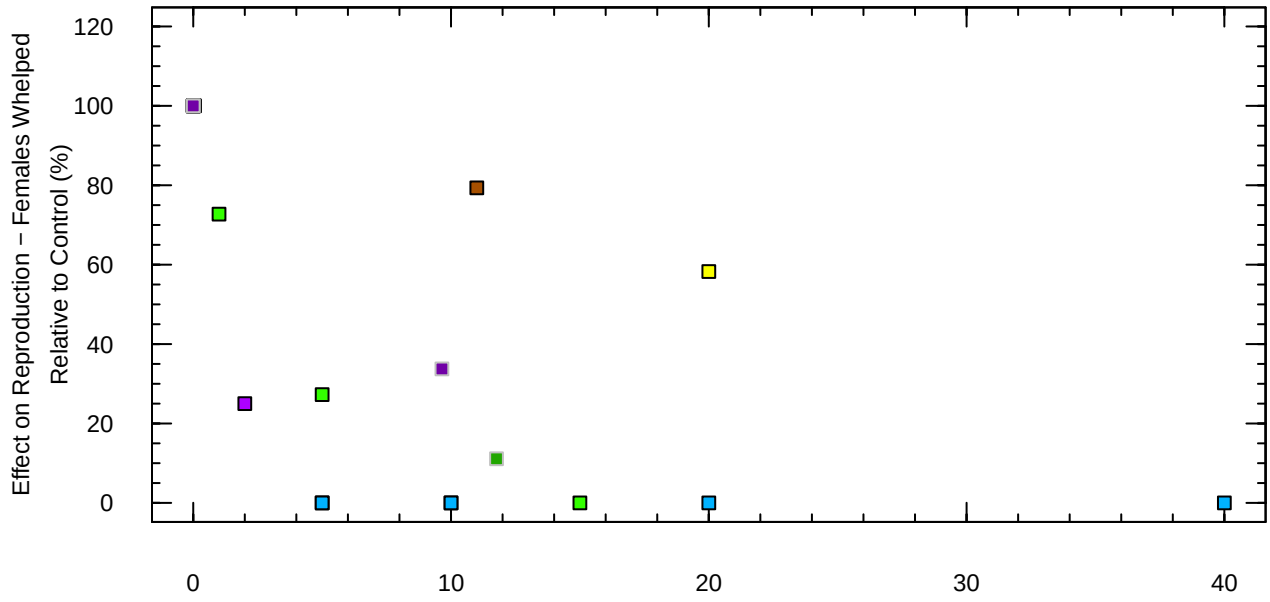
Figure H2−163. Concentration−Response Data for the Avian Reproduction Endpoint for Bis(2−ethylhexyl)phthalate



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1242	A
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1242	
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1248	B
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1248	
Lillie et al. 1974 & Cecil et al. 1974	chicken	hatchability	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	egg production	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny body weight gain at 3 weeks	diet	9	Aroclor 1254	
Lillie et al. 1974 & Cecil et al. 1974	chicken	progeny mortality	diet	9	Aroclor 1254	
Lillie et al. 1975	chicken	hatchability	diet	8	Aroclor 1242	A
Lillie et al. 1975	chicken	hatchability	diet	8	Aroclor 1248	B
Platanow and Reinhart 1973	chicken	hatchability	diet	14	Aroclor 1254	
Britton and Huston 1973	chicken	egg production	diet	6	Aroclor 1242	
Britton and Huston 1973	chicken	hatchability	diet	6	Aroclor 1242	A
Scott 1977	chicken	egg production	diet	8	Aroclor 1248	
Scott 1977	chicken	hatchability	diet	8	Aroclor 1248	B
Briggs and Harris 1973	chicken	hatchability (leghorn)	diet	6	Aroclor 1242	A
Briggs and Harris 1973	chicken	hatchability (broiler)	diet	6	Aroclor 1242	A

Tier 1

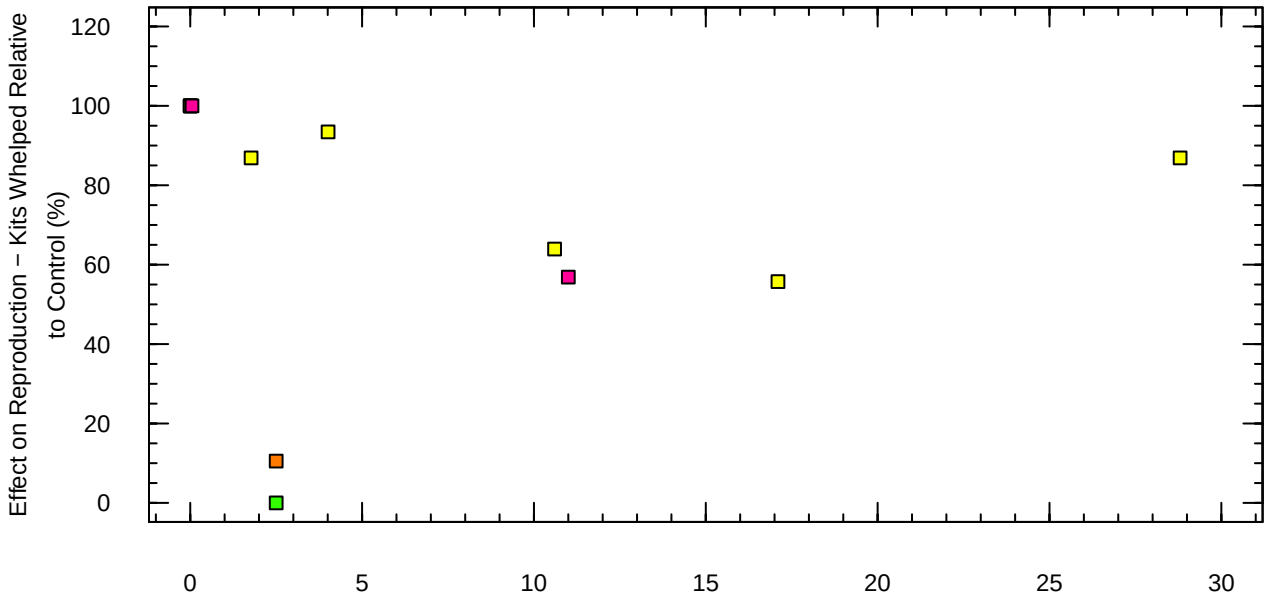
Figure H2−164. Concentration−Response Data for the Avian Reproduction Endpoint for Polychlorinated Biphenyls



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Aulerich and Ringer 1977	mink	females whelped	diet	16	Aroclor 1254	A
Bleavins et al. 1980	mink	females whelped	diet	35	Aroclor 1242	
Bleavins et al. 1980	mink	females whelped	diet	35	Aroclor 1016	
Jensen et al. 1977	mink	females whelped	diet	9.4	NR	
Kihlstrom et al. 1992	mink	females whelped	diet	12	Clophen A50	B
Kihlstrom et al. 1992	mink	females whelped	diet	12	Aroclor 1254	A

Tier 1

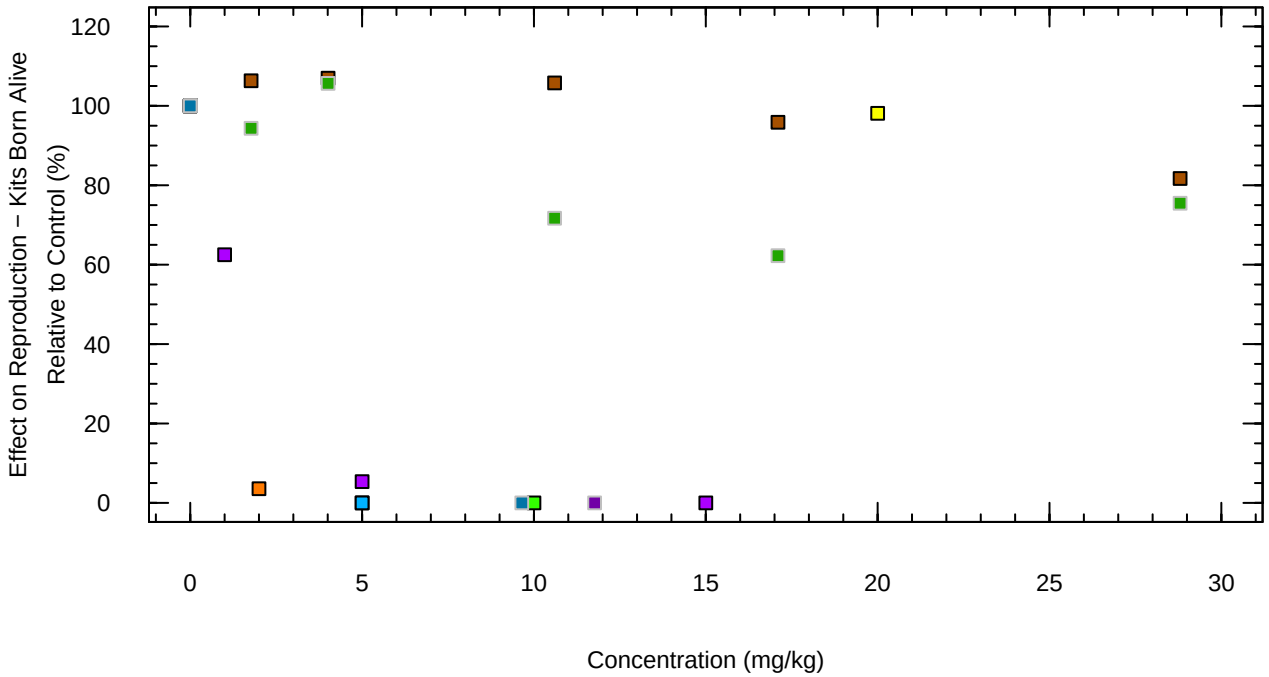
Figure H2−165. Concentration−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls (Females Whelped)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Aulerich et al. 1985	mink	kits whelped	diet	~12	Aroclor 1254
Aulerich et al. 1985	mink	kits whelped	diet	~12	Aroclor 1254
Folland et al. 2016	mink	kits whelped	diet	16	Aroclor 1268
Jensen et al. 1977	mink	kits whelped	diet	9.4	NR

Tier 1

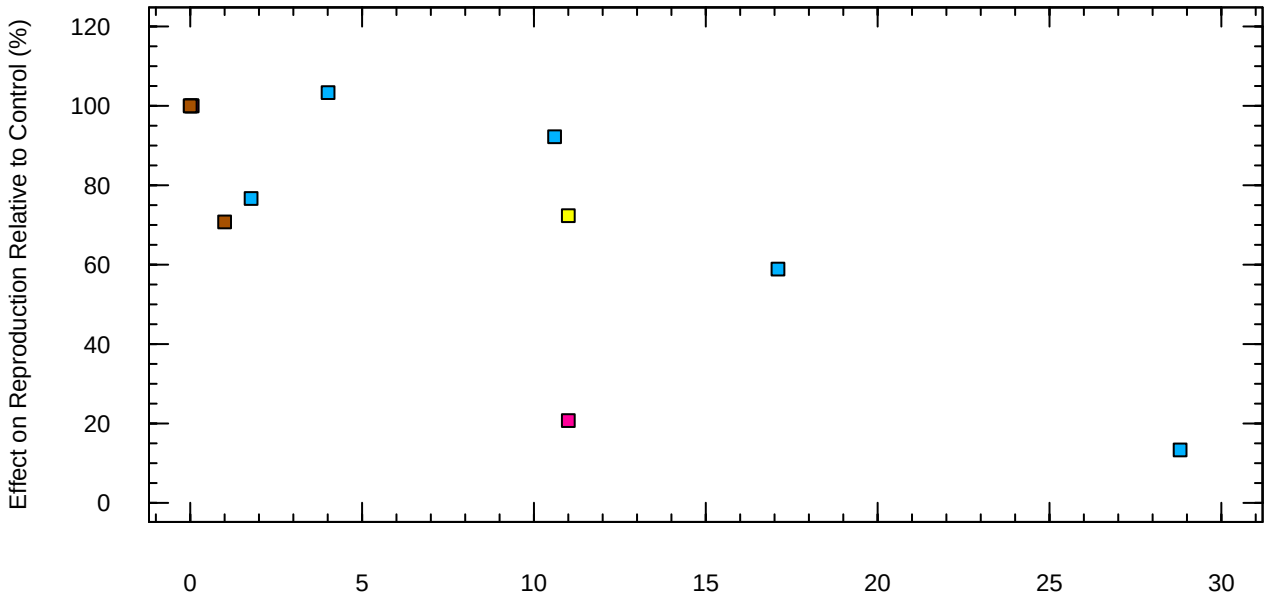
Figure H2−166. Concentration−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls (Kits Whelped)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Aulerich and Ringer 1977	mink	kits born alive	diet	16	Aroclor 1254	C
Bleavins et al. 1980	mink	kits born alive	diet	35	Aroclor 1242	
Bleavins et al. 1980	mink	kits born alive	diet	35	Aroclor 1016	
Folland et al. 2016	mink	kits born alive	diet	16	Aroclor 1268	
Folland et al. 2016	mink	kits born alive	diet	16	Aroclor 1268	
Kihlstrom et al. 1992	mink	kits born alive	diet	12	Clophen A50	E
Kihlstrom et al. 1992	mink	kits born alive	diet	12	Aroclor 1254	

Tier 1

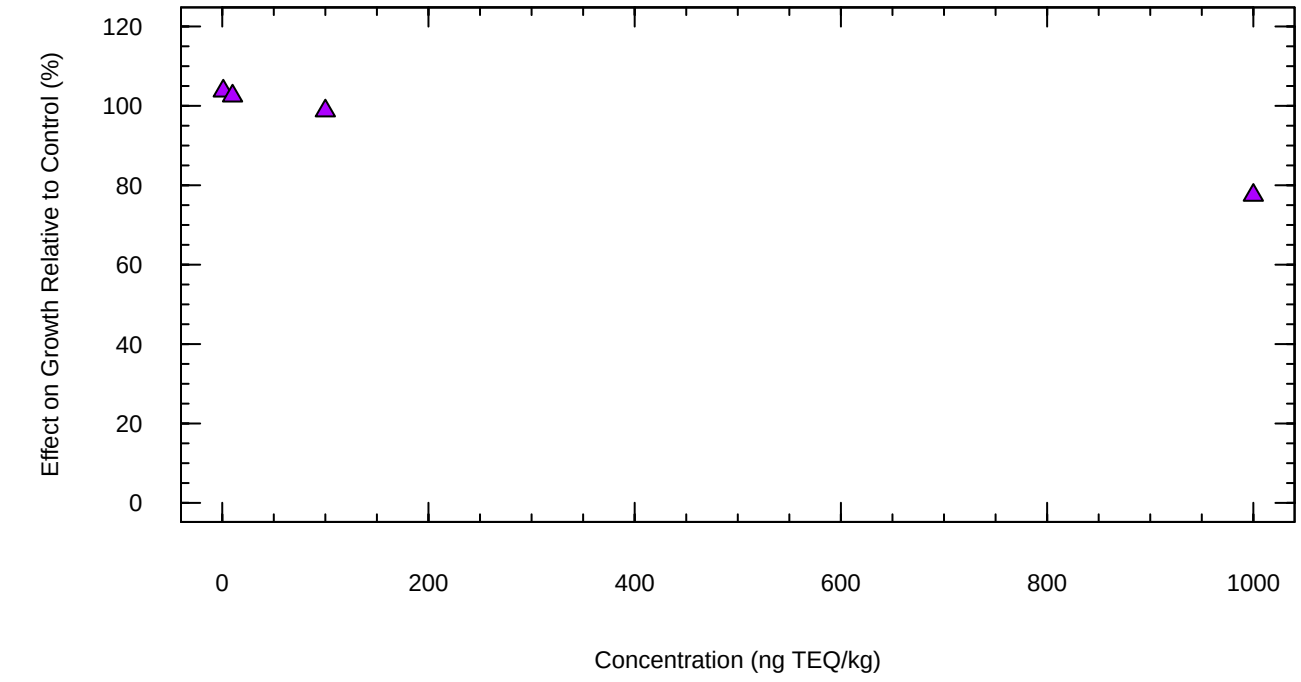
Figure H2−167. Concentration−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls (Kits Born Alive)



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
Folland et al. 2016	mink	kit survival to 6 weeks	diet	16	Aroclor 1268
Jensen et al. 1977	mink	kit weight of young	diet	9.4	NR
Jensen et al. 1977	mink	kit survival after 5 days	diet	9.4	NR
Wren et al. 1987	mink	kit weight at 5 weeks	diet	24	Aroclor 1254

Tier 1

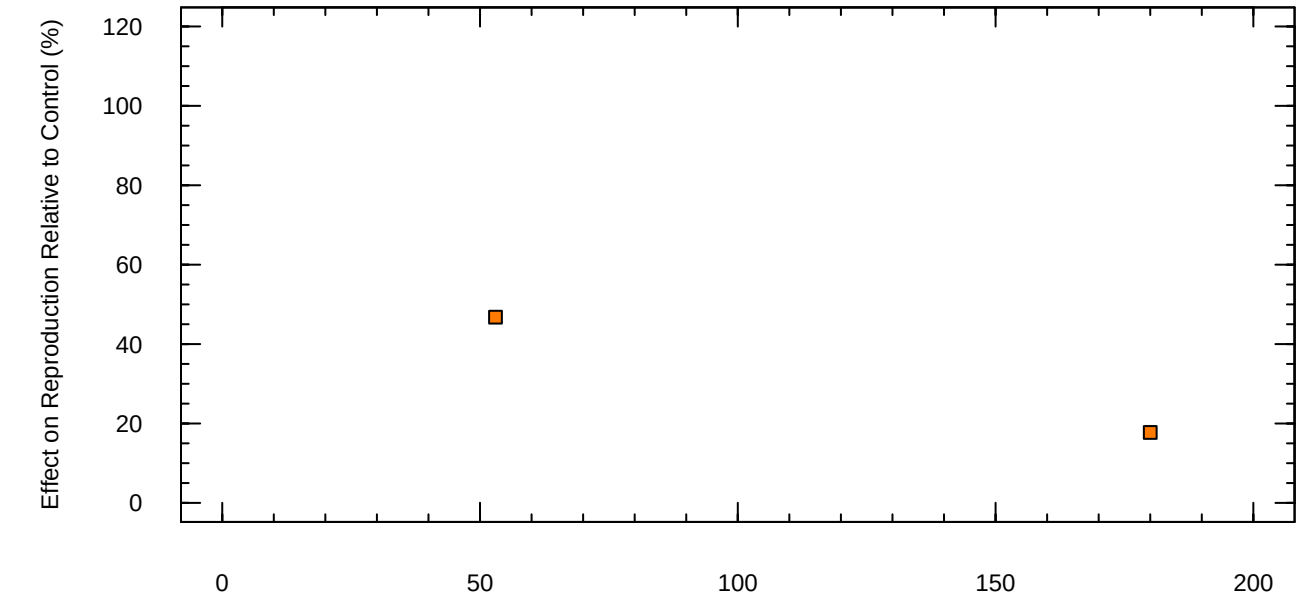
Figure H2−168. Concentration−Response Data for the Mammalian Reproduction Endpoint for Polychlorinated Biphenyls



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form
▲ Hochstein et al. 1998	mink	body weight	diet	17.9	2,3,7,8−TCDD

△ Tier 2

Figure H2−169. Concentration−Response Data for the Mammalian Growth Endpoint for Dioxins/Furans



Source	Receptor	Specific Endpoint	Exposure Route	Duration (weeks)	Chemical Form	Pooling Group
Hochstein et al. 2001	mink	kit survival	diet	18.7−18.8	2,3,7,8−TCDD	B

Tier 1

Figure H2−170. Concentration−Response Data for the Mammalian Reproduction Endpoint for Dioxins/Furans

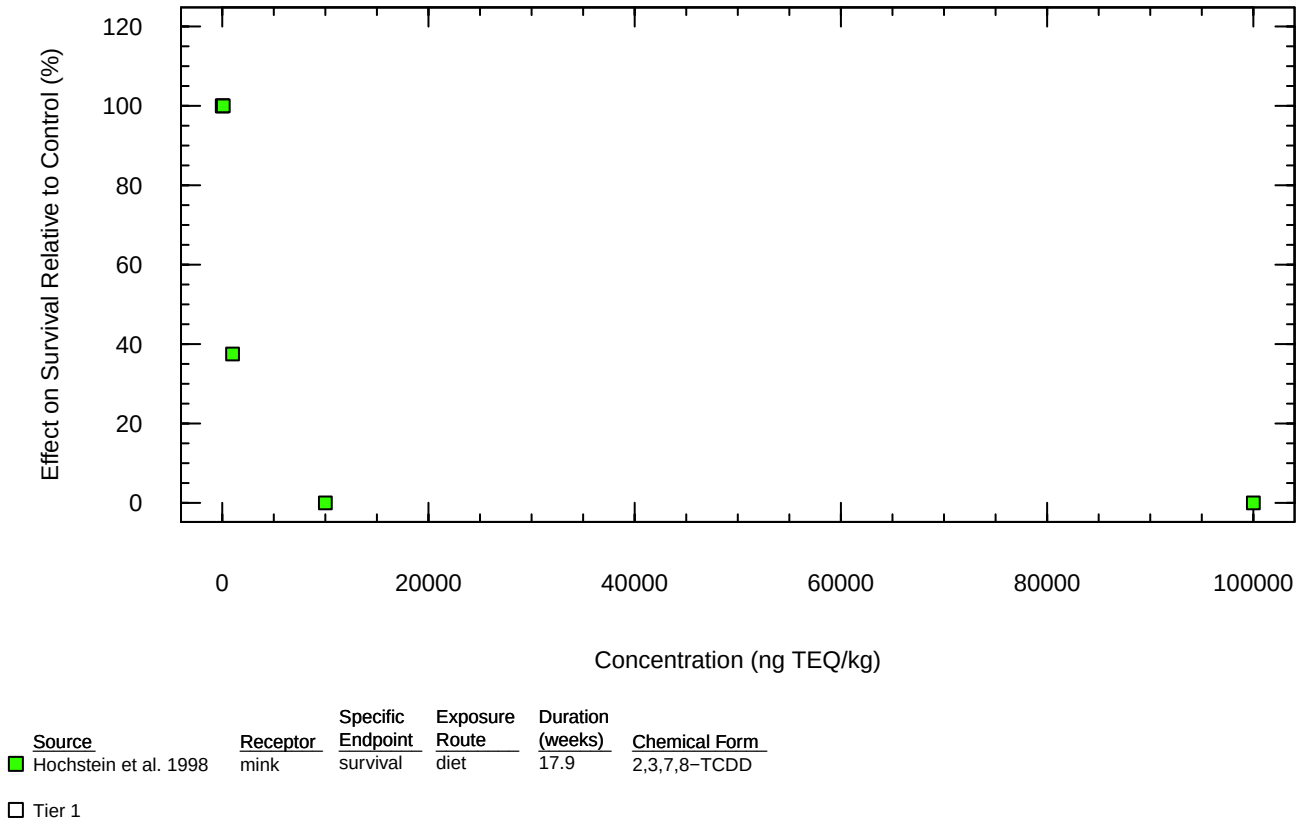


Figure H2−171. Concentration−Response Data for the Mammalian Survival Endpoint for Dioxins/Furans

Tables

Table H2-1. Number of Wildlife Studies Reviewed and Usable Dose-Response Data Sets

		Number of Studies Reviewed [a]			Number of Usable Data Sets [a]		
Receptor Group	Endpoint	Tier 1 [b]	Tier 2 [c]	Total	Tier 1 [b]	Tier 2 [c]	Total
Aluminum							
Bird	growth	4	0	4	4	0	4
	reproduction	0	0	0	0	0	0
	survival	1	0	1	1	0	1
Mammal	growth	2	1	3	1	2	3
	reproduction	4	0	4	6	0	6
	survival	1	0	1	1	0	1
Antimony							
Bird	growth	0	0	0	0	0	0
	reproduction	0	0	0	0	0	0
	survival	0	0	0	0	0	0
Mammal	growth	0	3	3	0	0	0
	reproduction	0	1	1	0	0	0
	survival	0	1	1	0	0	0
Arsenic							
Bird	growth	6	2	8	1	0	1
	reproduction	1	0	1	1	0	1
	survival	2	0	2	1	0	1
Barium							
Bird	growth	1	0	1	2	0	2
	reproduction	0	0	0	0	0	0
	survival	1	0	1	2	0	2
Mammal	growth	0	2	2	0	2	2
	reproduction	0	0	0	0	0	0
	survival	1	1	2	1	3	4
Beryllium							
Bird	growth	0	0	0	0	0	0
	reproduction	0	0	0	0	0	0
	survival	0	0	0	0	0	0
Chromium							
Bird	growth	1	0	1	1	0	1
	reproduction	0	0	0	0	0	0
	survival	0	0	0	0	0	0
Mammal	growth	0	2	2	0	1	1
	reproduction	0	1	1	0	2	2
	survival	0	0	0	0	0	0
Iron							
Bird	growth	3	0	3	3	0	1
	reproduction	0	0	0	0	0	0
	survival	3	0	3	3	0	2
Mammal	growth	6	0	6	8	0	4
	reproduction	0	0	0	0	0	0
	survival	2	0	2	3	0	2
Methylmercury							
Bird	growth	2	1	3	0	1	1
	reproduction	7	0	7	21	0	21
	survival	7	0	7	9	0	9
Mammal	growth	6	2	8	4	2	6
	reproduction	3	0	3	3	0	3
	survival	3	0	3	5	0	5
Molybdenum							
Bird	growth	3	0	3	3	0	3
	reproduction	1	0	1	1	0	1
	survival	1	0	1	1	0	1
Mammal	growth	3	2	5	3	1	4
	reproduction	0	1	1	0	1	1
	survival	0	0	0	0	0	0
Nickel							
	growth	6	0	6	8	0	8

Table H2-1. Number of Wildlife Studies Reviewed and Usable Dose-Response Data Sets

		Number of Studies Reviewed [a]			Number of Usable Data Sets [a]		
Receptor Group	Endpoint	Tier 1 [b]	Tier 2 [c]	Total	Tier 1 [b]	Tier 2 [c]	Total
Bird	reproduction	0	1	1	0	1	1
	survival	2	0	2	2	0	2
Selenium							
Bird	growth	10	2	12	9	0	9
	reproduction	6	0	6	10	0	10
	survival	7	0	7	7	0	7
Mammal	growth	9	2	11	5	3	8
	reproduction	5	0	5	2	0	2
	survival	6	0	6	9	0	9
Thallium							
Bird	growth	0	0	0	0	0	0
	reproduction	0	0	0	0	0	0
	survival	0	0	0	0	0	0
Mammal	growth	1	0	1	2	0	2
	reproduction	0	0	0	0	0	0
	survival	1	0	1	2	0	2
Vanadium							
Bird	growth	11	0	11	12	0	12
	reproduction	4	0	4	4	0	4
	survival	5	0	5	8	0	8
Bis(2-ethylhexyl)phthalate							
Bird	growth	1	0	1	0	0	0
	reproduction	2	0	2	2	0	2
	survival	0	0	0	0	0	0
Di-n-butyl phthalate							
Bird	growth	0	0	0	0	0	0
	reproduction	0	0	0	0	0	0
	survival	0	0	0	0	0	0
High-Molecular-Weight Polyaromatic Hydrocarbons							
Bird	growth	2	0	2	0	0	0
	reproduction	0	0	0	0	0	0
	survival	1	0	1	0	0	0
Polychlorinated Biphenyls							
Bird	growth	NA	NA	NA	NA	NA	NA
	reproduction	6	0	6	12	0	12
	survival	NA	NA	NA	NA	NA	NA
Mammal	growth	NA	NA	NA	NA	NA	NA
	reproduction	8	0	8	28	0	28
	survival	NA	NA	NA	NA	NA	NA
Dioxin/Furan							
Bird	growth	0	0	0	0	0	0
	reproduction	0	0	0	0	0	0
	survival	1	0	1	1	0	1
Mammal	growth	2	1	3	3	1	4
	reproduction	3	0	3	4	0	4
	survival	2	0	2	2	0	2

Notes:

[a] Number of studies and usable data sets includes those reviewed for the purposes of pooling and for inclusion of unique receptors. The number of usable data sets may be higher than the number of unique studies because some studies included multiple experiments and/or measurements.

[b] Tier 1 includes growth studies with exposure during the critical lifestage or with a duration of at least 10 percent of the lifespan, and all survival and reproduction studies regardless of exposure duration. The exposure route for all Tier 1 data is diet or gavage.

[c] Tier 2 includes studies with drinking water exposure or studies for the growth endpoint if exposure was not during the critical lifestage or if the study duration was less than 10 percent of the lifespan.

NA - Not applicable; only studies with a reproduction endpoint were considered for review.

Table H2-2. Summary of Aluminum Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Capdevielle and Scanes (1995a)	**150**	**ED20**	**80**	**chicken**	**4-18 days**	**aluminum sulfate**	**body weight**	**diet**	**2**	**1**	**none**	1
Capdevielle and Scanes (1995b)	*500*	*LOAEL ≥ 20*	*68*	*mallard*	*duckling*	*aluminum sulfate*	*body weight*	*diet*	*2.1*	*1*	*none*	*4*
Pooling group A:	160	ED20	80	chicken	1- 4 days	aluminum sulfate	body weight	diet	1.5 - 2.3	1	A	5
Capdevielle et al. (1996)	640	LOAEL ≥ 20	58	chicken	4 days	aluminum sulfate	body weight	diet	1.5			
Elliot and Edwards (1991)	270	LOAEL ≥ 20	61	chicken	1 day	aluminum sulfate	body weight	diet	2.3			
Bird Survival												
Capdevielle and Scanes (1995a)	**560**	**LOAEL ≥ 20**	**75**	**chicken**	**4-18 days**	**aluminum sulfate**	**survival**	**diet**	**2**	**1**	**none**	**3**
Mammal Growth												
Belles et al. (1999)	**400**	**LOAEL ≥ 20**	**14**	**mouse**	**adult**	**aluminum nitrate nonahydrate**	**body weight gain**	**gavage**	**1.5**	**1**	**none**	**3**
Domingo et al. (1987a)	46	LOAEL ≥ 20	77	rat	adult	aluminum nitrate nonahydrate	body weight	drinking water	14	2	none	3
Domingo et al. (1987a)	460	LOAEL ≥ 20	65	rat	adult	aluminum nitrate nonahydrate	body weight	drinking water	14	2	none	3
Paternain et al. (1988)	no effect at 52	NA	NA	rat	adult	aluminum nitrate nonahydrate	body weight gain	gavage	1.3	1	none	3
Mammal Reproduction												
Belles et al. (1999)	400	LOAEL ≥ 20	58	mouse	adult	aluminum nitrate nonahydrate	fetal body weight	gavage	1.5	1	none	3
Bernuzzi et al. (1989)	270	LOAEL ≥ 20	53	rat	adult	aluminum chloride	postnatal survival	diet	2.6	1	none	4
Bernuzzi et al. (1989)	400	LOAEL ≥ 20	78	rat	adult	aluminum chloride	pup body weight	diet	2.6	1	none	4
Domingo et al. (1987b)	52	LOAEL ≥ 20	78	rat	adult	aluminum nitrate nonahydrate	pup survival	gavage	unclear	1	none	3
Paternain et al. (1988) [d]	13	LOAEL ≥ 20	76	rat	adult	aluminum nitrate nonahydrate	fetal survival	gavage	1.3	1	none	3
Paternain et al. (1988)	**27**	**ED20**	**80**	**rat**	**adult**	**aluminum nitrate nonahydrate**	**fetal body weight**	**gavage**	**1.3**	**1**	**none**	**1**
Mammal Survival												
Belles et al. (1999)	**400**	**LOAEL ≥ 20**	**44**	**mouse**	**adult**	**aluminum nitrate nonahydrate**	**survival**	**gavage**	**1.5**	**1**	**none**	**3**

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific TRV data set.

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

[d] Although statistically significant effects were observed at a dose of 13 mg/kg bw/day, no statistically significant effects were observed at the other higher doses of 26 and 52 mg/kg bw/day. The study concluded that the levels of aluminum used in the test did not significantly affect the number of live fetuses in the treated animals relative to the control (Paternain et al. 1988). Therefore, this LOAEL was not selected as the lowest effect level for TRV derivation.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

LOAEL - lowest-observed-adverse-effect level

NA - not applicable; the reduction in response was < 20 percent relative to the control

TRAP - Toxicity Relationship Analysis Program

TRV - toxicity reference value

UCR - Upper Columbia River

Table H2-3. Summary of Antimony Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group	Modeling Category [b]
Mammal Growth												
Poon et al. (1998)	no effect at 42	NA	NA	rat	127 g	antimony potassium tartrate	body weight (male)	drinking water	13	2	none	3
Poon et al. (1998)	no effect at 46	NA	NA	rat	136 g	antimony potassium tartrate	body weight (female)	drinking water	13	2	none	3
Rossi et al. (1987)	no effect at 1.2	NA	NA	rat	birth	antimony trichloride	body weight	drinking water	8.6	2	none	3
Rossi et al. (1987)	no effect at 1.1	NA	NA	rat	adult	antimony trichloride	body weight	drinking water	6.3	2	none	3
Shroeder et al. (1968)	no effect at 0.35	NA	NA	mouse	weanling	antimony potassium tartrate	body weight (male)	drinking water	80	2	none	3
Shroeder et al. (1968)	no effect at 0.35	NA	NA	mouse	weanling	antimony potassium tartrate	body weight (female)	drinking water	80	2	none	3
Mammal Reproduction												
Rossi et al. (1987)	no effect at 1.1	NA	NA	rat	adult	antimony trichloride	pups per litter	drinking water	6.3	2	none	3
Mammal Survival												
Dieter et al. (1991)	no effect at 74	NA	NA	mouse	~8 weeks	antimony potassium tartrate	survival (female)	drinking water	2	2	none	3

Notes:

No studies were found with at percent effect relative to the control of at least 20 percent, so no effect level was selected for antimony.

[a] See Attachment H2 references section for full citations.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the effective ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

NA - not applicable; the reduction in response was < 20 percent relative to the control

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

Table H2-4. Summary of Arsenic Dose-Response Data Sets

Source [a]	Effect Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group	Modeling Category [b]
Bird Growth												
Albert et al. 2008a	no effect at 39	NA	NA	zebra finch	adult	monomethylarsonic acid	body weight	gavage	2	2	none	3
Albert et al. 2008b	no effect at 13	NA	NA	zebra finch	1 day	monomethylarsonic acid	body weight	gavage	3	1	none	3
Camardese et al. 1990	no effect at 41	NA	NA	mallard	1 day	sodium arsenate	body weight	diet	10	1	none	3
Hoffman et al. 1992	***20***	***LOAEL ≥ 20***	***69***	***mallard***	***1 day***	***sodium arsenate***	***body weight***	***diet***	***4***	***1***	***none***	***3***
Howell and Hill 1978	no effect at 5.6	NA	NA	chicken	1 day	arsenic trichloride	body weight gain	diet	3	1	none	3
Naraharisetti et al. 2009	no effect at 5.3	NA	NA	chicken	1 month	sodium arsenite	body weight	drinking water	4	2	none	3
Sattar et al. 2016	no effect at 50	NA	NA	chicken	7 days	disodium hydrogen arsenate	body weight	gavage	4	1	none	3
Stanley et al. 1994	no effect at 40 [c]	NA	42	mallard	1 year	sodium arsenate	body weight gain	diet	11.6 - 24.7	1	none	3
Bird Reproduction												
Stanley et al. 1994	***40***	***LOAEL ≥ 20***	***16***	***mallard***	***1 year***	***sodium arsenate***	***duckling survival***	***diet***	***11.6 - 24.7***	***1***	***none***	***3***
Bird Survival												
Albert et al. 2008b	**6.9**	**ED20**	**80**	**zebra finch**	**1 day**	**monomethylarsonic acid**	**survival**	**gavage**	**3**	**1**	**none**	**1**
Howell and Hill 1978	no effect at 5.6	NA	NA	chicken	1 day	arsenic trichloride	survival	diet	3	1	none	3

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific TRV data set.

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

[c] At 9.3 mg/kg bw/d there was an effect <80% of control, but it was not significantly different from the control.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

NA - not applicable; the reduction in response was < 20 percent relative to the control

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

TRV - toxicity reference value

Table H2-5. Summary of Barium Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Johnson et al. (1960)	530	ED20	80	chicken	1 day	barium hydroxide	body weight gain	diet	4	1	none	1
Johnson et al. (1960)	**480**	**ED20**	**80**	**chicken**	**1 day**	**barium acetate**	**body weight gain**	**diet**	**4**	**1**	**none**	**1**
Bird Survival												
Johnson et al. (1960)	**890**	**LOAEL ≥ 20**	**32**	**chicken**	**1 day**	**barium hydroxide**	**survival**	**diet**	**4**	**1**	**none**	**2**
Johnson et al. (1960)	**890**	**LOAEL ≥ 20**	**44**	**chicken**	**1 day**	**barium acetate**	**survival**	**diet**	**4**	**1**	**none**	**2**
Mammal Growth												
Pooling group A:	**440**	**ED20**	**80**	**mouse**	**42 days**	**barium chloride dihydrate**	**body weight**	**drinking water**	**13**			
Dietz et al. 1992	480	LOAEL ≥ 20	56	mouse	42 days	barium chloride dihydrate	body weight (female)	drinking water	13	**2**	**A**	**5**
Dietz et al. 1992	470	LOAEL ≥ 20	70	mouse	42 days	barium chloride dihydrate	body weight (male)	drinking water	13			
Dietz et al. 1992	no effect at 220	NA	NA	rat	42 days	barium chloride dihydrate	body weight (female)	drinking water	13	2	B	3
Dietz et al. 1992	no effect at 280	NA	NA	rat	42 days	barium chloride dihydrate	body weight (male)	drinking water	13	2	B	3
Schroeder and Mitchener 1975	no effect at 0.73	NA	NA	mouse	19-20 days	barium acetate	body weight (female)	drinking water	104	2	none	3
Mammal Survival												
Borzelleca et al. 1988	**200**	**LOAEL ≥ 20**	**70**	**rat**	**29 - 37 days**	**barium chloride**	**survival (female)**	**gavage**	**1.4**	**1**	**none**	**3**
Dietz et al. 1992	280	LOAEL ≥ 20	70	rat	42 days	barium chloride dihydrate	survival (male)	drinking water	13	2	none	3
Dietz et al. 1992	480	LOAEL ≥ 20	30	mouse	42 days	barium chloride dihydrate	survival (female)	drinking water	13	2	C	3
Dietz et al. 1992	470	LOAEL ≥ 20	40	mouse	42 days	barium chloride dihydrate	survival (male)	drinking water	13	2	C	3

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in EPA's TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

NA - not applicable; the reduction in response was < 20 percent relative to the control

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

Table H2-6. Summary of Chromium Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group	Modeling Category [b]
Bird Growth												
Chung et al. (1985)	**510**	**LOAEL ≥ 20**	**57**	**chicken**	**chick**	**chromium sulfate (chromium [III])**	**body weight**	**diet**	**2**	**1**	**none**	**3**
Mammal Growth												
Bataineh et al. (1997)	**110**	**LOAEL ≥ 20**	**76**	**rat**	**adult**	**chromium chloride (chromium [III])**	**body weight (male)**	**drinking water**	**12**	**2**	**none**	**3**
Elbetieha and Al-Hamood (1997)	no effect at 230	NA	NA	mouse	50 days	chromium chloride (chromium [III])	body weight	drinking water	12	2	none	3
Mammal Reproduction												
Elbetieha and Al-Hamood (1997)	230	LOAEL ≥ 20	53	mouse	50 days	chromium chloride (chromium [III])	pregnancy success	drinking water	12	2	none	4
Elbetieha and Al-Hamood (1997)	**91**	**LOAEL ≥ 20**	**63**	**mouse**	**50 days**	**chromium chloride (chromium [III])**	**viability of fetuses**	**drinking water**	**12**	**2**	**none**	**3**

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

[a] See Attachment H2 references section for full citations.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight
ED20 - dose with a 20 percent reduction in the response relative to the control
NA - not applicable; the reduction in response was < 20 percent relative to the control
LOAEL - lowest-observed-adverse-effect level
TRAP - Toxicity Relationship Analysis Program

Table H2-7. Summary of Iron Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Cao et al. 1996	no effect at 80	NA	NA	chicken	1 day	iron sulfate	body weight	diet	3	1	none	3
McGhee et al. 1965	**160**	**LOAEL ≥ 20**	**76**	**chicken**	**juvenile**	**iron sulfate**	**body weight**	**diet**	**4**	**1**	**none**	**2**
Pescatore and Harter-Dennis 1989	no effect at 1,400	NA	NA	chicken	3 days	iron sulfate	body weight	gavage	single dose	1	none	3
Bird Survival												
McGhee et al. 1965	no effect at 160	NA	NA	chicken	juvenile	iron sulfate	survival	diet	4	1	none	3
Pooling group A:	**1,100**	**ED20**	**80**	**chicken**	**2-3 days**	**iron sulfate**	**survival**	**gavage**	**single dose**			
Pescatore and Harter-Dennis 1989	1,200	LOAEL ≥ 20	74	chicken	3 days	iron sulfate	survival	gavage	single dose	**1**	**A**	**2**
Wallner-Pendleton et al. 1986	2,010	LOAEL ≥ 20	80	chicken	2 days	iron sulfate	survival	gavage	single dose			
Mammal Growth												
Pooling group A:	**140**	**geometric mean**	**NA**	**rat**	**weanling**	**iron sulfate**	**body weight**	**diet**	**3-4**			
Banis et al. 1969	47	LOAEL ≥ 20	77	rat	weanling	iron sulfate	body weight	diet	4	**1**	**A**	**2**
Storey and Greger 1987	410	LOAEL ≥ 20	79	rat	weanling	iron sulfate	body weight	diet	3			
Plummer et al. 1997	650	LOAEL ≥ 20	77	rat	suckling	carbonyl iron	body weight (male)	diet	32	1	none	2
Plummer et al. 1997	no effect at 1,600	NA	NA	rat	suckling	carbonyl iron	body weight (female)	diet	32	1	none	3
Prince et al. 1979	no effect at 46	NA	NA	pig	70 days	ferrous sulfide	body weight	diet	16	1	none	3
Whittaker et al. 2002	no effect at 1,200	NA	NA	rat	young	iron sulfate	body weight	gavage	single dose	1	none	3
Whittaker et al. 2002	40000	LOAEL ≥ 20	74	rat	young	carbonyl iron	body weight	gavage	single dose	1	none	3, 4
Zhu et al. 2016	no effect at 320	NA	NA	rat	6 weeks	carbonyl iron	body weight	diet	13	1	none	3
Mammal Survival												
Whittaker et al. 1996	**870**	**ED20**	**80**	**rat**	**weanling**	**carbonyl iron**	**survival**	**diet**	**12**	**1**	**none**	**1**
Whittaker et al. 2002	1,000	ED20	80	rat	young	iron sulfate	survival	gavage	single dose	1	none	1
Whittaker et al. 2002	no effect at 50,000	NA	NA	rat	young	carbonyl iron	survival	gavage	single dose	1	none	3

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in EPA's TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

NA - not applicable; the reduction in response was < 20 percent relative to the control

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

Table H2-8. Summary of Methylmercury Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Sell and Horani (1976)	no effect at 2.2	NA	NA	chicken	1 day	methylmercury chloride	body weight gain (Experiment 1)	diet	4	1	A	3
Sell and Horani (1976)	no effect at 2.2	NA	NA	chicken	6 days	methylmercury chloride	body weight gain (Experiment 2)	diet	3.6	1	A	3
Scott et al. (1975)	**0.97**	**ED20**	**80**	**chicken**	**12.5 months**	**methylmercury chloride**	**body weight**	**diet**	**8**	**2**	**none**	**1**
Spalding et al. (2000)	no effect at 0.70	NA	NA	egret	1 week	methylmercury chloride	weight index	diet	14	1	none	3
Bird Reproduction												
Albers et al. (2007)	0.48	LOAEL ≥ 20	63	kestrel	adult	methylmercury chloride	egg production	diet	at least 11	1	none	4
Albers et al. (2007)	*0.25*	*ED20*	*80*	*kestrel*	*adult*	*methylmercury chloride*	*number of eggs hatched*	*diet*	*at least 11*	*1*	*none*	*1*
Albers et al. (2007)	0.35	ED20	80	kestrel	adult	methylmercury chloride	% eggs hatched	diet	at least 11	1	none	1
Albers et al. (2007)	0.26	ED20	80	kestrel	adult	methylmercury chloride	% fledged	diet	at least 11	1	none	1
El-Begearmi et al. (1977)	2.0	LOAEL ≥ 20	34	quail	1 day	methylmercury hydroxide	% egg fertility	diet	16	1	none	4
El-Begearmi et al. (1977)	0.66	LOAEL ≥ 20	61	quail	1 day	methylmercury hydroxide	egg production	diet	16	1	none	4
El-Begearmi et al. (1977)	2.0	LOAEL ≥ 20	0	quail	1 day	methylmercury hydroxide	% hatchability	diet	16	1	none	4
Eskeland and Nafstad (1978)	0.53	LOAEL ≥ 20	45	quail	juvenile	methylmercury chloride	chick survival	diet	6	1	none	4
Eskeland and Nafstad (1978)	1.1	LOAEL ≥ 20	73	quail	juvenile	methylmercury chloride	hatch success	diet	6	1	none	4
Heinz and Hoffman (1998)	1.0	LOAEL ≥ 20	26	mallard	19 months	methylmercury chloride	% hatchability	diet	up to 11	1	none	4
Heinz and Hoffman (1998)	1.0	LOAEL ≥ 20	74	mallard	19 months	methylmercury chloride	duckling survival	diet	up to 11	1	none	4
Pooling group B:	*0.68*	*ED20*	*80*	*mallard*	*adult*	*methylmercury chloride*	*ducklings per hen*	*diet*	*3.7 - 11*	*1*	*B*	5
Heinz and Hoffman (1998)	1.0	LOAEL ≥ 20	14	mallard	19 months	methylmercury chloride	ducklings per hen	diet	up to 11			
Heinz et al. (2010)	0.80	LOAEL ≥ 20	74	mallard	adult	methylmercury chloride	ducklings per hen	diet	3.7			
Heinz et al. (2010)	no effect at 0.80	NA	NA	mallard	adult	methylmercury chloride	duckling body weight	diet	3.7	1	none	3
Scott et al. (1975)	0.70	LOAEL ≥ 20	63	chicken	12.5 months	methylmercury chloride	egg fertility	diet	8	1	none	4
Scott et al. (1975)	0.70	LOAEL ≥ 20	73	chicken	12.5 months	methylmercury chloride	egg production	diet	8	1	none	4
Scott et al. (1975)	0.70	LOAEL ≥ 20	17	chicken	12.5 months	methylmercury chloride	egg hatchability	diet	8	1	none	4
Varian-Ramos et al. (2014)	no effect at 0.41	NA	NA	finch	adult	methylmercury cysteine	% hatchability	diet	52	1	none	3
Varian-Ramos et al. (2014)	0.047	ED20	80	finch	adult	methylmercury cysteine	% chicks fledged	diet	52	1	none	1
Varian-Ramos et al. (2014)	0.043	ED20	80	finch	adult	methylmercury cysteine	number of offspring	diet	52	1	none	1
Varian-Ramos et al. (2014)	0.10	LOAEL ≥ 20	67	finch	adult	methylmercury cysteine	F1 % hatchability	diet	unclear	1	none	4
Varian-Ramos et al. (2014)	0.10	LOAEL ≥ 20	73	finch	adult	methylmercury cysteine	F1 % chicks fledged	diet	unclear	1	none	2
Varian-Ramos et al. (2014)	**0.012**	**ED20**	**80**	**finch**	**adult**	**methylmercury cysteine**	**F1 number of offspring**	**diet**	**unclear**	**1**	**none**	**1**
Bird Survival												
Bennett et al. (2009) [d]	1.3	LOAEL ≥ 20	0	kestrel	adult	methylmercury chloride	survival	diet	5 - 7	1	none	3
El-Begearmi et al. (1977)	2.0	LOAEL ≥ 20	11	quail	hatchling	methylmercury hydroxide	survival (female)	diet	16	1	C	3
El-Begearmi et al. (1977)	2.0	LOAEL ≥ 20	27	quail	hatchling	methylmercury hydroxide	survival (male)	diet	16	1	C	3
Hill and Soares (1987)	3.7	LOAEL ≥ 20	62	quail	hatchling	methylmercury chloride	survival	diet	0.71	1	none	4
Hill and Soares (1987)	5.5	LOAEL ≥ 20	61	quail	14 days	methylmercury chloride	survival	diet	0.71	1	none	4
Scheuhammer (1988)	1.8	LOAEL ≥ 20	75	finch	adult	methylmercury chloride	survival	diet	11	1	none	3
Sell and Horani (1976)	no effect at 2.2	NA	NA	chicken	1 day	methylmercury chloride	survival (Experiment 1)	diet	4	1	none	3
Sell and Horani (1976)	no effect at 2.2	NA	NA	chicken	6 days	methylmercury chloride	survival (Experiment 2)	diet	3.6	1	none	3
Sell and Horani (1976)	no effect at 2.6	NA	NA	quail	8 days	methylmercury chloride	survival (Experiment 2)	diet	3.3	1	none	3
Spann et al. (1986)	2.0	LOAEL ≥ 20	19	quail	12 days	methylmercury chloride	survival	diet	6	1	none	4
Varian-Ramos et al. (2014)	**0.051**	**LOAEL ≥ 20**	**76**	**finch**	**adult**	**methylmercury cysteine**	**survival**	**diet**	**52**	**1**	**none**	**2**
Varian-Ramos et al. (2014)	**0.051**	**LOAEL ≥ 20**	**77**	**finch**	**adult**	**methylmercury cysteine**	**F1 survival**	**diet**	**unclear**	**1**	**none**	**3**

Table H2-8. Summary of Methylmercury Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Mammal Growth												
Friedman et al. (1978)	2.2	LOAEL ≥ 20	68	rat	unclear	methlymercury chloride	body weight	diet	10	1	none	4
Gandhi et al. (2013)	1.9	LOAEL ≥ 20	47	rat	adult	methylmercury chloride	body weight gain (female)	gavage	3	2	none	4
Mitsumori et al. (1983)	**0.65**	**LOAEL ≥ 20**	**64**	**rat**	**4 weeks**	**methylmercury chloride**	**body weight**	**diet**	**130**	**1**	**none**	**2**
Mitsumori et al. (1990)	0.69	LOAEL ≥ 20	64	mouse	4 weeks	methylmercury chloride	body weight	diet	104	1	none	2
Stillings et al. (1974)	3.1	LOAEL ≥ 20	14	rat	weanling	methylmercury chloride	body weight gain	diet	4	1	none	4
Verschuuren et al. (1976a)	no effect at 0.23	NA	NA	rat	4 weeks	methylmercury chloride	F2 body weight gain (female)	diet	12	1	none	3
Verschuuren et al. (1976b)	no effect at 0.20	NA	NA	rat	4 weeks	methylmercury chloride	body weight	diet	104	1	none	3
Wobeser et al. (1976)	0.080	LOAEL ≥ 20	76	mink	adult	methylmercury chloride	body weight (female)	diet	13	2	none	2
Mammal Reproduction												
Gandhi et al. (2013)	1.9	LOAEL ≥ 20	0	rat	adult	methylmercury chloride	fetal survival	gavage	3	1	none	4
Tonk et al. (2010)	1.4	LOAEL ≥ 20	78	rat	adult	methylmercury chloride	litter survival	gavage	variable	1	none	4
Verschuuren et al. (1976a)	**0.23**	**LOAEL ≥ 20**	**42**	**rat**	**4 weeks**	**methylmercury chloride**	**F1 viability index**	**diet**	**12**	**1**	**none**	**2**
Mammal Survival												
Pooling group E:	**0.24**	**ED20**	**80**	**rat**	**4 weeks**	**methylmercury chloride**	**survival**	**diet**	**104 - 130**			
Mitsumori et al. (1983)	0.65	LOAEL ≥ 20	28	rat	4 weeks	methylmercury chloride	survival	diet	130			
Mitsumori et al. (1983)	0.65	LOAEL ≥ 20	33	rat	4 weeks	methylmercury chloride	survival	diet	130	**1**	**E**	**5**
Verschuuren et al. (1976b)	0.0081	LOAEL ≥ 20	79	rat	4 weeks	methylmercury chloride	survival (female)	diet	104			
Verschuuren et al. (1976b)	0.340	LOAEL ≥ 20	67	rat	4 weeks	methylmercury chloride	survival (male)	diet	104			
Mitsumori et al. (1990)	0.69	LOAEL ≥ 20	35	mouse	4 weeks	methylmercury chloride	survival	diet	104	1	none	2

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific TRV data set.

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

[d] The effect level from Bennett et al. (2009) was not selected as a receptor-specific TRV for survival because the LOAEL ≥ 20 was a level at which 100 percent mortality occurred, indicating that is not likely to be a protective value.

F1 - first filial generation

F2 - second filial generation

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

NA - not applicable; the reduction in response was < 20 percent relative to the control

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

TRV - toxicity reference value

Table H2-9. Summary of Molybdenum Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Pooling group A:	**100**	**ED20**	**80**	**chicken**	**1 day**	**sodium molybdate**	**body weight**	**diet**	**4**			
Davies et al. (1960)	84	LOAEL ≥ 20	78	chicken	1 day	sodium molybdate	body weight (Experiment 1b)	diet	4	**1**	**A**	**5**
Davies et al. (1960)	220	LOAEL ≥ 20	64	chicken	1 day	sodium molybdate	body weight (Experiment 1c)	diet	4			
Kratzer (1952)	no effect at 28	NA	NA	chicken	1 week	sodium molybdate	body weight gain	diet	3.3	1	none	3
Stafford et al. (2015)	no effect at 550	NA	NA	bobwhite quail	9 days	molydenum disulfide	body weight gain	diet	4.3	1	none	3
Stafford et al. (2015)	360	LOAEL ≥ 20	78	bobwhite quail	9 days	sodium molybdate	body weight gain	diet	4.3	1	none	4
Bird Reproduction												
Lepore and Miller (1965)	**36**	**ED20**	**80**	**chicken**	**7 months**	**sodium molybdate**	**egg production**	**diet**	**3**	**1**	**none**	**1**
Bird Survival												
Davies et al. (1960)	no effect at 170	NA	NA	chicken	1 day	sodium molybdate	survival (Experiment 1b)	diet	4	1	none	3
Davies et al. (1960)	**610**	**ED20**	**80**	**chicken**	**1 day**	**sodium molybdate**	**survival (Experiment 1c)**	**diet**	**4**	**1**	**none**	**1**
Mammal Growth												
Bandyopadhyay et al. (1981)	240	LOAEL ≥ 20	45	rat	juvenile	ammonium molybdate	body weight gain	oral	4	1	A	4
Bandyopadhyay et al. (1981)	240	LOAEL ≥ 20	62	rat	juvenile	ammonium molybdate	body weight gain	oral	4	1	A	4
Brinkman and Miller (1961)	**28**	**LOAEL ≥ 20**	**46**	**rat**	**weanling**	**sodium molybdate**	**body weight gain**	**diet**	**6**	**1**	**none**	**3**
Fungwe et al. (1990)	28	LOAEL ≥ 20	79	rat	21 days	sodium molybdate	body weight gain	drinking water	9	2	none	3
Lyubimov et al. (2004)	no effect at 24	NA	NA	rat	20-23 weeks	ammonium tetrathiomolybdate	body weight	gavage	8	2	none	3
Murray et al. (2013)	no effect at 55	NA	NA	rat	9 weeks	sodium molybdate dihydrate	body weight	diet	12	1	none	3
Mammal Reproduction												
Fungwe et al. (1990)	**4.5**	**ED20**	**80**	**rat**	**21 days**	**sodium molybdate**	**litter weight**	**drinking water**	**9**	**2**	**none**	**1**

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

NA - not applicable; the reduction in response was < 20 percent relative to the control

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

Table H2-10. Summary of Nickel Dose-Response Data Sets

Source [a]	Effect Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Pooling group A:	**6.8**	**ED20**	**80**	**chicken**	**chick**	**nickel chloride**	**body weight gain**	**diet**	**2 - 2.7**			
Hill 1979	51	LOAEL ≥ 20	63	chicken	1 day	nickel chloride	body weight gain	diet	2	**1**	**A**	**5**
Hill 1985	51	LOAEL ≥ 20	56	chicken	chick	nickel chloride	body weight gain	diet	2.7			
Cain and Pafford 1981	110	LOAEL ≥ 20	78	mallard	1 day	nickel sulfate	body weight (female)	diet	8.6	1	none	2
Cain and Pafford 1981	*87*	*ED20*	*80*	*mallard*	*1 day*	*nickel sulfate*	*body weight (male)*	*diet*	*4*	*1*	*none*	*1*
Ling and Leach 1979	42	ED20	80	chicken	1 day	nickel chloride	body weight	diet	3	1	none	1
Martinez and Diaz 1996	36	ED20	80	chicken	1 day	nickel chloride	body weight	diet	6	1	none	1
Weber and Reid 1968	78	LOAEL ≥ 20	67	chicken	1 day	nickel sulfate	body weight	diet	4	1	none	4
Weber and Reid 1968	78	LOAEL ≥ 20	69	chicken	1 day	nickel acetate	body weight	diet	4	1	none	4
Bird Reproduction												
Arpasova et al. 2007	**0.54[d]**	**ED20**	**80**	**chicken**	**adult**	**nickel chloride**	**egg production**	**drinking water**	**4**	**2**	**none**	**1**
Bird Survival												
Cain and Pafford 1981	*80*	*ED20*	*80*	*mallard*	*1 day*	*nickel sulfate*	*survival*	*diet*	*12.9*	*1*	*none*	*1*
Ling and Leach 1979	**60**	**ED20**	**80**	**chicken**	**1 day**	**nickel chloride**	**survival**	**diet**	**3**	**1**	**none**	**1**

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

[d] This dose is less than the Eco-SSL of 6.71 mg/kg bw/day; the Eco-SSL is the lowest effect level for TRV derivation.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

Table H2-11. Summary of Selenium Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Pooling group A:	**0.28**	**ED20**	**80**	**chicken**	**1 - 7 days**	**sodium selenite**	**body weight**	**diet**	**3 - 4**			
Dafalla and Adam (1986)	0.26	LOAEL ≥ 20	70	chicken	1 week	sodium selenite	body weight	diet	4			
El-Begearmi and Combs (1982)	2.7	LOAEL ≥ 20	36	chicken	1 day	sodium selenite	body weight	diet	4	**1**	**A**	**5**
El-Begearmi and Combs (1982)	2.7	LOAEL ≥ 20	33	chicken	1 day	sodium selenite	body weight	diet	4			
Jensen (1986)	0.57	LOAEL ≥ 20	77	chicken	1 day	sodium selenite	body weight	diet	3			
Echevarria et al. (1988)	1.0	LOAEL ≥ 20	74	chicken	1 day	sodium selenite	body weight gain	diet	3	1	C	4
Gad and El-Twab (2009)	no effect at 3.4	NA	NA	quail	adult	sodium selenite	body weight	gavage	4	2	none	3
Heinz and Fitzgerald (1993a)	no effect at 2.0	NA	NA	mallard	adult	seleno-DL-methionine	body weight	diet	21	1	D	4
Hill (1979a)	1.1	LOAEL ≥ 20	79	chicken	1 day	selenium dioxide	body weight gain	diet	4-5	1	B	4
Hill (1979a)	2.2	LOAEL ≥ 20	35	chicken	1 day	selenium dioxide	body weight gain	diet	4-5	1	B	4
Hoffman et al. (1992)	*1.6*	*ED20*	*80*	*mallard*	*1 day*	*seleno-DL-methionine*	*body weight*	*diet*	*4*	*1*	*none*	*1*
O'Toole and Raisbeck (1997)	4.6	LOAEL ≥ 20	70	mallard	adult	seleno-L-methionine	body weight	diet	21	1	D	4
Santolo et al. (2010)	no effect at 2.9	NA	NA	quail	adult	seleno-L-methionine	body weight gain	diet	4	2	none	3
Sell and Horani (1976)	no effect at 0.89	NA	NA	chicken	1 day	sodium selenite	body weight gain	diet	4	1	C	4
Stoewsand et al. (1977)	no effect at 1.0	NA	NA	quail	2 weeks	sodium selenite	body weight	diet	10	1	none	3
Stoewsand et al. (1977)	no effect at 1.0	NA	NA	quail	2 weeks	seleniferous wheat	body weight	diet	10	1	none	3
Bird Reproduction												
Kaantee and Kurbela (1980)	no effect at 0.16	NA	NA	chicken	18 months	sodium selenite	egg production	diet	4	1	none	3
Pooling group E:	*0.56*	*ED20*	*80*	*mallard*	*adult*	*selenomethionine*	*hatching success*	*diet*	*variable*			
Heinz et al. (1989)	0.82	LOAEL ≥ 20	62	mallard	adult	selenomethionine	hatching success	diet	>14	*1*	*E*	*5*
Hoffman and Heinz (1988)	0.82	LOAEL ≥ 20	64	mallard	adult	selenomethionine	hatching success	diet	at least 30 eggs produced			
Heinz et al. (1989)	1.6	LOAEL ≥ 20	0	mallard	adult	selenomethionine	duckling survival	diet	>14	1	none	4
Heinz et al. (1989)	0.60	ED20	80	mallard	adult	selenomethionine	number of 6-day-old ducklings	diet	>14	1	none	1
Hoffman and Heinz (1988)	2.5	LOAEL ≥ 20	56.0	mallard	adult	sodium selenite	hatching success	diet	at least 30 eggs produced	1	none	4
Ort and Latshaw (1978)	0.71	LOAEL ≥ 20	74	chicken	32 weeks	sodium selenite	egg production	diet	16	1	none	2
Ort and Latshaw (1978)	**0.55**	**ED20**	**80**	**chicken**	**32 weeks**	**sodium selenite**	**hatchability**	**diet**	**16**	**1**	**none**	**1**
Stone and Soares (1976)	no effect at 0.14	NA	NA	quail	adult	sodium selenite	egg production (Experiments 1 and 3)	diet	3.9 - 4.6	1	none	3
Wiemeyer and Hoffman (1996)	4.2	LOAEL ≥ 20	75	owl	adult	seleno-DL-methionine	% pairs with hatchlings	diet	12	1	none	4
Wiemeyer and Hoffman (1996)	14	LOAEL ≥ 20	0	owl	adult	seleno-DL-methionine	pairs with 5-day-old young	diet	12	1	none	4
Wiemeyer and Hoffman (1996)	14	LOAEL ≥ 20	5	owl	adult	seleno-DL-methionine	% hatch of eggs incubated	diet	12	1	none	4
Bird Survival												
Pooling group I:	*4.7*	*geometric mean*	*NA*	*mallard*	*adult*	*seleno-DL-methionine*	*survival*	*diet*	*16*			
Albers et al. (1996)	11	LOAEL ≥ 20	0	mallard	1 year	seleno-DL-methionine	survival	diet	16	*1*	*I*	2
Heinz and Fitzgerald (1993b)	2.0	LOAEL ≥ 20	75	mallard	adult	seleno-DL-methionine	survival	diet	16			
Arnold et al. (1973)	**0.59**	**LOAEL ≥ 20**	**65**	**chicken**	**1 day**	**sodium selenite**	**survival**	**diet**	**64**	**1**	**none**	**3**
El-Begearmi and Combs (1982)	2.7	LOAEL ≥ 20	63	chicken	1 day	sodium selenite	survival	diet	4	1	G	4
El-Begearmi and Combs (1982)	5.4	LOAEL ≥ 20	8	chicken	1 day	sodium selenite	survival	diet	4	1	G	4
El-Begearmi et al. (1977)	no effect at 1.6	NA	NA	quail	1 day	sodium selenite	survival	diet	16	1	H	4
El-Begearmi et al. (1977)	1.6	LOAEL ≥ 20	57	quail	1 day	sodium selenite	survival	diet	16	1	H	4
Gad and El-Twab (2009)	no effect at 3.4	NA	NA	quail	adult	sodium selenite	survival	gavage	4	1	none	3
Khan et al. (1993)	2.5	LOAEL ≥ 20	60	chicken	2 weeks	sodium selenite	survival	gavage	0.86	1	none	3
Mammal Growth												
Baker et al. (1989)	no effect at 0.63	NA	NA	pig	8 - 14 weeks	sodium selenate	body weight	diet	3.7	1	none	3
Behne et al. (1992)	no effect at 0.15	NA	NA	rat	30 days	L-selenomethionine	body weight	diet	14	1	none	3
Birt et al. (1983)	no effect at 0.85	NA	NA	hamster	4 weeks	sodium selenite	body weight	diet	25	1	none	3
Birt et al. (1986)	no effect at 0.27	NA	NA	hamster	4 weeks	sodium selenite	body weight	diet	64	1	none	3
Boylan et al. (1990)	no effect at 0.22	NA	NA	mouse	NR	sodium selenite	body weight	diet	26	1	none	3
Goehring et al. (1984)	0.87	LOAEL ≥ 20	78	rat	adult (assumed)	seleniferous grain	body weight gain	diet	4	2	none	3
Goehring et al. (1984)	0.60	LOAEL ≥ 20	72	rat	adult (assumed)	sodium selenite	body weight gain	diet	4	2	none	3

Table H2-11. Summary of Selenium Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Mammal Growth (continued)												
Julius et al. (1983)	2.6	LOAEL ≥ 20	79	hamster	4 weeks	sodium selenite	body weight (male, Experiment 1)	diet	3	1	A	4
Julius et al. (1983)	4.7	LOAEL ≥ 20	69	hamster	4 weeks	sodium selenite	body weight (female, Experiment 1)	diet	3	1	A	4
Julius et al. (1983)	1.4	LOAEL ≥ 20	77	hamster	4 weeks	sodium selenite	body weight (male, Experiment 2)	diet	3	1	A	4
Kaur and Parshad (1994)	0.19	LOAEL ≥ 20	77	rat	adult	sodium selenite	body weight	diet	5.1	2	none	3
Mahan and Moxon (1984)	**0.33**	**ED20**	**80**	**pig**	**4 weeks**	**sodium selenite**	**body weight**	**diet**	**5.3**	**1**	**none**	**1**
Spallholz et al. (1973)	5.7	LOAEL ≥ 20	58	mouse	weanling	sodium selenite	body weight gain	diet	5	1	none	4
Wahlstrom et al. (1956)	no effect at 0.56	NA	NA	pig	weanling	sodium selenite	body weight	diet	14	1	none	3
Mammal Reproduction												
Chernoff and Kavlock (1982)	no effect at 4.6	NA	NA	mouse	60 days	sodium selenite	number pregnant	gavage	0.71	1	none	3
Gray and Kavlock (1984)	no effect at 4.6	NA	NA	mouse	90 days	sodium selenite	number of live offspring	gavage	0.71	1	none	3
Hardin et al. (1987)	6.4	LOAEL ≥ 20	45	mouse	adult	sodium selenite	% viable litters	gavage	1.1	1	none	4
Seidenberg et al. (1986)	**5.0**	**LOAEL ≥ 20**	**46**	**mouse**	**adult**	**sodium selenate**	**number of litters born**	**gavage**	**0.71**	**1**	**none**	**3**
Wahlstrom and Olson (1959)	no effect at 0.0011	NA	NA	pig	8 weeks	sodium selenite	number of live piglets	diet	34	1	none	3
Mammal Survival												
Halverson et al. (1966)	1.1	LOAEL ≥ 20	38	rat	weanling	seleniferous wheat	survival	diet	6	1	B	4
Julius et al. (1983)	9.9	LOAEL ≥ 20	70	hamster	4 weeks	sodium selenite	survival	diet	3	1	none	4
McAdam and Levander (1987)	1.2	LOAEL ≥ 20	0	rat	weanling	D-selenomethionine	survival	diet	6	1	B	4
McAdam and Levander (1987)	0.61	LOAEL ≥ 20	63	rat	weanling	L-selenomethionine	survival	diet	6	1	B	4
McAdam and Levander (1987)	**0.61**	**LOAEL ≥ 20**	**38**	**rat**	**weanling**	**sodium selenite**	**survival**	**diet**	**6**	**1**	**none**	**2**
McAdam and Levander (1987)	1.2	LOAEL ≥ 20	75	rat	weanling	sodium selenate	survival	diet	6	1	none	4
Moxon and Mahan (1981)	0.81	LOAEL ≥ 20	75	pig	weanling	sodium selenite	survival	diet	5.3	1	none	4
Palmer et al. (1982)	0.92	LOAEL ≥ 20	80	rat	NR	seleniferous corn	survival	diet	4	1	B	4
Spallholz et al. (1973)	5.7	LOAEL ≥ 20	63	mouse	weanling	sodium selenite	survival	diet	5	1	none	4

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific TRV data set.

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

NA - not applicable; the reduction in response was < 20 percent relative to the control

NR - not reported

LOAEL - lowest-observed-adverse-effect level

TRAP - Toxicity Relationship Analysis Program

UCR - Upper Columbia River

Table H2-12. Summary of Thallium Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Mammal Growth												
Pooling group A:	**2.6**	**ED20**	**80**	**rat**	**weanling**	**thallic oxide**	**body weight**	**diet**	**15**			
Downs et al. (1960)	3.0	LOAEL ≥ 20	44	rat	weanling	thallic oxide	body weight	diet	15	**1**	**A**	**5**
Downs et al. (1960)	3.5	LOAEL ≥ 20	75	rat	weanling	thallic oxide	body weight	diet	15			
Mammal Survival												
Pooling group B:	**2.1**	**ED20**	**80**	**rat**	**weanling**	**thallic oxide**	**survival**	**diet**	**15**			
Downs et al. (1960)	3.0	LOAEL ≥ 20	25	rat	weanling	thallic oxide	survival	diet	15	**1**	**B**	**5**
Downs et al. (1960)	2.0	LOAEL ≥ 20	60	rat	weanling	thallic oxide	survival	diet	15			

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in EPA's TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the effective dose with a 20 % reduction in the response relative to the control (modeled) (ED20) presented in this table.
2. Data were selected for modeling as an individual or pooled data set but, an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight
ED20 - dose with a 20 percent reduction in the response relative to the control
EPA - US Environmental Protection Agency
LOAEL ≥ 20 - LOAEL with ≥ 20 percent reduction in the response relative to the control
TRAP - Toxicity Relationship Analysis Program

Table H2-13. Summary of Vanadium Dose-Response Data Sets

Source [a]	Effective Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Growth												
Pooling group A:	5.2	ED20	80	chicken	chick	ammonium metavanadate	body weight	diet	2 - 4			
Berg and Lawrence (1971)	1.2	LOAEL ≥ 20	63	chicken	chick	ammonium metavanadate	body weight	diet	2			
Cervantes and Jensen (1986)	2.2	LOAEL ≥ 20	75	chicken	1 day	ammonium metavanadate	body weight	diet	4			
Nelson et al. (1962)	9.7	LOAEL ≥ 20	68	chicken	chick	ammonium metavanadate	body weight	diet	4	1	A	5
Nelson et al. (1962)	5.2	LOAEL ≥ 20	72	chicken	chick	ammonium metavanadate	body weight	diet	4			
Qureshi et al. (1999)	5.6	LOAEL ≥ 20	68	chicken	chick	ammonium metavanadate	body weight	diet	3			
Hill (1994)	5.6	LOAEL ≥ 20	50	chicken	hatchling	ammonium metavanadate	body weight	diet	2.9			
Pooling group B:	1.3	ED20	80	chicken	1 day	sodium metavanadate	body weight gain	diet	2 - 2.7			
Hill (1974)	no effect at 1.2	NA	NA	chicken	1 day	sodium metavanadate	body weight gain	diet	2			
Hill (1979a)	1.4	LOAEL ≥ 20	78	chicken	1 day	sodium metavanadate	body weight gain	diet	2	1	B	5
Hill (1990a)	4.5	LOAEL ≥ 20	55	chicken	1 day	sodium metavanadate	body weight gain	diet	2.7			
Hill (1990b)	2.8	LOAEL ≥ 20	38	chicken	1 day	sodium metavanadate	body weight gain	diet	2.7			
Pooling group E:	2.3	geometric mean	NA	chicken	chick	vanadyl chloride	body weight	diet	2 - 3			
Berg and Lawrence (1971)	1.2	LOAEL ≥ 20	75	chicken	chick	vanadyl dichloride	body weight	diet	2	1	E	2
Blalock and Hill (1987)	4.5	LOAEL ≥ 20	54	chicken	1 day	vanadyl chloride	body weight	diet	3			
Berg and Lawrence (1971)	**1.2**	**ED20**	**80**	**chicken**	**chick**	**vanadyl sulfate**	**body weight**	**diet**	**2**	**1**	**none**	**1**
Summers and Moran (1972)	no effect at 1.1	NA	NA	chicken	chick	NR	body weight gain	diet	3	1	none	3
Bird Reproduction												
Hafez and Kratzer (1976b)	23	LOAEL ≥ 20	33	chicken	28 weeks	ammonium metavanadate	egg production	diet	NR	1	C	2
Kubena and Phillips (1982)	7.3	LOAEL ≥ 20	30	chicken	29 weeks	calcium orthovanadate	egg production	diet	20	1	none	2
Ousterhout and Berg (1980)	3.1	LOAEL ≥ 20	77	chicken	40 weeks	ammonium vanadate	egg production	diet	4	1	C	2
Toussant and Latshaw (1994)	**2.1**	**LOAEL ≥ 20**	**51**	**chicken**	**25 weeks**	**ammonium metavanadate**	**egg production**	**diet**	**4**	**1**	**C**	**2**
Bird Survival												
Pooling group D:	5.0	geometric mean	NA	chicken	chick	ammonium metavanadate	survival	diet	2 - 4			
Berg and Lawrence (1971)	2.3	LOAEL ≥ 20	30	chicken	chick	ammonium metavanadate	survival	diet	2			
Hafez and Kratzer (1976a)	22	LOAEL ≥ 20	80	chicken	1 day	ammonium metavanadate	survival (Experiment 1)	diet	4	1	D	2
Hafez and Kratzer (1976a)	6.0	LOAEL ≥ 20	80	chicken	1 day	ammonium metavanadate	survival (Experiment 2)	diet	4			
Hathcock et al. (1964)	3.2	LOAEL ≥ 20	5.9	chicken	1 day	ammonium metavanadate	survival	diet	2			
Hathcock et al. (1964)	3.2	LOAEL ≥ 20	18	chicken	1 day	ammonium metavanadate	survival	diet	2			
Blalock and Hill (1987)	**2.4**	**ED20**	**80**	**chicken**	**1 day**	**vanadyl chloride**	**survival**	**diet**	**3**	**1**	**none**	**1**
Hathcock et al. (1964)	3.2	LOAEL ≥ 20	16	chicken	1 day	vanadyl sulfate	survival	diet	2	1	none	3
Kubena and Phillips (1982)	7.3	LOAEL ≥ 20	44	chicken	29 weeks	calcium orthovanadate	survival	diet	20	1	none	4

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow and blue highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

LOAEL - lowest-observed-adverse-effect level

NA - not applicable; the reduction in response was < 20 percent relative to the control

NR - not reported

TRAP - Toxicity Relationship Analysis Program

Table H2-14. Summary of Bis(2-ethylhexyl)phthalate Dose-Response Data Sets

Source [a]	Effect Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group	Modeling Category [b]
Bird Growth												
Wood and Bitman 1984	no effect at 750	NA	NA	chicken	~ 20 weeks	bis(2-ethylhexyl)phthalate	body weight	diet	4	1	none	3
Bird Reproduction												
Ishida et al. 1982	**350**	**LOAEL ≥ 20**	**ND[c]**	**chicken**	**10 months**	**bis(2-ethylhexyl)phthalate**	**egg production**	**diet**	**33**	**1**	**none**	**3**
Wood and Bitman 1984	750	LOAEL ≥ 20	58	chicken	~ 20 weeks	bis(2-ethylhexyl)phthalate	egg production	diet	4	1	none	3

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Yellow and blue highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

[c] Ishida et al. (1982) indicated that egg production ceased in birds at the lowest dose level, but data were not provided to determine effects relative to the control. It is assumed that because reproduction ceased completely, the reduction was at least 20 percent greater than in the control.

bw - body weight

EPA - US Environmental Protection Agency

LOAEL - lowest-observed-adverse-effect level

NA - not applicable; the reduction in response was < 20 percent relative to the control

ND - no data

TRAP - Toxicity Relationship Analysis Program

Table H2-15. Summary of High-Molecular-Weight Polyaromatic Hydrocarbon Dose-Response Data Sets

Source [a]	Effect Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group	Modeling Category [b]
Bird Growth												
Patton and Dieter 1980	no effect at 140	NA	NA	mallard	NR	aromatic mixture	body weight	diet	28	1	none	3
Trust et al. 1994	no effect at 20	NA	NA	European starling	9 days	7,12-dimethylbenz[a]anthracene	body weight	gavage	0.86	1	none	3
Bird Survival												
Patton and Dieter 1980	no effect at 140	NA	NA	mallard	NR	aromatic mixture	survival	diet	28	1	none	3

Notes:

[a] See Attachment H2 references section for full citations.

[b] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

LOAEL - lowest-observed-adverse-effect level

NA - not applicable; the reduction in response was < 20 percent relative to the control

NR - not reported

TRAP - Toxicity Relationship Analysis Program

Table H2-16. Summary of Polychlorinated Biphenyls (PCBs) Dose-Response Data Sets

Source [a]	Effect Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Bird Reproduction												
Pooled Dataset A:	0.66	ED20	80	chicken	20 weeks - adult	Aroclor 1242	hatchability	diet	6 - 9	1	A	5
Briggs and Harris 1973	1.4	LOAEL ≥ 20	10	chicken	adult	Aroclor 1242	hatchability (leghorn)	diet	6			
Briggs and Harris 1973	1.3	LOAEL ≥ 20	9	chicken	adult	Aroclor 1242	hatchability (broiler)	diet	6			
Britton and Huston 1973	1.4	LOAEL ≥ 20	55	chicken	10 months	Aroclor 1242	hatchability	diet	6			
Lillie et al. 1974 & Cecil et al. 1974[c]	1.4	LOAEL ≥ 20	20	chicken	adult	Aroclor 1242	hatchability	diet	9			
Lillie et al. 1975	0.70	LOAEL ≥ 20	74	chicken	20 weeks	Aroclor 1242	hatchability	diet	8			
Pooled Dataset B:	**0.56**	**ED20**	**80**	**chicken**	**20 weeks - adult**	**Aroclor 1248**	**hatchability**	**diet**	**8 - 9**	**1**	**B**	**5**
Lillie et al. 1974 & Cecil et al. 1974[c]	1.4	LOAEL ≥ 20	12	chicken	adult	Aroclor 1248	hatchability	diet	9			
Lillie et al. 1975	0.70	LOAEL ≥ 20	69	chicken	20 weeks	Aroclor 1248	hatchability	diet	8			
Scott 1977	0.70	LOAEL ≥ 20	50	chicken	adult	Aroclor 1248	hatchability	diet	8			
Britton and Huston 1973	no effect at 5.6	NA	NA	chicken	10 months	Aroclor 1242	egg production	diet	6	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1242	egg production	diet	9	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	1.4	LOAEL ≥ 20	71	chicken	adult	Aroclor 1242	progeny body weight gain at 3 weeks	diet	9	1	none	4
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1242	progeny mortality	diet	9	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1248	egg production	diet	9	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	1.4	LOAEL ≥ 20	67	chicken	adult	Aroclor 1248	progeny body weight gain at 3 weeks	diet	9	1	none	4
Lillie et al. 1974 & Cecil et al. 1974[c]	1.4	LOAEL ≥ 20	44	chicken	adult	Aroclor 1248	progeny mortality	diet	9	1	none	2
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1254	hatchability	diet	9	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1254	egg production	diet	9	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1254	progeny body weight gain at 3 weeks	diet	9	1	none	3
Lillie et al. 1974 & Cecil et al. 1974[c]	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1254	progeny mortality	diet	9	1	none	3
Platanow and Reinhart 1973	3.5	LOAEL ≥ 20	0	chicken	6 months	Aroclor 1254	hatchability	diet	14	1	none	3
Scott 1977	no effect at 1.4	NA	NA	chicken	adult	Aroclor 1248	egg production	diet	8	1	none	3
Mammal Reproduction												
Aulerich and Ringer 1977	0.77	LOAEL ≥ 20	0	mink	adult	Aroclor 1254	females whelped	diet	16	1	A	4
Aulerich and Ringer 1977	0.15	LOAEL ≥ 20	73	mink	adult	Aroclor 1254	females whelped	diet	16	1	A	4
Aulerich and Ringer 1977	0.31	LOAEL ≥ 20	25	mink	adult	Aroclor 1254	females whelped	diet	16	1	A	4
Aulerich and Ringer 1977	0.31	LOAEL ≥ 20	4	mink	adult	Aroclor 1254	kits born alive	diet	16	1	C	4
Aulerich and Ringer 1977	0.77	LOAEL ≥ 20	0	mink	adult	Aroclor 1254	kits born alive	diet	16	1	C	4
Aulerich and Ringer 1977	0.15	LOAEL ≥ 20	63	mink	adult	Aroclor 1254	kits born alive	diet	16	1	C	4
Aulerich et al. 1985	0.39	LOAEL ≥ 20	11	mink	adult	Aroclor 1254	kits whelped	diet	~12	1	none	4
Aulerich et al. 1985	0.39	LOAEL ≥ 20	0	mink	adult	Aroclor 1254	kits whelped	diet	~12	1	none	4
Bleavins et al. 1980	0.77	LOAEL ≥ 20	0	mink	adult	Aroclor 1242	kits born alive	diet	35	1	none	4
Bleavins et al. 1980	no effect at 3.1	NA	NA	mink	adult	Aroclor 1016	kits born alive	diet	35	1	none	3
Bleavins et al. 1980	0.77	LOAEL ≥ 20	0	mink	adult	Aroclor 1242	females whelped	diet	35	1	none	4
Bleavins et al. 1980	3.1	LOAEL ≥ 20	58	mink	adult	Aroclor 1016	females whelped	diet	35	1	none	4
Brunström et al. 2001	***0.082***	***LOAEL ≥ 20***	***67***	***mink***	***6 months***	***Clophen A50***	***kit growth***	***diet***	***72***	***1***	***none***	***2***
Brunström et al. 2001	no effect at 0.2	NA	NA	mink	6 months	Clophen A50	kits whelped	diet	72	1	none	3
Brunström et al. 2001	no effect at 0.2	NA	NA	mink	6 months	Clophen A50	kit birth weight	diet	72	1	none	3
Brunström et al. 2001	0.24	LOAEL ≥ 20	80	mink	6 months	Clophen A50	kits whelped	diet	24	1	none	4
Brunström et al. 2001	0.24	LOAEL ≥ 20	42	mink	6 months	Clophen A50	females whelped	diet	24	1	B	4
Brunström et al. 2001	0.24	LOAEL ≥ 20	75	mink	6 months	Clophen A50	kit birth weight	diet	24	1	none	4
Brunström et al. 2001	0.24	LOAEL ≥ 20	45	mink	6 months	Clophen A50	kits born alive	diet	24	1	E	4
Folland et al. 2016	0.27	LOAEL ≥ 20	77	mink	adult	Aroclor 1268	kit survival	diet	16	1	none	4
Folland et al. 2016	no effect at 4.4	NA	NA	mink	adult	Aroclor 1268	kits born alive	diet	16	1	none	3
Folland et al. 2016	1.6	LOAEL ≥ 20	82	mink	adult	Aroclor 1268	kits whelped	diet	16	1	none	4
Folland et al. 2016	1.6	LOAEL ≥ 20	64	mink	adult	Aroclor 1268	kits born alive	diet	16	1	none	4
Jensen et al. 1977	1.7	LOAEL ≥ 20	72	mink	adult	NR	females whelped	diet	9.4	1	none	4

Table H2-16. Summary of Polychlorinated Biphenyls (PCBs) Dose-Response Data Sets

Source [a]	Effect Dose (mg/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group [b]	Modeling Category [c]
Jensen et al. 1977	1.7	LOAEL ≥ 20	79	mink	adult	NR	kits whelped	diet	9.4	1	none	4
Jensen et al. 1977	1.7	LOAEL ≥ 20	57	mink	adult	NR	kit weight of young	diet	9.4	1	none	4
Jensen et al. 1977	1.7	LOAEL ≥ 20	21	mink	adult	NR	kit survival after 5 days	diet	9.4	1	none	4
Kihlstrom et al. 1992	1.3	LOAEL ≥ 20	34	mink	2 years	Aroclor 1254	females whelped	diet	12	1	A	4
Kihlstrom et al. 1992	1.3	LOAEL ≥ 20	0	mink	2 years	Aroclor 1254	kits born alive	diet	12	1	none	4
Kihlstrom et al. 1992	2.0	LOAEL ≥ 20	11	mink	2 years	Clophen A50	females whelped	diet	12	1	B	4
Kihlstrom et al. 1992	2.0	LOAEL ≥ 20	0	mink	2 years	Clophen A50	kits born alive	diet	12	1	E	4
Wren et al. 1987	0.15	LOAEL ≥ 20	71	mink	8 months	Aroclor 1254	kit weight at 5 weeks	diet	24	1	none	4

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific TRV data set.

Yellow and blue highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight
ED20 - dose with a 20 percent reduction in the response relative to the control
EPA - US Environmental Protection Agency
LOAEL - lowest-observed-adverse-effect level
NA - not applicable; the reduction in response was < 20 percent relative to the control
NR - not reported
TRAP - Toxicity Relationship Analysis Program
TRV - toxicity reference value
UCR - Upper Columbia River

Table H2-17. Summary of Dioxin/Furan Dose-Response Data Sets

Source	Effect Dose (ng TEQ/kg bw/day)	Type of Effect Level	Effect as Percent of Control	Receptor	Lifestage/Age	Chemical Form	Effect Measure	Exposure Route	Exposure Duration (weeks unless noted otherwise)	Data Tier	Pooling Group[a]	Modeling Category[b]
Bird Survival												
Schwetz et al. 1973	**1000**	**LOAEL ≥ 20**	**20**	**chicken**	**3 days**	**2,3,7,8-TCDD**	**survival**	**oral intubation**	**3**	**1**	**none**	**2**
Mammal Growth												
Pooled Dataset A:	**10**	**ED20**	**80**	**guinea pig**	**weanling**	**2,3,7,8-TCDD**	**body weight**	**diet**	**12.9**			
DeCaprio et al. 1986	26	LOAEL ≥ 20	61	guinea pig	weanling	2,3,7,8-TCDD	body weight (male)	diet	12.9	**1**	**A**	**5**
DeCaprio et al. 1986	31	LOAEL ≥ 20	58	guinea pig	weanling	2,3,7,8-TCDD	body weight (female)	diet	12.9			
Hochstein et al. 1998	*54*	*LOAEL ≥ 20*	*78*	*mink*	*adult*	*2,3,7,8-TCDD*	*body weight*	*diet*	*17.9*	*2*	*none*	*3*
Van Birgelen et al. 1995	1000	LOAEL ≥ 20	72	rat	7 weeks	2,3,7,8-TCDD	body weight	diet	13	1	none	4
Mammal Reproduction												
Hochstein et al. 2001	***0.77***	***ED20***	***80***	***mink***	***adult***	***2,3,7,8-TCDD***	***kit survival***	***diet***	***18.7 - 18.8***	***1***	***none***	***1***
Moore et al. 2012	no effect at 8.4	NA	NA	mink	adult	2,3,7,8-TCDD	females whelping	diet	20.4 - 25.1	1	none	3
Moore et al. 2012	2.1	LOAEL ≥ 20	NA	mink	adult	2,3,7,8-TCDD	kit survival	diet	20.4 - 25.2	1	none	3
Murray et al. 1979	10	LOAEL ≥ 20	63	rat	6-7 weeks	2,3,7,8-TCDD	females with litter	diet	12.9	1	none	3
Murray et al. 1979	10	LOAEL ≥ 20	68	rat	6-7 weeks	2,3,7,8-TCDD	postnatal survival	diet	12.9	1	none	4
Mammal Survival												
DeCaprio et al. 1986	**29**	**LOAEL ≥ 20**	**40**	**guinea pig**	**weanling**	**2,3,7,8-TCDD**	**survival**	**diet**	**12.9**	**1**	**none**	**4**
Hochstein et al. 1998	*54*	*LOAEL ≥ 20*	*38*	*mink*	*adult*	*2,3,7,8-TCDD*	*survival*	*diet*	*17.9*	*1*	*none*	*2*

Notes:

Bold indicates the lowest effect level, selected from the lowest tier evaluated, and as the lowest value from the following:

1. LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set,
2. Modeled effective ED20 from an individual data set, or
3. ED20 or geometric mean from a pooled data set that was selected for modeling because the effect concentration had the potential for being lower than other ED20s and/or LOAELs based on visual inspection of the plotted data (i.e., Category 2 or 5).

Italics indicate UCR receptor-specific TRV data set.

Yellow highlights indicate pooled data sets modeled in EPA's TRAP.

[a] See Attachment H2 references section for full citations.

[b] Pooling groups were evaluated only as a group and not on an individual basis for the purposes of selecting data to model in TRAP. Not all pooling groups were run in TRAP.

[c] Modeling categories are defined as follows:

1. Data were modeled in TRAP as an individual data set to derive the ED20 presented in this table.
2. Data were selected for modeling as an individual or pooled data set, but an ED20 could not be generated or the ED20 was not used due to poor model fit.
3. Data do not meet criteria for modeling as an individual data set (e.g., no effect with a ≥ 20 percent reduction in response relative to control, lack of two consecutively lower and different effects less than the control or consecutively lower effects are followed by an increased effect, a lower tier data set is available).
4. Not selected for modeling because the effect concentration for the individual or pooled data set is substantially higher than other ED20s and/or LOAELs.
5. Modeled in TRAP as part of a pooled data set.

bw - body weight

ED20 - dose with a 20 percent reduction in the response relative to the control

EPA - US Environmental Protection Agency

LOAEL - lowest-observed-adverse-effect level

NA - not applicable; the reduction in response was < 20 percent relative to the control

PeCDF - pentachlorodibenzofuran

TCDD - tetrachlorodibenzodioxin

TEQ - toxic equivalent

TRAP - Toxicity Relationship Analysis Program

TRV - toxicity reference value

UCR - Upper Columbia River

Table H2-18. Summary of Selected Effect Levels

			Growth					Reproduction					Survival				
Chemical	Units	Eco-SSL TRV	Selected Effect Level	Effect Level Type	Effect as Percent of Control	Tier	Source [a]	Selected Effect Level	Effect Level Type	Effect as Percent of Control	Tier	Source [a]	Selected Effect Level	Effect Level Type	Effect as Percent of Control	Tier	Source [a]
Birds [b]																	
Aluminum	mg/kg bw/day	na	150	ED20	80	1	Capdevielle and Scanes (1995a)	no data	no data	no data	no data	no data	560	LOAEL ≥ 20	75	1	Capdevielle and Scanes (1995a)
Antimony	mg/kg bw/day	na	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Arsenic	mg/kg bw/day	2.24	20	LOAEL ≥ 20	69	1	Hoffman et al. 1992	40	LOAEL ≥ 20	16	1	Stanley et al. (1994)	6.9	ED20	80	1	Albert et al. (2008b)
Barium	mg/kg bw/day	na	480	ED20	80	1	Johnson et al. (1960)	no data	no data	no data	no data	no data	890	LOAEL ≥ 20	32, 44	1	Johnson et al. (1960) (two pooled data sets)
Beryllium	mg/kg bw/day	na	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Chromium (III)	mg/kg bw/day	2.66	510	LOAEL ≥ 20	57	1	Chung et al. (1985)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Iron	mg/kg bw/day	na	160	LOAEL ≥ 20	76	1	McGhee et al. (1965)	no data	no data	no data	no data	no data	1,100	ED20	80	1	Pescatore and Harter-Dennis (1989); Wallner-Pendleton et al. (1986) (pooled)
Methylmercury	mg/kg bw/day	na	0.97	ED20	80	2	Scott et al. (1975)	0.012	ED20	80	1	Varian-Ramos et al. (2014)	0.051	LOAEL ≥ 20	76 - 77	1	Varian-Ramos et al. (2014)
Molybdenum	mg/kg bw/day	na	100	ED20	80	1	Davies et al. (1960) (two pooled data sets)	36	ED20	80	1	Lepore and Miller (1965)	610	ED20	80	1	Davies et al. (1960)
Nickel	mg/kg bw/day	6.71	6.8	ED20	80	1	Hill (1979); Hill (1985) (pooled)	0.54	ED20	80	1	Arpasova et al. (2007)	60	ED20	80	1	Ling and Leach 1979
Selenium	mg/kg bw/day	0.29	0.28	ED20	80	1	Dafalla and Adam (1986); El-Begearmi and Combs (1982); Jensen (1986) (pooled)	0.55	ED20	80	1	Ort and Latshaw (1978)	0.59	LOAEL ≥ 20	65	1	Arnold et al. (1973)
Thallium	mg/kg bw/day	na	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Vanadium	mg/kg bw/day	0.344	1.2	ED20	80	1	Berg and Lawrence (1971)	2.1	LOAEL ≥ 20	51	1	Toussant and Latshaw (1994)	2.4	ED20	80	1	Blalock and Hill (1987)
Bis(2-ethylhexyl)phthalate	mg/kg bw/day	na	no data	no data	no data	no data	no data	350	LOAEL ≥ 20	ND	1	Ishida et al. (1982)	no data	no data	no data	no data	no data
Di-n-butyl phthalate	mg/kg bw/day	na	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Dioxins/furans	ng TEQ/kg bw/day	na	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	1000	LOAEL ≥ 20	20	1	Schwetz et al. (1973)
HPAHs	mg/kg bw/day	na	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
PCBs	mg/kg bw/day	na	no data	no data	no data	no data	no data	0.56	ED20	80	1	Lillie et al. (1974) & Cecil et al. (1974c); Lillie et al. (1975); Scott (1977) (pooled)	no data	no data	no data	no data	no data
American Kestrel [b]																	
Methylmercury	mg/kg bw/day	na	no data	no data	no data	no data	no data	0.25	ED20	80	1	Albers et al. (2007)	data not selected [c]	data not selected [c]	data not selected [c]	data not selected [c]	data not selected [c]
Mallard [b]																	
Aluminum	mg/kg bw/day	na	500	LOAEL ≥ 20	68	1	Capdevielle and Scanes (1995b)	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Cadmium	mg/kg bw/day	1.47	41	ED20	80	2	DiGiulio and Scanlon (1984)	20	LOAEL ≥ 20	29	1	White and Finley (1978)	39	LOAEL ≥ 20	10	1	VanVleet et al. (1981)
Copper	mg/kg bw/day	4.05	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	130	geometric mean	NA	1	VanVleet et al. (1981)
Methylmercury	mg/kg bw/day	na	no data	no data	no data	no data	no data	0.68	ED20	80	1	Heinz and Hoffman (1998); Heinz et al. (2010) (pooled)	no data	no data	no data	no data	no data
Nickel	mg/kg bw/day	6.71	87	ED20	80	1	Cain and Pafford (1981)	no data	no data	no data	no data	no data	80	ED20	80	1	Cain and Pafford (1981)
Selenium	mg/kg bw/day	0.29	1.6	ED20	80	1	Hoffman et al. (1992)	0.56	ED20	80	1	Heinz et al. (1989), Hoffmand and Heinz (1988) (pooled)	4.7	geometric mean	NA	1	Albers et al. (1996); Heinz and Fitzgerald (1993b) (pooled)
Mammals [b]																	
Aluminum	mg/kg bw/day	na	400	LOAEL ≥ 20	14	1	Belles et al. (1999)	27	ED20	80	1	Paternain et al. (1988)	400	LOAEL ≥ 20	44	1	Belles et al. (1999)
Antimony	mg/kg bw/day	0.059	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Barium	mg/kg bw/day	51.8	440	ED20	80	2	Dietz et al. (1992) (pooled)	no data	no data	no data	no data	no data	200	LOAEL ≥ 20	70	1	Borzelleca et al. (1988)
Chromium (III)	mg/kg bw/day	2.4	110	LOAEL ≥ 20	76	2	Bataineh et al. (1997)	91	LOAEL ≥ 20	63	2	Elbetieha and Al-Hamood (1997)	no data	no data	no data	no data	no data
Iron	mg/kg bw/day	na	140	geometric mean	NA	1	Banis et al. (1969); Storey and Greger (1987) (pooled)	no data	no data	no data	no data	no data	870	ED20	80	1	Whittaker et al. (1996)
Methylmercury	mg/kg bw/day	na	0.65	LOAEL ≥ 20	64	1	Mitsumori et al. (1983)	0.23	LOAEL ≥ 20	42	1	Verschuuren et al. (1976a)	0.24	ED20	80	1	Mitsumori et al. (1983); Verschuuren et al. (1976b) (pooled)
Molybdenum	mg/kg bw/day	na	28	LOAEL ≥ 20	46	1	Brinkman and Miller (1961)	4.5	ED20	80	2	Fungwe et al. (1990)	no data	no data	no data	no data	no data
Selenium	mg/kg bw/day	0.143	0.33	ED20	80	1	Mahan and Moxon (1984)	5.0	LOAEL ≥ 20	46	1	Seidenberg et al. (1986)	0.61	LOAEL ≥ 20	38	1	McAdam and Levander (1987)
Thallium	mg/kg bw/day	na	2.6	ED20	80	1	Downs et al. (1960) (two pooled data sets)	no data	no data	no data	no data	no data	2.1	ED20	80	1	Downs et al. (1960) (two pooled data sets)
PCBs	mg/kg bw/day	na	no data	no data	no data	no data	no data	0.082	LOAEL ≥ 20	62	1	Brunström et al. (2001)	no data	no data	no data	no data	no data
Dioxins/furans	ng TEQ/kg bw/day	na	10	ED20	80	1	DeCaprio et al. (1986) (pooled)	0.77	ED20	80	1	Hochstein et al. (1998)	29	LOAEL ≥ 20	40	1	DeCaprio et al. (1986)
Mink [b]																	
PCBs	mg/kg bw/day	na	no data	no data	no data	no data	no data	0.082	LOAEL ≥ 20	62	1	Brunström et al. (2001)	no data	no data	no data	no data	no data
Dioxins/furans	ng TEQ/kg bw/day	n/a	54	LOAEL ≥ 20	78	2	Hochstein et al. (1998)	0.77	ED20	80	1	Hochstein et al. (1998)	54	LOAEL ≥ 20	38	1	Hochstein et al. (1998)

Notes:

Green shading indicates selected effect levels, which were derived from the modeled effective ED20 or the lowest LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from the lowest tier study reviewed.

[a] See Attachment H2 references section for full citations.

[b] Effect levels for birds and mammals are generic levels applied to all representative receptors in the BERA for which receptor-specific data are not available. American kestrel, mallard, and mink are representative receptors for which receptor-specific data are available.

c The effect level from Bennett et al. (2009) is not selected for American kestrel survival because the LOAEL ≥ 20 is a level at which 100 percent mortality occurred, indicating that it is not likely to be a protective value.

bw - body weight

Eco-SSL – ecological soil screening level

ED20 - dose with a 20 percent reduction in the response relative to the control

HPAH - high-molecular-weight polyaromatic hydrocarbon

LOAEL - lowest-observed-adverse-effect level

NA - not applicable

na - not available

ND - no data; Ishida et al. (1982) indicated that egg production ceased in birds at the lowest dose level, but data were not provided to determine effects relative to the control. It is assumed that because reproduction ceased completely, the reduction was at least 20 percent greater than in the control.

PCB - polychlorinated biphenyl

TRV - toxicity reference value

Table H2-19. Summary of TRVs

COPC or COI	Units	Growth		Reproduction		Survival	
		TRV	TRV Type	TRV	TRV Type	TRV	TRV Type
Birds [a]							
Aluminum	mg/kg bw/day	150	ED20	none	NA	560	LOAEL ≥ 20
Antimony	mg/kg bw/day	none	NA	none	NA	none	NA
Arsenic	mg/kg bw/day	20	LOAEL ≥ 20	40	LOAEL ≥ 20	6.9	ED20
Barium	mg/kg bw/day	480	ED20	none	NA	890	LOAEL ≥ 20
Beryllium	mg/kg bw/day	none	NA	none	NA	none	NA
Chromium (III)	mg/kg bw/day	510	LOAEL ≥ 20	none	NA	none	NA
Iron	mg/kg bw/day	160	LOAEL ≥ 20	none	NA	1,100	ED20
Methylmercury	mg/kg bw/day	0.97	ED20	0.012	ED20	0.051	LOAEL ≥ 20
Molybdenum	mg/kg bw/day	100	ED20	36	ED20	610	ED20
Nickel	mg/kg bw/day	6.8	ED20	6.71 [b]	Eco-SSL	60	ED20
Selenium	mg/kg bw/day	0.29 [b]	Eco-SSL	0.55	ED20	0.59	LOAEL ≥ 20
Thallium	mg/kg bw/day	none	NA	none	NA	none	NA
Vanadium	mg/kg bw/day	1.2	ED20	2.1	LOAEL ≥ 20	2.4	ED20
Bis(2-ethylhexyl)phthalate	mg/kg bw/day	none	NA	350	LOAEL ≥ 20	none	NA
Di-n-butyl phthalate	mg/kg bw/day	none	NA	none	NA	none	NA
HPAHs	mg/kg bw/day	none	NA	none	NA	none	NA
PCBs [c]	mg/kg bw/day	none	NA	0.56	ED20	none	NA
PCB TEQ [c] Dioxin/furan TEQ [c] Total TEQ [c]	ng/kg bw/day	none	NA	none	NA	1,000	LOAEL ≥ 20
American Kestrel [a]							
Methylmercury	mg/kg bw/day	none	NA	0.25	ED20	none	NA
Mallard [a]							
Aluminum	mg/kg bw/day	500	LOAEL ≥ 20	none	NA	none	NA
Cadmium	mg/kg bw/day	41	ED20	20	LOAEL ≥ 20	39	LOAEL ≥ 20
Copper	mg/kg bw/day	none	NA	none	NA	130	geometric mean
Methylmercury	mg/kg bw/day	none	NA	0.68	ED20	none	NA
Nickel	mg/kg bw/day	87	ED20	none	NA	80	ED20
Selenium	mg/kg bw/day	1.6	ED20	0.56	ED20	4.7	geometric mean
Mammals [a]							
Aluminum	mg/kg bw/day	400	LOAEL ≥ 20	27	ED20	400	LOAEL ≥ 20
Antimony	mg/kg bw/day	none	NA	none	NA	none	NA
Barium	mg/kg bw/day	440	ED20	none	NA	200	LOAEL ≥ 20
Chromium (III)	mg/kg bw/day	110	LOAEL ≥ 20	91	LOAEL ≥ 20	none	NA
Iron	mg/kg bw/day	140	geometric mean	none	NA	870	ED20
Methylmercury	mg/kg bw/day	0.65	LOAEL ≥ 20	0.23	LOAEL ≥ 20	0.24	ED20
Molybdenum	mg/kg bw/day	28	LOAEL ≥ 20	4.5	ED20	none	NA
Selenium	mg/kg bw/day	0.33	ED20	5.0	LOAEL ≥ 20	0.61	LOAEL ≥ 20
Thallium	mg/kg bw/day	2.6	ED20	none	NA	2.1	ED20
PCBs [c]	mg/kg bw/day	none	NA	0.082	LOAEL ≥ 20	none	NA
PCB TEQ [d] Dioxin/furan TEQ [d] Total TEQ [d]	ng/kg bw/day	10	ED20	0.77	ED20	29	LOAEL ≥ 20

Table H2-19. Summary of TRVs

COPC or COI	Units	Growth		Reproduction		Survival	
		TRV	TRV Type	TRV	TRV Type	TRV	TRV Type
Mink [a]							
PCB TEQ [d]							
Dioxin/furan TEQ [d]	ng/kg bw/day	54	LOAEL ≥ 20	0.77	ED20	54	LOAEL ≥ 20
Total TEQ [d]							

Notes:

Green shading indicates selected TRVs. TRVs were derived from the lowest value from the lowest tier from among the following values: 1) modeled effective ED20 from an individual data set; 2) LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set; or 3) ED20 or geometric mean of LOAELs ≥ 20 from a pooled data set.

[a] TRVs for birds and mammals are generic levels applied to all representative receptors in the BERA for which receptor-specific data are not available. American kestrel, mallard, and mink are representative receptors for which receptor-specific data are available.

[b] The selected TRV is the Eco-SSL because the lowest effect level is less than the Eco-SSL.

[c] TRVs for PCBs are derived from toxicity studies conducted with Aroclor 1248 for birds and Clophen A50 for mammals.

[d] TRVs for PCB TEQ, dioxin/furan TEQ, and total TEQ are derived from toxicity studies with 2,3,7,8-tetrachlorodibenzodioxin.

bw - body weight

COI - chemical of interest

COPC - chemical of potential concern

Eco-SSL - ecological soil screening level

ED20 - dose with a 20 percent reduction in the response relative to the control

HPAH - high-molecular-weight polyaromatic hydrocarbon

LOAEL - lowest-observed-adverse-effect level

NA - not applicable

PCB - polychlorinated biphenyl

TEQ - toxic equivalent

TRV - toxicity reference value

Table H2-20. Updated receptor-specific TRVs

	Growth		Reproduction		Survival	
Chemical - Receptor	TRV (mg/kg bw/day)	TRV Type	TRV (mg/kg bw/day)	TRV Type	TRV (mg/kg bw/day)	TRV Type
Cadmium - mallard	41	ED20	20	LOAEL ≥ 20	39 [a]	LOAEL ≥ 20
Copper - mallard	none	NA	none	NA	130 [b]	geometric mean

Notes:

TRVs that have been updated from the original wildlife TRV document (Windward 2019) are highlighted in blue. Receptor-specific TRVs were added for cadmium and copper survival endpoints for mallard.

[a] This LOAEL ≥ 20 was incorrectly reported as 130 mg/kg bw/day in Table 4-1 in the original wildlife TRV document (Windward 2019). Data source: Van Vleet et al. (1981).
[b] Data source: Van Vleet et al. (1981)
bw - body weight
ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)
LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control
NA - not applicable
TRV - toxicity reference value

Table H2-21. Uncertainty Considerations for Selected Avian Effect Levels for Aluminum

	Growth	Growth - Mallard [a]	Reproduction	Survival
Selected Effect Level Details				
Dose (mg/kg bw/day)	150	500	no data	560
Reference [b]	Capdevielle and Scanes (1995a)	Capdevielle and Scanes (1995b)	NA	Capdevielle and Scanes (1995a)
Receptor used in study	chicken	mallard	NA	chicken
Considerations in Study Used to Derive Selected Effect Level				
Is species a representative receptor for the Aquatic BERA?	no	yes	NA	no
Dose administration	diet	diet	NA	diet
Growth study exposure	critical lifestage	critical lifestage	NA	NA
Chemical form	aluminum sulfate	aluminum sulfate	NA	aluminum sulfate
Source of body weight and FIR	body weight and FIR – secondary source	body weight – study; FIR – secondary source	NA	body weight and FIR – secondary source
Type of effect level	ED20 [c]	LOAEL ≥ 20 (32% reduction in response relative to the control)	NA	LOAEL ≥ 20 (25% reduction in response relative to the control)
Level of Confidence and Bias				
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	NA	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature				
Number of species with LOAEL ≥ 20 or ED20	two (chicken, mallard)	NA	NA	one (chicken)
Number of dose-response data sets evaluated	4 - Tier 1	1 - Tier 1	NA	1 - Tier 1

Notes:

[a] Effect level for the growth endpoint from mallard studies are receptor-specific and will be used to evaluate risk to mallards in the UCR.

[b] See Attachment H2 references section for full citations.

[c] Data were insufficient to calculate confidence limits for the growth ED20 (see Table H2.D-1 in Annex D).

[d] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 - effective dose with a 20 percent reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

UCR - Upper Columbia River

Table H2-22. Uncertainty Considerations for Selected Mammalian Effect Levels for Aluminum

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	400	27	400
Reference [a]	Belles et al. (1999)	Paternain et al. (1988)	Belles et al. (1999)
Receptor used in study	mouse	rat	mouse
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	no
Dose administration	gavage	gavage	gavage
Growth study exposure	non-critical lifestage, < 10% of lifespan	NA	NA
Chemical form	aluminum nitrate nonahydrate	aluminum nitrate nonahydrate	aluminum nitrate nonahydrate
Source of body weight and FIR	NA (doses reported in the study)	NA (doses reported in the study)	NA (doses reported in the study)
Type of effect level	LOAEL ≥ 20 (86% reduction in response relative to the control)	ED20 [b]	LOAEL ≥ 20 (56% reduction in response relative to the control)
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) exposure life stage and duration (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [c] dose administration (unknown)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	two (mouse, rat)	two (mouse, rat)	one (mouse)
Number of dose-response data sets evaluated	2 - Tier 1, 2 - Tier 2	6 - Tier 1	1 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Data were insufficient to calculate confidence limits for the reproduction ED20 (see Table H2.D-1 in Annex D).

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 - effective dose with a 20 percent reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-23. Uncertainty Considerations for Avian Selected Effect Levels for Arsenic

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	20	40	6.9
Reference [a]	Hoffman et al. 1992	Stanley et al. 1994	Albert et al. 2008b
Receptor used in study	mallard duck	mallard duck	zebra finch
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	yes	yes	no
Dose administration	diet	diet	gavage
Growth study exposure	critical lifestage	NA	NA
Chemical form	sodium arsenate	sodium arsenate	monomethylarsonic acid
Source of BW and FIR	body weight – study; FIR – secondary source	body weight and FIR – secondary source	NA (doses reported in the study)
Type of effect level	LOAEL ≥ 20 (31% reduction in response relative to the control)	LOAEL ≥ 20 (84% reduction in response relative to the control)	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) chemical form (high) [d]
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (mallard)	one (mallard)	one (zebra finch)
Number of dose-response datasets evaluated	6 - Tier 1; 2 - Tier 2	1 - Tier 1	2 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled survival ED20 are presented in Table H2.D-1 of Annex D.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

[d] Inorganic arsenic is known to be more toxic than organic arsenic; an organic form was used in this study.

BERA - baseline ecological risk assessment

bw/BW - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

mg/kg bw/day - milligrams per kilogram of body weight per day

NA – not applicable

Table H2-24. Uncertainty Considerations for Selected Avian Effect Levels for Barium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	480	no data	890
Reference [a]	Johnson et al. (1960)	NA	Johnson et al. (1960) (two data sets)
Receptor used in study	chicken	NA	chicken
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	NA	no
Dose administration	diet	NA	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	barium acetate	NA	barium hydroxide, barium acetate
Source of body weight and FIR	body weight and FIR – secondary source	NA	body weight and FIR – secondary source
Type of effect level	ED20 [b]	NA	LOAEL ≥ 20 (56% and 68% reduction in response relative to the control)
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	NA	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (chicken)	NA	one (chicken)
Number of dose-response data sets evaluated	2 - Tier 1	NA	2 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled growth ED20 are presented in Table H2.D-1 of Annex D.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-25. Uncertainty Considerations for Selected Mammalian Effect Levels for Barium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	440	no data	200
Reference [a]	Dietz et al. 1992 (pooled)	NA	Borzelleca et al. 1988
Receptor used in study	mouse	NA	rat
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	NA	no
Dose administration	drinking water	NA	gavage
Growth study exposure	critical lifestage, >10% of lifespan	NA	NA
Chemical form	barium chloride dihydrate	NA	barium chloride
Source of body weight and FIR	body weight and water ingestion rate – study	NA	NA (doses reported in the study)
Type of effect level	ED20 [b]	NA	LOAEL ≥ 20 (30% reduction in response relative to the control)
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (low)	NA	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (mouse)	NA	two (mouse, rat)
Number of dose-response data sets evaluated	5 - Tier 2	NA	1 - Tier 1, 3 - Tier 2

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled growth ED20 are presented in Table H2.D-1 of Annex D.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-26. Uncertainty Considerations for Selected Avian Effect Levels for Chromium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	510	no data	no data
Reference [a]	Chung et al. (1985)	NA	NA
Receptor used in study	chicken	NA	NA
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	NA	NA
Dose administration	diet	NA	NA
Growth study exposure	critical lifestage	NA	NA
Chemical form	chromium sulfate	NA	NA
Source of body weight and FIR	body weight and FIR – secondary source	NA	NA
Type of effect level	LOAEL ≥ 20 (43% reduction in response relative to the control)	NA	NA
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [b] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	NA	NA
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (chicken)	NA	NA
Number of dose-response data sets evaluated	2 - Tier 1	NA	NA

Notes:

[a] See Attachment H2 references section for full citations.

[b] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment
bw - body weight
ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)
FIR - food ingestion rate
LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control
NA - not applicable

Table H2-27. Uncertainty Considerations for Selected Mammalian Effect Levels for Chromium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	110	91	no data
Reference [a]	Bataineh et al. (1997)	Elbetieha and Al-Hamood (1997)	NA
Receptor used in study	rat	mouse	NA
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	NA
Dose administration	drinking water	drinking water	NA
Growth study exposure	> 10% of lifespan	NA	NA
Chemical form	chromium chloride	chromium chloride	NA
Source of body weight and FIR	body weight – study; FIR – secondary source	body weight – study; water ingestion rate – secondary source	NA
Type of effect level	LOAEL ≥ 20 (24% reduction in response relative to the control)	LOAEL ≥ 20 (37% reduction in response relative to the control)	NA
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [b] (unknown) dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [b] (unknown) dose administration (low) estimated water ingestion rate (unknown) effect level based on LOAEL ≥ 20 (high)	NA
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (rat)	one (mouse)	NA
Number of dose-response data sets evaluated	2 - Tier 2	2 - Tier 2	NA

Notes:

[a] See Attachment H2 references section for full citations.

[b] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-28. Uncertainty Considerations for Selected Avian Effect Levels for Iron

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	160	no data	1,100
Reference [a]	McGhee et al. (1965)	NA	Pescatore and Harter-Dennis (1989); Wallner-Pendleton et al. (1986) (pooled)
Receptor used in study	chicken	NA	chicken
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	NA	no
Dose administration	diet	NA	gavage
Growth study exposure	critical lifestage	NA	NA
Chemical form	iron sulfate	NA	iron sulfate
Source of body weight and FIR	body weight – study; FIR – secondary source	NA	body weight – study and secondary source; FIR – NA (gavage study)
Type of effect level	LOAEL ≥ 20 (24% reduction in response relative to the control)	NA	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	NA	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (high) [d] estimated body weight (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (chicken)	NA	one (chicken)
Number of dose-response data sets evaluated	3 - Tier 1	NA	3 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled survival ED20 are presented in Table H2.D-1 of Annex D.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

[d] Dose was administered via gavage as a single dose, which could reflect a higher toxicity threshold than a chronic dose.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-29. Uncertainty Considerations for Selected Mammalian Effect Levels for Iron

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	140	no data	870
Reference [a]	Banis et al. (1969); Storey and Greger (1987) (pooled)	NA	Whittaker et al. (1996)
Receptor used in study	rat	NA	rat
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	NA	no
Dose administration	diet	NA	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	iron sulfate	NA	carbonyl iron
Source of body weight and FIR	body weight - study and secondary source; FIR - secondary source	NA	body weight and FIR - secondary source
Type of effect level	geometric mean	NA	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	NA	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (rat)	NA	one (rat)
Number of dose-response data sets evaluated	8 - Tier 1	NA	3 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Data were insufficient to calculate confidence limits for the survival ED20 (see Table H2.D-1 in Annex D).

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-30. Uncertainty Considerations for Selected Avian Effect Levels for Methylmercury

	Growth	Reproduction	Reproduction - American Kestrel [a]	Reproduction - Mallard [a]	Survival
Selected Effect Level Details					
Dose (mg/kg bw/day)	0.97	0.012	0.25	0.68	0.051
Reference [b]	Scott et al. (1975)	Varian-Ramos et al. (2014)	Albers et al. (2007)	Heinz and Hoffman (1998); Heinz et al. (2010) (pooled)	Varian-Ramos et al. (2014)
Receptor used in study	chicken	finch	American kestrel	mallard	finch
Considerations in Study Used to Derive Selected Effect Level					
Is species a representative receptor for the Aquatic BERA?	no	no	yes	yes	no
Dose administration	diet	diet	diet	diet	diet
Growth study exposure	non-critical lifestage, <10% of lifespan	NA	NA	NA	NA
Chemical form	methylmercury chloride	methylmercury cysteine	methylmercury chloride	methylmercury chloride	methylmercury cysteine
Source of body weight and FIR	body weight and FIR – secondary source	body weight and FIR – secondary source	body weight and FIR – secondary source	body weight – study; FIR – secondary source	body weight and FIR – secondary source
Type of effect level	ED20 [c]	ED20 [c]	ED20 [c]	ED20 [c]	LOAEL ≥ 20 (23-24% reduction in response relative to the control)
Level of Confidence and Bias					
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) exposure life stage and duration (unknown) estimated body weight and FIR (unknown)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated FIR (unknown)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature					
Number of species with LOAEL ≥ 20 or ED20	one (chicken)	five (chicken, finch, kestrel, mallard, quail)	NA	NA	three (finch, kestrel, quail)
Number of dose-response data sets evaluated	3 - Tier 1, 1 - Tier 2	23 - Tier 1	4 - Tier 1	5 - Tier 1	12 - Tier 1

Notes:

[a] Effect levels for the reproduction endpoint for American kestrel and mallard are receptor-specific and will be used to evaluate risk to American kestrels and mallards in the UCR.

[b] See Attachment H2 references section for full citations.

[c] Data were insufficient to calculate confidence limits for the growth and reproduction ED20s (see Table H2.D-1 in Annex D).

[d] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment
bw - body weight
ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)
FIR - food ingestion rate
LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control
NA - not applicable

Table H2-31. Uncertainty Considerations for Selected Mammalian Effect Levels for Methylmercury

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	0.65	0.23	0.24
Reference [a]	Mitsumori et al. (1983)	Verschuuren et al. (1976a)	Mitsumori et al. (1983) (two data sets); Verschuuren et al. (1976b) (two data sets) (pooled)
Receptor used in study	rat	rat	rat
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	no
Dose administration	diet	diet	diet
Growth study exposure	critical lifestage, > 10% of lifespan	NA	NA
Chemical form	methylmercury chloride	methylmercury chloride	methylmercury chloride
Source of body weight and FIR	body weight - study; FIR - secondary source	body weight - study; FIR - secondary source	body weight - study; FIR - secondary source
Type of effect level	LOAEL ≥ 20 (36% reduction in response relative to the control)	LOAEL ≥ 20 (58% reduction in response relative to the control)	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated FIR (unknown)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated FIR (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	three (mink, mouse, rat)	one (rat)	two (mouse, rat)
Number of dose-response data sets evaluated	6 - Tier 1, 2 - Tier 2	3 - Tier 1	5 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled survival ED20 are presented in Table H2.D-1 of Annex D.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-32. Uncertainty Considerations for Selected Avian Effect Levels for Molybdenum

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	100	36	610
Reference [a]	Davies et al. (1960) (two pooled data sets)	Lepore and Miller (1965)	Davies et al. (1960)
Receptor used in study	chicken	chicken	chicken
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	no
Dose administration	diet	diet	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	sodium molybdate	sodium molybdate	sodium molybdate
Source of body weight and FIR	body weight and FIR – secondary source	body weight and FIR – secondary source	body weight and FIR – secondary source
Type of effect level	ED20 [b]	ED20 [b]	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	two (chicken, bobwhite quail)	one (chicken)	one (chicken)
Number of dose-response data sets evaluated	5 - Tier 1	1 - Tier 1	2 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled growth and survival ED20s are presented in Table H2.D-1 of Annex D. Data were insufficient to calculate confidence limits for the reproduction ED20.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-33. Uncertainty Considerations for Selected Mammalian Effect Levels for Molybdenum

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	28	4.5	no data
Reference [a]	Brinkman and Miller (1961)	Fungwe et al. (1990)	NA
Receptor used in study	rat	rat	NA
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	NA
Dose administration	diet	drinking water	NA
Growth study exposure	critical lifestage	NA	NA
Chemical form	sodium molybdate	sodium molybdate	NA
Source of body weight and FIR	body weight and FIR – secondary source	body weight - secondary source; water ingestion rate - study	NA
Type of effect level	LOAEL ≥ 20 (54% reduction in response relative to the control)	ED20 [b]	NA
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (low) estimated body weight (unknown)	NA
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (rat)	one (rat)	NA
Number of dose-response data sets evaluated	4 - Tier 1, 2 - Tier 2	1 - Tier 2	NA

Notes:

[a] See Attachment H2 references section for full citations.

[b] Data were insufficient to calculate confidence limits for the reproduction ED20 (see Table H2.D-1 in Annex D).

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-34. Uncertainty Considerations for Avian Selected Effect Levels for Nickel

	Growth	Growth - Mallard [a]	Reproduction	Survival	Survival - Mallard [a]
Selected Effect Level Details					
Dose (mg/kg bw/day)	6.8	87	0.54[b]	60	80
Reference [c]	Hill 1979, Hill 1985 (2 pooled datasets)	Cain and Pafford 1981	Arpasova et al. 2007	Ling and Leach 1979	Cain and Pafford 1981
Receptor used in study	chicken	mallard duck	chicken	chicken	mallard duck
Considerations in Study Used to Derive Selected Effect Level					
Is species a representative receptor for the Aquatic BERA?	no	yes	no	no	yes
Dose administration	diet	diet	drinking water	diet	diet
Growth study exposure	critical lifestage	critical lifestage	NA	NA	NA
Chemical form	nickel chloride	nickel sulfate	nickel chloride	nickel chloride	nickel sulfate
Source of body weight and FIR	body weight and FIR – secondary source	body weight – study; FIR – secondary source	body weight – study; water ingestion rate – secondary source	body weight and FIR – secondary source	body weight – study; FIR – secondary source
Type of effect level	ED20 [d]	ED20 [d]	ED20 [d]	ED20 [d]	ED20 [d]
Level of Confidence and Bias					
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [e] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated FIR (unknown)	not a representative receptor for the Aquatic BERA [e] (unknown) dose administration (unknown) estimated water ingestion rate (unknown)	not a representative receptor for the Aquatic BERA [e] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated FIR (unknown)
Considerations Associated with Available Literature					
Number of species with LOAEL ≥ 20 or ED20	two (chicken, mallard)	NA	one (chicken)	two (chicken, mallard)	NA
Number of dose-response datasets evaluated	8 - Tier 1	2 - Tier 1	1 - Tier 2	2 - Tier 1	1 - Tier 1

Notes:

[a] Effect levels for the growth and survival endpoints from mallard studies are receptor-specific and will be used to evaluate risk to mallards in the UCR.

[b] This dose is less than the Eco-SSL of 6.71 mg/kg bw/day; the Eco-SSL is the lowest effect level for TRV derivation.

[c] See Attachment H2 references section for full citations.

[d] Confidence limits associated with the modeled survival ED20 are presented in Table H2.D-1 of Annex D. Data were insufficient to calculate confidence limits for the growth, reproduction, and mallard survival ED20s.

[e] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

Eco-SSL - ecological soil screening level

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

TRV - toxicity reference value

UCR - Upper Columbia River

Table H2-35. Uncertainty Considerations for Selected Avian Effect Levels for Selenium

	Growth	Growth - Mallard [a]	Reproduction	Reproduction - Mallard [a]	Survival	Survival - Mallard [a]
Selected Effect Level Details						
Dose (mg/kg bw/day)	0.28	1.6	0.55	0.56	0.59	4.7
Reference [b]	Dafalla and Adam (1986); El-Begearmi and Combs (1982) (two data sets); Jensen (1986) (pooled)	Hoffman et al. (1992)	Ort and Latshaw (1978)	Heinz et al. (1989); Hoffman and Heinz (1988) (pooled)	Arnold et al. (1973)	Albers et al. (1996); Heinz and Fitzgerald (1993b) (pooled)
Receptor used in study	chicken	mallard	chicken	mallard	chicken	mallard
Considerations in Study Used to Derive Selected Effect Level						
Is species a representative receptor for the Aquatic BERA?	no	yes	no	yes	no	yes
Dose administration	diet	diet	diet	diet	diet	diet
Growth study exposure	critical lifestage	critical lifestage	NA	NA	NA	NA
Chemical form	sodium selenite	seleno-DL-methionine	sodium selenite	selenomethionine	sodium selenite	seleno-DL-methionine
Source of body weight and FIR	body weight – study (one data set) and secondary source (three data sets); FIR – secondary source	body weight – study; FIR – secondary source	body weight and FIR – secondary source	body weight – study and secondary source; FIR – secondary source	body weight – study; FIR – secondary source	body weight – study; FIR – study and secondary source
Type of effect level	ED20 [c]	ED20 [c]	ED20 [c]	ED20 [c]	LOAEL ≥ 20 (35% reduction in response relative to the control)	LOAEL ≥ 20 (100% and 25% reduction in response relative to the control)
Level of Confidence and Bias						
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated FIR (unknown)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	dose administration (unknown) estimated body weight and FIR (unknown)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)	dose administration (unknown) estimated FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature						
Number of species with LOAEL ≥ 20 or ED20	two (chicken, duck)	NA	three (chicken, duck, owl)	NA	three (chicken, duck, quail)	NA
Number of dose-response data sets evaluated	13 - Tier 1, 2 - Tier 2	3 - Tier 1	12 - Tier 1	5 - Tier 1	9 - Tier 1	2 - Tier 1

Notes:

[a] Effect levels for the reproduction endpoint for mallard are receptor-specific and will be used to evaluate risk to mallards in the UCR.

[b] See Attachment H2 references section for full citations.

[c] Confidence limits associated with the modeled growth and reproduction ED20s are presented in Table H2.D-1 of Annex D. Data were insufficient to calculate confidence limits for the mallard growth and reproduction ED20s.

[d] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

Eco-SSL - ecological soil screening level

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

UCR - Upper Columbia River

Table H2-36. Uncertainty Considerations for Selected Mammalian Effect Levels for Selenium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	0.33	5.0	0.61
Reference [a]	Mahan and Moxon (1984)	Seidenberg et al. (1986)	McAdam and Levander (1987)
Receptor used in study	pig	mouse	rat
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	no
Dose administration	diet	gavage	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	sodium selenite	sodium selenate	sodium selenite
Source of body weight and FIR	body weight and FIR – study	doses reported in the study	body weight and FIR – secondary source
Type of effect level	ED20 [b]	LOAEL ≥ 20 (54% reduction in response relative to the control)	LOAEL ≥ 20 (62% reduction in response relative to the control)
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	four (hamster, mouse, pig, rat)	one (mouse)	four (hamster, mouse, pig, rat)
Number of dose-response data sets evaluated	11 - Tier 1, 3 - Tier 2	6 - Tier 1	9 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Confidence limits associated with the modeled growth ED20 are presented in Table H2.D-1 of Annex D.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-37. Uncertainty Considerations for Selected Mammalian Effect Levels for Thallium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	2.1	no data	2.6
Reference [a]	Downs et al. (1960) (pooled)	NA	Downs et al. (1960) (pooled)
Receptor used in study	rat	NA	rat
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	NA	no
Dose administration	diet	NA	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	thallic oxide	NA	thallic oxide
Source of body weight and FIR	body weight – study; FIR – secondary source	NA	body weight – study; FIR – secondary source
Type of effect level	ED20 [b]	NA	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated FIR (unknown)	NA	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated FIR (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (rat)	NA	one (rat)
Number of dose-response data sets evaluated	2 - Tier 1	NA	2 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Data were insufficient to calculate confidence limits for the growth and survival ED20s (see Table D-1 in Annex D).

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment
bw - body weight
ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)
FIR - food ingestion rate
LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control
NA - not applicable

Table H2-38. Uncertainty Considerations for Selected Avian Effect Levels for Vanadium

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	1.2	2.1	2.4
Reference [a]	Berg and Lawrence (1971)	Toussant and Latshaw (1994)	Blalock and Hill (1987)
Receptor used in study	chicken	chicken	chicken
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	no	no	no
Dose administration	diet	diet	diet
Growth study exposure	critical lifestage	NA	NA
Chemical form	vanadyl sulfate	ammonium metavanadate	vanadyl chloride
Source of body weight and FIR	body weight and FIR – secondary source	body weight and FIR – secondary source	body weight and FIR – secondary source
Type of effect level	ED20 [b]	LOAEL ≥ 20 (49% reduction in response relative to the control)	ED20 [b]
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	one (chicken)	one (chicken)	one (chicken)
Number of dose-response data sets evaluated	15 - Tier 1	4 - Tier 1	9 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Data were insufficient to calculate confidence limits for the growth and survival ED20s (see Table D-1 in Annex D).

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-39. Uncertainty Considerations for Avian Selected Effect Levels for Bis(2-ethylhexyl)phthalate

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	no data	349	no data
Reference [a]	NA	Ishida et al. 1982	NA
Receptor used in study	NA	chicken	NA
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	NA	no	NA
Dose administration	NA	diet	NA
Growth study exposure	NA	NA	NA
Chemical form	NA	bis(2-ethylhexyl)phthalate	NA
Source of BW and FIR	NA	body weight and FIR – secondary source	NA
Type of effect level	NA	LOAEL ≥ 20 assumed (data not provided to calculate response relative to the control) [b]	NA
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	NA	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown) effect level based on assumed LOAEL ≥ 20 (high) no data on effect relative to control (unknown)	NA
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	NA	one (chicken)	NA
Number of dose-response datasets evaluated	NA	2 - Tier 1	NA

Notes:

[a] See Attachment H2 references section for full citations.

[b] Study reported that egg production stopped completely in dosed groups but did not report egg production levels in the control group. In addition, it is noted that the cessation of egg-laying could have been due to reduced food consumption caused by the unpalatability of the dosed food used in the Ishida et al. (1982) study; this was the case in Wood and Bitman (1984) for 2-ethylhexanol.

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

Table H2-40. Uncertainty Considerations for Avian Selected Effect Levels for PCBs

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	NRV	0.56	NRV
Reference [a]	NRV	Lillie et al. 1974; Cecil et al. 1974; Lillie et al. 1975; Scott 1977 (pooled datasets)	NRV
Receptor used in study	NRV	chicken	NRV
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	NRV	no	NRV
Dose administration	NRV	diet	NRV
Growth study exposure	NRV	NA	NRV
Chemical form	NRV	Aroclor 1248	NRV
Source of body weight and FIR	NRV	body weight and FIR – secondary source	NRV
Type of effect level	NRV	ED20 [b]	NRV
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	NRV	not a representative receptor for the Aquatic BERA [c] (unknown) dose administration (unknown) estimated body weight and FIR (unknown)	NRV
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	NRV	NA [d]	NRV
Number of dose-response datasets evaluated	NRV	21 - Tier 1	NRV

Notes:

[a] See Attachment H2 references section for full citations.

[b] Data were insufficient to calculate confidence limits for the reproduction ED20 (see Table H2.D-1 in Annex D).

[c] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

[d] Only chicken data were evaluated because of the known sensitivity of chickens to PCBs.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

NRV - not reviewed; PCB growth and survival data were not reviewed because of the known sensitivity of the reproduction endpoint to PCBs, and to focus the TRV derivation process since there were very few HQs>1 from the COPC refinement and HQs were relatively low.

PCB - polychlorinated biphenyl

Table H2-41. Uncertainty Considerations for Mammalian Selected Effect Levels for PCBs

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (mg/kg bw/day)	NRV	0.082	NRV
Reference [a]	NRV	Brunström et al. 2001	NRV
Receptor used in study	NRV	mink	NRV
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	NRV	yes	NRV
Dose administration	NRV	diet	NRV
Growth study exposure	NRV	NA	NRV
Chemical form	NRV	Clophen A50	NRV
Source of body weight and FIR	NRV	body weight and FIR – study	NRV
Type of effect level	NRV	LOAEL ≥ 20 (33% reduction in response relative to the control)	NRV
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	NRV	dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	NRV
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	NRV	NA [b]	NRV
Number of dose-response datasets evaluated	NRV	32 - Tier 1	NRV

Notes:

[a] See Attachment H2 references section for full citations.

[b] Only mink data were evaluated because of the known sensitivity of mink to PCBs.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

NRV - not reviewed; PCB growth and survival data were not reviewed because of the known sensitivity of the reproduction endpoint to PCBs, and to focus the TRV derivation process since there were very few HQs>1 from the COPC refinement and HQs were relatively low.

PCB - polychlorinated biphenyl

Table H2-42. Uncertainty Considerations for Avian Selected Effect Levels for 2,3,7,8-TCDD

	Growth	Reproduction	Survival
Selected Effect Level Details			
Dose (ng TEQ/kg bw/day)	no data	no data	1000
Reference [a]	NA	NA	Schwetz et al. 1973
Receptor used in study	NA	NA	chicken
Considerations in Study Used to Derive Selected Effect Level			
Is species a representative receptor for the Aquatic BERA?	NA	NA	no
Dose administration	NA	NA	oral intubation
Growth study exposure	NA	NA	NA
Chemical form	NA	NA	2,3,7,8 - TCDD
Source of body weight and FIR	NA	NA	NA (doses reported in the study)
Type of effect level	NA	NA	LOAEL ≥ 20 (80% reduction in response relative to the control)
Level of Confidence and Bias			
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	NA	NA	not a representative receptor for the Aquatic BERA [b] (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature			
Number of species with LOAEL ≥ 20 or ED20	NA	NA	one (chicken)
Number of dose-response datasets evaluated	NA	NA	1 - Tier 1

Notes:

[a] See Attachment H2 references section for full citations.

[b] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment

bw - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR – food ingestion rate

LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control

NA – not applicable

TCDD -

TEQ - toxic equivalent

Table H2-43. Uncertainty Considerations for Mammal Selected Effect Levels for Dioxins/Furans

	Growth	Reproduction	Survival	Growth - Mink[a]	Survival - Mink[a]
Selected Effect Level Details					
Dose (ng TEQ/kg bw/day)	10	0.77	29	54	54
Reference [b]	Decaprio et al. 1986 (2 pooled datasets)	Hochstein et al. 2001	DeCaprio et al. 1986	Hochstein et al. 1998	Hochstein et al. 1998
Receptor used in study	guinea pig	mink	guinea pig	mink	mink
Considerations in Study Used to Derive Selected Effect Level					
Is species a representative receptor for the Aquatic BERA?	no	yes	no	yes	yes
Dose administration	diet	diet	diet	diet	diet
Growth study exposure	critical lifestage	NA	NA	< 10% of lifespan, non-critical lifestage	NA
Chemical form	2,3,7,8 - TCDD	2,3,7,8 - TCDD	2,3,7,8 - TCDD	2,3,7,8 - TCDD	2,3,7,8 - TCDD
Source of body weight and FIR	NA (doses reported in study)	BW and FIR – secondary source (Hochstein et al. 1998)	NA (doses reported in the study)	BW and FIR – study	BW and FIR – study
Type of effect level	ED20 [c]	ED20 [c]	LOAEL ≥ 20 (60% reduction in response relative to the control)	LOAEL ≥ 20 (22% reduction in response relative to the control)	LOAEL ≥ 20 (62% reduction in response relative to the control)
Level of Confidence and Bias					
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown)	dose administration (unknown) estimated body weight and FIR (unknown)	not a representative receptor for the Aquatic BERA [d] (unknown) dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	dose administration (unknown) effect level based on LOAEL ≥ 20 (high)	dose administration (unknown) effect level based on LOAEL ≥ 20 (high)
Considerations Associated with Available Literature					
Number of species with LOAEL ≥ 20 or ED20	three (guinea pig, mink, rat)	two (mink, rat)	two (guinea pig, mink)	NA	NA
Number of dose-response datasets evaluated	3 - Tier 1; 1 - Tier 2	6 - Tier 1	2 - Tier 1	1 - Tier 2	1 - Tier 1

Notes:

[a] Effect level for the survival endpoint from the mink study is receptor-specific and will be used to evaluate risk to mink in the UCR.

[b] See Attachment H2 references section for full citations.

[c] Confidence limits associated with the modeled growth ED20 are presented in Table H2.D-1 of Annex D. Data were insufficient to calculate confidence limits for the reproduction ED20.

[d] Representative receptors are those selected for dietary modeling in the Aquatic BERA to represent the different feeding guilds.

BERA - baseline ecological risk assessment
bw/BW - body weight
ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)
FIR – food ingestion rate
LOAEL ≥ 20 – lowest observed adverse effect level with ≥20% reduction in the response relative to the control
NA – not applicable
TCDD - tetrachlorodibenzo-p-dioxin
TEQ - toxic equivalent

Table H2-44. Uncertainty Considerations for Updated Terrestrial Receptor-Specific TRVs

	Cadmium Survival - Mallard[a]	Copper Survival - Mallard[a]
Selected Effect Level Details		
Dose (mg/kg bw/day)	39	130
Reference[b]	Van Vleet et al. 1981	Van Vleet et al. 1981
Receptor used in study	Pekin duck	Pekin duck
Considerations in Study Used to Derive Selected Effect Level		
Is species a representative receptor for the Aquatic BERA?	yes	yes
Dose administration	diet	diet
Growth study exposure	NA	NA
Chemical form	cadmium sulfate	copper sulfate
Source of body weight and FIR	body weight and FIR – secondary source	body weight and FIR – secondary source
Type of effect level	LOAEL ≥ 20 (90% reduction in response relative to the control)	geomean (75 and 40% reduction in response relative to the control)
Level of Confidence and Bias		
Considerations decreasing the level of confidence in effect level (potential bias is indicated in parentheses)	dose administration (unknown) estimated body weight and FIR (unknown) effect level based on LOAEL ≥ 20 (high)	dose administration (unknown) estimated body weight and FIR (unknown) effect level based on geomean of LOAEL ≥ 20s (high)
Considerations Associated with Available Literature		
Number of species with LOAEL ≥ 20 or ED20	NA	NA
Number of dose-response data sets evaluated	1 - Tier 1	2 - Tier 1

Notes:

[a] TRV is receptor-specific and will be used to evaluate risk to the representative receptor in the BERA.

[b] See Attachment H2 references section for full citations.

BERA - baseline ecological risk assessment

bw/BW - body weight

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

FIR - food ingestion rate

LOAEL ≥ 20 - lowest-observed-adverse-effect level with ≥ 20 percent reduction in the response relative to the control

NA - not applicable

TRV - toxicity reference value

Table H2-45. Summary of All TRVs for Terrestrial Birds and Mammals

COPC or COI	Units	Growth		Reproduction		Survival	
		TRV	TRV Type	TRV	TRV Type	TRV	TRV Type
Birds [a]							
Aluminum	mg/kg bw/day	150	ED20	none	NA	560	LOAEL ≥ 20
Antimony	mg/kg bw/day	none	NA	none	NA	none	NA
Arsenic	mg/kg bw/day	20	LOAEL ≥ 20	40	LOAEL ≥ 20	6.9	ED20
Barium	mg/kg bw/day	480	ED20	none	NA	890	LOAEL ≥ 20
Beryllium	mg/kg bw/day	none	NA	none	NA	none	NA
Cadmium	mg/kg bw/day	2.0	ED20	2.3	ED20	7.4	ED20
Chromium (III)	mg/kg bw/day	510	LOAEL ≥ 20	none	NA	none	NA
Copper	mg/kg bw/day	62	ED20	28	ED20	67	ED20
Iron	mg/kg bw/day	160	LOAEL ≥ 20	none	NA	1,100	ED20
Lead	mg/kg bw/day	29	LOAEL ≥ 20	4.7	geometric mean	11	ED20
Managanese	mg/kg bw/day	none	NA	none	NA	none	NA
Methylmercury	mg/kg bw/day	0.97	ED20	0.012	ED20	0.051	LOAEL ≥ 20
Molybdenum	mg/kg bw/day	100	ED20	36	ED20	610	ED20
Nickel	mg/kg bw/day	7	ED20	6.71 [b]	Eco-SSL	60	ED20
Selenium	mg/kg bw/day	0.29 [b]	Eco-SSL	0.55	ED20	0.59	LOAEL ≥ 20
Thallium	mg/kg bw/day	none	NA	none	NA	none	NA
Vanadium	mg/kg bw/day	1.2	ED20	2.1	LOAEL ≥ 20	2.4	ED20
Zinc	mg/kg bw/day	66 [b]	Eco-SSL	77	ED20	250	LOAEL ≥ 20
Bis(2-ethylhexyl)phthalate	mg/kg bw/day	none	NA	350	LOAEL ≥ 20	none	NA
Di-n-butyl phthalate	mg/kg bw/day	none	NA	none	NA	none	NA
HPAHs	mg/kg bw/day	none	NA	none	NA	none	NA
PCBs [c]	mg/kg bw/day	none	NA	0.56	ED20	none	NA
PCB TEQ [d] Dioxin/furan TEQ [d] Total TEQ [d]	ng/kg bw/day	none	NA	none	NA	1,000	LOAEL ≥ 20
UCR Receptor-Specific Bird TRVs [a]							
Aluminum - mallard	mg/kg bw/day	500	LOAEL ≥ 20	none	NA	none	NA
Cadmium - mallard	mg/kg bw/day	41	ED20	20	LOAEL ≥ 20	39	LOAEL ≥ 20
Copper - mallard	mg/kg bw/day	none	NA	none	NA	130	geometric mean
Methylmercury - kestrel	mg/kg bw/day	none	NA	0.25	ED20	none	NA
Methylmercury - mallard	mg/kg bw/day	none	NA	0.68	ED20	none	NA
Nickel - mallard	mg/kg bw/day	87	ED20	none	NA	80	ED20
Selenium - mallard	mg/kg bw/day	1.6	ED20	0.56	ED20	4.7	geometric mean
Zinc - mallard	mg/kg bw/day	200	ED20	none	NA	330	LOAEL ≥ 20
Mammals [a]							
Aluminum	mg/kg bw/day	400	LOAEL ≥ 20	27	ED20	400	LOAEL ≥ 20
Antimony	mg/kg bw/day	none	NA	none	NA	none	NA
Barium	mg/kg bw/day	440	ED20	none	NA	200	LOAEL ≥ 20
Cadmium	mg/kg bw/day	4.2	ED20	2.7	ED20	1.5	ED20
Chromium (III)	mg/kg bw/day	110	LOAEL ≥ 20	91	LOAEL ≥ 20	none	NA
Copper	mg/kg bw/day	12	ED20	27	LOAEL ≥ 20	8.7	geometric mean
Iron	mg/kg bw/day	140	geometric mean	none	NA	870	ED20
Lead	mg/kg bw/day	20	LOAEL ≥ 20	4.7 [b]	Eco-SSL	7.6	ED20
Manganese	mg/kg bw/day	71	LOAEL ≥ 20	310	ED20	91	ED20
Methylmercury	mg/kg bw/day	0.65	LOAEL ≥ 20	0.23	LOAEL ≥ 20	0.24	ED20
Molybdenum	mg/kg bw/day	28	LOAEL ≥ 20	4.5	ED20	none	NA
Selenium	mg/kg bw/day	0.33	ED20	5.0	LOAEL ≥ 20	0.61	LOAEL ≥ 20
Thallium	mg/kg bw/day	2.6	ED20	none	NA	2.1	ED20
Zinc	mg/kg bw/day	75 [b]	Eco-SSL	75 [b]	Eco-SSL	190	geometric mean
PCBs [c]	mg/kg bw/day	none	NA	0.082	LOAEL ≥ 20	none	NA
PCB TEQ [d] Dioxin/furan TEQ [d] Total TEQ [d]	ng/kg bw/day	10	ED20	0.77	ED20	29	LOAEL ≥ 20
UCR Receptor-Specific Mammal TRVs [a]							
Copper - mink	mg/kg bw/day	35	LOAEL ≥ 20	27	LOAEL ≥ 20	35	LOAEL ≥ 20
PCB TEQ - mink [d] Dioxin/furan TEQ - mink [d] Total TEQ - mink [d]	ng/kg bw/day	54	LOAEL ≥ 20	0.77	ED20	54	LOAEL ≥ 20

Notes:

Green shading indicates selected TRVs. TRVs were derived from the lowest value from the lowest tier from among the following values: 1) modeled effective ED20 from an individual data set; 2) LOAEL with ≥ 20 percent reduction in the response relative to control (LOAEL ≥ 20) from an individual data set; or 3) ED20 or geometric mean of LOAELs ≥ 20 from a pooled data set.

[a] TRVs for birds and mammals are generic levels applied to all representative receptors in the BERA for which receptor-specific data are not available. American kestrel, mallard, and mink are representative receptors for which receptor-specific data are available.

[b] The selected TRV is the Eco-SSL because the lowest effect level is less than the Eco-SSL.

[c] TRVs for PCBs are derived from toxicity studies conducted with Aroclor 1248 for birds and Clophen A50 for mammals.

[d] TRVs for PCB TEQ, dioxin/furan TEQ, and total TEQ are derived from toxicity studies with 2,3,7,8-tetrachlorodibenzodioxin.

bw - body weight

COI - chemical of interest

COPC - chemical of potential concern

Eco-SSL - ecological soil screening level

ED20 – effect dose with a 20% reduction in the response relative to the control (modeled)

HPAH - high-molecular-weight polyaromatic hydrocarbon

LOAEL - lowest-observed-adverse-effect level

NA - not applicable

PCB - polychlorinated biphenyl

TEQ - toxic equivalent

TRV - toxicity reference value

ANNEX A

LITERATURE COMPILATION AND STUDY ACCEPTABILITY RESULTS

Table H2.A-1. Acronyms, Abbreviations, and Units of Measure

Term	Definition
Acronyms and Abbreviations	
A	additional studies reviewed if five data sets were not available from the top five studies
ABNM	abnormal
AD	adult
ALWT	albumin weight
BDWT	body weight changes
DEYO	death of young
DNF	data not found
DR	drinking water
Eco-SSL	ecological soil screening level
ED20	dose that causes a 20 percent effect
EG	egg response site
EGG	egg effect type
EGPN	egg production
EGWT	egg weight
EM	embryo
ENR	endpoint not relevant
EQUA	egg quality
ESQU	eggshell quality
ESTH	eggshell thickness
ESWT	eggshell weight
FD	food
GE	gestation
GGRO	general growth
GRO	growth
GREP	general reproduction
GV	gavage
HULT	humerus length
HM	humerus
HTCH	hatch
ICF	irrelevant chemical form
ID	insufficient data
IM	immature
JV	juvenile
LB	laying bird
LC	lactation
LOAEL	lowest-observed-adverse-effect level
M	measured
MA	mature
MOR	mortality effect type
MORT	mortality effect measure
MPH	morphology
NA	not applicable
na	not available
NDAY	number of days between eggs laid
NOAEL	no-observed-adverse-effect level
NR	not reported
NRV	not reviewed because five usable data sets were available in higher ranked studies
NT	no tier applied because study was not acceptable for TRV derivation
ODVP	offspring development
OR	oral
ORWT	organ weight changes
OV	ovary
P	studies included for pooling with a comparable study
PLBR	pairs with litter or brood
PROG	progeny numbers/counts
PRWT	progeny weight
REP	reproduction
RSEM	resorbed embryos
RSUC	reproductive success
RU	ruminant study
S	studies included for receptors not represented in the other studies reviewed
SDC	study design concern
SI	study inadequacies, as described in Lynch et al. 1999
SM	sexually mature
SPCL	sperm cell counts
SPCV	sperm cell viability
SURV	survival
T	top five study based on tier and lowest-observed-adverse-effect level (LOAEL)
TDTH	time to death
TE	testes
TERA	teratogenic measurements
TEWT	testes weight
TPRD	total production
TRV	toxicity reference value
U	unmeasured
UN	unbounded no-observed-adverse-effect level (NOAEL)
UX	measured but data not reported
WO	whole organism
YO	young
Units of Measure	
mg/kg bw	milligram(s) per kilogram of body weight
mg/kg bw/day	milligram(s) per kilogram of body weight per day

Table H2.A-2. Antimony Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
12	Rossi et al. (1987)	231	rat (*Rattus norvegicus*)	3	U	DR	31	days	NR	NR	GE	female	REP	PRWT	WO	0.0590	0.590	78	yes
13	Gurnani et al. (1993)	225	mouse (*Mus musculus*)	4	U	GV	14	days	8	weeks	JV	male	REP	SPCV	WO	835	na	79	no (ENR, UN)
Growth																			
14	Shroeder et al. (1970)	252	rat (*Rattus norvegicus*)	2	U	DR	725	days	21	days	JV	male	GRO	BDWT	WO	0.533	na	67	no (UN)
15	Kanisawa and Shroeder (1969)	3701	mouse (*Mus musculus*)	2	U	DR	519	days	21	days	JV	both	GRO	BDWT	WO	0.664	na	67	no (UN)
16	Poon et al. (1998)	224	rat (*Rattus norvegicus*)	5	UX	DR	13	weeks	7	weeks	JV	male	GRO	BDWT	WO	5.60	42.0	82	yes
17	Dieter (1992)	3780	rat (*Rattus norvegicus*)	6	U	DR	14	days	8	weeks	JV	both	GRO	BDWT	WO	67.0	na	78	no (UN)
18	Dieter (1992)	3780	mouse (*Mus musculus*)	6	U	DR	14	days	8	weeks	JV	female	GRO	BDWT	WO	106	161	84	no (ID)
19	Hext et al. (1999)	189	rat (*Rattus norvegicus*)	4	UX	FD	90	days	NR	NR	AD	male	GRO	BDWT	WO	1410	na	85	no (UN)
20	Rossi et al. (1987)	231	rat (*Rattus norvegicus*)	3	U	DR	20	days	NR	NR	GE	female	GRO	BDWT	WO	na	0.0590	72	yes
21	Shroeder et al. (1968)	238	mouse (*Mus musculus*)	2	U	DR	339	days	21	days	JV	female	GRO	BDWT	WO	na	0.678	66	yes
Survival																			
22	Poon et al. (1998)	224	rat (*Rattus norvegicus*)	5	UX	DR	13	weeks	NR	NR	IM	female	MOR	MORT	WO	46.0	na	74	no (UN)
23	Ainsworth et al. (1991)	221	short-tailed vole (*Microtus agrestis)*	2	U	FD	60	days	35	days	NR	male	MOR	MORT	WO	60.9	na	70	no (UN)
24	Dieter (1992)	3780	rat (*Rattus norvegicus*)	6	U	DR	14	days	8	weeks	JV	both	MOR	SURV	WO	66.6	na	78	no (UN)
25	Dieter (1992)	3780	mouse (*Mus musculus*)	6	U	DR	14	days	8	weeks	JV	male	MOR	MORT	WO	108	161	84	yes
26	Gurnani et al. (1993)	225	mouse (*Mus musculus*)	4	U	GV	21	days	8	weeks	JV	male	MOR	MORT	WO	557	835	91	no (ID)
27	Ainsworth et al. (1991)	270	short-tailed vole (*Microtus agrestis)*	3	U	FD	21	days	NR	NR	NR	NR	MOR	MORT	WO	673	na	73	no (UN)
28	Ainsworth et al. (1991)	270	mouse (*Mus musculus*)	3	U	FD	18	days	NR	NR	NR	NR	MOR	MORT	WO	826	na	73	no (UN)
29	Hext et al. (1999)	189	rat (*Rattus norvegicus*)	4	UX	FD	90	days	NR	NR	AD	male	MOR	MORT	WO	1408	na	86	no (UN)
30	Ainsworth et al. (1991)	221	short-tailed vole (*Microtus agrestis)*	3	U	FD	12	days	35	days	NR	male	MOR	MORT	WO	2440	na	74	no (UN)
31	Shroeder et al. (1970)	252	rat (*Rattus norvegicus*)	2	U	DR	784	days	21	days	JV	female	MOR	TDTH	WO	na	0.533	68	no (SI)

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
Not all studies presented in the antimony ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).
See Eco-SSL document (USEPA 2005a) for the full reference list for studies cited in this table.
[a] Rationale for study unacceptability is in parentheses.

Table H2.A-3. Arsenic Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
8	Holcman and Stibilj 1997	5305	chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	LB	F	REP	PROG	WO	2.24		72	no (UN)
Growth																			
10	Camardese et al. 1990	5747	mallard duck (*Anas platyrhynchos*)	4	UX	FD	2	w	1	d	JV	F	GRO	GGRO	WO		1.49	83	no (UN[b])
11	Howell and Hill 1978	1387	chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO		3.55	76	no (UN[b])
12	Hoffman et al. 1992	1376	mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	GRO	BDWT	WO		17.3	82	yes
9	Holcman and Stibilj 1997	5305	chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	SM	F	GRO	BDWT	WO	2.24		66	no (UN)
Survival																			
13	Holcman and Stibilj 1997	5305	chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	SM	F	MOR	MORT	WO	2.24		74	no (UN)
14	Howell and Hill 1978	1387	chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	MOR	MORT	WO	3.55		77	no (UN)
15	Camardese et al. 1990	5747	mallard duck (*Anas platyrhynchos*)	4	UX	FD	10	w	1	d	JV	B	MOR	MORT	WO	3.72		84	no (UN)
16	Hoffman et al. 1992	1376	mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	MOR	SURV	WO	17.3		83	no (UN)

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the arsenic ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2005) for the full reference list for studies cited in this table.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Rationale for study unacceptability is in parentheses

[b] Dose/response dataset was reviewed and determined to be an unbounded no-observed-adverse-effect level (NOAEL) (differs from the Eco-SSL document).

Table H2.A-4. Barium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
16	Dietz et al. 1992	18186	rat (*Rattus norvegicus*)	6	UX	DR	92	d	43-44	d	JV	M	REP	RHIS	TE	121		74	no (ENR, UN)
17	Borzelleca et al. 1988	18734	rat (*Rattus norvegicus*)	5	U	GV	10	d	37	d	JV	F	REP	RHIS	OV	138	198	87	no (ENR)
18	Dietz et al. 1992	18186	mouse *(Mus musculus)*	6	UX	DR	92	d	43-44	d	JV	F	REP	RHIS	TE	165	499	87	no (ENR)
Growth																			
19	Schroeder and Mitchener 1975	17086	rat (*Rattus norvegicus*)	2	U	DR	520	d	21	d	JV	B	GRO	BDWT	WO	0.57		72	no (UN)
20	Stoewsand et al. 1988	18053	rat (*Rattus norvegicus*)	2	U	FD	29	d	NR	NR	JV	M	GRO	BDWT	WO	16.5		76	no (UN)
21	Dietz et al. 1992	18186	rat (*Rattus norvegicus*)	6	UX	DR	92	d	43-44	d	JV	M	GRO	BDWT	WO	61.1	121	87	yes
22	Dietz et al. 1992	18186	mouse *(Mus musculus)*	6	UX	DR	92	d	43-44	d	JV	M	GRO	BDWT	WO	165	436	87	yes
23	Borzelleca et al. 1988	18734	rat (*Rattus norvegicus*)	5	U	GV	10	d	37	d	JV	B	GRO	BDWT	WO	198		84	no (UN)
24	Schroeder and Mitchener 1975	1858	mouse *(Mus musculus)*	2	U	DR	10	d	19-20	d	JV	F	GRO	BDWT	WO		0.74	67	yes
Survival																			
25	Dietz et al. 1992	18186	rat (*Rattus norvegicus*)	6	UX	DR	92	d	43-44	d	JV	M	MOR	MORT	WO	61.1	121	88	yes
26	Borzelleca et al. 1988	18734	rat (*Rattus norvegicus*)	5	U	GV	10	d	37	d	JV	F	MOR	MORT	WO	137	197	91	yes
27	Dietz et al. 1992	18186	mouse *(Mus musculus)*	6	UX	DR	13	d	43-44	d	JV	M	MOR	MORT	WO	165	436	88	yes

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the barium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2005c) for the full reference list for studies cited in this table.

Blank cells are shown as reported in the Eco-SSL document; no description was provided.

[a] Rationale for study unacceptability is in parentheses

Table H2.A-5. Chromium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
11	Jensen and Maurice (1980)	9749	chicken (*Gallus domesticus*)	2	U	FD	4	weeks	NR	NR	LB	female	REP	TPRD	WO	0.238	na	78	no (UN)
12	Maurice and Jensen (1979)	12571	chicken (*Gallus domesticus*)	2	U	FD	12	weeks	40	weeks	LB	female	REP	TPRD	WO	0.483	na	70	no (UN)
13	Jensen and Maurice (1980)	9749	chicken (*Gallus domesticus*)	2	U	FD	4	weeks	NR	NR	LB	female	REP	TPRD	WO	0.494	na	69	no (UN)
14	Haseltine et al. (unpublished)	3739	black duck (*Anas rubripes*)	3	U	FD	180-190	days	NR	NR	LB	female	REP	RSUC	WO	0.569	2.78	78	no (DNF)
15	Sauveur and Thapon (1983)	9621	chicken (*Gallus domesticus*)	2	U	FD	8	weeks	40	weeks	LB	female	REP	TPRD	WO	0.744	na	79	no (UN)
16	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	2	U	FD	6	days	50	weeks	LB	female	EGG	ESQU	SL	0.988	na	69	no (ENR, UN)
17	Meluzzi et al. (1996)	2771	chicken (*Gallus domesticus*)	4	U	FD	15	days	22	weeks	LB	female	EGG	ALWT	EG	37.7	75.4	81	no (ENR)
Growth																			
18	Maurice and Jensen (1979)	12571	chicken (*Gallus domesticus*)	2	U	FD	12	weeks	40	weeks	SM	female	GRO	BDWT	WO	0.483	na	68	no (UN)
19	Cupo and Donaldson (1987)	5971	chicken (*Gallus domesticus*)	2	U	FD	21	days	1	days	JV	male	GRO	BDWT	WO	1.45	na	77	no (UN)
20	Steele and Rosebrough (1979)	13720	turkey (*Meleagris gallopavo*)	4	U	FD	14	days	1	weeks	JV	both	GRO	BDWT	WO	6.42	na	77	no (UN)
21	Hill (1974)	92	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	85.9	na	76	no (UN)
22	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	AD	male	GRO	BDWT	WO	359	na	76	no (UN)
23	Motozono et al. (1998)	3067	chicken (*Gallus domesticus*)	3	U	FD	35	days	7	days	JV	female	GRO	BDWT	WO	na	9.91	73	no (ICF)
24	Nielsen et al. (1980)	15690	chicken (*Gallus domesticus*)	2	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	na	28.7	72	no (UN [b])
Survival																			
25	Hossain et al. (1998)	11682	chicken (*Gallus domesticus*)	2	U	FD	19	days	28	days	JV	both	MOR	MORT	WO	0.0248	na	79	no (UN)
26	Haseltine et al. (unpublished)	3739	black duck (*Anas rubripes*)	3	U	FD	10	m	NR	NR	MA	male	MOR	MORT	WO	0.557	2.78	77	no (DNF)
27	Hill (1974)	92	chicken (*Gallus domesticus*)	2	U	FD	5	weeks	1	days	JV	both	MOR	MORT	WO	85.9	na	77	no (UN)
28	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	AD	male	MOR	MORT	WO	359	na	77	no (UN)

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the chromium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2008) for the full reference list for studies cited in this table.

[a] Rationale for study unacceptability is in parentheses.

[b] Dose/response data set was reviewed and determined to be an unbounded no-observed-adverse-effect level (NOAEL) (differs from the Eco-SSL document).

Table H2.A-6. Chromium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
18	Zahid et al. (1990)	3098	mouse (*Mus musculus*)	4	U	FD	35	days	21	days	JV	male	REP	SPCL	TE	na	9.62	80	no (ENR)
19	Bataineh et al. (1997)	3009	rat (*Rattus norvegicus*)	2	U	DR	12	weeks	NR	NR	AD	male	REP	TEWT	TE	na	36.2	74	no (ENR)
20	Elbetieha and Al-Hamood (1997)	3025	mouse (*Mus musculus*)	3	U	DR	12	weeks	50	days	JV	female	REP	PROG	WO	na	91.1	73	yes
21	Elbetieha and Al-Hamood (1997)	3025	mouse (*Mus musculus*)	2	U	DR	12	weeks	50	days	JV	male	REP	ORWT	OV	na	228	74	no (ENR)
Growth																			
22	Van Heugten and Spears (1997)	25908	pig (*Sus scrofa*)	2	U	FD	32	days	3	weeks	JV	NR	GRO	BDWT	WO	0.00663	na	69	no (UN)
23	Kegley and Spears (1995)	25914	cattle (*Bos taurus*)	2	U	FD	56	days	NR	NR	JV	male	GRO	BDWT	WO	0.00933	na	69	no (UN)
24	Shroeder et al. (1963)	14446	rat (*Rattus norvegicus*)	2	U	DR	60	days	28	days	JV	male	GRO	BDWT	WO	0.537	na	66	no (UN)
25	Mooney and Cromwell (1997)	25905	pig (*Sus scrofa*)	2	M	FD	103	days	NR	NR	JV	both	GRO	BDWT	WO	0.595	na	74	no (UN)
26	Mooney and Cromwell (1997)	25905	pig (*Sus scrofa*)	3	M	FD	35	days	NR	NR	JV	both	GRO	BDWT	WO	0.927	na	74	no (UN)
27	Anderson et al. (1997)	3004	rat (*Rattus norvegicus*)	5	U	FD	20	weeks	4	weeks	JV	NR	GRO	BDWT	WO	8.09	na	68	no (UN)
28	Zahid et al. (1990)	3098	mouse (*Mus musculus*)	4	U	FD	35	days	21	days	JV	male	GRO	BDWT	WO	44.6	na	69	no (UN)
29	Elbetieha and Al-Hamood (1997)	3025	mouse (*Mus musculus*)	2	U	DR	12	weeks	50	days	JV	male	GRO	BDWT	WO	228	na	72	no (UN)
30	Ivankovic and Preussmann (1975)	3729	rat (*Rattus norvegicus*)	3	U	FD	90	days	100	days	SM	female	GRO	BDWT	WO	1770	na	72	no (UN)
31	Elbetieha and Al-Hamood (1997)	3025	mouse (*Mus musculus*)	3	U	DR	12	weeks	50	days	JV	male	GRO	BDWT	WO	na	92.1	72	yes
Survival																			
32	Meenakshi et al. (1989)	3061	rat (*Rattus norvegicus*)	2	U	GV	60	days	NR	NR	JV	male	MOR	MORT	WO	10.0	na	85	no (UN)
33	Mercado and Bibby (1973)	757	rat (*Rattus norvegicus*)	2	U	DR	50	days	23	days	JV	male	MOR	MORT	WO	na	2.82	72	no (ID)

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the chromium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2008) for the full reference list for studies cited in this table.

[a] Rationale for study unacceptability is in parentheses.

Table H2.A-7. Nickel Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
13	Meluzzi et al. 1996	2771	chicken *(Gallus domesticus)*	4	U	FD	60	d	22	w	LB	F	EGG	ESWT	EG		8.16	75	no (ENR)
12	Eastin and O'Shea 1981	6492	duck (*Anas platyrhynchos*)	5	U	FD	90	d	20	mo	LB	F	REP	HTCH	EG	149		70	no (UN)
Growth																			
21	Hill 1979	397	chicken *(Gallus domesticus)*	3	U	FD	5	w	1	d	JV	F	GRO	BDWT	WO		8.95	76	yes
22	Cain and Pafford 1981	6461	duck (*Anas platyrhynchos*)	4	M	FD	60	d	1	d	JV	F	MPH	HULT	HM		10.7	82	yes[b]
16	Martinez and Diaz 1996	5345	chicken *(Gallus domesticus)*	4	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	5.76	11.5	83	yes
17	Hill 1979	397	chicken *(Gallus domesticus)*	3	U	FD	5	w	1	d	JV	F	GRO	BDWT	WO	8.95	17.9	82	yes
23	Ling and Leach 1979	6666	chicken *(Gallus domesticus)*	6	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO		23.9	77	yes
19	Weber and Reid 1968	60	chicken *(Gallus domesticus)*	8	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	28.3	30.2	79	yes
20	Weber and Reid 1968	60	chicken *(Gallus domesticus)*	8	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	31	31.5	84	yes
24	Hill 1985	36708	chicken *(Gallus domesticus)*	2	U	FD	19	d	NR	NR	JV	B	GRO	BDWT	WO		71.8	76	yes
14	Oscar et al. 1995	5407	chicken *(Gallus domesticus)*	3	U	FD	28	d	21	d	JV	F	GRO	BDWT	WO	0.136		77	no (UN)
15	Nielsen et al. 1975	6885	chicken *(Gallus domesticus)*	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	0.195		77	no (UN)
18	Blalock and Hill 1985	36697	chicken *(Gallus domesticus)*	2	U	FD	25	d	1	d	JV	B	GRO	BDWT	WO	22.9		67	no (UN)
Survival																			
28	Ling and Leach 1979	6666	chicken *(Gallus domesticus)*	6	U	FD	3	w	1	d	JV	M	MOR	SURV	WO	23.9	39.9	84	yes
25	Cain and Pafford 1981	6461	duck (*Anas platyrhynchos*)	4	M	FD	30	d	1	d	JV	B	MOR	SURV	WO	10.7	47	87	yes
26	Blalock and Hill 1985	36697	chicken *(Gallus domesticus)*	2	U	FD	25	d	1	d	JV	B	MOR	MORT	WO	22.9		77	no (UN)
27	Martinez and Diaz 1996	5345	chicken *(Gallus domesticus)*	4	U	FD	42	d	1	d	JV	M	MOR	MORT	WO	23		69	no (UN)

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
Not all studies presented in the antimony ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).
See Eco-SSL document (USEPA 2007) for the full reference list for studies cited in this table.
Blank cells are shown as reported in the Eco-SSL document; no description was provided.
[a] Rationale for study unacceptability is in parentheses
[b] This study was used for a different endpoint than the one reported in the Eco-SSL.

Table H2.A-8. Selenium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
85	Thapar et al. (1969)	1592	chicken (*Gallus domesticus*)	3	U	FD	76	weeks	1	days	LB	female	EGG	EGWT	EG	0.092	0.368	83	no (ENR)
86	Stanley et al. (1996)	1569	mallard (*Anas platyrhynchos*)	3	UX	FD	122	days	1	years	AD	both	REP	HTCH	WO	0.212	0.425	89	no (SDC)
87	Poley and Moxon (1937)	3788	chicken (*Gallus domesticus*)	4	U	FD	1	weeks	NR	NR	LB	female	REP	RSUC	WO	0.214	0.429	85	no (SDC)
88	Heinz et. al. (1989)	1354	duck (*Anas platyrhynchos*)	6	UX	FD	46	days	NR	NR	LB	both	REP	PROG	WO	0.219	0.438	90	yes
89	Ort and Latshaw (1978)	1489	chicken (*Gallus domesticus*)	4	U	FD	28	weeks	32	weeks	LB	female	REP	HTCH	WO	0.247	0.412	85	yes
90	Hoffman and Heinz (1988)	1372	mallard (*Anas platyrhynchos*)	5	UX	FD	6	weeks	NR	NR	LB	both	REP	RSUC	WO	0.273	0.546	89	yes
91	Moksnes and Norheim (1982)	1465	chicken (*Gallus domesticus*)	4	U	FD	31	weeks	20	weeks	LB	both	REP	PROG	WO	0.284	na	70	no (UN)
92	Moksnes (1983)	1464	chicken (*Gallus domesticus*)	6	U	FD	18	weeks	20	weeks	LB	female	EGG	EGWT	EG	0.292	na	79	no (UN)
93	Thapar et al. (1969)	1592	chicken (*Gallus domesticus*)	3	U	FD	105	weeks	1	days	LB	female	REP	PROG	WO	0.378	na	70	no (UN)
94	Albers et al. (1996)	1208	duck (*Anas platyrhynchos*)	5	U	FD	16	weeks	1	years	AD	male	REP	TEWT	TE	0.644	1.29	81	no (ENR)
95	Heinz et. al. (1989)	1354	duck (*Anas platyrhynchos*)	2	UX	FD	49	days	NR	NR	LB	both	REP	PROG	WO	0.890	na	70	no (UN)
96	Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	2	U	FD	10	weeks	2	weeks	LB	both	EGG	ESTH	WO	0.896	na	75	no (UN)
97	Heinz and Hoffman (1987)	1356	mallard (*Anas platyrhynchos*)	6	UX	FD	57	weeks	2	years	LB	female	REP	NDAY	WO	1.03	2.58	87	no (ENR)
98	Santolo et al. (1999)	1535	American kestrel (*Falco sparverius*)	3	M	FD	11	weeks	NR	months	LB	female	EGG	EGWT	EM	1.37	na	83	no (UN)
99	Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	2	M	FD	10	weeks	NR	NR	JV	both	EGG	ESTH	WO	3.64	na	80	no (UN)
100	Arnold et al. (1973)	69	chicken (*Gallus domesticus*)	3	U	FD	24	weeks	1	days	LB	female	EGG	EGWT	EG	na	0.0911	79	no (ENR)
101	Kaantee and Kurkela (1980)	36819	chicken (*Gallus domesticus*)	3	M	FD	2	weeks	18	months	LB	female	REP	PROG	WO	na	0.0988	85	yes
102	Stone and Soares (1976)	2898	Japanese quail (*Coturnix japonica*)	2	U	FD	32	days	NR	NR	LB	female	REP	PROG	WO	na	0.120	79	yes
103	Poley et al. (1937)	3787	chicken (*Gallus domesticus*)	2	M	FD	1	weeks	NR	NR	LB	female	REP	HTCH	WO	na	0.127	79	no (SDC)
104	Stanley et al. (1994)	1570	mallard (*Anas platyrhynchos*)	2	M	FD	93	days	1	years	LB	both	REP	TERA	EM	na	0.355	83	no (ENR)
105	Heinz and Hoffman (1998)	1353	mallard (*Anas platyrhynchos*)	2	M	FD	75	days	18	months	LB	female	REP	TERA	EM	na	0.456	84	no (ENR)
106	Heinz and Hoffman (1996)	1352	mallard (*Anas platyrhynchos*)	2	M	FD	4	weeks	NR	months	LB	female	REP	TERA	EM	na	0.524	83	no (ENR)
107	Hoffman and Heinz (1988)	1372	mallard (*Anas platyrhynchos*)	2	UX	FD	6	weeks	NR	NR	LB	both	REP	ABNM	WO	na	0.546	83	yes
108	Heinz and Hoffman (1996)	1352	mallard (*Anas platyrhynchos*)	2	M	FD	4	weeks	NR	months	LB	female	REP	TERA	EM	na	0.580	83	no (ENR)
109	Heinz and Hoffman (1996)	1352	mallard (*Anas platyrhynchos*)	2	M	FD	4	weeks	NR	months	LB	female	REP	TPRD	EM	na	0.614	77	yes
110	Smith et al. (1988)	1562	black-crowned night-heron (*Nycticorax nycti*)	2	UX	FD	92	days	NR	NR	LB	both	REP	ODVP	WO	na	0.675	76	no (ENR)
111	El-Begerami et al. (1977)	1291	Japanese quail (*Coturnix japonica*)	3	U	FD	16	weeks	1	days	JV	both	REP	ABNM	WO	na	0.702	78	no (ENR)
112	El-Begearmi et al. (1982)	6433	Japanese quail (*Coturnix japonica*)	2	U	FD	16	weeks	NR	NR	LB	female	REP	HTCH	WO	na	0.780	78	yes
113	Stoewsand et al. (1978)	1575	Japanese quail (*Coturnix japonica*)	2	U	FD	5	weeks	15	days	JV	female	REP	EGPN	WO	na	0.826	78	yes
114	Heinz and Hoffman (1987)	1356	mallard (*Anas platyrhynchos*)	2	UX	FD	41	days	2	years	LB	female	REP	PROG	WO	na	0.898	85	yes
115	Heinz and Fitzgerald (1993)	36813	mallard (*Anas platyrhynchos*)	2	M	FD	21	weeks	NR	NR	LB	female	REP	PROG	WO	na	1.19	84	yes
116	Wiemeyer and Hoffman (1996)	1622	owl (*Otus asio*)	3	M	FD	3	months	3	years	LB	both	REP	PLBR	WO	na	4.49	85	yes
Growth																			
117	Colnago et al. (1984)	9356	chicken (*Gallus domesticus*)	3	M	FD	24	days	1	days	JV	male	GRO	BDWT	WO	0.0632	na	73	no (UN)
118	Jensen (1986)	1402	chicken (*Gallus domesticus*)	4	U	FD	3	weeks	1	days	JV	male	GRO	BDWT	WO	0.0740	0.370	75	yes
119	Hegazy and Adachi (2000)	7725	chicken (*Gallus domesticus*)	2	U	FD	15	days	1	days	JV	NR	GRO	BDWT	WO	0.0859	na	70	no (UN)
120	Thapar et al. (1969)	1592	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	0.180	0.721	81	no (UN [b])
121	Hill (1979)	397	chicken (*Gallus domesticus*)	4	U	FD	5	weeks	1	days	JV	female	GRO	BDWT	WO	0.204	0.408	77	yes
122	Echevarria et al. (1988)	1289	chicken (*Gallus domesticus*)	4	U	FD	3	weeks	1	days	JV	male	GRO	BDWT	WO	0.213	0.426	82	yes
123	Moksnes and Norheim (1982)	1465	chicken (*Gallus domesticus*)	4	U	FD	31	weeks	20	weeks	JV	both	GRO	BDWT	WO	0.284	na	68	no (UN)
124	Moksnes (1983)	1464	chicken (*Gallus domesticus*)	6	U	FD	18	weeks	20	weeks	SM	female	GRO	BDWT	WO	0.292	na	77	no (UN)
125	Moksnes and Norheim (1982)	1465	chicken (*Gallus domesticus*)	4	U	FD	6	weeks	1	days	JV	both	GRO	BDWT	WO	0.319	na	68	no (UN)
126	Arnold et al. (1973)	69	chicken (*Gallus domesticus*)	3	U	FD	104	weeks	1	days	JV	both	GRO	BDWT	WO	0.371	na	68	no (UN)
127	Thapar et al. (1969)	1592	chicken (*Gallus domesticus*)	3	U	FD	105	weeks	1	days	JV	female	GRO	BDWT	WO	0.379	na	68	no (UN)
128	Poley and Moxon (1937)	3788	chicken (*Gallus domesticus*)	4	U	FD	6	weeks	NR	NR	SM	female	GRO	BDWT	WO	0.429	na	68	no (UN)
129	Hill (1974)	1369	chicken (*Gallus domesticus*)	6	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	0.429	0.859	82	yes
130	Jensen et al. (1977)	1404	chicken (*Gallus domesticus*)	5	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	0.617	1.23	77	yes
131	O'Toole and Raisbeck (1997)	1476	mallard (*Anas platyrhynchos*)	4	U	FD	21	days	NR	NR	JV	male	GRO	BDWT	WO	0.690	1.73	79	yes
132	Cantor et al. (1984)	1245	chicken (*Gallus domesticus*)	4	U	DR	7	days	6	days	JV	male	GRO	BDWT	WO	0.718	1.44	78	yes
133	Sell and Horani (1976)	1550	Japanese quail (*Coturnix japonica*)	2	U	FD	23	days	8	days	JV	both	GRO	BDWT	WO	0.909	na	69	no (UN)
134	Yamamoto et al. (1998)	1636	American kestrel (*Falco sparverius*)	3	M	FD	77	days	NR	NR	MA	male	GRO	BDWT	WO	1.06	na	68	no (UN)
135	Hoffman et al. (1991)	1377	mallard (*Anas platyrhynchos*)	3	UX	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	1.13	4.53	86	yes
136	Hoffman et al. (1992)	1378	mallard (*Anas platyrhynchos*)	3	UX	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	1.23	4.94	86	yes
137	Ansari and Britton (1974)	36789	chicken (*Gallus domesticus*)	2	U	FD	10	days	1	days	JV	male	GRO	BDWT	WO	1.38	na	67	no (UN)
Growth (continued)																			
138	Howell and Hill (1978)	1387	chicken (*Gallus domesticus*)	2	U	FD	20	days	1	days	JV	both	GRO	BDWT	WO	1.42	na	67	no (UN)
139	Cantor et al. (1984)	1245	chicken (*Gallus domesticus*)	4	U	DR	7	days	9	days	JV	both	GRO	BDWT	WO	1.45	2.90	78	yes
140	Heinz et al. (1988)	1355	mallard (*Anas platyrhynchos*)	5	UX	FD	3	weeks	1	days	JV	NR	GRO	BDWT	WO	1.74	3.48	89	yes
141	Heinz et al. (1988)	1355	mallard (*Anas platyrhynchos*)	5	UX	FD	3	weeks	1	days	JV	NR	GRO	BDWT	WO	2.13	4.26	89	yes
142	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	2	U	FD	2	weeks	1	days	JV	NR	GRO	BDWT	WO	3.04	na	72	no (UN)

Table H2.A-8. Selenium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
143	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	3	U	FD	2	weeks	1	days	JV	NR	GRO	BDWT	WO	4.16	8.32	84	yes
144	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	3	U	FD	1	weeks	1	days	JV	NR	GRO	BDWT	WO	5.75	11.5	84	yes
145	Jensen et al. (1977)	1404	chicken (*Gallus domesticus*)	5	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	6.34	11.9	77	yes
146	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	3	U	FD	2	weeks	1	days	JV	NR	GRO	BDWT	WO	7.31	na	72	no (UN)
147	El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	na	0.0912	77	yes
148	Poley et al. (1937)	3787	chicken (*Gallus domesticus*)	2	M	FD	1	weeks	NR	NR	SM	female	GRO	BDWT	WO	na	0.127	77	yes
149	El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	na	0.130	77	yes
150	El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	na	0.180	77	yes
151	Fairbrother and Fowles (1990)	1297	mallard (*Anas platyrhynchos*)	3	U	DR	9	days	9	months	JV	male	GRO	BDWT	WO	na	0.275	72	yes
152	Dafalla and Adam (1986)	1273	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	7	days	JV	both	GRO	BDWT	WO	na	0.306	77	yes
153	Khan et al. (1993)	1415	chicken (*Gallus domesticus*)	2	U	GV	28	days	43	days	JV	both	GRO	BDWT	WO	na	0.50	84	yes
154	Khan et al. (1993)	5483	chicken (*Gallus domesticus*)	2	U	OR	4	weeks	NR	NR	JV	both	GRO	BDWT	WO	na	0.50	79	yes
155	Sell and Horani (1976)	1550	chicken (*Gallus domesticus*)	2	U	FD	28	days	1	days	JV	male	GRO	BDWT	WO	na	0.629	78	yes
156	Elzubeir and Davis (1988)	1294	chicken (*Gallus domesticus*)	2	U	FD	24	days	14	days	JV	male	GRO	BDWT	WO	na	0.788	77	yes
157	Davis et al. (1996)	1278	chicken (*Gallus domesticus*)	2	U	FD	21	days	14	days	JV	male	GRO	BDWT	WO	na	0.855	77	yes
158	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	na	0.859	71	yes
159	Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	2	U	FD	10	weeks	2	weeks	JV	both	GRO	BDWT	WO	na	0.896	77	yes
160	Heinz and Fitzgerald (1993)	36813	mallard (*Anas platyrhynchos*)	2	M	FD	21	weeks	NR	NR	SM	both	GRO	BDWT	WO	na	1.08	75	yes
161	Hoffman et al. (1992)	1376	duck (*Anas platyrhynchos*)	3	UX	FD	4	weeks	1	days	JV	both	GRO	BDWT	WO	na	1.20	82	yes
162	Berg and Martinson (1972)	93	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	1	days	JV	NR	GRO	BDWT	WO	na	1.38	77	yes
163	Lowry and Baker (1989)	1445	chicken (*Gallus domesticus*)	2	U	FD	14	days	8	days	JV	male	GRO	BDWT	WO	na	1.55	77	yes
164	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	na	1.72	71	yes
165	Howell and Hill (1978)	1387	chicken (*Gallus domesticus*)	2	U	FD	21	days	1	days	JV	both	GRO	BDWT	WO	na	1.78	76	yes
166	Donaldson and McGowan (1989)	1285	chicken (*Gallus domesticus*)	3	U	FD	20	days	1	days	JV	male	GRO	BDWT	WO	na	2.27	77	yes
167	Hill (1980)	395	chicken (*Gallus domesticus*)	2	U	FD	1	weeks	1	days	JV	female	GRO	BDWT	WO	na	2.76	71	yes
168	Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	2	M	FD	10	weeks	NR	NR	JV	both	GRO	BDWT	WO	na	3.64	82	yes
Survival																			
169	Arnold et al. (1973)	69	chicken (*Gallus domesticus*)	3	U	FD	24	weeks	1	days	JV	female	MOR	MORT	WO	0.093	0.371	82	yes
170	Van Vleet et al. (1981)	80	duck (*Anas platyrhynchos*)	2	U	FD	15	days	1	days	JV	male	MOR	MORT	WO	0.153	na	77	no (UN)
171	El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	4	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	0.290	0.579	84	yes
172	Moksnes (1983)	1464	chicken (*Gallus domesticus*)	6	U	FD	18	weeks	20	weeks	SM	female	MOR	MORT	WO	0.292	na	78	no (UN)
173	Thapar et al. (1969)	1592	chicken (*Gallus domesticus*)	3	U	FD	76	weeks	1	days	JV	female	MOR	MORT	WO	0.368	na	78	no (UN)
174	Thapar et al. (1969)	1592	chicken (*Gallus domesticus*)	3	U	FD	105	weeks	1	days	JV	both	MOR	MORT	WO	0.378	na	77	no (UN)
175	El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	0.412	0.823	84	yes
176	Heinz and Fitzgerald (1993)	1350	mallard (*Anas platyrhynchos*)	5	UX	FD	13	weeks	NR	months	AD	male	MOR	MORT	WO	0.563	1.13	85	yes
177	El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	4	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	0.572	1.14	84	yes
178	Stoewsand et al. (1974)	1577	Japanese quail (*Coturnix japonica*)	2	U	FD	4	weeks	1	days	JV	both	MOR	MORT	WO	0.610	na	77	no (UN)
179	Sell and Horani (1976)	1550	chicken (*Gallus domesticus*)	2	U	FD	28	days	1	days	JV	male	MOR	MORT	WO	0.629	na	79	no (UN)
180	Echevarria et al. (1988)	1289	chicken (*Gallus domesticus*)	4	U	FD	3	weeks	1	days	JV	male	MOR	MORT	WO	0.64	na	68	no (UN)
181	O'Toole and Raisbeck (1997)	1476	mallard (*Anas platyrhynchos*)	4	U	FD	50	days	NR	NR	AD	male	MOR	MORT	WO	0.699	4.19	82	yes
182	El-Begerami et al. (1977)	1291	Japanese quail (*Coturnix japonica*)	3	U	FD	12	weeks	1	days	JV	both	MOR	SURV	WO	0.702	1.40	83	yes
183	El-Begearmi et al. (1982)	6433	Japanese quail (*Coturnix japonica*)	2	U	FD	16	weeks	NR	NR	NR	both	MOR	SURV	WO	0.780	na	70	no (UN)
184	Heinz (1993)	1347	duck (*Anas platyrhynchos*)	2	U	FD	21	weeks	NR	NR	AD	male	MOR	MORT	WO	0.844	na	70	no (UN)
185	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	0.859	na	72	no (UN)
186	Heinz et. al. (1989)	1354	duck (*Anas platyrhynchos*)	2	UX	FD	49	days	NR	NR	SM	both	MOR	MORT	WO	0.890	na	76	no (UN)
187	Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	2	U	FD	10	weeks	2	weeks	JV	both	MOR	MORT	WO	0.896	na	78	no (UN)
188	Sell and Horani (1976)	1550	Japanese quail (*Coturnix japonica*)	2	U	FD	23	days	8	days	JV	both	MOR	MORT	WO	0.909	na	78	no (UN)
189	Heinz et. al. (1989)	1354	duck (*Anas platyrhynchos*)	6	UX	FD	46	weeks	NR	NR	SM	both	MOR	MORT	WO	0.910	na	79	no (UN)
190	Yamamoto et al. (1998)	1636	American Kestrel (*Falco sparverius*)	2	M	FD	77	days	NR	NR	MA	both	MOR	MORT	WO	0.944	na	75	no (UN)
Survival (continued)																			
191	Heinz and Hoffman (1987)	1356	mallard (*Anas platyrhynchos*)	2	UX	FD	41	days	2	years	SM	female	MOR	MORT	WO	1.01	na	84	no (UN)
192	Yamamoto et al. (1998)	1636	American Kestrel (*Falco sparverius*)	3	M	FD	77	days	NR	NR	MA	both	MOR	MORT	WO	1.06	na	78	no (UN)
193	Heinz and Fitzgerald (1993)	36813	mallard (*Anas platyrhynchos*)	2	M	FD	21	weeks	NR	NR	SM	both	MOR	MORT	WO	1.08	na	76	no (UN)
194	Hoffman et al. (1991)	1377	mallard (*Anas platyrhynchos*)	3	UX	FD	4	weeks	1	days	JV	both	MOR	SURV	WO	1.13	4.53	87	yes
195	Hoffman et al. (1992)	1376	duck (*Anas platyrhynchos*)	3	UX	FD	4	weeks	1	days	JV	both	MOR	SURV	WO	1.20	4.80	87	yes
196	Green and Albers (1997)	1319	mallard (*Anas platyrhynchos*)	5	U	FD	16	weeks	14	months	AD	male	MOR	MORT	WO	1.22	2.44	83	yes
197	Hoffman et al. (1992)	1378	mallard (*Anas platyrhynchos*)	3	UX	FD	4	weeks	1	days	JV	both	MOR	SURV	WO	1.23	4.94	87	yes
198	Santolo et al. (1999)	1535	American kestrel (*Falco sparverius*)	3	M	FD	11	weeks	NR	months	AD	both	MOR	MORT	WO	1.37	na	78	no (UN)
199	Ansari and Britton (1974)	36789	chicken (*Gallus domesticus*)	2	U	FD	10	days	1	days	JV	male	MOR	MORT	WO	1.38	na	77	no (UN)
200	Howell and Hill (1978)	1387	chicken (*Gallus domesticus*)	2	U	FD	20	days	1	days	JV	both	MOR	MORT	WO	1.42	na	77	no (UN)
214	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	1.72	na	72	no (UN)

Table H2.A-8. Selenium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
201	Hoffman et al. (1991)	1374	mallard (*Anas platyrhynchos*)	7	U	FD	14	weeks	2	years	AD	male	MOR	SURV	WO	1.87	na	78	no (UN)
202	Smith et al. (1988)	1562	black-crowned night-heron (*Nycticorax nycti*)	3	UX	FD	92	days	NR	NR	AD	both	MOR	MORT	WO	2.03	na	78	no (UN)
203	Albers et al. (1996)	1208	duck (*Anas platyrhynchos*)	5	U	FD	16	weeks	1	years	AD	male	MOR	MORT	WO	2.38	4.75	80	yes
204	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	2	U	FD	2	weeks	1	days	JV	NR	MOR	SURV	WO	3.04	na	73	no (UN)
205	Donaldson and McGowan (1989)	1285	chicken (*Gallus domesticus*)	3	U	FD	18	days	1	days	JV	male	MOR	MORT	WO	3.04	6.08	84	yes
206	Jensen et al. (1977)	1404	chicken (*Gallus domesticus*)	5	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	3.07	6.14	78	yes
207	Heinz and Hoffman (1987)	1356	mallard (*Anas platyrhynchos*)	6	UX	FD	57	days	2	years	SM	both	MOR	MORT	WO	3.08	12.3	84	yes
208	Heinz et al.(1996)	1357	mallard (*Anas platyrhynchos*)	3	U	FD	1	weeks	1	days	JV	NR	MOR	SURV	WO	3.49	6.99	85	yes
209	Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	2	M	FD	10	weeks	2	weeks	JV	both	MOR	MORT	WO	3.64	na	83	no (UN)
210	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	3	U	FD	2	weeks	1	days	JV	NR	MOR	SURV	WO	3.72	na	79	no (UN)
211	Heinz et al. (1988)	1355	mallard (*Anas platyrhynchos*)	5	UX	FD	3	weeks	1	days	JV	NR	MOR	MORT	WO	3.99	7.98	90	yes
212	Heinz et al. (1988)	1355	mallard (*Anas platyrhynchos*)	5	UX	FD	2	weeks	1	days	JV	NR	MOR	MORT	WO	5.84	11.7	90	yes
213	Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	3	U	FD	2	weeks	1	days	JV	NR	MOR	SURV	WO	7.31	na	66	no (UN)
215	Jensen et al. (1977)	1404	chicken (*Gallus domesticus*)	5	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	28.2	29.0	78	yes
216	Khan et al. (1993)	1415	chicken (*Gallus domesticus*)	2	U	GV	28	days	43	days	JV	female	MOR	MORT	WO	na	0.50	78	yes
217	Howell and Hill (1978)	1387	chicken (*Gallus domesticus*)	2	U	FD	21	days	1	days	JV	both	MOR	MORT	WO	na	1.78	77	yes
218	Hill (1974)	1369	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	na	3.44	77	yes
219	Heinz (1993)	1347	duck (*Anas platyrhynchos*)	2	U	FD	5	weeks	NR	NR	AD	male	MOR	MORT	WO	na	5.75	71	yes

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the selenium ecological soil screening level (Eco-SSL) document for growth reproduction and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007b) for the full reference list for studies cited in this table.

[a] Rationale for study unacceptability is in parentheses.

[b] Dose/response data set was reviewed and determined to be an unbounded no-observed-adverse-effect level (NOAEL) (differs from the Eco-SSL document).

Table H2.A-9. Selenium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
231	Nobunaga et al. (1979)	1473	mouse (*Mus musculus*)	3	U	DR	56	days	60	days	GE	female	REP	PRWT	WO	0.072	0.145	81	yes
232	Fredriksson et al. (1993)	1304	rat (*Rattus norvegicus*)	2	M	FD	14	weeks	NR	NR	GE	female	REP	ODVP	WO	0.108	na	74	no (UN)
233	Gunter et al. (2003)	25959	cattle (*Bos taurus*)	2	U	FD	42	weeks	NR	NR	GE	female	REP	PRWT	WO	0.173	na	70	no (UN)
234	Nebbia et al. (1987)	1471	rat (*Rattus norvegicus*)	4	U	DR	240	days	NR	NR	JV	male	REP	TEWT	TE	0.384	0.768	80	no (ENR)
235	Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	4	U	FD	5	weeks	NR	NR	JV	male	REP	SPCL	GO	0.388	0.776	86	no (ENR)
236	Abdo (1994)	1475	rat (*Rattus norvegicus*)	6	UX	DR	13	weeks	6	weeks	JV	female	REP	GREP	WO	0.393	0.763	95	yes
237	Halverson (1974)	1329	rat (*Rattus norvegicus*)	5	U	FD	42	days	90	days	GE	female	REP	PROG	WO	0.456	na	71	no (UN)
238	Abdo (1994)	1475	mouse (*Mus musculus*)	6	UX	DR	13	weeks	6	weeks	JV	male	REP	GREP	WO	0.735	1.51	92	yes
239	Panter et al. (1995)	1498	sheep (*Ovis aries*)	2	M	FD	88	days	NR	months	GE	female	REP	PRWT	WO	0.780	na	77	no (UN)
240	Panter et al. (1995)	1498	sheep (*Ovis aries*)	2	M	FD	88	days	NR	NR	GE	female	REP	PRWT	WO	0.945	na	69	no (UN)
241	Hau et al. (1987)	1344	mouse (*Mus musculus*)	4	U	DR	29	days	8	weeks	GE	female	REP	PRWT	WO	1.21	6.03	78	yes
242	Piccirillo et al. (1983)	1507	mouse (*Mus musculus*)	2	U	GV	8	days	64	days	GE	female	REP	PRWT	WO	1.60	na	86	no (UN)
243	Abdo (1994)	1475	mouse (*Mus musculus*)	6	UX	DR	13	weeks	6	weeks	JV	both	REP	SPCL	TE	2.28	na	85	no (ENR, UN)
244	Webster (1979)	823	mouse (*Mus musculus*)	5	U	FD	19	days	4	months	GE	female	REP	PRWT	WO	2.54	25.4	78	yes
245	Hardin et al. (1987)	1335	mouse (*Mus musculus*)	5	U	GV	8	days	6-8	weeks	GE	female	REP	PRWT	WO	3.20	6.39	87	yes
246	Plasterer et al. (1985)	1509	mouse (*Mus musculus*)	2	U	GV	8	days	61-71	days	GE	female	REP	PRWT	WO	3.20	na	86	no (UN)
247	Booth et al. (1983)	1234	mouse (*Mus musculus*)	2	U	GV	8	days	NR	NR	GE	female	REP	PROG	WO	7.0	na	90	no (UN)
248	Kaur and Parshad (1994)	1411	rat (*Rattus norvegicus*)	3	U	FD	5	weeks	NR	NR	JV	male	REP	SPCV	TE	na	0.089	79	no (ENR)
249	Abdo (1994)	1475	rat (*Rattus norvegicus*)	6	UX	DR	13	weeks	6	weeks	JV	female	REP	GREP	WO	na	0.130	89	yes
250	Wahlstrom and Olson (1959)	14497	pig (*Sus scrofa*)	2	U	FD	239	days	8	weeks	GE	female	REP	PRWT	WO	na	0.296	79	yes
251	Schroeder and Mitchener (1971)	66	mouse (*Mus musculus*)	2	U	DR	6	months	21	days	JV	female	REP	DEYO	WO	na	0.434	73	yes
252	Thorlacius-Ussing (1990)	1595	rat (*Rattus norvegicus*)	3	U	DR	21	days	NR	NR	LC	female	REP	PRWT	WO	na	0.504	73	yes
253	Parshad and Sud (1989)	1500	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	male	REP	TEWT	TE	na	0.550	79	no (ENR)
254	Thorlacius-Ussing et al. (1987)	1596	rat (*Rattus norvegicus*)	2	U	DR	21	days	NR	months	LC	female	REP	PRWT	WO	na	0.749	73	yes
255	Chermoff and Kavlock (1982)	1259	mouse (*Mus musculus*)	2	U	GV	5	days	60	days	GE	female	REP	PROG	WO	na	4.18	86	yes
256	Gray and Kavlock (1984)	1316	mouse (*Mus musculus*)	2	U	OR	5	days	90	days	GE	female	REP	PROG	WO	na	4.57	81	yes
Growth																			
258	Shull and Checke (1973)	1557	rat (*Rattus norvegicus*)	3	U	FD	8	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.053	0.265	82	yes
259	Meyer et al. (1982)	662	rat (*Rattus norvegicus*)	2	U	FD	30	days	NR	NR	JV	male	GRO	BDWT	WO	0.0642	na	78	no (UN)
260	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	3	M	FD	4	weeks	NR	NR	JV	NR	GRO	BDWT	WO	0.0838	0.763	86	yes
261	Chen et al. (1990)	1255	rat (*Rattus norvegicus*)	2	U	FD	2	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.0869	na	77	no (UN)
262	Glattre et al. (1995)	11361	rat (*Rattus norvegicus*)	2	U	DR	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.090	na	67	no (UN)
263	Debski et al. (1992)	1280	rat (*Rattus norvegicus*)	2	U	FD	2	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.110	na	81	no (UN)
264	Kim and Mahan (2001)	25957	pig (*Sus scrofa*)	6	U	FD	12	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.112	0.157	84	no (SDC)
265	Kim and Mahan (2001)	25948	pig (*Sus scrofa*)	4	U	FD	12	weeks	8	weeks	JV	both	GRO	BDWT	WO	0.137	0.273	84	yes
266	Mahan and Moxon (1984)	1450	pig (*Sus scrofa*)	7	U	FD	37	days	4	weeks	JV	both	GRO	BDWT	WO	0.143	0.215	84	yes
267	Goehring et. al. (1983)	1313	pig (*Sus scrofa*)	6	M	FD	5	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.146	0.273	89	yes
268	Liu et al. (1994)	1442	rat (*Rattus norvegicus*)	4	M	FD	2	weeks	45	days	JV	female	GRO	BDWT	WO	0.151	0.304	89	yes
269	Liu and Milner (1992)	12370	rat (*Rattus norvegicus*)	2	M	FD	2	weeks	41	days	JV	female	GRO	BDWT	WO	0.153	na	76	no (UN)
270	Kim and Mahan (2001)	25958	pig (*Sus scrofa*)	2	UX	FD	14	weeks	NR	NR	JV	female	GRO	BDWT	WO	0.155	0.221	89	yes
271	Behne et al. (1992)	1224	rat (*Rattus norvegicus*)	2	U	FD	110	days	30	days	JV	male	GRO	BDWT	WO	0.163	na	77	no (UN)
272	Jenkins and Hidiroglou (1986)	1401	cattle (*Bos taurus*)	5	U	FD	6	weeks	3	days	JV	male	GRO	BDWT	WO	0.165	0.330	83	no (RU)
273	Mahan and Magee (1991)	1448	pig (*Sus scrofa*)	3	UX	FD	35	days	23	days	JV	both	GRO	BDWT	WO	0.170	0.510	89	yes
274	Gunter et al. (2003)	25959	cattle (*Bos taurus*)	2	U	FD	42	weeks	NR	NR	GE	female	GRO	BDWT	WO	0.173	na	68	no (UN)
275	Nehru et al. (1997)	2788	rat (*Rattus norvegicus*)	2	U	GV	8	weeks	NR	NR	JV	female	GRO	BDWT	WO	0.175	na	79	no (UN)
276	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	3	M	DR	42	days	21	days	JV	male	GRO	BDWT	WO	0.181	na	76	no (UN)
277	Mahan and Magee (1991)	1448	pig (*Sus scrofa*)	3	UX	FD	35	days	23	days	JV	both	GRO	BDWT	WO	0.183	0.548	89	yes
278	Mandisodza et al. (1979)	1454	pig (*Sus scrofa*)	3	M	FD	61	days	5-7	weeks	JV	both	GRO	BDWT	WO	0.189	na	74	no (UN)
279	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	3	M	DR	42	days	21	days	JV	male	GRO	BDWT	WO	0.191	na	78	no (UN)
280	Coudray et. al. (1996)	1271	rat (*Rattus norvegicus*)	2	U	FD	8	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.198	na	77	no (UN)
281	Mandisodza et al. (1979)	1454	pig (*Sus scrofa*)	3	M	FD	61	days	5-7	weeks	JV	both	GRO	BDWT	WO	0.202	na	68	no (UN)
282	Salbe and Levander (1990)	1533	rat (*Rattus norvegicus*)	3	UX	FD	6	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.214	na	82	no (UN)
283	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	GRO	BDWT	WO	0.217	0.435	82	yes
284	Goehring et al. (1984)	1312	rat (*Rattus norvegicus*)	4	M	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.217	0.470	88	yes
285	Salbe and Levander (1990)	1533	rat (*Rattus norvegicus*)	3	UX	FD	6	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.217	na	82	no (UN)
286	Moxon and Mahan (1981 [b])	1468	pig (*Sus scrofa*)	8	UX	FD	37	days	NR	NR	JV	NR	GRO	BDWT	WO	0.227	0.340	89	yes
287	Kim and Mahan (2001)	25958	pig (*Sus scrofa*)	4	UX	FD	14	weeks	NR	NR	JV	female	GRO	BDWT	WO	0.236	na	74	no (UN)
288	Tsunoda et al. (2000)	36834	mouse (*Mus musculus*)	4	U	DR	14	days	7-8	weeks	JV	male	GRO	BDWT	WO	0.240	0.580	79	yes
Growth (continued)																			
289	Lane et al. (1984)	1429	mouse (*Mus musculus*)	2	U	FD	26	weeks	4	weeks	JV	female	GRO	BDWT	WO	0.254	na	77	no (UN)
290	LeBoeuf et al. (1985)	1433	rat (*Rattus norvegicus*)	3	U	FD	6	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.261	0.521	82	yes
291	Goehring et al. (1984)	1312	pig (*Sus scrofa*)	4	M	FD	6	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.265	na	74	no (UN)
292	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	4	M	DR	7	days	21	days	JV	male	GRO	BDWT	WO	0.274	0.540	84	yes
293	Turan et al. (1997)	1602	rabbit (*Oryctolagus cuniculus*)	2	U	FD	12	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.277	na	73	no (UN)

Table H2.A-9. Selenium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
294	Wahlstrom and Olson (1959)	14497	pig (*Sus scrofa*)	2	U	FD	239	days	8	weeks	GE	female	GRO	BDWT	WO	0.296	na	68	no (UN)
295	Bioulac-Sage et al. (1992)	1228	rat (*Rattus norvegicus*)	3	U	FD	2	months	NR	NR	JV	male	GRO	BDWT	WO	0.318	na	70	no (UN)
296	Julius et al. (1983)	1408	hamster (*Mesocricetus auratus*)	3	U	FD	21	days	4	weeks	JV	both	GRO	BDWT	WO	0.356	0.712	84	yes
297	Kim and Mahan (2001)	25948	pig (*Sus scrofa*)	4	U	FD	12	weeks	8	weeks	JV	both	GRO	BDWT	WO	0.367	0.489	79	yes
298	Yeh et al. (1997)	1640	rat (*Rattus norvegicus*)	4	U	FD	8	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.367	na	77	no (UN)
299	Abdo (1994)	1475	rat (*Rattus norvegicus*)	6	U	DR	13	weeks	6	weeks	JV	female	GRO	BDWT	WO	0.368	0.564	93	yes
300	Kiremidjian-Schumacher et al. (1992)	1422	mouse (*Mus musculus*)	2	U	FD	8	weeks	6	weeks	JV	male	GRO	BDWT	WO	0.371	na	69	no (UN)
301	Julius et al. (1983)	1408	hamster (*Mesocricetus auratus*)	3	U	FD	21	days	4	weeks	JV	male	GRO	BDWT	WO	0.374	0.747	84	yes
302	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	2	U	FD	5	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.375	na	76	no (UN)
303	Spallholz et al. (1973)	1566	mouse (*Mus musculus*)	10	U	FD	5	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.384	0.523	83	yes
304	Nebbia et al. (1987)	1471	rat (*Rattus norvegicus*)	4	U	DR	240	days	NR	NR	JV	male	GRO	BDWT	WO	0.384	0.768	78	yes
305	Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	4	U	FD	5	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.388	0.776	84	yes
306	Abdo (1994)	1475	rat (*Rattus norvegicus*)	6	U	DR	13	weeks	6	weeks	JV	female	GRO	BDWT	WO	0.393	0.763	93	yes
307	Schroeder and Mitchener (1972)	3725	mouse (*Mus musculus*)	2	U	DR	360	days	NR	lf	JV	male	GRO	BDWT	WO	0.407	na	68	no (UN)
308	Halverson et al. (1966)	1332	rat (*Rattus norvegicus*)	8	U	FD	6	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.425	0.567	77	yes
309	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	2	U	FD	5	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.426	na	74	no (UN)
310	Halverson et al. (1966)	1332	rat (*Rattus norvegicus*)	7	U	FD	6	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.432	0.577	83	yes
311	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	GRO	BDWT	WO	0.435	0.869	82	yes
312	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	GRO	BDWT	WO	0.435	0.869	82	yes
313	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	GRO	BDWT	WO	0.435	0.869	82	yes
314	Johnson et al. (2000)	36818	mouse (*Mus musculus*)	4	U	DR	14	days	6-7	weeks	JV	male	GRO	BDWT	WO	0.438	1.31	78	yes
315	Jacobs and Forst (1981)	1393	rat (*Rattus norvegicus*)	6	U	DR	35	days	5, 12	weeks	JV	both	GRO	BDWT	WO	0.452	0.904	77	yes
316	Goehring et al. (1984)	1312	pig (*Sus scrofa*)	4	M	FD	17	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.464	na	74	no (UN)
317	Whanger and Butler (1988)	1618	rat (*Rattus norvegicus*)	4	U	FD	9	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.490	na	78	no (UN)
318	Whanger and Butler (1988)	1618	rat (*Rattus norvegicus*)	4	U	FD	9	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.500	na	78	no (UN)
319	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	5	U	FD	5	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.515	1.54	77	yes
320	Beems and van Beek (1985)	1223	hamster (*Mesocricetus auratus*)	5	M	FD	42	days	NR	NR	JV	male	GRO	BDWT	WO	0.610	1.21	92	yes
321	Turan et al. (1997)	1603	rabbit (*Oryctolagus cuniculus*)	2	U	FD	14	weeks	NR	NR	JV	both	GRO	BDWT	WO	0.652	na	68	no (UN)
322	Hadjimarkos (1970)	14488	hamster (*Mesocricetus auratus*)	4	U	DR	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	0.680	0.88	82	yes
323	Abdo (1994)	1475	mouse (*Mus musculus*)	6	U	DR	13	weeks	6	weeks	JV	male	GRO	BDWT	WO	0.735	1.51	90	yes
324	Panter et al. (1995)	1498	sheep (*Ovis aries*)	2	M	FD	88	days	NR	NR	GE	female	GRO	BDWT	WO	0.780	na	73	no (UN)
325	Abdo (1994)	1475	mouse (*Mus musculus*)	6	U	DR	13	weeks	6	weeks	JV	both	GRO	BDWT	WO	0.781	1.23	93	yes
326	Jacobs and Forst (1981)	1394	mouse (*Mus musculus*)	4	U	DR	47	weeks	6	weeks	JV	female	GRO	BDWT	WO	0.784	1.21	78	yes
327	Julius et al. (1983)	1408	hamster (*Mesocricetus auratus*)	5	U	FD	21	days	4	weeks	JV	both	GRO	BDWT	WO	0.810	1.62	84	yes
328	Panter et al. (1995)	1498	sheep (*Ovis aries*)	2	M	FD	88	days	NR	NR	GE	female	GRO	BDWT	WO	0.945	na	67	no (UN)
329	Hermann et.al. (1991)	1364	rat (*Rattus norvegicus*)	3	U	FD	8	weeks	NR	NR	JV	female	GRO	BDWT	WO	0.996	1.59	82	yes
330	Hermann et.al. (1991)	1364	rat (*Rattus norvegicus*)	3	U	FD	8	weeks	NR	NR	JV	female	GRO	BDWT	WO	0.996	1.59	82	yes
331	Ishikawa et al. (1992)	1392	mouse (*Mus musculus*)	5	U	DR	12	weeks	5	weeks	JV	male	GRO	BDWT	WO	1.09	na	72	no (UN)
332	Jacobs and Forst (1981)	1394	mouse (*Mus musculus*)	7	U	DR	46	days	7	weeks	JV	male	GRO	BDWT	WO	1.14	2.27	77	yes
333	Beems and van Beek (1985)	1223	hamster (*Mesocricetus auratus*)	5	M	FD	42	days	NR	NR	JV	female	GRO	BDWT	WO	1.26	na	77	no (UN)
334	Piccirillo et al. (1983)	1507	mouse (*Mus musculus*)	2	U	GV	8	days	64	days	GE	female	GRO	BDWT	WO	1.60	na	84	no (UN)
335	Tsunoda et al. (2000)	36834	mouse (*Mus musculus*)	4	U	DR	14	days	7-8	weeks	JV	male	GRO	BDWT	WO	1.96	na	71	no (UN)
336	Hardin et al. (1987)	1335	mouse (*Mus musculus*)	5	U	GV	8	days	6-8	weeks	JV	female	GRO	BDWT	WO	3.20	6.39	85	yes
337	Plasterer et al. (1985)	1509	mouse (*Mus musculus*)	2	U	GV	8	days	61-71	days	GE	female	GRO	BDWT	WO	3.20	na	84	no (UN)
338	Piccirillo et al. (1983)	1507	mouse (*Mus musculus*)	6	U	GV	8	days	64	days	JV	female	GRO	BDWT	WO	4.57	na	84	no (UN)
339	Plasterer et al. (1985)	1509	mouse (*Mus musculus*)	4	U	GV	8	days	61-71	days	JV	female	GRO	BDWT	WO	4.57	na	84	no (UN)
340	Booth et al. (1983)	1234	mouse (*Mus musculus*)	4	U	GV	8	days	68-81	days	JV	female	GRO	BDWT	WO	10.0	na	90	no (UN)
341	Sayato et al. (1993)	1538	mouse (*Mus musculus*)	5	U	GV	30	days	5	weeks	JV	male	GRO	BDWT	WO	10.0	20.0	85	yes
342	Kaur and Parshad (1994)	1411	rat (*Rattus norvegicus*)	3	U	FD	1	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.0908	77	yes
343	Spallholz et al. (1973)	1566	mouse (*Mus musculus*)	3	U	FD	5	weeks	NR	NR	JV	both	GRO	BDWT	WO	na	0.0968	77	yes
344	Boylan et al. (1990)	1239	mouse (*Mus musculus*)	2	M	FD	6	months	NR	NR	JV	female	GRO	BDWT	WO	na	0.156	82	yes
345	Wahlstrom et al. (1956)	14498	pig (*Sus scrofa*)	2	U	FD	108	days	NR	NR	JV	NR	GRO	BDWT	WO	na	0.163	78	yes
346	Behne et al. (1992)	1224	rat (*Rattus norvegicus*)	2	U	FD	110	days	30	days	JV	male	GRO	BDWT	WO	na	0.166	77	yes
Growth (continued)																			
347	Baker et al. (1989)	1219	pig (*Sus scrofa*)	2	M	FD	9	weeks	8-14	weeks	JV	both	GRO	BDWT	WO	na	0.205	81	yes
348	Rhian and Moxon (1943)	14494	dog (*Canis familiaris*)	2	U	FD	8	weeks	150	days	JV	female	GRO	BDWT	WO	na	0.209	77	no (ID)
349	Goehring et al. (1984)	1312	rat (*Rattus norvegicus*)	4	M	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.215	82	yes
350	Chen et al. (1985)	1256	rat (*Rattus norvegicus*)	4	U	DR	32	days	NR	NR	JV	male	GRO	BDWT	WO	na	0.232	72	yes
351	Miller (1938)	14492	pig (*Sus scrofa*)	5	U	FD	63	days	4	months	JV	both	GRO	BDWT	WO	na	0.235	78	yes
352	Wahlstrom et al. (1956)	14498	pig (*Sus scrofa*)	2	U	FD	3	months	NR	NR	JV	NR	GRO	BDWT	WO	na	0.254	78	yes
353	Schroeder (1967)	1540	rat (*Rattus norvegicus*)	2	U	DR	30	days	21	days	JV	both	GRO	BDWT	WO	na	0.267	72	yes
354	Schroeder (1967)	1540	mouse (*Mus musculus*)	2	U	DR	99	days	21	days	JV	female	GRO	BDWT	WO	na	0.274	72	yes
355	Schroeder (1967)	1540	rat (*Rattus norvegicus*)	2	U	DR	30	days	21	days	JV	both	GRO	BDWT	WO	na	0.276	72	yes
356	Mercado and Bibby (1973)	757	rat (*Rattus norvegicus*)	2	U	DR	50	days	23	days	JV	male	GRO	BDWT	WO	na	0.282	71	yes
357	Wahlstrom et al. (1984)	1612	pig (*Sus scrofa*)	2	U	FD	6	weeks	5-6	weeks	JV	male	GRO	BDWT	WO	na	0.303	82	yes

Table H2.A-9. Selenium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
358	Baker et al. (1989)	1219	pig (*Sus scrofa*)	2	M	FD	9	weeks	8-14	weeks	JV	both	GRO	BDWT	WO	na	0.307	81	yes
359	Wahlstrom et al. (1956)	14498	pig (*Sus scrofa*)	2	U	FD	98	days	NR	NR	JV	NR	GRO	BDWT	WO	na	0.323	78	yes
360	Birt et al. (1983)	1233	hamster (*Mesocricetus auratus*)	3	U	FD	25	weeks	4	weeks	JV	female	GRO	BDWT	WO	na	0.345	82	yes
361	Baker et al. (1989)	1219	pig (*Sus scrofa*)	2	M	FD	9	weeks	8-14	weeks	JV	both	GRO	BDWT	WO	na	0.352	81	yes
362	Thorlacius-Ussing et al. (1988)	1597	rat (*Rattus norvegicus*)	2	U	DR	21	days	25	days	JV	female	GRO	BDWT	WO	na	0.378	72	yes
363	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	3	U	FD	3	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.390	76	yes
364	Thorlacius-Ussing et al. (1988)	1598	rat (*Rattus norvegicus*)	2	U	DR	21	days	21	days	JV	male	GRO	BDWT	WO	na	0.411	72	yes
365	Liu and Boylan (1994)	1443	rat (*Rattus norvegicus*)	2	M	FD	8	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.420	82	yes
366	Schroeder and Mitchener (1972)	3725	mouse (*Mus musculus*)	2	U	DR	90	days	NR	lf	JV	male	GRO	BDWT	WO	na	0.425	72	yes
367	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	3	U	FD	5	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.441	76	yes
368	Carmichael and Fowler (1980)	1249	rat (*Rattus norvegicus*)	2	U	DR	22	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.454	73	yes
369	Birt et al. (1986)	1232	hamster (*Mesocricetus auratus*)	2	U	FD	10	weeks	4	weeks	JV	male	GRO	BDWT	WO	na	0.490	77	yes
370	Raisbeck et al. (1996)	1521	pronghorn (*Antilocapra americana*)	2	M	FD	164	days	6-96	months	JV	male	GRO	BDWT	WO	na	0.493	81	no (RU)
371	Salbe et al. (1990)	1532	rat (*Rattus norvegicus*)	3	U	DR	21	days	21	days	JV	both	GRO	BDWT	WO	na	0.498	72	yes
372	LeBoeuf and Hoekstra (1983)	1432	rat (*Rattus norvegicus*)	2	U	FD	6	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.521	76	yes
373	Thorlacius-Ussing (1990)	1595	rat (*Rattus norvegicus*)	2	U	DR	21	days	21	days	JV	both	GRO	BDWT	WO	na	0.543	71	yes
374	Parshad and Sud (1989)	1500	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.550	77	yes
375	Gronbaek et al. (1995)	1323	rat (*Rattus norvegicus*)	2	U	DR	14	days	3-4	weeks	JV	male	GRO	BDWT	WO	na	0.570	73	yes
376	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	4	U	FD	3	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.589	76	yes
377	Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	4	U	FD	5	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.653	78	yes
378	Hadjimarkos (1967)	1327	rat (*Rattus norvegicus*)	2	U	DR	21	days	NR	NR	JV	male	GRO	BDWT	WO	na	0.667	73	yes
379	Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.704	76	yes
380	Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	2	U	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.754	77	yes
381	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	4	M	DR	7	days	21	days	JV	male	GRO	BDWT	WO	na	0.767	78	yes
382	Cabe et al. (1979)	1244	rat (*Rattus norvegicus*)	2	U	DR	13	weeks	50	days	JV	male	GRO	BDWT	WO	na	0.769	72	yes
383	Panter et al. (1996)	1499	pig (*Sus scrofa*)	2	U	FD	6	weeks	8-10	weeks	JV	both	GRO	BDWT	WO	na	0.794	70	yes
384	Panter et al. (1996)	1499	pig (*Sus scrofa*)	2	U	FD	6	weeks	8-10	weeks	JV	both	GRO	BDWT	WO	na	0.794	76	yes
385	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	NR	GRO	BDWT	WO	na	0.794	82	yes
386	Panter et al. (1996)	1499	pig (*Sus scrofa*)	2	U	FD	6	weeks	8-10	weeks	JV	both	GRO	BDWT	WO	na	0.794	76	yes
387	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	NR	GRO	BDWT	WO	na	0.809	82	yes
388	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	NR	GRO	BDWT	WO	na	0.817	82	yes
389	Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	2	U	FD	8	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.823	77	yes
390	Obermeyer et al. (1971)	12934	rat (*Rattus norvegicus*)	2	U	FD	4	weeks	NR	NR	JV	NR	GRO	BDWT	WO	na	0.903	77	yes
391	Halverson and Monty (1960)	36812	rat (*Rattus norvegicus*)	2	U	FD	28	days	NR	NR	JV	male	GRO	BDWT	WO	na	0.968	77	yes
392	Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	2	U	FD	18	days	NR	NR	NR	male	GRO	BDWT	WO	na	0.984	77	yes
393	Halverson and Monty (1960)	36812	rat (*Rattus norvegicus*)	2	U	FD	28	days	NR	NR	JV	male	GRO	BDWT	WO	na	0.988	77	yes
394	Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	2	U	FD	18	days	NR	NR	NR	male	GRO	BDWT	WO	na	1.02	77	yes
395	Cutler (1974)	21137	rat (*Rattus norvegicus*)	2	U	DR	5	months	NR	NR	JV	male	GRO	BDWT	WO	na	1.11	72	yes
396	Hermann et.al. (1991)	1364	rat (*Rattus norvegicus*)	2	U	FD	8	weeks	NR	NR	JV	female	GRO	BDWT	WO	na	1.59	76	yes
397	Rastogi et al. (1976)	1523	rat (*Rattus norvegicus*)	2	U	DR	1	weeks	1	months	JV	both	GRO	BDWT	WO	na	1.59	73	yes
398	Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	2	U	FD	65	days	28	days	JV	both	GRO	BDWT	WO	na	1.79	81	yes
399	Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	2	M	FD	18	days	NR	NR	NR	male	GRO	BDWT	WO	na	1.94	71	yes
400	Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	2	U	FD	5	days	28	days	JV	male	GRO	BDWT	WO	na	3.54	81	yes
401	Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	2	U	FD	5	days	28	days	JV	both	GRO	BDWT	WO	na	3.74	78	yes
402	Chermoff and Kavlock (1982)	1259	mouse (*Mus musculus*)	2	U	GV	5	days	60	days	GE	female	GRO	BDWT	WO	na	4.18	84	yes
Survival																			
403	Spallholz et al. (1973)	1566	mouse (*Mus musculus*)	3	U	FD	5	weeks	NR	NR	JV	both	MOR	SURV	WO	0.0961	0.385	82	yes
404	Spallholz et al. (1973)	1566	mouse (*Mus musculus*)	10	U	FD	5	weeks	NR	NR	JV	both	MOR	SURV	WO	0.101	0.168	84	no (SDC)
405	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	3	M	DR	42	days	21	days	JV	male	MOR	MORT	WO	0.181	na	79	no (UN)
406	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	3	M	DR	42	days	21	days	JV	male	MOR	MORT	WO	0.186	na	79	no (UN)
407	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	MOR	MORT	WO	0.217	0.435	83	yes
408	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	MOR	MORT	WO	0.217	0.435	83	yes
409	Schroeder (1967)	1540	rat (*Rattus norvegicus*)	2	U	DR	180	days	21	days	JV	both	MOR	MORT	WO	0.221	na	73	no (UN)
410	Gronbaek and Thorlacius-Ussing (1990)	1324	rat (*Rattus norvegicus*)	4	U	DR	2	weeks	NR	NR	NR	male	MOR	SURV	WO	0.239	na	68	no (UN)
411	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	4	M	DR	21	days	21	days	JV	male	MOR	MORT	WO	0.274	0.540	85	yes
412	Jenkins and Hidiroglou (1986)	1401	cattle (*Bos taurus*)	5	U	FD	6	weeks	3	days	JV	male	MOR	MORT	WO	0.334	na	78	no (UN)
413	Birt et al. (1983)	1233	hamster (*Mesocricetus auratus*)	2	U	FD	25	weeks	4	weeks	JV	both	MOR	MORT	WO	0.350	na	79	no (UN)
414	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	2	U	FD	3	weeks	NR	NR	JV	male	MOR	SURV	WO	0.375	na	77	no (UN)
415	Abdo (1994)	1475	rat (*Rattus norvegicus*)	6	UX	DR	13	weeks	6	weeks	JV	female	MOR	MORT	WO	0.393	0.763	94	yes
416	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	4	U	FD	3	weeks	NR	NR	JV	male	MOR	MORT	WO	0.426	1.28	83	yes
417	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	MOR	MORT	WO	0.435	0.869	83	yes
418	McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	4	U	FD	6	weeks	21	days	JV	male	MOR	MORT	WO	0.435	0.869	83	yes
419	Moxon and Mahan (1981 [b])	1468	pig (*Sus scrofa*)	8	UX	FD	37	days	NR	NR	JV	NR	MOR	MORT	WO	0.474	0.632	90	yes
420	Abdo (1994)	1475	rat (*Rattus norvegicus*)	6	UX	DR	13	weeks	6	weeks	JV	female	MOR	MORT	WO	0.564	0.769	94	yes
421	Halverson et al. (1966)	1332	rat (*Rattus norvegicus*)	8	U	FD	4	weeks	NR	NR	JV	male	MOR	MORT	WO	0.576	0.720	78	yes

Table H2.A-9. Selenium Data for Mammals as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
422	Halverson et al. (1966)	1332	rat (*Rattus norvegicus*)	7	U	FD	4	weeks	NR	NR	JV	male	MOR	MORT	WO	0.587	0.733	84	yes
423	Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	4	M	DR	21	days	21	days	JV	male	MOR	MORT	WO	0.595	0.892	85	yes
424	Wilson et al. (1988)	1629	pig (*Sus scrofa*)	4	U	OR	9	days	6	weeks	JV	male	MOR	MORT	WO	0.639	1.19	91	yes
425	Birt et al. (1983)	1233	hamster (*Mesocricetus auratus*)	3	U	FD	25	weeks	4	weeks	JV	both	MOR	MORT	WO	0.652	na	72	no (UN)
426	Turan et al. (1997)	1603	rabbit (*Oryctolagus cuniculus*)	2	U	FD	14	weeks	NR	NR	JV	both	MOR	MORT	WO	0.652	na	78	no (UN)
427	Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	4	U	FD	22	days	NR	NR	JV	male	MOR	MORT	WO	0.653	0.980	85	yes
428	Chen et al. (1982)	1254	rat (*Rattus norvegicus*)	3	U	FD	4	weeks	NR	NR	JV	male	MOR	MORT	WO	0.680	na	78	no (UN)
429	Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	male	MOR	MORT	WO	0.704	na	77	no (UN)
430	Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	2	U	FD	4	weeks	NR	NR	JV	male	MOR	MORT	WO	0.754	na	78	no (UN)
431	Cabe et al. (1979)	1244	rat (*Rattus norvegicus*)	2	U	DR	18	weeks	50	days	JV	male	MOR	MORT	WO	0.769	na	73	no (UN)
432	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	NR	MOR	MORT	WO	0.794	na	83	no (UN)
433	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	3	M	FD	4	weeks	NR	NR	JV	NR	MOR	MORT	WO	0.820	na	83	no (UN)
434	Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	4	U	FD	22	days	NR	NR	JV	male	MOR	MORT	WO	0.857	1.71	85	yes
435	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	3	U	FD	3	weeks	NR	NR	JV	male	MOR	SURV	WO	0.881	na	77	no (UN)
436	Jacobs and Forst (1981)	1393	rat (*Rattus norvegicus*)	6	U	DR	35	days	5, 12	weeks	JV	both	MOR	SURV	WO	0.904	1.81	78	yes
437	Rastogi et al. (1976)	1523	rat (*Rattus norvegicus*)	2	U	DR	8	weeks	1	months	JV	both	MOR	MORT	WO	0.953	na	74	no (UN)
438	Piccirillo et al. (1983)	1507	mouse (*Mus musculus*)	6	U	GV	8	days	64	days	JV	female	MOR	MORT	WO	1.14	2.28	91	yes
439	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	3	U	FD	3	weeks	NR	NR	JV	male	MOR	MORT	WO	1.17	na	77	no (UN)
440	Hadjimarkos (1970)	14488	hamster (*Mesocricetus auratus*)	4	U	DR	4	weeks	NR	NR	JV	male	MOR	MORT	WO	1.17	na	77	no (UN)
441	Jacobs and Forst (1981)	1394	mouse (*Mus musculus*)	4	U	DR	47	weeks	6	weeks	JV	female	MOR	MORT	WO	1.21	na	73	no (UN)
442	Beems and van Beek (1985)	1223	hamster (*Mesocricetus auratus*)	5	M	FD	42	days	NR	NR	JV	male	MOR	MORT	WO	1.21	na	87	no (UN)
443	Beems and van Beek (1985)	1223	hamster (*Mesocricetus auratus*)	5	M	FD	42	days	NR	NR	JV	female	MOR	MORT	WO	1.26	na	87	no (UN)
444	Miller (1938)	14492	pig (*Sus scrofa*)	5	U	FD	63	days	4	months	JV	both	MOR	MORT	WO	1.49	5.96	83	yes
445	Abdo (1994)	1475	mouse (*Mus musculus*)	6	UX	DR	13	weeks	6	weeks	JV	male	MOR	MORT	WO	1.51	na	85	no (UN)
446	Piccirillo et al. (1983)	1507	mouse (*Mus musculus*)	2	U	GV	8	days	64	days	GE	female	MOR	MORT	WO	1.60	na	85	no (UN)
447	Jacobs and Forst (1981)	1394	mouse (*Mus musculus*)	7	U	DR	46	days	7	weeks	JV	both	MOR	MORT	WO	2.27	4.55	78	yes
448	Abdo (1994)	1475	mouse (*Mus musculus*)	6	UX	DR	13	weeks	6	weeks	JV	both	MOR	MORT	WO	2.28	na	88	no (UN)
449	Plasterer et al. (1985)	1509	mouse (*Mus musculus*)	6	U	GV	8	days	61-71	days	JV	female	MOR	MORT	WO	2.28	4.57	91	yes
450	Pathak and Datta (1984)	1501	goat (*Capra hircus*)	4	U	OR	17	days	6	months	MA	NR	MOR	MORT	WO	3.0	6.0	87	no (RU)
451	Julius et al. (1983)	1408	hamster (*Mesocricetus auratus*)	5	U	FD	21	days	4	weeks	JV	both	MOR	MORT	WO	3.18	6.36	85	yes
452	Hardin et al. (1987)	1335	mouse (*Mus musculus*)	5	U	GV	8	days	6-8	weeks	GE	female	MOR	MORT	WO	3.20	6.39	86	yes
453	Plasterer et al. (1985)	1509	mouse (*Mus musculus*)	2	U	GV	8	days	61-71	days	GE	female	MOR	SURV	WO	3.20	na	85	no (UN)
454	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	4	U	FD	3	weeks	NR	NR	JV	male	MOR	SURV	WO	3.53	na	77	no (UN)
455	Chermoff and Kavlock (1982)	1259	mouse (*Mus musculus*)	2	U	GV	5	days	60	days	GE	female	MOR	MORT	WO	4.18	na	85	no (UN)
456	Booth et al. (1983)	1234	mouse (*Mus musculus*)	6	U	GV	8	days	68-81	days	JV	female	MOR	MORT	WO	10.0	20	97	yes
457	Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	5	U	FD	3	weeks	NR	NR	JV	male	MOR	SURV	WO	15.4	na	78	no (UN)
458	Schroeder (1967)	1540	rat (*Rattus norvegicus*)	2	U	DR	16	days	21	days	JV	both	MOR	MORT	WO	na	0.275	73	yes
459	Jacobs and Forst (1981)	1393	rat (*Rattus norvegicus*)	2	U	DR	10	weeks	5	weeks	JV	male	MOR	SURV	WO	na	0.440	73	yes
Survival (continued)																			
460	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	NR	MOR	MORT	WO	na	0.809	83	yes
461	Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	2	M	FD	4	weeks	NR	NR	JV	NR	MOR	MORT	WO	na	0.817	83	yes
462	Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	2	U	FD	8	weeks	NR	NR	JV	male	MOR	SURV	WO	na	0.823	72	yes
463	Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	2	U	FD	18	days	NR	NR	NR	male	MOR	MORT	WO	na	0.975	78	yes
464	Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	2	U	FD	18	days	NR	NR	NR	male	MOR	MORT	WO	na	0.984	78	yes
465	Cutler (1974)	21137	rat (*Rattus norvegicus*)	2	U	DR	5	months	NR	NR	JV	male	MOR	MORT	WO	na	1.11	73	yes
466	Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	2	U	FD	100	days	28	days	JV	male	MOR	MORT	WO	na	1.79	82	yes
467	Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	2	M	FD	18	days	NR	NR	NR	male	MOR	MORT	WO	na	1.94	72	yes
468	Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	2	U	FD	100	days	28	days	JV	both	MOR	MORT	WO	na	3.54	82	yes
469	Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	2	U	FD	100	days	28	days	JV	both	MOR	MORT	WO	na	3.74	79	yes
470	Davidson-York et al. (1999)	1277	pig (*Sus scrofa*)	2	M	FD	19	days	NR	NR	NR	both	MOR	MORT	WO	na	4.17	76	yes
471	Seidenberg et al. (1986)	113	mouse (*Mus musculus*)	2	U	GV	4	days	NR	NR	GE	female	MOR	MORT	WO	na	5.01	85	yes

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the selenium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2007b) for the full reference list for studies cited in this table.

[a] Rationale for study unacceptability is in parentheses.

[b] Publication year was listed as 1982 in the Eco-SSL document. The correct year is 1981.

Table H2.A-10. Vanadium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Reproduction																			
37	Sell et al. (1982)	8577	chicken (*Gallus domesticus*)	4	U	FD	7	days	41	weeks	LB	female	EGG	EQUA	EG	0.275	0.413	85	no (ENR)
38	Sell et al. (1986)	6469	chicken (*Gallus domesticus*)	3	M	FD	4	weeks	25	weeks	LB	female	EGG	EQUA	EG	0.325	0.524	90	no (ENR)
39	Benabdeljelil and Jensen (1989)	5843	chicken (*Gallus domesticus*)	2	U	FD	6	weeks	72	weeks	LB	female	EGG	EGWT	EG	0.366	na	70	no (UN)
40	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	40	weeks	LB	female	EGG	EQUA	EG	0.988	1.98	80	no (ENR)
41	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	35-40	weeks	LB	female	EGG	EQUA	EG	0.988	1.98	84	no (ENR)
42	Kubena and Phillips (1982)	6388	chicken (*Gallus domesticus*)	5	UX	FD	84	days	29	weeks	LB	female	REP	TPRD	WO	1.25	2.50	90	yes
43	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	50	weeks	LB	female	EGG	EQUA	EG	3.95	na	69	no (UN)
44	Hafez and Kratzer (1976)	6848	chicken (*Gallus domesticus*)	3	U	FD	1	months	28	weeks	LB	female	REP	PROG	WO	4.94	14.8	84	yes
45	Hafez and Kratzer (1976)	6848	Japanese quail (*Coturnix japonica*)	5	U	FD	1	months	NR	NR	LB	female	REP	PROG	WO	39.0	na	74	no (UN)
46	Benabdeljelil and Jensen (1989)	5843	chicken (*Gallus domesticus*)	2	U	FD	8	weeks	25	weeks	LB	female	EGG	EQUA	EG	na	0.319	79	no (ENR)
47	Jensen and Maurice (1980)	9749	chicken (*Gallus domesticus*)	2	U	FD	6	weeks	NR	NR	LB	female	EGG	EQUA	EG	na	0.475	79	no (ENR)
48	Jensen and Maurice (1980)	9749	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	NR	NR	LB	female	REP	EQUA	EG	na	0.494	78	no (ENR)
49	Benabdeljelil and Jensen (1990)	5749	chicken (*Gallus domesticus*)	4	U	FD	2	weeks	43	weeks	LB	female	EGG	EQUA	EG	na	0.669	79	no (ENR)
50	Sell et al. (1982)	8577	chicken (*Gallus domesticus*)	4	M	FD	7	days	41	weeks	LB	female	EGG	EQUA	EG	na	0.740	84	no (ENR)
51	Jensen and Maurice (1980)	9749	chicken (*Gallus domesticus*)	2	U	FD	4	weeks	NR	NR	LB	female	EGG	EQUA	EG	na	0.988	78	no (ENR)
52	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	35-40	weeks	LB	female	EGG	EQUA	EG	na	0.988	78	no (ENR)
53	Bressman et al. (2002)	25961	chicken (*Gallus domesticus*)	4	U	FD	14	days	32	weeks	LB	female	EGG	ESQU	EG	na	1.31	79	no (ENR)
54	Toussant and Latshaw (1994)	5456	chicken (*Gallus domesticus*)	2	M	FD	9	days	25	weeks	LB	female	REP	PROG	WO	na	1.33	84	yes
55	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	48	weeks	LB	female	EGG	EGWT	EG	na	1.98	79	no (ENR)
56	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	2	U	FD	7	weeks	40-60	weeks	LB	female	REP	TPRD	WO	na	2.75	79	yes
Growth																			
57	Phillips et al. (1982)	6412	chicken (*Gallus domesticus*)	4	U	FD	25	weeks	1	days	JV	female	GRO	BDWT	WO	0.244	0.489	82	no (ID)
58	Cervantes and Jensen (1986)	6085	chicken (*Gallus domesticus*)	2	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	0.279	na	69	no (UN)
59	Nielsen et al. (1980)	15690	chicken (*Gallus domesticus*)	2	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	0.284	na	68	no (UN)
60	Cervantes and Jensen (1986)	6085	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	0.295	0.589	84	yes
61	Hill (1979)	397	chicken (*Gallus domesticus*)	4	U	FD	5	weeks	1	days	JV	female	GRO	BDWT	WO	0.344	0.688	82	yes
62	Benabdeljelil and Jensen (1989)	5843	chicken (*Gallus domesticus*)	2	U	FD	8	weeks	25	weeks	SM	female	GRO	BDWT	WO	0.366	na	68	no (UN)
63	Jensen and Maurice (1980)	9749	chicken (*Gallus domesticus*)	2	U	FD	6	weeks	NR	NR	SM	female	GRO	BDWT	WO	0.475	na	68	no (UN)
64	Hill (1990)	8125	chicken (*Gallus domesticus*)	4	U	FD	19	days	1	days	JV	female	GRO	BDWT	WO	0.711	1.42	82	yes
65	Hill (1990)	8125	chicken (*Gallus domesticus*)	4	U	FD	19	days	1	days	JV	female	GRO	BDWT	WO	0.711	1.42	82	yes
66	Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	3	U	FD	14	days	1	days	JV	NR	GRO	BDWT	WO	0.904	2.26	82	yes
67	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	35-40	weeks	SM	female	GRO	BDWT	WO	0.988	1.98	82	yes
68	Romoser,et al. (1961)	3740	chicken (*Gallus domesticus*)	6	U	FD	21	days	7	days	JV	male	GRO	BDWT	WO	1.050	1.59	82	yes
69	Qureshi et al. (1999)	5079	chicken (*Gallus domesticus*)	4	U	FD	14	days	1	days	JV	both	GRO	BDWT	WO	1.22	3.05	83	yes
70	Kubena and Phillips (1982)	6388	chicken (*Gallus domesticus*)	5	UX	FD	56	days	29	weeks	SM	female	GRO	BDWT	WO	1.26	2.51	88	yes
71	Benabdeljelil and Jensen (1990)	5749	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	43	weeks	SM	female	GRO	BDWT	WO	1.84	6.13	81	yes
72	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	40	weeks	SM	female	GRO	BDWT	WO	1.98	na	67	no (UN)
73	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	40	weeks	SM	female	GRO	BDWT	WO	1.98	na	67	no (UN)
74	Sell et al. (1982)	8577	chicken (*Gallus domesticus*)	4	M	FD	4	weeks	41	weeks	SM	female	GRO	BDWT	WO	2.20	na	73	no (UN)
75	Nelson et al. (1962)	14516	chicken (*Gallus domesticus*)	5	U	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	2.34	4.08	83	yes
76	Kubena et al. (1986)	6041	chicken (*Gallus domesticus*)	3	U	FD	28	days	1	days	JV	male	GRO	BDWT	WO	2.36	na	68	no (UN)
77	Nelson et al. (1962)	14516	chicken (*Gallus domesticus*)	10	U	FD	4	weeks	NR	NR	JV	male	GRO	BDWT	WO	2.68	3.58	83	yes
78	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	2.87	5.74	82	yes
79	Hafez and Kratzer (1976)	6848	Japanese quail (*Coturnix japonica*)	5	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	46.1	na	74	no (UN)
80	Summers and Moran (1972)	7051	chicken (*Gallus domesticus*)	2	U	FD	3	weeks	NR	NR	JV	NR	GRO	BDWT	WO	na	0.339	71	yes
81	Hill (1974)	92	chicken (*Gallus domesticus*)	6	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	na	0.429	76	yes
82	Berg and Lawrence (1971)	9290	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.859	76	yes
83	Berg and Lawrence (1971)	9290	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.859	76	yes
84	Berg and Lawrence (1971)	9290	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	NR	NR	JV	male	GRO	BDWT	WO	na	0.859	76	yes
85	Blalock and Hill (1987)	5927	chicken (*Gallus domesticus*)	4	U	FD	3	weeks	1	days	JV	female	GRO	BDWT	WO	na	0.968	77	yes
86	Romoser,et al. (1961)	3740	chicken (*Gallus domesticus*)	4	U	FD	21	days	9	days	JV	male	GRO	BDWT	WO	na	1.32	76	yes
87	Toussant and Latshaw (1994)	5456	chicken (*Gallus domesticus*)	2	M	FD	14	days	25	weeks	SM	female	GRO	BDWT	WO	na	1.33	82	yes
88	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	na	1.72	76	yes
89	Hill (1990)	5736	chicken (*Gallus domesticus*)	2	U	FD	18	days	1	days	JV	female	GRO	BDWT	WO	na	1.77	77	yes
90	Hill (1990)	8125	chicken (*Gallus domesticus*)	2	U	FD	19	days	1	days	JV	female	GRO	BDWT	WO	na	1.78	76	yes
91	Cupo and Donaldson (1987)	5971	chicken (*Gallus domesticus*)	2	U	FD	21	days	1	days	JV	male	GRO	BDWT	WO	na	2.00	77	yes

Table H2.A-10. Vanadium Data for Birds as Presented in Eco-SSL Document, Including Study Acceptability Determination

Result Number	Reference	Reference Number	Test Organism	Number of Concentrations or Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score	Study Acceptable for TRV Derivation? [a]
Growth (continued)																			
92	Romoser,et al. (1961)	3740	chicken (*Gallus domesticus*)	7	U	FD	21	days	11	days	JV	male	GRO	BDWT	WO	na	2.12	76	yes
93	Hill (1990)	5736	chicken (*Gallus domesticus*)	2	U	FD	18	days	1	days	JV	female	GRO	BDWT	WO	na	2.13	76	yes
94	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	GRO	BDWT	WO	na	2.15	76	yes
95	Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	2	U	FD	14	days	1	days	JV	NR	GRO	BDWT	WO	na	2.15	76	yes
96	Hill (1980)	395	chicken (*Gallus domesticus*)	2	U	FD	1	weeks	1	days	JV	female	GRO	BDWT	WO	na	2.15	76	yes
97	Hill (1974)	92	chicken (*Gallus domesticus*)	3	U	FD	2	weeks	1	days	JV	female	GRO	BDWT	WO	na	2.15	76	yes
98	Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	2	U	FD	7	weeks	40-60	weeks	SM	female	GRO	BDWT	WO	na	2.75	77	yes
99	Hill (1990)	5734	chicken (*Gallus domesticus*)	2	U	FD	19	days	1	days	JV	female	GRO	BDWT	WO	na	2.84	76	yes
100	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	na	2.87	76	yes
101	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	na	2.87	76	yes
102	Hill (1994)	5453	chicken (*Gallus domesticus*)	2	U	FD	21	days	1	days	JV	male	GRO	BDWT	WO	na	3.55	76	yes
103	Hill (1992)	8028	chicken (*Gallus domesticus*)	2	U	FD	19	days	1	days	JV	NR	GRO	BDWT	WO	na	3.55	76	yes
104	Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	2	U	FD	14	days	1	days	JV	NR	GRO	BDWT	WO	na	4.29	76	yes
105	Burt et al. (1991)	5295	chicken (*Gallus domesticus*)	2	U	FD	14	days	1	days	JV	NR	GRO	BDWT	WO	na	4.29	76	yes
106	Kubena et al. (1985)	6192	chicken (*Gallus domesticus*)	2	U	FD	14	days	1	days	JV	male	GRO	BDWT	WO	na	4.76	77	yes
107	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	JV	male	GRO	BDWT	WO	na	5.74	76	yes
108	Hafez and Kratzer (1976)	6876	chicken (*Gallus domesticus*)	2	U	FD	8	weeks	1	days	JV	male	GRO	BDWT	WO	na	8.36	77	yes
Survival																			
109	Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	3	U	FD	14	days	1	days	JV	NR	MOR	MORT	WO	0.859	2.15	83	yes
110	Blalock and Hill (1987)	5927	chicken (*Gallus domesticus*)	4	U	FD	3	weeks	1	days	JV	female	MOR	MORT	WO	0.962	1.92	84	yes
111	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	1.72	na	68	no (UN)
112	Hill (1974)	92	chicken (*Gallus domesticus*)	3	U	FD	5	weeks	1	days	JV	both	MOR	MORT	WO	2.15	4.294	83	yes
113	Hill (1979)	1370	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	1	days	JV	both	MOR	MORT	WO	2.15	na	68	no (UN)
114	Hill (1974)	92	chicken (*Gallus domesticus*)	6	U	FD	5	weeks	1	days	JV	female	MOR	MORT	WO	2.15	na	77	no (UN)
115	Kubena et al. (1986)	6041	chicken (*Gallus domesticus*)	3	U	FD	28	days	1	days	JV	male	MOR	MORT	WO	2.36	na	78	no (UN)
116	Kubena and Phillips (1982)	6388	chicken (*Gallus domesticus*)	5	UX	FD	84	days	29	weeks	SM	female	MOR	MORT	WO	2.50	4.99	89	yes
117	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	JV	male	MOR	MORT	WO	2.87	5.74	83	yes
118	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	male	MOR	MORT	WO	2.87	5.74	83	yes
119	Hill (1994)	5453	chicken (*Gallus domesticus*)	2	U	FD	21	days	1	days	JV	male	MOR	MORT	WO	3.55	na	70	no (UN)
120	Kubena et al. (1985)	6192	chicken (*Gallus domesticus*)	2	U	FD	28	days	1	days	JV	male	MOR	MORT	WO	4.76	na	78	no (UN)
121	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	4	U	FD	4	weeks	1	days	JV	male	MOR	MORT	WO	5.74	11.5	83	yes
122	Romoser,et al. (1961)	3740	chicken (*Gallus domesticus*)	7	U	FD	21	days	11	days	JV	male	MOR	MORT	WO	6.37	10.6	83	yes
123	Qureshi et al. (1999)	5079	chicken (*Gallus domesticus*)	4	U	FD	14	days	1	days	JV	both	MOR	MORT	WO	7.15	na	78	no (UN)
124	White and Dieter (1978)	6727	duck (*Anas platyrhynchos*)	4	M	FD	12	weeks	1	years	AD	both	MOR	MORT	WO	12.0	na	80	no (UN)
125	Van Vleet et al. (1981)	80	duck (*Anas* sp.)	2	U	FD	15	days	1	days	JV	male	MOR	MORT	WO	13.4	na	68	no (UN)
126	Hafez and Kratzer (1976)	6848	chicken (*Gallus domesticus*)	3	U	FD	1	months	28	weeks	JV	female	MOR	MORT	WO	14.8	na	77	no (UN)
127	Hafez and Kratzer (1976)	6848	Japanese quail (*Coturnix japonica*)	5	U	FD	4	weeks	1	days	JV	male	MOR	MORT	WO	98.7	na	77	no (UN)
128	Berg and Lawrence (1971)	9290	chicken (*Gallus domesticus*)	2	U	FD	2	weeks	NR	NR	JV	male	MOR	MORT	WO	na	1.72	77	yes
129	Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	2	U	FD	14	days	1	days	JV	NR	MOR	MORT	WO	na	2.15	77	yes
130	Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	2	U	FD	14	days	1	days	JV	NR	MOR	MORT	WO	na	4.29	77	yes
131	Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	3	U	FD	4	weeks	1	days	JV	male	MOR	MORT	WO	na	5.74	77	yes

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

Not all studies presented in the vanadium ecological soil screening level (Eco-SSL) document for growth, reproduction, and survival were used to derive the Eco-SSL toxicity reference value (TRV).

See Eco-SSL document (USEPA 2005c) for the full reference list for studies cited in this table.

[a] Rationale for study unacceptability is in parentheses.

Table H2.A-11. Wildlife TRV References Not Included in Eco-SSL Documents[a]

Receptor	Test Organism	Reference[b]	Information Used to Determine Tier	Tier
Arsenic				
Growth				
Bird	zebra finch (*Taeniopygia guttata*)	Albert et al. 2008a	UN	NT
Bird	zebra finch (*Taeniopygia guttata*)	Albert et al. 2008b	UN	NT
Bird	chicken (*Gallus domesticus*)	Naraharisetti et al. 2009	UN	NT
Bird	chicken (*Gallus domesticus*)	Sattar et al. 2016	UN	NT
Bird	mallard duck (*Anas platyrhynchos*)	Stanley et al. 1994	SDA	2
Bird	chicken (*Gallus domesticus*)	Hermayer et al. 1977	ID	NT
Reproduction				
Bird	mallard duck (*Anas platyrhynchos*)	Stanley et al. 1994	FD	1
Bird	chicken (*Gallus domesticus*)	Hermayer et al. 1977	ID	NT
Survival				
Bird	zebra finch (*Taeniopygia guttata*)	Albert et al. 2008b	GV	1
Chromium (trivalent)				
Growth				
Bird	chicken (*Gallus domesticus*)	Chung et al. 1985	FD	1
Bird	chicken (*Gallus domesticus*)	Bahrami et al. 2012	UN	NT
Bird	chicken (*Gallus domesticus*)	Nielsen et al. 1980	UN	NT
Bird	chicken (*Gallus domesticus*)	Romoser et al. 1961	UN	NT
Bird	Japanese quail (*Coturnix japonica*)	Rouhalamini and Salarmoini 2014	UN	NT
Mammal	rat (*Rattus norvegicus*)	Bataineh et al. 1997	UN	NT
Mammal	rat (*Rattus norvegicus*)	Hasten et al. 1997a	UN	NT
Mammal	rat (*Rattus norvegicus*)	Hasten et al. 1997b	UN	NT
Mammal	mouse (*Mus musculus*)	Junaid et al. 1996	ICF[c]	NT
Mammal	rat (*Rattus norvegicus*)	MacKenzie et al. 1958	UN	NT
Mammal	rat (*Rattus norvegicus*)	Mercado and Bibby 1973	UN	NT
Reproduction				
Mammal	mouse (*Mus musculus*)	Junaid et al. 1996	ICF[c]	NT
Mammal	rat (*Rattus norvegicus*)	Gross and Heller 1946	ID	NT
Mammal	rat (*Rattus norvegicus*)	Kanojia et al. 1998	ICF[c]	NT
Mammal	mouse (*Mus musculus*)	Trivedi et al. 1989	ICF[c], UN	NT
Survival				
Bird	chicken (*Gallus domesticus*)	Lien et al. 2004	UN	NT
Bird	chicken (*Gallus domesticus*)	Ma et al. 2014	UN	NT
Bird	chicken (*Gallus domesticus*)	Torki et al. 2013	UN	NT
Mammal	rat (*Rattus norvegicus*)	Anderson et al. 1997	UN	NT
Mammal	rat (*Rattus norvegicus*)	Ivankovic and Preussman 1975	UN	NT
Mammal	rat (*Rattus norvegicus*)	MacKenzie et al. 1958	UN	NT
Mammal	rat (*Rattus norvegicus*)	Schroeder et al. 1963	UN	NT
Mammal	rat (*Rattus norvegicus*)	Schroeder et al. 1965	SDC, UN	NT
Mammal	mouse (*Mus musculus*)	Trivedi et al. 1989	UN	NT
Nickel				
Growth				
Bird	Chicken (*Gallus domesticus*)	Arpasova et al. 2007	DW	2
Reproduction				
Bird	Chicken (*Gallus domesticus*)	Arpasova et al. 2007	DW	2

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

[a] Chemicals included in this table are those for which an Eco-SSL document was developed.

[b] See Attachment H2 references section for full citations.

[c] Chemical form evaluated was chromium (VI).

Table H2.A-12. Wildlife TRV References with Unbounded NOAELs Not Included for TRV Derivation [a]

Receptor	Test Organism	Reference [b]
Aluminum		
Growth		
Bird	ring dove (*Streptopelia risoria*)	Carriere et al. (1986)
Reproduction		
Mammal	rat (*Rattus norvegicus*)	Bataineh et al. (1998)
Mammal	rat (*Rattus norvegicus*)	Gomez et al. (1991)
Mammal	rat (*Rattus norvegicus*)	McCormack et al. (1979)
Iron		
Growth		
Bird	chicken (*Gallus domesticus*)	Jensen and Maurice (1978)
Mammal	bank vole (*Clethrionomys glareolus*)	Bonda et al. (2004)
Reproduction		
Mammal	rat (*Rattus norvegicus*)	Webster (1979)
Methylmercury		
Growth		
Mammal	rat (*Rattus norvegicus*)	Fredriksson et al. (1993)
Molybdenum		
Growth		
Mammal	rat (*Rattus norvegicus*)	Ale-Ebrahim et al. (2015)
Mammal	rat (*Rattus norvegicus*)	Franke and Moxon (1937)
Mammal	rat (*Rattus norvegicus*)	Murray et al. (2014)
Mammal	rat (*Rattus norvegicus*)	Seaborn and Yang (1993)
Mammal	rat (*Rattus norvegicus*)	Wang et al. (1992)
Mammal	rat (*Rattus norvegicus*)	Yang and Yang (1989)
Reproduction		
Mammal	rat (*Rattus norvegicus*)	Dulak et al. (1984)
Mammal	rat (*Rattus norvegicus*)	Murray et al. (2014)
Thallium		
Growth		
Mammal	rat (*Rattus norvegicus*)	MRI (1988)

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

[a] Chemicals included in this table are those for which an ecological soil screening level (Eco-SSL) document was not developed. These studies were excluded from the toxicity reference value (TRV) derivation process beause the study concluded that there were no effects on growth, survival, and/or reproduction at the lowest dose tested.

[b] See Attachment H2 references section for full citations.

Table H2.A-13. Tier Determination and Results of Study Selection Process for Acceptable Antimony Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Reproduction										
Rossi et al. (1987)	231	rat (*Rattus norvegicus*)	0.590	NA	NA	yes	2	1	T	0
Growth										
Rossi et al. (1987)	231	rat (*Rattus norvegicus*)	0.0590	na	no	yes	2	1	T	0
Shroeder et al. (1968)	238	mouse *(Mus musculus)*	0.678	yes	yes	yes	2	2	T	0
Poon et al. (1998)	224	rat (*Rattus norvegicus*)	42.0	yes	yes	yes	2	3	T	0
Survival										
Shroeder et al. (1970)	252	rat (*Rattus norvegicus*)	0.533	NA	NA	yes	2	1	T	0
Dieter (1991)	3780	mouse (*Mus musculus*)	161	NA	NA	yes	2	2	T	0

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
See ecological soil screening level (Eco-SSL) document (USEPA 2005a) for the full reference list for studies cited in this table.

Table H2.A-14. Tier Determination and Results of Study Selection Process for Acceptable Arsenic Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process							
Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Datasets
Growth										
Hoffman et al. 1992	1376	mallard duck (*Anas platyrhynchos*)	17.3	yes	no	no	1	1	T	1

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
See Eco-SSL document (USEPA 2005a) for the full references for studies cited in this table.

Table H2.A-15. Tier Determination and Results of Study Selection Process for Acceptable Barium Studies for Mammals from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Datasets
Growth										
Dietz et al. 1992	18186	rat (*Rattus norvegicus*), mouse (*Mus musculus*)	121	yes	no	yes	2	1	T	2
Schroeder and Mitchener 1975	1858	mouse *(Mus musculus)*	0.74	yes	yes	yes	2	2	T	2
Survival										
Borzelleca et al. 1988	18734	rat (*Rattus norvegicus*)	197	NA	NA	no	1	1	T	1
Dietz et al. 1992	18186	rat (*Rattus norvegicus*), mouse (*Mus musculus*)	121	NA	NA	yes	2	2	T	3

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
See Eco-SSL document (USEPA 2005c) for the full references for studies cited in this table.

Table H2.A-16. Tier Determination and Results of Study Selection Process for Acceptable Chromium Studies for Mammals from the Eco-SSL Document

Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Results of Study Selection Process: Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Reproduction										
Elbetieha and Al-Hamood (1997)	3025	mouse (*Mus musculus*)	91.1	NA	NA	yes	2	1	T	2
Growth										
Elbetieha and Al-Hamood (1997)	3025	mouse (*Mus musculus*)	92.1	no	yes	yes	2	1	T	0

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
See ecological soil screening level (Eco-SSL) document (USEPA 2008) for the full references for studies cited in this table.

Table H2.A-17. Tier Determination and Results of Study Selection Process for Acceptable Nickel Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process							
Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifepan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Datasets
Growth										
Hill 1979	397	chicken *(Gallus domesticus)*	8.95	yes	no	no	1	1	T	1
Cain and Pafford 1981	6461	duck (*Anas platyrhynchos*)	10.7	yes	no	no	1	2	T	2
Martinez and Diaz 1996	5345	chicken *(Gallus domesticus)*	11.5	yes	no	no	1	3	T	1
Ling and Leach 1979	6666	chicken *(Gallus domesticus)*	23.9	yes	no	no	1	4	T	1
Weber and Reid 1968	60	chicken *(Gallus domesticus)*	30.2	yes	no	no	1	5	T	2
Hill 1985	36708	chicken *(Gallus domesticus)*	71.8	yes	no	no	1	6	P	1
Survival										
Ling and Leach 1979	6666	chicken *(Gallus domesticus)*	39.9	NA	NA	no	1	1	T	1
Cain and Pafford 1981	6461	duck (*Anas platyrhynchos*)	47	NA	NA	no	1	2	T	1

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
See Eco-SSL document (USEPA 2005a) for the full references for studies cited in this table.

Table H2.A-18. Tier Determination and Results of Study Selection Process for Acceptable Selenium Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Reproduction										
Kaantee and Kurkela (1980)	36819	chicken (*Gallus domesticus*)	0.0988	NA	NA	no	1	1	T	0
Stone and Soares (1976)	2898	Japanese quail (*Coturnix japonica*)	0.120	NA	NA	no	1	2	T	1
Ort and Latshaw (1978)	1489	chicken (*Gallus domesticus*)	0.412	NA	NA	no	1	3	T	2
Heinz et. al. (1989)	1354	duck (*Anas platyrhynchos*)	0.438	NA	NA	no	1	4	T	3
Hoffman and Heinz (1988)	1372	mallard (*Anas platyrhynchos*)	0.546	NA	NA	no	1	5	T	2
Heinz and Hoffman (1996)	1352	mallard (*Anas platyrhynchos*)	0.614	NA	NA	no	1	6	NRV	NRV
El-Begearmi et al. (1982)	6433	Japanese quail (*Coturnix japonica*)	0.780	NA	NA	no	1	7	NRV	NRV
Stoewsand et al. (1978)	1575	Japanese quail (*Coturnix japonica*)	0.826	NA	NA	no	1	8	NRV	NRV
Heinz and Hoffman (1987)	1356	mallard (*Anas platyrhynchos*)	0.898	NA	NA	no	1	9	NRV	NRV
Heinz and Fitzgerald (1993)	36813	mallard (*Anas platyrhynchos*)	1.19	NA	NA	no	1	10	NRV	NRV
Wiemeyer and Hoffman (1996)	1622	owl (*Otus asio*)	4.49	NA	NA	no	1	11	S	3
Growth										
El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	0.0912	yes	no	no	1	1	T	2
Dafalla and Adam (1986)	1273	chicken (*Gallus domesticus*)	0.306	yes	no	no	1	2	T	1
Jensen (1986)	1402	chicken (*Gallus domesticus*)	0.370	yes	no	no	1	3	T	1
Hill (1979)	397	chicken (*Gallus domesticus*)	0.408	yes	no	no	1	4	T	2
Echevarria et al. (1988)	1289	chicken (*Gallus domesticus*)	0.426	yes	no	no	1	5	T	1
Khan et al. (1993)	1415	chicken (*Gallus domesticus*)	0.50	yes	no	no	1	6	NRV	NRV
Khan et al. (1993)	5483	chicken (*Gallus domesticus*)	0.50	yes	no	no	1	7	NRV	NRV
Sell and Horani (1976)	1550	chicken (*Gallus domesticus*)	0.629	yes	no	no	1	8	P	0
Elzubeir and Davis (1988)	1294	chicken (*Gallus domesticus*)	0.788	yes	no	no	1	9	NRV	NRV
Davis el. al. (1996)	1278	chicken (*Gallus domesticus*)	0.855	yes	no	no	1	10	NRV	NRV
Hill (1974)	1369	chicken (*Gallus domesticus*)	0.859	yes	no	no	1	11	NRV	NRV
Hill (1979)	1370	chicken (*Gallus domesticus*)	0.859	yes	no	no	1	12	NRV	NRV
Stoewsand et al. (1977)	1574	Japanese quail (*Coturnix japonica*)	0.896	yes	no	no	1	13	S	0
Heinz and Fitzgerald (1993)	36813	mallard (*Anas platyrhynchos*)	1.08	no	yes	no	1	14	S	0
Hoffman et al. (1992)	1376	duck (*Anas platyrhynchos*)	1.20	yes	no	no	1	15	S	1
Jensen et al. (1977)	1404	chicken (*Gallus domesticus*)	1.23	yes	no	no	1	16	NRV	NRV
Berg and Martinson (1972)	93	chicken (*Gallus domesticus*)	1.38	yes	no	no	1	17	NRV	NRV
Lowry and Baker (1989)	1445	chicken (*Gallus domesticus*)	1.55	yes	no	no	1	18	NRV	NRV
O'Toole and Raisbeck (1997)	1476	mallard (*Anas platyrhynchos*)	1.73	yes	no	no	1	19	S	1
Howell and Hill (1978)	1387	chicken (*Gallus domesticus*)	1.78	yes	no	no	1	20	NRV	NRV
Donaldson and McGowan (1989)	1285	chicken (*Gallus domesticus*)	2.27	yes	no	no	1	21	NRV	NRV
Hill (1980)	395	chicken (*Gallus domesticus*)	2.76	yes	no	no	1	22	NRV	NRV
Heinz et al. (1988)	1355	mallard (*Anas platyrhynchos*)	3.48	yes	no	no	1	23	NRV	NRV
Growth (continued)										
Hoffman et al. (1991)	1377	mallard (*Anas platyrhynchos*)	4.53	yes	no	no	1	24	NRV	NRV
Hoffman et al. (1992)	1378	mallard (*Anas platyrhynchos*)	4.94	yes	no	no	1	25	NRV	NRV
Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	8.32	yes	no	no	1	26	NRV	NRV
Poley et al. (1937)	3787	chicken (*Gallus domesticus*)	0.127	no	no	no	2	27	NRV	NRV
Fairbrother and Fowles (1990)	1297	mallard (*Anas platyrhynchos*)	0.275	no	no	yes	2	28	NRV	NRV
Cantor et al. (1984)	1245	chicken (*Gallus domesticus*)	1.44	yes	no	yes	2	29	NRV	NRV
Survival										
Arnold et al. (1973)	69	chicken (*Gallus domesticus*)	0.371	NA	NA	no	1	1	T	1
Khan et al. (1993)	1415	chicken (*Gallus domesticus*)	0.50	NA	NA	no	1	2	T	1
El-Begearmi and Combs (1982)	1290	chicken (*Gallus domesticus*)	0.579	NA	NA	no	1	3	T	2
Heinz and Fitzgerald (1993)	1350	mallard (*Anas platyrhynchos*)	1.13	NA	NA	no	1	4	T	1
El-Begerami et al. (1977)	1291	Japanese quail (*Coturnix japonica*)	1.40	NA	NA	no	1	5	T	1
Howell and Hill (1978)	1387	chicken (*Gallus domesticus*)	1.78	NA	NA	no	1	6	NRV	NRV
Green and Albers (1997)	1319	mallard (*Anas platyrhynchos*)	2.44	NA	NA	no	1	7	NRV	NRV
Hill (1974)	1369	chicken (*Gallus domesticus*)	3.44	NA	NA	no	1	8	NRV	NRV
O'Toole and Raisbeck (1997)	1476	mallard (*Anas platyrhynchos*)	4.19	NA	NA	no	1	9	NRV	NRV
Hoffman et al. (1991)	1377	mallard (*Anas platyrhynchos*)	4.53	NA	NA	no	1	10	NRV	NRV
Albers et al. (1996)	1208	duck (*Anas platyrhynchos*)	4.75	NA	NA	no	1	11	P	1
Hoffman et al. (1992)	1376	duck (*Anas platyrhynchos*)	4.80	NA	NA	no	1	12	NRV	NRV
Hoffman et al. (1992)	1378	mallard (*Anas platyrhynchos*)	4.94	NA	NA	no	1	13	NRV	NRV
Heinz (1993)	1347	duck (*Anas platyrhynchos*)	5.75	NA	NA	no	1	14	NRV	NRV
Donaldson and McGowan (1989)	1285	chicken (*Gallus domesticus*)	6.08	NA	NA	no	1	15	NRV	NRV
Jensen et al. (1977)	1404	chicken (*Gallus domesticus*)	6.14	NA	NA	no	1	16	NRV	NRV
Heinz et al. (1996)	1357	mallard (*Anas platyrhynchos*)	6.99	NA	NA	no	1	17	NRV	NRV
Heinz et al. (1988)	1355	mallard (*Anas platyrhynchos*)	7.98	NA	NA	no	1	18	NRV	NRV
Heinz and Hoffman (1987)	1356	mallard (*Anas platyrhynchos*)	12.3	NA	NA	no	1	19	NRV	NRV

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

See ecological soil screening level (Eco-SSL) document (USEPA 2007b) for the full references for studies cited in this table.

Table H2.A-19. Tier Determination and Results of Study Selection Process for Acceptable Selenium Studies for Mammals from the Eco-SSL Document

Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Results of Study Selection Process						
				Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Reproduction										
Wahlstrom and Olson (1959)	14497	pig (*Sus scrofa*)	0.296	NA	NA	no	1	1	T	0
Chermoff and Kavlock (1982)	1259	mouse (*Mus musculus*)	4.18	NA	NA	no	1	2	T	1
Gray and Kavlock (1984)	1316	mouse (*Mus musculus*)	4.57	NA	NA	no	1	3	T	0
Seidenberg et al. (1986)	113	mouse (*Mus musculus*)	5.01	NA	NA	no	1	4	T	1
Hardin et al. (1987)	1335	mouse (*Mus musculus*)	6.39	NA	NA	no	1	5	T	1
Webster (1979)	823	mouse (*Mus musculus*)	25.4	NA	NA	no	1	6	A	1
Abdo (1994)	1475	rat (*Rattus norvegicus*)	0.130	NA	NA	yes	2	7	NRV [a]	NRV
Nobunaga et al. (1979)	1473	mouse (*Mus musculus*)	0.145	NA	NA	yes	2	8	NRV [a]	NRV
Schroeder and Mitchener (1971)	66	mouse (*Mus musculus*)	0.434	NA	NA	yes	2	9	NRV [a]	NRV
Thorlacius-Ussing (1990)	1595	rat (*Rattus norvegicus*)	0.504	NA	NA	yes	2	10	NRV [a]	NRV
Thorlacius-Ussing et al. (1987)	1596	rat (*Rattus norvegicus*)	0.749	NA	NA	yes	2	11	NRV [a]	NRV
Hau et al. (1987)	1344	mouse (*Mus musculus*)	6.03	NA	NA	yes	2	12	NRV [a]	NRV
Growth										
Kaur and Parshad (1994)	1411	rat (*Rattus norvegicus*)	0.0908	yes	no	no	1	1	T	1
Spallholz et al. (1973)	1566	mouse (*Mus musculus*)	0.0968	yes	no	no	1	2	T	1
Boylan et al. (1990)	1239	mouse (*Mus musculus*)	0.156	yes	yes	no	1	3	T	0
Wahlstrom et al. (1956)	14498	pig (*Sus scrofa*)	0.163	yes	yes	no	1	4	T	0
Behne et al. (1992)	1224	rat (*Rattus norvegicus*)	0.166	yes	yes	no	1	5	T	0
Baker et al. (1989)	1219	pig (*Sus scrofa*)	0.205	yes	no	no	1	6	A	0
Mahan and Moxon (1984)	1450	pig (*Sus scrofa*)	0.215	yes	no	no	1	7	A	1
Goehring et al. (1984)	1312	rat (*Rattus norvegicus*)	0.215	yes	no	no	1	8	A	2
Kim and Mahan (2001)	25958	pig (*Sus scrofa*)	0.221	yes	yes	no	1	9	NRV	NRV
Miller (1938)	14492	pig (*Sus scrofa*)	0.235	yes	no	no	1	10	NRV	NRV
Shull and Checke (1973)	1557	rat (*Rattus norvegicus*)	0.265	yes	no	no	1	11	NRV	NRV
Kim and Mahan (2001)	25948	pig (*Sus scrofa*)	0.273	yes	yes	no	1	12	NRV	NRV
Goehring et al. (1983)	1313	pig (*Sus scrofa*)	0.273	yes	no	no	1	13	NRV	NRV
Wahlstrom et al. (1984)	1612	pig (*Sus scrofa*)	0.303	yes	no	no	1	14	NRV	NRV
Liu et al. (1994)	1442	rat (*Rattus norvegicus*)	0.304	yes	no	no	1	15	NRV	NRV
Baker et al. (1989)	1219	pig (*Sus scrofa*)	0.307	yes	no	no	1	16	NRV	NRV
Moxon and Mahan (1981) [b]	1468	pig (*Sus scrofa*)	0.340	yes	no	no	1	17	NRV	NRV
Birt et al. (1983)	1233	hamster (*Mesocricetus auratus*)	0.345	yes	yes	no	1	18	S	0
Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	0.390	yes	no	no	1	19	NRV	NRV
Liu and Boylan (1994)	1443	rat (*Rattus norvegicus*)	0.420	yes	no	no	1	20	NRV	NRV
McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	0.435	yes	no	no	1	21	NRV	NRV
Birt et al. (1986)	1232	hamster (*Mesocricetus auratus*)	0.490	yes	no	no	1	22	S	0
Mahan and Magee (1991)	1448	pig (*Sus scrofa*)	0.510	yes	no	no	1	23	NRV	NRV

Table H2.A-19. Tier Determination and Results of Study Selection Process for Acceptable Selenium Studies for Mammals from the Eco-SSL Document

Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Results of Study Selection Process: Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Growth (continued)										
LeBoeuf et al. (1985)	1433	rat (*Rattus norvegicus*)	0.521	yes	no	no	1	24	NRV	NRV
LeBoeuf and Hoekstra (1983)	1432	rat (*Rattus norvegicus*)	0.521	yes	no	no	1	25	NRV	NRV
Parshad and Sud (1989)	1500	rat (*Rattus norvegicus*)	0.550	yes	no	no	1	26	NRV	NRV
Halverson et al. (1966)	1332	rat (*Rattus norvegicus*)	0.567	yes	no	no	1	27	NRV	NRV
Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	0.653	yes	no	no	1	28	NRV	NRV
Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	0.704	yes	no	no	1	29	NRV	NRV
Julius et al. (1983)	1408	hamster (*Mesocricetus auratus*)	0.712	yes	no	no	1	30	S	3
Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	0.763	yes	no	no	1	31	NRV	NRV
Panter et al. (1996)	1499	pig (*Sus scrofa*)	0.794	yes	no	no	1	32	NRV	NRV
Obermeyer et al. (1971)	12934	rat (*Rattus norvegicus*)	0.903	yes	no	no	1	33	NRV	NRV
Halverson and Monty (1960)	36812	rat (*Rattus norvegicus*)	0.968	yes	no	no	1	34	NRV	NRV
Beems and van Beek (1985)	1223	hamster (*Mesocricetus auratus*)	1.21	yes	no	no	1	35	NRV	NRV
Hermann etal. (1991)	1364	rat (*Rattus norvegicus*)	1.59	yes	no	no	1	36	NRV	NRV
Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	1.79	yes	no	no	1	37	NRV	NRV
Chermoff and Kavlock (1982)	1259	mouse (*Mus musculus*)	4.18	no	no	no	1	38	NRV	NRV
Hardin et al. (1987)	1335	mouse (*Mus musculus*)	6.39	yes	no	no	1	39	NRV	NRV
Sayato et al. (1993)	1538	mouse (*Mus musculus*)	20.0	yes	no	no	1	40	NRV	NRV
Chen et al. (1985)	1256	rat (*Rattus norvegicus*)	0.232	yes	no	yes	2	41	NRV	NRV
Schroeder (1967)	1540	rat (*Rattus norvegicus*), mouse (Mus musculus)	0.267	yes	no	yes	2	42	NRV	NRV
Mercado and Bibby (1973)	757	rat (*Rattus norvegicus*)	0.282	yes	no	yes	2	43	NRV	NRV
Thorlacius-Ussing et al. (1988)	1597	rat (*Rattus norvegicus*)	0.378	yes	no	yes	2	44	NRV	NRV
Thorlacius-Ussing et al. (1988)	1598	rat (*Rattus norvegicus*)	0.411	yes	no	yes	2	45	NRV	NRV
Schroeder and Mitchener (1972)	3725	mouse (*Mus musculus*)	0.425	yes	no	yes	2	46	NRV	NRV
Carmichael and Fowler (1980)	1249	rat (*Rattus norvegicus*)	0.454	yes	no	yes	2	47	NRV	NRV
Salbe et al. (1990)	1532	rat (*Rattus norvegicus*)	0.498	yes	no	yes	2	48	NRV	NRV
Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	0.540	yes	no	yes	2	49	NRV	NRV
Thorlacius-Ussing (1990)	1595	rat (*Rattus norvegicus*)	0.543	yes	no	yes	2	50	NRV	NRV
Abdo (1994)	1475	rat (*Rattus norvegicus*), mouse (Mus musculus)	0.564	yes	no	yes	2	51	NRV	NRV
Gronbaek et al. (1995)	1323	rat (*Rattus norvegicus*)	0.570	yes	no	yes	2	52	NRV	NRV
Tsunoda et al. (2000)	36834	mouse (*Mus musculus*)	0.580	yes	no	yes	2	53	NRV	NRV
Hadjimarkos (1967)	1327	rat (*Rattus norvegicus*)	0.667	yes	no	yes	2	54	NRV	NRV
Nebbia et al. (1987)	1471	rat (*Rattus norvegicus*)	0.768	yes	no	yes	2	55	NRV	NRV
Cabe et al. (1979)	1244	rat (*Rattus norvegicus*)	0.769	yes	no	yes	2	56	NRV	NRV
Hadjimarkos (1970)	14488	hamster (*Mesocricetus auratus*)	0.88	yes	no	yes	2	57	NRV	NRV
Jacobs and Forst (1981)	1393	rat (*Rattus norvegicus*)	0.904	yes	no	yes	2	58	NRV	NRV

Table H2.A-19. Tier Determination and Results of Study Selection Process for Acceptable Selenium Studies for Mammals from the Eco-SSL Document

Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Results of Study Selection Process						
				Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Growth (continued)										
Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	0.984	yes	no	no	2	59	NRV	NRV
Cutler (1974)	21137	rat (*Rattus norvegicus*)	1.11	yes	no	yes	2	60	NRV	NRV
Jacobs and Forst (1981)	1394	mouse (*Mus musculus*)	1.21	yes	no	yes	2	61	NRV	NRV
Johnson et al. (2000)	36818	mouse (*Mus musculus*)	1.31	yes	no	yes	2	62	NRV	NRV
Rastogi et al. (1976)	1523	rat (*Rattus norvegicus*)	1.59	yes	no	yes	2	63	NRV	NRV
Survival										
Spallholz et al. (1973)	1566	mouse (*Mus musculus*)	0.168	NA	NA	no	1	1	T	1
McAdam and Levander (1987)	1457	rat (*Rattus norvegicus*)	0.435	NA	NA	no	1	2	T	4
Moxon and Mahan (1982c)	1468	pig (*Sus scrofa*)	0.632	NA	NA	no	1	3	T	1
Halverson et al. (1966)	1332	rat (*Rattus norvegicus*)	0.720	NA	NA	no	1	4	T	1
Palmer et al. (1982)	1496	rat (*Rattus norvegicus*)	0.809	NA	NA	no	1	5	T	1
Palmer et al. (1983)	15262	rat (*Rattus norvegicus*)	0.823	NA	NA	no	1	6	NRV	NRV
Halverson et al. (1962)	14489	rat (*Rattus norvegicus*)	0.975	NA	NA	no	1	7	NRV	NRV
Kezhou et al. (1987)	1413	rat (*Rattus norvegicus*)	0.980	NA	NA	no	1	8	NRV	NRV
Wilson et al. (1988)	1629	pig (*Sus scrofa*)	1.19	NA	NA	no	1	9	NRV	NRV
Dausch and Fullerton (1993)	1276	rat (*Rattus norvegicus*)	1.28	NA	NA	no	1	10	NRV	NRV
Franke and Moxon (1937)	14508	rat (*Rattus norvegicus*)	1.79	NA	NA	no	1	11	NRV	NRV
Piccirillo et al. (1983)	1507	mouse (*Mus musculus*)	2.28	NA	NA	no	1	12	NRV	NRV
Davidson-York et al. (1999)	1277	pig (*Sus scrofa*)	4.17	NA	NA	no	1	13	NRV	NRV
Plasterer et al. (1985)	1509	mouse (*Mus musculus*)	4.57	NA	NA	no	1	14	NRV	NRV
Seidenberg et al. (1986)	113	mouse (*Mus musculus*)	5.01	NA	NA	no	1	15	NRV	NRV
Miller (1938)	14492	pig (*Sus scrofa*)	5.96	NA	NA	no	1	16	NRV	NRV
Julius et al. (1983)	1408	hamster (*Mesocricetus auratus*)	6.36	NA	NA	no	1	17	A	1
Hardin et al. (1987)	1335	mouse (*Mus musculus*)	6.39	NA	NA	no	1	18	NRV	NRV
Booth et al. (1983)	1234	mouse (*Mus musculus*)	20	NA	NA	no	1	19	NRV	NRV
Schroeder (1967)	1540	rat (*Rattus norvegicus*)	0.275	NA	NA	yes	2	20	NRV	NRV
Jacobs and Forst (1981)	1393	rat (*Rattus norvegicus*)	0.440	NA	NA	yes	2	21	NRV	NRV
Palmer and Olson (1974)	1497	rat (*Rattus norvegicus*)	0.540	NA	NA	yes	2	22	NRV	NRV
Abdo (1994)	1475	rat (*Rattus norvegicus*)	0.763	NA	NA	yes	2	23	NRV	NRV
Cutler (1974)	21137	rat (*Rattus norvegicus*)	1.11	NA	NA	yes	2	24	NRV	NRV
Jacobs and Forst (1981)	1394	mouse (*Mus musculus*)	4.55	NA	NA	yes	2	25	NRV	NRV

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

See ecological soil screening level (Eco-SSL) document (USEPA 2007b) for the full references for studies cited in this table.

[a] Four usable growth data sets were available from the six Tier 1 studies reviewed. Tier 2 studies were not reviewed because the toxicity reference value (TRV) was selected from the Tier 1 studies, which are preferred over Tier 2.

[b] Publication year was listed as 1982 in the Eco-SSL document. The correct year is 1981.

Table H2.A-20. Tier Determination and Results of Study Selection Process for Acceptable Vanadium Studies for Birds from the Eco-SSL Document

				Results of Study Selection Process						
Reference	Reference Number	Test Organism	LOAEL Dose (mg/kg bw/day)	Critical Lifestage?	Length of Study > 10% of Species Lifespan?	Drinking Water Exposure?	Tier	Study Rank	Rationale for Study Selection	Number of Usable Data Sets
Reproduction										
Toussant and Latshaw (1994)	5456	chicken (*Gallus domesticus*)	1.33	NA	NA	no	1	1	T	1
Kubena and Phillips (1982)	6388	chicken (*Gallus domesticus*)	2.50	NA	NA	no	1	2	T	1
Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	2.75	NA	NA	no	1	3	T	1
Hafez and Kratzer (1976)	6848	chicken (*Gallus domesticus*)	14.8	NA	NA	no	1	4	T	1
Growth										
Summers and Moran (1972)	7051	chicken (*Gallus domesticus*)	0.339	yes	no	no	1	1	T	0
Hill (1974)	92	chicken (*Gallus domesticus*)	0.429	yes	no	no	1	2	T	0
Cervantes and Jensen (1986)	6085	chicken (*Gallus domesticus*)	0.589	yes	no	no	1	3	T	1
Hill (1979)	397	chicken (*Gallus domesticus*)	0.688	yes	no	no	1	4	T	1
Berg and Lawrence (1971)	9290	chicken (*Gallus domesticus*)	0.859	yes	no	no	1	5	T	3
Blalock and Hill (1987)	5927	chicken (*Gallus domesticus*)	0.968	yes	no	no	1	6	P	1
Romoser et al. (1961)	3740	chicken (*Gallus domesticus*)	1.32	yes	no	no	1	7	NRV	NRV
Hill (1990)	8125	chicken (*Gallus domesticus*)	1.42	yes	no	no	1	8	P	1
Hill (1979)	1370	chicken (*Gallus domesticus*)	1.72	yes	no	no	1	9	NRV	NRV
Hill (1990)	5736	chicken (*Gallus domesticus*)	1.77	yes	no	no	1	10	NRV	NRV
Cupo and Donaldson (1987)	5971	chicken (*Gallus domesticus*)	2.00	yes	no	no	1	11	NRV	NRV
Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	2.15	yes	no	no	1	12	NRV	NRV
Hill (1980)	395	chicken (*Gallus domesticus*)	2.15	yes	no	no	1	13	NRV	NRV
Hill (1990)	5734	chicken (*Gallus domesticus*)	2.84	yes	no	no	1	14	P	1
Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	2.87	yes	no	no	1	15	NRV	NRV
Qureshi et al. (1999)	5079	chicken (*Gallus domesticus*)	3.05	yes	no	no	1	16	P	1
Hill (1994)	5453	chicken (*Gallus domesticus*)	3.55	yes	no	no	1	17	P	1
Hill (1992)	8028	chicken (*Gallus domesticus*)	3.55	yes	no	no	1	18	NRV	NRV
Nelson et al. (1962)	14516	chicken (*Gallus domesticus*)	3.58	yes	no	no	1	19	P	2
Burt et al. (1991)	5295	chicken (*Gallus domesticus*)	4.29	yes	no	no	1	20	NRV	NRV
Kubena et al. (1985)	6192	chicken (*Gallus domesticus*)	4.76	yes	no	no	1	21	NRV	NRV
Hafez and Kratzer (1976)	6876	chicken (*Gallus domesticus*)	8.36	yes	no	no	1	22	NRV	NRV
Toussant and Latshaw (1994)	5456	chicken (*Gallus domesticus*)	1.33	yes	no	no	2	23	NRV	NRV
Ousterhout and Berg (1981)	6508	chicken (*Gallus domesticus*)	1.98	yes	no	no	2	24	NRV	NRV
Kubena and Phillips (1982)	6388	chicken (*Gallus domesticus*)	2.51	yes	no	no	2	25	NRV	NRV
Benabdeljelil and Jensen (1990)	5749	chicken (*Gallus domesticus*)	6.13	yes	no	no	2	26	NRV	NRV
Survival										
Berg and Lawrence (1971)	9290	chicken (*Gallus domesticus*)	1.72	NA	NA	no	1	1	T	1
Blalock and Hill (1987)	5927	chicken (*Gallus domesticus*)	1.92	NA	NA	no	1	2	T	1
Hathcock et al. (1964)	14512	chicken (*Gallus domesticus*)	2.15	NA	NA	no	1	3	T	3
Hill (1974)	92	chicken (*Gallus domesticus*)	4.294	NA	NA	no	1	4	T	1
Kubena and Phillips (1982)	6388	chicken (*Gallus domesticus*)	4.99	NA	NA	no	1	5	T	1
Hafez and Kratzer (1976)	8663	chicken (*Gallus domesticus*)	5.74	NA	NA	no	1	6	P	2
Romoser et al. (1961)	3740	chicken (*Gallus domesticus*)	10.6	NA	NA	no	1	7	NRV	NRV

Notes:
Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.
See ecological soil screening level (Eco-SSL) document (USEPA 2005c) for the full references for studies cited in this table.

Table H2.A-21. Number of LOAELs in Eco-SSL Documents Less than the Selected UCR TRVs

					Number of Eco-SSL LOAELs < Selected TRV[a]										
					Acceptable Datasets Reviewed Based on Tiered Process					Acceptable Datasets Not Reviewed Based on Tiered Process[b]		Unacceptable Datasets			
Endpoint	Selected TRV	Number of LOAELs	Number of LOAELs < Selected TRV	% LOAELs < Selected TRV	Tier 2 Study	Different Body Weight and Food Ingestion Rate Used	Effect Not <80% Relative to the Control[c]	ED20 Calculated	Other Reason	Tier 2 Study	Based on LOAEL Ranking	Endpoint or Chemical Form not Relevant	NOAEL	Concerns with Study Design	Insufficient Data
Birds															
Arsenic															
Growth	20	3	3	100%	0	1	2	0	0	0	0	0	0	0	0
Reproduction	40	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Survival	6.9	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (III)															
Growth	510	2	2	100%	0	0	0	0	0	0	0	1	1	0	0
Reproduction	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Survival	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel															
Growth	6.8	8	0	0%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reproduction	6.71[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Survival	60	2	2	100%	0	0	0	2	0	0	0	0	0	0	0
Selenium															
Growth	0.29[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reproduction	0.55	25	12	48%	0	0	2	2	0	0	0	5	0	3	0
Survival	0.59	23	3	13%	0	2	0	0	1[e]	0	0	0	0	0	0
Vanadium															
Growth	1.2	43	9	21%	0	1	6	1	0	0	0	0	0	0	1
Reproduction	2.1	17	14	82%	0	0	1	0	0	0	0	13	0	0	0
Survival	2.4	12	4	33%	0	3	1	0	0	0	0	0	0	0	0
Mammals															
Barium															
Growth	440	3	2	67%	0	0	2	0	0	0	0	0	0	0	0
Reproduction	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Survival	200	3	1	33%	0	1	0	0	0	0	0	0	0	0	0
Chromium (III)															
Growth	110	1	1	100%	0	0	1	0	0	0	0	0	0	0	0
Reproduction	91	4	2	50%	0	0	0	0	0	0	0	2	0	0	0
Survival	no TRV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium															
Growth	0.33	105	25	24%	0	0	9	1	0	5	8	0	0	1	1
Reproduction	5.0	18	14	78%	0	0	3	0	0	7	0	4	0	0	0
Survival	0.61	40	7	18%	0	2	1	0	0	3	0	0	0	1	0

Notes:

Acronyms, abbreviations, and units of measure are defined in Table H2.A-1.

[a] There may be more than one reason why a lowest-observed-adverse-effect level (LOAEL) is less than the selected toxicity reference value (TRV). In such cases the primary reason is shown (e.g., the body weight and food ingestion rate may be different, but the primary reason is that the effect at the LOAEL selected in the ecological soil screening level [Eco-SSL] document is not < 80 percent relative to the control).

[b] See Figure H2-1 for a description of the process by which studies were selected for review.

[c] The dose reported as an LOAEL in the Eco-SSL document did not have an effect < 80 percent relative to the control. If an LOAEL ≥ 20 was reported in this document, it was at a higher dose level than the LOAEL in the Eco-SSL document.

[d] Eco-SSL was selected as the TRV.

[e] In the Khan et al. (1993) study, the dose via gavage was presented as mg/kg bw. In this document the exposure period included only the period during which birds were dosed, whereas in the Eco-SSL document the exposure period included the monitoring period after dosing was conducted, resulting in different daily doses.

ANNEX B

COMPILED LITERATURE AND STUDY DATA

Table H2.B-1. Acronyms, Abbreviations, and Units of Measure

Term	Definition
Acronyms and Abbreviations	
BW	body weight
DW	drinking water
dw	dry weight
ED20	modeled concentration resulting in a 20 percent effect relative to the control
F1	first filial generation
F2	second filial generation
FD	food (diet)
FIR	food ingestion rate
GV	gavage
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
IG	ingestion rate
LOAEL	lowest-observed-adverse-effect level
LOAEL ≥ 20	LOAEL representing a ≥ 20 percent reduction in the response compared to the control
NA	not applicable
NR	not reported
stats	statistical analyses
TCDD	tetrachlorodibenzo-p-dioxin
TRV	toxicity reference value
ww	wet weight
Units of Measure	
g	gram(s)
kg	kilogram(s)
kg/day	kilogram(s) per day
L/day	liter(s) per day
lb	pound(s)
mg/kg	milligram(s) per kilogram
mg/kg bw/day	milligram(s) per kilogram of body weight per day

Table H2.B-2. Aluminum TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)				
									Control	1	2	3	Notes
Growth													
Capdevielle and Scanes (1995a)	558	ED20	aluminum sulfate	chicken (*Gallus gallus domesticus*)	4-18 days	body weight	FD	2	0.0	112	558	NA	calculated from BW and FIR
Capdevielle and Scanes (1995b)	500	500	aluminum sulfate	mallard (*Anas platyrhynchos*)	duckling	body weight	FD	2.1	0.0	100	500	NA	calculated from BW and FIR
Capdevielle et al. (1996)	128	642	aluminum sulfate	chicken (*Gallus gallus domesticus*)	4 days	body weight	FD	1.5	0.0	128	642	NA	calculated from BW and FIR
Elliot and Edwards (1991)	no stats	273	aluminum sulfate	chicken (*Gallus gallus domesticus*)	1 day	body weight	FD	2.3	16	145	273	530	calculated from BW and FIR
Survival													
Capdevielle and Scanes (1995a)	no stats	558	aluminum sulfate	chicken (*Gallus gallus domesticus*)	4-18 days	survival	FD	2	0.0	112	558	NA	calculated from BW and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-2. Aluminum TRV Data for Birds

	BW (kg)					Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)						Concentration in Food (mg/kg)				
Source [a]	Control	Dose 1	Dose 2	Dose 3	Source [a]	Control	Dose 1	Dose 2	Dose 3	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Wet or Dry Weight Basis
Growth																
Capdevielle and Scanes (1995a)	0.36	0.36	0.36	NA	NRC (1994)	0.040	0.040	0.040	NA	NRC (1994)	dw	0.0	1000	5000	NA	dw
Capdevielle and Scanes (1995b)	0.17	0.17	0.17	NA	presented in paper	0.017	0.017	0.017	NA	Heinz et al. (1987)	dw	0.0	1000	5000	NA	dw
Capdevielle et al. (1996)	0.15	0.15	0.15	NA	NRC (1994)	0.019	0.019	0.019	NA	NRC (1994)	dw	0.0	1000	5000	NA	dw
Elliot and Edwards (1991)	0.15	0.15	0.15	0.15	NRC (1994)	0.019	0.019	0.019	0.019	NRC (1994)	dw	128	1128	2128	4128	dw
Survival																
Capdevielle and Scanes (1995a)	0.36	0.36	0.36	NA	NRC (1994)	0.040	0.040	0.040	NA	NRC (1994)	dw	0	1000	5000	NA	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-2. Aluminum TRV Data for Birds

Source [a]	Effect					Effect Relative to Control (%)		
	Control	Dose 1	Dose 2	Dose 3	Measurement	Dose 1	Dose 2	Dose 3
Growth								
Capdevielle and Scanes (1995a)	610	520	307	NA	mean body weight (g)	85	50	NA
Capdevielle and Scanes (1995b)	297	316	201	NA	mean body weight (g)	106	68	NA
Capdevielle et al. (1996)	434	379	253	NA	mean body weight (g)	87	58	NA
Elliot and Edwards (1991)	406	354	251	104	body weight after 16 days of exposure (g)	87	62	26
Survival								
Capdevielle and Scanes (1995a)	100	100	75	NA	% survival (reported as % mortality in paper)	100	75	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-3. Aluminum TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)				
									Control	1	2	3	Notes
Growth													
Belles et al. (1999)	398	398	aluminum nitrate nonahydrate	mouse (*Mus musculus*)	adult (25 - 32 g body weight)	body weight gain	GV	1.5	0.0	398	NA	NA	presented in paper
Domingo et al. (1987a)	46	46	aluminum nitrate nonahydrate	rat (*Rattus norvegicus*)	adult (70.5 +/-4.4 g)	body weight	DW	14	0.0	46	91	456	presented in paper
Domingo et al. (1987a)	456	456	aluminum nitrate nonahydrate	rat (*Rattus norvegicus*)	adult (70.5 +/-4.4 g)	body weight	DW	14	0.0	46	91	456	presented in paper
Paternain et al. (1988)	13	no effect	aluminum nitrate nonahydrate	rat (*Rattus norvegicus*)	adult (240 to 280 g body weight)	body weight gain	GV	1.3	0.0	13	26	52	presented in paper
Reproduction													
Belles et al. (1999)	398	398	aluminum nitrate nonahydrate	mouse (*Mus musculus*)	adult (25 - 32 g body weight)	fetal body weight	GV	1.5	0.0	398	NA	NA	presented in paper
Bernuzzi et al. (1989)	273	273	aluminum chloride	rat (*Rattus norvegicus*)	adult (precise age not provided; sexually mature)	postnatal survival	FD	2.6	0.0	96	273	399	presented in paper
Bernuzzi et al. (1989)	273	399	aluminum chloride	rat (*Rattus norvegicus*)	adult (precise age not provided; sexually mature)	pup body weight	FD	2.6	0.0	96	273	399	presented in paper
Domingo et al. (1987b)	no effect	52	aluminum nitrate nonahydrate	rat (*Rattus norvegicus*)	adult (240 to 280 g body weight)	pup survival	GV	unclear	0.0	13	26	52	presented in paper
Paternain et al. (1988)	13	13	aluminum nitrate nonahydrate	rat (*Rattus norvegicus*)	adult (240 to 280 g body weight)	fetal survival	GV	1.3	0.0	13	26	52	presented in paper
Paternain et al. (1988)	13	ED20	aluminum nitrate nonahydrate	rat (*Rattus norvegicus*)	adult (240 to 280 g body weight)	fetal body weight	GV	1.3	0.0	13	26	52	presented in paper
Survival													
Belles et al. (1999)	no stats	398	aluminum nitrate nonahydrate	mouse (*Mus musculus*)	adult (25 - 32 g body weight)	survival	GV	1.5	0.0	398	NA	NA	presented in paper

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-3. Aluminum TRV Data for Mammals

	Body Weight (kg)					Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)						Concentration in Food (mg/kg)					
Source [a]	Control	Dose 1	Dose 2	Dose 3	Source	Control	Dose 1	Dose 2	Dose 3	Source	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Wet or Dry Weight Basis	
Growth																	
Belles et al. (1999)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Domingo et al. (1987a)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Domingo et al. (1987a)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Paternain et al. (1988)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Reproduction																	
Belles et al. (1999)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Bernuzzi et al. (1989)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Bernuzzi et al. (1989)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Domingo et al. (1987b)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Paternain et al. (1988)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Paternain et al. (1988)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	
Survival																	
Belles et al. (1999)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-3. Aluminum TRV Data for Mammals

Source [a]	Effect					Effect Relative to Control (%)		
	Control	Dose 1	Dose 2	Dose 3	Measurement	Dose 1	Dose 2	Dose 3
Growth								
Belles et al. (1999)	8.5	1.2	NA	NA	body weight (corrected weight change during gestation) (g)	14	NA	NA
Domingo et al. (1987a)	79	61	84	63	body weight at "7th fortnight" calculated from weight gain (g)	77	107	80
Domingo et al. (1987a)	263	268	257	171	body weight at "8th fortnight" calculated from weight gain (g)	102	98	65
Paternain et al. (1988)	122	99	98	99	weight gain during gestation (critical life stage) (g)	81	80	81
Reproduction								
Belles et al. (1999)	1.3	0.72	NA	NA	mean fetal body weight per litter (g)	58	NA	NA
Bernuzzi et al. (1989)	98	92	51	43	% of initial litter size on day 18	94	53	44
Bernuzzi et al. (1989)	5.8	5.6	4.9	4.5	pup growth (body weight on day 1) (g)	97	84	78
Domingo et al. (1987b)	12	12	13	9.4	mean alive neonates/litter (at age 1 day)	96	108	78
Paternain et al. (1988)	12	9.3	13	13	mean number of live fetuses per dam	76	102	104
Paternain et al. (1988)	3.3	2.8	2.8	2.2	fetal growth (mean fetal body weight) (g)	86	84	67
Survival								
Belles et al. (1999)	100	44	NA	NA	% maternal survival	44	NA	NA

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-4. Antimony TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Poon et al. (1998)	42	no effect	potassium antimony tartrate	rat (*Rattus norvegicus*)	127 g (young; based on USEPA [1988] growth curves)	body weight (male)	DW	13
Poon et al. (1998)	46	no effect	potassium antimony tartrate	rat (*Rattus norvegicus*)	136 g (young; based on USEPA [1988] growth curves)	body weight (female)	DW	13
Rossi et al. (1987)	1.2	no effect	antimony trichloride	rat (*Rattus norvegicus*)	birth	body weight	DW	8.6
Rossi et al. (1987)	0.11	no effect	antimony trichloride	rat (*Rattus norvegicus*)	adult	body weight	DW	6.3
Shroeder et al. (1968)	0.35	no effect	antimony potassium tartrate	mouse (*Mus musculus*)	weanling	body weight (male)	DW	80
Shroeder et al. (1968)	0.35	no effect	antimony potassium tartrate	mouse (*Mus musculus*)	weanling	body weight (female)	DW	80
Reproduction								
Rossi et al. (1987)	1.1	no effect	antimony trichloride	rat (*Rattus norvegicus*)	adult	pups per litter	DW	6.3
Survival								
Dieter et al. (1991)	no stats	no effect	antimony potassium tartrate	mouse (*Mus musculus*)	~8 weeks	survival	DW	2

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-4. Antimony TRV Data for Mammals

	Dose (mg/kg bw/day)							Body Weight (kg)						
Source [a]	Control	1	2	3	4	5	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source
Growth														
Poon et al. (1998)	0.0	0.060	0.56	5.6	42	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Poon et al. (1998)	0.0	0.060	0.64	6.1	46	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Rossi et al. (1987)	0.0	0.12	1.2	NA	NA	NA	calculated from body weight and FIR	0.10	0.10	0.10	NA	NA	NA	presented in paper
Rossi et al. (1987)	0.0	0.11	1.1	NA	NA	NA	calculated from body weight and FIR	0.31	0.31	0.31	NA	NA	NA	presented in paper
Shroeder et al. (1968)	0.0	0.35	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Shroeder et al. (1968)	0.0	0.35	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Reproduction														
Rossi et al. (1987)	0.0	0.11	1.1	NA	NA	NA	calculated from body weight and FIR	0.31	0.31	0.31	NA	NA	NA	presented in paper
Survival														
Dieter et al. (1991)	0.0	11	18	32	50	74	presented in paper	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[v] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-4. Antimony TRV Data for Mammals

	Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)								Concentration in Food (mg/kg)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis
Growth															
Poon et al. (1998)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	0.0	0.50	5.0	50	500	NA	NA (DW study)
Poon et al. (1998)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	0.0	0.50	5.0	50	500	NA	NA (DW study)
Rossi et al. (1987)	0.012	0.012	0.0	NA	NA	NA	Calder and Braun (1983) (DW ingestion for mammals)	NA	0.0	1.0	10	NA	NA	NA	NA (DW study)
Rossi et al. (1987)	0.034	0.034	0.034	NA	NA	NA	Calder and Braun (1983) (DW ingestion for mammals)	NA	0.0	1.0	10	NA	NA	NA	NA (DW study)
Shroeder et al. (1968)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	0.0	5.0	NA	NA	NA	NA	NA (DW study)
Shroeder et al. (1968)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	0.0	5.0	NA	NA	NA	NA	NA (DW study)
Reproduction															
Rossi et al. (1987)	0.034	0.034	0.034	NA	NA	NA	Calder and Braun (1983)	NA	0.0	1.0	10	NA	NA	NA	NA (DW study)
Survival															
Dieter et al. (1991)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (DW study)

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-4. Antimony TRV Data for Mammals

	Effect							Effect Relative to Control (%)				
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth												
Poon et al. (1998)	550	560	530	550	500	NA	male body weight (g) estimated from Figure 2 in paper	102	96	100	91	NA
Poon et al. (1998)	295	300	295	295	280	NA	female body weight (g) estimated from Figure 2 in paper	102	100	100	95	NA
Rossi et al. (1987)	195	186	174	NA	NA	NA	pup body weight (g)	95	89	NA	NA	NA
Rossi et al. (1987)	359	330	323	NA	NA	NA	maternal body weight (g)	92	90	NA	NA	NA
Shroeder et al. (1968)	58	52	NA	NA	NA	NA	mean final body weight (g) for males	89	NA	NA	NA	NA
Shroeder et al. (1968)	55	51	NA	NA	NA	NA	mean final body weight (g) for females	91	NA	NA	NA	NA
Reproduction												
Rossi et al. (1987)	8.0	9.0	7.0	NA	NA	NA	newborns per litter	113	88	NA	NA	NA
Survival												
Dieter et al. (1991)	100	100	100	100	100	90	% survival	100	100	100	100	90

Notes:
weight (dw) basis unless clearly stated otherwise in the study.
[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-5. Arsenic TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	6	Notes
Growth																
Albert et al. (2008a)	no effect	no effect	monomethylarsonic acid	zebra finch	adult	body weight	GV	2	0.0	4.3	12.8	38.5	NA	NA	NA	doses presented in the paper
Albert et al. (2008b)	no effect	no effect	monomethylarsonic acid	zebra finch	1 day	body weight	GV	3	0.0	2.1	4.3	6.4	12.8	NA	NA	doses presented in the paper
Camardese et al. (1990)	no stats	no effect	sodium arsenate	mallard	1 day	body weight	FD	10	0.0	4.1	13.7	41.1	NA	NA	NA	calculated from BW and FIR
Howell and Hill (1978)	no stats	no effect	arsenic trichloride	chicken	1 day	body weight gain	FD	3	0.0	5.6	NA	NA	NA	NA	NA	calculated from BW and FIR
Hoffman et al. (1992)	20	20	sodium arsenate	mallard	1 day	body weight	FD	4	0.0	20.0	NA	NA	NA	NA	NA	calculated from BW and FIR
Naraharisetti et al. (2009)	no stats	no effect	sodium arsenite	chicken	1 month	body weight	DW	4	0.0	5.3	NA	NA	NA	NA	NA	calculated from BW and IG
Sattar et al. (2016)	no effect	no effect	disodium hydrogen arsenate	chicken	7 days	body weight	GV	4	0.0	50.0	NA	NA	NA	NA	NA	doses presented in the paper
Stanley et al. (1994)	no effect	9.3 [d]	sodium arsenate	mallard	1 year	body weight gain	FD	11.6 - 24.7	0.0	2.2	9.3	40.3	NA	NA	NA	calculated from BW and FIR
Reproduction																
Stanley et al. (1994)	40	40	sodium arsenate	mallard	1 year	duckling survival	FD	11.6 - 24.7	0.0	2.2	9.3	40.3	NA	NA	NA	calculated from BW and FIR
Survival																
Albert et al. (2008b)	no stats	6.8799	monomethylarsonic acid	zebra finch	1 day	survival	GV	3	0.0	2.1	4.3	6.4	12.8	19.3	38.5	doses presented in the paper
Howell and Hill (1978)	no stats	no effect	arsenic trichloride	chicken	1 day	survival	FD	3	0.0	5.6	NA	NA	NA	NA	NA	calculated from BW and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

[d] Not used as selected effect level because not statistically different from control

Table H2.B-5. Arsenic TRV Data for Birds

	Body Weight (kg)					Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)						Concentration in Food (mg/kg)				
Source [a]	Control	Dose 1	Dose 2	Dose 3	Source [a]	Control	Dose 1	Dose 2	Dose 3	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Wet or Dry Weight Basis
Growth																
Albert et al. (2008a)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA (GV study)	NA	NA	NA	NA	NA (GV study)
Albert et al. (2008b)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA (GV study)	NA	NA	NA	NA	NA (GV study)
Camardese et al. (1990)	0.73	0.73	0.73	0.73	present study	0.10	0.10	0.10	0.10	presented in paper	dw assumed	0	30	100	300	dw assumed
Howell and Hill (1978)	0.36	0.36	NA	NA	NRC (1994)	0.04	0.04	NA	NA	NRC (1994)	dw assumed	0	50	NA	NA	dw assumed
Hoffman et al. (1992)	0.56	0.56	NA	NA	presented in paper	0.06	0.06	NA	NA	Heinz et al. (1987)	dw assumed	0	200	NA	NA	dw assumed
Naraharisetti et al. (2009)	2.40	2.40	NA	NA	presented in paper	0.25	0.25	NA	NA	EPA (1988)	NA (DW study)	0	50	NA	NA	NA (DW study)
Sattar et al. (2016)	1.45	1.45	NA	NA	presented in paper	NA	NA	NA	NA	NA (GV study)	NA (GV study)	NA	NA	NA	NA	NA (GV study)
Stanley et al. (1994)	1.08	1.08	1.08	1.08	Dunning (1983)	0.11	0.11	0.11	0.11	Heinz et al. (1987)	dw assumed	0.26	22	93	403	dw assumed
Reproduction																
Stanley et al. (1994)	1.08	1.08	1.08	1.08	Dunning (1983)	0.11	0.11	0.11	0.11	Heinz et al. (1987)	dw assumed	0.26	22	93	403	dw assumed
Survival																
Albert et al. (2008b)	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA (doses presented in paper)	NA (GV study)	NA	NA	NA	NA	NA (GV study)
Howell and Hill (1978)	0.36	0.36	NA	NA	NRC (1994)	0.04	0.04	NA	NA	NRC (1994)	dw assumed	0	50	NA	NA	dw assumed

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

[d] Not used as selected effect level because not statistically different from control

Table H2.B-5. Arsenic TRV Data for Birds

	Effect								Effect Relative to Control (%)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Measurement	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6
Growth															
Albert et al. (2008a)	15	14	14	13	NA	NA	NA	final mean body mass (g)	100	93	91	83	NA	NA	NA
Albert et al. (2008b)	12	12	12	12	11	NA	NA	final mean body mass (g)	100	100	99	99	NA	NA	NA
Camardese et al. (1990)	1070	1060	1030	1033		NA	NA	average male and female body weight at 10 weeks from Figures 1 and 2 in paper (g)	100	99	96	97	NA	NA	NA
Howell and Hill (1978)	306	249	NA	NA	NA	NA	NA	weight gain (g)	100	81	NA	NA	NA	NA	NA
Hoffman et al. (1992)	555	384	NA	NA	NA	NA	NA	body weight (g)	100	69	NA	NA	NA	NA	NA
Naraharisetti et al. (2009)	3	2	NA	NA	NA	NA	NA	final body weight (kg)	100	82	NA	NA	NA	NA	NA
Sattar et al. (2016)	2	2	NA	NA	NA	NA	NA	final body weight estimated from Figure 1 in paper (kg)	100	88	NA	NA	NA	NA	NA
Stanley et al. (1994)	53	78	22	27	NA	NA	NA	body weight gain (g)	100	148	42	51	NA	NA	NA
Reproduction															
Stanley et al. (1994)	10	10	11	2	NA	NA	NA	ducks alive at 14 days for nests producing at least one duckling	100	98	107	16	NA	NA	NA
Survival															
Albert et al. (2008b)	98	89	100	77	31	0	0	% survival (from Table 1 in paper; across whole study)	100	91	102	79	32	0	0
Howell and Hill (1978)	93	83	NA	NA	NA	NA	NA	% survival	100	89	NA	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

[d] Not used as selected effect level because not statistically different from control

Table H2.B-6. Barium TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)								
									Control	1	2	3	4	5	6	7	Notes
Growth																	
Johnson et al. (1960)	no stats	527	barium hydroxide	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	4	0.0	56	112	223	447	893	NA	NA	calculated from body weight and FIR
Johnson et al. (1960)	no stats	483	barium acetate	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	4	0.0	28	56	112	223	447	893	NA	calculated from body weight and FIR
Survival																	
Johnson et al. (1960)	no stats	893	barium hydroxide	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	4	0.0	56	112	223	447	893	1787	3573	calculated from body weight and FIR
Johnson et al. (1960)	no stats	893	barium acetate	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	4	0.0	28	56	112	223	447	893	1787	calculated from body weight and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-6. Barium TRV Data for Birds

	Body Weight (kg)									Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)										Concentration in Food (mg/kg)								
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Wet or Dry Weight Basis
Growth																												
Johnson et al. (1960)	0.4	0.4	0.4	0.4	0.4	0.4	NA	NA	NRC (1994)	0.040	0.040	0.040	0.040	0.040	0.040	NA	NA	NRC (1994)	dw	0	500	1000.0	2000	4000	8000	NA	NA	dw assumed
Johnson et al. (1960)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	NA	NRC (1994)	0.040	0.040	0.040	0.040	0.040	0.040	0.040	NA	NRC (1994)	dw	0	250	500	1000	2000	4000	8000	NA	dw assumed
Survival																												
Johnson et al. (1960)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	NRC (1994)	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	NRC (1994)	dw	0	500	1000	2000	4000	8000	16000	32000	dw assumed
Johnson et al. (1960)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	NRC (1994)	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	NRC (1994)	dw	0	250	500	1000	2000	4000	8000	16000	dw assumed

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-6. Barium TRV Data for Birds

	Effect									Effect Relative to Control (%)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7
Growth																
Johnson et al. (1960)	483	450	428	406	410	231	NA	NA	body weight gain (g)	93	89	84	85	48	NA	NA
Johnson et al. (1960)	435	436	410	448	428	357	218	NA	body weight gain (g)	100	94	103	98	82	50	NA
Survival																
Johnson et al. (1960)	19	20	20	20	19	6.0	0.0	0.0	number of chicks surviving	105	105	105	100	32	0	0
Johnson et al. (1960)	18	18	20	20	19	19	8.0	0.0	number of chicks surviving	100	111	111	106	106	44	0

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-7. Barium TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	Notes
Growth															
Dietz et al. (1992)	223	no effect	barium chloride dihydrate	rat (Rattus norvegicus)	42 days	body weight (female)	DW	13	0.0	11	44	84	147	223	presented in paper
Dietz et al. (1992)	282	no effect	barium chloride dihydrate	rat (*Rattus norvegicus*)	42 days	body weight (male)	DW	13	0.0	12	50	94	163	282	presented in paper
Dietz et al. (1992)	475	475	barium chloride dihydrate	mouse (*Mus musculus*)	42 days	body weight (female)	DW	13	0.0	17	70	128	234	475	presented in paper
Dietz et al. (1992)	469	469	barium chloride dihydrate	mouse (Mus musculus)	42 days	body weight (male)	DW	13	0.0	19	64	122	247	469	presented in paper
Schroeder and Mitchener (1975)	no effect	no effect	barium acetate	mouse (Mus musculus)	19-20days	body weight (female)	DW	104	0.0	0.73	NA	NA	NA	NA	calculate from body weight and drinking water IG
Survival															
Borzelleca et al. (1988)	no stats	198	barium chloride	rat (Rattus norvegicus)	29-37 days	survival (female)	GV	1	0.0	66	96	138	198	NA	presented in paper
Dietz et al. (1992)	no stats	282	barium chloride dihydrate	rat (*Rattus norvegicus*)	42 days	survival (male)	DW	13	0.0	12	50	94	163	282	presented in paper
Dietz et al. (1992)	no stats	475	barium chloride dihydrate	mouse (*Mus musculus*)	42 days	survival (female)	DW	13	0.0	17	70	128	234	475	presented in paper
Dietz et al. (1992)	no stats	469	barium chloride dihydrate	mouse (Mus musculus)	42 days	survival (male)	DW	13	0.0	19	64	122	247	469	presented in paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-7. Barium TRV Data for Mammals

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)								Concentration in Food (mg/kg)							
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis
Growth																							
Dietz et al. (1992)	0.15	0.15	0.15	0.15	0.15	0.15	presented in paper	0.016	0.016	0.016	0.016	0.016	0.016	presented in paper	NA (DW study)	0	70.3	281	562	1124	2249	NA (DW study)
Dietz et al. (1992)	0.24	0.24	0.24	0.24	0.24	0.24	presented in paper	0.023	0.023	0.023	0.023	0.023	0.023	presented in paper	NA	0	70.3	281	562	1124	2249	NA (DW study)
Dietz et al. (1992)	0.024	0.024	0.024	0.024	0.024	0.024	presented in paper	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	presented in paper	NA	0	70.3	281	562	1124	2249	NA (DW study)
Dietz et al. (1992)	0.032	0.032	0.032	0.032	0.032	0.032	presented in paper	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	presented in paper	NA	0	70.3	281	562	1124	2249	NA (DW study)
Schroeder and Mitchener (1975)	0.0205	0.0205	NA	NA	NA	NA	presented in paper	0.0030	0.0030	NA	NA	NA	NA	Calder and Braun (1983)	NA	0.021	0.0205	NA	NA	NA	NA	NA (DW study)
Survival																							
Borzelleca et al. (1988)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (GV study)	NA	NA	NA	NA	NA	NA	NA (GV study)
Dietz et al. (1992)	0.24	0.24	0.24	0.24	0.24	0.24	presented in paper	0.023	0.023	0.023	0.023	0.023	0.023	presented in paper	NA (DW study)	0	70.3	281	562	1124	2249	NA (DW study)
Dietz et al. (1992)	0.024	0.024	0.024	0.024	0.024	0.024	presented in paper	0.0048	0.0048	0.0048	0.0048	0.0048	0.0048	presented in paper	NA (DW study)	0	70.3	281	562	1124	2249	NA (DW study)
Dietz et al. (1992)	0.032	0.032	0.032	0.032	0.032	0.032	presented in paper	0.0061	0.0061	0.0061	0.0061	0.0061	0.0061	presented in paper	NA (DW study)	0	70.3	281	562	1124	2249	NA (DW study)

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-7. Barium TRV Data for Mammals

	Effect							Effect Relative to Control (%)				
Source[a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth												
Dietz et al. (1992)	190	197	191	187	186	173	final body weight (g) (female)	104	101	99	98	91
Dietz et al. (1992)	348	352	360	342	340	307	final body weight (g) (male)	101	103	98	98	88
Dietz et al. (1992)	29.5	28.5	27.8	29.1	27.6	16.4	final body weight (g) (female)	97	94	99	94	56
Dietz et al. (1992)	38.1	37.7	38.2	36.1	37.9	26.8	final body weight (g) (male)	99	100	95	99	70
Schroeder and Mitchener (1975)	20.5	17.8	NA	NA	NA	NA	body weight (g) (female)	87	NA	NA	NA	NA
Survival												
Borzelleca et al. (1988)	100	100	100	100	70	NA	% survival (female)	100	100	100	70	NA
Dietz et al. (1992)	100	100	100	100	100	70	% survival (male)	100	100	100	100	70
Dietz et al. (1992)	100	100	100	100	100	30	% survival (female)	100	100	100	100	30
Dietz et al. (1992)	100	90	100	100	100	40	% survival (male)	90	100	100	100	40

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[b] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-8. Chromium TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Chung et al. (1985)	514	514	chromium sulfate (chromium [III])	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	2

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-8. Chromium TRV Data for Birds

	Dose (mg/kg bw/day)				Body Weight (kg)				Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)				
Source [a]	Control	1	2	Notes	Control	Dose 1	Dose 2	Source [a]	Control	Dose 1	Dose 2	Source [a]	Wet or Dry Weight Basis
Growth													
Chung et al. (1985)	0.0	514	NA	calculated from body weight and FIR	0.15	0.15	NA	NRC (1994)	0.019	0.019	NA	NRC (1994)	ww

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-8. Chromium TRV Data for Birds

Source [a]	Concentration in Food (mg/kg)				Effect				Effect Relative to Control (%)	
	Control [c]	Dose 1	Dose 2	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Measurement	Dose 1	Dose 2
Growth										
Chung et al. (1985)	0.0	4000	NA	NA	174	100	NA	body weight gain at 2 weeks (g assumed)	57	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-9. Chromium TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	Notes
Growth												
Bataineh et al. (1997)	112	112	chromium chloride (chromium [III])	rat (*Rattus norvegicus*)	adult	body weight (male)	DW	12	0.0	112	NA	calculated from body weight and FIR
Elbetieha and Al-Hamood (1997)	91	no effect	chromium chloride (chromium [III])	mouse (*Mus musculus*)	50 days	body weight	DW	12	0.0	91	227	calculated from body weight and FIR
Reproduction												
Elbetieha and Al-Hamood (1997)	227	227	chromium chloride (chromium [III])	mouse (*Mus musculus*)	50 days	pregnancy success	DW	12	0.0	91	227	calculated from body weight and FIR
Elbetieha and Al-Hamood (1997)	91	91	chromium chloride (chromium [III])	mouse (*Mus musculus*)	50 days	viability of fetuses	DW	12	0.0	91	227	calculated from body weight and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-9. Chromium TRV Data for Mammals

	Body Weight (kg)				Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)					Concentration in Food (mg/kg)				Effect				Effect Relative to Control (%)	
Source [a]	Control	Dose 1	Dose 2	Source	Control	Dose 1	Dose 2	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Measurement	Dose 1	Dose 2
Growth																			
Bataineh et al. (1997)	0.30	0.30	NA	presented in paper	0.033	0.033	NA	Calder and Braun (1983)	NA (DW)	0.0	1000	NA	NA (DW)	446	341	NA	body weight (g) (Table IV in paper)	76	NA
Elbetieha and Al-Hamood (1997)	0.036	0.036	0.036	presented in paper	0.0049	0.0049	0.0049	Calder and Braun (1983)	NA (DW)	0.0	657	1642	NA (DW)	0.036	0.031	0.033	average male final weight (kg)	86	93
Reproduction																			
Elbetieha and Al-Hamood (1997)	0.036	0.036	0.036	presented in paper	0.0049	0.0049	0.0049	Calder and Braun (1983)	NA (DW)	0.0	657	1642	NA (DW)	83	90	44	% pregnant females	109	53
Elbetieha and Al-Hamood (1997)	0.036	0.036	0.036	presented in paper	0.0049	0.0049	0.005	Calder and Braun (1983)	NA (DW)	0.0	657	1642	NA (DW)	8.8	5.6	5.9	number of viable fetuses (Experiment 2)	63	67

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-10. Iron TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						
									Control	1	2	3	4	5	Notes
Growth															
Cao et al. (1996)	not clear	no effect	iron sulfate	chicken (*Gallus gallus domesticus*)	1 day	body weight	FD	3	15.3	47.9	64.1	80.4	NA	NA	calculated from body weight and FIR
McGhee et al. (1965)	no stats	156	iron sulfate	chicken (*Gallus gallus domesticus*)	juvenile	body weight	FD	4	4.9	9.8	19.5	39.1	78.1	156.3	calculated from body weight and FIR
Pescatore and Harter-Dennis (1989)	1418	no effect	iron sulfate	chicken (*Gallus gallus domesticus*)	3 days	body weight	GV	single dose	0	709	945	1182	1418	NA	calculated from body weight
Survival															
McGhee et al. (1965)	no stats	no effect	iron sulfate	chicken (*Gallus gallus domesticus*)	juvenile	survival	FD	4	4.9	9.8	19.5	39.1	78.1	156.3	calculated from body weight and FIR
Pescatore and Harter-Dennis (1989)	709	1182	iron sulfate	chicken (*Gallus gallus domesticus*)	3 days	survival	GV	single dose	0	709	945	1182	1418	2836	calculated from body weight
Wallner-Pendleton et al. (1986)	no stats	2009	iron sulfate	chicken (*Gallus gallus domesticus*)	2 days	survival	GV	single dose	0	6.7	67.0	670	2009	NA	calculated from body weight

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-10. Iron TRV Data for Birds

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)								Concentration in Food (mg/kg)							
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis
Growth																							
Cao et al. (1996)	0.378	0.378	0.378	0.378	NA	NA	presented in paper	0.031	0.031	0.031	0.031	NA	NA	presented in paper	dw	188	588	788	988	NA	NA	dw
McGhee et al. (1965)	0.1822	0.1822	0.1822	0.1822	0.1822	0.1822	presented in paper	0.018	0.018	0.018	0.018	0.018	0.018	USEPA (1988)	dw	50	100	200	400	800	1600	dw
Pescatore and Harter-Dennis (1989)	0.051	0.051	0.051	0.051	0.051	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (gavage study)	NA	NA	NA	NA	NA	NA	NA	NA
Survival																							
McGhee et al. (1965)	0.1822	0.1822	0.1822	0.1822	0.1822	0.1822	presented in paper	0.018	0.018	0.018	0.018	0.018	0.018	USEPA (1988)	dw	50	100	200	400	800	1600	dw
Pescatore and Harter-Dennis (1989)	0.051	0.051	0.051	0.051	0.051	0.051	presented in paper	NA	NA	NA	NA	NA	NA	NA (gavage study)	NA	NA	NA	NA	NA	NA	NA	NA
Wallner-Pendleton et al. (1986)	0.03	0.03	0.03	0.03	0.03	NA	USEPA (1988)	NA	NA	NA	NA	NA	NA	NA (gavage study)	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-10. Iron TRV Data for Birds

	Effect							Effect Relative to Control (%)				
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth												
Cao et al. (1996)	0.66	0.54	0.55	0.56	NA	NA	final body weight (week 3) (kg)	81	82	85	NA	NA
McGhee et al. (1965)	0.1822	0.1638	0.16	0.127	0.156	0.139	average body weight (kg)	90	88	70	86	76
Pescatore and Harter-Dennis (1989)	0.26	0.23	0.23	0.22	0.21	NA	final body weight (12 days after dosing) (kg)	88	88	85	81	NA
Survival												
McGhee et al. (1965)	100	100	90	100	100	100	% survival	100	90	100	100	100
Pescatore and Harter-Dennis (1989)	100	93.4	83.9	73.5	48.9	8.3	% survival after 24 hours	93	84	74	49	8.3
Wallner-Pendleton et al. (1986)	100	100	100	100	80	NA	% survival after 24 hours	100	100	100	80	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-11. Iron TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)							
									Control	1	2	3	4	5	6	Notes
Growth																
Banis et al. (1969)	no stats	47	iron sulfate	rat (*Rattus norvegicus*)	weanling	body weight	FD	4	11.7	47	NA	NA	NA	NA	NA	calculated from body weight and FIR
Plummer et al. (1997)	not clear	649	carbonyl iron	rat (*Rattus norvegicus*)	suckling to juvenile	body weight (male)	FD	32	4.3	327	649	1294	NA	NA	NA	calculated from body weight and FIR
Plummer et al. (1997)	not clear	no effect	carbonyl iron	rat (*Rattus norvegicus*)	suckling to juvenile	body weight (female)	FD	32	5.3	407	808	1612	NA	NA	NA	calculated from body weight and FIR
Prince et al. (1979)	not clear	no effect	ferrous sulfide	pig (*Sus domesticus*)	70 days	body weight	FD	16	0.6	12	23	46	NA	NA	NA	calculated from body weight and FIR
Storey and Greger (1987)	410	410	iron sulfate	rat (*Rattus norvegicus*)	weanling	body weight (male)	FD	3	4.7	190	410	NA	NA	NA	NA	calculated from body weight and FIR
Whittaker et al. (2002)	no stats	no effect	iron sulfate	rat (*Rattus norvegicus*)	young	body weight	GV	single dose	0.0	900	1000	1100	1200	NA	NA	presented in paper
Whittaker et al. (2002)	no stats	40000	carbonyl iron	rat (*Rattus norvegicus*)	young	body weight	GV	single dose	0.0	40000	50000	NA	NA	NA	NA	presented in paper
Zhu et al. (2016)	no stats	no effect	carbonyl iron	rat (*Rattus norvegicus*)	6 weeks	body weight (male)	FD	13	0.0	159	317	NA	NA	NA	NA	calculated from body weight and FIR
Survival																
Whittaker et al. (1996)	no stats	373	carbonyl iron	rat (*Rattus norvegicus*)	weanling	survival	FD	12	3.7	37	373	2,130	NA	NA	NA	calculated from body weight and FIR
Whittaker et al. (2002)	no stats	1000	iron sulfate	rat (*Rattus norvegicus*)	young	survival	GV	single dose	0.0	900	1000	1100	1200	1300	1400	presented in paper
Whittaker et al. (2002)	no stats	no effect	carbonyl iron	rat (*Rattus norvegicus*)	young	survival	GV	single dose	0.0	40000	50000	NA	NA	NA	NA	presented in paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.
[d] Final body weight calculated from weight gain per day and initial body weight.

Table H2.B-11. Iron TRV Data for Mammals

	Body Weight (kg)								Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)									Concentration in Food (mg/kg)							
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Wet or Dry Weight Basis
Growth																									
Banis et al. (1969)	0.1146	0.1146	NA	NA	NA	NA	NA	presented in paper	0.0134	0.0134	NA	NA	NA	NA	NA	USEPA (1988)	dw	100	400	NA	NA	NA	NA	NA	dw
Plummer et al. (1997)	0.66	0.66	0.66	0.66	NA	NA	NA	presented in paper	0.043	0.043	0.043	0.043	NA	NA	NA	USEPA (1988)	dw	66	5066	10066	20066	NA	NA	NA	dw
Plummer et al. (1997)	0.345	0.345	0.345	0.345	NA	NA	NA	presented in paper	0.028	0.028	0.028	0.028	NA	NA	NA	USEPA (1988)	dw	66	5066	10066	20066	NA	NA	NA	dw
Prince et al. (1979)	53.6	53.6	53.6	53.6	NA	NA	NA	presented in paper	0.69	0.69	0.69	0.69	NA	NA	NA	Nagy (2001)	dw	50	920	1790	3530	NA	NA	NA	dw
Storey and Greger (1987)	0.075	0.075	0.075	NA	NA	NA	NA	USEPA (1988)	0.010	0.010	0.010	NA	NA	NA	NA	USEPA (1988)	dw	35.2	1408	3042	NA	NA	NA	NA	dw
Whittaker et al. (2002)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Whittaker et al. (2002)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zhu et al. (2016)	0.41	0.41	0.41	NA	NA	NA	NA	presented in paper	0.65	0.65	0.65	NA	NA	NA	NA	presented in paper	dw	0	100	200	NA	NA	NA	NA	dw
Survival																									
Whittaker et al. (1996)	0.15	0.15	0.15	0.15	NA	NA	NA	USEPA (1988)	0.016	0.016	0.016	0.016	NA	NA	NA	USEPA (1988)	dw	35	350	3500	20000	NA	NA	NA	dw
Whittaker et al. (2002)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Whittaker et al. (2002)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.
[d] Final body weight calculated from weight gain per day and initial body weight.

Table H2.B-11. Iron TRV Data for Mammals

	Effect								Effect Relative to Control (%)					
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6
Growth														
Banis et al. (1969)	0.183	0.141	NA	NA	NA	NA	NA	final body weight (kg) [u]	77	NA	NA	NA	NA	NA
Plummer et al. (1997)	0.66	0.68	0.51	0.53	NA	NA	NA	final body weight (kg)	102	77	80	NA	NA	NA
Plummer et al. (1997)	0.345	0.340	0.290	0.295	NA	NA	NA	final body weight (kg)	99	84	86	NA	NA	NA
Prince et al. (1979)	89.8	86.3	85.4	85.2	NA	NA	NA	final body weight (kg) [u]	96	95	95	NA	NA	NA
Storey and Greger (1987)	0.181	0.174	0.137	NA	NA	NA	NA	final body weight (kg)	96	79	NA	NA	NA	NA
Whittaker et al. (2002)	0.12	0.12	0.13	0.14	0.14	NA	NA	final body weight (kg)	98	107	114	116	NA	NA
Whittaker et al. (2002)	0.121	0.089	0.092	NA	NA	NA	NA	final body weight (kg)	74	76	NA	NA	NA	NA
Zhu et al. (2016)	0.47	0.44	0.41	NA	NA	NA	NA	final body weight (kg)	95	88	NA	NA	NA	NA
Survival														
Whittaker et al. (1996)	100	100	80	72.2	NA	NA	NA	% survival	100	80	72.2	NA	NA	NA
Whittaker et al. (2002)	100	87.5	75	50	12.5	0	0	% survival	87.5	75	50	12.5	0	0
Whittaker et al. (2002)	100	100	100	NA	NA	NA	NA	% survival	100	100.0	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.
[d] Final body weight calculated from weight gain per day and initial body weight.

Table H2.B-12. Methylmercury TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Scott et al. (1975)	no stats	ED20	methylmercury chloride	chicken (*Gallus gallus domesticus*)	12.5 months	body weight	FD	8
Sell and Horani (1976)	2.2	no effect	methylmercury chloride	chicken (*Gallus gallus domesticus*)	1 day	body weight gain (Experiment 1)	FD	4
Sell and Horani (1976)	2.2	no effect	methylmercury chloride	chicken (*Gallus gallus domesticus*)	6 days	body weight gain (Experiment 2)	FD	3.6
Spalding et al. (2000)	0.070	no effect	methylmercury chloride	egret (*Ardea alba)*	1 week	weight index	FD	14
Reproduction								
Albers et al. (2007)	stats not clearly presented	0.48	methylmercury chloride	kestrel (*Falco sparverius*)	adult	egg production	FD	at least 11
Albers et al. (2007)	stats not clearly presented	ED20	methylmercury chloride	kestrel (*Falco sparverius*)	adult	number of eggs hatched	FD	at least 11
Albers et al. (2007)	stats not clearly presented	ED20	methylmercury chloride	kestrel (*Falco sparverius*)	adult	% eggs hatched	FD	at least 11
Albers et al. (2007)	stats not clearly presented	ED20	methylmercury chloride	kestrel (*Falco sparverius*)	adult	% fledged	FD	at least 11
El-Begearmi et al. (1977)	no stats	2.0	methylmercury hydroxide	quail (*Coturnix japonica*)	hatchling to adult (1 day to 12 weeks old)	% egg fertility	FD	16
El-Begearmi et al. (1977)	no stats	0.66	methylmercury hydroxide	quail (*Coturnix japonica*)	hatchling to adult (1 day to 12 weeks old)	egg production	FD	16
El-Begearmi et al. (1977)	no stats	2.0	methylmercury hydroxide	quail (*Coturnix japonica*)	hatchling to adult (1 day to 12 weeks old)	% hatchability	FD	16
Eskeland and Nafstad (1978)	0.53	0.53	methylmercury chloride	quail (*Coturnix japonica*)	6 weeks (juvenile)	chick survival	FD	6
Eskeland and Nafstad (1978)	1.1	1.1	methylmercury chloride	quail (*Coturnix japonica*)	6 weeks (juvenile)	hatch success	FD	6
Heinz et al. (2010)	no effect	0.80	methylmercury chloride	mallard (*Anas platyrhynchos*)	adult	ducklings per female	FD	3.7
Heinz et al. (2010)	0.40	no effect	methylmercury chloride	mallard (*Anas platyrhynchos*)	adult	duckling body weight	FD	3.7
Heinz and Hoffman (1998)	1.0	1.0	methylmercury chloride	mallard (*Anas platyrhynchos*)	19 months	ducklings per female	FD	up to 11
Heinz and Hoffman (1998)	1.0	1.0	methylmercury chloride	mallard (*Anas platyrhynchos*)	19 months	% hatchability	FD	up to 11
Heinz and Hoffman (1998)	no effect	1.0	methylmercury chloride	mallard (*Anas platyrhynchos*)	19 months	duckling survival	FD	up to 11
Scott et al. (1975)	0.70	0.70	methylmercury chloride	chicken (*Gallus gallus domesticus*)	12.5 months	egg fertility	FD	8
Scott et al. (1975)	1.4	0.70	methylmercury chloride	chicken (*Gallus gallus domesticus*)	12.5 months	egg production	FD	8
Scott et al. (1975)	0.70	0.70	methylmercury chloride	chicken (*Gallus gallus domesticus*)	12.5 months	egg hatchability	FD	8
Varian-Ramos et al. (2014)	0.41	no effect	methylmercury cysteine	finch (*Taeniopygia guttata*)	adult	% hatchability	FD	52
Varian-Ramos et al. (2014)	0.051	ED20	methylmercury cysteine	finch (*Taeniopygia guttata*)	adult	% chicks fledged	FD	52
Varian-Ramos et al. (2014)	0.051	ED20	methylmercury cysteine	finch (*Taeniopygia guttata*)	adult	number of offspring	FD	52
Varian-Ramos et al. (2014)	no stats	0.10	methylmercury cysteine	finch (*Taeniopygia guttata*)	F1 adult offspring of exposed parents	F1 % hatchability	FD	unclear
Varian-Ramos et al. (2014)	no stats	0.10	methylmercury cysteine	finch (*Taeniopygia guttata*)	F1 adult offspring of exposed parents	F1 % chicks fledged	FD	unclear
Varian-Ramos et al. (2014)	no stats	ED20	methylmercury cysteine	finch (*Taeniopygia guttata*)	F1 adult offspring of exposed parents	F1 number of offspring	FD	unclear
Survival								
Bennet et al. (2009)	no stats	1.3	methylmercury chloride	kestrel (*Falco sparverius*)	adult	survival	FD	5-7
El-Begearmi et al. (1977)	no stats	2.0	methylmercury hydroxide	quail (*Coturnix japonica*)	hatchling	survival (female)	FD	16
El-Begearmi et al. (1977)	no stats	2.0	methylmercury hydroxide	quail (*Coturnix japonica*)	hatchling	survival (male)	FD	16
Hill and Soares (1987)	no stats	3.7	methylmercury chloride	quail (*Coturnix japonica*)	hatchling	survival	FD	0.71
Hill and Soares (1987)	no stats	5.5	methylmercury chloride	quail (*Coturnix japonica*)	14 days	survival	FD	0.71
Scheuhammer (1988)	no stats	1.8	methylmercury chloride	finch (*Taeniopygia guttata*)	adult	survival	FD	11
Sell and Horani (1976)	no stats	no effect	methylmercury chloride	chicken (*Gallus gallus domesticus*)	1 day	survival (Experiment 1)	FD	4
Sell and Horani (1976)	no stats	no effect	methylmercury chloride	chicken (*Gallus gallus domesticus*)	6 days	survival (Experiment 2)	FD	3.6
Sell and Horani (1976)	no stats	no effect	methylmercury chloride	quail (*Coturnix japonica*)	8 days	survival (Experiment 2)	FD	3.3
Spann et al. (1986)	no stats	2.0	methylmercury chloride	quail (*Coturnix japonica*)	12 days	survival	FD	6
Varian-Ramos et al. (2014)	no effect	0.051	methylmercury cysteine	finch (*Taeniopygia guttata*)	adult	survival	FD	52
Varian-Ramos et al. (2014)	no stats	0.051	methylmercury cysteine	finch (*Taeniopygia guttata*)	F1 adult offspring of exposed parents	F1 survival	FD	unclear

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-12. Methylmercury TRV Data for Birds

	Dose (mg/kg bw/day)							Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source [a]	Control	1	2	3	4	5	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis
Growth																						
Scott et al. (1975)	0.0	0.70	1.4	NA	NA	NA	calculated from body weight and FIR	1.6	1.6	1.6	NA	NA	NA	USEPA (1988)	0.11	0.11	0.11	NA	NA	NA	USEPA (1988)	dw
Sell and Horani (1976)	0.0	2.2	NA	NA	NA	NA	calculated from body weight and FIR	0.080	0.080	NA	NA	NA	NA	USEPA (1988)	0.0089	0.0089	NA	NA	NA	NA	USEPA (1988)	dw
Sell and Horani (1976)	0.0	2.2	NA	NA	NA	NA	calculated from body weight and FIR	0.080	0.080	NA	NA	NA	NA	USEPA (1988)	0.0089	0.0089	NA	NA	NA	NA	USEPA (1988)	dw
Spalding et al. (2000)	0.0	0.070	0.70	NA	NA	NA	calculated from body weight and FIR	NA	NA	NA	NA	NA	NA	NA (FIR/body weight reported)	0.18	0.18	0.18	NA	NA	NA	presented in paper	ww
Reproduction																						
Albers et al. (2007)	0.0	0.079	0.21	0.34	0.48	0.62	calculated from body weight and FIR	0.13	0.13	0.13	0.13	0.13	0.13	Pattee (1984)	0.014	0.014	0.014	0.014	0.014	0.014	Nagy (2001) (for Eurasian kestrel)	dw
Albers et al. (2007)	0.0	0.079	0.21	0.34	0.48	0.62	calculated from body weight and FIR	0.13	0.13	0.13	0.13	0.13	0.13	Pattee (1984)	0.014	0.014	0.014	0.014	0.014	0.014	Nagy (2001) (for Eurasian kestrel)	dw
Albers et al. (2007)	0.0	0.079	0.21	0.34	0.48	0.62	calculated from body weight and FIR	0.13	0.13	0.13	0.13	0.13	0.13	Pattee (1984)	0.014	0.014	0.014	0.014	0.014	0.014	Nagy (2001) (for Eurasian kestrel)	dw
Albers et al. (2007)	0.0	0.079	0.21	0.34	0.48	0.62	calculated from body weight and FIR	0.13	0.13	0.13	0.13	0.13	0.13	Pattee (1984)	0.014	0.014	0.014	0.014	0.014	0.014	Nagy (2001) (for Eurasian kestrel)	dw
El-Begearmi et al. (1977)	0.0	0.66	2.0	3.9	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
El-Begearmi et al. (1977)	0.0	0.66	2.0	3.9	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
El-Begearmi et al. (1977)	0.0	0.66	2.0	3.9	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
Eskeland and Nafstad (1978)	0.0	0.13	0.26	0.53	1.1	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	0.15	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	0.020	NA	Nagy (2001) (for all birds)	dw
Eskeland and Nafstad (1978)	0.0	0.13	0.26	0.53	1.1	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	0.15	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	0.020	NA	Nagy (2001) (for all birds)	dw
Heinz et al. (2010)	0.0	0.10	0.20	0.40	0.80	NA	calculated from body weight and FIR	1.2	1.2	1.2	1.2	1.2	NA	presented in paper	0.12	0.12	0.12	0.12	0.12	NA	Heinz et al. (1987)	dw
Heinz et al. (2010)	0.0	0.10	0.20	0.40	0.80	NA	calculated from body weight and FIR	1.2	1.2	1.2	1.2	1.2	NA	presented in paper	0.12	0.12	0.12	0.12	0.12	NA	Heinz et al. (1987)	dw
Heinz and Hoffman (1998)	0.0	1.0	NA	NA	NA	NA	calculated from body weight and FIR	1.2	1.2	NA	NA	NA	NA	presented in paper	0.12	0.12	NA	NA	NA	NA	Heinz et al. (1987)	dw
Heinz and Hoffman (1998)	0.0	1.0	NA	NA	NA	NA	calculated from body weight and FIR	1.2	1.2	NA	NA	NA	NA	presented in paper	0.12	0.12	NA	NA	NA	NA	Heinz et al. (1987)	dw
Heinz and Hoffman (1998)	0.0	1.0	NA	NA	NA	NA	calculated from body weight and FIR	1.2	1.2	NA	NA	NA	NA	presented in paper	0.12	0.12	NA	NA	NA	NA	Heinz et al. (1987)	dw
Scott et al. (1975)	0.0	0.70	1.4	NA	NA	NA	calculated from body weight and FIR	1.6	1.6	1.6	NA	NA	NA	USEPA (1988)	0.11	0.11	0.11	NA	NA	NA	USEPA (1988)	dw
Scott et al. (1975)	0.0	0.70	1.4	NA	NA	NA	calculated from body weight and FIR	1.6	1.6	1.6	NA	NA	NA	USEPA (1988)	0.11	0.11	0.11	NA	NA	NA	USEPA (1988)	dw
Scott et al. (1975)	0.0	0.70	1.4	NA	NA	NA	calculated from body weight and FIR	1.6	1.6	1.6	NA	NA	NA	USEPA (1988)	0.11	0.11	0.11	NA	NA	NA	USEPA (1988)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw
Survival																						
Bennet et al. (2009)	0.0	0.31	0.67	1.3	NA	NA	calculated from body weight and FIR	0.13	0.13	0.13	0.13	NA	NA	Pattee (1984)	0.014	0.014	0.014	0.014	NA	NA	Nagy (2001) (for Eurasian kestrel)	dw
El-Begearmi et al. (1977)	0.0	0.66	2.0	3.9	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
El-Begearmi et al. (1977)	0.0	0.66	2.0	3.9	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
Hill and Soares (1987)	0.0	2.6	3.7	5.3	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
Hill and Soares (1987)	0.0	3.9	5.5	7.9	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	0.15	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	0.020	NA	NA	Nagy (2001) (for all birds)	dw
Scheuhammer (1988)	0.0	0.35	0.88	1.8	NA	NA	doses presented in paper	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA
Sell and Horani (1976)	0.0	2.2	NA	NA	NA	NA	calculated from body weight and FIR	0.080	0.080	NA	NA	NA	NA	USEPA (1988)	0.0089	0.0089	NA	NA	NA	NA	USEPA (1988)	dw
Sell and Horani (1976)	0.0	2.2	NA	NA	NA	NA	calculated from body weight and FIR	0.080	0.080	NA	NA	NA	NA	USEPA (1988)	0.0089	0.0089	NA	NA	NA	NA	USEPA (1988)	dw
Sell and Horani (1976)	0.0	2.6	NA	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	NA	NA	NA	NA	Vos et al. (1971)	0.020	0.020	NA	NA	NA	NA	Nagy (2001) (for all birds)	dw
Spann et al. (1986)	0.0	0.54	2.0	NA	NA	NA	calculated from body weight and FIR	0.18	0.18	0.18	NA	NA	NA	Dunning (1993)	0.022	0.022	0.022	NA	NA	NA	Nagy (2001) (for all birds)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw
Varian-Ramos et al. (2014)	0.0	0.051	0.10	0.20	0.41	NA	calculated from body weight and FIR	0.012	0.012	0.012	0.012	0.012	NA	Dunning (1993)	0.0034	0.0034	0.0034	0.0034	0.0034	NA	Nagy (2001) (for passerines)	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-12. Methylmercury TRV Data for Birds

	Concentration in Food (mg/kg)							Effect							Effect Relative to Control (%)				
Source [a]	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth																			
Scott et al. (1975)	0.0	10	20	NA	NA	NA	dw	1.7	1.5	1.1	NA	NA	NA	Paper only presented weight change results (not body weights themselves). Mean body weight from USEPA (1988) (1.55 kg) used to calculate final body weights (with weight change results in paper).	88	68	NA	NA	NA
Sell and Horani (1976)	0.0	20	NA	NA	NA	NA	dw	267	225	NA	NA	NA	NA	weight gain (g)	84	NA	NA	NA	NA
Sell and Horani (1976)	0.0	20	NA	NA	NA	NA	dw	251	211	NA	NA	NA	NA	weight gain (g)	84	NA	NA	NA	NA
Spalding et al. (2000)	0.0	0.43	4.3	NA	NA	NA	ww	0.10	0.085	0.083	NA	NA	NA	weight index (weight/bill length) (unitless)	85	83	NA	NA	NA
Reproduction																			
Albers et al. (2007)	0.0	0.75	2.0	3.2	4.6	5.9	dw	3.9	3.2	3.7	3.2	2.4	1.3	mean number of eggs laid	83	95	82	63	32
Albers et al. (2007)	0.0	0.75	2.0	3.2	4.6	5.9	dw	2.3	1.9	1.3	1.5	0.1	0.0	mean number of eggs hatched	84	58	67	6.2	0.0
Albers et al. (2007)	0.0	0.75	2.0	3.2	4.6	5.9	dw	64	65	38	52	7.0	0.0	% eggs hatched	102	59	81	11	0.0
Albers et al. (2007)	0.0	0.75	2.0	3.2	4.6	5.9	dw	100	71	77	40	0.0	0.0	% fledged	71	77	40	0.0	0.0
El-Begearmi et al. (1977)	0.0	5.0	15	30	NA	NA	dw	97	90	33	0.0	NA	NA	% egg fertility (number of fertile eggs per total eggs set)	93	34	0.0	NA	NA
El-Begearmi et al. (1977)	0.0	5.0	15	30	NA	NA	dw	72	44	37	0.0	NA	NA	% egg production (% hen-day)	61	52	0.0	NA	NA
El-Begearmi et al. (1977)	0.0	5.0	15	30	NA	NA	dw	68	64	0.0	0.0	NA	NA	% hatchability (number of chicks / number of fertile eggs)	94	0.0	0.0	NA	NA
Eskeland and Nafstad (1978)	0.0	1.0	2.0	4.0	8.0	NA	dw	90	89	88	41	0.0	NA	% survival (originally reported as % mortality)	99	97	45	0.0	NA
Eskeland and Nafstad (1978)	0.0	1.0	2.0	4.0	8.0	NA	dw	57	68	70	55	41	NA	% hatchability	120	123	96	73	NA
Heinz et al. (2010)	0.0	1.0	2.0	4.0	8.0	NA	dw	17	18	15	15	13	NA	number of 6-day-old ducklings produced	107	91	87	74	NA
Heinz et al. (2010)	0.0	1.0	2.0	4.0	8.0	NA	dw	81	83	79	72	75	NA	duckling body weight at 6 days old (g)	103	97	89	92	NA
Heinz and Hoffman (1998)	0.0	10	NA	NA	NA	NA	dw	7.6	1.1	NA	NA	NA	NA	number of 7-day-old ducklings produced per female	14	NA	NA	NA	NA
Heinz and Hoffman (1998)	0.0	10	NA	NA	NA	NA	dw	44	11	NA	NA	NA	NA	% hatchability (number of ducklings / number of fertile eggs)	26	NA	NA	NA	NA
Heinz and Hoffman (1998)	0.0	10	NA	NA	NA	NA	dw	96	71	NA	NA	NA	NA	% duckling survival (reaching 7 days old)	74	NA	NA	NA	NA
Scott et al. (1975)	0.0	10	20	NA	NA	NA	dw	92	58	57	NA	NA	NA	% fertile eggs	63	62	NA	NA	NA
Scott et al. (1975)	0.0	10	20	NA	NA	NA	dw	70	52	25	NA	NA	NA	% egg production (authors did not define egg production)	73	36	NA	NA	NA
Scott et al. (1975)	0.0	10	20	NA	NA	NA	dw	91	15	7.7	NA	NA	NA	% hatch of fertile eggs	17	8.4	NA	NA	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.71	1.4	NA	dw	45	52	45	48	38	NA	% hatchability	116	100	107	84	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.71	1.4	NA	dw	78	62	60	58	60	NA	% chicks fledged	79	77	74	77	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.71	1.4	NA	dw	13	11	8.5	7.5	6.0	NA	number of independent offspring in 1 year	81	65	58	46	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.71	1.4	NA	dw	55	61	37	62	45	NA	F1 % hatchability	111	67	113	82	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.71	1.4	NA	dw	79	65	58	60	70	NA	F1 % chicks fledged	82	73	76	89	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.71	1.4	NA	dw	13	9.0	6.0	7.0	8.0	NA	F1 number of independent offspring in 1 year	69	46	54	62	NA
Survival																			
Bennet et al. (2009)	0.0	3.0	6.4	12	NA	NA	dw	100	100	100	0.0	NA	NA	% survival	100	100	0.0	NA	NA
El-Begearmi et al. (1977)	0.0	5.0	15	30	NA	NA	dw	87	75	10	0.0	NA	NA	female % survival after 16 weeks (last time point)	86	11	0.0	NA	NA
El-Begearmi et al. (1977)	0.0	5.0	15	30	NA	NA	dw	100	27	0.0	0.0	NA	NA	male % survival after 16 weeks (last time point)	27	0.0	0.0	NA	NA
Hill and Soares (1987)	0.0	20	28	40	NA	NA	dw	97	84	60	32	NA	NA	% survival (originally reported as % mortality)	87	62	33	NA	NA
Hill and Soares (1987)	0.0	30	42	60	NA	NA	dw	98	87	60	27	NA	NA	% survival (originally reported as % mortality)	89	61	28	NA	NA
Scheuhammer (1988)	0.0	1.0	2.5	5.0	NA	NA	dw	100	100	100	75	NA	NA	% survival	100	100	75	NA	NA
Sell and Horani (1976)	0.0	20	NA	NA	NA	NA	dw	100	93	NA	NA	NA	NA	% survival	93	NA	NA	NA	NA
Sell and Horani (1976)	0.0	20	NA	NA	NA	NA	dw	100	100	NA	NA	NA	NA	% survival	100	NA	NA	NA	NA
Sell and Horani (1976)	0.0	20	NA	NA	NA	NA	dw	100	89	NA	NA	NA	NA	% survival	89	NA	NA	NA	NA
Spann et al. (1986)	0.0	4.3	16	NA	NA	NA	dw	94	90	18	NA	NA	NA	Figure 1 in paper. Values for control and low dose (5.4 mg/kg) are	96	19	NA	NA	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.7	1.4	NA	dw	85	65	70	68	68	NA	% adult survival	76	82	80	80	NA
Varian-Ramos et al. (2014)	0.0	0.18	0.36	0.7	1.4	NA	dw	78	60	42	50	55	NA	F1 % adult survival	77	54	64	71	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-13. Methylmercury TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Friedman et al. (1978)	no stats	2.2	methlymercury chloride	rat (*Rattus norvegicus*)	NR	body weight	FD	10
Gandhi et al. (2013)	1.9	1.9	methylmercury chloride	rat (*Rattus norvegicus*)	sexually mature (weighing 180-200 g; gestational exposure)	body weight gain	GV	3
Mitsumori et al. (1990)	no stats	0.69	methylmercury chloride	mouse (*Mus musculus*)	4 weeks	body weight	FD	104
Mitsumori et al. (1983)	0.65	0.65	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	body weight	FD	130
Stillings et al. (1974)	no stats	3.1	methylmercury chloride	rat (*Rattus norvegicus*)	weanling (24 days)	body weight gain	FD	4
Verschuuren et al. (1976a)	0.0091	no effect	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	F2 body weight gain	FD	12
Verschuuren et al. (1976b)	0.20	no effect	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	body weight	FD	104
Wobeser et al. (1976)	no stats	0.080	methylmercury chloride	mink (*Neovison vison)*	adult (female)	body weight	FD	13
Reproduction								
Gandhi et al. (2013)	1.9	1.9	methylmercury chloride	rat (*Rattus norvegicus*)	sexually mature (weighing 180-200 g; gestational exposure)	fetal survival	GV	3
Tonk et al. (2010)	no stats	1.4	methylmercury chloride	rat (*Rattus norvegicus*)	sexually mature females	litter survival	GV	variable (gestational day 6 to postnatal day 13)
Verschuuren et al. (1976a)	no stats	0.23	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	F1 viability index	FD	12
Survival								
Mitsumori et al. (1990)	no stats	0.69	methylmercury chloride	mouse (*Mus musculus*)	4 weeks	survival	FD	104
Mitsumori et al. (1983)	no stats	0.65	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	survival (male)	FD	130
Mitsumori et al. (1983)	no stats	0.65	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	survival (female)	FD	130
Verschuuren et al. (1976b)	no stats	0.0081	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	survival (female)	FD	104
Verschuuren et al. (1976b)	no stats	0.035	methylmercury chloride	rat (*Rattus norvegicus*)	4 weeks	survival (male)	FD	104

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-13. Methylmercury TRV Data for Mammals

Source [a]	Dose (mg/kg bw/day)								Body Weight (kg)							
	Control	1	2	3	4	5	6	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source [a]
Growth																
Friedman et al. (1978)	0.0	2.2	4.4	NA	NA	NA	NA	calculated from body weight and FIR	0.11	0.11	0.11	NA	NA	NA	NA	presented in paper
Gandhi et al. (2013)	0.0	0.47	0.93	1.9	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Mitsumori et al. (1990)	0.0	0.031	0.14	0.69	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Mitsumori et al. (1983)	0.0	0.026	0.13	0.65	NA	NA	NA	calculated from body weight and FIR	0.34	0.34	0.34	0.34	NA	NA	NA	average initial and final control female body weight estimated from Figure 2
Stillings et al. (1974)	0.0	3.1	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.10	0.10	NA	NA	NA	NA	NA	USEPA (1988)
Verschuuren et al. (1976a)	0.0	0.0091	0.045	0.23	NA	NA	NA	calculated from body weight and FIR	0.12	0.12	0.12	0.12	NA	NA	NA	presented in paper
Verschuuren et al. (1976b)	0.0	0.0081	0.040	0.20	NA	NA	NA	calculated from body weight and FIR	0.17	0.17	0.17	0.17	NA	NA	NA	presented in paper
Wobeser et al. (1976)	0.0	0.049	0.080	0.21	0.37	0.67	NA	calculated from body weight and FIR	1.3	1.3	1.3	1.3	1.3	1.3	NA	Bleavins and Aulerich (1981)
Reproduction																
Gandhi et al. (2013)	0.0	0.47	0.93	1.9	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Tonk et al. (2010)	0.0	0.093	0.37	0.65	0.93	1.4	1.9	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Verschuuren et al. (1976a)	0.0	0.0091	0.045	0.23	NA	NA	NA	calculated from body weight and FIR	0.12	0.12	0.12	0.12	NA	NA	NA	presented in paper
Survival																
Mitsumori et al. (1990)	0.0	0.031	0.14	0.69	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Mitsumori et al. (1983)	0.0	0.026	0.13	0.65	NA	NA	NA	calculated from body weight and FIR	0.33	0.33	0.33	0.33	NA	NA	NA	average initial and final control male body weight estimated from Figure 2
Mitsumori et al. (1983)	0.0	0.026	0.13	0.65	NA	NA	NA	calculated from body weight and FIR	0.34	0.34	0.34	0.34	NA	NA	NA	average initial and final control female body weight estimated from Figure 2
Verschuuren et al. (1976b)	0.0	0.0081	0.040	0.20	NA	NA	NA	calculated from body weight and FIR	0.17	0.17	0.17	0.17	NA	NA	NA	presented in paper
Verschuuren et al. (1976b)	0.0	0.0071	0.035	0.18	NA	NA	NA	calculated from body weight and FIR	0.26	0.26	0.26	0.26	NA	NA	NA	presented in paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-13. Methylmercury TRV Data for Mammals

Source [a]	Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)									Concentration in Food (mg/kg)							
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Wet or Dry Weight Basis
Growth																	
Friedman et al. (1978)	0.013	0.013	0.013	NA	NA	NA	NA	USEPA (1988)	dw	0.0	19	37	NA	NA	NA	NA	dw
Gandhi et al. (2013)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mitsumori et al. (1990)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mitsumori et al. (1983)	0.027	0.027	0.027	0.027	NA	NA	NA	USEPA (1988)	dw	0.0	0.32	1.6	8.0	NA	NA	NA	dw
Stillings et al. (1974)	0.012	0.012	NA	NA	NA	NA	NA	USEPA (1988)	dw	0.0	25	NA	NA	NA	NA	NA	dw
Verschuuren et al. (1976a)	0.014	0.014	0.014	0.014	NA	NA	NA	USEPA (1988)	dw	0.0	0.080	0.40	2.0	NA	NA	NA	dw
Verschuuren et al. (1976b)	0.018	0.018	0.018	0.018	NA	NA	NA	USEPA (1988)	dw	0.0	0.080	0.40	2.0	NA	NA	NA	dw
Wobeser et al. (1976)	0.059	0.059	0.059	0.059	0.059	0.059		Bleavins and Aulerich (1981)	dw	0.0	1.1	1.8	4.8	8.3	15	NA	dw
Reproduction																	
Gandhi et al. (2013)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tonk et al. (2010)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Verschuuren et al. (1976a)	0.014	0.014	0.014	0.014	NA	NA	NA	USEPA (1988)	dw	0.0	0.1	0.4	1.99725	NA	NA	NA	dw
Verschuuren et al. (1976a)	0.014	0.014	0.014	0.014	NA	NA	NA	USEPA (1988)	dw	0.0	0.1	0.4	1.99725	NA	NA	NA	dw
Survival																	
Mitsumori et al. (1990)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mitsumori et al. (1983)	0.027	0.027	0.027	0.027	NA	NA	NA	USEPA (1988)	dw	0.0	0.32	1.6	8.0	NA	NA	NA	dw
Mitsumori et al. (1983)	0.027	0.027	0.027	0.027	NA	NA	NA	USEPA (1988)	dw	0.0	0.32	1.6	8.0	NA	NA	NA	dw
Verschuuren et al. (1976b)	0.018	0.018	0.018	0.018	NA	NA	NA	USEPA (1988)	dw	0.0	0.08	0.40	2.0	NA	NA	NA	dw
Verschuuren et al. (1976b)	0.023	0.023	0.023	0.023	NA	NA	NA	USEPA (1988)	dw	0.0	0.08	0.40	2.0	NA	NA	NA	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-13. Methylmercury TRV Data for Mammals

Source [a]	Effect								Effect Relative to Control (%)					
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6
Growth														
Friedman et al. (1978)	0.38	0.26	0.14	NA	NA	NA	NA	body weight (kg) estimated based on treatments without acetaldehyde (Figure 1 in paper)	68	37		NA	NA	NA
Gandhi et al. (2013)	44	47	48	21	NA	NA	NA	maternal weight gain (%)	107	108	47	NA	NA	NA
Mitsumori et al. (1990)	47	46	48	30	NA	NA	NA	Approximate male body weight (g) at end of exposure period (104 weeks). Values estimated from Figure 2 in paper .	98	102	64	NA	NA	NA
Mitsumori et al. (1983)	550	500	500	350	NA	NA	NA	Approximate mean female body weight (g) at 124 weeks exposure. Values estimated from Figure 2 in paper.	91	91	64	NA	NA	NA
Stillings et al. (1974)	140	20	NA	NA	NA	NA	NA	Approximate weight gain (g) at 4 weeks (all methylmercury treated rats died after 4 weeks). Values estimated from Figure 1 in paper.	14	NA	NA	NA	NA	NA
Verschuuren et al. (1976a)	153	142	140	134	NA	NA	NA	F2 female weight gain (g) at 12 weeks of exposure	93	92	88	NA	NA	NA
Verschuuren et al. (1976b)	219	212	216	205	NA	NA	NA	Female weight gain (g) at week 60 (only females had significant effect). Authors reported weight gain at several time points between weeks 6 and 104, but only week 60 had a significant difference relative to control.	97	99	94	NA	NA	NA
Wobeser et al. (1976)	1.3	1.1	1.0	1.2	1.1	1.1	NA	body weight (kg) (calculated using % change in body weight reported in paper and mean body weight from Bleavins and Aulerich [1981])	81	76	90	86	83	NA
Reproduction														
Gandhi et al. (2013)	9.4	9.9	10	0.00	NA	NA	NA	live fetuses per litter	105	111	0.0	NA	NA	NA
Tonk et al. (2010)	0.90	0.92	0.80	0.91	0.79	0.70	0.50	Fraction of dams with litter survival (reported in paper as fraction of dams with complete litter loss). Values estimated from Figure 2 in paper.	102	89	101	88	78	56
Verschuuren et al. (1976a)	66	66	59	28	NA	NA	NA	F1 viability index ("number of pups alive at day 5 x 100 divided by the number of pups born")	100	89	42	NA	NA	NA
Survival														
Mitsumori et al. (1990)	48	58	60	17	NA	NA	NA	% male survival at end of exposure period (104 weeks). Values for middle two doses estimated from survival curve graph (Figure 1 in paper).	121	125	35	NA	NA	NA
Mitsumori et al. (1983)	88	88	95	25	NA	NA	NA	Approximate % male survival at 80 weeks (within the 130-week exposure period, the largest difference between the control and treated group occurred at approximately 80 weeks). Values estimated from Figure 1 in paper.	100	108	28	NA	NA	NA
Mitsumori et al. (1983)	60	65	65	20	NA	NA	NA	Approximate % female survival at 112 weeks (within the 130-week exposure period, the largest difference between the control and treated group occurred at approximately 112 weeks). Values estimated from Figure 1 in paper.	108	108	33	NA	NA	NA
Verschuuren et al. (1976b)	19	15	16	14	NA	NA	NA	Female survival. Final number of surviving rats at week 104. Initial group sizes were 25 rats (all groups).	79	84	74	NA	NA	NA
Verschuuren et al. (1976b)	18	17	12	12	NA	NA	NA	Male survival. Final number of surviving rats at week 104. Initial group sizes were 25 rats (all groups).	94	67	67	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-14. Molybdenum TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)						Notes
									Control	1	2	3	4	5	
Growth															
Davies et al. (1960)	no stats	84	sodium molybdate	chicken (*Gallus gallus domesticus*)	1 day	body weight (Experiment 1b)	FD	4	0.0	56	84	112	140	168	calculated from body weight and FIR
Davies et al. (1960)	no stats	223	sodium molybdate	chicken (*Gallus gallus domesticus*)	1 day	body weight (Experiment 1c)	FD	4	0.0	223	447	670	894	NA	calculated from body weight and FIR
Kratzer (1952)	no stats	no effect	sodium molybdate	chicken (*Gallus gallus domesticus*)	1 week	weight gain	FD	3.3	0.2	9.4	19	28	NA	NA	calculated from body weight and FIR
Stafford et al. (2015)	no effect	no effect	molydenum disulfide	bobwhite quail (*Colinus virginianus*)	9 days	body weight gain	FD	4.3	0.0	75	218	545	NA	NA	presented in the paper
Stafford et al. (2015)	253.00	362	sodium molybdate	bobwhite quail (*Colinus virginianus*)	9 days	body weight gain	FD	4.3	0.0	45	74	134	253	362	presented in the paper
Reproduction															
Lepore and Miller (1965)	no stats	35.7	sodium molybdate	chicken (*Gallus gallus domesticus*)	7 months	egg production	FD	3	0.0	32	63	126	NA	NA	calculated from body weight and FIR
Survival															
Davies et al. (1960)	no stats	no effect	sodium molybdate	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	4	0.0	56	84	112	140	168	calculated from body weight and FIR
Davies et al. (1960)	no stats	606	sodium molybdate	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	4	0.0	223	447	670	894	NA	calculated from body weight and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-14. Molybdenum TRV Data for Birds

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)								Concentration in Food (mg/kg)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis
Growth																						
Davies et al. (1960)	0.36	0.36	0.36	0.36	0.36	0.36	NRC (1994)	0.04	0.04	0.04	0.04	0.04	0.04	NRC (1994)	dw	0	500	750	1000	1250	1500	dw
Davies et al. (1960)	0.36	0.36	0.36	0.36	0.36	NA	NRC (1994)	0.04	0.04	0.04	0.04	0.04	NA	NRC (1994)	dw	0	2000	4000	6000	8000	NA	dw
Kratzer (1952)	0.08	0.08	0.08	0.08	NA	NA	USEPA (1988)	0.01	0.01	0.01	0.01	NA	NA	USEPA (1988)	dw	2	85	170	255	NA	NA	dw
Stafford et al. (2015)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	0	700	2000	5000	NA	NA	dw
Stafford et al. (2015)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	0	420	700	1200	2000	3000	dw
Reproduction																						
Lepore and Miller (1965)	3.20	3.20	3.20	3.20	NA	NA	NRC (1994)	0.20	0.20	0.20	0.20	NA	NA	NRC (1994)	dw	0	500	1000	2000	NA	NA	dw
Survival																						
Davies et al. (1960)	0.36	0.36	0.36	0.36	0.36	0.36	NRC (1994)	0.04	0.04	0.04	0.04	0.04	0.04	NRC (1994)	dw	0	500	750	1000	1250	1500	dw
Davies et al. (1960)	0.36	0.36	0.36	0.36	0.36	NA	NRC (1994)	0.04	0.04	0.04	0.04	0.04	NA	NRC (1994)	dw	0	2000	4000	6000	8000	NA	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-14. Molybdenum TRV Data for Birds

	Effect							Effect Relative to Control (%)				
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth												
Davies et al. (1960)	352	313	274	260	263	230	final body weight for Experiment 1b (g)	89	78	74	75	65
Davies et al. (1960)	301	194	103	64	47	NA	final body weight for Experiment 1c (g)	64	34	21	16	NA
Kratzer (1952)	229	244	217	194	NA	NA	average weight gain (g)	107	95	85	NA	NA
Stafford et al. (2015)	3.2	3.05	3.2	3.2	NA	NA	proportional body weight change at day 30	95	98	100	NA	NA
Stafford et al. (2015)	3.2	3.1	3.1	3.0	2.8	2.5	proportional body weight change at day 30	97	95	92	88	78
Reproduction												
Lepore and Miller (1965)	15.6	13.3	8.0	2.8	NA	NA	number of eggs per hen	85	51	18	NA	NA
Survival												
Davies et al. (1960)	100	95	100	100	100	100	% survival for Experiment 1b	95	100	100	100	100
Davies et al. (1960)	100	94	94	67	39	NA	% survival for Experiment 1c	94	94	67	39	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-15. Molybdenum TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)					Notes
									Control	1	2	3	4	
Growth														
Bandyopadhyay et al. (1981)	242	242	ammonium molybdate	rat (*Rattus norvegicus*)	juvenile	body weight gain	oral	4	0.0	242	NA	NA	NA	presented in paper
Bandyopadhyay et al. (1981)	242	242	ammonium molybdate	rat (*Rattus norvegicus*)	juvenile	body weight gain	oral	4	0.0	242	NA	NA	NA	presented in paper
Brinkman and Miller (1961)	no stats	28	sodium molybdate	rat (*Rattus norvegicus*)	weanling	body weight gain	FD	6	0.0	28	NA	NA	NA	calculated from body weight and FIR
Fungwe et al. (1990)	2.6	28	sodium molybdate	rat (*Rattus norvegicus*)	21 days	body weight gain	DW	9	0.0	1.4	2.6	13	28	weighed average from Table 1 in paper
Lyubimov et al. (2004)	24	no effect	ammonium tetrathiomolybdate	rat (*Rattus norvegicus*)	~20-23 weeks	body weight	GV	8	0.0	2.0	8.0	24	NA	presented in paper
Murray et al. (2013)	NR	no effect	sodium molybdate dihydrate	rat (*Rattus norvegicus*)	9 weeks	body weight	FD	12	0.08	4.5	15	55	NA	presented in paper
Reproduction														
Fungwe et al. (1990)	2.6	ED20	sodium molybdate	rat (*Rattus norvegicus*)	21 days	litter weight	DW	9	0.0	1.4	2.6	13	28	weighed average from Table 1 in paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-15. Molybdenum TRV Data for Mammals

	Body Weight (kg)						Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							Concentration in Food (mg/kg)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Wet or Dry Weight Basis
Growth																				
Bandyopadhyay et al. (1981)	NA	NA	NA	NA	NA	NA (doses presented)	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA
Bandyopadhyay et al. (1981)	NA	NA	NA	NA	NA	NA (doses presented)	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA
Brinkman and Miller (1961)	0.070	0.070	NA	NA	NA	USEPA (1988)	0.010	0.010	NA	NA	NA	USEPA (1988)	NA	0.0	200	NA	NA	NA	dw
Fungwe et al. (1990)	0.070	0.070	0.070	0.070	0.070	USEPA (1988)	NA	NA	NA	NA	NA	NA (doses calculated using FIR data in Table 1)	NA	0.025	5.0	10	50	100	NA
Lyubimov et al. (2004)	NA	NA	NA	NA	NA	NA (doses presented)	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA
Murray et al. (2013)	NA	NA	NA	NA	NA	NA (doses presented)	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA
Reproduction																				
Fungwe et al. (1990)	0.070	0.070	0.070	0.070	0.070	USEPA (1988)	NA	NA	NA	NA	NA	NA (doses calculated using FIR data in Table 1)	NA	0.025	5.0	10	50	100	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-15. Molybdenum TRV Data for Mammals

	Effect						Effect Relative to Control (%)			
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Measurement	Dose 1	Dose 2	Dose 3	Dose 4
Growth										
Bandyopadhyay et al. (1981)	54	24	NA	NA	NA	weight gain (g assumed)	45	NA	NA	NA
Bandyopadhyay et al. (1981)	65	40	NA	NA	NA	weight gain (g assumed)	62	NA	NA	NA
Brinkman and Miller (1961)	135	62	NA	NA	NA	6 weeks weight gain (g)	46	NA	NA	NA
Fungwe et al. (1990)	119	120	98	98	94	gestation weight gain (g)	100	82	82	79
Lyubimov et al. (2004)	580	575	560	540	NA	final body weight (g) (Figure 1 in paper)	99	97	93	NA
Murray et al. (2013)	578	578	570	485	NA	body weight (g) (Figure 1 in paper)	100	99	84	NA
Reproduction										
Fungwe et al. (1990)	50	48	34	34	34	total litter weight (g)	94	67	66	67

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-16. Nickel TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	6	7	Notes
Growth																	
Cain and Pafford (1981)	106.90	107	nickel sulfate	mallard	1 day	body weight (female)	FD	8.6	0.2	18	77	107	NA	NA	NA	NA	calculated from BW and FIR
Cain and Pafford (1981)	106.90	87	nickel sulfate	mallard	1 day	body weight (male)	FD	4.0	0.2	18	77	107	NA	NA	NA	NA	calculated from BW and FIR
Hill (1979)	no stats	51	nickel chloride	chicken	1 day	body weight gain	FD	2.0	0.0	51	103	NA	NA	NA	NA	NA	calculated from BW and FIR
Hill (1985)	no stats	51	nickel chloride	chicken	chick	body weight gain	FD	2.7	0.0	51	NA	NA	NA	NA	NA	NA	calculated from BW and FIR
Ling and Leach (1979)	34.96	42	nickel chloride	chicken	1 day	body weight	FD	3.0	0.0	35	58	82	105	128	NA	NA	calculated from BW and FIR
Martinez and Diaz (1996)	24.85	36	nickel chloride	chicken	1 day	body weight	FD	6.0	0.5	12	25	50	NA	NA	NA	NA	calculated from BW and FIR
Weber and Reid (1968)	78.19	78	nickel sulfate	chicken	1 day	body weight	FD	4.0	0.0	11	34	56	78	101	123	145	calculated from BW and FIR
Weber and Reid (1968)	78.19	78	nickel acetate	chicken	1 day	body weight	FD	4.0	0.0	11	34	56	78	101	123	145	calculated from BW and FIR
Reproduction																	
Arpasova et al. (2007)	no stats	0.5	nickel chloride	chicken	adult	egg production	DW	4.0	0.0	1.0	10	102	NA	NA	NA	NA	calculated from BW and IG
Survival																	
Cain and Pafford (1981)	no stats	80	nickel sulfate	mallard	1 day	survival	FD	12.9	0.2	18	77	107	NA	NA	NA	NA	calculated from BW and FIR
Ling and Leach (1979)	no stats	59.9	nickel chloride	chicken	1 day	survival	FD	3.0	0.0	35	58	82	105	128	NA	NA	calculated from BW and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-16. Nickel TRV Data for Birds

	Body Weight (kg)									Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)									
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Source [a]	Wet or Dry Weight Basis
Growth																			
Cain and Pafford (1981)	0.46	0.46	0.46	0.46	NA	NA	NA	NA	presented in paper	0.046	0.046	0.046	0.046	NA	NA	NA	NA	Heinz et al. (1987)	dw
Cain and Pafford (1981)	0.22	0.22	0.22	0.22	NA	NA	NA	NA	presented in paper	0.022	0.022	0.022	0.022	NA	NA	NA	NA	Heinz et al. (1987)	dw
Hill (1979)	0.15	0.15	0.15	NA	NA	NA	NA	NA	NRC (1994)	0.019	0.019	0.019	NA	NA	NA	NA	NA	NRC (1994)	dw
Hill (1985)	0.15	0.15	NA	NA	NA	NA	NA	NA	NRC (1994)	0.019	0.019	NA	NA	NA	NA	NA	NA	NRC (1994)	dw
Ling and Leach (1979)	0.25	0.25	0.25	0.25	0.25	0.25	NA	NA	NRC (1994)	0.030	0.030	0.030	0.030	0.030	0.030	NA	NA	NRC (1994)	dw
Martinez and Diaz (1996)	0.79	0.79	0.79	0.79	NA	NA	NA	NA	presented in paper	0.080	0.080	0.080	0.080	NA	NA	NA	NA	presented in paper	dw assumed
Weber and Reid (1968)	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	NRC (1994)	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	NRC (1994)	dw
Weber and Reid (1968)	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	NRC (1994)	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	NRC (1994)	dw
Reproduction																			
Arpasova et al. (2007)	1.83	1.83	1.83	1.83	NA	NA	NA	NA	presented in paper	0.205	0.205	0.205	0.205	NA	NA	NA	NA	EPA (1988)	NA (DW)
Survival																			
Cain and Pafford (1981)	0.59	0.59	0.59	0.59	NA	NA	NA	NA	presented in paper	0.059	0.059	0.059	0.059	NA	NA	NA	NA	Heinz et al. (1987)	dw
Ling and Leach (1979)	0.25	0.25	0.25	0.25	0.25	0.25	NA	NA	NRC (1994)	0.030	0.030	0.030	0.030	0.030	0.030	NA	NA	NRC (1994)	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-16. Nickel TRV Data for Birds

	Concentration in Food (mg/kg)									Effect								
Source [a]	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Measurement
Growth																		
Cain and Pafford (1981)	2	176	774	1069	NA	NA	NA	NA	dw assumed	1079	1023	1028	837	NA	NA	NA	NA	female body weight at 60 days (g)
Cain and Pafford (1981)	2	176	774	1069	NA	NA	NA	NA	dw assumed	445	505	445	284	NA	NA	NA	NA	male body weight at 28 days (g)
Hill (1979)	0	400	800	NA	NA	NA	NA	NA	dw	133	84	67	NA	NA	NA	NA	NA	final body weight (g)
Hill (1985)	0	400	NA	NA	NA	NA	NA	NA	dw assumed	371	206	NA	NA	NA	NA	NA	NA	body weight gain (g)
Ling and Leach (1979)	0	300	500	700	900	1100	NA	NA	dw assumed	472	405	298	205	118	80	NA	NA	final body weight (g)
Martinez and Diaz (1996)	5	124	247	494	NA	NA	NA	NA	dw assumed	2017	1890	1729	1488	NA	NA	NA	NA	final body weight (g)
Weber and Reid (1968)	0	100	300	500	700	900	1100	1300	dw assumed	565	534	568	467	376	247	180	179	final body weight (g)
Weber and Reid (1968)	0	100	300	500	700	900	1100	1300	dw assumed	565	514	559	484	390	259	256	173	final body weight (g)
Reproduction																		
Arpasova et al. (2007)	0	9	91	906	NA	NA	NA	NA	NA (DW)	130	97	51	21	NA	NA	NA	NA	egg production
Survival																		
Cain and Pafford (1981)	2	176	774	1069	NA	NA	NA	NA	dw assumed	100	100	92	33	NA	NA	NA	NA	average % survival for days 30, 60, and 90
Ling and Leach (1979)	0	300	500	700	900	1100	NA	NA	dw assumed	100	94	75	81	50	31	NA	NA	% survival

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-16. Nickel TRV Data for Birds

Source [a]	Effect Relative to Control (%)							
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7
Growth								
Cain and Pafford (1981)	100	95	95	78	NA	NA	NA	NA
Cain and Pafford (1981)	100	113	100	64	NA	NA	NA	NA
Hill (1979)	100	63	51	NA	NA	NA	NA	NA
Hill (1985)	100	56	NA	NA	NA	NA	NA	NA
Ling and Leach (1979)	100	86	63	43	25	17	NA	NA
Martinez and Diaz (1996)	100	94	86	74	NA	NA	NA	NA
Weber and Reid (1968)	100	95	101	83	67	44	32	32
Weber and Reid (1968)	100	91	99	86	69	46	45	31
Reproduction								
Arpasova et al. (2007)	100	75	39	16	NA	NA	NA	NA
Survival								
Cain and Pafford (1981)	100	100	92	33	NA	NA	NA	NA
Ling and Leach (1979)	100	94	75	81	50	31	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-17. Selenium TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Dafalla and Adam (1986)	no stats	0.26	sodium selenite	chicken (*Gallus gallus domesticus*)	1 week	body weight	FD	4
Echevarria et al. (1988)	0.69	1.0	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	3
El-Begearmi and Combs (1982)	2.7	2.7	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	body weight (brewer's yeast diet)	FD	4
El-Begearmi and Combs (1982)	2.7	2.7	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	body weight (corn-soy diet)	FD	4
Gad and El-Twab (2009)	3.4	no effect	sodium selenite	quail (*Coturnix coturnix*)	adult	body weight	GV	4
Heinz and Fitzgerald (1993a)	2.0	no effect	seleno-DL-methionine	mallard (*Anas platyrhynchos*)	adult	body weight	FD	21
Hill (1979a)	NR	1.1	selenium dioxide	chicken (*Gallus gallus domesticus*)	1 day	body weight gain (Experiment 1)	FD	4-5
Hill (1979a)	NR	2.2	selenium dioxide	chicken (*Gallus gallus domesticus*)	1 day	body weight gain (Experiment 2)	FD	4-5
Hoffman et al. (1992)	1.5	ED20	seleno-DL-methionine	mallard (*Anas platyrhynchos*)	1 day	body weight	FD	4
Jensen (1986)	NR	0.57	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	body weight	FD	3
O'Toole and Raisbeck (1997)	4.6	4.6	seleno-L-methionine	mallard (*Anas platyrhynchos*)	adult	body weight	FD	21
Santolo et al (2010)	2.9	no effect	seleno-L-methionine	quail (*Coturnix coturnix*)	adult	body weight gain	FD	4
Sell and Horani (1976)	0.89	no effect	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	4
Stoewsand et al. (1977)	1.0	no effect	sodium selenite	quail (*Coturnix japonica*)	2 weeks	body weight	FD	10
Stoewsand et al. (1977)	1.0	no effect	seleniferous wheat	quail (*Coturnix japonica*)	2 weeks	body weight	FD	10
Reproduction								
Heinz et al. (1989)	1.6	0.82	selenomethionine	mallard (*Anas platyrhynchos*)	adult	% hatch of fertile eggs	FD	>14
Heinz et al. (1989)	0.82	1.6	selenomethionine	mallard (*Anas platyrhynchos*)	adult	duckling survival	FD	>14
Heinz et al. (1989)	0.82	ED20	selenomethionine	mallard (*Anas platyrhynchos*)	adult	number of ducklings	FD	>14
Hoffman and Heinz (1988)	2.5	2.5	sodium selenite	mallard (*Anas platyrhynchos*)	adult	hatching success	FD	NR
Hoffman and Heinz (1988)	0.82	0.82	seleno-methionine	mallard (*Anas platyrhynchos*)	adult	hatching success	FD	NR
Kaantee and Kurkela (1980)	no stats	no effect	sodium selenite	chicken (*Gallus gallus domesticus*)	18 months	egg production	FD	4
Ort and Latshaw (1978)	0.71	0.71	sodium selenite	chicken (*Gallus gallus domesticus*)	32 weeks	egg production (Experiment 2)	FD	16
Ort and Latshaw (1978)	0.71	ED20	sodium selenite	chicken (*Gallus gallus domesticus*)	32 weeks	hatchability (Experiment 2)	FD	16
Stone and Soares (1976)	0.14/no effect	no effect	sodium selenite	quail (*Coturnix japonica*)	adult	egg production (Experiments 1 and 3)	FD	3.9-4.6
Wiemeyer and Hoffman (1996)	4.2	4.2	seleno-DL-methionine	owl (*Otus asio*)	adult	% pairs with hatchlings	FD	12
Wiemeyer and Hoffman (1996)	NR	14	seleno-DL-methionine	owl (*Otus asio*)	adult	pairs with 5 day young	FD	12
Wiemeyer and Hoffman (1996)	14	14	seleno-DL-methionine	owl (*Otus asio*)	adult	% hatch of eggs incubated	FD	12

Table H2.B-17. Selenium TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Survival								
Albers et al. (1996)	11	11	seleno-DL-methionine	mallard (*Anas platyrhynchos*)	1 year	survival	FD	16
Arnold et al. (1973)	no stats	0.59	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	64
El-Begearmi and Combs (1982)	2.7	2.7	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	survival (brewer's yeast diet)	FD	4
El-Begearmi and Combs (1982)	5.4	5.4	sodium selenite	chicken (*Gallus gallus domesticus*)	1 day	survival (corn-soy diet)	FD	4
El-Begearmi et al. (1977)	no stats	no effect	sodium selenite	quail (*Coturnix japonica*)	1 day	survival (males)	FD	16
El-Begearmi et al. (1977)	no stats	1.6	sodium selenite	quail (*Coturnix japonica*)	1 day	survival (females)	FD	16
Gad and El-Twab (2009)	no stats	no effect	sodium selenite	quail (*Coturnix japonica*)	adult	survival	GV	4
Heinz and Fitzgerald (1993b)	2.0	2.0	seleno-DL-methionine	mallard (*Anas platyrhynchos*)	adult (male)	survival	FD	16
Khan et al. (1993)	no stats	2.5	sodium selenite	chicken (*Gallus gallus domesticus*)	2 weeks	survival	GV	0.86

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-17. Selenium TRV Data for Birds

	Dose (mg/kg bw/day)							Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source [a]	Control	1	2	3	4	5	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight
Growth																						
Dafalla and Adam (1986)	0.0	0.26	NA	NA	NA	NA	calculated from body weight and FIR	0.40	0.40	NA	NA	NA	NA	presented in paper	0.035	0.035	NA	NA	NA	NA	USEPA (1988)	dw
Echevarria et al. (1988)	0.022	0.36	0.69	1.0	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NRC (1994)	0.040	0.040	0.040	0.040	NA	NA	NRC (1994)	dw
El-Begearmi and Combs (1982)	0.0	2.7	5.4	8.2	NA	NA	calculated from body weight and FIR	0.090	0.090	0.090	0.090	NA	NA	USEPA (1988)	0.010	0.010	0.010	0.010	NA	NA	USEPA (1988)	dw
El-Begearmi and Combs (1982)	0.0	2.7	5.4	8.2	NA	NA	calculated from body weight and FIR	0.090	0.090	0.090	0.090	NA	NA	USEPA (1988)	0.010	0.010	0.010	0.010	NA	NA	USEPA (1988)	dw
Gad and El-Twab (2009)	0.0	3.4	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	0.57	0.57	NA	NA	NA	NA	NA (dose presented in paper)	-
Heinz and Fitzgerald (1993a)	0.0	2.0	NA	NA	NA	NA	calculated from body weight and FIR	0.99	0.99	NA	NA	NA	NA	presented in paper	0.099	0.099	NA	NA	NA	NA	Heinz et al. (1987)	dw
Hill (1979a)	0.0	0.56	1.1	2.2	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NRC (1994)	0.040	0.040	0.040	0.040	NA	NA	NRC (1994)	dw
Hill (1979a)	0.0	0.56	1.1	2.2	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NRC (1994)	0.040	0.040	0.040	0.040	NA	NA	NRC (1994)	dw
Hoffman et al. (1992)	0.020	1.5	6.0	NA	NA	NA	calculated from body weight and FIR	0.56	0.56	0.56	NA	NA	NA	presented in paper	0.056	0.056	0.056	NA	NA	NA	Heinz et al. (1987)	dw
Jensen (1986)	0.011	0.022	0.039	0.12	0.57	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	0.36	NA	NRC (1994)	0.040	0.040	0.040	0.040	0.040	NA	NRC (1994)	dw
O'Toole and Raisbeck (1997)	0.025	0.79	1.9	4.6	NA	NA	calculated from body weight and FIR	1.3	1.3	1.3	1.3	NA	NA	presented in paper	0.10	0.10	0.10	0.10	NA	NA	presented in paper	dw
Santolo et al (2010)	0.092	1.6	2.9	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	NA	NA	NA	Vos et al. (1971)	0.020	0.020	0.020	NA	NA	NA	Nagy (2001)	dw
Sell and Horani (1976)	0.0	0.89	NA	NA	NA	NA	calculated from body weight and FIR	0.080	0.080	NA	NA	NA	NA	USEPA (1988)	0.0089	0.0089	NA	NA	NA	NA	USEPA (1988)	dw
Stoewsand et al. (1977)	0.0018	1.0	NA	NA	NA	NA	calculated from body weight and FIR	0.12	0.12	NA	NA	NA	NA	presented in paper	0.016	0.016	NA	NA	NA	NA	Nagy (2001)	dw
Stoewsand et al. (1977)	0.0018	1.0	NA	NA	NA	NA	calculated from body weight and FIR	0.12	0.12	NA	NA	NA	NA	presented in paper	0.016	0.016	NA	NA	NA	NA	Nagy (2001)	dw
Reproduction																						
Heinz et al. (1989)	0.015	0.12	0.22	0.42	0.82	1.6	calculated from body weight and FIR	1.1	1.1	1.1	1.1	1.1	1.1	presented in paper	0.11	0.11	0.11	0.11	0.11	0.11	Heinz et al. (1987)	dw
Heinz et al. (1989)	0.015	0.12	0.22	0.42	0.82	1.6	calculated from body weight and FIR	1.1	1.1	1.1	1.1	1.1	1.1	presented in paper	0.11	0.11	0.11	0.11	0.11	0.11	Heinz et al. (1987)	dw
Heinz et al. (1989)	0.015	0.12	0.22	0.42	0.82	1.6	calculated from body weight and FIR	1.1	1.1	1.1	1.1	1.1	1.1	presented in paper	0.11	0.11	0.11	0.11	0.11	0.11	Heinz et al. (1987)	dw
Hoffman and Heinz (1988)	0.020	0.12	0.52	1.0	2.5	NA	calculated from body weight and FIR	1.1	1.1	1.1	1.1	1.1	NA	Dunning (1993)	0.11	0.11	0.11	0.11	0.11	NA	Heinz et al. (1987)	dw
Hoffman and Heinz (1988)	0.020	0.12	0.22	0.42	0.82	1.6	calculated from body weight and FIR	1.1	1.1	1.1	1.1	1.1	1.1	Dunning (1993)	0.11	0.11	0.11	0.11	0.11	0.11	Heinz et al. (1987)	dw
Kaantee and Kurkela (1980)	0.0047	0.10	0.16	NA	NA	NA	calculated from body weight and FIR	0.78	0.78	0.78	NA	NA	NA	USEPA (1988)	0.061	0.061	0.061	NA	NA	NA	USEPA (1988)	dw
Ort and Latshaw (1978)	0.0094	0.40	0.55	0.71	NA	NA	calculated from body weight and FIR	0.78	0.78	0.78	0.78	NA	NA	USEPA (1988)	0.061	0.061	0.1	0.061	NA	NA	USEPA (1988)	dw
Ort and Latshaw (1978)	0.0094	0.40	0.55	0.71	NA	NA	calculated from body weight and FIR	0.78	0.78	0.78	0.78	NA	NA	USEPA (1988)	0.061	0.061	0.061	0.061	NA	NA	USEPA (1988)	dw
Stone and Soares (1976)	0.0	0.14	NA	NA	NA	NA	calculated from body weight and FIR	0.13	0.13	NA	NA	NA	NA	presented in paper	0.018	0.018	NA	NA	NA	NA	Nagy (2001)	dw
Wiemeyer and Hoffman (1996)	0.13	4.2	14	NA	NA	NA	calculated from body weight and FIR	0.21	0.21	0.21	NA	NA	NA	presented in paper	0.10	0.10	0.10	NA	NA	NA	presented in paper	dw
Wiemeyer and Hoffman (1996)	0.13	4.2	14	NA	NA	NA	calculated from body weight and FIR	0.21	0.21	0.21	NA	NA	NA	presented in paper	0.10	0.10	0.10	NA	NA	NA	presented in paper	dw
Wiemeyer and Hoffman (1996)	0.13	4.2	14	NA	NA	NA	calculated from body weight and FIR	0.21	0.21	0.21	NA	NA	NA	presented in paper	0.10	0.10	0.10	NA	NA	NA	presented in paper	dw

Table H2.B-17. Selenium TRV Data for Birds

	Dose (mg/kg bw/day)							Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source [a]	Control	1	2	3	4	5	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight
Survival																						
Albers et al. (1996)	0.014	1.4	2.8	5.6	11	NA	calculated from body weight and FIR	1.1	1.1	1.1	1.1	1.1	NA	presented in paper	0.16	0.16	0.16	0.16	0.16	NA	presented in paper	dw
Arnold et al. (1973)	0.0	0.15	0.59	NA	NA	NA	calculated from body weight and FIR	1.2	1.2	1.2	NA	NA	NA	presented in paper	0.086	0.086	0.09	NA	NA	NA	USEPA (1988)	dw
El-Begearmi and Combs (1982)	0.0	2.7	5.4	NA	NA	NA	calculated from body weight and FIR	0.090	0.090	0.090	NA	NA	NA	USEPA (1988)	0.010	0.010	0.010	NA	NA	NA	USEPA (1988)	dw
El-Begearmi and Combs (1982)	0.0	2.7	5.4	NA	NA	NA	calculated from body weight and FIR	0.090	0.090	0.090	NA	NA	NA	USEPA (1988)	0.010	0.010	0.010	NA	NA	NA	USEPA (1988)	dw
El-Begearmi et al. (1977)	0.020	1.6	NA	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	NA	NA	NA	NA	Vos et al. (1971)	0.020	0.020	NA	NA	NA	NA	Nagy (2001)	dw
El-Begearmi et al. (1977)	0.020	1.6	NA	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	NA	NA	NA	NA	Vos et al. (1971)	0.020	0.020	NA	NA	NA	NA	Nagy (2001)	dw
Gad and El-Twab (2009)	0.0	3.4	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	0.57	0.57	NA	NA	NA	NA	NA (dose presented in paper)	NA
Heinz and Fitzgerald (1993b)	0.031	1.0	2.0	4.0	8.0	NA	calculated from body weight and FIR	1.2	1.2	1.2	1.2	1.2	NA	presented in paper	0.12	0.12	0.12	0.12	0.12	NA	Heinz et al. (1987)	dw
Khan et al. (1993)	0.0	2.5	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-17. Selenium TRV Data for Birds

	Concentration in Food (mg/kg)							Effect							Effect Relative to Control (%)				
Source [a]	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Growth																			
Dafalla and Adam (1986)	0.0	3.0	NA	NA	NA	NA	dw	1000	700	NA	NA	NA	NA	body weight at week 4 (end of exposure period) (g) estimated from Figure 1 in paper	70	NA	NA	NA	NA
Echevarria et al. (1988)	0.20	3.2	6.2	9.2	NA	NA	dw	27	27	22	20	NA	NA	average daily gain (g) at week 3	100	84	74	NA	NA
El-Begearmi and Combs (1982)	0.0	25	50	75	NA	NA	dw	0.34	0.12	0.065	0.059	NA	NA	final body weight (calculated from daily weight gain [g per day] * 28 days + initial body weight estimated as 0.09 kg)	36	19	17	NA	NA
El-Begearmi and Combs (1982)	0.0	25	50	75	NA	NA	dw	0.38	0.13	0.121	0.073	NA	NA	final body weight (calculated from daily weight gain [g per day] * 28 days + initial body weight estimated as 0.09 kg)	33	32	19	NA	NA
Gad and El-Twab (2009)	0.0	6.0	NA	NA	NA	NA	NA	188	163	NA	NA	NA	NA	final body weight estimated from an average starting body weight of 180 g and body weight gain in g estimated at week 4 from Figure 2 in paper	87	NA	NA	NA	NA
Heinz and Fitzgerald (1993a)	0.0	20	NA	NA	NA	NA	dw	0.97	0.91	NA	NA	NA	NA	final female body weight	95	NA	NA	NA	NA
Hill (1979a)	0.0	5.0	10	20	NA	NA	dw	228	NR	NR	NR	NA	NA	mean body weight gain (g) reported for control; other treatments report mean body weight gain as % of control (see Effect Relative to Control cells)	101	79	32	NA	NA
Hill (1979a)	0.0	5.0	10	20	NA	NA	dw	226	NR	NR	NR	NA	NA	mean body weight gain (g) reported for control, other treatments report mean body weight gain as % of control (see Effect Relative to Control cells)	100	85	35	NA	NA
Hoffman et al. (1992)	0.20	15	60	NA	NA	NA	dw	555	479	210	NA	NA	NA	final body weight	86	38	NA	NA	NA
Jensen (1986)	0.10	0.20	0.35	1.1	5.1	NA	dw	528	542	545	503	405	NA	body weight at 3 weeks	103	103	95	77	NA
O'Toole and Raisbeck (1997)	0.32	10	25	60	NA	NA	dw	1320	1400	1300	925	NA	NA	final body weight (estimated from Figure 1 in paper)	106	98	70	NA	NA
Santolo et al (2010)	0.70	12	22	NA	NA	NA	dw	102	102	97	NA	NA	NA	% body weight gain in comparison to initial body mass	100	95	NA	NA	NA
Sell and Horani (1976)	0.0	8.0	NA	NA	NA	NA	dw	267	242	NA	NA	NA	NA	weight gain	91	NA	NA	NA	NA
Stoewsand et al. (1977)	0.013	7.0	NA	NA	NA	NA	dw	115	104	NA	NA	NA	NA	final body weight (g)	91	NA	NA	NA	NA
Stoewsand et al. (1977)	0.013	7.0	NA	NA	NA	NA	dw	115	100	NA	NA	NA	NA	final body weight (g)	87	NA	NA	NA	NA
Reproduction																			
Heinz et al. (1989)	0.15	1.2	2.2	4.2	8.2	16	dw	60	71	60	53	37	2.2	% hatch of fertile eggs	119	101	90	62	4
Heinz et al. (1989)	0.15	1.2	2.2	4.2	8.2	16	dw	99	98	99	100	81	0.0	% duckling survival to 6 days	98	99	100	81	0.0
Heinz et al. (1989)	0.15	1.2	2.2	4.2	8.2	16	dw	8.1	8.5	8.2	7.5	4.6	0.0	number of 6-day-old ducklings produced per hen	105	101	93	57	0.0
Hoffman and Heinz (1988)	0.20	1.2	5.2	10	25	NA	dw	100	114	103	100	56	NA	hatching success as % of control	114	103	100	56	NA
Hoffman and Heinz (1988)	0.20	1.2	2.2	4.2	8.2	16	dw	100	111	105	92	64	11.0	hatching success as % of control	111	105	92	64	11
Kaantee and Kurkela (1980)	0.060	1.3	2.0	NA	NA	NA	dw	207	210	174	NA	NA	NA	total number of eggs over 4-week trial	101	84	NA	NA	NA
Ort and Latshaw (1978)	0.12	5.1	7.1	9.1	NA	NA	dw	69	66	66	51	NA	NA	average egg producton for a 4-week period	96	96	74	NA	NA
Ort and Latshaw (1978)	0.12	5.1	7.1	9.1	NA	NA	dw	92	84	67	65	NA	NA	% average hatchability	92	73	71	NA	NA
Stone and Soares (1976)	0.00	1.0	NA	NA	NA	NA	dw	0.52	0.60	NA	NA	NA	NA	eggs per hen per day, average of two experiments	117	NA	NA	NA	NA
Wiemeyer and Hoffman (1996)	0.28	8.8	30	NA	NA	NA	dw	100	75	17	NA	NA	NA	% pairs with hatchlings	75	17	NA	NA	NA
Wiemeyer and Hoffman (1996)	0.28	8.8	30	NA	NA	NA	dw	92	75	0.0	NA	NA	NA	% pairs with 5-day-old young	81	0.0	NA	NA	NA
Wiemeyer and Hoffman (1996)	0.28	8.8	30	NA	NA	NA	dw	85	74	4.0	NA	NA	NA	% hatch of eggs incubated	87	4.7	NA	NA	NA

Table H2.B-17. Selenium TRV Data for Birds

Source [a]	Concentration in Food (mg/kg)							Effect							Effect Relative to Control (%)				
	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Survival																			
Albers et al. (1996)	0.10	10	20	40	80	NA	dw	21	21	20	18	0.0	NA	number surviving	100	95	86	0.0	NA
Arnold et al. (1973)	0.0	2.0	8.0	NA	NA	NA	dw	82	84	53	NA	NA	NA	% survival at 64 weeks	103	65	NA	NA	NA
El-Begearmi and Combs (1982)	0.0	25	50	NA	NA	NA	dw	80	50	3.0	NA	NA	NA	survival	63	3.8	NA	NA	NA
El-Begearmi and Combs (1982)	0.0	25	50	NA	NA	NA	dw	93	87	7.0	NA	NA	NA	survival	94	7.5	NA	NA	NA
El-Begearmi et al. (1977)	0.15	12	NA	NA	NA	NA	dw	100	89	NA	NA	NA	NA	% survival at 16 weeks (males) (Experiment 3)	89	NA	NA	NA	NA
El-Begearmi et al. (1977)	0.15	12	NA	NA	NA	NA	dw	87	50	NA	NA	NA	NA	% survival at 16 weeks (females) (Experiment 3)	57	NA	NA	NA	NA
Gad and El-Twab (2009)	0.0	6.0	NA	NA	NA	NA	NA	12	10.3	NA	NA	NA	NA	Mortality was reported at 14.3% of 12 birds. Assumed that 100% of control survived.	86	NA	NA	NA	NA
Heinz and Fitzgerald (1993b)	0.31	10	20	40	80	NA	dw	100	100	75	5.0	0.0	NA	survival at end of experiment	100	75	5.0	0.0	NA
Khan et al. (1993)	0.0	5.0	NA	NA	NA	NA	NA	10	6.0	NA	NA	NA	NA	survival	60	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[c] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-18. Selenium TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Baker et al. (1989)	no stats	no effect	sodium selenate	pig (*Sus domesticus*)	8-14 weeks	body weight	FD	3.7
Behne et al. (1992)	0.15	no effect	L-selenomethionine	rat (*Rattus norvegicus*)	30 days	body weight	FD	14
Birt et al. (1983)	0.43	no effect	sodium selenite	hamster (*Mesocricetus auratus*)	4 weeks	body weight	FD	25
Birt et al. (1986)	0.0065	no effect	sodium selenite	hamster (*Mesocricetus auratus*)	4 weeks	body weight	FD	64
Boylan et al. (1990)	0.22	no effect	sodium selenite	mouse (*Mus musculus*)	NR	body weight	FD	26
Goehring et al. (1984)	0.58	0.87	seleniferous grain	rat (*Rattus norvegicus*)	adult assumed based on body weight	body weight gain	FD	4
Goehring et al. (1984)	0.60	0.60	sodium selenite	rat (*Rattus norvegicus*)	adult assumed based on body weight	body weight gain	FD	4
Kaur and Parshad (1994)	0.095	0.19	sodium selenite	rat (*Rattus norvegicus*)	adult	body weight	FD	5.1
Julius et al. (1983)	2.6	2.6	sodium selenite	hamster (*Mesocricetus auratus*)	4 weeks	male body weight (Experiment 1)	FD	3
Julius et al. (1983)	2.3	4.7	sodium selenite	hamster (*Mesocricetus auratus*)	4 weeks	female body weight (Experiment 1)	FD	3
Julius et al. (1983)	1.4	1.4	sodium selenite	hamster (*Mesocricetus auratus*)	4 weeks	male body weight (Experiment 2)	FD	3
Mahan and Moxon (1984)	no stats	ED20	sodium selenite	pig (*Sus domesticus*)	weanlings, 4 weeks	body weight	FD	5.3
Spallholz et al. (1973)	no stats	5.7	sodium selenite	mouse (*Mus musculus*)	weanling	body weight gain	FD	5
Wahlstrom et al. (1956)	0.56	no effect	sodium selenite	pig (*Sus domesticus*)	weanling	body weight	FD	14
Reproduction								
Chernoff and Kavlock (1982)	no stats	no effect	sodium selenite	mouse (*Mus musculus*)	60 days	% pregnant	GV	0.71
Gray and Kavlock (1984)	4.6	no effect	sodium selenite	mouse (*Mus musculus*)	90 days	live offspring	GV	0.71
Hardin et al. (1987)	6.4	6.4	sodium selenite	mouse (*Mus musculus*)	adult	% viable litters	GV	1.1
Seidenberg et al. (1986)	no stats	5.0	sodium selenate	mouse (*Mus musculus*)	adult	number of litters born	GV	0.71
Wahlstrom and Olson (1959)	0.0011	no effect	sodium selenite	pig (*Sus domesticus*)	8 weeks	number of live piglets	FD	34
Webster (1979)	37	37	sodium selenite	mouse (*Mus musculus*)	adult	% with litters	FD	2.7
Survival								
Halverson et al. (1966)	no stats	1.1	seleniferous wheat	rat (*Rattus norvegicus*)	weanling	survival	FD	6
Julius et al. (1983)	no stats	10	sodium selenite	hamster (*Mesocricetus auratus*)	4 weeks	survival	FD	3
McAdam and Levander (1987)	NR	1.2	D-selenomethionine	rat (*Rattus norvegicus*)	weanling	survival	FD	6
McAdam and Levander (1987)	NR	0.61	L-selenomethionine	rat (*Rattus norvegicus*)	weanling	survival	FD	6
McAdam and Levander (1987)	NR	0.61	sodium selenite	rat (*Rattus norvegicus*)	weanling	survival	FD	6
McAdam and Levander (1987)	NR	1.2	sodium selenate	rat (*Rattus norvegicus*)	weanling	survival	FD	6
Moxon and Mahan (1981)	no stats	0.81	sodium selenite	pig (*Sus domesticus*)	weanling	survival	FD	5.3
Palmer et al. (1982)	no stats	0.92	seleniferous corn	rat (*Rattus norvegicus*)	NR	survival	FD	4
Spallholz et al. (1973)	no stats	5.7	sodium selenite	mouse (*Mus musculus*)	weanling	survival	FD	5

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-18. Selenium TRV Data for Mammals

	Dose (mg/kg bw/day)									Body Weight (kg)								
Source [a]	Control	1	2	3	4	5	6	7	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Source [a]
Growth																		
Baker et al. (1989)	0.020	0.63	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	20	20	NA	NA	NA	NA	NA	NA	Cai et al. (2009)
Behne et al. (1992)	0.023	0.15	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.40	0.40	NA	NA	NA	NA	NA	NA	presented in paper
Birt et al. (1983)	0.0017	0.0060	0.0077	0.010	0.023	0.044	0.43	0.85	calculated from body weight and FIR	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	presented in paper
Birt et al. (1986)	0.0011	0.0065	0.27	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.12	0.12	0.12	NA	NA	NA	NA	NA	presented in paper
Boylan et al. (1990)	0.041	0.22	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.026	0.026	NA	NA	NA	NA	NA	NA	presented in paper
Goehring et al. (1984)	0.049	0.27	0.58	0.87	NA	NA	NA	NA	calculated from body weight and FIR	0.16	0.16	0.16	0.16	NA	NA	NA	NA	presented in paper
Goehring et al. (1984)	0.057	0.28	0.60	0.88	NA	NA	NA	NA	calculated from body weight and FIR	0.16	0.16	0.16	0.16	NA	NA	NA	NA	presented in paper
Kaur and Parshad (1994)	0.0	0.095	0.19	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.16	0.16	0.16	NA	NA	NA	NA	NA	presented in paper
Julius et al. (1983)	0.033	1.3	2.6	5.3	11	NA	NA	NA	calculated from body weight and FIR	0.068	0.068	0.068	0.068	0.068	NA	NA	NA	presented in paper
Julius et al. (1983)	0.029	1.2	2.3	4.7	9.4	NA	NA	NA	calculated from body weight and FIR	0.077	0.077	0.077	0.077	0.077	NA	NA	NA	presented in paper
Julius et al. (1983)	0.014	0.72	1.4	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.057	0.057	0.057	NA	NA	NA	NA	NA	presented in paper
Mahan and Moxon (1984)	0.0	0.10	0.20	0.31	0.41	0.61	0.82	1.6	calculated from body weight and FIR	13	13	13	13	13	13	13	13	presented in paper
Spallholz et al. (1973)	0.12	0.28	0.76	5.7	NA	NA	NA	NA	calculated from body weight and FIR	0.015	0.015	0.015	0.015		NA	NA	NA	presented in paper
Wahlstrom et al. (1956)	0.0	0.56	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	38	38	NA	NA	NA	NA	NA	NA	presented in paper
Reproduction																		
Chernoff and Kavlock (1982)	0.0	4.6	NA	NA	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA	NA (dose presented)
Gray and Kavlock (1984)	0.0	4.6	NA	NA	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA	NA (dose presented)
Hardin et al. (1987)	0.0	1.6	2.3	3.2	6.4	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA	NA (doses presented)
Seidenberg et al. (1986)	0.0	5.0	NA	NA	NA	NA	NA	NA	presented in paper	NA	NA	NA	NA	NA	NA	NA	NA	NA (dose presented)
Wahlstrom and Olson (1959)	0.0	0.0011	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	64	64	NA	NA	NA	NA	NA	NA	presented in paper
Webster (1979)	0.0	0.0092	0.37	3.7	37	NA	NA	NA	calculated from body weight and FIR	0.0295	0.0295	0.0	0.0	0.0	NA	NA	NA	presented in paper
Survival																		
Halverson et al. (1966)	0.073	0.24	0.41	0.58	0.74	0.91	1.1	1.2	calculated from body weight and FIR	0.158	0.158	0.158	0.158	0.2	0.2	0.2	0.2	presented in paper
Julius et al. (1983)	0.031	1.2	2.5	5.0	9.9	NA	NA	NA	calculated from body weight and FIR	0.0725	0.0725	0.1	0.1	0.1	NA	NA	NA	presented in paper
McAdam and Levander (1987)	0.015	0.31	0.61	1.2	NA	NA	NA	NA	calculated from body weight and FIR	0.1	0.1	0.1	0.1	NA	NA	NA	NA	USEPA (1988)
McAdam and Levander (1987)	0.015	0.31	0.61	1.2	NA	NA	NA	NA	calculated from body weight and FIR	0.1	0.1	0.1	0.1	NA	NA	NA	NA	USEPA (1988)
McAdam and Levander (1987)	0.015	0.31	0.61	1.2	NA	NA	NA	NA	calculated from body weight and FIR	0.100	0.100	0.100	0.100	NA	NA	NA	NA	USEPA (1988)
McAdam and Levander (1987)	0.015	0.31	0.61	1.2	NA	NA	NA	NA	calculated from body weight and FIR	0.1	0.1	0.1	0.1	NA	NA	NA	NA	USEPA (1988)
Moxon and Mahan (1981)	0.0	0.10	0.20	0.30	0.40	0.60	0.81	1.6	calculated from body weight and FIR	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	presented in paper
Palmer et al. (1982)	0.025	0.92	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.1	0.1	NA	NA	NA	NA	NA	NA	presented in paper
Spallholz et al. (1973)	0.12	0.28	0.76	5.7	NA	NA	NA	NA	presented in paper	0.0	0.0	0.0	0.0	NA	NA	NA	NA	presented in paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-18. Selenium TRV Data for Mammals

	Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)										Concentration in Food (mg/kg)								
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Wet or Dry Weight Basis
Growth																			
Baker et al. (1989)	NA	NA	NA	NA	NA	NA	NA	NA	not needed (paper presents dose as mg per pig per day in Table 1)	dw	0.40	27	NA	NA	NA	NA	NA	NA	dw
Behne et al. (1992)	0.031	0.031	NA	NA	NA	NA	NA	NA	USEPA (1988)	dw	0.30	2.0	NA	NA	NA	NA	NA	NA	dw
Birt et al. (1983)	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	presented in paper	dw	0.020	0.070	0.090	0.12	0.27	0.52	5.0	10	dw
Birt et al. (1986)	0.0063	0.0063	0.0063	NA	NA	NA	NA	NA	presented in paper	dw	0.020	0.12	5.0	NA	NA	NA	NA	NA	dw
Boylan et al. (1990)	0.0050	0.0050	NA	NA	NA	NA	NA	NA	USEPA (1988)	dw	0.21	1.2	NA	NA	NA	NA	NA	NA	dw
Goehring et al. (1984)	0.017	0.017	0.017	0.017	NA	NA	NA	NA	USEPA (1988)	dw	0.47	2.6	5.6	8.4	NA	NA	NA	NA	dw
Goehring et al. (1984)	0.016	0.016	0.016	0.016	NA	NA	NA	NA	USEPA (1988)	dw	0.54	2.6	5.7	8.3	NA	NA	NA	NA	dw
Kaur and Parshad (1994)	0.017	0.017	0.017	NA	NA	NA	NA	NA	USEPA (1988)	dw	0.0	0.91	1.8	NA	NA	NA	NA	NA	dw
Julius et al. (1983)	0.0090	0.0090	0.0090	0.0090	0.0090	NA	NA	NA	presented in paper	dw	0.25	10	20	40	80	NA	NA	NA	dw
Julius et al. (1983)	0.0090	0.009	0.0090	0.0090	0.0090	NA	NA	NA	presented in paper	dw	0.25	10	20	40	80	NA	NA	NA	dw
Julius et al. (1983)	0.0082	0.0082	0.0082	NA	NA	NA	NA	NA	presented in paper	dw	0.10	5.0	10	NA	NA	NA	NA	NA	dw
Mahan and Moxon (1984)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	presented in paper	dw	0.0	2.5	5.0	7.5	10	15	20	40	dw
Spallholz et al. (1973)	0.0035	0.0035	0.0035	0.0035	NA	NA	NA	NA	USEPA (1988)	dw	0.50	1.2	3.3	NA	NA	NA	NA	NA	dw
Wahlstrom et al. (1956)	1.9	1.9	NA	NA	NA	NA	NA	NA	presented in paper	dw	0.0	11	NA	NA	NA	NA	NA	NA	dw
Reproduction																			
Chernoff and Kavlock (1982)	NA	NA	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gray and Kavlock (1984)	NA	NA	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hardin et al. (1987)	NA	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Seidenberg et al. (1986)	NA	NA	NA	NA	NA	NA	NA	NA	NA (dose presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wahlstrom and Olson (1959)	0.0072	0.0072	NA	NA	NA	NA	NA	NA	Nagy (2001)	dw	0.00	10	NA	NA	NA	NA	NA	NA	dw
Webster (1979)	0.0055	0.0055	0.0055	0.0055	0.0055	NA	NA	NA	USEPA (1988)	dw	0.0	0.050	2.0	20	200	NA	NA	NA	dw
Survival																			
Halverson et al. (1966)	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	USEPA (1988)	dw	0.70	2.3	3.9	5.5	7.1	8.7	10	12	dw
Julius et al. (1983)	0.0090	0.0090	0.0090	0.0090	0.0090	NA	NA	NA	presented in paper	dw	0.25	10	20	40	80	NA	NA	NA	dw
McAdam and Levander (1987)	0.012	0.012	0.012	0.012	NA	NA	NA	NA	USEPA (1988)	dw	0.12	2.5	5.0	10	NA	NA	NA	NA	dw
McAdam and Levander (1987)	0.012	0.012	0.012	0.012	NA	NA	NA	NA	USEPA (1988)	dw	0.12	2.5	5.0	10	NA	NA	NA	NA	dw
McAdam and Levander (1987)	0.012	0.012	0.012	0.012	NA	NA	NA	NA	USEPA (1988)	dw	0.12	2.5	5.0	10	NA	NA	NA	NA	dw
McAdam and Levander (1987)	0.012	0.012	0.012	0.012	NA	NA	NA	NA	USEPA (1988)	dw	0.12	2.5	5.0	10	NA	NA	NA	NA	dw
Moxon and Mahan (1981)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	presented in paper	dw	0.0	2.5	5.0	7.5	10	15	20	40	dw
Palmer et al. (1982)	0.016	0.016	NA	NA	NA	NA	NA	NA	USEPA (1988)	dw	0.23	8.6	NA	NA	NA	NA	NA	NA	dw
Spallholz et al. (1973)	0.0035	0.0035	0.0035	0.0035	NA	NA	NA	NA	USEPA (1988)	dw	0.50	1.2	3.3	NA	NA	NA	NA	NA	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-18. Selenium TRV Data for Mammals

	Effect									Effect Relative to Control (%)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7
Growth																
Baker et al. (1989)	27	25	NA	NA	NA	NA	NA	NA	final body weight, calculated as initial body weight (kg) plus weight gain after 26 days (some were euthanized starting at this date)	95	NA	NA	NA	NA	NA	NA
Behne et al. (1992)	400	340	NA	NA	NA	NA	NA	NA	final body weight (g)	85	NA	NA	NA	NA	NA	NA
Birt et al. (1983)	185	184	193	204	180	191	172	158	final weight (g) = body weight gain + initial weight (62 g)	99	104	110	97	103	93	85
Birt et al. (1986)	159	142	135	NA	NA	NA	NA	NA	male body weight (g) at 64 weeks estimated from Figure 1 for semi-purified diet	89	85	NA	NA	NA	NA	NA
Boylan et al. (1990)	26	23	NA	NA	NA	NA	NA	NA	mean body weight (g)	88	NA	NA	NA	NA	NA	NA
Goehring et al. (1984)	7.3	6.6	6.3	5.7	NA	NA	NA	NA	average daily weight gain (g)	90	86	78	NA	NA	NA	NA
Goehring et al. (1984)	6.8	7.0	4.9	3.2	NA	NA	NA	NA	average daily weight gain (g)	103	72	47	NA	NA	NA	NA
Kaur and Parshad (1994)	0.18	0.15	0.14	NA	NA	NA	NA	NA	mean body weight (kg), estimated from Figure 1A in paper	85	77	NA	NA	NA	NA	NA
Julius et al. (1983)	112	105	88	78	62	NA	NA	NA	final body weight male - calculated from initial body weight (68 g) + body weight gain in Table 2 in paper	94	79	70	55	NA	NA	NA
Julius et al. (1983)	104	96	92	72	42	NA	NA	NA	final body weight female - calculated from initial body weight (77 g) + body weight gain in Table 2 in paper	92	88	69	40	NA	NA	NA
Julius et al. (1983)	117	113	90	NA	NA	NA	NA	NA	final body weight male - calculated from initial body weight (68 g) + body weight gain in Table 5 in paper	97	77	NA	NA	NA	NA	NA
Mahan and Moxon (1984)	19	19	17	16	15	11	9.1	5.7	final weight (kg)	99	93	86	81	60	49	30
Spallholz et al. (1973)	13	13	14	7.3	NA	NA	NA	NA	body weight gain (g)	106	112	58	NA	NA	NA	NA
Wahlstrom et al. (1956)	64	53	NA	NA	NA	NA	NA	NA	final weight, reported in lb and converted to kg	82	NA	NA	NA	NA	NA	NA
Reproduction																
Chernoff and Kavlock (1982)	80	77	NA	NA	NA	NA	NA	NA	% pregnant	96	NA	NA	NA	NA	NA	NA
Gray and Kavlock (1984)	11	9.4	NA	NA	NA	NA	NA	NA	number of live offspring at day 3	85	NA	NA	NA	NA	NA	NA
Hardin et al. (1987)	each treatment group had its own control; calculations provided in Effect Relative to Control cells								% viable litters	103	97	97	45	NA	NA	NA
Seidenberg et al. (1986)	26	12	NA	NA	NA	NA	NA	NA	number of litters born	46	NA	NA	NA	NA	NA	NA
Wahlstrom and Olson (1959)	9.3	7.5	NA	NA	NA	NA	NA	NA	average number of live piglets farrowed	81	NA	NA	NA	NA	NA	NA
Webster (1979)	88	80	90	80	40	NA	NA	NA	% with litters	91	102	91	45	NA	NA	NA
Survival																
Halverson et al. (1966)	100	100	100	100	100	88	38	0.0	% survival	100	100	100	100	88	38	0.0
Julius et al. (1983)	100	100	80	100	70	NA	NA	NA	% survival	100	80	100	70	NA	NA	NA
McAdam and Levander (1987)	100	100	88	0.0	NA	NA	NA	NA	survival	100	88	0.0	NA	NA	NA	NA
McAdam and Levander (1987)	100	100	63	0.0	NA	NA	NA	NA	survival	100	63	0.0	NA	NA	NA	NA
McAdam and Levander (1987)	100	100	38	0.0	NA	NA	NA	NA	survival	100	38	0.0	NA	NA	NA	NA
McAdam and Levander (1987)	100	75	88	0.0	NA	NA	NA	NA	survival	75	88	0.0	NA	NA	NA	NA
Moxon and Mahan (1981)	100	100	100	100	100	100	75	0.0	survival	100	100	100	100	100	75	0.0
Palmer et al. (1982)	100	80	NA	NA	NA	NA	NA	NA	% survival	80	NA	NA	NA	NA	NA	NA
Spallholz et al. (1973)	8.0	8.0	7.0	5.0	NA	NA	NA	NA	number surviving	100	88	63	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-19. Thallium TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day)				Notes
									Control	1	2	3	
Growth													
Downs et al. (1960)	no stats	3.0	thallic oxide	rat (*Rattus norvegicus*)	weanling (male)	body weight	FD	15	0.0	1.7	3.0	NA	calculated from body weight and FIR
Downs et al. (1960)	no stats	3.5	thallic oxide	rat (*Rattus norvegicus*)	weanling (female)	body weight	FD	15	0.0	2.0	3.5	NA	calculated from body weight and FIR
Survival													
Downs et al. (1960)	no stats	3.0	thallic oxide	rat (*Rattus norvegicus*)	weanling (male)	survival	FD	15	0.0	1.7	3.0	4.3	calculated from body weight and FIR
Downs et al. (1960)	no stats	2.0	thallic oxide	rat (*Rattus norvegicus*)	weanling (female)	survival	FD	15	0.0	2.0	3.5	5.1	calculated from body weight and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-19. Thallium TRV Data for Mammals

	Body Weight (kg)					Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)						Concentration in Food (mg/kg)				
Source [a]	Control	Dose 1	Dose 2	Dose 3	Source	Control	Dose 1	Dose 2	Dose 3	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Wet or Dry Weight Basis
Growth																
Downs et al. (1960)	0.198	0.198	0.198	NA	presented in paper	0.019	0.019	0.019	NA	USEPA (1988)	dw	0.0	17.9	31.3	NA	dw
Downs et al. (1960)	0.125	0.125	0.125	NA	presented in paper	0.014	0.014	0.014	NA	USEPA (1988)	dw	0.0	17.9	31.3	NA	dw
Survival																
Downs et al. (1960)	0.198	0.198	0.198	0.198	presented in paper	0.019	0.019	0.019	0.019	USEPA (1988)	dw	0.0	17.9	31.3	44.7	dw
Downs et al. (1960)	0.125	0.125	0.125	0.125	presented in paper	0.014	0.014	0.014	0.014	USEPA (1988)	dw	0.0	17.9	31.3	44.7	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[v] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-19. Thallium TRV Data for Mammals

Source [a]	Effect					Effect Relative to Control (%)		
	Control	Dose 1	Dose 2	Dose 3	Measurement	Dose 1	Dose 2	Dose 3
Growth								
Downs et al. (1960)	0.34	0.28	0.15	NA	final average body weight (kg)	82	44	NA
Downs et al. (1960)	0.20	0.19	0.15	NA	final average body weight (kg)	95	75	NA
Survival								
Downs et al. (1960)	80	100	20	0	% survival	125	25	0
Downs et al. (1960)	100	60	60	0	% survival	60	60	0

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[v] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-20. Vanadium TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Berg and Lawrence (1971)	no stats	1.2	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	2
Berg and Lawrence (1971)	no stats	ED20	vanadyl sulfate	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	2
Berg and Lawrence (1971)	no stats	1.2	vanadyl dichloride	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	2
Blalock and Hill (1987)	not clear	4.5	vanadyl chloride	chicken (*Gallus gallus domesticus*)	1 day	body weight	FD	3
Cervantes and Jensen (1986)	no stats	2.2	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	body weight	FD	4
Hill (1974)	1.2	no effect	sodium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	2
Hill (1979a)	1.4	1.4	sodium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	2
Hill (1990b)	2.8	2.8	sodium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	2.7
Hill (1990a)	no stats	4.5	sodium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	body weight gain	FD	2.7
Hill (1994)	5.6	5.6	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	hatchling	body weight	FD	2.9
Nelson et al. (1962)	5.3	9.7	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	4
Nelson et al. (1962)	5.2	5.2	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	4
Summers and Moran (1972)	1.1	no effect	NR	chicken (*Gallus gallus domesticus*)	chick	body weight gain	FD	3
Qureshi et al. (1999)	no stats	5.6	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	chick	body weight	FD	3
Reproduction								
Hafez and Kratzer (1976b)	23	23	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	28 weeks	egg production	FD	NR
Kubena and Phillips (1982)	7.3	7.3	calcium orthovanadate	chicken (*Gallus gallus domesticus*)	29 weeks	egg production	FD	20
Ousterhout and Berg (1980)	3.1	3.1	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	40 weeks	egg production	FD	4
Toussant and Latshaw (1994)	2.1	2.1	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	25 weeks	egg production	FD	4
Survival								
Berg and Lawrence (1971)	no stats	2.3	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	chick	survival	FD	2
Blalock and Hill (1987)	not clear	4.5	vanadyl chloride	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	3
Hafez and Kratzer (1976a)	no stats	22	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	survival (Experiment 1)	FD	4
Hafez and Kratzer (1976a)	no stats	5.6	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	survival (Experiment 2)	FD	4
Hathcock et al. (1964)	3.2	3.2	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	survival (Experiment 1)	FD	2
Hathcock et al. (1964)	3.2	3.2	ammonium metavanadate	chicken (*Gallus gallus domesticus*)	1 day	survival (Experiment 2)	FD	2
Hathcock et al. (1964)	3.2	3.2	vanadyl sulfate	chicken (*Gallus gallus domesticus*)	1 day	survival	FD	2
Kubena and Phillips (1982)	no stats	7.3	calcium orthovanadate	chicken (*Gallus gallus domesticus*)	29 weeks	survival	FD	20

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-20. Vanadium TRV Data for Birds

	Dose (mg/kg bw/day)											Body Weight (kg)										
Source [a]	Control	1	2	3	4	5	6	7	8	9	Notes	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Dose 9	Source [a]
Growth																						
Berg and Lawrence (1971)	0.0	1.2	2.3	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.060	0.060	0.060	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Berg and Lawrence (1971)	0.0	1.2	2.3	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.060	0.060	0.060	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Berg and Lawrence (1971)	0.0	1.2	2.3		NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.060	0.060	0.060	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Blalock and Hill (1987)	0.0	1.1	2.2	4.5	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NA	NA	NA	NA	NRC (1994)
Cervantes and Jensen (1986)	0.0	0.56	1.1	2.2	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NA	NA	NA	NA	NRC (1994)
Hill (1974)	0.0	1.2	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.25	0.25	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Hill (1979a)	0.0	0.35	0.70	1.4	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.25	0.25	0.25	0.25	NA	NA	NA	NA	NA	NA	NRC (1994)
Hill (1990b)	0.0	2.8	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Hill (1990a)	0.0	4.5	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Hill (1994)	0.0	5.6	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Nelson et al. (1962)	0.78	1.6	1.9	2.4	3.0	3.9	5.3	7.1	9.7	13	calculated from body weight and FIR	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	NRC (1994)
Nelson et al. (1962)	0.77	1.9	3.0	5.2	9.6	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.085	0.085	0.085	0.085	0.085	NA	NA	NA	NA	NA	USEPA (1988)
Summers and Moran (1972)	0.0	1.1	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.070	0.070	NA	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Qureshi et al. (1999)	0.0	1.1	2.8	5.6	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NA	NA	NA	NA	NRC (1994)
Reproduction																						
Hafez and Kratzer (1976b)	0.0	7.8	23	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.80	0.80	0.80	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Kubena and Phillips (1982)	0.25	1.1	2.0	3.7	7.3	NA	NA	NA	NA	NA	calculated from body weight and FIR	1.5	1.5	1.5	1.5	1.5	NA	NA	NA	NA	NA	presented in paper
Ousterhout and Berg (1980)	0.0	1.6	3.1	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.80	0.80	0.80	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Toussant and Latshaw (1994)	0.28	2.1	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.80	0.80	NA	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Survival																						
Berg and Lawrence (1971)	0.0	2.3	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.060	0.060	NA	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)
Blalock and Hill (1987)	0.0	1.1	2.2	4.5	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NA	NA	NA	NA	NRC (1994)
Hafez and Kratzer (1976a)	0.0	5.6	11	22	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NA	NA	NA	NA	NRC (1994)
Hafez and Kratzer (1976a)	0.0	5.6	11	22	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.36	0.36	0.36	0.36	NA	NA	NA	NA	NA	NA	NRC (1994)
Hathcock et al. (1964)	0.0	1.3	3.2	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Hathcock et al. (1964)	0.0	3.2	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	0.15	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Hathcock et al. (1964)	0.0	3.2	NA	NA	NA	NA	NA	NA	NA	NA	calculated from body weight and FIR	0.15	0.15	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)
Kubena and Phillips (1982)	0.2	1.1	2.0	3.7	7.3	NA	NA	NA	NA	NA	calculated from body weight and FIR	1.55	1.55	1.5	1.5	1.5	NA	NA	NA	NA	NA	presented in paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-20. Vanadium TRV Data for Birds

	Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)												Concentration in Food (mg/kg)										
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Dose 9	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Dose 9	Wet or Dry Weight Basis
Growth																							
Berg and Lawrence (1971)	0.0070	0.0070	0.0070	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	10	20	NA	NA	NA	NA	NA	NA	NA	dw
Berg and Lawrence (1971)	0.0070	0.0070	0.0070	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	10	20	NA	NA	NA	NA	NA	NA	NA	dw
Berg and Lawrence (1971)	0.0070	0.0070	0.0070	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	10	20	NA	NA	NA	NA	NA	NA	NA	dw
Blalock and Hill (1987)	0.040	0.040	0.040	0.040	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	10	20	40	NA	NA	NA	NA	NA	NA	dw
Cervantes and Jensen (1986)	0.040	0.040	0.040	0.040	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	5.0	10	20	NA	NA	NA	NA	NA	NA	dw
Hill (1974)	0.030	0.030	0.030	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	average of 1- and 2-week FIR of broiler chickens	0.0	10	NA	NA	NA	NA	NA	NA	NA	NA	dw
Hill (1979a)	0.030	0.030	0.030	0.030	NA	NA	NA	NA	NA	NA	NRC (1994)	average of 1- and 2-week FIR of broiler chickens	0.0	3.0	6.0	12	NA	NA	NA	NA	NA	NA	dw
Hill (1990b)	0.040	0.040	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	25	NA	NA	NA	NA	NA	NA	NA	NA	dw
Hill (1990a)	0.040	0.040	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	40	NA	NA	NA	NA	NA	NA	NA	NA	dw
Hill (1994)	0.040	0.040	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	50	NA	NA	NA	NA	NA	NA	NA	NA	dw
Nelson et al. (1962)	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	NRC (1994)	FIR for 2-week-old broiler chickens	7.0	14	17	21	27	35	47	64	87	120	dw
Nelson et al. (1962)	0.0093	0.0093	0.0093	0.0093	0.0093	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	7.0	17	27	47	87	NA	NA	NA	NA	NA	dw
Summers and Moran (1972)	0.008	0.008	NA	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	10	NA	NA	NA	NA	NA	NA	NA	NA	dw
Qureshi et al. (1999)	0.040	0.040	0.040	0.040	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	10	25	50	NA	NA	NA	NA	NA	NA	dw
Reproduction																							
Hafez and Kratzer (1976b)	0.062	0.062	0.062	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	100	300	NA	NA	NA	NA	NA	NA	NA	dw
Kubena and Phillips (1982)	0.11	0.11	0.11	0.11	0.11	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	3.5	16	29	54	104	NA	NA	NA	NA	NA	dw
Ousterhout and Berg (1980)	0.062	0.062	0.062	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	20	40	NA	NA	NA	NA	NA	NA	NA	dw
Toussant and Latshaw (1994)	0.062	0.062	NA	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	3.6	27	NA	NA	NA	NA	NA	NA	NA	NA	dw
Survival																							
Berg and Lawrence (1971)	0.0070	0.0070	NA	NA	NA	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	0.0	20	NA	NA	NA	NA	NA	NA	NA	NA	dw
Blalock and Hill (1987)	0.040	0.040	0.040	0.040	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	10	20	40	NA	NA	NA	NA	NA	NA	dw
Hafez and Kratzer (1976a)	0.040	0.040	0.040	0.040	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	50	100	200	NA	NA	NA	NA	NA	NA	dw
Hafez and Kratzer (1976a)	0.040	0.040	0.040	0.040	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 2-week-old broiler chickens	0.0	50	100	NA	NA	NA	NA	NA	NA	NA	dw
Hathcock et al. (1964)	0.019	0.019	0.019	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 1-week-old broiler chickens	0.0	10	25	NA	NA	NA	NA	NA	NA	NA	dw
Hathcock et al. (1964)	0.019	0.019	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 1-week-old broiler chickens	0.0	25	NA	NA	NA	NA	NA	NA	NA	NA	dw
Hathcock et al. (1964)	0.019	0.019	NA	NA	NA	NA	NA	NA	NA	NA	NRC (1994)	FIR for 1-week-old broiler chickens	0.0	25	NA	NA	NA	NA	NA	NA	NA	NA	dw
Kubena and Phillips (1982)	0.11	0.11	0.11	0.11	0.11	NA	NA	NA	NA	NA	USEPA (1988)	FIR for chickens	3.5	16	29	54	104	NA	NA	NA	NA	NA	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-20. Vanadium TRV Data for Birds

Source [a]	Effect											Effect Relative to Control (%)								
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Dose 9	Measurement	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Dose 7	Dose 8	Dose 9
Growth																				
Berg and Lawrence (1971)	126	80	56	NA	NA	NA	NA	NA	NA	NA	final body weight (g) (Table 9 in paper)	63	44	NA	NA	NA	NA	NA	NA	NA
Berg and Lawrence (1971)	126	102	68	NA	NA	NA	NA	NA	NA	NA	final body weight (g) (Table 9 in paper)	81	54	NA	NA	NA	NA	NA	NA	NA
Berg and Lawrence (1971)	126	95	63	NA	NA	NA	NA	NA	NA	NA	final body weight (g) (Table 9 in paper)	75	50	NA	NA	NA	NA	NA	NA	NA
Blalock and Hill (1987)	280	233	237	152	NA	NA	NA	NA	NA	NA	body weight (g) (adequate iron group) at 3 weeks	83	85	54	NA	NA	NA	NA	NA	NA
Cervantes and Jensen (1986)	739	637	650	557	NA	NA	NA	NA	NA	NA	final body weight (g) at 4 weeks (Table 2 in paper)	86	88	75	NA	NA	NA	NA	NA	NA
Hill (1974)	213	185	NA	NA	NA	NA	NA	NA	NA	NA	weight gain (g)	87	NA	NA	NA	NA	NA	NA	NA	NA
Hill (1979a)	202	202	214	157	NA	NA	NA	NA	NA	NA	weight gain (converted from % of control; with sufficient protein: 20%)	100	106	78	NA	NA	NA	NA	NA	NA
Hill (1990b)	177	67	NA	NA	NA	NA	NA	NA	NA	NA	body weight gain (g) at 19 days (from Table 4 in paper)	38	NA	NA	NA	NA	NA	NA	NA	NA
Hill (1990a)	419	231	NA	NA	NA	NA	NA	NA	NA	NA	body weight gain (g) at 19 days (from Table 1 in paper)	55	NA	NA	NA	NA	NA	NA	NA	NA
Hill (1994)	478	241	NA	NA	NA	NA	NA	NA	NA	NA	body weight (g) for 0.5% phosphorus group	50	NA	NA	NA	NA	NA	NA	NA	NA
Nelson et al. (1962)	470	492	477	478	479	464	431	388	318	235	body weight (g)	105	101	102	102	99	92	83	68	50
Nelson et al. (1962)	333	344	319	240	206	NA	NA	NA	NA	NA	body weight (g)	103	96	72	62	NA	NA	NA	NA	NA
Summers and Moran (1972)	234	210	NA	NA	NA	NA	NA	NA	NA	NA	weight gain (g) for 0.7% calcium and 0.2% phosphorus group	90	NA	NA	NA	NA	NA	NA	NA	NA
Qureshi et al. (1999)	112	120	97	76	NA	NA	NA	NA	NA	NA	body weight (g)	107	87	68	NA	NA	NA	NA	NA	NA
Reproduction																				
Hafez and Kratzer (1976b)	72	73	24	NA	NA	NA	NA	NA	NA	NA	% egg production	101	33	NA	NA	NA	NA	NA	NA	NA
Kubena and Phillips (1982)	56	55	57	56	17	NA	NA	NA	NA	NA	final hen-day egg production (%)	99	103	101	30	NA	NA	NA	NA	NA
Ousterhout and Berg (1980)	74	68	57	NA	NA	NA	NA	NA	NA	NA	% rate of lay	92	77	NA	NA	NA	NA	NA	NA	NA
Toussant and Latshaw (1994)	95	48	NA	NA	NA	NA	NA	NA	NA	NA	egg production (14 days; estimated from Figure 1 in paper)	51	NA	NA	NA	NA	NA	NA	NA	NA
Survival																				
Berg and Lawrence (1971)	100	30	NA	NA	NA	NA	NA	NA	NA	NA	% survival	30	NA	NA	NA	NA	NA	NA	NA	NA
Blalock and Hill (1987)	95	100	83	15	NA	NA	NA	NA	NA	NA	% survival (for adequate iron group)	105	87	16	NA	NA	NA	NA	NA	NA
Hafez and Kratzer (1976a)	100	100	100	80	NA	NA	NA	NA	NA	NA	% survival	100	100	80	NA	NA	NA	NA	NA	NA
Hafez and Kratzer (1976a)	100	80	0.0	0.0	NA	NA	NA	NA	NA	NA	% survival	80	0.0	0.0	NA	NA	NA	NA	NA	NA
Hathcock et al. (1964)	85	85	5	NA	NA	NA	NA	NA	NA	NA	% survival	100	5.9	NA	NA	NA	NA	NA	NA	NA
Hathcock et al. (1964)	95	18	NA	NA	NA	NA	NA	NA	NA	NA	% survival	18	NA	NA	NA	NA	NA	NA	NA	NA
Hathcock et al. (1964)	95	15	NA	NA	NA	NA	NA	NA	NA	NA	% survival	16	NA	NA	NA	NA	NA	NA	NA	NA
Kubena and Phillips (1982)	100	100	100	100	44	NA	NA	NA	NA	NA	% survival	100	100	100	44	NA	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-21. Bis(2-ethylhexyl)phthalate TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	Notes
Growth												
Wood and Bitman (1984)	747	no effect	di-(2-ethylhexyl) phthalate	chicken	about 20 weeks	body weight	FD	4	0.0	747	NA	calculated from BW and FIR
Reproduction												
Wood and Bitman (1984)	747	747	di-(2-ethylhexyl) phthalate	chicken	about 20 weeks	egg production	FD	4	0.0	747	NA	calculated from BW and FIR
Ishida et al. (1982)	349	349	di-(2-ethylhexyl) phthalate	chicken	10 months	egg production	FD	33	0.0	349	700	calculated from BW and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-21. Bis(2-ethylhexyl)phthalate TRV Data for Birds

	Body Weight (kg)				Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)					Concentration in Food (mg/kg)			
Source [a]	Control	Dose 1	Dose 2	Source [a]	Control	Dose 1	Dose 2	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Wet or Dry Weight Basis
Growth													
Wood and Bitman (1984)	3.9	3.9	NA	presented in paper	0.1	0.1	NA	presented in paper	dw	0	20000	NA	dw
Reproduction													
Wood and Bitman (1984)	3.9	3.9	NA	presented in paper	0.1	0.1	NA	presented in paper	dw	0	20000	NA	dw
Ishida et al. (1982)	1.6	1.6	1.6	EPA (1988)	0.1	0.1	0.1	EPA (1988)	dw	0	5000	10000	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-21. Bis(2-ethylhexyl)phthalate TRV Data for Birds

	Effect				Effect Relative to Control (%)		
Source [a]	Control	Dose 1	Dose 2	Measurement	Control	Dose 1	Dose 2
Growth							
Wood and Bitman (1984)	3.9	3.8	NA	body weight (kg)	100	96	NA
Reproduction							
Wood and Bitman (1984)	81	47	NA	% egg production	100	58	NA
Ishida et al. (1982)	NA	NA	NA	NR but paper stated that egg production stopped in the dosed groups	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-22. High-molecular-weight polycyclic aromatic hydrocarbon TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
Patton and Dieter (1980)	no effect	no effect	aromatic mixture	mallard	NR	body weight	FD	28
Trust et al. (1994)	20	no effect	7,12-dimethylbenz[a]anthracene	European starling	9 days	body weight	GV	0.86
Survival								
Patton and Dieter (1980)	no effect	no effect	aromatic mixture	mallard	NR	survival	FD	28

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-22. High-molecular-weight polycyclic aromatic hydrocarbon TRV Data for Birds

	Dose (mg/kg bw/day)				Body Weight (kg)			
Source [a]	Control	1	2	Notes	Control	Dose 1	Dose 2	Source [a]
Growth								
Patton and Dieter (1980)	0.0	40	140	calculated from body weight and FIR	1.082	1.082	1.082	Dunning (1993)
Trust et al. (1994)	0.0	2.0	20	doses presented in the paper	NA	NA	NA	NA (doses presented in paper)
Survival								
Patton and Dieter (1980)	0.0	40	140	calculated from body weight and FIR	1.1	1.1	1.1	Dunning (1993)

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-22. High-molecular-weight polycyclic aromatic hydrocarbon TRV Data for Birds

	Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)					Concentration in Food (mg/kg)			
Source [a]	Control	Dose 1	Dose 2	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Wet or Dry Weight Basis
Growth									
Patton and Dieter (1980)	0.1082	0.1082	0.1082	Heinz et al. (1987)	dw	0	400	1400	dw
Trust et al. (1994)	NA	NA	NA	paper)	NA (doses presented in paper)	NA	NA	NA	NA (doses presented in paper)
Survival									
Patton and Dieter (1980)	0.1	0.1	0.1	Heinz et al. (1987)	dw	0	400	1400	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-22. High-molecular-weight polycyclic aromatic hydrocarbon TRV Data for Birds

Source [a]	Effect				Effect Relative to Control (%)		
	Control	Dose 1	Dose 2	Measurement	Control	Dose 1	Dose 2
Growth							
Patton and Dieter (1980)	1.36	1.34	1.34	final body weight (kg) (estimated from Fig. 1)	100	99	99
Trust et al. (1994)	62.0	NR	55	final body weight (g)	100	NA	89
Survival							
Patton and Dieter (1980)	100	100	100	% survival	100	100	100

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-23. Dioxin/furan TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (ng TEQ/kg bw/day)					
									Control	1	2	3	4	Notes
Survival														
Schwetz et al. (1973)	no stats	1000	2378 TCDD	chicken	3 days	survival	oral intubation	3.0	0.0	10	100	1000	10000	doses presented in the paper

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-23. Dioxin/furan TRV Data for Birds

Source [a]	Body Weight (kg)						Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)						
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Source	Control	Dose 1	Dose 2	Dose 3	Dose 4	Source	Wet or Dry Weight Basis
Survival													
Schwetz et al. (1973)	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-23. Dioxin/furan TRV Data for Birds

	Concentration in Food (ng TEQ/kg)						Effect						Effect Relative to Control (%)				
Source [a]	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Measurement	Control	Dose 1	Dose 2	Dose 3	Dose 4
Survival																	
Schwetz et al. (1973)	NA	NA	NA	NA	NA	NA (doses presented in paper)	100	100	100	20	0	% survival	100	100	100	20	0

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-24. Dioxin/furan TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)
Growth								
DeCaprio et al. (1986)	4.9	26.0	2378 TCDD	guinea pig	weanling (250-370 g)	body weight (male)	FD	12.9
DeCaprio et al. (1986)	4.9	31.0	2378 TCDD	guinea pig	weanling (230-340 g)	body weight (female)	FD	12.9
Hochstein et al. (1998)	54.4	54.4	2378 TCDD	mink	adult	body weight	FD	17.9
Van Birgelen et al. (1995)	46.9	1,024	2378 TCDD	rat	7 weeks	body weight	FD	13.0
Reproduction								
Hochstein et al. (2001)	no stats	0.8	2378 TCDD	mink	adult	kit survival	FD	18.7-18.8
Moore et al. (2012)	no stats	no effect	2378 TCDD	mink	adult	females whelping	FD	20.4-25.1
Moore et al. (2012)	no stats	2.1	2378 TCDD	mink	adult	kit survival	FD	20.4-25.2
Murray et al. (1979)	10	10	2378 TCDD	rat	6-7 weeks	females with litter	FD	12.9
Murray et al. (1979)	10	10	2378 TCDD	rat	6-7 weeks	postnatal % survival	FD	12.9
Survival								
DeCaprio et al. (1986)	no stats	28.5	2378 TCDD	guinea pig	weanling (230-370 g)	survival	FD	12.9
Hochstein et al. (1998)	54.4	54.4	2378 TCDD	mink	adult	survival	FD	17.9

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-24. Dioxin/furan TRV Data for Mammals

Source [a]	Dose (ng TEQ/kg bw/day)							Notes	Body Weight (kg)							Source [a]
	Control	1	2	3	4	5	6		Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	
Growth																
DeCaprio et al. (1986)	0.0	0.1	0.6	4.9	26	NA	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
DeCaprio et al. (1986)	0.0	0.1	0.7	4.9	31	NA	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Hochstein et al. (1998)	0.0	0.1	0.5	5.4	54	544	5443	calculated from BW and FIR	0.9	0.9	0.9	0.9	0.9	0.9	0.9	present study
Van Birgelen et al. (1995)	0.0	14	26	47	320	1024	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Reproduction																
Hochstein et al. (2001)	0.0	2.9	9.8	NA	NA	NA	NA	calculated from BW and FIR	0.9	0.9	0.9	NA	NA	NA	NA	Hochstein et al. (1998)
Moore et al. (2012)	0.0	2.1	4.6	6.0	8.4	NA	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Moore et al. (2012)	0.0	2.1	4.6	6.0	8.4	NA	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Murray et al. (1979)	0.0	1.0	10	NA	NA	NA	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Murray et al. (1979)	0.0	1.0	10	NA	NA	NA	NA	doses presented in the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Survival																
DeCaprio et al. (1986)	0.0	0.1	0.6	4.9	29	NA	NA	average of male and female doses from the paper	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Hochstein et al. (1998)	0.0	0.1	0.5	5.4	54	544	5443	calculated from BW and FIR	0.9	0.9	0.9	0.9	0.9	0.9	0.9	present study

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-24. Dioxin/furan TRV Data for Mammals

	Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)									Concentration in Food (ng TEQ/kg)							
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Wet or Dry Weight Basis
Growth																	
DeCaprio et al. (1986)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
DeCaprio et al. (1986)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Hochstein et al. (1998)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	present study	dw assumed	0.0	1.0	10	100	1000	10000	100000	dw assumed
Van Birgelen et al. (1995)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Reproduction																	
Hochstein et al. (2001)	0.05	0.05	0.05	NA	NA	NA	NA	Hochstein et al. (1998)	dw assumed	0.6	53	180	NA	NA	NA	NA	dw assumed
Moore et al. (2012)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Moore et al. (2012)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Murray et al. (1979)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Murray et al. (1979)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Survival																	
DeCaprio et al. (1986)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)	NA (doses presented in paper)	NA	NA	NA	NA	NA	NA	NA	NA (doses presented in paper)
Hochstein et al. (1998)	NA	0.05	0.05	0.05	0.05	0.05	0.05	present study	dw assumed	0.0	1.0	10	100	1000	10000	100000	dw assumed

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[c] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-24. Dioxin/furan TRV Data for Mammals

	Effect								Effect Relative to Control (%)						
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6	Measurement	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Dose 6
Growth															
DeCaprio et al. (1986)	713	682	651	603	433	NA	NA	body weight (g)	100	96	91	85	61	NA	NA
DeCaprio et al. (1986)	602	583	570	531	351	NA	NA	body weight (g)	100	97	95	88	58	NA	NA
Hochstein et al. (1998)	80	83	82	79	62	NA	NA	% change in female body weight at 18 wks	100	104	103	99	78	NA	NA
Van Birgelen et al. (1995)	318	299	297	286	267	229	NA	terminal body weight (g) (Table 2 in paper)	100	94	93	90	84	72	NA
Reproduction															
Hochstein et al. (2001)	62	29	11	NA	NA	NA	NA	% survival of kits at 6 weeks (Table 1 in paper)	100	47	18	NA	NA	NA	NA
Moore et al. (2012)	100	78	78	89	89	NA	NA	% of females whelped	100	78	78	89	89	NA	NA
Moore et al. (2012)	80	46	53	52	68	NA	NA	% kit viability through 6 weeks	100	58	66	64	84	NA	NA
Murray et al. (1979)	88	100	55	NA	NA	NA	NA	% females delivering a litter in f2 (Table 1 in paper)	100	114	63	NA	NA	NA	NA
Murray et al. (1979)	87	85	59	NA	NA	NA	NA	% postnatal survival to 21 days in f2	100	98	68	NA	NA	NA	NA
Survival															
DeCaprio et al. (1986)	100	100	100	100	40	NA	NA	% survival	100	100	100	100	40	NA	NA
Hochstein et al. (1998)	100	100	100	100	38	0	0	% survival	100	100	100	100	38	0	0

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-25. PCBs TRV Data for Birds

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	Notes
Reproduction															
Briggs and Harris (1973)	no stats	1.40	Aroclor 1242	chicken	adult	hatchability (leghorn)	FD	6.0	0.0	1.4	3.5	NA	NA	NA	calculated from BW and FIR
Briggs and Harris (1973)	no stats	1.26	Aroclor 1242	chicken	adult	hatchability (broiler)	FD	6.0	0.0	1.3	3.2	NA	NA	NA	calculated from BW and FIR
Britton and Huston (1973)	no stats	no effect	Aroclor 1242	chicken	10 months	egg production	FD	6.0	0.0	0.35	0.70	1.4	2.8	5.6	calculated from BW and FIR
Britton and Huston (1973)	0.70	1.40	Aroclor 1242	chicken	10 months	hatchability	FD	6.0	0.0	0.35	0.70	1.4	2.8	5.6	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	1.40	1.40	Aroclor 1242	chicken	adult	hatchability	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	no stats	no effect	Aroclor 1242	chicken	adult	egg production	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	1.40	1.40	Aroclor 1242	chicken	adult	progeny weight gain	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	no effect	no effect	Aroclor 1242	chicken	adult	progeny mortality	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	1.40	1.40	Aroclor 1248	chicken	adult	hatchability	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	no stats	no effect	Aroclor 1248	chicken	adult	egg production	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	0.14	1.40	Aroclor 1248	chicken	adult	progeny weight gain	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	1.40	1.40	Aroclor 1248	chicken	adult	progeny mortality	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	1.40	no effect	Aroclor 1254	chicken	adult	hatchability	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	no stats	no effect	Aroclor 1254	chicken	adult	egg production	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	0.14	no effect	Aroclor 1254	chicken	adult	progeny weight gain	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1974); Cecil et al. (1974)	no effect	no effect	Aroclor 1254	chicken	adult	progeny mortality	FD	9.0	0.0	0.14	1.4	NA	NA	NA	calculated from BW and FIR
Lillie et al. (1975)	no stats	0.70	Aroclor 1242	chicken	20 weeks	hatchability	FD	8.0	0.0	0.35	0.70	1.4	NA	NA	calculated from BW and FIR
Lillie et al. (1975)	no stats	0.70	Aroclor 1248	chicken	20 weeks	hatchability	FD	8.0	0.0	0.35	0.70	1.4	NA	NA	calculated from BW and FIR
Platanow and Reinhart (1973)	no stats	3.50	Aroclor 1254	chicken	6 months	hatchability	FD	14.0	0.0	0.35	3.50	NA	NA	NA	calculated from BW and FIR
Scott (1977)	1.40	no effect	Aroclor 1248	chicken	adult	egg production	FD	8.0	0.0	0.04	0.07	0.70	1.4	NA	calculated from BW and FIR
Scott (1977)	0.70	0.70	Aroclor 1248	chicken	adult	hatchability	FD	8.0	0.0	0.04	0.07	0.70	1.4	NA	calculated from BW and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-25. PCBs TRV Data for Birds

Source [a]	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)								Concentration in Food (mg/kg)						
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis
Reproduction																						
Briggs and Harris (1973)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	20	50	NA	NA	NA	dw
Briggs and Harris (1973)	3.2	3.2	3.2	NA	NA	NA	NRC (1994)	0.2	0.2	0.2	NA	NA	NA	NRC (1994)	dw	0	20	50	NA	NA	NA	dw
Britton and Huston (1973)	1.6	1.6	1.6	1.6	1.6	1.6	EPA (1988)	0.1	0.1	0.1	0.1	0.1	0.1	EPA (1988)	dw	0	5	10	20	40	80	dw
Britton and Huston (1973)	1.6	1.6	1.6	1.6	1.6	1.6	EPA (1988)	0.1	0.1	0.1	0.1	0.1	0.1	EPA (1988)	dw	0	5	10	20	40	80	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1974); Cecil et al. (1974)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	2	20	NA	NA	NA	dw
Lillie et al. (1975)	1.6	1.6	1.6	1.6	NA	NA	EPA (1988)	0.1	0.1	0.1	0.1	NA	NA	EPA (1988)	dw	0	5	10	20	NA	NA	dw
Lillie et al. (1975)	1.6	1.6	1.6	1.6	NA	NA	EPA (1988)	0.1	0.1	0.1	0.1	NA	NA	EPA (1988)	dw	0	5	10	20	NA	NA	dw
Platanow and Reinhart (1973)	1.6	1.6	1.6	NA	NA	NA	EPA (1988)	0.1	0.1	0.1	NA	NA	NA	EPA (1988)	dw	0	5	50	NA	NA	NA	dw
Scott (1977)	1.6	1.6	1.6	1.6	1.6	NA	EPA (1988)	0.1	0.1	0.1	0.1	0.1	NA	EPA (1988)	dw	0	0.5	1	10	20	NA	dw
Scott (1977)	1.6	1.6	1.6	1.6	1.6	NA	EPA (1988)	0.1	0.1	0.1	0.1	0.1	NA	EPA (1988)	dw	0	0.5	1	10	20	NA	dw

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-25. PCBs TRV Data for Birds

Source [a]	Effect							Effect Relative to Control (%)					
	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Reproduction													
Briggs and Harris (1973)	69	7	0	NA	NA	NA	% hatchability at 6 weeks	100	10	0	NA	NA	NA
Briggs and Harris (1973)	66	6	5	NA	NA	NA	% hatchability at 6 weeks	100	9	7	NA	NA	NA
Britton and Huston (1973)	61	56	22	25	47	55	% egg production at 6 weeks	100	92	36	41	77	90
Britton and Huston (1973)	91	94	75	50	0	0	% hatchability	100	103	82	55	0	0
Lillie et al. (1974); Cecil et al. (1974)	94	92	18	NA	NA	NA	% hatchability - Period 1	100	98	20	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	79	76	68	NA	NA	NA	hen-day % egg production - Period 1	100	95	85	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	163	160	115	NA	NA	NA	progeny body weight gain at 3 weeks (g)	100	98	71	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	98	97	92	NA	NA	NA	progeny % survival - Period 1	100	99	93	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	94	92	12	NA	NA	NA	% hatchability - Period 1	100	99	13	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	79	77	68	NA	NA	NA	hen-day % egg production - Period 1	100	97	85	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	163	153	109	NA	NA	NA	progeny body weight gain at 3 weeks (g)	100	94	67	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	98	98	44	NA	NA	NA	progeny % survival - Period 1	100	99	44	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	94	90	81	NA	NA	NA	% hatchability - Period 1	100	96	86	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	79	77	71	NA	NA	NA	hen-day % egg production - Period 1	100	97	90	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	163	151	141	NA	NA	NA	progeny body weight gain at 3 weeks (g)	100	93	87	NA	NA	NA
Lillie et al. (1974); Cecil et al. (1974)	98	99	94	NA	NA	NA	progeny % survival - Period 1	100	100	95	NA	NA	NA
Lillie et al. (1975)	91	76	67	28	NA	NA	% hatchability	100	84	74	31	NA	NA
Lillie et al. (1975)	91	87	69	22	NA	NA	% hatchability	100	96	76	24	NA	NA
Platanow and Reinhart (1973)	90	90	0	NA	NA	NA	% hatchability	100	100	0	NA	NA	NA
Scott (1977)	75	74	77	69	65	NA	% egg production at 8 weeks	100	99	103	92	87	NA
Scott (1977)	91	92	94	50	2	NA	% hatchability at 8 weeks	100	101	104	55	3	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.

[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.

[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-26. PCBs TRV Data for Mammals

Source [a]	Reported LOAEL [b] (mg/kg bw/day)	LOAEL ≥ 20 (mg/kg bw/day)	Chemical Form	Receptor	Lifestage	Endpoint Detail	Exposure Mode	Exposure Duration (weeks unless noted otherwise)	Dose (mg/kg bw/day) Control	1	2	3	4	5	Notes
Reproduction															
Aulerich and Ringer (1977)	NR	0.77	Aroclor 1254	mink	adult	females whelped	FD	16	0.0	0.8	1.5	NA	NA	NA	calculated from BW and FIR
Aulerich and Ringer (1977)	NR	0.15	Aroclor 1254	mink	adult	females whelped	FD	16	0.0	0.2	0.8	2.3	NA	NA	calculated from BW and FIR
Aulerich and Ringer (1977)	NR	0.31	Aroclor 1254	mink	adult	kits born alive	FD	16	0.0	0.3	NA	NA	NA	NA	calculated from BW and FIR
Aulerich and Ringer (1977)	NR	0.31	Aroclor 1254	mink	adult	females whelped	FD	16	0.0	0.3	NA	NA	NA	NA	calculated from BW and FIR
Aulerich and Ringer (1977)	NR	0.77	Aroclor 1254	mink	adult	kits born alive	FD	16	0.0	0.8	1.5	NA	NA	NA	calculated from BW and FIR
Aulerich and Ringer (1977)	NR	0.15	Aroclor 1254	mink	adult	kits born alive	FD	16.0	0.0	0.2	0.8	2.3	NA	NA	calculated from BW and FIR
Aulerich et al. (1985)	NR	0.39	Aroclor 1254	mink	adult	kits whelped	FD	about 12	0.0	0.4	NA	NA	NA	NA	calculated from BW and FIR
Aulerich et al. (1985)	NR	0.39	Aroclor 1254	mink	adult	kits whelped	FD	about 12	0.0	0.4	NA	NA	NA	NA	calculated from BW and FIR
Bleavins et al. (1980)	NR	0.77	Aroclor 1242	mink	adult	kits born alive	FD	35	0.0	0.8	1.5	3.1	6.2	NA	calculated from BW and FIR
Bleavins et al. (1980)	NR	no effect	Aroclor 1016	mink	adult	kits born alive	FD	35	0.0	3.1	NA	NA	NA	NA	calculated from BW and FIR
Bleavins et al. (1980)	NR	0.77	Aroclor 1242	mink	adult	females whelped	FD	35	0.0	0.8	1.5	3.1	6.2	NA	calculated from BW and FIR
Bleavins et al. (1980)	NR	3.08	Aroclor 1016	mink	adult	females whelped	FD	35	0.0	3.1	NA	NA	NA	NA	calculated from BW and FIR
Brunström et al. (2001)	no effect	no effect	Clophen A50	mink	6 months	kits whelped	FD	72	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Brunström et al. (2001)	0.24	no effect	Clophen A50	mink	6 months	kit birth weight	FD	72	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Brunström et al. (2001)	0.082	0.08	Clophen A50	mink	6 months	kit growth	FD	72	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Brunström et al. (2001)	0.082	0.24	Clophen A50	mink	6 months	females whelped	FD	24	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Brunström et al. (2001)	0.24	0.24	Clophen A50	mink	6 months	kits born alive	FD	24	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Brunström et al. (2001)	no effect	0.24	Clophen A50	mink	6 months	kits whelped	FD	24	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Brunström et al. (2001)	0.24	0.24	Clophen A50	mink	6 months	kit birth weight	FD	24	0.0	0.08	0.2	NA	NA	NA	calculated from BW and daily dose
Folland et al. (2016)	no stats	0.27	Aroclor 1268	mink	adult	kit survival to 6 wks	FD	16	0.0	0.3	0.6	1.6	2.6	4.4	calculated from BW and FIR
Folland et al. (2016)	4.44	no effect	Aroclor 1268	mink	adult	kits born alive	FD	16	0.0	0.3	0.6	1.6	2.6	4.4	calculated from BW and FIR
Folland et al. (2016)	1.63	1.63	Aroclor 1268	mink	adult	kits whelped	FD	16	0.0	0.3	0.6	1.6	2.6	4.4	calculated from BW and FIR
Folland et al. (2016)	2.63	1.63	Aroclor 1268	mink	adult	kits born alive	FD	16	0.0	0.3	0.6	1.6	2.6	4.4	calculated from BW and FIR
Jensen et al. (1977)	no stats	1.69	NR	mink	adult	females whelped	FD	9.4	0.0	1.7	NA	NA	NA	NA	calculated from BW and FIR
Jensen et al. (1977)	no stats	1.69	NR	mink	adult	kits whelped	FD	9.4	0.0	1.7	NA	NA	NA	NA	calculated from BW and FIR
Jensen et al. (1977)	no stats	1.69	NR	mink	adult	kit weight of young	FD	9.4	0.0	1.7	NA	NA	NA	NA	calculated from BW and FIR
Jensen et al. (1977)	no stats	1.69	NR	mink	adult	kit survival after 5 days	FD	9.4	0.0	1.7	NA	NA	NA	NA	calculated from BW and FIR
Kihlstrom et al. (1992)	2.05	2.05	Clophen A50	mink	2 years	females whelped	FD	12	0.0	2.0	NA	NA	NA	NA	calculated from BW and FIR
Kihlstrom et al. (1992)	1.32	1.32	Aroclor 1254	mink	2 years	females whelped	FD	12	0.0	1.3	NA	NA	NA	NA	calculated from BW and FIR
Kihlstrom et al. (1992)	2.05	2.05	Clophen A50	mink	2 years	kits born alive	FD	12	0.0	2.0	NA	NA	NA	NA	calculated from BW and FIR
Kihlstrom et al. (1992)	1.32	1.32	Aroclor 1254	mink	2 years	kits born alive	FD	12	0.0	1.3	NA	NA	NA	NA	calculated from BW and FIR
Wren et al. (1987)	no stats	0.15	Aroclor 1254	mink	8 months	kit weight at 5 weeks	FD	24	0.0	0.2	NA	NA	NA	NA	calculated from BW and FIR

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[b] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

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Table H2.B-26. PCBs TRV Data for Mammals

	Body Weight (kg)							Food Ingestion Rate (kg/day) or Drinking Water Ingestion Rate (L/day)							
Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Source [a]	Wet or Dry Weight Basis
Reproduction															
Aulerich and Ringer (1977)	0.9	0.9	0.9	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	0.1	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich and Ringer (1977)	0.9	0.9	0.9	0.9	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich and Ringer (1977)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich and Ringer (1977)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich and Ringer (1977)	0.9	0.9	0.9	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	0.1	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich and Ringer (1977)	0.9	0.9	0.9	0.9	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich et al. (1985)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Aulerich et al. (1985)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Bleavins et al. (1980)	0.9	0.9	0.9	0.9	0.9	NA	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	0.1	NA	Bleavins and Aulerich (1981)	ww
Bleavins et al. (1980)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Bleavins et al. (1980)	0.9	0.9	0.9	0.9	0.9	NA	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	0.1	NA	Bleavins and Aulerich (1981)	ww
Bleavins et al. (1980)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Brunström et al. (2001)	1.3	1.3	1.3	NA	NA	NA	presented in the paper	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	NA (dose presented in the paper)
Folland et al. (2016)	0.9	0.9	0.9	0.9	0.9	0.9	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	0.1	0.1	Bleavins and Aulerich (1981)	ww
Folland et al. (2016)	0.9	0.9	0.9	0.9	0.9	0.9	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	0.1	0.1	Bleavins and Aulerich (1981)	ww
Folland et al. (2016)	0.9	0.9	0.9	0.9	0.9	0.9	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	0.1	0.1	Bleavins and Aulerich (1981)	ww
Folland et al. (2016)	0.9	0.9	0.9	0.9	0.9	0.9	Bleavins and Aulerich (1981)	0.1	0.1	0.1	0.1	0.1	0.1	Bleavins and Aulerich (1981)	ww
Jensen et al. (1977)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Jensen et al. (1977)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Jensen et al. (1977)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Jensen et al. (1977)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww
Kihlstrom et al. (1992)	1.0	1.0	NA	NA	NA	NA	presented in the paper	0.2	0.2	NA	NA	NA	NA	presented in the paper	ww
Kihlstrom et al. (1992)	1.2	1.2	NA	NA	NA	NA	presented in the paper	0.2	0.2	NA	NA	NA	NA	presented in the paper	ww
Kihlstrom et al. (1992)	1.0	1.0	NA	NA	NA	NA	presented in the paper	0.2	0.2	NA	NA	NA	NA	presented in the paper	ww
Kihlstrom et al. (1992)	1.2	1.2	NA	NA	NA	NA	presented in the paper	0.2	0.2	NA	NA	NA	NA	presented in the paper	ww
Wren et al. (1987)	0.9	0.9	NA	NA	NA	NA	Bleavins and Aulerich (1981)	0.1	0.1	NA	NA	NA	NA	Bleavins and Aulerich (1981)	ww

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

Table H2.B-26. PCBs TRV Data for Mammals

	Concentration in Food (mg/kg)							Effect							Effect Relative to Control (%)					
Source [a]	Control [c]	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Wet or Dry Weight Basis	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5	Measurement	Control	Dose 1	Dose 2	Dose 3	Dose 4	Dose 5
Reproduction																				
Aulerich and Ringer (1977)	0	5	10	NA	NA	NA	ww	3	0	0	NA	NA	NA	females whelped	100	0	0	NA	NA	NA
Aulerich and Ringer (1977)	0	1	5	15.0	NA	NA	ww	11	8	3	0	NA	NA	females whelped	100	73	27	0	NA	NA
Aulerich and Ringer (1977)	0	2	NA	NA	NA	NA	ww	28	1	NA	NA	NA	NA	kits born alive	100	4	NA	NA	NA	NA
Aulerich and Ringer (1977)	0	2	NA	NA	NA	NA	ww	8	2	NA	NA	NA	NA	females whelped	100	25	NA	NA	NA	NA
Aulerich and Ringer (1977)	0	5	10	NA	NA	NA	ww	17	0	0	NA	NA	NA	kits born alive	100	0	0	NA	NA	NA
Aulerich and Ringer (1977)	0	1	5	15	NA	NA	ww	56	35	3	0	NA	NA	kits born alive	100	63	5	0	NA	NA
Aulerich et al. (1985)	0	2.5	NA	NA	NA	NA	ww	1	0	NA	NA	NA	NA	% females whelped	100	11	NA	NA	NA	NA
Aulerich et al. (1985)	0	2.5	NA	NA	NA	NA	ww	105	0	NA	NA	NA	NA	alive number of kits whelped	100	0	NA	NA	NA	NA
Bleavins et al. (1980)	0	5	10	20	40.0	NA	ww	85	0	0	0	0	NA	% kits alive at birth	100	0	NA	NA	NA	NA
Bleavins et al. (1980)	0	20	NA	NA	NA	NA	ww	85	83	NA	NA	NA	NA	% kits alive at birth	100	98	NA	NA	NA	NA
Bleavins et al. (1980)	0	5	10	20	40.0	NA	ww	76	0	0	0	0	NA	% females whelped	100	0	0	0	0	NA
Bleavins et al. (1980)	0	20	NA	NA	NA	NA	ww	76	44	NA	NA	NA	NA	% females whelped	100	58	NA	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	5	6	5	NA	NA	NA	litter size (total # kits)	100	120	104	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	10	10	8	NA	NA	NA	kit birth weight (g)	100	99	82	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	260	175	0	NA	NA	NA	kit growth at weeks (g)	100	67	0	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	93	88	39	NA	NA	NA	% mated females whelping	100	95	42	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	4	6	2	NA	NA	NA	live litter size (number of live kits)	100	134	45	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	5	6	4	NA	NA	NA	litter size (total number of kits)	100	122	80	NA	NA	NA
Brunström et al. (2001)	NA	NA	NA	NA	NA	NA	NA (dose presented in the paper)	9	8	7	NA	NA	NA	kit birth weight	100	90	75	NA	NA	NA
Folland et al. (2016)	0	1.77	4.01	10.6	17.1	28.8	ww	90	69	93	83	53	12	% kit survival through 6 weeks including infanticide	100	77	103	92	59	13
Folland et al. (2016)	0	1.77	4.01	10.6	17.1	28.8	ww	92	98	98	97	88	75	% live kits of total number of kits	100	106	107	106	96	82
Folland et al. (2016)	0	1.77	4.01	10.6	17.1	28.8	ww	6	5	6	4	3	5	total kits per litter	100	87	93	64	56	87
Folland et al. (2016)	0	1.77	4.01	10.6	17.1	28.8	ww	5	5	6	4	3	4	live kits per litter	100	94	106	72	62	75
Jensen et al. (1977)	0.05	11	NA	NA	NA	NA	ww	92	73	NA	NA	NA	NA	delivering females (%)	100	79	NA	NA	NA	NA
Jensen et al. (1977)	0.05	11	NA	NA	NA	NA	ww	5	3	NA	NA	NA	NA	number of whelps born/pregnant female	100	57	NA	NA	NA	NA
Jensen et al. (1977)	0.05	11	NA	NA	NA	NA	ww	9	7	NA	NA	NA	NA	mean weight of young (g)	100	72	NA	NA	NA	NA
Jensen et al. (1977)	0.05	11	NA	NA	NA	NA	ww	82	17	NA	NA	NA	NA	% of whelps alive 5 days after birth	100	21	NA	NA	NA	NA
Kihlstrom et al. (1992)	0	11.8	NA	NA	NA	NA	ww	90	10	NA	NA	NA	NA	% dams whelping	100	11	NA	NA	NA	NA
Kihlstrom et al. (1992)	0	9.6	NA	NA	NA	NA	ww	89	30	NA	NA	NA	NA	% dams whelping	100	34	NA	NA	NA	NA
Kihlstrom et al. (1992)	0	11.8	NA	NA	NA	NA	ww	66	0	NA	NA	NA	NA	% whelps born living	100	0	NA	NA	NA	NA
Kihlstrom et al. (1992)	0	9.6	NA	NA	NA	NA	ww	85	0	NA	NA	NA	NA	% whelps born living	100	0	NA	NA	NA	NA
Wren et al. (1987)	0	1	NA	NA	NA	NA	ww	228	161	NA	NA	NA	NA	average kit weight at 5 weeks (g)	100	71	NA	NA	NA	NA

Notes:

Concentrations in food were assumed to be reported on a dry weight (dw) basis unless clearly stated otherwise in the study. The wet weight (ww) or dw basis of the food ingestion rate (FIR) was selected to match the basis of the food concentration.

[a] See Attachment H2 references section for full citations.
[u] Lowest-observed-adverse-effect level (LOAEL) determined by study based on statistical analyses.
[c] If reported, the basal diet concentration is included in the control diet concentration.

ANNEX C

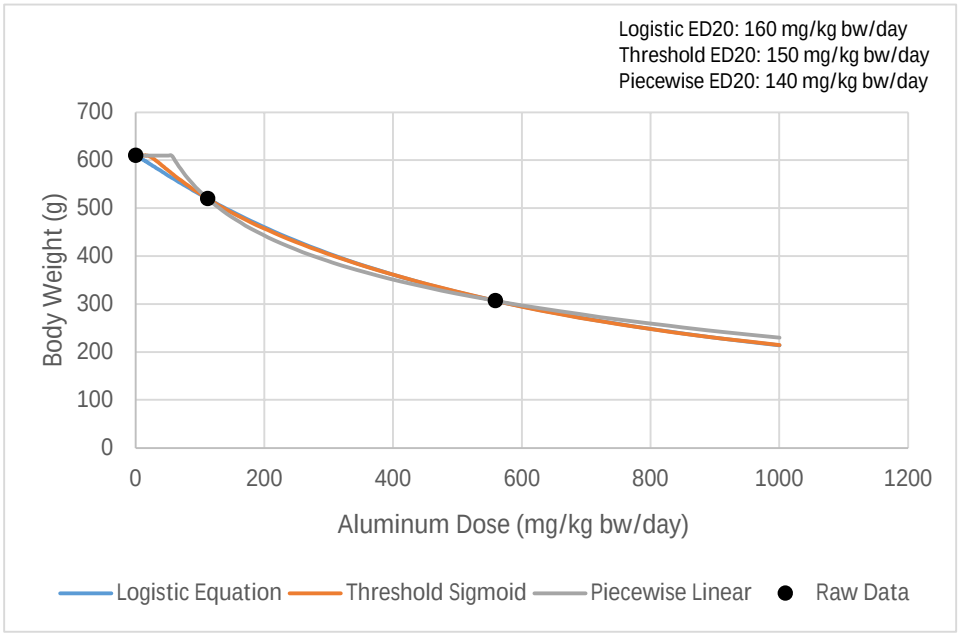
MODELED DOSE-RESPONSE CURVES

ACRONYMS AND ABBREVIATIONS

ED20	effective dose with 20 percent reduction in the response relative to the control
Exp	experiment
F1	first filial generation

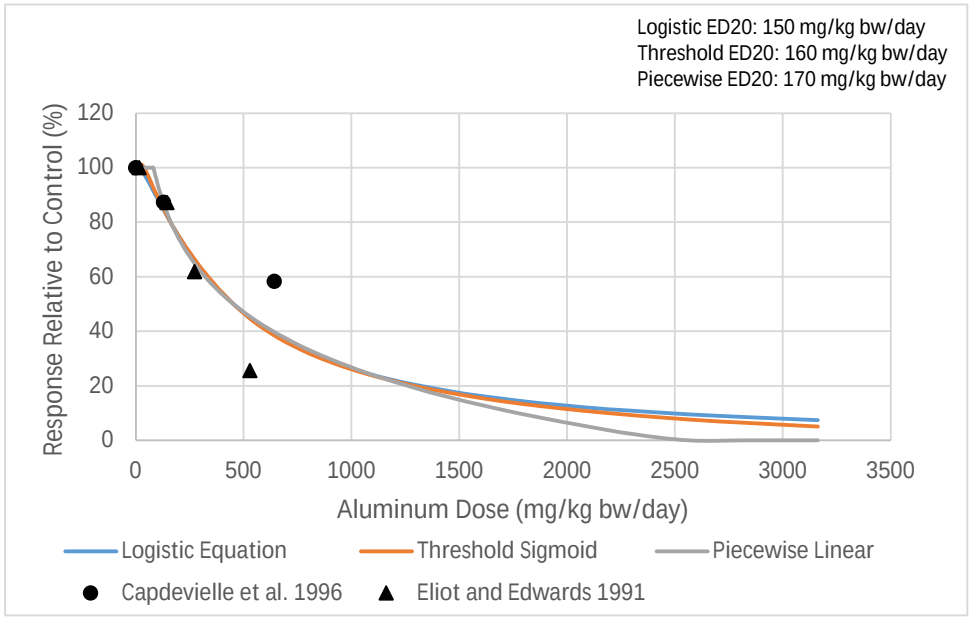
UNITS OF MEASURE

g	gram(s)
kg	kilogram(s)
mg/kg bw/day	milligram(s) per kilogram of body weight per day
ng TEQ/kg bw/day	nanogram(s) toxic equivalency per kilogram of body weight per day



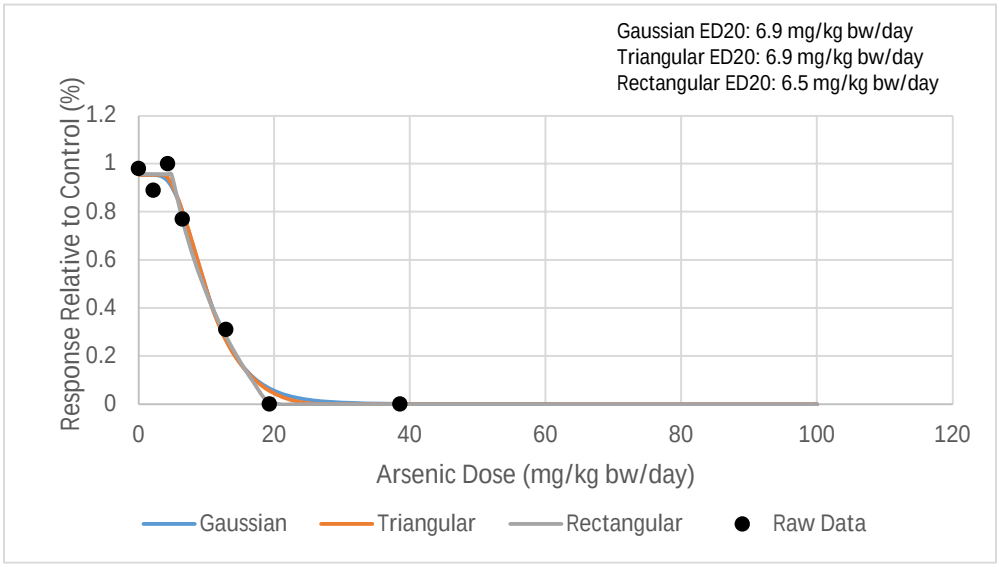
Note: Model based on log-transformed data from Capdevielle and Scanes (1995a).

Figure H2.C-1. Dose-Response Curves for Avian Growth Endpoint for Aluminum



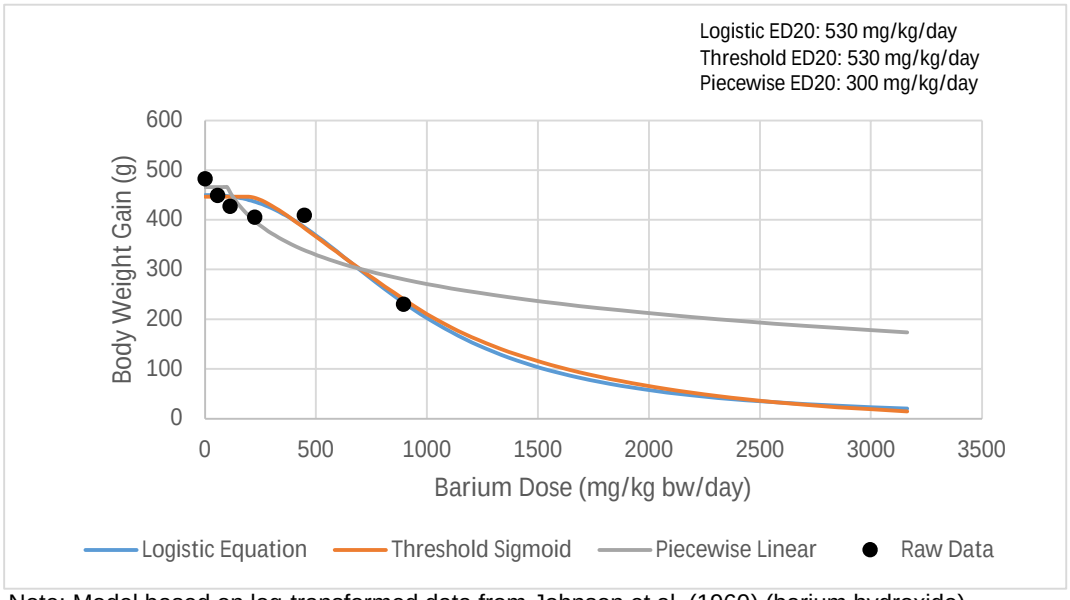
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-2. Dose-Response Curves for Avian Growth Endpoint for Aluminum



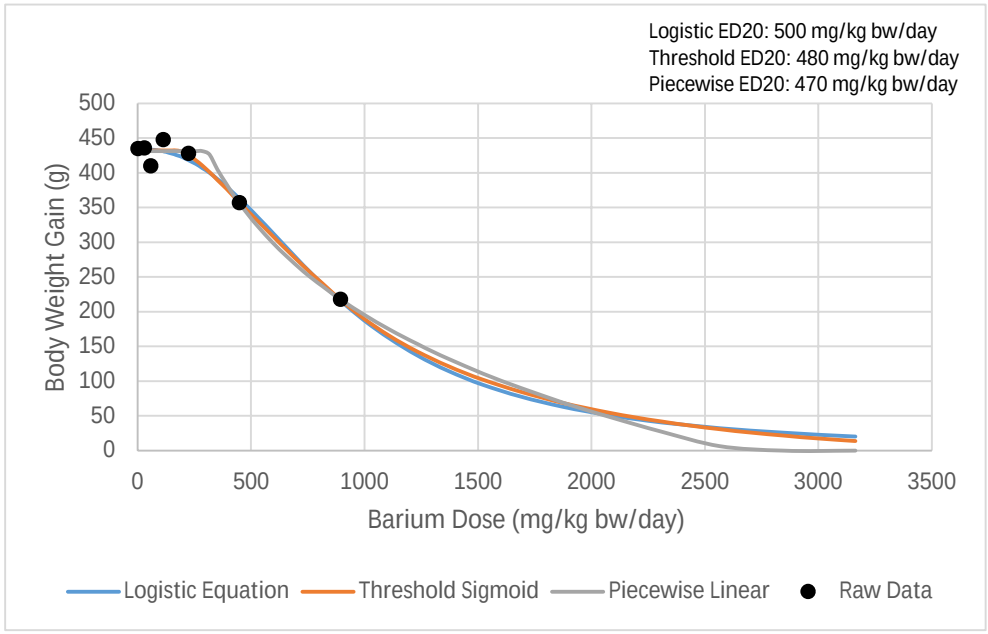
Note: Model based on log-transformed data from Albert et al. (2008b).

Figure H2.C-3. Dose-Response Curves for Avian Survival Endpoint for Arsenic



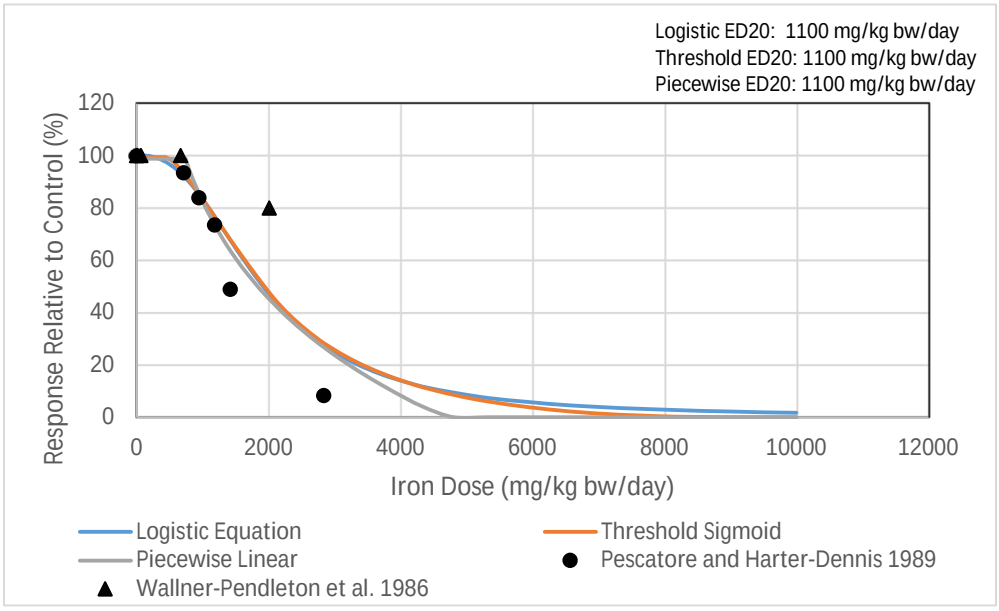
Note: Model based on log-transformed data from Johnson et al. (1960) (barium hydroxide).

Figure H2.C-4. Dose-Response Curves for Avian Growth Endpoint for Barium



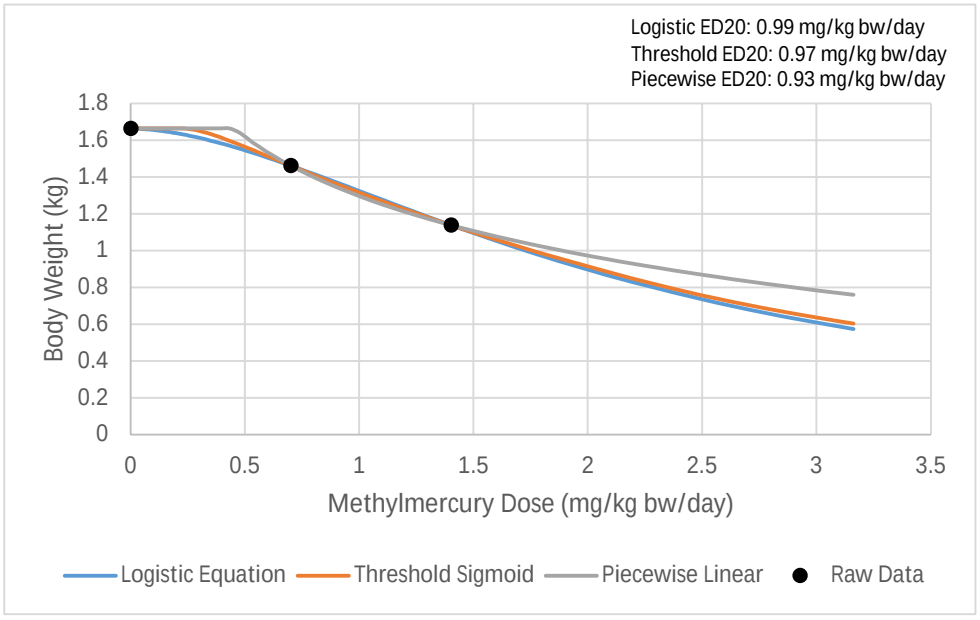
Note: Model based on log-transformed data from Johnson et al. (1960) (barium acetate).

Figure H2.C-5. Dose-Response Curves for Avian Growth Endpoint for Barium



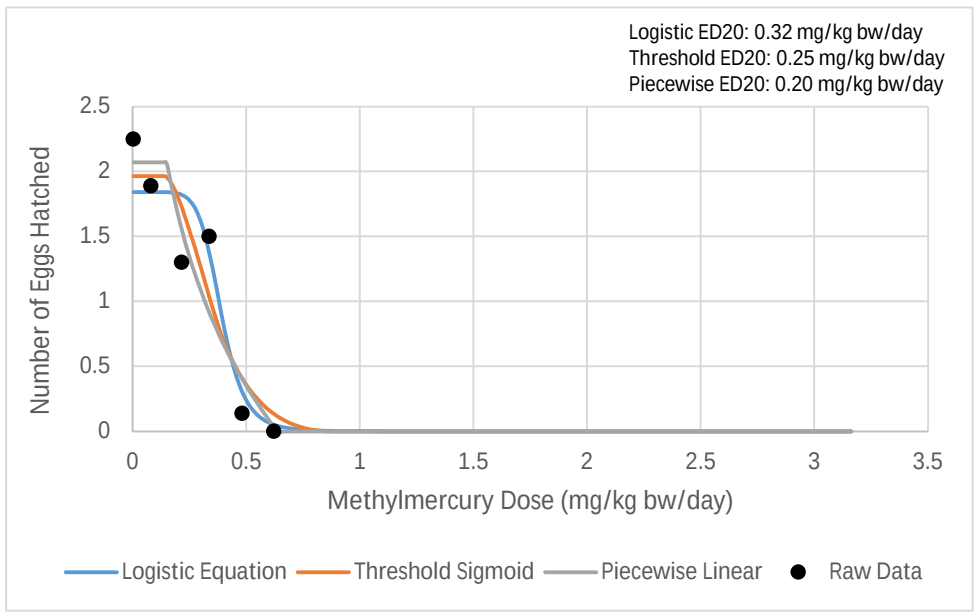
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-6. Dose-Response Curves for Avian Survival Endpoint for Iron



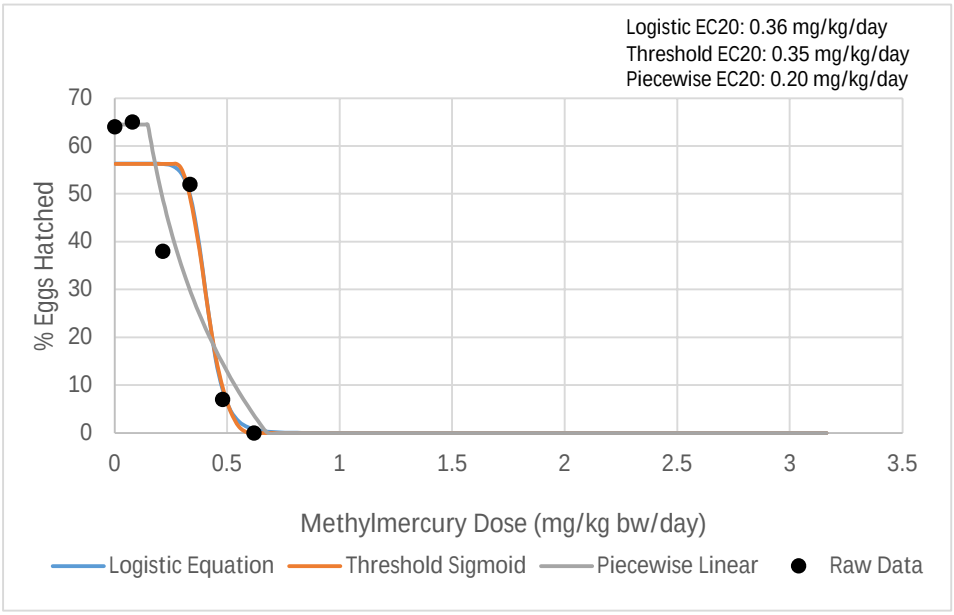
Note: Model based on log-transformed data from Scott et al. (1975).

Figure H2.C-7. Dose-Response Curves for Avian Growth Endpoint for Methylmercury



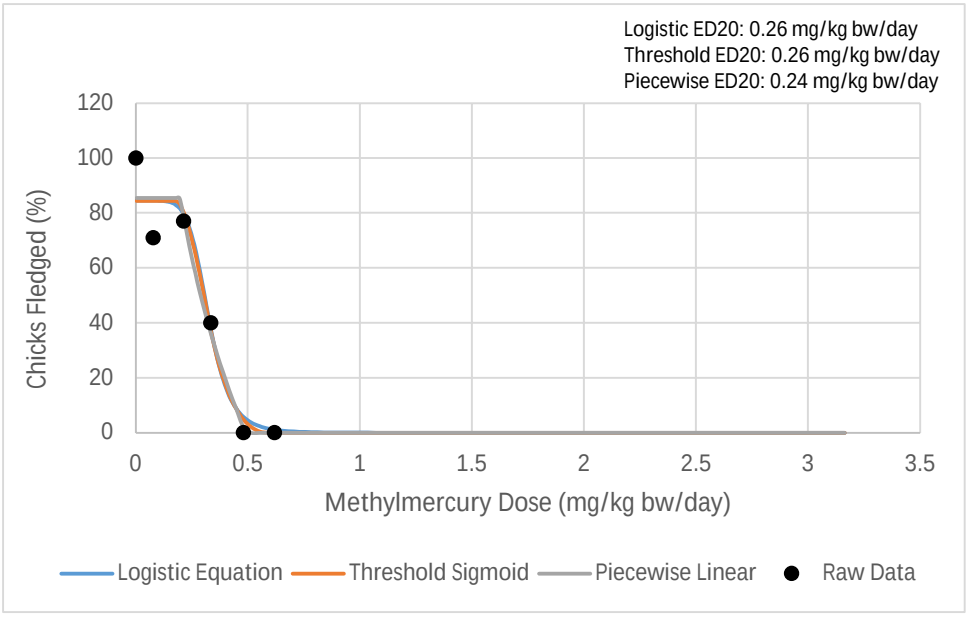
Note: Model based on log-transformed data from Albers et al. (2007).

Figure H2.C-8. Dose-Response Curves for Kestrel Reproduction Endpoint for Methylmercury



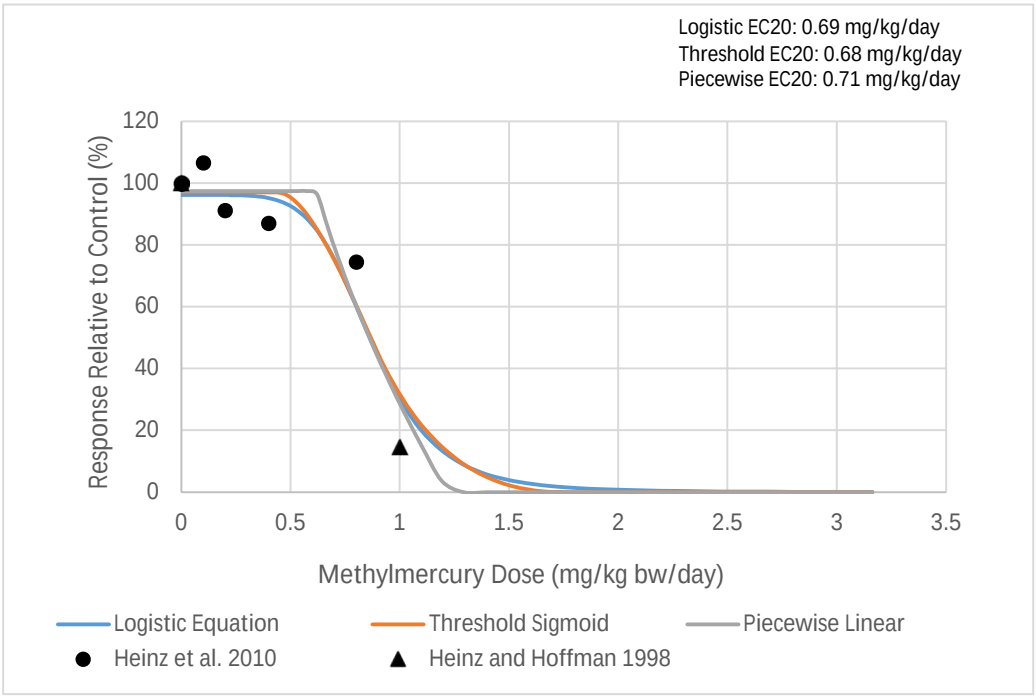
Note: Model based on log-transformed data from Albers et al. (2007).

Figure H2.C-9. Dose-Response Curves for Kestrel Reproduction Endpoint for Methylmercury



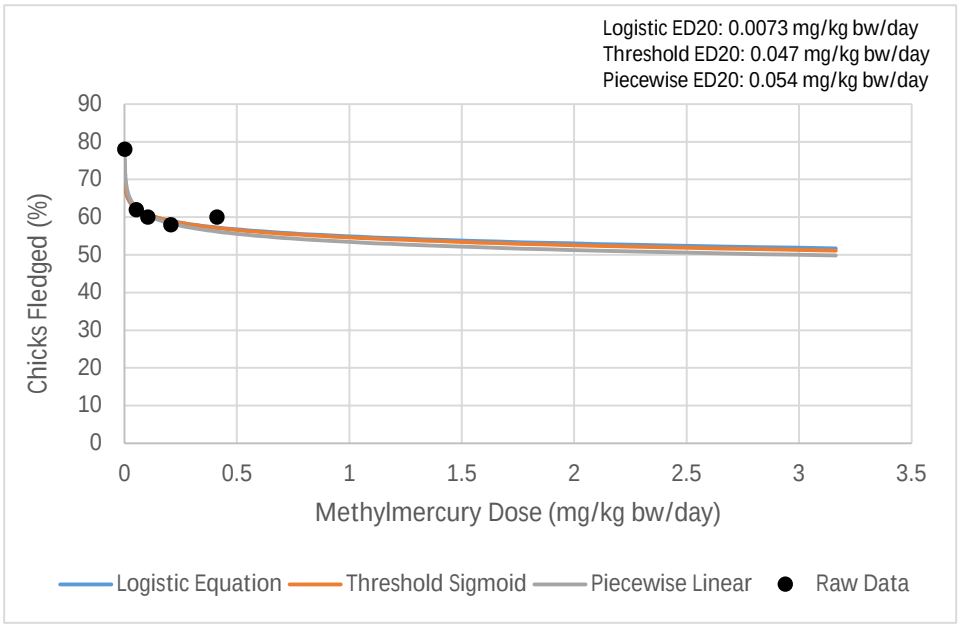
Note: Model based on log-transformed data from Albers et al. (2007).

Figure H2.C-10. Dose-Response Curves for Kestrel Reproduction Endpoint for Methylmercury



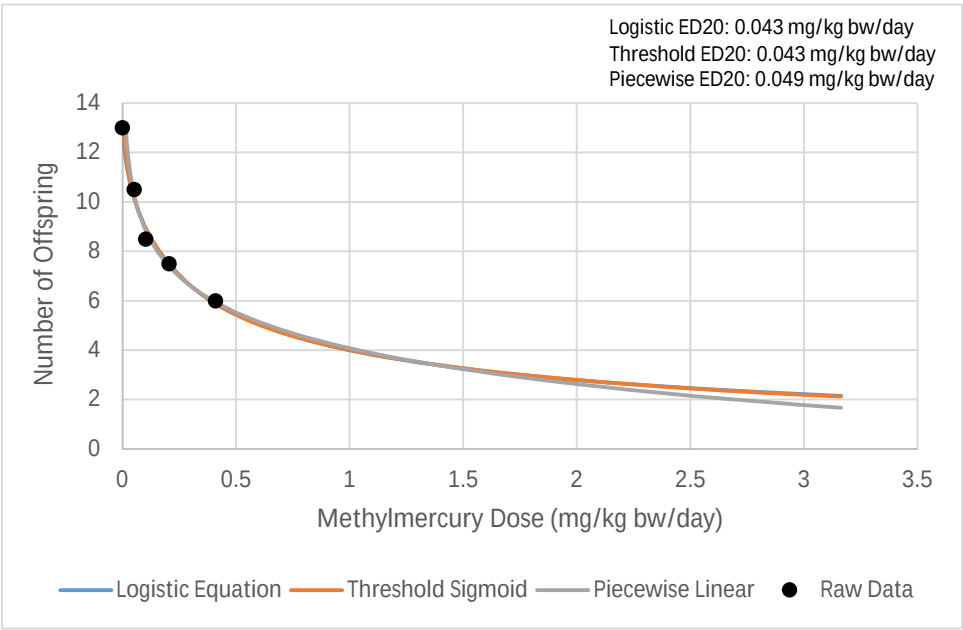
Note: Model based on log-transformed data from pooling group B.

Figure H2.C-11. Dose-Response Curves for Mallard Reproduction Endpoint for Methylmercury



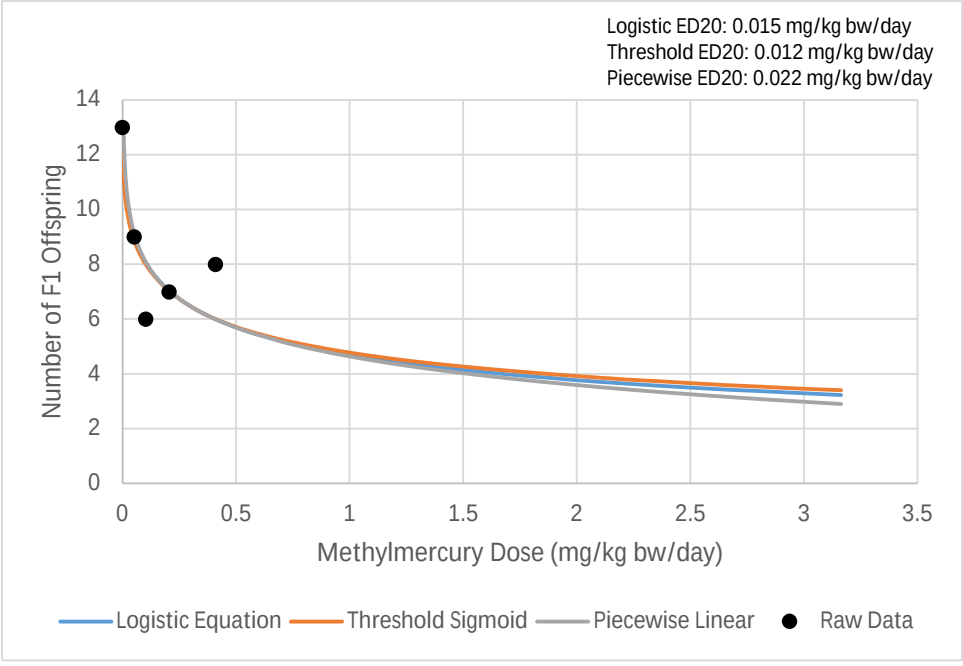
Note: Model based on log-transformed data from Varian-Ramos et al. (2014).

Figure H2.C-12. Dose-Response Curves for Avian Reproduction Endpoint for Methylmercury



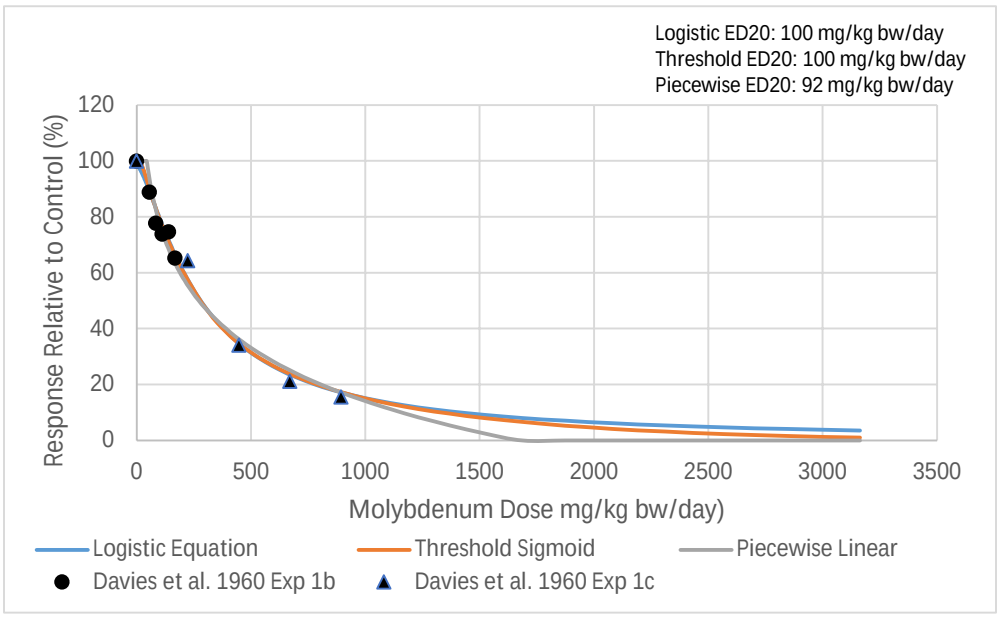
Note: Model based on log-transformed data from Varian-Ramos et al. (2014).

Figure H2.C-13. Dose-Response Curves for Avian Reproduction Endpoint for Methylmercury



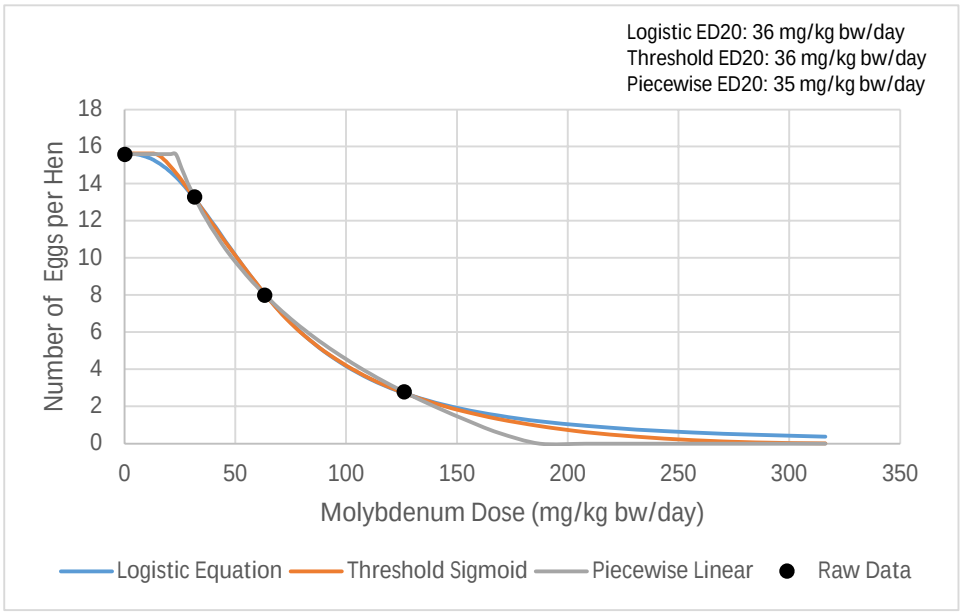
Note: Model based on log-transformed data from Varian-Ramos et al. (2014).

Figure H2.C-14. Dose-Response Curves for Avian Reproduction Endpoint for Methylmercury



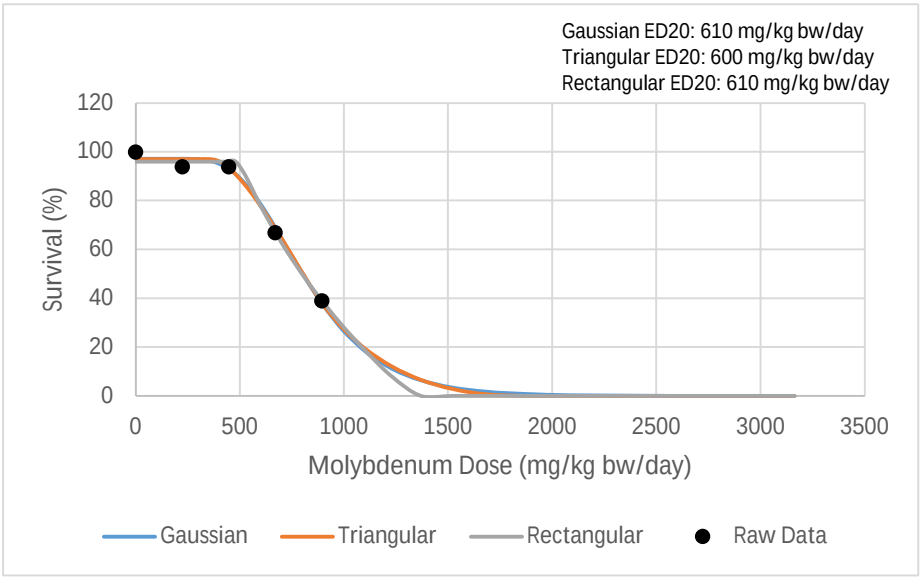
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-15. Dose-Response Curves for Avian Growth Endpoint for Molybdenum



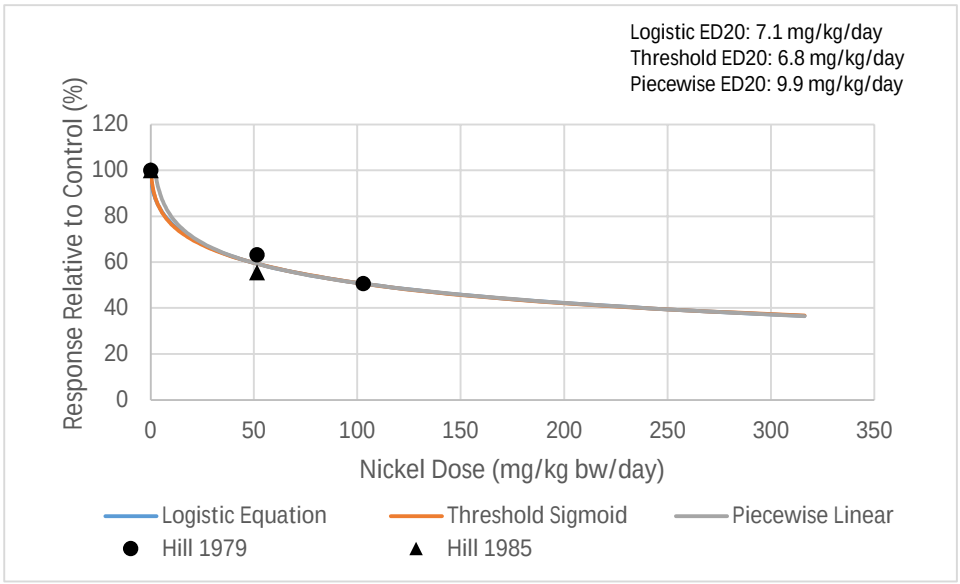
Note: Model based on log-transformed data from Lepore and Miller (1965) (egg production).

Figure H2.C-16. Dose-Response Curves for Avian Reproduction Endpoint for Molybdenum



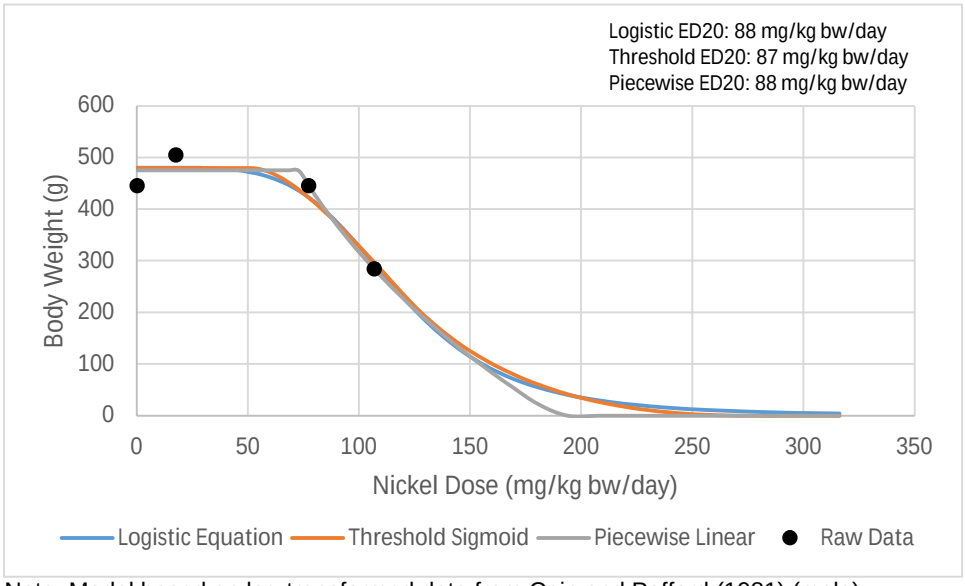
Note: Model based on log-transformed data from Davies et al. (1960) (Experiment 1c).

Figure H2.C-17. Dose-Response Curves for Avian Survival Endpoint for Molybdenum



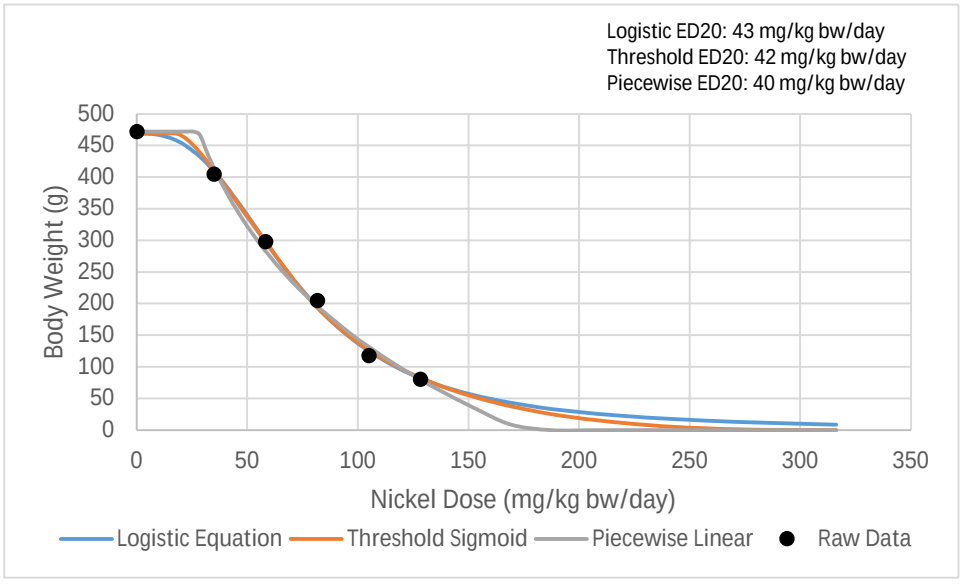
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-18. Dose-Response Curves for Avian Growth Endpoint for Nickel



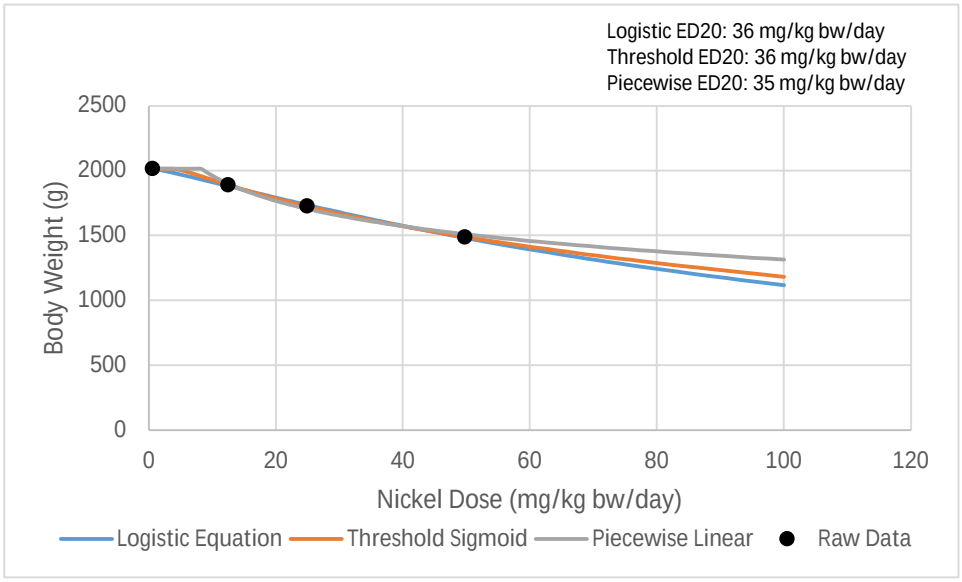
Note: Model based on log-transformed data from Cain and Pafford (1981) (male).

Figure H2.C-19. Dose-Response Curves for Mallard Growth Endpoint for Nickel



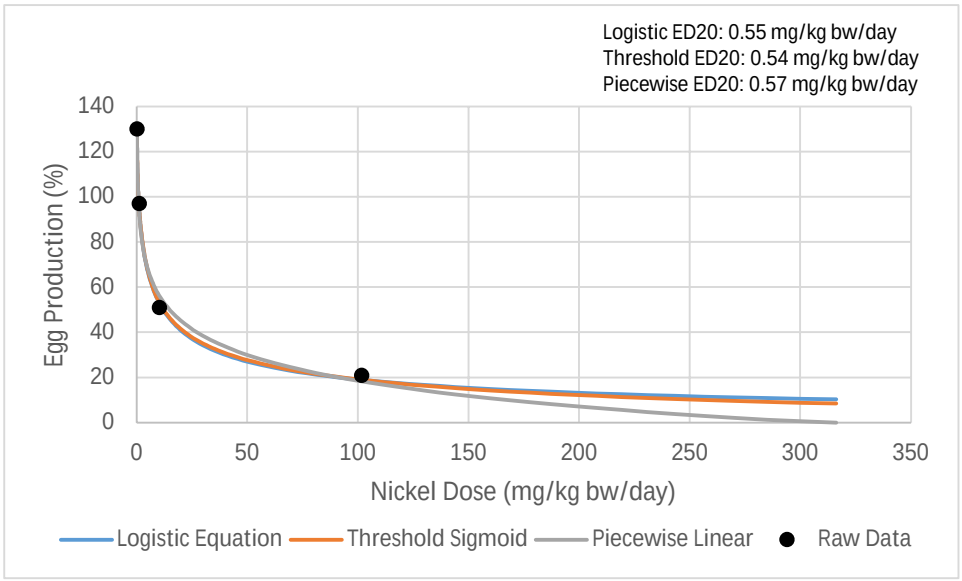
Note: Model based on log-transformed data from Ling and Leach (1979).

Figure H2.C-20. Dose-Response Curves for Avian Growth Endpoint for Nickel



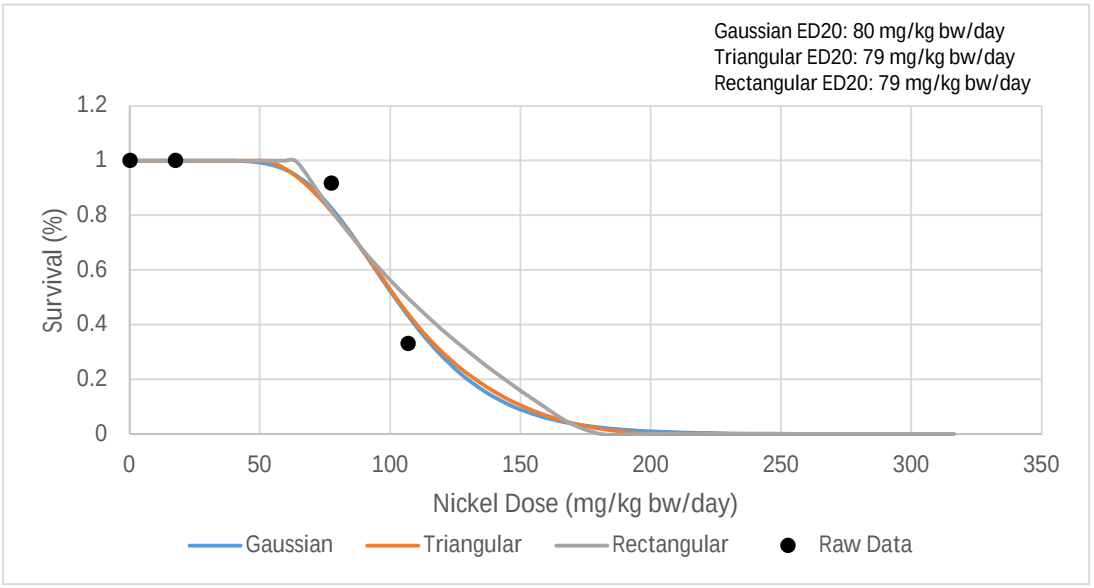
Note: Model based on log-transformed data from Martinez and Diaz (1996).

Figure H2.C-21. Dose-Response Curves for Avian Growth Endpoint for Nickel



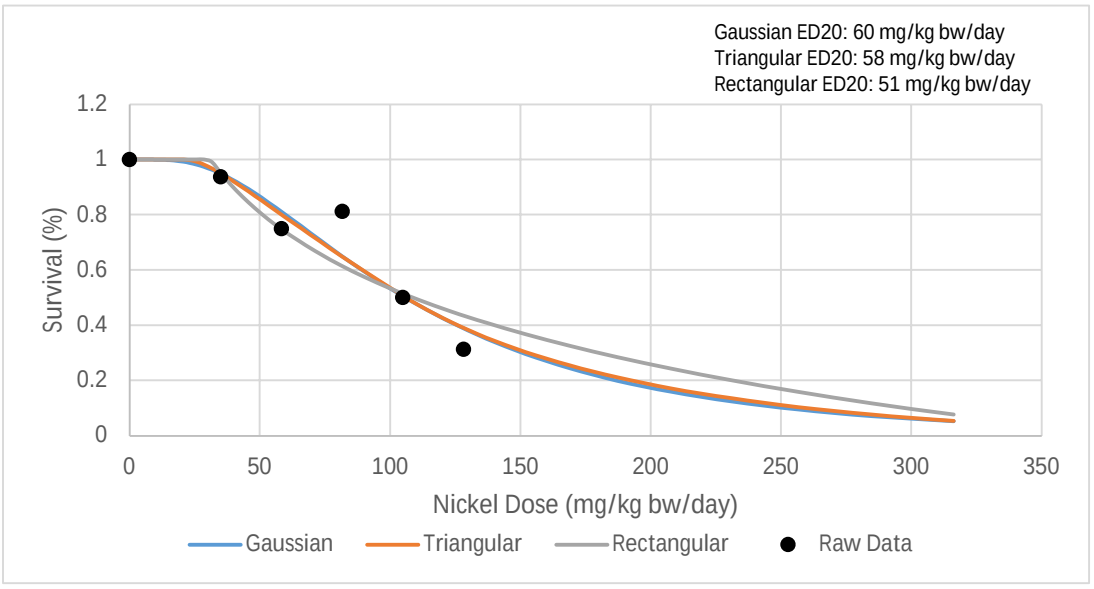
Note: Model based on log-transformed data from Arpasova et al. (2007).

Figure H2.C-22. Dose-Response Curves for Avian Reproduction Endpoint for Nickel



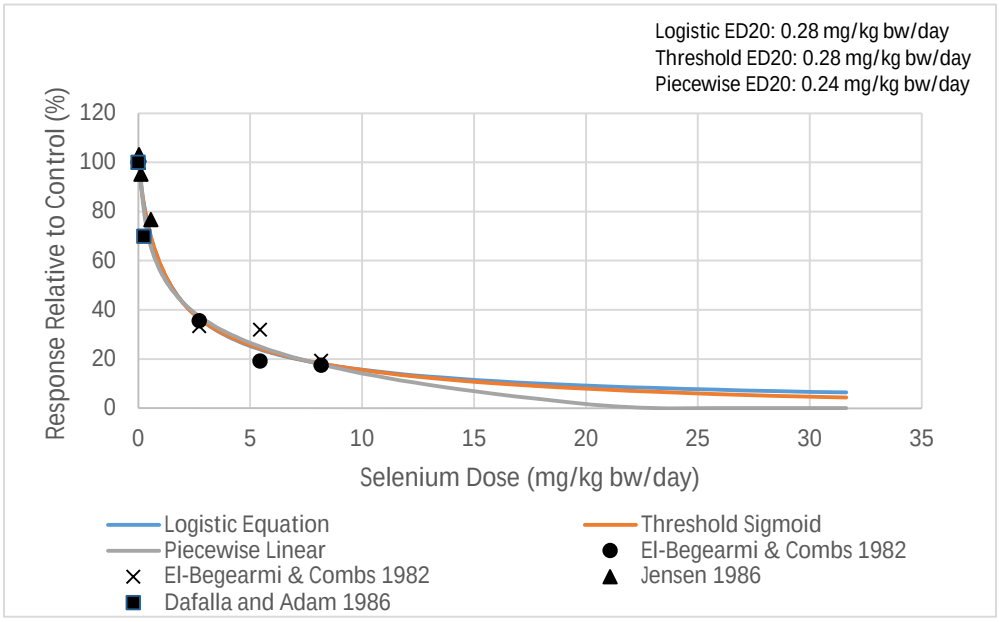
Note: Model based on log-transformed data from Cain and Pafford (1981).

Figure H2.C-23. Dose-Response Curves for Mallard Survival Endpoint for Nickel



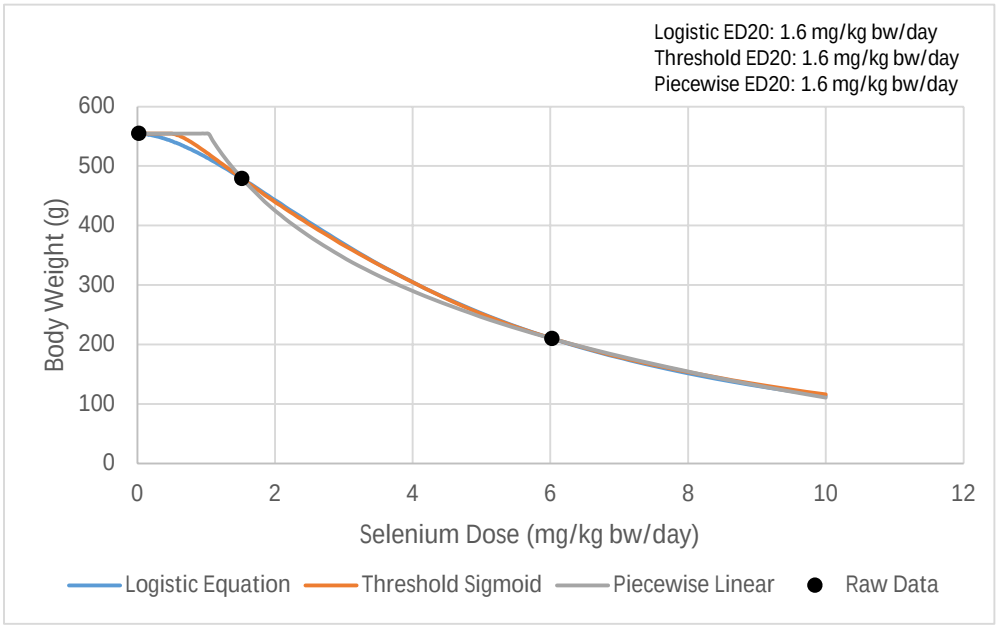
Note: Model based on log-transformed data from Ling and Leach (1979).

Figure H2.C-24. Dose-Response Curves for Avian Survival Endpoint for Nickel



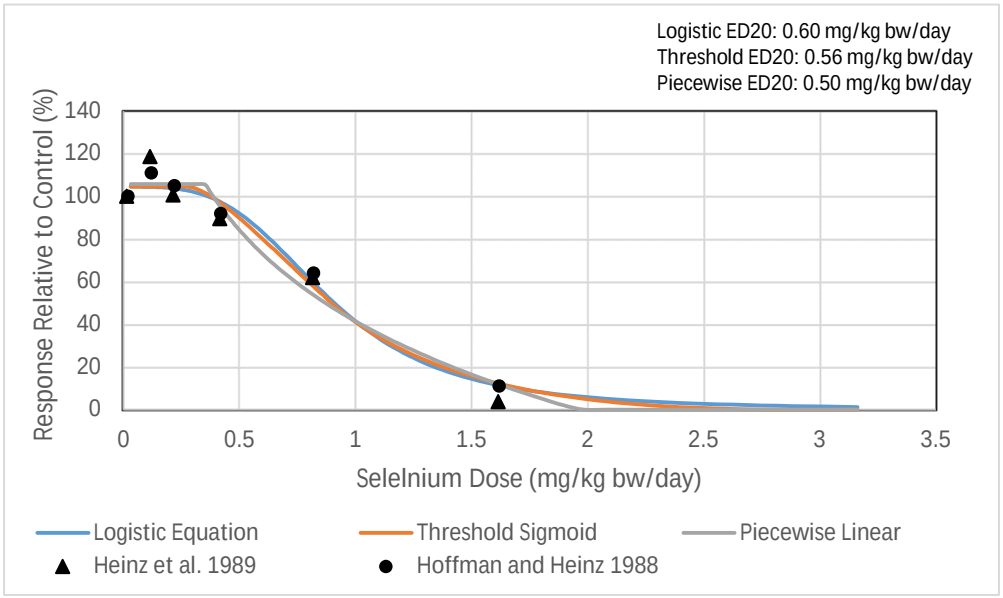
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-25. Dose-Response Curves for Avian Growth Endpoint for Selenium



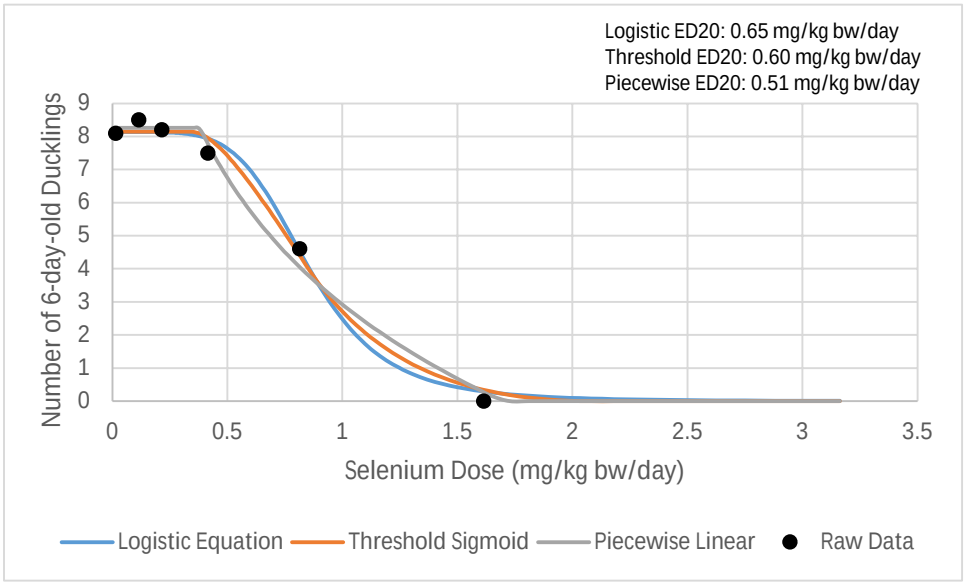
Note: Model based on log-transformed data from Hoffman et al. (1992).

Figure H2.C-26. Dose-Response Curves for Mallard Growth Endpoint for Selenium



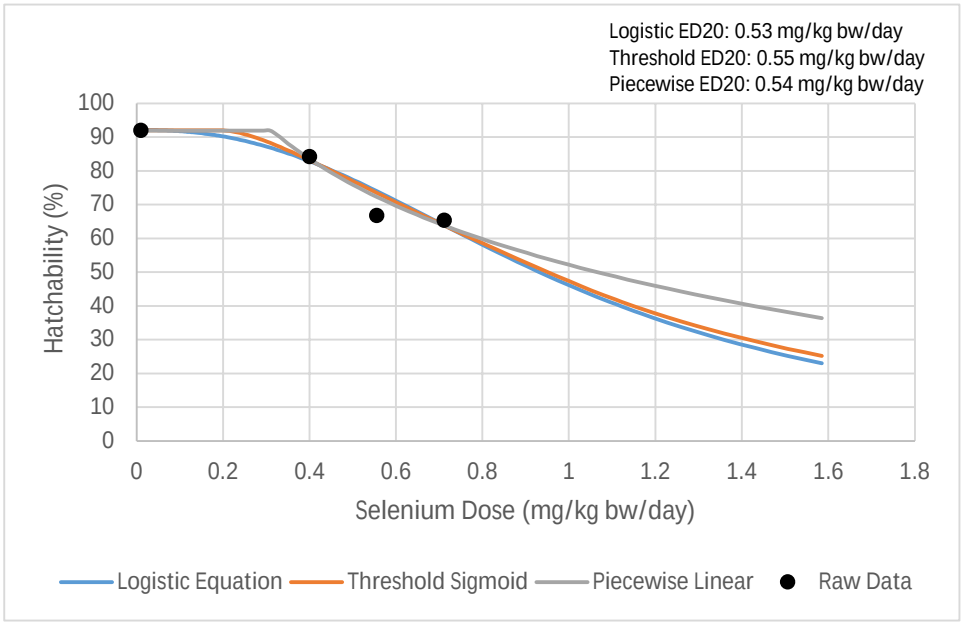
Note: Model based on log-transformed data from pooling group E.

Figure H2.C-27. Dose-Response Curves for Mallard Reproduction Endpoint for Selenium



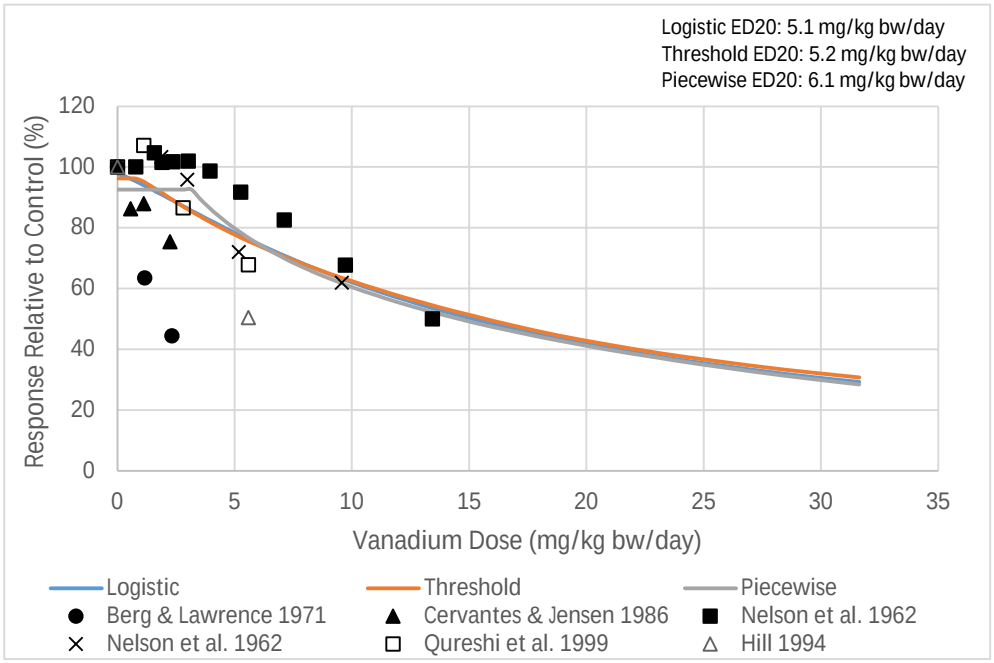
Note: Model based on log-transformed data from Heinz et al. (1989).

Figure H2.C-28. Dose-Response Curves for Mallard Reproduction Endpoint for Selenium



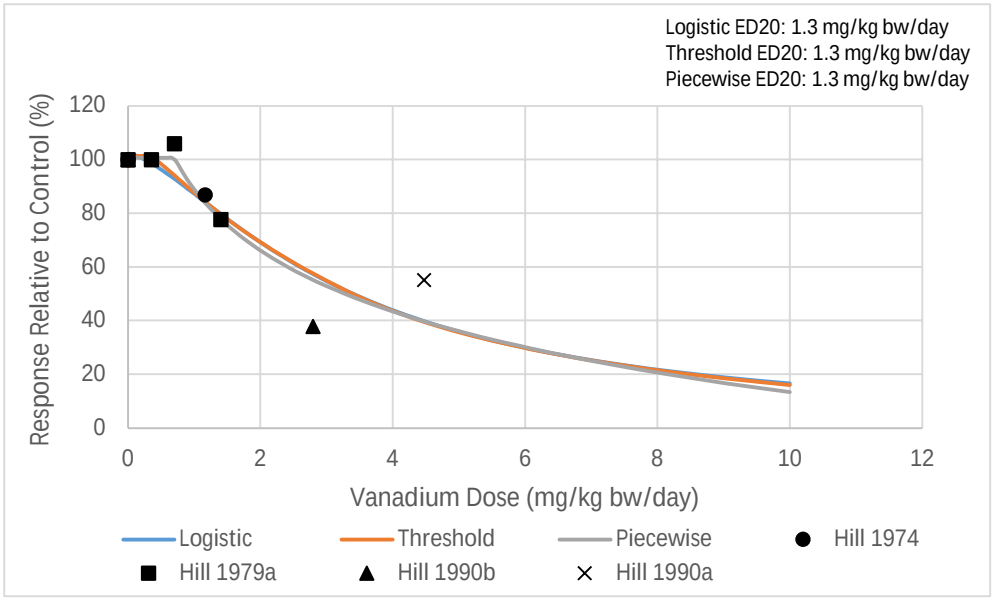
Note: Model based on log-transformed data from Ort and Latshaw (1978).

Figure H2.C-29. Dose-Response Curves for Avian Reproduction Endpoint for Selenium



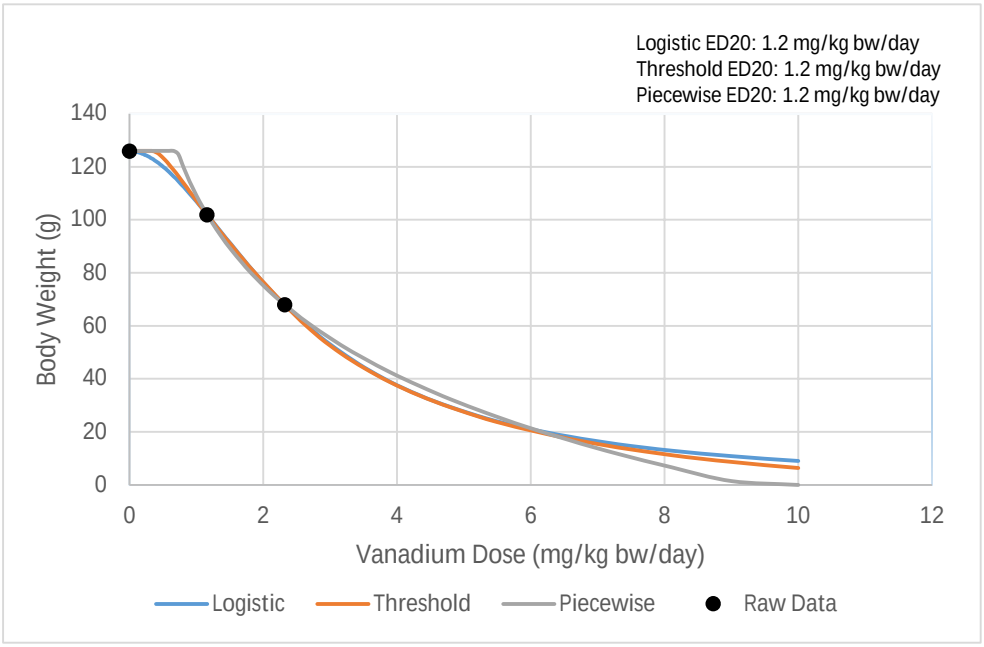
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-30. Dose-Response Curves for Avian Growth Endpoint for Vanadium



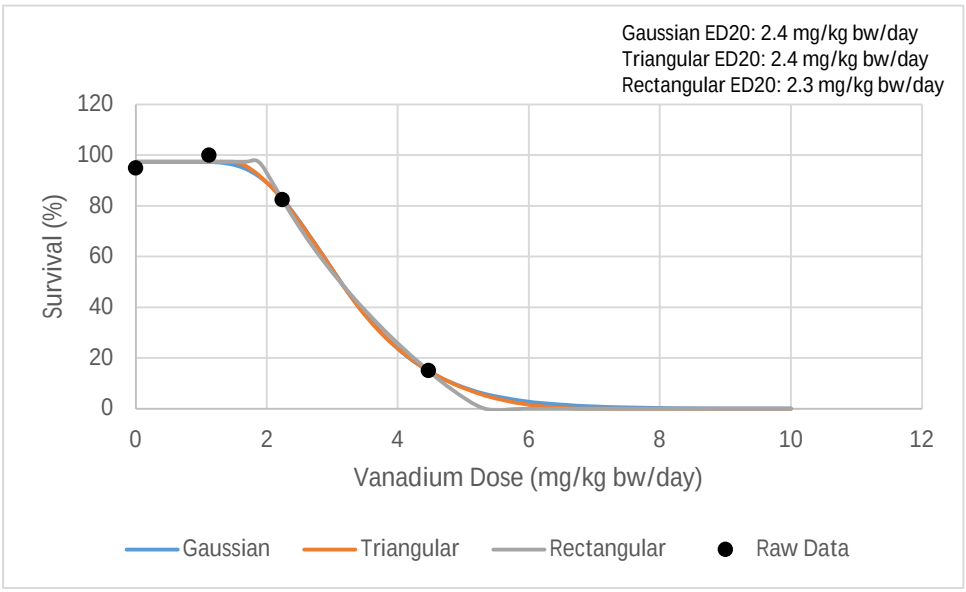
Note: Model based on log-transformed data from pooling group B.

Figure H2.C-31. Dose-Response Curves for Avian Growth Endpoint for Vanadium



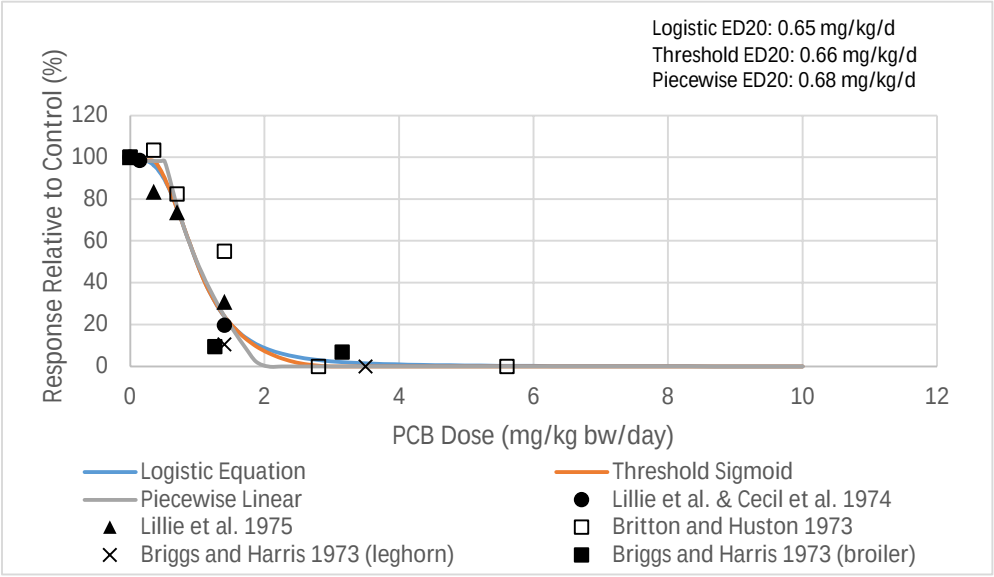
Note: Model based on log-transformed data from Berg and Lawrence (1971).

Figure H2.C-32. Dose-Response Curves for Avian Growth Endpoint for Vanadium



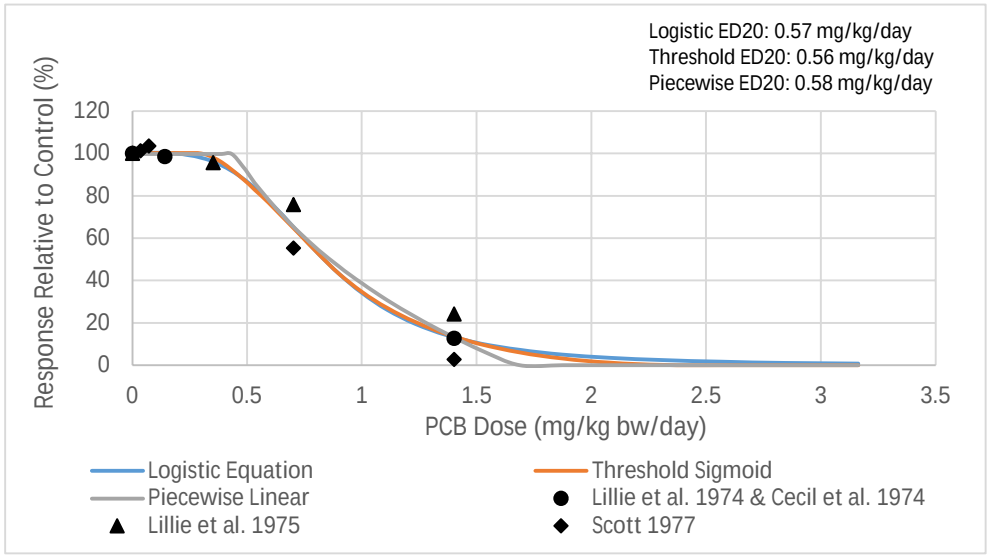
Note: Model based on log-transformed data from Blalock and Hill (1987).

Figure H2.C-33. Dose-Response Curves for Avian Survival Endpoint for Vanadium



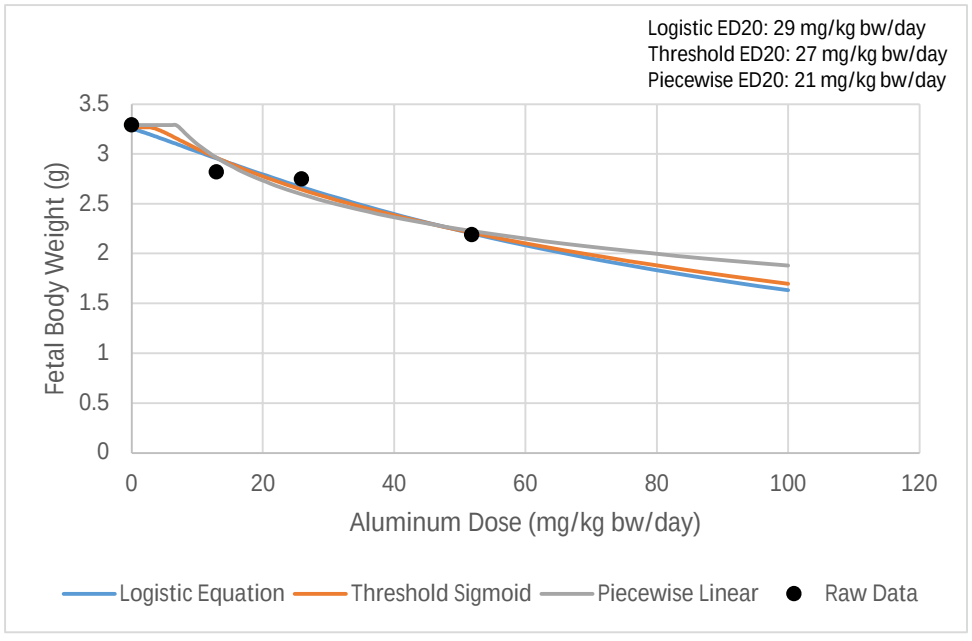
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-34. Dose-Response Curves for Avian Reproduction Endpoint for PCBs



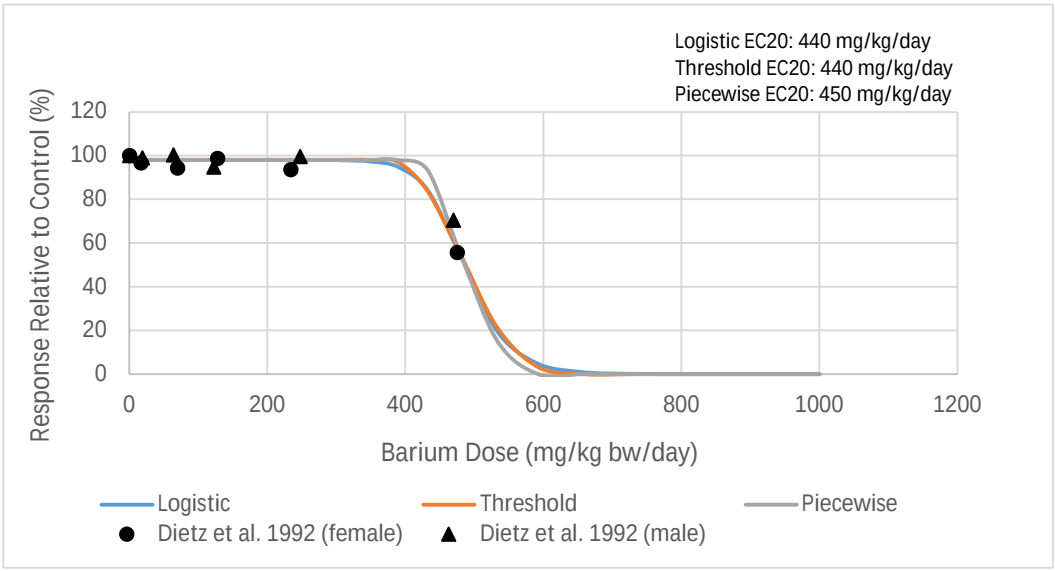
Note: Model based on log-transformed data from pooling group B.

Figure H2.C-35. Dose-Response Curves for Avian Reproduction Endpoint for PCBs



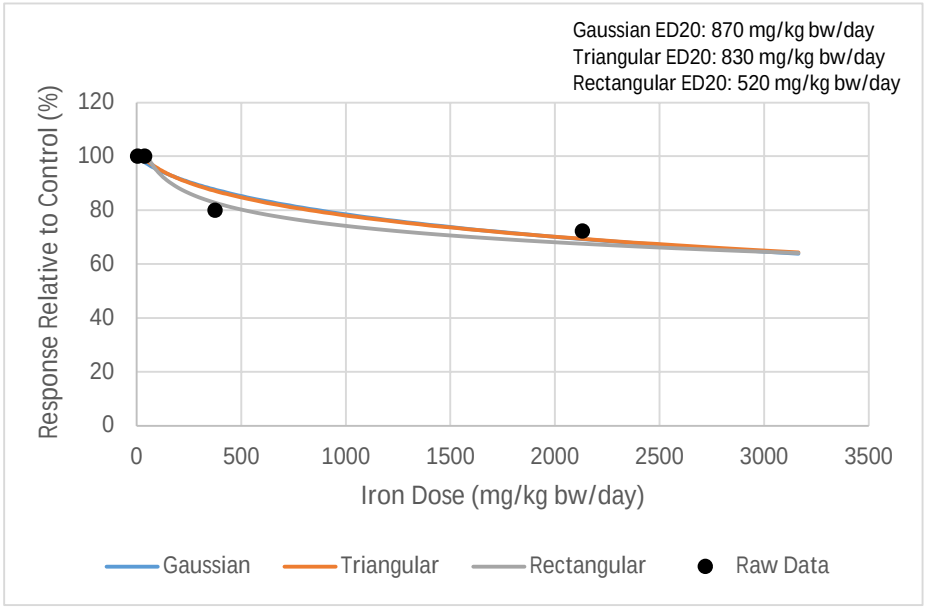
Note: Model based on log-transformed data from Paternain et al. (1988).

Figure H2.C-36. Dose-Response Curves for Mammalian Reproduction Endpoint for Aluminum



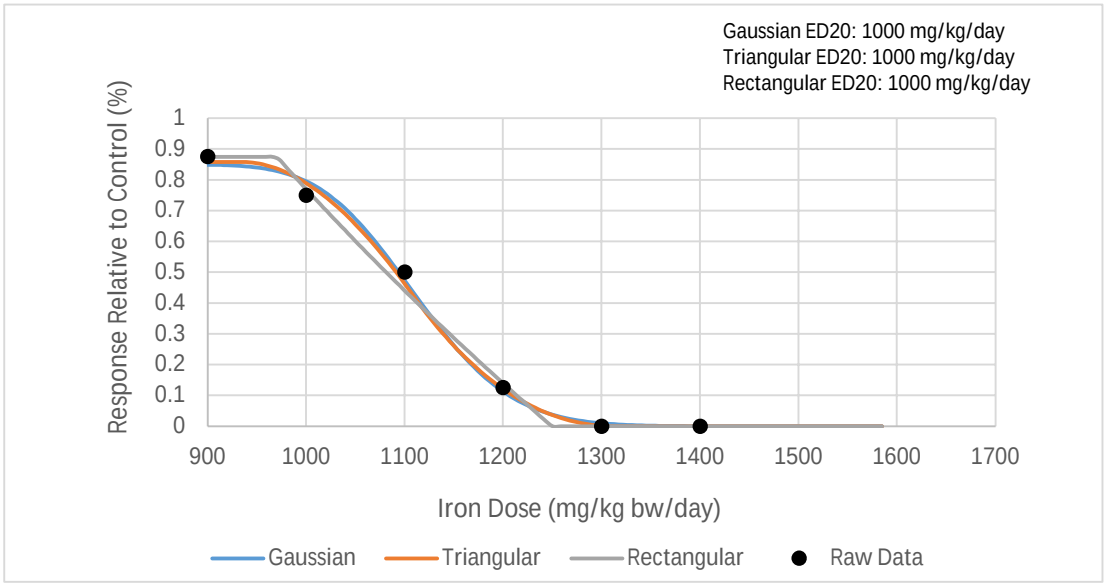
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-37. Dose-Response Curves for Mammalian Growth Endpoint for Barium



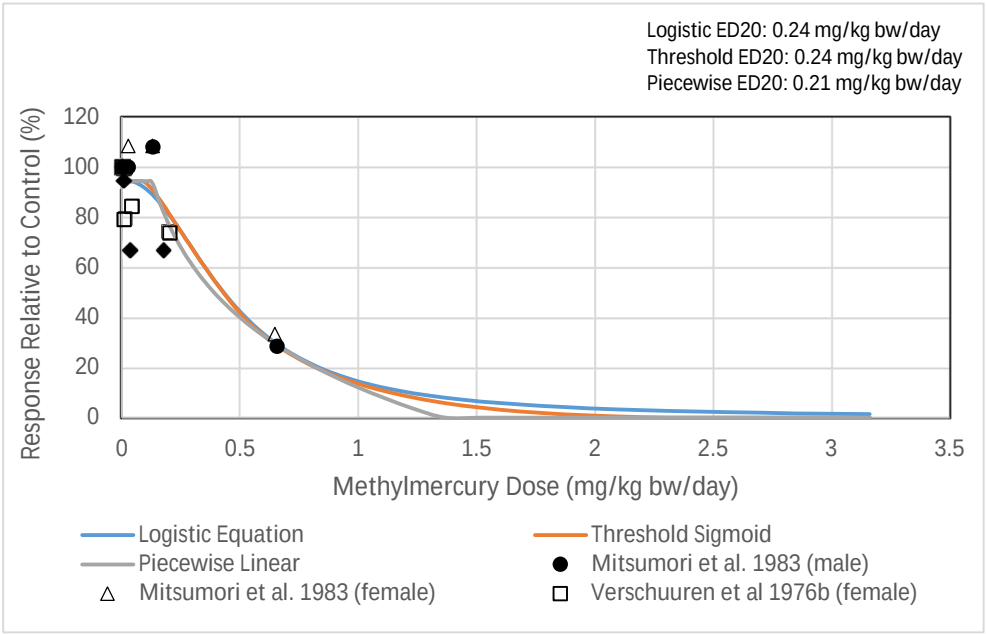
Note: Model based on log-transformed data from Whittaker et al. (1996).

Figure H2.C-38. Dose-Response Curves for Mammalian Survival Endpoint for Iron



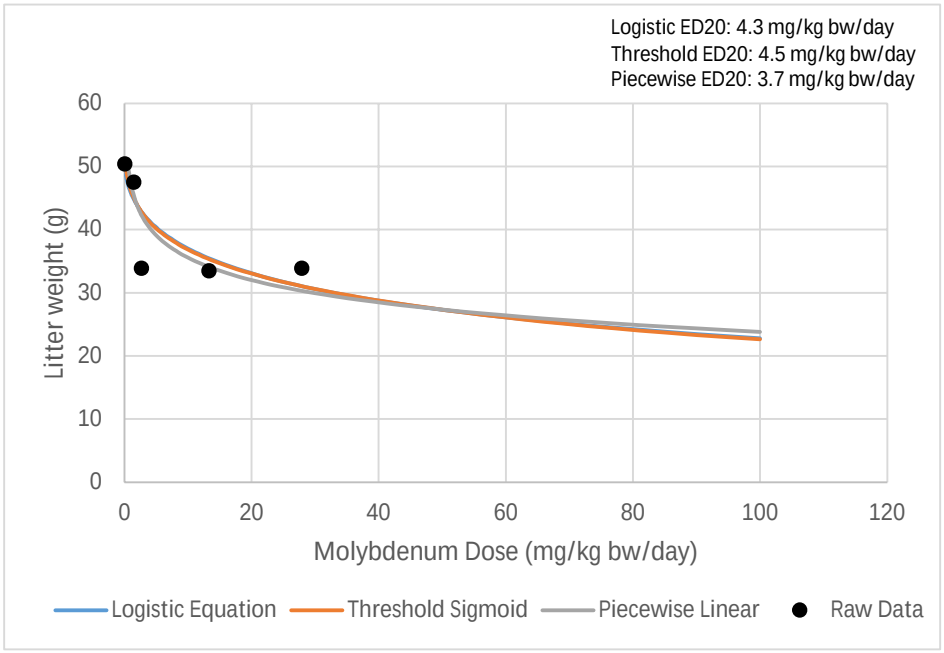
Note: Model based on log-transformed data from Whittaker et al. (2002).

Figure H2.C-39. Dose-Response Curves for Mammalian Survival Endpoint for Iron



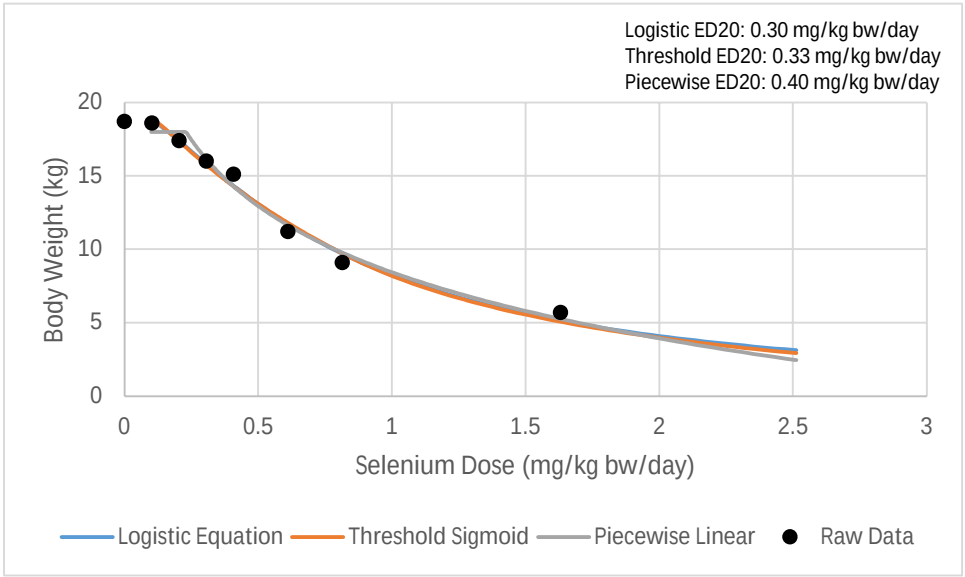
Note: Model based on log-transformed data from pooling group E.

Figure H2.C-40. Dose-Response Curves for Mammalian Survival Endpoint for Methylmercury



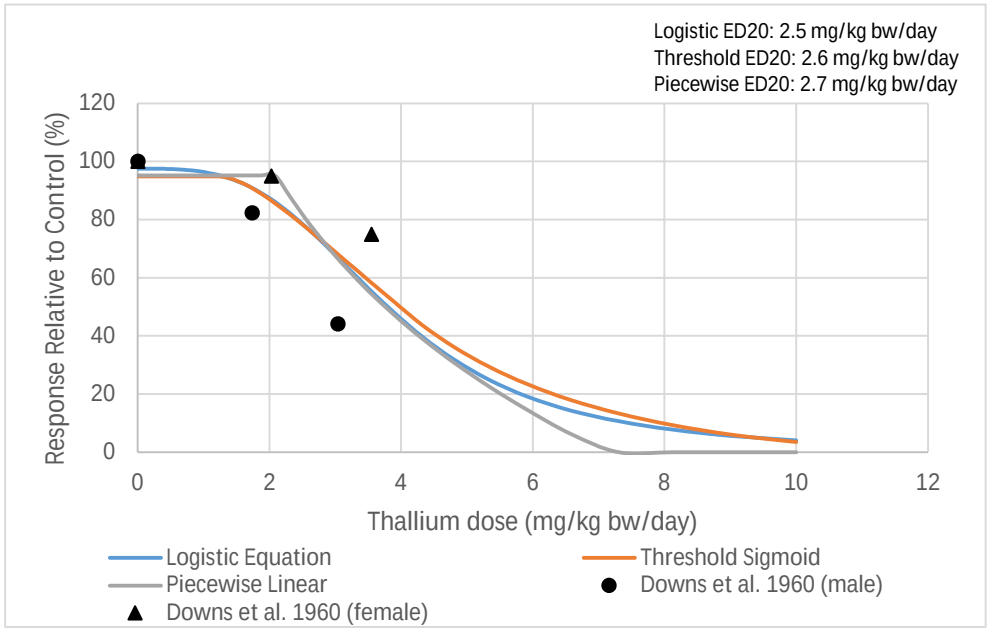
Note: Model based on log-transformed data from Fungwe et al. (1990).

Figure H2.C-41. Dose-Response Curves for Mammalian Reproduction Endpoint for Molybdenum



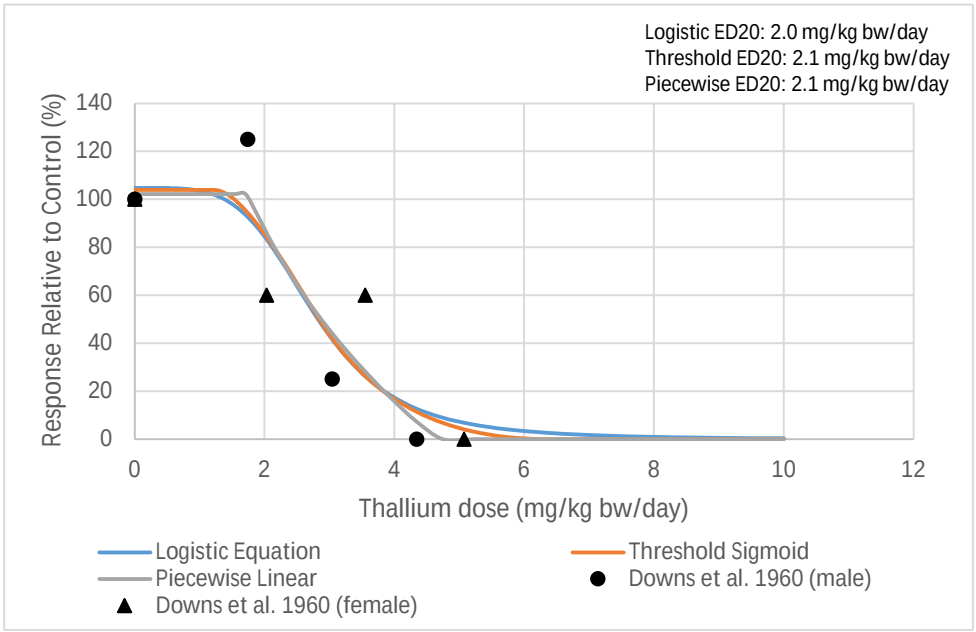
Note: Model based on log-transformed data from Mahan and Moxon (1984).

Figure H2.C-42. Dose-Response Curves for Mammalian Growth Endpoint for Selenium



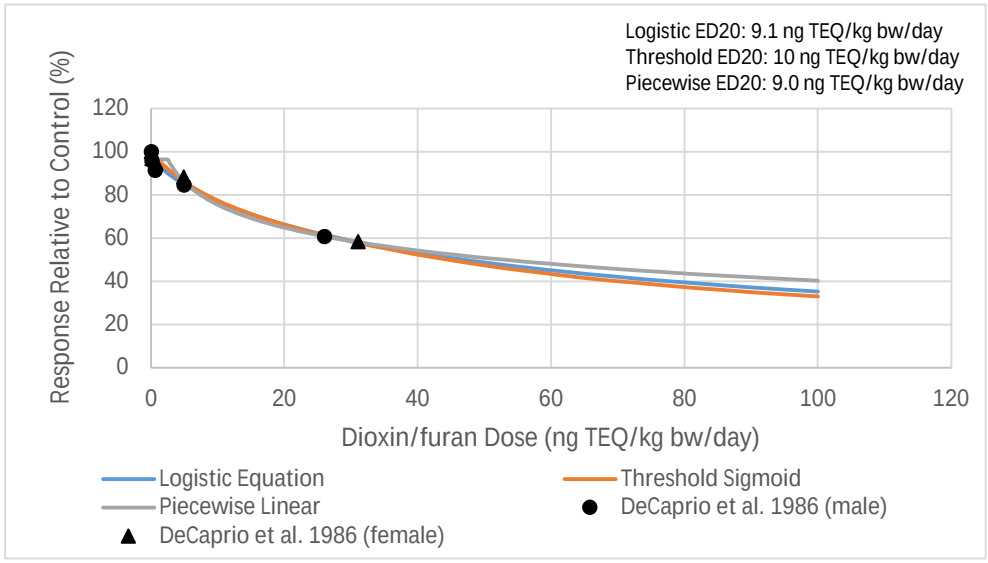
Note: Model based on log-transformed data from pooling group A.

Figure H2.C-43. Dose-Response Curves for Mammalian Growth Endpoint for Thallium



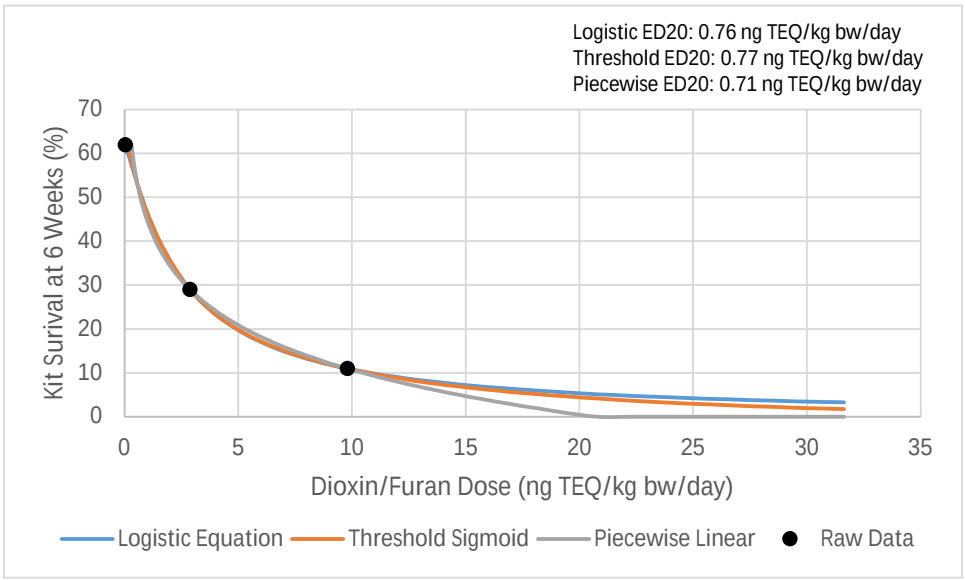
Note: Model based on log-transformed data from pooling group B.

Figure H2.C-44. Dose-Response Curves for Mammalian Survival Endpoint for Thallium



Note: Model based on log-transformed data from pooling group A.

Figure H2.C-45. Dose-Response Curves for Mammalian Growth Endpoint for Dioxin/Furan



Note: Model based on log-transformed data from Hochstein et al. (2001).

Figure H2.C-46. Dose-Response Curves for Mammalian Reproduction Endpoint for Dioxin/Furan

ANNEX D

DOSE-RESPONSE MODEL PARAMETERS AND EFFECT VALUES

Table H2.D-1. TRAP Output for TRVs Based on ED20s

TRAP Output Table	Receptor Group	Endpoint	ED20 TRV	Data Source(s) [a]	Selected Model	Number of Data Points	Dose-Response Model Parameters [b]			Dose-Response Effect Values			ED20 Confidence Limits [c]		Units for TRVs, Effect Values, and Confidence Limits
							Log X50	S	Y0	ED20	ED50	ED80	95 LCL	95 UCL	
Aluminum															
H2.D-2a	bird	growth	150	Capdevielle and Scanes (1995a)	threshold sigmoid, log	3	2.752	0.6488	610.0	150	560	2100	NC	NC	mg/kg bw/day
H2.D-2b	mammal	reproduction	27	Paternain et al. (1988)	threshold sigmoid, log	4	2.031	0.6170	3.268	27	110	420	NC	NC	mg/kg bw/day
Arsenic															
H2.D-3	bird	survival	6.9	Albert et al. (2008b)	gaussian, log	7	0.9991	0.1919	0.9544	6.9	10	14	5.4	8.7	mg/kg bw/day
Barium															
H2.D-4a	bird	growth	480	Johnson et al. (1960)	threshold sigmoid, log	7	2.953	1.360	433.0	480	900	1700	380	610	mg/kg bw/day
H2.D-4b	mammal	growth	440	pooling group A: Dietz et al. (1992) (two datasets)	threshold sigmoid, log	12	2.688	8.761	98.08	440	490	540	350	570	mg/kg bw/day
Cadmium															
H2.D-5a	bird	growth	2.0	Bokori et al. (1995b)	threshold sigmoid, log	4	0.9659	0.5510	1.480	2.0	9.2	43	NC	NC	mg/kg bw/day
H2.D-5b	mallard	growth	41	DiGiulio and Scanlon (1984)	threshold sigmoid, log	4	2.189	0.6410	1.213	41	150	580	NC	NC	mg/kg bw/day
H2.D-5c	bird	reproduction	2.3	Leach et al. (1979)	threshold sigmoid, log	4	1.022	0.5640	66.60	2.3	11	47	NC	NC	mg/kg bw/day
H2.D-5d	bird	survival	7.4	pooling group C: Bokori et al. (1995a); Olgun (2015)	threshold sigmoid, log	10	1.343	0.7770	102.0	7.4	22	65	2.7	20	mg/kg bw/day
H2.D-5e	mammal	growth	4.2	Wilson et al. (1941)	threshold sigmoid, log	6	1.250	0.5850	0.1990	4.2	18	76	2.0	8.7	mg/kg bw/day
H2.D-5f	mammal	reproduction	2.7	Sutou et al. (1980)	threshold sigmoid, log	4	1.022	0.6230	14.00	2.7	11	41	NC	NC	mg/kg bw/day
H2.D-5g	mammal	survival	1.5	Swiergosz et al. (1998)	gaussian, log	3	1.032	1.010	0.8716	1.5	11	76	NC	NC	mg/kg bw/day
Copper															
H2.D-6a	bird	growth	62	pooling group D: Poupoulis and Jensen (1976) (three data sets); Wang et al. (1987) (two data sets)	threshold sigmoid, log	18	2.019	1.610	100.0	62	100	180	53	72	mg/kg bw/day
H2.D-6b	bird	reproduction	28	pooling group A: Chiou et al. (1997); Harms and Buresh (1986); Pearce et al. (1983); Stevenson and Jackson (1980a); Stevenson and Jackson (1980b)	threshold sigmoid, log	21	1.624	2.090	102.1	28	42	63	22	35	mg/kg bw/day
H2.D-6c	bird	survival	67	Mehring et al. (1960)	gaussian, log	5	2.025	0.2390	0.9623	67	110	170	47	93	mg/kg bw/day
H2.D-6d	mammal	growth	12	Allcroft et al. (1961)	threshold sigmoid, log	4	1.168	3.450	1.240	12	15	19	NC	NC	mg/kg bw/day
Iron															
H2.D-7a	bird	survival	1100	pooling group A: Pescatore and Harter-Dennis (1989); Wallner-Pendleton et al. (1986)	threshold sigmoid, log	11	3.289	1.490	99.50	1100	1900	3400	620	1900	mg/kg bw/day
			NA	Pescatore and Harter-Dennis (1989)	threshold sigmoid, log	6	3.167	2.230	99.70	1000	1500	NA	820	1200	mg/kg bw/day
			NA	Wallner-Pendleton et al. (1986)	threshold sigmoid, log	5	NC	NC	NC	NC	NC	NC	NC	NC	mg/kg bw/day
H2.D-7b	mammal	survival	870	Whittaker et al. (1996)	gaussian, log	4	3.911	1.150	0.9999	870	8100	75000	NC	NC	mg/kg bw/day
Lead															
H2.D-8a	bird	survival	11	pooling group F: Anders et al. (1982); Barthalmus et al. (1977)	threshold sigmoid, log	6	1.410	1.040	99.58	11	26	58	5.5	24	mg/kg bw/day
H2.D-8b	mammal	survival	7.6	Lorenzo et al. (1978)	gaussian, log	5	1.068	0.2200	0.8260	7.6	12	18	5.9	9.9	mg/kg bw/day
Methylmercury															
H2.D-9a	bird	growth	0.97	Scott et al. (1975)	threshold sigmoid, log	3	0.3518	1.002	1.664	0.97	2.2	5.2	NC	NC	mg/kg bw/day
H2.D-9b	bird	reproduction	0.012	Varian-Ramos et al. (2014)	threshold sigmoid, log	5	-0.5377	0.2672	13.03	0.012	0.29	6.9	NC	NC	mg/kg bw/day
H2.D-9c	kestrel	reproduction	0.25	Albers et al. (2007)	threshold sigmoid, log	6	-0.4611	2.470	1.965	0.25	0.35	0.49	NC	NC	mg/kg bw/day
H2.D-9d	mallard	reproduction	0.68	pooling group B: Heinz and Hoffman (1998); Heinz et al. (2010)	threshold sigmoid, log	7	-0.0573	3.364	97.00	0.68	0.88	1.1	NC	NC	mg/kg bw/day
H2.D-9e	mammal	survival	0.24	pooling group E: Mitsumori et al. (1983) (two data sets); Verschuuren et al. (1976b) (two data sets)	threshold sigmoid, log	16	-0.3457	1.345	94.43	0.24	0.45	0.85	0.13	0.44	mg/kg bw/day

Table H2.D-1. TRAP Output for TRVs Based on ED20s

TRAP Output Table	Receptor Group	Endpoint	ED20 TRV	Data Source(s) [a]	Selected Model	Number of Data Points	Dose-Response Model Parameters [b]			Dose-Response Effect Values			ED20 Confidence Limits [c]		Units for TRVs, Effect Values, and Confidence Limits
							Log X50	S	Y0	ED20	ED50	ED80	95 LCL	95 UCL	
Molybdenum															
H2.D-10a	bird	growth	100	pooling group A: Davies et al. (1960) (two data sets)	threshold sigmoid, log	11	2.453	0.8180	98.80	100	280	800	77	130	mg/kg bw/day
			NA	Davies et al. (1960) (Experiment 1b)	threshold sigmoid, log	6	2.514	0.6370	100.0	86	330	NC	49	150	mg/kg bw/day
			NA	Davies et al. (1960) (Experiment 1c)	threshold sigmoid, log	5	2.494	1.0200	100.0	140	310	NC	100	180	mg/kg bw/day
H2.D-10b	bird	reproduction	36	Lepore and Miller (1965)	threshold sigmoid, log	4	1.812	1.4200	15.60	36	65	120	NC	NC	mg/kg bw/day
H2.D-10c	bird	survival	610	Davies et al. (1960)	gaussian, log	5	2.909	0.1500	0.9715	610	810	1100	480	770	mg/kg bw/day
H2.D-10d	mammal	reproduction	4.5	Fungwe et al. (1990)	threshold sigmoid, log	5	1.821	0.3140	50.85	4.5	66	980	NC	NC	mg/kg bw/day
Nickel															
H2.D-11a	bird	growth	6.8	pooling group A: Hill (1979); Hill (1985)	threshold sigmoid, log	5	2.034	0.3052	100.0	6.800	110	1700	NC	NC	mg/kg bw/day
H2.D-11b	mallard	growth	87	Cain and Pafford (1981)	threshold sigmoid, log	4	2.075	2.743	479.5	87.00	120	160	NC	NC	mg/kg bw/day
H2.D-11c	bird	reproduction	0.54 [d]	Arpasova et al. (2007)	threshold sigmoid, log	4	0.7449	0.3643	130.4	0.5400	NA	NA	NC	NC	mg/kg bw/day
H2.D-11d	bird	survival	60	Ling and Leach (1979)	gaussian, log	6	2.025	0.2938	1.000	60.00	110	190	44	81	mg/kg bw/day
H2.D-11e	mallard	survival	80	Cain and Pafford (1981)	gaussian, log	4	2.007	0.1258	1.000	80.00	100	130	NC	NC	mg/kg bw/day
Selenium															
H2.D-12a	bird	growth	0.28 [d]	pooling group A: El-Begearmi and Combs (1982) (two data sets); Jensen (1986); Dafalla and Adam (1986)	threshold sigmoid, log	15	0.1487	0.5236	101.0	0.28	1.4	7.1	0.16	0.49	mg/kg bw/day
H2.D-12b	mallard	growth	1.6	Hoffman et al. (1992)	threshold sigmoid, log	3	0.2887	4.005	561.6	1.6	1.9	2.4	NC	NC	mg/kg bw/day
H2.D-12c	bird	reproduction	0.55	Ort and Latshaw (1978)	threshold sigmoid, log	4	0.0108	1.371	92.08	0.55	1.0	1.9	NC	NC	mg/kg bw/day
H2.D-12d	mallard	reproduction	0.56	pooling group E: Heinz et al. (1989); Hoffman and Heinz (1988)	threshold sigmoid, log	12	-0.0590	1.930	104.7	0.56	0.9	1.4	0.45	0.7	mg/kg bw/day
H2.D-12e	mammal	growth	0.33	Mahan and Moxon (1984)	threshold sigmoid, log	8	-0.0804	0.9294	19.15	0.33	0.83	2.1	0.19	0.58	mg/kg bw/day
Thallium															
H2.D-13a	mammal	growth	2.6	pooling group A: Downs et al. (1960) (two data sets)	threshold sigmoid, log	6	0.6147	1.890	94.90	2.6	4.1	6.4	NC	NC	mg/kg bw/day
H2.D-13b	mammal	survival	2.1	pooling group B: Downs et al. (1960) (two data sets)	threshold sigmoid, log	8	0.4466	2.775	104.0	2.1	2.8	3.8	NC	NC	mg/kg bw/day
Vanadium															
H2.D-14a	bird	growth	1.2	Berg and Lawrence (1971)	threshold sigmoid, log	3	0.4012	1.140	126.0	1.2	2.5	5.3	NC	NC	mg/kg bw/day
H2.D-14b	bird	survival	2.4	Blalock and Hill (1987)	gaussian, log	4	0.5004	0.1457	0.9747	2.4	3.2	4.2	NC	NC	mg/kg bw/day
Zinc															
H2.D-15a	mallard	growth	200	Gasaway and Buss (1972)	piecewise, log	5	3.126	0.3670	102.0	200	1300	8800	NC	NC	mg/kg bw/day
H2.D-15b	bird	reproduction	77	Gibson et al. (1986)	threshold sigmoid, log	6	2.052	2.230	6.418	77	110	160	57	100	mg/kg bw/day
PCBs															
H2-D-17	bird	reproduction	0.56	pooling group B: Lillie et al. (1974) and Cecil et al. (1974); Lillie et al. (1975); Scott (1977)	threshold sigmoid, log	12	-0.07909	2.130	100.2	0.56	0.83	1.2	NC	NC	mg/kg bw/day
Dioxin/Furan															
H2.D-16a	mammal	growth	10	pooling group A: DeCaprio et al. (1986) (two data sets)	threshold sigmoid, log	10	1.684	0.5452	96.42	10	48	230	7.2	14	ng TEQ/kg bw/day
H2.D-16b	mammal	reproduction	0.77	Hochstein et al. (2001)	threshold sigmoid, log	3	0.4132	0.6997	62.00	0.77	2.6	8.7	NC	NC	ng TEQ/kg bw/day

Notes:

[a] References are cited in Attachment H1 or Attachment H2.

[b] Dose-Response model parameter values are those calculated using EPA's Toxicity Relationship Analysis Program (TRAP).

[c] For pooled data sets, confidence limits were calculated for the individual data sets for comparison purposes if at least two of the data sets had five or more data points. Confidence limits calculated by TRAP are not reliable unless there are at least five data points.

[d] Selected toxicity reference value (TRV) is based on the ecological soil screening level (Eco-SSL) instead of the ED20.

95 LCL - 95 percent lower confidence limit of the mean

95 UCL - 95 percent upper confidence limit of the mean

ED20 - modeled effective dose with a 20 percent reduction in the response relative to the control, as provided by TRAP

ED50 - modeled effective dose with a 50 percent reduction in the response relative to the control, as provided by TRAP

Table H2.D-1. TRAP Output for TRVs Based on ED20s

TRAP Output Table	Receptor Group	Endpoint	ED20 TRV	Data Source(s) [a]	Selected Model	Number of Data Points	Dose-Response Model Parameters [b]			Dose-Response Effect Values			ED20 Confidence Limits [c]		Units for TRVs, Effect Values, and Confidence Limits
							Log X50	S	Y0	ED20	ED50	ED80	95 LCL	95 UCL	

ED80 - modeled effective dose with a 80 eprcent reduction in the response relative to the control, as calculated using the dose-response model provided by TRAP

NA - not applicable; these values or calculations are only presented for data sets used to derive TRVs

NC - not calculated; warning messages in TRAP indicated that the model was unreliable, error estimates could not be determined, or there was a large standard error for model parameters

S - measure of the steepness of the relationship

X50 - value associated with a 50 percent reduction in the effect variable from its control value

Y0 - control value

Table H2.D-2a. TRAP Model Output for Aluminum Data for the Bird Growth Endpoint (Capdevielle and Scanes 1995a)

Chemical:	Aluminum
Study Authors:	Capdevielle and Scanes 1995a
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
1.00E-06	610	13.4
111.67	520	13.8
558.33	307	5.45

Modeling Parameters			
Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.7522	2.7522			
S	0.62267	6.23E-01			
Y0	6.10E+02	6.10E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.7522	2.752			
S	0.62267	6.49E-01			
Y0	6.10E+02	6.10E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.7522	2.7535			
S	0.62267	0.49956			
Y0	6.10E+02	6.10E+02			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	565.14				2.7522
20	1.57E+02				2.1956
10	7.41E+01				1.87
5	3.72E+01				1.57
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	564.88				2.752
20	153.27				2.1855
10	7.94E+01				1.9
5	49.897				1.6981
0	16.244				1.21E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	566.84				2.7535
20	142.21				2.1529
10	89.693				1.9528
5	71.231				1.8527
0	56.57				1.7526

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	6.10E+02	6.10E+02
2	2.05E+00	5.20E+02	5.20E+02
3	2.75E+00	3.07E+02	3.07E+02
4			
5			
6			

Analysis of Variance

R-squared: 0.759

	DF	SS	MS	F	Sig
Total (adj)	6	4439.4	739.9		
Regression	2	3368.6	1684.3	6.2914	0.0582
Error	4	1070.8	267.71		

Prediction Line

	X	Y
1	-1	6.10E+02
2	-9.60E-01	6.10E+02
3	-9.19E-01	6.10E+02
4	-8.79E-01	6.10E+02
5	-8.38E-01	6.10E+02
6	-7.98E-01	6.10E+02
7	-7.58E-01	6.10E+02
8	-7.17E-01	6.10E+02
9	-6.77E-01	6.10E+02
10	-6.36E-01	6.10E+02
11	-5.96E-01	6.10E+02
12	-5.56E-01	6.10E+02
13	-5.15E-01	6.10E+02
14	-0.47475	6.10E+02
15	-0.43434	6.10E+02
16	-0.39394	6.10E+02
17	-0.35354	6.10E+02
18	-0.31313	6.10E+02
19	-0.27273	6.10E+02
20	-0.23232	6.10E+02
21	-1.92E-01	6.10E+02
22	-1.52E-01	6.10E+02
23	-1.11E-01	6.10E+02
24	-7.07E-02	6.09E+02
25	-3.03E-02	6.09E+02
26	1.01E-02	6.09E+02
27	5.05E-02	6.09E+02
28	9.09E-02	6.09E+02
29	1.31E-01	6.09E+02
30	1.72E-01	6.09E+02
31	0.21212	6.09E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	6.10E+02	6.10E+02
2	2.05E+00	5.20E+02	5.20E+02
3	2.75E+00	3.07E+02	3.07E+02
4			
5			
6			

R-squared: 0.759

	DF	SS	MS	F	Sig
Total (adj)	6	4439.4	739.9		
Regression	2	3368.6	1684.3	6.2914	0.0582
Error	4	1070.8	267.71		

	X	Y
1	-1	6.10E+02
2	-9.60E-01	6.10E+02
3	-9.19E-01	6.10E+02
4	-8.79E-01	6.10E+02
5	-8.38E-01	6.10E+02
6	-7.98E-01	6.10E+02
7	-7.58E-01	6.10E+02
8	-7.17E-01	6.10E+02
9	-6.77E-01	6.10E+02
10	-6.36E-01	6.10E+02
11	-5.96E-01	6.10E+02
12	-5.56E-01	6.10E+02
13	-5.15E-01	6.10E+02
14	-0.47475	6.10E+02
15	-0.43434	6.10E+02
16	-0.39394	6.10E+02
17	-0.35354	6.10E+02
18	-0.31313	6.10E+02
19	-0.27273	6.10E+02
20	-0.23232	6.10E+02
21	-1.92E-01	6.10E+02
22	-1.52E-01	6.10E+02
23	-1.11E-01	6.10E+02
24	-7.07E-02	6.10E+02
25	-3.03E-02	6.10E+02
26	1.01E-02	6.10E+02
27	5.05E-02	6.10E+02
28	9.09E-02	6.10E+02
29	1.31E-01	6.10E+02
30	1.72E-01	6.10E+02
31	0.21212	6.10E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	6.10E+02	6.10E+02
2	2.05E+00	5.20E+02	5.20E+02
3	2.75E+00	3.07E+02	3.07E+02
4			
5			
6			

R-squared: 0.759

	DF	SS	MS	F	Sig
Total (adj)	6	4439.4	739.9		
Regression	2	3368.6	1684.3	6.2914	0.0582
Error	4	1070.8	267.71		

	X	Y
1	-1	6.10E+02
2	-9.60E-01	6.10E+02
3	-9.19E-01	6.10E+02
4	-8.79E-01	6.10E+02
5	-8.38E-01	6.10E+02
6	-7.98E-01	6.10E+02
7	-7.58E-01	6.10E+02
8	-7.17E-01	6.10E+02
9	-6.77E-01	6.10E+02
10	-6.36E-01	6.10E+02
11	-5.96E-01	6.10E+02
12	-5.56E-01	6.10E+02
13	-5.15E-01	6.10E+02
14	-0.47475	6.10E+02
15	-0.43434	6.10E+02
16	-0.39394	6.10E+02
17	-0.35354	6.10E+02
18	-0.31313	6.10E+02
19	-0.27273	6.10E+02
20	-0.23232	6.10E+02
21	-1.92E-01	6.10E+02
22	-1.52E-01	6.10E+02
23	-1.11E-01	6.10E+02
24	-7.07E-02	6.10E+02
25	-3.03E-02	6.10E+02
26	1.01E-02	6.10E+02
27	5.05E-02	6.10E+02
28	9.09E-02	6.10E+02
29	1.31E-01	6.10E+02
30	1.72E-01	6.10E+02
31	0.21212	6.10E+02

Prediction Line

	X	Y
32	0.25253	6.09E+02
33	0.29293	6.09E+02
34	0.33333	6.09E+02
35	0.37374	6.08E+02
36	0.41414	6.08E+02
37	0.45455	6.08E+02
38	0.49495	6.08E+02
39	0.53535	6.08E+02
40	0.57576	6.07E+02
41	0.61616	6.07E+02
42	0.65657	6.07E+02
43	0.69697	6.06E+02
44	0.73737	6.06E+02
45	0.77778	6.06E+02
46	0.81818	6.05E+02
47	0.85859	6.05E+02
48	0.89899	6.04E+02
49	0.93939	6.03E+02
50	0.9798	6.03E+02
51	1.0202	6.02E+02
52	1.0606	6.01E+02
53	1.101	6.00E+02
54	1.1414	5.99E+02
55	1.1818	5.98E+02
56	1.2222	5.97E+02
57	1.2626	5.95E+02
58	1.303	5.94E+02
59	1.3434	5.92E+02
60	1.3838	5.90E+02
61	1.4242	5.88E+02
62	1.4646	5.86E+02
63	1.5051	5.84E+02
64	1.5455	5.81E+02
65	1.5859	5.78E+02
66	1.6263	5.75E+02
67	1.6667	5.72E+02
68	1.7071	5.68E+02
69	1.7475	5.64E+02
70	1.7879	5.59E+02
71	1.8283	5.54E+02
72	1.8687	5.49E+02
73	1.9091	5.43E+02
74	1.9495	5.37E+02
75	1.9899	5.31E+02
76	2.0303	5.23E+02
77	2.0707	5.16E+02
78	2.1111	5.07E+02
79	2.1515	4.98E+02
80	2.1919	4.89E+02
81	2.2323	4.79E+02
82	2.2727	4.68E+02

	X	Y
32	0.25253	6.10E+02
33	0.29293	6.10E+02
34	0.33333	6.10E+02
35	0.37374	6.10E+02
36	0.41414	6.10E+02
37	0.45455	6.10E+02
38	0.49495	6.10E+02
39	0.53535	6.10E+02
40	0.57576	6.10E+02
41	0.61616	6.10E+02
42	0.65657	6.10E+02
43	0.69697	6.10E+02
44	0.73737	6.10E+02
45	0.77778	6.10E+02
46	0.81818	6.10E+02
47	0.85859	6.10E+02
48	0.89899	6.10E+02
49	0.93939	6.10E+02
50	0.9798	6.10E+02
51	1.0202	6.10E+02
52	1.0606	6.10E+02
53	1.101	6.10E+02
54	1.1414	6.10E+02
55	1.1818	6.10E+02
56	1.2222	6.10E+02
57	1.2626	6.10E+02
58	1.303	6.09E+02
59	1.3434	6.08E+02
60	1.3838	6.06E+02
61	1.4242	6.04E+02
62	1.4646	6.02E+02
63	1.5051	5.99E+02
64	1.5455	5.96E+02
65	1.5859	5.92E+02
66	1.6263	5.88E+02
67	1.6667	5.83E+02
68	1.7071	5.78E+02
69	1.7475	5.73E+02
70	1.7879	5.67E+02
71	1.8283	5.61E+02
72	1.8687	5.54E+02
73	1.9091	5.47E+02
74	1.9495	5.40E+02
75	1.9899	5.32E+02
76	2.0303	5.24E+02
77	2.0707	5.15E+02
78	2.1111	5.06E+02
79	2.1515	4.96E+02
80	2.1919	4.86E+02
81	2.2323	4.76E+02
82	2.2727	4.65E+02

	X	Y
32	0.25253	6.10E+02
33	0.29293	6.10E+02
34	0.33333	6.10E+02
35	0.37374	6.10E+02
36	0.41414	6.10E+02
37	0.45455	6.10E+02
38	0.49495	6.10E+02
39	0.53535	6.10E+02
40	0.57576	6.10E+02
41	0.61616	6.10E+02
42	0.65657	6.10E+02
43	0.69697	6.10E+02
44	0.73737	6.10E+02
45	0.77778	6.10E+02
46	0.81818	6.10E+02
47	0.85859	6.10E+02
48	0.89899	6.10E+02
49	0.93939	6.10E+02
50	0.9798	6.10E+02
51	1.0202	6.10E+02
52	1.0606	6.10E+02
53	1.101	6.10E+02
54	1.1414	6.10E+02
55	1.1818	6.10E+02
56	1.2222	6.10E+02
57	1.2626	6.10E+02
58	1.303	6.10E+02
59	1.3434	6.10E+02
60	1.3838	6.10E+02
61	1.4242	6.10E+02
62	1.4646	6.10E+02
63	1.5051	6.10E+02
64	1.5455	6.10E+02
65	1.5859	6.10E+02
66	1.6263	6.10E+02
67	1.6667	6.10E+02
68	1.7071	6.10E+02
69	1.7475	6.10E+02
70	1.7879	5.99E+02
71	1.8283	5.87E+02
72	1.8687	5.75E+02
73	1.9091	5.62E+02
74	1.9495	5.50E+02
75	1.9899	5.38E+02
76	2.0303	5.25E+02
77	2.0707	5.13E+02
78	2.1111	5.01E+02
79	2.1515	4.88E+02
80	2.1919	4.76E+02
81	2.2323	4.64E+02
82	2.2727	4.51E+02

Prediction Line

	X	Y
83	2.3131	4.57E+02
84	2.3535	4.45E+02
85	2.3939	4.33E+02
86	2.4343	4.20E+02
87	2.4747	4.06E+02
88	2.5152	3.93E+02
89	2.5556	3.78E+02
90	2.596	3.64E+02
91	2.6364	3.49E+02
92	2.6768	3.34E+02
93	2.7172	3.18E+02
94	2.7576	3.03E+02
95	2.798	2.88E+02
96	2.8384	2.72E+02
97	2.8788	2.57E+02
98	2.9192	2.42E+02
99	2.9596	2.28E+02
100	3	2.14E+02

	X	Y
83	2.3131	4.54E+02
84	2.3535	4.42E+02
85	2.3939	4.30E+02
86	2.4343	4.18E+02
87	2.4747	4.05E+02
88	2.5152	3.92E+02
89	2.5556	3.78E+02
90	2.596	3.64E+02
91	2.6364	3.49E+02
92	2.6768	3.34E+02
93	2.7172	3.19E+02
94	2.7576	3.03E+02
95	2.798	2.87E+02
96	2.8384	2.72E+02
97	2.8788	2.57E+02
98	2.9192	2.42E+02
99	2.9596	2.28E+02
100	3	2.15E+02

	X	Y
83	2.3131	4.39E+02
84	2.3535	4.27E+02
85	2.3939	4.15E+02
86	2.4343	4.02E+02
87	2.4747	3.90E+02
88	2.5152	3.78E+02
89	2.5556	3.65E+02
90	2.596	3.53E+02
91	2.6364	3.41E+02
92	2.6768	3.28E+02
93	2.7172	3.16E+02
94	2.7576	3.04E+02
95	2.798	2.91E+02
96	2.8384	2.79E+02
97	2.8788	2.67E+02
98	2.9192	2.54E+02
99	2.9596	2.42E+02
100	3	2.30E+02

Table H2.D-2b. TRAP Model Output for Aluminum Data for the Mammal Reproduction Endpoint (Paternain et al. 1988)

Chemical:	Aluminum
Study Authors:	Paternain et al. 1988 fetal growth
Receptor Group:	Mammal
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
1.00E-06	3.29	0.72
12.92	2.82	0.68
25.89	2.75	0.5
51.79	2.19	0.35

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.1616	2.0026			
S	0.45724	6.43E-01			
Y0	3.29E+00	3.25E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.1616	2.0311			
S	0.45724	6.17E-01			
Y0	3.29E+00	3.27E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.1616	2.1925			
S	0.45724	0.37054			
Y0	3.29E+00	3.29E+00			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	100.61	3.1079	3256.8	0.11885	2.0026
20	2.91E+01	4.23E-01	2.00E+03	0.1446	1.4633
10	1.41E+01	8.43E-03	2.34E+04	0.25358	1.1479
5	7.20E+00	1.88E-04	2.75E+05	0.36062	0.85717
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	107.42	1.3597	8486.4	0.14935	2.0311
20	27.254	1.98E-01	3742.3	0.16824	1.4354
10	1.37E+01	5.59E-03	3.34E+04	0.26665	1.1352
5	8.3739	3.70E-04	1.89E+05	0.34271	0.92293
0	2.5729	4.32E-07	1.53E+07	0.53317	4.10E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	155.77	3.59E-02	6.75E+05	0.28625	2.1925
20	24.146	5.00E-02	11656	0.21121	1.3829
10	12.971	4.01E-03	41928	0.27621	1.113
5	9.5068	8.95E-04	1.01E+05	0.31686	0.97804
0	6.9678	1.83E-04	2.66E+05	0.36059	0.8431

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	3.29E+00	3.25E+00
2	1.11E+00	2.82E+00	2.95E+00
3	1.41E+00	2.75E+00	2.67E+00
4	1.71E+00	2.19E+00	2.20E+00
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	3.29E+00	3.27E+00
2	1.11E+00	2.82E+00	2.96E+00
3	1.41E+00	2.75E+00	2.64E+00
4	1.71E+00	2.19E+00	2.21E+00
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	3.29E+00	3.29E+00
2	1.11E+00	2.82E+00	2.96E+00
3	1.41E+00	2.75E+00	2.60E+00
4	1.71E+00	2.19E+00	2.23E+00
5			
6			

Analysis of Variance

R-squared: 0.998

	DF	SS	MS	F	Sig
Total (adj)	3	29.235	9.7451		
Regression	2	29.165	14.582	206.57	0.0491
Error	1	7.06E-02	7.06E-02		

R-squared: 0.997

	DF	SS	MS	F	Sig
Total (adj)	3	29.235	9.7451		
Regression	2	29.141	14.571	154.3	0.0568
Error	1	9.44E-02	9.44E-02		

R-squared: 0.995

	DF	SS	MS	F	Sig
Total (adj)	3	29.235	9.7451		
Regression	2	29.083	14.542	95.63	0.0721
Error	1	0.15206	0.15206		

Prediction Line

	X	Y
1	-2	3.25E+00
2	-1.96E+00	3.25E+00
3	-1.92E+00	3.25E+00
4	-1.88E+00	3.25E+00
5	-1.84E+00	3.25E+00
6	-1.80E+00	3.25E+00
7	-1.76E+00	3.25E+00
8	-1.72E+00	3.25E+00
9	-1.68E+00	3.25E+00
10	-1.64E+00	3.25E+00
11	-1.60E+00	3.25E+00
12	-1.56E+00	3.25E+00
13	-1.52E+00	3.25E+00
14	-1.4747	3.25E+00
15	-1.4343	3.25E+00
16	-1.3939	3.25E+00
17	-1.3535	3.25E+00
18	-1.3131	3.25E+00
19	-1.2727	3.25E+00
20	-1.2323	3.25E+00
21	-1.19E+00	3.25E+00
22	-1.15E+00	3.25E+00
23	-1.11E+00	3.25E+00
24	-1.07E+00	3.25E+00
25	-1.03E+00	3.25E+00
26	-9.90E-01	3.25E+00
27	-9.49E-01	3.25E+00
28	-9.09E-01	3.25E+00
29	-8.69E-01	3.25E+00
30	-8.28E-01	3.25E+00
31	-0.78788	3.25E+00

	X	Y
1	-2	3.27E+00
2	-1.96E+00	3.27E+00
3	-1.92E+00	3.27E+00
4	-1.88E+00	3.27E+00
5	-1.84E+00	3.27E+00
6	-1.80E+00	3.27E+00
7	-1.76E+00	3.27E+00
8	-1.72E+00	3.27E+00
9	-1.68E+00	3.27E+00
10	-1.64E+00	3.27E+00
11	-1.60E+00	3.27E+00
12	-1.56E+00	3.27E+00
13	-1.52E+00	3.27E+00
14	-1.4747	3.27E+00
15	-1.4343	3.27E+00
16	-1.3939	3.27E+00
17	-1.3535	3.27E+00
18	-1.3131	3.27E+00
19	-1.2727	3.27E+00
20	-1.2323	3.27E+00
21	-1.19E+00	3.27E+00
22	-1.15E+00	3.27E+00
23	-1.11E+00	3.27E+00
24	-1.07E+00	3.27E+00
25	-1.03E+00	3.27E+00
26	-9.90E-01	3.27E+00
27	-9.49E-01	3.27E+00
28	-9.09E-01	3.27E+00
29	-8.69E-01	3.27E+00
30	-8.28E-01	3.27E+00
31	-0.78788	3.27E+00

	X	Y
1	-2	3.29E+00
2	-1.96E+00	3.29E+00
3	-1.92E+00	3.29E+00
4	-1.88E+00	3.29E+00
5	-1.84E+00	3.29E+00
6	-1.80E+00	3.29E+00
7	-1.76E+00	3.29E+00
8	-1.72E+00	3.29E+00
9	-1.68E+00	3.29E+00
10	-1.64E+00	3.29E+00
11	-1.60E+00	3.29E+00
12	-1.56E+00	3.29E+00
13	-1.52E+00	3.29E+00
14	-1.4747	3.29E+00
15	-1.4343	3.29E+00
16	-1.3939	3.29E+00
17	-1.3535	3.29E+00
18	-1.3131	3.29E+00
19	-1.2727	3.29E+00
20	-1.2323	3.29E+00
21	-1.19E+00	3.29E+00
22	-1.15E+00	3.29E+00
23	-1.11E+00	3.29E+00
24	-1.07E+00	3.29E+00
25	-1.03E+00	3.29E+00
26	-9.90E-01	3.29E+00
27	-9.49E-01	3.29E+00
28	-9.09E-01	3.29E+00
29	-8.69E-01	3.29E+00
30	-8.28E-01	3.29E+00
31	-0.78788	3.29E+00

Prediction Line

	X	Y
32	-0.74747	3.25E+00
33	-0.70707	3.25E+00
34	-0.66667	3.25E+00
35	-0.62626	3.25E+00
36	-0.58586	3.25E+00
37	-0.54545	3.25E+00
38	-0.50505	3.25E+00
39	-0.46465	3.25E+00
40	-0.42424	3.25E+00
41	-0.38384	3.25E+00
42	-0.34343	3.25E+00
43	-0.30303	3.25E+00
44	-0.26263	3.24E+00
45	-0.22222	3.24E+00
46	-0.18182	3.24E+00
47	-0.14141	3.24E+00
48	-0.10101	3.24E+00
49	-6.06E-02	3.24E+00
50	-2.02E-02	3.24E+00
51	2.02E-02	3.23E+00
52	6.06E-02	3.23E+00
53	0.10101	3.23E+00
54	0.14141	3.23E+00
55	0.18182	3.22E+00
56	0.22222	3.22E+00
57	0.26263	3.22E+00
58	0.30303	3.21E+00
59	0.34343	3.21E+00
60	0.38384	3.20E+00
61	0.42424	3.20E+00
62	0.46465	3.19E+00
63	0.50505	3.19E+00
64	0.54545	3.18E+00
65	0.58586	3.17E+00
66	0.62626	3.16E+00
67	0.66667	3.15E+00
68	0.70707	3.14E+00
69	0.74747	3.13E+00
70	0.78788	3.12E+00
71	0.82828	3.10E+00
72	0.86869	3.09E+00
73	0.90909	3.07E+00
74	0.94949	3.05E+00
75	0.9899	3.03E+00
76	1.0303	3.01E+00
77	1.0707	2.98E+00
78	1.1111	2.96E+00
79	1.1515	2.93E+00
80	1.1919	2.89E+00
81	1.2323	2.86E+00
82	1.2727	2.82E+00

	X	Y
32	-0.74747	3.27E+00
33	-0.70707	3.27E+00
34	-0.66667	3.27E+00
35	-0.62626	3.27E+00
36	-0.58586	3.27E+00
37	-0.54545	3.27E+00
38	-0.50505	3.27E+00
39	-0.46465	3.27E+00
40	-0.42424	3.27E+00
41	-0.38384	3.27E+00
42	-0.34343	3.27E+00
43	-0.30303	3.27E+00
44	-0.26263	3.27E+00
45	-0.22222	3.27E+00
46	-0.18182	3.27E+00
47	-0.14141	3.27E+00
48	-0.10101	3.27E+00
49	-6.06E-02	3.27E+00
50	-2.02E-02	3.27E+00
51	2.02E-02	3.27E+00
52	6.06E-02	3.27E+00
53	0.10101	3.27E+00
54	0.14141	3.27E+00
55	0.18182	3.27E+00
56	0.22222	3.27E+00
57	0.26263	3.27E+00
58	0.30303	3.27E+00
59	0.34343	3.27E+00
60	0.38384	3.27E+00
61	0.42424	3.27E+00
62	0.46465	3.27E+00
63	0.50505	3.26E+00
64	0.54545	3.26E+00
65	0.58586	3.25E+00
66	0.62626	3.24E+00
67	0.66667	3.23E+00
68	0.70707	3.21E+00
69	0.74747	3.20E+00
70	0.78788	3.18E+00
71	0.82828	3.16E+00
72	0.86869	3.14E+00
73	0.90909	3.11E+00
74	0.94949	3.09E+00
75	0.9899	3.06E+00
76	1.0303	3.03E+00
77	1.0707	3.00E+00
78	1.1111	2.96E+00
79	1.1515	2.93E+00
80	1.1919	2.89E+00
81	1.2323	2.85E+00
82	1.2727	2.81E+00

	X	Y
32	-0.74747	3.29E+00
33	-0.70707	3.29E+00
34	-0.66667	3.29E+00
35	-0.62626	3.29E+00
36	-0.58586	3.29E+00
37	-0.54545	3.29E+00
38	-0.50505	3.29E+00
39	-0.46465	3.29E+00
40	-0.42424	3.29E+00
41	-0.38384	3.29E+00
42	-0.34343	3.29E+00
43	-0.30303	3.29E+00
44	-0.26263	3.29E+00
45	-0.22222	3.29E+00
46	-0.18182	3.29E+00
47	-0.14141	3.29E+00
48	-0.10101	3.29E+00
49	-6.06E-02	3.29E+00
50	-2.02E-02	3.29E+00
51	2.02E-02	3.29E+00
52	6.06E-02	3.29E+00
53	0.10101	3.29E+00
54	0.14141	3.29E+00
55	0.18182	3.29E+00
56	0.22222	3.29E+00
57	0.26263	3.29E+00
58	0.30303	3.29E+00
59	0.34343	3.29E+00
60	0.38384	3.29E+00
61	0.42424	3.29E+00
62	0.46465	3.29E+00
63	0.50505	3.29E+00
64	0.54545	3.29E+00
65	0.58586	3.29E+00
66	0.62626	3.29E+00
67	0.66667	3.29E+00
68	0.70707	3.29E+00
69	0.74747	3.29E+00
70	0.78788	3.29E+00
71	0.82828	3.29E+00
72	0.86869	3.26E+00
73	0.90909	3.21E+00
74	0.94949	3.16E+00
75	0.9899	3.11E+00
76	1.0303	3.06E+00
77	1.0707	3.01E+00
78	1.1111	2.96E+00
79	1.1515	2.91E+00
80	1.1919	2.86E+00
81	1.2323	2.82E+00
82	1.2727	2.77E+00

Prediction Line

	X	Y
83	1.3131	2.78E+00
84	1.3535	2.74E+00
85	1.3939	2.69E+00
86	1.4343	2.64E+00
87	1.4747	2.59E+00
88	1.5152	2.53E+00
89	1.5556	2.47E+00
90	1.596	2.41E+00
91	1.6364	2.34E+00
92	1.6768	2.27E+00
93	1.7172	2.20E+00
94	1.7576	2.12E+00
95	1.798	2.05E+00
96	1.8384	1.97E+00
97	1.8788	1.88E+00
98	1.9192	1.80E+00
99	1.9596	1.72E+00
100	2	1.63E+00

	X	Y
83	1.3131	2.76E+00
84	1.3535	2.71E+00
85	1.3939	2.67E+00
86	1.4343	2.62E+00
87	1.4747	2.56E+00
88	1.5152	2.51E+00
89	1.5556	2.45E+00
90	1.596	2.39E+00
91	1.6364	2.33E+00
92	1.6768	2.27E+00
93	1.7172	2.21E+00
94	1.7576	2.14E+00
95	1.798	2.07E+00
96	1.8384	2.00E+00
97	1.8788	1.93E+00
98	1.9192	1.85E+00
99	1.9596	1.77E+00
100	2	1.70E+00

	X	Y
83	1.3131	2.72E+00
84	1.3535	2.67E+00
85	1.3939	2.62E+00
86	1.4343	2.57E+00
87	1.4747	2.52E+00
88	1.5152	2.47E+00
89	1.5556	2.42E+00
90	1.596	2.37E+00
91	1.6364	2.32E+00
92	1.6768	2.27E+00
93	1.7172	2.22E+00
94	1.7576	2.18E+00
95	1.798	2.13E+00
96	1.8384	2.08E+00
97	1.8788	2.03E+00
98	1.9192	1.98E+00
99	1.9596	1.93E+00
100	2	1.88E+00

Table H2.D-3. TRAP Model Output for Arsenic Data for the Bird Survival Endpoint (Albert et al. 2008b)

Chemical:	Arsenic
Study Authors:	Albert et al. 2008b
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
0.000001	47.04	48	0.98
2.14	23.14	26	0.89
4.28	15	15	1.0
6.42	30.8	40	0.77
12.84	8.06	26	0.31
19.260	0.0	5.0	0.0
38.520	0.0	7.0	0.0

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.97343	0.99906	3.73E-02	0.92242	1.0757
S	0.16244	1.92E-01	4.08E-02	0.136	0.32524
Y0	0.95667	0.95439	2.37E-02	0.88119	0.98879

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.97343	0.99891	3.69E-02	0.92262	1.0752
S	0.16244	1.77E-01	3.62E-02	0.12716	0.29285
Y0	0.95667	0.95404	2.36E-02	0.88154	0.98845

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.97343	0.98845	2.55E-02	0.93709	1.0398
S	0.16244	0.17101	1.48E-02	0.14634	0.20578
Y0	0.95667	0.95711	2.15E-02	0.89174	0.98867

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	9.9783	8.36E+00	1.19E+01	3.73E-02	0.99906
20	6.8799	5.43E+00	8.71E+00	4.80E-02	0.83758
10	5.6647	4.12E+00	7.78E+00	6.09E-02	0.75318
5	4.8247	3.21E+00	7.26E+00	7.33E-02	0.68347
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	9.9748	8.37E+00	1.19E+01	3.69E-02	0.99891
20	6.9061	5.48E+00	8.70E+00	4.64E-02	0.83923
10	5.74E+00	4.228	7.7873	5.79E-02	0.75876
5	5.0334	3.447	7.3497	6.78E-02	0.70186
0	3.6684	1.931	6.9692	9.36E-02	5.64E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	9.7377	8.65E+00	1.10E+01	2.55E-02	0.98845
20	6.4674	5.3426	7.8291	4.08E-02	0.81073
10	5.6428	4.5436	7.0079	4.59E-02	0.75149
5	5.2707	4.19E+00	6.6325	4.84E-02	0.72187
0	4.9233	3.86E+00	6.28E+00	5.10E-02	0.69225

Model Fit Summary

Dataset		Exposure	Effects Var	Est Effects Var
	1	-6.00E+00	0.98	0.95439
	2	3.30E-01	0.89	0.95415
	3	6.31E-01	1	0.92797
	4	8.08E-01	0.77	0.80258
	5	1.11E+00	0.31	0.27119
	6	1.28E+00	0	6.53E-02
	7	1.5857	0	1.16E-03

Dataset		Exposure	Effects Var	Est Effects Var
	1	-6.00E+00	0.98	0.95404
	2	3.30E-01	0.89	0.95404
	3	6.31E-01	1	0.94271
	4	8.08E-01	0.77	0.80474
	5	1.11E+00	0.31	0.26666
	6	1.28E+00	0	5.60E-02
	7	1.5857	0	9.54E-05

Dataset		Exposure	Effects Var	Est Effects Var
	1	-6.00E+00	0.98	0.95711
	2	3.30E-01	0.89	0.95711
	3	6.31E-01	1	0.95711
	4	8.08E-01	0.77	0.77088
	5	1.11E+00	0.31	0.28457
	6	1.28E+00	0	9.57E-05
	7	1.5857	0	9.57E-05

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-2.5	0.95439
2	-2.45E+00	0.95439
3	-2.41E+00	0.95439
4	-2.36E+00	0.95439
5	-2.32E+00	0.95439
6	-2.27E+00	0.95439
7	-2.23E+00	0.95439
8	-2.18E+00	0.95439
9	-2.14E+00	0.95439
10	-2.09E+00	0.95439
11	-2.05E+00	0.95439
12	-2.00E+00	0.95439
13	-1.95E+00	0.95439
14	-1.9091	0.95439
15	-1.8636	0.95439
16	-1.8182	0.95439
17	-1.7727	0.95439
18	-1.7273	0.95439
19	-1.6818	0.95439
20	-1.6364	0.95439
21	-1.5909	0.95439
22	-1.5455	0.95439
23	-1.5	0.95439
24	-1.4545	0.95439
25	-1.4091	0.95439
26	-1.3636	0.95439
27	-1.3182	0.95439
28	-1.2727	0.95439
29	-1.2273	0.95439

	X	Y
1	-2.5	0.95404
2	-2.45E+00	0.95404
3	-2.41E+00	0.95404
4	-2.36E+00	0.95404
5	-2.32E+00	0.95404
6	-2.27E+00	0.95404
7	-2.23E+00	0.95404
8	-2.18E+00	0.95404
9	-2.14E+00	0.95404
10	-2.09E+00	0.95404
11	-2.05E+00	0.95404
12	-2.00E+00	0.95404
13	-1.95E+00	0.95404
14	-1.9091	0.95404
15	-1.8636	0.95404
16	-1.8182	0.95404
17	-1.7727	0.95404
18	-1.7273	0.95404
19	-1.6818	0.95404
20	-1.6364	0.95404
21	-1.5909	0.95404
22	-1.5455	0.95404
23	-1.5	0.95404
24	-1.4545	0.95404
25	-1.4091	0.95404
26	-1.3636	0.95404
27	-1.3182	0.95404
28	-1.2727	0.95404
29	-1.2273	0.95404

	X	Y
1	-2.5	0.95711
2	-2.45E+00	0.95711
3	-2.41E+00	0.95711
4	-2.36E+00	0.95711
5	-2.32E+00	0.95711
6	-2.27E+00	0.95711
7	-2.23E+00	0.95711
8	-2.18E+00	0.95711
9	-2.14E+00	0.95711
10	-2.09E+00	0.95711
11	-2.05E+00	0.95711
12	-2.00E+00	0.95711
13	-1.95E+00	0.95711
14	-1.9091	0.95711
15	-1.8636	0.95711
16	-1.8182	0.95711
17	-1.7727	0.95711
18	-1.7273	0.95711
19	-1.6818	0.95711
20	-1.6364	0.95711
21	-1.5909	0.95711
22	-1.5455	0.95711
23	-1.5	0.95711
24	-1.4545	0.95711
25	-1.4091	0.95711
26	-1.3636	0.95711
27	-1.3182	0.95711
28	-1.2727	0.95711
29	-1.2273	0.95711

Prediction Line

	X	Y
30	-1.1818	0.95439
31	-1.1364	0.95439
32	-1.0909	0.95439
33	-1.0455	0.95439
34	-1	0.95439
35	-0.95455	0.95439
36	-0.90909	0.95439
37	-0.86364	0.95439
38	-0.81818	0.95439
39	-0.77273	0.95439
40	-0.72727	0.95439
41	-0.68182	0.95439
42	-0.63636	0.95439
43	-0.59091	0.95439
44	-0.54545	0.95439
45	-0.5	0.95439
46	-0.45455	0.95439
47	-0.40909	0.95439
48	-0.36364	0.95439
49	-0.31818	0.95439
50	-0.27273	0.95439
51	-0.22727	0.95439
52	-0.18182	0.95439
53	-0.13636	0.95439
54	-9.09E-02	0.95439
55	-4.55E-02	0.95439
56	0	0.95439
57	4.55E-02	0.95439
58	9.09E-02	0.95439
59	0.13636	0.95438
60	0.18182	0.95438
61	0.22727	0.95436
62	0.27273	0.95431
63	0.31818	0.9542
64	0.36364	0.95394
65	0.40909	0.95338
66	0.45455	0.95222
67	0.5	0.94995
68	0.54545	0.94577
69	0.59091	0.93845
70	0.63636	0.92638
71	0.68182	0.90752
72	0.72727	0.87966
73	0.77273	0.84076
74	0.81818	0.78938
75	0.86364	0.72522
76	0.90909	0.64943
77	0.95455	0.56478
78	1	0.47537
79	1.0455	0.38607
80	1.0909	0.30171

	X	Y
30	-1.1818	0.95404
31	-1.1364	0.95404
32	-1.0909	0.95404
33	-1.0455	0.95404
34	-1	0.95404
35	-0.95455	0.95404
36	-0.90909	0.95404
37	-0.86364	0.95404
38	-0.81818	0.95404
39	-0.77273	0.95404
40	-0.72727	0.95404
41	-0.68182	0.95404
42	-0.63636	0.95404
43	-0.59091	0.95404
44	-0.54545	0.95404
45	-0.5	0.95404
46	-0.45455	0.95404
47	-0.40909	0.95404
48	-0.36364	0.95404
49	-0.31818	0.95404
50	-0.27273	0.95404
51	-0.22727	0.95404
52	-0.18182	0.95404
53	-0.13636	0.95404
54	-9.09E-02	0.95404
55	-4.55E-02	0.95404
56	0	0.95404
57	4.55E-02	0.95404
58	9.09E-02	0.95404
59	0.13636	0.95404
60	0.18182	0.95404
61	0.22727	0.95404
62	0.27273	0.95404
63	0.31818	0.95404
64	0.36364	0.95404
65	0.40909	0.95404
66	0.45455	0.95404
67	0.5	0.95404
68	0.54545	0.95404
69	0.59091	0.95228
70	0.63636	0.94098
71	0.68182	0.91925
72	0.72727	0.88707
73	0.77273	0.84444
74	0.81818	0.79137
75	0.86364	0.72786
76	0.90909	0.6539
77	0.95455	0.56951
78	1	0.47467
79	1.0455	0.38033
80	1.0909	0.29643

	X	Y
30	-1.1818	0.95711
31	-1.1364	0.95711
32	-1.0909	0.95711
33	-1.0455	0.95711
34	-1	0.95711
35	-0.95455	0.95711
36	-0.90909	0.95711
37	-0.86364	0.95711
38	-0.81818	0.95711
39	-0.77273	0.95711
40	-0.72727	0.95711
41	-0.68182	0.95711
42	-0.63636	0.95711
43	-0.59091	0.95711
44	-0.54545	0.95711
45	-0.5	0.95711
46	-0.45455	0.95711
47	-0.40909	0.95711
48	-0.36364	0.95711
49	-0.31818	0.95711
50	-0.27273	0.95711
51	-0.22727	0.95711
52	-0.18182	0.95711
53	-0.13636	0.95711
54	-9.09E-02	0.95711
55	-4.55E-02	0.95711
56	0	0.95711
57	4.55E-02	0.95711
58	9.09E-02	0.95711
59	0.13636	0.95711
60	0.18182	0.95711
61	0.22727	0.95711
62	0.27273	0.95711
63	0.31818	0.95711
64	0.36364	0.95711
65	0.40909	0.95711
66	0.45455	0.95711
67	0.5	0.95711
68	0.54545	0.95711
69	0.59091	0.95711
70	0.63636	0.95711
71	0.68182	0.95711
72	0.72727	0.90054
73	0.77273	0.82711
74	0.81818	0.75368
75	0.86364	0.68025
76	0.90909	0.60682
77	0.95455	0.53338
78	1	0.45995
79	1.0455	0.38652
80	1.0909	0.31309

Prediction Line

	X	Y
81	1.1364	0.22636
82	1.1818	0.16271
83	1.2273	0.11187
84	1.2727	7.35E-02
85	1.3182	4.60E-02
86	1.3636	2.75E-02
87	1.4091	1.56E-02
88	1.4545	8.49E-03
89	1.5	4.40E-03
90	1.5455	2.20E-03
91	1.5909	1.07E-03
92	1.6364	5.22E-04
93	1.6818	2.73E-04
94	1.7273	1.66E-04
95	1.7727	1.22E-04
96	1.8182	1.05E-04
97	1.8636	9.86E-05
98	1.9091	9.64E-05
99	1.9545	9.57E-05
100	2	9.55E-05

	X	Y
81	1.1364	0.22298
82	1.1818	0.15997
83	1.2273	0.10741
84	1.2727	6.53E-02
85	1.3182	3.36E-02
86	1.3636	1.24E-02
87	1.4091	1.58E-03
88	1.4545	9.54E-05
89	1.5	9.54E-05
90	1.5455	9.54E-05
91	1.5909	9.54E-05
92	1.6364	9.54E-05
93	1.6818	9.54E-05
94	1.7273	9.54E-05
95	1.7727	9.54E-05
96	1.8182	9.54E-05
97	1.8636	9.54E-05
98	1.9091	9.54E-05
99	1.9545	9.54E-05
100	2	9.54E-05

	X	Y
81	1.1364	0.23966
82	1.1818	0.16623
83	1.2273	9.28E-02
84	1.2727	1.94E-02
85	1.3182	9.57E-05
86	1.3636	9.57E-05
87	1.4091	9.57E-05
88	1.4545	9.57E-05
89	1.5	9.57E-05
90	1.5455	9.57E-05
91	1.5909	9.57E-05
92	1.6364	9.57E-05
93	1.6818	9.57E-05
94	1.7273	9.57E-05
95	1.7727	9.57E-05
96	1.8182	9.57E-05
97	1.8636	9.57E-05
98	1.9091	9.57E-05
99	1.9545	9.57E-05
100	2	9.57E-05

Table H2.D-4a. TRAP Model Output for Barium Data for the Bird Growth Endpoint (Johnson et al. 1960)

Chemical:	Barium
Study Authors:	Johnson et al. 1960
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
0.000001	435	not reported
27.91667	436	not reported
55.83333	410	not reported
111.6667	448	not reported
223.3333	428	not reported
446.6667	357	not reported
893.3333	218	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.9342	2.9492	2.66E-02	2.8755	3.023
S	1.6072	1.37E+00	0.24739	0.67944	2.0532
Y0	4.31E+02	4.34E+02	7.956	412.24	456.42

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.9342	2.9533	2.40E-02	2.8867	3.0199
S	1.6072	1.36E+00	0.19522	0.82246	1.9065
Y0	4.31E+02	4.33E+02	6.7433	413.83	451.28

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.9342	2.956	3.15E-02	2.8686	3.0434
S	1.6072	1.0703	0.15278	0.64617	1.4945
Y0	4.31E+02	4.31E+02	6.2418	414.07	448.73

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	889.7	750.77	1054.3	2.66E-02	2.9492
20	4.96E+02	3.72E+02	6.62E+02	4.51E-02	2.6956
10	3.53E+02	2.27E+02	5.48E+02	6.90E-02	2.5472
5	2.57E+02	1.42E+02	4.65E+02	9.25E-02	2.4105
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	898.07	770.44	1046.9	2.40E-02	2.9533
20	483	3.83E+02	609.85	3.65E-02	2.6839
10	3.53E+02	2.51E+02	4.97E+02	5.33E-02	2.5482
5	283.26	1.86E+02	4.32E+02	6.60E-02	2.4522
0	166.12	8.88E+01	3.11E+02	9.79E-02	2.22E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	903.64	738.98	1105	3.15E-02	2.956
20	473.93	391.73	573.37	2.98E-02	2.6757
10	382.19	296.79	492.18	3.96E-02	2.5823
5	343.22	257.19	458.02	4.51E-02	2.5356
0	308.22	222.51	426.95	5.10E-02	2.4889

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	4.35E+02	4.34E+02
2	1.45E+00	4.36E+02	4.34E+02
3	1.75E+00	4.10E+02	4.34E+02
4	2.05E+00	4.48E+02	4.31E+02
5	2.35E+00	428	418.59
6	2.65E+00	357	363.5
7	2.951	218	216.11

Analysis of Variance

R-squared: 0.975

	DF	SS	MS	F	Sig
Total (adj)	6	40021	6670.2		
Regression	2	39038	19519	79.429	0.0006
Error	4	982.97	245.74		

Prediction Line

	X	Y
1	-1	4.34E+02
2	-9.55E-01	4.34E+02
3	-9.09E-01	4.34E+02
4	-8.64E-01	4.34E+02
5	-8.18E-01	4.34E+02
6	-7.73E-01	4.34E+02
7	-7.27E-01	4.34E+02
8	-6.82E-01	4.34E+02
9	-6.36E-01	4.34E+02
10	-5.91E-01	4.34E+02
11	-5.45E-01	4.34E+02
12	-5.00E-01	4.34E+02
13	-4.55E-01	4.34E+02
14	-0.40909	4.34E+02
15	-0.36364	4.34E+02
16	-0.31818	4.34E+02
17	-0.27273	4.34E+02
18	-0.22727	4.34E+02
19	-0.18182	4.34E+02
20	-0.13636	4.34E+02
21	-9.09E-02	4.34E+02
22	-4.55E-02	4.34E+02
23	0.00E+00	4.34E+02
24	4.55E-02	4.34E+02
25	9.09E-02	4.34E+02
26	1.36E-01	4.34E+02
27	1.82E-01	4.34E+02
28	2.27E-01	4.34E+02
29	2.73E-01	4.34E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	4.35E+02	4.33E+02
2	1.45E+00	4.36E+02	4.33E+02
3	1.75E+00	4.10E+02	4.33E+02
4	2.05E+00	4.48E+02	4.33E+02
5	2.35E+00	428	425.9
6	2.65E+00	357	358.26
7	2.951	218	217.63

R-squared: 0.981

	DF	SS	MS	F	Sig
Total (adj)	6	40021	6670.2		
Regression	2	39250	19625	101.79	0.0004
Error	4	771.23	192.81		

	X	Y
1	-1	4.33E+02
2	-9.55E-01	4.33E+02
3	-9.09E-01	4.33E+02
4	-8.64E-01	4.33E+02
5	-8.18E-01	4.33E+02
6	-7.73E-01	4.33E+02
7	-7.27E-01	4.33E+02
8	-6.82E-01	4.33E+02
9	-6.36E-01	4.33E+02
10	-5.91E-01	4.33E+02
11	-5.45E-01	4.33E+02
12	-5.00E-01	4.33E+02
13	-4.55E-01	4.33E+02
14	-0.40909	4.33E+02
15	-0.36364	4.33E+02
16	-0.31818	4.33E+02
17	-0.27273	4.33E+02
18	-0.22727	4.33E+02
19	-0.18182	4.33E+02
20	-0.13636	4.33E+02
21	-9.09E-02	4.33E+02
22	-4.55E-02	4.33E+02
23	0.00E+00	4.33E+02
24	4.55E-02	4.33E+02
25	9.09E-02	4.33E+02
26	1.36E-01	4.33E+02
27	1.82E-01	4.33E+02
28	2.27E-01	4.33E+02
29	2.73E-01	4.33E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	4.35E+02	4.31E+02
2	1.45E+00	4.36E+02	4.31E+02
3	1.75E+00	4.10E+02	4.31E+02
4	2.05E+00	4.48E+02	4.31E+02
5	2.35E+00	428	431.4
6	2.65E+00	357	357
7	2.951	218	218

R-squared: 0.981

	DF	SS	MS	F	Sig
Total (adj)	6	40021	6670.2		
Regression	2	39242	19621	100.72	0.0004
Error	4	779.2	194.8		

	X	Y
1	-1	4.31E+02
2	-9.55E-01	4.31E+02
3	-9.09E-01	4.31E+02
4	-8.64E-01	4.31E+02
5	-8.18E-01	4.31E+02
6	-7.73E-01	4.31E+02
7	-7.27E-01	4.31E+02
8	-6.82E-01	4.31E+02
9	-6.36E-01	4.31E+02
10	-5.91E-01	4.31E+02
11	-5.45E-01	4.31E+02
12	-5.00E-01	4.31E+02
13	-4.55E-01	4.31E+02
14	-0.40909	4.31E+02
15	-0.36364	4.31E+02
16	-0.31818	4.31E+02
17	-0.27273	4.31E+02
18	-0.22727	4.31E+02
19	-0.18182	4.31E+02
20	-0.13636	4.31E+02
21	-9.09E-02	4.31E+02
22	-4.55E-02	4.31E+02
23	0.00E+00	4.31E+02
24	4.55E-02	4.31E+02
25	9.09E-02	4.31E+02
26	1.36E-01	4.31E+02
27	1.82E-01	4.31E+02
28	2.27E-01	4.31E+02
29	2.73E-01	4.31E+02

Prediction Line

	X	Y
30	3.18E-01	4.34E+02
31	0.36364	4.34E+02
32	0.40909	4.34E+02
33	0.45455	4.34E+02
34	0.5	4.34E+02
35	0.54545	4.34E+02
36	0.59091	4.34E+02
37	0.63636	4.34E+02
38	0.68182	4.34E+02
39	0.72727	4.34E+02
40	0.77273	4.34E+02
41	0.81818	4.34E+02
42	0.86364	4.34E+02
43	0.90909	4.34E+02
44	0.95455	4.34E+02
45	1	4.34E+02
46	1.0455	4.34E+02
47	1.0909	4.34E+02
48	1.1364	4.34E+02
49	1.1818	4.34E+02
50	1.2273	4.34E+02
51	1.2727	4.34E+02
52	1.3182	4.34E+02
53	1.3636	4.34E+02
54	1.4091	4.34E+02
55	1.4545	4.34E+02
56	1.5	4.34E+02
57	1.5455	4.34E+02
58	1.5909	4.34E+02
59	1.6364	4.34E+02
60	1.6818	4.34E+02
61	1.7273	4.34E+02
62	1.7727	4.34E+02
63	1.8182	4.33E+02
64	1.8636	4.33E+02
65	1.9091	4.33E+02
66	1.9545	4.32E+02
67	2	4.32E+02
68	2.0455	4.31E+02
69	2.0909	4.30E+02
70	2.1364	4.29E+02
71	2.1818	4.28E+02
72	2.2273	4.26E+02
73	2.2727	4.24E+02
74	2.3182	4.21E+02
75	2.3636	4.17E+02
76	2.4091	4.13E+02
77	2.4545	4.07E+02
78	2.5	4.00E+02
79	2.5455	3.91E+02
80	2.5909	3.81E+02

	X	Y
30	3.18E-01	4.33E+02
31	0.36364	4.33E+02
32	0.40909	4.33E+02
33	0.45455	4.33E+02
34	0.5	4.33E+02
35	0.54545	4.33E+02
36	0.59091	4.33E+02
37	0.63636	4.33E+02
38	0.68182	4.33E+02
39	0.72727	4.33E+02
40	0.77273	4.33E+02
41	0.81818	4.33E+02
42	0.86364	4.33E+02
43	0.90909	4.33E+02
44	0.95455	4.33E+02
45	1	4.33E+02
46	1.0455	4.33E+02
47	1.0909	4.33E+02
48	1.1364	4.33E+02
49	1.1818	4.33E+02
50	1.2273	4.33E+02
51	1.2727	4.33E+02
52	1.3182	4.33E+02
53	1.3636	4.33E+02
54	1.4091	4.33E+02
55	1.4545	4.33E+02
56	1.5	4.33E+02
57	1.5455	4.33E+02
58	1.5909	4.33E+02
59	1.6364	4.33E+02
60	1.6818	4.33E+02
61	1.7273	4.33E+02
62	1.7727	4.33E+02
63	1.8182	4.33E+02
64	1.8636	4.33E+02
65	1.9091	4.33E+02
66	1.9545	4.33E+02
67	2	4.33E+02
68	2.0455	4.33E+02
69	2.0909	4.33E+02
70	2.1364	4.33E+02
71	2.1818	4.33E+02
72	2.2273	4.33E+02
73	2.2727	4.31E+02
74	2.3182	4.29E+02
75	2.3636	4.24E+02
76	2.4091	4.18E+02
77	2.4545	4.10E+02
78	2.5	4.01E+02
79	2.5455	3.90E+02
80	2.5909	3.77E+02

	X	Y
30	3.18E-01	4.31E+02
31	0.36364	4.31E+02
32	0.40909	4.31E+02
33	0.45455	4.31E+02
34	0.5	4.31E+02
35	0.54545	4.31E+02
36	0.59091	4.31E+02
37	0.63636	4.31E+02
38	0.68182	4.31E+02
39	0.72727	4.31E+02
40	0.77273	4.31E+02
41	0.81818	4.31E+02
42	0.86364	4.31E+02
43	0.90909	4.31E+02
44	0.95455	4.31E+02
45	1	4.31E+02
46	1.0455	4.31E+02
47	1.0909	4.31E+02
48	1.1364	4.31E+02
49	1.1818	4.31E+02
50	1.2273	4.31E+02
51	1.2727	4.31E+02
52	1.3182	4.31E+02
53	1.3636	4.31E+02
54	1.4091	4.31E+02
55	1.4545	4.31E+02
56	1.5	4.31E+02
57	1.5455	4.31E+02
58	1.5909	4.31E+02
59	1.6364	4.31E+02
60	1.6818	4.31E+02
61	1.7273	4.31E+02
62	1.7727	4.31E+02
63	1.8182	4.31E+02
64	1.8636	4.31E+02
65	1.9091	4.31E+02
66	1.9545	4.31E+02
67	2	4.31E+02
68	2.0455	4.31E+02
69	2.0909	4.31E+02
70	2.1364	4.31E+02
71	2.1818	4.31E+02
72	2.2273	4.31E+02
73	2.2727	4.31E+02
74	2.3182	4.31E+02
75	2.3636	4.31E+02
76	2.4091	4.31E+02
77	2.4545	4.31E+02
78	2.5	4.26E+02
79	2.5455	4.05E+02
80	2.5909	3.84E+02

Prediction Line

	X	Y
81	2.6364	3.68E+02
82	2.6818	3.53E+02
83	2.7273	3.35E+02
84	2.7727	3.14E+02
85	2.8182	2.92E+02
86	2.8636	2.67E+02
87	2.9091	2.41E+02
88	2.9545	2.14E+02
89	3	1.87E+02
90	3.0455	1.61E+02
91	3.0909	1.37E+02
92	3.1364	1.15E+02
93	3.1818	9.52E+01
94	3.2273	7.80E+01
95	3.2727	6.33E+01
96	3.3182	5.10E+01
97	3.3636	4.09E+01
98	3.4091	3.25E+01
99	3.4545	2.58E+01
100	3.5	2.04E+01

	X	Y
81	2.6364	3.63E+02
82	2.6818	3.47E+02
83	2.7273	3.29E+02
84	2.7727	3.10E+02
85	2.8182	2.89E+02
86	2.8636	2.66E+02
87	2.9091	2.42E+02
88	2.9545	2.16E+02
89	3	1.90E+02
90	3.0455	1.65E+02
91	3.0909	1.43E+02
92	3.1364	1.22E+02
93	3.1818	1.02E+02
94	3.2273	8.48E+01
95	3.2727	6.88E+01
96	3.3182	5.45E+01
97	3.3636	4.19E+01
98	3.4091	3.09E+01
99	3.4545	2.16E+01
100	3.5	1.40E+01

	X	Y
81	2.6364	3.63E+02
82	2.6818	3.42E+02
83	2.7273	3.21E+02
84	2.7727	3.00E+02
85	2.8182	2.79E+02
86	2.8636	2.58E+02
87	2.9091	2.37E+02
88	2.9545	2.16E+02
89	3	1.95E+02
90	3.0455	1.74E+02
91	3.0909	1.53E+02
92	3.1364	1.32E+02
93	3.1818	1.11E+02
94	3.2273	9.04E+01
95	3.2727	6.94E+01
96	3.3182	4.85E+01
97	3.3636	2.75E+01
98	3.4091	6.48E+00
99	3.4545	0.00E+00
100	3.5	0.00E+00

Table H2.D-4b. TRAP Model Output for Barium Data for the Mammal Growth Endpoint (pooling group A: Dietz et al. 1992)

Chemical:	Barium
Study Authors:	Pooling group A
Receptor Group:	Mammal
Effect Description:	Growth

Input Data:

Dose	Effect Relative to Control	SE
0.000001	100	2.6
17	96.61016949	2.5
69.9	94.23728814	3.3
127.5	98.6440678	3.2
233.9	93.55932203	3.2
475.1	55.59322034	3.4
0.000001	100	1.9
18.6	98.95013123	4.4
63.9	100.2624672	3.1
122.1	94.75065617	3.4
247.4	99.47506562	3.3
469.4	70.34120735	4.9

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes	yes	yes
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.727	2.6874	1.87E-02	2.6451	2.7297
S	2.9204	8.76E+00	13.152	-20.99	38.512
Y0	9.74E+01	9.80E+01	0.96856	95.812	100.19

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.727	2.688	2.12E-02	2.64	2.7359
S	2.9204	8.76E+00	14.295	-23.576	41.099
Y0	9.74E+01	9.81E+01	0.97636	95.869	100.29

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.727	2.6877	1.79E-02	2.6472	2.7281
S	2.9204	8.7613	12.209	-18.858	36.381
Y0	9.74E+01	9.80E+01	0.95782	95.863	100.2

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	486.86	441.65	536.69	1.87E-02	2.6874
20	4.44E+02	3.59E+02	5.51E+02	4.12E-02	2.6478
10	4.21E+02	2.84E+02	6.26E+02	7.59E-02	2.6247
5	4.01E+02	2.29E+02	7.04E+02	0.10784	2.6034
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	487.49	436.51	544.44	2.12E-02	2.688
20	442.61	3.45E+02	567.7	4.78E-02	2.646
10	4.22E+02	2.75E+02	6.47E+02	8.22E-02	2.6249
5	407.31	2.34E+02	7.10E+02	0.10659	2.6099
0	374.83	1.58E+02	8.87E+02	0.16545	2.57E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	487.14	443.86	534.65	1.79E-02	2.6877
20	450.21	384.29	527.45	3.04E-02	2.6534
10	438.53	344.68	557.94	4.62E-02	2.642
5	432.81	326.41	573.89	5.42E-02	2.6363
0	427.16	309.1	590.31	6.21E-02	2.6306

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.80E+01
2	-6.00E+00	1.00E+02	9.80E+01
3	1.23E+00	9.66E+01	9.80E+01
4	1.27E+00	9.90E+01	9.80E+01
5	1.81E+00	100.26	98.003
6	1.84E+00	94.237	98.003
7	2.09E+00	94.751	98.003
8	2.11E+00	98.644	98.003
9	2.37E+00	93.559	98.002
10	2.39E+00	99.475	98
11	2.67E+00	70.341	62.279
12	2.6768	55.593	58.014

Dataset	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.81E+01
2	-6.00E+00	1.00E+02	9.81E+01
3	1.23E+00	9.66E+01	9.81E+01
4	1.27E+00	9.90E+01	9.81E+01
5	1.81E+00	100.26	98.078
6	1.84E+00	94.237	98.078
7	2.09E+00	94.751	98.078
8	2.11E+00	98.644	98.078
9	2.37E+00	93.559	98.078
10	2.39E+00	99.475	98.078
11	2.67E+00	70.341	62.139
12	2.6768	55.593	58.179

Dataset	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.80E+01
2	-6.00E+00	1.00E+02	9.80E+01
3	1.23E+00	9.66E+01	9.80E+01
4	1.27E+00	9.90E+01	9.80E+01
5	1.81E+00	100.26	98.029
6	1.84E+00	94.237	98.029
7	2.09E+00	94.751	98.029
8	2.11E+00	98.644	98.029
9	2.37E+00	93.559	98.029
10	2.39E+00	99.475	98.029
11	2.67E+00	70.341	62.855
12	2.6768	55.593	58.353

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	11	50720	4610.9		
Regression	2	50710	25355	22413	0
Error	9	10.181	1.1313		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	11	50720	4610.9		
Regression	2	50710	25355	22052	0
Error	9	10.348	1.1498		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	11	50720	4610.9		
Regression	2	50710	25355	22914	0
Error	9	9.9587	1.1065		

Prediction Line

	X	Y	
1	-1.5	9.80E+01	3.16E-02
2	-1.45E+00	9.80E+01	3.51E-02
3	-1.41E+00	9.80E+01	3.90E-02
4	-1.36E+00	9.80E+01	4.33E-02
5	-1.32E+00	9.80E+01	4.81E-02
6	-1.27E+00	9.80E+01	5.34E-02
7	-1.23E+00	9.80E+01	5.93E-02
8	-1.18E+00	9.80E+01	6.58E-02
9	-1.14E+00	9.80E+01	7.30E-02
10	-1.09E+00	9.80E+01	8.11E-02
11	-1.05E+00	9.80E+01	9.01E-02
12	-1.00E+00	9.80E+01	1.00E-01
13	-9.55E-01	9.80E+01	1.11E-01
14	-0.90909	9.80E+01	1.23E-01
15	-0.86364	9.80E+01	1.37E-01
16	-0.81818	9.80E+01	1.52E-01

	X	Y	
1	-1.5	9.81E+01	0.031623
2	-1.45E+00	9.81E+01	0.035116
3	-1.41E+00	9.81E+01	0.038985
4	-1.36E+00	9.81E+01	0.043291
5	-1.32E+00	9.81E+01	0.048062
6	-1.27E+00	9.81E+01	0.05337
7	-1.23E+00	9.81E+01	0.059252
8	-1.18E+00	9.81E+01	0.065796
9	-1.14E+00	9.81E+01	0.073047
10	-1.09E+00	9.81E+01	0.081115
11	-1.05E+00	9.81E+01	0.090053
12	-1.00E+00	9.81E+01	0.1
13	-9.55E-01	9.81E+01	0.111032
14	-0.90909	9.81E+01	0.123285
15	-0.86364	9.81E+01	0.136886
16	-0.81818	9.81E+01	0.151992

	X	Y	
1	-1.5	9.80E+01	0.031623
2	-1.45E+00	9.80E+01	0.035116
3	-1.41E+00	9.80E+01	0.038985
4	-1.36E+00	9.80E+01	0.043291
5	-1.32E+00	9.80E+01	0.048062
6	-1.27E+00	9.80E+01	0.05337
7	-1.23E+00	9.80E+01	0.059252
8	-1.18E+00	9.80E+01	0.065796
9	-1.14E+00	9.80E+01	0.073047
10	-1.09E+00	9.80E+01	0.081115
11	-1.05E+00	9.80E+01	0.090053
12	-1.00E+00	9.80E+01	0.1
13	-9.55E-01	9.80E+01	0.111032
14	-0.90909	9.80E+01	0.123285
15	-0.86364	9.80E+01	0.136886
16	-0.81818	9.80E+01	0.151992

Prediction Line

	X	Y	
17	-0.77273	9.80E+01	1.69E-01
18	-0.72727	9.80E+01	1.87E-01
19	-0.68182	9.80E+01	2.08E-01
20	-0.63636	9.80E+01	2.31E-01
21	-5.91E-01	9.80E+01	2.57E-01
22	-5.45E-01	9.80E+01	2.85E-01
23	-5.00E-01	9.80E+01	3.16E-01
24	-4.55E-01	9.80E+01	3.51E-01
25	-4.09E-01	9.80E+01	3.90E-01
26	-3.64E-01	9.80E+01	4.33E-01
27	-3.18E-01	9.80E+01	4.81E-01
28	-2.73E-01	9.80E+01	5.34E-01
29	-2.27E-01	9.80E+01	5.93E-01
30	-1.82E-01	9.80E+01	6.58E-01
31	-0.13636	9.80E+01	7.31E-01
32	-9.09E-02	9.80E+01	8.11E-01
33	-4.55E-02	9.80E+01	9.01E-01
34	0	9.80E+01	1.00E+00
35	4.55E-02	9.80E+01	1.11E+00
36	9.09E-02	9.80E+01	1.23E+00
37	0.13636	9.80E+01	1.37E+00
38	0.18182	9.80E+01	1.52E+00
39	0.22727	9.80E+01	1.69E+00
40	0.27273	9.80E+01	1.87E+00
41	0.31818	9.80E+01	2.08E+00
42	0.36364	9.80E+01	2.31E+00
43	0.40909	9.80E+01	2.57E+00
44	0.45455	9.80E+01	2.85E+00
45	0.5	9.80E+01	3.16E+00
46	0.54545	9.80E+01	3.51E+00
47	0.59091	9.80E+01	3.90E+00
48	0.63636	9.80E+01	4.33E+00
49	0.68182	9.80E+01	4.81E+00
50	0.72727	9.80E+01	5.34E+00
51	0.77273	9.80E+01	5.93E+00
52	0.81818	9.80E+01	6.58E+00
53	0.86364	9.80E+01	7.31E+00
54	0.90909	9.80E+01	8.11E+00
55	0.95455	9.80E+01	9.01E+00
56	1	9.80E+01	1.00E+01
57	1.0455	9.80E+01	1.11E+01
58	1.0909	9.80E+01	1.23E+01
59	1.1364	9.80E+01	1.37E+01
60	1.1818	9.80E+01	1.52E+01
61	1.2273	9.80E+01	1.69E+01
62	1.2727	9.80E+01	1.87E+01
63	1.3182	9.80E+01	2.08E+01
64	1.3636	9.80E+01	2.31E+01
65	1.4091	9.80E+01	2.57E+01
66	1.4545	9.80E+01	2.85E+01
67	1.5	9.80E+01	3.16E+01

	X	Y	
17	-0.77273	9.81E+01	0.16876
18	-0.72727	9.81E+01	0.187383
19	-0.68182	9.81E+01	0.208056
20	-0.63636	9.81E+01	0.231015
21	-5.91E-01	9.81E+01	0.256502
22	-5.45E-01	9.81E+01	0.284807
23	-5.00E-01	9.81E+01	0.316228
24	-4.55E-01	9.81E+01	0.351115
25	-4.09E-01	9.81E+01	0.389861
26	-3.64E-01	9.81E+01	0.432873
27	-3.18E-01	9.81E+01	0.48064
28	-2.73E-01	9.81E+01	0.533667
29	-2.27E-01	9.81E+01	0.592557
30	-1.82E-01	9.81E+01	0.65793
31	-0.13636	9.81E+01	0.730533
32	-9.09E-02	9.81E+01	0.811131
33	-4.55E-02	9.81E+01	0.900627
34	0	9.81E+01	1
35	4.55E-02	9.81E+01	1.110337
36	9.09E-02	9.81E+01	1.232846
37	0.13636	9.81E+01	1.368863
38	0.18182	9.81E+01	1.519917
39	0.22727	9.81E+01	1.687602
40	0.27273	9.81E+01	1.873829
41	0.31818	9.81E+01	2.080559
42	0.36364	9.81E+01	2.310149
43	0.40909	9.81E+01	2.565016
44	0.45455	9.81E+01	2.848066
45	0.5	9.81E+01	3.162278
46	0.54545	9.81E+01	3.511155
47	0.59091	9.81E+01	3.898612
48	0.63636	9.81E+01	4.328725
49	0.68182	9.81E+01	4.806401
50	0.72727	9.81E+01	5.336666
51	0.77273	9.81E+01	5.925568
52	0.81818	9.81E+01	6.579305
53	0.86364	9.81E+01	7.305333
54	0.90909	9.81E+01	8.111291
55	0.95455	9.81E+01	9.006374
56	1	9.81E+01	10
57	1.0455	9.81E+01	11.10453
58	1.0909	9.81E+01	12.32821
59	1.1364	9.81E+01	13.68989
60	1.1818	9.81E+01	15.19847
61	1.2273	9.81E+01	16.87718
62	1.2727	9.81E+01	18.737
63	1.3182	9.81E+01	20.80655
64	1.3636	9.81E+01	23.09936
65	1.4091	9.81E+01	25.65075
66	1.4545	9.81E+01	28.47738
67	1.5	9.81E+01	31.62278

	X	Y	
17	-0.77273	9.80E+01	0.16876
18	-0.72727	9.80E+01	0.187383
19	-0.68182	9.80E+01	0.208056
20	-0.63636	9.80E+01	0.231015
21	-5.91E-01	9.80E+01	0.256502
22	-5.45E-01	9.80E+01	0.284807
23	-5.00E-01	9.80E+01	0.316228
24	-4.55E-01	9.80E+01	0.351115
25	-4.09E-01	9.80E+01	0.389861
26	-3.64E-01	9.80E+01	0.432873
27	-3.18E-01	9.80E+01	0.48064
28	-2.73E-01	9.80E+01	0.533667
29	-2.27E-01	9.80E+01	0.592557
30	-1.82E-01	9.80E+01	0.65793
31	-0.13636	9.80E+01	0.730533
32	-9.09E-02	9.80E+01	0.811131
33	-4.55E-02	9.80E+01	0.900627
34	0	9.80E+01	1
35	4.55E-02	9.80E+01	1.110337
36	9.09E-02	9.80E+01	1.232846
37	0.13636	9.80E+01	1.368863
38	0.18182	9.80E+01	1.519917
39	0.22727	9.80E+01	1.687602
40	0.27273	9.80E+01	1.873829
41	0.31818	9.80E+01	2.080559
42	0.36364	9.80E+01	2.310149
43	0.40909	9.80E+01	2.565016
44	0.45455	9.80E+01	2.848066
45	0.5	9.80E+01	3.162278
46	0.54545	9.80E+01	3.511155
47	0.59091	9.80E+01	3.898612
48	0.63636	9.80E+01	4.328725
49	0.68182	9.80E+01	4.806401
50	0.72727	9.80E+01	5.336666
51	0.77273	9.80E+01	5.925568
52	0.81818	9.80E+01	6.579305
53	0.86364	9.80E+01	7.305333
54	0.90909	9.80E+01	8.111291
55	0.95455	9.80E+01	9.006374
56	1	9.80E+01	10
57	1.0455	9.80E+01	11.10453
58	1.0909	9.80E+01	12.32821
59	1.1364	9.80E+01	13.68989
60	1.1818	9.80E+01	15.19847
61	1.2273	9.80E+01	16.87718
62	1.2727	9.80E+01	18.737
63	1.3182	9.80E+01	20.80655
64	1.3636	9.80E+01	23.09936
65	1.4091	9.80E+01	25.65075
66	1.4545	9.80E+01	28.47738
67	1.5	9.80E+01	31.62278

Prediction Line

	X	Y	
68	1.5455	9.80E+01	3.51E+01
69	1.5909	9.80E+01	3.90E+01
70	1.6364	9.80E+01	4.33E+01
71	1.6818	9.80E+01	4.81E+01
72	1.7273	9.80E+01	5.34E+01
73	1.7727	9.80E+01	5.93E+01
74	1.8182	9.80E+01	6.58E+01
75	1.8636	9.80E+01	7.30E+01
76	1.9091	9.80E+01	8.11E+01
77	1.9545	9.80E+01	9.01E+01
78	2	9.80E+01	1.00E+02
79	2.0455	9.80E+01	1.11E+02
80	2.0909	9.80E+01	1.23E+02
81	2.1364	9.80E+01	1.37E+02
82	2.1818	9.80E+01	1.52E+02
83	2.2273	9.80E+01	1.69E+02
84	2.2727	9.80E+01	1.87E+02
85	2.3182	9.80E+01	2.08E+02
86	2.3636	9.80E+01	2.31E+02
87	2.4091	9.80E+01	2.57E+02
88	2.4545	9.80E+01	2.85E+02
89	2.5	9.79E+01	3.16E+02
90	2.5455	9.73E+01	3.51E+02
91	2.5909	9.48E+01	3.90E+02
92	2.6364	8.40E+01	4.33E+02
93	2.6818	5.38E+01	4.81E+02
94	2.7273	1.94E+01	5.34E+02
95	2.7727	4.69E+00	5.93E+02
96	2.8182	9.92E-01	6.58E+02
97	2.8636	2.03E-01	7.30E+02
98	2.9091	4.14E-02	8.11E+02
99	2.9545	8.42E-03	9.01E+02
100	3	1.71E-03	1.00E+03

	X	Y	
68	1.5455	9.81E+01	35.11559
69	1.5909	9.81E+01	38.98522
70	1.6364	9.81E+01	43.29124
71	1.6818	9.81E+01	48.0618
72	1.7273	9.81E+01	53.37034
73	1.7727	9.81E+01	59.25159
74	1.8182	9.81E+01	65.79608
75	1.8636	9.81E+01	73.0466
76	1.9091	9.81E+01	81.11478
77	1.9545	9.81E+01	90.05338
78	2	9.81E+01	100
79	2.0455	9.81E+01	111.0453
80	2.0909	9.81E+01	123.2821
81	2.1364	9.81E+01	136.8989
82	2.1818	9.81E+01	151.9847
83	2.2273	9.81E+01	168.7718
84	2.2727	9.81E+01	187.37
85	2.3182	9.81E+01	208.0655
86	2.3636	9.81E+01	230.9936
87	2.4091	9.81E+01	256.5075
88	2.4545	9.81E+01	284.7738
89	2.5	9.81E+01	316.2278
90	2.5455	9.81E+01	351.1559
91	2.5909	9.70E+01	389.8522
92	2.6364	8.34E+01	432.9124
93	2.6818	5.42E+01	480.618
94	2.7273	2.11E+01	533.7034
95	2.7727	3.25E+00	592.5159
96	2.8182	0.00E+00	657.9608
97	2.8636	0.00E+00	730.466
98	2.9091	0.00E+00	811.1478
99	2.9545	0.00E+00	900.5338
100	3	0.00E+00	1000

	X	Y	
68	1.5455	9.80E+01	35.11559
69	1.5909	9.80E+01	38.98522
70	1.6364	9.80E+01	43.29124
71	1.6818	9.80E+01	48.0618
72	1.7273	9.80E+01	53.37034
73	1.7727	9.80E+01	59.25159
74	1.8182	9.80E+01	65.79608
75	1.8636	9.80E+01	73.0466
76	1.9091	9.80E+01	81.11478
77	1.9545	9.80E+01	90.05338
78	2	9.80E+01	100
79	2.0455	9.80E+01	111.0453
80	2.0909	9.80E+01	123.2821
81	2.1364	9.80E+01	136.8989
82	2.1818	9.80E+01	151.9847
83	2.2273	9.80E+01	168.7718
84	2.2727	9.80E+01	187.37
85	2.3182	9.80E+01	208.0655
86	2.3636	9.80E+01	230.9936
87	2.4091	9.80E+01	256.5075
88	2.4545	9.80E+01	284.7738
89	2.5	9.80E+01	316.2278
90	2.5455	9.80E+01	351.1559
91	2.5909	9.80E+01	389.8522
92	2.6364	9.31E+01	432.9124
93	2.6818	5.40E+01	480.618
94	2.7273	1.50E+01	533.7034
95	2.7727	0.00E+00	592.5159
96	2.8182	0.00E+00	657.9608
97	2.8636	0.00E+00	730.466
98	2.9091	0.00E+00	811.1478
99	2.9545	0.00E+00	900.5338
100	3	0.00E+00	1000

Table H2.D-5a. TRAP Model Output for Cadmium Data for the Bird Growth Endpoint (Bokori et al. 1995)

Chemical:	Cadmium
Study Authors:	Bokori et al. 1995
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Response	SE
1.00E-06	1.469	5.00E-02
4.7361	1.03	4.30E-02
18.944	0.476	1.70E-02
37.889	0.353	1.70E-02

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.026	0.96423			
S	0.56968	5.20E-01			
Y0	1.47E+00	1.49E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.026	0.96588			
S	0.56968	5.51E-01			
Y0	1.47E+00	1.48E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.026	0.96385			
S	0.56968	0.45768			
Y0	1.47E+00	1.47E+00			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	9.2095	0.13027	651.09	0.14555	0.96423
20	1.99E+00	4.17E-04	9.48E+03	0.28952	2.98E-01
10	8.10E-01	1.18E-05	5.55E+04	0.38058	-9.13E-02
5	3.55E-01	4.28E-07	2.94E+05	0.46582	-0.4502
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	9.2444	0.12738	670.89	0.14645	0.96588
20	1.9911	2.92E-04	13557	0.30167	2.99E-01
10	9.18E-01	6.35E-06	1.33E+05	0.40614	-3.70E-02
5	0.53137	2.51E-07	1.12E+06	0.4978	-0.27461
0	1.42E-01	7.54E-14	2.67E+11	0.96603	-8.48E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	9.2012	2.19E-02	3874.7	0.20654	0.96385
20	2.034	1.61E-05	2.57E+05	0.40155	0.30836
10	1.2299	1.32E-06	1.15E+06	0.46981	8.99E-02
5	0.95635	3.75E-07	2.44E+06	0.50419	-1.94E-02
0	0.74365	1.06E-07	5.20E+06	0.53869	-0.12863

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.47E+00	1.49E+00
2	6.75E-01	1.03E+00	9.60E-01
3	1.28E+00	4.76E-01	5.09E-01
4	1.58E+00	3.53E-01	3.24E-01
5			
6			

Analysis of Variance

R-squared: 0.996

	DF	SS	MS	F	Sig
Total (adj)	3	2548.9	849.64		
Regression	2	2539.4	1269.7	133.21	0.0612
Error	1	9.5315	9.5315		

Prediction Line

	X	Y
1	-2.5	1.49E+00
2	-2.45E+00	1.49E+00
3	-2.41E+00	1.49E+00
4	-2.36E+00	1.49E+00
5	-2.32E+00	1.49E+00
6	-2.27E+00	1.48E+00
7	-2.23E+00	1.48E+00
8	-2.18E+00	1.48E+00
9	-2.14E+00	1.48E+00
10	-2.09E+00	1.48E+00
11	-2.05E+00	1.48E+00
12	-2.00E+00	1.48E+00
13	-1.95E+00	1.48E+00
14	-1.9091	1.48E+00
15	-1.8636	1.48E+00
16	-1.8182	1.48E+00
17	-1.7727	1.48E+00
18	-1.7273	1.48E+00
19	-1.6818	1.48E+00
20	-1.6364	1.48E+00
21	-1.59E+00	1.48E+00
22	-1.55E+00	1.48E+00
23	-1.50E+00	1.48E+00
24	-1.45E+00	1.48E+00
25	-1.41E+00	1.48E+00
26	-1.36E+00	1.48E+00
27	-1.32E+00	1.47E+00
28	-1.27E+00	1.47E+00
29	-1.23E+00	1.47E+00
30	-1.18E+00	1.47E+00

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.47E+00	1.48E+00
2	6.75E-01	1.03E+00	9.61E-01
3	1.28E+00	4.76E-01	5.09E-01
4	1.58E+00	3.53E-01	3.25E-01
5			
6			

R-squared: 0.996

	DF	SS	MS	F	Sig
Total (adj)	3	2548.9	849.64		
Regression	2	2539.8	1269.9	139.78	0.0597
Error	1	9.0852	9.0852		

	X	Y
1	-2.5	1.48E+00
2	-2.45E+00	1.48E+00
3	-2.41E+00	1.48E+00
4	-2.36E+00	1.48E+00
5	-2.32E+00	1.48E+00
6	-2.27E+00	1.48E+00
7	-2.23E+00	1.48E+00
8	-2.18E+00	1.48E+00
9	-2.14E+00	1.48E+00
10	-2.09E+00	1.48E+00
11	-2.05E+00	1.48E+00
12	-2.00E+00	1.48E+00
13	-1.95E+00	1.48E+00
14	-1.9091	1.48E+00
15	-1.8636	1.48E+00
16	-1.8182	1.48E+00
17	-1.7727	1.48E+00
18	-1.7273	1.48E+00
19	-1.6818	1.48E+00
20	-1.6364	1.48E+00
21	-1.59E+00	1.48E+00
22	-1.55E+00	1.48E+00
23	-1.50E+00	1.48E+00
24	-1.45E+00	1.48E+00
25	-1.41E+00	1.48E+00
26	-1.36E+00	1.48E+00
27	-1.32E+00	1.48E+00
28	-1.27E+00	1.48E+00
29	-1.23E+00	1.48E+00
30	-1.18E+00	1.48E+00

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.47E+00	1.47E+00
2	6.75E-01	1.03E+00	9.28E-01
3	1.28E+00	4.76E-01	5.24E-01
4	1.58E+00	3.53E-01	3.21E-01
5			
6			

R-squared: 0.993

	DF	SS	MS	F	Sig
Total (adj)	3	2548.9	849.64		
Regression	2	2532	1266	74.815	0.0815
Error	1	16.922	16.922		

	X	Y
1	-2.5	1.47E+00
2	-2.45E+00	1.47E+00
3	-2.41E+00	1.47E+00
4	-2.36E+00	1.47E+00
5	-2.32E+00	1.47E+00
6	-2.27E+00	1.47E+00
7	-2.23E+00	1.47E+00
8	-2.18E+00	1.47E+00
9	-2.14E+00	1.47E+00
10	-2.09E+00	1.47E+00
11	-2.05E+00	1.47E+00
12	-2.00E+00	1.47E+00
13	-1.95E+00	1.47E+00
14	-1.9091	1.47E+00
15	-1.8636	1.47E+00
16	-1.8182	1.47E+00
17	-1.7727	1.47E+00
18	-1.7273	1.47E+00
19	-1.6818	1.47E+00
20	-1.6364	1.47E+00
21	-1.59E+00	1.47E+00
22	-1.55E+00	1.47E+00
23	-1.50E+00	1.47E+00
24	-1.45E+00	1.47E+00
25	-1.41E+00	1.47E+00
26	-1.36E+00	1.47E+00
27	-1.32E+00	1.47E+00
28	-1.27E+00	1.47E+00
29	-1.23E+00	1.47E+00
30	-1.18E+00	1.47E+00

Prediction Line

	X	Y
31	-1.1364	1.47E+00
32	-1.0909	1.47E+00
33	-1.0455	1.46E+00
34	-1	1.46E+00
35	-0.95455	1.46E+00
36	-0.90909	1.46E+00
37	-0.86364	1.45E+00
38	-0.81818	1.45E+00
39	-0.77273	1.45E+00
40	-0.72727	1.44E+00
41	-0.68182	1.44E+00
42	-0.63636	1.44E+00
43	-0.59091	1.43E+00
44	-0.54545	1.43E+00
45	-0.5	1.42E+00
46	-0.45455	1.41E+00
47	-0.40909	1.41E+00
48	-0.36364	1.40E+00
49	-0.31818	1.39E+00
50	-0.27273	1.38E+00
51	-0.22727	1.37E+00
52	-0.18182	1.36E+00
53	-0.13636	1.35E+00
54	-9.09E-02	1.34E+00
55	-4.55E-02	1.32E+00
56	0	1.31E+00
57	4.55E-02	1.30E+00
58	9.09E-02	1.28E+00
59	0.13636	1.26E+00
60	0.18182	1.24E+00
61	0.22727	1.22E+00
62	0.27273	1.20E+00
63	0.31818	1.18E+00
64	0.36364	1.16E+00
65	0.40909	1.13E+00
66	0.45455	1.10E+00
67	0.5	1.08E+00
68	0.54545	1.05E+00
69	0.59091	1.02E+00
70	0.63636	9.88E-01
71	0.68182	9.56E-01
72	0.72727	9.23E-01
73	0.77273	8.90E-01
74	0.81818	8.55E-01
75	0.86364	8.21E-01
76	0.90909	7.86E-01
77	0.95455	7.51E-01
78	1	7.16E-01
79	1.0455	6.81E-01
80	1.0909	6.46E-01
81	1.1364	6.12E-01

	X	Y
31	-1.1364	1.48E+00
32	-1.0909	1.48E+00
33	-1.0455	1.48E+00
34	-1	1.48E+00
35	-0.95455	1.48E+00
36	-0.90909	1.48E+00
37	-0.86364	1.48E+00
38	-0.81818	1.48E+00
39	-0.77273	1.48E+00
40	-0.72727	1.48E+00
41	-0.68182	1.48E+00
42	-0.63636	1.47E+00
43	-0.59091	1.47E+00
44	-0.54545	1.46E+00
45	-0.5	1.46E+00
46	-0.45455	1.45E+00
47	-0.40909	1.44E+00
48	-0.36364	1.43E+00
49	-0.31818	1.42E+00
50	-0.27273	1.41E+00
51	-0.22727	1.40E+00
52	-0.18182	1.38E+00
53	-0.13636	1.37E+00
54	-9.09E-02	1.35E+00
55	-4.55E-02	1.34E+00
56	0	1.32E+00
57	4.55E-02	1.30E+00
58	9.09E-02	1.29E+00
59	0.13636	1.27E+00
60	0.18182	1.24E+00
61	0.22727	1.22E+00
62	0.27273	1.20E+00
63	0.31818	1.18E+00
64	0.36364	1.15E+00
65	0.40909	1.13E+00
66	0.45455	1.10E+00
67	0.5	1.07E+00
68	0.54545	1.05E+00
69	0.59091	1.02E+00
70	0.63636	9.87E-01
71	0.68182	9.56E-01
72	0.72727	9.24E-01
73	0.77273	8.92E-01
74	0.81818	8.58E-01
75	0.86364	8.23E-01
76	0.90909	7.88E-01
77	0.95455	7.51E-01
78	1	7.14E-01
79	1.0455	6.78E-01
80	1.0909	6.43E-01
81	1.1364	6.09E-01

	X	Y
31	-1.1364	1.47E+00
32	-1.0909	1.47E+00
33	-1.0455	1.47E+00
34	-1	1.47E+00
35	-0.95455	1.47E+00
36	-0.90909	1.47E+00
37	-0.86364	1.47E+00
38	-0.81818	1.47E+00
39	-0.77273	1.47E+00
40	-0.72727	1.47E+00
41	-0.68182	1.47E+00
42	-0.63636	1.47E+00
43	-0.59091	1.47E+00
44	-0.54545	1.47E+00
45	-0.5	1.47E+00
46	-0.45455	1.47E+00
47	-0.40909	1.47E+00
48	-0.36364	1.47E+00
49	-0.31818	1.47E+00
50	-0.27273	1.47E+00
51	-0.22727	1.47E+00
52	-0.18182	1.47E+00
53	-0.13636	1.47E+00
54	-9.09E-02	1.44E+00
55	-4.55E-02	1.41E+00
56	0	1.38E+00
57	4.55E-02	1.35E+00
58	9.09E-02	1.32E+00
59	0.13636	1.29E+00
60	0.18182	1.26E+00
61	0.22727	1.23E+00
62	0.27273	1.20E+00
63	0.31818	1.17E+00
64	0.36364	1.14E+00
65	0.40909	1.11E+00
66	0.45455	1.08E+00
67	0.5	1.05E+00
68	0.54545	1.02E+00
69	0.59091	9.85E-01
70	0.63636	9.55E-01
71	0.68182	9.24E-01
72	0.72727	8.94E-01
73	0.77273	8.63E-01
74	0.81818	8.32E-01
75	0.86364	8.02E-01
76	0.90909	7.71E-01
77	0.95455	7.41E-01
78	1	7.10E-01
79	1.0455	6.80E-01
80	1.0909	6.49E-01
81	1.1364	6.19E-01

Prediction Line

	X	Y
82	1.1818	5.78E-01
83	1.2273	5.45E-01
84	1.2727	5.13E-01
85	1.3182	4.81E-01
86	1.3636	4.51E-01
87	1.4091	4.22E-01
88	1.4545	3.94E-01
89	1.5	3.67E-01
90	1.5455	3.42E-01
91	1.5909	3.17E-01
92	1.6364	2.94E-01
93	1.6818	2.73E-01
94	1.7273	2.52E-01
95	1.7727	2.33E-01
96	1.8182	2.15E-01
97	1.8636	1.98E-01
98	1.9091	1.82E-01
99	1.9545	1.68E-01
100	2	1.54E-01

	X	Y
82	1.1818	5.76E-01
83	1.2273	5.44E-01
84	1.2727	5.12E-01
85	1.3182	4.82E-01
86	1.3636	4.52E-01
87	1.4091	4.24E-01
88	1.4545	3.96E-01
89	1.5	3.69E-01
90	1.5455	3.44E-01
91	1.5909	3.19E-01
92	1.6364	2.95E-01
93	1.6818	2.72E-01
94	1.7273	2.50E-01
95	1.7727	2.29E-01
96	1.8182	2.09E-01
97	1.8636	1.89E-01
98	1.9091	1.71E-01
99	1.9545	1.54E-01
100	2	1.37E-01

	X	Y
82	1.1818	5.88E-01
83	1.2273	5.57E-01
84	1.2727	5.27E-01
85	1.3182	4.96E-01
86	1.3636	4.66E-01
87	1.4091	4.35E-01
88	1.4545	4.05E-01
89	1.5	3.74E-01
90	1.5455	3.43E-01
91	1.5909	3.13E-01
92	1.6364	2.82E-01
93	1.6818	2.52E-01
94	1.7273	2.21E-01
95	1.7727	1.91E-01
96	1.8182	1.60E-01
97	1.8636	1.30E-01
98	1.9091	9.90E-02
99	1.9545	6.84E-02
100	2	3.79E-02

Table H2.D-5b. TRAP Model Output for Cadmium Data for the Bird Growth Endpoint (DiGiulio and Scanlon 1984)

Chemical:	Cadmium
Study Authors:	DiGiulio and Scanlon 1984
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Response	SE
0.000001	1.201	0.046
5.985663	1.22	0.037
17.95699	1.11	0.037
53.87097	0.911	0.026

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	2.1018	2.1026			
S	0.72817	7.21E-01			
Y0	1.21E+00	1.22E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	2.1018	2.1886			
S	0.72817	6.41E-01			
Y0	1.21E+00	1.21E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	2.1018	2.1062			
S	0.72817	0.73669			
Y0	1.21E+00	1.17E+00			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	126.66	4.0872	3925.3	0.11736	2.1026
20	4.19E+01	4.58E+00	3.83E+02	7.56E-02	1.622
10	2.19E+01	1.82E-01	2.64E+03	0.16381	1.3408
5	1.21E+01	7.73E-03	1.88E+04	0.25133	1.0817
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	154.39	23.868	998.64	6.38E-02	2.1886
20	41.227	1.36E+01	124.63	3.78E-02	1.6152
10	2.12E+01	2.70E+00	1.66E+02	7.04E-02	1.3262
5	13.238	7.75E-01	2.26E+02	9.70E-02	1.1218
0	4.2505	3.51E-02	5.14E+02	0.16392	6.28E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	127.69				2.1062
20	49.995				1.6989
10	36.575				1.5632
5	31.284				1.4953
0	26.757				1.4274

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.20E+00	1.22E+00
2	7.77E-01	1.22E+00	1.20E+00
3	1.25E+00	1.11E+00	1.12E+00
4	1.73E+00	9.11E-01	9.10E-01
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.20E+00	1.21E+00
2	7.77E-01	1.22E+00	1.21E+00
3	1.25E+00	1.11E+00	1.12E+00
4	1.73E+00	9.11E-01	9.10E-01
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.20E+00	1.17E+00
2	7.77E-01	1.22E+00	1.17E+00
3	1.25E+00	1.11E+00	1.17E+00
4	1.73E+00	9.11E-01	9.11E-01
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	3638	1212.7		
Regression	2	3637.2	1818.6	2298.1	0.0147
Error	1	0.79134	0.79134		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	3638	1212.7		
Regression	2	3637.8	1818.9	8864.5	0.0075
Error	1	0.20519	0.20519		

R-squared: 0.999

	DF	SS	MS	F	Sig
Total (adj)	3	3638	1212.7		
Regression	2	3633.1	1816.5	372.08	0.0366
Error	1	4.8821	4.8821		

Prediction Line

	X	Y
1	-2	1.22E+00
2	-1.96E+00	1.22E+00
3	-1.92E+00	1.22E+00
4	-1.88E+00	1.22E+00
5	-1.84E+00	1.22E+00
6	-1.80E+00	1.22E+00
7	-1.76E+00	1.22E+00
8	-1.72E+00	1.22E+00
9	-1.68E+00	1.22E+00
10	-1.64E+00	1.22E+00
11	-1.60E+00	1.22E+00
12	-1.56E+00	1.22E+00
13	-1.52E+00	1.22E+00
14	-1.4747	1.22E+00
15	-1.4343	1.22E+00
16	-1.3939	1.22E+00
17	-1.3535	1.22E+00
18	-1.3131	1.22E+00
19	-1.2727	1.22E+00
20	-1.2323	1.22E+00
21	-1.19E+00	1.22E+00
22	-1.15E+00	1.22E+00
23	-1.11E+00	1.22E+00
24	-1.07E+00	1.22E+00
25	-1.03E+00	1.22E+00
26	-9.90E-01	1.22E+00
27	-9.49E-01	1.22E+00
28	-9.09E-01	1.22E+00
29	-8.69E-01	1.22E+00
30	-8.28E-01	1.22E+00

	X	Y
1	-2	1.21E+00
2	-1.96E+00	1.21E+00
3	-1.92E+00	1.21E+00
4	-1.88E+00	1.21E+00
5	-1.84E+00	1.21E+00
6	-1.80E+00	1.21E+00
7	-1.76E+00	1.21E+00
8	-1.72E+00	1.21E+00
9	-1.68E+00	1.21E+00
10	-1.64E+00	1.21E+00
11	-1.60E+00	1.21E+00
12	-1.56E+00	1.21E+00
13	-1.52E+00	1.21E+00
14	-1.4747	1.21E+00
15	-1.4343	1.21E+00
16	-1.3939	1.21E+00
17	-1.3535	1.21E+00
18	-1.3131	1.21E+00
19	-1.2727	1.21E+00
20	-1.2323	1.21E+00
21	-1.19E+00	1.21E+00
22	-1.15E+00	1.21E+00
23	-1.11E+00	1.21E+00
24	-1.07E+00	1.21E+00
25	-1.03E+00	1.21E+00
26	-9.90E-01	1.21E+00
27	-9.49E-01	1.21E+00
28	-9.09E-01	1.21E+00
29	-8.69E-01	1.21E+00
30	-8.28E-01	1.21E+00

	X	Y
1	-2	1.17E+00
2	-1.96E+00	1.17E+00
3	-1.92E+00	1.17E+00
4	-1.88E+00	1.17E+00
5	-1.84E+00	1.17E+00
6	-1.80E+00	1.17E+00
7	-1.76E+00	1.17E+00
8	-1.72E+00	1.17E+00
9	-1.68E+00	1.17E+00
10	-1.64E+00	1.17E+00
11	-1.60E+00	1.17E+00
12	-1.56E+00	1.17E+00
13	-1.52E+00	1.17E+00
14	-1.4747	1.17E+00
15	-1.4343	1.17E+00
16	-1.3939	1.17E+00
17	-1.3535	1.17E+00
18	-1.3131	1.17E+00
19	-1.2727	1.17E+00
20	-1.2323	1.17E+00
21	-1.19E+00	1.17E+00
22	-1.15E+00	1.17E+00
23	-1.11E+00	1.17E+00
24	-1.07E+00	1.17E+00
25	-1.03E+00	1.17E+00
26	-9.90E-01	1.17E+00
27	-9.49E-01	1.17E+00
28	-9.09E-01	1.17E+00
29	-8.69E-01	1.17E+00
30	-8.28E-01	1.17E+00

Prediction Line												
	31	-0.78788	1.22E+00		31	-0.78788	1.21E+00		31	-0.78788	1.17E+00	
	32	-0.74747	1.22E+00		32	-0.74747	1.21E+00		32	-0.74747	1.17E+00	
	33	-0.70707	1.22E+00		33	-0.70707	1.21E+00		33	-0.70707	1.17E+00	
	34	-0.66667	1.22E+00		34	-0.66667	1.21E+00		34	-0.66667	1.17E+00	
	35	-0.62626	1.22E+00		35	-0.62626	1.21E+00		35	-0.62626	1.17E+00	
	36	-0.58586	1.22E+00		36	-0.58586	1.21E+00		36	-0.58586	1.17E+00	
	37	-0.54545	1.22E+00		37	-0.54545	1.21E+00		37	-0.54545	1.17E+00	
	38	-0.50505	1.22E+00		38	-0.50505	1.21E+00		38	-0.50505	1.17E+00	
	39	-0.46465	1.22E+00		39	-0.46465	1.21E+00		39	-0.46465	1.17E+00	
	40	-0.42424	1.22E+00		40	-0.42424	1.21E+00		40	-0.42424	1.17E+00	
	41	-0.38384	1.22E+00		41	-0.38384	1.21E+00		41	-0.38384	1.17E+00	
	42	-0.34343	1.22E+00		42	-0.34343	1.21E+00		42	-0.34343	1.17E+00	
	43	-0.30303	1.22E+00		43	-0.30303	1.21E+00		43	-0.30303	1.17E+00	
	44	-0.26263	1.22E+00		44	-0.26263	1.21E+00		44	-0.26263	1.17E+00	
	45	-0.22222	1.22E+00		45	-0.22222	1.21E+00		45	-0.22222	1.17E+00	
	46	-0.18182	1.22E+00		46	-0.18182	1.21E+00		46	-0.18182	1.17E+00	
	47	-0.14141	1.22E+00		47	-0.14141	1.21E+00		47	-0.14141	1.17E+00	
	48	-0.10101	1.22E+00		48	-0.10101	1.21E+00		48	-0.10101	1.17E+00	
	49	-6.06E-02	1.22E+00		49	-6.06E-02	1.21E+00		49	-6.06E-02	1.17E+00	
	50	-2.02E-02	1.22E+00		50	-2.02E-02	1.21E+00		50	-2.02E-02	1.17E+00	
	51	2.02E-02	1.22E+00		51	2.02E-02	1.21E+00		51	2.02E-02	1.17E+00	
	52	6.06E-02	1.22E+00		52	6.06E-02	1.21E+00		52	6.06E-02	1.17E+00	
	53	0.10101	1.22E+00		53	0.10101	1.21E+00		53	0.10101	1.17E+00	
	54	0.14141	1.22E+00		54	0.14141	1.21E+00		54	0.14141	1.17E+00	
	55	0.18182	1.22E+00		55	0.18182	1.21E+00		55	0.18182	1.17E+00	
	56	0.22222	1.22E+00		56	0.22222	1.21E+00		56	0.22222	1.17E+00	
	57	0.26263	1.22E+00		57	0.26263	1.21E+00		57	0.26263	1.17E+00	
	58	0.30303	1.21E+00		58	0.30303	1.21E+00		58	0.30303	1.17E+00	
	59	0.34343	1.21E+00		59	0.34343	1.21E+00		59	0.34343	1.17E+00	
	60	0.38384	1.21E+00		60	0.38384	1.21E+00		60	0.38384	1.17E+00	
	61	0.42424	1.21E+00		61	0.42424	1.21E+00		61	0.42424	1.17E+00	
	62	0.46465	1.21E+00		62	0.46465	1.21E+00		62	0.46465	1.17E+00	
	63	0.50505	1.21E+00		63	0.50505	1.21E+00		63	0.50505	1.17E+00	
	64	0.54545	1.21E+00		64	0.54545	1.21E+00		64	0.54545	1.17E+00	
	65	0.58586	1.21E+00		65	0.58586	1.21E+00		65	0.58586	1.17E+00	
	66	0.62626	1.20E+00		66	0.62626	1.21E+00		66	0.62626	1.17E+00	
	67	0.66667	1.20E+00		67	0.66667	1.21E+00		67	0.66667	1.17E+00	
	68	0.70707	1.20E+00		68	0.70707	1.21E+00		68	0.70707	1.17E+00	
	69	0.74747	1.20E+00		69	0.74747	1.21E+00		69	0.74747	1.17E+00	
	70	0.78788	1.19E+00		70	0.78788	1.21E+00		70	0.78788	1.17E+00	
	71	0.82828	1.19E+00		71	0.82828	1.20E+00		71	0.82828	1.17E+00	
	72	0.86869	1.19E+00		72	0.86869	1.20E+00		72	0.86869	1.17E+00	
	73	0.90909	1.18E+00		73	0.90909	1.19E+00		73	0.90909	1.17E+00	
	74	0.94949	1.18E+00		74	0.94949	1.19E+00		74	0.94949	1.17E+00	
	75	0.9899	1.17E+00		75	0.9899	1.18E+00		75	0.9899	1.17E+00	
	76	1.0303	1.17E+00		76	1.0303	1.17E+00		76	1.0303	1.17E+00	
	77	1.0707	1.16E+00		77	1.0707	1.16E+00		77	1.0707	1.17E+00	
	78	1.1111	1.16E+00		78	1.1111	1.16E+00		78	1.1111	1.17E+00	
	79	1.1515	1.15E+00		79	1.1515	1.15E+00		79	1.1515	1.17E+00	
	80	1.1919	1.14E+00		80	1.1919	1.13E+00		80	1.1919	1.17E+00	
	81	1.2323	1.13E+00		81	1.2323	1.12E+00		81	1.2323	1.17E+00	
	82	1.2727	1.12E+00		82	1.2727	1.11E+00		82	1.2727	1.17E+00	

Prediction Line									
83	1.3131	1.11E+00	83	1.3131	1.10E+00	83	1.3131	1.17E+00
84	1.3535	1.10E+00	84	1.3535	1.08E+00	84	1.3535	1.17E+00
85	1.3939	1.08E+00	85	1.3939	1.07E+00	85	1.3939	1.17E+00
86	1.4343	1.07E+00	86	1.4343	1.05E+00	86	1.4343	1.17E+00
87	1.4747	1.05E+00	87	1.4747	1.03E+00	87	1.4747	1.13E+00
88	1.5152	1.03E+00	88	1.5152	1.02E+00	88	1.5152	1.10E+00
89	1.5556	1.01E+00	89	1.5556	9.99E-01	89	1.5556	1.06E+00
90	1.596	9.91E-01	90	1.596	9.80E-01	90	1.596	1.03E+00
91	1.6364	9.69E-01	91	1.6364	9.60E-01	91	1.6364	9.93E-01
92	1.6768	9.45E-01	92	1.6768	9.39E-01	92	1.6768	9.58E-01
93	1.7172	9.19E-01	93	1.7172	9.18E-01	93	1.7172	9.23E-01
94	1.7576	8.92E-01	94	1.7576	8.96E-01	94	1.7576	8.88E-01
95	1.798	8.63E-01	95	1.798	8.72E-01	95	1.798	8.53E-01
96	1.8384	8.33E-01	96	1.8384	8.48E-01	96	1.8384	8.18E-01
97	1.8788	8.01E-01	97	1.8788	8.24E-01	97	1.8788	7.84E-01
98	1.9192	7.69E-01	98	1.9192	7.98E-01	98	1.9192	7.49E-01
99	1.9596	7.35E-01	99	1.9596	7.72E-01	99	1.9596	7.14E-01
100	2	7.00E-01	100	2	7.45E-01	100	2	6.79E-01

Table H2.D-5c. TRAP Model Output for Cadmium Data for the Bird Reproduction Endpoint (Leach et al. 1979)

Chemical:	Cadmium
Study Authors:	Leach et al. 1979
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Response	SE
0.0055	64.3	not reported
0.2393	69.5	not reported
0.9408	59.9	not reported
3.7469	48.3	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	0.92368	0.93309			
S	0.6145	6.55E-01			
Y0	6.69E+01	6.67E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	0.92368	1.0222			
S	0.6145	5.64E-01			
Y0	6.69E+01	6.66E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	0.92368	0.94956			
S	0.6145	0.65994			
Y0	6.69E+01	6.46E+01			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	8.5722	5.33E-04	1.38E+05	0.33107	0.93309
20	2.54E+00	2.80E-03	2.29E+03	0.23267	0.40416
10	1.24E+00	1.61E-06	9.60E+05	0.46336	9.48E-02
5	6.45E-01	8.44E-10	4.93E+08	0.69912	-0.19035
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	10.525	1.24E-03	89163	3.09E-01	1.0222
20	2.3442	1.01E-02	545.42	1.86E-01	0.36999
10	1.10E+00	1.03E-04	1.17E+04	0.31697	4.13E-02
5	6.44E-01	2.13E-06	1.94E+05	0.43128	-0.19119
0	1.77E-01	1.08E-10	2.89E+08	0.72505	-7.52E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	8.9035				0.94956
20	3.1259				0.49497
10	2.2052				0.34344
5	1.8522				0.26768
0	1.5557				0.19191

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-2.26E+00	6.43E+01	6.67E+01
2	-6.21E-01	6.95E+01	6.56E+01
3	-2.65E-02	5.99E+01	6.17E+01
4	5.74E-01	4.83E+01	4.80E+01
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-2.26E+00	6.43E+01	6.66E+01
2	-6.21E-01	6.95E+01	6.64E+01
3	-2.65E-02	5.99E+01	6.10E+01
4	5.74E-01	4.83E+01	4.80E+01
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-2.26E+00	6.43E+01	6.46E+01
2	-6.21E-01	6.95E+01	6.46E+01
3	-2.65E-02	5.99E+01	6.46E+01
4	0.57367	48.3	48.3
5			
6			

Analysis of Variance

R-squared: 0.9

	DF	SS	MS	F	Sig
Total (adj)	3	244.64	81.547		
Regression	2	220.24	110.12	4.5141	0.3158
Error	1	24.395	24.395		

R-squared: 0.934

	DF	SS	MS	F	Sig
Total (adj)	3	244.64	81.547		
Regression	2	228.49	114.25	7.0742	0.2569
Error	1	16.15	16.15		

R-squared: 0.811

	DF	SS	MS	F	Sig
Total (adj)	3	244.64	81.547		
Regression	2	198.45	99.227	2.1484	0.4345
Error	1	46.187	46.187		

Prediction Line

	X	Y
1	-2	6.67E+01
2	-1.97E+00	6.67E+01
3	-1.94E+00	6.67E+01
4	-1.91E+00	6.67E+01
5	-1.88E+00	6.67E+01
6	-1.85E+00	6.67E+01
7	-1.82E+00	6.67E+01
8	-1.79E+00	6.67E+01
9	-1.76E+00	6.66E+01
10	-1.73E+00	6.66E+01
11	-1.70E+00	6.66E+01
12	-1.67E+00	6.66E+01
13	-1.64E+00	6.66E+01
14	-1.6061	6.66E+01
15	-1.5758	6.66E+01
16	-1.5455	6.66E+01
17	-1.5152	6.66E+01
18	-1.4848	6.66E+01
19	-1.4545	6.66E+01
20	-1.4242	6.66E+01
21	-1.39E+00	6.66E+01
22	-1.36E+00	6.65E+01
23	-1.33E+00	6.65E+01
24	-1.30E+00	6.65E+01
25	-1.27E+00	6.65E+01
26	-1.24E+00	6.65E+01
27	-1.21E+00	6.65E+01
28	-1.18E+00	6.64E+01
29	-1.15E+00	6.64E+01
30	-1.12E+00	6.64E+01
31	-1.0909	6.64E+01
32	-1.06E+00	6.63E+01

	X	Y
1	-2	6.66E+01
2	-1.97E+00	6.66E+01
3	-1.94E+00	6.66E+01
4	-1.91E+00	6.66E+01
5	-1.88E+00	6.66E+01
6	-1.85E+00	6.66E+01
7	-1.82E+00	6.66E+01
8	-1.79E+00	6.66E+01
9	-1.76E+00	6.66E+01
10	-1.73E+00	6.66E+01
11	-1.70E+00	6.66E+01
12	-1.67E+00	6.66E+01
13	-1.64E+00	6.66E+01
14	-1.6061	6.66E+01
15	-1.5758	6.66E+01
16	-1.5455	6.66E+01
17	-1.5152	6.66E+01
18	-1.4848	6.66E+01
19	-1.4545	6.66E+01
20	-1.4242	6.66E+01
21	-1.39E+00	6.66E+01
22	-1.36E+00	6.66E+01
23	-1.33E+00	6.66E+01
24	-1.30E+00	6.66E+01
25	-1.27E+00	6.66E+01
26	-1.24E+00	6.66E+01
27	-1.21E+00	6.66E+01
28	-1.18E+00	6.66E+01
29	-1.15E+00	6.66E+01
30	-1.12E+00	6.66E+01
31	-1.0909	6.66E+01
32	-1.06E+00	6.66E+01

	X	Y
1	-2	6.46E+01
2	-1.97E+00	6.46E+01
3	-1.94E+00	6.46E+01
4	-1.91E+00	6.46E+01
5	-1.88E+00	6.46E+01
6	-1.85E+00	6.46E+01
7	-1.82E+00	6.46E+01
8	-1.79E+00	6.46E+01
9	-1.76E+00	6.46E+01
10	-1.73E+00	6.46E+01
11	-1.70E+00	6.46E+01
12	-1.67E+00	6.46E+01
13	-1.64E+00	6.46E+01
14	-1.6061	6.46E+01
15	-1.5758	6.46E+01
16	-1.5455	6.46E+01
17	-1.5152	6.46E+01
18	-1.4848	6.46E+01
19	-1.4545	6.46E+01
20	-1.4242	6.46E+01
21	-1.39E+00	6.46E+01
22	-1.36E+00	6.46E+01
23	-1.33E+00	6.46E+01
24	-1.30E+00	6.46E+01
25	-1.27E+00	6.46E+01
26	-1.24E+00	6.46E+01
27	-1.21E+00	6.46E+01
28	-1.18E+00	6.46E+01
29	-1.15E+00	6.46E+01
30	-1.12E+00	6.46E+01
31	-1.0909	6.46E+01
32	-1.06E+00	6.46E+01

Prediction Line

	X	Y
33	-1.03E+00	6.63E+01
34	-1	6.63E+01
35	-9.70E-01	6.63E+01
36	-9.39E-01	6.62E+01
37	-9.09E-01	6.62E+01
38	-8.79E-01	6.61E+01
39	-8.48E-01	6.61E+01
40	-8.18E-01	6.60E+01
41	-7.88E-01	6.60E+01
42	-7.58E-01	6.59E+01
43	-7.27E-01	6.59E+01
44	-6.97E-01	6.58E+01
45	-6.67E-01	6.57E+01
46	-6.36E-01	6.56E+01
47	-6.06E-01	6.55E+01
48	-5.76E-01	6.55E+01
49	-5.45E-01	6.53E+01
50	-5.15E-01	6.52E+01
51	-0.48485	6.51E+01
52	-0.45455	6.50E+01
53	-0.42424	6.49E+01
54	-0.39394	6.47E+01
55	-0.36364	6.45E+01
56	-0.33333	6.44E+01
57	-0.30303	6.42E+01
58	-0.27273	6.40E+01
59	-0.24242	6.38E+01
60	-0.21212	6.35E+01
61	-0.18182	6.33E+01
62	-0.15152	6.30E+01
63	-0.12121	6.27E+01
64	-9.09E-02	6.24E+01
65	-6.06E-02	6.21E+01
66	-3.03E-02	6.18E+01
67	0	6.14E+01
68	3.03E-02	6.10E+01
69	6.06E-02	6.06E+01
70	9.09E-02	6.01E+01
71	0.12121	5.96E+01
72	0.15152	5.91E+01
73	0.18182	5.85E+01
74	0.21212	5.79E+01
75	0.24242	5.73E+01
76	0.27273	5.67E+01
77	0.30303	5.60E+01
78	0.33333	5.52E+01
79	0.36364	5.45E+01
80	0.39394	5.36E+01
81	0.42424	5.28E+01
82	0.45455	5.19E+01
83	0.48485	5.10E+01
84	0.51515	5.00E+01
85	0.54545	4.90E+01

	X	Y
33	-1.03E+00	6.66E+01
34	-1	6.66E+01
35	-9.70E-01	6.66E+01
36	-9.39E-01	6.66E+01
37	-9.09E-01	6.66E+01
38	-8.79E-01	6.66E+01
39	-8.48E-01	6.66E+01
40	-8.18E-01	6.66E+01
41	-7.88E-01	6.66E+01
42	-7.58E-01	6.66E+01
43	-7.27E-01	6.66E+01
44	-6.97E-01	6.66E+01
45	-6.67E-01	6.65E+01
46	-6.36E-01	6.64E+01
47	-6.06E-01	6.64E+01
48	-5.76E-01	6.63E+01
49	-5.45E-01	6.61E+01
50	-5.15E-01	6.60E+01
51	-0.48485	6.58E+01
52	-0.45455	6.56E+01
53	-0.42424	6.54E+01
54	-0.39394	6.52E+01
55	-0.36364	6.50E+01
56	-0.33333	6.47E+01
57	-0.30303	6.45E+01
58	-0.27273	6.42E+01
59	-0.24242	6.38E+01
60	-0.21212	6.35E+01
61	-0.18182	6.31E+01
62	-0.15152	6.28E+01
63	-0.12121	6.24E+01
64	-9.09E-02	6.20E+01
65	-6.06E-02	6.15E+01
66	-3.03E-02	6.11E+01
67	0	6.06E+01
68	3.03E-02	6.01E+01
69	6.06E-02	5.96E+01
70	9.09E-02	5.91E+01
71	0.12121	5.85E+01
72	0.15152	5.79E+01
73	0.18182	5.74E+01
74	0.21212	5.68E+01
75	0.24242	5.61E+01
76	0.27273	5.55E+01
77	0.30303	5.48E+01
78	0.33333	5.41E+01
79	0.36364	5.34E+01
80	0.39394	5.27E+01
81	0.42424	5.20E+01
82	0.45455	5.12E+01
83	0.48485	5.04E+01
84	0.51515	4.96E+01
85	0.54545	4.88E+01

	X	Y
33	-1.03E+00	6.46E+01
34	-1	6.46E+01
35	-9.70E-01	6.46E+01
36	-9.39E-01	6.46E+01
37	-9.09E-01	6.46E+01
38	-8.79E-01	6.46E+01
39	-8.48E-01	6.46E+01
40	-8.18E-01	6.46E+01
41	-7.88E-01	6.46E+01
42	-7.58E-01	6.46E+01
43	-7.27E-01	6.46E+01
44	-6.97E-01	6.46E+01
45	-6.67E-01	6.46E+01
46	-6.36E-01	6.46E+01
47	-6.06E-01	6.46E+01
48	-5.76E-01	6.46E+01
49	-5.45E-01	6.46E+01
50	-5.15E-01	6.46E+01
51	-0.48485	6.46E+01
52	-0.45455	6.46E+01
53	-0.42424	6.46E+01
54	-0.39394	6.46E+01
55	-0.36364	6.46E+01
56	-0.33333	6.46E+01
57	-0.30303	6.46E+01
58	-0.27273	6.46E+01
59	-0.24242	6.46E+01
60	-0.21212	6.46E+01
61	-0.18182	6.46E+01
62	-0.15152	6.46E+01
63	-0.12121	6.46E+01
64	-9.09E-02	6.46E+01
65	-6.06E-02	6.46E+01
66	-3.03E-02	6.46E+01
67	0	6.46E+01
68	3.03E-02	6.46E+01
69	6.06E-02	6.46E+01
70	9.09E-02	6.46E+01
71	0.12121	6.46E+01
72	0.15152	6.46E+01
73	0.18182	6.46E+01
74	0.21212	6.37E+01
75	0.24242	6.24E+01
76	0.27273	6.11E+01
77	0.30303	5.98E+01
78	0.33333	5.85E+01
79	0.36364	5.73E+01
80	0.39394	5.60E+01
81	0.42424	5.47E+01
82	0.45455	5.34E+01
83	0.48485	5.21E+01
84	0.51515	5.08E+01
85	0.54545	4.95E+01

Prediction Line

	X	Y
86	0.57576	4.79E+01
87	0.60606	4.68E+01
88	0.63636	4.57E+01
89	0.66667	4.45E+01
90	0.69697	4.34E+01
91	0.72727	4.21E+01
92	0.75758	4.09E+01
93	0.78788	3.96E+01
94	0.81818	3.83E+01
95	0.84848	3.70E+01
96	0.87879	3.57E+01
97	0.90909	3.44E+01
98	0.93939	3.31E+01
99	0.9697	3.18E+01
100	1	3.04E+01

	X	Y
86	0.57576	4.79E+01
87	0.60606	4.71E+01
88	0.63636	4.62E+01
89	0.66667	4.53E+01
90	0.69697	4.44E+01
91	0.72727	4.34E+01
92	0.75758	4.25E+01
93	0.78788	4.15E+01
94	0.81818	4.05E+01
95	0.84848	3.95E+01
96	0.87879	3.85E+01
97	0.90909	3.74E+01
98	0.93939	3.63E+01
99	0.9697	3.52E+01
100	1	3.41E+01

	X	Y
86	0.57576	4.82E+01
87	0.60606	4.69E+01
88	0.63636	4.56E+01
89	0.66667	4.43E+01
90	0.69697	4.30E+01
91	0.72727	4.18E+01
92	0.75758	4.05E+01
93	0.78788	3.92E+01
94	0.81818	3.79E+01
95	0.84848	3.66E+01
96	0.87879	3.53E+01
97	0.90909	3.40E+01
98	0.93939	3.27E+01
99	0.9697	3.14E+01
100	1	3.01E+01

Table H2.D-5d. TRAP Model Output for Cadmium Data for the Bird Survival Endpoint (pooling group C: Bokori et al. 1995a; Olgun 2015)

Chemical:	Cadmium
Study Authors:	Pooling group C
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	Effect Relative to Control
1.00E-06	100
9.3623	77.778
18.725	55.556
37.449	44.444
4.21E-02	100
0.70027	100
1.3584	100
2.6747	106.67
5.307	106.7
10.572	46.7

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.3404	1.3276	0.12523	1.0314	1.6237
S	1.0536	6.96E-01	0.27924	3.53E-02	1.3558
Y0	1.02E+02	1.04E+02	7.5804	86.267	122.12

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.3404	1.3431	0.1223	1.0539	1.6323
S	1.0536	7.77E-01	0.28693	9.89E-02	1.4559
Y0	1.02E+02	1.02E+02	6.7468	86.286	118.19

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.3404	1.3501	0.11178	1.0858	1.6144
S	1.0536	0.64819	0.18422	0.21258	1.0838
Y0	1.02E+02	1.01E+02	5.2929	88.818	113.85

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	21.26	10.751	42.043	0.12523	1.3276
20	6.75E+00	2.04E+00	2.24E+01	0.22005	0.82929
10	3.45E+00	5.93E-01	2.01E+01	0.32354	0.53782
5	1.86E+00	1.84E-01	1.88E+01	0.42515	0.26925
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	22.034	11.322	42.884	0.1223	1.3431
20	7.4186	2.69E+00	20.495	0.18664	0.87032
10	4.29E+00	9.78E-01	1.88E+01	0.27131	0.63204
5	2.9077	4.42E-01	1.91E+01	0.34603	0.46355
0	1.1397	4.76E-02	2.73E+01	0.58317	5.68E-02

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	22.392	12.184	41.152	0.11178	1.3501
20	7.7136	3.992	14.905	0.12098	0.88726
10	5.4073	2.3663	12.357	0.15179	0.73298
5	4.5274	1.8004	11.385	0.16936	0.65585
0	3.7906	1.3631	10.541	0.18785	0.57871

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.04E+02
2	9.71E-01	7.78E+01	1.04E+02
3	1.27E+00	5.56E+01	1.03E+02
4	1.57E+00	4.44E+01	1.01E+02
5	-1.38E+00	1.00E+02	9.63E+01
6	-1.55E-01	1.00E+02	8.78E+01
7	1.33E-01	100	75.985
8	4.27E-01	106.67	72.864
9	0.72487	106.67	56.085
10	1.0242	46.667	34.941

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.02E+02
2	-1.38E+00	1.00E+02	1.02E+02
3	-1.55E-01	1.00E+02	1.02E+02
4	1.33E-01	1.00E+02	1.02E+02
5	4.27E-01	1.07E+02	9.80E+01
6	7.25E-01	1.07E+02	8.85E+01
7	9.71E-01	77.778	76.396
8	1.02E+00	46.667	73.327
9	1.2724	55.556	56.584
10	1.5734	44.444	34.451

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.01E+02
2	-1.38E+00	1.00E+02	1.01E+02
3	-1.55E-01	1.00E+02	1.01E+02
4	1.33E-01	1.00E+02	1.01E+02
5	4.27E-01	1.07E+02	1.01E+02
6	7.25E-01	1.07E+02	9.17E+01
7	9.71E-01	77.778	75.541
8	1.02E+00	46.667	72.073
9	1.2724	55.556	55.768
10	1.5734	44.444	35.996

Analysis of Variance

R-squared: 0.781

	DF	SS	MS	F	Sig
Total (adj)	9	5857.3	650.81		
Regression	2	4572	2286	12.451	0.0049
Error	7	1285.2	183.61		

R-squared: 0.788

	DF	SS	MS	F	Sig
Total (adj)	9	5857.3	650.81		
Regression	2	4617.4	2308.7	13.035	0.0044
Error	7	1239.9	177.12		

R-squared: 0.833

	DF	SS	MS	F	Sig
Total (adj)	9	5857.3	650.81		
Regression	2	4876.8	2438.4	17.408	0.0019
Error	7	980.51	140.07		

Prediction Line

	X	Y
1	-2.5	1.04E+02
2	-2.45E+00	1.04E+02
3	-2.41E+00	1.04E+02
4	-2.36E+00	1.04E+02
5	-2.32E+00	1.04E+02
6	-2.27E+00	1.04E+02
7	-2.23E+00	1.04E+02
8	-2.18E+00	1.04E+02
9	-2.14E+00	1.04E+02
10	-2.09E+00	1.04E+02
11	-2.05E+00	1.04E+02
12	-2.00E+00	1.04E+02
13	-1.95E+00	1.04E+02
14	-1.9091	1.04E+02
15	-1.8636	1.04E+02
16	-1.8182	1.04E+02
17	-1.7727	1.04E+02
18	-1.7273	1.04E+02
19	-1.6818	1.04E+02
20	-1.6364	1.04E+02
21	-1.59E+00	1.04E+02
22	-1.55E+00	1.04E+02
23	-1.50E+00	1.04E+02
24	-1.45E+00	1.04E+02
25	-1.41E+00	1.04E+02
26	-1.36E+00	1.04E+02
27	-1.32E+00	1.04E+02
28	-1.27E+00	1.04E+02
29	-1.23E+00	1.04E+02
30	-1.18E+00	1.04E+02
31	-1.1364	1.04E+02
32	-1.0909	1.04E+02
33	-1.0455	1.04E+02
34	-1	1.04E+02
35	-0.95455	1.04E+02
36	-0.90909	1.04E+02
37	-0.86364	1.04E+02
38	-0.81818	1.04E+02
39	-0.77273	1.04E+02
40	-0.72727	1.04E+02
41	-6.82E-01	1.04E+02
42	-6.36E-01	1.04E+02
43	-5.91E-01	1.04E+02
44	-5.45E-01	1.04E+02
45	-5.00E-01	1.04E+02
46	-4.55E-01	1.03E+02
47	-0.40909	1.03E+02
48	-0.36364	1.03E+02
49	-0.31818	1.03E+02
50	-0.27273	1.03E+02
51	-0.22727	1.03E+02

	X	Y
1	-2.5	1.02E+02
2	-2.45E+00	1.02E+02
3	-2.41E+00	1.02E+02
4	-2.36E+00	1.02E+02
5	-2.32E+00	1.02E+02
6	-2.27E+00	1.02E+02
7	-2.23E+00	1.02E+02
8	-2.18E+00	1.02E+02
9	-2.14E+00	1.02E+02
10	-2.09E+00	1.02E+02
11	-2.05E+00	1.02E+02
12	-2.00E+00	1.02E+02
13	-1.95E+00	1.02E+02
14	-1.9091	1.02E+02
15	-1.8636	1.02E+02
16	-1.8182	1.02E+02
17	-1.7727	1.02E+02
18	-1.7273	1.02E+02
19	-1.6818	1.02E+02
20	-1.6364	1.02E+02
21	-1.59E+00	1.02E+02
22	-1.55E+00	1.02E+02
23	-1.50E+00	1.02E+02
24	-1.45E+00	1.02E+02
25	-1.41E+00	1.02E+02
26	-1.36E+00	1.02E+02
27	-1.32E+00	1.02E+02
28	-1.27E+00	1.02E+02
29	-1.23E+00	1.02E+02
30	-1.18E+00	1.02E+02
31	-1.1364	1.02E+02
32	-1.0909	1.02E+02
33	-1.0455	1.02E+02
34	-1	1.02E+02
35	-0.95455	1.02E+02
36	-0.90909	1.02E+02
37	-0.86364	1.02E+02
38	-0.81818	1.02E+02
39	-0.77273	1.02E+02
40	-0.72727	1.02E+02
41	-6.82E-01	1.02E+02
42	-6.36E-01	1.02E+02
43	-5.91E-01	1.02E+02
44	-5.45E-01	1.02E+02
45	-5.00E-01	1.02E+02
46	-4.55E-01	1.02E+02
47	-0.40909	1.02E+02
48	-0.36364	1.02E+02
49	-0.31818	1.02E+02
50	-0.27273	1.02E+02
51	-0.22727	1.02E+02

	X	Y
1	-2.5	1.01E+02
2	-2.45E+00	1.01E+02
3	-2.41E+00	1.01E+02
4	-2.36E+00	1.01E+02
5	-2.32E+00	1.01E+02
6	-2.27E+00	1.01E+02
7	-2.23E+00	1.01E+02
8	-2.18E+00	1.01E+02
9	-2.14E+00	1.01E+02
10	-2.09E+00	1.01E+02
11	-2.05E+00	1.01E+02
12	-2.00E+00	1.01E+02
13	-1.95E+00	1.01E+02
14	-1.9091	1.01E+02
15	-1.8636	1.01E+02
16	-1.8182	1.01E+02
17	-1.7727	1.01E+02
18	-1.7273	1.01E+02
19	-1.6818	1.01E+02
20	-1.6364	1.01E+02
21	-1.59E+00	1.01E+02
22	-1.55E+00	1.01E+02
23	-1.50E+00	1.01E+02
24	-1.45E+00	1.01E+02
25	-1.41E+00	1.01E+02
26	-1.36E+00	1.01E+02
27	-1.32E+00	1.01E+02
28	-1.27E+00	1.01E+02
29	-1.23E+00	1.01E+02
30	-1.18E+00	1.01E+02
31	-1.1364	1.01E+02
32	-1.0909	1.01E+02
33	-1.0455	1.01E+02
34	-1	1.01E+02
35	-0.95455	1.01E+02
36	-0.90909	1.01E+02
37	-0.86364	1.01E+02
38	-0.81818	1.01E+02
39	-0.77273	1.01E+02
40	-0.72727	1.01E+02
41	-6.82E-01	1.01E+02
42	-6.36E-01	1.01E+02
43	-5.91E-01	1.01E+02
44	-5.45E-01	1.01E+02
45	-5.00E-01	1.01E+02
46	-4.55E-01	1.01E+02
47	-0.40909	1.01E+02
48	-0.36364	1.01E+02
49	-0.31818	1.01E+02
50	-0.27273	1.01E+02
51	-0.22727	1.01E+02

Prediction Line

	X	Y
52	-0.18182	1.03E+02
53	-0.13636	1.02E+02
54	-9.09E-02	1.02E+02
55	-4.55E-02	1.02E+02
56	0	1.02E+02
57	4.55E-02	1.01E+02
58	9.09E-02	1.01E+02
59	0.13636	1.01E+02
60	0.18182	1.00E+02
61	0.22727	9.95E+01
62	0.27273	9.89E+01
63	0.31818	9.83E+01
64	0.36364	9.75E+01
65	0.40909	9.67E+01
66	0.45455	9.58E+01
67	0.5	9.47E+01
68	0.54545	9.36E+01
69	0.59091	9.23E+01
70	0.63636	9.09E+01
71	0.68182	8.94E+01
72	0.72727	8.77E+01
73	0.77273	8.59E+01
74	0.81818	8.39E+01
75	0.86364	8.17E+01
76	0.90909	7.94E+01
77	0.95455	7.69E+01
78	1	7.43E+01
79	1.0455	7.16E+01
80	1.0909	6.87E+01
81	1.1364	6.56E+01
82	1.1818	6.25E+01
83	1.2273	5.93E+01
84	1.2727	5.61E+01
85	1.3182	5.28E+01
86	1.3636	4.95E+01
87	1.4091	4.62E+01
88	1.4545	4.30E+01
89	1.5	3.98E+01
90	1.5455	3.68E+01
91	1.5909	3.38E+01
92	1.6364	3.10E+01
93	1.6818	2.83E+01
94	1.7273	2.58E+01
95	1.7727	2.34E+01
96	1.8182	2.12E+01
97	1.8636	1.91E+01
98	1.9091	1.72E+01
99	1.9545	1.55E+01
100	2	1.39E+01

	X	Y
52	-0.18182	1.02E+02
53	-0.13636	1.02E+02
54	-9.09E-02	1.02E+02
55	-4.55E-02	1.02E+02
56	0	1.02E+02
57	4.55E-02	1.02E+02
58	9.09E-02	1.02E+02
59	0.13636	1.02E+02
60	0.18182	1.02E+02
61	0.22727	1.01E+02
62	0.27273	1.01E+02
63	0.31818	1.00E+02
64	0.36364	9.93E+01
65	0.40909	9.84E+01
66	0.45455	9.74E+01
67	0.5	9.62E+01
68	0.54545	9.49E+01
69	0.59091	9.34E+01
70	0.63636	9.19E+01
71	0.68182	9.02E+01
72	0.72727	8.84E+01
73	0.77273	8.64E+01
74	0.81818	8.43E+01
75	0.86364	8.21E+01
76	0.90909	7.98E+01
77	0.95455	7.73E+01
78	1	7.48E+01
79	1.0455	7.20E+01
80	1.0909	6.92E+01
81	1.1364	6.62E+01
82	1.1818	6.31E+01
83	1.2273	5.99E+01
84	1.2727	5.66E+01
85	1.3182	5.31E+01
86	1.3636	4.95E+01
87	1.4091	4.60E+01
88	1.4545	4.26E+01
89	1.5	3.94E+01
90	1.5455	3.63E+01
91	1.5909	3.33E+01
92	1.6364	3.05E+01
93	1.6818	2.77E+01
94	1.7273	2.51E+01
95	1.7727	2.27E+01
96	1.8182	2.03E+01
97	1.8636	1.81E+01
98	1.9091	1.60E+01
99	1.9545	1.41E+01
100	2	1.22E+01

	X	Y
52	-0.18182	1.01E+02
53	-0.13636	1.01E+02
54	-9.09E-02	1.01E+02
55	-4.55E-02	1.01E+02
56	0	1.01E+02
57	4.55E-02	1.01E+02
58	9.09E-02	1.01E+02
59	0.13636	1.01E+02
60	0.18182	1.01E+02
61	0.22727	1.01E+02
62	0.27273	1.01E+02
63	0.31818	1.01E+02
64	0.36364	1.01E+02
65	0.40909	1.01E+02
66	0.45455	1.01E+02
67	0.5	1.01E+02
68	0.54545	1.01E+02
69	0.59091	1.01E+02
70	0.63636	9.75E+01
71	0.68182	9.46E+01
72	0.72727	9.16E+01
73	0.77273	8.86E+01
74	0.81818	8.56E+01
75	0.86364	8.26E+01
76	0.90909	7.96E+01
77	0.95455	7.66E+01
78	1	7.37E+01
79	1.0455	7.07E+01
80	1.0909	6.77E+01
81	1.1364	6.47E+01
82	1.1818	6.17E+01
83	1.2273	5.87E+01
84	1.2727	5.57E+01
85	1.3182	5.28E+01
86	1.3636	4.98E+01
87	1.4091	4.68E+01
88	1.4545	4.38E+01
89	1.5	4.08E+01
90	1.5455	3.78E+01
91	1.5909	3.48E+01
92	1.6364	3.19E+01
93	1.6818	2.89E+01
94	1.7273	2.59E+01
95	1.7727	2.29E+01
96	1.8182	1.99E+01
97	1.8636	1.69E+01
98	1.9091	1.39E+01
99	1.9545	1.10E+01
100	2	7.98E+00

Table H2.D-5e. TRAP Model Output for Cadmium Data for the Mammal Growth Endpoint (Wilson et al. 1941)

Chemical:	Cadmium
Study Authors:	Wilson et al. 1941
Receptor Group:	Mammal
Effect Description:	Growth

Input Data:

Dose	Response	SE
1.00E-06	0.2	not reported
3.5124	0.16	not reported
7.0248	0.14	not reported
14.163	0.12	not reported
28.326	0.07	not reported
56.652	0.05	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.2363	1.251	5.48E-02	1.0766	1.4254
S	0.53259	5.55E-01	6.44E-02	3.50E-01	0.7597
Y0	2.00E-01	1.99E-01	7.41E-03	1.75E-01	0.22211

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.2363	1.25	5.36E-02	1.0795	1.4204
S	0.53259	5.85E-01	6.45E-02	0.37972	0.79017
Y0	2.00E-01	1.99E-01	7.26E-03	1.76E-01	0.22173

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.2363	1.2331	6.71E-02	1.0195	1.4467
S	0.53259	0.47995	5.48E-02	0.30545	0.65445
Y0	2.00E-01	2.00E-01	9.52E-03	0.16969	0.23031

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	17.823	11.928	26.633	5.48E-02	1.251
20	4.23E+00	2.00E+00	8.95E+00	0.10228	0.62619
10	1.82E+00	6.52E-01	5.10E+00	0.14038	0.2607
5	8.39E-01	2.29E-01	3.08E+00	0.17724	-7.61E-02
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	17.781	12.008	26.329	5.36E-02	1.25
20	4.1842	2.02E+00	8.6834	9.96E-02	0.62162
10	2.02E+00	7.33E-01	5.56E+00	0.13826	0.30493
5	1.205	3.38E-01	4.30E+00	0.17352	8.10E-02
0	0.34705	3.65E-02	3.30E+00	0.30735	-4.60E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	17.104	10.46	27.969	6.71E-02	1.2331
20	4.0554	1.8526	8.8778	1.07E-01	0.60804
10	2.5101	0.9932	6.3436	0.12652	0.39968
5	1.9747	0.72456	5.382	0.13682	0.29551
0	1.5536	0.52765	4.5742	0.14737	0.19133

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	2.00E-01	1.99E-01
2	5.46E-01	1.60E-01	1.64E-01
3	8.47E-01	1.40E-01	1.41E-01
4	1.15E+00	1.20E-01	1.10E-01
5	1.45E+00	7.00E-02	7.75E-02
6	1.7532	5.00E-02	4.91E-02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	2.00E-01	1.99E-01
2	5.46E-01	1.60E-01	1.64E-01
3	8.47E-01	1.40E-01	1.41E-01
4	1.15E+00	1.20E-01	1.10E-01
5	1.45E+00	7.00E-02	7.72E-02
6	1.7532	5.00E-02	4.94E-02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	2.00E-01	2.00E-01
2	5.46E-01	1.60E-01	1.66E-01
3	8.47E-01	1.40E-01	1.37E-01
4	1.15E+00	1.20E-01	1.08E-01
5	1.45E+00	7.00E-02	7.90E-02
6	1.7532	5.00E-02	5.01E-02

Analysis of Variance

R-squared: 0.989

	DF	SS	MS	F	Sig
Total (adj)	5	1.57E-02	3.15E-03		
Regression	2	1.56E-02	7.78E-03	134.67	0.0012
Error	3	1.73E-04	5.78E-05		

R-squared: 0.99

	DF	SS	MS	F	Sig
Total (adj)	5	1.57E-02	3.15E-03		
Regression	2	1.56E-02	7.78E-03	142.45	0.0011
Error	3	1.64E-04	5.47E-05		

R-squared: 0.983

	DF	SS	MS	F	Sig
Total (adj)	5	1.57E-02	3.15E-03		
Regression	2	1.55E-02	7.73E-03	85.251	0.0023
Error	3	2.72E-04	9.07E-05		

Prediction Line

	X	Y
1	-2	1.98E-01
2	-1.96E+00	1.98E-01
3	-1.92E+00	1.98E-01
4	-1.88E+00	1.98E-01
5	-1.84E+00	1.98E-01
6	-1.80E+00	1.98E-01
7	-1.76E+00	1.98E-01
8	-1.72E+00	1.98E-01
9	-1.68E+00	1.98E-01
10	-1.64E+00	1.98E-01
11	-1.60E+00	1.98E-01
12	-1.56E+00	1.98E-01
13	-1.52E+00	1.98E-01
14	-1.4747	1.98E-01
15	-1.4343	1.98E-01
16	-1.3939	1.98E-01
17	-1.3535	1.98E-01
18	-1.3131	1.98E-01
19	-1.2727	1.98E-01
20	-1.2323	1.98E-01
21	-1.19E+00	1.98E-01
22	-1.15E+00	1.98E-01
23	-1.11E+00	1.97E-01
24	-1.07E+00	1.97E-01
25	-1.03E+00	1.97E-01
26	-9.90E-01	1.97E-01
27	-9.49E-01	1.97E-01
28	-9.09E-01	1.97E-01
29	-8.69E-01	1.97E-01
30	-8.28E-01	1.97E-01
31	-0.78788	1.96E-01
32	-0.74747	1.96E-01

	X	Y
1	-2	1.99E-01
2	-1.96E+00	1.99E-01
3	-1.92E+00	1.99E-01
4	-1.88E+00	1.99E-01
5	-1.84E+00	1.99E-01
6	-1.80E+00	1.99E-01
7	-1.76E+00	1.99E-01
8	-1.72E+00	1.99E-01
9	-1.68E+00	1.99E-01
10	-1.64E+00	1.99E-01
11	-1.60E+00	1.99E-01
12	-1.56E+00	1.99E-01
13	-1.52E+00	1.99E-01
14	-1.4747	1.99E-01
15	-1.4343	1.99E-01
16	-1.3939	1.99E-01
17	-1.3535	1.99E-01
18	-1.3131	1.99E-01
19	-1.2727	1.99E-01
20	-1.2323	1.99E-01
21	-1.19E+00	1.99E-01
22	-1.15E+00	1.99E-01
23	-1.11E+00	1.99E-01
24	-1.07E+00	1.99E-01
25	-1.03E+00	1.99E-01
26	-9.90E-01	1.99E-01
27	-9.49E-01	1.99E-01
28	-9.09E-01	1.99E-01
29	-8.69E-01	1.99E-01
30	-8.28E-01	1.99E-01
31	-0.78788	1.99E-01
32	-0.74747	1.99E-01

	X	Y
1	-2	2.00E-01
2	-1.96E+00	2.00E-01
3	-1.92E+00	2.00E-01
4	-1.88E+00	2.00E-01
5	-1.84E+00	2.00E-01
6	-1.80E+00	2.00E-01
7	-1.76E+00	2.00E-01
8	-1.72E+00	2.00E-01
9	-1.68E+00	2.00E-01
10	-1.64E+00	2.00E-01
11	-1.60E+00	2.00E-01
12	-1.56E+00	2.00E-01
13	-1.52E+00	2.00E-01
14	-1.4747	2.00E-01
15	-1.4343	2.00E-01
16	-1.3939	2.00E-01
17	-1.3535	2.00E-01
18	-1.3131	2.00E-01
19	-1.2727	2.00E-01
20	-1.2323	2.00E-01
21	-1.19E+00	2.00E-01
22	-1.15E+00	2.00E-01
23	-1.11E+00	2.00E-01
24	-1.07E+00	2.00E-01
25	-1.03E+00	2.00E-01
26	-9.90E-01	2.00E-01
27	-9.49E-01	2.00E-01
28	-9.09E-01	2.00E-01
29	-8.69E-01	2.00E-01
30	-8.28E-01	2.00E-01
31	-0.78788	2.00E-01
32	-0.74747	2.00E-01

Prediction Line

	X	Y
33	-0.70707	1.96E-01
34	-0.66667	1.96E-01
35	-0.62626	1.96E-01
36	-0.58586	1.95E-01
37	-0.54545	1.95E-01
38	-0.50505	1.95E-01
39	-0.46465	1.94E-01
40	-0.42424	1.94E-01
41	-0.38384	1.93E-01
42	-0.34343	1.93E-01
43	-0.30303	1.92E-01
44	-0.26263	1.92E-01
45	-0.22222	1.91E-01
46	-0.18182	1.91E-01
47	-0.14141	1.90E-01
48	-0.10101	1.89E-01
49	-6.06E-02	1.88E-01
50	-2.02E-02	1.87E-01
51	2.02E-02	1.86E-01
52	6.06E-02	1.85E-01
53	0.10101	1.84E-01
54	0.14141	1.83E-01
55	0.18182	1.82E-01
56	0.22222	1.80E-01
57	0.26263	1.79E-01
58	0.30303	1.77E-01
59	0.34343	1.75E-01
60	0.38384	1.73E-01
61	0.42424	1.71E-01
62	0.46465	1.69E-01
63	0.50505	1.67E-01
64	0.54545	1.64E-01
65	0.58586	1.62E-01
66	0.62626	1.59E-01
67	0.66667	1.56E-01
68	0.70707	1.53E-01
69	0.74747	1.50E-01
70	0.78788	1.46E-01
71	0.82828	1.43E-01
72	0.86869	1.39E-01
73	0.90909	1.35E-01
74	0.94949	1.31E-01
75	0.9899	1.27E-01
76	1.0303	1.23E-01
77	1.0707	1.19E-01
78	1.1111	1.15E-01
79	1.1515	1.10E-01
80	1.1919	1.06E-01
81	1.2323	1.01E-01
82	1.2727	9.69E-02
83	1.3131	9.24E-02

	X	Y
33	-0.70707	1.99E-01
34	-0.66667	1.99E-01
35	-0.62626	1.99E-01
36	-0.58586	1.99E-01
37	-0.54545	1.99E-01
38	-0.50505	1.99E-01
39	-0.46465	1.99E-01
40	-0.42424	1.99E-01
41	-0.38384	1.98E-01
42	-0.34343	1.98E-01
43	-0.30303	1.98E-01
44	-0.26263	1.97E-01
45	-0.22222	1.97E-01
46	-0.18182	1.96E-01
47	-0.14141	1.95E-01
48	-0.10101	1.94E-01
49	-6.06E-02	1.93E-01
50	-2.02E-02	1.92E-01
51	2.02E-02	1.91E-01
52	6.06E-02	1.89E-01
53	0.10101	1.88E-01
54	0.14141	1.86E-01
55	0.18182	1.85E-01
56	0.22222	1.83E-01
57	0.26263	1.81E-01
58	0.30303	1.79E-01
59	0.34343	1.77E-01
60	0.38384	1.74E-01
61	0.42424	1.72E-01
62	0.46465	1.70E-01
63	0.50505	1.67E-01
64	0.54545	1.64E-01
65	0.58586	1.61E-01
66	0.62626	1.59E-01
67	0.66667	1.56E-01
68	0.70707	1.52E-01
69	0.74747	1.49E-01
70	0.78788	1.46E-01
71	0.82828	1.42E-01
72	0.86869	1.39E-01
73	0.90909	1.35E-01
74	0.94949	1.31E-01
75	0.9899	1.27E-01
76	1.0303	1.23E-01
77	1.0707	1.19E-01
78	1.1111	1.15E-01
79	1.1515	1.10E-01
80	1.1919	1.06E-01
81	1.2323	1.01E-01
82	1.2727	9.67E-02
83	1.3131	9.21E-02

	X	Y
33	-0.70707	2.00E-01
34	-0.66667	2.00E-01
35	-0.62626	2.00E-01
36	-0.58586	2.00E-01
37	-0.54545	2.00E-01
38	-0.50505	2.00E-01
39	-0.46465	2.00E-01
40	-0.42424	2.00E-01
41	-0.38384	2.00E-01
42	-0.34343	2.00E-01
43	-0.30303	2.00E-01
44	-0.26263	2.00E-01
45	-0.22222	2.00E-01
46	-0.18182	2.00E-01
47	-0.14141	2.00E-01
48	-0.10101	2.00E-01
49	-6.06E-02	2.00E-01
50	-2.02E-02	2.00E-01
51	2.02E-02	2.00E-01
52	6.06E-02	2.00E-01
53	0.10101	2.00E-01
54	0.14141	2.00E-01
55	0.18182	2.00E-01
56	0.22222	1.97E-01
57	0.26263	1.93E-01
58	0.30303	1.89E-01
59	0.34343	1.85E-01
60	0.38384	1.82E-01
61	0.42424	1.78E-01
62	0.46465	1.74E-01
63	0.50505	1.70E-01
64	0.54545	1.66E-01
65	0.58586	1.62E-01
66	0.62626	1.58E-01
67	0.66667	1.54E-01
68	0.70707	1.50E-01
69	0.74747	1.47E-01
70	0.78788	1.43E-01
71	0.82828	1.39E-01
72	0.86869	1.35E-01
73	0.90909	1.31E-01
74	0.94949	1.27E-01
75	0.9899	1.23E-01
76	1.0303	1.19E-01
77	1.0707	1.16E-01
78	1.1111	1.12E-01
79	1.1515	1.08E-01
80	1.1919	1.04E-01
81	1.2323	1.00E-01
82	1.2727	9.62E-02
83	1.3131	9.23E-02

Prediction Line

	X	Y
84	1.3535	8.80E-02
85	1.3939	8.37E-02
86	1.4343	7.94E-02
87	1.4747	7.51E-02
88	1.5152	7.10E-02
89	1.5556	6.69E-02
90	1.596	6.30E-02
91	1.6364	5.92E-02
92	1.6768	5.56E-02
93	1.7172	5.21E-02
94	1.7576	4.87E-02
95	1.798	4.55E-02
96	1.8384	4.24E-02
97	1.8788	3.95E-02
98	1.9192	3.67E-02
99	1.9596	3.41E-02
100	2	3.17E-02

	X	Y
84	1.3535	8.76E-02
85	1.3939	8.33E-02
86	1.4343	7.90E-02
87	1.4747	7.49E-02
88	1.5152	7.09E-02
89	1.5556	6.70E-02
90	1.596	6.32E-02
91	1.6364	5.95E-02
92	1.6768	5.59E-02
93	1.7172	5.24E-02
94	1.7576	4.91E-02
95	1.798	4.58E-02
96	1.8384	4.27E-02
97	1.8788	3.97E-02
98	1.9192	3.68E-02
99	1.9596	3.40E-02
100	2	3.13E-02

	X	Y
84	1.3535	8.84E-02
85	1.3939	8.46E-02
86	1.4343	8.07E-02
87	1.4747	7.68E-02
88	1.5152	7.29E-02
89	1.5556	6.90E-02
90	1.596	6.52E-02
91	1.6364	6.13E-02
92	1.6768	5.74E-02
93	1.7172	5.35E-02
94	1.7576	4.97E-02
95	1.798	4.58E-02
96	1.8384	4.19E-02
97	1.8788	3.80E-02
98	1.9192	3.41E-02
99	1.9596	3.03E-02
100	2	2.64E-02

Table H2.D-5f. TRAP Model Output for Cadmium Data for the Mammal Reproduction Endpoint (Sutou et al. 1980)

Chemical:	Cadmium
Study Authors:	Sutou et al. 1980
Receptor Group:	Mammal
Effect Description:	Reproduction

Input Data:

Dose	Response	SE
0.00	14.2	2
0.10	13.9	1.7
1.00	13.1	2.3
10.00	7.2	2.4

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.1393	1.0183			
S	0.48025	6.26E-01			
Y0	1.41E+01	1.41E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.1393	1.0215			
S	0.48025	6.23E-01			
Y0	1.41E+01	1.40E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.1393	1.0317			
S	0.48025	0.42065			
Y0	1.41E+01	1.40E+01			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	10.43	5.2665	20.657	2.34E-02	1.0183
20	2.91E+00	5.80E-01	1.46E+01	5.52E-02	0.46456
10	1.38E+00	1.17E-01	1.64E+01	8.45E-02	0.14065
5	6.95E-01	2.59E-02	1.86E+01	0.1124	-1.58E-01
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	10.509	3.9407	28.024	3.35E-02	1.0215
20	2.7027	5.14E-01	14.198	5.67E-02	0.4318
10	1.36E+00	1.25E-01	1.48E+01	8.16E-02	0.13457
5	0.84024	4.47E-02	1.58E+01	0.10031	-7.56E-02
0	0.26121	3.55E-03	1.92E+01	0.14689	-5.83E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	10.757	2.5205	45.912	4.96E-02	1.0317
20	2.0822	0.65954	6.5739	3.93E-02	0.31853
10	1.2045	0.30525	4.7529	4.69E-02	8.08E-02
5	0.9161	0.19973	4.2019	5.21E-02	-3.81E-02
0	0.69675	0.12846	3.779	5.78E-02	-0.15692

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.42E+01	1.41E+01
2	-1.00E+00	1.39E+01	1.40E+01
3	0.00E+00	1.31E+01	1.31E+01
4	1.00E+00	7.20E+00	7.20E+00
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	1.90E+02	6.33E+01		
Regression	2	1.90E+02	9.50E+01	14168	0.0059
Error	1	6.71E-03	6.71E-03		

Prediction Line

	X	Y
1	-3	1.41E+01
2	-2.95E+00	1.41E+01
3	-2.91E+00	1.41E+01
4	-2.86E+00	1.41E+01
5	-2.82E+00	1.41E+01
6	-2.77E+00	1.41E+01
7	-2.73E+00	1.41E+01
8	-2.68E+00	1.41E+01
9	-2.64E+00	1.41E+01
10	-2.59E+00	1.41E+01
11	-2.55E+00	1.41E+01
12	-2.50E+00	1.41E+01
13	-2.45E+00	1.41E+01
14	-2.4091	1.41E+01
15	-2.3636	1.41E+01
16	-2.3182	1.41E+01
17	-2.2727	1.41E+01
18	-2.2273	1.41E+01
19	-2.1818	1.41E+01
20	-2.1364	1.41E+01
21	-2.09E+00	1.41E+01
22	-2.05E+00	1.41E+01
23	-2.00E+00	1.41E+01
24	-1.95E+00	1.41E+01
25	-1.91E+00	1.41E+01
26	-1.86E+00	1.41E+01
27	-1.82E+00	1.41E+01
28	-1.77E+00	1.41E+01
29	-1.73E+00	1.41E+01
30	-1.68E+00	1.41E+01
31	-1.6364	1.41E+01

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.42E+01	1.40E+01
2	-1.00E+00	1.39E+01	1.40E+01
3	0.00E+00	1.31E+01	1.31E+01
4	1.00E+00	7.20E+00	7.20E+00
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	1.90E+02	6.33E+01		
Regression	2	1.90E+02	9.50E+01	7273.2	0.0083
Error	1	1.31E-02	1.31E-02		

Prediction Line

	X	Y
1	-3	1.40E+01
2	-2.95E+00	1.40E+01
3	-2.91E+00	1.40E+01
4	-2.86E+00	1.40E+01
5	-2.82E+00	1.40E+01
6	-2.77E+00	1.40E+01
7	-2.73E+00	1.40E+01
8	-2.68E+00	1.40E+01
9	-2.64E+00	1.40E+01
10	-2.59E+00	1.40E+01
11	-2.55E+00	1.40E+01
12	-2.50E+00	1.40E+01
13	-2.45E+00	1.40E+01
14	-2.4091	1.40E+01
15	-2.3636	1.40E+01
16	-2.3182	1.40E+01
17	-2.2727	1.40E+01
18	-2.2273	1.40E+01
19	-2.1818	1.40E+01
20	-2.1364	1.40E+01
21	-2.09E+00	1.40E+01
22	-2.05E+00	1.40E+01
23	-2.00E+00	1.40E+01
24	-1.95E+00	1.40E+01
25	-1.91E+00	1.40E+01
26	-1.86E+00	1.40E+01
27	-1.82E+00	1.40E+01
28	-1.77E+00	1.40E+01
29	-1.73E+00	1.40E+01
30	-1.68E+00	1.40E+01
31	-1.6364	1.40E+01

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.42E+01	1.40E+01
2	-1.00E+00	1.39E+01	1.40E+01
3	0.00E+00	1.31E+01	1.31E+01
4	1.00E+00	7.20E+00	7.20E+00
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	1.90E+02	6.33E+01		
Regression	2	1.90E+02	9.50E+01	7273.2	0.0083
Error	1	1.31E-02	1.31E-02		

Prediction Line

	X	Y
1	-3	1.40E+01
2	-2.95E+00	1.40E+01
3	-2.91E+00	1.40E+01
4	-2.86E+00	1.40E+01
5	-2.82E+00	1.40E+01
6	-2.77E+00	1.40E+01
7	-2.73E+00	1.40E+01
8	-2.68E+00	1.40E+01
9	-2.64E+00	1.40E+01
10	-2.59E+00	1.40E+01
11	-2.55E+00	1.40E+01
12	-2.50E+00	1.40E+01
13	-2.45E+00	1.40E+01
14	-2.4091	1.40E+01
15	-2.3636	1.40E+01
16	-2.3182	1.40E+01
17	-2.2727	1.40E+01
18	-2.2273	1.40E+01
19	-2.1818	1.40E+01
20	-2.1364	1.40E+01
21	-2.09E+00	1.40E+01
22	-2.05E+00	1.40E+01
23	-2.00E+00	1.40E+01
24	-1.95E+00	1.40E+01
25	-1.91E+00	1.40E+01
26	-1.86E+00	1.40E+01
27	-1.82E+00	1.40E+01
28	-1.77E+00	1.40E+01
29	-1.73E+00	1.40E+01
30	-1.68E+00	1.40E+01
31	-1.6364	1.40E+01

Prediction Line

	X	Y
32	-1.5909	1.41E+01
33	-1.5455	1.41E+01
34	-1.5	1.41E+01
35	-1.4545	1.41E+01
36	-1.4091	1.41E+01
37	-1.36E+00	1.41E+01
38	-1.32E+00	1.40E+01
39	-1.27E+00	1.40E+01
40	-1.23E+00	1.40E+01
41	-1.18E+00	1.40E+01
42	-1.14E+00	1.40E+01
43	-1.09E+00	1.40E+01
44	-1.05E+00	1.40E+01
45	-1	1.40E+01
46	-0.95455	1.40E+01
47	-0.90909	1.40E+01
48	-0.86364	1.40E+01
49	-0.81818	1.39E+01
50	-0.77273	1.39E+01
51	-0.72727	1.39E+01
52	-0.68182	1.39E+01
53	-0.63636	1.39E+01
54	-0.59091	1.38E+01
55	-0.54545	1.38E+01
56	-0.5	1.38E+01
57	-0.45455	1.37E+01
58	-0.40909	1.37E+01
59	-0.36364	1.37E+01
60	-0.31818	1.36E+01
61	-0.27273	1.36E+01
62	-0.22727	1.35E+01
63	-0.18182	1.34E+01
64	-0.13636	1.33E+01
65	-9.09E-02	1.33E+01
66	-4.55E-02	1.32E+01
67	0	1.31E+01
68	4.55E-02	1.30E+01
69	9.09E-02	1.28E+01
70	0.13636	1.27E+01
71	0.18182	1.25E+01
72	0.22727	1.24E+01
73	0.27273	1.22E+01
74	0.31818	1.20E+01
75	0.36364	1.18E+01
76	0.40909	1.16E+01
77	0.45455	1.13E+01
78	0.5	1.11E+01
79	0.54545	1.08E+01
80	0.59091	1.05E+01
81	0.63636	1.02E+01
82	0.68182	9.85E+00

	X	Y
32	-1.5909	1.40E+01
33	-1.5455	1.40E+01
34	-1.5	1.40E+01
35	-1.4545	1.40E+01
36	-1.4091	1.40E+01
37	-1.36E+00	1.40E+01
38	-1.32E+00	1.40E+01
39	-1.27E+00	1.40E+01
40	-1.23E+00	1.40E+01
41	-1.18E+00	1.40E+01
42	-1.14E+00	1.40E+01
43	-1.09E+00	1.40E+01
44	-1.05E+00	1.40E+01
45	-1	1.40E+01
46	-0.95455	1.40E+01
47	-0.90909	1.40E+01
48	-0.86364	1.40E+01
49	-0.81818	1.40E+01
50	-0.77273	1.40E+01
51	-0.72727	1.40E+01
52	-0.68182	1.40E+01
53	-0.63636	1.40E+01
54	-0.59091	1.40E+01
55	-0.54545	1.40E+01
56	-0.5	1.40E+01
57	-0.45455	1.40E+01
58	-0.40909	1.39E+01
59	-0.36364	1.39E+01
60	-0.31818	1.38E+01
61	-0.27273	1.38E+01
62	-0.22727	1.37E+01
63	-0.18182	1.36E+01
64	-0.13636	1.35E+01
65	-9.09E-02	1.34E+01
66	-4.55E-02	1.32E+01
67	0	1.31E+01
68	4.55E-02	1.30E+01
69	9.09E-02	1.28E+01
70	0.13636	1.26E+01
71	0.18182	1.24E+01
72	0.22727	1.22E+01
73	0.27273	1.20E+01
74	0.31818	1.18E+01
75	0.36364	1.16E+01
76	0.40909	1.13E+01
77	0.45455	1.11E+01
78	0.5	1.08E+01
79	0.54545	1.06E+01
80	0.59091	1.03E+01
81	0.63636	9.98E+00
82	0.68182	9.67E+00

	X	Y
32	-1.5909	1.40E+01
33	-1.5455	1.40E+01
34	-1.5	1.40E+01
35	-1.4545	1.40E+01
36	-1.4091	1.40E+01
37	-1.36E+00	1.40E+01
38	-1.32E+00	1.40E+01
39	-1.27E+00	1.40E+01
40	-1.23E+00	1.40E+01
41	-1.18E+00	1.40E+01
42	-1.14E+00	1.40E+01
43	-1.09E+00	1.40E+01
44	-1.05E+00	1.40E+01
45	-1	1.40E+01
46	-0.95455	1.40E+01
47	-0.90909	1.40E+01
48	-0.86364	1.40E+01
49	-0.81818	1.40E+01
50	-0.77273	1.40E+01
51	-0.72727	1.40E+01
52	-0.68182	1.40E+01
53	-0.63636	1.40E+01
54	-0.59091	1.40E+01
55	-0.54545	1.40E+01
56	-0.5	1.40E+01
57	-0.45455	1.40E+01
58	-0.40909	1.40E+01
59	-0.36364	1.40E+01
60	-0.31818	1.40E+01
61	-0.27273	1.40E+01
62	-0.22727	1.40E+01
63	-0.18182	1.40E+01
64	-0.13636	1.39E+01
65	-9.09E-02	1.36E+01
66	-4.55E-02	1.34E+01
67	0	1.31E+01
68	4.55E-02	1.28E+01
69	9.09E-02	1.26E+01
70	0.13636	1.23E+01
71	0.18182	1.20E+01
72	0.22727	1.18E+01
73	0.27273	1.15E+01
74	0.31818	1.12E+01
75	0.36364	1.10E+01
76	0.40909	1.07E+01
77	0.45455	1.04E+01
78	0.5	1.02E+01
79	0.54545	9.88E+00
80	0.59091	9.61E+00
81	0.63636	9.35E+00
82	0.68182	9.08E+00

Prediction Line

	X	Y
83	0.72727	9.50E+00
84	0.77273	9.14E+00
85	0.81818	8.77E+00
86	0.86364	8.39E+00
87	0.90909	8.00E+00
88	0.95455	7.60E+00
89	1	7.20E+00
90	1.0455	6.80E+00
91	1.0909	6.41E+00
92	1.1364	6.01E+00
93	1.1818	5.62E+00
94	1.2273	5.24E+00
95	1.2727	4.87E+00
96	1.3182	4.52E+00
97	1.3636	4.18E+00
98	1.4091	3.85E+00
99	1.4545	3.54E+00
100	1.5	3.25E+00

	X	Y
83	0.72727	9.35E+00
84	0.77273	9.02E+00
85	0.81818	8.68E+00
86	0.86364	8.33E+00
87	0.90909	7.96E+00
88	0.95455	7.59E+00
89	1	7.20E+00
90	1.0455	6.81E+00
91	1.0909	6.42E+00
92	1.1364	6.05E+00
93	1.1818	5.68E+00
94	1.2273	5.33E+00
95	1.2727	4.99E+00
96	1.3182	4.66E+00
97	1.3636	4.34E+00
98	1.4091	4.03E+00
99	1.4545	3.74E+00
100	1.5	3.45E+00

	X	Y
83	0.72727	8.81E+00
84	0.77273	8.54E+00
85	0.81818	8.27E+00
86	0.86364	8.00E+00
87	0.90909	7.74E+00
88	0.95455	7.47E+00
89	1	7.20E+00
90	1.0455	6.93E+00
91	1.0909	6.66E+00
92	1.1364	6.40E+00
93	1.1818	6.13E+00
94	1.2273	5.86E+00
95	1.2727	5.59E+00
96	1.3182	5.32E+00
97	1.3636	5.05E+00
98	1.4091	4.79E+00
99	1.4545	4.52E+00
100	1.5	4.25E+00

Table H2.D-5g. TRAP Model Output for Cadmium Data for the Mammal Survival Endpoint (Swiergosz et al. 1998)

Chemical:	Cadmium
Study Authors:	Swiergosz et al. 1998
Receptor Group:	Mammal
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
6.18E-02	12.9	15	0.86
3.4331	9	15	0.60
9.155	6.9	15	0.46

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50	yes	yes	yes
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.0471	1.032	0.39269	0.15705	1.907
S	1.1009	1.01E+00	1.4931	0.70581	1.7727
Y0	0.86	0.87155	0.14146	0.52151	0.99341

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.0471	1.0424	0.4341	7.52E-02	2.0096
S	1.1009	9.31E-01	1.2563	0.65022	1.6331
Y0	0.86	0.86007	9.31E-02	0.57398	0.98335

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.0471	1.0528	0.50126	-6.41E-02	2.1697
S	1.1009	0.75527	0.97661	0.52772	1.3255
Y0	0.86	0.86001	8.96E-02	0.58744	0.9812

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	10.765	1.44E+00	8.07E+01	0.39269	1.032
20	1.52	3.63E-03	6.36E+02	1.1203	0.18185
10	0.54633	2.19E-05	1.37E+04	1.7571	-0.26255
5	0.23467	1.42E-07	3.87E+05	2.2915	-0.62953
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	11.026	1.19E+00	1.02E+02	0.4341	1.0424
20	1.6018	1.23E-02	2.09E+02	0.89792	0.2046
10	6.06E-01	1.30E-04	2819.9	1.4448	-0.21766
5	0.30462	2.84E-06	32725	1.84	-0.51624
0	5.79E-02	5.52E-12	6.08E+08	2.8034	-1.24E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	11.293	8.63E-01	1.48E+02	0.50126	1.0528
20	1.853	3.69E-02	93.002	0.70784	0.26789
10	1.0145	2.50E-03	411.79	1.0208	6.25E-03
5	0.75064	5.43E-04	1038.2	1.1826	-0.12457
0	0.55541	1.02E-04	3.03E+03	1.3461	-0.25538

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-1.21E+00	0.86	0.86
2	5.36E-01	0.6	0.60001
3	9.62E-01	0.46	0.46001
4			
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-1	0.85226
2	-9.75E-01	0.85109
3	-9.49E-01	0.84985
4	-9.24E-01	0.84855
5	-8.99E-01	0.84718
6	-8.74E-01	0.84575
7	-8.48E-01	0.84425
8	-8.23E-01	0.84268
9	-7.98E-01	0.84103
10	-7.73E-01	0.83931
11	-7.47E-01	0.8375
12	-7.22E-01	0.83562
13	-6.97E-01	0.83366
14	-0.67172	0.8316
15	-0.64646	0.82946
16	-0.62121	0.82723
17	-0.59596	0.82491
18	-0.57071	0.82249
19	-0.54545	0.81997
20	-0.5202	0.81735
21	-0.49495	0.81463
22	-0.4697	0.81181
23	-0.44444	0.80887
24	-0.41919	0.80583
25	-0.39394	0.80268
26	-0.36869	0.79941
27	-0.34343	0.79603
28	-0.31818	0.79253
29	-0.29293	0.78892
30	-0.26768	0.78518

	Exposure	Effects Var	Est Effects Var
1	-1.21E+00	0.86	0.86
2	5.36E-01	0.6	0.6
3	9.62E-01	0.46	0.46
4			
5			
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-1	0.85541
2	-9.75E-01	0.85437
3	-9.49E-01	0.85322
4	-9.24E-01	0.85197
5	-8.99E-01	0.85061
6	-8.74E-01	0.84914
7	-8.48E-01	0.84757
8	-8.23E-01	0.84589
9	-7.98E-01	0.84411
10	-7.73E-01	0.84222
11	-7.47E-01	0.84023
12	-7.22E-01	0.83813
13	-6.97E-01	0.83593
14	-0.67172	0.83362
15	-0.64646	0.8312
16	-0.62121	0.82868
17	-0.59596	0.82605
18	-0.57071	0.82332
19	-0.54545	0.82048
20	-0.5202	0.81754
21	-0.49495	0.81449
22	-0.4697	0.81133
23	-0.44444	0.80807
24	-0.41919	0.80471
25	-0.39394	0.80124
26	-0.36869	0.79766
27	-0.34343	0.79398
28	-0.31818	0.79019
29	-0.29293	0.7863
30	-0.26768	0.7823

	Exposure	Effects Var	Est Effects Var
1	-1.21E+00	0.86	0.86001
2	5.36E-01	0.6	0.6
3	9.62E-01	0.46	0.46
4			
5			
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-1	0.86001
2	-9.75E-01	0.86001
3	-9.49E-01	0.86001
4	-9.24E-01	0.86001
5	-8.99E-01	0.86001
6	-8.74E-01	0.86001
7	-8.48E-01	0.86001
8	-8.23E-01	0.86001
9	-7.98E-01	0.86001
10	-7.73E-01	0.86001
11	-7.47E-01	0.86001
12	-7.22E-01	0.86001
13	-6.97E-01	0.86001
14	-0.67172	0.86001
15	-0.64646	0.86001
16	-0.62121	0.86001
17	-0.59596	0.86001
18	-0.57071	0.86001
19	-0.54545	0.86001
20	-0.5202	0.86001
21	-0.49495	0.86001
22	-0.4697	0.86001
23	-0.44444	0.86001
24	-0.41919	0.86001
25	-0.39394	0.86001
26	-0.36869	0.86001
27	-0.34343	0.86001
28	-0.31818	0.86001
29	-0.29293	0.86001
30	-0.26768	0.86001

Prediction Line

	X	Y
31	-0.24242	0.78132
32	-0.21717	0.77734
33	-0.19192	0.77323
34	-0.16667	0.76899
35	-0.14141	0.76463
36	-0.11616	0.76014
37	-9.09E-02	0.75552
38	-6.57E-02	0.75077
39	-4.04E-02	0.74589
40	-1.52E-02	0.74087
41	1.01E-02	0.73573
42	3.54E-02	0.73045
43	6.06E-02	0.72505
44	8.59E-02	0.71951
45	0.11111	0.71384
46	0.13636	0.70803
47	0.16162	0.7021
48	0.18687	0.69604
49	0.21212	0.68985
50	0.23737	0.68354
51	0.26263	0.6771
52	0.28788	0.67053
53	0.31313	0.66385
54	0.33838	0.65704
55	0.36364	0.65012
56	0.38889	0.64308
57	0.41414	0.63592
58	0.43939	0.62866
59	0.46465	0.62129
60	0.4899	0.61382
61	0.51515	0.60624
62	0.5404	0.59857
63	0.56566	0.5908
64	0.59091	0.58294
65	0.61616	0.575
66	0.64141	0.56698
67	0.66667	0.55887
68	0.69192	0.5507
69	0.71717	0.54245
70	0.74242	0.53414
71	0.76768	0.52577
72	0.79293	0.51734
73	0.81818	0.50887
74	0.84343	0.50035
75	0.86869	0.49179
76	0.89394	0.48319
77	0.91919	0.47457
78	0.94444	0.46592
79	0.9697	0.45725
80	0.99495	0.44857
81	1.0202	0.43988

	X	Y
31	-0.24242	0.7782
32	-0.21717	0.77399
33	-0.19192	0.76967
34	-0.16667	0.76525
35	-0.14141	0.76072
36	-0.11616	0.75609
37	-9.09E-02	0.75135
38	-6.57E-02	0.74651
39	-4.04E-02	0.74156
40	-1.52E-02	0.73651
41	1.01E-02	0.73135
42	3.54E-02	0.72608
43	6.06E-02	0.72071
44	8.59E-02	0.71524
45	0.11111	0.70965
46	0.13636	0.70397
47	0.16162	0.69817
48	0.18687	0.69227
49	0.21212	0.68627
50	0.23737	0.68016
51	0.26263	0.67395
52	0.28788	0.66762
53	0.31313	0.6612
54	0.33838	0.65467
55	0.36364	0.64803
56	0.38889	0.64129
57	0.41414	0.63444
58	0.43939	0.62748
59	0.46465	0.62042
60	0.4899	0.61326
61	0.51515	0.60599
62	0.5404	0.59861
63	0.56566	0.59113
64	0.59091	0.58354
65	0.61616	0.57585
66	0.64141	0.56805
67	0.66667	0.56015
68	0.69192	0.55214
69	0.71717	0.54403
70	0.74242	0.5358
71	0.76768	0.52748
72	0.79293	0.51905
73	0.81818	0.51051
74	0.84343	0.50187
75	0.86869	0.49312
76	0.89394	0.48427
77	0.91919	0.47531
78	0.94444	0.46624
79	0.9697	0.45707
80	0.99495	0.4478
81	1.0202	0.43841

	X	Y
31	-0.24242	0.85575
32	-0.21717	0.84745
33	-0.19192	0.83915
34	-0.16667	0.83085
35	-0.14141	0.82255
36	-0.11616	0.81425
37	-9.09E-02	0.80595
38	-6.57E-02	0.79765
39	-4.04E-02	0.78935
40	-1.52E-02	0.78105
41	1.01E-02	0.77275
42	3.54E-02	0.76445
43	6.06E-02	0.75615
44	8.59E-02	0.74785
45	0.11111	0.73955
46	0.13636	0.73125
47	0.16162	0.72295
48	0.18687	0.71465
49	0.21212	0.70635
50	0.23737	0.69805
51	0.26263	0.68975
52	0.28788	0.68145
53	0.31313	0.67315
54	0.33838	0.66485
55	0.36364	0.65655
56	0.38889	0.64825
57	0.41414	0.63995
58	0.43939	0.63165
59	0.46465	0.62335
60	0.4899	0.61505
61	0.51515	0.60675
62	0.5404	0.59845
63	0.56566	0.59016
64	0.59091	0.58186
65	0.61616	0.57356
66	0.64141	0.56526
67	0.66667	0.55696
68	0.69192	0.54866
69	0.71717	0.54036
70	0.74242	0.53206
71	0.76768	0.52376
72	0.79293	0.51546
73	0.81818	0.50716
74	0.84343	0.49886
75	0.86869	0.49056
76	0.89394	0.48226
77	0.91919	0.47396
78	0.94444	0.46566
79	0.9697	0.45736
80	0.99495	0.44906
81	1.0202	0.44076

Prediction Line

	X	Y
82	1.0455	0.43119
83	1.0707	0.4225
84	1.096	0.41383
85	1.1212	0.40516
86	1.1465	0.39651
87	1.1717	0.38789
88	1.197	0.3793
89	1.2222	0.37074
90	1.2475	0.36222
91	1.2727	0.35375
92	1.298	0.34533
93	1.3232	0.33696
94	1.3485	0.32865
95	1.3737	0.32041
96	1.399	0.31224
97	1.4242	0.30414
98	1.4495	0.29612
99	1.4747	0.28818
100	1.5	0.28033

	X	Y
82	1.0455	0.42893
83	1.0707	0.41947
84	1.096	0.41011
85	1.1212	0.40086
86	1.1465	0.39172
87	1.1717	0.38268
88	1.197	0.37374
89	1.2222	0.36491
90	1.2475	0.35619
91	1.2727	0.34757
92	1.298	0.33906
93	1.3232	0.33066
94	1.3485	0.32236
95	1.3737	0.31416
96	1.399	0.30607
97	1.4242	0.29809
98	1.4495	0.29021
99	1.4747	0.28244
100	1.5	0.27477

	X	Y
82	1.0455	0.43246
83	1.0707	0.42416
84	1.096	0.41586
85	1.1212	0.40756
86	1.1465	0.39926
87	1.1717	0.39096
88	1.197	0.38266
89	1.2222	0.37436
90	1.2475	0.36606
91	1.2727	0.35776
92	1.298	0.34946
93	1.3232	0.34116
94	1.3485	0.33286
95	1.3737	0.32456
96	1.399	0.31626
97	1.4242	0.30796
98	1.4495	0.29966
99	1.4747	0.29136
100	1.5	0.28306

Table H2.D-6a. TRAP Model Output for Copper Data for the Bird Growth Endpoint (Pooling Group D: Poupoulis and Jensen 1976; Wang et al. 1987)

Chemical:	Copper
Study Authors:	Pooling group D
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect Relative to Control
2.23E-01	100
14.182	97.39
28.14	102.61
56.057	83.936
111.89	48.594
0.22333	100
2.81E+01	97.727
56.057	82.727
83.973	45.227
1.12E+02	46.136
0.22333	100
28.14	99.044
56.057	93.499
111.89	50.287
0.64189	100
64.831	82.947
0.64189	100
64.831	76.34

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm

Error Messages Encountered

Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.9506	2.0127	2.01E-02	1.9698	2.0555
S	2.0271	1.53E+00	0.2195	1.0636	1.9993
Y0	9.93E+01	1.01E+02	2.2542	96.089	105.7

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.9506	2.0187	2.02E-02	1.9755	2.0618
S	2.0271	1.61E+00	0.22216	1.1389	2.0859
Y0	9.93E+01	1.00E+02	2.1279	95.425	104.5

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.9506	2.0158	2.07E-02	1.9717	2.0598
S	2.0271	1.3468	0.14404	1.0398	1.6538
Y0	9.93E+01	9.96E+01	1.8164	95.77	103.51

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	102.96	93.287	113.63	2.01E-02	2.0127
20	6.11E+01	5.19E+01	7.21E+01	3.35E-02	1.7864
10	4.51E+01	3.52E+01	5.77E+01	5.02E-02	1.654
5	3.40E+01	2.45E+01	4.72E+01	6.66E-02	1.532
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	104.39	94.523	115.28	2.02E-02	2.0187
20	61.76	5.30E+01	71.979	3.12E-02	1.7907
10	4.74E+01	3.78E+01	5.94E+01	4.59E-02	1.6758
5	39.317	2.95E+01	5.25E+01	5.88E-02	1.5946
0	25.03	1.48E+01	4.23E+01	0.1069	1.40E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	103.7	93.697	114.77	2.07E-02	2.0158
20	62.091	56.363	68.4	1.97E-02	1.793
10	52.333	46.275	59.184	2.51E-02	1.7188
5	48.045	41.835	55.177	2.82E-02	1.6817
0	44.109	37.786	51.49	3.15E-02	1.6445

Model Fit Summary

Dataset		Exposure	Effects Var	Est Effects Var
	1	-6.51E-01	1.00E+02	1.01E+02
	2	-6.51E-01	1.00E+02	1.01E+02
	3	-6.51E-01	1.00E+02	1.01E+02
	4	-1.93E-01	1.00E+02	1.01E+02
	5	-1.93E-01	1.00E+02	1.01E+02
	6	1.15E+00	9.74E+01	1.00E+02
	7	1.45E+00	1.03E+02	9.78E+01
	8	1.45E+00	9.90E+01	9.78E+01
	9	1.45E+00	9.77E+01	9.78E+01
	10	1.75E+00	93.499	84.189
	11	1.75E+00	83.936	84.189
	12	1.75E+00	8.27E+01	8.42E+01
	13	1.81E+00	8.29E+01	7.81E+01
	14	1.81E+00	76.34	78.082
	15	1.92E+00	45.227	63.798
	16	2.05E+00	50.287	44.887
	17	2.05E+00	48.594	44.887
	18	2.05E+00	46.136	44.887
	19			
	20			

	Exposure	Effects Var	Est Effects Var
1	-6.51E-01	1.00E+02	1.00E+02
2	-6.51E-01	1.00E+02	1.00E+02
3	-6.51E-01	1.00E+02	1.00E+02
4	-1.93E-01	1.00E+02	1.00E+02
5	-1.93E-01	1.00E+02	1.00E+02
6	1.15E+00	9.74E+01	1.00E+02
7	1.45E+00	1.03E+02	9.96E+01
8	1.45E+00	9.90E+01	9.96E+01
9	1.45E+00	9.77E+01	9.96E+01
10	1.75E+00	93.499	84.027
11	1.75E+00	83.936	84.027
12	1.75E+00	8.27E+01	8.40E+01
13	1.81E+00	8.29E+01	7.78E+01
14	1.81E+00	76.34	77.762
15	1.92E+00	45.227	64.052
16	2.05E+00	50.287	45.241
17	2.05E+00	48.594	45.241
18	2.05E+00	46.136	45.241
19			
20			

	Exposure	Effects Var	Est Effects Var
1	-6.51E-01	1.00E+02	9.96E+01
2	-6.51E-01	1.00E+02	9.96E+01
3	-6.51E-01	1.00E+02	9.96E+01
4	-1.93E-01	1.00E+02	9.96E+01
5	-1.93E-01	1.00E+02	9.96E+01
6	1.15E+00	9.74E+01	9.96E+01
7	1.45E+00	1.03E+02	9.96E+01
8	1.45E+00	9.90E+01	9.96E+01
9	1.45E+00	9.77E+01	9.96E+01
10	1.75E+00	93.499	85.671
11	1.75E+00	83.936	85.671
12	1.75E+00	8.27E+01	8.57E+01
13	1.81E+00	8.29E+01	7.72E+01
14	1.81E+00	76.34	77.196
15	1.92E+00	45.227	62.118
16	2.05E+00	50.287	45.39
17	2.05E+00	48.594	45.39
18	2.05E+00	46.136	45.39
19			
20			

Analysis of Variance

R-squared: 0.93

	DF	SS	MS	F	Sig
Total (adj)	17	7697.4	452.79		
Regression	2	7154.8	3577.4	98.886	0
Error	15	542.66	36.177		

R-squared: 0.931

	DF	SS	MS	F	Sig
Total (adj)	17	7697.4	452.79		
Regression	2	7165.7	3582.9	101.08	0
Error	15	531.69	35.446		

R-squared: 0.942

	DF	SS	MS	F	Sig
Total (adj)	17	7697.4	452.79		
Regression	2	7252	3626	122.11	0
Error	15	445.4	29.694		

Prediction Line

	X	Y
1	-0.5	1.01E+02
2	-4.70E-01	1.01E+02
3	-4.39E-01	1.01E+02
4	-4.09E-01	1.01E+02
5	-3.79E-01	1.01E+02
6	-3.48E-01	1.01E+02

	X	Y
1	-0.5	1.00E+02
2	-4.70E-01	1.00E+02
3	-4.39E-01	1.00E+02
4	-4.09E-01	1.00E+02
5	-3.79E-01	1.00E+02
6	-3.48E-01	1.00E+02

	X	Y
1	-0.5	9.96E+01
2	-4.70E-01	9.96E+01
3	-4.39E-01	9.96E+01
4	-4.09E-01	9.96E+01
5	-3.79E-01	9.96E+01
6	-3.48E-01	9.96E+01

Prediction Line

	X	Y
7	-3.18E-01	1.01E+02
8	-2.88E-01	1.01E+02
9	-2.58E-01	1.01E+02
10	-2.27E-01	1.01E+02
11	-1.97E-01	1.01E+02
12	-1.67E-01	1.01E+02
13	-1.36E-01	1.01E+02
14	-0.10606	1.01E+02
15	-7.58E-02	1.01E+02
16	-4.55E-02	1.01E+02
17	-1.52E-02	1.01E+02
18	1.52E-02	1.01E+02
19	4.55E-02	1.01E+02
20	7.58E-02	1.01E+02
21	1.06E-01	1.01E+02
22	1.36E-01	1.01E+02
23	1.67E-01	1.01E+02
24	1.97E-01	1.01E+02
25	2.27E-01	1.01E+02
26	2.58E-01	1.01E+02
27	2.88E-01	1.01E+02
28	3.18E-01	1.01E+02
29	3.48E-01	1.01E+02
30	3.79E-01	1.01E+02
31	0.40909	1.01E+02
32	4.39E-01	1.01E+02
33	4.70E-01	1.01E+02
34	0.5	1.01E+02
35	5.30E-01	1.01E+02
36	5.61E-01	1.01E+02
37	0.59091	1.01E+02
38	0.62121	1.01E+02
39	0.65152	1.01E+02
40	0.68182	1.01E+02
41	0.71212	1.01E+02
42	0.74242	1.01E+02
43	0.77273	1.01E+02
44	0.80303	1.01E+02
45	0.83333	1.01E+02
46	0.86364	1.01E+02
47	0.89394	1.01E+02
48	0.92424	1.01E+02
49	0.95455	1.01E+02
50	0.98485	1.01E+02
51	1.0152	1.01E+02
52	1.0455	1.01E+02
53	1.0758	1.01E+02
54	1.1061	1.01E+02
55	1.1364	1.00E+02
56	1.1667	1.00E+02
57	1.197	1.00E+02

	X	Y
7	-3.18E-01	1.00E+02
8	-2.88E-01	1.00E+02
9	-2.58E-01	1.00E+02
10	-2.27E-01	1.00E+02
11	-1.97E-01	1.00E+02
12	-1.67E-01	1.00E+02
13	-1.36E-01	1.00E+02
14	-0.10606	1.00E+02
15	-7.58E-02	1.00E+02
16	-4.55E-02	1.00E+02
17	-1.52E-02	1.00E+02
18	1.52E-02	1.00E+02
19	4.55E-02	1.00E+02
20	7.58E-02	1.00E+02
21	1.06E-01	1.00E+02
22	1.36E-01	1.00E+02
23	1.67E-01	1.00E+02
24	1.97E-01	1.00E+02
25	2.27E-01	1.00E+02
26	2.58E-01	1.00E+02
27	2.88E-01	1.00E+02
28	3.18E-01	1.00E+02
29	3.48E-01	1.00E+02
30	3.79E-01	1.00E+02
31	0.40909	1.00E+02
32	4.39E-01	1.00E+02
33	4.70E-01	1.00E+02
34	0.5	1.00E+02
35	5.30E-01	1.00E+02
36	5.61E-01	1.00E+02
37	0.59091	1.00E+02
38	0.62121	1.00E+02
39	0.65152	1.00E+02
40	0.68182	1.00E+02
41	0.71212	1.00E+02
42	0.74242	1.00E+02
43	0.77273	1.00E+02
44	0.80303	1.00E+02
45	0.83333	1.00E+02
46	0.86364	1.00E+02
47	0.89394	1.00E+02
48	0.92424	1.00E+02
49	0.95455	1.00E+02
50	0.98485	1.00E+02
51	1.0152	1.00E+02
52	1.0455	1.00E+02
53	1.0758	1.00E+02
54	1.1061	1.00E+02
55	1.1364	1.00E+02
56	1.1667	1.00E+02
57	1.197	1.00E+02

	X	Y
7	-3.18E-01	9.96E+01
8	-2.88E-01	9.96E+01
9	-2.58E-01	9.96E+01
10	-2.27E-01	9.96E+01
11	-1.97E-01	9.96E+01
12	-1.67E-01	9.96E+01
13	-1.36E-01	9.96E+01
14	-0.10606	9.96E+01
15	-7.58E-02	9.96E+01
16	-4.55E-02	9.96E+01
17	-1.52E-02	9.96E+01
18	1.52E-02	9.96E+01
19	4.55E-02	9.96E+01
20	7.58E-02	9.96E+01
21	1.06E-01	9.96E+01
22	1.36E-01	9.96E+01
23	1.67E-01	9.96E+01
24	1.97E-01	9.96E+01
25	2.27E-01	9.96E+01
26	2.58E-01	9.96E+01
27	2.88E-01	9.96E+01
28	3.18E-01	9.96E+01
29	3.48E-01	9.96E+01
30	3.79E-01	9.96E+01
31	0.40909	9.96E+01
32	4.39E-01	9.96E+01
33	4.70E-01	9.96E+01
34	0.5	9.96E+01
35	5.30E-01	9.96E+01
36	5.61E-01	9.96E+01
37	0.59091	9.96E+01
38	0.62121	9.96E+01
39	0.65152	9.96E+01
40	0.68182	9.96E+01
41	0.71212	9.96E+01
42	0.74242	9.96E+01
43	0.77273	9.96E+01
44	0.80303	9.96E+01
45	0.83333	9.96E+01
46	0.86364	9.96E+01
47	0.89394	9.96E+01
48	0.92424	9.96E+01
49	0.95455	9.96E+01
50	0.98485	9.96E+01
51	1.0152	9.96E+01
52	1.0455	9.96E+01
53	1.0758	9.96E+01
54	1.1061	9.96E+01
55	1.1364	9.96E+01
56	1.1667	9.96E+01
57	1.197	9.96E+01

Prediction Line

	X	Y
58	1.2273	1.00E+02
59	1.2576	9.99E+01
60	1.2879	9.97E+01
61	1.3182	9.95E+01
62	1.3485	9.92E+01
63	1.3788	9.89E+01
64	1.4091	9.85E+01
65	1.4394	9.80E+01
66	1.4697	9.74E+01
67	1.5	9.67E+01
68	1.5303	9.59E+01
69	1.5606	9.49E+01
70	1.5909	9.38E+01
71	1.6212	9.25E+01
72	1.6515	9.09E+01
73	1.6818	8.91E+01
74	1.7121	8.71E+01
75	1.7424	8.47E+01
76	1.7727	8.20E+01
77	1.803	7.90E+01
78	1.8333	7.57E+01
79	1.8636	7.20E+01
80	1.8939	6.80E+01
81	1.9242	6.38E+01
82	1.9545	5.93E+01
83	1.9848	5.47E+01
84	2.0152	5.01E+01
85	2.0455	4.54E+01
86	2.0758	4.08E+01
87	2.1061	3.64E+01
88	2.1364	3.22E+01
89	2.1667	2.83E+01
90	2.197	2.47E+01
91	2.2273	2.14E+01
92	2.2576	1.84E+01
93	2.2879	1.58E+01
94	2.3182	1.35E+01
95	2.3485	1.14E+01
96	2.3788	9.68E+00
97	2.4091	8.18E+00
98	2.4394	6.89E+00
99	2.4697	5.79E+00
100	2.5	4.85E+00

	X	Y
58	1.2273	1.00E+02
59	1.2576	1.00E+02
60	1.2879	1.00E+02
61	1.3182	1.00E+02
62	1.3485	1.00E+02
63	1.3788	1.00E+02
64	1.4091	9.99E+01
65	1.4394	9.97E+01
66	1.4697	9.93E+01
67	1.5	9.86E+01
68	1.5303	9.77E+01
69	1.5606	9.65E+01
70	1.5909	9.51E+01
71	1.6212	9.35E+01
72	1.6515	9.16E+01
73	1.6818	8.95E+01
74	1.7121	8.72E+01
75	1.7424	8.46E+01
76	1.7727	8.18E+01
77	1.803	7.87E+01
78	1.8333	7.54E+01
79	1.8636	7.18E+01
80	1.8939	6.81E+01
81	1.9242	6.40E+01
82	1.9545	5.98E+01
83	1.9848	5.53E+01
84	2.0152	5.05E+01
85	2.0455	4.58E+01
86	2.0758	4.12E+01
87	2.1061	3.69E+01
88	2.1364	3.28E+01
89	2.1667	2.90E+01
90	2.197	2.54E+01
91	2.2273	2.20E+01
92	2.2576	1.89E+01
93	2.2879	1.60E+01
94	2.3182	1.34E+01
95	2.3485	1.10E+01
96	2.3788	8.79E+00
97	2.4091	6.86E+00
98	2.4394	5.17E+00
99	2.4697	3.72E+00
100	2.5	2.51E+00

	X	Y
58	1.2273	9.96E+01
59	1.2576	9.96E+01
60	1.2879	9.96E+01
61	1.3182	9.96E+01
62	1.3485	9.96E+01
63	1.3788	9.96E+01
64	1.4091	9.96E+01
65	1.4394	9.96E+01
66	1.4697	9.96E+01
67	1.5	9.96E+01
68	1.5303	9.96E+01
69	1.5606	9.96E+01
70	1.5909	9.96E+01
71	1.6212	9.96E+01
72	1.6515	9.87E+01
73	1.6818	9.46E+01
74	1.7121	9.06E+01
75	1.7424	8.65E+01
76	1.7727	8.24E+01
77	1.803	7.84E+01
78	1.8333	7.43E+01
79	1.8636	7.02E+01
80	1.8939	6.62E+01
81	1.9242	6.21E+01
82	1.9545	5.80E+01
83	1.9848	5.40E+01
84	2.0152	4.99E+01
85	2.0455	4.58E+01
86	2.0758	4.18E+01
87	2.1061	3.77E+01
88	2.1364	3.36E+01
89	2.1667	2.96E+01
90	2.197	2.55E+01
91	2.2273	2.14E+01
92	2.2576	1.74E+01
93	2.2879	1.33E+01
94	2.3182	9.24E+00
95	2.3485	5.17E+00
96	2.3788	1.11E+00
97	2.4091	0.00E+00
98	2.4394	0.00E+00
99	2.4697	0.00E+00
100	2.5	0.00E+00

Table H2.D-6b. TRAP Model Output for Copper Data for the Bird Reproduction Endpoint (Pooling Group A: Chiou et al. 1997; Harms and Buresh 1986; Pearce et al. 1983; Stevenson and Jackson 1980a; Stevenson and Jackson 1980b)

Chemical:	Copper
Study Authors:	Pooling group A
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:	Dose	Effect Relative to Control
	1.8506	100
	13.3653	103
	27.7587	99
	40.9870	51
	51.9534	34
	0.3785	100
	31.9197	32
	0.3154	100
	15.7706	111
	31.5412	89
	63.0824	22
	126.1648	11
	0.4731	100
	32.0143	78
	63.5555	22
	126.6379	9
	0.4794	100
	16.2500	100
	32.0206	78
	63.5618	22
	126.6442	11

Modeling Parameters			
Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.6786	1.6234	2.97E-02	1.5609	1.6859
S	1.6525	1.88E+00	0.37164	1.0972	2.6588
Y0	1.01E+02	1.03E+02	4.7041	93.319	113.08

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	42.017	36.386	48.518	2.97E-02	1.6234
20	2.75E+01	2.16E+01	3.49E+01	4.93E-02	1.4389
10	2.14E+01	1.54E+01	2.97E+01	6.76E-02	1.3309
5	1.70E+01	1.13E+01	2.58E+01	8.58E-02	1.2315
0					

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-5.01E-01	1.00E+02	1.03E+02
2	-4.22E-01	1.00E+02	1.03E+02
3	-3.25E-01	1.00E+02	1.03E+02
4	-3.19E-01	1.00E+02	1.03E+02
5	2.67E-01	1.00E+02	1.03E+02
6	1.13E+00	1.03E+02	1.01E+02
7	1.20E+00	1.11E+02	9.91E+01
8	1.21E+00	1.00E+02	9.88E+01
9	1.44E+00	9.90E+01	8.20E+01
10	1.50E+00	8.90E+01	7.41E+01
11	1.50E+00	3.20E+01	7.33E+01
12	1.51E+00	7.80E+01	7.31E+01
13	1.51E+00	78	73.082
14	1.61E+00	5.10E+01	5.37E+01
15	1.72E+00	3.40E+01	3.44E+01
16	1.80E+00	2.20E+01	2.17E+01
17	1.80E+00	2.20E+01	2.12E+01
18	1.80E+00	2.20E+01	2.12E+01
19	2.10E+00	1.10E+01	2.78E+00
20	2.10E+00	9.00E+00	2.75E+00
21	2.10E+00	1.10E+01	2.75E+00
22			
23			

Analysis of Variance

R-squared: 0.911

	DF	SS	MS	F	Sig
Total (adj)	20	29739	1486.9		
Regression	2	27093	13546	92.146	0
Error	18	2646.1	147.01		

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.6786	1.624	2.89E-02	1.5633	1.6846
S	1.6525	2.09E+00	0.42271	1.2053	2.9814
Y0	1.01E+02	1.02E+02	4.5689	92.49	111.69

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	42.07	36.586	48.375	2.89E-02	1.624
20	28.08	2.23E+01	35.363	4.77E-02	1.4484
10	2.29E+01	1.68E+01	3.12E+01	6.42E-02	1.3599
5	19.83	1.38E+01	2.86E+01	7.55E-02	1.2973
0	14.005	9.12E+00	2.15E+01	8.86E-02	1.15E+00

	Exposure	Effects Var	Est Effects Var
1	-5.01E-01	1.00E+02	1.02E+02
2	-4.22E-01	1.00E+02	1.02E+02
3	-3.25E-01	1.00E+02	1.02E+02
4	-3.19E-01	1.00E+02	1.02E+02
5	2.67E-01	1.00E+02	1.02E+02
6	1.13E+00	1.03E+02	1.02E+02
7	1.20E+00	1.11E+02	1.01E+02
8	1.21E+00	1.00E+02	1.01E+02
9	1.44E+00	9.90E+01	8.23E+01
10	1.50E+00	8.90E+01	7.43E+01
11	1.50E+00	3.20E+01	7.35E+01
12	1.51E+00	7.80E+01	7.32E+01
13	1.51E+00	78	73.234
14	1.61E+00	5.10E+01	5.34E+01
15	1.72E+00	3.40E+01	3.33E+01
16	1.80E+00	2.20E+01	2.04E+01
17	1.80E+00	2.20E+01	1.99E+01
18	1.80E+00	2.20E+01	1.99E+01
19	2.10E+00	1.10E+01	1.19E-04
20	2.10E+00	9.00E+00	0.00E+00
21	2.10E+00	1.10E+01	0.00E+00
22			
23			

R-squared: 0.909

	DF	SS	MS	F	Sig
Total (adj)	20	29739	1486.9		
Regression	2	27026	13513	89.654	0
Error	18	2713	150.72		

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.6786	1.6294	2.48E-02	1.5774	1.6814
S	1.6525	1.7466	0.28011	1.1581	2.3351
Y0	1.01E+02	1.02E+02	4.2851	92.747	110.75

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	42.602	37.793	48.023	2.48E-02	1.6294
20	28.686	23.842	34.514	3.82E-02	1.4577
10	25.143	20.163	31.353	4.56E-02	1.4004
5	23.539	18.522	29.915	4.96E-02	1.3718
0	22.037	17.006	28.558	5.36E-02	1.3432

	Exposure	Effects Var	Est Effects Var
1	-5.01E-01	1.00E+02	1.02E+02
2	-4.22E-01	1.00E+02	1.02E+02
3	-3.25E-01	1.00E+02	1.02E+02
4	-3.19E-01	1.00E+02	1.02E+02
5	2.67E-01	1.00E+02	1.02E+02
6	1.13E+00	1.03E+02	1.02E+02
7	1.20E+00	1.11E+02	1.02E+02
8	1.21E+00	1.00E+02	1.02E+02
9	1.44E+00	9.90E+01	8.39E+01
10	1.50E+00	8.90E+01	7.41E+01
11	1.50E+00	3.20E+01	7.32E+01
12	1.51E+00	7.80E+01	7.29E+01
13	1.51E+00	78	72.912
14	1.61E+00	5.10E+01	5.39E+01
15	1.72E+00	3.40E+01	3.56E+01
16	1.80E+00	2.20E+01	2.06E+01
17	1.80E+00	2.20E+01	2.00E+01
18	1.80E+00	2.20E+01	2.00E+01
19	2.10E+00	1.10E+01	0.00E+00
20	2.10E+00	9.00E+00	0.00E+00
21	2.10E+00	1.10E+01	0.00E+00
22			
23			

R-squared: 0.911

	DF	SS	MS	F	Sig
Total (adj)	20	29739	1486.9		
Regression	2	27094	13547	92.221	0
Error	18	2644.2	146.9		

Prediction Line

	X	Y
1	-0.5	1.03E+02
2	-4.70E-01	1.03E+02
3	-4.39E-01	1.03E+02
4	-4.09E-01	1.03E+02
5	-3.79E-01	1.03E+02
6	-3.48E-01	1.03E+02
7	-3.18E-01	1.03E+02
8	-2.88E-01	1.03E+02
9	-2.58E-01	1.03E+02
10	-2.27E-01	1.03E+02
11	-1.97E-01	1.03E+02
12	-1.67E-01	1.03E+02
13	-1.36E-01	1.03E+02
14	-0.10606	1.03E+02
15	-7.58E-02	1.03E+02
16	-4.55E-02	1.03E+02
17	-1.52E-02	1.03E+02
18	1.52E-02	1.03E+02
19	4.55E-02	1.03E+02
20	7.58E-02	1.03E+02
21	1.06E-01	1.03E+02
22	1.36E-01	1.03E+02
23	1.67E-01	1.03E+02
24	1.97E-01	1.03E+02
25	2.27E-01	1.03E+02
26	2.58E-01	1.03E+02
27	2.88E-01	1.03E+02
28	3.18E-01	1.03E+02
29	3.48E-01	1.03E+02
30	3.79E-01	1.03E+02
31	0.40909	1.03E+02
32	0.43939	1.03E+02
33	0.4697	1.03E+02
34	0.5	1.03E+02
35	0.5303	1.03E+02
36	0.56061	1.03E+02
37	0.59091	1.03E+02
38	0.62121	1.03E+02
39	0.65152	1.03E+02
40	0.68182	1.03E+02
41	0.71212	1.03E+02
42	0.74242	1.03E+02
43	0.77273	1.03E+02
44	0.80303	1.03E+02
45	0.83333	1.03E+02
46	0.86364	1.03E+02
47	0.89394	1.03E+02
48	0.92424	1.03E+02
49	0.95455	1.03E+02
50	0.98485	1.02E+02
51	1.0152	1.02E+02

	X	Y
1	-0.5	1.02E+02
2	-4.70E-01	1.02E+02
3	-4.39E-01	1.02E+02
4	-4.09E-01	1.02E+02
5	-3.79E-01	1.02E+02
6	-3.48E-01	1.02E+02
7	-3.18E-01	1.02E+02
8	-2.88E-01	1.02E+02
9	-2.58E-01	1.02E+02
10	-2.27E-01	1.02E+02
11	-1.97E-01	1.02E+02
12	-1.67E-01	1.02E+02
13	-1.36E-01	1.02E+02
14	-0.10606	1.02E+02
15	-7.58E-02	1.02E+02
16	-4.55E-02	1.02E+02
17	-1.52E-02	1.02E+02
18	1.52E-02	1.02E+02
19	4.55E-02	1.02E+02
20	7.58E-02	1.02E+02
21	1.06E-01	1.02E+02
22	1.36E-01	1.02E+02
23	1.67E-01	1.02E+02
24	1.97E-01	1.02E+02
25	2.27E-01	1.02E+02
26	2.58E-01	1.02E+02
27	2.88E-01	1.02E+02
28	3.18E-01	1.02E+02
29	3.48E-01	1.02E+02
30	3.79E-01	1.02E+02
31	0.40909	1.02E+02
32	0.43939	1.02E+02
33	0.4697	1.02E+02
34	0.5	1.02E+02
35	0.5303	1.02E+02
36	0.56061	1.02E+02
37	0.59091	1.02E+02
38	0.62121	1.02E+02
39	0.65152	1.02E+02
40	0.68182	1.02E+02
41	0.71212	1.02E+02
42	0.74242	1.02E+02
43	0.77273	1.02E+02
44	0.80303	1.02E+02
45	0.83333	1.02E+02
46	0.86364	1.02E+02
47	0.89394	1.02E+02
48	0.92424	1.02E+02
49	0.95455	1.02E+02
50	0.98485	1.02E+02
51	1.0152	1.02E+02

	X	Y
1	-0.5	1.02E+02
2	-4.70E-01	1.02E+02
3	-4.39E-01	1.02E+02
4	-4.09E-01	1.02E+02
5	-3.79E-01	1.02E+02
6	-3.48E-01	1.02E+02
7	-3.18E-01	1.02E+02
8	-2.88E-01	1.02E+02
9	-2.58E-01	1.02E+02
10	-2.27E-01	1.02E+02
11	-1.97E-01	1.02E+02
12	-1.67E-01	1.02E+02
13	-1.36E-01	1.02E+02
14	-0.10606	1.02E+02
15	-7.58E-02	1.02E+02
16	-4.55E-02	1.02E+02
17	-1.52E-02	1.02E+02
18	1.52E-02	1.02E+02
19	4.55E-02	1.02E+02
20	7.58E-02	1.02E+02
21	1.06E-01	1.02E+02
22	1.36E-01	1.02E+02
23	1.67E-01	1.02E+02
24	1.97E-01	1.02E+02
25	2.27E-01	1.02E+02
26	2.58E-01	1.02E+02
27	2.88E-01	1.02E+02
28	3.18E-01	1.02E+02
29	3.48E-01	1.02E+02
30	3.79E-01	1.02E+02
31	0.40909	1.02E+02
32	0.43939	1.02E+02
33	0.4697	1.02E+02
34	0.5	1.02E+02
35	0.5303	1.02E+02
36	0.56061	1.02E+02
37	0.59091	1.02E+02
38	0.62121	1.02E+02
39	0.65152	1.02E+02
40	0.68182	1.02E+02
41	0.71212	1.02E+02
42	0.74242	1.02E+02
43	0.77273	1.02E+02
44	0.80303	1.02E+02
45	0.83333	1.02E+02
46	0.86364	1.02E+02
47	0.89394	1.02E+02
48	0.92424	1.02E+02
49	0.95455	1.02E+02
50	0.98485	1.02E+02
51	1.0152	1.02E+02

Prediction Line

	X	Y
52	1.0455	1.02E+02
53	1.0758	1.02E+02
54	1.1061	1.01E+02
55	1.1364	1.01E+02
56	1.1667	1.00E+02
57	1.197	9.92E+01
58	1.2273	9.82E+01
59	1.2576	9.70E+01
60	1.2879	9.55E+01
61	1.3182	9.37E+01
62	1.3485	9.16E+01
63	1.3788	8.90E+01
64	1.4091	8.60E+01
65	1.4394	8.25E+01
66	1.4697	7.85E+01
67	1.5	7.39E+01
68	1.5303	6.89E+01
69	1.5606	6.36E+01
70	1.5909	5.79E+01
71	1.6212	5.20E+01
72	1.6515	4.62E+01
73	1.6818	4.05E+01
74	1.7121	3.50E+01
75	1.7424	3.00E+01
76	1.7727	2.54E+01
77	1.803	2.13E+01
78	1.8333	1.77E+01
79	1.8636	1.46E+01
80	1.8939	1.20E+01
81	1.9242	9.75E+00
82	1.9545	7.92E+00
83	1.9848	6.41E+00
84	2.0152	5.17E+00
85	2.0455	4.16E+00
86	2.0758	3.34E+00
87	2.1061	2.68E+00
88	2.1364	2.14E+00
89	2.1667	1.71E+00
90	2.197	1.37E+00
91	2.2273	1.09E+00
92	2.2576	8.73E-01
93	2.2879	6.97E-01
94	2.3182	5.56E-01
95	2.3485	4.43E-01
96	2.3788	3.53E-01
97	2.4091	2.81E-01
98	2.4394	2.24E-01
99	2.4697	1.79E-01
100	2.5	1.42E-01

	X	Y
52	1.0455	1.02E+02
53	1.0758	1.02E+02
54	1.1061	1.02E+02
55	1.1364	1.02E+02
56	1.1667	1.02E+02
57	1.197	1.02E+02
58	1.2273	1.01E+02
59	1.2576	9.93E+01
60	1.2879	9.76E+01
61	1.3182	9.55E+01
62	1.3485	9.29E+01
63	1.3788	9.00E+01
64	1.4091	8.66E+01
65	1.4394	8.29E+01
66	1.4697	7.87E+01
67	1.5	7.41E+01
68	1.5303	6.91E+01
69	1.5606	6.37E+01
70	1.5909	5.79E+01
71	1.6212	5.16E+01
72	1.6515	4.53E+01
73	1.6818	3.94E+01
74	1.7121	3.39E+01
75	1.7424	2.89E+01
76	1.7727	2.42E+01
77	1.803	1.99E+01
78	1.8333	1.61E+01
79	1.8636	1.27E+01
80	1.8939	9.65E+00
81	1.9242	7.04E+00
82	1.9545	4.84E+00
83	1.9848	3.05E+00
84	2.0152	1.67E+00
85	2.0455	7.07E-01
86	2.0758	1.50E-01
87	2.1061	0.00E+00
88	2.1364	0.00E+00
89	2.1667	0.00E+00
90	2.197	0.00E+00
91	2.2273	0.00E+00
92	2.2576	0.00E+00
93	2.2879	0.00E+00
94	2.3182	0.00E+00
95	2.3485	0.00E+00
96	2.3788	0.00E+00
97	2.4091	0.00E+00
98	2.4394	0.00E+00
99	2.4697	0.00E+00
100	2.5	0.00E+00

	X	Y
52	1.0455	1.02E+02
53	1.0758	1.02E+02
54	1.1061	1.02E+02
55	1.1364	1.02E+02
56	1.1667	1.02E+02
57	1.197	1.02E+02
58	1.2273	1.02E+02
59	1.2576	1.02E+02
60	1.2879	1.02E+02
61	1.3182	1.02E+02
62	1.3485	1.01E+02
63	1.3788	9.54E+01
64	1.4091	9.00E+01
65	1.4394	8.46E+01
66	1.4697	7.93E+01
67	1.5	7.39E+01
68	1.5303	6.85E+01
69	1.5606	6.31E+01
70	1.5909	5.77E+01
71	1.6212	5.23E+01
72	1.6515	4.70E+01
73	1.6818	4.16E+01
74	1.7121	3.62E+01
75	1.7424	3.08E+01
76	1.7727	2.54E+01
77	1.803	2.00E+01
78	1.8333	1.46E+01
79	1.8636	9.25E+00
80	1.8939	3.87E+00
81	1.9242	0.00E+00
82	1.9545	0.00E+00
83	1.9848	0.00E+00
84	2.0152	0.00E+00
85	2.0455	0.00E+00
86	2.0758	0.00E+00
87	2.1061	0.00E+00
88	2.1364	0.00E+00
89	2.1667	0.00E+00
90	2.197	0.00E+00
91	2.2273	0.00E+00
92	2.2576	0.00E+00
93	2.2879	0.00E+00
94	2.3182	0.00E+00
95	2.3485	0.00E+00
96	2.3788	0.00E+00
97	2.4091	0.00E+00
98	2.4394	0.00E+00
99	2.4697	0.00E+00
100	2.5	0.00E+00

Table H2.D-6c. TRAP Model Output for Copper Data for the Bird Survival Endpoint (Mehring et al. 1960)

Chemical:	Copper
Study Authors:	Mehring et al. 1960
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
1.926585	39	40	0.975
29.86207	18	20	0.9
42.23668	19	20	0.95
55.50048	17	20	0.85
87.43733	12	20	0.6

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			yes
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	1.9864	2.0245	9.67E-02	1.8089	2.24
S	0.17442	2.39E-01	0.11223	0.16732	0.42025
Y0	0.94167	0.96229	2.79E-02	0.86119	0.99629

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	1.9864	2.002	7.67E-02	1.831	2.1729
S	0.17442	1.84E-01	8.02E-02	0.12852	0.3228
Y0	0.94167	0.95152	2.72E-02	0.86507	0.98984

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	1.9864	2.0404	0.13385	1.7421	2.3386
S	0.17442	0.21652	0.11753	0.15129	0.37998
Y0	0.94167	0.95	2.44E-02	0.8769	0.98621

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	105.8	64.407	173.78	9.67E-02	2.0245
20	66.517	47.49	93.166	6.25E-02	1.8229
10	52.189	31.004	87.852	9.04E-02	1.7176
5	42.715	19.697	92.633	0.12391	1.6306
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	100.45	67.764	148.9	7.67E-02	2.002
20	68.605	51.541	91.318	5.27E-02	1.8364
10	5.66E+01	37.197	86.156	7.18E-02	1.7529
5	49.417	27.707	88.139	9.19E-02	1.6939
0	35.596	10.549	120.11	0.14776	1.5514

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	109.74	55.224	218.07	0.13385	2.0404
20	65.365	48.689	87.752	5.32E-02	1.8153
10	54.997	37.163	81.39	6.66E-02	1.7403
5	50.447	30.83	82.546	8.05E-02	1.7028
0	46.274	24.932	85.884	9.67E-02	1.6653

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	2.85E-01	0.975	0.96229
2	1.48E+00	0.9	0.95181
3	1.63E+00	0.95	0.91618
4	1.74E+00	0.85	0.84587
5	1.94E+00	0.6	0.61129
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	0.2	0.96229
2	2.20E-01	0.96229
3	2.40E-01	0.96229
4	2.61E-01	0.96229
5	2.81E-01	0.96229
6	3.01E-01	0.96229
7	3.21E-01	0.96229
8	3.41E-01	0.96229
9	3.62E-01	0.96229
10	3.82E-01	0.96229
11	4.02E-01	0.96229
12	4.22E-01	0.96229
13	4.42E-01	0.96229
14	0.46263	0.96229
15	0.48283	0.96229
16	0.50303	0.96229
17	0.52323	0.96229
18	0.54343	0.96229
19	0.56364	0.96229
20	0.58384	0.96229
21	0.60404	0.96229
22	0.62424	0.96229
23	0.64444	0.96229
24	0.66465	0.96229
25	0.68485	0.96229
26	0.70505	0.96229
27	0.72525	0.96229
28	0.74545	0.96229
29	0.76566	0.96229
30	0.78586	0.96229
31	0.80606	0.96229

	Exposure	Effects Var	Est Effects Var
1	2.85E-01	0.975	0.95152
2	1.48E+00	0.9	0.95152
3	1.63E+00	0.95	0.93858
4	1.74E+00	0.85	0.86432
5	1.94E+00	0.6	0.59454
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	0.2	0.95152
2	2.20E-01	0.95152
3	2.40E-01	0.95152
4	2.61E-01	0.95152
5	2.81E-01	0.95152
6	3.01E-01	0.95152
7	3.21E-01	0.95152
8	3.41E-01	0.95152
9	3.62E-01	0.95152
10	3.82E-01	0.95152
11	4.02E-01	0.95152
12	4.22E-01	0.95152
13	4.42E-01	0.95152
14	0.46263	0.95152
15	0.48283	0.95152
16	0.50303	0.95152
17	0.52323	0.95152
18	0.54343	0.95152
19	0.56364	0.95152
20	0.58384	0.95152
21	0.60404	0.95152
22	0.62424	0.95152
23	0.64444	0.95152
24	0.66465	0.95152
25	0.68485	0.95152
26	0.70505	0.95152
27	0.72525	0.95152
28	0.74545	0.95152
29	0.76566	0.95152
30	0.78586	0.95152
31	0.80606	0.95152

	Exposure	Effects Var	Est Effects Var
1	2.85E-01	0.975	0.95
2	1.48E+00	0.9	0.95
3	1.63E+00	0.95	0.95
4	1.74E+00	0.85	0.85
5	1.94E+00	0.6	0.6
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	0.2	0.95
2	2.20E-01	0.95
3	2.40E-01	0.95
4	2.61E-01	0.95
5	2.81E-01	0.95
6	3.01E-01	0.95
7	3.21E-01	0.95
8	3.41E-01	0.95
9	3.62E-01	0.95
10	3.82E-01	0.95
11	4.02E-01	0.95
12	4.22E-01	0.95
13	4.42E-01	0.95
14	0.46263	0.95
15	0.48283	0.95
16	0.50303	0.95
17	0.52323	0.95
18	0.54343	0.95
19	0.56364	0.95
20	0.58384	0.95
21	0.60404	0.95
22	0.62424	0.95
23	0.64444	0.95
24	0.66465	0.95
25	0.68485	0.95
26	0.70505	0.95
27	0.72525	0.95
28	0.74545	0.95
29	0.76566	0.95
30	0.78586	0.95
31	0.80606	0.95

Prediction Line

	X	Y
32	0.82626	0.96229
33	0.84646	0.96229
34	0.86667	0.96229
35	0.88687	0.96229
36	0.90707	0.96229
37	0.92727	0.96229
38	0.94747	0.96229
39	0.96768	0.96229
40	0.98788	0.96229
41	1.0081	0.96228
42	1.0283	0.96228
43	1.0485	0.96227
44	1.0687	0.96226
45	1.0889	0.96225
46	1.1091	0.96223
47	1.1293	0.9622
48	1.1495	0.96217
49	1.1697	0.96212
50	1.1899	0.96206
51	1.2101	0.96197
52	1.2303	0.96186
53	1.2505	0.9617
54	1.2707	0.9615
55	1.2909	0.96124
56	1.3111	0.9609
57	1.3313	0.96047
58	1.3515	0.95991
59	1.3717	0.95921
60	1.3919	0.95832
61	1.4121	0.95722
62	1.4323	0.95584
63	1.4525	0.95415
64	1.4727	0.95209
65	1.4929	0.94957
66	1.5131	0.94655
67	1.5333	0.94292
68	1.5535	0.93861
69	1.5737	0.93352
70	1.5939	0.92756
71	1.6141	0.92062
72	1.6343	0.91261
73	1.6545	0.90341
74	1.6747	0.89293
75	1.6949	0.88108
76	1.7152	0.86778
77	1.7354	0.85294
78	1.7556	0.83651
79	1.7758	0.81845
80	1.796	0.79874
81	1.8162	0.77738
82	1.8364	0.75439

	X	Y
32	0.82626	0.95152
33	0.84646	0.95152
34	0.86667	0.95152
35	0.88687	0.95152
36	0.90707	0.95152
37	0.92727	0.95152
38	0.94747	0.95152
39	0.96768	0.95152
40	0.98788	0.95152
41	1.0081	0.95152
42	1.0283	0.95152
43	1.0485	0.95152
44	1.0687	0.95152
45	1.0889	0.95152
46	1.1091	0.95152
47	1.1293	0.95152
48	1.1495	0.95152
49	1.1697	0.95152
50	1.1899	0.95152
51	1.2101	0.95152
52	1.2303	0.95152
53	1.2505	0.95152
54	1.2707	0.95152
55	1.2909	0.95152
56	1.3111	0.95152
57	1.3313	0.95152
58	1.3515	0.95152
59	1.3717	0.95152
60	1.3919	0.95152
61	1.4121	0.95152
62	1.4323	0.95152
63	1.4525	0.95152
64	1.4727	0.95152
65	1.4929	0.95152
66	1.5131	0.95152
67	1.5333	0.95152
68	1.5535	0.95151
69	1.5737	0.95035
70	1.5939	0.94728
71	1.6141	0.94229
72	1.6343	0.93539
73	1.6545	0.92658
74	1.6747	0.91586
75	1.6949	0.90323
76	1.7152	0.88868
77	1.7354	0.87222
78	1.7556	0.85384
79	1.7758	0.83356
80	1.796	0.81136
81	1.8162	0.78725
82	1.8364	0.76122

	X	Y
32	0.82626	0.95
33	0.84646	0.95
34	0.86667	0.95
35	0.88687	0.95
36	0.90707	0.95
37	0.92727	0.95
38	0.94747	0.95
39	0.96768	0.95
40	0.98788	0.95
41	1.0081	0.95
42	1.0283	0.95
43	1.0485	0.95
44	1.0687	0.95
45	1.0889	0.95
46	1.1091	0.95
47	1.1293	0.95
48	1.1495	0.95
49	1.1697	0.95
50	1.1899	0.95
51	1.2101	0.95
52	1.2303	0.95
53	1.2505	0.95
54	1.2707	0.95
55	1.2909	0.95
56	1.3111	0.95
57	1.3313	0.95
58	1.3515	0.95
59	1.3717	0.95
60	1.3919	0.95
61	1.4121	0.95
62	1.4323	0.95
63	1.4525	0.95
64	1.4727	0.95
65	1.4929	0.95
66	1.5131	0.95
67	1.5333	0.95
68	1.5535	0.95
69	1.5737	0.95
70	1.5939	0.95
71	1.6141	0.95
72	1.6343	0.95
73	1.6545	0.95
74	1.6747	0.93808
75	1.6949	0.9125
76	1.7152	0.88691
77	1.7354	0.86133
78	1.7556	0.83574
79	1.7758	0.81016
80	1.796	0.78457
81	1.8162	0.75899
82	1.8364	0.7334

Prediction Line

	X	Y
83	1.8566	0.72983
84	1.8768	0.70377
85	1.897	0.67632
86	1.9172	0.64761
87	1.9374	0.61779
88	1.9576	0.58705
89	1.9778	0.55557
90	1.998	0.52358
91	2.0182	0.49128
92	2.0384	0.45891
93	2.0586	0.4267
94	2.0788	0.39487
95	2.099	0.36364
96	2.1192	0.33323
97	2.1394	0.30381
98	2.1596	0.27556
99	2.1798	0.24862
100	2.2	0.22312

	X	Y
83	1.8566	0.73328
84	1.8768	0.70343
85	1.897	0.67167
86	1.9172	0.63799
87	1.9374	0.6024
88	1.9576	0.5649
89	1.9778	0.52549
90	1.998	0.48416
91	2.0182	0.44215
92	2.0384	0.40199
93	2.0586	0.36373
94	2.0788	0.32739
95	2.099	0.29296
96	2.1192	0.26045
97	2.1394	0.22984
98	2.1596	0.20115
99	2.1798	0.17438
100	2.2	0.14951

	X	Y
83	1.8566	0.70782
84	1.8768	0.68223
85	1.897	0.65665
86	1.9172	0.63106
87	1.9374	0.60548
88	1.9576	0.57989
89	1.9778	0.5543
90	1.998	0.52872
91	2.0182	0.50313
92	2.0384	0.47755
93	2.0586	0.45196
94	2.0788	0.42638
95	2.099	0.40079
96	2.1192	0.37521
97	2.1394	0.34962
98	2.1596	0.32404
99	2.1798	0.29845
100	2.2	0.27287

Table H2.D-6d. TRAP Model Output for Copper Data for the Mammal Growth Endpoint (Allcroft et al. 1961)

Chemical:	Copper
Study Authors:	Allcroft et al. 1961
Receptor Group:	Mammal
Effect Description:	Growth

Input Data:

Dose	Response	SE
0.24667	1.24	not reported
9.3	1.18	not reported
17.267	0.36	not reported
36.667	9.00E-02	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.2662	1.1714			
S	2.5514	3.36E+00			
Y0	1.21E+00	1.25E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.2662	1.1682			
S	2.5514	3.45E+00			
Y0	1.21E+00	1.24E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.2662	1.152			
S	2.5514	2.4608			
Y0	1.21E+00	1.24E+00			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	14.84	4.8885	45.051	3.80E-02	1.1714
20	1.17E+01	1.22E+00	1.12E+02	7.73E-02	1.0684
10	1.02E+01	5.08E-01	2.04E+02	0.10246	1.0081
5	8.97E+00	2.25E-01	3.58E+02	0.12602	0.95256
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	14.73	5.2827	41.073	3.51E-02	1.1682
20	11.525	1.79E+00	74.202	6.37E-02	1.0617
10	1.02E+01	9.68E-01	1.07E+02	8.04E-02	1.0079
5	9.332	6.16E-01	1.41E+02	9.29E-02	0.96997
0	7.556	1.66E-01	3.45E+02	0.13058	8.78E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	14.191	6.5055	30.955	2.67E-02	1.152
20	10.717	4.0273	28.522	3.35E-02	1.0301
10	9.7602	3.2043	29.729	3.81E-02	0.98946
5	9.314	2.8372	30.577	4.06E-02	0.96914
0	8.8883	2.5027	31.567	4.33E-02	0.94882

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.08E-01	1.24E+00	1.25E+00
2	9.68E-01	1.18E+00	1.17E+00
3	1.24E+00	3.60E-01	3.65E-01
4	1.56E+00	9.00E-02	6.29E-03
5			
6			

Analysis of Variance

R-squared: 0.993

	DF	SS	MS	F	Sig
Total (adj)	3	1.0085	0.33616		
Regression	2	1.0013	0.50066	69.903	0.0843
Error	1	7.16E-03	7.16E-03		

Prediction Line

	X	Y
1	-0.5	1.25E+00
2	-4.75E-01	1.25E+00
3	-4.49E-01	1.25E+00
4	-4.24E-01	1.25E+00
5	-3.99E-01	1.25E+00
6	-3.74E-01	1.25E+00
7	-3.48E-01	1.25E+00
8	-3.23E-01	1.25E+00
9	-2.98E-01	1.25E+00
10	-2.73E-01	1.25E+00
11	-2.47E-01	1.25E+00
12	-2.22E-01	1.25E+00
13	-1.97E-01	1.25E+00
14	-0.17172	1.25E+00
15	-0.14646	1.25E+00
16	-0.12121	1.25E+00
17	-9.60E-02	1.25E+00
18	-7.07E-02	1.25E+00
19	-4.55E-02	1.25E+00
20	-2.02E-02	1.25E+00
21	5.05E-03	1.25E+00
22	3.03E-02	1.25E+00
23	5.56E-02	1.25E+00
24	8.08E-02	1.25E+00
25	1.06E-01	1.25E+00
26	1.31E-01	1.25E+00
27	1.57E-01	1.25E+00
28	1.82E-01	1.25E+00
29	2.07E-01	1.25E+00
30	2.32E-01	1.25E+00

	Exposure	Effects Var	Est Effects Var
1	-6.08E-01	1.24E+00	1.24E+00
2	9.68E-01	1.18E+00	1.18E+00
3	1.24E+00	3.60E-01	3.60E-01
4	1.56E+00	9.00E-02	0.00E+00
5			
6			

R-squared: 0.992

	DF	SS	MS	F	Sig
Total (adj)	3	1.0085	0.33616		
Regression	2	1.0004	0.50019	61.752	0.0896
Error	1	8.10E-03	8.10E-03		

	X	Y
1	-0.5	1.24E+00
2	-4.75E-01	1.24E+00
3	-4.49E-01	1.24E+00
4	-4.24E-01	1.24E+00
5	-3.99E-01	1.24E+00
6	-3.74E-01	1.24E+00
7	-3.48E-01	1.24E+00
8	-3.23E-01	1.24E+00
9	-2.98E-01	1.24E+00
10	-2.73E-01	1.24E+00
11	-2.47E-01	1.24E+00
12	-2.22E-01	1.24E+00
13	-1.97E-01	1.24E+00
14	-0.17172	1.24E+00
15	-0.14646	1.24E+00
16	-0.12121	1.24E+00
17	-9.60E-02	1.24E+00
18	-7.07E-02	1.24E+00
19	-4.55E-02	1.24E+00
20	-2.02E-02	1.24E+00
21	5.05E-03	1.24E+00
22	3.03E-02	1.24E+00
23	5.56E-02	1.24E+00
24	8.08E-02	1.24E+00
25	1.06E-01	1.24E+00
26	1.31E-01	1.24E+00
27	1.57E-01	1.24E+00
28	1.82E-01	1.24E+00
29	2.07E-01	1.24E+00
30	2.32E-01	1.24E+00

	Exposure	Effects Var	Est Effects Var
1	-6.08E-01	1.24E+00	1.24E+00
2	9.68E-01	1.18E+00	1.18E+00
3	1.24E+00	3.60E-01	3.60E-01
4	1.56E+00	9.00E-02	0.00E+00
5			
6			

R-squared: 0.992

	DF	SS	MS	F	Sig
Total (adj)	3	1.0085	0.33616		
Regression	2	1.0004	0.50019	61.752	0.0896
Error	1	8.10E-03	8.10E-03		

	X	Y
1	-0.5	1.24E+00
2	-4.75E-01	1.24E+00
3	-4.49E-01	1.24E+00
4	-4.24E-01	1.24E+00
5	-3.99E-01	1.24E+00
6	-3.74E-01	1.24E+00
7	-3.48E-01	1.24E+00
8	-3.23E-01	1.24E+00
9	-2.98E-01	1.24E+00
10	-2.73E-01	1.24E+00
11	-2.47E-01	1.24E+00
12	-2.22E-01	1.24E+00
13	-1.97E-01	1.24E+00
14	-0.17172	1.24E+00
15	-0.14646	1.24E+00
16	-0.12121	1.24E+00
17	-9.60E-02	1.24E+00
18	-7.07E-02	1.24E+00
19	-4.55E-02	1.24E+00
20	-2.02E-02	1.24E+00
21	5.05E-03	1.24E+00
22	3.03E-02	1.24E+00
23	5.56E-02	1.24E+00
24	8.08E-02	1.24E+00
25	1.06E-01	1.24E+00
26	1.31E-01	1.24E+00
27	1.57E-01	1.24E+00
28	1.82E-01	1.24E+00
29	2.07E-01	1.24E+00
30	2.32E-01	1.24E+00

Prediction Line

	X	Y
31	0.25758	1.25E+00
32	0.28283	1.25E+00
33	0.30808	1.25E+00
34	0.33333	1.25E+00
35	0.35859	1.25E+00
36	0.38384	1.25E+00
37	0.40909	1.25E+00
38	0.43434	1.25E+00
39	0.4596	1.25E+00
40	0.48485	1.25E+00
41	0.5101	1.25E+00
42	0.53535	1.25E+00
43	0.56061	1.25E+00
44	0.58586	1.25E+00
45	0.61111	1.25E+00
46	0.63636	1.25E+00
47	0.66162	1.25E+00
48	0.68687	1.25E+00
49	0.71212	1.24E+00
50	0.73737	1.24E+00
51	0.76263	1.24E+00
52	0.78788	1.24E+00
53	0.81313	1.24E+00
54	0.83838	1.23E+00
55	0.86364	1.23E+00
56	0.88889	1.22E+00
57	0.91414	1.21E+00
58	0.93939	1.19E+00
59	0.96465	1.17E+00
60	0.9899	1.15E+00
61	1.0152	1.11E+00
62	1.0404	1.06E+00
63	1.0657	1.01E+00
64	1.0909	9.32E-01
65	1.1162	8.46E-01
66	1.1414	7.48E-01
67	1.1667	6.44E-01
68	1.1919	5.38E-01
69	1.2172	4.38E-01
70	1.2424	3.47E-01
71	1.2677	2.68E-01
72	1.2929	2.04E-01
73	1.3182	1.52E-01
74	1.3434	1.12E-01
75	1.3687	8.21E-02
76	1.3939	5.95E-02
77	1.4192	4.30E-02
78	1.4444	3.09E-02
79	1.4697	2.22E-02
80	1.4949	1.59E-02
81	1.5202	1.13E-02

	X	Y
31	0.25758	1.24E+00
32	0.28283	1.24E+00
33	0.30808	1.24E+00
34	0.33333	1.24E+00
35	0.35859	1.24E+00
36	0.38384	1.24E+00
37	0.40909	1.24E+00
38	0.43434	1.24E+00
39	0.4596	1.24E+00
40	0.48485	1.24E+00
41	0.5101	1.24E+00
42	0.53535	1.24E+00
43	0.56061	1.24E+00
44	0.58586	1.24E+00
45	0.61111	1.24E+00
46	0.63636	1.24E+00
47	0.66162	1.24E+00
48	0.68687	1.24E+00
49	0.71212	1.24E+00
50	0.73737	1.24E+00
51	0.76263	1.24E+00
52	0.78788	1.24E+00
53	0.81313	1.24E+00
54	0.83838	1.24E+00
55	0.86364	1.24E+00
56	0.88889	1.24E+00
57	0.91414	1.23E+00
58	0.93939	1.21E+00
59	0.96465	1.19E+00
60	0.9899	1.15E+00
61	1.0152	1.10E+00
62	1.0404	1.05E+00
63	1.0657	9.81E-01
64	1.0909	9.07E-01
65	1.1162	8.23E-01
66	1.1414	7.29E-01
67	1.1667	6.27E-01
68	1.1919	5.23E-01
69	1.2172	4.28E-01
70	1.2424	3.43E-01
71	1.2677	2.68E-01
72	1.2929	2.01E-01
73	1.3182	1.44E-01
74	1.3434	9.70E-02
75	1.3687	5.90E-02
76	1.3939	3.04E-02
77	1.4192	1.12E-02
78	1.4444	1.38E-03
79	1.4697	0.00E+00
80	1.4949	0.00E+00
81	1.5202	0.00E+00

	X	Y
31	0.25758	1.24E+00
32	0.28283	1.24E+00
33	0.30808	1.24E+00
34	0.33333	1.24E+00
35	0.35859	1.24E+00
36	0.38384	1.24E+00
37	0.40909	1.24E+00
38	0.43434	1.24E+00
39	0.4596	1.24E+00
40	0.48485	1.24E+00
41	0.5101	1.24E+00
42	0.53535	1.24E+00
43	0.56061	1.24E+00
44	0.58586	1.24E+00
45	0.61111	1.24E+00
46	0.63636	1.24E+00
47	0.66162	1.24E+00
48	0.68687	1.24E+00
49	0.71212	1.24E+00
50	0.73737	1.24E+00
51	0.76263	1.24E+00
52	0.78788	1.24E+00
53	0.81313	1.24E+00
54	0.83838	1.24E+00
55	0.86364	1.24E+00
56	0.88889	1.24E+00
57	0.91414	1.24E+00
58	0.93939	1.24E+00
59	0.96465	1.19E+00
60	0.9899	1.11E+00
61	1.0152	1.04E+00
62	1.0404	9.61E-01
63	1.0657	8.83E-01
64	1.0909	8.06E-01
65	1.1162	7.29E-01
66	1.1414	6.52E-01
67	1.1667	5.75E-01
68	1.1919	4.98E-01
69	1.2172	4.21E-01
70	1.2424	3.44E-01
71	1.2677	2.67E-01
72	1.2929	1.90E-01
73	1.3182	1.13E-01
74	1.3434	3.59E-02
75	1.3687	0.00E+00
76	1.3939	0.00E+00
77	1.4192	0.00E+00
78	1.4444	0.00E+00
79	1.4697	0.00E+00
80	1.4949	0.00E+00
81	1.5202	0.00E+00

Prediction Line

	X	Y
82	1.5455	8.09E-03
83	1.5707	5.77E-03
84	1.596	4.12E-03
85	1.6212	2.93E-03
86	1.6465	2.09E-03
87	1.6717	1.49E-03
88	1.697	1.06E-03
89	1.7222	7.55E-04
90	1.7475	5.38E-04
91	1.7727	3.83E-04
92	1.798	2.73E-04
93	1.8232	1.94E-04
94	1.8485	1.38E-04
95	1.8737	9.84E-05
96	1.899	7.01E-05
97	1.9242	4.99E-05
98	1.9495	3.55E-05
99	1.9747	2.53E-05
100	2	1.80E-05

	X	Y
82	1.5455	0.00E+00
83	1.5707	0.00E+00
84	1.596	0.00E+00
85	1.6212	0.00E+00
86	1.6465	0.00E+00
87	1.6717	0.00E+00
88	1.697	0.00E+00
89	1.7222	0.00E+00
90	1.7475	0.00E+00
91	1.7727	0.00E+00
92	1.798	0.00E+00
93	1.8232	0.00E+00
94	1.8485	0.00E+00
95	1.8737	0.00E+00
96	1.899	0.00E+00
97	1.9242	0.00E+00
98	1.9495	0.00E+00
99	1.9747	0.00E+00
100	2	0.00E+00

	X	Y
82	1.5455	0.00E+00
83	1.5707	0.00E+00
84	1.596	0.00E+00
85	1.6212	0.00E+00
86	1.6465	0.00E+00
87	1.6717	0.00E+00
88	1.697	0.00E+00
89	1.7222	0.00E+00
90	1.7475	0.00E+00
91	1.7727	0.00E+00
92	1.798	0.00E+00
93	1.8232	0.00E+00
94	1.8485	0.00E+00
95	1.8737	0.00E+00
96	1.899	0.00E+00
97	1.9242	0.00E+00
98	1.9495	0.00E+00
99	1.9747	0.00E+00
100	2	0.00E+00

Table H2.D-7a. TRAP Model Output for Iron Data for the Bird Survival Endpoint (Pooling Group A: Pescatore and Harter-Dennis 1989; Wallner-Pendleton et al. 1986)

Chemical:	Iron
Study Authors:	Pooled dataset A
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	Effect Relative to Control
0.000001	100
708.9038	93.40
945.2051	83.90
1181.5064	73.50
1417.8077	48.90
2835.6153	8.30
0.000001	100.00
6.6952	100.00
66.9520	100.00
669.5203	100.00
2008.5608	80

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.2429	3.2813	7.07E-02	3.1182	3.4444
S	1.91E+00	1.42E+00	5.56E-01	1.37E-01	2.70E+00
Y0	1.00E+02	1.00E+02	7.3059	83.419	117.11

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.2429	3.2886	7.15E-02	3.1236	3.4535
S	1.91E+00	1.49E+00	5.48E-01	2.26E-01	2.76E+00
Y0	1.00E+02	9.95E+01	7.3997	82.437	116.56

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.2429	3.268	6.51E-02	3.12E+00	3.418
S	1.9071	1.2445	0.40992	0.29927	2.1898
Y0	1.00E+02	9.89E+01	6.1466	84.726	113.07

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1911.1	1312.7	2782.4	7.07E-02	3.2813
20	1.09E+03	5.98E+02	1.98E+03	1.13E-01	3.0372
10	7.84E+02	3.34E+02	1.84E+03	1.60E-01	2.8944
5	5.79E+02	1.92E+02	1.75E+03	2.08E-01	2.7628
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1943.4	1329.3	2841.2	7.15E-02	3.2886
20	1101.4	6.23E+02	1946.9	0.10729	3.042
10	8.27E+02	3.75E+02	1.83E+03	0.14912	2.9177
5	675.73	2.50E+02	1.83E+03	0.18731	2.8298
0	414.57	6.81E+01	2.52E+03	0.34004	2.62E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1853.4	1311.9	2618.4	6.51E-02	3.268
20	1063.9	673.68	1680.2	8.61E-02	3.0269
10	884.21	503.28	1553.5	0.10614	2.9466
5	806.09	432.79	1501.4	0.11713	2.9064
0	734.86	3.71E+02	1454.2	0.12855	2.8662

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	8.26E-01	1.00E+02	1.00E+02
4	1.83E+00	1.00E+02	1.00E+02
5	2.83E+00	1.00E+02	9.33E+01
6	2.85E+00	9.34E+01	9.23E+01
7	2.98E+00	8.39E+01	8.53E+01
8	3.07E+00	7.35E+01	7.68E+01
9	3.15E+00	4.89E+01	6.78E+01
10	3.30E+00	8.00E+01	4.71E+01
11	3.45E+00	8.3	2.75E+01
12			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.95E+01
2	-6.00E+00	1.00E+02	9.95E+01
3	8.26E-01	1.00E+02	9.95E+01
4	1.83E+00	1.00E+02	9.95E+01
5	2.83E+00	1.00E+02	9.47E+01
6	2.85E+00	9.34E+01	9.35E+01
7	2.98E+00	8.39E+01	8.53E+01
8	3.07E+00	7.35E+01	7.66E+01
9	3.15E+00	4.89E+01	6.80E+01
10	3.30E+00	8.00E+01	4.76E+01
11	3.45E+00	8.3	28.392
12			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.89E+01
2	-6.00E+00	1.00E+02	9.89E+01
3	8.26E-01	1.00E+02	9.89E+01
4	1.83E+00	1.00E+02	9.89E+01
5	2.83E+00	1.00E+02	9.89E+01
6	2.85E+00	9.34E+01	9.89E+01
7	2.98E+00	8.39E+01	8.54E+01
8	3.07E+00	7.35E+01	7.35E+01
9	3.15E+00	4.89E+01	6.38E+01
10	3.30E+00	8.00E+01	4.52E+01
11	3.45E+00	8.3	26.718
12			

Analysis of Variance

R-squared: 0.776

	DF	SS	MS	F	Sig
Total (adj)	10	8339.3	833.93		
Regression	2	6468.7	3234.4	13.833	0.0025
Error	8	1870.6	233.82		

R-squared: 0.778

	DF	SS	MS	F	Sig
Total (adj)	10	8339.3	833.93		
Regression	2	6483.8	3241.9	13.978	0.0025
Error	8	1855.5	231.94		

R-squared: 0.783

	DF	SS	MS	F	Sig
Total (adj)	10	8339.3	833.93		
Regression	2	6525.8	3262.9	14.394	0.0022
Error	8	1813.5	226.68		

Prediction Line

	X	Y
1	-0.5	1.00E+02
2	-4.55E-01	1.00E+02
3	-4.09E-01	1.00E+02
4	-3.64E-01	1.00E+02
5	-3.18E-01	1.00E+02
6	-2.73E-01	1.00E+02
7	-2.27E-01	1.00E+02
8	-1.82E-01	1.00E+02
9	-1.36E-01	1.00E+02
10	-9.09E-02	1.00E+02
11	-4.55E-02	1.00E+02
12	0.00E+00	1.00E+02
13	4.55E-02	1.00E+02
14	9.09E-02	1.00E+02
15	0.13636	1.00E+02
16	0.18182	1.00E+02
17	0.22727	1.00E+02

	X	Y
1	-0.5	9.95E+01
2	-4.55E-01	9.95E+01
3	-4.09E-01	9.95E+01
4	-3.64E-01	9.95E+01
5	-3.18E-01	9.95E+01
6	-2.73E-01	9.95E+01
7	-2.27E-01	9.95E+01
8	-1.82E-01	9.95E+01
9	-1.36E-01	9.95E+01
10	-9.09E-02	9.95E+01
11	-4.55E-02	9.95E+01
12	0.00E+00	9.95E+01
13	4.55E-02	9.95E+01
14	9.09E-02	9.95E+01
15	0.13636	9.95E+01
16	0.18182	9.95E+01
17	0.22727	9.95E+01

	X	Y
1	-0.5	9.89E+01
2	-4.55E-01	9.89E+01
3	-4.09E-01	9.89E+01
4	-3.64E-01	9.89E+01
5	-3.18E-01	9.89E+01
6	-2.73E-01	9.89E+01
7	-2.27E-01	9.89E+01
8	-1.82E-01	9.89E+01
9	-1.36E-01	9.89E+01
10	-9.09E-02	9.89E+01
11	-4.55E-02	9.89E+01
12	0.00E+00	9.89E+01
13	4.55E-02	9.89E+01
14	9.09E-02	9.89E+01
15	0.13636	9.89E+01
16	0.18182	9.89E+01
17	0.22727	9.89E+01

Prediction Line

	X	Y
18	0.27273	1.00E+02
19	0.31818	1.00E+02
20	0.36364	1.00E+02
21	4.09E-01	1.00E+02
22	4.55E-01	1.00E+02
23	5.00E-01	1.00E+02
24	5.45E-01	1.00E+02
25	5.91E-01	1.00E+02
26	6.36E-01	1.00E+02
27	6.82E-01	1.00E+02
28	7.27E-01	1.00E+02
29	7.73E-01	1.00E+02
30	8.18E-01	1.00E+02
31	0.86364	1.00E+02
32	0.90909	1.00E+02
33	0.95455	1.00E+02
34	1	1.00E+02
35	1.0455	1.00E+02
36	1.0909	1.00E+02
37	1.1364	1.00E+02
38	1.1818	1.00E+02
39	1.2273	1.00E+02
40	1.2727	1.00E+02
41	1.3182	1.00E+02
42	1.3636	1.00E+02
43	1.41E+00	1.00E+02
44	1.45E+00	1.00E+02
45	1.5	1.00E+02
46	1.55E+00	1.00E+02
47	1.59E+00	1.00E+02
48	1.6364	1.00E+02
49	1.6818	1.00E+02
50	1.7273	1.00E+02
51	1.7727	1.00E+02
52	1.8182	1.00E+02
53	1.8636	1.00E+02
54	1.9091	1.00E+02
55	1.9545	1.00E+02
56	2	1.00E+02
57	2.0455	1.00E+02
58	2.0909	1.00E+02
59	2.1364	1.00E+02
60	2.1818	1.00E+02
61	2.2273	1.00E+02
62	2.2727	9.99E+01
63	2.3182	9.98E+01
64	2.3636	9.97E+01
65	2.4091	9.96E+01
66	2.4545	9.94E+01
67	2.5	9.91E+01
68	2.5455	9.88E+01
69	2.5909	9.83E+01
70	2.6364	9.78E+01

	X	Y
18	0.27273	9.95E+01
19	0.31818	9.95E+01
20	0.36364	9.95E+01
21	4.09E-01	9.95E+01
22	4.55E-01	9.95E+01
23	5.00E-01	9.95E+01
24	5.45E-01	9.95E+01
25	5.91E-01	9.95E+01
26	6.36E-01	9.95E+01
27	6.82E-01	9.95E+01
28	7.27E-01	9.95E+01
29	7.73E-01	9.95E+01
30	8.18E-01	9.95E+01
31	0.86364	9.95E+01
32	0.90909	9.95E+01
33	0.95455	9.95E+01
34	1	9.95E+01
35	1.0455	9.95E+01
36	1.0909	9.95E+01
37	1.1364	9.95E+01
38	1.1818	9.95E+01
39	1.2273	9.95E+01
40	1.2727	9.95E+01
41	1.3182	9.95E+01
42	1.3636	9.95E+01
43	1.41E+00	9.95E+01
44	1.45E+00	9.95E+01
45	1.5	9.95E+01
46	1.55E+00	9.95E+01
47	1.59E+00	9.95E+01
48	1.6364	9.95E+01
49	1.6818	9.95E+01
50	1.7273	9.95E+01
51	1.7727	9.95E+01
52	1.8182	9.95E+01
53	1.8636	9.95E+01
54	1.9091	9.95E+01
55	1.9545	9.95E+01
56	2	9.95E+01
57	2.0455	9.95E+01
58	2.0909	9.95E+01
59	2.1364	9.95E+01
60	2.1818	9.95E+01
61	2.2273	9.95E+01
62	2.2727	9.95E+01
63	2.3182	9.95E+01
64	2.3636	9.95E+01
65	2.4091	9.95E+01
66	2.4545	9.95E+01
67	2.5	9.95E+01
68	2.5455	9.95E+01
69	2.5909	9.95E+01
70	2.6364	9.95E+01

	X	Y
18	0.27273	9.89E+01
19	0.31818	9.89E+01
20	0.36364	9.89E+01
21	4.09E-01	9.89E+01
22	4.55E-01	9.89E+01
23	5.00E-01	9.89E+01
24	5.45E-01	9.89E+01
25	5.91E-01	9.89E+01
26	6.36E-01	9.89E+01
27	6.82E-01	9.89E+01
28	7.27E-01	9.89E+01
29	7.73E-01	9.89E+01
30	8.18E-01	9.89E+01
31	0.86364	9.89E+01
32	0.90909	9.89E+01
33	0.95455	9.89E+01
34	1	9.89E+01
35	1.0455	9.89E+01
36	1.0909	9.89E+01
37	1.1364	9.89E+01
38	1.1818	9.89E+01
39	1.2273	9.89E+01
40	1.2727	9.89E+01
41	1.3182	9.89E+01
42	1.3636	9.89E+01
43	1.41E+00	9.89E+01
44	1.45E+00	9.89E+01
45	1.5	9.89E+01
46	1.55E+00	9.89E+01
47	1.59E+00	9.89E+01
48	1.6364	9.89E+01
49	1.6818	9.89E+01
50	1.7273	9.89E+01
51	1.7727	9.89E+01
52	1.8182	9.89E+01
53	1.8636	9.89E+01
54	1.9091	9.89E+01
55	1.9545	9.89E+01
56	2	9.89E+01
57	2.0455	9.89E+01
58	2.0909	9.89E+01
59	2.1364	9.89E+01
60	2.1818	9.89E+01
61	2.2273	9.89E+01
62	2.2727	9.89E+01
63	2.3182	9.89E+01
64	2.3636	9.89E+01
65	2.4091	9.89E+01
66	2.4545	9.89E+01
67	2.5	9.89E+01
68	2.5455	9.89E+01
69	2.5909	9.89E+01
70	2.6364	9.89E+01

Prediction Line

	X	Y
71	2.6818	9.70E+01
72	2.7273	9.61E+01
73	2.7727	9.50E+01
74	2.8182	9.35E+01
75	2.8636	9.17E+01
76	2.91E+00	8.95E+01
77	2.95E+00	8.67E+01
78	3	8.34E+01
79	3.05E+00	7.95E+01
80	3.09E+00	7.49E+01
81	3.1364	6.97E+01
82	3.1818	6.39E+01
83	3.2273	5.78E+01
84	3.2727	5.14E+01
85	3.3182	4.49E+01
86	3.3636	3.86E+01
87	3.4091	3.27E+01
88	3.4545	2.73E+01
89	3.5	2.25E+01
90	3.5455	1.83E+01
91	3.5909	1.47E+01
92	3.6364	1.18E+01
93	3.6818	9.35E+00
94	3.7273	7.38E+00
95	3.7727	5.80E+00
96	3.8182	4.54E+00
97	3.8636	3.54E+00
98	3.9091	2.76E+00
99	3.9545	2.14E+00
100	4	1.66E+00

	X	Y
71	2.6818	9.90E+01
72	2.7273	9.82E+01
73	2.7727	9.68E+01
74	2.8182	9.51E+01
75	2.8636	9.28E+01
76	2.91E+00	9.01E+01
77	2.95E+00	8.70E+01
78	3	8.33E+01
79	3.05E+00	7.93E+01
80	3.09E+00	7.47E+01
81	3.1364	6.98E+01
82	3.1818	6.43E+01
83	3.2273	5.84E+01
84	3.2727	5.21E+01
85	3.3182	4.55E+01
86	3.3636	3.92E+01
87	3.4091	3.35E+01
88	3.4545	2.82E+01
89	3.5	2.33E+01
90	3.5455	1.89E+01
91	3.5909	1.50E+01
92	3.6364	1.15E+01
93	3.6818	8.52E+00
94	3.7273	5.96E+00
95	3.7727	3.86E+00
96	3.8182	2.21E+00
97	3.8636	1.02E+00
98	3.9091	2.81E-01
99	3.9545	2.74E-03
100	4	0.00E+00

	X	Y
71	2.6818	9.89E+01
72	2.7273	9.89E+01
73	2.7727	9.89E+01
74	2.8182	9.89E+01
75	2.8636	9.89E+01
76	2.91E+00	9.36E+01
77	2.95E+00	8.80E+01
78	3	8.24E+01
79	3.05E+00	7.68E+01
80	3.09E+00	7.12E+01
81	3.1364	6.56E+01
82	3.1818	6.01E+01
83	3.2273	5.45E+01
84	3.2727	4.89E+01
85	3.3182	4.33E+01
86	3.3636	3.77E+01
87	3.4091	3.21E+01
88	3.4545	2.65E+01
89	3.5	2.09E+01
90	3.5455	1.53E+01
91	3.5909	9.70E+00
92	3.6364	4.11E+00
93	3.6818	0.00E+00
94	3.7273	0.00E+00
95	3.7727	0.00E+00
96	3.8182	0.00E+00
97	3.8636	0.00E+00
98	3.9091	0.00E+00
99	3.9545	0.00E+00
100	4	0.00E+00

Table H2.D-7b. TRAP Model Output for Iron Data for the Mammal Survival Endpoint (Whittaker et al. 1996)

Chemical:	Iron
Study Authors:	Whittaker et al. 1996
Receptor Group:	Mammal
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
3.728024	11	11	1
37.28024	10	10	1
372.8024	8	10	0.80
2130.3	13	18	0.722

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			yes
X50 at Maximum or Minimum Limit			yes
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50	yes	yes	yes
Large Standard Error for Steepness	yes		yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.7022	3.9108	0.60679	2.5588	5.2628
S	1.0497	1.15E+00	0.73843	0.8061	2.0247
Y0	1	0.9999	1.76E-02	0.69134	1

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.7022	3.9243	0.5432	2.714	5.1347
S	1.0497	1.12E+00	0.45239	0.78017	1.9595
Y0	1	0.9999	3.01E-03	0.71505	1

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.7022	4.2022	1.3617	1.1682	7.2363
S	1.0497	1.4316	1.5229	1.0003	2.5123
Y0	1	0.9999	2.18E-03	0.83872	1

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	8143.1	3.62E+02	1.83E+05	0.60679	3.9108
20	870.6	1.55E+02	4.90E+03	0.32074	2.9398
10	270.57	1.34E+01	5.45E+03	0.52116	2.4323
5	103.07	9.22E-01	1.15E+04	0.75503	2.0131
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	8401.4	5.18E+02	1.36E+05	0.5432	3.9243
20	830.04	1.74E+02	3.95E+03	0.28744	2.9191
10	2.59E+02	40.226	1661.1	0.31825	2.4125
5	113.29	8.7573	1465.7	0.40662	2.0542
0	15.464	4.76E-02	5022.3	0.7026	1.19E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	15930	1.47E+01	1.72E+07	1.3617	4.2022
20	518.21	34.396	7807.5	0.49032	2.7145
10	165.42	0.8146	33593	0.90312	2.2186
5	93.465	8.48E-02	1.03E+05	1.1454	1.9706
0	52.807	7.05E-03	3.96E+05	1.3955	1.7227

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	5.71E-01	1	0.998
2	1.57E+00	1	0.97861
3	2.57E+00	0.8	0.87708
4	3.33E+00	0.72222	0.6931
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	0	0.99955
2	3.54E-02	0.99951
3	7.07E-02	0.99946
4	1.06E-01	0.99941
5	1.41E-01	0.99936
6	1.77E-01	0.9993
7	2.12E-01	0.99923
8	2.47E-01	0.99915
9	2.83E-01	0.99907
10	3.18E-01	0.99898
11	3.54E-01	0.99888
12	3.89E-01	0.99877
13	4.24E-01	0.99865
14	0.4596	0.99851
15	0.49495	0.99837
16	0.5303	0.99821
17	0.56566	0.99803
18	0.60101	0.99784
19	0.63636	0.99763
20	0.67172	0.9974
21	0.70707	0.99716
22	0.74242	0.99689
23	0.77778	0.99659
24	0.81313	0.99627
25	0.84848	0.99593
26	0.88384	0.99555
27	0.91919	0.99514
28	0.95455	0.9947
29	0.9899	0.99423
30	1.0253	0.99371

Dataset

	Exposure	Effects Var	Est Effects Var
1	5.71E-01	1	0.9999
2	1.57E+00	1	0.99014
3	2.57E+00	0.8	0.87223
4	3.33E+00	0.72222	0.6941
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	0	0.9999
2	3.54E-02	0.9999
3	7.07E-02	0.9999
4	1.06E-01	0.9999
5	1.41E-01	0.9999
6	1.77E-01	0.9999
7	2.12E-01	0.9999
8	2.47E-01	0.9999
9	2.83E-01	0.9999
10	3.18E-01	0.9999
11	3.54E-01	0.9999
12	3.89E-01	0.9999
13	4.24E-01	0.9999
14	0.4596	0.9999
15	0.49495	0.9999
16	0.5303	0.9999
17	0.56566	0.9999
18	0.60101	0.9999
19	0.63636	0.9999
20	0.67172	0.9999
21	0.70707	0.9999
22	0.74242	0.9999
23	0.77778	0.9999
24	0.81313	0.9999
25	0.84848	0.9999
26	0.88384	0.9999
27	0.91919	0.9999
28	0.95455	0.9999
29	0.9899	0.9999
30	1.0253	0.9999

Dataset

	Exposure	Effects Var	Est Effects Var
1	5.71E-01	1	0.9999
2	1.57E+00	1	0.9999
3	2.57E+00	0.8	0.82878
4	3.33E+00	0.72222	0.67616
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	0	0.9999
2	3.54E-02	0.9999
3	7.07E-02	0.9999
4	1.06E-01	0.9999
5	1.41E-01	0.9999
6	1.77E-01	0.9999
7	2.12E-01	0.9999
8	2.47E-01	0.9999
9	2.83E-01	0.9999
10	3.18E-01	0.9999
11	3.54E-01	0.9999
12	3.89E-01	0.9999
13	4.24E-01	0.9999
14	0.4596	0.9999
15	0.49495	0.9999
16	0.5303	0.9999
17	0.56566	0.9999
18	0.60101	0.9999
19	0.63636	0.9999
20	0.67172	0.9999
21	0.70707	0.9999
22	0.74242	0.9999
23	0.77778	0.9999
24	0.81313	0.9999
25	0.84848	0.9999
26	0.88384	0.9999
27	0.91919	0.9999
28	0.95455	0.9999
29	0.9899	0.9999
30	1.0253	0.9999

Prediction Line

	X	Y
31	1.0606	0.99315
32	1.096	0.99255
33	1.1313	0.99191
34	1.1667	0.99121
35	1.202	0.99046
36	1.2374	0.98966
37	1.2727	0.98879
38	1.3081	0.98787
39	1.3434	0.98687
40	1.3788	0.98581
41	1.4141	0.98467
42	1.4495	0.98346
43	1.4848	0.98216
44	1.5202	0.98078
45	1.5556	0.9793
46	1.5909	0.97773
47	1.6263	0.97606
48	1.6616	0.97429
49	1.697	0.97241
50	1.7323	0.97041
51	1.7677	0.96829
52	1.803	0.96605
53	1.8384	0.96369
54	1.8737	0.96118
55	1.9091	0.95854
56	1.9444	0.95576
57	1.9798	0.95282
58	2.0152	0.94973
59	2.0505	0.94648
60	2.0859	0.94307
61	2.1212	0.93948
62	2.1566	0.93572
63	2.1919	0.93179
64	2.2273	0.92767
65	2.2626	0.92336
66	2.298	0.91885
67	2.3333	0.91415
68	2.3687	0.90925
69	2.404	0.90415
70	2.4394	0.89883
71	2.4747	0.89331
72	2.5101	0.88757
73	2.5455	0.88161
74	2.5808	0.87543
75	2.6162	0.86903
76	2.6515	0.8624
77	2.6869	0.85556
78	2.7222	0.84848
79	2.7576	0.84118
80	2.7929	0.83365
81	2.8283	0.82589

	X	Y
31	1.0606	0.9999
32	1.096	0.9999
33	1.1313	0.9999
34	1.1667	0.9999
35	1.202	0.99989
36	1.2374	0.99975
37	1.2727	0.99944
38	1.3081	0.99896
39	1.3434	0.99831
40	1.3788	0.9975
41	1.4141	0.99652
42	1.4495	0.99538
43	1.4848	0.99406
44	1.5202	0.99258
45	1.5556	0.99094
46	1.5909	0.98912
47	1.6263	0.98714
48	1.6616	0.98499
49	1.697	0.98268
50	1.7323	0.9802
51	1.7677	0.97755
52	1.803	0.97473
53	1.8384	0.97175
54	1.8737	0.9686
55	1.9091	0.96528
56	1.9444	0.96179
57	1.9798	0.95814
58	2.0152	0.95432
59	2.0505	0.95034
60	2.0859	0.94618
61	2.1212	0.94186
62	2.1566	0.93738
63	2.1919	0.93272
64	2.2273	0.9279
65	2.2626	0.92291
66	2.298	0.91776
67	2.3333	0.91244
68	2.3687	0.90695
69	2.404	0.90129
70	2.4394	0.89547
71	2.4747	0.88948
72	2.5101	0.88332
73	2.5455	0.877
74	2.5808	0.8705
75	2.6162	0.86385
76	2.6515	0.85702
77	2.6869	0.85003
78	2.7222	0.84287
79	2.7576	0.83554
80	2.7929	0.82805
81	2.8283	0.82039

	X	Y
31	1.0606	0.9999
32	1.096	0.9999
33	1.1313	0.9999
34	1.1667	0.9999
35	1.202	0.9999
36	1.2374	0.9999
37	1.2727	0.9999
38	1.3081	0.9999
39	1.3434	0.9999
40	1.3788	0.9999
41	1.4141	0.9999
42	1.4495	0.9999
43	1.4848	0.9999
44	1.5202	0.9999
45	1.5556	0.9999
46	1.5909	0.9999
47	1.6263	0.9999
48	1.6616	0.9999
49	1.697	0.9999
50	1.7323	0.99796
51	1.7677	0.99083
52	1.803	0.9837
53	1.8384	0.97658
54	1.8737	0.96945
55	1.9091	0.96232
56	1.9444	0.95519
57	1.9798	0.94807
58	2.0152	0.94094
59	2.0505	0.93381
60	2.0859	0.92668
61	2.1212	0.91955
62	2.1566	0.91243
63	2.1919	0.9053
64	2.2273	0.89817
65	2.2626	0.89104
66	2.298	0.88392
67	2.3333	0.87679
68	2.3687	0.86966
69	2.404	0.86253
70	2.4394	0.85541
71	2.4747	0.84828
72	2.5101	0.84115
73	2.5455	0.83402
74	2.5808	0.8269
75	2.6162	0.81977
76	2.6515	0.81264
77	2.6869	0.80551
78	2.7222	0.79838
79	2.7576	0.79126
80	2.7929	0.78413
81	2.8283	0.777

Prediction Line

	X	Y
82	2.8636	0.81791
83	2.899	0.8097
84	2.9343	0.80127
85	2.9697	0.79261
86	3.0051	0.78374
87	3.0404	0.77465
88	3.0758	0.76535
89	3.1111	0.75584
90	3.1465	0.74613
91	3.1818	0.73621
92	3.2172	0.72611
93	3.2525	0.71581
94	3.2879	0.70534
95	3.3232	0.69468
96	3.3586	0.68387
97	3.3939	0.67289
98	3.4293	0.66176
99	3.4646	0.65048
100	3.5	0.63908

	X	Y
82	2.8636	0.81256
83	2.899	0.80456
84	2.9343	0.7964
85	2.9697	0.78807
86	3.0051	0.77958
87	3.0404	0.77091
88	3.0758	0.76208
89	3.1111	0.75308
90	3.1465	0.74392
91	3.1818	0.73459
92	3.2172	0.72509
93	3.2525	0.71542
94	3.2879	0.70559
95	3.3232	0.69559
96	3.3586	0.68543
97	3.3939	0.67509
98	3.4293	0.66459
99	3.4646	0.65392
100	3.5	0.64309

	X	Y
82	2.8636	0.76987
83	2.899	0.76275
84	2.9343	0.75562
85	2.9697	0.74849
86	3.0051	0.74136
87	3.0404	0.73424
88	3.0758	0.72711
89	3.1111	0.71998
90	3.1465	0.71285
91	3.1818	0.70573
92	3.2172	0.6986
93	3.2525	0.69147
94	3.2879	0.68434
95	3.3232	0.67721
96	3.3586	0.67009
97	3.3939	0.66296
98	3.4293	0.65583
99	3.4646	0.6487
100	3.5	0.64158

Table H2.D-8a. TRAP Model Output for Lead Data for the Bird Survival Endpoint (Pooling Group F: Anders et al. 1982; Barthalmus et al. 1977)

Chemical:	Lead
Study Authors:	Pooling group F
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	Effect Relative to Control
1.00E-06	100
6.25	100
12.5	80
25	50
1.00E-06	100
6.250	83.3

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.4136	1.4049	6.66E-02	1.1931	1.6167
S	0.9957	1.07E+00	0.3437	-2.70E-02	2.1607
Y0	1.00E+02	9.96E+01	4.6939	84.612	114.49

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.4136	1.4101	7.20E-02	1.1809	1.6393
S	0.9957	1.04E+00	0.29366	0.10577	1.9749
Y0	1.00E+02	9.96E+01	5.0005	83.666	115.49

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.4136	1.4188	9.20E-02	1.126	1.7117
S	0.9957	1.0399	0.41101	-0.2681	2.3479
Y0	1.00E+02	9.58E+01	4.1667	82.573	109.09

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	25.403	15.599	41.369	6.66E-02	1.4049
20	1.20E+01	5.63E+00	2.57E+01	0.1035	1.08
10	7.76E+00	2.46E+00	2.45E+01	0.15666	0.88999
5	5.19E+00	1.12E+00	2.41E+01	0.20958	0.71489
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	25.71	15.168	43.578	7.20E-02	1.4101
20	11.397	5.50E+00	23.629	9.95E-02	1.0568
10	7.56E+00	2.70E+00	2.12E+01	0.14076	0.87873
5	5.6601	1.60E+00	2.01E+01	0.17284	0.75283
0	2.811	4.37E-01	1.81E+01	0.25411	4.49E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	26.233	13.366	51.487	9.20E-02	1.4188
20	13.501	7.4009	24.628	8.20E-02	1.1304
10	10.819	4.8598	24.087	0.10922	1.0342
5	9.6853	3.88E+00	24.196	0.12494	0.98611
0	8.6703	3.07E+00	24.45	0.14148	0.93803

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.96E+01
2	7.96E-01	1.00E+02	9.96E+01
3	1.10E+00	8.00E+01	9.27E+01
4	1.40E+00	5.00E+01	9.27E+01
5	-6.00E+00	100	78.467
6	0.79588	83.333	50.512

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.96E+01
2	-6.00E+00	1.00E+02	9.96E+01
3	7.96E-01	1.00E+02	9.31E+01
4	7.96E-01	8.33E+01	9.31E+01
5	1.10E+00	80	76.949
6	1.3979	50	51.041

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.58E+01
2	-6.00E+00	1.00E+02	9.58E+01
3	7.96E-01	1.00E+02	9.58E+01
4	7.96E-01	8.33E+01	9.58E+01
5	1.10E+00	80	80
6	1.3979	50	50

Analysis of Variance

R-squared: 0.925

	DF	SS	MS	F	Sig
Total (adj)	5	1925.9	385.19		
Regression	2	1782	891.02	18.579	0.0204
Error	3	143.88	47.959		

R-squared: 0.92

	DF	SS	MS	F	Sig
Total (adj)	5	1925.9	385.19		
Regression	2	1772.2	886.12	17.297	0.0225
Error	3	153.69	51.23		

R-squared: 0.892

	DF	SS	MS	F	Sig
Total (adj)	5	1925.9	385.19		
Regression	2	1717.6	858.8	12.367	0.0356
Error	3	208.33	69.444		

Prediction Line

	X	Y
1	-2.5	9.96E+01
2	-2.45E+00	9.96E+01
3	-2.41E+00	9.96E+01
4	-2.36E+00	9.96E+01
5	-2.32E+00	9.96E+01
6	-2.27E+00	9.96E+01
7	-2.23E+00	9.96E+01
8	-2.18E+00	9.96E+01
9	-2.14E+00	9.96E+01
10	-2.09E+00	9.96E+01
11	-2.05E+00	9.96E+01
12	-2.00E+00	9.96E+01
13	-1.95E+00	9.96E+01
14	-1.9091	9.96E+01
15	-1.8636	9.96E+01
16	-1.8182	9.96E+01
17	-1.7727	9.96E+01
18	-1.7273	9.96E+01
19	-1.6818	9.96E+01
20	-1.6364	9.96E+01
21	-1.59E+00	9.96E+01
22	-1.55E+00	9.96E+01
23	-1.50E+00	9.96E+01
24	-1.45E+00	9.95E+01
25	-1.41E+00	9.95E+01
26	-1.36E+00	9.95E+01
27	-1.32E+00	9.95E+01
28	-1.27E+00	9.95E+01
29	-1.23E+00	9.95E+01
30	-1.18E+00	9.95E+01

	X	Y
1	-2.5	9.96E+01
2	-2.45E+00	9.96E+01
3	-2.41E+00	9.96E+01
4	-2.36E+00	9.96E+01
5	-2.32E+00	9.96E+01
6	-2.27E+00	9.96E+01
7	-2.23E+00	9.96E+01
8	-2.18E+00	9.96E+01
9	-2.14E+00	9.96E+01
10	-2.09E+00	9.96E+01
11	-2.05E+00	9.96E+01
12	-2.00E+00	9.96E+01
13	-1.95E+00	9.96E+01
14	-1.9091	9.96E+01
15	-1.8636	9.96E+01
16	-1.8182	9.96E+01
17	-1.7727	9.96E+01
18	-1.7273	9.96E+01
19	-1.6818	9.96E+01
20	-1.6364	9.96E+01
21	-1.59E+00	9.96E+01
22	-1.55E+00	9.96E+01
23	-1.50E+00	9.96E+01
24	-1.45E+00	9.96E+01
25	-1.41E+00	9.96E+01
26	-1.36E+00	9.96E+01
27	-1.32E+00	9.96E+01
28	-1.27E+00	9.96E+01
29	-1.23E+00	9.96E+01
30	-1.18E+00	9.96E+01

	X	Y
1	-2.5	9.58E+01
2	-2.45E+00	9.58E+01
3	-2.41E+00	9.58E+01
4	-2.36E+00	9.58E+01
5	-2.32E+00	9.58E+01
6	-2.27E+00	9.58E+01
7	-2.23E+00	9.58E+01
8	-2.18E+00	9.58E+01
9	-2.14E+00	9.58E+01
10	-2.09E+00	9.58E+01
11	-2.05E+00	9.58E+01
12	-2.00E+00	9.58E+01
13	-1.95E+00	9.58E+01
14	-1.9091	9.58E+01
15	-1.8636	9.58E+01
16	-1.8182	9.58E+01
17	-1.7727	9.58E+01
18	-1.7273	9.58E+01
19	-1.6818	9.58E+01
20	-1.6364	9.58E+01
21	-1.59E+00	9.58E+01
22	-1.55E+00	9.58E+01
23	-1.50E+00	9.58E+01
24	-1.45E+00	9.58E+01
25	-1.41E+00	9.58E+01
26	-1.36E+00	9.58E+01
27	-1.32E+00	9.58E+01
28	-1.27E+00	9.58E+01
29	-1.23E+00	9.58E+01
30	-1.18E+00	9.58E+01

Prediction Line

	X	Y
31	-1.1364	9.95E+01
32	-1.0909	9.95E+01
33	-1.0455	9.95E+01
34	-1	9.95E+01
35	-0.95455	9.95E+01
36	-0.90909	9.95E+01
37	-0.86364	9.95E+01
38	-0.81818	9.95E+01
39	-0.77273	9.95E+01
40	-0.72727	9.95E+01
41	-0.68182	9.95E+01
42	-0.63636	9.95E+01
43	-0.59091	9.95E+01
44	-0.54545	9.95E+01
45	-0.5	9.95E+01
46	-0.45455	9.95E+01
47	-0.40909	9.95E+01
48	-0.36364	9.95E+01
49	-0.31818	9.95E+01
50	-0.27273	9.95E+01
51	-0.22727	9.95E+01
52	-0.18182	9.94E+01
53	-0.13636	9.94E+01
54	-9.09E-02	9.94E+01
55	-4.55E-02	9.93E+01
56	0	9.93E+01
57	4.55E-02	9.93E+01
58	9.09E-02	9.92E+01
59	0.13636	9.91E+01
60	0.18182	9.90E+01
61	0.22727	9.89E+01
62	0.27273	9.88E+01
63	0.31818	9.86E+01
64	0.36364	9.84E+01
65	0.40909	9.81E+01
66	0.45455	9.79E+01
67	0.5	9.75E+01
68	0.54545	9.71E+01
69	0.59091	9.66E+01
70	0.63636	9.59E+01
71	0.68182	9.52E+01
72	0.72727	9.43E+01
73	0.77273	9.33E+01
74	0.81818	9.20E+01
75	0.86364	9.06E+01
76	0.90909	8.88E+01
77	0.95455	8.68E+01
78	1	8.45E+01
79	1.0455	8.19E+01
80	1.0909	7.89E+01
81	1.1364	7.55E+01

	X	Y
31	-1.1364	9.96E+01
32	-1.0909	9.96E+01
33	-1.0455	9.96E+01
34	-1	9.96E+01
35	-0.95455	9.96E+01
36	-0.90909	9.96E+01
37	-0.86364	9.96E+01
38	-0.81818	9.96E+01
39	-0.77273	9.96E+01
40	-0.72727	9.96E+01
41	-0.68182	9.96E+01
42	-0.63636	9.96E+01
43	-0.59091	9.96E+01
44	-0.54545	9.96E+01
45	-0.5	9.96E+01
46	-0.45455	9.96E+01
47	-0.40909	9.96E+01
48	-0.36364	9.96E+01
49	-0.31818	9.96E+01
50	-0.27273	9.96E+01
51	-0.22727	9.96E+01
52	-0.18182	9.96E+01
53	-0.13636	9.96E+01
54	-9.09E-02	9.96E+01
55	-4.55E-02	9.96E+01
56	0	9.96E+01
57	4.55E-02	9.96E+01
58	9.09E-02	9.96E+01
59	0.13636	9.96E+01
60	0.18182	9.96E+01
61	0.22727	9.96E+01
62	0.27273	9.96E+01
63	0.31818	9.96E+01
64	0.36364	9.96E+01
65	0.40909	9.96E+01
66	0.45455	9.96E+01
67	0.5	9.94E+01
68	0.54545	9.91E+01
69	0.59091	9.85E+01
70	0.63636	9.77E+01
71	0.68182	9.67E+01
72	0.72727	9.54E+01
73	0.77273	9.39E+01
74	0.81818	9.22E+01
75	0.86364	9.03E+01
76	0.90909	8.82E+01
77	0.95455	8.58E+01
78	1	8.32E+01
79	1.0455	8.04E+01
80	1.0909	7.74E+01
81	1.1364	7.41E+01

	X	Y
31	-1.1364	9.58E+01
32	-1.0909	9.58E+01
33	-1.0455	9.58E+01
34	-1	9.58E+01
35	-0.95455	9.58E+01
36	-0.90909	9.58E+01
37	-0.86364	9.58E+01
38	-0.81818	9.58E+01
39	-0.77273	9.58E+01
40	-0.72727	9.58E+01
41	-0.68182	9.58E+01
42	-0.63636	9.58E+01
43	-0.59091	9.58E+01
44	-0.54545	9.58E+01
45	-0.5	9.58E+01
46	-0.45455	9.58E+01
47	-0.40909	9.58E+01
48	-0.36364	9.58E+01
49	-0.31818	9.58E+01
50	-0.27273	9.58E+01
51	-0.22727	9.58E+01
52	-0.18182	9.58E+01
53	-0.13636	9.58E+01
54	-9.09E-02	9.58E+01
55	-4.55E-02	9.58E+01
56	0	9.58E+01
57	4.55E-02	9.58E+01
58	9.09E-02	9.58E+01
59	0.13636	9.58E+01
60	0.18182	9.58E+01
61	0.22727	9.58E+01
62	0.27273	9.58E+01
63	0.31818	9.58E+01
64	0.36364	9.58E+01
65	0.40909	9.58E+01
66	0.45455	9.58E+01
67	0.5	9.58E+01
68	0.54545	9.58E+01
69	0.59091	9.58E+01
70	0.63636	9.58E+01
71	0.68182	9.58E+01
72	0.72727	9.58E+01
73	0.77273	9.58E+01
74	0.81818	9.58E+01
75	0.86364	9.58E+01
76	0.90909	9.58E+01
77	0.95455	9.42E+01
78	1	8.97E+01
79	1.0455	8.51E+01
80	1.0909	8.06E+01
81	1.1364	7.61E+01

Prediction Line

	X	Y
82	1.1818	7.18E+01
83	1.2273	6.78E+01
84	1.2727	6.35E+01
85	1.3182	5.89E+01
86	1.3636	5.41E+01
87	1.4091	4.93E+01
88	1.4545	4.45E+01
89	1.5	3.98E+01
90	1.5455	3.53E+01
91	1.5909	3.10E+01
92	1.6364	2.70E+01
93	1.6818	2.34E+01
94	1.7273	2.01E+01
95	1.7727	1.71E+01
96	1.8182	1.46E+01
97	1.8636	1.23E+01
98	1.9091	1.04E+01
99	1.9545	8.70E+00
100	2	7.28E+00

	X	Y
82	1.1818	7.06E+01
83	1.2273	6.69E+01
84	1.2727	6.30E+01
85	1.3182	5.89E+01
86	1.3636	5.45E+01
87	1.4091	4.99E+01
88	1.4545	4.53E+01
89	1.5	4.09E+01
90	1.5455	3.68E+01
91	1.5909	3.28E+01
92	1.6364	2.91E+01
93	1.6818	2.56E+01
94	1.7273	2.24E+01
95	1.7727	1.93E+01
96	1.8182	1.65E+01
97	1.8636	1.39E+01
98	1.9091	1.15E+01
99	1.9545	9.36E+00
100	2	7.43E+00

	X	Y
82	1.1818	7.15E+01
83	1.2273	6.70E+01
84	1.2727	6.25E+01
85	1.3182	5.79E+01
86	1.3636	5.34E+01
87	1.4091	4.89E+01
88	1.4545	4.44E+01
89	1.5	3.98E+01
90	1.5455	3.53E+01
91	1.5909	3.08E+01
92	1.6364	2.62E+01
93	1.6818	2.17E+01
94	1.7273	1.72E+01
95	1.7727	1.26E+01
96	1.8182	8.12E+00
97	1.8636	3.59E+00
98	1.9091	0.00E+00
99	1.9545	0.00E+00
100	2	0.00E+00

Table H2.D-8b. TRAP Model Output for Lead Data for the Mammal Survival Endpoint (Lorenzo et al. 1978)

Chemical:	Lead
Study Authors:	Lorenzo et al. 1978
Receptor Group:	Mammal
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
1.00E-06	65	78	0.84
2.2	64	78	0.83
10	39	78	0.5
19.9	11	78	0.15
39.9	0	78	0

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.0132	1.0683	3.40E-02	0.9997	1.1369
S	0.29483	2.20E-01	3.44E-02	0.16835	0.31567
Y0	0.82692	0.82602	3.04E-02	0.75704	0.88212

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.0132	1.064	3.63E-02	0.99045	1.1376
S	0.29483	2.23E-01	2.79E-02	0.17915	0.29497
Y0	0.82692	0.82676	3.03E-02	0.7581	0.88258

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.0132	1.072	3.87E-02	0.99241	1.1516
S	0.29483	0.19871	3.89E-02	0.14415	0.31965
Y0	0.82692	0.82692	3.03E-02	0.75826	0.88273

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	11.703	9.99E+00	1.37E+01	3.40E-02	1.0683
20	7.6476	5.91E+00	9.90E+00	5.44E-02	0.88353
10	6.1227	4.40E+00	8.52E+00	6.76E-02	0.78694
5	5.0954	3.42E+00	7.60E+00	7.90E-02	0.70718
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	11.589	9.78E+00	1.37E+01	3.63E-02	1.064
20	7.3011	5.66E+00	9.41E+00	5.36E-02	0.86339
10	5.78E+00	4.2559	7.8621	6.35E-02	0.76226
5	4.9064	3.4633	6.9507	7.06E-02	0.69076
0	3.2971	2.0686	5.2553	8.83E-02	5.18E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	11.804	9.83E+00	1.42E+01	3.87E-02	1.072
20	7.3368	5.1026	10.549	7.28E-02	0.86551
10	6.2614	4.0131	9.7693	8.54E-02	0.79667
5	5.7843	3.54E+00	9.4536	9.17E-02	0.76225
0	5.3436	3.11E+00	9.19E+00	9.82E-02	0.72784

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	0.83333	0.82602
2	3.42E-01	0.82051	0.82563
3	1.00E+00	0.5	0.51393
4	1.30E+00	0.14103	0.12135
5	1.60E+00	0	6.38E-03
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-2.5	0.82602
2	-2.45E+00	0.82602
3	-2.41E+00	0.82602
4	-2.36E+00	0.82602
5	-2.32E+00	0.82602
6	-2.27E+00	0.82602
7	-2.23E+00	0.82602
8	-2.18E+00	0.82602
9	-2.14E+00	0.82602
10	-2.09E+00	0.82602
11	-2.05E+00	0.82602
12	-2.00E+00	0.82602
13	-1.95E+00	0.82602
14	-1.9091	0.82602
15	-1.8636	0.82602
16	-1.8182	0.82602
17	-1.7727	0.82602
18	-1.7273	0.82602
19	-1.6818	0.82602
20	-1.6364	0.82602
21	-1.5909	0.82602
22	-1.5455	0.82602
23	-1.5	0.82602
24	-1.4545	0.82602
25	-1.4091	0.82602
26	-1.3636	0.82602
27	-1.3182	0.82602
28	-1.2727	0.82602
29	-1.2273	0.82602
30	-1.1818	0.82602

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	0.83333	0.82676
2	3.42E-01	0.82051	0.82676
3	1.00E+00	0.5	0.50469
4	1.30E+00	0.14103	0.1343
5	1.60E+00	0	1.94E-04
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-2.5	0.82676
2	-2.45E+00	0.82676
3	-2.41E+00	0.82676
4	-2.36E+00	0.82676
5	-2.32E+00	0.82676
6	-2.27E+00	0.82676
7	-2.23E+00	0.82676
8	-2.18E+00	0.82676
9	-2.14E+00	0.82676
10	-2.09E+00	0.82676
11	-2.05E+00	0.82676
12	-2.00E+00	0.82676
13	-1.95E+00	0.82676
14	-1.9091	0.82676
15	-1.8636	0.82676
16	-1.8182	0.82676
17	-1.7727	0.82676
18	-1.7273	0.82676
19	-1.6818	0.82676
20	-1.6364	0.82676
21	-1.5909	0.82676
22	-1.5455	0.82676
23	-1.5	0.82676
24	-1.4545	0.82676
25	-1.4091	0.82676
26	-1.3636	0.82676
27	-1.3182	0.82676
28	-1.2727	0.82676
29	-1.2273	0.82676
30	-1.1818	0.82676

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	0.83333	0.82692
2	3.42E-01	0.82051	0.82692
3	1.00E+00	0.5	0.5
4	1.30E+00	0.14103	0.14103
5	1.60E+00	0	8.27E-05
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-2.5	0.82692
2	-2.45E+00	0.82692
3	-2.41E+00	0.82692
4	-2.36E+00	0.82692
5	-2.32E+00	0.82692
6	-2.27E+00	0.82692
7	-2.23E+00	0.82692
8	-2.18E+00	0.82692
9	-2.14E+00	0.82692
10	-2.09E+00	0.82692
11	-2.05E+00	0.82692
12	-2.00E+00	0.82692
13	-1.95E+00	0.82692
14	-1.9091	0.82692
15	-1.8636	0.82692
16	-1.8182	0.82692
17	-1.7727	0.82692
18	-1.7273	0.82692
19	-1.6818	0.82692
20	-1.6364	0.82692
21	-1.5909	0.82692
22	-1.5455	0.82692
23	-1.5	0.82692
24	-1.4545	0.82692
25	-1.4091	0.82692
26	-1.3636	0.82692
27	-1.3182	0.82692
28	-1.2727	0.82692
29	-1.2273	0.82692
30	-1.1818	0.82692

Prediction Line

	X	Y
31	-1.1364	0.82602
32	-1.09E+00	0.82602
33	-1.05E+00	0.82602
34	-1	0.82602
35	-9.55E-01	0.82602
36	-9.09E-01	0.82602
37	-0.86364	0.82602
38	-0.81818	0.82602
39	-0.77273	0.82602
40	-0.72727	0.82602
41	-0.68182	0.82602
42	-0.63636	0.82602
43	-0.59091	0.82602
44	-0.54545	0.82602
45	-0.5	0.82602
46	-0.45455	0.82602
47	-0.40909	0.82602
48	-0.36364	0.82602
49	-0.31818	0.82602
50	-0.27273	0.82602
51	-0.22727	0.82602
52	-0.18182	0.82602
53	-0.13636	0.82602
54	-9.09E-02	0.82602
55	-4.55E-02	0.82602
56	0	0.82602
57	4.55E-02	0.82602
58	9.09E-02	0.82602
59	0.13636	0.82601
60	0.18182	0.826
61	0.22727	0.82597
62	0.27273	0.8259
63	0.31818	0.82576
64	0.36364	0.82547
65	0.40909	0.82491
66	0.45455	0.82388
67	0.5	0.82204
68	0.54545	0.8189
69	0.59091	0.81377
70	0.63636	0.80573
71	0.68182	0.79367
72	0.72727	0.77632
73	0.77273	0.75243
74	0.81818	0.72088
75	0.86364	0.68098
76	0.90909	0.63261
77	0.95455	0.57644
78	1	0.51393
79	1.0455	0.44728
80	1.0909	0.37918
81	1.1364	0.31251

	X	Y
31	-1.1364	0.82676
32	-1.09E+00	0.82676
33	-1.05E+00	0.82676
34	-1	0.82676
35	-9.55E-01	0.82676
36	-9.09E-01	0.82676
37	-0.86364	0.82676
38	-0.81818	0.82676
39	-0.77273	0.82676
40	-0.72727	0.82676
41	-0.68182	0.82676
42	-0.63636	0.82676
43	-0.59091	0.82676
44	-0.54545	0.82676
45	-0.5	0.82676
46	-0.45455	0.82676
47	-0.40909	0.82676
48	-0.36364	0.82676
49	-0.31818	0.82676
50	-0.27273	0.82676
51	-0.22727	0.82676
52	-0.18182	0.82676
53	-0.13636	0.82676
54	-9.09E-02	0.82676
55	-4.55E-02	0.82676
56	0	0.82676
57	4.55E-02	0.82676
58	9.09E-02	0.82676
59	0.13636	0.82676
60	0.18182	0.82676
61	0.22727	0.82676
62	0.27273	0.82676
63	0.31818	0.82676
64	0.36364	0.82676
65	0.40909	0.82676
66	0.45455	0.82676
67	0.5	0.82676
68	0.54545	0.82572
69	0.59091	0.81941
70	0.63636	0.80737
71	0.68182	0.7896
72	0.72727	0.76609
73	0.77273	0.73685
74	0.81818	0.70188
75	0.86364	0.66118
76	0.90909	0.61475
77	0.95455	0.56259
78	1	0.50469
79	1.0455	0.44107
80	1.0909	0.37371
81	1.1364	0.31114

	X	Y
31	-1.1364	0.82692
32	-1.09E+00	0.82692
33	-1.05E+00	0.82692
34	-1	0.82692
35	-9.55E-01	0.82692
36	-9.09E-01	0.82692
37	-0.86364	0.82692
38	-0.81818	0.82692
39	-0.77273	0.82692
40	-0.72727	0.82692
41	-0.68182	0.82692
42	-0.63636	0.82692
43	-0.59091	0.82692
44	-0.54545	0.82692
45	-0.5	0.82692
46	-0.45455	0.82692
47	-0.40909	0.82692
48	-0.36364	0.82692
49	-0.31818	0.82692
50	-0.27273	0.82692
51	-0.22727	0.82692
52	-0.18182	0.82692
53	-0.13636	0.82692
54	-9.09E-02	0.82692
55	-4.55E-02	0.82692
56	0	0.82692
57	4.55E-02	0.82692
58	9.09E-02	0.82692
59	0.13636	0.82692
60	0.18182	0.82692
61	0.22727	0.82692
62	0.27273	0.82692
63	0.31818	0.82692
64	0.36364	0.82692
65	0.40909	0.82692
66	0.45455	0.82692
67	0.5	0.82692
68	0.54545	0.82692
69	0.59091	0.82692
70	0.63636	0.82692
71	0.68182	0.82692
72	0.72727	0.82692
73	0.77273	0.77299
74	0.81818	0.7184
75	0.86364	0.6638
76	0.90909	0.6092
77	0.95455	0.5546
78	1	0.5
79	1.0455	0.4454
80	1.0909	0.3908
81	1.1364	0.3362

Prediction Line

	X	Y
82	1.1818	0.24998
83	1.2273	0.19377
84	1.2727	0.14536
85	1.3182	0.10541
86	1.3636	7.38E-02
87	1.4091	4.99E-02
88	1.4545	3.25E-02
89	1.5	2.04E-02
90	1.5455	1.24E-02
91	1.5909	7.22E-03
92	1.6364	4.08E-03
93	1.6818	2.23E-03
94	1.7273	1.19E-03
95	1.7727	6.33E-04
96	1.8182	3.45E-04
97	1.8636	2.03E-04
98	1.9091	1.36E-04
99	1.9545	1.05E-04
100	2	9.17E-05

	X	Y
82	1.1818	0.25429
83	1.2273	0.20317
84	1.2727	0.15779
85	1.3182	0.11814
86	1.3636	8.42E-02
87	1.4091	5.60E-02
88	1.4545	3.36E-02
89	1.5	1.68E-02
90	1.5455	5.85E-03
91	1.5909	5.84E-04
92	1.6364	8.27E-05
93	1.6818	8.27E-05
94	1.7273	8.27E-05
95	1.7727	8.27E-05
96	1.8182	8.27E-05
97	1.8636	8.27E-05
98	1.9091	8.27E-05
99	1.9545	8.27E-05
100	2	8.27E-05

	X	Y
82	1.1818	0.2816
83	1.2273	0.22701
84	1.2727	0.17241
85	1.3182	0.11781
86	1.3636	6.32E-02
87	1.4091	8.61E-03
88	1.4545	8.27E-05
89	1.5	8.27E-05
90	1.5455	8.27E-05
91	1.5909	8.27E-05
92	1.6364	8.27E-05
93	1.6818	8.27E-05
94	1.7273	8.27E-05
95	1.7727	8.27E-05
96	1.8182	8.27E-05
97	1.8636	8.27E-05
98	1.9091	8.27E-05
99	1.9545	8.27E-05
100	2	8.27E-05

Table H2.D-9a. TRAP Model Output for Methylmercury Data for the Bird Growth Endpoint (Scott et al. 1975)

Chemical:	Mercury
Study Authors:	Scott et al. 1975
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
1.00E-06	1.664	not reported
0.70071	1.462	not reported
1.4014	1.139	not reported

Modeling Parameters			
Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.34009	0.34009			
S	1.0006	1.00E+00			
Y0	1.66E+00	1.66E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.34009	0.3518			
S	1.0006	1.00E+00			
Y0	1.66E+00	1.66E+00			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.34009	0.43269			
S	1.0006	0.64482			
Y0	1.66E+00	1.66E+00			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.1882	Infinity	0	0.12997	0.34009
20	9.86E-01	Infinity	0.00E+00	0.12997	-6.29E-03
10	6.18E-01	Infinity	0.00E+00	0.12997	-0.20891
5	4.02E-01	Infinity	0.00E+00	0.12997	-0.39561
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.248	Infinity	0	0.12997	0.3518
20	0.96602	Infinity	0	0.12997	-1.50E-02
10	6.31E-01	Infinity	0.00E+00	0.12997	-0.19989
5	0.46707	Infinity	0.00E+00	0.12997	-0.33062
0	0.22583	Infinity	0.00E+00	0.12997	-6.46E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.7083	Infinity	0	0.12997	0.43269
20	0.92778	Infinity	0	0.12997	-3.26E-02
10	0.64918	Infinity	0	0.12997	-0.18764
5	0.54303	Infinity	0	0.12997	-0.26518
0	0.45423	Infinity	0	0.12997	-0.34272

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.66E+00	1.66E+00
2	-1.54E-01	1.46E+00	1.46E+00
3	1.47E-01	1.14E+00	1.14E+00
4			
5			
6			

Analysis of Variance

R-squared: 0.902

	DF	SS	MS	F	Sig
Total (adj)	5	4.2398	0.84796		
Regression	2	3.8229	1.9115	13.756	0.0308
Error	3	0.41686	0.13895		

Prediction Line

	X	Y
1	-4	1.66E+00
2	-3.95E+00	1.66E+00
3	-3.91E+00	1.66E+00
4	-3.86E+00	1.66E+00
5	-3.82E+00	1.66E+00
6	-3.77E+00	1.66E+00
7	-3.73E+00	1.66E+00
8	-3.68E+00	1.66E+00
9	-3.64E+00	1.66E+00
10	-3.59E+00	1.66E+00
11	-3.55E+00	1.66E+00
12	-3.50E+00	1.66E+00
13	-3.45E+00	1.66E+00
14	-3.4091	1.66E+00
15	-3.3636	1.66E+00
16	-3.3182	1.66E+00
17	-3.2727	1.66E+00
18	-3.2273	1.66E+00
19	-3.1818	1.66E+00
20	-3.1364	1.66E+00
21	-3.09E+00	1.66E+00
22	-3.05E+00	1.66E+00
23	-3.00E+00	1.66E+00
24	-2.95E+00	1.66E+00
25	-2.91E+00	1.66E+00
26	-2.86E+00	1.66E+00
27	-2.82E+00	1.66E+00
28	-2.77E+00	1.66E+00
29	-2.73E+00	1.66E+00
30	-2.68E+00	1.66E+00

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.66E+00	1.66E+00
2	-1.54E-01	1.46E+00	1.46E+00
3	1.47E-01	1.14E+00	1.14E+00
4			
5			
6			

R-squared: 0.902

	DF	SS	MS	F	Sig
Total (adj)	5	4.2398	0.84796		
Regression	2	3.8229	1.9115	13.756	0.0308
Error	3	0.41686	0.13895		

	X	Y
1	-4	1.66E+00
2	-3.95E+00	1.66E+00
3	-3.91E+00	1.66E+00
4	-3.86E+00	1.66E+00
5	-3.82E+00	1.66E+00
6	-3.77E+00	1.66E+00
7	-3.73E+00	1.66E+00
8	-3.68E+00	1.66E+00
9	-3.64E+00	1.66E+00
10	-3.59E+00	1.66E+00
11	-3.55E+00	1.66E+00
12	-3.50E+00	1.66E+00
13	-3.45E+00	1.66E+00
14	-3.4091	1.66E+00
15	-3.3636	1.66E+00
16	-3.3182	1.66E+00
17	-3.2727	1.66E+00
18	-3.2273	1.66E+00
19	-3.1818	1.66E+00
20	-3.1364	1.66E+00
21	-3.09E+00	1.66E+00
22	-3.05E+00	1.66E+00
23	-3.00E+00	1.66E+00
24	-2.95E+00	1.66E+00
25	-2.91E+00	1.66E+00
26	-2.86E+00	1.66E+00
27	-2.82E+00	1.66E+00
28	-2.77E+00	1.66E+00
29	-2.73E+00	1.66E+00
30	-2.68E+00	1.66E+00

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.66E+00	1.66E+00
2	-1.54E-01	1.46E+00	1.46E+00
3	1.47E-01	1.14E+00	1.14E+00
4			
5			
6			

R-squared: 0.902

	DF	SS	MS	F	Sig
Total (adj)	5	4.2398	0.84796		
Regression	2	3.8229	1.9115	13.756	0.0308
Error	3	0.41686	0.13895		

	X	Y
1	-4	1.66E+00
2	-3.95E+00	1.66E+00
3	-3.91E+00	1.66E+00
4	-3.86E+00	1.66E+00
5	-3.82E+00	1.66E+00
6	-3.77E+00	1.66E+00
7	-3.73E+00	1.66E+00
8	-3.68E+00	1.66E+00
9	-3.64E+00	1.66E+00
10	-3.59E+00	1.66E+00
11	-3.55E+00	1.66E+00
12	-3.50E+00	1.66E+00
13	-3.45E+00	1.66E+00
14	-3.4091	1.66E+00
15	-3.3636	1.66E+00
16	-3.3182	1.66E+00
17	-3.2727	1.66E+00
18	-3.2273	1.66E+00
19	-3.1818	1.66E+00
20	-3.1364	1.66E+00
21	-3.09E+00	1.66E+00
22	-3.05E+00	1.66E+00
23	-3.00E+00	1.66E+00
24	-2.95E+00	1.66E+00
25	-2.91E+00	1.66E+00
26	-2.86E+00	1.66E+00
27	-2.82E+00	1.66E+00
28	-2.77E+00	1.66E+00
29	-2.73E+00	1.66E+00
30	-2.68E+00	1.66E+00

Prediction Line

	X	Y
31	-2.6364	1.66E+00
32	-2.5909	1.66E+00
33	-2.5455	1.66E+00
34	-2.5	1.66E+00
35	-2.4545	1.66E+00
36	-2.4091	1.66E+00
37	-2.3636	1.66E+00
38	-2.3182	1.66E+00
39	-2.2727	1.66E+00
40	-2.2273	1.66E+00
41	-2.1818	1.66E+00
42	-2.1364	1.66E+00
43	-2.0909	1.66E+00
44	-2.0455	1.66E+00
45	-2	1.66E+00
46	-1.9545	1.66E+00
47	-1.9091	1.66E+00
48	-1.8636	1.66E+00
49	-1.8182	1.66E+00
50	-1.7727	1.66E+00
51	-1.7273	1.66E+00
52	-1.6818	1.66E+00
53	-1.6364	1.66E+00
54	-1.5909	1.66E+00
55	-1.5455	1.66E+00
56	-1.5	1.66E+00
57	-1.4545	1.66E+00
58	-1.4091	1.66E+00
59	-1.3636	1.66E+00
60	-1.3182	1.66E+00
61	-1.2727	1.66E+00
62	-1.2273	1.66E+00
63	-1.1818	1.66E+00
64	-1.1364	1.66E+00
65	-1.0909	1.66E+00
66	-1.0455	1.66E+00
67	-1	1.66E+00
68	-0.95455	1.65E+00
69	-0.90909	1.65E+00
70	-0.86364	1.65E+00
71	-0.81818	1.65E+00
72	-0.77273	1.64E+00
73	-0.72727	1.64E+00
74	-0.68182	1.64E+00
75	-0.63636	1.63E+00
76	-0.59091	1.62E+00
77	-0.54545	1.62E+00
78	-0.5	1.61E+00
79	-0.45455	1.60E+00
80	-0.40909	1.59E+00
81	-0.36364	1.57E+00

	X	Y
31	-2.6364	1.66E+00
32	-2.5909	1.66E+00
33	-2.5455	1.66E+00
34	-2.5	1.66E+00
35	-2.4545	1.66E+00
36	-2.4091	1.66E+00
37	-2.3636	1.66E+00
38	-2.3182	1.66E+00
39	-2.2727	1.66E+00
40	-2.2273	1.66E+00
41	-2.1818	1.66E+00
42	-2.1364	1.66E+00
43	-2.0909	1.66E+00
44	-2.0455	1.66E+00
45	-2	1.66E+00
46	-1.9545	1.66E+00
47	-1.9091	1.66E+00
48	-1.8636	1.66E+00
49	-1.8182	1.66E+00
50	-1.7727	1.66E+00
51	-1.7273	1.66E+00
52	-1.6818	1.66E+00
53	-1.6364	1.66E+00
54	-1.5909	1.66E+00
55	-1.5455	1.66E+00
56	-1.5	1.66E+00
57	-1.4545	1.66E+00
58	-1.4091	1.66E+00
59	-1.3636	1.66E+00
60	-1.3182	1.66E+00
61	-1.2727	1.66E+00
62	-1.2273	1.66E+00
63	-1.1818	1.66E+00
64	-1.1364	1.66E+00
65	-1.0909	1.66E+00
66	-1.0455	1.66E+00
67	-1	1.66E+00
68	-0.95455	1.66E+00
69	-0.90909	1.66E+00
70	-0.86364	1.66E+00
71	-0.81818	1.66E+00
72	-0.77273	1.66E+00
73	-0.72727	1.66E+00
74	-0.68182	1.66E+00
75	-0.63636	1.66E+00
76	-0.59091	1.66E+00
77	-0.54545	1.66E+00
78	-0.5	1.65E+00
79	-0.45455	1.63E+00
80	-0.40909	1.62E+00
81	-0.36364	1.60E+00

	X	Y
31	-2.6364	1.66E+00
32	-2.5909	1.66E+00
33	-2.5455	1.66E+00
34	-2.5	1.66E+00
35	-2.4545	1.66E+00
36	-2.4091	1.66E+00
37	-2.3636	1.66E+00
38	-2.3182	1.66E+00
39	-2.2727	1.66E+00
40	-2.2273	1.66E+00
41	-2.1818	1.66E+00
42	-2.1364	1.66E+00
43	-2.0909	1.66E+00
44	-2.0455	1.66E+00
45	-2	1.66E+00
46	-1.9545	1.66E+00
47	-1.9091	1.66E+00
48	-1.8636	1.66E+00
49	-1.8182	1.66E+00
50	-1.7727	1.66E+00
51	-1.7273	1.66E+00
52	-1.6818	1.66E+00
53	-1.6364	1.66E+00
54	-1.5909	1.66E+00
55	-1.5455	1.66E+00
56	-1.5	1.66E+00
57	-1.4545	1.66E+00
58	-1.4091	1.66E+00
59	-1.3636	1.66E+00
60	-1.3182	1.66E+00
61	-1.2727	1.66E+00
62	-1.2273	1.66E+00
63	-1.1818	1.66E+00
64	-1.1364	1.66E+00
65	-1.0909	1.66E+00
66	-1.0455	1.66E+00
67	-1	1.66E+00
68	-0.95455	1.66E+00
69	-0.90909	1.66E+00
70	-0.86364	1.66E+00
71	-0.81818	1.66E+00
72	-0.77273	1.66E+00
73	-0.72727	1.66E+00
74	-0.68182	1.66E+00
75	-0.63636	1.66E+00
76	-0.59091	1.66E+00
77	-0.54545	1.66E+00
78	-0.5	1.66E+00
79	-0.45455	1.66E+00
80	-0.40909	1.66E+00
81	-0.36364	1.66E+00

Prediction Line

	X	Y
82	-0.31818	1.55E+00
83	-0.27273	1.53E+00
84	-0.22727	1.51E+00
85	-0.18182	1.48E+00
86	-0.13636	1.45E+00
87	-9.09E-02	1.41E+00
88	-4.55E-02	1.37E+00
89	0	1.32E+00
90	4.55E-02	1.27E+00
91	9.09E-02	1.22E+00
92	0.13636	1.15E+00
93	0.18182	1.09E+00
94	0.22727	1.02E+00
95	0.27273	9.43E-01
96	0.31818	8.68E-01
97	0.36364	7.93E-01
98	0.40909	7.18E-01
99	0.45455	6.45E-01
100	0.5	5.74E-01

	X	Y
82	-0.31818	1.57E+00
83	-0.27273	1.55E+00
84	-0.22727	1.52E+00
85	-0.18182	1.48E+00
86	-0.13636	1.45E+00
87	-9.09E-02	1.41E+00
88	-4.55E-02	1.36E+00
89	0	1.32E+00
90	4.55E-02	1.26E+00
91	9.09E-02	1.21E+00
92	0.13636	1.15E+00
93	0.18182	1.09E+00
94	0.22727	1.03E+00
95	0.27273	9.59E-01
96	0.31818	8.87E-01
97	0.36364	8.12E-01
98	0.40909	7.39E-01
99	0.45455	6.70E-01
100	0.5	6.03E-01

	X	Y
82	-0.31818	1.64E+00
83	-0.27273	1.59E+00
84	-0.22727	1.54E+00
85	-0.18182	1.49E+00
86	-0.13636	1.44E+00
87	-9.09E-02	1.39E+00
88	-4.55E-02	1.35E+00
89	0	1.30E+00
90	4.55E-02	1.25E+00
91	9.09E-02	1.20E+00
92	0.13636	1.15E+00
93	0.18182	1.10E+00
94	0.22727	1.05E+00
95	0.27273	1.00E+00
96	0.31818	9.55E-01
97	0.36364	9.06E-01
98	0.40909	8.57E-01
99	0.45455	8.09E-01
100	0.5	7.60E-01

Table H2.D-9b. TRAP Model Output for Methylmercury Data for the Bird Reproduction Endpoint (Varian-Ramos et al. 2014)

Chemical:	Mercury
Study Authors:	Varian-Ramos et al. 2014
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
1.00E-06	13	not reported
5.12E-02	9	not reported
0.10241	6	not reported
0.20482	7	not reported
0.40964	8	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	yes
X50 at Maximum or Minimum Limit	yes	yes	yes
Steepness At Maximum Or Minimum Limit	yes	yes	yes
Error Estimates Cannot Be Determined			
Large Standard Error for X50	yes	yes	yes
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-1.0377	-0.53774	0.48603	-2.629	1.5535
S	0.80148	2.67E-01	0.26351	-0.86665	1.401
Y0	1.30E+01	1.30E+01	2.1094	3.9495	22.102

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-1.0377	-0.53774	0.50271	-2.7007	1.6252
S	0.80148	2.67E-01	0.26691	-0.88127	1.4156
Y0	1.30E+01	1.30E+01	1.996	4.437	21.613

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-1.0377	-0.53774	0.49315	-2.6596	1.5841
S	0.80148	0.26716	0.23761	-0.75519	1.2895
Y0	1.30E+01	1.30E+01	2.05	4.2024	21.843

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.28991	2.35E-03	35.768	0.48603	-0.53774
20	1.46E-02	7.61E-08	2.81E+03	1.2279	-1.835
10	2.55E-03	1.13E-11	5.75E+05	1.9415	-2.5938
5	5.09E-04	2.82E-15	9.21E+07	2.6164	-3.293
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.28991	1.99E-03	42.192	0.50271	-0.53774
20	1.22E-02	2.21E-08	6726.5	1.3344	-1.9135
10	2.47E-03	1.78E-12	3.43E+06	2.1247	-2.6069
5	8.00E-04	8.91E-16	7.18E+08	2.7781	-3.0971
0	5.24E-05	1.30E-25	2.12E+16	4.7892	-4.28E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.28991	2.19E-03	38.38	0.49315	-0.53774
20	2.18E-02	2.68E-06	177.84	0.9089	-1.6607
10	9.23E-03	5.75E-08	1481	1.2098	-2.035
5	6.00E-03	7.96E-09	4516.3	1.3659	-2.2221
0	3.90E-03	1.08E-09	14077	1.5241	-2.4093

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.30E+01	1.30E+01
2	-1.29E+00	9.00E+00	9.00E+00
3	-9.90E-01	6.00E+00	8.06E+00
4	-6.89E-01	7.00E+00	7.04E+00
5	-3.88E-01	8	5.9914
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.30E+01	1.30E+01
2	-1.29E+00	9.00E+00	8.87E+00
3	-9.90E-01	6.00E+00	7.99E+00
4	-6.89E-01	7.00E+00	7.03E+00
5	-3.88E-01	8	6.0005
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.30E+01	1.30E+01
2	-1.29E+00	9.00E+00	9.13E+00
3	-9.90E-01	6.00E+00	8.08E+00
4	-6.89E-01	7.00E+00	7.04E+00
5	-3.88E-01	8	5.989
6			

Analysis of Variance

R-squared: 0.717

	DF	SS	MS	F	Sig
Total (adj)	4	29.2	7.3		
Regression	2	20.939	10.469	2.5346	0.2829
Error	2	8.2612	4.1306		

R-squared: 0.727

	DF	SS	MS	F	Sig
Total (adj)	4	29.2	7.3		
Regression	2	21.223	10.611	2.6605	0.2732
Error	2	7.9771	3.9885		

R-squared: 0.712

	DF	SS	MS	F	Sig
Total (adj)	4	29.2	7.3		
Regression	2	20.795	10.398	2.4742	0.2878
Error	2	8.4048	4.2024		

Prediction Line

	X	Y
1	-4.5	1.28E+01
2	-4.45E+00	1.28E+01
3	-4.40E+00	1.28E+01
4	-4.35E+00	1.28E+01
5	-4.30E+00	1.28E+01
6	-4.25E+00	1.28E+01
7	-4.20E+00	1.28E+01
8	-4.15E+00	1.28E+01
9	-4.10E+00	1.27E+01
10	-4.05E+00	1.27E+01
11	-3.99E+00	1.27E+01
12	-3.94E+00	1.27E+01
13	-3.89E+00	1.27E+01
14	-3.8434	1.27E+01
15	-3.7929	1.26E+01
16	-3.7424	1.26E+01
17	-3.6919	1.26E+01
18	-3.6414	1.26E+01
19	-3.5909	1.25E+01
20	-3.5404	1.25E+01
21	-3.49E+00	1.25E+01
22	-3.44E+00	1.25E+01
23	-3.39E+00	1.24E+01
24	-3.34E+00	1.24E+01
25	-3.29E+00	1.24E+01
26	-3.24E+00	1.23E+01
27	-3.19E+00	1.23E+01
28	-3.14E+00	1.23E+01
29	-3.09E+00	1.22E+01
30	-3.04E+00	1.22E+01
31	-2.9848	1.21E+01
32	-2.9343	1.21E+01

	X	Y
1	-4.5	1.30E+01
2	-4.45E+00	1.30E+01
3	-4.40E+00	1.30E+01
4	-4.35E+00	1.30E+01
5	-4.30E+00	1.30E+01
6	-4.25E+00	1.30E+01
7	-4.20E+00	1.30E+01
8	-4.15E+00	1.30E+01
9	-4.10E+00	1.30E+01
10	-4.05E+00	1.30E+01
11	-3.99E+00	1.30E+01
12	-3.94E+00	1.30E+01
13	-3.89E+00	1.30E+01
14	-3.8434	1.29E+01
15	-3.7929	1.29E+01
16	-3.7424	1.29E+01
17	-3.6919	1.29E+01
18	-3.6414	1.28E+01
19	-3.5909	1.28E+01
20	-3.5404	1.28E+01
21	-3.49E+00	1.27E+01
22	-3.44E+00	1.27E+01
23	-3.39E+00	1.27E+01
24	-3.34E+00	1.26E+01
25	-3.29E+00	1.26E+01
26	-3.24E+00	1.25E+01
27	-3.19E+00	1.25E+01
28	-3.14E+00	1.24E+01
29	-3.09E+00	1.24E+01
30	-3.04E+00	1.23E+01
31	-2.9848	1.22E+01
32	-2.9343	1.22E+01

	X	Y
1	-4.5	1.30E+01
2	-4.45E+00	1.30E+01
3	-4.40E+00	1.30E+01
4	-4.35E+00	1.30E+01
5	-4.30E+00	1.30E+01
6	-4.25E+00	1.30E+01
7	-4.20E+00	1.30E+01
8	-4.15E+00	1.30E+01
9	-4.10E+00	1.30E+01
10	-4.05E+00	1.30E+01
11	-3.99E+00	1.30E+01
12	-3.94E+00	1.30E+01
13	-3.89E+00	1.30E+01
14	-3.8434	1.30E+01
15	-3.7929	1.30E+01
16	-3.7424	1.30E+01
17	-3.6919	1.30E+01
18	-3.6414	1.30E+01
19	-3.5909	1.30E+01
20	-3.5404	1.30E+01
21	-3.49E+00	1.30E+01
22	-3.44E+00	1.30E+01
23	-3.39E+00	1.30E+01
24	-3.34E+00	1.30E+01
25	-3.29E+00	1.30E+01
26	-3.24E+00	1.30E+01
27	-3.19E+00	1.30E+01
28	-3.14E+00	1.30E+01
29	-3.09E+00	1.30E+01
30	-3.04E+00	1.30E+01
31	-2.9848	1.30E+01
32	-2.9343	1.30E+01

Prediction Line

	X	Y
33	-2.8838	1.20E+01
34	-2.8333	1.20E+01
35	-2.7828	1.19E+01
36	-2.7323	1.19E+01
37	-2.6818	1.18E+01
38	-2.6313	1.18E+01
39	-2.5808	1.17E+01
40	-2.5303	1.16E+01
41	-2.4798	1.16E+01
42	-2.4293	1.15E+01
43	-2.3788	1.14E+01
44	-2.3283	1.14E+01
45	-2.2778	1.13E+01
46	-2.2273	1.12E+01
47	-2.1768	1.11E+01
48	-2.1263	1.10E+01
49	-2.0758	1.09E+01
50	-2.0253	1.08E+01
51	-1.9747	1.07E+01
52	-1.9242	1.06E+01
53	-1.8737	1.05E+01
54	-1.8232	1.04E+01
55	-1.7727	1.03E+01
56	-1.7222	1.02E+01
57	-1.6717	1.00E+01
58	-1.6212	9.91E+00
59	-1.5707	9.78E+00
60	-1.5202	9.65E+00
61	-1.4697	9.51E+00
62	-1.4192	9.37E+00
63	-1.3687	9.23E+00
64	-1.3182	9.08E+00
65	-1.2677	8.93E+00
66	-1.2172	8.78E+00
67	-1.1667	8.62E+00
68	-1.1162	8.46E+00
69	-1.0657	8.30E+00
70	-1.0152	8.14E+00
71	-0.96465	7.97E+00
72	-0.91414	7.81E+00
73	-0.86364	7.64E+00
74	-0.81313	7.46E+00
75	-0.76263	7.29E+00
76	-0.71212	7.12E+00
77	-0.66162	6.94E+00
78	-0.61111	6.77E+00
79	-0.56061	6.59E+00
80	-0.5101	6.42E+00
81	-0.4596	6.24E+00
82	-0.40909	6.07E+00
83	-0.35859	5.89E+00
84	-0.30808	5.72E+00
85	-0.25758	5.55E+00

	X	Y
33	-2.8838	1.21E+01
34	-2.8333	1.21E+01
35	-2.7828	1.20E+01
36	-2.7323	1.19E+01
37	-2.6818	1.18E+01
38	-2.6313	1.18E+01
39	-2.5808	1.17E+01
40	-2.5303	1.16E+01
41	-2.4798	1.15E+01
42	-2.4293	1.14E+01
43	-2.3788	1.13E+01
44	-2.3283	1.13E+01
45	-2.2778	1.12E+01
46	-2.2273	1.11E+01
47	-2.1768	1.10E+01
48	-2.1263	1.09E+01
49	-2.0758	1.08E+01
50	-2.0253	1.07E+01
51	-1.9747	1.06E+01
52	-1.9242	1.04E+01
53	-1.8737	1.03E+01
54	-1.8232	1.02E+01
55	-1.7727	1.01E+01
56	-1.7222	9.98E+00
57	-1.6717	9.86E+00
58	-1.6212	9.74E+00
59	-1.5707	9.61E+00
60	-1.5202	9.48E+00
61	-1.4697	9.35E+00
62	-1.4192	9.22E+00
63	-1.3687	9.08E+00
64	-1.3182	8.95E+00
65	-1.2677	8.80E+00
66	-1.2172	8.66E+00
67	-1.1667	8.52E+00
68	-1.1162	8.37E+00
69	-1.0657	8.22E+00
70	-1.0152	8.07E+00
71	-0.96465	7.91E+00
72	-0.91414	7.76E+00
73	-0.86364	7.60E+00
74	-0.81313	7.44E+00
75	-0.76263	7.27E+00
76	-0.71212	7.11E+00
77	-0.66162	6.94E+00
78	-0.61111	6.77E+00
79	-0.56061	6.59E+00
80	-0.5101	6.42E+00
81	-0.4596	6.24E+00
82	-0.40909	6.07E+00
83	-0.35859	5.90E+00
84	-0.30808	5.74E+00
85	-0.25758	5.57E+00

	X	Y
33	-2.8838	1.30E+01
34	-2.8333	1.30E+01
35	-2.7828	1.30E+01
36	-2.7323	1.30E+01
37	-2.6818	1.30E+01
38	-2.6313	1.30E+01
39	-2.5808	1.30E+01
40	-2.5303	1.30E+01
41	-2.4798	1.30E+01
42	-2.4293	1.30E+01
43	-2.3788	1.29E+01
44	-2.3283	1.27E+01
45	-2.2778	1.26E+01
46	-2.2273	1.24E+01
47	-2.1768	1.22E+01
48	-2.1263	1.20E+01
49	-2.0758	1.19E+01
50	-2.0253	1.17E+01
51	-1.9747	1.15E+01
52	-1.9242	1.13E+01
53	-1.8737	1.12E+01
54	-1.8232	1.10E+01
55	-1.7727	1.08E+01
56	-1.7222	1.06E+01
57	-1.6717	1.05E+01
58	-1.6212	1.03E+01
59	-1.5707	1.01E+01
60	-1.5202	9.93E+00
61	-1.4697	9.75E+00
62	-1.4192	9.58E+00
63	-1.3687	9.40E+00
64	-1.3182	9.23E+00
65	-1.2677	9.05E+00
66	-1.2172	8.88E+00
67	-1.1667	8.70E+00
68	-1.1162	8.52E+00
69	-1.0657	8.35E+00
70	-1.0152	8.17E+00
71	-0.96465	8.00E+00
72	-0.91414	7.82E+00
73	-0.86364	7.65E+00
74	-0.81313	7.47E+00
75	-0.76263	7.29E+00
76	-0.71212	7.12E+00
77	-0.66162	6.94E+00
78	-0.61111	6.77E+00
79	-0.56061	6.59E+00
80	-0.5101	6.42E+00
81	-0.4596	6.24E+00
82	-0.40909	6.06E+00
83	-0.35859	5.89E+00
84	-0.30808	5.71E+00
85	-0.25758	5.54E+00

Prediction Line

	X	Y
86	-0.20707	5.37E+00
87	-0.15657	5.20E+00
88	-0.10606	5.04E+00
89	-5.56E-02	4.87E+00
90	-5.05E-03	4.71E+00
91	4.55E-02	4.55E+00
92	9.60E-02	4.39E+00
93	0.14646	4.23E+00
94	0.19697	4.08E+00
95	0.24747	3.93E+00
96	0.29798	3.78E+00
97	0.34848	3.64E+00
98	0.39899	3.50E+00
99	0.44949	3.36E+00
100	0.5	3.23E+00

	X	Y
86	-0.20707	5.41E+00
87	-0.15657	5.25E+00
88	-0.10606	5.10E+00
89	-5.56E-02	4.94E+00
90	-5.05E-03	4.79E+00
91	4.55E-02	4.64E+00
92	9.60E-02	4.49E+00
93	0.14646	4.35E+00
94	0.19697	4.21E+00
95	0.24747	4.07E+00
96	0.29798	3.93E+00
97	0.34848	3.79E+00
98	0.39899	3.66E+00
99	0.44949	3.53E+00
100	0.5	3.40E+00

	X	Y
86	-0.20707	5.36E+00
87	-0.15657	5.19E+00
88	-0.10606	5.01E+00
89	-5.56E-02	4.83E+00
90	-5.05E-03	4.66E+00
91	4.55E-02	4.48E+00
92	9.60E-02	4.31E+00
93	0.14646	4.13E+00
94	0.19697	3.96E+00
95	0.24747	3.78E+00
96	0.29798	3.60E+00
97	0.34848	3.43E+00
98	0.39899	3.25E+00
99	0.44949	3.08E+00
100	0.5	2.90E+00

Table H2.D-9c. TRAP Model Output for Methylmercury Data for the Bird Reproduction Endpoint (Albers et al. 2007)

Chemical:	Mercury
Study Authors:	Albers et al. 2007
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
1.67E-03	2.25	0.45
7.87E-02	1.89	0.45
0.21367	1.3	0.34
0.33517	1.5	0.34
0.48075	0.14	0.14
0.620	0.0	0.0

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes		
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes		
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.691	-0.41055	5.84E-02	-0.59648	-0.22462
S	1.4481	4.34E+00	3.0405	-5.3318	14.021
Y0	2.25E+00	1.84E+00	0.23982	1.0792	2.6056

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.691	-0.46109	8.21E-02	-0.72232	-0.19986
S	1.4481	2.47E+00	1.4431	-2.1224	7.0626
Y0	2.25E+00	1.97E+00	0.30184	1.0045	2.9257

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.691	-0.50849	8.57E-02	-0.78114	-0.23584
S	1.4481	1.5956	0.63395	-0.42188	3.6131
Y0	2.25E+00	2.07E+00	0.30059	1.1134	3.0266

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.38855	0.25323	0.59618	5.84E-02	-0.41055
20	3.23E-01	1.77E-01	5.92E-01	8.25E-02	-0.49033
10	2.90E-01	1.32E-01	6.41E-01	0.10802	-0.53699
5	2.63E-01	9.83E-02	7.04E-01	0.13433	-0.57999
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.34587	0.18953	0.63115	8.21E-02	-0.46109
20	0.24553	8.76E-02	0.68799	0.14061	-0.60989
10	2.07E-01	4.92E-02	8.67E-01	0.19572	-0.68488
5	0.18285	2.87E-02	1.16E+00	0.2527	-0.73791
0	0.13616	9.69E-03	1.91E+00	0.36061	-8.66E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.31011	0.16552	0.58098	8.57E-02	-0.50849
20	0.20114	7.12E-02	0.56808	0.14169	-0.6965
10	0.17411	5.25E-02	0.57786	0.16371	-0.75917
5	0.16199	4.49E-02	0.58405	0.17501	-0.79051
0	0.15071	3.84E-02	0.59094	0.18646	-0.82184

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-2.78E+00	2.25E+00	1.84E+00
2	-1.10E+00	1.89E+00	1.84E+00
3	-6.70E-01	1.30E+00	1.82E+00
4	-4.75E-01	1.50E+00	1.39E+00
5	-3.18E-01	0.14	0.30769
6	-0.20757	0	5.26E-02

Analysis of Variance

R-squared: 0.886

	DF	SS	MS	F	Sig
Total (adj)	5	4.2398	0.84796		
Regression	2	3.755	1.8775	11.617	0.0387
Error	3	0.48485	0.16162		

Prediction Line

	X	Y
1	-2.5	1.84E+00
2	-2.47E+00	1.84E+00
3	-2.44E+00	1.84E+00
4	-2.41E+00	1.84E+00
5	-2.38E+00	1.84E+00
6	-2.35E+00	1.84E+00
7	-2.32E+00	1.84E+00
8	-2.29E+00	1.84E+00
9	-2.26E+00	1.84E+00
10	-2.23E+00	1.84E+00
11	-2.20E+00	1.84E+00
12	-2.17E+00	1.84E+00
13	-2.14E+00	1.84E+00
14	-2.1061	1.84E+00
15	-2.0758	1.84E+00
16	-2.0455	1.84E+00
17	-2.0152	1.84E+00
18	-1.9848	1.84E+00
19	-1.9545	1.84E+00
20	-1.9242	1.84E+00
21	-1.89E+00	1.84E+00
22	-1.86E+00	1.84E+00
23	-1.83E+00	1.84E+00
24	-1.80E+00	1.84E+00
25	-1.77E+00	1.84E+00
26	-1.74E+00	1.84E+00
27	-1.71E+00	1.84E+00
28	-1.68E+00	1.84E+00
29	-1.65E+00	1.84E+00
30	-1.62E+00	1.84E+00

	Exposure	Effects Var	Est Effects Var
1	-2.78E+00	2.25E+00	1.97E+00
2	-1.10E+00	1.89E+00	1.97E+00
3	-6.70E-01	1.30E+00	1.74E+00
4	-4.75E-01	1.50E+00	1.05E+00
5	-3.18E-01	0.14	0.41097
6	-0.20757	0	0.13726

R-squared: 0.865

	DF	SS	MS	F	Sig
Total (adj)	5	4.2398	0.84796		
Regression	2	3.6664	1.8332	9.5915	0.0497
Error	3	0.57339	0.19113		

	X	Y
1	-2.5	1.97E+00
2	-2.47E+00	1.97E+00
3	-2.44E+00	1.97E+00
4	-2.41E+00	1.97E+00
5	-2.38E+00	1.97E+00
6	-2.35E+00	1.97E+00
7	-2.32E+00	1.97E+00
8	-2.29E+00	1.97E+00
9	-2.26E+00	1.97E+00
10	-2.23E+00	1.97E+00
11	-2.20E+00	1.97E+00
12	-2.17E+00	1.97E+00
13	-2.14E+00	1.97E+00
14	-2.1061	1.97E+00
15	-2.0758	1.97E+00
16	-2.0455	1.97E+00
17	-2.0152	1.97E+00
18	-1.9848	1.97E+00
19	-1.9545	1.97E+00
20	-1.9242	1.97E+00
21	-1.89E+00	1.97E+00
22	-1.86E+00	1.97E+00
23	-1.83E+00	1.97E+00
24	-1.80E+00	1.97E+00
25	-1.77E+00	1.97E+00
26	-1.74E+00	1.97E+00
27	-1.71E+00	1.97E+00
28	-1.68E+00	1.97E+00
29	-1.65E+00	1.97E+00
30	-1.62E+00	1.97E+00

	Exposure	Effects Var	Est Effects Var
1	-2.78E+00	2.25E+00	2.07E+00
2	-1.10E+00	1.89E+00	2.07E+00
3	-6.70E-01	1.30E+00	1.57E+00
4	-4.75E-01	1.50E+00	9.24E-01
5	-3.18E-01	0.14	0.40608
6	-0.20757	0	4.11E-02

R-squared: 0.872

	DF	SS	MS	F	Sig
Total (adj)	5	4.2398	0.84796		
Regression	2	3.6977	1.8488	10.231	0.0457
Error	3	0.54214	0.18071		

	X	Y
1	-2.5	2.07E+00
2	-2.47E+00	2.07E+00
3	-2.44E+00	2.07E+00
4	-2.41E+00	2.07E+00
5	-2.38E+00	2.07E+00
6	-2.35E+00	2.07E+00
7	-2.32E+00	2.07E+00
8	-2.29E+00	2.07E+00
9	-2.26E+00	2.07E+00
10	-2.23E+00	2.07E+00
11	-2.20E+00	2.07E+00
12	-2.17E+00	2.07E+00
13	-2.14E+00	2.07E+00
14	-2.1061	2.07E+00
15	-2.0758	2.07E+00
16	-2.0455	2.07E+00
17	-2.0152	2.07E+00
18	-1.9848	2.07E+00
19	-1.9545	2.07E+00
20	-1.9242	2.07E+00
21	-1.89E+00	2.07E+00
22	-1.86E+00	2.07E+00
23	-1.83E+00	2.07E+00
24	-1.80E+00	2.07E+00
25	-1.77E+00	2.07E+00
26	-1.74E+00	2.07E+00
27	-1.71E+00	2.07E+00
28	-1.68E+00	2.07E+00
29	-1.65E+00	2.07E+00
30	-1.62E+00	2.07E+00

Prediction Line

	X	Y
31	-1.5909	1.84E+00
32	-1.5606	1.84E+00
33	-1.5303	1.84E+00
34	-1.5	1.84E+00
35	-1.4697	1.84E+00
36	-1.4394	1.84E+00
37	-1.4091	1.84E+00
38	-1.3788	1.84E+00
39	-1.3485	1.84E+00
40	-1.3182	1.84E+00
41	-1.2879	1.84E+00
42	-1.2576	1.84E+00
43	-1.2273	1.84E+00
44	-1.197	1.84E+00
45	-1.1667	1.84E+00
46	-1.1364	1.84E+00
47	-1.1061	1.84E+00
48	-1.0758	1.84E+00
49	-1.0455	1.84E+00
50	-1.0152	1.84E+00
51	-0.98485	1.84E+00
52	-0.95455	1.84E+00
53	-0.92424	1.84E+00
54	-0.89394	1.84E+00
55	-0.86364	1.84E+00
56	-0.83333	1.84E+00
57	-0.80303	1.84E+00
58	-0.77273	1.84E+00
59	-0.74242	1.84E+00
60	-0.71212	1.83E+00
61	-0.68182	1.83E+00
62	-0.65152	1.81E+00
63	-0.62121	1.80E+00
64	-0.59091	1.77E+00
65	-0.56061	1.72E+00
66	-0.5303	1.64E+00
67	-0.5	1.52E+00
68	-0.4697	1.36E+00
69	-0.43939	1.15E+00
70	-0.40909	9.10E-01
71	-0.37879	6.73E-01
72	-0.34848	4.68E-01
73	-0.31818	3.08E-01
74	-0.28788	1.95E-01
75	-0.25758	1.21E-01
76	-0.22727	7.32E-02
77	-0.19697	4.40E-02
78	-0.16667	2.62E-02
79	-0.13636	1.56E-02
80	-0.10606	9.23E-03
81	-7.58E-02	5.46E-03

	X	Y
31	-1.5909	1.97E+00
32	-1.5606	1.97E+00
33	-1.5303	1.97E+00
34	-1.5	1.97E+00
35	-1.4697	1.97E+00
36	-1.4394	1.97E+00
37	-1.4091	1.97E+00
38	-1.3788	1.97E+00
39	-1.3485	1.97E+00
40	-1.3182	1.97E+00
41	-1.2879	1.97E+00
42	-1.2576	1.97E+00
43	-1.2273	1.97E+00
44	-1.197	1.97E+00
45	-1.1667	1.97E+00
46	-1.1364	1.97E+00
47	-1.1061	1.97E+00
48	-1.0758	1.97E+00
49	-1.0455	1.97E+00
50	-1.0152	1.97E+00
51	-0.98485	1.97E+00
52	-0.95455	1.97E+00
53	-0.92424	1.97E+00
54	-0.89394	1.97E+00
55	-0.86364	1.97E+00
56	-0.83333	1.96E+00
57	-0.80303	1.94E+00
58	-0.77273	1.91E+00
59	-0.74242	1.87E+00
60	-0.71212	1.82E+00
61	-0.68182	1.76E+00
62	-0.65152	1.69E+00
63	-0.62121	1.61E+00
64	-0.59091	1.51E+00
65	-0.56061	1.41E+00
66	-0.5303	1.29E+00
67	-0.5	1.16E+00
68	-0.4697	1.02E+00
69	-0.43939	8.80E-01
70	-0.40909	7.46E-01
71	-0.37879	6.24E-01
72	-0.34848	5.12E-01
73	-0.31818	4.11E-01
74	-0.28788	3.22E-01
75	-0.25758	2.43E-01
76	-0.22727	1.75E-01
77	-0.19697	1.19E-01
78	-0.16667	7.31E-02
79	-0.13636	3.85E-02
80	-0.10606	1.49E-02
81	-7.58E-02	2.28E-03

	X	Y
31	-1.5909	2.07E+00
32	-1.5606	2.07E+00
33	-1.5303	2.07E+00
34	-1.5	2.07E+00
35	-1.4697	2.07E+00
36	-1.4394	2.07E+00
37	-1.4091	2.07E+00
38	-1.3788	2.07E+00
39	-1.3485	2.07E+00
40	-1.3182	2.07E+00
41	-1.2879	2.07E+00
42	-1.2576	2.07E+00
43	-1.2273	2.07E+00
44	-1.197	2.07E+00
45	-1.1667	2.07E+00
46	-1.1364	2.07E+00
47	-1.1061	2.07E+00
48	-1.0758	2.07E+00
49	-1.0455	2.07E+00
50	-1.0152	2.07E+00
51	-0.98485	2.07E+00
52	-0.95455	2.07E+00
53	-0.92424	2.07E+00
54	-0.89394	2.07E+00
55	-0.86364	2.07E+00
56	-0.83333	2.07E+00
57	-0.80303	2.01E+00
58	-0.77273	1.91E+00
59	-0.74242	1.81E+00
60	-0.71212	1.71E+00
61	-0.68182	1.61E+00
62	-0.65152	1.51E+00
63	-0.62121	1.41E+00
64	-0.59091	1.31E+00
65	-0.56061	1.21E+00
66	-0.5303	1.11E+00
67	-0.5	1.01E+00
68	-0.4697	9.07E-01
69	-0.43939	8.07E-01
70	-0.40909	7.07E-01
71	-0.37879	6.07E-01
72	-0.34848	5.07E-01
73	-0.31818	4.06E-01
74	-0.28788	3.06E-01
75	-0.25758	2.06E-01
76	-0.22727	1.06E-01
77	-0.19697	6.06E-03
78	-0.16667	0.00E+00
79	-0.13636	0.00E+00
80	-0.10606	0.00E+00
81	-7.58E-02	0.00E+00

Prediction Line

	X	Y
82	-4.55E-02	3.23E-03
83	-1.52E-02	1.91E-03
84	1.52E-02	1.13E-03
85	4.55E-02	6.66E-04
86	7.58E-02	3.94E-04
87	0.10606	2.33E-04
88	0.13636	1.37E-04
89	0.16667	8.11E-05
90	0.19697	4.79E-05
91	0.22727	2.83E-05
92	0.25758	1.67E-05
93	0.28788	9.87E-06
94	0.31818	5.83E-06
95	0.34848	3.44E-06
96	0.37879	2.03E-06
97	0.40909	1.20E-06
98	0.43939	7.09E-07
99	0.4697	4.19E-07
100	0.5	2.47E-07

	X	Y
82	-4.55E-02	0.00E+00
83	-1.52E-02	0.00E+00
84	1.52E-02	0.00E+00
85	4.55E-02	0.00E+00
86	7.58E-02	0.00E+00
87	0.10606	0.00E+00
88	0.13636	0.00E+00
89	0.16667	0.00E+00
90	0.19697	0.00E+00
91	0.22727	0.00E+00
92	0.25758	0.00E+00
93	0.28788	0.00E+00
94	0.31818	0.00E+00
95	0.34848	0.00E+00
96	0.37879	0.00E+00
97	0.40909	0.00E+00
98	0.43939	0.00E+00
99	0.4697	0.00E+00
100	0.5	0.00E+00

	X	Y
82	-4.55E-02	0.00E+00
83	-1.52E-02	0.00E+00
84	1.52E-02	0.00E+00
85	4.55E-02	0.00E+00
86	7.58E-02	0.00E+00
87	0.10606	0.00E+00
88	0.13636	0.00E+00
89	0.16667	0.00E+00
90	0.19697	0.00E+00
91	0.22727	0.00E+00
92	0.25758	0.00E+00
93	0.28788	0.00E+00
94	0.31818	0.00E+00
95	0.34848	0.00E+00
96	0.37879	0.00E+00
97	0.40909	0.00E+00
98	0.43939	0.00E+00
99	0.4697	0.00E+00
100	0.5	0.00E+00

Table H2.D-9d. TRAP Model Output for Mercury Data for the Bird Reproduction Endpoint (Pooling Group B: Heinz and Hoffman 1998; Heinz et al. 2010)

Chemical:	Mercury
Study Authors:	Pooling group B (mallard)
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
1.00E-03	100	not reported
1.00E-01	106.55	not reported
0.2	91.071	not reported
0.4	86.905	not reported
0.8	74.405	not reported
0.000	100.0	not reported
1	14.474	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes	yes	yes
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.13981	-5.88E-02	3.89E-02	-0.18253	6.49E-02
S	1.1212	3.36E+00	2.5047	-4.6073	11.335
Y0	1.03E+02	9.62E+01	7.6097	71.979	120.41

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.13981	-5.73E-02	4.28E-02	-0.19344	7.88E-02
S	1.1212	3.36E+00	2.8065	-5.5677	12.295
Y0	1.03E+02	9.70E+01	7.7584	72.309	121.69

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.13981	-6.15E-02	3.44E-02	-0.17096	4.81E-02
S	1.1212	3.3637	2.1978	-3.6306	10.358
Y0	1.03E+02	9.75E+01	7.2903	74.254	120.66

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.87338	0.65685	1.1613	3.89E-02	-5.88E-02
20	6.89E-01	3.51E-01	1.35E+00	9.20E-02	-0.16183
10	6.00E-01	2.24E-01	1.60E+00	0.13414	-0.2221
5	5.28E-01	1.47E-01	1.89E+00	0.17418	-0.27764
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.87637	0.64056	1.199	4.28E-02	-5.73E-02
20	0.68143	3.07E-01	1.5103	0.10861	-0.16658
10	6.00E-01	1.79E-01	2.01E+00	0.16491	-0.22165
5	0.54879	1.09E-01	2.76E+00	0.22063	-0.26059
0	0.44197	5.14E-03	3.80E+01	0.6079	-3.55E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.86806	0.6746	1.117	3.44E-02	-6.15E-02
20	0.70691	0.40644	1.2295	7.55E-02	-0.15064
10	0.66014	0.333	1.3087	9.34E-02	-0.18037
5	0.63792	0.30094	1.3522	0.10253	-0.19523
0	0.61646	0.27178	1.3983	0.11177	-0.2101

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-3.00E+00	1.00E+02	9.62E+01
2	-1.00E+00	1.07E+02	9.62E+01
3	-6.99E-01	9.11E+01	9.62E+01
4	-3.98E-01	8.69E+01	9.52E+01
5	-9.69E-02	74.405	60.167
6	0.00E+00	14.474	30.006
7			

	Exposure	Effects Var	Est Effects Var
1	-3.00E+00	1.00E+02	9.70E+01
2	-1.00E+00	1.07E+02	9.70E+01
3	-6.99E-01	9.11E+01	9.70E+01
4	-3.98E-01	8.69E+01	9.70E+01
5	-9.69E-02	74.405	60.559
6	0.00E+00	14.474	31.603
7			

	Exposure	Effects Var	Est Effects Var
1	-3.00E+00	1.00E+02	9.75E+01
2	-1.00E+00	1.07E+02	9.75E+01
3	-6.99E-01	9.11E+01	9.75E+01
4	-3.98E-01	8.69E+01	9.75E+01
5	-9.69E-02	74.405	60.351
6	0.00E+00	14.474	28.583
7			

Analysis of Variance

R-squared: 0.882

	DF	SS	MS	F	Sig
Total (adj)	5	5592.8	1118.6		
Regression	2	4932.2	2466.1	11.2	0.0406
Error	3	660.55	220.18		

R-squared: 0.871

	DF	SS	MS	F	Sig
Total (adj)	5	5592.8	1118.6		
Regression	2	4870.5	2435.2	10.114	0.0464
Error	3	722.31	240.77		

R-squared: 0.886

	DF	SS	MS	F	Sig
Total (adj)	5	5592.8	1118.6		
Regression	2	4955	2477.5	11.654	0.0385
Error	3	637.79	212.6		

Prediction Line

	X	Y
1	-3	9.62E+01
2	-2.96E+00	9.62E+01
3	-2.93E+00	9.62E+01
4	-2.89E+00	9.62E+01
5	-2.86E+00	9.62E+01
6	-2.82E+00	9.62E+01
7	-2.79E+00	9.62E+01
8	-2.75E+00	9.62E+01
9	-2.72E+00	9.62E+01
10	-2.68E+00	9.62E+01
11	-2.65E+00	9.62E+01
12	-2.61E+00	9.62E+01
13	-2.58E+00	9.62E+01
14	-2.5404	9.62E+01
15	-2.5051	9.62E+01
16	-2.4697	9.62E+01
17	-2.4343	9.62E+01
18	-2.399	9.62E+01
19	-2.3636	9.62E+01
20	-2.3283	9.62E+01
21	-2.29E+00	9.62E+01
22	-2.26E+00	9.62E+01
23	-2.22E+00	9.62E+01
24	-2.19E+00	9.62E+01
25	-2.15E+00	9.62E+01
26	-2.12E+00	9.62E+01
27	-2.08E+00	9.62E+01
28	-2.05E+00	9.62E+01
29	-2.01E+00	9.62E+01

	X	Y
1	-3	9.70E+01
2	-2.96E+00	9.70E+01
3	-2.93E+00	9.70E+01
4	-2.89E+00	9.70E+01
5	-2.86E+00	9.70E+01
6	-2.82E+00	9.70E+01
7	-2.79E+00	9.70E+01
8	-2.75E+00	9.70E+01
9	-2.72E+00	9.70E+01
10	-2.68E+00	9.70E+01
11	-2.65E+00	9.70E+01
12	-2.61E+00	9.70E+01
13	-2.58E+00	9.70E+01
14	-2.5404	9.70E+01
15	-2.5051	9.70E+01
16	-2.4697	9.70E+01
17	-2.4343	9.70E+01
18	-2.399	9.70E+01
19	-2.3636	9.70E+01
20	-2.3283	9.70E+01
21	-2.29E+00	9.70E+01
22	-2.26E+00	9.70E+01
23	-2.22E+00	9.70E+01
24	-2.19E+00	9.70E+01
25	-2.15E+00	9.70E+01
26	-2.12E+00	9.70E+01
27	-2.08E+00	9.70E+01
28	-2.05E+00	9.70E+01
29	-2.01E+00	9.70E+01

	X	Y
1	-3	9.75E+01
2	-2.96E+00	9.75E+01
3	-2.93E+00	9.75E+01
4	-2.89E+00	9.75E+01
5	-2.86E+00	9.75E+01
6	-2.82E+00	9.75E+01
7	-2.79E+00	9.75E+01
8	-2.75E+00	9.75E+01
9	-2.72E+00	9.75E+01
10	-2.68E+00	9.75E+01
11	-2.65E+00	9.75E+01
12	-2.61E+00	9.75E+01
13	-2.58E+00	9.75E+01
14	-2.5404	9.75E+01
15	-2.5051	9.75E+01
16	-2.4697	9.75E+01
17	-2.4343	9.75E+01
18	-2.399	9.75E+01
19	-2.3636	9.75E+01
20	-2.3283	9.75E+01
21	-2.29E+00	9.75E+01
22	-2.26E+00	9.75E+01
23	-2.22E+00	9.75E+01
24	-2.19E+00	9.75E+01
25	-2.15E+00	9.75E+01
26	-2.12E+00	9.75E+01
27	-2.08E+00	9.75E+01
28	-2.05E+00	9.75E+01
29	-2.01E+00	9.75E+01

Prediction Line

	X	Y
30	-1.97E+00	9.62E+01
31	-1.9394	9.62E+01
32	-1.904	9.62E+01
33	-1.8687	9.62E+01
34	-1.8333	9.62E+01
35	-1.798	9.62E+01
36	-1.7626	9.62E+01
37	-1.7273	9.62E+01
38	-1.6919	9.62E+01
39	-1.6566	9.62E+01
40	-1.6212	9.62E+01
41	-1.5859	9.62E+01
42	-1.5505	9.62E+01
43	-1.5152	9.62E+01
44	-1.4798	9.62E+01
45	-1.4444	9.62E+01
46	-1.4091	9.62E+01
47	-1.3737	9.62E+01
48	-1.3384	9.62E+01
49	-1.303	9.62E+01
50	-1.2677	9.62E+01
51	-1.2323	9.62E+01
52	-1.197	9.62E+01
53	-1.1616	9.62E+01
54	-1.1263	9.62E+01
55	-1.0909	9.62E+01
56	-1.0556	9.62E+01
57	-1.0202	9.62E+01
58	-0.98485	9.62E+01
59	-0.94949	9.62E+01
60	-0.91414	9.62E+01
61	-0.87879	9.62E+01
62	-0.84343	9.62E+01
63	-0.80808	9.62E+01
64	-0.77273	9.62E+01
65	-0.73737	9.62E+01
66	-0.70202	9.62E+01
67	-0.66667	9.62E+01
68	-0.63131	9.62E+01
69	-0.59596	9.61E+01
70	-0.56061	9.61E+01
71	-0.52525	9.60E+01
72	-0.4899	9.59E+01
73	-0.45455	9.57E+01
74	-0.41919	9.54E+01
75	-0.38384	9.50E+01
76	-0.34848	9.43E+01
77	-0.31313	9.32E+01
78	-0.27778	9.14E+01
79	-0.24242	8.87E+01
80	-0.20707	8.47E+01

	X	Y
30	-1.97E+00	9.70E+01
31	-1.9394	9.70E+01
32	-1.904	9.70E+01
33	-1.8687	9.70E+01
34	-1.8333	9.70E+01
35	-1.798	9.70E+01
36	-1.7626	9.70E+01
37	-1.7273	9.70E+01
38	-1.6919	9.70E+01
39	-1.6566	9.70E+01
40	-1.6212	9.70E+01
41	-1.5859	9.70E+01
42	-1.5505	9.70E+01
43	-1.5152	9.70E+01
44	-1.4798	9.70E+01
45	-1.4444	9.70E+01
46	-1.4091	9.70E+01
47	-1.3737	9.70E+01
48	-1.3384	9.70E+01
49	-1.303	9.70E+01
50	-1.2677	9.70E+01
51	-1.2323	9.70E+01
52	-1.197	9.70E+01
53	-1.1616	9.70E+01
54	-1.1263	9.70E+01
55	-1.0909	9.70E+01
56	-1.0556	9.70E+01
57	-1.0202	9.70E+01
58	-0.98485	9.70E+01
59	-0.94949	9.70E+01
60	-0.91414	9.70E+01
61	-0.87879	9.70E+01
62	-0.84343	9.70E+01
63	-0.80808	9.70E+01
64	-0.77273	9.70E+01
65	-0.73737	9.70E+01
66	-0.70202	9.70E+01
67	-0.66667	9.70E+01
68	-0.63131	9.70E+01
69	-0.59596	9.70E+01
70	-0.56061	9.70E+01
71	-0.52525	9.70E+01
72	-0.4899	9.70E+01
73	-0.45455	9.70E+01
74	-0.41919	9.70E+01
75	-0.38384	9.70E+01
76	-0.34848	9.70E+01
77	-0.31313	9.61E+01
78	-0.27778	9.38E+01
79	-0.24242	9.01E+01
80	-0.20707	8.51E+01

	X	Y
30	-1.97E+00	9.75E+01
31	-1.9394	9.75E+01
32	-1.904	9.75E+01
33	-1.8687	9.75E+01
34	-1.8333	9.75E+01
35	-1.798	9.75E+01
36	-1.7626	9.75E+01
37	-1.7273	9.75E+01
38	-1.6919	9.75E+01
39	-1.6566	9.75E+01
40	-1.6212	9.75E+01
41	-1.5859	9.75E+01
42	-1.5505	9.75E+01
43	-1.5152	9.75E+01
44	-1.4798	9.75E+01
45	-1.4444	9.75E+01
46	-1.4091	9.75E+01
47	-1.3737	9.75E+01
48	-1.3384	9.75E+01
49	-1.303	9.75E+01
50	-1.2677	9.75E+01
51	-1.2323	9.75E+01
52	-1.197	9.75E+01
53	-1.1616	9.75E+01
54	-1.1263	9.75E+01
55	-1.0909	9.75E+01
56	-1.0556	9.75E+01
57	-1.0202	9.75E+01
58	-0.98485	9.75E+01
59	-0.94949	9.75E+01
60	-0.91414	9.75E+01
61	-0.87879	9.75E+01
62	-0.84343	9.75E+01
63	-0.80808	9.75E+01
64	-0.77273	9.75E+01
65	-0.73737	9.75E+01
66	-0.70202	9.75E+01
67	-0.66667	9.75E+01
68	-0.63131	9.75E+01
69	-0.59596	9.75E+01
70	-0.56061	9.75E+01
71	-0.52525	9.75E+01
72	-0.4899	9.75E+01
73	-0.45455	9.75E+01
74	-0.41919	9.75E+01
75	-0.38384	9.75E+01
76	-0.34848	9.75E+01
77	-0.31313	9.75E+01
78	-0.27778	9.75E+01
79	-0.24242	9.75E+01
80	-0.20707	9.65E+01

Prediction Line

	X	Y
81	-0.17172	7.89E+01
82	-0.13636	7.11E+01
83	-0.10101	6.14E+01
84	-6.57E-02	5.03E+01
85	-3.03E-02	3.90E+01
86	5.05E-03	2.86E+01
87	4.04E-02	2.00E+01
88	7.58E-02	1.35E+01
89	0.11111	8.88E+00
90	0.14646	5.72E+00
91	0.18182	3.63E+00
92	0.21717	2.29E+00
93	0.25253	1.44E+00
94	0.28788	8.98E-01
95	0.32323	5.60E-01
96	0.35859	3.49E-01
97	0.39394	2.17E-01
98	0.42929	1.35E-01
99	0.46465	8.40E-02
100	0.5	5.22E-02

	X	Y
81	-0.17172	7.86E+01
82	-0.13636	7.09E+01
83	-0.10101	6.17E+01
84	-6.57E-02	5.12E+01
85	-3.03E-02	4.01E+01
86	5.05E-03	3.03E+01
87	4.04E-02	2.19E+01
88	7.58E-02	1.48E+01
89	0.11111	9.11E+00
90	0.14646	4.80E+00
91	0.18182	1.86E+00
92	0.21717	2.85E-01
93	0.25253	0.00E+00
94	0.28788	0.00E+00
95	0.32323	0.00E+00
96	0.35859	0.00E+00
97	0.39394	0.00E+00
98	0.42929	0.00E+00
99	0.46465	0.00E+00
100	0.5	0.00E+00

	X	Y
81	-0.17172	8.49E+01
82	-0.13636	7.33E+01
83	-0.10101	6.17E+01
84	-6.57E-02	5.01E+01
85	-3.03E-02	3.85E+01
86	5.05E-03	2.69E+01
87	4.04E-02	1.53E+01
88	7.58E-02	3.75E+00
89	0.11111	0.00E+00
90	0.14646	0.00E+00
91	0.18182	0.00E+00
92	0.21717	0.00E+00
93	0.25253	0.00E+00
94	0.28788	0.00E+00
95	0.32323	0.00E+00
96	0.35859	0.00E+00
97	0.39394	0.00E+00
98	0.42929	0.00E+00
99	0.46465	0.00E+00
100	0.5	0.00E+00

Table H2.D-9e. TRAP Model Output for Methylmercury Data for the Mammal Survival Endpoint (Pooling Group E: Mitsumori et al. 1983; Verschuuren et al. 1976b)

Chemical:	Mercury
Study Authors:	Pooling group E
Receptor Group:	Mammal
Effect Description:	Survival

Input Data:	Dose	Effect Relative to Control
	1.00E-06	100
	2.62E-02	100
	0.13096	107.95
	0.65479	28.409
	1.00E-06	100
	2.59E-02	108.33
	0.12929	108.33
	0.64647	33.333
	1.00E-06	100
	8.10E-03	78.947
	4.05E-02	84.211
	0.2025	73.684
	0.000001	100.0
	7.08E-03	94.444
	3.54E-02	66.667
	0.1769	66.667

Modeling Parameters																		
Analysis Type:	Nonlinear Regression						Nonlinear Regression						Nonlinear Regression					
Model Shape:	Logistic Equation						Threshold Sigmoid						Piecewise Linear					
# of Parameters:	Three						Three						Three					
Exposure Variable Transform:	Logarithm						Logarithm						Logarithm					
Error Messages Encountered																		
Inadequate Partial Effects - Proceed Anyway?																		
Use Only for Exploratory Data Analysis!																		
Maximum Iterations Reached Without Convergence													yes					
X50 at Maximum or Minimum Limit																		
Steepness At Maximum Or Minimum Limit																		
Error Estimates Cannot Be Determined																		
Large Standard Error for X50																		
Large Standard Error for Steepness																		
Large Standard Error for Y0																		
Inadequate Number of Partial Effects																		
Insufficient Data to Plot																		
Insufficient Data to Analyze																		
Model Parameters		Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL		Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL		Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
	LogX50	-0.36035	-0.34511	9.07E-02	-5.41E-01	-0.14907	LogX50	-0.36035	-0.34567	8.51E-02	-5.30E-01	-0.16184	LogX50	-0.36035	-0.37893	7.33E-02	-0.5372	-0.22066
	S	1.2775	1.24E+00	0.44876	0.27104	2.21	S	1.2775	1.35E+00	0.41605	0.44656	2.2442	S	1.2775	0.98137	0.2036	0.54153	1.4212
	Y0	9.43E+01	9.50E+01	4.5166	85.213	104.73	Y0	9.43E+01	9.44E+01	4.3065	85.122	103.73	Y0	9.43E+01	9.44E+01	3.9775	85.794	102.98

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.45174	2.88E-01	0.70947	9.07E-02	-0.34511
20	2.37E-01	1.14E-01	4.95E-01	0.14772	-0.62448
10	1.63E-01	6.08E-02	4.37E-01	0.19809	-0.78791
5	1.15E-01	3.36E-02	3.96E-01	0.24795	-0.93849
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.45116	2.95E-01	0.68891	8.51E-02	-0.34567
20	0.24051	1.31E-01	0.43999	0.12142	-0.61886
10	1.75E-01	8.14E-02	3.77E-01	0.15404	-0.75655
5	1.40E-01	5.68E-02	3.45E-01	0.1814	-0.85391
0	8.15E-02	1.69E-02	3.94E-01	0.31672	-1.09E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.4179	0.29027	0.60164	7.33E-02	-0.37893
20	0.20672	0.14224	0.30042	7.52E-02	-0.68463
10	0.16348	0.10617	0.25173	8.68E-02	-0.78652
5	0.14539	9.12E-02	0.23187	9.38E-02	-0.83747
0	0.12929	7.80E-02	0.21423	0.10151	-0.88842

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.50E+01
2	-6.00E+00	1.00E+02	9.50E+01
3	-6.00E+00	1.00E+02	9.50E+01
4	-6.00E+00	1.00E+02	9.50E+01
5	-2.15E+00	94.4	94.958
6	-2.09E+00	78.9	94.954
7	-1.59E+00	108.3	94.771
8	-1.58E+00	100	94.765
9	-1.45E+00	66.7	94.579
10	-1.39E+00	84.2	94.448
11	-8.88E-01	108.3	88.967
12	-8.83E-01	108	88.81
13	-7.52E-01	66.7	83.851
14	-6.94E-01	73.7	80.658
15	-1.89E-01	33.3	30.007
16	-0.1839	28.4	29.444

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.44E+01
2	-6.00E+00	1.00E+02	9.44E+01
3	-6.00E+00	1.00E+02	9.44E+01
4	-6.00E+00	1.00E+02	9.44E+01
5	-2.15E+00	94.4	94.426
6	-2.09E+00	78.9	94.426
7	-1.59E+00	108.3	94.426
8	-1.58E+00	100	94.426
9	-1.45E+00	66.7	94.426
10	-1.39E+00	84.2	94.426
11	-8.88E-01	108.3	90.989
12	-8.83E-01	108	90.796
13	-7.52E-01	66.7	84.738
14	-6.94E-01	73.7	81.067
15	-1.89E-01	33.3	29.452
16	-0.1839	28.4	28.898

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.44E+01
2	-6.00E+00	1.00E+02	9.44E+01
3	-6.00E+00	1.00E+02	9.44E+01
4	-6.00E+00	1.00E+02	9.44E+01
5	-2.15E+00	94.4	94.387
6	-2.09E+00	78.9	94.387
7	-1.59E+00	108.3	94.387
8	-1.58E+00	100	94.387
9	-1.45E+00	66.7	94.387
10	-1.39E+00	84.2	94.387
11	-8.88E-01	108.3	94.387
12	-8.83E-01	108	93.873
13	-7.52E-01	66.7	81.775
14	-6.94E-01	73.7	76.339
15	-1.89E-01	33.3	29.642
16	-0.1839	28.4	29.128

Analysis of Variance

R-squared: 0.733

	DF	SS	MS	F	Sig
Total (adj)	15	9534.7	635.65		
Regression	2	6986.3	3493.1	17.819	0.0002
Error	13	2548.5	196.04		

R-squared: 0.743

	DF	SS	MS	F	Sig
Total (adj)	15	9534.7	635.65		
Regression	2	7082.2	3541.1	18.77	0.0001
Error	13	2452.5	188.66		

R-squared: 0.779

	DF	SS	MS	F	Sig
Total (adj)	15	9534.7	635.65		
Regression	2	7432.2	3716.1	22.976	0.0001
Error	13	2102.6	161.74		

Prediction Line

	X	Y
1	-4	9.50E+01
2	-3.95E+00	9.50E+01
3	-3.91E+00	9.50E+01
4	-3.86E+00	9.50E+01
5	-3.82E+00	9.50E+01
6	-3.77E+00	9.50E+01
7	-3.73E+00	9.50E+01
8	-3.68E+00	9.50E+01
9	-3.64E+00	9.50E+01
10	-3.59E+00	9.50E+01
11	-3.55E+00	9.50E+01
12	-3.50E+00	9.50E+01

	X	Y
1	-4	9.44E+01
2	-3.95E+00	9.44E+01
3	-3.91E+00	9.44E+01
4	-3.86E+00	9.44E+01
5	-3.82E+00	9.44E+01
6	-3.77E+00	9.44E+01
7	-3.73E+00	9.44E+01
8	-3.68E+00	9.44E+01
9	-3.64E+00	9.44E+01
10	-3.59E+00	9.44E+01
11	-3.55E+00	9.44E+01
12	-3.50E+00	9.44E+01

Prediction Line

	X	Y
13	-3.45E+00	9.50E+01
14	-3.41E+00	9.50E+01
15	-3.36E+00	9.50E+01
16	-3.3182	9.50E+01
17	-3.2727	9.50E+01
18	-3.2273	9.50E+01
19	-3.1818	9.50E+01
20	-3.1364	9.50E+01
21	-3.09E+00	9.50E+01
22	-3.05E+00	9.50E+01
23	-3.00E+00	9.50E+01
24	-2.95E+00	9.50E+01
25	-2.91E+00	9.50E+01
26	-2.86E+00	9.50E+01
27	-2.82E+00	9.50E+01
28	-2.77E+00	9.50E+01
29	-2.73E+00	9.50E+01
30	-2.68E+00	9.50E+01
31	-2.6364	9.50E+01
32	-2.5909	9.50E+01
33	-2.5455	9.50E+01
34	-2.5	9.50E+01
35	-2.4545	9.50E+01
36	-2.4091	9.50E+01
37	-2.3636	9.50E+01
38	-2.3182	9.50E+01
39	-2.2727	9.50E+01
40	-2.2273	9.50E+01
41	-2.1818	9.50E+01
42	-2.1364	9.50E+01
43	-2.0909	9.50E+01
44	-2.0455	9.49E+01
45	-2	9.49E+01
46	-1.9545	9.49E+01
47	-1.9091	9.49E+01
48	-1.8636	9.49E+01
49	-1.8182	9.49E+01
50	-1.7727	9.49E+01
51	-1.7273	9.49E+01
52	-1.6818	9.48E+01
53	-1.6364	9.48E+01
54	-1.5909	9.48E+01
55	-1.5455	9.47E+01
56	-1.5	9.47E+01
57	-1.4545	9.46E+01
58	-1.4091	9.45E+01
59	-1.3636	9.44E+01
60	-1.3182	9.42E+01
61	-1.2727	9.40E+01
62	-1.2273	9.38E+01
63	-1.1818	9.35E+01

	X	Y
13	-3.45E+00	9.44E+01
14	-3.41E+00	9.44E+01
15	-3.36E+00	9.44E+01
16	-3.3182	9.44E+01
17	-3.2727	9.44E+01
18	-3.2273	9.44E+01
19	-3.1818	9.44E+01
20	-3.1364	9.44E+01
21	-3.09E+00	9.44E+01
22	-3.05E+00	9.44E+01
23	-3.00E+00	9.44E+01
24	-2.95E+00	9.44E+01
25	-2.91E+00	9.44E+01
26	-2.86E+00	9.44E+01
27	-2.82E+00	9.44E+01
28	-2.77E+00	9.44E+01
29	-2.73E+00	9.44E+01
30	-2.68E+00	9.44E+01
31	-2.6364	9.44E+01
32	-2.5909	9.44E+01
33	-2.5455	9.44E+01
34	-2.5	9.44E+01
35	-2.4545	9.44E+01
36	-2.4091	9.44E+01
37	-2.3636	9.44E+01
38	-2.3182	9.44E+01
39	-2.2727	9.44E+01
40	-2.2273	9.44E+01
41	-2.1818	9.44E+01
42	-2.1364	9.44E+01
43	-2.0909	9.44E+01
44	-2.0455	9.44E+01
45	-2	9.44E+01
46	-1.9545	9.44E+01
47	-1.9091	9.44E+01
48	-1.8636	9.44E+01
49	-1.8182	9.44E+01
50	-1.7727	9.44E+01
51	-1.7273	9.44E+01
52	-1.6818	9.44E+01
53	-1.6364	9.44E+01
54	-1.5909	9.44E+01
55	-1.5455	9.44E+01
56	-1.5	9.44E+01
57	-1.4545	9.44E+01
58	-1.4091	9.44E+01
59	-1.3636	9.44E+01
60	-1.3182	9.44E+01
61	-1.2727	9.44E+01
62	-1.2273	9.44E+01
63	-1.1818	9.44E+01

	X	Y
13	-3.45E+00	9.44E+01
14	-3.4091	9.44E+01
15	-3.3636	9.44E+01
16	-3.3182	9.44E+01
17	-3.2727	9.44E+01
18	-3.2273	9.44E+01
19	-3.1818	9.44E+01
20	-3.1364	9.44E+01
21	-3.09E+00	9.44E+01
22	-3.05E+00	9.44E+01
23	-3.00E+00	9.44E+01
24	-2.95E+00	9.44E+01
25	-2.91E+00	9.44E+01
26	-2.86E+00	9.44E+01
27	-2.82E+00	9.44E+01
28	-2.77E+00	9.44E+01
29	-2.73E+00	9.44E+01
30	-2.68E+00	9.44E+01
31	-2.6364	9.44E+01
32	-2.5909	9.44E+01
33	-2.5455	9.44E+01
34	-2.5	9.44E+01
35	-2.4545	9.44E+01
36	-2.4091	9.44E+01
37	-2.3636	9.44E+01
38	-2.3182	9.44E+01
39	-2.2727	9.44E+01
40	-2.2273	9.44E+01
41	-2.1818	9.44E+01
42	-2.1364	9.44E+01
43	-2.0909	9.44E+01
44	-2.0455	9.44E+01
45	-2	9.44E+01
46	-1.9545	9.44E+01
47	-1.9091	9.44E+01
48	-1.8636	9.44E+01
49	-1.8182	9.44E+01
50	-1.7727	9.44E+01
51	-1.7273	9.44E+01
52	-1.6818	9.44E+01
53	-1.6364	9.44E+01
54	-1.5909	9.44E+01
55	-1.5455	9.44E+01
56	-1.5	9.44E+01
57	-1.4545	9.44E+01
58	-1.4091	9.44E+01
59	-1.3636	9.44E+01
60	-1.3182	9.44E+01
61	-1.2727	9.44E+01
62	-1.2273	9.44E+01
63	-1.1818	9.44E+01

Prediction Line

	X	Y
64	-1.1364	9.31E+01
65	-1.0909	9.27E+01
66	-1.0455	9.21E+01
67	-1	9.14E+01
68	-0.95455	9.06E+01
69	-0.90909	8.95E+01
70	-0.86364	8.82E+01
71	-0.81818	8.67E+01
72	-0.77273	8.48E+01
73	-0.72727	8.26E+01
74	-0.68182	7.99E+01
75	-0.63636	7.69E+01
76	-0.59091	7.33E+01
77	-0.54545	6.93E+01
78	-0.5	6.49E+01
79	-0.45455	6.01E+01
80	-0.40909	5.50E+01
81	-0.36364	4.97E+01
82	-0.31818	4.43E+01
83	-0.27273	3.90E+01
84	-0.22727	3.40E+01
85	-0.18182	2.92E+01
86	-0.13636	2.49E+01
87	-9.09E-02	2.10E+01
88	-4.55E-02	1.75E+01
89	0	1.45E+01
90	4.55E-02	1.20E+01
91	9.09E-02	9.79E+00
92	0.13636	7.98E+00
93	0.18182	6.48E+00
94	0.22727	5.24E+00
95	0.27273	4.23E+00
96	0.31818	3.41E+00
97	0.36364	2.74E+00
98	0.40909	2.20E+00
99	0.45455	1.76E+00
100	0.5	1.41E+00

	X	Y
64	-1.1364	9.44E+01
65	-1.0909	9.44E+01
66	-1.0455	9.43E+01
67	-1	9.38E+01
68	-0.95455	9.29E+01
69	-0.90909	9.17E+01
70	-0.86364	9.01E+01
71	-0.81818	8.82E+01
72	-0.77273	8.59E+01
73	-0.72727	8.32E+01
74	-0.68182	8.03E+01
75	-0.63636	7.69E+01
76	-0.59091	7.32E+01
77	-0.54545	6.92E+01
78	-0.5	6.48E+01
79	-0.45455	6.00E+01
80	-0.40909	5.49E+01
81	-0.36364	4.95E+01
82	-0.31818	4.38E+01
83	-0.27273	3.84E+01
84	-0.22727	3.34E+01
85	-0.18182	2.87E+01
86	-0.13636	2.44E+01
87	-9.09E-02	2.04E+01
88	-4.55E-02	1.68E+01
89	0	1.35E+01
90	4.55E-02	1.06E+01
91	9.09E-02	8.04E+00
92	0.13636	5.83E+00
93	0.18182	3.98E+00
94	0.22727	2.48E+00
95	0.27273	1.33E+00
96	0.31818	5.39E-01
97	0.36364	9.87E-02
98	0.40909	0.00E+00
99	0.45455	0.00E+00
100	0.5	0.00E+00

	X	Y
64	-1.1364	9.44E+01
65	-1.0909	9.44E+01
66	-1.0455	9.44E+01
67	-1	9.44E+01
68	-0.95455	9.44E+01
69	-0.90909	9.44E+01
70	-0.86364	9.21E+01
71	-0.81818	8.79E+01
72	-0.77273	8.37E+01
73	-0.72727	7.95E+01
74	-0.68182	7.53E+01
75	-0.63636	7.10E+01
76	-0.59091	6.68E+01
77	-0.54545	6.26E+01
78	-0.5	5.84E+01
79	-0.45455	5.42E+01
80	-0.40909	5.00E+01
81	-0.36364	4.58E+01
82	-0.31818	4.16E+01
83	-0.27273	3.74E+01
84	-0.22727	3.31E+01
85	-0.18182	2.89E+01
86	-0.13636	2.47E+01
87	-9.09E-02	2.05E+01
88	-4.55E-02	1.63E+01
89	0	1.21E+01
90	4.55E-02	7.88E+00
91	9.09E-02	3.67E+00
92	0.13636	0.00E+00
93	0.18182	0.00E+00
94	0.22727	0.00E+00
95	0.27273	0.00E+00
96	0.31818	0.00E+00
97	0.36364	0.00E+00
98	0.40909	0.00E+00
99	0.45455	0.00E+00
100	0.5	0.00E+00

Table H2.D-10a. TRAP Model Output for Molybdenum Data for the Bird Growth Endpoint (Pooling Group A: Davies et al. 1960)

Chemical:	Molybdenum
Study Authors:	Pooling group A
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect Relative to Control
0.000001	100
55.85317	88.920
83.77976	77.841
111.7063	73.864
139.6329	74.716
167.5595	65.341
0.000001	100
223.4127	64.452
446.8254	34.219
670.2381	21.262
893.6508	15.615

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.4294	2.4557	3.01E-02	2.3862	2.5251
S	0.75981	7.83E-01	6.14E-02	0.64146	0.92459
Y0	1.00E+02	9.87E+01	2.4568	93.04	104.37

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.4294	2.4528	3.09E-02	2.3815	2.524
S	0.75981	8.18E-01	6.17E-02	0.6755	0.96001
Y0	1.00E+02	9.88E+01	2.54	92.945	104.66

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.4294	2.4342	3.82E-02	2.346	2.5224
S	0.75981	0.63458	4.73E-02	0.52549	0.74368
Y0	1.00E+02	1.00E+02	3.4606	92.02	107.98

Xp Estimates

	p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
1504.991	50	285.54	243.34	335.07	3.01E-02	2.4557
#REF!	20	1.03E+02	7.91E+01	1.34E+02	4.99E-02	2.0131
	10	5.68E+01	3.97E+01	8.12E+01	6.74E-02	1.7542
	5	3.28E+01	2.09E+01	5.14E+01	8.46E-02	1.5156
	0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	283.63	240.72	334.19	3.09E-02	2.4528
20	100.76	7.70E+01	131.85	5.06E-02	2.0033
10	5.98E+01	4.15E+01	8.63E+01	6.90E-02	1.7768
5	41.362	2.60E+01	6.57E+01	8.71E-02	1.6166
0	16.978	7.05E+00	4.09E+01	0.16558	1.23E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	271.76	221.81	332.96	3.82E-02	2.4342
20	91.505	68.022	123.09	5.59E-02	1.9614
10	63.659	45.081	89.893	6.50E-02	1.8039
5	53.097	36.643	76.939	6.99E-02	1.7251
0	44.287	29.761	65.902	7.49E-02	1.6463

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.87E+01
2	-6.00E+00	1.00E+02	9.87E+01
3	1.75E+00	8.89E+01	8.90E+01
4	1.92E+00	7.78E+01	8.30E+01
5	2.05E+00	73.864	77.175
6	2.15E+00	74.716	71.634
7	2.22E+00	65.341	66.5
8	2.35E+00	64.452	57.513
9	2.65E+00	34.219	34.771
10	2.83E+00	21.262	23.546
11	2.9512	15.615	17.254

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.88E+01
2	-6.00E+00	1.00E+02	9.88E+01
3	1.75E+00	8.89E+01	9.00E+01
4	1.92E+00	7.78E+01	8.29E+01
5	2.05E+00	73.864	76.688
6	2.15E+00	74.716	71.139
7	2.22E+00	65.341	66.144
8	2.35E+00	64.452	57.421
9	2.65E+00	34.219	34.741
10	2.83E+00	21.262	23.834
11	2.9512	15.615	17.338

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	1.75E+00	8.89E+01	9.36E+01
4	1.92E+00	7.78E+01	8.24E+01
5	2.05E+00	73.864	74.502
6	2.15E+00	74.716	68.353
7	2.22E+00	65.341	63.328
8	2.35E+00	64.452	55.399
9	2.65E+00	34.219	36.296
10	2.83E+00	21.262	25.122
11	2.9512	15.615	17.194

Analysis of Variance

R-squared: 0.987

	DF	SS	MS	F	Sig
Total (adj)	10	8659.7	865.97		
Regression	2	8551.1	4275.5	315.05	0
Error	8	108.57	13.571		

R-squared: 0.987

	DF	SS	MS	F	Sig
Total (adj)	10	8659.7	865.97		
Regression	2	8549.1	4274.6	309.39	0
Error	8	110.53	13.816		

R-squared: 0.978

	DF	SS	MS	F	Sig
Total (adj)	10	8659.7	865.97		
Regression	2	8468	4234	176.77	0
Error	8	191.62	23.952		

Prediction Line

	X	Y
1	-1	9.87E+01
2	-9.55E-01	9.87E+01
3	-9.09E-01	9.87E+01
4	-8.64E-01	9.87E+01
5	-8.18E-01	9.87E+01
6	-7.73E-01	9.87E+01
7	-7.27E-01	9.87E+01
8	-6.82E-01	9.87E+01
9	-6.36E-01	9.87E+01
10	-5.91E-01	9.87E+01
11	-5.45E-01	9.87E+01
12	-5.00E-01	9.87E+01
13	-4.55E-01	9.87E+01
14	-0.40909	9.87E+01
15	-0.36364	9.87E+01
16	-0.31818	9.87E+01
17	-0.27273	9.87E+01

	X	Y
1	-1	9.88E+01
2	-9.55E-01	9.88E+01
3	-9.09E-01	9.88E+01
4	-8.64E-01	9.88E+01
5	-8.18E-01	9.88E+01
6	-7.73E-01	9.88E+01
7	-7.27E-01	9.88E+01
8	-6.82E-01	9.88E+01
9	-6.36E-01	9.88E+01
10	-5.91E-01	9.88E+01
11	-5.45E-01	9.88E+01
12	-5.00E-01	9.88E+01
13	-4.55E-01	9.88E+01
14	-0.40909	9.88E+01
15	-0.36364	9.88E+01
16	-0.31818	9.88E+01
17	-0.27273	9.88E+01

	X	Y
1	-1	1.00E+02
2	-9.55E-01	1.00E+02
3	-9.09E-01	1.00E+02
4	-8.64E-01	1.00E+02
5	-8.18E-01	1.00E+02
6	-7.73E-01	1.00E+02
7	-7.27E-01	1.00E+02
8	-6.82E-01	1.00E+02
9	-6.36E-01	1.00E+02
10	-5.91E-01	1.00E+02
11	-5.45E-01	1.00E+02
12	-5.00E-01	1.00E+02
13	-4.55E-01	1.00E+02
14	-0.40909	1.00E+02
15	-0.36364	1.00E+02
16	-0.31818	1.00E+02
17	-0.27273	1.00E+02

Prediction Line

	X	Y
18	-0.22727	9.87E+01
19	-0.18182	9.87E+01
20	-0.13636	9.87E+01
21	-9.09E-02	9.87E+01
22	-4.55E-02	9.87E+01
23	0.00E+00	9.87E+01
24	4.55E-02	9.87E+01
25	9.09E-02	9.86E+01
26	1.36E-01	9.86E+01
27	1.82E-01	9.86E+01
28	2.27E-01	9.86E+01
29	2.73E-01	9.86E+01
30	3.18E-01	9.86E+01
31	0.36364	9.86E+01
32	0.40909	9.85E+01
33	0.45455	9.85E+01
34	0.5	9.85E+01
35	0.54545	9.85E+01
36	0.59091	9.84E+01
37	0.63636	9.84E+01
38	0.68182	9.83E+01
39	0.72727	9.83E+01
40	0.77273	9.82E+01
41	0.81818	9.81E+01
42	0.86364	9.80E+01
43	0.90909	9.79E+01
44	0.95455	9.78E+01
45	1	9.77E+01
46	1.0455	9.75E+01
47	1.0909	9.74E+01
48	1.1364	9.71E+01
49	1.1818	9.69E+01
50	1.2273	9.66E+01
51	1.2727	9.63E+01
52	1.3182	9.60E+01
53	1.3636	9.56E+01
54	1.4091	9.51E+01
55	1.4545	9.46E+01
56	1.5	9.40E+01
57	1.5455	9.33E+01
58	1.5909	9.25E+01
59	1.6364	9.17E+01
60	1.6818	9.07E+01
61	1.7273	8.96E+01
62	1.7727	8.83E+01
63	1.8182	8.69E+01
64	1.8636	8.53E+01
65	1.9091	8.36E+01
66	1.9545	8.17E+01
67	2	7.96E+01
68	2.0455	7.73E+01

	X	Y
18	-0.22727	9.88E+01
19	-0.18182	9.88E+01
20	-0.13636	9.88E+01
21	-9.09E-02	9.88E+01
22	-4.55E-02	9.88E+01
23	0.00E+00	9.88E+01
24	4.55E-02	9.88E+01
25	9.09E-02	9.88E+01
26	1.36E-01	9.88E+01
27	1.82E-01	9.88E+01
28	2.27E-01	9.88E+01
29	2.73E-01	9.88E+01
30	3.18E-01	9.88E+01
31	0.36364	9.88E+01
32	0.40909	9.88E+01
33	0.45455	9.88E+01
34	0.5	9.88E+01
35	0.54545	9.88E+01
36	0.59091	9.88E+01
37	0.63636	9.88E+01
38	0.68182	9.88E+01
39	0.72727	9.88E+01
40	0.77273	9.88E+01
41	0.81818	9.88E+01
42	0.86364	9.88E+01
43	0.90909	9.88E+01
44	0.95455	9.88E+01
45	1	9.88E+01
46	1.0455	9.88E+01
47	1.0909	9.88E+01
48	1.1364	9.88E+01
49	1.1818	9.88E+01
50	1.2273	9.88E+01
51	1.2727	9.87E+01
52	1.3182	9.85E+01
53	1.3636	9.82E+01
54	1.4091	9.77E+01
55	1.4545	9.71E+01
56	1.5	9.64E+01
57	1.5455	9.55E+01
58	1.5909	9.45E+01
59	1.6364	9.33E+01
60	1.6818	9.21E+01
61	1.7273	9.06E+01
62	1.7727	8.91E+01
63	1.8182	8.74E+01
64	1.8636	8.55E+01
65	1.9091	8.36E+01
66	1.9545	8.15E+01
67	2	7.92E+01
68	2.0455	7.68E+01

	X	Y
18	-0.22727	1.00E+02
19	-0.18182	1.00E+02
20	-0.13636	1.00E+02
21	-9.09E-02	1.00E+02
22	-4.55E-02	1.00E+02
23	0.00E+00	1.00E+02
24	4.55E-02	1.00E+02
25	9.09E-02	1.00E+02
26	1.36E-01	1.00E+02
27	1.82E-01	1.00E+02
28	2.27E-01	1.00E+02
29	2.73E-01	1.00E+02
30	3.18E-01	1.00E+02
31	0.36364	1.00E+02
32	0.40909	1.00E+02
33	0.45455	1.00E+02
34	0.5	1.00E+02
35	0.54545	1.00E+02
36	0.59091	1.00E+02
37	0.63636	1.00E+02
38	0.68182	1.00E+02
39	0.72727	1.00E+02
40	0.77273	1.00E+02
41	0.81818	1.00E+02
42	0.86364	1.00E+02
43	0.90909	1.00E+02
44	0.95455	1.00E+02
45	1	1.00E+02
46	1.0455	1.00E+02
47	1.0909	1.00E+02
48	1.1364	1.00E+02
49	1.1818	1.00E+02
50	1.2273	1.00E+02
51	1.2727	1.00E+02
52	1.3182	1.00E+02
53	1.3636	1.00E+02
54	1.4091	1.00E+02
55	1.4545	1.00E+02
56	1.5	1.00E+02
57	1.5455	1.00E+02
58	1.5909	1.00E+02
59	1.6364	1.00E+02
60	1.6818	9.77E+01
61	1.7273	9.49E+01
62	1.7727	9.20E+01
63	1.8182	8.91E+01
64	1.8636	8.62E+01
65	1.9091	8.33E+01
66	1.9545	8.04E+01
67	2	7.76E+01
68	2.0455	7.47E+01

Prediction Line

	X	Y
69	2.0909	7.48E+01
70	2.1364	7.22E+01
71	2.1818	6.93E+01
72	2.2273	6.63E+01
73	2.2727	6.31E+01
74	2.3182	5.98E+01
75	2.3636	5.64E+01
76	2.4091	5.29E+01
77	2.4545	4.94E+01
78	2.5	4.59E+01
79	2.5455	4.25E+01
80	2.5909	3.91E+01
81	2.6364	3.57E+01
82	2.6818	3.26E+01
83	2.7273	2.95E+01
84	2.7727	2.67E+01
85	2.8182	2.40E+01
86	2.8636	2.15E+01
87	2.9091	1.92E+01
88	2.9545	1.71E+01
89	3	1.52E+01
90	3.0455	1.34E+01
91	3.0909	1.19E+01
92	3.1364	1.05E+01
93	3.1818	9.21E+00
94	3.2273	8.08E+00
95	3.2727	7.09E+00
96	3.3182	6.21E+00
97	3.3636	5.43E+00
98	3.4091	4.74E+00
99	3.4545	4.14E+00
100	3.5	3.61E+00

	X	Y
69	2.0909	7.43E+01
70	2.1364	7.17E+01
71	2.1818	6.89E+01
72	2.2273	6.59E+01
73	2.2727	6.29E+01
74	2.3182	5.97E+01
75	2.3636	5.63E+01
76	2.4091	5.29E+01
77	2.4545	4.93E+01
78	2.5	4.57E+01
79	2.5455	4.22E+01
80	2.5909	3.89E+01
81	2.6364	3.57E+01
82	2.6818	3.26E+01
83	2.7273	2.97E+01
84	2.7727	2.69E+01
85	2.8182	2.43E+01
86	2.8636	2.18E+01
87	2.9091	1.94E+01
88	2.9545	1.72E+01
89	3	1.51E+01
90	3.0455	1.31E+01
91	3.0909	1.13E+01
92	3.1364	9.61E+00
93	3.1818	8.06E+00
94	3.2273	6.64E+00
95	3.2727	5.36E+00
96	3.3182	4.22E+00
97	3.3636	3.22E+00
98	3.4091	2.35E+00
99	3.4545	1.61E+00
100	3.5	1.02E+00

	X	Y
69	2.0909	7.18E+01
70	2.1364	6.89E+01
71	2.1818	6.60E+01
72	2.2273	6.31E+01
73	2.2727	6.02E+01
74	2.3182	5.74E+01
75	2.3636	5.45E+01
76	2.4091	5.16E+01
77	2.4545	4.87E+01
78	2.5	4.58E+01
79	2.5455	4.29E+01
80	2.5909	4.01E+01
81	2.6364	3.72E+01
82	2.6818	3.43E+01
83	2.7273	3.14E+01
84	2.7727	2.85E+01
85	2.8182	2.56E+01
86	2.8636	2.27E+01
87	2.9091	1.99E+01
88	2.9545	1.70E+01
89	3	1.41E+01
90	3.0455	1.12E+01
91	3.0909	8.33E+00
92	3.1364	5.44E+00
93	3.1818	2.56E+00
94	3.2273	0.00E+00
95	3.2727	0.00E+00
96	3.3182	0.00E+00
97	3.3636	0.00E+00
98	3.4091	0.00E+00
99	3.4545	0.00E+00
100	3.5	0.00E+00

Table H2.D-10b. TRAP Model Output for Molybdenum Data for the Bird Reproduction Endpoint (Lepore and Miller 1965)

Chemical:	Molybdenum
Study Authors:	Lepore and Miller 1965
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
0.000001	15.6	not reported
31.53449	13.3	not reported
63.06898	8	not reported
126.138	2.8	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.8174	1.8126			
S	1.3598	1.35E+00			
Y0	1.56E+01	1.56E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.8174	1.8122			
S	1.3598	1.42E+00			
Y0	1.56E+01	1.56E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.8174	1.8132			
S	1.3598	1.118			
Y0	1.56E+01	1.56E+01			

Xp Estimates

	p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
483.784	50	64.954	52.497	80.368	7.28E-03	1.8126
	20	3.60E+01	2.48E+01	5.22E+01	1.27E-02	1.556
	10	2.55E+01	1.54E+01	4.21E+01	1.72E-02	1.4059
	5	1.85E+01	9.85E+00	3.48E+01	2.16E-02	1.2676
	0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	64.892	53.582	78.589	6.55E-03	1.8122
20	35.733	2.55E+01	49.983	1.15E-02	1.5531
10	2.65E+01	1.66E+01	4.22E+01	1.59E-02	1.4225
5	21.386	1.18E+01	3.86E+01	2.02E-02	1.3301
0	12.799	4.80E+00	3.41E+01	3.35E-02	1.11E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	65.042	61.725	68.538	1.79E-03	1.8132
20	35.063	32.398	37.947	2.70E-03	1.5448
10	28.536	26.033	31.281	3.14E-03	1.4554
5	25.744	23.327	28.411	3.37E-03	1.4107
0	23.225	20.9	25.808	3.61E-03	1.366

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.56E+01	1.56E+01
2	1.50E+00	1.33E+01	1.32E+01
3	1.80E+00	8.00E+00	8.09E+00
4	2.10E+00	2.80E+00	2.72E+00
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	98.068	32.689		
Regression	2	98.044	49.022	2127.2	0.0153
Error	1	2.30E-02	2.30E-02		

Prediction Line

	X	Y
1	-2	1.56E+01
2	-1.95E+00	1.56E+01
3	-1.91E+00	1.56E+01
4	-1.86E+00	1.56E+01
5	-1.82E+00	1.56E+01
6	-1.77E+00	1.56E+01
7	-1.73E+00	1.56E+01
8	-1.68E+00	1.56E+01
9	-1.64E+00	1.56E+01
10	-1.59E+00	1.56E+01
11	-1.55E+00	1.56E+01
12	-1.50E+00	1.56E+01
13	-1.45E+00	1.56E+01
14	-1.4091	1.56E+01
15	-1.3636	1.56E+01
16	-1.3182	1.56E+01
17	-1.2727	1.56E+01
18	-1.2273	1.56E+01
19	-1.1818	1.56E+01
20	-1.1364	1.56E+01
21	-1.09E+00	1.56E+01
22	-1.05E+00	1.56E+01
23	-1.00E+00	1.56E+01
24	-9.55E-01	1.56E+01
25	-9.09E-01	1.56E+01
26	-8.64E-01	1.56E+01
27	-8.18E-01	1.56E+01
28	-7.73E-01	1.56E+01
29	-7.27E-01	1.56E+01
30	-6.82E-01	1.56E+01

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.56E+01	1.56E+01
2	1.50E+00	1.33E+01	1.32E+01
3	1.80E+00	8.00E+00	8.09E+00
4	2.10E+00	2.80E+00	2.73E+00
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	98.068	32.689		
Regression	2	98.047	49.023	2383.9	0.0145
Error	1	2.06E-02	2.06E-02		

Prediction Line

	X	Y
1	-2	1.56E+01
2	-1.95E+00	1.56E+01
3	-1.91E+00	1.56E+01
4	-1.86E+00	1.56E+01
5	-1.82E+00	1.56E+01
6	-1.77E+00	1.56E+01
7	-1.73E+00	1.56E+01
8	-1.68E+00	1.56E+01
9	-1.64E+00	1.56E+01
10	-1.59E+00	1.56E+01
11	-1.55E+00	1.56E+01
12	-1.50E+00	1.56E+01
13	-1.45E+00	1.56E+01
14	-1.4091	1.56E+01
15	-1.3636	1.56E+01
16	-1.3182	1.56E+01
17	-1.2727	1.56E+01
18	-1.2273	1.56E+01
19	-1.1818	1.56E+01
20	-1.1364	1.56E+01
21	-1.09E+00	1.56E+01
22	-1.05E+00	1.56E+01
23	-1.00E+00	1.56E+01
24	-9.55E-01	1.56E+01
25	-9.09E-01	1.56E+01
26	-8.64E-01	1.56E+01
27	-8.18E-01	1.56E+01
28	-7.73E-01	1.56E+01
29	-7.27E-01	1.56E+01
30	-6.82E-01	1.56E+01

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.56E+01	1.56E+01
2	1.50E+00	1.33E+01	1.33E+01
3	1.80E+00	8.00E+00	8.03E+00
4	2.10E+00	2.80E+00	2.78E+00
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	98.068	32.689		
Regression	2	98.066	49.033	29419	0.0041
Error	1	1.67E-03	1.67E-03		

Prediction Line

	X	Y
1	-2	1.56E+01
2	-1.95E+00	1.56E+01
3	-1.91E+00	1.56E+01
4	-1.86E+00	1.56E+01
5	-1.82E+00	1.56E+01
6	-1.77E+00	1.56E+01
7	-1.73E+00	1.56E+01
8	-1.68E+00	1.56E+01
9	-1.64E+00	1.56E+01
10	-1.59E+00	1.56E+01
11	-1.55E+00	1.56E+01
12	-1.50E+00	1.56E+01
13	-1.45E+00	1.56E+01
14	-1.4091	1.56E+01
15	-1.3636	1.56E+01
16	-1.3182	1.56E+01
17	-1.2727	1.56E+01
18	-1.2273	1.56E+01
19	-1.1818	1.56E+01
20	-1.1364	1.56E+01
21	-1.09E+00	1.56E+01
22	-1.05E+00	1.56E+01
23	-1.00E+00	1.56E+01
24	-9.55E-01	1.56E+01
25	-9.09E-01	1.56E+01
26	-8.64E-01	1.56E+01
27	-8.18E-01	1.56E+01
28	-7.73E-01	1.56E+01
29	-7.27E-01	1.56E+01
30	-6.82E-01	1.56E+01

Prediction Line

	X	Y
31	-0.63636	1.56E+01
32	-0.59091	1.56E+01
33	-0.54545	1.56E+01
34	-0.5	1.56E+01
35	-0.45455	1.56E+01
36	-0.40909	1.56E+01
37	-0.36364	1.56E+01
38	-0.31818	1.56E+01
39	-0.27273	1.56E+01
40	-0.22727	1.56E+01
41	-0.18182	1.56E+01
42	-0.13636	1.56E+01
43	-9.09E-02	1.56E+01
44	-4.55E-02	1.56E+01
45	0	1.56E+01
46	4.55E-02	1.56E+01
47	9.09E-02	1.56E+01
48	0.13636	1.56E+01
49	0.18182	1.56E+01
50	0.22727	1.56E+01
51	0.27273	1.56E+01
52	0.31818	1.56E+01
53	0.36364	1.56E+01
54	0.40909	1.56E+01
55	0.45455	1.56E+01
56	0.5	1.56E+01
57	0.54545	1.56E+01
58	0.59091	1.56E+01
59	0.63636	1.56E+01
60	0.68182	1.56E+01
61	0.72727	1.56E+01
62	0.77273	1.56E+01
63	0.81818	1.56E+01
64	0.86364	1.55E+01
65	0.90909	1.55E+01
66	0.95455	1.55E+01
67	1	1.54E+01
68	1.0455	1.54E+01
69	1.0909	1.53E+01
70	1.1364	1.52E+01
71	1.1818	1.51E+01
72	1.2273	1.50E+01
73	1.2727	1.48E+01
74	1.3182	1.46E+01
75	1.3636	1.44E+01
76	1.4091	1.41E+01
77	1.4545	1.37E+01
78	1.5	1.32E+01
79	1.5455	1.27E+01
80	1.5909	1.20E+01
81	1.6364	1.13E+01

	X	Y
31	-0.63636	1.56E+01
32	-0.59091	1.56E+01
33	-0.54545	1.56E+01
34	-0.5	1.56E+01
35	-0.45455	1.56E+01
36	-0.40909	1.56E+01
37	-0.36364	1.56E+01
38	-0.31818	1.56E+01
39	-0.27273	1.56E+01
40	-0.22727	1.56E+01
41	-0.18182	1.56E+01
42	-0.13636	1.56E+01
43	-9.09E-02	1.56E+01
44	-4.55E-02	1.56E+01
45	0	1.56E+01
46	4.55E-02	1.56E+01
47	9.09E-02	1.56E+01
48	0.13636	1.56E+01
49	0.18182	1.56E+01
50	0.22727	1.56E+01
51	0.27273	1.56E+01
52	0.31818	1.56E+01
53	0.36364	1.56E+01
54	0.40909	1.56E+01
55	0.45455	1.56E+01
56	0.5	1.56E+01
57	0.54545	1.56E+01
58	0.59091	1.56E+01
59	0.63636	1.56E+01
60	0.68182	1.56E+01
61	0.72727	1.56E+01
62	0.77273	1.56E+01
63	0.81818	1.56E+01
64	0.86364	1.56E+01
65	0.90909	1.56E+01
66	0.95455	1.56E+01
67	1	1.56E+01
68	1.0455	1.56E+01
69	1.0909	1.56E+01
70	1.1364	1.56E+01
71	1.1818	1.55E+01
72	1.2273	1.54E+01
73	1.2727	1.52E+01
74	1.3182	1.49E+01
75	1.3636	1.46E+01
76	1.4091	1.42E+01
77	1.4545	1.37E+01
78	1.5	1.32E+01
79	1.5455	1.26E+01
80	1.5909	1.20E+01
81	1.6364	1.12E+01

	X	Y
31	-0.63636	1.56E+01
32	-0.59091	1.56E+01
33	-0.54545	1.56E+01
34	-0.5	1.56E+01
35	-0.45455	1.56E+01
36	-0.40909	1.56E+01
37	-0.36364	1.56E+01
38	-0.31818	1.56E+01
39	-0.27273	1.56E+01
40	-0.22727	1.56E+01
41	-0.18182	1.56E+01
42	-0.13636	1.56E+01
43	-9.09E-02	1.56E+01
44	-4.55E-02	1.56E+01
45	0	1.56E+01
46	4.55E-02	1.56E+01
47	9.09E-02	1.56E+01
48	0.13636	1.56E+01
49	0.18182	1.56E+01
50	0.22727	1.56E+01
51	0.27273	1.56E+01
52	0.31818	1.56E+01
53	0.36364	1.56E+01
54	0.40909	1.56E+01
55	0.45455	1.56E+01
56	0.5	1.56E+01
57	0.54545	1.56E+01
58	0.59091	1.56E+01
59	0.63636	1.56E+01
60	0.68182	1.56E+01
61	0.72727	1.56E+01
62	0.77273	1.56E+01
63	0.81818	1.56E+01
64	0.86364	1.56E+01
65	0.90909	1.56E+01
66	0.95455	1.56E+01
67	1	1.56E+01
68	1.0455	1.56E+01
69	1.0909	1.56E+01
70	1.1364	1.56E+01
71	1.1818	1.56E+01
72	1.2273	1.56E+01
73	1.2727	1.56E+01
74	1.3182	1.56E+01
75	1.3636	1.56E+01
76	1.4091	1.48E+01
77	1.4545	1.41E+01
78	1.5	1.33E+01
79	1.5455	1.25E+01
80	1.5909	1.17E+01
81	1.6364	1.09E+01

Prediction Line

	X	Y
82	1.6818	1.05E+01
83	1.7273	9.59E+00
84	1.7727	8.66E+00
85	1.8182	7.70E+00
86	1.8636	6.75E+00
87	1.9091	5.83E+00
88	1.9545	4.96E+00
89	2	4.17E+00
90	2.0455	3.46E+00
91	2.0909	2.84E+00
92	2.1364	2.32E+00
93	2.1818	1.87E+00
94	2.2273	1.50E+00
95	2.2727	1.20E+00
96	2.3182	9.56E-01
97	2.3636	7.58E-01
98	2.4091	5.99E-01
99	2.4545	4.73E-01
100	2.5	3.72E-01

	X	Y
82	1.6818	1.04E+01
83	1.7273	9.59E+00
84	1.7727	8.67E+00
85	1.8182	7.68E+00
86	1.8636	6.72E+00
87	1.9091	5.82E+00
88	1.9545	4.98E+00
89	2	4.21E+00
90	2.0455	3.50E+00
91	2.0909	2.86E+00
92	2.1364	2.28E+00
93	2.1818	1.77E+00
94	2.2273	1.32E+00
95	2.2727	9.40E-01
96	2.3182	6.23E-01
97	2.3636	3.71E-01
98	2.4091	1.84E-01
99	2.4545	6.17E-02
100	2.5	4.66E-03

	X	Y
82	1.6818	1.01E+01
83	1.7273	9.30E+00
84	1.7727	8.51E+00
85	1.8182	7.71E+00
86	1.8636	6.92E+00
87	1.9091	6.13E+00
88	1.9545	5.33E+00
89	2	4.54E+00
90	2.0455	3.75E+00
91	2.0909	2.96E+00
92	2.1364	2.16E+00
93	2.1818	1.37E+00
94	2.2273	5.78E-01
95	2.2727	0.00E+00
96	2.3182	0.00E+00
97	2.3636	0.00E+00
98	2.4091	0.00E+00
99	2.4545	0.00E+00
100	2.5	0.00E+00

Table H2.D-10c. TRAP Model Output for Molybdenum Data for the Bird Suvival Endpoint (Davies et al. 1960)

Chemical:	Molybdenum
Study Authors:	Davies et al. 1960
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
0.000001	19	19	1
223.4127	17.86	19	0.94
446.8254	17.86	19	0.94
670.2381	12.73	19	0.67
893.6508	7.41	19	0.39

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			yes
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.9099	2.9093	3.44E-02	2.8374	2.9812
S	0.1263	1.50E-01	5.29E-02	0.10511	0.26401
Y0	0.96	0.97147	2.67E-02	0.86046	0.99901

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.9099	2.9103	3.59E-02	2.8343	2.9863
S	0.1263	1.46E-01	4.48E-02	0.10207	0.25636
Y0	0.96	0.97067	2.72E-02	0.85846	0.99893

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.9099	2.911	3.77E-02	2.8278	2.9942
S	0.1263	0.12364	6.87E-02	8.64E-02	0.21699
Y0	0.96	0.96	2.60E-02	0.87173	0.99407

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	811.44	6.88E+02	9.58E+02	3.44E-02	2.9093
20	606.24	4.79E+02	7.68E+02	4.68E-02	2.7826
10	520.55	3.66E+02	7.40E+02	6.55E-02	2.7165
5	458.99	2.84E+02	7.42E+02	8.28E-02	2.6618
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	813.35	6.83E+02	9.69E+02	3.59E-02	2.9103
20	600.85	4.83E+02	7.48E+02	4.26E-02	2.7788
10	5.16E+02	375.33	708.85	5.76E-02	2.7125
5	463.04	305.13	702.67	7.04E-02	2.6656
0	356.83	158.94	801.11	0.10534	2.55E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	814.68	6.73E+02	9.87E+02	3.77E-02	2.911
20	606.03	417.77	879.12	6.79E-02	2.7825
10	549.11	326.81	922.63	8.91E-02	2.7397
5	522.69	2.85E+02	958.19	0.10018	2.7182
0	497.54	2.46E+02	1.01E+03	0.1114	2.6968

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1	0.97147
2	2.35E+00	0.94	0.97137
3	2.65E+00	0.94	0.93019
4	2.83E+00	0.67	0.68928
5	2.95E+00	0.39	0.3792
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-1	0.97147
2	-9.55E-01	0.97147
3	-9.09E-01	0.97147
4	-8.64E-01	0.97147
5	-8.18E-01	0.97147
6	-7.73E-01	0.97147
7	-7.27E-01	0.97147
8	-6.82E-01	0.97147
9	-6.36E-01	0.97147
10	-5.91E-01	0.97147
11	-5.45E-01	0.97147
12	-5.00E-01	0.97147
13	-4.55E-01	0.97147
14	-0.40909	0.97147
15	-0.36364	0.97147
16	-0.31818	0.97147
17	-0.27273	0.97147
18	-0.22727	0.97147
19	-0.18182	0.97147
20	-0.13636	0.97147
21	-9.09E-02	0.97147
22	-4.55E-02	0.97147
23	0	0.97147
24	4.55E-02	0.97147
25	9.09E-02	0.97147
26	0.13636	0.97147
27	0.18182	0.97147
28	0.22727	0.97147
29	0.27273	0.97147
30	0.31818	0.97147

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1	0.97067
2	2.35E+00	0.94	0.97067
3	2.65E+00	0.94	0.93451
4	2.83E+00	0.67	0.68659
5	2.95E+00	0.39	0.38081
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-1	0.97067
2	-9.55E-01	0.97067
3	-9.09E-01	0.97067
4	-8.64E-01	0.97067
5	-8.18E-01	0.97067
6	-7.73E-01	0.97067
7	-7.27E-01	0.97067
8	-6.82E-01	0.97067
9	-6.36E-01	0.97067
10	-5.91E-01	0.97067
11	-5.45E-01	0.97067
12	-5.00E-01	0.97067
13	-4.55E-01	0.97067
14	-0.40909	0.97067
15	-0.36364	0.97067
16	-0.31818	0.97067
17	-0.27273	0.97067
18	-0.22727	0.97067
19	-0.18182	0.97067
20	-0.13636	0.97067
21	-9.09E-02	0.97067
22	-4.55E-02	0.97067
23	0	0.97067
24	4.55E-02	0.97067
25	9.09E-02	0.97067
26	0.13636	0.97067
27	0.18182	0.97067
28	0.22727	0.97067
29	0.27273	0.97067
30	0.31818	0.97067

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1	0.96
2	2.35E+00	0.94	0.96
3	2.65E+00	0.94	0.96
4	2.83E+00	0.67	0.67
5	2.95E+00	0.39	0.39
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-1	0.96
2	-9.55E-01	0.96
3	-9.09E-01	0.96
4	-8.64E-01	0.96
5	-8.18E-01	0.96
6	-7.73E-01	0.96
7	-7.27E-01	0.96
8	-6.82E-01	0.96
9	-6.36E-01	0.96
10	-5.91E-01	0.96
11	-5.45E-01	0.96
12	-5.00E-01	0.96
13	-4.55E-01	0.96
14	-0.40909	0.96
15	-0.36364	0.96
16	-0.31818	0.96
17	-0.27273	0.96
18	-0.22727	0.96
19	-0.18182	0.96
20	-0.13636	0.96
21	-9.09E-02	0.96
22	-4.55E-02	0.96
23	0	0.96
24	4.55E-02	0.96
25	9.09E-02	0.96
26	0.13636	0.96
27	0.18182	0.96
28	0.22727	0.96
29	0.27273	0.96
30	0.31818	0.96

Prediction Line

	X	Y
31	0.36364	0.97147
32	0.40909	0.97147
33	0.45455	0.97147
34	0.5	0.97147
35	0.54545	0.97147
36	0.59091	0.97147
37	0.63636	0.97147
38	0.68182	0.97147
39	0.72727	0.97147
40	0.77273	0.97147
41	0.81818	0.97147
42	0.86364	0.97147
43	0.90909	0.97147
44	0.95455	0.97147
45	1	0.97147
46	1.0455	0.97147
47	1.0909	0.97147
48	1.1364	0.97147
49	1.1818	0.97147
50	1.2273	0.97147
51	1.2727	0.97147
52	1.3182	0.97147
53	1.3636	0.97147
54	1.4091	0.97147
55	1.4545	0.97147
56	1.5	0.97147
57	1.5455	0.97147
58	1.5909	0.97147
59	1.6364	0.97147
60	1.6818	0.97147
61	1.7273	0.97147
62	1.7727	0.97147
63	1.8182	0.97147
64	1.8636	0.97147
65	1.9091	0.97147
66	1.9545	0.97147
67	2	0.97147
68	2.0455	0.97147
69	2.0909	0.97147
70	2.1364	0.97147
71	2.1818	0.97147
72	2.2273	0.97147
73	2.2727	0.97146
74	2.3182	0.97143
75	2.3636	0.97133
76	2.4091	0.97104
77	2.4545	0.97025
78	2.5	0.9683
79	2.5455	0.96389
80	2.5909	0.95479
81	2.6364	0.93762

	X	Y
31	0.36364	0.97067
32	0.40909	0.97067
33	0.45455	0.97067
34	0.5	0.97067
35	0.54545	0.97067
36	0.59091	0.97067
37	0.63636	0.97067
38	0.68182	0.97067
39	0.72727	0.97067
40	0.77273	0.97067
41	0.81818	0.97067
42	0.86364	0.97067
43	0.90909	0.97067
44	0.95455	0.97067
45	1	0.97067
46	1.0455	0.97067
47	1.0909	0.97067
48	1.1364	0.97067
49	1.1818	0.97067
50	1.2273	0.97067
51	1.2727	0.97067
52	1.3182	0.97067
53	1.3636	0.97067
54	1.4091	0.97067
55	1.4545	0.97067
56	1.5	0.97067
57	1.5455	0.97067
58	1.5909	0.97067
59	1.6364	0.97067
60	1.6818	0.97067
61	1.7273	0.97067
62	1.7727	0.97067
63	1.8182	0.97067
64	1.8636	0.97067
65	1.9091	0.97067
66	1.9545	0.97067
67	2	0.97067
68	2.0455	0.97067
69	2.0909	0.97067
70	2.1364	0.97067
71	2.1818	0.97067
72	2.2273	0.97067
73	2.2727	0.97067
74	2.3182	0.97067
75	2.3636	0.97067
76	2.4091	0.97067
77	2.4545	0.97067
78	2.5	0.97067
79	2.5455	0.97067
80	2.5909	0.96507
81	2.6364	0.94399

	X	Y
31	0.36364	0.96
32	0.40909	0.96
33	0.45455	0.96
34	0.5	0.96
35	0.54545	0.96
36	0.59091	0.96
37	0.63636	0.96
38	0.68182	0.96
39	0.72727	0.96
40	0.77273	0.96
41	0.81818	0.96
42	0.86364	0.96
43	0.90909	0.96
44	0.95455	0.96
45	1	0.96
46	1.0455	0.96
47	1.0909	0.96
48	1.1364	0.96
49	1.1818	0.96
50	1.2273	0.96
51	1.2727	0.96
52	1.3182	0.96
53	1.3636	0.96
54	1.4091	0.96
55	1.4545	0.96
56	1.5	0.96
57	1.5455	0.96
58	1.5909	0.96
59	1.6364	0.96
60	1.6818	0.96
61	1.7273	0.96
62	1.7727	0.96
63	1.8182	0.96
64	1.8636	0.96
65	1.9091	0.96
66	1.9545	0.96
67	2	0.96
68	2.0455	0.96
69	2.0909	0.96
70	2.1364	0.96
71	2.1818	0.96
72	2.2273	0.96
73	2.2727	0.96
74	2.3182	0.96
75	2.3636	0.96
76	2.4091	0.96
77	2.4545	0.96
78	2.5	0.96
79	2.5455	0.96
80	2.5909	0.96
81	2.6364	0.96

Prediction Line

	X	Y
82	2.6818	0.90805
83	2.7273	0.86151
84	2.7727	0.79462
85	2.8182	0.70681
86	2.8636	0.60152
87	2.9091	0.48621
88	2.9545	0.37086
89	3	0.26547
90	3.0455	0.17751
91	3.0909	0.11047
92	3.1364	6.38E-02
93	3.1818	3.41E-02
94	3.2273	1.69E-02
95	3.2727	7.72E-03
96	3.3182	3.29E-03
97	3.3636	1.32E-03
98	3.4091	5.30E-04
99	3.4545	2.38E-04
100	3.5	1.39E-04

	X	Y
82	2.6818	0.90725
83	2.7273	0.85484
84	2.7727	0.78678
85	2.8182	0.70305
86	2.8636	0.60366
87	2.9091	0.4886
88	2.9545	0.37274
89	3	0.27253
90	3.0455	0.18798
91	3.0909	0.1191
92	3.1364	6.59E-02
93	3.1818	2.83E-02
94	3.2273	6.41E-03
95	3.2727	9.71E-05
96	3.3182	9.71E-05
97	3.3636	9.71E-05
98	3.4091	9.71E-05
99	3.4545	9.71E-05
100	3.5	9.71E-05

	X	Y
82	2.6818	0.96
83	2.7273	0.89177
84	2.7727	0.7899
85	2.8182	0.68803
86	2.8636	0.58617
87	2.9091	0.4843
88	2.9545	0.38243
89	3	0.28056
90	3.0455	0.17869
91	3.0909	7.68E-02
92	3.1364	9.60E-05
93	3.1818	9.60E-05
94	3.2273	9.60E-05
95	3.2727	9.60E-05
96	3.3182	9.60E-05
97	3.3636	9.60E-05
98	3.4091	9.60E-05
99	3.4545	9.60E-05
100	3.5	9.60E-05

Table H2.D-10d. TRAP Model Output for Molybdenum Data for the Mammal Reproduction Endpoint (Fungwe et al. 1990)

Chemical:	Molybdenum
Study Authors:	Fungwe et al. 1990
Receptor Group:	Mammal
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
1.00E-06	50.4	4.1
1.4273	47.5	2.7
2.6427	33.9	5.3
13.231	33.5	4.6
27.823	33.9	5.3

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			yes
X50 at Maximum or Minimum Limit			yes
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50	yes	yes	yes
Large Standard Error for Steepness	yes	yes	
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.3648	1.8132	0.61174	-0.81894	4.4453
S	0.43823	2.95E-01	0.21404	-0.62617	1.2157
Y0	5.04E+01	5.12E+01	6.024	25.273	77.112

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.3648	1.8206	0.60763	-0.79383	4.435
S	0.43823	3.14E-01	0.19655	-0.53169	1.1597
Y0	5.04E+01	5.09E+01	5.8755	25.572	76.132

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.3648	1.8648	0.66755	-1.0074	4.737
S	0.43823	0.2309	0.10544	-0.22277	0.68457
Y0	5.04E+01	5.08E+01	5.4823	27.23	74.407

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	65.039	0.15173	27880	0.61174	1.8132
20	4.34E+00	5.94E-03	3.17E+03	0.66564	0.63747
10	8.91E-01	2.08E-05	3.82E+04	1.0766	-5.03E-02
5	2.07E-01	7.04E-08	6.09E+05	1.5034	-0.68399
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	66.159	0.16076	27228	0.60763	1.8206
20	4.468	1.32E-02	1511.2	0.58782	0.65011
10	1.15E+00	2.28E-04	5.79E+03	0.86052	6.02E-02
5	0.43959	9.13E-06	2.12E+04	1.0883	-0.35695
0	4.33E-02	2.59E-09	7.22E+05	1.6787	-1.36E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	73.245	9.83E-02	54576	0.66755	1.8648
20	3.6773	4.87E-02	277.8	0.43652	0.56552
10	1.3566	8.52E-03	216.12	0.51184	0.13244
5	0.82394	2.85E-03	237.9	0.57186	-8.41E-02
0	0.50044	8.69E-04	288.3	0.64158	-0.30065

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	5.04E+01	5.12E+01
2	1.55E-01	4.75E+01	4.48E+01
3	4.22E-01	3.39E+01	4.29E+01
4	1.12E+00	3.35E+01	3.55E+01
5	1.44E+00	33.9	31.075
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	5.04E+01	5.09E+01
2	1.55E-01	4.75E+01	4.51E+01
3	4.22E-01	3.39E+01	4.29E+01
4	1.12E+00	3.35E+01	3.54E+01
5	1.44E+00	33.9	31.078
6			

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	5.04E+01	5.08E+01
2	1.55E-01	4.75E+01	4.55E+01
3	4.22E-01	3.39E+01	4.23E+01
4	1.12E+00	3.35E+01	3.41E+01
5	1.44E+00	33.9	30.342
6			

Analysis of Variance

R-squared: 0.999

	DF	SS	MS	F	Sig
Total (adj)	4	5502.7	1375.7		
Regression	2	5498.4	2749.2	1266.3	0.0008
Error	2	4.342	2.171		

R-squared: 0.999

	DF	SS	MS	F	Sig
Total (adj)	4	5502.7	1375.7		
Regression	2	5498.6	2749.3	1333.4	0.0007
Error	2	4.1236	2.0618		

R-squared: 0.999

	DF	SS	MS	F	Sig
Total (adj)	4	5502.7	1375.7		
Regression	2	5499.1	2749.6	1537.8	0.0006
Error	2	3.576	1.788		

Prediction Line

	X	Y
1	-2.5	5.09E+01
2	-2.45E+00	5.09E+01
3	-2.41E+00	5.08E+01
4	-2.36E+00	5.08E+01
5	-2.32E+00	5.08E+01
6	-2.27E+00	5.08E+01
7	-2.23E+00	5.08E+01
8	-2.18E+00	5.07E+01
9	-2.14E+00	5.07E+01
10	-2.09E+00	5.07E+01
11	-2.05E+00	5.07E+01
12	-2.00E+00	5.06E+01
13	-1.95E+00	5.06E+01
14	-1.9091	5.06E+01
15	-1.8636	5.05E+01
16	-1.8182	5.05E+01
17	-1.7727	5.05E+01
18	-1.7273	5.04E+01
19	-1.6818	5.04E+01
20	-1.6364	5.03E+01
21	-1.59E+00	5.03E+01
22	-1.55E+00	5.02E+01
23	-1.50E+00	5.02E+01
24	-1.45E+00	5.01E+01
25	-1.41E+00	5.01E+01
26	-1.36E+00	5.00E+01
27	-1.32E+00	4.99E+01
28	-1.27E+00	4.99E+01
29	-1.23E+00	4.98E+01
30	-1.18E+00	4.97E+01

	X	Y
1	-2.5	5.09E+01
2	-2.45E+00	5.09E+01
3	-2.41E+00	5.09E+01
4	-2.36E+00	5.09E+01
5	-2.32E+00	5.09E+01
6	-2.27E+00	5.09E+01
7	-2.23E+00	5.09E+01
8	-2.18E+00	5.09E+01
9	-2.14E+00	5.09E+01
10	-2.09E+00	5.09E+01
11	-2.05E+00	5.09E+01
12	-2.00E+00	5.09E+01
13	-1.95E+00	5.09E+01
14	-1.9091	5.09E+01
15	-1.8636	5.09E+01
16	-1.8182	5.09E+01
17	-1.7727	5.09E+01
18	-1.7273	5.09E+01
19	-1.6818	5.09E+01
20	-1.6364	5.09E+01
21	-1.59E+00	5.09E+01
22	-1.55E+00	5.09E+01
23	-1.50E+00	5.09E+01
24	-1.45E+00	5.09E+01
25	-1.41E+00	5.09E+01
26	-1.36E+00	5.09E+01
27	-1.32E+00	5.08E+01
28	-1.27E+00	5.08E+01
29	-1.23E+00	5.08E+01
30	-1.18E+00	5.08E+01

	X	Y
1	-2.5	5.08E+01
2	-2.45E+00	5.08E+01
3	-2.41E+00	5.08E+01
4	-2.36E+00	5.08E+01
5	-2.32E+00	5.08E+01
6	-2.27E+00	5.08E+01
7	-2.23E+00	5.08E+01
8	-2.18E+00	5.08E+01
9	-2.14E+00	5.08E+01
10	-2.09E+00	5.08E+01
11	-2.05E+00	5.08E+01
12	-2.00E+00	5.08E+01
13	-1.95E+00	5.08E+01
14	-1.9091	5.08E+01
15	-1.8636	5.08E+01
16	-1.8182	5.08E+01
17	-1.7727	5.08E+01
18	-1.7273	5.08E+01
19	-1.6818	5.08E+01
20	-1.6364	5.08E+01
21	-1.59E+00	5.08E+01
22	-1.55E+00	5.08E+01
23	-1.50E+00	5.08E+01
24	-1.45E+00	5.08E+01
25	-1.41E+00	5.08E+01
26	-1.36E+00	5.08E+01
27	-1.32E+00	5.08E+01
28	-1.27E+00	5.08E+01
29	-1.23E+00	5.08E+01
30	-1.18E+00	5.08E+01

Prediction Line

	X	Y
31	-1.1364	4.97E+01
32	-1.0909	4.96E+01
33	-1.0455	4.95E+01
34	-1	4.94E+01
35	-0.95455	4.93E+01
36	-0.90909	4.92E+01
37	-0.86364	4.91E+01
38	-0.81818	4.90E+01
39	-0.77273	4.89E+01
40	-0.72727	4.88E+01
41	-0.68182	4.86E+01
42	-0.63636	4.85E+01
43	-0.59091	4.84E+01
44	-0.54545	4.82E+01
45	-0.5	4.81E+01
46	-0.45455	4.79E+01
47	-0.40909	4.77E+01
48	-0.36364	4.75E+01
49	-0.31818	4.74E+01
50	-0.27273	4.72E+01
51	-0.22727	4.70E+01
52	-0.18182	4.67E+01
53	-0.13636	4.65E+01
54	-9.09E-02	4.63E+01
55	-4.55E-02	4.60E+01
56	0	4.58E+01
57	4.55E-02	4.55E+01
58	9.09E-02	4.53E+01
59	0.13636	4.50E+01
60	0.18182	4.47E+01
61	0.22727	4.44E+01
62	0.27273	4.40E+01
63	0.31818	4.37E+01
64	0.36364	4.33E+01
65	0.40909	4.30E+01
66	0.45455	4.26E+01
67	0.5	4.22E+01
68	0.54545	4.18E+01
69	0.59091	4.14E+01
70	0.63636	4.10E+01
71	0.68182	4.05E+01
72	0.72727	4.01E+01
73	0.77273	3.96E+01
74	0.81818	3.91E+01
75	0.86364	3.86E+01
76	0.90909	3.81E+01
77	0.95455	3.75E+01
78	1	3.70E+01
79	1.0455	3.65E+01
80	1.0909	3.59E+01
81	1.1364	3.53E+01

	X	Y
31	-1.1364	5.07E+01
32	-1.0909	5.07E+01
33	-1.0455	5.06E+01
34	-1	5.05E+01
35	-0.95455	5.04E+01
36	-0.90909	5.03E+01
37	-0.86364	5.02E+01
38	-0.81818	5.01E+01
39	-0.77273	5.00E+01
40	-0.72727	4.98E+01
41	-0.68182	4.97E+01
42	-0.63636	4.95E+01
43	-0.59091	4.94E+01
44	-0.54545	4.92E+01
45	-0.5	4.90E+01
46	-0.45455	4.88E+01
47	-0.40909	4.86E+01
48	-0.36364	4.83E+01
49	-0.31818	4.81E+01
50	-0.27273	4.79E+01
51	-0.22727	4.76E+01
52	-0.18182	4.73E+01
53	-0.13636	4.71E+01
54	-9.09E-02	4.68E+01
55	-4.55E-02	4.65E+01
56	0	4.62E+01
57	4.55E-02	4.59E+01
58	9.09E-02	4.55E+01
59	0.13636	4.52E+01
60	0.18182	4.49E+01
61	0.22727	4.45E+01
62	0.27273	4.41E+01
63	0.31818	4.38E+01
64	0.36364	4.34E+01
65	0.40909	4.30E+01
66	0.45455	4.26E+01
67	0.5	4.21E+01
68	0.54545	4.17E+01
69	0.59091	4.13E+01
70	0.63636	4.08E+01
71	0.68182	4.04E+01
72	0.72727	3.99E+01
73	0.77273	3.94E+01
74	0.81818	3.89E+01
75	0.86364	3.84E+01
76	0.90909	3.79E+01
77	0.95455	3.74E+01
78	1	3.68E+01
79	1.0455	3.63E+01
80	1.0909	3.57E+01
81	1.1364	3.52E+01

	X	Y
31	-1.1364	5.08E+01
32	-1.0909	5.08E+01
33	-1.0455	5.08E+01
34	-1	5.08E+01
35	-0.95455	5.08E+01
36	-0.90909	5.08E+01
37	-0.86364	5.08E+01
38	-0.81818	5.08E+01
39	-0.77273	5.08E+01
40	-0.72727	5.08E+01
41	-0.68182	5.08E+01
42	-0.63636	5.08E+01
43	-0.59091	5.08E+01
44	-0.54545	5.08E+01
45	-0.5	5.08E+01
46	-0.45455	5.08E+01
47	-0.40909	5.08E+01
48	-0.36364	5.08E+01
49	-0.31818	5.08E+01
50	-0.27273	5.05E+01
51	-0.22727	5.00E+01
52	-0.18182	4.94E+01
53	-0.13636	4.89E+01
54	-9.09E-02	4.84E+01
55	-4.55E-02	4.78E+01
56	0	4.73E+01
57	4.55E-02	4.68E+01
58	9.09E-02	4.62E+01
59	0.13636	4.57E+01
60	0.18182	4.52E+01
61	0.22727	4.46E+01
62	0.27273	4.41E+01
63	0.31818	4.36E+01
64	0.36364	4.30E+01
65	0.40909	4.25E+01
66	0.45455	4.20E+01
67	0.5	4.14E+01
68	0.54545	4.09E+01
69	0.59091	4.04E+01
70	0.63636	3.98E+01
71	0.68182	3.93E+01
72	0.72727	3.88E+01
73	0.77273	3.82E+01
74	0.81818	3.77E+01
75	0.86364	3.72E+01
76	0.90909	3.66E+01
77	0.95455	3.61E+01
78	1	3.56E+01
79	1.0455	3.50E+01
80	1.0909	3.45E+01
81	1.1364	3.40E+01

Prediction Line

	X	Y
82	1.1818	3.47E+01
83	1.2273	3.41E+01
84	1.2727	3.35E+01
85	1.3182	3.29E+01
86	1.3636	3.22E+01
87	1.4091	3.16E+01
88	1.4545	3.09E+01
89	1.5	3.03E+01
90	1.5455	2.96E+01
91	1.5909	2.89E+01
92	1.6364	2.83E+01
93	1.6818	2.76E+01
94	1.7273	2.69E+01
95	1.7727	2.62E+01
96	1.8182	2.55E+01
97	1.8636	2.48E+01
98	1.9091	2.42E+01
99	1.9545	2.35E+01
100	2	2.28E+01

	X	Y
82	1.1818	3.46E+01
83	1.2273	3.40E+01
84	1.2727	3.34E+01
85	1.3182	3.28E+01
86	1.3636	3.22E+01
87	1.4091	3.16E+01
88	1.4545	3.09E+01
89	1.5	3.03E+01
90	1.5455	2.96E+01
91	1.5909	2.90E+01
92	1.6364	2.83E+01
93	1.6818	2.76E+01
94	1.7273	2.69E+01
95	1.7727	2.62E+01
96	1.8182	2.55E+01
97	1.8636	2.47E+01
98	1.9091	2.40E+01
99	1.9545	2.33E+01
100	2	2.26E+01

	X	Y
82	1.1818	3.34E+01
83	1.2273	3.29E+01
84	1.2727	3.24E+01
85	1.3182	3.18E+01
86	1.3636	3.13E+01
87	1.4091	3.08E+01
88	1.4545	3.02E+01
89	1.5	2.97E+01
90	1.5455	2.92E+01
91	1.5909	2.86E+01
92	1.6364	2.81E+01
93	1.6818	2.76E+01
94	1.7273	2.70E+01
95	1.7727	2.65E+01
96	1.8182	2.60E+01
97	1.8636	2.54E+01
98	1.9091	2.49E+01
99	1.9545	2.44E+01
100	2	2.38E+01

Table H2.D-11a. TRAP Model Output for Nickel Data for the Bird Growth Endpoint (Pooling Group A: Hill 1979; Hill 1985)

Chemical:	Nickel
Study Authors:	Pooling group A
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect Relative to Control
0.000001	100
51.35135	63.233
102.7027	50.677
0.000001	100
51.35135	55.526

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.0347	2.0346	0.14873	1.3946	2.6745
S	0.29283	2.93E-01	0.15917	-0.39207	0.97767
Y0	1.00E+02	1.00E+02	2.7286	88.268	111.75

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.0347	2.0338	0.14381	1.415	2.6526
S	0.29283	3.05E-01	0.16395	-0.40025	1.0106
Y0	1.00E+02	1.00E+02	2.725	88.275	111.72

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.0347	2.035	0.15138	1.3837	2.6863
S	0.29283	0.2891	0.15699	-0.38637	0.96456
Y0	1.00E+02	1.00E+02	2.725	88.275	111.72

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	108.28	24.809	472.61	0.14873	2.0346
20	7.09E+00	3.47E-02	1.45E+03	0.53701	0.85089
10	1.44E+00	1.75E-04	1.19E+04	0.90996	0.1585
5	3.32E-01	1.31E-06	8.36E+04	1.2554	-0.47949
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	108.1	26.005	449.38	0.14381	2.0338
20	6.7531	2.99E-02	1525.7	0.5471	0.8295
10	1.67E+00	3.01E-04	9.25E+03	0.87009	0.22253
5	0.62134	1.15E-05	3.35E+04	1.0996	-0.20667
0	5.72E-02	4.33E-09	7.54E+05	1.6549	-1.24E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	108.39	24.191	485.65	0.15138	2.035
20	9.9374	0.11038	894.67	0.45423	0.99727
10	4.4809	7.96E-03	2521.6	0.63921	0.65136
5	3.0089	2.13E-03	4256.2	0.73225	0.47841
0	2.0205	5.67E-04	7198.4	0.82549	0.30546

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	1.71E+00	6.32E+01	5.94E+01
4	1.71E+00	5.55E+01	5.94E+01
5	2.01E+00	50.677	50.677
6			

Analysis of Variance

R-squared: 0.987

	DF	SS	MS	F	Sig
Total (adj)	4	2353.1	588.29		
Regression	2	2323.4	1161.7	78.224	0.0126
Error	2	29.703	14.851		

Prediction Line

	X	Y
1	-2	9.91E+01
2	-1.95E+00	9.91E+01
3	-1.91E+00	9.90E+01
4	-1.86E+00	9.90E+01
5	-1.82E+00	9.89E+01
6	-1.77E+00	9.89E+01
7	-1.73E+00	9.88E+01
8	-1.68E+00	9.87E+01
9	-1.64E+00	9.87E+01
10	-1.59E+00	9.86E+01
11	-1.55E+00	9.85E+01
12	-1.50E+00	9.84E+01
13	-1.45E+00	9.84E+01
14	-1.4091	9.83E+01
15	-1.3636	9.82E+01
16	-1.3182	9.81E+01
17	-1.2727	9.80E+01
18	-1.2273	9.79E+01
19	-1.1818	9.77E+01
20	-1.1364	9.76E+01
21	-1.09E+00	9.75E+01
22	-1.05E+00	9.74E+01
23	-1.00E+00	9.72E+01
24	-9.55E-01	9.71E+01
25	-9.09E-01	9.69E+01
26	-8.64E-01	9.68E+01
27	-8.18E-01	9.66E+01
28	-7.73E-01	9.64E+01
29	-7.27E-01	9.62E+01
30	-6.82E-01	9.60E+01

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	1.71E+00	6.32E+01	5.94E+01
4	1.71E+00	5.55E+01	5.94E+01
5	2.01E+00	50.677	50.677
6			

R-squared: 0.987

	DF	SS	MS	F	Sig
Total (adj)	4	2353.1	588.29		
Regression	2	2323.4	1161.7	78.224	0.0126
Error	2	29.703	14.851		

	X	Y
1	-2	1.00E+02
2	-1.95E+00	1.00E+02
3	-1.91E+00	1.00E+02
4	-1.86E+00	1.00E+02
5	-1.82E+00	1.00E+02
6	-1.77E+00	1.00E+02
7	-1.73E+00	1.00E+02
8	-1.68E+00	1.00E+02
9	-1.64E+00	1.00E+02
10	-1.59E+00	1.00E+02
11	-1.55E+00	1.00E+02
12	-1.50E+00	1.00E+02
13	-1.45E+00	1.00E+02
14	-1.4091	1.00E+02
15	-1.3636	1.00E+02
16	-1.3182	1.00E+02
17	-1.2727	1.00E+02
18	-1.2273	1.00E+02
19	-1.1818	1.00E+02
20	-1.1364	9.99E+01
21	-1.09E+00	9.99E+01
22	-1.05E+00	9.98E+01
23	-1.00E+00	9.97E+01
24	-9.55E-01	9.96E+01
25	-9.09E-01	9.95E+01
26	-8.64E-01	9.93E+01
27	-8.18E-01	9.92E+01
28	-7.73E-01	9.90E+01
29	-7.27E-01	9.88E+01
30	-6.82E-01	9.85E+01

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	1.71E+00	6.32E+01	5.94E+01
4	1.71E+00	5.55E+01	5.94E+01
5	2.01E+00	50.677	50.677
6			

R-squared: 0.987

	DF	SS	MS	F	Sig
Total (adj)	4	2353.1	588.29		
Regression	2	2323.4	1161.7	78.224	0.0126
Error	2	29.703	14.851		

	X	Y
1	-2	1.00E+02
2	-1.95E+00	1.00E+02
3	-1.91E+00	1.00E+02
4	-1.86E+00	1.00E+02
5	-1.82E+00	1.00E+02
6	-1.77E+00	1.00E+02
7	-1.73E+00	1.00E+02
8	-1.68E+00	1.00E+02
9	-1.64E+00	1.00E+02
10	-1.59E+00	1.00E+02
11	-1.55E+00	1.00E+02
12	-1.50E+00	1.00E+02
13	-1.45E+00	1.00E+02
14	-1.4091	1.00E+02
15	-1.3636	1.00E+02
16	-1.3182	1.00E+02
17	-1.2727	1.00E+02
18	-1.2273	1.00E+02
19	-1.1818	1.00E+02
20	-1.1364	1.00E+02
21	-1.09E+00	1.00E+02
22	-1.05E+00	1.00E+02
23	-1.00E+00	1.00E+02
24	-9.55E-01	1.00E+02
25	-9.09E-01	1.00E+02
26	-8.64E-01	1.00E+02
27	-8.18E-01	1.00E+02
28	-7.73E-01	1.00E+02
29	-7.27E-01	1.00E+02
30	-6.82E-01	1.00E+02

Prediction Line

	X	Y
31	-0.63636	9.58E+01
32	-0.59091	9.56E+01
33	-0.54545	9.54E+01
34	-0.5	9.51E+01
35	-0.45455	9.49E+01
36	-0.40909	9.46E+01
37	-0.36364	9.43E+01
38	-0.31818	9.40E+01
39	-0.27273	9.37E+01
40	-0.22727	9.34E+01
41	-0.18182	9.31E+01
42	-0.13636	9.27E+01
43	-9.09E-02	9.23E+01
44	-4.55E-02	9.20E+01
45	0	9.16E+01
46	4.55E-02	9.11E+01
47	9.09E-02	9.07E+01
48	0.13636	9.02E+01
49	0.18182	8.98E+01
50	0.22727	8.93E+01
51	0.27273	8.87E+01
52	0.31818	8.82E+01
53	0.36364	8.76E+01
54	0.40909	8.70E+01
55	0.45455	8.64E+01
56	0.5	8.58E+01
57	0.54545	8.51E+01
58	0.59091	8.44E+01
59	0.63636	8.37E+01
60	0.68182	8.30E+01
61	0.72727	8.22E+01
62	0.77273	8.14E+01
63	0.81818	8.06E+01
64	0.86364	7.98E+01
65	0.90909	7.89E+01
66	0.95455	7.80E+01
67	1	7.71E+01
68	1.0455	7.61E+01
69	1.0909	7.51E+01
70	1.1364	7.41E+01
71	1.1818	7.31E+01
72	1.2273	7.20E+01
73	1.2727	7.09E+01
74	1.3182	6.98E+01
75	1.3636	6.87E+01
76	1.4091	6.75E+01
77	1.4545	6.64E+01
78	1.5	6.52E+01
79	1.5455	6.39E+01
80	1.5909	6.27E+01
81	1.6364	6.15E+01
82	1.6818	6.02E+01

	X	Y
31	-0.63636	9.83E+01
32	-0.59091	9.80E+01
33	-0.54545	9.77E+01
34	-0.5	9.74E+01
35	-0.45455	9.71E+01
36	-0.40909	9.68E+01
37	-0.36364	9.64E+01
38	-0.31818	9.60E+01
39	-0.27273	9.56E+01
40	-0.22727	9.52E+01
41	-0.18182	9.48E+01
42	-0.13636	9.43E+01
43	-9.09E-02	9.38E+01
44	-4.55E-02	9.33E+01
45	0	9.28E+01
46	4.55E-02	9.23E+01
47	9.09E-02	9.17E+01
48	0.13636	9.11E+01
49	0.18182	9.05E+01
50	0.22727	8.99E+01
51	0.27273	8.93E+01
52	0.31818	8.87E+01
53	0.36364	8.80E+01
54	0.40909	8.73E+01
55	0.45455	8.66E+01
56	0.5	8.59E+01
57	0.54545	8.51E+01
58	0.59091	8.43E+01
59	0.63636	8.36E+01
60	0.68182	8.27E+01
61	0.72727	8.19E+01
62	0.77273	8.11E+01
63	0.81818	8.02E+01
64	0.86364	7.93E+01
65	0.90909	7.84E+01
66	0.95455	7.75E+01
67	1	7.66E+01
68	1.0455	7.56E+01
69	1.0909	7.46E+01
70	1.1364	7.36E+01
71	1.1818	7.26E+01
72	1.2273	7.16E+01
73	1.2727	7.05E+01
74	1.3182	6.95E+01
75	1.3636	6.84E+01
76	1.4091	6.72E+01
77	1.4545	6.61E+01
78	1.5	6.50E+01
79	1.5455	6.38E+01
80	1.5909	6.26E+01
81	1.6364	6.14E+01
82	1.6818	6.02E+01

	X	Y
31	-0.63636	1.00E+02
32	-0.59091	1.00E+02
33	-0.54545	1.00E+02
34	-0.5	1.00E+02
35	-0.45455	1.00E+02
36	-0.40909	1.00E+02
37	-0.36364	1.00E+02
38	-0.31818	1.00E+02
39	-0.27273	1.00E+02
40	-0.22727	1.00E+02
41	-0.18182	1.00E+02
42	-0.13636	1.00E+02
43	-9.09E-02	1.00E+02
44	-4.55E-02	1.00E+02
45	0	1.00E+02
46	4.55E-02	1.00E+02
47	9.09E-02	1.00E+02
48	0.13636	1.00E+02
49	0.18182	1.00E+02
50	0.22727	1.00E+02
51	0.27273	1.00E+02
52	0.31818	9.96E+01
53	0.36364	9.83E+01
54	0.40909	9.70E+01
55	0.45455	9.57E+01
56	0.5	9.44E+01
57	0.54545	9.31E+01
58	0.59091	9.17E+01
59	0.63636	9.04E+01
60	0.68182	8.91E+01
61	0.72727	8.78E+01
62	0.77273	8.65E+01
63	0.81818	8.52E+01
64	0.86364	8.39E+01
65	0.90909	8.25E+01
66	0.95455	8.12E+01
67	1	7.99E+01
68	1.0455	7.86E+01
69	1.0909	7.73E+01
70	1.1364	7.60E+01
71	1.1818	7.47E+01
72	1.2273	7.34E+01
73	1.2727	7.20E+01
74	1.3182	7.07E+01
75	1.3636	6.94E+01
76	1.4091	6.81E+01
77	1.4545	6.68E+01
78	1.5	6.55E+01
79	1.5455	6.42E+01
80	1.5909	6.28E+01
81	1.6364	6.15E+01
82	1.6818	6.02E+01

Prediction Line

	X	Y
83	1.7273	5.89E+01
84	1.7727	5.76E+01
85	1.8182	5.63E+01
86	1.8636	5.50E+01
87	1.9091	5.37E+01
88	1.9545	5.23E+01
89	2	5.10E+01
90	2.0455	4.97E+01
91	2.0909	4.84E+01
92	2.1364	4.70E+01
93	2.1818	4.57E+01
94	2.2273	4.44E+01
95	2.2727	4.31E+01
96	2.3182	4.18E+01
97	2.3636	4.05E+01
98	2.4091	3.92E+01
99	2.4545	3.79E+01
100	2.5	3.67E+01

	X	Y
83	1.7273	5.89E+01
84	1.7727	5.77E+01
85	1.8182	5.64E+01
86	1.8636	5.51E+01
87	1.9091	5.37E+01
88	1.9545	5.24E+01
89	2	5.10E+01
90	2.0455	4.96E+01
91	2.0909	4.83E+01
92	2.1364	4.69E+01
93	2.1818	4.56E+01
94	2.2273	4.43E+01
95	2.2727	4.30E+01
96	2.3182	4.17E+01
97	2.3636	4.04E+01
98	2.4091	3.92E+01
99	2.4545	3.80E+01
100	2.5	3.68E+01

	X	Y
83	1.7273	5.89E+01
84	1.7727	5.76E+01
85	1.8182	5.63E+01
86	1.8636	5.50E+01
87	1.9091	5.36E+01
88	1.9545	5.23E+01
89	2	5.10E+01
90	2.0455	4.97E+01
91	2.0909	4.84E+01
92	2.1364	4.71E+01
93	2.1818	4.58E+01
94	2.2273	4.44E+01
95	2.2727	4.31E+01
96	2.3182	4.18E+01
97	2.3636	4.05E+01
98	2.4091	3.92E+01
99	2.4545	3.79E+01
100	2.5	3.66E+01

Table H2.D-11b. TRAP Model Output for Nickel Data for the Bird Growth Endpoint (Cain and Pafford 1981)

Chemical:	Nickel
Study Authors:	Cain and Pafford 1981 (male)
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
0.23	445	not reported
17.6	505	not reported
77.4	445	not reported
106.9	284	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes	yes	
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.3578	2.0702			
S	0.9142	2.74E+00			
Y0	4.75E+02	4.81E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.3578	2.0754			
S	0.9142	2.74E+00			
Y0	4.75E+02	4.79E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.3578	2.0695			
S	0.9142	2.417			
Y0	4.75E+02	4.75E+02			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	117.53	21.749	635.14	5.77E-02	2.0702
20	8.79E+01	1.16E+01	6.66E+02	6.92E-02	1.9438
10	7.41E+01	2.36E+00	2.33E+03	0.11786	1.8699
5	6.34E+01	4.88E-01	8.22E+03	0.1663	1.8018
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	118.95	18.088	782.31	6.44E-02	2.0754
20	87.371	1.35E+01	564.87	6.38E-02	1.9414
10	7.48E+01	3.90E+00	1.43E+03	0.10096	1.8738
5	66.999	1.47E+00	3.04E+03	0.13044	1.8261
0	51.377	1.28E-01	2.06E+04	0.20491	1.71E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	117.35	26.759	514.64	5.05E-02	2.0695
20	88.178	32.763	237.32	3.38E-02	1.9454
10	80.165	24.39	263.49	4.07E-02	1.904
5	76.436	20.051	291.39	4.57E-02	1.8833
0	72.88	16.152	328.84	5.15E-02	1.8626

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.38E-01	4.45E+02	4.81E+02
2	1.25E+00	5.05E+02	4.80E+02
3	1.89E+00	4.45E+02	4.23E+02
4	2.03E+00	2.84E+02	2.94E+02
5			
6			

Analysis of Variance

R-squared: 0.909

	DF	SS	MS	F	Sig
Total (adj)	3	26971	8990.2		
Regression	2	24519	12260	5.0006	0.3015
Error	1	2451.6	2451.6		

Prediction Line

	X	Y
1	-0.5	4.81E+02
2	-4.70E-01	4.81E+02
3	-4.39E-01	4.81E+02
4	-4.09E-01	4.81E+02
5	-3.79E-01	4.81E+02
6	-3.48E-01	4.81E+02
7	-3.18E-01	4.81E+02
8	-2.88E-01	4.81E+02
9	-2.58E-01	4.81E+02
10	-2.27E-01	4.81E+02
11	-1.97E-01	4.81E+02
12	-1.67E-01	4.81E+02
13	-1.36E-01	4.81E+02
14	-0.10606	4.81E+02
15	-7.58E-02	4.81E+02
16	-4.55E-02	4.81E+02
17	-1.52E-02	4.81E+02
18	1.52E-02	4.81E+02
19	4.55E-02	4.81E+02
20	7.58E-02	4.81E+02
21	1.06E-01	4.81E+02
22	1.36E-01	4.81E+02
23	1.67E-01	4.81E+02
24	1.97E-01	4.81E+02
25	2.27E-01	4.81E+02
26	2.58E-01	4.81E+02
27	2.88E-01	4.81E+02
28	3.18E-01	4.81E+02
29	3.48E-01	4.81E+02
30	3.79E-01	4.81E+02

	Exposure	Effects Var	Est Effects Var
1	-6.38E-01	4.45E+02	4.79E+02
2	1.25E+00	5.05E+02	4.79E+02
3	1.89E+00	4.45E+02	4.22E+02
4	2.03E+00	2.84E+02	2.97E+02
5			
6			

R-squared: 0.907

	DF	SS	MS	F	Sig
Total (adj)	3	26971	8990.2		
Regression	2	24452	12226	4.8541	0.3056
Error	1	2518.7	2518.7		

	X	Y
1	-0.5	4.79E+02
2	-4.70E-01	4.79E+02
3	-4.39E-01	4.79E+02
4	-4.09E-01	4.79E+02
5	-3.79E-01	4.79E+02
6	-3.48E-01	4.79E+02
7	-3.18E-01	4.79E+02
8	-2.88E-01	4.79E+02
9	-2.58E-01	4.79E+02
10	-2.27E-01	4.79E+02
11	-1.97E-01	4.79E+02
12	-1.67E-01	4.79E+02
13	-1.36E-01	4.79E+02
14	-0.10606	4.79E+02
15	-7.58E-02	4.79E+02
16	-4.55E-02	4.79E+02
17	-1.52E-02	4.79E+02
18	1.52E-02	4.79E+02
19	4.55E-02	4.79E+02
20	7.58E-02	4.79E+02
21	1.06E-01	4.79E+02
22	1.36E-01	4.79E+02
23	1.67E-01	4.79E+02
24	1.97E-01	4.79E+02
25	2.27E-01	4.79E+02
26	2.58E-01	4.79E+02
27	2.88E-01	4.79E+02
28	3.18E-01	4.79E+02
29	3.48E-01	4.79E+02
30	3.79E-01	4.79E+02

	Exposure	Effects Var	Est Effects Var
1	-6.38E-01	4.45E+02	4.75E+02
2	1.25E+00	5.05E+02	4.75E+02
3	1.89E+00	4.45E+02	4.45E+02
4	2.03E+00	2.84E+02	2.84E+02
5			
6			

R-squared: 0.933

	DF	SS	MS	F	Sig
Total (adj)	3	26971	8990.2		
Regression	2	25171	12585	6.9919	0.2583
Error	1	1800	1800		

	X	Y
1	-0.5	4.75E+02
2	-4.70E-01	4.75E+02
3	-4.39E-01	4.75E+02
4	-4.09E-01	4.75E+02
5	-3.79E-01	4.75E+02
6	-3.48E-01	4.75E+02
7	-3.18E-01	4.75E+02
8	-2.88E-01	4.75E+02
9	-2.58E-01	4.75E+02
10	-2.27E-01	4.75E+02
11	-1.97E-01	4.75E+02
12	-1.67E-01	4.75E+02
13	-1.36E-01	4.75E+02
14	-0.10606	4.75E+02
15	-7.58E-02	4.75E+02
16	-4.55E-02	4.75E+02
17	-1.52E-02	4.75E+02
18	1.52E-02	4.75E+02
19	4.55E-02	4.75E+02
20	7.58E-02	4.75E+02
21	1.06E-01	4.75E+02
22	1.36E-01	4.75E+02
23	1.67E-01	4.75E+02
24	1.97E-01	4.75E+02
25	2.27E-01	4.75E+02
26	2.58E-01	4.75E+02
27	2.88E-01	4.75E+02
28	3.18E-01	4.75E+02
29	3.48E-01	4.75E+02
30	3.79E-01	4.75E+02

Prediction Line

	X	Y
31	0.40909	4.81E+02
32	0.43939	4.81E+02
33	0.4697	4.81E+02
34	0.5	4.81E+02
35	0.5303	4.81E+02
36	0.56061	4.81E+02
37	0.59091	4.81E+02
38	0.62121	4.81E+02
39	0.65152	4.81E+02
40	0.68182	4.81E+02
41	0.71212	4.81E+02
42	0.74242	4.81E+02
43	0.77273	4.81E+02
44	0.80303	4.81E+02
45	0.83333	4.81E+02
46	0.86364	4.81E+02
47	0.89394	4.81E+02
48	0.92424	4.81E+02
49	0.95455	4.81E+02
50	0.98485	4.81E+02
51	1.0152	4.81E+02
52	1.0455	4.81E+02
53	1.0758	4.81E+02
54	1.1061	4.81E+02
55	1.1364	4.81E+02
56	1.1667	4.81E+02
57	1.197	4.81E+02
58	1.2273	4.80E+02
59	1.2576	4.80E+02
60	1.2879	4.80E+02
61	1.3182	4.80E+02
62	1.3485	4.80E+02
63	1.3788	4.80E+02
64	1.4091	4.80E+02
65	1.4394	4.80E+02
66	1.4697	4.80E+02
67	1.5	4.80E+02
68	1.5303	4.79E+02
69	1.5606	4.79E+02
70	1.5909	4.78E+02
71	1.6212	4.77E+02
72	1.6515	4.76E+02
73	1.6818	4.74E+02
74	1.7121	4.71E+02
75	1.7424	4.68E+02
76	1.7727	4.63E+02
77	1.803	4.56E+02
78	1.8333	4.47E+02
79	1.8636	4.35E+02
80	1.8939	4.20E+02
81	1.9242	4.00E+02

	X	Y
31	0.40909	4.79E+02
32	0.43939	4.79E+02
33	0.4697	4.79E+02
34	0.5	4.79E+02
35	0.5303	4.79E+02
36	0.56061	4.79E+02
37	0.59091	4.79E+02
38	0.62121	4.79E+02
39	0.65152	4.79E+02
40	0.68182	4.79E+02
41	0.71212	4.79E+02
42	0.74242	4.79E+02
43	0.77273	4.79E+02
44	0.80303	4.79E+02
45	0.83333	4.79E+02
46	0.86364	4.79E+02
47	0.89394	4.79E+02
48	0.92424	4.79E+02
49	0.95455	4.79E+02
50	0.98485	4.79E+02
51	1.0152	4.79E+02
52	1.0455	4.79E+02
53	1.0758	4.79E+02
54	1.1061	4.79E+02
55	1.1364	4.79E+02
56	1.1667	4.79E+02
57	1.197	4.79E+02
58	1.2273	4.79E+02
59	1.2576	4.79E+02
60	1.2879	4.79E+02
61	1.3182	4.79E+02
62	1.3485	4.79E+02
63	1.3788	4.79E+02
64	1.4091	4.79E+02
65	1.4394	4.79E+02
66	1.4697	4.79E+02
67	1.5	4.79E+02
68	1.5303	4.79E+02
69	1.5606	4.79E+02
70	1.5909	4.79E+02
71	1.6212	4.79E+02
72	1.6515	4.79E+02
73	1.6818	4.79E+02
74	1.7121	4.79E+02
75	1.7424	4.78E+02
76	1.7727	4.73E+02
77	1.803	4.64E+02
78	1.8333	4.52E+02
79	1.8636	4.37E+02
80	1.8939	4.19E+02
81	1.9242	3.97E+02

	X	Y
31	0.40909	4.75E+02
32	0.43939	4.75E+02
33	0.4697	4.75E+02
34	0.5	4.75E+02
35	0.5303	4.75E+02
36	0.56061	4.75E+02
37	0.59091	4.75E+02
38	0.62121	4.75E+02
39	0.65152	4.75E+02
40	0.68182	4.75E+02
41	0.71212	4.75E+02
42	0.74242	4.75E+02
43	0.77273	4.75E+02
44	0.80303	4.75E+02
45	0.83333	4.75E+02
46	0.86364	4.75E+02
47	0.89394	4.75E+02
48	0.92424	4.75E+02
49	0.95455	4.75E+02
50	0.98485	4.75E+02
51	1.0152	4.75E+02
52	1.0455	4.75E+02
53	1.0758	4.75E+02
54	1.1061	4.75E+02
55	1.1364	4.75E+02
56	1.1667	4.75E+02
57	1.197	4.75E+02
58	1.2273	4.75E+02
59	1.2576	4.75E+02
60	1.2879	4.75E+02
61	1.3182	4.75E+02
62	1.3485	4.75E+02
63	1.3788	4.75E+02
64	1.4091	4.75E+02
65	1.4394	4.75E+02
66	1.4697	4.75E+02
67	1.5	4.75E+02
68	1.5303	4.75E+02
69	1.5606	4.75E+02
70	1.5909	4.75E+02
71	1.6212	4.75E+02
72	1.6515	4.75E+02
73	1.6818	4.75E+02
74	1.7121	4.75E+02
75	1.7424	4.75E+02
76	1.7727	4.75E+02
77	1.803	4.75E+02
78	1.8333	4.75E+02
79	1.8636	4.74E+02
80	1.8939	4.39E+02
81	1.9242	4.04E+02

Prediction Line

	X	Y
82	1.9545	3.75E+02
83	1.9848	3.45E+02
84	2.0152	3.11E+02
85	2.0455	2.73E+02
86	2.0758	2.33E+02
87	2.1061	1.94E+02
88	2.1364	1.57E+02
89	2.1667	1.24E+02
90	2.197	9.57E+01
91	2.2273	7.28E+01
92	2.2576	5.45E+01
93	2.2879	4.04E+01
94	2.3182	2.97E+01
95	2.3485	2.17E+01
96	2.3788	1.57E+01
97	2.4091	1.14E+01
98	2.4394	8.22E+00
99	2.4697	5.93E+00
100	2.5	4.26E+00

	X	Y
82	1.9545	3.72E+02
83	1.9848	3.44E+02
84	2.0152	3.12E+02
85	2.0455	2.77E+02
86	2.0758	2.39E+02
87	2.1061	2.01E+02
88	2.1364	1.66E+02
89	2.1667	1.35E+02
90	2.197	1.07E+02
91	2.2273	8.16E+01
92	2.2576	6.00E+01
93	2.2879	4.17E+01
94	2.3182	2.68E+01
95	2.3485	1.51E+01
96	2.3788	6.76E+00
97	2.4091	1.72E+00
98	2.4394	6.63E-04
99	2.4697	0.00E+00
100	2.5	0.00E+00

	X	Y
82	1.9545	3.69E+02
83	1.9848	3.35E+02
84	2.0152	3.00E+02
85	2.0455	2.65E+02
86	2.0758	2.30E+02
87	2.1061	1.96E+02
88	2.1364	1.61E+02
89	2.1667	1.26E+02
90	2.197	9.11E+01
91	2.2273	5.63E+01
92	2.2576	2.16E+01
93	2.2879	0.00E+00
94	2.3182	0.00E+00
95	2.3485	0.00E+00
96	2.3788	0.00E+00
97	2.4091	0.00E+00
98	2.4394	0.00E+00
99	2.4697	0.00E+00
100	2.5	0.00E+00

Table H2.D-11c. TRAP Model Output for Nickel Data for the Bird Reproduction Endpoint (Arpasova et al. 2007)

Chemical:	Ni
Study Authors:	Arpasova et al. 2007
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
0.000001	130	not reported
1.015736	97	not reported
10.15736	51	not reported
101.5736	21	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.76061	0.73621			
S	0.34063	3.48E-01			
Y0	1.30E+02	1.30E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.76061	0.74494			
S	0.34063	3.64E-01			
Y0	1.30E+02	1.30E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.76061	0.77871			
S	0.34063	0.29231			
Y0	1.30E+02	1.30E+02			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	5.4476	0.76155	38.969	6.73E-02	0.73621
20	5.50E-01	1.65E-02	1.83E+01	0.11988	-0.25965
10	1.44E-01	1.23E-03	1.68E+01	0.16268	-0.8422
5	4.18E-02	1.06E-04	1.65E+01	0.20432	-1.379
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	5.5583	0.65478	47.184	7.31E-02	0.74494
20	0.54459	1.08E-02	27.465	0.13401	-0.26393
10	1.69E-01	7.08E-04	4.03E+01	0.18712	-0.7724
5	7.38E-02	6.14E-05	8.87E+01	0.2424	-1.1319
0	1.00E-02	8.84E-10	1.13E+05	0.55512	-2.00E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	6.0077	0.11852	304.54	0.13418	0.77871
20	0.56545	7.16E-04	446.7	0.22805	-0.24761
10	0.25721	1.03E-04	640.31	0.26728	-0.58971
5	0.17348	3.85E-05	780.95	0.28753	-0.76076
0	0.117	1.42E-05	961.23	0.30809	-0.93182

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.30E+02	1.30E+02
2	6.78E-03	9.70E+01	9.57E+01
3	1.01E+00	5.10E+01	5.31E+01
4	2.01E+00	2.10E+01	1.90E+01
5			
6			

Analysis of Variance

R-squared: 0.999

	DF	SS	MS	F	Sig
Total (adj)	3	7000.8	2333.6		
Regression	2	6990.7	3495.4	348.03	0.0379
Error	1	10.043	10.043		

Prediction Line

	X	Y
1	-2	1.28E+02
2	-1.95E+00	1.27E+02
3	-1.91E+00	1.27E+02
4	-1.86E+00	1.27E+02
5	-1.82E+00	1.27E+02
6	-1.77E+00	1.27E+02
7	-1.73E+00	1.26E+02
8	-1.68E+00	1.26E+02
9	-1.64E+00	1.26E+02
10	-1.59E+00	1.25E+02
11	-1.55E+00	1.25E+02
12	-1.50E+00	1.25E+02
13	-1.45E+00	1.25E+02
14	-1.4091	1.24E+02
15	-1.3636	1.24E+02
16	-1.3182	1.23E+02
17	-1.2727	1.23E+02
18	-1.2273	1.22E+02
19	-1.1818	1.22E+02
20	-1.1364	1.21E+02
21	-1.09E+00	1.21E+02
22	-1.05E+00	1.20E+02
23	-1.00E+00	1.20E+02
24	-9.55E-01	1.19E+02
25	-9.09E-01	1.18E+02
26	-8.64E-01	1.18E+02
27	-8.18E-01	1.17E+02
28	-7.73E-01	1.16E+02
29	-7.27E-01	1.15E+02
30	-6.82E-01	1.15E+02

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.30E+02	1.30E+02
2	6.78E-03	9.70E+01	9.55E+01
3	1.01E+00	5.10E+01	5.34E+01
4	2.01E+00	2.10E+01	1.90E+01
5			
6			

Analysis of Variance

R-squared: 0.998

	DF	SS	MS	F	Sig
Total (adj)	3	7000.8	2333.6		
Regression	2	6989.1	3494.5	299.52	0.0408
Error	1	11.667	11.667		

Prediction Line

	X	Y
1	-2	1.30E+02
2	-1.95E+00	1.30E+02
3	-1.91E+00	1.30E+02
4	-1.86E+00	1.30E+02
5	-1.82E+00	1.30E+02
6	-1.77E+00	1.30E+02
7	-1.73E+00	1.30E+02
8	-1.68E+00	1.30E+02
9	-1.64E+00	1.29E+02
10	-1.59E+00	1.29E+02
11	-1.55E+00	1.29E+02
12	-1.50E+00	1.28E+02
13	-1.45E+00	1.28E+02
14	-1.4091	1.27E+02
15	-1.3636	1.27E+02
16	-1.3182	1.26E+02
17	-1.2727	1.26E+02
18	-1.2273	1.25E+02
19	-1.1818	1.25E+02
20	-1.1364	1.24E+02
21	-1.09E+00	1.23E+02
22	-1.05E+00	1.23E+02
23	-1.00E+00	1.22E+02
24	-9.55E-01	1.21E+02
25	-9.09E-01	1.20E+02
26	-8.64E-01	1.19E+02
27	-8.18E-01	1.18E+02
28	-7.73E-01	1.17E+02
29	-7.27E-01	1.16E+02
30	-6.82E-01	1.15E+02

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.30E+02	1.30E+02
2	6.78E-03	9.70E+01	9.43E+01
3	1.01E+00	5.10E+01	5.63E+01
4	2.01E+00	2.10E+01	1.83E+01
5			
6			

Analysis of Variance

R-squared: 0.994

	DF	SS	MS	F	Sig
Total (adj)	3	7000.8	2333.6		
Regression	2	6958.1	3479	81.54	0.0781
Error	1	42.667	42.667		

Prediction Line

	X	Y
1	-2	1.30E+02
2	-1.95E+00	1.30E+02
3	-1.91E+00	1.30E+02
4	-1.86E+00	1.30E+02
5	-1.82E+00	1.30E+02
6	-1.77E+00	1.30E+02
7	-1.73E+00	1.30E+02
8	-1.68E+00	1.30E+02
9	-1.64E+00	1.30E+02
10	-1.59E+00	1.30E+02
11	-1.55E+00	1.30E+02
12	-1.50E+00	1.30E+02
13	-1.45E+00	1.30E+02
14	-1.4091	1.30E+02
15	-1.3636	1.30E+02
16	-1.3182	1.30E+02
17	-1.2727	1.30E+02
18	-1.2273	1.30E+02
19	-1.1818	1.30E+02
20	-1.1364	1.30E+02
21	-1.09E+00	1.30E+02
22	-1.05E+00	1.30E+02
23	-1.00E+00	1.30E+02
24	-9.55E-01	1.30E+02
25	-9.09E-01	1.29E+02
26	-8.64E-01	1.27E+02
27	-8.18E-01	1.26E+02
28	-7.73E-01	1.24E+02
29	-7.27E-01	1.22E+02
30	-6.82E-01	1.21E+02

Prediction Line

	X	Y
31	-0.63636	1.14E+02
32	-0.59091	1.13E+02
33	-0.54545	1.12E+02
34	-0.5	1.11E+02
35	-0.45455	1.10E+02
36	-0.40909	1.08E+02
37	-0.36364	1.07E+02
38	-0.31818	1.06E+02
39	-0.27273	1.05E+02
40	-0.22727	1.03E+02
41	-0.18182	1.02E+02
42	-0.13636	1.01E+02
43	-9.09E-02	9.91E+01
44	-4.55E-02	9.75E+01
45	0	9.60E+01
46	4.55E-02	9.43E+01
47	9.09E-02	9.27E+01
48	0.13636	9.09E+01
49	0.18182	8.92E+01
50	0.22727	8.74E+01
51	0.27273	8.55E+01
52	0.31818	8.37E+01
53	0.36364	8.17E+01
54	0.40909	7.98E+01
55	0.45455	7.78E+01
56	0.5	7.58E+01
57	0.54545	7.38E+01
58	0.59091	7.18E+01
59	0.63636	6.97E+01
60	0.68182	6.77E+01
61	0.72727	6.56E+01
62	0.77273	6.35E+01
63	0.81818	6.15E+01
64	0.86364	5.94E+01
65	0.90909	5.74E+01
66	0.95455	5.54E+01
67	1	5.34E+01
68	1.0455	5.14E+01
69	1.0909	4.94E+01
70	1.1364	4.75E+01
71	1.1818	4.56E+01
72	1.2273	4.37E+01
73	1.2727	4.19E+01
74	1.3182	4.01E+01
75	1.3636	3.84E+01
76	1.4091	3.67E+01
77	1.4545	3.51E+01
78	1.5	3.35E+01
79	1.5455	3.19E+01
80	1.5909	3.04E+01
81	1.6364	2.90E+01

	X	Y
31	-0.63636	1.14E+02
32	-0.59091	1.13E+02
33	-0.54545	1.12E+02
34	-0.5	1.11E+02
35	-0.45455	1.10E+02
36	-0.40909	1.08E+02
37	-0.36364	1.07E+02
38	-0.31818	1.06E+02
39	-0.27273	1.05E+02
40	-0.22727	1.03E+02
41	-0.18182	1.02E+02
42	-0.13636	1.00E+02
43	-9.09E-02	9.89E+01
44	-4.55E-02	9.73E+01
45	0	9.58E+01
46	4.55E-02	9.42E+01
47	9.09E-02	9.26E+01
48	0.13636	9.09E+01
49	0.18182	8.92E+01
50	0.22727	8.75E+01
51	0.27273	8.57E+01
52	0.31818	8.39E+01
53	0.36364	8.21E+01
54	0.40909	8.02E+01
55	0.45455	7.83E+01
56	0.5	7.63E+01
57	0.54545	7.43E+01
58	0.59091	7.23E+01
59	0.63636	7.03E+01
60	0.68182	6.82E+01
61	0.72727	6.60E+01
62	0.77273	6.39E+01
63	0.81818	6.18E+01
64	0.86364	5.97E+01
65	0.90909	5.76E+01
66	0.95455	5.56E+01
67	1	5.36E+01
68	1.0455	5.17E+01
69	1.0909	4.98E+01
70	1.1364	4.79E+01
71	1.1818	4.61E+01
72	1.2273	4.43E+01
73	1.2727	4.25E+01
74	1.3182	4.08E+01
75	1.3636	3.91E+01
76	1.4091	3.75E+01
77	1.4545	3.58E+01
78	1.5	3.43E+01
79	1.5455	3.27E+01
80	1.5909	3.12E+01
81	1.6364	2.97E+01

	X	Y
31	-0.63636	1.19E+02
32	-0.59091	1.17E+02
33	-0.54545	1.15E+02
34	-0.5	1.14E+02
35	-0.45455	1.12E+02
36	-0.40909	1.10E+02
37	-0.36364	1.08E+02
38	-0.31818	1.07E+02
39	-0.27273	1.05E+02
40	-0.22727	1.03E+02
41	-0.18182	1.02E+02
42	-0.13636	9.98E+01
43	-9.09E-02	9.80E+01
44	-4.55E-02	9.63E+01
45	0	9.46E+01
46	4.55E-02	9.29E+01
47	9.09E-02	9.11E+01
48	0.13636	8.94E+01
49	0.18182	8.77E+01
50	0.22727	8.60E+01
51	0.27273	8.42E+01
52	0.31818	8.25E+01
53	0.36364	8.08E+01
54	0.40909	7.90E+01
55	0.45455	7.73E+01
56	0.5	7.56E+01
57	0.54545	7.39E+01
58	0.59091	7.21E+01
59	0.63636	7.04E+01
60	0.68182	6.87E+01
61	0.72727	6.70E+01
62	0.77273	6.52E+01
63	0.81818	6.35E+01
64	0.86364	6.18E+01
65	0.90909	6.00E+01
66	0.95455	5.83E+01
67	1	5.66E+01
68	1.0455	5.49E+01
69	1.0909	5.31E+01
70	1.1364	5.14E+01
71	1.1818	4.97E+01
72	1.2273	4.80E+01
73	1.2727	4.62E+01
74	1.3182	4.45E+01
75	1.3636	4.28E+01
76	1.4091	4.10E+01
77	1.4545	3.93E+01
78	1.5	3.76E+01
79	1.5455	3.59E+01
80	1.5909	3.41E+01
81	1.6364	3.24E+01

Prediction Line

	X	Y
82	1.6818	2.76E+01
83	1.7273	2.62E+01
84	1.7727	2.49E+01
85	1.8182	2.37E+01
86	1.8636	2.25E+01
87	1.9091	2.13E+01
88	1.9545	2.02E+01
89	2	1.92E+01
90	2.0455	1.81E+01
91	2.0909	1.72E+01
92	2.1364	1.63E+01
93	2.1818	1.54E+01
94	2.2273	1.45E+01
95	2.2727	1.37E+01
96	2.3182	1.30E+01
97	2.3636	1.23E+01
98	2.4091	1.16E+01
99	2.4545	1.09E+01
100	2.5	1.03E+01

	X	Y
82	1.6818	2.83E+01
83	1.7273	2.69E+01
84	1.7727	2.55E+01
85	1.8182	2.42E+01
86	1.8636	2.29E+01
87	1.9091	2.16E+01
88	1.9545	2.04E+01
89	2	1.92E+01
90	2.0455	1.81E+01
91	2.0909	1.69E+01
92	2.1364	1.59E+01
93	2.1818	1.48E+01
94	2.2273	1.38E+01
95	2.2727	1.28E+01
96	2.3182	1.19E+01
97	2.3636	1.10E+01
98	2.4091	1.01E+01
99	2.4545	9.27E+00
100	2.5	8.48E+00

	X	Y
82	1.6818	3.07E+01
83	1.7273	2.90E+01
84	1.7727	2.72E+01
85	1.8182	2.55E+01
86	1.8636	2.38E+01
87	1.9091	2.20E+01
88	1.9545	2.03E+01
89	2	1.86E+01
90	2.0455	1.69E+01
91	2.0909	1.51E+01
92	2.1364	1.34E+01
93	2.1818	1.17E+01
94	2.2273	9.95E+00
95	2.2727	8.23E+00
96	2.3182	6.50E+00
97	2.3636	4.77E+00
98	2.4091	3.05E+00
99	2.4545	1.32E+00
100	2.5	0.00E+00

Table H2.D-11d. TRAP Model Output for Nickel Data for the Bird Survival Endpoint (Ling and Leach 1979)

Chemical:	Nickel
Study Authors:	Ling and Leach 1979
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
0.000001	16	16	1
34.96063	15	16	0.9375
58.26772	12	16	0.75
81.5748	13	16	0.8125
104.8819	8	16	0.5
128.189	5.0	16.0	0.3125

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.0281	2.0247	5.33E-02	1.916	2.1334
S	0.31769	2.94E-01	8.07E-02	0.20527	0.51558
Y0	1	0.9999	2.50E-03	0.79396	1

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.0281	2.0258	5.42E-02	1.9147	2.1368
S	0.31769	2.88E-01	7.10E-02	0.20114	0.5052
Y0	1	0.9999	2.51E-03	0.79394	1

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.0281	2.0369	7.77E-02	1.8725	2.2012
S	0.31769	0.31573	6.42E-02	0.2266	0.52017
Y0	1	0.9999	2.52E-03	0.79391	1

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	105.86	8.24E+01	1.36E+02	5.33E-02	2.0247
20	59.904	4.43E+01	8.11E+01	6.16E-02	1.7775
10	44.485	2.79E+01	7.10E+01	8.92E-02	1.6482
5	34.792	1.81E+01	6.67E+01	0.11535	1.5415
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	106.11	8.22E+01	1.37E+02	5.42E-02	2.0258
20	58.425	4.39E+01	7.77E+01	5.74E-02	1.7666
10	4.32E+01	28.043	66.7	8.13E-02	1.636
5	34.963	19.568	62.472	0.10166	1.5436
0	20.923	6.6541	65.791	0.15577	1.32E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	108.86	7.46E+01	1.59E+02	7.77E-02	2.0369
20	51.138	40.757	64.164	4.39E-02	1.7087
10	39.753	30.249	52.244	5.04E-02	1.5994
5	35.05	2.55E+01	48.121	5.67E-02	1.5447
0	30.903	2.13E+01	4.48E+01	6.43E-02	1.49

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1	0.9999
2	1.54E+00	0.9375	0.94917
3	1.77E+00	0.75	0.8112
4	1.91E+00	0.8125	0.64992
5	2.02E+00	0.5	0.50545
6	2.1079	0.3125	0.38862

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1	0.9999
2	1.54E+00	0.9375	0.94992
3	1.77E+00	0.75	0.80099
4	1.91E+00	0.8125	0.64882
5	2.02E+00	0.5	0.50716
6	2.1079	0.3125	0.39039

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1	0.9999
2	1.54E+00	0.9375	0.95092
3	1.77E+00	0.75	0.74813
4	1.91E+00	0.8125	0.61455
5	2.02E+00	0.5	0.51478
6	2.1079	0.3125	0.43511

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-2	0.9999
2	-1.95E+00	0.9999
3	-1.91E+00	0.9999
4	-1.86E+00	0.9999
5	-1.82E+00	0.9999
6	-1.77E+00	0.9999
7	-1.73E+00	0.9999
8	-1.68E+00	0.9999
9	-1.64E+00	0.9999
10	-1.59E+00	0.9999
11	-1.55E+00	0.9999
12	-1.50E+00	0.9999
13	-1.45E+00	0.9999
14	-1.4091	0.9999
15	-1.3636	0.9999
16	-1.3182	0.9999
17	-1.2727	0.9999
18	-1.2273	0.9999
19	-1.1818	0.9999
20	-1.1364	0.9999
21	-1.0909	0.9999
22	-1.0455	0.9999
23	-1	0.9999
24	-0.95455	0.9999
25	-0.90909	0.9999
26	-0.86364	0.9999
27	-0.81818	0.9999
28	-0.77273	0.9999
29	-0.72727	0.9999
30	-0.68182	0.9999

	X	Y
1	-2	0.9999
2	-1.95E+00	0.9999
3	-1.91E+00	0.9999
4	-1.86E+00	0.9999
5	-1.82E+00	0.9999
6	-1.77E+00	0.9999
7	-1.73E+00	0.9999
8	-1.68E+00	0.9999
9	-1.64E+00	0.9999
10	-1.59E+00	0.9999
11	-1.55E+00	0.9999
12	-1.50E+00	0.9999
13	-1.45E+00	0.9999
14	-1.4091	0.9999
15	-1.3636	0.9999
16	-1.3182	0.9999
17	-1.2727	0.9999
18	-1.2273	0.9999
19	-1.1818	0.9999
20	-1.1364	0.9999
21	-1.0909	0.9999
22	-1.0455	0.9999
23	-1	0.9999
24	-0.95455	0.9999
25	-0.90909	0.9999
26	-0.86364	0.9999
27	-0.81818	0.9999
28	-0.77273	0.9999
29	-0.72727	0.9999
30	-0.68182	0.9999

	X	Y
1	-2	0.9999
2	-1.95E+00	0.9999
3	-1.91E+00	0.9999
4	-1.86E+00	0.9999
5	-1.82E+00	0.9999
6	-1.77E+00	0.9999
7	-1.73E+00	0.9999
8	-1.68E+00	0.9999
9	-1.64E+00	0.9999
10	-1.59E+00	0.9999
11	-1.55E+00	0.9999
12	-1.50E+00	0.9999
13	-1.45E+00	0.9999
14	-1.4091	0.9999
15	-1.3636	0.9999
16	-1.3182	0.9999
17	-1.2727	0.9999
18	-1.2273	0.9999
19	-1.1818	0.9999
20	-1.1364	0.9999
21	-1.0909	0.9999
22	-1.0455	0.9999
23	-1	0.9999
24	-0.95455	0.9999
25	-0.90909	0.9999
26	-0.86364	0.9999
27	-0.81818	0.9999
28	-0.77273	0.9999
29	-0.72727	0.9999
30	-0.68182	0.9999

Prediction Line

	X	Y
31	-0.63636	0.9999
32	-0.59091	0.9999
33	-0.54545	0.9999
34	-0.5	0.9999
35	-0.45455	0.9999
36	-0.40909	0.9999
37	-0.36364	0.9999
38	-0.31818	0.9999
39	-0.27273	0.9999
40	-0.22727	0.9999
41	-0.18182	0.9999
42	-0.13636	0.9999
43	-9.09E-02	0.9999
44	-4.55E-02	0.9999
45	0	0.9999
46	4.55E-02	0.9999
47	9.09E-02	0.9999
48	0.13636	0.9999
49	0.18182	0.9999
50	0.22727	0.9999
51	0.27273	0.9999
52	0.31818	0.9999
53	0.36364	0.9999
54	0.40909	0.9999
55	0.45455	0.9999
56	0.5	0.9999
57	0.54545	0.9999
58	0.59091	0.9999
59	0.63636	0.9999
60	0.68182	0.9999
61	0.72727	0.99989
62	0.77273	0.99989
63	0.81818	0.99988
64	0.86364	0.99986
65	0.90909	0.99983
66	0.95455	0.99977
67	1	0.99966
68	1.0455	0.99947
69	1.0909	0.99916
70	1.1364	0.99865
71	1.1818	0.99784
72	1.2273	0.99658
73	1.2727	0.99466
74	1.3182	0.99181
75	1.3636	0.98768
76	1.4091	0.98184
77	1.4545	0.97376
78	1.5	0.96286
79	1.5455	0.9485
80	1.5909	0.93002
81	1.6364	0.90681

	X	Y
31	-0.63636	0.9999
32	-0.59091	0.9999
33	-0.54545	0.9999
34	-0.5	0.9999
35	-0.45455	0.9999
36	-0.40909	0.9999
37	-0.36364	0.9999
38	-0.31818	0.9999
39	-0.27273	0.9999
40	-0.22727	0.9999
41	-0.18182	0.9999
42	-0.13636	0.9999
43	-9.09E-02	0.9999
44	-4.55E-02	0.9999
45	0	0.9999
46	4.55E-02	0.9999
47	9.09E-02	0.9999
48	0.13636	0.9999
49	0.18182	0.9999
50	0.22727	0.9999
51	0.27273	0.9999
52	0.31818	0.9999
53	0.36364	0.9999
54	0.40909	0.9999
55	0.45455	0.9999
56	0.5	0.9999
57	0.54545	0.9999
58	0.59091	0.9999
59	0.63636	0.9999
60	0.68182	0.9999
61	0.72727	0.9999
62	0.77273	0.9999
63	0.81818	0.9999
64	0.86364	0.9999
65	0.90909	0.9999
66	0.95455	0.9999
67	1	0.9999
68	1.0455	0.9999
69	1.0909	0.9999
70	1.1364	0.9999
71	1.1818	0.9999
72	1.2273	0.9999
73	1.2727	0.9999
74	1.3182	0.9999
75	1.3636	0.99804
76	1.4091	0.99203
77	1.4545	0.98187
78	1.5	0.96755
79	1.5455	0.94908
80	1.5909	0.92645
81	1.6364	0.89967

	X	Y
31	-0.63636	0.9999
32	-0.59091	0.9999
33	-0.54545	0.9999
34	-0.5	0.9999
35	-0.45455	0.9999
36	-0.40909	0.9999
37	-0.36364	0.9999
38	-0.31818	0.9999
39	-0.27273	0.9999
40	-0.22727	0.9999
41	-0.18182	0.9999
42	-0.13636	0.9999
43	-9.09E-02	0.9999
44	-4.55E-02	0.9999
45	0	0.9999
46	4.55E-02	0.9999
47	9.09E-02	0.9999
48	0.13636	0.9999
49	0.18182	0.9999
50	0.22727	0.9999
51	0.27273	0.9999
52	0.31818	0.9999
53	0.36364	0.9999
54	0.40909	0.9999
55	0.45455	0.9999
56	0.5	0.9999
57	0.54545	0.9999
58	0.59091	0.9999
59	0.63636	0.9999
60	0.68182	0.9999
61	0.72727	0.9999
62	0.77273	0.9999
63	0.81818	0.9999
64	0.86364	0.9999
65	0.90909	0.9999
66	0.95455	0.9999
67	1	0.9999
68	1.0455	0.9999
69	1.0909	0.9999
70	1.1364	0.9999
71	1.1818	0.9999
72	1.2273	0.9999
73	1.2727	0.9999
74	1.3182	0.9999
75	1.3636	0.9999
76	1.4091	0.9999
77	1.4545	0.9999
78	1.5	0.99076
79	1.5455	0.94921
80	1.5909	0.90766
81	1.6364	0.86611

Prediction Line

	X	Y
82	1.6818	0.87835
83	1.7273	0.84427
84	1.7727	0.80442
85	1.8182	0.75892
86	1.8636	0.70821
87	1.9091	0.65302
88	1.9545	0.59437
89	2	0.53352
90	2.0455	0.47187
91	2.0909	0.41089
92	2.1364	0.35199
93	2.1818	0.29645
94	2.2273	0.24532
95	2.2727	0.19934
96	2.3182	0.15899
97	2.3636	0.1244
98	2.4091	9.55E-02
99	2.4545	7.18E-02
100	2.5	5.29E-02

	X	Y
82	1.6818	0.86874
83	1.7273	0.83365
84	1.7727	0.79441
85	1.8182	0.75101
86	1.8636	0.70345
87	1.9091	0.65175
88	1.9545	0.59589
89	2	0.53587
90	2.0455	0.47248
91	2.0909	0.41191
92	2.1364	0.35549
93	2.1818	0.30323
94	2.2273	0.25512
95	2.2727	0.21116
96	2.3182	0.17136
97	2.3636	0.13572
98	2.4091	0.10423
99	2.4545	7.69E-02
100	2.5	5.37E-02

	X	Y
82	1.6818	0.82456
83	1.7273	0.783
84	1.7727	0.74145
85	1.8182	0.6999
86	1.8636	0.65835
87	1.9091	0.6168
88	1.9545	0.57525
89	2	0.5337
90	2.0455	0.49215
91	2.0909	0.4506
92	2.1364	0.40905
93	2.1818	0.3675
94	2.2273	0.32595
95	2.2727	0.28439
96	2.3182	0.24284
97	2.3636	0.20129
98	2.4091	0.15974
99	2.4545	0.11819
100	2.5	7.66E-02

Table H2.D-11e. TRAP Model Output for Nickel Data for the Bird Survival Endpoint (Cain and Pafford 1981)

Chemical:	Nickel
Study Authors:	Cain and Pafford 1981
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
0.23	36	36	1
17.6	36	36	1
77.4	32.9988	36	0.91663
106.9	11.9196	36	0.3311

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes	yes	yes
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.1114	2.0072	2.28E-02	1.9606	2.0538
S	0.3773	1.26E-01	3.65E-02	8.79E-02	0.22071
Y0	1	0.9999	1.18E-03	0.94985	1

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.1114	2.0095	2.39E-02	1.9606	2.0584
S	0.3773	1.26E-01	3.82E-02	8.79E-02	0.22071
Y0	1	0.9999	1.18E-03	0.94985	1

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	2.1114	2.0274	3.59E-02	1.9494	2.1055
S	0.3773	0.12577	4.11E-02	8.79E-02	0.22071
Y0	1	0.9999	1.18E-03	0.94985	1

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	101.67	9.13E+01	1.13E+02	2.28E-02	2.0072
20	79.682	6.93E+01	9.16E+01	2.83E-02	1.9014
10	70.151	5.65E+01	8.71E+01	4.12E-02	1.846
5	63.146	4.68E+01	8.53E+01	5.32E-02	1.8003
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	102.21	9.13E+01	1.14E+02	2.39E-02	2.0095
20	78.754	6.75E+01	9.19E+01	3.11E-02	1.8963
10	6.91E+01	54.122	88.112	4.57E-02	1.8392
5	62.929	45.255	87.507	5.77E-02	1.7989
0	50.285	25.949	97.442	8.99E-02	1.70E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	106.52	8.90E+01	1.28E+02	3.59E-02	2.0274
20	78.837	68.348	90.936	2.65E-02	1.8967
10	71.312	57.932	87.784	3.63E-02	1.8532
5	67.824	5.28E+01	87.15	4.22E-02	1.8314
0	64.506	4.78E+01	8.71E+01	4.84E-02	1.8096

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.38E-01	1	0.9999
2	1.25E+00	1	0.9999
3	1.89E+00	0.91663	0.82683
4	2.03E+00	0.3311	0.4313
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-0.5	0.9999
2	-4.70E-01	0.9999
3	-4.39E-01	0.9999
4	-4.09E-01	0.9999
5	-3.79E-01	0.9999
6	-3.48E-01	0.9999
7	-3.18E-01	0.9999
8	-2.88E-01	0.9999
9	-2.58E-01	0.9999
10	-2.27E-01	0.9999
11	-1.97E-01	0.9999
12	-1.67E-01	0.9999
13	-1.36E-01	0.9999
14	-0.10606	0.9999
15	-7.58E-02	0.9999
16	-4.55E-02	0.9999
17	-1.52E-02	0.9999
18	1.52E-02	0.9999
19	4.55E-02	0.9999
20	7.58E-02	0.9999
21	0.10606	0.9999
22	0.13636	0.9999
23	0.16667	0.9999
24	0.19697	0.9999
25	0.22727	0.9999
26	0.25758	0.9999
27	0.28788	0.9999
28	0.31818	0.9999
29	0.34848	0.9999
30	0.37879	0.9999

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.38E-01	1	0.9999
2	1.25E+00	1	0.9999
3	1.89E+00	0.91663	0.8151
4	2.03E+00	0.3311	0.43878
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-0.5	0.9999
2	-4.70E-01	0.9999
3	-4.39E-01	0.9999
4	-4.09E-01	0.9999
5	-3.79E-01	0.9999
6	-3.48E-01	0.9999
7	-3.18E-01	0.9999
8	-2.88E-01	0.9999
9	-2.58E-01	0.9999
10	-2.27E-01	0.9999
11	-1.97E-01	0.9999
12	-1.67E-01	0.9999
13	-1.36E-01	0.9999
14	-0.10606	0.9999
15	-7.58E-02	0.9999
16	-4.55E-02	0.9999
17	-1.52E-02	0.9999
18	1.52E-02	0.9999
19	4.55E-02	0.9999
20	7.58E-02	0.9999
21	0.10606	0.9999
22	0.13636	0.9999
23	0.16667	0.9999
24	0.19697	0.9999
25	0.22727	0.9999
26	0.25758	0.9999
27	0.28788	0.9999
28	0.31818	0.9999
29	0.34848	0.9999
30	0.37879	0.9999

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.38E-01	1	0.9999
2	1.25E+00	1	0.9999
3	1.89E+00	0.91663	0.81828
4	2.03E+00	0.3311	0.49645
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-0.5	0.9999
2	-4.70E-01	0.9999
3	-4.39E-01	0.9999
4	-4.09E-01	0.9999
5	-3.79E-01	0.9999
6	-3.48E-01	0.9999
7	-3.18E-01	0.9999
8	-2.88E-01	0.9999
9	-2.58E-01	0.9999
10	-2.27E-01	0.9999
11	-1.97E-01	0.9999
12	-1.67E-01	0.9999
13	-1.36E-01	0.9999
14	-0.10606	0.9999
15	-7.58E-02	0.9999
16	-4.55E-02	0.9999
17	-1.52E-02	0.9999
18	1.52E-02	0.9999
19	4.55E-02	0.9999
20	7.58E-02	0.9999
21	0.10606	0.9999
22	0.13636	0.9999
23	0.16667	0.9999
24	0.19697	0.9999
25	0.22727	0.9999
26	0.25758	0.9999
27	0.28788	0.9999
28	0.31818	0.9999
29	0.34848	0.9999
30	0.37879	0.9999

Prediction Line

	X	Y
31	0.40909	0.9999
32	0.43939	0.9999
33	0.4697	0.9999
34	0.5	0.9999
35	0.5303	0.9999
36	0.56061	0.9999
37	0.59091	0.9999
38	0.62121	0.9999
39	0.65152	0.9999
40	0.68182	0.9999
41	0.71212	0.9999
42	0.74242	0.9999
43	0.77273	0.9999
44	0.80303	0.9999
45	0.83333	0.9999
46	0.86364	0.9999
47	0.89394	0.9999
48	0.92424	0.9999
49	0.95455	0.9999
50	0.98485	0.9999
51	1.0152	0.9999
52	1.0455	0.9999
53	1.0758	0.9999
54	1.1061	0.9999
55	1.1364	0.9999
56	1.1667	0.9999
57	1.197	0.9999
58	1.2273	0.9999
59	1.2576	0.9999
60	1.2879	0.9999
61	1.3182	0.9999
62	1.3485	0.9999
63	1.3788	0.9999
64	1.4091	0.9999
65	1.4394	0.9999
66	1.4697	0.99989
67	1.5	0.99987
68	1.5303	0.99983
69	1.5606	0.99971
70	1.5909	0.99943
71	1.6212	0.99883
72	1.6515	0.99756
73	1.6818	0.99506
74	1.7121	0.99042
75	1.7424	0.98227
76	1.7727	0.96878
77	1.803	0.94767
78	1.8333	0.91651
79	1.8636	0.87311
80	1.8939	0.81605
81	1.9242	0.74523

	X	Y
31	0.40909	0.9999
32	0.43939	0.9999
33	0.4697	0.9999
34	0.5	0.9999
35	0.5303	0.9999
36	0.56061	0.9999
37	0.59091	0.9999
38	0.62121	0.9999
39	0.65152	0.9999
40	0.68182	0.9999
41	0.71212	0.9999
42	0.74242	0.9999
43	0.77273	0.9999
44	0.80303	0.9999
45	0.83333	0.9999
46	0.86364	0.9999
47	0.89394	0.9999
48	0.92424	0.9999
49	0.95455	0.9999
50	0.98485	0.9999
51	1.0152	0.9999
52	1.0455	0.9999
53	1.0758	0.9999
54	1.1061	0.9999
55	1.1364	0.9999
56	1.1667	0.9999
57	1.197	0.9999
58	1.2273	0.9999
59	1.2576	0.9999
60	1.2879	0.9999
61	1.3182	0.9999
62	1.3485	0.9999
63	1.3788	0.9999
64	1.4091	0.9999
65	1.4394	0.9999
66	1.4697	0.9999
67	1.5	0.9999
68	1.5303	0.9999
69	1.5606	0.9999
70	1.5909	0.9999
71	1.6212	0.9999
72	1.6515	0.9999
73	1.6818	0.9999
74	1.7121	0.9993
75	1.7424	0.99105
76	1.7727	0.97313
77	1.803	0.94553
78	1.8333	0.90826
79	1.8636	0.86132
80	1.8939	0.8047
81	1.9242	0.73841

	X	Y
31	0.40909	0.9999
32	0.43939	0.9999
33	0.4697	0.9999
34	0.5	0.9999
35	0.5303	0.9999
36	0.56061	0.9999
37	0.59091	0.9999
38	0.62121	0.9999
39	0.65152	0.9999
40	0.68182	0.9999
41	0.71212	0.9999
42	0.74242	0.9999
43	0.77273	0.9999
44	0.80303	0.9999
45	0.83333	0.9999
46	0.86364	0.9999
47	0.89394	0.9999
48	0.92424	0.9999
49	0.95455	0.9999
50	0.98485	0.9999
51	1.0152	0.9999
52	1.0455	0.9999
53	1.0758	0.9999
54	1.1061	0.9999
55	1.1364	0.9999
56	1.1667	0.9999
57	1.197	0.9999
58	1.2273	0.9999
59	1.2576	0.9999
60	1.2879	0.9999
61	1.3182	0.9999
62	1.3485	0.9999
63	1.3788	0.9999
64	1.4091	0.9999
65	1.4394	0.9999
66	1.4697	0.9999
67	1.5	0.9999
68	1.5303	0.9999
69	1.5606	0.9999
70	1.5909	0.9999
71	1.6212	0.9999
72	1.6515	0.9999
73	1.6818	0.9999
74	1.7121	0.9999
75	1.7424	0.9999
76	1.7727	0.9999
77	1.803	0.9999
78	1.8333	0.94543
79	1.8636	0.87589
80	1.8939	0.80635
81	1.9242	0.73681

Prediction Line

	X	Y
82	1.9545	0.66227
83	1.9848	0.57054
84	2.0152	0.47483
85	2.0455	0.38055
86	2.0758	0.2929
87	2.1061	0.21599
88	2.1364	0.15229
89	2.1667	0.1025
90	2.197	6.58E-02
91	2.2273	4.02E-02
92	2.2576	2.34E-02
93	2.2879	1.29E-02
94	2.3182	6.80E-03
95	2.3485	3.43E-03
96	2.3788	1.67E-03
97	2.4091	7.98E-04
98	2.4394	3.95E-04
99	2.4697	2.18E-04
100	2.5	1.45E-04

	X	Y
82	1.9545	0.66244
83	1.9848	0.5768
84	2.0152	0.48182
85	2.0455	0.39011
86	2.0758	0.30808
87	2.1061	0.23573
88	2.1364	0.17304
89	2.1667	0.12003
90	2.197	7.67E-02
91	2.2273	4.30E-02
92	2.2576	1.91E-02
93	2.2879	4.74E-03
94	2.3182	1.00E-04
95	2.3485	1.00E-04
96	2.3788	1.00E-04
97	2.4091	1.00E-04
98	2.4394	1.00E-04
99	2.4697	1.00E-04
100	2.5	1.00E-04

	X	Y
82	1.9545	0.66726
83	1.9848	0.59772
84	2.0152	0.52818
85	2.0455	0.45864
86	2.0758	0.3891
87	2.1061	0.31955
88	2.1364	0.25001
89	2.1667	0.18047
90	2.197	0.11093
91	2.2273	4.14E-02
92	2.2576	1.00E-04
93	2.2879	1.00E-04
94	2.3182	1.00E-04
95	2.3485	1.00E-04
96	2.3788	1.00E-04
97	2.4091	1.00E-04
98	2.4394	1.00E-04
99	2.4697	1.00E-04
100	2.5	1.00E-04

Table H2.D-12a. TRAP Model Output for Selenium Data for the Bird Growth Endpoint (Pooling Group A: El-Begearmi and Combs 1982; Jensen 1986; Dafalla and Adam 1986)

Chemical:	Selenium
Study Authors:	Pooling group A
Receptor Group:	Bird
Effect Description:	Growth

Input Data:	Dose	Effect Relative to Control
	1.00E-06	100
	2.7239	35.613
	5.4479	19.104
	8.1718	17.453
	1.00E-06	100
	2.724	33.4
	5.4479	31.924
	8.1718	19.345
	1.12E-02	100
	2.23E-02	102.65
	0.039	103.2
	0.12283	95.265
	0.5695	76.705
	1.00E-06	100
	0.25936	70

Modeling Parameters			
Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.18426	1.43E-01	6.84E-02	-5.89E-03	0.29198
S	0.56175	4.98E-01	5.51E-02	0.37822	0.61811
Y0	1.01E+02	1.02E+02	2.6067	96.329	107.69

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.18426	0.14871	6.15E-02	1.46E-02	0.2828
S	0.56175	5.24E-01	5.02E-02	0.41421	0.63302
Y0	1.01E+02	1.01E+02	2.3271	95.972	106.11

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.18426	0.11983	5.14E-02	7.87E-03	0.23179
S	0.56175	0.4085	2.87E-02	0.34589	0.4711
Y0	1.01E+02	1.01E+02	2.1713	96.248	105.71

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.3901	0.98652	1.9588	6.84E-02	1.43E-01
20	2.80E-01	1.48E-01	5.29E-01	0.12685	-0.55266
10	1.10E-01	4.72E-02	2.55E-01	0.16808	-0.95962
5	4.63E-02	1.63E-02	1.31E-01	0.20745	-1.3346
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.4083	1.0342	1.9178	6.15E-02	0.14871
20	0.27975	1.60E-01	0.48955	0.11154	-0.55323
10	1.24E-01	5.95E-02	2.58E-01	0.14623	-0.90701
5	6.96E-02	2.87E-02	1.69E-01	0.1767	-1.1572
0	1.73E-02	3.12E-03	9.64E-02	0.34205	-1.76E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.3178	1.0183	1.7053	5.14E-02	0.11983
20	0.2429	0.15903	0.371	8.44E-02	-0.61457
10	0.13824	8.41E-02	0.22721	9.90E-02	-0.85937
5	1.04E-01	6.11E-02	0.17807	0.10664	-0.98177
0	7.87E-02	4.43E-02	0.13965	0.11438	-1.1042

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.02E+02
2	-6.00E+00	1.00E+02	1.02E+02
3	-6.00E+00	1.00E+02	1.02E+02
4	-1.95E+00	1.00E+02	1.00E+02
5	-1.65E+00	1.03E+02	9.92E+01
6	-1.41E+00	1.03E+02	9.76E+01
7	-9.11E-01	9.53E+01	9.09E+01
8	-5.86E-01	7.00E+01	8.27E+01
9	-2.45E-01	7.67E+01	6.98E+01
10	4.35E-01	35.613	36.563
11	4.35E-01	3.34E+01	3.66E+01
12	7.36E-01	3.19E+01	2.39E+01
13	7.36E-01	19.104	23.94
14	9.12E-01	19.345	18.114
15	0.91232	17.453	18.114

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.01E+02
2	-6.00E+00	1.00E+02	1.01E+02
3	-6.00E+00	1.00E+02	1.01E+02
4	-1.95E+00	1.00E+02	1.01E+02
5	-1.65E+00	1.03E+02	1.01E+02
6	-1.41E+00	1.03E+02	9.93E+01
7	-9.11E-01	9.53E+01	9.10E+01
8	-5.86E-01	7.00E+01	8.19E+01
9	-2.45E-01	7.67E+01	6.92E+01
10	4.35E-01	35.613	36.501
11	4.35E-01	3.34E+01	3.65E+01
12	7.36E-01	3.19E+01	2.42E+01
13	7.36E-01	19.104	24.218
14	9.12E-01	19.345	18.198
15	0.91232	17.453	18.198

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.01E+02
2	-6.00E+00	1.00E+02	1.01E+02
3	-6.00E+00	1.00E+02	1.01E+02
4	-1.95E+00	1.00E+02	1.01E+02
5	-1.65E+00	1.03E+02	1.01E+02
6	-1.41E+00	1.03E+02	1.01E+02
7	-9.11E-01	9.53E+01	9.30E+01
8	-5.86E-01	7.00E+01	7.96E+01
9	-2.45E-01	7.67E+01	6.55E+01
10	4.35E-01	35.613	37.481
11	4.35E-01	3.34E+01	3.75E+01
12	7.36E-01	3.19E+01	2.51E+01
13	7.36E-01	19.104	25.063
14	9.12E-01	19.345	17.8
15	0.91232	17.453	17.8

Analysis of Variance

R-squared: 0.979

	DF	SS	MS	F	Sig
Total (adj)	14	18205	1300.4		
Regression	2	17821	8910.7	278.63	0
Error	12	383.77	31.981		

R-squared: 0.981

	DF	SS	MS	F	Sig
Total (adj)	14	18205	1300.4		
Regression	2	17868	8934	318	0
Error	12	337.13	28.094		

R-squared: 0.981

	DF	SS	MS	F	Sig
Total (adj)	14	18205	1300.4		
Regression	2	17866	8932.9	315.79	0
Error	12	339.45	28.288		

Prediction Line

	X	Y
1	-3	1.02E+02
2	-2.95E+00	1.02E+02
3	-2.91E+00	1.02E+02
4	-2.86E+00	1.02E+02
5	-2.82E+00	1.02E+02
6	-2.77E+00	1.02E+02
7	-2.73E+00	1.02E+02
8	-2.68E+00	1.02E+02
9	-2.64E+00	1.02E+02
10	-2.59E+00	1.02E+02
11	-2.55E+00	1.02E+02
12	-2.50E+00	1.01E+02
13	-2.45E+00	1.01E+02

	X	Y
1	-3	1.01E+02
2	-2.95E+00	1.01E+02
3	-2.91E+00	1.01E+02
4	-2.86E+00	1.01E+02
5	-2.82E+00	1.01E+02
6	-2.77E+00	1.01E+02
7	-2.73E+00	1.01E+02
8	-2.68E+00	1.01E+02
9	-2.64E+00	1.01E+02
10	-2.59E+00	1.01E+02
11	-2.55E+00	1.01E+02
12	-2.50E+00	1.01E+02
13	-2.45E+00	1.01E+02

	X	Y
1	-3	1.01E+02
2	-2.95E+00	1.01E+02
3	-2.91E+00	1.01E+02
4	-2.86E+00	1.01E+02
5	-2.82E+00	1.01E+02
6	-2.77E+00	1.01E+02
7	-2.73E+00	1.01E+02
8	-2.68E+00	1.01E+02
9	-2.64E+00	1.01E+02
10	-2.59E+00	1.01E+02
11	-2.55E+00	1.01E+02
12	-2.50E+00	1.01E+02
13	-2.45E+00	1.01E+02

Prediction Line

	X	Y
14	-2.4091	1.01E+02
15	-2.3636	1.01E+02
16	-2.3182	1.01E+02
17	-2.2727	1.01E+02
18	-2.2273	1.01E+02
19	-2.1818	1.01E+02
20	-2.1364	1.01E+02
21	-2.09E+00	1.01E+02
22	-2.05E+00	1.01E+02
23	-2.00E+00	1.01E+02
24	-1.95E+00	1.00E+02
25	-1.91E+00	1.00E+02
26	-1.86E+00	1.00E+02
27	-1.82E+00	1.00E+02
28	-1.77E+00	9.98E+01
29	-1.73E+00	9.96E+01
30	-1.68E+00	9.94E+01
31	-1.6364	9.91E+01
32	-1.5909	9.89E+01
33	-1.5455	9.86E+01
34	-1.5	9.83E+01
35	-1.4545	9.79E+01
36	-1.4091	9.76E+01
37	-1.3636	9.72E+01
38	-1.3182	9.67E+01
39	-1.2727	9.63E+01
40	-1.2273	9.58E+01
41	-1.1818	9.52E+01
42	-1.1364	9.46E+01
43	-1.0909	9.40E+01
44	-1.0455	9.33E+01
45	-1	9.25E+01
46	-0.95455	9.17E+01
47	-0.90909	9.08E+01
48	-0.86364	8.99E+01
49	-0.81818	8.89E+01
50	-0.77273	8.78E+01
51	-0.72727	8.67E+01
52	-0.68182	8.55E+01
53	-0.63636	8.42E+01
54	-0.59091	8.28E+01
55	-5.45E-01	8.14E+01
56	-5.00E-01	7.98E+01
57	-4.55E-01	7.82E+01
58	-4.09E-01	7.65E+01
59	-3.64E-01	7.48E+01
60	-3.18E-01	7.29E+01
61	-0.27273	7.10E+01
62	-0.22727	6.90E+01
63	-0.18182	6.70E+01
64	-0.13636	6.48E+01

	X	Y
14	-2.4091	1.01E+02
15	-2.3636	1.01E+02
16	-2.3182	1.01E+02
17	-2.2727	1.01E+02
18	-2.2273	1.01E+02
19	-2.1818	1.01E+02
20	-2.1364	1.01E+02
21	-2.09E+00	1.01E+02
22	-2.05E+00	1.01E+02
23	-2.00E+00	1.01E+02
24	-1.95E+00	1.01E+02
25	-1.91E+00	1.01E+02
26	-1.86E+00	1.01E+02
27	-1.82E+00	1.01E+02
28	-1.77E+00	1.01E+02
29	-1.73E+00	1.01E+02
30	-1.68E+00	1.01E+02
31	-1.6364	1.01E+02
32	-1.5909	1.01E+02
33	-1.5455	1.00E+02
34	-1.5	1.00E+02
35	-1.4545	9.97E+01
36	-1.4091	9.93E+01
37	-1.3636	9.89E+01
38	-1.3182	9.83E+01
39	-1.2727	9.77E+01
40	-1.2273	9.71E+01
41	-1.1818	9.64E+01
42	-1.1364	9.56E+01
43	-1.0909	9.48E+01
44	-1.0455	9.39E+01
45	-1	9.30E+01
46	-0.95455	9.20E+01
47	-0.90909	9.10E+01
48	-0.86364	8.99E+01
49	-0.81818	8.87E+01
50	-0.77273	8.75E+01
51	-0.72727	8.62E+01
52	-0.68182	8.49E+01
53	-0.63636	8.35E+01
54	-0.59091	8.21E+01
55	-5.45E-01	8.06E+01
56	-5.00E-01	7.90E+01
57	-4.55E-01	7.74E+01
58	-4.09E-01	7.57E+01
59	-3.64E-01	7.40E+01
60	-3.18E-01	7.22E+01
61	-0.27273	7.04E+01
62	-0.22727	6.85E+01
63	-0.18182	6.65E+01
64	-0.13636	6.45E+01

	X	Y
14	-2.4091	1.01E+02
15	-2.3636	1.01E+02
16	-2.3182	1.01E+02
17	-2.2727	1.01E+02
18	-2.2273	1.01E+02
19	-2.1818	1.01E+02
20	-2.1364	1.01E+02
21	-2.09E+00	1.01E+02
22	-2.05E+00	1.01E+02
23	-2.00E+00	1.01E+02
24	-1.95E+00	1.01E+02
25	-1.91E+00	1.01E+02
26	-1.86E+00	1.01E+02
27	-1.82E+00	1.01E+02
28	-1.77E+00	1.01E+02
29	-1.73E+00	1.01E+02
30	-1.68E+00	1.01E+02
31	-1.6364	1.01E+02
32	-1.5909	1.01E+02
33	-1.5455	1.01E+02
34	-1.5	1.01E+02
35	-1.4545	1.01E+02
36	-1.4091	1.01E+02
37	-1.3636	1.01E+02
38	-1.3182	1.01E+02
39	-1.2727	1.01E+02
40	-1.2273	1.01E+02
41	-1.1818	1.01E+02
42	-1.1364	1.01E+02
43	-1.0909	1.00E+02
44	-1.0455	9.86E+01
45	-1	9.67E+01
46	-0.95455	9.48E+01
47	-0.90909	9.29E+01
48	-0.86364	9.11E+01
49	-0.81818	8.92E+01
50	-0.77273	8.73E+01
51	-0.72727	8.54E+01
52	-0.68182	8.36E+01
53	-0.63636	8.17E+01
54	-0.59091	7.98E+01
55	-5.45E-01	7.79E+01
56	-5.00E-01	7.61E+01
57	-4.55E-01	7.42E+01
58	-4.09E-01	7.23E+01
59	-3.64E-01	7.04E+01
60	-3.18E-01	6.86E+01
61	-0.27273	6.67E+01
62	-0.22727	6.48E+01
63	-0.18182	6.29E+01
64	-0.13636	6.11E+01

Prediction Line

	X	Y
65	-9.09E-02	6.27E+01
66	-4.55E-02	6.05E+01
67	0	5.82E+01
68	4.55E-02	5.59E+01
69	9.09E-02	5.37E+01
70	0.13636	5.13E+01
71	0.18182	4.90E+01
72	0.22727	4.67E+01
73	0.27273	4.45E+01
74	0.31818	4.22E+01
75	0.36364	4.00E+01
76	0.40909	3.78E+01
77	0.45455	3.57E+01
78	0.5	3.36E+01
79	0.54545	3.16E+01
80	0.59091	2.96E+01
81	0.63636	2.78E+01
82	0.68182	2.60E+01
83	0.72727	2.43E+01
84	0.77273	2.26E+01
85	0.81818	2.11E+01
86	0.86364	1.96E+01
87	0.90909	1.82E+01
88	0.95455	1.69E+01
89	1	1.57E+01
90	1.0455	1.45E+01
91	1.0909	1.34E+01
92	1.1364	1.24E+01
93	1.1818	1.14E+01
94	1.2273	1.05E+01
95	1.2727	9.72E+00
96	1.3182	8.95E+00
97	1.3636	8.24E+00
98	1.4091	7.58E+00
99	1.4545	6.97E+00
100	1.5	6.40E+00

	X	Y
65	-9.09E-02	6.24E+01
66	-4.55E-02	6.03E+01
67	0	5.81E+01
68	4.55E-02	5.58E+01
69	9.09E-02	5.35E+01
70	0.13636	5.12E+01
71	0.18182	4.88E+01
72	0.22727	4.65E+01
73	0.27273	4.42E+01
74	0.31818	4.20E+01
75	0.36364	3.98E+01
76	0.40909	3.77E+01
77	0.45455	3.56E+01
78	0.5	3.36E+01
79	0.54545	3.17E+01
80	0.59091	2.98E+01
81	0.63636	2.80E+01
82	0.68182	2.63E+01
83	0.72727	2.45E+01
84	0.77273	2.29E+01
85	0.81818	2.13E+01
86	0.86364	1.98E+01
87	0.90909	1.83E+01
88	0.95455	1.69E+01
89	1	1.55E+01
90	1.0455	1.42E+01
91	1.0909	1.30E+01
92	1.1364	1.18E+01
93	1.1818	1.06E+01
94	1.2273	9.57E+00
95	1.2727	8.55E+00
96	1.3182	7.59E+00
97	1.3636	6.69E+00
98	1.4091	5.84E+00
99	1.4545	5.05E+00
100	1.5	4.32E+00

	X	Y
65	-9.09E-02	5.92E+01
66	-4.55E-02	5.73E+01
67	0	5.54E+01
68	4.55E-02	5.36E+01
69	9.09E-02	5.17E+01
70	0.13636	4.98E+01
71	0.18182	4.79E+01
72	0.22727	4.61E+01
73	0.27273	4.42E+01
74	0.31818	4.23E+01
75	0.36364	4.04E+01
76	0.40909	3.86E+01
77	0.45455	3.67E+01
78	0.5	3.48E+01
79	0.54545	3.29E+01
80	0.59091	3.11E+01
81	0.63636	2.92E+01
82	0.68182	2.73E+01
83	0.72727	2.54E+01
84	0.77273	2.36E+01
85	0.81818	2.17E+01
86	0.86364	1.98E+01
87	0.90909	1.79E+01
88	0.95455	1.61E+01
89	1	1.42E+01
90	1.0455	1.23E+01
91	1.0909	1.04E+01
92	1.1364	8.56E+00
93	1.1818	6.68E+00
94	1.2273	4.81E+00
95	1.2727	2.93E+00
96	1.3182	1.06E+00
97	1.3636	0.00E+00
98	1.4091	0.00E+00
99	1.4545	0.00E+00
100	1.5	0.00E+00

Table H2.D-12b. TRAP Model Output for Selenium Data for the Bird Growth Endpoint (Hoffman et al. 1992)

Chemical:	Selenium
Study Authors:	Hoffman et al. 1992 (mallard)
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
2.00E-02	555	16
1.52	479	23
6.02	210	21

Modeling Parameters			
Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes	yes	
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.30578	0.28521	0.1104	-6.61E-02	0.63656
S	1.335	4.01E+00	3.4462	-6.9622	14.972
Y0	5.55E+02	5.59E+02	122.33	169.28	947.9

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.30578	0.28869	9.33E-02	-8.25E-03	0.58564
S	1.335	4.01E+00	2.7891	-4.8713	12.881
Y0	5.55E+02	5.62E+02	122.54	171.61	951.6

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.30578	0.29698	6.06E-02	0.10407	0.4899
S	1.335	3.1533	1.4111	-1.3375	7.6441
Y0	5.55E+02	5.55E+02	122.16	166.23	943.77

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.9285	0.85875	4.3307	0.1104	0.28521
20	1.58E+00	6.32E-01	3.95E+00	0.12501	0.19868
10	1.41E+00	4.65E-01	4.25E+00	0.15093	0.14806
5	1.26E+00	3.35E-01	4.76E+00	0.18092	0.10142
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.944	0.98118	3.8516	9.33E-02	0.28869
20	1.5737	6.65E-01	3.7242	0.11756	0.19692
10	1.41E+00	4.96E-01	4.03E+00	0.1429	0.15067
5	1.3121	3.02E-01	5.71E+00	0.20059	0.11796
0	1.094	1.57E-01	7.61E+00	0.26468	3.90E-02

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.9814	1.2708	3.0896	6.06E-02	0.29698
20	1.5916	0.85165	2.9746	8.53E-02	0.20184
10	1.4796	0.7301	2.9983	9.64E-02	0.17013
5	1.4265	0.67455	3.0167	0.1022	0.15427
0	1.3754	0.62253	3.0386	0.10817	0.13842

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	4.35E-01	3.56E+01	5.59E+02
2	7.36E-01	1.91E+01	4.69E+02
3	9.12E-01	1.75E+01	4.63E+01
4	-1.70E+00	5.55E+02	4.06E-01
5	1.82E-01	479	0.20291
6	7.80E-01	210	0.024212
7			
8			

	Exposure	Effects Var	Est Effects Var
1	-1.70E+00	5.55E+02	5.62E+02
2	1.82E-01	4.79E+02	4.70E+02
3	4.35E-01	3.56E+01	4.80E+01
4	7.36E-01	1.91E+01	0.00E+00
5	7.80E-01	210	0
6	9.12E-01	17.453	0
7			
8			

	Exposure	Effects Var	Est Effects Var
1	-1.70E+00	5.55E+02	5.55E+02
2	1.82E-01	4.79E+02	4.79E+02
3	4.35E-01	3.56E+01	3.56E+01
4	7.36E-01	1.91E+01	0.00E+00
5	7.80E-01	210	0
6	9.12E-01	17.453	0
7			
8			

Analysis of Variance

R-squared: 0.848

	DF	SS	MS	F	Sig
Total (adj)	5	2.95E+05	58957		
Regression	2	2.50E+05	1.25E+05	8.3492	0.0594
Error	3	44895	14965		

R-squared: 0.847

	DF	SS	MS	F	Sig
Total (adj)	5	2.95E+05	58957		
Regression	2	2.50E+05	1.25E+05	8.3149	0.0597
Error	3	45052	15017		

R-squared: 0.848

	DF	SS	MS	F	Sig
Total (adj)	5	2.95E+05	58957		
Regression	2	2.50E+05	1.25E+05	8.3768	0.0592
Error	3	44770	14923		

Prediction Line

	X	Y
1	-1.5	5.59E+02
2	-1.47E+00	5.59E+02
3	-1.44E+00	5.59E+02
4	-1.41E+00	5.59E+02
5	-1.38E+00	5.59E+02
6	-1.35E+00	5.59E+02
7	-1.32E+00	5.59E+02
8	-1.29E+00	5.59E+02
9	-1.26E+00	5.59E+02
10	-1.23E+00	5.59E+02
11	-1.20E+00	5.59E+02
12	-1.17E+00	5.59E+02
13	-1.14E+00	5.59E+02
14	-1.1061	5.59E+02
15	-1.0758	5.59E+02
16	-1.0455	5.59E+02
17	-1.0152	5.59E+02
18	-0.98485	5.59E+02
19	-0.95455	5.59E+02
20	-0.92424	5.59E+02
21	-8.94E-01	5.59E+02
22	-8.64E-01	5.59E+02
23	-8.33E-01	5.59E+02
24	-8.03E-01	5.59E+02
25	-7.73E-01	5.59E+02
26	-7.42E-01	5.59E+02
27	-7.12E-01	5.59E+02
28	-6.82E-01	5.59E+02

	X	Y
1	-1.5	5.62E+02
2	-1.47E+00	5.62E+02
3	-1.44E+00	5.62E+02
4	-1.41E+00	5.62E+02
5	-1.38E+00	5.62E+02
6	-1.35E+00	5.62E+02
7	-1.32E+00	5.62E+02
8	-1.29E+00	5.62E+02
9	-1.26E+00	5.62E+02
10	-1.23E+00	5.62E+02
11	-1.20E+00	5.62E+02
12	-1.17E+00	5.62E+02
13	-1.14E+00	5.62E+02
14	-1.1061	5.62E+02
15	-1.0758	5.62E+02
16	-1.0455	5.62E+02
17	-1.0152	5.62E+02
18	-0.98485	5.62E+02
19	-0.95455	5.62E+02
20	-0.92424	5.62E+02
21	-8.94E-01	5.62E+02
22	-8.64E-01	5.62E+02
23	-8.33E-01	5.62E+02
24	-8.03E-01	5.62E+02
25	-7.73E-01	5.62E+02
26	-7.42E-01	5.62E+02
27	-7.12E-01	5.62E+02
28	-6.82E-01	5.62E+02

	X	Y
1	-1.5	5.55E+02
2	-1.47E+00	5.55E+02
3	-1.44E+00	5.55E+02
4	-1.41E+00	5.55E+02
5	-1.38E+00	5.55E+02
6	-1.35E+00	5.55E+02
7	-1.32E+00	5.55E+02
8	-1.29E+00	5.55E+02
9	-1.26E+00	5.55E+02
10	-1.23E+00	5.55E+02
11	-1.20E+00	5.55E+02
12	-1.17E+00	5.55E+02
13	-1.14E+00	5.55E+02
14	-1.1061	5.55E+02
15	-1.0758	5.55E+02
16	-1.0455	5.55E+02
17	-1.0152	5.55E+02
18	-0.98485	5.55E+02
19	-0.95455	5.55E+02
20	-0.92424	5.55E+02
21	-8.94E-01	5.55E+02
22	-8.64E-01	5.55E+02
23	-8.33E-01	5.55E+02
24	-8.03E-01	5.55E+02
25	-7.73E-01	5.55E+02
26	-7.42E-01	5.55E+02
27	-7.12E-01	5.55E+02
28	-6.82E-01	5.55E+02

Prediction Line

	X	Y
29	-6.52E-01	5.59E+02
30	-6.21E-01	5.59E+02
31	-0.59091	5.59E+02
32	-0.56061	5.59E+02
33	-0.5303	5.59E+02
34	-0.5	5.59E+02
35	-0.4697	5.59E+02
36	-0.43939	5.59E+02
37	-0.40909	5.59E+02
38	-0.37879	5.59E+02
39	-0.34848	5.59E+02
40	-0.31818	5.59E+02
41	-0.28788	5.59E+02
42	-0.25758	5.58E+02
43	-0.22727	5.58E+02
44	-0.19697	5.58E+02
45	-0.16667	5.58E+02
46	-0.13636	5.58E+02
47	-0.10606	5.58E+02
48	-7.58E-02	5.57E+02
49	-4.55E-02	5.56E+02
50	-1.52E-02	5.54E+02
51	1.52E-02	5.51E+02
52	4.55E-02	5.47E+02
53	7.58E-02	5.40E+02
54	0.10606	5.29E+02
55	0.13636	5.11E+02
56	0.16667	4.86E+02
57	0.19697	4.49E+02
58	0.22727	4.00E+02
59	0.25758	3.40E+02
60	0.28788	2.73E+02
61	0.31818	2.07E+02
62	0.34848	1.49E+02
63	0.37879	1.02E+02
64	0.40909	6.75E+01
65	0.43939	4.36E+01
66	0.4697	2.76E+01
67	0.5	1.73E+01
68	0.5303	1.08E+01
69	0.56061	6.70E+00
70	0.59091	4.14E+00
71	0.62121	2.56E+00
72	0.65152	1.58E+00
73	0.68182	9.70E-01
74	0.71212	5.98E-01
75	0.74242	3.68E-01
76	0.77273	2.27E-01
77	0.80303	1.39E-01
78	0.83333	8.58E-02
79	0.86364	5.28E-02

	X	Y
29	-6.52E-01	5.62E+02
30	-6.21E-01	5.62E+02
31	-0.59091	5.62E+02
32	-0.56061	5.62E+02
33	-0.5303	5.62E+02
34	-0.5	5.62E+02
35	-0.4697	5.62E+02
36	-0.43939	5.62E+02
37	-0.40909	5.62E+02
38	-0.37879	5.62E+02
39	-0.34848	5.62E+02
40	-0.31818	5.62E+02
41	-0.28788	5.62E+02
42	-0.25758	5.62E+02
43	-0.22727	5.62E+02
44	-0.19697	5.62E+02
45	-0.16667	5.62E+02
46	-0.13636	5.62E+02
47	-0.10606	5.62E+02
48	-7.58E-02	5.62E+02
49	-4.55E-02	5.62E+02
50	-1.52E-02	5.62E+02
51	1.52E-02	5.62E+02
52	4.55E-02	5.61E+02
53	7.58E-02	5.56E+02
54	0.10606	5.41E+02
55	0.13636	5.19E+02
56	0.16667	4.88E+02
57	0.19697	4.49E+02
58	0.22727	4.02E+02
59	0.25758	3.46E+02
60	0.28788	2.83E+02
61	0.31818	2.18E+02
62	0.34848	1.62E+02
63	0.37879	1.15E+02
64	0.40909	7.53E+01
65	0.43939	4.41E+01
66	0.4697	2.12E+01
67	0.5	6.63E+00
68	0.5303	2.94E-01
69	0.56061	0.00E+00
70	0.59091	0.00E+00
71	0.62121	0.00E+00
72	0.65152	0.00E+00
73	0.68182	0.00E+00
74	0.71212	0.00E+00
75	0.74242	0.00E+00
76	0.77273	0.00E+00
77	0.80303	0.00E+00
78	0.83333	0.00E+00
79	0.86364	0.00E+00

	X	Y
29	-6.52E-01	5.55E+02
30	-6.21E-01	5.55E+02
31	-0.59091	5.55E+02
32	-0.56061	5.55E+02
33	-0.5303	5.55E+02
34	-0.5	5.55E+02
35	-0.4697	5.55E+02
36	-0.43939	5.55E+02
37	-0.40909	5.55E+02
38	-0.37879	5.55E+02
39	-0.34848	5.55E+02
40	-0.31818	5.55E+02
41	-0.28788	5.55E+02
42	-0.25758	5.55E+02
43	-0.22727	5.55E+02
44	-0.19697	5.55E+02
45	-0.16667	5.55E+02
46	-0.13636	5.55E+02
47	-0.10606	5.55E+02
48	-7.58E-02	5.55E+02
49	-4.55E-02	5.55E+02
50	-1.52E-02	5.55E+02
51	1.52E-02	5.55E+02
52	4.55E-02	5.55E+02
53	7.58E-02	5.55E+02
54	0.10606	5.55E+02
55	0.13636	5.55E+02
56	0.16667	5.06E+02
57	0.19697	4.53E+02
58	0.22727	4.00E+02
59	0.25758	3.46E+02
60	0.28788	2.93E+02
61	0.31818	2.40E+02
62	0.34848	1.87E+02
63	0.37879	1.34E+02
64	0.40909	8.13E+01
65	0.43939	2.83E+01
66	0.4697	0.00E+00
67	0.5	0.00E+00
68	0.5303	0.00E+00
69	0.56061	0.00E+00
70	0.59091	0.00E+00
71	0.62121	0.00E+00
72	0.65152	0.00E+00
73	0.68182	0.00E+00
74	0.71212	0.00E+00
75	0.74242	0.00E+00
76	0.77273	0.00E+00
77	0.80303	0.00E+00
78	0.83333	0.00E+00
79	0.86364	0.00E+00

Prediction Line

	X	Y
80	0.89394	3.25E-02
81	0.92424	2.00E-02
82	0.95455	1.23E-02
83	0.98485	7.58E-03
84	1.0152	4.66E-03
85	1.0455	2.87E-03
86	1.0758	1.77E-03
87	1.1061	1.09E-03
88	1.1364	6.69E-04
89	1.1667	4.12E-04
90	1.197	2.53E-04
91	1.2273	1.56E-04
92	1.2576	9.59E-05
93	1.2879	5.90E-05
94	1.3182	3.63E-05
95	1.3485	2.24E-05
96	1.3788	1.38E-05
97	1.4091	8.47E-06
98	1.4394	5.21E-06
99	1.4697	3.21E-06
100	1.5	1.97E-06

	X	Y
80	0.89394	0.00E+00
81	0.92424	0.00E+00
82	0.95455	0.00E+00
83	0.98485	0.00E+00
84	1.0152	0.00E+00
85	1.0455	0.00E+00
86	1.0758	0.00E+00
87	1.1061	0.00E+00
88	1.1364	0.00E+00
89	1.1667	0.00E+00
90	1.197	0.00E+00
91	1.2273	0.00E+00
92	1.2576	0.00E+00
93	1.2879	0.00E+00
94	1.3182	0.00E+00
95	1.3485	0.00E+00
96	1.3788	0.00E+00
97	1.4091	0.00E+00
98	1.4394	0.00E+00
99	1.4697	0.00E+00
100	1.5	0.00E+00

	X	Y
80	0.89394	0.00E+00
81	0.92424	0.00E+00
82	0.95455	0.00E+00
83	0.98485	0.00E+00
84	1.0152	0.00E+00
85	1.0455	0.00E+00
86	1.0758	0.00E+00
87	1.1061	0.00E+00
88	1.1364	0.00E+00
89	1.1667	0.00E+00
90	1.197	0.00E+00
91	1.2273	0.00E+00
92	1.2576	0.00E+00
93	1.2879	0.00E+00
94	1.3182	0.00E+00
95	1.3485	0.00E+00
96	1.3788	0.00E+00
97	1.4091	0.00E+00
98	1.4394	0.00E+00
99	1.4697	0.00E+00
100	1.5	0.00E+00

Table H2.D-12c. TRAP Model Output for Selenium Data for the Bird Reproduction Endpoint (Ort and Latshaw 1978)

Chemical:	Selenium
Study Authors:	Ort and Latshaw 1978
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
9.35E-03	92	3.2
0.39909	84.2	4.2
0.55498	66.8	8.7
0.71087	65.4	6

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-3.56E-02	5.96E-04			
S	1.5277	1.37E+00			
Y0	9.20E+01	9.22E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-3.56E-02	1.08E-02			
S	1.5277	1.37E+00			
Y0	9.20E+01	9.21E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-3.56E-02	7.88E-02			
S	1.5277	0.85643			
Y0	9.20E+01	9.20E+01			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.0014	6.03E-02	16.636	9.61E-02	5.96E-04
20	5.60E-01	1.15E-01	2.72E+00	5.40E-02	-0.25173
10	3.99E-01	2.25E-02	7.05E+00	9.82E-02	-0.39933
5	2.92E-01	3.57E-03	2.38E+01	0.15051	-0.53534
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.0251	6.88E-02	15.266	9.23E-02	1.08E-02
20	0.55286	1.39E-01	2.2002	4.72E-02	-0.25738
10	4.05E-01	4.67E-02	3.51E+00	7.38E-02	-0.39254
5	0.32501	1.67E-02	6.34E+00	0.10153	-0.4881
0	0.19106	1.12E-03	3.26E+01	0.1757	-7.19E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1.1991	5.78E-02	24.863	0.10363	7.88E-02
20	0.53524	0.1783	1.6068	3.76E-02	-0.27145
10	0.40906	0.11519	1.4526	4.33E-02	-0.38822
5	0.3576	7.65E-02	1.6716	5.27E-02	-0.4466
0	0.31262	4.77E-02	2.0478	6.42E-02	-0.50498

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-2.03E+00	9.20E+01	9.22E+01
2	-3.99E-01	8.42E+01	8.29E+01
3	-2.56E-01	6.68E+01	7.41E+01
4	-1.48E-01	6.54E+01	6.39E+01
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-2.03E+00	9.20E+01	9.21E+01
2	-3.99E-01	8.42E+01	8.32E+01
3	-2.56E-01	6.68E+01	7.35E+01
4	-1.48E-01	6.54E+01	6.39E+01
5			
6			

	Exposure	Effects Var	Est Effects Var
1	-2.03E+00	9.20E+01	9.20E+01
2	-3.99E-01	8.42E+01	8.36E+01
3	-2.56E-01	6.68E+01	7.24E+01
4	-1.48E-01	6.54E+01	6.39E+01
5			
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	18445	6148.4		
Regression	2	18444	9222.2	10867	0.0068
Error	1	0.84862	0.84862		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	18445	6148.4		
Regression	2	18445	9222.3	12924	0.0062
Error	1	0.71358	0.71358		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	3	18445	6148.4		
Regression	2	18445	9222.4	18844	0.0052
Error	1	0.48941	0.48941		

Prediction Line

	X	Y
1	-2	9.22E+01
2	-1.98E+00	9.22E+01
3	-1.96E+00	9.22E+01
4	-1.93E+00	9.22E+01
5	-1.91E+00	9.22E+01
6	-1.89E+00	9.22E+01
7	-1.87E+00	9.22E+01
8	-1.84E+00	9.22E+01
9	-1.82E+00	9.22E+01
10	-1.80E+00	9.22E+01
11	-1.78E+00	9.22E+01
12	-1.76E+00	9.22E+01
13	-1.73E+00	9.22E+01
14	-1.7111	9.22E+01
15	-1.6889	9.22E+01
16	-1.6667	9.22E+01
17	-1.6444	9.22E+01
18	-1.6222	9.22E+01
19	-1.6	9.22E+01
20	-1.5778	9.21E+01
21	-1.56E+00	9.21E+01
22	-1.53E+00	9.21E+01
23	-1.51E+00	9.21E+01
24	-1.49E+00	9.21E+01
25	-1.47E+00	9.21E+01
26	-1.44E+00	9.21E+01
27	-1.42E+00	9.21E+01
28	-1.40E+00	9.21E+01
29	-1.38E+00	9.21E+01
30	-1.36E+00	9.21E+01

	X	Y
1	-2	9.21E+01
2	-1.98E+00	9.21E+01
3	-1.96E+00	9.21E+01
4	-1.93E+00	9.21E+01
5	-1.91E+00	9.21E+01
6	-1.89E+00	9.21E+01
7	-1.87E+00	9.21E+01
8	-1.84E+00	9.21E+01
9	-1.82E+00	9.21E+01
10	-1.80E+00	9.21E+01
11	-1.78E+00	9.21E+01
12	-1.76E+00	9.21E+01
13	-1.73E+00	9.21E+01
14	-1.7111	9.21E+01
15	-1.6889	9.21E+01
16	-1.6667	9.21E+01
17	-1.6444	9.21E+01
18	-1.6222	9.21E+01
19	-1.6	9.21E+01
20	-1.5778	9.21E+01
21	-1.56E+00	9.21E+01
22	-1.53E+00	9.21E+01
23	-1.51E+00	9.21E+01
24	-1.49E+00	9.21E+01
25	-1.47E+00	9.21E+01
26	-1.44E+00	9.21E+01
27	-1.42E+00	9.21E+01
28	-1.40E+00	9.21E+01
29	-1.38E+00	9.21E+01
30	-1.36E+00	9.21E+01

	X	Y
1	-2	9.20E+01
2	-1.98E+00	9.20E+01
3	-1.96E+00	9.20E+01
4	-1.93E+00	9.20E+01
5	-1.91E+00	9.20E+01
6	-1.89E+00	9.20E+01
7	-1.87E+00	9.20E+01
8	-1.84E+00	9.20E+01
9	-1.82E+00	9.20E+01
10	-1.80E+00	9.20E+01
11	-1.78E+00	9.20E+01
12	-1.76E+00	9.20E+01
13	-1.73E+00	9.20E+01
14	-1.7111	9.20E+01
15	-1.6889	9.20E+01
16	-1.6667	9.20E+01
17	-1.6444	9.20E+01
18	-1.6222	9.20E+01
19	-1.6	9.20E+01
20	-1.5778	9.20E+01
21	-1.56E+00	9.20E+01
22	-1.53E+00	9.20E+01
23	-1.51E+00	9.20E+01
24	-1.49E+00	9.20E+01
25	-1.47E+00	9.20E+01
26	-1.44E+00	9.20E+01
27	-1.42E+00	9.20E+01
28	-1.40E+00	9.20E+01
29	-1.38E+00	9.20E+01
30	-1.36E+00	9.20E+01

Prediction Line

	X	Y
31	-1.3333	9.21E+01
32	-1.3111	9.21E+01
33	-1.2889	9.21E+01
34	-1.2667	9.21E+01
35	-1.2444	9.21E+01
36	-1.2222	9.21E+01
37	-1.2	9.20E+01
38	-1.1778	9.20E+01
39	-1.1556	9.20E+01
40	-1.1333	9.20E+01
41	-1.1111	9.20E+01
42	-1.0889	9.19E+01
43	-1.0667	9.19E+01
44	-1.0444	9.19E+01
45	-1.0222	9.18E+01
46	-1	9.18E+01
47	-0.97778	9.17E+01
48	-0.95556	9.17E+01
49	-0.93333	9.16E+01
50	-0.91111	9.16E+01
51	-0.88889	9.15E+01
52	-0.86667	9.14E+01
53	-0.84444	9.13E+01
54	-0.82222	9.12E+01
55	-0.8	9.10E+01
56	-0.77778	9.09E+01
57	-0.75556	9.07E+01
58	-0.73333	9.06E+01
59	-0.71111	9.04E+01
60	-0.68889	9.01E+01
61	-0.66667	8.99E+01
62	-0.64444	8.96E+01
63	-0.62222	8.93E+01
64	-0.6	8.89E+01
65	-0.57778	8.85E+01
66	-0.55556	8.80E+01
67	-0.53333	8.75E+01
68	-0.51111	8.69E+01
69	-0.48889	8.63E+01
70	-0.46667	8.56E+01
71	-0.44444	8.48E+01
72	-0.42222	8.39E+01
73	-0.4	8.30E+01
74	-0.37778	8.19E+01
75	-0.35556	8.08E+01
76	-0.33333	7.95E+01
77	-0.31111	7.81E+01
78	-0.28889	7.66E+01
79	-0.26667	7.49E+01
80	-0.24444	7.31E+01
81	-0.22222	7.12E+01

	X	Y
31	-1.3333	9.21E+01
32	-1.3111	9.21E+01
33	-1.2889	9.21E+01
34	-1.2667	9.21E+01
35	-1.2444	9.21E+01
36	-1.2222	9.21E+01
37	-1.2	9.21E+01
38	-1.1778	9.21E+01
39	-1.1556	9.21E+01
40	-1.1333	9.21E+01
41	-1.1111	9.21E+01
42	-1.0889	9.21E+01
43	-1.0667	9.21E+01
44	-1.0444	9.21E+01
45	-1.0222	9.21E+01
46	-1	9.21E+01
47	-0.97778	9.21E+01
48	-0.95556	9.21E+01
49	-0.93333	9.21E+01
50	-0.91111	9.21E+01
51	-0.88889	9.21E+01
52	-0.86667	9.21E+01
53	-0.84444	9.21E+01
54	-0.82222	9.21E+01
55	-0.8	9.21E+01
56	-0.77778	9.21E+01
57	-0.75556	9.21E+01
58	-0.73333	9.21E+01
59	-0.71111	9.21E+01
60	-0.68889	9.20E+01
61	-0.66667	9.18E+01
62	-0.64444	9.16E+01
63	-0.62222	9.13E+01
64	-0.6	9.09E+01
65	-0.57778	9.04E+01
66	-0.55556	8.98E+01
67	-0.53333	8.91E+01
68	-0.51111	8.83E+01
69	-0.48889	8.75E+01
70	-0.46667	8.66E+01
71	-0.44444	8.56E+01
72	-0.42222	8.45E+01
73	-0.4	8.33E+01
74	-0.37778	8.20E+01
75	-0.35556	8.07E+01
76	-0.33333	7.92E+01
77	-0.31111	7.77E+01
78	-0.28889	7.61E+01
79	-0.26667	7.44E+01
80	-0.24444	7.26E+01
81	-0.22222	7.07E+01

	X	Y
31	-1.3333	9.20E+01
32	-1.3111	9.20E+01
33	-1.2889	9.20E+01
34	-1.2667	9.20E+01
35	-1.2444	9.20E+01
36	-1.2222	9.20E+01
37	-1.2	9.20E+01
38	-1.1778	9.20E+01
39	-1.1556	9.20E+01
40	-1.1333	9.20E+01
41	-1.1111	9.20E+01
42	-1.0889	9.20E+01
43	-1.0667	9.20E+01
44	-1.0444	9.20E+01
45	-1.0222	9.20E+01
46	-1	9.20E+01
47	-0.97778	9.20E+01
48	-0.95556	9.20E+01
49	-0.93333	9.20E+01
50	-0.91111	9.20E+01
51	-0.88889	9.20E+01
52	-0.86667	9.20E+01
53	-0.84444	9.20E+01
54	-0.82222	9.20E+01
55	-0.8	9.20E+01
56	-0.77778	9.20E+01
57	-0.75556	9.20E+01
58	-0.73333	9.20E+01
59	-0.71111	9.20E+01
60	-0.68889	9.20E+01
61	-0.66667	9.20E+01
62	-0.64444	9.20E+01
63	-0.62222	9.20E+01
64	-0.6	9.20E+01
65	-0.57778	9.20E+01
66	-0.55556	9.20E+01
67	-0.53333	9.20E+01
68	-0.51111	9.20E+01
69	-0.48889	9.07E+01
70	-0.46667	8.90E+01
71	-0.44444	8.72E+01
72	-0.42222	8.55E+01
73	-0.4	8.37E+01
74	-0.37778	8.20E+01
75	-0.35556	8.02E+01
76	-0.33333	7.85E+01
77	-0.31111	7.67E+01
78	-0.28889	7.50E+01
79	-0.26667	7.32E+01
80	-0.24444	7.15E+01
81	-0.22222	6.97E+01

Prediction Line

	X	Y
82	-0.2	6.92E+01
83	-0.17778	6.70E+01
84	-0.15556	6.47E+01
85	-0.13333	6.23E+01
86	-0.11111	5.98E+01
87	-8.89E-02	5.72E+01
88	-6.67E-02	5.45E+01
89	-4.44E-02	5.18E+01
90	-2.22E-02	4.90E+01
91	0	4.62E+01
92	2.22E-02	4.33E+01
93	4.44E-02	4.06E+01
94	6.67E-02	3.78E+01
95	8.89E-02	3.51E+01
96	0.11111	3.25E+01
97	0.13333	3.00E+01
98	0.15556	2.76E+01
99	0.17778	2.53E+01
100	0.2	2.31E+01

	X	Y
82	-0.2	6.88E+01
83	-0.17778	6.68E+01
84	-0.15556	6.46E+01
85	-0.13333	6.24E+01
86	-0.11111	6.01E+01
87	-8.89E-02	5.78E+01
88	-6.67E-02	5.53E+01
89	-4.44E-02	5.27E+01
90	-2.22E-02	5.01E+01
91	0	4.74E+01
92	2.22E-02	4.46E+01
93	4.44E-02	4.19E+01
94	6.67E-02	3.93E+01
95	8.89E-02	3.67E+01
96	0.11111	3.42E+01
97	0.13333	3.19E+01
98	0.15556	2.96E+01
99	0.17778	2.74E+01
100	0.2	2.53E+01

	X	Y
82	-0.2	6.80E+01
83	-0.17778	6.62E+01
84	-0.15556	6.45E+01
85	-0.13333	6.27E+01
86	-0.11111	6.10E+01
87	-8.89E-02	5.92E+01
88	-6.67E-02	5.75E+01
89	-4.44E-02	5.57E+01
90	-2.22E-02	5.40E+01
91	0	5.22E+01
92	2.22E-02	5.05E+01
93	4.44E-02	4.87E+01
94	6.67E-02	4.70E+01
95	8.89E-02	4.52E+01
96	0.11111	4.35E+01
97	0.13333	4.17E+01
98	0.15556	4.00E+01
99	0.17778	3.82E+01
100	0.2	3.65E+01

Table H2.D-12d. TRAP Model Output for Selenium Data for the Bird Reproduction Endpoint (Pooling Group E: Heinz et al. 1989; Hoffman and Heinz 1988)

Chemical:	Selenium
Study Authors:	Pooling group E (mallard)
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect Relative to Control
1.50E-02	100
0.115	118.62
0.215	100.67
0.415	89.597
0.815	61.913
1.615	3.6913
2.00E-02	100
0.12	111
0.22	105
0.42	92
0.82	64
1.62	11

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.12379	-5.24E-02	2.46E-02	-0.1081	3.26E-03
S	1.9258	2.00E+00	0.38826	1.1245	2.8811
Y0	1.06E+02	1.05E+02	2.9414	97.929	111.24

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.12379	-5.90E-02	2.55E-02	-0.11674	-1.24E-03
S	1.9258	1.93E+00	0.29653	1.2591	2.6006
Y0	1.06E+02	1.05E+02	2.9866	97.926	111.44

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-0.12379	-8.07E-02	2.55E-02	-0.13841	-2.29E-02
S	1.9258	1.3406	0.13389	1.0378	1.6435
Y0	1.06E+02	1.06E+02	3.2405	98.552	113.21

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.8863	0.77965	1.0075	2.46E-02	-5.24E-02
20	5.95E-01	4.76E-01	7.43E-01	4.27E-02	-0.22546
10	4.71E-01	3.45E-01	6.44E-01	5.98E-02	-0.32668
5	3.80E-01	2.55E-01	5.67E-01	7.66E-02	-0.41995
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.873	0.7643	0.99715	2.55E-02	-5.90E-02
20	0.56307	4.54E-01	0.69893	4.15E-02	-0.24944
10	4.51E-01	3.31E-01	6.15E-01	5.95E-02	-0.34543
5	0.3861	2.57E-01	5.81E-01	7.84E-02	-0.4133
0	0.26475	1.39E-01	5.05E-01	0.12387	-5.77E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.8305	0.72709	0.94861	2.55E-02	-8.07E-02
20	0.4961	0.41157	0.59798	3.59E-02	-0.30443
10	0.41781	0.33665	0.51853	4.15E-02	-0.37903
5	0.38342	0.30415	0.48337	4.45E-02	-0.41632
0	0.35187	0.27464	0.45083	4.76E-02	-0.45362

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var
1	-1.82E+00	1.00E+02	1.05E+02
2	-9.39E-01	1.19E+02	1.05E+02
3	-6.68E-01	1.01E+02	1.05E+02
4	-3.82E-01	8.96E+01	1.04E+02
5	-8.88E-02	61.913	103.83
6	2.08E-01	3.6913	103.77
7	-1.70E+00	100	97.617
8	-9.21E-01	111	97.341
9	-6.58E-01	105	59.867
10	-3.77E-01	92	59.321
11	-8.62E-02	64	11.535
12	2.10E-01	11	11.425
13			
14			

	Exposure	Effects Var	Est Effects Var
1	-1.82E+00	1.00E+02	1.05E+02
2	-1.70E+00	1.00E+02	1.05E+02
3	-9.39E-01	1.19E+02	1.05E+02
4	-9.21E-01	1.11E+02	1.05E+02
5	-6.68E-01	100.67	104.68
6	-6.58E-01	105	104.68
7	-3.82E-01	89.597	97.254
8	-3.77E-01	92	96.852
9	-8.88E-02	61.913	58.198
10	-8.62E-02	64	57.691
11	2.08E-01	3.6913	12.283
12	2.10E-01	11	12.152
13			
14			

	Exposure	Effects Var	Est Effects Var
1	-1.82E+00	1.00E+02	1.06E+02
2	-1.70E+00	1.00E+02	1.06E+02
3	-9.39E-01	1.19E+02	1.06E+02
4	-9.21E-01	1.11E+02	1.06E+02
5	-6.68E-01	100.67	105.88
6	-6.58E-01	105	105.88
7	-3.82E-01	89.597	95.71
8	-3.77E-01	92	94.971
9	-8.88E-02	61.913	54.103
10	-8.62E-02	64	53.726
11	2.08E-01	3.6913	11.941
12	2.10E-01	11	11.751
13			
14			

Analysis of Variance

R-squared: 0.97

	DF	SS	MS	F	Sig
Total (adj)	11	15708	1428		
Regression	2	15232	7615.9	143.95	0
Error	9	476.17	52.907		

R-squared: 0.968

	DF	SS	MS	F	Sig
Total (adj)	11	15708	1428		
Regression	2	15203	7601.3	135.41	0
Error	9	505.22	56.136		

R-squared: 0.964

	DF	SS	MS	F	Sig
Total (adj)	11	15708	1428		
Regression	2	15141	7570.4	120.15	0
Error	9	567.06	63.007		

Prediction Line

	X	Y
1	-1.5	1.05E+02
2	-1.48E+00	1.05E+02
3	-1.46E+00	1.05E+02
4	-1.44E+00	1.05E+02
5	-1.42E+00	1.05E+02
6	-1.40E+00	1.05E+02
7	-1.38E+00	1.05E+02
8	-1.36E+00	1.05E+02
9	-1.34E+00	1.05E+02
10	-1.32E+00	1.05E+02
11	-1.30E+00	1.05E+02
12	-1.28E+00	1.05E+02
13	-1.26E+00	1.05E+02
14	-1.2374	1.05E+02

	X	Y
1	-1.5	1.05E+02
2	-1.48E+00	1.05E+02
3	-1.46E+00	1.05E+02
4	-1.44E+00	1.05E+02
5	-1.42E+00	1.05E+02
6	-1.40E+00	1.05E+02
7	-1.38E+00	1.05E+02
8	-1.36E+00	1.05E+02
9	-1.34E+00	1.05E+02
10	-1.32E+00	1.05E+02
11	-1.30E+00	1.05E+02
12	-1.28E+00	1.05E+02
13	-1.26E+00	1.05E+02
14	-1.2374	1.05E+02

	X	Y
1	-1.5	1.06E+02
2	-1.48E+00	1.06E+02
3	-1.46E+00	1.06E+02
4	-1.44E+00	1.06E+02
5	-1.42E+00	1.06E+02
6	-1.40E+00	1.06E+02
7	-1.38E+00	1.06E+02
8	-1.36E+00	1.06E+02
9	-1.34E+00	1.06E+02
10	-1.32E+00	1.06E+02
11	-1.30E+00	1.06E+02
12	-1.28E+00	1.06E+02
13	-1.26E+00	1.06E+02
14	-1.2374	1.06E+02

Prediction Line

	X	Y
15	-1.2172	1.05E+02
16	-1.197	1.05E+02
17	-1.1768	1.05E+02
18	-1.1566	1.05E+02
19	-1.1364	1.05E+02
20	-1.1162	1.05E+02
21	-1.10E+00	1.05E+02
22	-1.08E+00	1.05E+02
23	-1.06E+00	1.05E+02
24	-1.04E+00	1.05E+02
25	-1.02E+00	1.05E+02
26	-9.95E-01	1.05E+02
27	-9.75E-01	1.05E+02
28	-9.55E-01	1.05E+02
29	-9.34E-01	1.04E+02
30	-9.14E-01	1.04E+02
31	-0.89394	1.04E+02
32	-0.87374	1.04E+02
33	-0.85354	1.04E+02
34	-0.83333	1.04E+02
35	-0.81313	1.04E+02
36	-0.79293	1.04E+02
37	-0.77273	1.04E+02
38	-0.75253	1.04E+02
39	-0.73232	1.04E+02
40	-0.71212	1.04E+02
41	-0.69192	1.04E+02
42	-0.67172	1.04E+02
43	-0.65152	1.04E+02
44	-0.63131	1.04E+02
45	-0.61111	1.03E+02
46	-0.59091	1.03E+02
47	-0.57071	1.03E+02
48	-0.55051	1.03E+02
49	-0.5303	1.02E+02
50	-0.5101	1.02E+02
51	-0.4899	1.02E+02
52	-0.4697	1.01E+02
53	-0.44949	1.00E+02
54	-0.42929	9.97E+01
55	-0.40909	9.89E+01
56	-0.38889	9.80E+01
57	-0.36869	9.69E+01
58	-0.34848	9.57E+01
59	-0.32828	9.42E+01
60	-0.30808	9.26E+01
61	-0.28788	9.08E+01
62	-0.26768	8.88E+01
63	-0.24747	8.65E+01
64	-0.22727	8.39E+01
65	-0.20707	8.11E+01

	X	Y
15	-1.2172	1.05E+02
16	-1.197	1.05E+02
17	-1.1768	1.05E+02
18	-1.1566	1.05E+02
19	-1.1364	1.05E+02
20	-1.1162	1.05E+02
21	-1.10E+00	1.05E+02
22	-1.08E+00	1.05E+02
23	-1.06E+00	1.05E+02
24	-1.04E+00	1.05E+02
25	-1.02E+00	1.05E+02
26	-9.95E-01	1.05E+02
27	-9.75E-01	1.05E+02
28	-9.55E-01	1.05E+02
29	-9.34E-01	1.05E+02
30	-9.14E-01	1.05E+02
31	-0.89394	1.05E+02
32	-0.87374	1.05E+02
33	-0.85354	1.05E+02
34	-0.83333	1.05E+02
35	-0.81313	1.05E+02
36	-0.79293	1.05E+02
37	-0.77273	1.05E+02
38	-0.75253	1.05E+02
39	-0.73232	1.05E+02
40	-0.71212	1.05E+02
41	-0.69192	1.05E+02
42	-0.67172	1.05E+02
43	-0.65152	1.05E+02
44	-0.63131	1.05E+02
45	-0.61111	1.05E+02
46	-0.59091	1.05E+02
47	-0.57071	1.05E+02
48	-0.55051	1.05E+02
49	-0.5303	1.04E+02
50	-0.5101	1.04E+02
51	-0.4899	1.03E+02
52	-0.4697	1.02E+02
53	-0.44949	1.02E+02
54	-0.42929	1.00E+02
55	-0.40909	9.92E+01
56	-0.38889	9.78E+01
57	-0.36869	9.62E+01
58	-0.34848	9.45E+01
59	-0.32828	9.26E+01
60	-0.30808	9.06E+01
61	-0.28788	8.84E+01
62	-0.26768	8.60E+01
63	-0.24747	8.35E+01
64	-0.22727	8.08E+01
65	-0.20707	7.80E+01

	X	Y
15	-1.2172	1.06E+02
16	-1.197	1.06E+02
17	-1.1768	1.06E+02
18	-1.1566	1.06E+02
19	-1.1364	1.06E+02
20	-1.1162	1.06E+02
21	-1.10E+00	1.06E+02
22	-1.08E+00	1.06E+02
23	-1.06E+00	1.06E+02
24	-1.04E+00	1.06E+02
25	-1.02E+00	1.06E+02
26	-9.95E-01	1.06E+02
27	-9.75E-01	1.06E+02
28	-9.55E-01	1.06E+02
29	-9.34E-01	1.06E+02
30	-9.14E-01	1.06E+02
31	-0.89394	1.06E+02
32	-0.87374	1.06E+02
33	-0.85354	1.06E+02
34	-0.83333	1.06E+02
35	-0.81313	1.06E+02
36	-0.79293	1.06E+02
37	-0.77273	1.06E+02
38	-0.75253	1.06E+02
39	-0.73232	1.06E+02
40	-0.71212	1.06E+02
41	-0.69192	1.06E+02
42	-0.67172	1.06E+02
43	-0.65152	1.06E+02
44	-0.63131	1.06E+02
45	-0.61111	1.06E+02
46	-0.59091	1.06E+02
47	-0.57071	1.06E+02
48	-0.55051	1.06E+02
49	-0.5303	1.06E+02
50	-0.5101	1.06E+02
51	-0.4899	1.06E+02
52	-0.4697	1.06E+02
53	-0.44949	1.05E+02
54	-0.42929	1.02E+02
55	-0.40909	9.96E+01
56	-0.38889	9.67E+01
57	-0.36869	9.38E+01
58	-0.34848	9.10E+01
59	-0.32828	8.81E+01
60	-0.30808	8.52E+01
61	-0.28788	8.24E+01
62	-0.26768	7.95E+01
63	-0.24747	7.66E+01
64	-0.22727	7.38E+01
65	-0.20707	7.09E+01

Prediction Line

	X	Y
66	-0.18687	7.80E+01
67	-0.16667	7.47E+01
68	-0.14646	7.11E+01
69	-0.12626	6.73E+01
70	-0.10606	6.34E+01
71	-8.59E-02	5.93E+01
72	-6.57E-02	5.51E+01
73	-4.55E-02	5.08E+01
74	-2.53E-02	4.66E+01
75	-5.05E-03	4.25E+01
76	1.52E-02	3.85E+01
77	3.54E-02	3.46E+01
78	5.56E-02	3.10E+01
79	7.58E-02	2.76E+01
80	9.60E-02	2.44E+01
81	0.11616	2.15E+01
82	0.13636	1.89E+01
83	0.15657	1.65E+01
84	0.17677	1.44E+01
85	0.19697	1.25E+01
86	0.21717	1.08E+01
87	0.23737	9.34E+00
88	0.25758	8.06E+00
89	0.27778	6.93E+00
90	0.29798	5.95E+00
91	0.31818	5.11E+00
92	0.33838	4.38E+00
93	0.35859	3.75E+00
94	0.37879	3.20E+00
95	0.39899	2.74E+00
96	0.41919	2.34E+00
97	0.43939	1.99E+00
98	0.4596	1.70E+00
99	0.4798	1.45E+00
100	0.5	1.24E+00

	X	Y
66	-0.18687	7.50E+01
67	-0.16667	7.18E+01
68	-0.14646	6.85E+01
69	-0.12626	6.51E+01
70	-0.10606	6.14E+01
71	-8.59E-02	5.76E+01
72	-6.57E-02	5.37E+01
73	-4.55E-02	4.96E+01
74	-2.53E-02	4.57E+01
75	-5.05E-03	4.20E+01
76	1.52E-02	3.84E+01
77	3.54E-02	3.50E+01
78	5.56E-02	3.18E+01
79	7.58E-02	2.87E+01
80	9.60E-02	2.57E+01
81	0.11616	2.29E+01
82	0.13636	2.03E+01
83	0.15657	1.79E+01
84	0.17677	1.55E+01
85	0.19697	1.34E+01
86	0.21717	1.14E+01
87	0.23737	9.59E+00
88	0.25758	7.92E+00
89	0.27778	6.42E+00
90	0.29798	5.07E+00
91	0.31818	3.88E+00
92	0.33838	2.84E+00
93	0.35859	1.97E+00
94	0.37879	1.26E+00
95	0.39899	7.06E-01
96	0.41919	3.12E-01
97	0.43939	7.64E-02
98	0.4596	0.00E+00
99	0.4798	0.00E+00
100	0.5	0.00E+00

	X	Y
66	-0.18687	6.80E+01
67	-0.16667	6.52E+01
68	-0.14646	6.23E+01
69	-0.12626	5.94E+01
70	-0.10606	5.65E+01
71	-8.59E-02	5.37E+01
72	-6.57E-02	5.08E+01
73	-4.55E-02	4.79E+01
74	-2.53E-02	4.51E+01
75	-5.05E-03	4.22E+01
76	1.52E-02	3.93E+01
77	3.54E-02	3.65E+01
78	5.56E-02	3.36E+01
79	7.58E-02	3.07E+01
80	9.60E-02	2.79E+01
81	0.11616	2.50E+01
82	0.13636	2.21E+01
83	0.15657	1.93E+01
84	0.17677	1.64E+01
85	0.19697	1.35E+01
86	0.21717	1.07E+01
87	0.23737	7.80E+00
88	0.25758	4.93E+00
89	0.27778	2.06E+00
90	0.29798	0.00E+00
91	0.31818	0.00E+00
92	0.33838	0.00E+00
93	0.35859	0.00E+00
94	0.37879	0.00E+00
95	0.39899	0.00E+00
96	0.41919	0.00E+00
97	0.43939	0.00E+00
98	0.4596	0.00E+00
99	0.4798	0.00E+00
100	0.5	0.00E+00

Table H2.D-12e. TRAP Model Output for Selenium Data for the Mammal Growth Endpoint (Mahan and Moxon 1984)

Chemical:	Selenium
Study Authors:	Mahan and Moxon 1984
Receptor Group:	Mammal
Effect Description:	Growth

Input Data:

Dose	Effect	SE
0	18.7	0.55
0.10189	18.6	0.55
0.20377	17.4	0.55
0.30566	16	0.55
0.40755	15.1	0.55
0.61132	11.2	0.55
0.815	9.1	0.55
1.630	5.7	0.55

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-5.00E-02	-0.10206	3.94E-02	-0.21147	7.35E-03
S	0.9935	8.34E-01	0.10988	0.52883	1.139
Y0	1.86E+01	1.98E+01	0.95574	17.17	22.477

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-5.00E-02	-8.04E-02	4.04E-02	-0.19256	3.18E-02
S	0.9935	9.29E-01	0.1308	0.56628	1.2926
Y0	1.86E+01	1.92E+01	0.98312	16.422	21.881

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-5.00E-02	-3.73E-02	3.20E-02	-0.12613	5.16E-02
S	0.9935	0.83144	7.79E-02	0.61504	1.0478
Y0	1.86E+01	1.80E+01	0.53069	16.527	19.473

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.79057	0.61451	1.0171	3.94E-02	-0.10206
20	3.04E-01	1.78E-01	5.17E-01	8.32E-02	-0.51766
10	1.73E-01	8.40E-02	3.58E-01	0.11337	-0.76077
5	1.04E-01	4.18E-02	2.57E-01	0.14188	-0.98478
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.83107	0.64185	1.0761	4.04E-02	-8.04E-02
20	0.33434	1.91E-01	0.58433	8.73E-02	-0.47582
10	2.11E-01	9.57E-02	4.67E-01	0.12394	-0.67513
5	0.15274	5.62E-02	4.15E-01	0.15631	-0.81606
0	6.98E-02	1.38E-02	3.53E-01	0.25353	-1.16E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.91776	0.74794	1.1261	3.20E-02	-3.73E-02
20	0.39986	0.3091	0.51727	4.03E-02	-0.39809
10	0.30313	0.22266	0.4127	4.83E-02	-0.51837
5	0.26394	0.18843	0.3697	5.27E-02	-0.5785
0	0.22981	0.15925	0.33162	5.74E-02	-0.63864

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-9.92E-01	1.86E+01	1.89E+01
2	-6.91E-01	1.74E+01	1.74E+01
3	-5.15E-01	1.60E+01	1.58E+01
4	-3.90E-01	1.51E+01	1.43E+01
5	-2.14E-01	11.2	11.737
6	-8.88E-02	9.1	9.6923
7	2.12E-01	5.7	5.1448
8			

Analysis of Variance

R-squared: 0.996

	DF	SS	MS	F	Sig
Total (adj)	6	1276	212.66		
Regression	2	1270.6	635.29	472.16	0
Error	4	5.382	1.3455		

Prediction Line

	X	Y
1	-1	1.89E+01
2	-9.86E-01	1.88E+01
3	-9.72E-01	1.88E+01
4	-9.58E-01	1.87E+01
5	-9.43E-01	1.87E+01
6	-9.29E-01	1.86E+01
7	-9.15E-01	1.86E+01
8	-9.01E-01	1.85E+01
9	-8.87E-01	1.85E+01
10	-8.73E-01	1.84E+01
11	-8.59E-01	1.84E+01
12	-8.44E-01	1.83E+01
13	-8.30E-01	1.82E+01
14	-0.81616	1.81E+01
15	-0.80202	1.81E+01
16	-0.78788	1.80E+01
17	-0.77374	1.79E+01
18	-0.7596	1.78E+01
19	-0.74545	1.77E+01
20	-0.73131	1.77E+01
21	-7.17E-01	1.76E+01
22	-7.03E-01	1.75E+01
23	-6.89E-01	1.74E+01
24	-6.75E-01	1.73E+01
25	-6.61E-01	1.72E+01
26	-6.46E-01	1.71E+01
27	-6.32E-01	1.69E+01
28	-6.18E-01	1.68E+01

	Exposure	Effects Var	Est Effects Var
1	-9.92E-01	1.86E+01	1.89E+01
2	-6.91E-01	1.74E+01	1.74E+01
3	-5.15E-01	1.60E+01	1.57E+01
4	-3.90E-01	1.51E+01	1.43E+01
5	-2.14E-01	11.2	11.803
6	-8.88E-02	9.1	9.7253
7	2.12E-01	5.7	5.0757
8			

R-squared: 0.995

	DF	SS	MS	F	Sig
Total (adj)	6	1276	212.66		
Regression	2	1269.5	634.73	389.9	0
Error	4	6.5118	1.6279		

	X	Y
1	-1	1.89E+01
2	-9.86E-01	1.89E+01
3	-9.72E-01	1.89E+01
4	-9.58E-01	1.88E+01
5	-9.43E-01	1.88E+01
6	-9.29E-01	1.87E+01
7	-9.15E-01	1.87E+01
8	-9.01E-01	1.86E+01
9	-8.87E-01	1.86E+01
10	-8.73E-01	1.85E+01
11	-8.59E-01	1.84E+01
12	-8.44E-01	1.83E+01
13	-8.30E-01	1.83E+01
14	-0.81616	1.82E+01
15	-0.80202	1.81E+01
16	-0.78788	1.80E+01
17	-0.77374	1.79E+01
18	-0.7596	1.79E+01
19	-0.74545	1.78E+01
20	-0.73131	1.77E+01
21	-7.17E-01	1.76E+01
22	-7.03E-01	1.75E+01
23	-6.89E-01	1.73E+01
24	-6.75E-01	1.72E+01
25	-6.61E-01	1.71E+01
26	-6.46E-01	1.70E+01
27	-6.32E-01	1.69E+01
28	-6.18E-01	1.68E+01

	Exposure	Effects Var	Est Effects Var
1	-9.92E-01	1.86E+01	1.80E+01
2	-6.91E-01	1.74E+01	1.80E+01
3	-5.15E-01	1.60E+01	1.61E+01
4	-3.90E-01	1.51E+01	1.43E+01
5	-2.14E-01	11.2	11.641
6	-8.88E-02	9.1	9.771
7	2.12E-01	5.7	5.2658
8			

R-squared: 0.994

	DF	SS	MS	F	Sig
Total (adj)	6	1276	212.66		
Regression	2	1268.5	634.26	340.63	0
Error	4	7.4482	1.862		

	X	Y
1	-1	1.80E+01
2	-9.86E-01	1.80E+01
3	-9.72E-01	1.80E+01
4	-9.58E-01	1.80E+01
5	-9.43E-01	1.80E+01
6	-9.29E-01	1.80E+01
7	-9.15E-01	1.80E+01
8	-9.01E-01	1.80E+01
9	-8.87E-01	1.80E+01
10	-8.73E-01	1.80E+01
11	-8.59E-01	1.80E+01
12	-8.44E-01	1.80E+01
13	-8.30E-01	1.80E+01
14	-0.81616	1.80E+01
15	-0.80202	1.80E+01
16	-0.78788	1.80E+01
17	-0.77374	1.80E+01
18	-0.7596	1.80E+01
19	-0.74545	1.80E+01
20	-0.73131	1.80E+01
21	-7.17E-01	1.80E+01
22	-7.03E-01	1.80E+01
23	-6.89E-01	1.80E+01
24	-6.75E-01	1.80E+01
25	-6.61E-01	1.80E+01
26	-6.46E-01	1.80E+01
27	-6.32E-01	1.79E+01
28	-6.18E-01	1.77E+01

Prediction Line

	X	Y
29	-6.04E-01	1.67E+01
30	-5.90E-01	1.66E+01
31	-0.57576	1.64E+01
32	-0.56162	1.63E+01
33	-0.54747	1.62E+01
34	-0.53333	1.60E+01
35	-0.51919	1.59E+01
36	-0.50505	1.57E+01
37	-0.49091	1.56E+01
38	-0.47677	1.54E+01
39	-0.46263	1.52E+01
40	-0.44848	1.51E+01
41	-0.43434	1.49E+01
42	-0.4202	1.47E+01
43	-0.40606	1.45E+01
44	-0.39192	1.44E+01
45	-0.37778	1.42E+01
46	-0.36364	1.40E+01
47	-0.34949	1.38E+01
48	-0.33535	1.36E+01
49	-0.32121	1.34E+01
50	-0.30707	1.32E+01
51	-0.29293	1.30E+01
52	-0.27879	1.28E+01
53	-0.26465	1.25E+01
54	-0.25051	1.23E+01
55	-0.23636	1.21E+01
56	-0.22222	1.19E+01
57	-0.20808	1.16E+01
58	-0.19394	1.14E+01
59	-0.1798	1.12E+01
60	-0.16566	1.10E+01
61	-0.15152	1.07E+01
62	-0.13737	1.05E+01
63	-0.12323	1.03E+01
64	-0.10909	1.00E+01
65	-9.49E-02	9.79E+00
66	-8.08E-02	9.56E+00
67	-6.67E-02	9.33E+00
68	-5.25E-02	9.09E+00
69	-3.84E-02	8.86E+00
70	-2.42E-02	8.63E+00
71	-1.01E-02	8.40E+00
72	4.04E-03	8.18E+00
73	1.82E-02	7.95E+00
74	3.23E-02	7.73E+00
75	4.65E-02	7.51E+00
76	6.06E-02	7.29E+00
77	7.47E-02	7.07E+00
78	8.89E-02	6.86E+00
79	0.10303	6.65E+00

	X	Y
29	-6.04E-01	1.66E+01
30	-5.90E-01	1.65E+01
31	-0.57576	1.64E+01
32	-0.56162	1.62E+01
33	-0.54747	1.61E+01
34	-0.53333	1.59E+01
35	-0.51919	1.58E+01
36	-0.50505	1.56E+01
37	-0.49091	1.55E+01
38	-0.47677	1.53E+01
39	-0.46263	1.52E+01
40	-0.44848	1.50E+01
41	-0.43434	1.48E+01
42	-0.4202	1.47E+01
43	-0.40606	1.45E+01
44	-0.39192	1.43E+01
45	-0.37778	1.41E+01
46	-0.36364	1.40E+01
47	-0.34949	1.38E+01
48	-0.33535	1.36E+01
49	-0.32121	1.34E+01
50	-0.30707	1.32E+01
51	-0.29293	1.30E+01
52	-0.27879	1.28E+01
53	-0.26465	1.26E+01
54	-0.25051	1.24E+01
55	-0.23636	1.22E+01
56	-0.22222	1.19E+01
57	-0.20808	1.17E+01
58	-0.19394	1.15E+01
59	-0.1798	1.13E+01
60	-0.16566	1.10E+01
61	-0.15152	1.08E+01
62	-0.13737	1.06E+01
63	-0.12323	1.03E+01
64	-0.10909	1.01E+01
65	-9.49E-02	9.83E+00
66	-8.08E-02	9.58E+00
67	-6.67E-02	9.33E+00
68	-5.25E-02	9.09E+00
69	-3.84E-02	8.84E+00
70	-2.42E-02	8.60E+00
71	-1.01E-02	8.37E+00
72	4.04E-03	8.13E+00
73	1.82E-02	7.90E+00
74	3.23E-02	7.68E+00
75	4.65E-02	7.45E+00
76	6.06E-02	7.23E+00
77	7.47E-02	7.01E+00
78	8.89E-02	6.80E+00
79	0.10303	6.59E+00

	X	Y
29	-6.04E-01	1.75E+01
30	-5.90E-01	1.73E+01
31	-0.57576	1.71E+01
32	-0.56162	1.68E+01
33	-0.54747	1.66E+01
34	-0.53333	1.64E+01
35	-0.51919	1.62E+01
36	-0.50505	1.60E+01
37	-0.49091	1.58E+01
38	-0.47677	1.56E+01
39	-0.46263	1.54E+01
40	-0.44848	1.52E+01
41	-0.43434	1.49E+01
42	-0.4202	1.47E+01
43	-0.40606	1.45E+01
44	-0.39192	1.43E+01
45	-0.37778	1.41E+01
46	-0.36364	1.39E+01
47	-0.34949	1.37E+01
48	-0.33535	1.35E+01
49	-0.32121	1.32E+01
50	-0.30707	1.30E+01
51	-0.29293	1.28E+01
52	-0.27879	1.26E+01
53	-0.26465	1.24E+01
54	-0.25051	1.22E+01
55	-0.23636	1.20E+01
56	-0.22222	1.18E+01
57	-0.20808	1.16E+01
58	-0.19394	1.13E+01
59	-0.1798	1.11E+01
60	-0.16566	1.09E+01
61	-0.15152	1.07E+01
62	-0.13737	1.05E+01
63	-0.12323	1.03E+01
64	-0.10909	1.01E+01
65	-9.49E-02	9.86E+00
66	-8.08E-02	9.65E+00
67	-6.67E-02	9.44E+00
68	-5.25E-02	9.23E+00
69	-3.84E-02	9.02E+00
70	-2.42E-02	8.81E+00
71	-1.01E-02	8.59E+00
72	4.04E-03	8.38E+00
73	1.82E-02	8.17E+00
74	3.23E-02	7.96E+00
75	4.65E-02	7.75E+00
76	6.06E-02	7.54E+00
77	7.47E-02	7.32E+00
78	8.89E-02	7.11E+00
79	0.10303	6.90E+00

Prediction Line

	X	Y
80	0.11717	6.44E+00
81	0.13131	6.24E+00
82	0.14545	6.04E+00
83	0.1596	5.84E+00
84	0.17374	5.65E+00
85	0.18788	5.46E+00
86	0.20202	5.28E+00
87	0.21616	5.10E+00
88	0.2303	4.92E+00
89	0.24444	4.75E+00
90	0.25859	4.58E+00
91	0.27273	4.41E+00
92	0.28687	4.25E+00
93	0.30101	4.10E+00
94	0.31515	3.95E+00
95	0.32929	3.80E+00
96	0.34343	3.66E+00
97	0.35758	3.52E+00
98	0.37172	3.38E+00
99	0.38586	3.25E+00
100	0.4	3.13E+00

	X	Y
80	0.11717	6.38E+00
81	0.13131	6.18E+00
82	0.14545	5.98E+00
83	0.1596	5.78E+00
84	0.17374	5.59E+00
85	0.18788	5.40E+00
86	0.20202	5.21E+00
87	0.21616	5.03E+00
88	0.2303	4.84E+00
89	0.24444	4.67E+00
90	0.25859	4.49E+00
91	0.27273	4.32E+00
92	0.28687	4.15E+00
93	0.30101	3.99E+00
94	0.31515	3.83E+00
95	0.32929	3.67E+00
96	0.34343	3.52E+00
97	0.35758	3.37E+00
98	0.37172	3.22E+00
99	0.38586	3.08E+00
100	0.4	2.93E+00

	X	Y
80	0.11717	6.69E+00
81	0.13131	6.48E+00
82	0.14545	6.27E+00
83	0.1596	6.05E+00
84	0.17374	5.84E+00
85	0.18788	5.63E+00
86	0.20202	5.42E+00
87	0.21616	5.21E+00
88	0.2303	5.00E+00
89	0.24444	4.78E+00
90	0.25859	4.57E+00
91	0.27273	4.36E+00
92	0.28687	4.15E+00
93	0.30101	3.94E+00
94	0.31515	3.73E+00
95	0.32929	3.51E+00
96	0.34343	3.30E+00
97	0.35758	3.09E+00
98	0.37172	2.88E+00
99	0.38586	2.67E+00
100	0.4	2.46E+00

Table H2.D-13a. TRAP Model Output for Thallium Data for the Mammal Growth Endpoint (Pooling Group A: Downs et al. 1960)

Chemical:	Thallium
Study Authors:	Pooling group A
Receptor Group:	Mammal
Effect Description:	Growth

Input Data:

Dose	Effect Relative to Control
0.000001	100
1.736765899	82.35
3.039340323	44.12
0.000001	100
2.027991685	95
3.548985449	75

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence	yes	yes	yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit	yes	yes	yes
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.47876	0.58601	1.11E-01	0.23166	0.94035
S	5.6669	1.89E+00	2.03E+00	-4.5638	8.3417
Y0	9.25E+01	9.76E+01	12.998	56.211	138.94

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.47876	0.61471	0.14331	0.15865	1.0708
S	5.6669	1.89E+00	1.9384	-4.28	8.0579
Y0	9.25E+01	9.49E+01	13.109	53.173	136.61

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.47876	0.58837	0.18261	7.22E-03	1.1695
S	5.6669	1.889	4.2998	-11.795	15.573
Y0	9.25E+01	9.52E+01	9.7352	64.232	126.2

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	3.8548	1.7048	8.7167	1.11E-01	0.58601
20	2.53E+00	7.77E-01	8.22E+00	1.61E-01	0.40253
10	1.97E+00	2.85E-01	1.37E+01	2.64E-01	0.29521
5	1.57E+00	1.08E-01	2.29E+01	3.66E-01	0.19631
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	4.1183	1.441	11.77	0.14331	0.61471
20	2.6311	8.75E-01	7.9147	0.15029	0.42014
10	2.10E+00	3.83E-01	1.15E+01	0.23204	0.32207
5	1.7895	2.03E-01	1.58E+01	0.29693	0.25273
0	1.2171	4.14E-02	3.58E+01	0.46127	8.53E-02

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	3.8759	1.0168	14.775	0.18261	0.58837
20	2.6888	0.55115	13.117	0.21627	0.42955
10	2.3802	0.21101	26.849	0.33066	0.37661
5	2.2395	0.12924	38.805	0.38924	0.35014
0	2.107	7.89E-02	56.269	0.44827	0.32367

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.76E+01
2	2.40E-01	8.24E+01	9.76E+01
3	4.83E-01	4.41E+01	9.09E+01
4	-6.00E+00	1.00E+02	8.70E+01
5	3.07E-01	9.50E+01	6.69E+01
6	5.50E-01	7.50E+01	5.54E+01
7			
8			
9			
10			
11			
12			

Analysis of Variance

R-squared: 0.541

	DF	SS	MS	F	Sig
Total (adj)	5	2297.7	459.54		
Regression	2	1243.6	621.82	1.7698	0.3107
Error	3	1054	351.35		

Prediction Line

	X	Y
1	-3.5	9.76E+01
2	-3.45E+00	9.76E+01
3	-3.41E+00	9.76E+01
4	-3.36E+00	9.76E+01
5	-3.32E+00	9.76E+01
6	-3.27E+00	9.76E+01
7	-3.23E+00	9.76E+01
8	-3.18E+00	9.76E+01
9	-3.14E+00	9.76E+01
10	-3.09E+00	9.76E+01
11	-3.05E+00	9.76E+01
12	-3.00E+00	9.76E+01
13	-2.95E+00	9.76E+01
14	-2.91E+00	9.76E+01
15	-2.8636	9.76E+01
16	-2.8182	9.76E+01
17	-2.7727	9.76E+01
18	-2.7273	9.76E+01
19	-2.6818	9.76E+01
20	-2.6364	9.76E+01
21	-2.59E+00	9.76E+01
22	-2.55E+00	9.76E+01
23	-2.50E+00	9.76E+01
24	-2.45E+00	9.76E+01
25	-2.41E+00	9.76E+01
26	-2.36E+00	9.76E+01
27	-2.32E+00	9.76E+01

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.49E+01
2	-6.00E+00	1.00E+02	9.49E+01
3	2.40E-01	8.24E+01	9.09E+01
4	3.07E-01	9.50E+01	8.66E+01
5	4.83E-01	4.41E+01	6.81E+01
6	5.50E-01	7.50E+01	5.83E+01
7			
8			
9			
10			
11			
12			

R-squared: 0.543

	DF	SS	MS	F	Sig
Total (adj)	5	2297.7	459.54		
Regression	2	1246.5	623.25	1.7787	0.3094
Error	3	1051.2	350.39		

	X	Y
1	-3.5	9.49E+01
2	-3.45E+00	9.49E+01
3	-3.41E+00	9.49E+01
4	-3.36E+00	9.49E+01
5	-3.32E+00	9.49E+01
6	-3.27E+00	9.49E+01
7	-3.23E+00	9.49E+01
8	-3.18E+00	9.49E+01
9	-3.14E+00	9.49E+01
10	-3.09E+00	9.49E+01
11	-3.05E+00	9.49E+01
12	-3.00E+00	9.49E+01
13	-2.95E+00	9.49E+01
14	-2.91E+00	9.49E+01
15	-2.8636	9.49E+01
16	-2.8182	9.49E+01
17	-2.7727	9.49E+01
18	-2.7273	9.49E+01
19	-2.6818	9.49E+01
20	-2.6364	9.49E+01
21	-2.59E+00	9.49E+01
22	-2.55E+00	9.49E+01
23	-2.50E+00	9.49E+01
24	-2.45E+00	9.49E+01
25	-2.41E+00	9.49E+01
26	-2.36E+00	9.49E+01
27	-2.32E+00	9.49E+01

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.52E+01
2	-6.00E+00	1.00E+02	9.52E+01
3	2.40E-01	8.24E+01	9.52E+01
4	3.07E-01	9.50E+01	9.52E+01
5	4.83E-01	4.41E+01	6.66E+01
6	5.50E-01	7.50E+01	5.45E+01
7			
8			
9			
10			
11			
12			

R-squared: 0.505

	DF	SS	MS	F	Sig
Total (adj)	5	2297.7	459.54		
Regression	2	1160.4	580.2	1.5305	0.3482
Error	3	1137.3	379.1		

	X	Y
1	-3.5	9.52E+01
2	-3.45E+00	9.52E+01
3	-3.41E+00	9.52E+01
4	-3.36E+00	9.52E+01
5	-3.32E+00	9.52E+01
6	-3.27E+00	9.52E+01
7	-3.23E+00	9.52E+01
8	-3.18E+00	9.52E+01
9	-3.14E+00	9.52E+01
10	-3.09E+00	9.52E+01
11	-3.05E+00	9.52E+01
12	-3.00E+00	9.52E+01
13	-2.95E+00	9.52E+01
14	-2.91E+00	9.52E+01
15	-2.8636	9.52E+01
16	-2.8182	9.52E+01
17	-2.7727	9.52E+01
18	-2.7273	9.52E+01
19	-2.6818	9.52E+01
20	-2.6364	9.52E+01
21	-2.59E+00	9.52E+01
22	-2.55E+00	9.52E+01
23	-2.50E+00	9.52E+01
24	-2.45E+00	9.52E+01
25	-2.41E+00	9.52E+01
26	-2.36E+00	9.52E+01
27	-2.32E+00	9.52E+01

Prediction Line

	X	Y
28	-2.27E+00	9.76E+01
29	-2.23E+00	9.76E+01
30	-2.18E+00	9.76E+01
31	-2.1364	9.76E+01
32	-2.0909	9.76E+01
33	-2.0455	9.76E+01
34	-2	9.76E+01
35	-1.9545	9.76E+01
36	-1.9091	9.76E+01
37	-1.8636	9.76E+01
38	-1.8182	9.76E+01
39	-1.7727	9.76E+01
40	-1.7273	9.76E+01
41	-1.6818	9.76E+01
42	-1.6364	9.76E+01
43	-1.59E+00	9.76E+01
44	-1.55E+00	9.76E+01
45	-1.5	9.76E+01
46	-1.45E+00	9.76E+01
47	-1.41E+00	9.76E+01
48	-1.3636	9.76E+01
49	-1.3182	9.76E+01
50	-1.2727	9.76E+01
51	-1.2273	9.76E+01
52	-1.1818	9.76E+01
53	-1.1364	9.76E+01
54	-1.0909	9.76E+01
55	-1.0455	9.76E+01
56	-1	9.76E+01
57	-0.95455	9.76E+01
58	-0.90909	9.76E+01
59	-0.86364	9.76E+01
60	-0.81818	9.76E+01
61	-0.77273	9.76E+01
62	-0.72727	9.76E+01
63	-0.68182	9.76E+01
64	-0.63636	9.76E+01
65	-0.59091	9.76E+01
66	-0.54545	9.76E+01
67	-0.5	9.76E+01
68	-0.45455	9.75E+01
69	-0.40909	9.75E+01
70	-0.36364	9.75E+01
71	-0.31818	9.75E+01
72	-0.27273	9.74E+01
73	-0.22727	9.74E+01
74	-0.18182	9.73E+01
75	-0.13636	9.72E+01
76	-9.09E-02	9.70E+01
77	-4.55E-02	9.68E+01
78	0	9.64E+01
79	4.55E-02	9.60E+01
80	9.09E-02	9.53E+01

	X	Y
28	-2.27E+00	9.49E+01
29	-2.23E+00	9.49E+01
30	-2.18E+00	9.49E+01
31	-2.1364	9.49E+01
32	-2.0909	9.49E+01
33	-2.0455	9.49E+01
34	-2	9.49E+01
35	-1.9545	9.49E+01
36	-1.9091	9.49E+01
37	-1.8636	9.49E+01
38	-1.8182	9.49E+01
39	-1.7727	9.49E+01
40	-1.7273	9.49E+01
41	-1.6818	9.49E+01
42	-1.6364	9.49E+01
43	-1.59E+00	9.49E+01
44	-1.55E+00	9.49E+01
45	-1.5	9.49E+01
46	-1.45E+00	9.49E+01
47	-1.41E+00	9.49E+01
48	-1.3636	9.49E+01
49	-1.3182	9.49E+01
50	-1.2727	9.49E+01
51	-1.2273	9.49E+01
52	-1.1818	9.49E+01
53	-1.1364	9.49E+01
54	-1.0909	9.49E+01
55	-1.0455	9.49E+01
56	-1	9.49E+01
57	-0.95455	9.49E+01
58	-0.90909	9.49E+01
59	-0.86364	9.49E+01
60	-0.81818	9.49E+01
61	-0.77273	9.49E+01
62	-0.72727	9.49E+01
63	-0.68182	9.49E+01
64	-0.63636	9.49E+01
65	-0.59091	9.49E+01
66	-0.54545	9.49E+01
67	-0.5	9.49E+01
68	-0.45455	9.49E+01
69	-0.40909	9.49E+01
70	-0.36364	9.49E+01
71	-0.31818	9.49E+01
72	-0.27273	9.49E+01
73	-0.22727	9.49E+01
74	-0.18182	9.49E+01
75	-0.13636	9.49E+01
76	-9.09E-02	9.49E+01
77	-4.55E-02	9.49E+01
78	0	9.49E+01
79	4.55E-02	9.49E+01
80	9.09E-02	9.49E+01

	X	Y
28	-2.27E+00	9.52E+01
29	-2.23E+00	9.52E+01
30	-2.18E+00	9.52E+01
31	-2.1364	9.52E+01
32	-2.0909	9.52E+01
33	-2.0455	9.52E+01
34	-2	9.52E+01
35	-1.9545	9.52E+01
36	-1.9091	9.52E+01
37	-1.8636	9.52E+01
38	-1.8182	9.52E+01
39	-1.7727	9.52E+01
40	-1.7273	9.52E+01
41	-1.6818	9.52E+01
42	-1.6364	9.52E+01
43	-1.59E+00	9.52E+01
44	-1.55E+00	9.52E+01
45	-1.5	9.52E+01
46	-1.45E+00	9.52E+01
47	-1.41E+00	9.52E+01
48	-1.3636	9.52E+01
49	-1.3182	9.52E+01
50	-1.2727	9.52E+01
51	-1.2273	9.52E+01
52	-1.1818	9.52E+01
53	-1.1364	9.52E+01
54	-1.0909	9.52E+01
55	-1.0455	9.52E+01
56	-1	9.52E+01
57	-0.95455	9.52E+01
58	-0.90909	9.52E+01
59	-0.86364	9.52E+01
60	-0.81818	9.52E+01
61	-0.77273	9.52E+01
62	-0.72727	9.52E+01
63	-0.68182	9.52E+01
64	-0.63636	9.52E+01
65	-0.59091	9.52E+01
66	-0.54545	9.52E+01
67	-0.5	9.52E+01
68	-0.45455	9.52E+01
69	-0.40909	9.52E+01
70	-0.36364	9.52E+01
71	-0.31818	9.52E+01
72	-0.27273	9.52E+01
73	-0.22727	9.52E+01
74	-0.18182	9.52E+01
75	-0.13636	9.52E+01
76	-9.09E-02	9.52E+01
77	-4.55E-02	9.52E+01
78	0	9.52E+01
79	4.55E-02	9.52E+01
80	9.09E-02	9.52E+01

Prediction Line

	X	Y
81	0.13636	9.44E+01
82	0.18182	9.32E+01
83	0.22727	9.15E+01
84	0.27273	8.92E+01
85	0.31818	8.62E+01
86	0.36364	8.23E+01
87	0.40909	7.73E+01
88	0.45455	7.12E+01
89	0.5	6.41E+01
90	0.54545	5.62E+01
91	0.59091	4.79E+01
92	0.63636	3.96E+01
93	0.68182	3.19E+01
94	0.72727	2.50E+01
95	0.77273	1.91E+01
96	0.81818	1.44E+01
97	0.86364	1.07E+01
98	0.90909	7.81E+00
99	0.95455	5.68E+00
100	1	4.09E+00

	X	Y
81	0.13636	9.45E+01
82	0.18182	9.33E+01
83	0.22727	9.15E+01
84	0.27273	8.89E+01
85	0.31818	8.57E+01
86	0.36364	8.18E+01
87	0.40909	7.71E+01
88	0.45455	7.18E+01
89	0.5	6.58E+01
90	0.54545	5.90E+01
91	0.59091	5.16E+01
92	0.63636	4.36E+01
93	0.68182	3.62E+01
94	0.72727	2.94E+01
95	0.77273	2.33E+01
96	0.81818	1.80E+01
97	0.86364	1.33E+01
98	0.90909	9.35E+00
99	0.95455	6.08E+00
100	1	3.52E+00

	X	Y
81	0.13636	9.52E+01
82	0.18182	9.52E+01
83	0.22727	9.52E+01
84	0.27273	9.52E+01
85	0.31818	9.52E+01
86	0.36364	8.80E+01
87	0.40909	7.99E+01
88	0.45455	7.17E+01
89	0.5	6.35E+01
90	0.54545	5.53E+01
91	0.59091	4.72E+01
92	0.63636	3.90E+01
93	0.68182	3.08E+01
94	0.72727	2.26E+01
95	0.77273	1.45E+01
96	0.81818	6.27E+00
97	0.86364	0.00E+00
98	0.90909	0.00E+00
99	0.95455	0.00E+00
100	1	0.00E+00

Table H2.D-13b. TRAP Model Output for Thallium Data for the Mammal Survival Endpoint (Pooling Group B: Downs et al. 1960)

Chemical:	Thallium
Study Authors:	Pooling group B
Receptor Group:	Mammal
Effect Description:	Survival

Input Data:

Dose	Effect Relative to Control
0.000001	100
1.736765899	125
3.039340323	25
4.341914747	0
0.000001	100
2.027991685	60
3.548985449	60
5.069979213	0

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			yes
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness	yes	yes	
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.42985	0.44207	8.21E-02	0.23112	0.65302
S	3.6162	2.53E+00	1.52E+00	-1.3874	6.4472
Y0	1.13E+02	1.05E+02	17.49	59.831	149.75

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.42985	0.44655	7.64E-02	0.25006	0.64304
S	3.6162	2.78E+00	1.4885	-1.0509	6.6015
Y0	1.13E+02	1.04E+02	17.256	59.64	148.36

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.42985	0.45412	6.09E-02	0.29765	0.61059
S	3.6162	2.3323	0.95554	-0.12395	4.7886
Y0	1.13E+02	1.02E+02	15.564	62.192	142.21

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.7674	1.7026	4.498	8.21E-02	0.44207
20	2.02E+00	8.87E-01	4.60E+00	1.39E-01	0.30507
10	1.68E+00	5.73E-01	4.92E+00	1.82E-01	0.22494
5	1.42E+00	3.78E-01	5.30E+00	2.23E-01	0.1511
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.7961	1.7785	4.3959	7.64E-02	0.44655
20	2.0612	9.67E-01	4.3922	0.12782	0.31412
10	1.77E+00	6.55E-01	4.77E+00	0.16765	0.24738
5	1.5855	4.76E-01	5.28E+00	0.20312	0.20018
0	1.2197	2.61E-01	5.69E+00	0.26019	8.62E-02

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.8452	1.9845	4.0793	6.09E-02	0.45412
20	2.1159	1.1958	3.7441	9.64E-02	0.32549
10	1.917	0.99182	3.7051	0.11133	0.28262
5	1.8246	0.90184	3.6917	0.11906	0.26118
0	1.7368	0.81937	3.6813	0.12692	0.23974

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.05E+02
2	-6.00E+00	1.00E+02	1.05E+02
3	2.40E-01	1.25E+02	9.28E+01
4	3.07E-01	6.00E+01	8.35E+01
5	4.83E-01	2.50E+01	4.18E+01
6	5.50E-01	6.00E+01	2.63E+01
7	6.38E-01	0.00E+00	1.27E+01
8	7.05E-01	0.00E+00	6.85E+00
9			
10			
11			
12			

Analysis of Variance

R-squared: 0.794

	DF	SS	MS	F	Sig
Total (adj)	7	15837	2262.5		
Regression	2	12579	6289.4	9.6503	0.0192
Error	5	3258.7	651.73		

Prediction Line

	X	Y
1	-3	1.05E+02
2	-2.96E+00	1.05E+02
3	-2.92E+00	1.05E+02
4	-2.88E+00	1.05E+02
5	-2.84E+00	1.05E+02
6	-2.80E+00	1.05E+02
7	-2.76E+00	1.05E+02
8	-2.72E+00	1.05E+02
9	-2.68E+00	1.05E+02
10	-2.64E+00	1.05E+02
11	-2.60E+00	1.05E+02
12	-2.56E+00	1.05E+02
13	-2.52E+00	1.05E+02
14	-2.47E+00	1.05E+02
15	-2.4343	1.05E+02
16	-2.3939	1.05E+02
17	-2.3535	1.05E+02
18	-2.3131	1.05E+02
19	-2.2727	1.05E+02
20	-2.2323	1.05E+02
21	-2.19E+00	1.05E+02
22	-2.15E+00	1.05E+02
23	-2.11E+00	1.05E+02
24	-2.07E+00	1.05E+02
25	-2.03E+00	1.05E+02
26	-1.99E+00	1.05E+02
27	-1.95E+00	1.05E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.04E+02
2	-6.00E+00	1.00E+02	1.04E+02
3	2.40E-01	1.25E+02	9.46E+01
4	3.07E-01	6.00E+01	8.45E+01
5	4.83E-01	2.50E+01	4.21E+01
6	5.50E-01	6.00E+01	2.64E+01
7	6.38E-01	0.00E+00	1.15E+01
8	7.05E-01	0.00E+00	4.16E+00
9			
10			
11			
12			

R-squared: 0.803

	DF	SS	MS	F	Sig
Total (adj)	7	15837	2262.5		
Regression	2	12712	6355.9	10.167	0.0173
Error	5	3125.8	625.15		

	X	Y
1	-3	1.04E+02
2	-2.96E+00	1.04E+02
3	-2.92E+00	1.04E+02
4	-2.88E+00	1.04E+02
5	-2.84E+00	1.04E+02
6	-2.80E+00	1.04E+02
7	-2.76E+00	1.04E+02
8	-2.72E+00	1.04E+02
9	-2.68E+00	1.04E+02
10	-2.64E+00	1.04E+02
11	-2.60E+00	1.04E+02
12	-2.56E+00	1.04E+02
13	-2.52E+00	1.04E+02
14	-2.47E+00	1.04E+02
15	-2.4343	1.04E+02
16	-2.3939	1.04E+02
17	-2.3535	1.04E+02
18	-2.3131	1.04E+02
19	-2.2727	1.04E+02
20	-2.2323	1.04E+02
21	-2.19E+00	1.04E+02
22	-2.15E+00	1.04E+02
23	-2.11E+00	1.04E+02
24	-2.07E+00	1.04E+02
25	-2.03E+00	1.04E+02
26	-1.99E+00	1.04E+02
27	-1.95E+00	1.04E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.02E+02
2	-6.00E+00	1.00E+02	1.02E+02
3	2.40E-01	1.25E+02	1.02E+02
4	3.07E-01	6.00E+01	8.62E+01
5	4.83E-01	2.50E+01	4.43E+01
6	5.50E-01	6.00E+01	2.82E+01
7	6.38E-01	0.00E+00	7.35E+00
8	7.05E-01	0.00E+00	0.00E+00
9			
10			
11			
12			

R-squared: 0.833

	DF	SS	MS	F	Sig
Total (adj)	7	15837	2262.5		
Regression	2	13189	6594.4	12.449	0.0114
Error	5	2648.6	529.72		

	X	Y
1	-3	1.02E+02
2	-2.96E+00	1.02E+02
3	-2.92E+00	1.02E+02
4	-2.88E+00	1.02E+02
5	-2.84E+00	1.02E+02
6	-2.80E+00	1.02E+02
7	-2.76E+00	1.02E+02
8	-2.72E+00	1.02E+02
9	-2.68E+00	1.02E+02
10	-2.64E+00	1.02E+02
11	-2.60E+00	1.02E+02
12	-2.56E+00	1.02E+02
13	-2.52E+00	1.02E+02
14	-2.47E+00	1.02E+02
15	-2.4343	1.02E+02
16	-2.3939	1.02E+02
17	-2.3535	1.02E+02
18	-2.3131	1.02E+02
19	-2.2727	1.02E+02
20	-2.2323	1.02E+02
21	-2.19E+00	1.02E+02
22	-2.15E+00	1.02E+02
23	-2.11E+00	1.02E+02
24	-2.07E+00	1.02E+02
25	-2.03E+00	1.02E+02
26	-1.99E+00	1.02E+02
27	-1.95E+00	1.02E+02

Prediction Line

	X	Y
28	-1.91E+00	1.05E+02
29	-1.87E+00	1.05E+02
30	-1.83E+00	1.05E+02
31	-1.7879	1.05E+02
32	-1.7475	1.05E+02
33	-1.7071	1.05E+02
34	-1.6667	1.05E+02
35	-1.6263	1.05E+02
36	-1.5859	1.05E+02
37	-1.5455	1.05E+02
38	-1.5051	1.05E+02
39	-1.4646	1.05E+02
40	-1.4242	1.05E+02
41	-1.3838	1.05E+02
42	-1.3434	1.05E+02
43	-1.30E+00	1.05E+02
44	-1.26E+00	1.05E+02
45	-1.2222	1.05E+02
46	-1.18E+00	1.05E+02
47	-1.14E+00	1.05E+02
48	-1.101	1.05E+02
49	-1.0606	1.05E+02
50	-1.0202	1.05E+02
51	-0.9798	1.05E+02
52	-0.93939	1.05E+02
53	-0.89899	1.05E+02
54	-0.85859	1.05E+02
55	-0.81818	1.05E+02
56	-0.77778	1.05E+02
57	-0.73737	1.05E+02
58	-0.69697	1.05E+02
59	-0.65657	1.05E+02
60	-0.61616	1.05E+02
61	-0.57576	1.05E+02
62	-0.53535	1.05E+02
63	-0.49495	1.05E+02
64	-0.45455	1.05E+02
65	-0.41414	1.05E+02
66	-0.37374	1.05E+02
67	-0.33333	1.05E+02
68	-0.29293	1.05E+02
69	-0.25253	1.05E+02
70	-0.21212	1.05E+02
71	-0.17172	1.05E+02
72	-0.13131	1.04E+02
73	-9.09E-02	1.04E+02
74	-5.05E-02	1.04E+02
75	-1.01E-02	1.04E+02
76	3.03E-02	1.03E+02
77	7.07E-02	1.02E+02
78	0.11111	1.01E+02
79	0.15152	9.95E+01
80	0.19192	9.71E+01

	X	Y
28	-1.91E+00	1.04E+02
29	-1.87E+00	1.04E+02
30	-1.83E+00	1.04E+02
31	-1.7879	1.04E+02
32	-1.7475	1.04E+02
33	-1.7071	1.04E+02
34	-1.6667	1.04E+02
35	-1.6263	1.04E+02
36	-1.5859	1.04E+02
37	-1.5455	1.04E+02
38	-1.5051	1.04E+02
39	-1.4646	1.04E+02
40	-1.4242	1.04E+02
41	-1.3838	1.04E+02
42	-1.3434	1.04E+02
43	-1.30E+00	1.04E+02
44	-1.26E+00	1.04E+02
45	-1.2222	1.04E+02
46	-1.18E+00	1.04E+02
47	-1.14E+00	1.04E+02
48	-1.101	1.04E+02
49	-1.0606	1.04E+02
50	-1.0202	1.04E+02
51	-0.9798	1.04E+02
52	-0.93939	1.04E+02
53	-0.89899	1.04E+02
54	-0.85859	1.04E+02
55	-0.81818	1.04E+02
56	-0.77778	1.04E+02
57	-0.73737	1.04E+02
58	-0.69697	1.04E+02
59	-0.65657	1.04E+02
60	-0.61616	1.04E+02
61	-0.57576	1.04E+02
62	-0.53535	1.04E+02
63	-0.49495	1.04E+02
64	-0.45455	1.04E+02
65	-0.41414	1.04E+02
66	-0.37374	1.04E+02
67	-0.33333	1.04E+02
68	-0.29293	1.04E+02
69	-0.25253	1.04E+02
70	-0.21212	1.04E+02
71	-0.17172	1.04E+02
72	-0.13131	1.04E+02
73	-9.09E-02	1.04E+02
74	-5.05E-02	1.04E+02
75	-1.01E-02	1.04E+02
76	3.03E-02	1.04E+02
77	7.07E-02	1.04E+02
78	0.11111	1.04E+02
79	0.15152	1.02E+02
80	0.19192	9.95E+01

	X	Y
28	-1.91E+00	1.02E+02
29	-1.87E+00	1.02E+02
30	-1.83E+00	1.02E+02
31	-1.7879	1.02E+02
32	-1.7475	1.02E+02
33	-1.7071	1.02E+02
34	-1.6667	1.02E+02
35	-1.6263	1.02E+02
36	-1.5859	1.02E+02
37	-1.5455	1.02E+02
38	-1.5051	1.02E+02
39	-1.4646	1.02E+02
40	-1.4242	1.02E+02
41	-1.3838	1.02E+02
42	-1.3434	1.02E+02
43	-1.30E+00	1.02E+02
44	-1.26E+00	1.02E+02
45	-1.2222	1.02E+02
46	-1.18E+00	1.02E+02
47	-1.14E+00	1.02E+02
48	-1.101	1.02E+02
49	-1.0606	1.02E+02
50	-1.0202	1.02E+02
51	-0.9798	1.02E+02
52	-0.93939	1.02E+02
53	-0.89899	1.02E+02
54	-0.85859	1.02E+02
55	-0.81818	1.02E+02
56	-0.77778	1.02E+02
57	-0.73737	1.02E+02
58	-0.69697	1.02E+02
59	-0.65657	1.02E+02
60	-0.61616	1.02E+02
61	-0.57576	1.02E+02
62	-0.53535	1.02E+02
63	-0.49495	1.02E+02
64	-0.45455	1.02E+02
65	-0.41414	1.02E+02
66	-0.37374	1.02E+02
67	-0.33333	1.02E+02
68	-0.29293	1.02E+02
69	-0.25253	1.02E+02
70	-0.21212	1.02E+02
71	-0.17172	1.02E+02
72	-0.13131	1.02E+02
73	-9.09E-02	1.02E+02
74	-5.05E-02	1.02E+02
75	-1.01E-02	1.02E+02
76	3.03E-02	1.02E+02
77	7.07E-02	1.02E+02
78	0.11111	1.02E+02
79	0.15152	1.02E+02
80	0.19192	1.02E+02

Prediction Line

	X	Y
81	0.23232	9.36E+01
82	0.27273	8.88E+01
83	0.31313	8.24E+01
84	0.35354	7.44E+01
85	0.39394	6.49E+01
86	0.43434	5.44E+01
87	0.47475	4.38E+01
88	0.51515	3.39E+01
89	0.55556	2.52E+01
90	0.59596	1.82E+01
91	0.63636	1.29E+01
92	0.67677	8.92E+00
93	0.71717	6.10E+00
94	0.75758	4.13E+00
95	0.79798	2.78E+00
96	0.83838	1.87E+00
97	0.87879	1.25E+00
98	0.91919	8.32E-01
99	0.9596	5.54E-01
100	1	3.69E-01

	X	Y
81	0.23232	9.55E+01
82	0.27273	9.01E+01
83	0.31313	8.34E+01
84	0.35354	7.54E+01
85	0.39394	6.61E+01
86	0.43434	5.55E+01
87	0.47475	4.42E+01
88	0.51515	3.41E+01
89	0.55556	2.53E+01
90	0.59596	1.78E+01
91	0.63636	1.16E+01
92	0.67677	6.78E+00
93	0.71717	3.22E+00
94	0.75758	9.73E-01
95	0.79798	3.17E-02
96	0.83838	0.00E+00
97	0.87879	0.00E+00
98	0.91919	0.00E+00
99	0.9596	0.00E+00
100	1	0.00E+00

	X	Y
81	0.23232	1.02E+02
82	0.27273	9.43E+01
83	0.31313	8.47E+01
84	0.35354	7.51E+01
85	0.39394	6.54E+01
86	0.43434	5.58E+01
87	0.47475	4.62E+01
88	0.51515	3.66E+01
89	0.55556	2.69E+01
90	0.59596	1.73E+01
91	0.63636	7.66E+00
92	0.67677	0.00E+00
93	0.71717	0.00E+00
94	0.75758	0.00E+00
95	0.79798	0.00E+00
96	0.83838	0.00E+00
97	0.87879	0.00E+00
98	0.91919	0.00E+00
99	0.9596	0.00E+00
100	1	0.00E+00

Table H2.D-14a. TRAP Model Output for Vanadium Data for the Bird Growth Endpoint (Berg and Lawrence 1971)

Chemical:	Vanadium
Study Authors:	Berg and Lawrence 1971
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
0.000001	126	not reported
1.160299	102	not reported
2.320598	68	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.40278	0.40278			
S	1.0695	1.07E+00			
Y0	1.26E+02	1.26E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.40278	0.40122			
S	1.0695	1.14E+00			
Y0	1.26E+02	1.26E+02			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.40278	0.40987			
S	1.0695	0.89639			
Y0	1.26E+02	1.26E+02			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.528	Infinity	0	0	0.40278
20	1.20E+00	Infinity	0.00E+00	0	7.87E-02
10	7.75E-01	Infinity	0.00E+00	0	-0.11081
5	5.18E-01	Infinity	0.00E+00	0	-0.28547
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.519	Infinity	0	0	0.40122
20	1.1967	Infinity	0	0	7.80E-02
10	8.22E-01	Infinity	0.00E+00	0	-8.49E-02
5	0.63076	Infinity	0.00E+00	0	-0.20014
0	0.33247	Infinity	0.00E+00	0	-4.78E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.5696	Infinity	0	0	0.40987
20	1.189	Infinity	0	0	7.52E-02
10	0.91968	Infinity	0	0	-3.64E-02
5	0.80883	Infinity	0	0	-9.21E-02
0	0.71134	Infinity	0	0	-0.14792

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.26E+02	1.26E+02
2	6.46E-02	1.02E+02	1.02E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.26E+02	1.26E+02
2	6.46E-02	1.02E+02	1.02E+02

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.26E+02	1.26E+02
2	6.46E-02	1.02E+02	1.02E+02

3	3.66E-01	6.80E+01	6.80E+01	
4				
5				
6				

Analysis of Variance

R-squared: 0

	DF	SS	MS	F	Sig
Total (adj)	0	0	0		
Regression	0	0	0	0	0
Error	0	0	0		

Prediction Line

	X	Y
1	-3.5	1.26E+02
2	-3.45E+00	1.26E+02
3	-3.41E+00	1.26E+02
4	-3.36E+00	1.26E+02
5	-3.32E+00	1.26E+02
6	-3.27E+00	1.26E+02
7	-3.23E+00	1.26E+02
8	-3.18E+00	1.26E+02
9	-3.14E+00	1.26E+02
10	-3.09E+00	1.26E+02
11	-3.05E+00	1.26E+02
12	-3.00E+00	1.26E+02
13	-2.95E+00	1.26E+02
14	-2.9091	1.26E+02
15	-2.8636	1.26E+02
16	-2.8182	1.26E+02
17	-2.7727	1.26E+02
18	-2.7273	1.26E+02
19	-2.6818	1.26E+02
20	-2.6364	1.26E+02
21	-2.59E+00	1.26E+02
22	-2.55E+00	1.26E+02
23	-2.50E+00	1.26E+02
24	-2.45E+00	1.26E+02
25	-2.41E+00	1.26E+02
26	-2.36E+00	1.26E+02
27	-2.32E+00	1.26E+02
28	-2.27E+00	1.26E+02
29	-2.23E+00	1.26E+02
30	-2.18E+00	1.26E+02
31	-2.1364	1.26E+02
32	-2.0909	1.26E+02
33	-2.0455	1.26E+02
34	-2	1.26E+02
35	-1.9545	1.26E+02
36	-1.9091	1.26E+02

3	3.66E-01	6.80E+01	6.80E+01	
4				
5				
6				

R-squared: 0

	DF	SS	MS	F	Sig
Total (adj)	0	0	0		
Regression	0	0	0	0	0
Error	0	0	0		

	X	Y
1	-3.5	1.26E+02
2	-3.45E+00	1.26E+02
3	-3.41E+00	1.26E+02
4	-3.36E+00	1.26E+02
5	-3.32E+00	1.26E+02
6	-3.27E+00	1.26E+02
7	-3.23E+00	1.26E+02
8	-3.18E+00	1.26E+02
9	-3.14E+00	1.26E+02
10	-3.09E+00	1.26E+02
11	-3.05E+00	1.26E+02
12	-3.00E+00	1.26E+02
13	-2.95E+00	1.26E+02
14	-2.9091	1.26E+02
15	-2.8636	1.26E+02
16	-2.8182	1.26E+02
17	-2.7727	1.26E+02
18	-2.7273	1.26E+02
19	-2.6818	1.26E+02
20	-2.6364	1.26E+02
21	-2.59E+00	1.26E+02
22	-2.55E+00	1.26E+02
23	-2.50E+00	1.26E+02
24	-2.45E+00	1.26E+02
25	-2.41E+00	1.26E+02
26	-2.36E+00	1.26E+02
27	-2.32E+00	1.26E+02
28	-2.27E+00	1.26E+02
29	-2.23E+00	1.26E+02
30	-2.18E+00	1.26E+02
31	-2.1364	1.26E+02
32	-2.0909	1.26E+02
33	-2.0455	1.26E+02
34	-2	1.26E+02
35	-1.9545	1.26E+02
36	-1.9091	1.26E+02

3	3.66E-01	6.80E+01	6.80E+01	
4				
5				
6				

R-squared: 0

	DF	SS	MS	F	Sig
Total (adj)	0	0	0		
Regression	0	0	0	0	0
Error	0	0	0		

	X	Y
1	-3.5	1.26E+02
2	-3.45E+00	1.26E+02
3	-3.41E+00	1.26E+02
4	-3.36E+00	1.26E+02
5	-3.32E+00	1.26E+02
6	-3.27E+00	1.26E+02
7	-3.23E+00	1.26E+02
8	-3.18E+00	1.26E+02
9	-3.14E+00	1.26E+02
10	-3.09E+00	1.26E+02
11	-3.05E+00	1.26E+02
12	-3.00E+00	1.26E+02
13	-2.95E+00	1.26E+02
14	-2.9091	1.26E+02
15	-2.8636	1.26E+02
16	-2.8182	1.26E+02
17	-2.7727	1.26E+02
18	-2.7273	1.26E+02
19	-2.6818	1.26E+02
20	-2.6364	1.26E+02
21	-2.59E+00	1.26E+02
22	-2.55E+00	1.26E+02
23	-2.50E+00	1.26E+02
24	-2.45E+00	1.26E+02
25	-2.41E+00	1.26E+02
26	-2.36E+00	1.26E+02
27	-2.32E+00	1.26E+02
28	-2.27E+00	1.26E+02
29	-2.23E+00	1.26E+02
30	-2.18E+00	1.26E+02
31	-2.1364	1.26E+02
32	-2.0909	1.26E+02
33	-2.0455	1.26E+02
34	-2	1.26E+02
35	-1.9545	1.26E+02
36	-1.9091	1.26E+02

Prediction Line

	X	Y
37	-1.8636	1.26E+02
38	-1.8182	1.26E+02
39	-1.7727	1.26E+02
40	-1.7273	1.26E+02
41	-1.6818	1.26E+02
42	-1.6364	1.26E+02
43	-1.5909	1.26E+02
44	-1.5455	1.26E+02
45	-1.5	1.26E+02
46	-1.4545	1.26E+02
47	-1.4091	1.26E+02
48	-1.3636	1.26E+02
49	-1.3182	1.26E+02
50	-1.2727	1.26E+02
51	-1.2273	1.26E+02
52	-1.1818	1.26E+02
53	-1.1364	1.26E+02
54	-1.0909	1.26E+02
55	-1.0455	1.26E+02
56	-1	1.26E+02
57	-0.95455	1.26E+02
58	-0.90909	1.26E+02
59	-0.86364	1.25E+02
60	-0.81818	1.25E+02
61	-0.77273	1.25E+02
62	-0.72727	1.25E+02
63	-0.68182	1.25E+02
64	-0.63636	1.25E+02
65	-0.59091	1.24E+02
66	-0.54545	1.24E+02
67	-0.5	1.23E+02
68	-0.45455	1.23E+02
69	-0.40909	1.22E+02
70	-0.36364	1.21E+02
71	-0.31818	1.20E+02
72	-0.27273	1.19E+02
73	-0.22727	1.18E+02
74	-0.18182	1.16E+02
75	-0.13636	1.15E+02
76	-9.09E-02	1.12E+02
77	-4.55E-02	1.10E+02
78	0	1.07E+02
79	4.55E-02	1.04E+02
80	9.09E-02	9.97E+01
81	0.13636	9.55E+01
82	0.18182	9.07E+01
83	0.22727	8.56E+01
84	0.27273	8.01E+01
85	0.31818	7.43E+01
86	0.36364	6.83E+01
87	0.40909	6.22E+01

	X	Y
37	-1.8636	1.26E+02
38	-1.8182	1.26E+02
39	-1.7727	1.26E+02
40	-1.7273	1.26E+02
41	-1.6818	1.26E+02
42	-1.6364	1.26E+02
43	-1.5909	1.26E+02
44	-1.5455	1.26E+02
45	-1.5	1.26E+02
46	-1.4545	1.26E+02
47	-1.4091	1.26E+02
48	-1.3636	1.26E+02
49	-1.3182	1.26E+02
50	-1.2727	1.26E+02
51	-1.2273	1.26E+02
52	-1.1818	1.26E+02
53	-1.1364	1.26E+02
54	-1.0909	1.26E+02
55	-1.0455	1.26E+02
56	-1	1.26E+02
57	-0.95455	1.26E+02
58	-0.90909	1.26E+02
59	-0.86364	1.26E+02
60	-0.81818	1.26E+02
61	-0.77273	1.26E+02
62	-0.72727	1.26E+02
63	-0.68182	1.26E+02
64	-0.63636	1.26E+02
65	-0.59091	1.26E+02
66	-0.54545	1.26E+02
67	-0.5	1.26E+02
68	-0.45455	1.26E+02
69	-0.40909	1.26E+02
70	-0.36364	1.25E+02
71	-0.31818	1.24E+02
72	-0.27273	1.23E+02
73	-0.22727	1.21E+02
74	-0.18182	1.19E+02
75	-0.13636	1.16E+02
76	-9.09E-02	1.14E+02
77	-4.55E-02	1.11E+02
78	0	1.07E+02
79	4.55E-02	1.04E+02
80	9.09E-02	9.96E+01
81	0.13636	9.52E+01
82	0.18182	9.05E+01
83	0.22727	8.55E+01
84	0.27273	8.01E+01
85	0.31818	7.43E+01
86	0.36364	6.83E+01
87	0.40909	6.19E+01

	X	Y
37	-1.8636	1.26E+02
38	-1.8182	1.26E+02
39	-1.7727	1.26E+02
40	-1.7273	1.26E+02
41	-1.6818	1.26E+02
42	-1.6364	1.26E+02
43	-1.5909	1.26E+02
44	-1.5455	1.26E+02
45	-1.5	1.26E+02
46	-1.4545	1.26E+02
47	-1.4091	1.26E+02
48	-1.3636	1.26E+02
49	-1.3182	1.26E+02
50	-1.2727	1.26E+02
51	-1.2273	1.26E+02
52	-1.1818	1.26E+02
53	-1.1364	1.26E+02
54	-1.0909	1.26E+02
55	-1.0455	1.26E+02
56	-1	1.26E+02
57	-0.95455	1.26E+02
58	-0.90909	1.26E+02
59	-0.86364	1.26E+02
60	-0.81818	1.26E+02
61	-0.77273	1.26E+02
62	-0.72727	1.26E+02
63	-0.68182	1.26E+02
64	-0.63636	1.26E+02
65	-0.59091	1.26E+02
66	-0.54545	1.26E+02
67	-0.5	1.26E+02
68	-0.45455	1.26E+02
69	-0.40909	1.26E+02
70	-0.36364	1.26E+02
71	-0.31818	1.26E+02
72	-0.27273	1.26E+02
73	-0.22727	1.26E+02
74	-0.18182	1.26E+02
75	-0.13636	1.25E+02
76	-9.09E-02	1.20E+02
77	-4.55E-02	1.14E+02
78	0	1.09E+02
79	4.55E-02	1.04E+02
80	9.09E-02	9.90E+01
81	0.13636	9.39E+01
82	0.18182	8.88E+01
83	0.22727	8.36E+01
84	0.27273	7.85E+01
85	0.31818	7.34E+01
86	0.36364	6.82E+01
87	0.40909	6.31E+01

Prediction Line

	X	Y
88	0.45455	5.61E+01
89	0.5	5.01E+01
90	0.54545	4.43E+01
91	0.59091	3.89E+01
92	0.63636	3.39E+01
93	0.68182	2.93E+01
94	0.72727	2.52E+01
95	0.77273	2.15E+01
96	0.81818	1.82E+01
97	0.86364	1.54E+01
98	0.90909	1.30E+01
99	0.95455	1.09E+01
100	1	9.08E+00

	X	Y
88	0.45455	5.56E+01
89	0.5	4.96E+01
90	0.54545	4.40E+01
91	0.59091	3.88E+01
92	0.63636	3.38E+01
93	0.68182	2.92E+01
94	0.72727	2.49E+01
95	0.77273	2.10E+01
96	0.81818	1.74E+01
97	0.86364	1.42E+01
98	0.90909	1.12E+01
99	0.95455	8.66E+00
100	1	6.42E+00

	X	Y
88	0.45455	5.80E+01
89	0.5	5.28E+01
90	0.54545	4.77E+01
91	0.59091	4.26E+01
92	0.63636	3.74E+01
93	0.68182	3.23E+01
94	0.72727	2.72E+01
95	0.77273	2.20E+01
96	0.81818	1.69E+01
97	0.86364	1.17E+01
98	0.90909	6.62E+00
99	0.95455	1.48E+00
100	1	0.00E+00

Table H2.D-14b. TRAP Model Output for Vanadium Data for the Bird Survival Endpoint (Blalock and Hill 1987)

Chemical:	Vanadium
Study Authors:	Blalock and Hill 1987
Receptor Group:	Bird
Effect Description:	Survival

Input Data:

Dose	# of Org w/o response	Total # of Org	Survival
1.00E-06	38	40	0.95
1.1171	40	40	1.00
2.2341	33	40	0.83
4.4683	6	40	0.15

Modeling Parameters

Analysis Type:	Tolerance Distribution	Tolerance Distribution	Tolerance Distribution
Model Shape:	Gaussian Distribution	Triangular Distribution	Rectangular Distribution
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.48866	0.5004	2.69E-02	0.44547	0.55532
S	0.19364	1.46E-01	2.58E-02	0.10847	0.22176
Y0	0.975	0.97473	1.79E-02	0.91019	0.99707

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.48866	0.49959	2.63E-02	0.4456	0.55359
S	0.19364	1.38E-01	2.39E-02	0.10331	0.20773
Y0	0.975	0.975	1.75E-02	0.91259	0.99696

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.48866	0.4996	1.88E-02	0.46174	0.53746
S	0.19364	0.12551	1.55E-02	0.10118	0.16535
Y0	0.975	0.975	1.75E-02	0.91259	0.99696

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	3.1652	2.79E+00	3.59E+00	2.69E-02	0.5004
20	2.3867	2.00E+00	2.84E+00	3.63E-02	0.3778
10	2.0593	1.64E+00	2.58E+00	4.47E-02	0.31372
5	1.823	1.38E+00	2.40E+00	5.25E-02	0.26079
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	3.1593	2.79E+00	3.58E+00	2.63E-02	0.49959
20	2.3734	2.00E+00	2.82E+00	3.55E-02	0.37538
10	2.05E+00	1.6478	2.5623	4.35E-02	0.31277
5	1.8557	1.4254	2.4158	5.00E-02	0.2685
0	1.4509	0.96065	2.1913	6.80E-02	1.62E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	3.1594	2.90E+00	3.45E+00	1.88E-02	0.4996
20	2.3397	2.0704	2.6441	2.58E-02	0.36917
10	2.1168	1.8342	2.4431	2.98E-02	0.32569
5	2.0135	1.72E+00	2.3514	3.19E-02	0.30395
0	1.9152	1.62E+00	2.27E+00	3.41E-02	0.28221

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var

Dataset	Exposure	Effects Var	Est Effects Var

Dataset	Exposure	Effects Var	Est Effects Var

1	-6.00E+00	0.95	0.97473
2	4.81E-02	1	0.9738
3	3.49E-01	0.825	0.82902
4	6.50E-01	0.15	0.14823
5			
6			

Analysis of Variance

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

Prediction Line

	X	Y
1	-3.5	0.97473
2	-3.45E+00	0.97473
3	-3.41E+00	0.97473
4	-3.36E+00	0.97473
5	-3.32E+00	0.97473
6	-3.27E+00	0.97473
7	-3.23E+00	0.97473
8	-3.18E+00	0.97473
9	-3.14E+00	0.97473
10	-3.09E+00	0.97473
11	-3.05E+00	0.97473
12	-3.00E+00	0.97473
13	-2.95E+00	0.97473
14	-2.9091	0.97473
15	-2.8636	0.97473
16	-2.8182	0.97473
17	-2.7727	0.97473
18	-2.7273	0.97473
19	-2.6818	0.97473
20	-2.6364	0.97473
21	-2.5909	0.97473
22	-2.5455	0.97473
23	-2.5	0.97473
24	-2.4545	0.97473
25	-2.4091	0.97473
26	-2.3636	0.97473
27	-2.3182	0.97473
28	-2.2727	0.97473
29	-2.2273	0.97473
30	-2.1818	0.97473
31	-2.1364	0.97473
32	-2.0909	0.97473
33	-2.0455	0.97473
34	-2	0.97473

1	-6.00E+00	0.95	0.975
2	4.81E-02	1	0.975
3	3.49E-01	0.825	0.825
4	6.50E-01	0.15	0.15
5			
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-3.5	0.975
2	-3.45E+00	0.975
3	-3.41E+00	0.975
4	-3.36E+00	0.975
5	-3.32E+00	0.975
6	-3.27E+00	0.975
7	-3.23E+00	0.975
8	-3.18E+00	0.975
9	-3.14E+00	0.975
10	-3.09E+00	0.975
11	-3.05E+00	0.975
12	-3.00E+00	0.975
13	-2.95E+00	0.975
14	-2.9091	0.975
15	-2.8636	0.975
16	-2.8182	0.975
17	-2.7727	0.975
18	-2.7273	0.975
19	-2.6818	0.975
20	-2.6364	0.975
21	-2.5909	0.975
22	-2.5455	0.975
23	-2.5	0.975
24	-2.4545	0.975
25	-2.4091	0.975
26	-2.3636	0.975
27	-2.3182	0.975
28	-2.2727	0.975
29	-2.2273	0.975
30	-2.1818	0.975
31	-2.1364	0.975
32	-2.0909	0.975
33	-2.0455	0.975
34	-2	0.975

1	-6.00E+00	0.95	0.975
2	4.81E-02	1	0.975
3	3.49E-01	0.825	0.825
4	6.50E-01	0.15	0.15
5			
6			

R-squared:

	DF	SS	MS	F	Sig
Total (adj)					
Regression					
Error					

	X	Y
1	-3.5	0.975
2	-3.45E+00	0.975
3	-3.41E+00	0.975
4	-3.36E+00	0.975
5	-3.32E+00	0.975
6	-3.27E+00	0.975
7	-3.23E+00	0.975
8	-3.18E+00	0.975
9	-3.14E+00	0.975
10	-3.09E+00	0.975
11	-3.05E+00	0.975
12	-3.00E+00	0.975
13	-2.95E+00	0.975
14	-2.9091	0.975
15	-2.8636	0.975
16	-2.8182	0.975
17	-2.7727	0.975
18	-2.7273	0.975
19	-2.6818	0.975
20	-2.6364	0.975
21	-2.5909	0.975
22	-2.5455	0.975
23	-2.5	0.975
24	-2.4545	0.975
25	-2.4091	0.975
26	-2.3636	0.975
27	-2.3182	0.975
28	-2.2727	0.975
29	-2.2273	0.975
30	-2.1818	0.975
31	-2.1364	0.975
32	-2.0909	0.975
33	-2.0455	0.975
34	-2	0.975

Prediction Line

	X	Y
35	-1.9545	0.97473
36	-1.9091	0.97473
37	-1.8636	0.97473
38	-1.8182	0.97473
39	-1.7727	0.97473
40	-1.7273	0.97473
41	-1.6818	0.97473
42	-1.6364	0.97473
43	-1.5909	0.97473
44	-1.5455	0.97473
45	-1.5	0.97473
46	-1.4545	0.97473
47	-1.4091	0.97473
48	-1.3636	0.97473
49	-1.3182	0.97473
50	-1.2727	0.97473
51	-1.2273	0.97473
52	-1.1818	0.97473
53	-1.1364	0.97473
54	-1.0909	0.97473
55	-1.0455	0.97473
56	-1	0.97473
57	-0.95455	0.97473
58	-0.90909	0.97473
59	-0.86364	0.97473
60	-0.81818	0.97473
61	-0.77273	0.97473
62	-0.72727	0.97473
63	-0.68182	0.97473
64	-0.63636	0.97473
65	-0.59091	0.97473
66	-0.54545	0.97473
67	-0.5	0.97473
68	-0.45455	0.97473
69	-0.40909	0.97473
70	-0.36364	0.97473
71	-0.31818	0.97473
72	-0.27273	0.97473
73	-0.22727	0.97473
74	-0.18182	0.97473
75	-0.13636	0.97472
76	-9.09E-02	0.9747
77	-4.55E-02	0.97464
78	0	0.97444
79	4.55E-02	0.97386
80	9.09E-02	0.97232
81	0.13636	0.96866
82	0.18182	0.96072
83	0.22727	0.9451
84	0.27273	0.91719
85	0.31818	0.87192

	X	Y
35	-1.9545	0.975
36	-1.9091	0.975
37	-1.8636	0.975
38	-1.8182	0.975
39	-1.7727	0.975
40	-1.7273	0.975
41	-1.6818	0.975
42	-1.6364	0.975
43	-1.5909	0.975
44	-1.5455	0.975
45	-1.5	0.975
46	-1.4545	0.975
47	-1.4091	0.975
48	-1.3636	0.975
49	-1.3182	0.975
50	-1.2727	0.975
51	-1.2273	0.975
52	-1.1818	0.975
53	-1.1364	0.975
54	-1.0909	0.975
55	-1.0455	0.975
56	-1	0.975
57	-0.95455	0.975
58	-0.90909	0.975
59	-0.86364	0.975
60	-0.81818	0.975
61	-0.77273	0.975
62	-0.72727	0.975
63	-0.68182	0.975
64	-0.63636	0.975
65	-0.59091	0.975
66	-0.54545	0.975
67	-0.5	0.975
68	-0.45455	0.975
69	-0.40909	0.975
70	-0.36364	0.975
71	-0.31818	0.975
72	-0.27273	0.975
73	-0.22727	0.975
74	-0.18182	0.975
75	-0.13636	0.975
76	-9.09E-02	0.975
77	-4.55E-02	0.975
78	0	0.975
79	4.55E-02	0.975
80	9.09E-02	0.975
81	0.13636	0.975
82	0.18182	0.97326
83	0.22727	0.95661
84	0.27273	0.92233
85	0.31818	0.87041

	X	Y
35	-1.9545	0.975
36	-1.9091	0.975
37	-1.8636	0.975
38	-1.8182	0.975
39	-1.7727	0.975
40	-1.7273	0.975
41	-1.6818	0.975
42	-1.6364	0.975
43	-1.5909	0.975
44	-1.5455	0.975
45	-1.5	0.975
46	-1.4545	0.975
47	-1.4091	0.975
48	-1.3636	0.975
49	-1.3182	0.975
50	-1.2727	0.975
51	-1.2273	0.975
52	-1.1818	0.975
53	-1.1364	0.975
54	-1.0909	0.975
55	-1.0455	0.975
56	-1	0.975
57	-0.95455	0.975
58	-0.90909	0.975
59	-0.86364	0.975
60	-0.81818	0.975
61	-0.77273	0.975
62	-0.72727	0.975
63	-0.68182	0.975
64	-0.63636	0.975
65	-0.59091	0.975
66	-0.54545	0.975
67	-0.5	0.975
68	-0.45455	0.975
69	-0.40909	0.975
70	-0.36364	0.975
71	-0.31818	0.975
72	-0.27273	0.975
73	-0.22727	0.975
74	-0.18182	0.975
75	-0.13636	0.975
76	-9.09E-02	0.975
77	-4.55E-02	0.975
78	0	0.975
79	4.55E-02	0.975
80	9.09E-02	0.975
81	0.13636	0.975
82	0.18182	0.975
83	0.22727	0.975
84	0.27273	0.975
85	0.31818	0.89435

Prediction Line

	X	Y
86	0.36364	0.80524
87	0.40909	0.71607
88	0.45455	0.60781
89	0.5	0.48847
90	0.54545	0.36904
91	0.59091	0.2605
92	0.63636	0.17096
93	0.68182	0.10388
94	0.72727	5.83E-02
95	0.77273	3.01E-02
96	0.81818	1.43E-02
97	0.86364	6.26E-03
98	0.90909	2.54E-03
99	0.95455	9.86E-04
100	1	3.92E-04

	X	Y
86	0.36364	0.80085
87	0.40909	0.71366
88	0.45455	0.60883
89	0.5	0.48637
90	0.54545	0.36423
91	0.59091	0.25972
92	0.63636	0.17284
93	0.68182	0.10361
94	0.72727	5.20E-02
95	0.77273	1.80E-02
96	0.81818	1.70E-03
97	0.86364	9.75E-05
98	0.90909	9.75E-05
99	0.95455	9.75E-05
100	1	9.75E-05

	X	Y
86	0.36364	0.79242
87	0.40909	0.6905
88	0.45455	0.58858
89	0.5	0.48665
90	0.54545	0.38473
91	0.59091	0.28281
92	0.63636	0.18089
93	0.68182	7.90E-02
94	0.72727	9.75E-05
95	0.77273	9.75E-05
96	0.81818	9.75E-05
97	0.86364	9.75E-05
98	0.90909	9.75E-05
99	0.95455	9.75E-05
100	1	9.75E-05

Table H2.D-15a. TRAP Model Output for Zinc Data for the Bird Growth Endpoint (Gasaway and Buss 1972)

Chemical:	Zinc
Study Authors:	Gasaway and Buss 1972
Receptor Group:	Bird
Effect Description:	Growth

Input Data:

Dose	Effect	SE
25	102	3
325	76	14
625	66	11
925	52	7
1225	58	9

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50	yes	yes	
Large Standard Error for Steepness	yes	yes	yes
Large Standard Error for Y0		yes	
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			
Problem Estimating Errors For XP Row2			
Problem Estimating Errors For XP Row3			
Problem Estimating Errors For XP Row4			
Problem Estimating Errors For XP Row5			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.0171	2.9256	0.48894	0.82184	5.0293
S	5.53E-01	3.15E-01	0.27553	-0.8709	1.5001
Y0	1.02E+02	1.17E+02	34.352	-30.864	264.75

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.0171	2.8388	1.0338	-1.6092	7.2868
S	0.55258	2.90E-01	0.32539	-1.1098	1.6903
Y0	1.02E+02	1.23E+02	66.179	-161.92	407.57

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	3.0171	3.1256	0.13845	2.5299	3.7213
S	0.55258	0.36703	0.18466	-0.42751	1.1616
Y0	1.02E+02	1.02E+02	2.0893	93.01	110.99

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	842.49	6.635	1.07E+05	0.48894	2.9256
20	6.67E+01	4.15E-05	1.07E+08	1.4424	1.8239
10	1.51E+01	3.56E-08	6.41E+09	2.0051	1.1795
5	3.85E+00	5.30E-11	2.80E+11	2.5244	0.58568
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	689.86	2.46E-02	1.94E+07	1.0338	2.8388
20	37.381	9.96E-15	1.40E+17	3.6197	1.5727
10	8.60E+00	3.79E-29	1.95E+30	6.8227	0.93453
5	3.0431	4.01E-32	2.31E+32	7.4094	0.48332
0	0.24773	1.18E-24	5.21E+22	5.4206	-6.06E-01

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	1335.3	338.76	5263.3	0.13845	3.1256
20	203.34	8.3976	4923.5	0.32168	2.3082
10	108.58	1.2006	9820.1	0.45469	2.0358
5	79.348	0.45044	13978	0.52198	1.8995
0	57.984	0.16851	19952	0.58956	1.7633

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	1.40E+00	1.02E+02	1.02E+02
2	2.51E+00	7.60E+01	7.34E+01
3	2.80E+00	6.60E+01	6.32E+01
4	2.97E+00	5.20E+01	5.70E+01
5	3.09E+00	58	52.51
6			

	Exposure	Effects Var	Est Effects Var
1	1.40E+00	1.02E+02	1.02E+02
2	2.51E+00	7.60E+01	7.25E+01
3	2.80E+00	6.60E+01	6.29E+01
4	2.97E+00	5.20E+01	5.70E+01
5	3.09E+00	58	52.843
6			

	Exposure	Effects Var	Est Effects Var
1	1.40E+00	1.02E+02	1.02E+02
2	2.51E+00	7.60E+01	7.40E+01
3	2.80E+00	6.60E+01	6.33E+01
4	2.97E+00	5.20E+01	5.70E+01
5	3.09E+00	58	52.402
6			

Analysis of Variance

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	4	30614	7653.6		
Regression	2	30613	15307	31338	0
Error	2	0.97688	0.48844		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	4	30614	7653.6		
Regression	2	30613	15307	31582	0
Error	2	0.96933	0.48466		

R-squared: 1

	DF	SS	MS	F	Sig
Total (adj)	4	30614	7653.6		
Regression	2	30613	15307	31558	0
Error	2	0.97006	0.48503		

Prediction Line

	X	Y
1	1.2	1.05E+02
2	1.22E+00	1.05E+02
3	1.24E+00	1.04E+02
4	1.26E+00	1.04E+02
5	1.28E+00	1.04E+02
6	1.30E+00	1.04E+02
7	1.32E+00	1.03E+02
8	1.34E+00	1.03E+02
9	1.36E+00	1.03E+02
10	1.38E+00	1.02E+02
11	1.40E+00	1.02E+02
12	1.42E+00	1.02E+02
13	1.44E+00	1.01E+02
14	1.4626	1.01E+02
15	1.4828	1.01E+02
16	1.503	1.00E+02
17	1.5232	9.98E+01
18	1.5434	9.95E+01
19	1.5636	9.91E+01
20	1.5838	9.87E+01
21	1.60E+00	9.83E+01
22	1.62E+00	9.79E+01
23	1.64E+00	9.75E+01
24	1.66E+00	9.71E+01
25	1.68E+00	9.67E+01
26	1.71E+00	9.62E+01
27	1.73E+00	9.58E+01
28	1.75E+00	9.53E+01
29	1.77E+00	9.49E+01
30	1.79E+00	9.44E+01

	X	Y
1	1.2	1.06E+02
2	1.22E+00	1.06E+02
3	1.24E+00	1.05E+02
4	1.26E+00	1.05E+02
5	1.28E+00	1.04E+02
6	1.30E+00	1.04E+02
7	1.32E+00	1.04E+02
8	1.34E+00	1.03E+02
9	1.36E+00	1.03E+02
10	1.38E+00	1.02E+02
11	1.40E+00	1.02E+02
12	1.42E+00	1.02E+02
13	1.44E+00	1.01E+02
14	1.4626	1.01E+02
15	1.4828	1.00E+02
16	1.503	9.98E+01
17	1.5232	9.94E+01
18	1.5434	9.89E+01
19	1.5636	9.85E+01
20	1.5838	9.80E+01
21	1.60E+00	9.75E+01
22	1.62E+00	9.71E+01
23	1.64E+00	9.66E+01
24	1.66E+00	9.61E+01
25	1.68E+00	9.57E+01
26	1.71E+00	9.52E+01
27	1.73E+00	9.47E+01
28	1.75E+00	9.42E+01
29	1.77E+00	9.37E+01
30	1.79E+00	9.32E+01

	X	Y
1	1.2	1.02E+02
2	1.22E+00	1.02E+02
3	1.24E+00	1.02E+02
4	1.26E+00	1.02E+02
5	1.28E+00	1.02E+02
6	1.30E+00	1.02E+02
7	1.32E+00	1.02E+02
8	1.34E+00	1.02E+02
9	1.36E+00	1.02E+02
10	1.38E+00	1.02E+02
11	1.40E+00	1.02E+02
12	1.42E+00	1.02E+02
13	1.44E+00	1.02E+02
14	1.4626	1.02E+02
15	1.4828	1.02E+02
16	1.503	1.02E+02
17	1.5232	1.02E+02
18	1.5434	1.02E+02
19	1.5636	1.02E+02
20	1.5838	1.02E+02
21	1.60E+00	1.02E+02
22	1.62E+00	1.02E+02
23	1.64E+00	1.02E+02
24	1.66E+00	1.02E+02
25	1.68E+00	1.02E+02
26	1.71E+00	1.02E+02
27	1.73E+00	1.02E+02
28	1.75E+00	1.02E+02
29	1.77E+00	1.02E+02
30	1.79E+00	1.01E+02

31	1.8061	9.40E+01
32	1.8263	9.35E+01
33	1.8465	9.30E+01
34	1.8667	9.25E+01
35	1.8869	9.20E+01
36	1.9071	9.15E+01
37	1.9273	9.10E+01
38	1.9475	9.05E+01
39	1.9677	9.00E+01
40	1.9879	8.95E+01
41	2.0081	8.89E+01
42	2.0283	8.84E+01
43	2.0485	8.78E+01
44	2.0687	8.73E+01
45	2.0889	8.67E+01
46	2.1091	8.61E+01
47	2.1293	8.55E+01
48	2.1495	8.49E+01
49	2.1697	8.44E+01
50	2.1899	8.38E+01
51	2.2101	8.31E+01
52	2.2303	8.25E+01
53	2.2505	8.19E+01
54	2.2707	8.13E+01
55	2.2909	8.07E+01
56	2.3111	8.00E+01
57	2.3313	7.94E+01
58	2.3515	7.87E+01
59	2.3717	7.81E+01
60	2.3919	7.74E+01
61	2.4121	7.67E+01
62	2.4323	7.61E+01
63	2.4525	7.54E+01
64	2.4727	7.47E+01
65	2.4929	7.40E+01
66	2.5131	7.33E+01
67	2.5333	7.26E+01
68	2.5535	7.19E+01
69	2.5737	7.12E+01
70	2.5939	7.05E+01
71	2.6141	6.98E+01
72	2.6343	6.91E+01
73	2.6545	6.83E+01
74	2.6747	6.76E+01
75	2.6949	6.69E+01
76	2.7152	6.62E+01
77	2.7354	6.54E+01
78	2.7556	6.47E+01
79	2.7758	6.40E+01
80	2.796	6.32E+01
81	2.8162	6.25E+01
82	2.8364	6.17E+01
83	2.8566	6.10E+01

31	1.8061	9.27E+01
32	1.8263	9.22E+01
33	1.8465	9.17E+01
34	1.8667	9.12E+01
35	1.8869	9.07E+01
36	1.9071	9.01E+01
37	1.9273	8.96E+01
38	1.9475	8.91E+01
39	1.9677	8.85E+01
40	1.9879	8.80E+01
41	2.0081	8.75E+01
42	2.0283	8.69E+01
43	2.0485	8.64E+01
44	2.0687	8.58E+01
45	2.0889	8.52E+01
46	2.1091	8.47E+01
47	2.1293	8.41E+01
48	2.1495	8.35E+01
49	2.1697	8.30E+01
50	2.1899	8.24E+01
51	2.2101	8.18E+01
52	2.2303	8.12E+01
53	2.2505	8.06E+01
54	2.2707	8.00E+01
55	2.2909	7.94E+01
56	2.3111	7.88E+01
57	2.3313	7.82E+01
58	2.3515	7.76E+01
59	2.3717	7.69E+01
60	2.3919	7.63E+01
61	2.4121	7.57E+01
62	2.4323	7.51E+01
63	2.4525	7.44E+01
64	2.4727	7.38E+01
65	2.4929	7.31E+01
66	2.5131	7.25E+01
67	2.5333	7.18E+01
68	2.5535	7.12E+01
69	2.5737	7.05E+01
70	2.5939	6.98E+01
71	2.6141	6.92E+01
72	2.6343	6.85E+01
73	2.6545	6.78E+01
74	2.6747	6.71E+01
75	2.6949	6.64E+01
76	2.7152	6.57E+01
77	2.7354	6.50E+01
78	2.7556	6.43E+01
79	2.7758	6.36E+01
80	2.796	6.29E+01
81	2.8162	6.22E+01
82	2.8364	6.15E+01
83	2.8566	6.08E+01

31	1.8061	1.00E+02
32	1.8263	9.96E+01
33	1.8465	9.89E+01
34	1.8667	9.81E+01
35	1.8869	9.74E+01
36	1.9071	9.66E+01
37	1.9273	9.59E+01
38	1.9475	9.51E+01
39	1.9677	9.43E+01
40	1.9879	9.36E+01
41	2.0081	9.28E+01
42	2.0283	9.21E+01
43	2.0485	9.13E+01
44	2.0687	9.06E+01
45	2.0889	8.98E+01
46	2.1091	8.91E+01
47	2.1293	8.83E+01
48	2.1495	8.75E+01
49	2.1697	8.68E+01
50	2.1899	8.60E+01
51	2.2101	8.53E+01
52	2.2303	8.45E+01
53	2.2505	8.38E+01
54	2.2707	8.30E+01
55	2.2909	8.22E+01
56	2.3111	8.15E+01
57	2.3313	8.07E+01
58	2.3515	8.00E+01
59	2.3717	7.92E+01
60	2.3919	7.85E+01
61	2.4121	7.77E+01
62	2.4323	7.70E+01
63	2.4525	7.62E+01
64	2.4727	7.54E+01
65	2.4929	7.47E+01
66	2.5131	7.39E+01
67	2.5333	7.32E+01
68	2.5535	7.24E+01
69	2.5737	7.17E+01
70	2.5939	7.09E+01
71	2.6141	7.01E+01
72	2.6343	6.94E+01
73	2.6545	6.86E+01
74	2.6747	6.79E+01
75	2.6949	6.71E+01
76	2.7152	6.64E+01
77	2.7354	6.56E+01
78	2.7556	6.49E+01
79	2.7758	6.41E+01
80	2.796	6.33E+01
81	2.8162	6.26E+01
82	2.8364	6.18E+01
83	2.8566	6.11E+01

84	2.8768	6.03E+01		84	2.8768	6.01E+01		84	2.8768	6.03E+01	
85	2.897	5.95E+01		85	2.897	5.94E+01		85	2.897	5.96E+01	
86	2.9172	5.88E+01		86	2.9172	5.86E+01		86	2.9172	5.88E+01	
87	2.9374	5.80E+01		87	2.9374	5.79E+01		87	2.9374	5.80E+01	
88	2.9576	5.73E+01		88	2.9576	5.73E+01		88	2.9576	5.73E+01	
89	2.9778	5.66E+01		89	2.9778	5.66E+01		89	2.9778	5.65E+01	
90	2.998	5.58E+01		90	2.998	5.59E+01		90	2.998	5.58E+01	
91	3.0182	5.51E+01		91	3.0182	5.52E+01		91	3.0182	5.50E+01	
92	3.0384	5.43E+01		92	3.0384	5.45E+01		92	3.0384	5.43E+01	
93	3.0586	5.36E+01		93	3.0586	5.38E+01		93	3.0586	5.35E+01	
94	3.0788	5.29E+01		94	3.0788	5.32E+01		94	3.0788	5.28E+01	
95	3.099	5.21E+01		95	3.099	5.25E+01		95	3.099	5.20E+01	
96	3.1192	5.14E+01		96	3.1192	5.18E+01		96	3.1192	5.12E+01	
97	3.1394	5.07E+01		97	3.1394	5.12E+01		97	3.1394	5.05E+01	
98	3.1596	4.99E+01		98	3.1596	5.05E+01		98	3.1596	4.97E+01	
99	3.1798	4.92E+01		99	3.1798	4.99E+01		99	3.1798	4.90E+01	
100	3.2	4.85E+01		100	3.2	4.92E+01		100	3.2	4.82E+01	

Table H2.D-15b. TRAP Model Output for Zinc Data for the Bird Reproduction Endpoint (Gibson et al. 1986)

Chemical:	Zinc
Study Authors:	Gibson et al. 1986
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Response	SE
2.097289	6.4	not reported
63.78227	5.8	not reported
125.4673	2.6	not reported
187.1522	0.6	not reported
248.8372	0.5	not reported
310.522	0.3	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	2.0633	2.0534	1.68E-02	2.0001	2.1067
S	1.9608	2.23E+00	0.24912	1.4415	3.0272
Y0	6.4	6.4134	0.18207	5.834	6.9928

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	2.0633	2.0517	2.42E-02	1.9746	2.1288
S	1.9608	2.23E+00	0.30068	1.2682	3.182
Y0	6.4	6.418	0.27815	5.5328	7.3032

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
X50	2.0633	2.0405	2.33E-02	1.9662	2.1147
S	1.9608	1.7342	0.18274	1.1526	2.3157
Y0	6.4	6.4	0.33815	5.3238	7.4762

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	113.08	100.01	127.86	1.68E-02	2.0534
20	79.12	63.459	98.644	3.01E-02	1.8983
10	64.202	48.117	85.664	3.94E-02	1.8075
5	52.96	37.203	75.39	4.82E-02	1.7239
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	112.65	94.326	134.53	2.42E-02	2.0517
20	77.011	56.532	104.91	4.22E-02	1.8866
10	6.36E+01	43.293	93.366	5.24E-02	1.8033
5	55.518	36.423	84.624	5.75E-02	1.7444
0	40.024	23.31	68.723	7.38E-02	1.6023

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	109.76	92.515	130.23	2.33E-02	2.0405
20	73.699	57.135	95.064	3.47E-02	1.8675
10	64.535	48.248	86.32	3.97E-02	1.8098
5	60.39	44.301	82.321	4.23E-02	1.781
0	56.511	40.661	78.539	4.49E-02	1.7521

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	3.22E-01	6.4	6.4134
2	1.80E+00	5.8	5.7866
3	2.10E+00	2.6	2.5686
4	2.27E+00	0.6	0.79498
5	2.40E+00	0.5	0.28691
6	2.4921	0.3	0.12468

	Exposure	Effects Var	Est Effects Var
1	3.22E-01	6.4	6.418
2	1.80E+00	5.8	5.7672
3	2.10E+00	2.6	2.5755
4	2.27E+00	0.6	0.83283
5	2.40E+00	0.5	0.17594
6	2.4921	0.3	1.30E-03

	Exposure	Effects Var	Est Effects Var
1	3.22E-01	6.4	6.4
2	1.80E+00	5.8	5.8166
3	2.10E+00	2.6	2.5554
4	2.27E+00	0.6	0.628
5	2.40E+00	0.5	0
6	2.4921	0.3	0

Analysis of Variance

R-squared: 0.997

	DF	SS	MS	F	Sig
Total (adj)	5	38.32	7.664		
Regression	2	38.204	19.102	496.11	0.0002
Error	3	0.11551	3.85E-02		

R-squared: 0.993

	DF	SS	MS	F	Sig
Total (adj)	5	38.32	7.664		
Regression	2	38.07	19.035	228.01	0.0005
Error	3	0.25045	8.35E-02		

R-squared: 0.991

	DF	SS	MS	F	Sig
Total (adj)	5	38.32	7.664		
Regression	2	37.977	18.988	166.06	0.0008
Error	3	0.34304	0.11435		

Prediction Line

	X	Y
1	0	6.4134
2	3.03E-02	6.4134
3	6.06E-02	6.4134
4	9.09E-02	6.4134
5	1.21E-01	6.4134
6	1.52E-01	6.4134
7	1.82E-01	6.4134
8	2.12E-01	6.4134
9	2.42E-01	6.4134
10	2.73E-01	6.4134
11	3.03E-01	6.4134
12	3.33E-01	6.4134
13	3.64E-01	6.4134
14	0.39394	6.4134
15	0.42424	6.4134
16	0.45455	6.4134
17	0.48485	6.4134
18	0.51515	6.4134
19	0.54545	6.4134
20	0.57576	6.4134
21	0.60606	6.4134
22	0.63636	6.4134
23	0.66667	6.4134
24	0.69697	6.4134
25	0.72727	6.4134
26	0.75758	6.4134
27	0.78788	6.4133
28	0.81818	6.4133
29	0.84848	6.4133
30	0.87879	6.4132

	X	Y
1	0	6.418
2	3.03E-02	6.418
3	6.06E-02	6.418
4	9.09E-02	6.418
5	1.21E-01	6.418
6	1.52E-01	6.418
7	1.82E-01	6.418
8	2.12E-01	6.418
9	2.42E-01	6.418
10	2.73E-01	6.418
11	3.03E-01	6.418
12	3.33E-01	6.418
13	3.64E-01	6.418
14	0.39394	6.418
15	0.42424	6.418
16	0.45455	6.418
17	0.48485	6.418
18	0.51515	6.418
19	0.54545	6.418
20	0.57576	6.418
21	0.60606	6.418
22	0.63636	6.418
23	0.66667	6.418
24	0.69697	6.418
25	0.72727	6.418
26	0.75758	6.418
27	0.78788	6.418
28	0.81818	6.418
29	0.84848	6.418
30	0.87879	6.418

	X	Y
1	0	6.4
2	3.03E-02	6.4
3	6.06E-02	6.4
4	9.09E-02	6.4
5	1.21E-01	6.4
6	1.52E-01	6.4
7	1.82E-01	6.4
8	2.12E-01	6.4
9	2.42E-01	6.4
10	2.73E-01	6.4
11	3.03E-01	6.4
12	3.33E-01	6.4
13	3.64E-01	6.4
14	0.39394	6.4
15	0.42424	6.4
16	0.45455	6.4
17	0.48485	6.4
18	0.51515	6.4
19	0.54545	6.4
20	0.57576	6.4
21	0.60606	6.4
22	0.63636	6.4
23	0.66667	6.4
24	0.69697	6.4
25	0.72727	6.4
26	0.75758	6.4
27	0.78788	6.4
28	0.81818	6.4
29	0.84848	6.4
30	0.87879	6.4

Prediction Line

	X	Y
31	0.90909	6.4132
32	0.93939	6.4131
33	0.9697	6.413
34	1	6.4129
35	1.0303	6.4127
36	1.0606	6.4125
37	1.0909	6.4122
38	1.1212	6.4119
39	1.1515	6.4114
40	1.1818	6.4108
41	1.2121	6.4099
42	1.2424	6.4089
43	1.2727	6.4074
44	1.303	6.4056
45	1.3333	6.4032
46	1.3636	6.4
47	1.3939	6.3958
48	1.4242	6.3903
49	1.4545	6.3832
50	1.4848	6.3738
51	1.5152	6.3616
52	1.5455	6.3457
53	1.5758	6.3249
54	1.6061	6.2978
55	1.6364	6.2627
56	1.6667	6.2173
57	1.697	6.1587
58	1.7273	6.0836
59	1.7576	5.9878
60	1.7879	5.8667
61	1.8182	5.7151
62	1.8485	5.5279
63	1.8788	5.3002
64	1.9091	5.0288
65	1.9394	4.7123
66	1.9697	4.3531
67	2	3.9577
68	2.0303	3.5365
69	2.0606	3.1034
70	2.0909	2.6741
71	2.1212	2.2636
72	2.1515	1.8844
73	2.1818	1.545
74	2.2121	1.2499
75	2.2424	0.99955
76	2.2727	0.79167
77	2.303	0.62206
78	2.3333	0.48565
79	2.3636	0.37721
80	2.3939	0.29178
81	2.4242	0.22499

	X	Y
31	0.90909	6.418
32	0.93939	6.418
33	0.9697	6.418
34	1	6.418
35	1.0303	6.418
36	1.0606	6.418
37	1.0909	6.418
38	1.1212	6.418
39	1.1515	6.418
40	1.1818	6.418
41	1.2121	6.418
42	1.2424	6.418
43	1.2727	6.418
44	1.303	6.418
45	1.3333	6.418
46	1.3636	6.418
47	1.3939	6.418
48	1.4242	6.418
49	1.4545	6.418
50	1.4848	6.418
51	1.5152	6.418
52	1.5455	6.418
53	1.5758	6.418
54	1.6061	6.4178
55	1.6364	6.3996
56	1.6667	6.3522
57	1.697	6.2757
58	1.7273	6.1699
59	1.7576	6.035
60	1.7879	5.8709
61	1.8182	5.6777
62	1.8485	5.4552
63	1.8788	5.2036
64	1.9091	4.9228
65	1.9394	4.6128
66	1.9697	4.2736
67	2	3.9053
68	2.0303	3.5077
69	2.0606	3.0835
70	2.0909	2.6739
71	2.1212	2.2935
72	2.1515	1.9422
73	2.1818	1.6201
74	2.2121	1.3272
75	2.2424	1.0635
76	2.2727	0.82897
77	2.303	0.62361
78	2.3333	0.44743
79	2.3636	0.30043
80	2.3939	0.1826
81	2.4242	9.40E-02

	X	Y
31	0.90909	6.4
32	0.93939	6.4
33	0.9697	6.4
34	1	6.4
35	1.0303	6.4
36	1.0606	6.4
37	1.0909	6.4
38	1.1212	6.4
39	1.1515	6.4
40	1.1818	6.4
41	1.2121	6.4
42	1.2424	6.4
43	1.2727	6.4
44	1.303	6.4
45	1.3333	6.4
46	1.3636	6.4
47	1.3939	6.4
48	1.4242	6.4
49	1.4545	6.4
50	1.4848	6.4
51	1.5152	6.4
52	1.5455	6.4
53	1.5758	6.4
54	1.6061	6.4
55	1.6364	6.4
56	1.6667	6.4
57	1.697	6.4
58	1.7273	6.4
59	1.7576	6.3396
60	1.7879	6.0032
61	1.8182	5.6669
62	1.8485	5.3306
63	1.8788	4.9943
64	1.9091	4.658
65	1.9394	4.3216
66	1.9697	3.9853
67	2	3.649
68	2.0303	3.3127
69	2.0606	2.9764
70	2.0909	2.64
71	2.1212	2.3037
72	2.1515	1.9674
73	2.1818	1.6311
74	2.2121	1.2947
75	2.2424	0.95842
76	2.2727	0.6221
77	2.303	0.28578
78	2.3333	0
79	2.3636	0
80	2.3939	0
81	2.4242	0

Prediction Line

	X	Y
82	2.4545	0.17305
83	2.4848	0.13284
84	2.5152	0.10182
85	2.5455	7.80E-02
86	2.5758	5.96E-02
87	2.6061	4.56E-02
88	2.6364	3.48E-02
89	2.6667	2.66E-02
90	2.697	2.03E-02
91	2.7273	1.55E-02
92	2.7576	1.18E-02
93	2.7879	9.03E-03
94	2.8182	6.89E-03
95	2.8485	5.26E-03
96	2.8788	4.01E-03
97	2.9091	3.06E-03
98	2.9394	2.33E-03
99	2.9697	1.78E-03
100	3	1.36E-03

	X	Y
82	2.4545	3.45E-02
83	2.4848	4.22E-03
84	2.5152	0
85	2.5455	0
86	2.5758	0
87	2.6061	0
88	2.6364	0
89	2.6667	0
90	2.697	0
91	2.7273	0
92	2.7576	0
93	2.7879	0
94	2.8182	0
95	2.8485	0
96	2.8788	0
97	2.9091	0
98	2.9394	0
99	2.9697	0
100	3	0

	X	Y
82	2.4545	0
83	2.4848	0
84	2.5152	0
85	2.5455	0
86	2.5758	0
87	2.6061	0
88	2.6364	0
89	2.6667	0
90	2.697	0
91	2.7273	0
92	2.7576	0
93	2.7879	0
94	2.8182	0
95	2.8485	0
96	2.8788	0
97	2.9091	0
98	2.9394	0
99	2.9697	0
100	3	0

Table H2.D-16a. TRAP Model Output for Dioxin/Furan Data for the Mammal Growth Endpoint (Pooling Group A: DeCaprio et al. 1986)

Chemical:	Dioxin/furan
Study Authors:	Pooling group A
Receptor Group:	Mammal
Effect Description:	Growth

Input Data:

Dose	Effect Relative to Control
0.000001	100
0.12	95.652
0.61	91.304
4.9	84.572
26	60.729
0.000001	100
0.12	96.844
0.68	94.684
4.86	88.206
31	58.306

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.7141	1.6953	5.21E-02	1.5722	1.8185
S	0.52873	4.70E-01	5.74E-02	0.33425	0.6058
Y0	9.56E+01	9.79E+01	1.181	95.098	100.68

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.7141	1.6839	6.54E-02	1.5292	1.8387
S	0.52873	5.45E-01	7.31E-02	0.37234	0.71798
Y0	9.56E+01	9.64E+01	1.2196	93.535	99.302

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	1.7141	1.7752	9.01E-02	1.5621	1.9883
S	0.52873	0.36438	4.05E-02	0.26873	0.46003
Y0	9.56E+01	9.64E+01	1.2128	93.546	99.282

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	49.582	37.34	65.838	5.21E-02	1.6953
20	9.08E+00	6.25E+00	1.32E+01	6.85E-02	0.95798
10	3.36E+00	1.79E+00	6.31E+00	0.11565	0.52666

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	48.299	33.822	68.972	6.54E-02	1.6839
20	10.227	7.23E+00	14.471	6.38E-02	1.0097
10	4.68E+00	2.70E+00	8.09E+00	0.10073	0.66995

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	59.591	36.483	97.337	9.01E-02	1.7752
20	8.9509	6.7374	11.892	5.22E-02	0.95187
10	4.758	3.2843	6.8931	6.81E-02	0.67743

5	1.35E+00	5.57E-01	3.26E+00	0.16214	0.12922
0					

5	2.6895	1.32E+00	5.46E+00	0.1302	0.42968
0	0.70732	2.32E-01	2.16E+00	0.20478	-1.50E-01

5	3.469	2.2527	5.3421	7.93E-02	0.54021
0	2.5292	1.5354	4.1664	9.17E-02	0.40299

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.79E+01
2	-6.00E+00	1.00E+02	9.79E+01
3	-9.21E-01	9.68E+01	9.72E+01
4	-9.21E-01	9.57E+01	9.72E+01
5	-2.15E-01	9.13E+01	9.53E+01
6	-1.67E-01	9.47E+01	9.50E+01
7	6.87E-01	8.82E+01	8.51E+01
8	6.90E-01	8.46E+01	8.50E+01
9	1.42E+00	60.729	61.554
10	1.4914	58.306	58.216

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.64E+01
2	-6.00E+00	1.00E+02	9.64E+01
3	-9.21E-01	9.68E+01	9.64E+01
4	-9.21E-01	9.57E+01	9.64E+01
5	-2.15E-01	9.13E+01	9.64E+01
6	-1.67E-01	9.47E+01	9.64E+01
7	6.87E-01	8.82E+01	8.64E+01
8	6.90E-01	8.46E+01	8.63E+01
9	1.42E+00	60.729	61.31
10	1.4914	58.306	57.8

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.64E+01
2	-6.00E+00	1.00E+02	9.64E+01
3	-9.21E-01	9.68E+01	9.64E+01
4	-9.21E-01	9.57E+01	9.64E+01
5	-2.15E-01	9.13E+01	9.64E+01
6	-1.67E-01	9.47E+01	9.64E+01
7	6.87E-01	8.82E+01	8.64E+01
8	6.90E-01	8.46E+01	8.63E+01
9	1.42E+00	60.729	60.862
10	1.4914	58.306	58.178

Analysis of Variance

R-squared: 0.982

	DF	SS	MS	F	Sig
Total (adj)	9	2108.2	234.24		
Regression	2	2070.6	1035.3	192.7	0
Error	7	37.608	5.3726		

R-squared: 0.97

	DF	SS	MS	F	Sig
Total (adj)	9	2108.2	234.24		
Regression	2	2045.7	1022.9	114.6	0
Error	7	62.477	8.9253		

R-squared: 0.971

	DF	SS	MS	F	Sig
Total (adj)	9	2108.2	234.24		
Regression	2	2046.4	1023.2	115.95	0
Error	7	61.773	8.8248		

Prediction Line

	X	Y
1	-2.5	9.79E+01
2	-2.45E+00	9.79E+01
3	-2.41E+00	9.78E+01
4	-2.36E+00	9.78E+01
5	-2.32E+00	9.78E+01
6	-2.27E+00	9.78E+01
7	-2.23E+00	9.78E+01
8	-2.18E+00	9.78E+01
9	-2.14E+00	9.78E+01
10	-2.09E+00	9.78E+01
11	-2.05E+00	9.78E+01
12	-2.00E+00	9.78E+01
13	-1.95E+00	9.78E+01
14	-1.9091	9.78E+01
15	-1.8636	9.78E+01
16	-1.8182	9.78E+01
17	-1.7727	9.77E+01
18	-1.7273	9.77E+01
19	-1.6818	9.77E+01
20	-1.6364	9.77E+01
21	-1.59E+00	9.77E+01
22	-1.55E+00	9.77E+01
23	-1.50E+00	9.77E+01

	X	Y
1	-2.5	9.64E+01
2	-2.45E+00	9.64E+01
3	-2.41E+00	9.64E+01
4	-2.36E+00	9.64E+01
5	-2.32E+00	9.64E+01
6	-2.27E+00	9.64E+01
7	-2.23E+00	9.64E+01
8	-2.18E+00	9.64E+01
9	-2.14E+00	9.64E+01
10	-2.09E+00	9.64E+01
11	-2.05E+00	9.64E+01
12	-2.00E+00	9.64E+01
13	-1.95E+00	9.64E+01
14	-1.9091	9.64E+01
15	-1.8636	9.64E+01
16	-1.8182	9.64E+01
17	-1.7727	9.64E+01
18	-1.7273	9.64E+01
19	-1.6818	9.64E+01
20	-1.6364	9.64E+01
21	-1.59E+00	9.64E+01
22	-1.55E+00	9.64E+01
23	-1.50E+00	9.64E+01

	X	Y
1	-2.5	9.64E+01
2	-2.45E+00	9.64E+01
3	-2.41E+00	9.64E+01
4	-2.36E+00	9.64E+01
5	-2.32E+00	9.64E+01
6	-2.27E+00	9.64E+01
7	-2.23E+00	9.64E+01
8	-2.18E+00	9.64E+01
9	-2.14E+00	9.64E+01
10	-2.09E+00	9.64E+01
11	-2.05E+00	9.64E+01
12	-2.00E+00	9.64E+01
13	-1.95E+00	9.64E+01
14	-1.9091	9.64E+01
15	-1.8636	9.64E+01
16	-1.8182	9.64E+01
17	-1.7727	9.64E+01
18	-1.7273	9.64E+01
19	-1.6818	9.64E+01
20	-1.6364	9.64E+01
21	-1.59E+00	9.64E+01
22	-1.55E+00	9.64E+01
23	-1.50E+00	9.64E+01

24	-1.45E+00	9.76E+01
25	-1.41E+00	9.76E+01
26	-1.36E+00	9.76E+01
27	-1.32E+00	9.76E+01
28	-1.27E+00	9.75E+01
29	-1.23E+00	9.75E+01
30	-1.18E+00	9.75E+01
31	-1.1364	9.74E+01
32	-1.0909	9.74E+01
33	-1.0455	9.73E+01
34	-1	9.73E+01
35	-0.95455	9.72E+01
36	-0.90909	9.72E+01
37	-0.86364	9.71E+01
38	-0.81818	9.70E+01
39	-0.77273	9.70E+01
40	-0.72727	9.69E+01
41	-0.68182	9.68E+01
42	-0.63636	9.67E+01
43	-0.59091	9.66E+01
44	-0.54545	9.65E+01
45	-0.5	9.63E+01
46	-0.45455	9.62E+01
47	-0.40909	9.61E+01
48	-0.36364	9.59E+01
49	-0.31818	9.57E+01
50	-0.27273	9.55E+01
51	-0.22727	9.53E+01
52	-0.18182	9.51E+01
53	-0.13636	9.49E+01
54	-9.09E-02	9.46E+01
55	-4.55E-02	9.43E+01
56	0	9.40E+01
57	4.55E-02	9.37E+01
58	9.09E-02	9.33E+01
59	0.13636	9.29E+01
60	0.18182	9.25E+01
61	0.22727	9.21E+01
62	0.27273	9.16E+01
63	0.31818	9.11E+01
64	0.36364	9.05E+01
65	0.40909	8.99E+01
66	0.45455	8.92E+01
67	0.5	8.85E+01
68	0.54545	8.78E+01
69	0.59091	8.70E+01
70	0.63636	8.61E+01
71	0.68182	8.52E+01
72	0.72727	8.42E+01
73	0.77273	8.32E+01
74	0.81818	8.21E+01
75	0.86364	8.09E+01
76	0.90909	7.97E+01

24	-1.45E+00	9.64E+01
25	-1.41E+00	9.64E+01
26	-1.36E+00	9.64E+01
27	-1.32E+00	9.64E+01
28	-1.27E+00	9.64E+01
29	-1.23E+00	9.64E+01
30	-1.18E+00	9.64E+01
31	-1.1364	9.64E+01
32	-1.0909	9.64E+01
33	-1.0455	9.64E+01
34	-1	9.64E+01
35	-0.95455	9.64E+01
36	-0.90909	9.64E+01
37	-0.86364	9.64E+01
38	-0.81818	9.64E+01
39	-0.77273	9.64E+01
40	-0.72727	9.64E+01
41	-0.68182	9.64E+01
42	-0.63636	9.64E+01
43	-0.59091	9.64E+01
44	-0.54545	9.64E+01
45	-0.5	9.64E+01
46	-0.45455	9.64E+01
47	-0.40909	9.64E+01
48	-0.36364	9.64E+01
49	-0.31818	9.64E+01
50	-0.27273	9.64E+01
51	-0.22727	9.64E+01
52	-0.18182	9.64E+01
53	-0.13636	9.64E+01
54	-9.09E-02	9.64E+01
55	-4.55E-02	9.63E+01
56	0	9.61E+01
57	4.55E-02	9.59E+01
58	9.09E-02	9.56E+01
59	0.13636	9.52E+01
60	0.18182	9.48E+01
61	0.22727	9.44E+01
62	0.27273	9.39E+01
63	0.31818	9.33E+01
64	0.36364	9.26E+01
65	0.40909	9.19E+01
66	0.45455	9.12E+01
67	0.5	9.04E+01
68	0.54545	8.95E+01
69	0.59091	8.85E+01
70	0.63636	8.76E+01
71	0.68182	8.65E+01
72	0.72727	8.54E+01
73	0.77273	8.42E+01
74	0.81818	8.30E+01
75	0.86364	8.17E+01
76	0.90909	8.03E+01

24	-1.45E+00	9.64E+01
25	-1.41E+00	9.64E+01
26	-1.36E+00	9.64E+01
27	-1.32E+00	9.64E+01
28	-1.27E+00	9.64E+01
29	-1.23E+00	9.64E+01
30	-1.18E+00	9.64E+01
31	-1.1364	9.64E+01
32	-1.0909	9.64E+01
33	-1.0455	9.64E+01
34	-1	9.64E+01
35	-0.95455	9.64E+01
36	-0.90909	9.64E+01
37	-0.86364	9.64E+01
38	-0.81818	9.64E+01
39	-0.77273	9.64E+01
40	-0.72727	9.64E+01
41	-0.68182	9.64E+01
42	-0.63636	9.64E+01
43	-0.59091	9.64E+01
44	-0.54545	9.64E+01
45	-0.5	9.64E+01
46	-0.45455	9.64E+01
47	-0.40909	9.64E+01
48	-0.36364	9.64E+01
49	-0.31818	9.64E+01
50	-0.27273	9.64E+01
51	-0.22727	9.64E+01
52	-0.18182	9.64E+01
53	-0.13636	9.64E+01
54	-9.09E-02	9.64E+01
55	-4.55E-02	9.64E+01
56	0	9.64E+01
57	4.55E-02	9.64E+01
58	9.09E-02	9.64E+01
59	0.13636	9.64E+01
60	0.18182	9.64E+01
61	0.22727	9.64E+01
62	0.27273	9.64E+01
63	0.31818	9.64E+01
64	0.36364	9.64E+01
65	0.40909	9.62E+01
66	0.45455	9.46E+01
67	0.5	9.30E+01
68	0.54545	9.14E+01
69	0.59091	8.98E+01
70	0.63636	8.82E+01
71	0.68182	8.66E+01
72	0.72727	8.50E+01
73	0.77273	8.34E+01
74	0.81818	8.18E+01
75	0.86364	8.02E+01
76	0.90909	7.86E+01

77	0.95455	7.84E+01
78	1	7.70E+01
79	1.0455	7.56E+01
80	1.0909	7.41E+01
81	1.1364	7.25E+01
82	1.1818	7.09E+01
83	1.2273	6.92E+01
84	1.2727	6.74E+01
85	1.3182	6.56E+01
86	1.3636	6.37E+01
87	1.4091	6.18E+01
88	1.4545	5.98E+01
89	1.5	5.78E+01
90	1.5455	5.58E+01
91	1.5909	5.37E+01
92	1.6364	5.17E+01
93	1.6818	4.96E+01
94	1.7273	4.75E+01
95	1.7727	4.54E+01
96	1.8182	4.33E+01
97	1.8636	4.13E+01
98	1.9091	3.92E+01
99	1.9545	3.72E+01
100	2	3.53E+01

77	0.95455	7.89E+01
78	1	7.75E+01
79	1.0455	7.59E+01
80	1.0909	7.43E+01
81	1.1364	7.27E+01
82	1.1818	7.10E+01
83	1.2273	6.92E+01
84	1.2727	6.74E+01
85	1.3182	6.55E+01
86	1.3636	6.36E+01
87	1.4091	6.16E+01
88	1.4545	5.95E+01
89	1.5	5.74E+01
90	1.5455	5.52E+01
91	1.5909	5.30E+01
92	1.6364	5.07E+01
93	1.6818	4.83E+01
94	1.7273	4.60E+01
95	1.7727	4.37E+01
96	1.8182	4.14E+01
97	1.8636	3.92E+01
98	1.9091	3.71E+01
99	1.9545	3.50E+01
100	2	3.30E+01

77	0.95455	7.70E+01
78	1	7.54E+01
79	1.0455	7.38E+01
80	1.0909	7.22E+01
81	1.1364	7.07E+01
82	1.1818	6.91E+01
83	1.2273	6.75E+01
84	1.2727	6.59E+01
85	1.3182	6.43E+01
86	1.3636	6.27E+01
87	1.4091	6.11E+01
88	1.4545	5.95E+01
89	1.5	5.79E+01
90	1.5455	5.63E+01
91	1.5909	5.47E+01
92	1.6364	5.31E+01
93	1.6818	5.15E+01
94	1.7273	4.99E+01
95	1.7727	4.83E+01
96	1.8182	4.67E+01
97	1.8636	4.51E+01
98	1.9091	4.35E+01
99	1.9545	4.19E+01
100	2	4.03E+01

Table H2.D-16b. TRAP Model Output for Dioxin/Furan Data for the Mammal Reproduction Endpoint (Hochstein et al. 2001)

Chemical:	Dioxin/furan
Study Authors:	Hochstein et al. 2001
Receptor Group:	Mammal
Effect Description:	Reproduction

Input Data:

Dose	Effect	SE
0.032657	62	not reported
2.884739	29	not reported
9.797225	11	not reported

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined	yes	yes	yes
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.41126	0.40629			
S	0.66136	6.59E-01			
Y0	6.20E+01	6.24E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.41126	0.41323			
S	0.66136	7.00E-01			
Y0	6.20E+01	6.20E+01			

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	0.41126	0.40111			
S	0.66136	0.54675			
Y0	6.20E+01	6.20E+01			

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.5485	Infinity	0	2.3859	0.40629
20	7.60E-01	Infinity	0.00E+00	2.3859	-0.11941
10	3.74E-01	Infinity	0.00E+00	2.3859	-0.42693
5	1.95E-01	Infinity	0.00E+00	2.3859	-0.71028
0					

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.5896	Infinity	0	2.3859	0.41323
20	0.77254	Infinity	0	2.3859	-0.11208
10	4.20E-01	Infinity	0.00E+00	2.3859	-0.37684
5	0.27287	Infinity	0.00E+00	2.3859	-0.56405
0	9.64E-02	Infinity	0.00E+00	2.3859	-1.02E+00

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	2.5183	Infinity	0	2.3859	0.40111
20	0.71189	Infinity	0	2.3859	-0.14759
10	0.46721	Infinity	0	2.3859	-0.33049
5	0.3785	Infinity	0	2.3859	-0.42194
0	0.30663	Infinity	0	2.3859	-0.51339

Model Fit Summary

Dataset	Exposure	Effects Var	Est Effects Var
1	-1.49E+00	6.20E+01	6.20E+01
2	4.60E-01	2.90E+01	2.90E+01

	Exposure	Effects Var	Est Effects Var
1	-1.49E+00	6.20E+01	6.20E+01
2	4.60E-01	2.90E+01	2.90E+01

	Exposure	Effects Var	Est Effects Var
1	-1.49E+00	6.20E+01	6.20E+01
2	4.60E-01	2.90E+01	2.90E+01

3	9.91E-01	1.10E+01	1.10E+01		
4					
5					
6					

Analysis of Variance

R-squared: 0.954

	DF	SS	MS	F	Sig
Total (adj)	9	2108.2	234.24		
Regression	2	2011.8	1005.9	73.041	0
Error	7	96.402	13.772		

Prediction Line

	X	Y
1	-1.5	6.20E+01
2	-1.47E+00	6.20E+01
3	-1.44E+00	6.19E+01
4	-1.41E+00	6.19E+01
5	-1.38E+00	6.19E+01
6	-1.35E+00	6.18E+01
7	-1.32E+00	6.18E+01
8	-1.29E+00	6.17E+01
9	-1.26E+00	6.17E+01
10	-1.23E+00	6.16E+01
11	-1.20E+00	6.15E+01
12	-1.17E+00	6.15E+01
13	-1.14E+00	6.14E+01
14	-1.1061	6.13E+01
15	-1.0758	6.12E+01
16	-1.0455	6.11E+01
17	-1.0152	6.10E+01
18	-0.98485	6.09E+01
19	-0.95455	6.07E+01
20	-0.92424	6.06E+01
21	-8.94E-01	6.05E+01
22	-8.64E-01	6.03E+01
23	-8.33E-01	6.01E+01
24	-8.03E-01	6.00E+01
25	-7.73E-01	5.98E+01
26	-7.42E-01	5.95E+01
27	-7.12E-01	5.93E+01
28	-6.82E-01	5.91E+01
29	-6.52E-01	5.88E+01
30	-6.21E-01	5.85E+01
31	-0.59091	5.82E+01
32	-0.56061	5.79E+01
33	-0.5303	5.76E+01
34	-0.5	5.72E+01
35	-0.4697	5.68E+01
36	-0.43939	5.64E+01

3	9.91E-01	1.10E+01	1.10E+01		
4					
5					
6					

R-squared: 0.954

	DF	SS	MS	F	Sig
Total (adj)	9	2108.2	234.24		
Regression	2	2011.8	1005.9	73.041	0
Error	7	96.402	13.772		

	X	Y
1	-1.5	6.20E+01
2	-1.47E+00	6.20E+01
3	-1.44E+00	6.20E+01
4	-1.41E+00	6.20E+01
5	-1.38E+00	6.20E+01
6	-1.35E+00	6.20E+01
7	-1.32E+00	6.20E+01
8	-1.29E+00	6.20E+01
9	-1.26E+00	6.20E+01
10	-1.23E+00	6.20E+01
11	-1.20E+00	6.20E+01
12	-1.17E+00	6.20E+01
13	-1.14E+00	6.20E+01
14	-1.1061	6.20E+01
15	-1.0758	6.20E+01
16	-1.0455	6.20E+01
17	-1.0152	6.20E+01
18	-0.98485	6.20E+01
19	-0.95455	6.19E+01
20	-0.92424	6.19E+01
21	-8.94E-01	6.18E+01
22	-8.64E-01	6.16E+01
23	-8.33E-01	6.15E+01
24	-8.03E-01	6.13E+01
25	-7.73E-01	6.11E+01
26	-7.42E-01	6.09E+01
27	-7.12E-01	6.06E+01
28	-6.82E-01	6.03E+01
29	-6.52E-01	6.00E+01
30	-6.21E-01	5.96E+01
31	-0.59091	5.93E+01
32	-0.56061	5.89E+01
33	-0.5303	5.84E+01
34	-0.5	5.80E+01
35	-0.4697	5.75E+01
36	-0.43939	5.70E+01

3	9.91E-01	1.10E+01	1.10E+01		
4					
5					
6					

R-squared: 0.954

	DF	SS	MS	F	Sig
Total (adj)	9	2108.2	234.24		
Regression	2	2011.8	1005.9	73.041	0
Error	7	96.402	13.772		

	X	Y
1	-1.5	6.20E+01
2	-1.47E+00	6.20E+01
3	-1.44E+00	6.20E+01
4	-1.41E+00	6.20E+01
5	-1.38E+00	6.20E+01
6	-1.35E+00	6.20E+01
7	-1.32E+00	6.20E+01
8	-1.29E+00	6.20E+01
9	-1.26E+00	6.20E+01
10	-1.23E+00	6.20E+01
11	-1.20E+00	6.20E+01
12	-1.17E+00	6.20E+01
13	-1.14E+00	6.20E+01
14	-1.1061	6.20E+01
15	-1.0758	6.20E+01
16	-1.0455	6.20E+01
17	-1.0152	6.20E+01
18	-0.98485	6.20E+01
19	-0.95455	6.20E+01
20	-0.92424	6.20E+01
21	-8.94E-01	6.20E+01
22	-8.64E-01	6.20E+01
23	-8.33E-01	6.20E+01
24	-8.03E-01	6.20E+01
25	-7.73E-01	6.20E+01
26	-7.42E-01	6.20E+01
27	-7.12E-01	6.20E+01
28	-6.82E-01	6.20E+01
29	-6.52E-01	6.20E+01
30	-6.21E-01	6.20E+01
31	-0.59091	6.20E+01
32	-0.56061	6.20E+01
33	-0.5303	6.20E+01
34	-0.5	6.15E+01
35	-0.4697	6.05E+01
36	-0.43939	5.95E+01

37	-0.40909	5.59E+01
38	-0.37879	5.54E+01
39	-0.34848	5.49E+01
40	-0.31818	5.44E+01
41	-0.28788	5.38E+01
42	-0.25758	5.32E+01
43	-0.22727	5.25E+01
44	-0.19697	5.19E+01
45	-0.16667	5.11E+01
46	-0.13636	5.04E+01
47	-0.10606	4.96E+01
48	-7.58E-02	4.87E+01
49	-4.55E-02	4.79E+01
50	-1.52E-02	4.70E+01
51	1.52E-02	4.60E+01
52	4.55E-02	4.50E+01
53	7.58E-02	4.40E+01
54	0.10606	4.30E+01
55	0.13636	4.19E+01
56	0.16667	4.08E+01
57	0.19697	3.96E+01
58	0.22727	3.84E+01
59	0.25758	3.73E+01
60	0.28788	3.60E+01
61	0.31818	3.48E+01
62	0.34848	3.36E+01
63	0.37879	3.23E+01
64	0.40909	3.11E+01
65	0.43939	2.99E+01
66	0.4697	2.86E+01
67	0.5	2.74E+01
68	0.5303	2.62E+01
69	0.56061	2.49E+01
70	0.59091	2.38E+01
71	0.62121	2.26E+01
72	0.65152	2.15E+01
73	0.68182	2.03E+01
74	0.71212	1.93E+01
75	0.74242	1.82E+01
76	0.77273	1.72E+01
77	0.80303	1.62E+01
78	0.83333	1.53E+01
79	0.86364	1.44E+01
80	0.89394	1.35E+01
81	0.92424	1.27E+01
82	0.95455	1.19E+01
83	0.98485	1.12E+01
84	1.0152	1.04E+01
85	1.0455	9.76E+00
86	1.0758	9.12E+00
87	1.1061	8.52E+00
88	1.1364	7.95E+00
89	1.1667	7.41E+00

37	-0.40909	5.64E+01
38	-0.37879	5.58E+01
39	-0.34848	5.52E+01
40	-0.31818	5.46E+01
41	-0.28788	5.40E+01
42	-0.25758	5.33E+01
43	-0.22727	5.26E+01
44	-0.19697	5.18E+01
45	-0.16667	5.11E+01
46	-0.13636	5.03E+01
47	-0.10606	4.94E+01
48	-7.58E-02	4.86E+01
49	-4.55E-02	4.77E+01
50	-1.52E-02	4.68E+01
51	1.52E-02	4.59E+01
52	4.55E-02	4.49E+01
53	7.58E-02	4.39E+01
54	0.10606	4.29E+01
55	0.13636	4.18E+01
56	0.16667	4.08E+01
57	0.19697	3.97E+01
58	0.22727	3.85E+01
59	0.25758	3.74E+01
60	0.28788	3.62E+01
61	0.31818	3.50E+01
62	0.34848	3.37E+01
63	0.37879	3.25E+01
64	0.40909	3.12E+01
65	0.43939	2.99E+01
66	0.4697	2.86E+01
67	0.5	2.74E+01
68	0.5303	2.61E+01
69	0.56061	2.49E+01
70	0.59091	2.38E+01
71	0.62121	2.26E+01
72	0.65152	2.15E+01
73	0.68182	2.04E+01
74	0.71212	1.94E+01
75	0.74242	1.84E+01
76	0.77273	1.74E+01
77	0.80303	1.64E+01
78	0.83333	1.55E+01
79	0.86364	1.45E+01
80	0.89394	1.37E+01
81	0.92424	1.28E+01
82	0.95455	1.20E+01
83	0.98485	1.12E+01
84	1.0152	1.04E+01
85	1.0455	9.64E+00
86	1.0758	8.92E+00
87	1.1061	8.23E+00
88	1.1364	7.57E+00
89	1.1667	6.93E+00

37	-0.40909	5.85E+01
38	-0.37879	5.74E+01
39	-0.34848	5.64E+01
40	-0.31818	5.54E+01
41	-0.28788	5.44E+01
42	-0.25758	5.33E+01
43	-0.22727	5.23E+01
44	-0.19697	5.13E+01
45	-0.16667	5.02E+01
46	-0.13636	4.92E+01
47	-0.10606	4.82E+01
48	-7.58E-02	4.72E+01
49	-4.55E-02	4.61E+01
50	-1.52E-02	4.51E+01
51	1.52E-02	4.41E+01
52	4.55E-02	4.31E+01
53	7.58E-02	4.20E+01
54	0.10606	4.10E+01
55	0.13636	4.00E+01
56	0.16667	3.89E+01
57	0.19697	3.79E+01
58	0.22727	3.69E+01
59	0.25758	3.59E+01
60	0.28788	3.48E+01
61	0.31818	3.38E+01
62	0.34848	3.28E+01
63	0.37879	3.18E+01
64	0.40909	3.07E+01
65	0.43939	2.97E+01
66	0.4697	2.87E+01
67	0.5	2.76E+01
68	0.5303	2.66E+01
69	0.56061	2.56E+01
70	0.59091	2.46E+01
71	0.62121	2.35E+01
72	0.65152	2.25E+01
73	0.68182	2.15E+01
74	0.71212	2.05E+01
75	0.74242	1.94E+01
76	0.77273	1.84E+01
77	0.80303	1.74E+01
78	0.83333	1.63E+01
79	0.86364	1.53E+01
80	0.89394	1.43E+01
81	0.92424	1.33E+01
82	0.95455	1.22E+01
83	0.98485	1.12E+01
84	1.0152	1.02E+01
85	1.0455	9.16E+00
86	1.0758	8.13E+00
87	1.1061	7.10E+00
88	1.1364	6.08E+00
89	1.1667	5.05E+00

90	1.197	6.90E+00
91	1.2273	6.43E+00
92	1.2576	5.98E+00
93	1.2879	5.56E+00
94	1.3182	5.17E+00
95	1.3485	4.80E+00
96	1.3788	4.46E+00
97	1.4091	4.14E+00
98	1.4394	3.84E+00
99	1.4697	3.56E+00
100	1.5	3.30E+00

90	1.197	6.32E+00
91	1.2273	5.74E+00
92	1.2576	5.19E+00
93	1.2879	4.67E+00
94	1.3182	4.17E+00
95	1.3485	3.70E+00
96	1.3788	3.26E+00
97	1.4091	2.85E+00
98	1.4394	2.47E+00
99	1.4697	2.11E+00
100	1.5	1.78E+00

90	1.197	4.02E+00
91	1.2273	2.99E+00
92	1.2576	1.97E+00
93	1.2879	9.40E-01
94	1.3182	0.00E+00
95	1.3485	0.00E+00
96	1.3788	0.00E+00
97	1.4091	0.00E+00
98	1.4394	0.00E+00
99	1.4697	0.00E+00
100	1.5	0.00E+00

Table H2.D-17. TRAP Model Output for PCBs Data for the Bird Reproduction Endpoint (Pooling Group B: Lillie et al. 1974 and Cecil et al. 1974; Lillie et al. 1975; Scott 1977)

Chemical:	PCBs
Study Authors:	Pooling group B
Receptor Group:	Bird
Effect Description:	Reproduction

Input Data:

Dose	Effect Relative to Control
0.000001	100
0.140143	98.5058698
1.401428	12.70010672
0.000001	100
0.350357	95.6043956
0.700714	75.82417582
1.401428	24.17582418
0.000001	100
0.035036	101.2154696
0.070071	103.5359116
0.700714	55.24861878
1.401428	2.651933702

Modeling Parameters

Analysis Type:	Nonlinear Regression	Nonlinear Regression	Nonlinear Regression
Model Shape:	Logistic Equation	Threshold Sigmoid	Piecewise Linear
# of Parameters:	Three	Three	Three
Exposure Variable Transform:	Logarithm	Logarithm	Logarithm
Error Messages Encountered			
Inadequate Partial Effects - Proceed Anyway?			
Use Only for Exploratory Data Analysis!			
Maximum Iterations Reached Without Convergence			
X50 at Maximum or Minimum Limit			
Steepness At Maximum Or Minimum Limit			
Error Estimates Cannot Be Determined			
Large Standard Error for X50			
Large Standard Error for Steepness			
Large Standard Error for Y0			
Inadequate Number of Partial Effects			
Insufficient Data to Plot			
Insufficient Data to Analyze			

Model Parameters

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-9.34E-02	-7.96E-02	2.42E-02	-0.13437	-2.49E-02
S	1.4281	2.08E+00	0.3418	1.3077	2.8541
Y0	1.01E+02	1.00E+02	2.7978	94.16	106.82

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-9.34E-02	-7.91E-02	2.48E-02	-0.13522	-2.30E-02
S	1.4281	2.13E+00	0.32176	1.4024	2.8581
Y0	1.01E+02	1.00E+02	2.8349	93.809	106.64

	Initial Guess	Final Estimate	Standard Error	95% LCL	95% UCL
LogX50	-9.34E-02	-6.47E-02	2.34E-02	-0.11763	-1.17E-02
S	1.4281	1.7422	0.22676	1.2293	2.2552
Y0	1.01E+02	9.98E+01	2.7574	93.6	106.08

Xp Estimates

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.83244	0.73388	0.94422	2.42E-02	-7.96E-02
20	5.67E-01	4.65E-01	6.93E-01	3.84E-02	-0.2462

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.83351	0.73245	0.94852	2.48E-02	-7.91E-02
20	0.56024	4.52E-01	0.69371	4.10E-02	-0.25162

p	Xp	95% LCL	95% UCL	Xp Std Err	Log Xp
50	0.86165	0.76273	0.9734	2.34E-02	-6.47E-02
20	0.57961	0.46963	0.71535	4.04E-02	-0.23687

10	4.53E-01	3.46E-01	5.94E-01	5.18E-02	-0.34363
5	3.69E-01	2.62E-01	5.18E-01	6.52E-02	-0.4334
0					

10	4.59E-01	3.39E-01	6.21E-01	5.81E-02	-0.33858
5	0.39804	2.60E-01	6.10E-01	8.18E-02	-0.40007
0	0.2828	9.71E-02	8.24E-01	0.20527	-5.49E-01

10	0.50785	0.39741	0.64898	4.71E-02	-0.29426
5	0.47538	0.36542	0.61842	5.05E-02	-0.32296
0	0.44498	0.33594	0.58941	5.40E-02	-0.35166

Model Fit Summary

Dataset

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	-6.00E+00	1.00E+02	1.00E+02
4	-1.46E+00	1.01E+02	1.00E+02
5	-1.15E+00	103.54	100.48
6	-8.53E-01	98.506	100.33
7	-4.55E-01	95.604	96.273
8	-1.54E-01	75.824	65.401
9	-1.54E-01	55.249	65.401
10	1.47E-01	24.176	13.27
11	1.47E-01	12.7	13.27
12	0.14657	2.6519	13.27

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	1.00E+02
2	-6.00E+00	1.00E+02	1.00E+02
3	-6.00E+00	1.00E+02	1.00E+02
4	-1.46E+00	1.01E+02	1.00E+02
5	-1.15E+00	103.54	100.22
6	-8.53E-01	98.506	100.22
7	-4.55E-01	95.604	98.254
8	-1.54E-01	75.824	64.911
9	-1.54E-01	55.249	64.911
10	1.47E-01	24.176	13.513
11	1.47E-01	12.7	13.513
12	0.14657	2.6519	13.513

	Exposure	Effects Var	Est Effects Var
1	-6.00E+00	1.00E+02	9.98E+01
2	-6.00E+00	1.00E+02	9.98E+01
3	-6.00E+00	1.00E+02	9.98E+01
4	-1.46E+00	1.01E+02	9.98E+01
5	-1.15E+00	103.54	99.837
6	-8.53E-01	98.506	99.837
7	-4.55E-01	95.604	99.837
8	-1.54E-01	75.824	65.536
9	-1.54E-01	55.249	65.536
10	1.47E-01	24.176	13.176
11	1.47E-01	12.7	13.176
12	0.14657	2.6519	13.176

Analysis of Variance

R-squared: 0.972

	DF	SS	MS	F	Sig
Total (adj)	11	16365	1487.8		
Regression	2	15907	7953.6	156.26	0
Error	9	458.1	50.9		

R-squared: 0.971

	DF	SS	MS	F	Sig
Total (adj)	11	16365	1487.8		
Regression	2	15898	7949.2	153.24	0
Error	9	466.86	51.874		

R-squared: 0.971

	DF	SS	MS	F	Sig
Total (adj)	11	16365	1487.8		
Regression	2	15886	7943.2	149.24	0
Error	9	479	53.223		

Prediction Line

	X	Y
1	-4	1.00E+02
2	-3.95E+00	1.00E+02
3	-3.91E+00	1.00E+02
4	-3.86E+00	1.00E+02
5	-3.82E+00	1.00E+02
6	-3.77E+00	1.00E+02
7	-3.73E+00	1.00E+02
8	-3.68E+00	1.00E+02
9	-3.64E+00	1.00E+02
10	-3.59E+00	1.00E+02
11	-3.55E+00	1.00E+02
12	-3.50E+00	1.00E+02
13	-3.45E+00	1.00E+02
14	-3.4091	1.00E+02
15	-3.3636	1.00E+02
16	-3.3182	1.00E+02
17	-3.2727	1.00E+02
18	-3.2273	1.00E+02
19	-3.1818	1.00E+02
20	-3.1364	1.00E+02

	X	Y
1	-4	1.00E+02
2	-3.95E+00	1.00E+02
3	-3.91E+00	1.00E+02
4	-3.86E+00	1.00E+02
5	-3.82E+00	1.00E+02
6	-3.77E+00	1.00E+02
7	-3.73E+00	1.00E+02
8	-3.68E+00	1.00E+02
9	-3.64E+00	1.00E+02
10	-3.59E+00	1.00E+02
11	-3.55E+00	1.00E+02
12	-3.50E+00	1.00E+02
13	-3.45E+00	1.00E+02
14	-3.4091	1.00E+02
15	-3.3636	1.00E+02
16	-3.3182	1.00E+02
17	-3.2727	1.00E+02
18	-3.2273	1.00E+02
19	-3.1818	1.00E+02
20	-3.1364	1.00E+02

	X	Y
1	-4	9.98E+01
2	-3.95E+00	9.98E+01
3	-3.91E+00	9.98E+01
4	-3.86E+00	9.98E+01
5	-3.82E+00	9.98E+01
6	-3.77E+00	9.98E+01
7	-3.73E+00	9.98E+01
8	-3.68E+00	9.98E+01
9	-3.64E+00	9.98E+01
10	-3.59E+00	9.98E+01
11	-3.55E+00	9.98E+01
12	-3.50E+00	9.98E+01
13	-3.45E+00	9.98E+01
14	-3.4091	9.98E+01
15	-3.3636	9.98E+01
16	-3.3182	9.98E+01
17	-3.2727	9.98E+01
18	-3.2273	9.98E+01
19	-3.1818	9.98E+01
20	-3.1364	9.98E+01

21	-3.09E+00	1.00E+02
22	-3.05E+00	1.00E+02
23	-3.00E+00	1.00E+02
24	-2.95E+00	1.00E+02
25	-2.91E+00	1.00E+02
26	-2.86E+00	1.00E+02
27	-2.82E+00	1.00E+02
28	-2.77E+00	1.00E+02
29	-2.73E+00	1.00E+02
30	-2.68E+00	1.00E+02
31	-2.6364	1.00E+02
32	-2.5909	1.00E+02
33	-2.5455	1.00E+02
34	-2.5	1.00E+02
35	-2.4545	1.00E+02
36	-2.4091	1.00E+02
37	-2.3636	1.00E+02
38	-2.3182	1.00E+02
39	-2.2727	1.00E+02
40	-2.2273	1.00E+02
41	-2.1818	1.00E+02
42	-2.1364	1.00E+02
43	-2.0909	1.00E+02
44	-2.0455	1.00E+02
45	-2	1.00E+02
46	-1.9545	1.00E+02
47	-1.9091	1.00E+02
48	-1.8636	1.00E+02
49	-1.8182	1.00E+02
50	-1.7727	1.00E+02
51	-1.7273	1.00E+02
52	-1.6818	1.00E+02
53	-1.6364	1.00E+02
54	-1.5909	1.00E+02
55	-1.5455	1.00E+02
56	-1.5	1.00E+02
57	-1.4545	1.00E+02
58	-1.4091	1.00E+02
59	-1.3636	1.00E+02
60	-1.3182	1.00E+02
61	-1.2727	1.00E+02
62	-1.2273	1.00E+02
63	-1.1818	1.00E+02
64	-1.1364	1.00E+02
65	-1.0909	1.00E+02
66	-1.0455	1.00E+02
67	-1	1.00E+02
68	-0.95455	1.00E+02
69	-0.90909	1.00E+02
70	-0.86364	1.00E+02
71	-0.81818	1.00E+02
72	-0.77273	1.00E+02
73	-0.72727	1.00E+02

21	-3.09E+00	1.00E+02
22	-3.05E+00	1.00E+02
23	-3.00E+00	1.00E+02
24	-2.95E+00	1.00E+02
25	-2.91E+00	1.00E+02
26	-2.86E+00	1.00E+02
27	-2.82E+00	1.00E+02
28	-2.77E+00	1.00E+02
29	-2.73E+00	1.00E+02
30	-2.68E+00	1.00E+02
31	-2.6364	1.00E+02
32	-2.5909	1.00E+02
33	-2.5455	1.00E+02
34	-2.5	1.00E+02
35	-2.4545	1.00E+02
36	-2.4091	1.00E+02
37	-2.3636	1.00E+02
38	-2.3182	1.00E+02
39	-2.2727	1.00E+02
40	-2.2273	1.00E+02
41	-2.1818	1.00E+02
42	-2.1364	1.00E+02
43	-2.0909	1.00E+02
44	-2.0455	1.00E+02
45	-2	1.00E+02
46	-1.9545	1.00E+02
47	-1.9091	1.00E+02
48	-1.8636	1.00E+02
49	-1.8182	1.00E+02
50	-1.7727	1.00E+02
51	-1.7273	1.00E+02
52	-1.6818	1.00E+02
53	-1.6364	1.00E+02
54	-1.5909	1.00E+02
55	-1.5455	1.00E+02
56	-1.5	1.00E+02
57	-1.4545	1.00E+02
58	-1.4091	1.00E+02
59	-1.3636	1.00E+02
60	-1.3182	1.00E+02
61	-1.2727	1.00E+02
62	-1.2273	1.00E+02
63	-1.1818	1.00E+02
64	-1.1364	1.00E+02
65	-1.0909	1.00E+02
66	-1.0455	1.00E+02
67	-1	1.00E+02
68	-0.95455	1.00E+02
69	-0.90909	1.00E+02
70	-0.86364	1.00E+02
71	-0.81818	1.00E+02
72	-0.77273	1.00E+02
73	-0.72727	1.00E+02

21	-3.09E+00	9.98E+01
22	-3.05E+00	9.98E+01
23	-3.00E+00	9.98E+01
24	-2.95E+00	9.98E+01
25	-2.91E+00	9.98E+01
26	-2.86E+00	9.98E+01
27	-2.82E+00	9.98E+01
28	-2.77E+00	9.98E+01
29	-2.73E+00	9.98E+01
30	-2.68E+00	9.98E+01
31	-2.6364	9.98E+01
32	-2.5909	9.98E+01
33	-2.5455	9.98E+01
34	-2.5	9.98E+01
35	-2.4545	9.98E+01
36	-2.4091	9.98E+01
37	-2.3636	9.98E+01
38	-2.3182	9.98E+01
39	-2.2727	9.98E+01
40	-2.2273	9.98E+01
41	-2.1818	9.98E+01
42	-2.1364	9.98E+01
43	-2.0909	9.98E+01
44	-2.0455	9.98E+01
45	-2	9.98E+01
46	-1.9545	9.98E+01
47	-1.9091	9.98E+01
48	-1.8636	9.98E+01
49	-1.8182	9.98E+01
50	-1.7727	9.98E+01
51	-1.7273	9.98E+01
52	-1.6818	9.98E+01
53	-1.6364	9.98E+01
54	-1.5909	9.98E+01
55	-1.5455	9.98E+01
56	-1.5	9.98E+01
57	-1.4545	9.98E+01
58	-1.4091	9.98E+01
59	-1.3636	9.98E+01
60	-1.3182	9.98E+01
61	-1.2727	9.98E+01
62	-1.2273	9.98E+01
63	-1.1818	9.98E+01
64	-1.1364	9.98E+01
65	-1.0909	9.98E+01
66	-1.0455	9.98E+01
67	-1	9.98E+01
68	-0.95455	9.98E+01
69	-0.90909	9.98E+01
70	-0.86364	9.98E+01
71	-0.81818	9.98E+01
72	-0.77273	9.98E+01
73	-0.72727	9.98E+01

74	-0.68182	9.98E+01	
75	-0.63636	9.95E+01	
76	-0.59091	9.91E+01	
77	-0.54545	9.85E+01	
78	-0.5	9.75E+01	
79	-0.45455	9.62E+01	
80	-0.40909	9.44E+01	
81	-0.36364	9.18E+01	
82	-0.31818	8.84E+01	
83	-0.27273	8.37E+01	
84	-0.22727	7.77E+01	
85	-0.18182	7.04E+01	
86	-0.13636	6.19E+01	
87	-9.09E-02	5.26E+01	
88	-4.55E-02	4.31E+01	
89	0	3.42E+01	
90	4.55E-02	2.62E+01	
91	9.09E-02	1.96E+01	
92	0.13636	1.43E+01	
93	0.18182	1.02E+01	
94	0.22727	7.25E+00	
95	0.27273	5.08E+00	
96	0.31818	3.54E+00	
97	0.36364	2.45E+00	
98	0.40909	1.69E+00	
99	0.45455	1.16E+00	
100	0.5	8.00E-01	

74	-0.68182	1.00E+02	
75	-0.63636	1.00E+02	
76	-0.59091	1.00E+02	
77	-0.54545	1.00E+02	
78	-0.5	9.97E+01	
79	-0.45455	9.82E+01	
80	-0.40909	9.58E+01	
81	-0.36364	9.24E+01	
82	-0.31818	8.82E+01	
83	-0.27273	8.29E+01	
84	-0.22727	7.68E+01	
85	-0.18182	6.96E+01	
86	-0.13636	6.16E+01	
87	-9.09E-02	5.26E+01	
88	-4.55E-02	4.32E+01	
89	0	3.46E+01	
90	4.55E-02	2.70E+01	
91	9.09E-02	2.04E+01	
92	0.13636	1.47E+01	
93	0.18182	9.89E+00	
94	0.22727	6.05E+00	
95	0.27273	3.15E+00	
96	0.31818	1.18E+00	
97	0.36364	1.62E-01	
98	0.40909	0.00E+00	
99	0.45455	0.00E+00	
100	0.5	0.00E+00	

74	-0.68182	9.98E+01	
75	-0.63636	9.98E+01	
76	-0.59091	9.98E+01	
77	-0.54545	9.98E+01	
78	-0.5	9.98E+01	
79	-0.45455	9.98E+01	
80	-0.40909	9.98E+01	
81	-0.36364	9.98E+01	
82	-0.31818	9.40E+01	
83	-0.27273	8.61E+01	
84	-0.22727	7.82E+01	
85	-0.18182	7.03E+01	
86	-0.13636	6.24E+01	
87	-9.09E-02	5.45E+01	
88	-4.55E-02	4.66E+01	
89	0	3.87E+01	
90	4.55E-02	3.08E+01	
91	9.09E-02	2.29E+01	
92	0.13636	1.50E+01	
93	0.18182	7.05E+00	
94	0.22727	0.00E+00	
95	0.27273	0.00E+00	
96	0.31818	0.00E+00	
97	0.36364	0.00E+00	
98	0.40909	0.00E+00	
99	0.45455	0.00E+00	
100	0.5	0.00E+00	

ANNEX E

ECO-SSL TRV DERIVATION PLOTS COMPARED TO SELECTED TRVS

ACRONYMS AND ABBREVIATIONS

BERA	baseline ecological risk assessment
Eco-SSL	ecological soil screening level
EPA	U.S. Environmental Protection Agency
LOAEL	lowest-observed-adverse-effect level
NOAEL	no-observed-adverse-effect level
TRV	toxicity reference value
UCR	Upper Columbia River

UNITS OF MEASURE

mg/kg bw/day	milligram(s) per kilogram of body weight per day

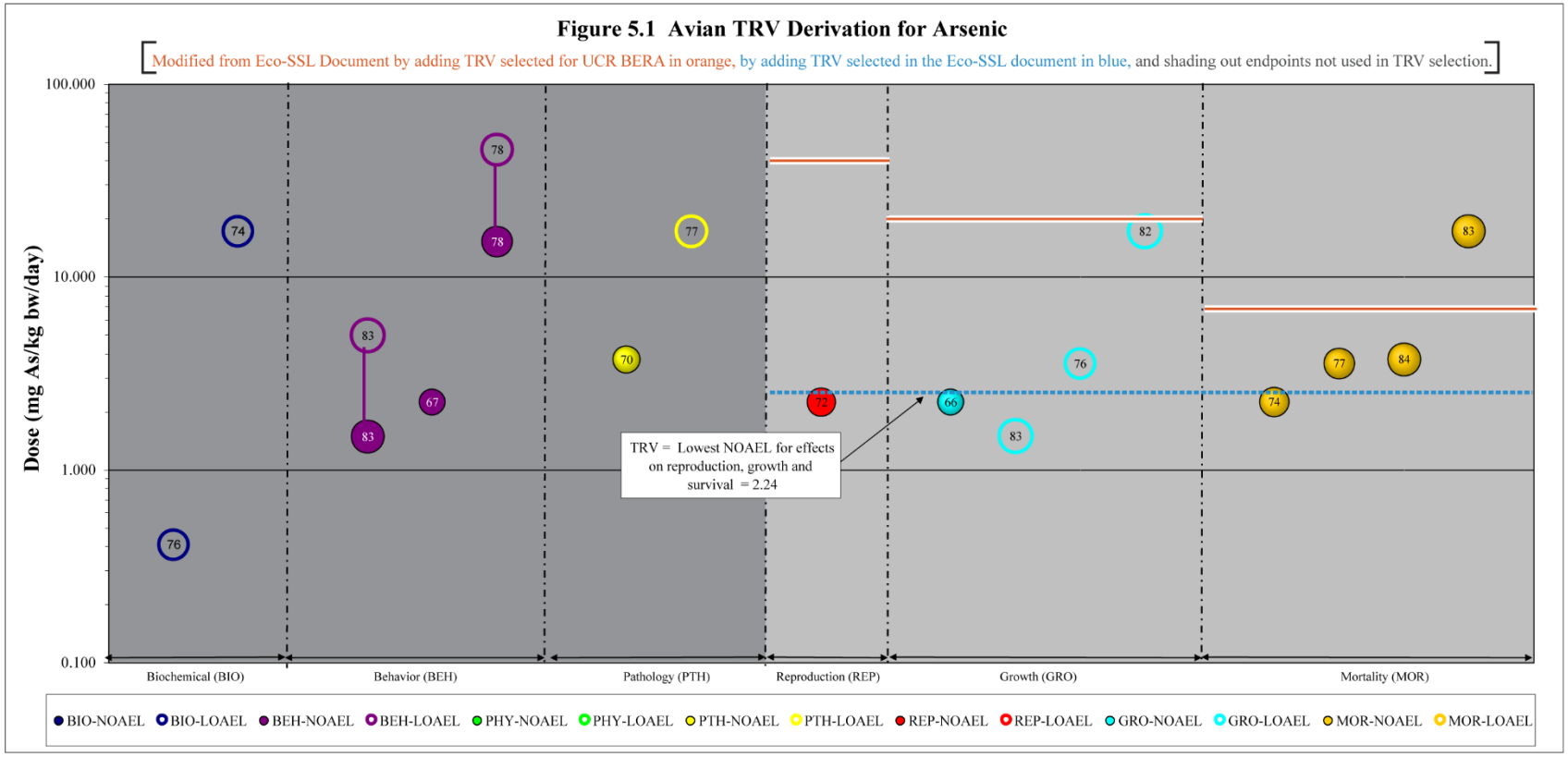
ECO-SSL TRV DERIVATION PLOTS COMPARED TO SELECTED TRVS

The purpose of this annex is to show the bird and mammal toxicity reference values (TRVs) derived for the Upper Columbia River (UCR) Aquatic baseline ecological risk assessment (BERA) compared to the bird and mammal TRVs derived by the U.S. Environmental Protection Agency (EPA) for use in calculating ecological soil screening levels (Eco-SSLs).

EPA's TRV derivation figures in this annex were extracted from Eco-SSL documents. Each figure shows the no-observed-adverse-effect levels (NOAELs) and the lowest-observed-adverse-effect levels (LOAELs) used in deriving the Eco-SSL wildlife TRV for a particular receptor and metal. The Eco-SSL TRV derivation process depended on the available data for a particular receptor and metal and is described below the figure. Only reproduction, growth, and/or survival data were used to derive the Eco-SSL TRVs, although the figures also show other endpoints, such as behavior and pathology.

The following modifications were overlaid on these figures for the purposes of this annex:

- The reproduction, growth, and survival TRVs derived for use in the Aquatic BERA were added in orange.
- The single TRV derived by EPA (representing reproduction, growth, and survival combined) was added in blue.
- The NOAELs/LOAELs for endpoints other than reproduction, growth, or survival are shaded because they were not used in TRV derivation.

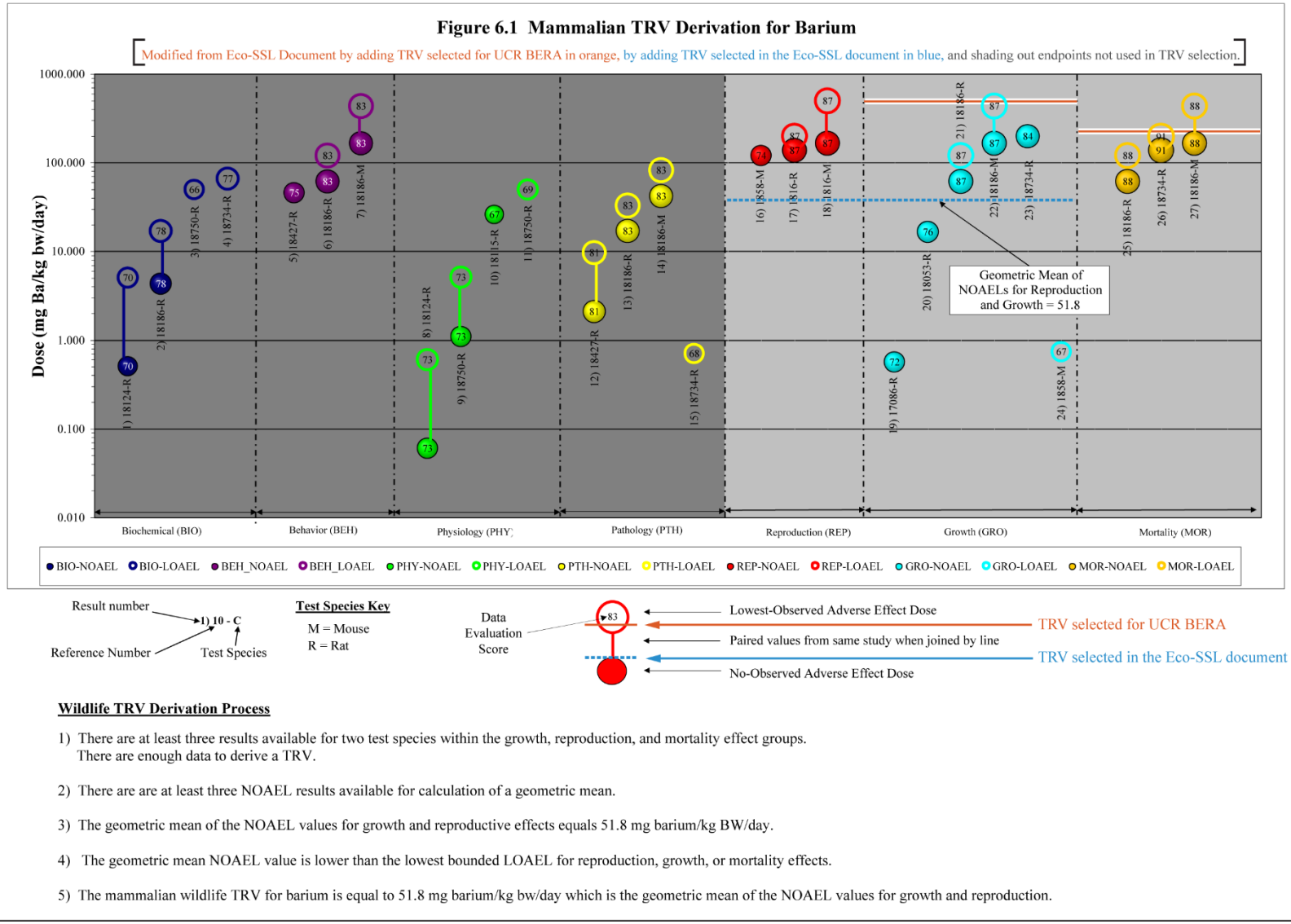


Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.
2) There are not three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.
3) There are no bounded LOAEL values for comparison.
4) The avian wildlife TRV for arsenic is equal to 2.24 mg arsenic/kg bw/day which is the lowest NOAEL value for effects on reproduction, growth or survival.

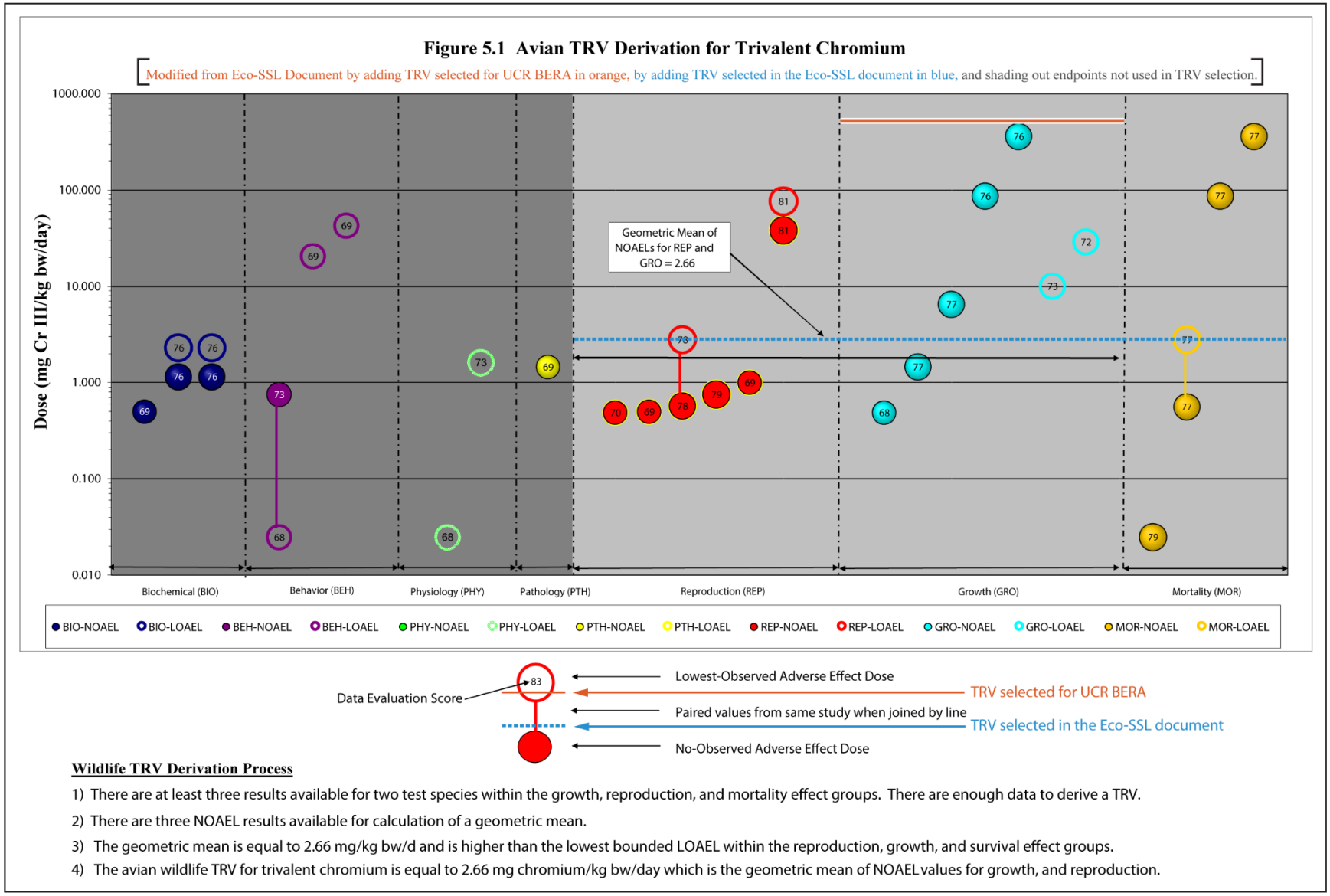
Note: Selected BERA wildlife TRVs for comparative purposes (in mg As/kg bw/day): Reproduction = 40; Growth = 20; Survival = 6.9

Figure H2.H-1. Avian TRV Derivation for Arsenic as Presented in Figure 5.1 of EPA's Eco-SSL Document (USEPA 2005b)



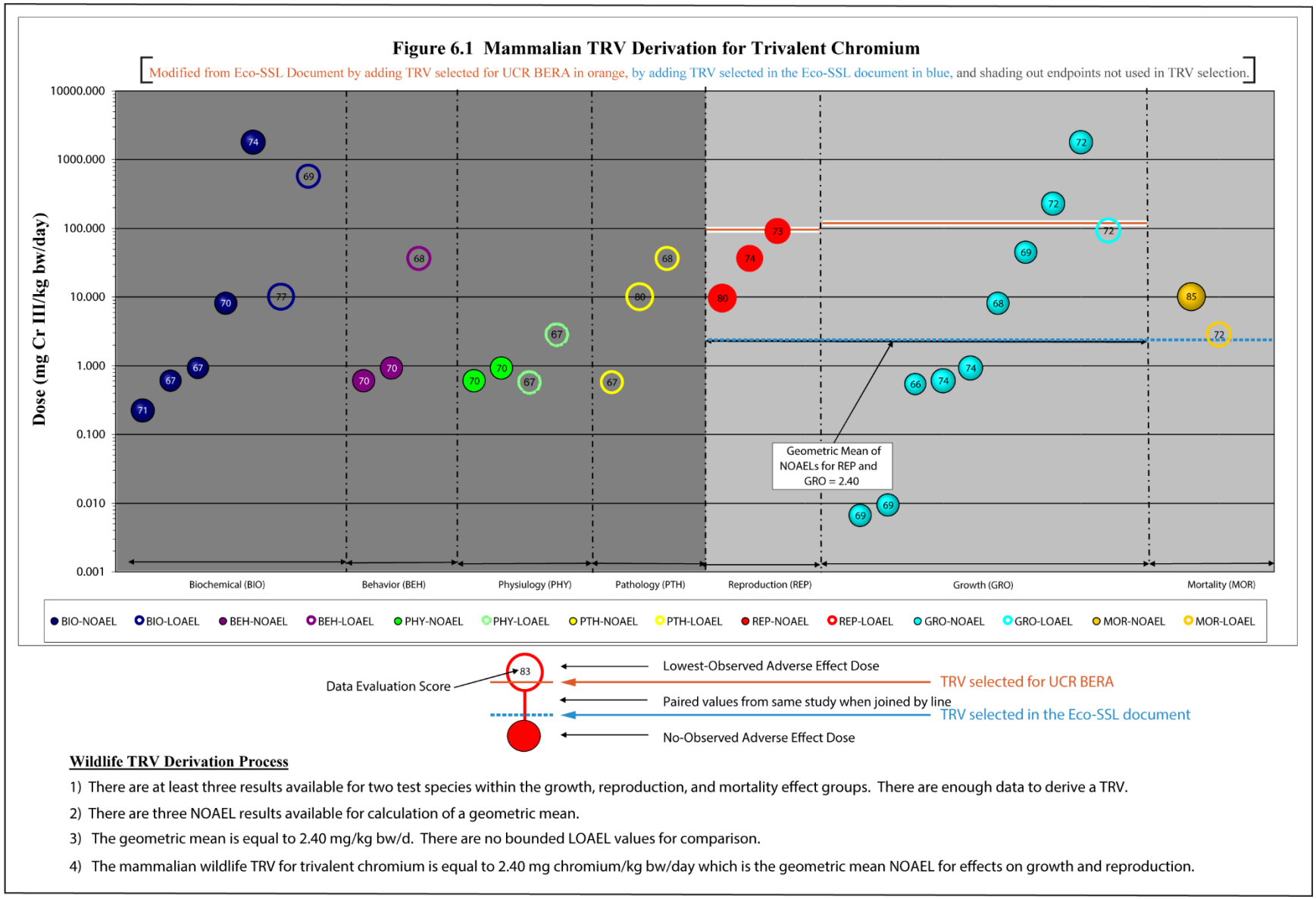
Note: Selected BERA wildlife TRVs for comparative purposes (in mg Ba/kg bw/day): Reproduction = none; Growth = 440; Survival = 200

Figure H2.H-2. Mammalian TRV Derivation for Barium as Presented in Figure 6.1 of EPA's Eco-SSL Document (USEPA 2005c)



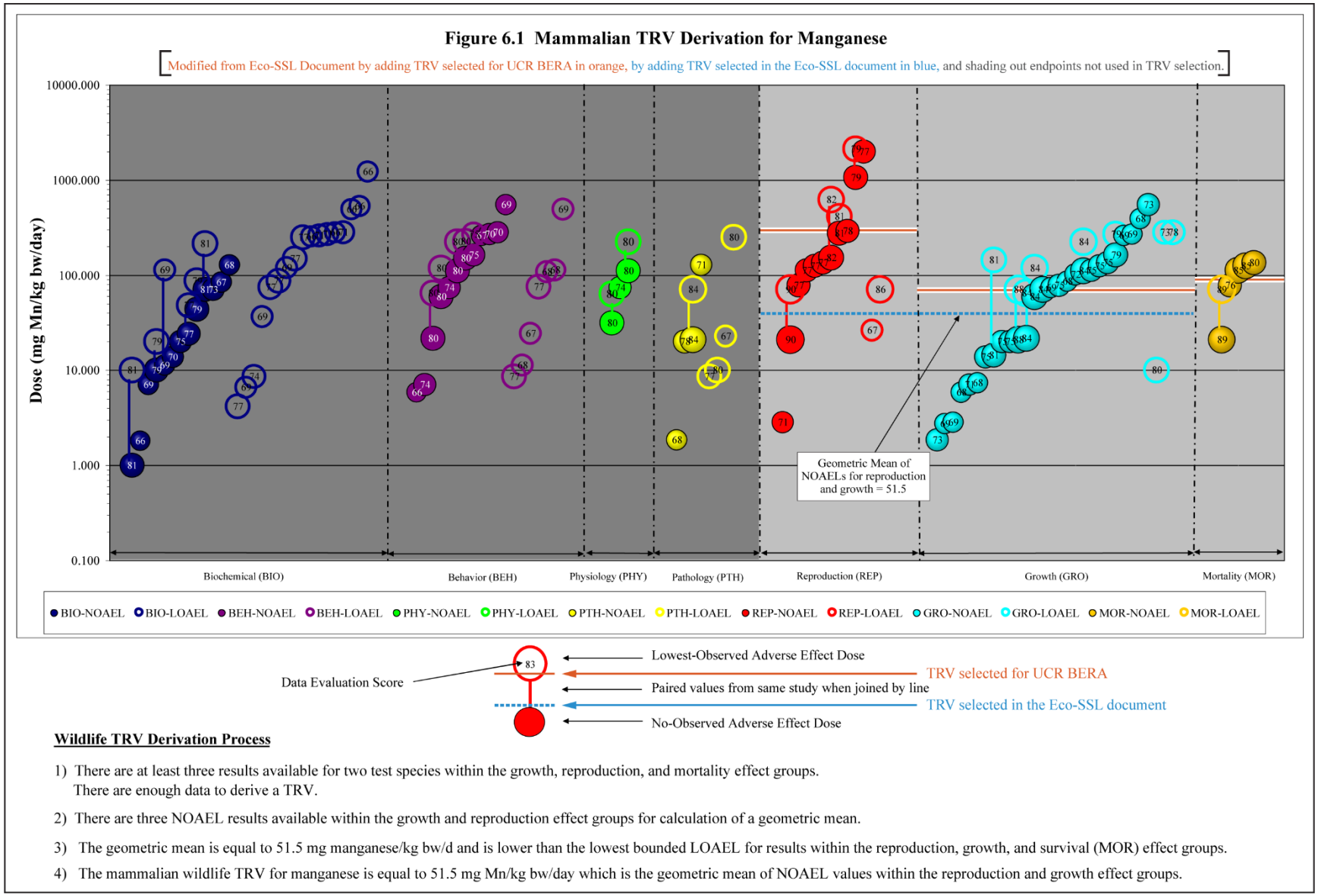
Note: Selected BERA wildlife TRVs for comparative purposes (in mg Cr III/kg bw/day): Reproduction = none; Growth = 510; Survival = none

Figure H2.H-3. Avian TRV Derivation for Chromium (III) as Presented in Figure 5.1 of EPA's Eco-SSL Document (USEPA 2005d)



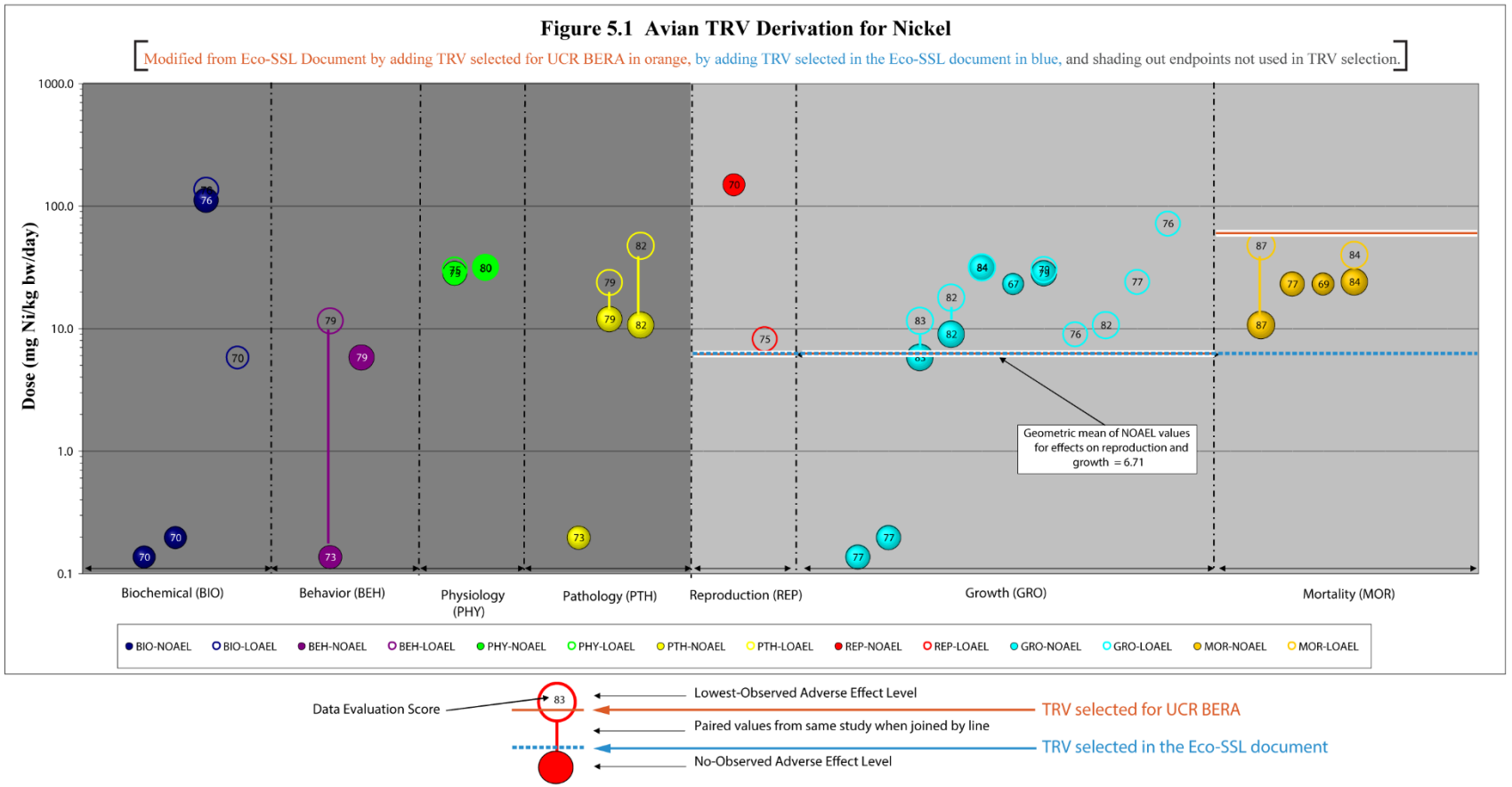
Note: Selected BERA wildlife TRVs for comparative purposes (in mg Cr III/kg bw/day): Reproduction = 91; Growth = 110; Survival = none

Figure H2.H-4. Mammalian TRV Derivation for Chromium (III) as Presented in Figure 6.1 of EPA's Eco-SSL Document (USEPA 2008)



Note: Selected BERA wildlife TRVs for comparative purposes (in mg Mn/kg bw/day): Reproduction = 310; Growth = 71; Survival = 91

Figure H2.H-5. Mammalian TRV Derivation for Manganese as Presented in Figure 6.1 of EPA's Eco-SSL Document (USEPA 2007a)

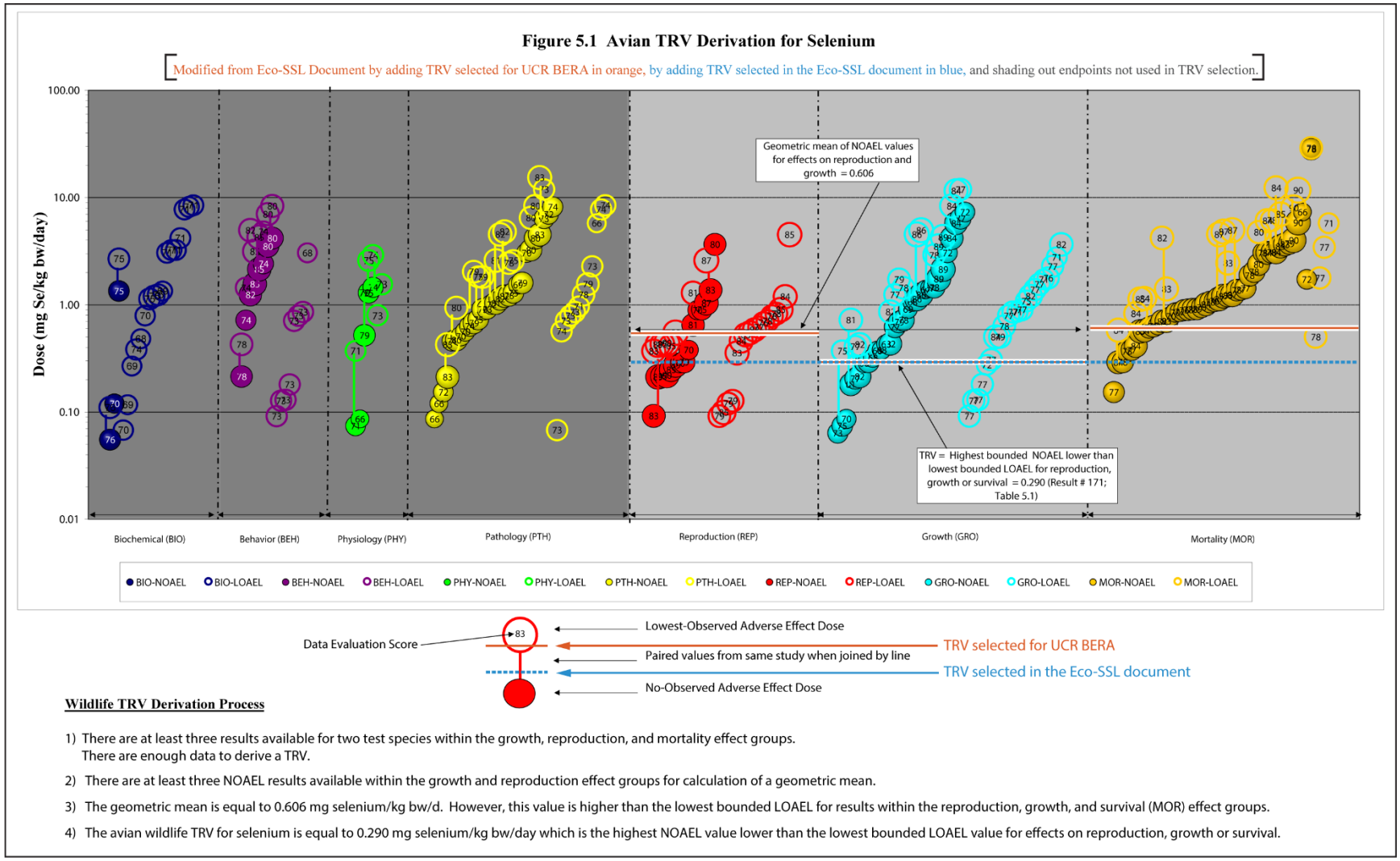


Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.
2) There are at least three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.
3) The geometric mean is equal to 6.71 mg nickel/kg bw/d and is lower than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.
4) The avian wildlife TRV for nickel is equal to 6.71 mg nickel/kg bw/day which is the geometric mean of NOAEL values for effects on reproduction and growth.

Note: Selected BERA wildlife TRVs for comparative purposes (in mg Ni/kg bw/day): Reproduction = 6.71; Growth = 7.0; Survival = 60

Figure H2.H-6. Avian TRV Derivation for Nickel as Presented in Figure 5.1 of EPA's Eco-SSL Document (USEPA 2007b)

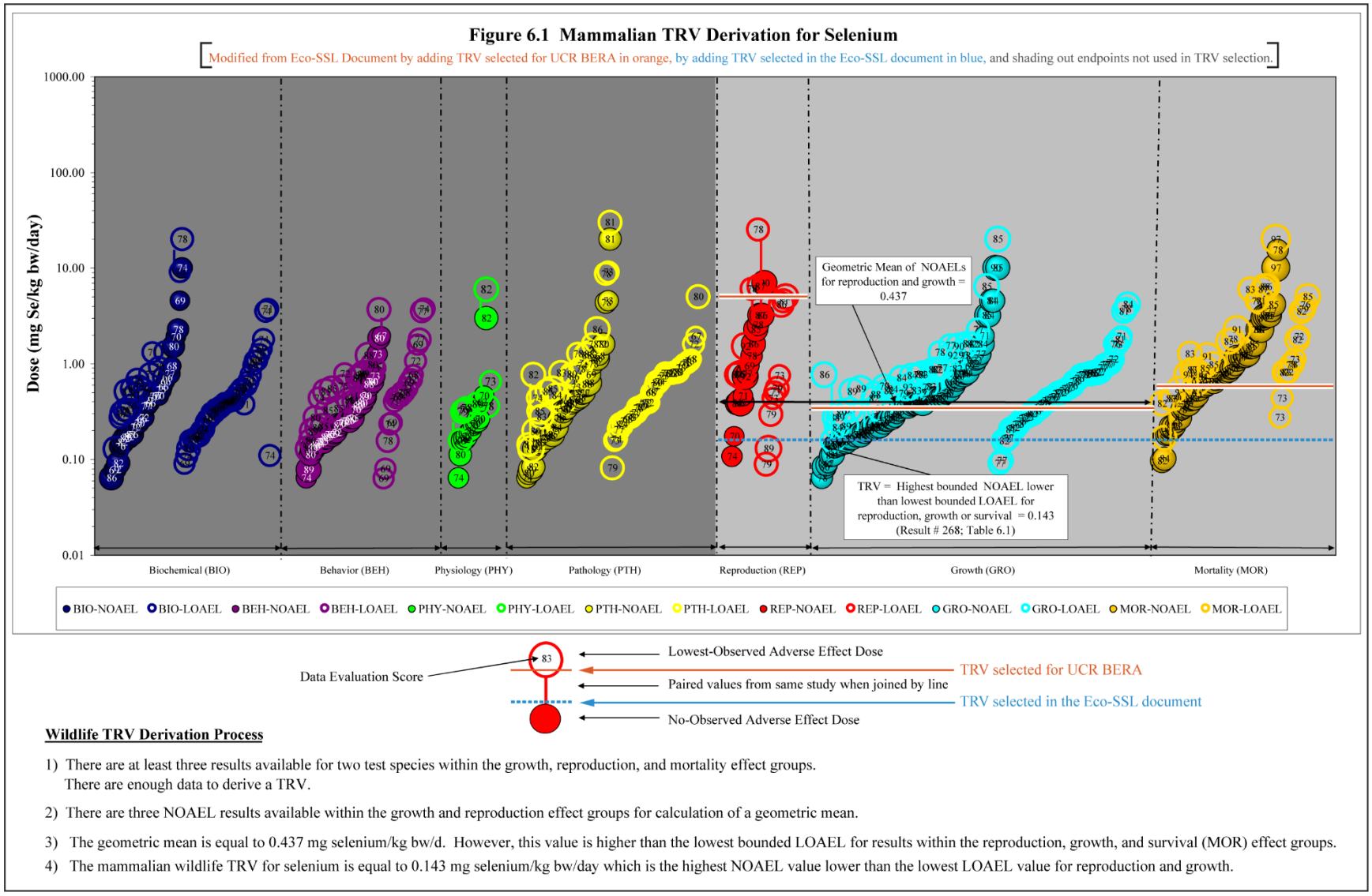


Wildlife TRV Derivation Process

1) There are at least three results available for two test species within the growth, reproduction, and mortality effect groups. There are enough data to derive a TRV.
2) There are at least three NOAEL results available within the growth and reproduction effect groups for calculation of a geometric mean.
3) The geometric mean is equal to 0.606 mg selenium/kg bw/d. However, this value is higher than the lowest bounded LOAEL for results within the reproduction, growth, and survival (MOR) effect groups.
4) The avian wildlife TRV for selenium is equal to 0.290 mg selenium/kg bw/day which is the highest NOAEL value lower than the lowest bounded LOAEL value for effects on reproduction, growth or survival.

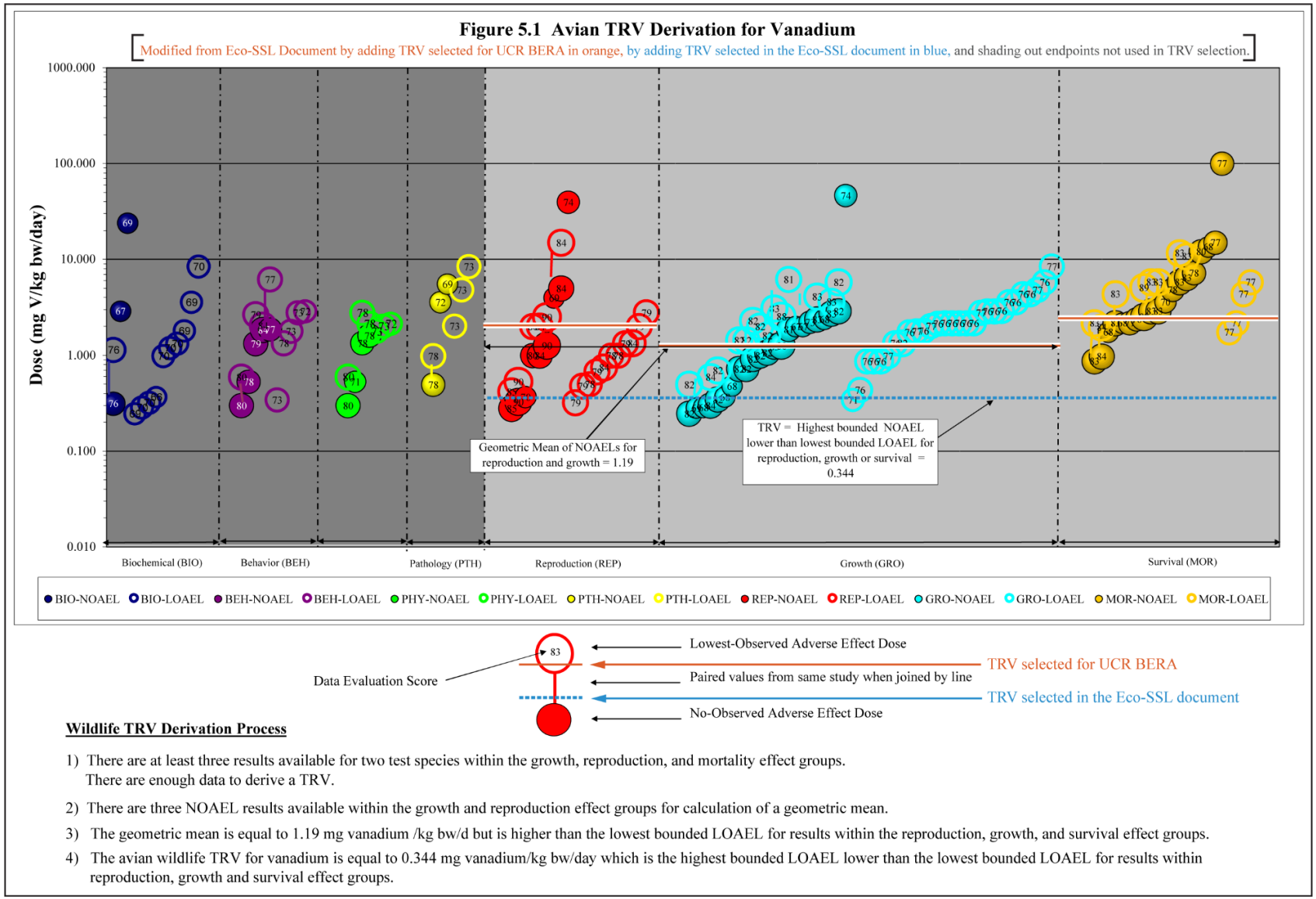
Note: Selected BERA wildlife TRVs for comparative purposes (in mg Se/kg bw/day): Reproduction = 0.55; Growth = 0.29; Survival = 0.59

Figure H2.H-7. Avian TRV Derivation for Selenium as Presented in Figure 5.1 of EPA's Eco-SSL Document (USEPA 2007c)



Note: Selected BERA wildlife TRVs for comparative purposes (in mg Se/kg bw/day): Reproduction = 5.0; Growth = 0.33; Survival = 0.61

Figure H2.H-8. Mammalian TRV Derivation for Selenium as Presented in Figure 6.1 of EPA's Eco-SSL Document (USEPA 2007c)



Note: Selected BERA wildlife TRVs for comparative purposes (in mg V/kg bw/day): Reproduction = 2.1; Growth = 1.2; Survival = 2.4

Figure H2.H-9. Avian TRV Derivation for Vanadium as Presented in Figure 6.1 of EPA's Eco-SSL Document (USEPA 2005e)

ATTACHMENT H3

UCR WILDLIFE BIOAVAILABILITY FACTORS

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MEMORANDUM

To: Teck American Incorporated

From: Berit Bergquist (Windward Environmental LLC) and Phyllis Fuchsman (Ramboll)

Subject: Wildlife Bioavailability Factors for the Upper Columbia River Aquatic BERA

Date: October 2025

1 INTRODUCTION

This technical memorandum presents the rationale for deriving wildlife bioavailability factors for use in the aquatic baseline ecological risk assessment (BERA) for the Upper Columbia River (UCR) Site[1] (hereinafter referred to as the Aquatic BERA), along with the uncertainty associated with the use of these factors. Bioavailability factors allow for a more realistic estimate of the absorption of metals from sediment, soil, and food items ingested by receptors. The amount absorbed from the Site is expected to be less than the amount absorbed from exposures administered in toxicity tests (i.e., metals added to food or water or administered via gavage) used to develop toxicity reference values (TRVs). This memorandum presents bioavailability factors for metals for which bird and mammal hazard quotients (HQs) are calculated in the Aquatic BERA,[2] with a focus on the metal chemicals of potential concern (COPCs) with the greatest exceedances of screening-level TRVs: copper, lead, and zinc.

[1] The Site is defined in the June 2, 2006, UCR remedial investigation and feasibility study settlement agreement as "the areal extent of hazardous substances contamination within the United States in or adjacent to the UCR, including the Franklin D. Roosevelt Lake, from the U.S.-Canada border to the Grand Coulee Dam, and those areas in proximity to the contamination that are suitable and necessary for implementation of response actions described in the Agreement." Sec. II, ¶ 6 o (USEPA 2006).

[2] HQs are calculated for aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc in the Aquatic BERA.

Section 2 of this memorandum presents background information about how bioavailability factors are used in the calculation of wildlife doses, and how in vitro bioaccessibility assay (IVBA) results from UCR samples are used to estimate bioavailability. Section 3 presents a data usability evaluation for the available IVBA data, including the applicability of IVBA data to wildlife receptors. Section 4 addresses the methods for extrapolating IVBA data for use in areas where these analyses have not been conducted, and for estimating bioavailability from IVBA data. Section 5 discusses bioavailability factors for wildlife food ingestion based on bioaccessibility data from the literature. A summary and list of references are presented in Sections 6 and 7, respectively.

2 BACKGROUND INFORMATION

The wildlife bioavailability factors used in the Aquatic BERA are modifiers defined as relative bioavailability (RBA) factors in the wildlife dose equation and are used as follows:

$$\boldsymbol{Dietary\ dose} = \frac{[(\boldsymbol{FIR}\times\boldsymbol{C_{food}}\times\boldsymbol{RBA_{food}})+(\boldsymbol{SIR}\times\boldsymbol{C_s}\times\boldsymbol{RBA_s})]}{\boldsymbol{BW\ x\ AUF}} \qquad \text{Equation 1}$$

Where:

Dietary dose = bioavailable COPC exposure per day via food, water, sediment, or soil (mg / kg bw / day)
FIR = food ingestion rate (kg food dw / day)
C_{food} = concentration in plant, invertebrate, or animal prey items (mg / kg food dw)
RBA_{food} = bioavailability of the COPC in plant, invertebrate, or animal prey items relative to that in the applicable TRV study (fraction)
SIR = incidental sediment or soil ingestion rate (kg sediment or soil dw / day)
C_s = concentration in sediment or soil (mg / kg dw)
RBA_s = bioavailability of the COPC in sediment or soil relative to that in the applicable TRV study (fraction)
BW = species body weight (kg)
AUF = area use factor (fraction)

The RBA factors account for the difference between the absolute bioavailability (ABA) of a metal in Site sediment, soil, or food and the ABA of the metal from the TRV study to which the dietary dose is being compared. For example, for sediment or soil ingestion:

$$\boldsymbol{RBA_s} = \frac{\boldsymbol{ABA\ for\ sediment\ or\ soil}}{\boldsymbol{ABA\ for\ reference\ material\ in\ toxicity\ study}} \qquad \text{Equation 2}$$

ABA is defined as the fraction of an administered dose that crosses the gastrointestinal epithelium and reaches systemic circulation (NRC 2003; Health Canada 2017; USEPA 2017) :

$$\textbf{\textit{Absolute bioavailability}}\ (\textbf{\textit{ABA}}) = \frac{\textbf{\textit{Absorbed dose}}}{\textbf{\textit{Administered dose}}} \qquad \text{Equation 3}$$

It is not necessary to identify ABA for risk assessment purposes; indeed, ABA is not typically measured directly. However, RBA may be measured experimentally using an indicator of ABA (e.g., metal concentration in blood or organ tissue), with parallel in vivo exposures conducted for a contaminated sediment or soil of interest and a reference substance representative of TRV studies.

Site-specific data on the RBAs of metals in the UCR are not available. However, data are available from IVBA analyses, which simulate the conditions in an organism's gut to provide an estimate of the metal fraction available for absorption from the gastrointestinal tract. IVBA analyses are defined operationally. The relationship between the bioaccessibility of a metal in a particular medium derived from in vitro analysis and the RBA of that metal in that medium can be estimated from in vivo validation studies, if data are available. Such relationships are available for lead for modelled mammalian and avian species (see Section 4.2), but not for copper or zinc. Section 4 discusses the basis for interpreting IVBA data for metals lacking in vivo validation studies; to be conservative in such cases, it is assumed that the RBA is equivalent to the IVBA.

3 UCR IVBA DATA USABILITY ASSESSMENT

This section describes the data usability assessment conducted to establish an IVBA dataset suitable and of acceptable quality for use in the Aquatic BERA. This assessment is also discussed in Appendix A of the Aquatic BERA.

The data usability assessment for establishing the IVBA dataset included four steps:

1) A data inventory step, to identify all IVBA studies with data relevant for use in the Aquatic BERA
2) A data quality step, to determine whether data identified in Step 1 are of acceptable quality for use in the Aquatic BERA
3) A data suitability step, to assess the relevance of sampling methods relative to the objectives of the analyses
4) A data comparability step, to determine whether data collected from different studies or using different methods can be combined for specific evaluations

The results of each of these steps are discussed in the following sections.

3.1 Data inventory

IVBA data were considered potentially relevant for the Aquatic BERA if they could be used in either of the following ways:

- To estimate RBA at the specific Aquatic BERA locations where IVBA was analyzed (herein referred to as the sample-specific IVBA dataset)
- To establish statistical relationships with other co-located parameters so that IVBA (and thus RBA) could be estimated for locations with data for these parameters but not for IVBA (as described in Section 4)

For the second of these data uses, an IVBA dataset consisting of both sediment and soil data was used, allowing for a more robust evaluation. Five UCR studies have involved the collection of IVBA data in sediment or soil: the 2009 to 2011 beach sediment study (TAI 2014), the 2014 upland soil study conducted by Teck American Incorporated (TAI) (TAI 2015), the 2015 Bossburg Flat sediment and soil study (TAI 2016), and two residential soil studies conducted in 2014 (CH2M HILL 2016) and 2016 (TAI 2017). The two residential soil studies are excluded from the IVBA dataset because 1) they are not included in the Aquatic BERA soil dataset (see Appendix A of the Aquatic BERA), and 2) data are not available for soil parameters that could be used to estimate IVBA for samples lacking IVBA data. Table 3-1 summarizes the sampling design for each of the three studies in the IVBA dataset. The following subsections describe each of the three studies in more detail.

Table 3-1. Summary of sampling designs for IVBA dataset studies

Study	Medium	Size Fraction Analyzed	Number of DUs/SDUs with IVBA Data	Analytes[a]
2014 upland soil study (TAI 2015)	soil	< 149 µm	ADA – 22[b,c] RFDA – 3[b,c]	IVBA for all target analyte metals, grain size, TOC, pH
2015 Bossburg Flat sediment and soil study (TAI 2016)	soil	< 150 µm	upland – 6[c]	lead and arsenic IVBA, grain size, TOC, pH
	sediment	< 250 µm	beaches – 10[c]	
2009–2011 beach sediment study (TAI 2014)	sediment	< 63 µm 63 to < 125 µm 125 to < 250 µm 250 µm to < 2 mm	33 beaches	lead and arsenic IVBA, grain size, TOC, pH

[a] TOC and pH were measured on the < 2-mm size fraction.

[b] Only a subset of soil samples from the 142 ADA DUs and the 16 RFDA DUs were analyzed for IVBA. None of the soil samples from the 13 WSDA DUs were analyzed for IVBA.

[c] A subset of DUs or SDUs were sampled in triplicate for IVBA analysis as part of the 2014 upland soil study (TAI 2015) and the 2015 Bossburg Flat sediment and soil study (TAI 2016).

ADA – aerial deposition area
DU – decision unit (soil study)
IVBA – in vitro bioaccessibility
RFDA – relict floodplain deposition area
SDU – sediment or soil decision unit (Bossburg Flat study)
TOC – total organic carbon
WSDA – windblown sediment deposition area

3.1.1 2014 upland soil study

Soil samples were collected from 171 decision units (DUs) during the 2014 upland soil study (TAI 2015). Samples were collected from the aerial deposition area (ADA), windblown sediment deposition areas (WSDAs), and relict floodplain deposition areas (RFDAs). The samples were processed prior to analysis to represent both the < 149-µm fraction (for use in the human health risk assessment [HHRA]) and the < 2-mm fraction (for use in the BERA).

A total of 142 locations, each approximately 25 acres in size, were sampled in the ADA. Incremental composite sampling was used to collect 1 composite sample from each of the 142 upland soil locations (TAI 2015). A total of 16 composite samples were collected from the RFDAs, and a total of 13 composite samples were collected from the WSDAs. Maps with sampling locations for the study are presented in the data summary report.

IVBA analyses were conducted on 25 samples sieved to < 149 µm, all collected from DUs with lead concentrations > 100 mg/kg. This was slightly more than 20% of the samples with lead concentrations > 100 mg/kg. IVBA analyses were conducted on samples from 22 DUs in the ADA and 3 DUs in the RFDAs (Table 3-1). Triplicate samples were collected for IVBA analysis from one DU in the ADA, and from one DU in each of the RFDAs from separate increment locations to estimate the variance of the mean.[3] IVBA analyses were not conducted on any WSDA samples. Only RFDA and WSDA locations are included in the Aquatic BERA for the estimation of wildlife exposure to metals. However, IVBA data from both the ADA and RFDA locations are used to develop regression relationships between IVBA and soil conventional parameters to estimate IVBA at locations without such data, as described in Section 4.

IVBA summary statistics for metals for which wildlife HQs were calculated in the Aquatic BERA are shown in Table 3-2. The IVBA results for copper, lead, and zinc are shown by area in Figure 3-1.

[3] The IVBA triplicate samples were not averaged in this evaluation unless otherwise noted.

Table 3-2. Summary of UCR IVBA data

Metal[a]	Sample Type and Size Fraction	Number of Locations[b]	Number of Samples	IVBA (%)[c,d]			
				Min.	Max.	Mean	Median
ADA (soil)							
Aluminum	< 149 µm	22	24	9.40	30.6	19.8	19.6
Arsenic		22	24	14.9	49.2	32.3	32.5
Barium		22	24	45.8	76.6	62.3	62.4
Cadmium		22	24	68.0	91.9	82.0	83.2
Chromium		22	24	1.60	6.90	3.53	3.50
Copper		22	24	13.2	40.0	24.3	24.2
Iron		22	24	3.10	10.8	6.36	6.15
Lead		22	24	65.0	95.9	84.9	86.6
Manganese		22	24	37.6	74.5	51.9	52.7
Mercury		15	16	2.80	9.50	6.90	7.10
Molybdenum		3	4	4.80	7.20	5.63	4.90
Nickel		22	24	3.10	9.40	5.98	6.10
Selenium		2	2	11.8	21.7	16.8	16.8
Thallium		22	24	8.70	41.1	18.2	16.4
Vanadium		22	24	3.00	8.60	5.04	5.00
Zinc		22	24	19.4	52.2	39.8	43.3
RFDA (soil)							
Aluminum	< 149 µm	3	5	14.7	18.8	17.0	17.6
Arsenic		3	5	16.4	27.3	21.5	20.7
Barium		3	5	26.4	43.6	33.1	29.4
Cadmium		3	5	37.7	43.4	39.8	38.3
Chromium		3	5	11.4	13.8	12.5	12.3
Copper		3	5	38.6	54.2	48.6	53.0
Iron		3	5	13.5	21.1	16.9	16.1
Lead		3	5	55.2	67.0	61.2	61.3
Manganese		3	5	53.4	58.0	55.9	56.2
Mercury		1	1	0.900	0.900	0.900	0.900
Molybdenum		3	5	2.90	3.90	3.40	3.40
Nickel		3	5	11.4	13.1	12.3	12.3
Selenium		1	1	13.0	13.0	13.0	13.0
Thallium		3	5	10.4	13.2	11.8	11.9
Vanadium		3	5	15.4	19.2	16.7	15.6
Zinc		3	5	42.7	53.0	46.6	44.1
Bossburg Flat Uplands (soil)							
Arsenic	< 150 µm	6	8	18.7	27.2	22.9	22.7
Lead		6	8	58.9	91.8	70.2	68.1
Bossburg Flat Beaches (sediment)							
Arsenic	< 250 µm	10	18	16.6	32.0	26.0	26.7
Lead		10	18	52.8	81.1	62.7	60.9

Metal[a]	Sample Type and Size Fraction	Number of Locations[b]	Number of Samples	IVBA (%)[c,d]			
				Min.	Max.	Mean	Median
UCR Beaches (sediment)[e]							
Arsenic	< 63 µm	33	33	7.11	34.6	19.8	19.6
	63–< 125 µm	33	33	11.4	37.6	22.5	22.0
	125–< 250 µm	32	32	6.99	46.9	20.2	17.8
	250 µm–< 2 mm	32	32	2.71	60.1	16.0	12.0
Lead	< 63 µm	33	33	29.4	82.0	56.0	54.9
	63–< 125 µm	33	33	25.5	69.5	48.9	52.4
	125–< 250 µm	33	33	21.1	71.8	47.4	49.7
	250 µm–< 2 mm	33	33	18.1	69.3	39.3	36.4

[a] Only metals for which HQs are calculated in the Aquatic BERA are presented.

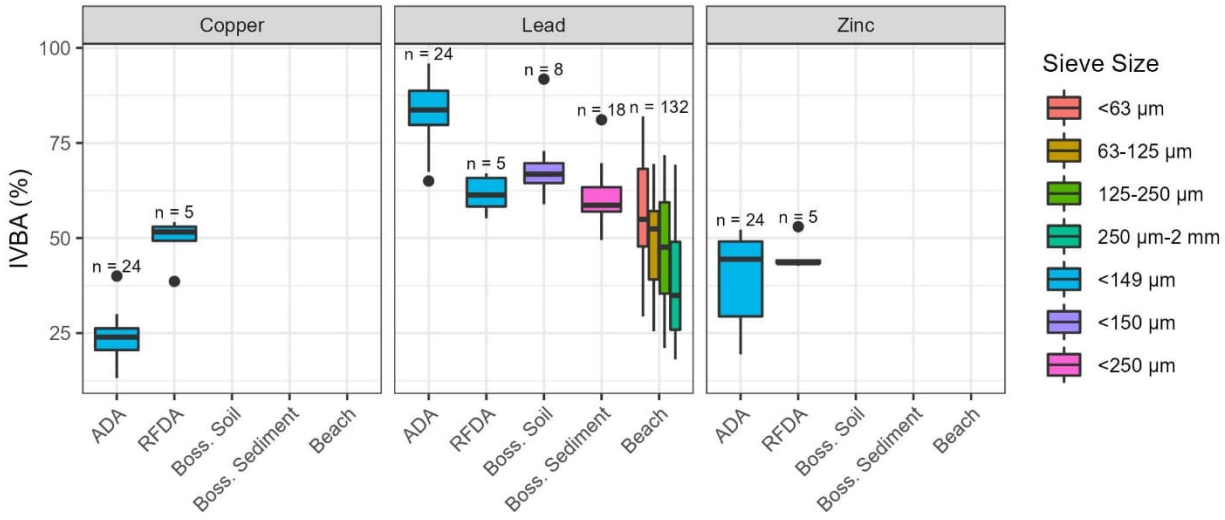
[b] %IVBA was not calculated for samples with non-detected or rejected values for either the IVBA or total metal concentration.

[c] %IVBA was calculated as the concentration of metal derived from the IVBA method divided by the total concentration of metal in the sample.

[d] For locations with replicate samples, only the maximum result among replicates was retained for use in calculating statistics.

[e] Results from the reanalysis of samples from five beaches in 2013 (where samples were sieved to < 250 µm) indicated that IVBA values were greater than those from the same five beaches sampled in 2011 (when values for the three size fractions < 250 µm were averaged on a weighted basis) (USEPA 2014). However, lead concentrations in the 2013 samples were less than those in the 2011 samples, resulting in comparable HHRA RBA-adjusted lead concentrations.

ADA – aerial deposition area
BERA – baseline ecological risk assessment
HHRA – human health risk assessment
HQ – hazard quotient
IVBA – in vitro bioaccessibility
RBA – relative bioavailability
RFDA – relict floodplain deposition area
UCR – Upper Columbia River



Box and whisker plots: Box encompasses the second and third quartiles of data, with the inner horizontal line representing the median. Whiskers show minimum and maximum values excluding outliers (i.e., data points beyond 1.5× the difference between the 25th and 75th percentiles). Outliers are plotted as individual points.

ADA – aerial deposition area
Boss. – Bossburg Flat
IVBA – in vitro bioaccessibility
RFDA – relict floodplain deposition area

Figure 3-1. Bioaccessibility of copper, lead, and zinc in areas of the Site

3.1.2 2015 Bossburg Flat sediment and soil study

Similar to sampling for the 2014 upland soil study, sampling for the 2015 Bossburg Flat sediment and soil study was conducted within sediment or decision units DUs (SDUs) using the incremental composite sampling method (TAI 2016). Six soil SDUs were sampled in the upland area and 10 sediment SDUs were sampled in the beach area. All SDU samples were analyzed for lead and arsenic IVBA. Triplicate samples were collected for IVBA analysis from one soil SDU and four sediment SDUs from separate increment locations, to estimate the variance of the mean. Soil samples were sieved to the < 150-µm size fraction, and sediment samples were sieved to the < 250-µm size fraction.

3.1.3 2009 to 2011 beach sediment study

For the 2009 to 2011 beach sediment study (TAI 2014), 5 composite samples were collected from each of 33 beaches, and IVBA analysis was conducted on 1 composite sample randomly selected from each beach. Each selected composite was sieved into four size fractions and analyzed for arsenic and lead IVBA (Table 3-1).[4]

[4] In 2013, lead IVBA analyses were rerun on archived samples from 5 of the 33 beaches (USEPA 2013). These samples were analyzed for the sediment fraction sieved to < 250 µm, rather than for three separate size fractions (< 63, 63 to < 125, and 125 to < 250 µm).

3.2 Data quality

The data quality assessment included a review of the availability of a list of data documentation items considered important to ensure data usability (e.g., supporting documentation on sampling methods, information on analytical methods, description of data validation process). The full list of items evaluated and the results of the assessment are described in detail in Appendix A of the Aquatic BERA. None of the IVBA data sources are missing any data documentation items, and all three studies are acceptable for use in the Aquatic BERA.

3.3 Data suitability

IVBA data are used in the Aquatic BERA to estimate the bioavailability of metals in sediments and soils incidentally ingested by wildlife. IVBA data were generated for this Site using a method designed for HHRA purposes; therefore, this section evaluates the suitability and applicability of the IVBA data for use in the wildlife risk assessment.

In the proceedings of an industry-government workshop on the development of metal cleanup values, Sample et al. (2014) recommended the evaluation of metal bioaccessibility as one component of ecological exposure assessment refinements. Although IVBA methods are designed to address human exposure to metals, metal bioaccessibility data are also useful for improving wildlife exposure estimates. Although not yet routine, bioaccessibility analyses have been used in ecological risk assessments at other sites, including the Coeur d'Alene Superfund site (USEPA 2001).

As shown in Table 3-1, IVBA analyses were conducted on the < 149- or < 150-µm size fractions, which are considered relevant for the HHRA, whereas the < 2-mm size fraction is considered relevant for the Aquatic BERA. However, metals in larger particles are often less bioaccessible than those in smaller particles, due to a lower surface-to-volume ratio (Walraven et al. 2015). Therefore, the use of the < 149- or < 150-µm size fractions as a surrogate for the < 2-mm size fraction would likely result in a high bias—and therefore conservative bias—in the estimation of bioavailability in the size fraction ingested by wildlife. Therefore, data from the < 149- or < 150-µm size fractions are suitable for application to wildlife for a conservative estimate of bioavailability.

The remainder of this section covers three technical issues with applying IVBA data to wildlife exposure estimation. Section 3.3.1 considers the influence of digestive system characteristics, which differ among species. Section 3.3.2 evaluates validation studies comparing IVBA and RBA data in animals. Section 3.3.3 verifies the applicability of IVBA data to the specific TRVs selected for use in the Aquatic BERA.

3.3.1 Digestive physiology

The method used to measure metal bioaccessibility at the Site (US Environmental Protection Agency [USEPA] Method 1340) uses a non-exhaustive extraction process to simulate the digestive system of a child ingesting soil on an empty stomach. The sample

is extracted for one hour, using an extraction fluid of 0.4 molar glycine at a pH of 1.5, and applied at a solution-to-soil ratio of 100:1.

Several factors affect how well different IVBA methods reflect in vivo-related bioavailability of metals, such as pH, extraction duration, extraction fluid composition, and the section of the gastrointestinal tract simulated. IVBA methods are designed to reflect the human digestive system, and their applicability to other species could be affected by interspecies differences in gastric pH, retention time, and gastrointestinal enzymes. The following paragraphs discuss interspecies variation in gastric pH and digestive retention time, to explore whether the pH and extraction time designed to mimic human digestion can be considered reasonably conservative with respect to a range of other species. Simultaneously, the following discussion recognizes that these are not the only factors potentially affecting interspecies differences in the relative bioavailabilities of metals.

Comparisons across IVBA methods indicate that extractant pH strongly affects IVBA outcomes for several metals, especially lead (Ng et al. 2015; Yan et al. 2016; ESG 2011), with lower pH resulting in higher estimated bioaccessibility. It is reasonable to expect that gut pH affects metal extraction during digestion in a similar manner. Among mammalian and avian species, differences in gastric pH tend to be associated with different feeding guilds (Beasley et al. 2015). Low gastric pH can serve as a barrier to infection; from an evolutionary perspective, scavengers and carnivores benefit more from low pH than do herbivores and insectivores.

Table 3-3 classifies the potential wildlife species assessed in the Aquatic BERA by feeding guild and provides gastric pH data for other representative species in each feeding guild. The gastric pH ranges summarized in Table 3-3 are all similar to or greater than the pH of 1.5 used in USEPA Method 1340. Thus, with respect to pH, the IVBA results generated using this method of measuring metal bioaccessibility should be conservative when applied to the wildlife species of interest. Indeed, the overestimation bias could be strong for pH-sensitive metals like lead, since many wildlife species' stomach fluids are estimated to be orders of magnitude less acidic than the extractant used in USEPA Method 1340.

Table 3-3. Gastric pH of representative mammalian and avian species

Feeding Guild[a]	Potential UCR Wildlife Receptors	Similar Species with Gastric pH Data[b]	pH Range[b]
Mammals			
Carnivores/piscivores	mink, river otter, short-tailed weasel	ferret, dog, cat	1.5–4.5
Invertivores	little brown bat, water shrew, masked shrew	common pipistrelle, echidna	5.1–6.8
Omnivores	deer mouse	mouse, rat	3.8–4.4
Herbivores (hindgut fermenters)	muskrat, meadow vole	hamster, guinea pig, gerbil, beaver, porcupine	1.7 (beaver) 4.3–4.9 (others)

Feeding Guild[a]	Potential UCR Wildlife Receptors	Similar Species with Gastric pH Data[b]	pH Range[b]
Birds			
Carnivores (including vertebrates/carrion prey)	bald eagle, American kestrel	bald eagle, various falcons	1.3–1.8
Piscivores/ aquatic invertivores	belted kingfisher, common merganser	great cormorant, various penguins	2.3–3.0
Invertivores/ omnivores (excluding vertebrate prey)	tree swallow, American robin, black-capped chickadee, mallard	starling, chicken, mallard	2.0–3.7
Invertivores with opportunistic vertebrate carrion consumption	spotted sandpiper	oystercatcher, moorhen	1.2–1.4
Herbivores	tundra swan, California quail	Japanese quail,[c] pigeon[d]	2.0–4.8

[a] Feeding guilds are consistent with those presented in the BERA work plan and expanded problem formulation (TAI 2011, 2012).

[b] pH data are from Beasley et al. (2015) unless noted otherwise.

[c] Japanese quail data are from Beyer et al. (2016).

[d] Pigeon data are from Langlois (2003).

BERA – baseline ecological risk assessment

UCR – Upper Columbia River

Although probably less influential than pH, gut passage time also varies substantially among species and could affect how well IVBA data represent metal bioaccessibility for a given species of interest. While this parameter does not contribute greatly to differences in results among various IVBA methods (Ng et al. 2015), significantly shorter or longer digestion times could affect bioaccessibility (i.e., the amount of metal solubilized from soil could increase with greater digestion time). Table 3-4 provides examples of food passage times through the guts of various species. Small birds and mammals have much shorter gut passage times than do humans, whereas ruminants (e.g., cows, bison) can have much longer gut passage times. The durations given in Table 3-4 represent the complete digestive process, whereas USEPA Method 1340 specifically simulates the gastric (i.e., stomach) phase of digestion. Nevertheless, if the gastric phase is even roughly proportional across species, then the duration of extraction in USEPA Method 1340 is conservative with respect to small birds and mammals.[5]

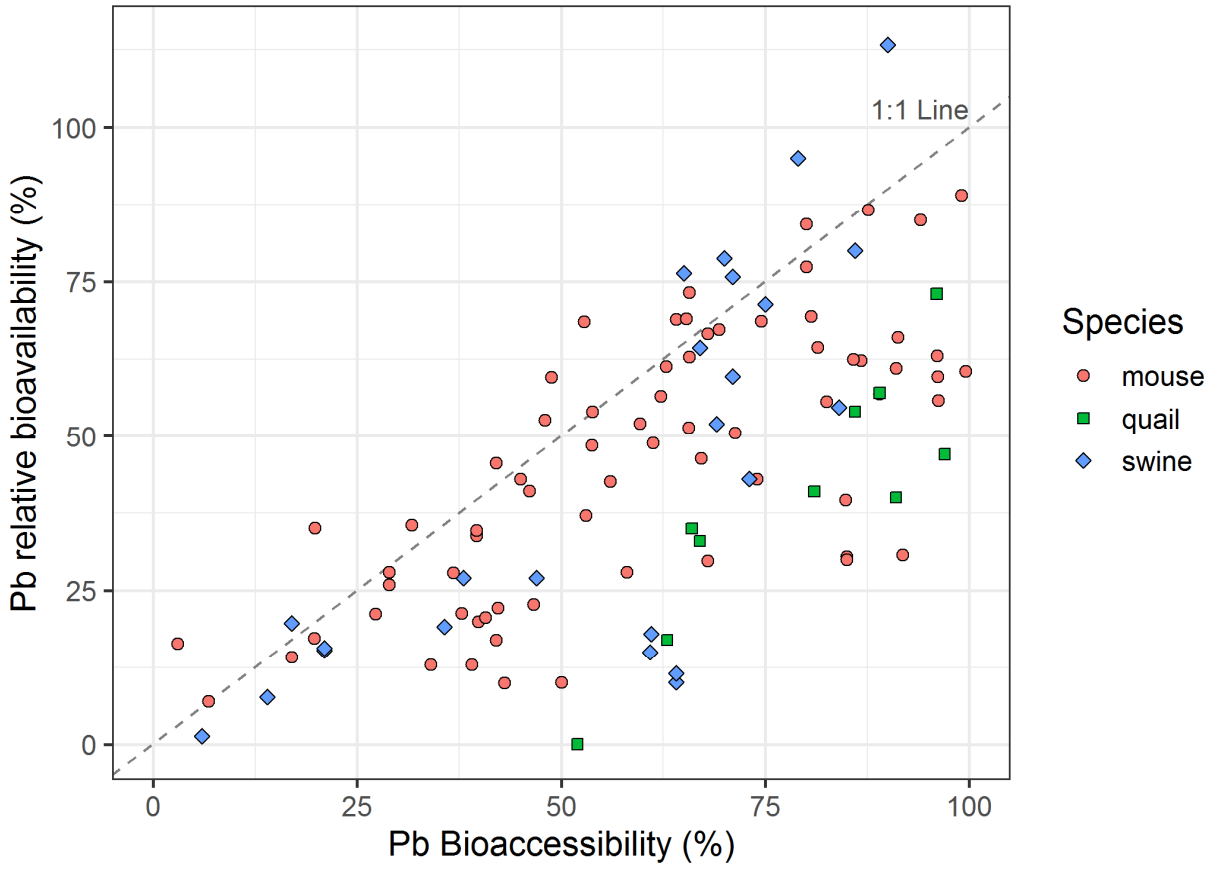
[5] The duration of extraction is not necessarily conservative with respect to ruminants. Additionally, ruminant digestion involves bacterial fermentation in a reducing environment, which could change metal speciation and possibly bioavailability compared to non-ruminant digestive conditions (Suedel et al. 2006). However, the applicability of IVBA data to ruminants is not a concern for the Aquatic BERA, because ruminants are not evaluated as receptors of concern.

Table 3-4. Examples of gut retention times for various species

Species	Gut Retention Time (hours)	Reference
Human	47	Hatton et al. (2015)
Swine	49	Hatton et al. (2015)
Rat	30	Hatton et al. (2015)
Songbirds	0.8–1.8	Karasov and Douglas (2013) and Levey and Karasov (1994)
Great mouse-eared bat	5	Hernout et al. (2015)
Brandt's vole	5.5	Clauss et al. (2007)
Bison	79	Clauss et al. (2007)

3.3.2 In vivo validation of bioaccessibility analyses

Studies providing paired measurements of lead bioaccessibility and in vivo bioavailability for the same soils are available for swine (*Suidae*), mice (*Mus*), and Japanese quail (*Coturnix japonica*) (Li et al. 2020 and references therein; Beyer et al. 2016). The validation studies relevant to this memorandum measured IVBA lead using USEPA Method 1340 and directly measured lead bioavailability in animals. Bioavailability was measured based on lead concentrations in blood or organ tissues, and in vivo results were interpreted by comparing lead uptake from contaminated soils to the uptake of a soluble lead reference compound (generally lead acetate). Figure 3-2 compares the resulting IVBA and RBA data; results that plot to the right of the 1:1 line represent soils and species for which the measured IVBA results are greater than the RBA results, so the use of IVBA data tends to overestimate true exposure. USEPA Method 1340 tends to overestimate in vivo RBA more strongly in avian species (e.g., quail) than in mammalian species. No systematic difference between the swine and mice overestimation biases is evident.



Data sources: Beyer et al. (2016) for Japanese quail, Li et al. (2020) for mammals

Figure 3-2. Comparison of in vitro bioaccessibility and in vivo relative bioavailability of lead in soils ingested by mice, swine, and Japanese quail

In addition to lead, USEPA Method 1340 has been validated for assessing arsenic and cadmium bioaccessibility in soils (Li et al. 2020; USEPA 2017). For several other metals in soil (e.g., antimony,[6] cobalt, nickel), more limited validation efforts have been documented using swine and rats (*Rattus*); these efforts have yielded qualitative agreement between approaches (i.e., consistently very low IVBA and RBA results) (Vasiluk et al. 2019; Suh et al. 2019; Denys et al. 2012). For zinc, data to compare IVBA and RBA measurements are only available for pure zinc minerals, rather than zinc-contaminated soils (Molina et al. 2013). Although USEPA Method 1340 severely over-predicted RBA, it is unclear whether that result was primarily due to the IVBA method or the materials tested. Paired IVBA and RBA data for copper based on USEPA Method 1340 are not available.

Overall, the successful validation of IVBA methods in laboratory animals implies the methods' applicability to wildlife and humans. The similarity of results between swine and mice suggests that the IVBA approach's applicability should not be unduly affected by specific digestive system characteristics, at least among non-ruminant mammals. Although avian validation data are limited, the available information suggests that the application of IVBA data from USEPA Method 1340 to birds is conservative.

3.3.3 IVBA applicability relative to Site TRVs

Metal bioavailability for the reference dosing medium in a TRV study, while typically not measured, is expected to be high relative to many environmentally relevant forms, given that soluble forms of metals are generally used to deliver the dose via spiked food, gavage, or drinking water. In studies used to derive the UCR wildlife TRVs for copper, lead, and zinc, all forms were soluble or bioavailable (i.e., copper sulfate, lead nitrate, lead acetate, zinc carbonate, zinc chloride, zinc acetate, zinc sulfate, and zinc methionine), with the exceptions of copper oxide and zinc oxide (Table 3-5). Copper oxide had greater toxicity than did copper sulfate, which could reflect copper oxide's similar bioavailability to that of the more soluble sulfate form, or it could be a result of other aspects of the study design. Although zinc oxide is insoluble in water, some in vitro studies have shown it to have bioaccessibility similar to or greater than those of soluble forms of zinc when added to food (Etcheverry et al. 2012). Therefore, for this evaluation, the TRVs are derived for metal forms to which typical RBA derivations apply.

[6] The antimony validation used a European IVBA method rather than USEPA Method 1340.

Table 3-5. Exposure routes and forms of metals in studies used to derive UCR TRVs

Metal	Exposure Form and Route	Mammals			Birds		
		Survival	Growth	Reproduction	Survival	Growth	Reproduction
Copper	form	sulfate	sulfate	sulfate	oxide	sulfate	sulfate
	route	diet	diet	diet	diet	diet	diet
Lead	form	nitrate	nitrate	acetate	nitrate	acetate	acetate
	route[a]	gavage	gavage	gavage	gavage	diet	diet
Zinc	form	carbonate	multiple[b]	multiple[b]	carbonate	multiple[b]	acetate
	route[a]	diet	gavage and diet	gavage and diet	diet	diet	diet

Note: Details on studies used to derive TRVs are available in Attachment H2.

[a] During gavage administration, food was available to the animals *ad libitum*.

[b] USEPA's Eco-SSL is used as the zinc TRV for mammals/growth, mammals/reproduction, and birds/growth (USEPA 2007a). The mammal and bird Eco-SSLs for zinc were derived as the geomean of NOAEL values for growth and reproduction from studies that used zinc in the forms of acetate, carbonate, chloride, methionine, oxide, or sulfate; a small number of studies did not specify the form of zinc.

Eco-SSL – ecological soil screening level
NOAEL – no-observable-adverse-effect level
TRV – toxicity reference value
UCR – Upper Columbia River
USEPA – US Environmental Protection Agency

3.4 Data comparability

To develop regression relationships for locations with no IVBA data, IVBA data from all three studies—the 2014 upland soil study, the 2015 Bossburg Flat sediment and soil study, and the 2009 to 2011 beach sediment study—were grouped to determine if there was a relationship that would support combining the data. As shown in Table 3-1, although the same IVBA method was used, data were collected from both sediment and soil as well as from different grain size fractions. As described in Section 5, the evaluation of data from all three groups showed that the relationships between lead and pH and zinc and total organic carbon (TOC) displayed similar enough patterns to warrant combining data across media types and grain sizes.

4 APPLICATION OF IVBA DATA TO SEDIMENT AND SOIL INGESTION

To apply the Site-specific IVBA data to sediment and soil ingestion as wildlife exposure pathways in the Aquatic BERA, it was necessary to determine 1) how to estimate metal bioaccessibility in samples with different characteristics than those analyzed for metal bioaccessibility, and 2) how to estimate RBA from measured or estimated IVBA results. These considerations are addressed in Sections 4.1 and 4.2.

4.1 Extrapolation of IVBA data to apply to additional samples

Limitations in spatial coverage of the existing Site-specific IVBA data include the following:

- Bioaccessibility was analyzed in a subset of sediment and soil samples, with the expectation that the results would be extrapolated to apply to the remaining locations.
- The only samples with bioaccessibility data in the Aquatic BERA dataset are sediment samples from the 2015 Bossburg flat sediment and soil study and the 2009 to 2011 beach sediment study (analyzed for arsenic and lead only), as well as a subset of RFDA soil samples from the 2014 upland soil study (analyzed for all metals).

Therefore, it was necessary to examine factors potentially affecting metal bioaccessibility to determine the most appropriate approach for extrapolating the existing data to additional areas. This evaluation focused on copper, lead, and zinc, the Site-related metal COPCs with the greatest exceedances of screening-level TRVs (TAI 2019, 2020).[7] A simpler default approach—informed by the findings for copper, lead, and zinc—was identified for other metals, as discussed later in this section. All available IVBA data for both sediment and soil samples were included in this evaluation to provide a robust extrapolation approach for lead IVBA data. Copper and zinc IVBA data were not available for sediment samples.

Metal bioaccessibility in soil depends on the metal's physical/chemical form and the soil's capacity to bind the metal. Factors that could potentially affect metal speciation and binding include (Walraven et al. 2015; Grøn and Andersen 2003; Furman et al. 2007; Dehghani et al. 2018; Yan et al. 2019)

- Metal form in the source material as originally released to the environment
- Soil characteristics such as pH, redox state, TOC content, cation exchange capacity (CEC), and grain size distribution
- Total metals concentrations, which when low relate primarily to chemical form (i.e., proportion in natural background minerals versus anthropogenic contamination), and when high may relate to saturation of binding sites

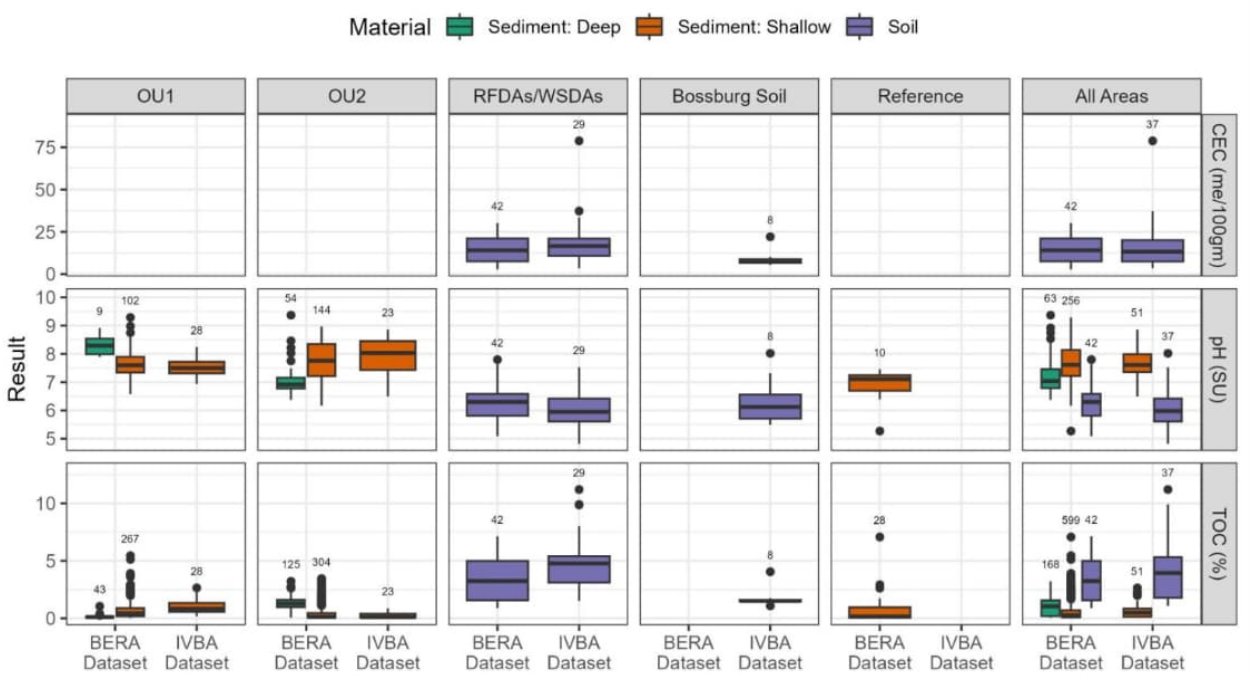
Metal speciation has not been analyzed at the Site, but generalizations can be made regarding typical metal forms in slag and airborne particles from smelter operations. In slag, zinc tends to be concentrated in mineral phases like spinels and silicates, while elements that are chemically incompatible with these mineral structures (e.g., lead, copper) are typically incorporated into amorphous glasses and minor alloy phases (Piatak et al. 2004; Piatak and Seal 2010; Ettler 2001). In soils contaminated by airborne particulates, metals are commonly found in a small size fraction of the total mass

[7] The COPC refinement (TAI 2019) included an addendum that was finalized in January 2020 (TAI 2020).

(< 10 μm) (Vespa et al. 2010; Batonneau et al. 2004). Depending on source and soil chemistry, zinc may be found in carbonates, hydroxides, iron oxides, or sulfides (Vespa et al. 2010; Roberts et al. 2002), while lead and copper may be found as various oxide, sulfide, sulfate, and alloy species (Spear et al. 1998; Burt et al. 2003). Slag fragments and dusts tend to be less soluble than airborne particles, and therefore metals in slag tend to be less bioavailable than those in airborne dusts (Spear et al. 1998; Ettler 2016). Thus, the origin of metal contamination (e.g., slag materials in sediment RFDAs versus airborne particulates in the ADA) is one of the factors considered in the assessment of bioaccessibility extrapolation approaches. However, because geochemical transformations of metals probably occur after their release into the environment, other previously listed factors also play an important role in determining bioaccessibility.

Sample characteristics that could influence metal bioaccessibility and that have been measured at the Site include pH, TOC, CEC, grain size distribution, and total metal concentrations; results are shown by area in Figures 4-1 through 4-3.[8] Data for all samples that have IVBA data are compared to data for all samples in the Aquatic BERA dataset, which includes samples for which IVBA data are not available and need to be estimated.

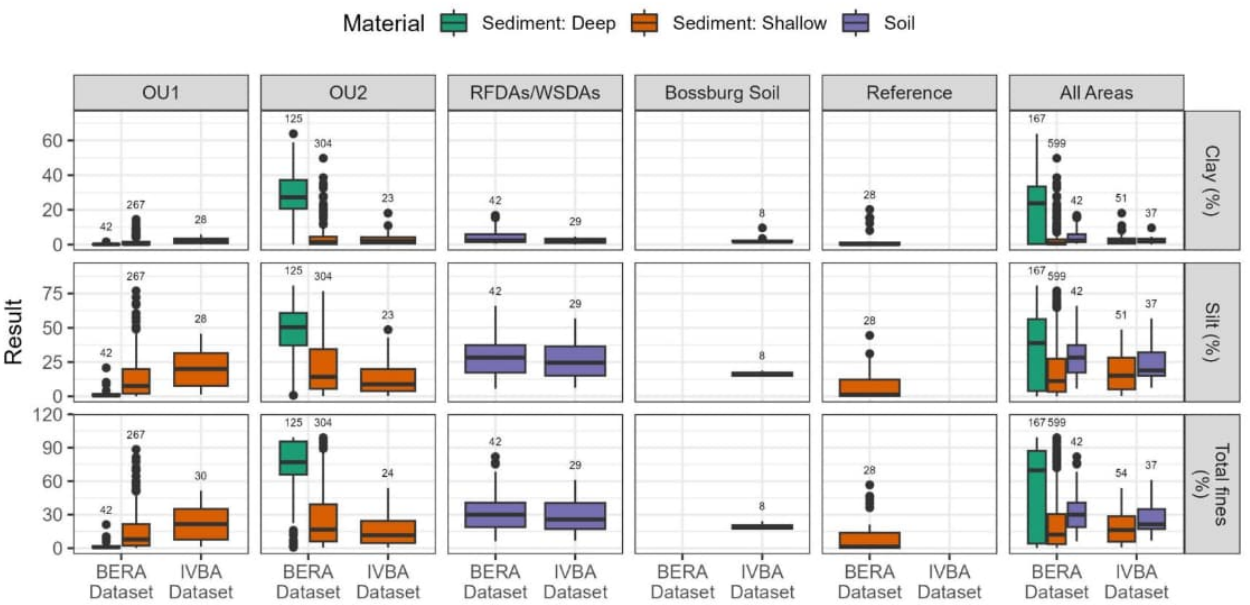
[8] CEC data are only available for the RFDAs, WSDAs, and Bossburg Flat soil samples.



Note: OU 1 includes the OU 1 North and OU 1 South CSM Units. OU 2 includes the transitional and lacustrine (upper, middle, and lower) CSM units.

BERA – baseline ecological risk assessment
CEC – cation exchange capacity
CSM – conceptual site model
IVBA – in vitro bioaccessibility
OU – operable unit
RFDA – relict floodplain deposition area
SU – standard unit
TOC – total organic carbon
WSDA – windblown sediment deposition area

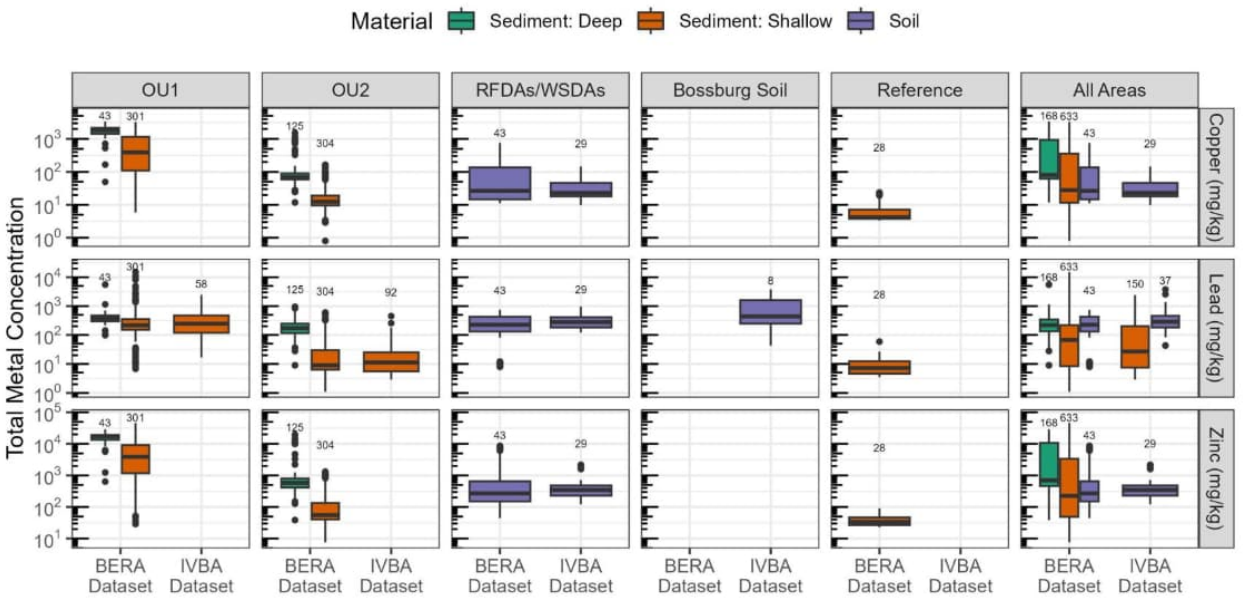
Figure 4-1. Sample characteristics that may influence bioaccessibility in areas of the Site



Note: OU 1 includes the OU 1 North and OU 1 South CSM Units. OU 2 includes the transitional and lacustrine (upper, middle, and lower) CSM units

BERA – baseline ecological risk assessment
CSM – conceptual site model
IVBA – in vitro bioaccessibility
OU – operable unit
RFDA – relict floodplain deposition area
WSDA – windblown sediment deposition area

Figure 4-2. Grain size characteristics of samples from the Site

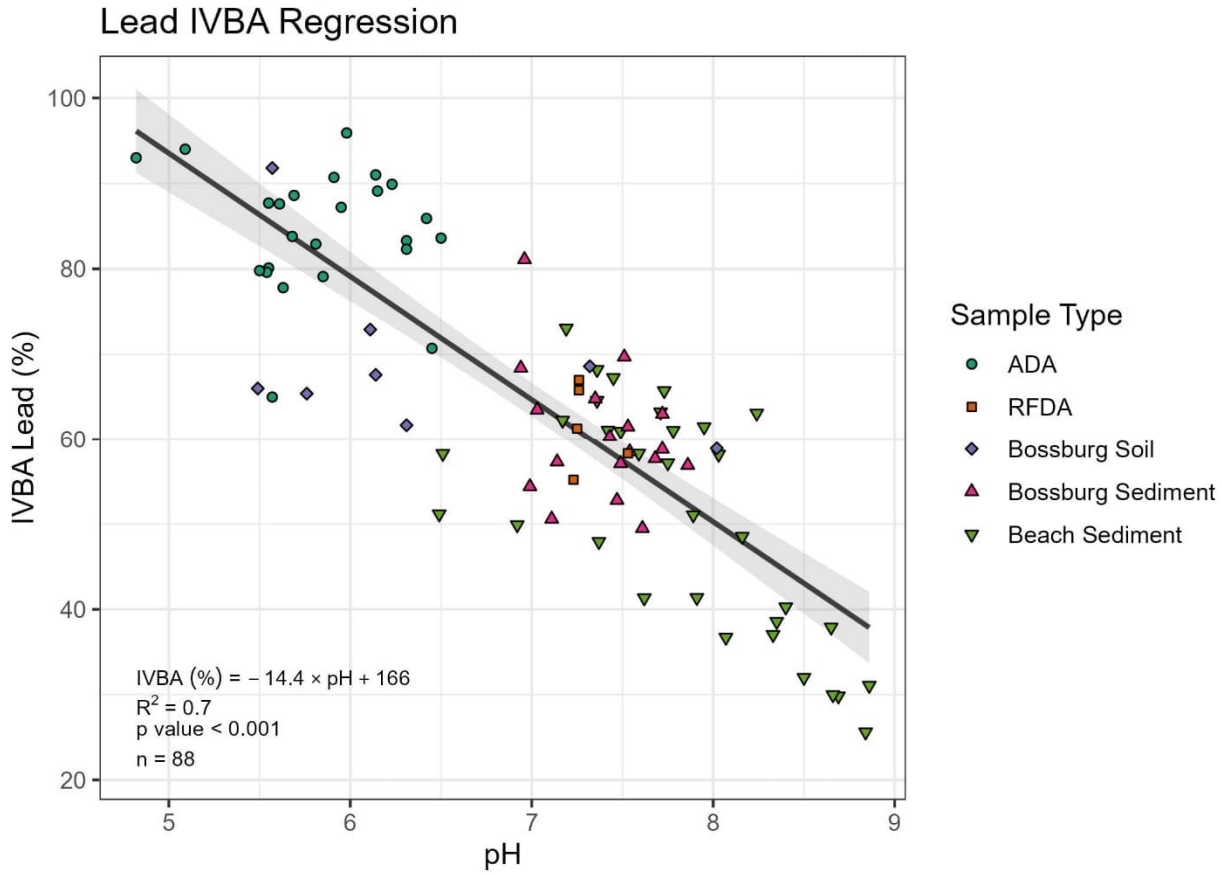


Note: OU 1 includes the OU 1 North and OU 1 South CSM Units. OU 2 includes the transitional and lacustrine (upper, middle, and lower) CSM units

BERA – baseline ecological risk assessment
CSM – conceptual site model
IVBA – in vitro bioaccessibility
OU – operable unit
RFDA – relict floodplain deposition area
WSDA – windblown sediment deposition area

Figure 4-3. Total copper, lead, and zinc concentrations in samples from the Site

Total metal concentration, pH, TOC, CEC, percent clay, and percent fines (silt + clay) were assessed to determine their usefulness as predictors of copper, lead, or zinc bioaccessibility. No relationship was observed for CEC, percent clay, or percent fines with lead or zinc bioaccessibility. A strong relationship was observed between pH and lead bioaccessibility, as shown in Figure 4-4; greater acidity evidently promotes greater lead bioaccessibility. This relationship bridges areas, source types, and media types, as a consistent linear relationship is evident across ADA and RFDA soils, as well as beach sediments and Bossburg Flat sediments and soils. This finding is consistent with those of other published studies identifying pH as a key determinant of lead bioaccessibility (e.g., Yang et al. 2003; Dehghani et al. 2018).

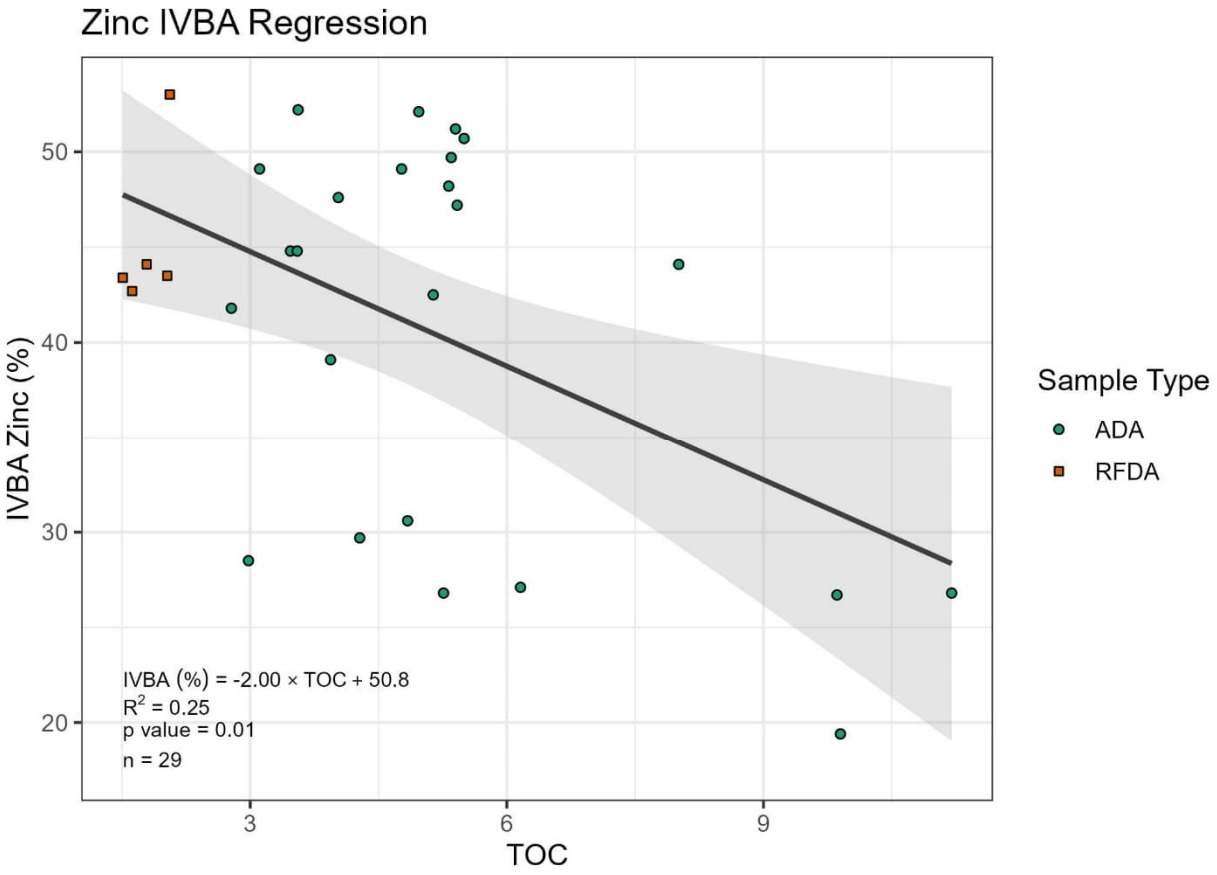


Note: Beach area bioaccessibility values represent the average of results for the < 63-µm, 63- to < 125-µm, and 125- to < 250-µm size fractions.

ADA – aerial deposition area
RFDA – relict floodplain deposition area
IVBA – in vitro bioaccessibility

Figure 4-4. Lead bioaccessibility as a function of pH in samples from the Site

For zinc, a more variable but still highly significant relationship was identified between soil TOC and percent bioaccessibility (Figure 4-5). This finding was based on data for ADA and RFDA soils; zinc bioaccessibility was not measured in soil or sediment collected during the 2015 Bossburg Flat sediment and soil study or 2009 to 2011 beach sediment study. At other sites, relationships between zinc bioaccessibility and soil characteristics have varied among studies, but TOC has sometimes been identified as an important predictive variable (e.g., Dehghani et al. 2018), consistent with the UCR dataset.



ADA – aerial deposition area
IVBA – in vitro bioaccessibility
RFDA – relict floodplain deposition area
TOC – total organic carbon

Figure 4-5. Zinc bioaccessibility as a function of TOC in soils from the Site

Although copper bioaccessibility was found to be correlated to total copper concentrations, this relationship was not usable for Site-specific data extrapolation purposes. The range of total copper concentrations in the grain size fraction analyzed for bioaccessible metals was low for the < 149-µm fraction (7.28 to 146 mg/kg) compared to the ranges of copper concentrations in sediment (0.8 to 3,370 mg/kg) and bulk soils (8.22 to 758 mg/kg). Applying the observed relationship from the < 149-µm fraction to sediment and bulk soils would result in predictions of more than 100% bioaccessibility, which would not be meaningful. In actuality, metals in larger particles are often less bioaccessible than those in smaller particles, due to a lower surface-to-volume ratio (e.g., Walraven et al. 2015); this pattern holds true on a Site-specific basis for lead in beach sediments.

Based on these findings, the approach to estimating lead and zinc bioaccessibility in the Aquatic BERA is as follows. Measured bioaccessibility data are used if available for a

given soil or sediment sample. In all other cases, the following equations from Figures 4-4 and 4-5 are applied:

- Lead: %bioaccessible = -14.4 × pH + 166
- Zinc: %bioaccessible = -2.0 × %TOC + 50.8

In the Aquatic BERA, IVBA values are estimated on a sample-specific basis using sample-specific pH and TOC data if available. For locations where pH and TOC data are not available, IVBA is estimated using the average pH and TOC for the conceptual site model (CSM) unit or RFDA within which the location falls.

Whereas bioaccessibilities for lead and zinc are estimated using regressions, the bioaccessibilities of copper and other metals are estimated according to the following approach:

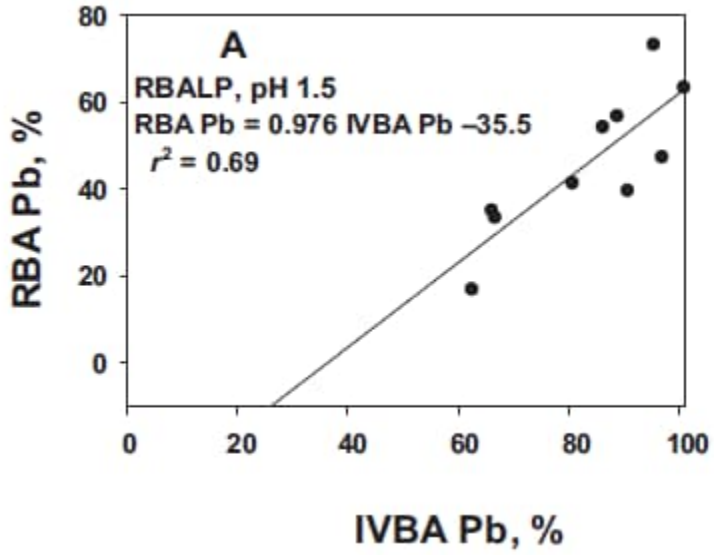
- Measured IVBA data are used for RFDA locations with available data.
- For locations with no IVBA data, the greater of the ADA or RFDA IVBA mean values is used.
- For arsenic, the greatest mean IVBA value for each grain size fraction from the sediment IVBA dataset, by CSM, is used.[9]

4.2 Estimation of relative bioavailability from bioaccessibility

For lead, the in vivo validation data described in Section 3 support regression equations to estimate RBA based on IVBA results. For birds, the applicable regression is as follows (Beyer et al. 2016) (Figure 4-6):

Avian lead: %RBA = 0.976 × %Bioaccessible – 35.5

[9] The 2015 Bossburg Flat sediment and soil study collected 8 sediment samples (3 of which were triplicates) sieved to < 250 µm; the 2009 to 2011 beach sediment study collected 33 samples, each of which was sieved to 4 different grain size fractions (Table 3-2).



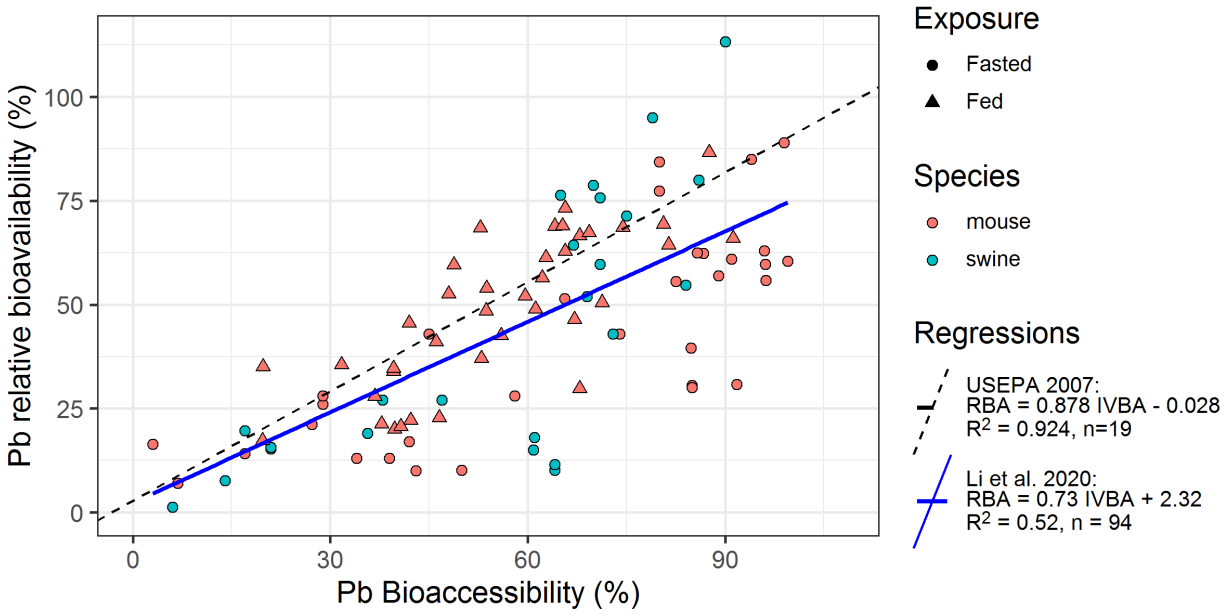
Note: From Beyer et al. (2016); regression model for in vitro method equivalent to USEPA Method 1340.

EPA – US Environmental Protection Agency
IVBA – in vitro bioaccessibility
RBA – relative bioavailability
RBALP – relative bioaccessibility leaching procedure

Figure 4-6. Linear regression to predict relative bioavailability of lead in birds

To estimate lead RBA in mammals, two options are available, and the most appropriate option depends on how lead was administered in the applicable TRV study. USEPA (2009) developed a regression to relate IVBA to RBA data for lead, based on validation data from swine. More recently, Li et al. (2020) identified an updated regression for the same purpose using a larger dataset representing both swine and mouse validation studies. Figure 4-7 shows the dataset compiled by Li et al. (2020) with regression lines from both the authors' own analysis and analyses by EPA USEPA (2009, 2007b). Symbols are used to differentiate between studies in which lead-contaminated soils were added to food and studies in which the test organisms were fasted and received lead-contaminated soils via gavage. Even though ABA is expected to be greater for fasted exposure (Wragg and Cave 2003), RBA tends to be greater for fed exposure (Figure 4-7). Apparently, the effect of food interactions (e.g., binding to phytate) on the ABA of lead is greater for the soluble lead salts used as reference compounds than it is for lead-contaminated soils.[10] The USEPA regression line provides a good representation of the IVBA-RBA relationship for "fed" studies, whereas the Li et al. (2020) regression line is generally intermediate between the "fed" and "fasted" studies.

[10] See definition of RBA in Section 2. ABA of the reference compound is the denominator, and if food binding causes a proportionally greater decrease in the denominator than in the numerator, then RBA increases.



Data source: Li et al. (2020); data for in vitro methods equivalent to USEPA Method 1340.

EPA – US Environmental Protection Agency RBA – relative bioavailability

IVBA – in vitro bioaccessibility

Figure 4-7. Linear regression models to predict relative bioavailability of lead in mammals

As shown in Table 3-5, the Aquatic BERA TRVs for lead effects on reproduction, growth, and survival are all from studies in which lead was administered via gavage, although test organisms were not fasted. Given this method of exposure, the Li et al. (2020) regression is considered more applicable. Therefore, lead RBA is estimated for mammals according to the following equation:

Mammalian lead: $\%RBA = 0.73 \times \%Bioaccessible + 2.32$

While the available data support the described extrapolation methods to estimate RBA from IVBA results, there are associated uncertainties. The paired IVBA and RBA datasets are robust for swine and mice but are limited to a single study for birds using Japanese quail. Thus, the avian extrapolation is more uncertain than the mammalian extrapolation. Also, the in vivo validation for mammals is limited to two species, both of which are monogastric. As such, there would be greater uncertainty in applying this approach to ruminant species; however, none of the wildlife species assessed in the Aquatic BERA are ruminants.

For copper and zinc, comparable in vivo data are not available to quantify relationships between IVBA and RBA. Therefore, conservative assumptions are necessary and are informed by the validation for lead, as well as the validations for other metals. For lead, assuming that RBA is equal to IVBA would overestimate the true RBA for most sediments and soils (see 1:1 line in Figure 3-2), when IVBA lead is measured using USEPA Method 1340. The assumption of RBA and IVBA equivalence would also be

conservative for arsenic and highly conservative for cadmium (as reviewed by Li et al. (2020)), the other two metals for which extensive validation data are available. On this basis, RBA is estimated for metals other than lead by setting RBA equal to the measured or estimated IVBA for each DU, SDU, or sampling location. Although this conservative assumption might overestimate metal exposure, the overestimation is less extreme than if a default RBA of 100% were assumed.

The RBA factors calculated for use in the Aquatic BERA for samples with IVBA data, RFDA and WSDA samples, and sediment samples in each of the CSM units are presented in Annex A of this attachment. The calculated RBA factors for lead and zinc are provided in Table H3.A-3, and measured IVBA data are provided in Table H3.A-1 for all metals for which HQs are calculated in the Aquatic BERA.

5 APPLICATION OF LITERATURE BIOACCESSIBILITY DATA TO FOOD INGESTION

There are no Site-specific wildlife food bioaccessibility data. The development of generic, literature-based bioaccessibility estimates entails considerable uncertainty for two reasons: the paucity of literature data for metal bioaccessibility in dietary items relevant to UCR wildlife, and the high variability in the bioaccessibility results when data are available. In addition, there are uncertainties associated with differences among extraction methodologies and a lack of validation studies specific to metals biologically incorporated into the diet. Therefore, the Aquatic BERA assumes an RBA of 100% for food items in dietary exposures.[11]

6 SUMMARY

Although IVBA data for Site sediment and soil samples were generated using a method designed to assess the bioaccessibility of metals in humans, they can also appropriately be used to decrease uncertainty in wildlife exposure assessment and are therefore used in the Aquatic BERA. With respect to extractant pH and extraction time in the IVBA method, the results are expected to be conservative when applied to the wildlife receptors. In addition, the successful validation of IVBA methods for laboratory animals implies those methods' applicability to animals (i.e., wildlife, except for ruminants) as well as humans. Although avian validation data are limited, the available information suggests that applying IVBA data from USEPA Method 1340 to birds is conservative.

Limitations in spatial coverage among existing Site-specific IVBA data necessitate extrapolating IVBA data to areas where data are not available. Factors potentially affecting metal bioaccessibility were evaluated to determine the most appropriate approach. Suitable regression relationships for predicting bioaccessibility from soil bioavailability parameters were found for lead and zinc, but not for copper. A summary of methods used in the Aquatic BERA to estimate IVBA where data are lacking is presented in Table 6-1.

[11] If new information becomes available that warrants a less conservative assumption, the approach will be reconsidered.

Table 6-1. Summary of methods for estimating bioaccessibility

Chemical	IVBA Derivation Method	RBA Derivation Method
Lead	For locations with available data, use measured IVBA data.[a] For locations without available data, use regression to estimate IVBA: IVBA = -14.4 × pH + 166.[b]	bird RBA = 0.976 × IVBA - 35.5[c] mammal RBA = 0.73 × IVBA + 2.32
Zinc	For locations with available data, use measured IVBA data. For locations without available data, use regression to estimate IVBA: IVBA = -2.00 × TOC + 50.8.[b]	equal to RBA
Arsenic	For locations with available data, use measured IVBA data.[a] For locations without available data: • Use the mean ADA IVBA value for the one ADA soil location. • Use the mean of RFDA IVBAs for RFDA soil sample locations. • Use the greatest mean IVBA value from the ADA or RFDA for the remaining soil locations. • Use the greatest mean IVBA value of each grain size fraction in the sediment IVBA dataset, by CSM unit, for the sediment sample locations.[d]	equal to RBA
Other metals[e]	For locations with available data, use measured IVBA data. For locations without available data: • Use the mean ADA value for the one ADA soil location. • Use the mean of RFDAs for RFDA soil locations. • Use the greater of the mean ADA or mean RFDA value for the remaining soil and sediment locations.	equal to RBA

[a] IVBA was measured for lead and arsenic in four size fractions for each sediment sample collected during the 2009–2011 beach sediment study (see Table 3-1). The greatest IVBA among the size fractions for a particular sample from that study was used as the IVBA for that sample. For locations with replicate samples where IVBA was measured in one replicate but not in all replicates (such as locations in the 2009–2011 beach sediment study), the available IVBA data were used for replicates without measured IVBA.

[b] If a sample-specific value for pH or TOC in sediment was not available, the average pH or TOC in sediment samples was used for the CSM unit or reference area in Canada where the sample was located. For the Northport Waterfront Remedial Investigation sample (XRF-26; an RFDA sample without pH data), the average pH from the RFC sampling area was used. For BTVs, the average pH or TOC value used as a surrogate was the average for the given CSM unit or for all soil samples in the RFDA and WSDA dataset.

[c] If lead IVBA values produced a negative RBA for birds using this equation (pH of 9.29 for location 2-B2 or a measured IVBA < 36.4), the RBA was set to 0%.

[d] IVBA was measured for arsenic in four size fractions for each sediment sample collected during 2009–2011 beach sediment study (see Table 3-1). The mean IVBA was calculated for each size fraction within each CSM unit in OUs 1 and 2. The greatest mean IVBA among the size fractions in a particular CSM unit was used as the IVBA for all samples in that CSM unit. For reference area samples, the greatest arsenic IVBA measured in any Site-specific sample was used, as a conservative approach.

[e] Other metals includes aluminum, barium, cadmium, chromium, copper, iron, manganese, mercury, molybdenum, nickel, selenium, thallium, and vanadium.

ADA – aerial deposition area
BTV – background threshold value
CSM – conceptual site model
IVBA – in vitro bioaccessibility
OU – operable unit
RBA – relative bioavailability
RFC – Relict Floodplain C
RFDA – relict floodplain deposition area
RI – remedial investigation
TOC – total organic carbon

The RBA factors in the Aquatic BERA are estimated from in vivo validation studies for birds (Beyer et al. 2016) and mammals (Li et al. 2020) using equations shown in Table 5-1. Comparable in vivo data are not available for metals other than lead. Therefore, as a conservative assumption, the RBAs for other metals are estimated by setting them equal to the measured or estimated IVBA for each DU, SDU, or discrete sampling location. The resulting RBA factors are used in the dietary dose equation to adjust metals exposures that may occur through sediment and soil ingestion.

Bioavailability factors are not used in the dietary dose equation to adjust metals exposures occurring through food ingestion, because Site-specific bioaccessibility data are not available for metals in wildlife food. Instead, the default RBA for metals in wildlife food is assumed to be 100%. Uncertainty associated with this conservative assumption is evaluated in the Aquatic BERA uncertainty analysis.

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ANNEX A

CALCULATED RBA FACTORS FOR USE IN THE UPPER COLUMBIA RIVER AQUATIC BERA

Table H3.A-1. Measured IVBA Data Set

Aquatic BERA Data Set Sample Location	Media	Size Fraction Analyzed	IVBAs for Both Birds and Mammals (%)													
			Aluminum	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium	Zinc
2009–2011 Beach Sediment Study																
SD-AAE	Sediment	<63 µm	nm	26.3	nm	nm	nm	nm	nm	58.0	nm	nm	nm	nm	nm	nm
SD-AAE	Sediment	63–125 µm	nm	26.8	nm	nm	nm	nm	nm	44.6	nm	nm	nm	nm	nm	nm
SD-AAE	Sediment	125–250 µm	nm	19.8	nm	nm	nm	nm	nm	41.2	nm	nm	nm	nm	nm	nm
SD-AAE	Sediment	250 µm–2 mm	nm	12.3	nm	nm	nm	nm	nm	34.9	nm	nm	nm	nm	nm	nm
SD-BBA	Sediment	<63 µm	nm	14.1	nm	nm	nm	nm	nm	68.3	nm	nm	nm	nm	nm	nm
SD-BBA	Sediment	63–125 µm	nm	20.8	nm	nm	nm	nm	nm	55.4	nm	nm	nm	nm	nm	nm
SD-BBA	Sediment	125–250 µm	nm	19.2	nm	nm	nm	nm	nm	50.8	nm	nm	nm	nm	nm	nm
SD-BBA	Sediment	250 µm–2 mm	nm	11.0	nm	nm	nm	nm	nm	41.2	nm	nm	nm	nm	nm	nm
SD-BCE	Sediment	<63 µm	nm	21.4	nm	nm	nm	nm	nm	52.5	nm	nm	nm	nm	nm	nm
SD-BCE	Sediment	63–125 µm	nm	24.3	nm	nm	nm	nm	nm	49.6	nm	nm	nm	nm	nm	nm
SD-BCE	Sediment	125–250 µm	nm	nm	nm	nm	nm	nm	nm	47.6	nm	nm	nm	nm	nm	nm
SD-BCE	Sediment	250 µm–2 mm	nm	nm	nm	nm	nm	nm	nm	32.7	nm	nm	nm	nm	nm	nm
SD-BFC	Sediment	<63 µm	nm	33.0	nm	nm	nm	nm	nm	77.8	nm	nm	nm	nm	nm	nm
SD-BFC	Sediment	63–125 µm	nm	28.0	nm	nm	nm	nm	nm	69.5	nm	nm	nm	nm	nm	nm
SD-BFC	Sediment	125–250 µm	nm	22.6	nm	nm	nm	nm	nm	71.8	nm	nm	nm	nm	nm	nm
SD-BFC	Sediment	250 µm–2 mm	nm	14.6	nm	nm	nm	nm	nm	67.0	nm	nm	nm	nm	nm	nm
SD-BSE	Sediment	<63 µm	nm	13.4	nm	nm	nm	nm	nm	48.5	nm	nm	nm	nm	nm	nm
SD-BSE	Sediment	63–125 µm	nm	22.5	nm	nm	nm	nm	nm	53.3	nm	nm	nm	nm	nm	nm
SD-BSE	Sediment	125–250 µm	nm	18.0	nm	nm	nm	nm	nm	69.7	nm	nm	nm	nm	nm	nm
SD-BSE	Sediment	250 µm–2 mm	nm	30.2	nm	nm	nm	nm	nm	46.2	nm	nm	nm	nm	nm	nm
SD-CBC	Sediment	<63 µm	nm	19.5	nm	nm	nm	nm	nm	68.2	nm	nm	nm	nm	nm	nm
SD-CBC	Sediment	63–125 µm	nm	26.6	nm	nm	nm	nm	nm	49.1	nm	nm	nm	nm	nm	nm
SD-CBC	Sediment	125–250 µm	nm	30.7	nm	nm	nm	nm	nm	57.6	nm	nm	nm	nm	nm	nm
SD-CBC	Sediment	250 µm–2 mm	nm	21.0	nm	nm	nm	nm	nm	23.3	nm	nm	nm	nm	nm	nm
SD-CFA	Sediment	<63 µm	nm	30.3	nm	nm	nm	nm	nm	67.4	nm	nm	nm	nm	nm	nm
SD-CFA	Sediment	63–125 µm	nm	36.3	nm	nm	nm	nm	nm	55.0	nm	nm	nm	nm	nm	nm
SD-CFA	Sediment	125–250 µm	nm	30.7	nm	nm	nm	nm	nm	64.4	nm	nm	nm	nm	nm	nm
SD-CFA	Sediment	250 µm–2 mm	nm	12.0	nm	nm	nm	nm	nm	51.4	nm	nm	nm	nm	nm	nm
SD-CRD	Sediment	<63 µm	nm	23.3	nm	nm	nm	nm	nm	56.6	nm	nm	nm	nm	nm	nm
SD-CRD	Sediment	63–125 µm	nm	22.0	nm	nm	nm	nm	nm	49.1	nm	nm	nm	nm	nm	nm
SD-CRD	Sediment	125–250 µm	nm	17.3	nm	nm	nm	nm	nm	39.9	nm	nm	nm	nm	nm	nm
SD-CRD	Sediment	250 µm–2 mm	nm	12.4	nm	nm	nm	nm	nm	33.3	nm	nm	nm	nm	nm	nm
SD-CSA	Sediment	<63 µm	nm	25.6	nm	nm	nm	nm	nm	29.4	nm	nm	nm	nm	nm	nm
SD-CSA	Sediment	63–125 µm	nm	25.9	nm	nm	nm	nm	nm	25.5	nm	nm	nm	nm	nm	nm
SD-CSA	Sediment	125–250 µm	nm	22.9	nm	nm	nm	nm	nm	21.9	nm	nm	nm	nm	nm	nm
SD-CSA	Sediment	250 µm–2 mm	nm	14.9	nm	nm	nm	nm	nm	19.5	nm	nm	nm	nm	nm	nm
SD-DMC	Sediment	<63 µm	nm	10.2	nm	nm	nm	nm	nm	54.9	nm	nm	nm	nm	nm	nm
SD-DMC	Sediment	63–125 µm	nm	19.3	nm	nm	nm	nm	nm	57.1	nm	nm	nm	nm	nm	nm
SD-DMC	Sediment	125–250 µm	nm	36.4	nm	nm	nm	nm	nm	71.2	nm	nm	nm	nm	nm	nm
SD-DMC	Sediment	250 µm–2 mm	nm	36.9	nm	nm	nm	nm	nm	46.1	nm	nm	nm	nm	nm	nm

Table H3.A-1. Measured IVBA Data Set

Aquatic BERA Data Set Sample Location	Media	Size Fraction Analyzed	IVBAs for Both Birds and Mammals (%)													
			Aluminum	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium	Zinc
SD-DSB	Sediment	<63 µm	nm	17.7	nm	nm	nm	nm	nm	64.0	nm	nm	nm	nm	nm	nm
SD-DSB	Sediment	63–125 µm	nm	28.8	nm	nm	nm	nm	nm	63.6	nm	nm	nm	nm	nm	nm
SD-DSB	Sediment	125–250 µm	nm	34.7	nm	nm	nm	nm	nm	61.7	nm	nm	nm	nm	nm	nm
SD-DSB	Sediment	250 µm–2 mm	nm	57.5	nm	nm	nm	nm	nm	61.0	nm	nm	nm	nm	nm	nm
SD-ENC	Sediment	<63 µm	nm	22.9	nm	nm	nm	nm	nm	52.1	nm	nm	nm	nm	nm	nm
SD-ENC	Sediment	63–125 µm	nm	16.8	nm	nm	nm	nm	nm	39.3	nm	nm	nm	nm	nm	nm
SD-ENC	Sediment	125–250 µm	nm	10.9	nm	nm	nm	nm	nm	22.3	nm	nm	nm	nm	nm	nm
SD-ENC	Sediment	250 µm–2 mm	nm	6.99	nm	nm	nm	nm	nm	28.7	nm	nm	nm	nm	nm	nm
SD-EVE	Sediment	<63 µm	nm	28.7	nm	nm	nm	nm	nm	82.0	nm	nm	nm	nm	nm	nm
SD-EVE	Sediment	63–125 µm	nm	33.6	nm	nm	nm	nm	nm	58.8	nm	nm	nm	nm	nm	nm
SD-EVE	Sediment	125–250 µm	nm	29.3	nm	nm	nm	nm	nm	63.8	nm	nm	nm	nm	nm	nm
SD-EVE	Sediment	250 µm–2 mm	nm	13.2	nm	nm	nm	nm	nm	49.0	nm	nm	nm	nm	nm	nm
SD-FCE	Sediment	<63 µm	nm	22.2	nm	nm	nm	nm	nm	73.0	nm	nm	nm	nm	nm	nm
SD-FCE	Sediment	63–125 µm	nm	22.8	nm	nm	nm	nm	nm	56.7	nm	nm	nm	nm	nm	nm
SD-FCE	Sediment	125–250 µm	nm	19.7	nm	nm	nm	nm	nm	53.6	nm	nm	nm	nm	nm	nm
SD-FCE	Sediment	250 µm–2 mm	nm	12.8	nm	nm	nm	nm	nm	45.6	nm	nm	nm	nm	nm	nm
SD-HCB	Sediment	<63 µm	nm	15.8	nm	nm	nm	nm	nm	32.5	nm	nm	nm	nm	nm	nm
SD-HCB	Sediment	63–125 µm	nm	11.4	nm	nm	nm	nm	nm	31.5	nm	nm	nm	nm	nm	nm
SD-HCB	Sediment	125–250 µm	nm	6.99	nm	nm	nm	nm	nm	25.5	nm	nm	nm	nm	nm	nm
SD-HCB	Sediment	250 µm–2 mm	nm	9.19	nm	nm	nm	nm	nm	29.1	nm	nm	nm	nm	nm	nm
SD-HTD	Sediment	<63 µm	nm	15.9	nm	nm	nm	nm	nm	40.9	nm	nm	nm	nm	nm	nm
SD-HTD	Sediment	63–125 µm	nm	21.2	nm	nm	nm	nm	nm	45.9	nm	nm	nm	nm	nm	nm
SD-HTD	Sediment	125–250 µm	nm	12.9	nm	nm	nm	nm	nm	37.3	nm	nm	nm	nm	nm	nm
SD-HTD	Sediment	250 µm–2 mm	nm	10.3	nm	nm	nm	nm	nm	28.0	nm	nm	nm	nm	nm	nm
SD-JBB	Sediment	<63 µm	nm	10.7	nm	nm	nm	nm	nm	35.5	nm	nm	nm	nm	nm	nm
SD-JBB	Sediment	63–125 µm	nm	15.1	nm	nm	nm	nm	nm	29.0	nm	nm	nm	nm	nm	nm
SD-JBB	Sediment	125–250 µm	nm	14.3	nm	nm	nm	nm	nm	25.4	nm	nm	nm	nm	nm	nm
SD-JBB	Sediment	250 µm–2 mm	nm	6.22	nm	nm	nm	nm	nm	18.1	nm	nm	nm	nm	nm	nm
SD-KFE	Sediment	<63 µm	nm	13.5	nm	nm	nm	nm	nm	56.1	nm	nm	nm	nm	nm	nm
SD-KFE	Sediment	63–125 µm	nm	19.2	nm	nm	nm	nm	nm	55.2	nm	nm	nm	nm	nm	nm
SD-KFE	Sediment	125–250 µm	nm	14.6	nm	nm	nm	nm	nm	41.9	nm	nm	nm	nm	nm	nm
SD-KFE	Sediment	250 µm–2 mm	nm	7.26	nm	nm	nm	nm	nm	25.9	nm	nm	nm	nm	nm	nm
SD-KLB	Sediment	<63 µm	nm	25.2	nm	nm	nm	nm	nm	51.4	nm	nm	nm	nm	nm	nm
SD-KLB	Sediment	63–125 µm	nm	35.5	nm	nm	nm	nm	nm	52.4	nm	nm	nm	nm	nm	nm
SD-KLB	Sediment	125–250 µm	nm	28.0	nm	nm	nm	nm	nm	49.7	nm	nm	nm	nm	nm	nm
SD-KLB	Sediment	250 µm–2 mm	nm	8.96	nm	nm	nm	nm	nm	36.4	nm	nm	nm	nm	nm	nm
SD-LYB	Sediment	<63 µm	nm	19.6	nm	nm	nm	nm	nm	73.2	nm	nm	nm	nm	nm	nm
SD-LYB	Sediment	63–125 µm	nm	22.2	nm	nm	nm	nm	nm	61.1	nm	nm	nm	nm	nm	nm
SD-LYB	Sediment	125–250 µm	nm	17.7	nm	nm	nm	nm	nm	59.5	nm	nm	nm	nm	nm	nm
SD-LYB	Sediment	250 µm–2 mm	nm	8.96	nm	nm	nm	nm	nm	55.1	nm	nm	nm	nm	nm	nm
SD-MGE	Sediment	<63 µm	nm	14.7	nm	nm	nm	nm	nm	41.2	nm	nm	nm	nm	nm	nm

Table H3.A-1. Measured IVBA Data Set

Aquatic BERA Data Set Sample Location	Media	Size Fraction Analyzed	IVBAs for Both Birds and Mammals (%)													
			Aluminum	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium	Zinc
SD-MGE	Sediment	63–125 µm	nm	14.3	nm	nm	nm	nm	nm	39.1	nm	nm	nm	nm	nm	nm
SD-MGE	Sediment	125–250 µm	nm	11.9	nm	nm	nm	nm	nm	35.4	nm	nm	nm	nm	nm	nm
SD-MGE	Sediment	250 µm–2 mm	nm	8.13	nm	nm	nm	nm	nm	23.8	nm	nm	nm	nm	nm	nm
SD-MPE	Sediment	<63 µm	nm	14.7	nm	nm	nm	nm	nm	34.3	nm	nm	nm	nm	nm	nm
SD-MPE	Sediment	63–125 µm	nm	13.8	nm	nm	nm	nm	nm	33.2	nm	nm	nm	nm	nm	nm
SD-MPE	Sediment	125–250 µm	nm	11.7	nm	nm	nm	nm	nm	28.5	nm	nm	nm	nm	nm	nm
SD-MPE	Sediment	250 µm–2 mm	nm	7.67	nm	nm	nm	nm	nm	19.3	nm	nm	nm	nm	nm	nm
SD-NAE	Sediment	<63 µm	nm	17.0	nm	nm	nm	nm	nm	57.9	nm	nm	nm	nm	nm	nm
SD-NAE	Sediment	63–125 µm	nm	13.6	nm	nm	nm	nm	nm	60.6	nm	nm	nm	nm	nm	nm
SD-NAE	Sediment	125–250 µm	nm	9.87	nm	nm	nm	nm	nm	56.3	nm	nm	nm	nm	nm	nm
SD-NAE	Sediment	250 µm–2 mm	nm	5.15	nm	nm	nm	nm	nm	47.8	nm	nm	nm	nm	nm	nm
SD-NPA	Sediment	<63 µm	nm	30.2	nm	nm	nm	nm	nm	81.8	nm	nm	nm	nm	nm	nm
SD-NPA	Sediment	63–125 µm	nm	37.3	nm	nm	nm	nm	nm	56.8	nm	nm	nm	nm	nm	nm
SD-NPA	Sediment	125–250 µm	nm	46.9	nm	nm	nm	nm	nm	63.2	nm	nm	nm	nm	nm	nm
SD-NPA	Sediment	250 µm–2 mm	nm	60.1	nm	nm	nm	nm	nm	56.8	nm	nm	nm	nm	nm	nm
SD-NZE	Sediment	<63 µm	nm	22.6	nm	nm	nm	nm	nm	47.9	nm	nm	nm	nm	nm	nm
SD-NZE	Sediment	63–125 µm	nm	16.0	nm	nm	nm	nm	nm	25.9	nm	nm	nm	nm	nm	nm
SD-NZE	Sediment	125–250 µm	nm	13.8	nm	nm	nm	nm	nm	36.3	nm	nm	nm	nm	nm	nm
SD-NZE	Sediment	250 µm–2 mm	nm	15.2	nm	nm	nm	nm	nm	38.3	nm	nm	nm	nm	nm	nm
SD-RVC	Sediment	<63 µm	nm	9.57	nm	nm	nm	nm	nm	50.9	nm	nm	nm	nm	nm	nm
SD-RVC	Sediment	63–125 µm	nm	26.4	nm	nm	nm	nm	nm	67.7	nm	nm	nm	nm	nm	nm
SD-RVC	Sediment	125–250 µm	nm	36.1	nm	nm	nm	nm	nm	65.9	nm	nm	nm	nm	nm	nm
SD-RVC	Sediment	250 µm–2 mm	nm	39.0	nm	nm	nm	nm	nm	69.3	nm	nm	nm	nm	nm	nm
SD-SBC	Sediment	<63 µm	nm	19.6	nm	nm	nm	nm	nm	44.7	nm	nm	nm	nm	nm	nm
SD-SBC	Sediment	63–125 µm	nm	13.9	nm	nm	nm	nm	nm	27.4	nm	nm	nm	nm	nm	nm
SD-SBC	Sediment	125–250 µm	nm	8.85	nm	nm	nm	nm	nm	21.1	nm	nm	nm	nm	nm	nm
SD-SBC	Sediment	250 µm–2 mm	nm	4.43	nm	nm	nm	nm	nm	24.4	nm	nm	nm	nm	nm	nm
SD-SCE	Sediment	<63 µm	nm	10.5	nm	nm	nm	nm	nm	47.8	nm	nm	nm	nm	nm	nm
SD-SCE	Sediment	63–125 µm	nm	12.7	nm	nm	nm	nm	nm	38.3	nm	nm	nm	nm	nm	nm
SD-SCE	Sediment	125–250 µm	nm	9.66	nm	nm	nm	nm	nm	34.7	nm	nm	nm	nm	nm	nm
SD-SCE	Sediment	250 µm–2 mm	nm	4.49	nm	nm	nm	nm	nm	26.6	nm	nm	nm	nm	nm	nm
SD-SRD	Sediment	<63 µm	nm	22.7	nm	nm	nm	nm	nm	72.7	nm	nm	nm	nm	nm	nm
SD-SRD	Sediment	63–125 µm	nm	28.8	nm	nm	nm	nm	nm	55.1	nm	nm	nm	nm	nm	nm
SD-SRD	Sediment	125–250 µm	nm	30.4	nm	nm	nm	nm	nm	69.4	nm	nm	nm	nm	nm	nm
SD-SRD	Sediment	250 µm–2 mm	nm	26.1	nm	nm	nm	nm	nm	63.3	nm	nm	nm	nm	nm	nm
SD-SWC	Sediment	<63 µm	nm	18.0	nm	nm	nm	nm	nm	48.2	nm	nm	nm	nm	nm	nm
SD-SWC	Sediment	63–125 µm	nm	13.6	nm	nm	nm	nm	nm	32.5	nm	nm	nm	nm	nm	nm
SD-SWC	Sediment	125–250 µm	nm	11.8	nm	nm	nm	nm	nm	30.4	nm	nm	nm	nm	nm	nm
SD-SWC	Sediment	250 µm–2 mm	nm	5.37	nm	nm	nm	nm	nm	21.6	nm	nm	nm	nm	nm	nm
SD-WBB	Sediment	<63 µm	nm	34.6	nm	nm	nm	nm	nm	69.0	nm	nm	nm	nm	nm	nm
SD-WBB	Sediment	63–125 µm	nm	37.6	nm	nm	nm	nm	nm	68.8	nm	nm	nm	nm	nm	nm

Table H3.A-1. Measured IVBA Data Set

Aquatic BERA Data Set Sample Location	Media	Size Fraction Analyzed	IVBAs for Both Birds and Mammals (%)													
			Aluminum	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium	Zinc
SD-WBB	Sediment	125–250 µm	nm	22.9	nm	nm	nm	nm	nm	51.9	nm	nm	nm	nm	nm	nm
SD-WBB	Sediment	250 µm–2 mm	nm	14.6	nm	nm	nm	nm	nm	62.7	nm	nm	nm	nm	nm	nm
SD-WCC	Sediment	<63 µm	nm	23.0	nm	nm	nm	nm	nm	64.8	nm	nm	nm	nm	nm	nm
SD-WCC	Sediment	63–125 µm	nm	19.8	nm	nm	nm	nm	nm	61.6	nm	nm	nm	nm	nm	nm
SD-WCC	Sediment	125–250 µm	nm	15.1	nm	nm	nm	nm	nm	56.5	nm	nm	nm	nm	nm	nm
SD-WCC	Sediment	250 µm–2 mm	nm	12.1	nm	nm	nm	nm	nm	53.3	nm	nm	nm	nm	nm	nm
SD-WSD	Sediment	<63 µm	nm	7.11	nm	nm	nm	nm	nm	44.0	nm	nm	nm	nm	nm	nm
SD-WSD	Sediment	63–125 µm	nm	15.0	nm	nm	nm	nm	nm	43.5	nm	nm	nm	nm	nm	nm
SD-WSD	Sediment	125–250 µm	nm	9.55	nm	nm	nm	nm	nm	36.5	nm	nm	nm	nm	nm	nm
SD-WSD	Sediment	250 µm–2 mm	nm	2.71	nm	nm	nm	nm	nm	18.5	nm	nm	nm	nm	nm	nm
2015 Bossburg Flat Sediment and Soil Study																
SDU-01-ICS	Sediment	<250 µm	nm	31.7	nm	nm	nm	nm	nm	68.4	nm	nm	nm	nm	nm	nm
SDU-02-ICS-A	Sediment	<250 µm	nm	26.0	nm	nm	nm	nm	nm	57.3	nm	nm	nm	nm	nm	nm
SDU-02-ICS-B	Sediment	<250 µm	nm	32.0	nm	nm	nm	nm	nm	81.1	nm	nm	nm	nm	nm	nm
SDU-02-ICS-C	Sediment	<250 µm	nm	29.8	nm	nm	nm	nm	nm	63.5	nm	nm	nm	nm	nm	nm
SDU-03-ICS-A	Sediment	<250 µm	nm	22.8	nm	nm	nm	nm	nm	58.5	nm	nm	nm	nm	nm	nm
SDU-03-ICS-B	Sediment	<250 µm	nm	24.7	nm	nm	nm	nm	nm	57.7	nm	nm	nm	nm	nm	nm
SDU-03-ICS-C	Sediment	<250 µm	nm	27.1	nm	nm	nm	nm	nm	69.7	nm	nm	nm	nm	nm	nm
SDU-04-ICS	Sediment	<250 µm	nm	16.6	nm	nm	nm	nm	nm	63.0	nm	nm	nm	nm	nm	nm
SDU-05-ICS	Sediment	<250 µm	nm	23.7	nm	nm	nm	nm	nm	54.4	nm	nm	nm	nm	nm	nm
SDU-06-ICS-A	Sediment	<250 µm	nm	21.7	nm	nm	nm	nm	nm	50.6	nm	nm	nm	nm	nm	nm
SDU-06-ICS-B	Sediment	<250 µm	nm	22.4	nm	nm	nm	nm	nm	49.5	nm	nm	nm	nm	nm	nm
SDU-06-ICS-C	Sediment	<250 µm	nm	20.2	nm	nm	nm	nm	nm	52.8	nm	nm	nm	nm	nm	nm
SDU-07-ICS-A	Sediment	<250 µm	nm	27.2	nm	nm	nm	nm	nm	61.5	nm	nm	nm	nm	nm	nm
SDU-07-ICS-B	Sediment	<250 µm	nm	26.3	nm	nm	nm	nm	nm	64.8	nm	nm	nm	nm	nm	nm
SDU-07-ICS-C	Sediment	<250 µm	nm	27.8	nm	nm	nm	nm	nm	60.3	nm	nm	nm	nm	nm	nm
SDU-08-ICS	Sediment	<250 µm	nm	29.0	nm	nm	nm	nm	nm	57.1	nm	nm	nm	nm	nm	nm
SDU-09A-ICS	Sediment	<250 µm	nm	26.3	nm	nm	nm	nm	nm	56.9	nm	nm	nm	nm	nm	nm
SDU-10-ICS	Sediment	<250 µm	nm	23.6	nm	nm	nm	nm	nm	58.8	nm	nm	nm	nm	nm	nm

Table H3.A-1. Measured IVBA Data Set

Aquatic BERA Data Set Sample Location	Media	Size Fraction Analyzed	IVBAs for Both Birds and Mammals (%)													
			Aluminum	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Molybdenum	Selenium	Thallium	Vanadium	Zinc
2014 Soil Study																
RFA-001-A	Soil	<149 µm	18.8	16.4[c]	43.6	36.5	13.8	51.6	13.5	67.0	nm	2.70	nm	11.9	15.6	43.4
RFA-001-B	Soil	<149 µm	16.3	15.8[c]	37.6	38.3	12.3	49.3	13.4	65.8	nm	2.20	nm	9.70	14.4	44.1
RFA-001-C	Soil	<149 µm	17.4	14.0[c]	41.6	35.6	12.6	54.2	13.5	58.3	nm	2.90	nm	11.0	14.2	43.5
RFA-005	Soil	<149 µm	14.7	20.7[c]	29.4	37.7	12.3	53.0	16.1	61.3	nm	3.90	13.0	13.2	15.4	42.7
RFD-002	Soil	<149 µm	17.6	27.3[c]	26.4	43.4	11.4	38.6	21.1	55.2	0.900	3.40	nm	10.4	19.2	53.0
ADA-001[a]	Soil	<149 µm	9.40	20.2[c]	62.2	87.1	1.60	22.4	3.20	87.2	nm	nm	nm	15.3	4.20	48.2
ADA-016[a,b]	Soil	<149 µm	19.4	36.2[c]	59.5	83.5	3.40	21.2	5.20	88.6	7.00	4.90	nm	22.2	5.70	49.1
ADA-035[a]	Soil	<149 µm	21.5	35.2[c]	62.8	84.6	4.00	24.1	8.00	83.6	nm	nm	nm	14.7	5.60	26.8
ADA-047[a]	Soil	<149 µm	12.8	32.0[c]	62.5	84.8	1.60	25.2	3.40	85.9	9.00	nm	nm	14.5	5.00	42.5
ADA-048[a]	Soil	<149 µm	20.1	26.6[c]	58.4	84.7	4.90	24.9	8.00	82.3	6.70	7.20	21.7	41.1	8.60	26.8
ADA-057[a]	Soil	<149 µm	10.1	14.9[c]	59.9	82.3	1.90	16.5	3.10	70.7	8.00	nm	nm	9.30	3.50	29.7
ADA-059[a]	Soil	<149 µm	15.1	27.7[c]	69.5	83.7	3.30	20.2	6.70	79.1	nm	nm	nm	9.70	3.90	27.1
ADA-061[a]	Soil	<149 µm	15.1	15.6[c]	54.3	82.5	1.80	13.2	3.70	65.0	nm	nm	nm	8.70	3.50	19.4
ADA-076[a]	Soil	<149 µm	30.6	42.9[c]	64.9	70.5	6.30	23.7	10.8	94.0	7.80	nm	nm	18.8	6.00	26.7
ADA-081[a]	Soil	<149 µm	24.5	27.1[c]	60.9	82.6	2.80	20.4	5.80	80.1	nm	nm	nm	15.0	4.30	30.6
ADA-096[a]	Soil	<149 µm	26.2	33.1[c]	76.6	86.9	6.90	26.7	10.5	89.9	7.40	nm	nm	21.7	8.20	44.1
ADA-125[a]	Soil	<149 µm	25.2	39.2[c]	59.4	81.9	4.90	24.9	8.80	87.7	nm	nm	nm	13.2	5.70	28.5
ADA-126[a]	Soil	<149 µm	19.3	43.4[c]	68.1	82.3	3.70	40.0	7.50	89.1	8.30	nm	nm	20.5	5.00	47.6
ADA-141[a]	Soil	<149 µm	14.8	28.8[c]	66.7	91.9	3.30	20.6	6.00	82.9	9.50	nm	nm	16.5	5.00	39.1
ADA-142[a]	Soil	<149 µm	21.6	38.9[c]	68.7	82.8	3.30	27.1	6.90	91.0	5.40	nm	nm	23.0	4.40	52.2
ADA-144[a]	Soil	<149 µm	28.4	26.3[c]	54.2	69.3	2.10	23.8	4.30	79.6	4.10	nm	11.8	26.8	5.10	52.1
ADA-145[a]	Soil	<149 µm	19.4	28.8[c]	67.0	86.1	3.60	24.4	5.80	83.3	7.10	nm	nm	22.4	5.80	49.7
ADA-150[a]	Soil	<149 µm	19.9	31.6[c]	45.8	68.0	3.90	26.1	5.60	79.8	5.70	nm	nm	14.0	4.10	41.8
ADA-152[a]	Soil	<149 µm	22.9	49.2[c]	69.7	89.3	4.70	30.0	8.00	95.9	8.20	nm	nm	20.2	5.40	50.7
ADA-160[a]	Soil	<149 µm	24.4	39.6[c]	52.4	74.8	3.80	23.4	6.30	87.6	nm	nm	nm	16.4	4.30	44.8
ADA-161[a]	Soil	<149 µm	16.0	41.1[c]	66.7	83.7	3.60	28.8	8.00	93.0	6.50	nm	nm	15.6	4.60	47.2
ADA-162[a]	Soil	<149 µm	18.0	33.0[c]	60.9	81.4	2.30	26.7	4.40	90.7	2.80	4.80	nm	20.3	3.00	51.2

[a] No HQ was calculated for this location. Measured ADA IVBA data were used to calculate the mean ADA IVBA value for use when data are unavailable to calculate a location-specific RBA factor.
[b] This location was analyzed in triplicate, but only the maximum result was used for summary statistics.
[c] This metal is not a COPC or quantitatively evaluated COI for this spatial area group, but the data were used to calculate mean IVBA values for use when data are unavailable to calculate a location-specific RBA factor for other CSM units/areas.
ADA - aerial deposition area
BERA - baseline ecological risk assessment
COI - chemical of interest
COPC - chemical of potential concern
CSM - conceptual site model
HQ - hazard quotient
IVBA - in vitro bioaccessibility
nm - IVBA not measured or not detected
RBA - relative bioavailability

Table H3.A-2. Surrogate RBA Factors for Cases Where Location-Specific IVBA Data Are Not Available

Aquatic BERA Data Set CSM Unit/Area	Conventional Parameters Used for Calculating Zinc and Lead RBA Factors		RBA Factors for Both Birds and Mammals (%)[a]														RBA Factors for Both Birds and Mammals (%)[a,b]	RBA Factors for Birds Only (%)[a,b]	RBA Factors for Mammals Only (%)[a,b]
	Mean pH	Mean TOC (%)	Aluminum	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Manganese	Mercury	Molybdenum	Nickel	Selenium	Thallium	Vanadium	Zinc	Lead	Lead
OU 1 North[c]	7.86	0.435	19.8	44.7	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	49.9	16.0	40.9
OU 1 South[c]	7.68	0.934	19.8	28.0	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	48.9	18.6	42.8
Transitional[c]	7.11	0.959	19.8	30.8	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	48.9	26.6	48.7
Upper Lacustrine[c]	7.32	0.552	19.8	23.7	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	49.7	23.6	46.6
Middle Lacustrine[c]	7.92	0.331	19.8	18.2	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	50.1	15.3	40.3
Lower Lacustrine[c]	7.91	0.146	19.8	16.5	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	50.5	15.3	40.4
Reference[c]	6.87	0.852	19.8	60.1	62.3	82.0	12.5	48.6	16.9	55.9	6.90	5.63	12.3	16.8	NC[f]	16.7	NA[e]	30.0	51.3
ADAs	NA[e]	NA[e]	19.8	NC[f]	62.3	82.0	3.53	24.3	6.36	NC[f]	6.90	5.63	NC[f]	16.8	18.2	5.04	NA[e]	NA[e]	NA[e]
RFDAs	NA[e]	NA[e]	17.0	NC[f]	33.1	39.8	12.5	48.6	16.9	NC[f]	0.900	3.40	NC[f]	13.0	11.8	16.7	NA[e]	NA[e]	NA[e]
XRF-26[d]	6.34	4.71	17.0	NC[f]	33.1	39.8	12.5	48.6	16.9	NC[f]	0.900	3.40	NC[f]	13.0	11.8	16.7	41.4	37.4	56.9
WSDAs[c]	NA[e]	NA[e]	19.8	NC[f]	62.3	82.0	12.5	48.6	16.9	NC[f]	6.90	5.63	NC[f]	16.8	18.2	16.7	NA[e]	NA[e]	NA[e]

[a] RBA factors in this table are mean values by CSM unit that are used when data are unavailable to calculate a location-specific RBA factor.
[b] Mean RBA factors for lead and zinc are calculated using the mean pH and TOC value for the given spatial area group. These values may vary from the values reported in Table H3.A-4, which provides the mean of all selected RBAs for each CSM unit/area
[c] For locations and analytes where measured IVBA data are not available, the surrogate IVBA value selected is the higher of the mean IVBA value from the ADA or RFDAs.
[d] The pH and TOC values for XRF-26 are estimated using the average from the RFC sampling area.
[e] All locations in this CSM unit/area have a measured IVBA or have measured pH and TOC to calculate lead or zinc RBAs.
[f] This metal is not a COPC or quantitatively evaluated COI for this CSM unit/area.

ADA - aerial deposition area
BERA - baseline ecological risk assessment
COI - chemical of interest
COPC - chemical of potential concern
CSM - conceptual site model
IVBA - in vitro bioaccessibility
NA - not applicable
NC - not calculated
OU - operable unit
RBA - relative bioavailability
RFC – Relict Floodplain C
RFDA - relict floodplain deposition area
TOC - total organic carbon
WSDA - windblown sediment deposition area

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
OU 1 North									
2013 USGS Toxicity Evaluation	1-B1-NRT	CERC 01_1-B1_SD_1b-2	7.86[c]	0.240	nm	52.8	16.0	40.9	50.3
2013 USGS Toxicity Evaluation	1-B2-NRT	CERC 02_1-B2_SD_1a-1b-3	7.86[c]	0.100	nm	52.8	16.0	40.9	50.6
2013 USGS Toxicity Evaluation	1-B4-NRT	CERC 05_1-B4_SD_1a-1b-3	7.86[c]	0.0500	nm	52.8	16.0	40.9	50.7
2013 Phase 2 Sediment Study	1-B5	SE-1-B5	7.29	0.993	nm	61.0	24.0	46.8	48.8
2013 USGS Toxicity Evaluation	1-B5-NRT	CERC 04_1-B5_SD_1b-2	7.86[c]	0.0900	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	1-B5-NRT-2019	1-B5-NRT-SE-1-101519	7.86[c]	1.22	nm	52.8	16.0	40.9	48.4
2013 USGS Toxicity Evaluation	1-B6-NRT	CERC 03_1-B6_SD_1b-2	7.86[c]	0.0500	nm	52.8	16.0	40.9	50.7
2019 Phase 3 Sediment Study	1-B6-NRT-2019	1-B6-NRT-SE-1-101619	7.86[c]	0.306	nm	52.8	16.0	40.9	50.2
2013 Phase 2 Sediment Study	1-R1	SE-1-R1	8.13	0.0790	nm	48.9	12.2	38.0	50.6
2013 Phase 2 Sediment Study	1-R2	SE-1-R2	7.38	0.298	nm	59.7	22.8	45.9	50.2
2013 Phase 2 Sediment Study	1-R5	SE-1-R5	8.38	0.108	nm	45.3	8.71	35.4	50.6
2013 Phase 2 Sediment Study	1-R8	SE-1-R8	7.41	0.523	nm	59.3	22.4	45.6	49.8
2013 Phase 2 Sediment Study	1B-C1	SE-1B-C1	7.77	0.920	nm	54.1	17.3	41.8	49.0
2013 Phase 2 Sediment Study	1B-C3	SE-1B-C3	7.79	0.694	nm	53.8	17.0	41.6	49.4
2013 USGS Toxicity Evaluation	1B-C3-NRT	CERC 06_1B-C3_SD_1a-1b-3	7.86[c]	0.120	nm	52.8	16.0	40.9	50.6
2013 Phase 2 Sediment Study	1B-R2	SE-1B-R2	7.47	1.59	nm	58.4	21.5	45.0	47.6
2013 Phase 2 Sediment Study	1B-R3	SE-1B-R3	7.92	0.298	nm	52.0	15.3	40.3	50.2
2013 Phase 2 Sediment Study	2-B1	SE-2-B1	7.67	0.637	nm	55.6	18.8	42.9	49.5
2013 USGS Toxicity Evaluation	2-B1-NRT	CERC 07_2-B1_SD_1a-1b-3	7.86[c]	0.120	nm	52.8	16.0	40.9	50.6
2013 Phase 2 Sediment Study	2-B2	SE-2-B2	9.29	0.296	nm	32.2	0.00	25.8	50.2
2013 USGS Toxicity Evaluation	2-B2-NRT	CERC 08_2-B2_SD_1b-2	7.86[c]	0.0800	nm	52.8	16.0	40.9	50.6
2013 USGS Toxicity Evaluation	2-B3-NRT	CERC 15_2-B3_SD_1a-1b-3	7.86[c]	0.490	nm	52.8	16.0	40.9	49.8
2013 Phase 2 Sediment Study	2-B4	SE-2-B4	8.14	0.0940	nm	48.8	12.1	37.9	50.6
2013 USGS Toxicity Evaluation	2-B4-NRT	CERC 13_2-B4_SD_1b-2	7.86[c]	0.170	nm	52.8	16.0	40.9	50.5
2013 USGS Toxicity Evaluation	2-B5-NRT	CERC 12_2-B5_SD_1a-1b-3	7.86[c]	0.0600	nm	52.8	16.0	40.9	50.7
2013 USGS Toxicity Evaluation	2-B6-NRT	CERC 11_2-B6_SD_1a-1b	7.86[c]	0.0700	nm	52.8	16.0	40.9	50.7
2013 Phase 2 Sediment Study	2-C1	SE-2-C1	7.09	0.691	nm	63.9	26.9	49.0	49.4
2013 Phase 2 Sediment Study	2-R1	SE-2-R1	8.14	0.446	nm	48.8	12.1	37.9	49.9
2013 Phase 2 Sediment Study	2-R3	SE-2-R3	7.89	0.352	nm	52.4	15.6	40.6	50.1
2009-2011 Beach Sediment Study	CR-BSA	CR-BSA1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-BSB	CR-BSB1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-BSC	CR-BSC1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-BSD	CR-BSD1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-BSE	CR-BSE1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DM	CR-DM1	7.96	0.226	nm	51.4	14.7	39.8	50.3
2009-2011 Beach Sediment Study	CR-DMA	CR-DMA1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DMB	CR-DMB1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DMC	CR-DMC1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DMD	CR-DMD1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DME	CR-DME1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DSA	CR-DSA1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DSB	CR-DSB1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DSC	CR-DSC1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DSD	CR-DSD1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-DSE	CR-DSE1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-NP	CR-NP1	7.57	1.10	nm	57.0	20.1	43.9	48.6
2009-2011 Beach Sediment Study	CR-NPA	CR-NPA1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-NPB	CR-NPB1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-NPC	CR-NPC1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-NPD	CR-NPD1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-NPE	CR-NPE1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-RV	CR-RV1-1	7.95	1.56	nm	51.5	14.8	39.9	47.7
2009-2011 Beach Sediment Study	CR-RVA	CR-RVA1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-RVB	CR-RVB1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-RVC	CR-RVC1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-RVD	CR-RVD1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2009-2011 Beach Sediment Study	CR-RVE	CR-RVE1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2010 White Sturgeon Toxicity Study	DE	DE definitive	8.46	0.154	nm	44.2	7.64	34.6	50.5
2019 Phase 3 Sediment Study	DM002	DM002-SE-1-100919	7.86[c]	0.0600	nm	52.8	16.0	40.9	50.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2019 Phase 3 Sediment Study	DM007	DM007-SE-1-101519	7.86[c]	0.0720	nm	52.8	16.0	40.9	50.7
2019 Phase 3 Sediment Study	DM008	DM008-SE-1-101119	7.86[c]	0.0900	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	DM010	DM010-SE-1-101119	7.86[c]	0.139	nm	52.8	16.0	40.9	50.5
2019 Phase 3 Sediment Study	DM015	DM015-SE-1-101019	7.86[c]	0.157	nm	52.8	16.0	40.9	50.5
2019 Phase 3 Sediment Study	DM016	DM016-SE-1-101019	7.86[c]	0.127	nm	52.8	16.0	40.9	50.5
2019 Phase 3 Sediment Study	DM018	DM018-SE-1-100919	7.86[c]	0.146	nm	52.8	16.0	40.9	50.5
2019 Phase 3 Sediment Study	DM019	DM019-SE-1-101419	7.86[c]	0.149	nm	52.8	16.0	40.9	50.5
2019 Phase 3 Sediment Study	DM020	DM020-SE-1-101419	7.86[c]	0.409	nm	52.8	16.0	40.9	50.0
2019 Phase 3 Sediment Study	DM022	DM022-SE-1-092119	7.86[c]	0.351	nm	52.8	16.0	40.9	50.1
2019 Phase 3 Sediment Study	DM023	DM023-SE-1-092119	7.86[c]	0.0700	nm	52.8	16.0	40.9	50.7
2019 Phase 3 Sediment Study	DM024	DM024-SE-1-101519	7.86[c]	0.122	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	DM025	DM025-SE-1-101219	7.86[c]	0.113	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	DM026	DM026-SE-1-092119	7.86[c]	0.0790	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	DM027	DM027-SE-1-101419	7.86[c]	0.132	nm	52.8	16.0	40.9	50.5
2019 Phase 3 Sediment Study	DM036	DM036-SE-1-101819	7.86[c]	0.730	nm	52.8	16.0	40.9	49.3
2019 Phase 3 Sediment Study	DM038	DM038-SE-1-101919	7.86[c]	0.123	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	DM039	DM039-SE-1-101719	7.86[c]	0.0910	nm	52.8	16.0	40.9	50.6
2019 Phase 3 Sediment Study	DM044	DM044-SE-1-101619	7.86[c]	0.640	nm	52.8	16.0	40.9	49.5
2019 Phase 3 Sediment Study	DM045	DM045-SE-1-091919	7.86[c]	0.316	nm	52.8	16.0	40.9	50.2
2019 Phase 3 Sediment Study	DM046	DM046-SE-1-092019	7.86[c]	0.546	nm	52.8	16.0	40.9	49.7
2019 Phase 3 Sediment Study	DM047	DM047-SE-1-101819	7.86[c]	0.208	nm	52.8	16.0	40.9	50.4
2019 Phase 3 Sediment Study	DM050	DM050-SE-1-092019	7.86[c]	0.487	nm	52.8	16.0	40.9	49.8
2019 Phase 3 Sediment Study	DM057	DM057-SE-1-091819	7.86[c]	0.230	nm	52.8	16.0	40.9	50.3
2019 Phase 3 Sediment Study	DM061	DM061-SE-1-101219	7.86[c]	0.928	nm	52.8	16.0	40.9	48.9
2019 Northport Waterfront RI	HS-2	HS-2 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	HS-3	HS-3 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2010 White Sturgeon Toxicity Study	NP-03	NP-03 DEF	8.10	0.322	nm	49.4	12.7	38.4	50.2
2005 Phase 1 Sediment Sampling	RM728X1	5144410,J4EW3,MJ4EW3	7.86[c]	0.368	nm	52.8	16.0	40.9	50.1
2005 Phase 1 Sediment Sampling	RM728X3	5144420,J4EX3,MJ4EX3	7.86[c]	0.0948	nm	52.8	16.0	40.9	50.6
2005 Phase 1 Sediment Sampling	RM729A1(X1)	5164494,J4FN4,MJ4FN4	7.86[c]	0.263	nm	52.8	16.0	40.9	50.3
2005 Phase 1 Sediment Sampling	RM729B1	5144444,J4EZ2,MJ4EZ2	7.86[c]	0.400	nm	52.8	16.0	40.9	50.0
2005 Phase 1 Sediment Sampling	RM729B2	5144445,J4EZ3,MJ4EZ3	7.86[c]	0.194	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM729B3	5144446,J4EZ4,MJ4EZ4	7.86[c]	0.121	nm	52.8	16.0	40.9	50.6
2005 Phase 1 Sediment Sampling	RM729T2	5164412,J4FE2,MJ4FE2	7.86[c]	0.753	nm	52.8	16.0	40.9	49.3
2005 Phase 1 Sediment Sampling	RM729X2	5164411,J4FE1,MJ4FE1	7.86[c]	0.125	nm	52.8	16.0	40.9	50.6
2005 Phase 1 Sediment Sampling	RM729X3	5164410,J4FE0,MJ4FE0	7.86[c]	0.175	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM730A1	5164491,J4FN1,MJ4FN1	7.86[c]	0.154	nm	52.8	16.0	40.9	50.5
2005 Phase 1 Sediment Sampling	RM730T1	5164409,J4FD9,MJ4FD9	7.86[c]	2.20	nm	52.8	16.0	40.9	46.4
2005 Phase 1 Sediment Sampling	RM730X1	5164408,J4FD8,MJ4FD8	7.86[c]	0.215	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM731X1	5164400,J4FD0,MJ4FD0	7.86[c]	0.403	nm	52.8	16.0	40.9	50.0
2005 Phase 1 Sediment Sampling	RM731X3	5154542,J4FC8,MJ4FC8	7.86[c]	0.644	nm	52.8	16.0	40.9	49.5
2005 Phase 1 Sediment Sampling	RM732R1	5164470,J4FL0,MJ4FL0	7.86[c]	2.57	nm	52.8	16.0	40.9	45.7
2005 Phase 1 Sediment Sampling	RM732X1	5154543,J4FC9,MJ4FC9	7.86[c]	0.317	nm	52.8	16.0	40.9	50.2
2005 Phase 1 Sediment Sampling	RM732X2	5154530	7.86[c]	0.163	nm	52.8	16.0	40.9	50.5
2005 Phase 1 Sediment Sampling	RM732X3	5154541,J4FC7,MJ4FC7	7.86[c]	0.434	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM733A1(X1)	5164493,J4FN3,MJ4FN3	7.86[c]	0.383	nm	52.8	16.0	40.9	50.0
2005 Phase 1 Sediment Sampling	RM733X2	5154521,J4FA7,MJ4FA7	7.86[c]	0.179	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM733X3	5154522,J4FA8,MJ4FA8	7.86[c]	0.470	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM734A1	5164479,J4FL9,MJ4FL9	7.86[c]	0.0609	nm	52.8	16.0	40.9	50.7
2005 Phase 1 Sediment Sampling	RM734X3	5154520,J4FA6,MJ4FA6	7.86[c]	0.247	nm	52.8	16.0	40.9	50.3
2005 Phase 1 Sediment Sampling	RM735B1	5154401	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM735B1L	5154402,J4EX2,MJ4EX2	7.86[c]	0.129	nm	52.8	16.0	40.9	50.5
2005 Phase 1 Sediment Sampling	RM735B1R	5154403,J4EX4,MJ4EX4	7.86[c]	0.443	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM735B1c	5154400,J4EX1,MJ4EX1	7.86[c]	0.846	nm	52.8	16.0	40.9	49.1
2005 Phase 1 Sediment Sampling	RM735B2	5154405	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM735B2L	5154406,J4EY5,MJ4EY5	7.86[c]	0.122	nm	52.8	16.0	40.9	50.6

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2005 Phase 1 Sediment Sampling	RM735B2R	5154407,J4EY6,MJ4EY6	7.86[c]	0.466	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM735B2c	5154404,J4EY4,MJ4EY4	7.86[c]	0.914	nm	52.8	16.0	40.9	49.0
2005 Phase 1 Sediment Sampling	RM735B3	5154409	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM735B3L	5154410,J4EZ0,MJ4EZ0	7.86[c]	0.0810	nm	52.8	16.0	40.9	50.6
2005 Phase 1 Sediment Sampling	RM735B3R	5154412	7.86[c]	0.495	nm	52.8	16.0	40.9	49.8
2005 Phase 1 Sediment Sampling	RM735B3c	5154408,J4EY7,MJ4EY7	7.86[c]	0.318	nm	52.8	16.0	40.9	50.2
2005 Phase 1 Sediment Sampling	RM735BSF	5154414	7.86[c]	0.396	nm	52.8	16.0	40.9	50.0
2005 Phase 1 Sediment Sampling	RM735X1	5154488	7.86[c]	0.313	nm	52.8	16.0	40.9	50.2
2005 Phase 1 Sediment Sampling	RM735X3	5154486,J4F75,MJ4F75	7.86[c]	0.564	nm	52.8	16.0	40.9	49.7
2005 Phase 1 Sediment Sampling	RM736A1(X1)	5164474,J4FL4,MJ4FL4	7.86[c]	0.628	nm	52.8	16.0	40.9	49.5
2005 Phase 1 Sediment Sampling	RM736T1	5154464,J4F63,MJ4F63	7.86[c]	0.508	nm	52.8	16.0	40.9	49.8
2005 Phase 1 Sediment Sampling	RM736X3	5154456,J4F55,MJ4F55	7.86[c]	0.376	nm	52.8	16.0	40.9	50.0
2005 Phase 1 Sediment Sampling	RM737A1(X3)	5164472,J4FL2,MJ4FL2	7.86[c]	0.144	nm	52.8	16.0	40.9	50.5
2005 Phase 1 Sediment Sampling	RM737X1	5154452,J4F41,MJ4F41	7.86[c]	0.342	nm	52.8	16.0	40.9	50.1
2005 Phase 1 Sediment Sampling	RM737X2	5154446,J4F35,MJ4F35	7.86[c]	0.0324	nm	52.8	16.0	40.9	50.7
2005 Phase 1 Sediment Sampling	RM738A1(X3)	5164468,J4FK8,MJ4FK8	7.86[c]	0.325	nm	52.8	16.0	40.9	50.2
2005 Phase 1 Sediment Sampling	RM738X1	5154423,J4F13,MJ4F13	7.86[c]	0.212	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM739A1(X3)	5164469,J4FK9,MJ4FK9	7.86[c]	0.569	nm	52.8	16.0	40.9	49.7
2005 Phase 1 Sediment Sampling	RM739X1	5154427	7.86[c]	0.568	nm	52.8	16.0	40.9	49.7
2005 Phase 1 Sediment Sampling	RM740A1(X1)	5164460,J4FK0,MJ4FK0	7.86[c]	0.543	nm	52.8	16.0	40.9	49.7
2005 Phase 1 Sediment Sampling	RM740X3	5144432,J4EY3,MJ4EY3	7.86[c]	0.638	nm	52.8	16.0	40.9	49.5
2005 Phase 1 Sediment Sampling	RM741A1(X3)	5164459,J4FJ9,MJ4FJ9	7.86[c]	0.431	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM741X1	5144429,J4EY2,MJ4EY2	7.86[c]	0.438	nm	52.8	16.0	40.9	49.9
2005 Phase 1 Sediment Sampling	RM742A1(X1)	5164452,J4FJ2,MJ4FJ2	7.86[c]	0.0896	nm	52.8	16.0	40.9	50.6
2005 Phase 1 Sediment Sampling	RM742A2(X5)	5164455,J4FJ5,MJ4FJ5	7.86[c]	0.143	nm	52.8	16.0	40.9	50.5
2005 Phase 1 Sediment Sampling	RM742B1	5144411,J4EW4,MJ4EW4	7.86[c]	0.329	nm	52.8	16.0	40.9	50.1
2005 Phase 1 Sediment Sampling	RM742B2	5144409	7.86[c]	0.191	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM742B3	5144417,J4EX0,MJ4EX0	7.86[c]	0.215	nm	52.8	16.0	40.9	50.4
2005 Phase 1 Sediment Sampling	RM743A1(X1)	5164453,J4FJ3,MJ4FJ3	7.86[c]	0.702	nm	52.8	16.0	40.9	49.4
2005 Phase 1 Sediment Sampling	RM743A2(X3)	5164443,J4FH3,MJ4FH3	7.86[c]	0.246	nm	52.8	16.0	40.9	50.3
2005 Phase 1 Sediment Sampling	RM744A1(X1)	5164435,J4FG5,MJ4FG5	7.86[c]	0.400	nm	52.8	16.0	40.9	50.0
2005 Phase 1 Sediment Sampling	RM744A2(X3)	5164436,J4FG6,MJ4FG6	7.86[c]	0.112	nm	52.8	16.0	40.9	50.6
2005 Phase 1 Sediment Sampling	RM744X2	5144408	7.86[c]	0.0433	nm	52.8	16.0	40.9	50.7
2009-2011 Beach Sediment Study	SD-BS	SD-BSA	7.87	0.431	69.7[e]	NA	32.5	53.2	49.9
2009-2011 Beach Sediment Study	SD-BS	SD-BSB	7.77	0.598	69.7[e]	NA	32.5	53.2	49.6
2009-2011 Beach Sediment Study	SD-BS	SD-BSC	7.72	0.710	69.7[e]	NA	32.5	53.2	49.4
2009-2011 Beach Sediment Study	SD-BS	SD-BSD	7.68	0.760	69.7[e]	NA	32.5	53.2	49.3
2009-2011 Beach Sediment Study	SD-BS	SD-BSE	7.75	0.779	69.7	NA	32.5	53.2	49.2
2009-2011 Beach Sediment Study	SD-DM	SD-DMA	7.42	0.485	71.2[e]	NA	34.0	54.3	49.8
2009-2011 Beach Sediment Study	SD-DM	SD-DMB	7.63	0.411	71.2[e]	NA	34.0	54.3	50.0
2009-2011 Beach Sediment Study	SD-DM	SD-DMC	7.78	0.254	71.2	NA	34.0	54.3	50.3
2009-2011 Beach Sediment Study	SD-DM	SD-DMD	7.52	0.319	71.2[e]	NA	34.0	54.3	50.2
2009-2011 Beach Sediment Study	SD-DM	SD-DME	7.50	0.733	71.2[e]	NA	34.0	54.3	49.3
2009-2011 Beach Sediment Study	SD-DS	SD-DSA	7.92	0.760	64.0[e]	NA	27.0	49.0	49.3
2009-2011 Beach Sediment Study	SD-DS	SD-DSB	8.24	0.595	64.0	NA	27.0	49.0	49.6
2009-2011 Beach Sediment Study	SD-DS	SD-DSC	8.21	0.573	64.0[e]	NA	27.0	49.0	49.7
2009-2011 Beach Sediment Study	SD-NP	SD-NPA	7.45	0.846	81.8	NA	44.3	62.0	49.1
2009-2011 Beach Sediment Study	SD-NP	SD-NPB	7.56	1.27	81.8[e]	NA	44.3	62.0	48.3
2009-2011 Beach Sediment Study	SD-NP	SD-NPC	7.62	0.971	81.8[e]	NA	44.3	62.0	48.9
2009-2011 Beach Sediment Study	SD-RV	SD-RVA	8.05	1.39	69.3[e]	NA	32.1	52.9	48.0
2009-2011 Beach Sediment Study	SD-RV	SD-RVB	7.83	1.62	69.3[e]	NA	32.1	52.9	47.6
2009-2011 Beach Sediment Study	SD-RV	SD-RVC	7.95	1.55	69.3	NA	32.1	52.9	47.7
2009-2011 Beach Sediment Study	SD-RV	SD-RVD	8.03	1.26	69.3[e]	NA	32.1	52.9	48.3
2009-2011 Beach Sediment Study	SD-RV	SD-RVE	8.14	1.02	69.3[e]	NA	32.1	52.9	48.8
2019 Northport Waterfront RI	TP-1	TP-1 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-10	TP-10 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-12	TP-12 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2019 Northport Waterfront RI	TP-13	TP-13 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-14	TP-14 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-16	TP-16 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-18	TP-18 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-19	TP-19 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-22	TP-22 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-23	TP-23 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-25	TP-25 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-3	TP-3 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-4	TP-4 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-5	TP-5 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-6	TP-6 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-7	TP-7 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	TP-9	TP-9 (0.0-0.5)	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2013 Phase 2 Sediment Study	TRIB-6	SE-TRIB-6	7.57	1.34	nm	57.0	20.1	43.9	48.1
2013 USGS Toxicity Evaluation	TRIB-6-NRT	CERC 16_TRIB-6_SD_2	7.86[c]	5.12	nm	52.8	16.0	40.9	40.6
2019 Northport Waterfront RI	XRF-1	XRF-1	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-100	XRF-100	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-11	XRF-11	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-24	XRF-24	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-41	XRF-41	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-49	XRF-49	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-50	XRF-50	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-59	XRF-59	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-60	XRF-60	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-63	XRF-63	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-66	XRF-66	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-7	XRF-7	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-96	XRF-96	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
2019 Northport Waterfront RI	XRF-99	XRF-99	7.86[c]	0.435[c]	nm	52.8	16.0	40.9	49.9
OU 1 South									
2013 Phase 2 Sediment Study	2B-C3	SE-2B-C3	7.88	0.844	nm	52.5	15.7	40.6	49.1
2013 Phase 2 Sediment Study	2B-C4	SE-2B-C4	8.50	0.0910	nm	43.6	7.05	34.1	50.6
2013 Phase 2 Sediment Study	2B-R2	SE-2B-R2	8.28	0.170	nm	46.8	10.2	36.5	50.5
2013 Phase 2 Sediment Study	3-B1	SE-3-B1	7.93	0.0840	nm	51.8	15.1	40.1	50.6
2013 Phase 2 Sediment Study	3-B2	SE-3-B2	7.76	0.109	nm	54.3	17.5	42.0	50.6
2013 Phase 2 Sediment Study	3-B3	SE-3-B3	6.95	1.38	nm	65.9	28.8	50.4	48.0
2013 Phase 2 Sediment Study	3-B4	SE-3-B4	7.90	0.120	nm	52.2	15.4	40.4	50.6
2013 Phase 2 Sediment Study	3-C1	SE-3-C1	8.75	0.331	nm	40.0	3.54	31.5	50.1
2013 Phase 2 Sediment Study	3-R1	SE-3-R1	8.26	0.782	nm	47.1	10.5	36.7	49.2
2013 Phase 2 Sediment Study	3-R10	SE-3-R10	8.98	0.242	nm	36.7	0.319	29.1	50.3
2013 Phase 2 Sediment Study	3-R2	SE-3-R2	6.91	1.60	nm	66.5	29.4	50.9	47.6
2013 Phase 2 Sediment Study	3-R6	SE-3-R6	8.40	0.210	nm	45.0	8.42	35.2	50.4
2013 Phase 2 Sediment Study	3-R7	SE-3-R7	8.63	0.227	nm	41.7	5.20	32.8	50.3
2019 Phase 3 Sediment Study	3-R7-2019	3-R7-2019-SE-1-101519	7.68[c]	0.0700	nm	55.4	18.6	42.8	50.7
2013 Phase 2 Sediment Study	3-R9	SE-3-R9	7.47	1.16	nm	58.4	21.5	45.0	48.5
2013 Phase 2 Sediment Study	3B-C2	SE-3B-C2	6.58	3.59	nm	71.2	34.0	54.3	43.6
2013 Phase 2 Sediment Study	3B-C3	SE-3B-C3	7.85	0.0850	nm	53.0	16.2	41.0	50.6
2013 Phase 2 Sediment Study	3B-C4	SE-3B-C4	7.09	1.31	nm	63.9	26.9	49.0	48.2
2019 Phase 3 Sediment Study	CB002	CB002-SE-1-101619	7.68[c]	0.197	nm	55.4	18.6	42.8	50.4
2019 Phase 3 Sediment Study	CB006	CB006-SE-1-100919	7.68[c]	0.218	nm	55.4	18.6	42.8	50.4
2019 Phase 3 Sediment Study	CB007	CB007-SE-1-100919	7.68[c]	0.438	nm	55.4	18.6	42.8	49.9
2019 Phase 3 Sediment Study	CB009	CB009-SE-1-101219	7.68[c]	0.415	nm	55.4	18.6	42.8	50.0
2019 Phase 3 Sediment Study	CB010	CB010-SE-1-101219	7.68[c]	0.404	nm	55.4	18.6	42.8	50.0
2019 Phase 3 Sediment Study	CB012	CB012-SE-1-100919	7.68[c]	0.151	nm	55.4	18.6	42.8	50.5
2019 Phase 3 Sediment Study	CB016	CB016-SE-1-101119	7.68[c]	0.275	nm	55.4	18.6	42.8	50.2
2019 Phase 3 Sediment Study	CB018	CB018-SE-1-100919	7.68[c]	0.298	nm	55.4	18.6	42.8	50.2
2019 Phase 3 Sediment Study	CB020	CB020-SE-1-101419	7.68[c]	0.359	nm	55.4	18.6	42.8	50.1
2019 Phase 3 Sediment Study	CB021	CB021-SE-1-101419	7.68[c]	0.747	nm	55.4	18.6	42.8	49.3
2019 Phase 3 Sediment Study	CB024	CB024-SE-1-101419	7.68[c]	0.371	nm	55.4	18.6	42.8	50.1

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2019 Phase 3 Sediment Study	CB027	CB027-SE-1-101419	7.68[c]	0.209	nm	55.4	18.6	42.8	50.4
2019 Phase 3 Sediment Study	CB029	CB029-SE-1-101519	7.68[c]	0.220	nm	55.4	18.6	42.8	50.4
2019 Phase 3 Sediment Study	CB035	CB035-SE-1-100319	7.68[c]	0.106	nm	55.4	18.6	42.8	50.6
2019 Phase 3 Sediment Study	CB036	CB036-SE-1-100419	7.68[c]	0.155	nm	55.4	18.6	42.8	50.5
2019 Phase 3 Sediment Study	CB039	CB039-SE-1-101119	7.68[c]	0.103	nm	55.4	18.6	42.8	50.6
2019 Phase 3 Sediment Study	CB040	CB040-SE-1-101819	7.68[c]	0.180	nm	55.4	18.6	42.8	50.4
2019 Phase 3 Sediment Study	CB044	CB044-SE-1-101519	7.68[c]	0.249	nm	55.4	18.6	42.8	50.3
2019 Phase 3 Sediment Study	CB046	CB046-SE-1-100819	7.68[c]	0.112	nm	55.4	18.6	42.8	50.6
2019 Phase 3 Sediment Study	CB047	CB047-SE-1-101119	7.68[c]	0.150	nm	55.4	18.6	42.8	50.5
2019 Phase 3 Sediment Study	CB056	CB056-SE-1-101719	7.68[c]	0.309	nm	55.4	18.6	42.8	50.2
2009-2011 Beach Sediment Study	CR-BF	CR-BF1-1	6.51	1.06	nm	72.3	35.1	55.1	48.7
2009-2011 Beach Sediment Study	CR-BFA	CR-BFA1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-BFB	CR-BFB1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-BFC	CR-BFC1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-BFD	CR-BFD1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-BFE	CR-BFE1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-EV	CR-EV1-1	7.39	0.984	nm	59.6	22.7	45.8	48.8
2009-2011 Beach Sediment Study	CR-EVA	CR-EVA1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-EVB	CR-EVB1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-EVC	CR-EVC1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-EVD	CR-EVD1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-EVE	CR-EVE1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-FC	CR-FC1	6.54	1.82	nm	71.8	34.6	54.7	47.2
2009-2011 Beach Sediment Study	CR-FCA	CR-FCA1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-FCB	CR-FCB1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-FCC	CR-FCC1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-FCD	CR-FCD1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-FCE	CR-FCE1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-SRA	CR-SRA1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-SRB	CR-SRB1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-SRC	CR-SRC1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-SRD	CR-SRD1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2009-2011 Beach Sediment Study	CR-SRE	CR-SRE1	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2019 Phase 3 Sediment Study	EV011	EV011-SE-1-092819	7.68[c]	0.173	nm	55.4	18.6	42.8	50.5
2019 Phase 3 Sediment Study	EV022	EV022-SE-1-092819	7.68[c]	0.934[c]	nm	55.4	18.6	42.8	48.9
2019 Phase 3 Sediment Study	EV036	EV036-SE-1-091419	7.68[c]	0.661	nm	55.4	18.6	42.8	49.5
2019 Phase 3 Sediment Study	EV044	EV044-SE-1-092419	7.68[c]	2.78	nm	55.4	18.6	42.8	45.2
2019 Phase 3 Sediment Study	EV049	EV049-SE-1-092719	7.68[c]	0.754	nm	55.4	18.6	42.8	49.3
2019 Phase 3 Sediment Study	EV054	EV054-SE-1-091119	7.68[c]	2.79	nm	55.4	18.6	42.8	45.2
2019 Phase 3 Sediment Study	EV057	EV057-SE-1-091119	7.68[c]	2.30	nm	55.4	18.6	42.8	46.2
2019 Phase 3 Sediment Study	EV063	EV063-SE-1-091019	7.68[c]	2.94	nm	55.4	18.6	42.8	44.9
2019 Phase 3 Sediment Study	EV064	EV064-SE-1-091019	7.68[c]	1.78	nm	55.4	18.6	42.8	47.2
2015 Bossburg Flat Sediment and Soil Study	F-1	F-1-COR-01	6.47	0.0900	nm	72.8	35.6	55.5	50.6
2015 Bossburg Flat Sediment and Soil Study	F-1	F-1-COR-02	6.94	0.224	nm	66.1	29.0	50.6	50.4
2015 Bossburg Flat Sediment and Soil Study	F-1	F-1-COR-03	7.14	0.144	nm	63.2	26.2	48.5	50.5
2019 Phase 3 Sediment Study	JS001	JS001-SE-1-101019	7.68[c]	0.364	nm	55.4	18.6	42.8	50.1
2019 Phase 3 Sediment Study	JS002	JS002-SE-1-101019	7.68[c]	0.175	nm	55.4	18.6	42.8	50.4
2010 White Sturgeon Toxicity Study	LD-01	LD-01 DEF	8.30	0.130	nm	46.5	9.88	36.3	50.5
2005 Phase 1 Sediment Sampling	RM708A1(X3)	5164450,J4FJ0,MJ4FJ0	7.68[c]	1.47	nm	55.4	18.6	42.8	47.9
2005 Phase 1 Sediment Sampling	RM708X1	5154538,J4FC4,MJ4FC4	7.68[c]	1.17	nm	55.4	18.6	42.8	48.5
2005 Phase 1 Sediment Sampling	RM710X1	5154539,J4FC5,MJ4FC5	7.68[c]	2.17	nm	55.4	18.6	42.8	46.5
2005 Phase 1 Sediment Sampling	RM710X3	5154540	7.68[c]	0.764	nm	55.4	18.6	42.8	49.3
2005 Phase 1 Sediment Sampling	RM713A1(X3)	5164488	7.68[c]	0.902	nm	55.4	18.6	42.8	49.0
2005 Phase 1 Sediment Sampling	RM713X1	5154519,J4FA5,MJ4FA5	7.68[c]	2.93	nm	55.4	18.6	42.8	44.9
2005 Phase 1 Sediment Sampling	RM715X1	5154518	7.68[c]	1.88	nm	55.4	18.6	42.8	47.0
2005 Phase 1 Sediment Sampling	RM715X3	5154496,J4F85,MJ4F85	7.68[c]	0.539	nm	55.4	18.6	42.8	49.7
2005 Phase 1 Sediment Sampling	RM718B1	5144400,J4ET3,MJ4ET3	7.68[c]	0.279	nm	55.4	18.6	42.8	50.2
2005 Phase 1 Sediment Sampling	RM718B2	5144401,J4ET4,MJ4ET4	7.68[c]	2.03	nm	55.4	18.6	42.8	46.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2005 Phase 1 Sediment Sampling	RM718B3	5144402,J4ET5,MJ4ET5	7.68[c]	0.881	nm	55.4	18.6	42.8	49.0
2005 Phase 1 Sediment Sampling	RM718X1	5154485,J4F74,MJ4F74	7.68[c]	0.597	nm	55.4	18.6	42.8	49.6
2005 Phase 1 Sediment Sampling	RM718X3	5154495,J4F84,MJ4F84	7.68[c]	1.70	nm	55.4	18.6	42.8	47.4
2005 Phase 1 Sediment Sampling	RM721R1	5164477	7.68[c]	2.44	nm	55.4	18.6	42.8	45.9
2005 Phase 1 Sediment Sampling	RM721X1	5154484,J4F73,MJ4F73	7.68[c]	0.199	nm	55.4	18.6	42.8	50.4
2005 Phase 1 Sediment Sampling	RM721X3	5154483,J4F72,MJ4F72	7.68[c]	0.530	nm	55.4	18.6	42.8	49.7
2005 Phase 1 Sediment Sampling	RM722X1	5154468,J4F48,MJ4F48	7.68[c]	2.44	nm	55.4	18.6	42.8	45.9
2005 Phase 1 Sediment Sampling	RM722X2	5154469,J4F52,MJ4F52	7.68[c]	0.0494	nm	55.4	18.6	42.8	50.7
2005 Phase 1 Sediment Sampling	RM722X3	5154470,J4F53,MJ4F53	7.68[c]	3.76	nm	55.4	18.6	42.8	43.3
2005 Phase 1 Sediment Sampling	RM723A1(X1)	5164473,J4FL3,MJ4FL3	7.68[c]	0.375	nm	55.4	18.6	42.8	50.0
2005 Phase 1 Sediment Sampling	RM723A2(X3)	5164475,J4FL5,MJ4FL5	7.68[c]	1.44	nm	55.4	18.6	42.8	47.9
2005 Phase 1 Sediment Sampling	RM723X4	5154445	7.68[c]	0.0932	nm	55.4	18.6	42.8	50.6
2005 Phase 1 Sediment Sampling	RM723X5	5154447,J4F36,MJ4F36	7.68[c]	5.45	nm	55.4	18.6	42.8	39.9
2005 Phase 1 Sediment Sampling	RM724A1(X1)	5164461,J4FK1,MJ4FK1	7.68[c]	1.07	nm	55.4	18.6	42.8	48.7
2005 Phase 1 Sediment Sampling	RM724A2(X3)	5164471,J4FL1,MJ4FL1	7.68[c]	0.635	nm	55.4	18.6	42.8	49.5
2005 Phase 1 Sediment Sampling	RM725X1	5154424,J4F14,MJ4F14	7.68[c]	0.202	nm	55.4	18.6	42.8	50.4
2005 Phase 1 Sediment Sampling	RM725X3	5154425,J4F15,MJ4F15	7.68[c]	0.385	nm	55.4	18.6	42.8	50.0
2005 Phase 1 Sediment Sampling	RM726R1	5164478,J4FL8,MJ4FL8	7.68[c]	3.91	nm	55.4	18.6	42.8	43.0
2005 Phase 1 Sediment Sampling	RM726X1	5144448	7.68[c]	0.721	nm	55.4	18.6	42.8	49.4
2005 Phase 1 Sediment Sampling	RM726X3	5144436,J4EY9,MJ4EY9	7.68[c]	1.05	nm	55.4	18.6	42.8	48.7
2005 Phase 1 Sediment Sampling	RM727A1(X1)	5164508	7.68[c]	0.674	nm	55.4	18.6	42.8	49.5
2005 Phase 1 Sediment Sampling	RM727X3	5144422,J4EX5,MJ4EX5	7.68[c]	0.581	nm	55.4	18.6	42.8	49.6
2009-2011 Beach Sediment Study	SD-BF	SD-BFA	6.90	0.770	77.8[e]	NA	40.4	59.1	49.3
2009-2011 Beach Sediment Study	SD-BF	SD-BFB	6.91	0.696	77.8[e]	NA	40.4	59.1	49.4
2009-2011 Beach Sediment Study	SD-BF	SD-BFC	7.19	0.821	77.8	NA	40.4	59.1	49.2
2009-2011 Beach Sediment Study	SD-BF	SD-BFD	7.28	0.782	77.8[e]	NA	40.4	59.1	49.2
2009-2011 Beach Sediment Study	SD-BF	SD-BFE	7.08	0.852	77.8[e]	NA	40.4	59.1	49.1
2009-2011 Beach Sediment Study	SD-CB	SD-CBA	7.52	0.0200	68.2[e]	NA	31.1	52.1	50.8
2009-2011 Beach Sediment Study	SD-CB	SD-CBB	7.74	2.29	68.2[e]	NA	31.1	52.1	46.2
2009-2011 Beach Sediment Study	SD-CB	SD-CBC	7.59	0.826	68.2	NA	31.1	52.1	49.1
2009-2011 Beach Sediment Study	SD-CB	SD-CBD	7.61	1.05	68.2[e]	NA	31.1	52.1	48.7
2009-2011 Beach Sediment Study	SD-CB	SD-CBE	7.54	1.10	68.2[e]	NA	31.1	52.1	48.6
2009-2011 Beach Sediment Study	SD-EV	SD-EVA	6.97	0.968	82.0[e]	NA	44.5	62.2	48.9
2009-2011 Beach Sediment Study	SD-EV	SD-EVB	7.35	1.15	82.0[e]	NA	44.5	62.2	48.5
2009-2011 Beach Sediment Study	SD-EV	SD-EVC	7.16	0.672	82.0[e]	NA	44.5	62.2	49.5
2009-2011 Beach Sediment Study	SD-EV	SD-EVD	7.13	0.832	82.0[e]	NA	44.5	62.2	49.1
2009-2011 Beach Sediment Study	SD-EV	SD-EVE	7.36	0.843	82.0	NA	44.5	62.2	49.1
2009-2011 Beach Sediment Study	SD-FC	SD-FCA	7.40	1.45	73.0[e]	NA	35.7	55.6	47.9
2009-2011 Beach Sediment Study	SD-FC	SD-FCB	7.18	1.42	73.0[e]	NA	35.7	55.6	48.0
2009-2011 Beach Sediment Study	SD-FC	SD-FCC	7.15	1.04	73.0[e]	NA	35.7	55.6	48.7
2009-2011 Beach Sediment Study	SD-FC	SD-FCD	7.08	1.51	73.0[e]	NA	35.7	55.6	47.8
2009-2011 Beach Sediment Study	SD-FC	SD-FCE	7.42	1.06	73.0	NA	35.7	55.6	48.7
2009-2011 Beach Sediment Study	SD-SR	SD-SRA	7.25	1.32	72.7[e]	NA	35.5	55.4	48.2
2009-2011 Beach Sediment Study	SD-SR	SD-SRB	7.41	1.71	72.7[e]	NA	35.5	55.4	47.4
2009-2011 Beach Sediment Study	SD-SR	SD-SRC	7.23	0.946	72.7[e]	NA	35.5	55.4	48.9
2009-2011 Beach Sediment Study	SD-SR	SD-SRD	7.73	1.97	72.7	NA	35.5	55.4	46.9
2009-2011 Beach Sediment Study	SD-SR	SD-SRE	7.34	1.24	72.7[e]	NA	35.5	55.4	48.3
2015 Bossburg Flat Sediment and Soil Study	SDU-01	SDU-01-COR-01	7.47	2.38	68.4[e]	NA	31.3	52.3	46.0
2015 Bossburg Flat Sediment and Soil Study	SDU-01	SDU-01-COR-02	6.64	2.58	68.4[e]	NA	31.3	52.3	45.6
2015 Bossburg Flat Sediment and Soil Study	SDU-01	SDU-01-COR-03	7.01	3.31	68.4[e]	NA	31.3	52.3	44.2
2015 Bossburg Flat Sediment and Soil Study	SDU-01	SDU-01-ICS	6.94	2.65	68.4	NA	31.3	52.3	45.5
2015 Bossburg Flat Sediment and Soil Study	SDU-02	SDU-02-COR-01	7.28	2.29	81.1[e]	NA	43.7	61.5	46.2
2015 Bossburg Flat Sediment and Soil Study	SDU-02	SDU-02-COR-02	7.08	3.00	81.1[e]	NA	43.7	61.5	44.8
2015 Bossburg Flat Sediment and Soil Study	SDU-02	SDU-02-COR-03	7.05	2.28	81.1[e]	NA	43.7	61.5	46.2
2015 Bossburg Flat Sediment and Soil Study	SDU-02	SDU-02-ICS-A	7.14	2.13	57.3	NA	20.4	44.1	46.5
2015 Bossburg Flat Sediment and Soil Study	SDU-02	SDU-02-ICS-B	6.96	2.28	81.1	NA	43.7	61.5	46.2
2015 Bossburg Flat Sediment and Soil Study	SDU-02	SDU-02-ICS-C	7.03	2.26	63.5	NA	26.5	48.7	46.3
2015 Bossburg Flat Sediment and Soil Study	SDU-03	SDU-03-COR-01	7.38	0.468	69.7[e]	NA	32.5	53.2	49.9

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2015 Bossburg Flat Sediment and Soil Study	SDU-03	SDU-03-COR-02	7.09	0.738	69.7[e]	NA	32.5	53.2	49.3
2015 Bossburg Flat Sediment and Soil Study	SDU-03	SDU-03-COR-03	6.93	0.634	69.7[e]	NA	32.5	53.2	49.5
2015 Bossburg Flat Sediment and Soil Study	SDU-03	SDU-03-ICS-A	7.54	0.516	58.5	NA	21.6	45.0	49.8
2015 Bossburg Flat Sediment and Soil Study	SDU-03	SDU-03-ICS-B	7.68	0.622	57.7	NA	20.8	44.4	49.6
2015 Bossburg Flat Sediment and Soil Study	SDU-03	SDU-03-ICS-C	7.51	0.658	69.7	NA	32.5	53.2	49.5
2015 Bossburg Flat Sediment and Soil Study	SDU-04	SDU-04-COR-01	7.49	0.658	63.0[e]	NA	26.0	48.3	49.5
2015 Bossburg Flat Sediment and Soil Study	SDU-04	SDU-04-COR-02	7.71	0.312	63.0[e]	NA	26.0	48.3	50.2
2015 Bossburg Flat Sediment and Soil Study	SDU-04	SDU-04-COR-03	7.59	0.264	63.0[e]	NA	26.0	48.3	50.3
2015 Bossburg Flat Sediment and Soil Study	SDU-04	SDU-04-ICS	7.72	0.281	63.0	NA	26.0	48.3	50.2
2015 Bossburg Flat Sediment and Soil Study	SDU-05	SDU-05-COR-01	6.96	2.53	54.4[e]	NA	17.6	42.0	45.7
2015 Bossburg Flat Sediment and Soil Study	SDU-05	SDU-05-COR-02	7.14	2.36	54.4[e]	NA	17.6	42.0	46.1
2015 Bossburg Flat Sediment and Soil Study	SDU-05	SDU-05-COR-03	7.06	1.98	54.4[e]	NA	17.6	42.0	46.8
2015 Bossburg Flat Sediment and Soil Study	SDU-05	SDU-05-ICS	6.99	1.34	54.4	NA	17.6	42.0	48.1
2015 Bossburg Flat Sediment and Soil Study	SDU-06	SDU-06-COR-01	8.12	0.160	52.8[e]	NA	16.0	40.9	50.5
2015 Bossburg Flat Sediment and Soil Study	SDU-06	SDU-06-COR-02	7.22	0.128	52.8[e]	NA	16.0	40.9	50.5
2015 Bossburg Flat Sediment and Soil Study	SDU-06	SDU-06-COR-03	7.20	0.358	52.8[e]	NA	16.0	40.9	50.1
2015 Bossburg Flat Sediment and Soil Study	SDU-06	SDU-06-ICS-A	7.11	0.212	50.6	NA	13.9	39.3	50.4
2015 Bossburg Flat Sediment and Soil Study	SDU-06	SDU-06-ICS-B	7.61	0.175	49.5	NA	12.8	38.5	50.4
2015 Bossburg Flat Sediment and Soil Study	SDU-06	SDU-06-ICS-C	7.47	0.307	52.8	NA	16.0	40.9	50.2
2015 Bossburg Flat Sediment and Soil Study	SDU-07	SDU-07-COR-01	7.08	1.80	64.8[e]	NA	27.7	49.6	47.2
2015 Bossburg Flat Sediment and Soil Study	SDU-07	SDU-07-COR-02	7.11	2.02	64.8[e]	NA	27.7	49.6	46.8
2015 Bossburg Flat Sediment and Soil Study	SDU-07	SDU-07-COR-03	7.18	2.74	64.8[e]	NA	27.7	49.6	45.3
2015 Bossburg Flat Sediment and Soil Study	SDU-07	SDU-07-ICS-A	7.53	1.20	61.5	NA	24.5	47.2	48.4
2015 Bossburg Flat Sediment and Soil Study	SDU-07	SDU-07-ICS-B	7.35	0.661	64.8	NA	27.7	49.6	49.5
2015 Bossburg Flat Sediment and Soil Study	SDU-07	SDU-07-ICS-C	7.43	0.972	60.3	NA	23.4	46.3	48.9
2015 Bossburg Flat Sediment and Soil Study	SDU-08	SDU-08-COR-01	7.04	1.54	57.1[e]	NA	20.2	44.0	47.7
2015 Bossburg Flat Sediment and Soil Study	SDU-08	SDU-08-COR-02	7.35	1.05	57.1[e]	NA	20.2	44.0	48.7
2015 Bossburg Flat Sediment and Soil Study	SDU-08	SDU-08-COR-03	7.36	1.09	57.1[e]	NA	20.2	44.0	48.6
2015 Bossburg Flat Sediment and Soil Study	SDU-08	SDU-08-ICS	7.49	1.34	57.1	NA	20.2	44.0	48.1
2015 Bossburg Flat Sediment and Soil Study	SDU-09	SDU-09A-ICS	7.86	0.584	56.9	NA	20.0	43.9	49.6
2015 Bossburg Flat Sediment and Soil Study	SDU-10	SDU-10-ICS	7.72	0.489	58.8	NA	21.9	45.2	49.8
2013 USGS Toxicity Evaluation	TRB-04-NRT	CERC 10_TRB-04_SD_1a-1b	7.68[c]	0.130	nm	55.4	18.6	42.8	50.5
2013 Phase 2 Sediment Study	TRIB-4	SE-TRIB-4	8.03	0.290	nm	50.4	13.7	39.1	50.2
2013 Phase 2 Sediment Study	TRIB-5	SE-TRIB-5	7.61	0.942	nm	56.4	19.5	43.5	48.9
2013 USGS Toxicity Evaluation	TRIB-5-NRT	CERC 17_TRIB-5_SD_1a-1b	7.68[c]	0.310	nm	55.4	18.6	42.8	50.2
Transitional									
2013 Phase 2 Sediment Study	4-B3	SE-4-B3	7.07	1.94	nm	64.2	27.2	49.2	46.9
2013 Phase 2 Sediment Study	4-C2	SE-4-C2	6.48	1.32	nm	72.7	35.5	55.4	48.2
2013 Phase 2 Sediment Study	4-C3	SE-4-C3	7.44	0.552	nm	58.9	22.0	45.3	49.7
2013 Phase 2 Sediment Study	4-C4	SE-4-C4	6.86	2.33	nm	67.2	30.1	51.4	46.1
2013 Phase 2 Sediment Study	4-C5	SE-4-C5	7.03	1.46	nm	64.8	27.7	49.6	47.9
2013 Phase 2 Sediment Study	4-C6	SE-4-C6	7.22	1.81	nm	62.0	25.0	47.6	47.2
2013 Phase 2 Sediment Study	4-R5	SE-4-R5	6.38	2.53	nm	74.1	36.8	56.4	45.7
2009-2011 Beach Sediment Study	CR-KFA	CR-KFA1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KFB	CR-KFB1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KFC	CR-KFC1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KFD	CR-KFD1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KFE	CR-KFE1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KLA	CR-KLA1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KLB	CR-KLB1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KLC	CR-KLC1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KLD	CR-KLD1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-KLE	CR-KLE1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-WBA	CR-WBA1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-WBB	CR-WBB1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-WBC	CR-WBC1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-WBD	CR-WBD1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2009-2011 Beach Sediment Study	CR-WBE	CR-WBE1	7.11[c]	0.959[c]	nm	63.6	26.6	48.7	48.9
2005 Phase 1 Sediment Sampling	RM700B1L	5154430,J4F21,MJ4F21	7.11[c]	0.0430	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM700B1R	5154431,J4F22,MJ4F22	7.11[c]	0.0471	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM700B1c	5154428,J4F20,MJ4F20	7.11[c]	0.0475	nm	63.6	26.6	48.7	50.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2005 Phase 1 Sediment Sampling	RM700B2L	5154434,J4F24,MJ4F24	7.11[c]	0.0864	nm	63.6	26.6	48.7	50.6
2005 Phase 1 Sediment Sampling	RM700B2R	5154435,J4F25,MJ4F25	7.11[c]	0.0514	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM700B2c	5154432,J4F23,MJ4F23	7.11[c]	0.0694	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM700B3L	5154439	7.11[c]	0.0447	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM700B3R	5154440,J4F29,MJ4F29	7.11[c]	0.0963	nm	63.6	26.6	48.7	50.6
2005 Phase 1 Sediment Sampling	RM700B3c	5154436,J4F26,MJ4F26	7.11[c]	0.0555	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM700BSF	5154441,J4F30,MJ4F30	7.11[c]	0.0626	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM701X1	5144425,J4EX8,MJ4EX8	7.11[c]	0.205	nm	63.6	26.6	48.7	50.4
2005 Phase 1 Sediment Sampling	RM701X3	5144427,J4EY0,MJ4EY0	7.11[c]	0.0478	nm	63.6	26.6	48.7	50.7
2005 Phase 1 Sediment Sampling	RM704A1(X1)	5164433,J4FG3,MJ4FG3	7.11[c]	0.800	nm	63.6	26.6	48.7	49.2
2005 Phase 1 Sediment Sampling	RM704X3	5144424	7.11[c]	0.464	nm	63.6	26.6	48.7	49.9
2005 Phase 1 Sediment Sampling	RM705R1	5164486,J4FM6,MJ4FM6	7.11[c]	2.14	nm	63.6	26.6	48.7	46.5
2005 Phase 1 Sediment Sampling	RM705X1	5144413,J4EW6,MJ4EW6	7.11[c]	0.870	nm	63.6	26.6	48.7	49.1
2005 Phase 1 Sediment Sampling	RM705X3	5144415,J4EW8,MJ4EW8	7.11[c]	0.184	nm	63.6	26.6	48.7	50.4
2005 Phase 1 Sediment Sampling	RM706A1(X1)	5164442,J4FH2,MJ4FH2	7.11[c]	1.96	nm	63.6	26.6	48.7	46.9
2005 Phase 1 Sediment Sampling	RM706A2(X7)	5164449,J4FH9,MJ4FH9	7.11[c]	2.91	nm	63.6	26.6	48.7	45.0
2005 Phase 1 Sediment Sampling	RM706T1	5154533,J4FB9,MJ4FB9	7.11[c]	3.37	nm	63.6	26.6	48.7	44.1
2005 Phase 1 Sediment Sampling	RM706T2	5154537,J4FC3,MJ4FC3	7.11[c]	0.130	nm	63.6	26.6	48.7	50.5
2005 Phase 1 Sediment Sampling	RM706X2	5154523,J4FA9,MJ4FA9	7.11[c]	1.13	nm	63.6	26.6	48.7	48.5
2005 Phase 1 Sediment Sampling	RM706X3	5154536,J4FC2,MJ4FC2	7.11[c]	0.632	nm	63.6	26.6	48.7	49.5
2005 Phase 1 Sediment Sampling	RM706X5	5154531,J4FB7,MJ4FB7	7.11[c]	2.21	nm	63.6	26.6	48.7	46.4
2005 Phase 1 Sediment Sampling	RM706X6	5154532,J4FB8,MJ4FB8	7.11[c]	3.28	nm	63.6	26.6	48.7	44.2
2005 Phase 1 Sediment Sampling	RM707X1	5164406,J4FD6,MJ4FD6	7.11[c]	0.608	nm	63.6	26.6	48.7	49.6
2005 Phase 1 Sediment Sampling	RM707X3	5164407,J4FD7,MJ4FD7	7.11[c]	0.197	nm	63.6	26.6	48.7	50.4
2005 Phase 1 Sediment Sampling	RM708B1	5144404	7.11[c]	0.420	nm	63.6	26.6	48.7	50.0
2005 Phase 1 Sediment Sampling	RM708B2	5144405,J4ET8,MJ4ET8	7.11[c]	2.22	nm	63.6	26.6	48.7	46.4
2005 Phase 1 Sediment Sampling	RM708B3	5144406,J4ET9,MJ4ET9	7.11[c]	1.99	nm	63.6	26.6	48.7	46.8
2009-2011 Beach Sediment Study	SD-KF	SD-KFA	8.21	0.0930	56.1[e]	NA	19.3	43.3	50.6
2009-2011 Beach Sediment Study	SD-KF	SD-KFB	7.97	0.0690	56.1[e]	NA	19.3	43.3	50.7
2009-2011 Beach Sediment Study	SD-KF	SD-KFC	7.72	0.0620	56.1[e]	NA	19.3	43.3	50.7
2009-2011 Beach Sediment Study	SD-KF	SD-KFD	7.90	0.0760	56.1[e]	NA	19.3	43.3	50.6
2009-2011 Beach Sediment Study	SD-KF	SD-KFE	7.89	0.0600	56.1	NA	19.3	43.3	50.7
2009-2011 Beach Sediment Study	SD-KL	SD-KLA	6.94	0.600	52.4[e]	NA	15.6	40.6	49.6
2009-2011 Beach Sediment Study	SD-KL	SD-KLB	6.49	0.878	52.4	NA	15.6	40.6	49.0
2009-2011 Beach Sediment Study	SD-KL	SD-KLC	6.17	1.95	52.4[e]	NA	15.6	40.6	46.9
2009-2011 Beach Sediment Study	SD-KL	SD-KLD	6.58	0.949	52.4[e]	NA	15.6	40.6	48.9
2009-2011 Beach Sediment Study	SD-KL	SD-KLE	6.86	0.742	52.4[e]	NA	15.6	40.6	49.3
2009-2011 Beach Sediment Study	SD-WB	SD-WBA	7.79	0.538	69.0[e]	NA	31.8	52.7	49.7
2009-2011 Beach Sediment Study	SD-WB	SD-WBB	7.71	0.445	69.0	NA	31.8	52.7	49.9
2009-2011 Beach Sediment Study	SD-WB	SD-WBC	7.93	0.404	69.0[e]	NA	31.8	52.7	50.0
2009-2011 Beach Sediment Study	SD-WB	SD-WBD	7.84	0.407	69.0[e]	NA	31.8	52.7	50.0
2009-2011 Beach Sediment Study	SD-WB	SD-WBE	7.52	0.483	69.0[e]	NA	31.8	52.7	49.8
2013 USGS Toxicity Evaluation	TRB-02-NRT	CERC 09_TRB-02_SD_1a-1b-3	7.11[c]	0.160	nm	63.6	26.6	48.7	50.5
2013 Phase 2 Sediment Study	TRIB-2	SE-TRIB-2	7.40	0.261	nm	59.4	22.5	45.7	50.3
Upper Lacustrine									
2013 Phase 2 Sediment Study	4B-C2	SE-4B-C2	7.08	2.82	nm	64.0	27.0	NC[b]	45.2
2013 Phase 2 Sediment Study	4B-C4	SE-4B-C4	7.37	1.68	nm	59.9	23.0	NC[b]	47.4
2013 Phase 2 Sediment Study	5-B1	SE-5-B1	7.39	0.940	nm	59.6	22.7	NC[b]	48.9
2013 Phase 2 Sediment Study	5B-C3	SE-5B-C3	6.88	0.384	nm	66.9	29.8	NC[b]	50.0
2013 Phase 2 Sediment Study	6-B1	SE-6-B1	6.74	1.23	nm	68.9	31.7	NC[b]	48.3
2013 Phase 2 Sediment Study	6-B4	SE-6-B4	6.82	1.32	nm	67.8	30.7	NC[b]	48.2
2013 Phase 2 Sediment Study	6-B5	SE-6-B5	7.22	1.21	nm	62.0	25.0	NC[b]	48.4
2013 Phase 2 Sediment Study	6-C3	SE-6-C3	7.06	1.24	nm	64.3	27.3	NC[b]	48.3
2009-2011 Beach Sediment Study	CR-AA	CR-AA1	7.44	0.114	nm	58.9	22.0	NC[b]	50.6
2009-2011 Beach Sediment Study	CR-AAA	CR-AAA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC[b]	49.7
2009-2011 Beach Sediment Study	CR-AAB	CR-AAB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC[b]	49.7
2009-2011 Beach Sediment Study	CR-AAC	CR-AAC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC[b]	49.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2009-2011 Beach Sediment Study	CR-AAD	CR-AAD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-AAE	CR-AAE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BB	CR-BB1	7.91	0.0610	nm	52.1	15.3	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-BBA	CR-BBA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BBB	CR-BBB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BBC	CR-BBC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BBD	CR-BBD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BBE	CR-BBE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BC	CR-BC1	7.20	0.261	nm	62.3	25.3	NC [b]	50.3
2009-2011 Beach Sediment Study	CR-BCA	CR-BCA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BCB	CR-BCB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BCC	CR-BCC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BCD	CR-BCD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-BCE	CR-BCE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CF	CR-CF1	7.80	1.01	nm	53.7	16.9	NC [b]	48.8
2009-2011 Beach Sediment Study	CR-CFA	CR-CFA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CFB	CR-CFB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CFC	CR-CFC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CFD	CR-CFD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CFE	CR-CFE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CR	CR-CR1	7.85	0.120	nm	53.0	16.2	NC [b]	50.6
2009-2011 Beach Sediment Study	CR-CRA	CR-CRA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CRB	CR-CRB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CRC	CR-CRC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CRD	CR-CRD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-CRE	CR-CRE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-HT	CR-HT1	7.93	0.425	nm	51.8	15.1	NC [b]	49.9
2009-2011 Beach Sediment Study	CR-HTA	CR-HTA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-HTB	CR-HTB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-HTC	CR-HTC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-HTD	CR-HTD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-HTE	CR-HTE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-LY	CR-LY1	7.15	0.994	nm	63.0	26.0	NC [b]	48.8
2009-2011 Beach Sediment Study	CR-LYA	CR-LYA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-LYB	CR-LYB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-LYC	CR-LYC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-LYD	CR-LYD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-LYE	CR-LYE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-NZ	CR-NZ1	8.29	0.0430	nm	46.6	9.98	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-NZA	CR-NZA1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-NZB	CR-NZB1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-NZC	CR-NZC1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-NZD	CR-NZD1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2009-2011 Beach Sediment Study	CR-NZE	CR-NZE1	7.32[c]	0.552[c]	nm	60.6	23.6	NC [b]	49.7
2013 Phase 2 Sediment Study	REF-1	SE-REF-1	7.14	0.882	nm	63.2	26.2	NC [b]	49.0
2013 Phase 2 Sediment Study	REF-2	SE-REF-2	6.46	0.649	nm	73.0	35.7	NC [b]	49.5
2013 Phase 2 Sediment Study	REF-3	SE-REF-3	7.35	0.961	nm	60.2	23.3	NC [b]	48.9
2013 Phase 2 Sediment Study	REF-4	SE-REF-4	7.20	0.666	nm	62.3	25.3	NC [b]	49.5
2013 Phase 2 Sediment Study	REF-5	SE-REF-5	7.26	0.267	nm	61.5	24.5	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM658A1(X3)	5164484	7.32[c]	0.250	nm	60.6	23.6	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM658X1	5164421,J4FF1,MJ4FF1	7.32[c]	0.127	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM661A1(X1)	5164483,J4FM3,MJ4FM3	7.32[c]	0.136	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM661X3	5164428,J4FF8,MJ4FF8	7.32[c]	0.108	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM664X1	5164423,J4FF3,MJ4FF3	7.32[c]	0.119	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM664X3	5164426	7.32[c]	0.0369	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM667X1	5154514,J4FA0,MJ4FA0	7.32[c]	0.0465	nm	60.6	23.6	NC [b]	50.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2005 Phase 1 Sediment Sampling	RM667X3	5154516,J4FA2,MJ4FA2	7.32[c]	0.274	nm	60.6	23.6	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM670X1	5154493,J4F82,MJ4F82	7.32[c]	0.132	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM670X3	5154513,J4F99,MJ4F99	7.32[c]	0.108	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM673B1	5154479	7.32[c]	0.149	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM673B2	5154480,J4F69,MJ4F69	7.32[c]	0.368	nm	60.6	23.6	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM673B3	5154481,J4F70,MJ4F70	7.32[c]	0.466	nm	60.6	23.6	NC [b]	49.9
2005 Phase 1 Sediment Sampling	RM673X1	5154490,J4F79,MJ4F79	7.32[c]	0.718	nm	60.6	23.6	NC [b]	49.4
2005 Phase 1 Sediment Sampling	RM673X3	5154492,J4F81,MJ4F81	7.32[c]	0.0800	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM675B1	5154526	7.32[c]	0.922	nm	60.6	23.6	NC [b]	49.0
2005 Phase 1 Sediment Sampling	RM675B2	5154527,J4FB3,MJ4FB3	7.32[c]	0.347	nm	60.6	23.6	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM675B3	5154528,J4FB4,MJ4FB4	7.32[c]	0.533	nm	60.6	23.6	NC [b]	49.7
2005 Phase 1 Sediment Sampling	RM676A1(X3)	5164458	7.32[c]	0.107	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM676X1	5154482,J4F71,MJ4F71	7.32[c]	0.0590	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM677A1(X3)	5164456,J4FJ6,MJ4FJ6	7.32[c]	0.533	nm	60.6	23.6	NC [b]	49.7
2005 Phase 1 Sediment Sampling	RM677X1	5154463,J4F62,MJ4F62	7.32[c]	0.0380	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM678A1(X1)	5164454,J4FJ4,MJ4FJ4	7.32[c]	0.141	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM678X3	5154461,J4F60,MJ4F60	7.32[c]	1.62	nm	60.6	23.6	NC [b]	47.6
2005 Phase 1 Sediment Sampling	RM678X7	5154458,J4F57,MJ4F57	7.32[c]	0.0526	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM679X1	5154442,J4F31,MJ4F31	7.32[c]	0.314	nm	60.6	23.6	NC [b]	50.2
2005 Phase 1 Sediment Sampling	RM679X3	5154449	7.32[c]	0.128	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM680A1(X1)	5164451	7.32[c]	0.271	nm	60.6	23.6	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM681X1	5154451,J4F40,MJ4F40	7.32[c]	0.0493	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM683X1	5154419,J4F09,MJ4F09	7.32[c]	0.181	nm	60.6	23.6	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM683X3	5154421,J4F11,MJ4F11	7.32[c]	0.168	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM685R1	5164496,J4FN6,MJ4FN6	7.32[c]	3.18	nm	60.6	23.6	NC [b]	44.4
2005 Phase 1 Sediment Sampling	RM686A1(X3)	5164439,J4FG9,MJ4FG9	7.32[c]	0.0644	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM686R1	5164489,J4FM9,MJ4FM9	7.32[c]	1.52	nm	60.6	23.6	NC [b]	47.8
2005 Phase 1 Sediment Sampling	RM686X1	5154417,J4F07,MJ4F07	7.32[c]	0.0376	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM687A1	5164440,J4FH0,MJ4FH0	7.32[c]	1.67	nm	60.6	23.6	NC [b]	47.5
2005 Phase 1 Sediment Sampling	RM689A1(X3)	5164441,J4FH1,MJ4FH1	7.32[c]	0.387	nm	60.6	23.6	NC [b]	50.0
2005 Phase 1 Sediment Sampling	RM689X1	5154415,J4EZ8,MJ4EZ8	7.32[c]	0.0632	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM690B1	5154465,J4F49,MJ4F49	7.32[c]	0.253	nm	60.6	23.6	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM690B2	5154466,J4F50,MJ4F50	7.32[c]	0.236	nm	60.6	23.6	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM690B3	5154467,J4F51,MJ4F51	7.32[c]	0.370	nm	60.6	23.6	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM692A1(X1)	5164438	7.32[c]	0.0372	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM693X1	5154453,J4F42,MJ4F42	7.32[c]	0.0464	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM695X1	5144451,J4F02,MJ4F02	7.32[c]	0.0931	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM695X3	5144453,J4F04,MJ4F04	7.32[c]	0.0490	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM697B1	5154471,J4F44,MJ4F44	7.32[c]	0.143	nm	60.6	23.6	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM697B2	5154472,J4F45,MJ4F45	7.32[c]	0.0725	nm	60.6	23.6	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM697B3	5154474	7.32[c]	2.26	nm	60.6	23.6	NC [b]	46.3
2005 Phase 1 Sediment Sampling	RM698A1(X1)	5164434,J4FG4,MJ4FG4	7.32[c]	2.17	nm	60.6	23.6	NC [b]	46.5
2005 Phase 1 Sediment Sampling	RM698X3	5144450,J4F01,MJ4F01	7.32[c]	0.100	nm	60.6	23.6	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM699T1	5144428,J4EY1,MJ4EY1	7.32[c]	2.74	nm	60.6	23.6	NC [b]	45.3
2009-2011 Beach Sediment Study	SD-AA	SD-AAA	7.96	0.134	58.0[e]	NA	21.1	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-AA	SD-AAB	8.16	0.0940	58.0[e]	NA	21.1	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-AA	SD-AAC	7.12	0.101	58.0[e]	NA	21.1	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-AA	SD-AAD	7.13	0.104	58.0[e]	NA	21.1	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-AA	SD-AAE	7.37	0.0870	58.0	NA	21.1	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-BB	SD-BBA	8.03	0.218	68.3	NA	31.2	NC [b]	50.4
2009-2011 Beach Sediment Study	SD-BB	SD-BBB	7.82	0.427	68.3[e]	NA	31.2	NC [b]	49.9
2009-2011 Beach Sediment Study	SD-BB	SD-BBC	7.90	0.331	68.3[e]	NA	31.2	NC [b]	50.1
2009-2011 Beach Sediment Study	SD-BB	SD-BBD	7.79	0.166	68.3[e]	NA	31.2	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-BB	SD-BBE	7.72	0.236	68.3[e]	NA	31.2	NC [b]	50.3
2009-2011 Beach Sediment Study	SD-BC	SD-BCA	6.44	0.756	52.5[e]	NA	15.7	NC [b]	49.3
2009-2011 Beach Sediment Study	SD-BC	SD-BCB	6.29	0.365	52.5[e]	NA	15.7	NC [b]	50.1

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2009-2011 Beach Sediment Study	SD-BC	SD-BCC	6.69	0.343	52.5[e]	NA	15.7	NC [b]	50.1
2009-2011 Beach Sediment Study	SD-BC	SD-BCD	6.51	0.0970	52.5[e]	NA	15.7	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-BC	SD-BCE	6.92	0.429	52.5	NA	15.7	NC [b]	49.9
2009-2011 Beach Sediment Study	SD-CF	SD-CFA	7.17	0.857	67.4	NA	30.3	NC [b]	49.1
2009-2011 Beach Sediment Study	SD-CF	SD-CFB	7.26	1.05	67.4[e]	NA	30.3	NC [b]	48.7
2009-2011 Beach Sediment Study	SD-CF	SD-CFC	7.60	0.365	67.4[e]	NA	30.3	NC [b]	50.1
2009-2011 Beach Sediment Study	SD-CF	SD-CFD	7.45	0.577	67.4[e]	NA	30.3	NC [b]	49.6
2009-2011 Beach Sediment Study	SD-CF	SD-CFE	7.44	0.703	67.4[e]	NA	30.3	NC [b]	49.4
2009-2011 Beach Sediment Study	SD-CR	SD-CRA	7.60	0.174	56.6[e]	NA	19.7	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-CR	SD-CRB	7.96	0.127	56.6[e]	NA	19.7	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-CR	SD-CRC	8.25	0.105	56.6[e]	NA	19.7	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-CR	SD-CRD	8.16	0.132	56.6	NA	19.7	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-CR	SD-CRE	8.09	0.115	56.6[e]	NA	19.7	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-HT	SD-HTA	8.16	0.443	45.9[e]	NA	9.30	NC [b]	49.9
2009-2011 Beach Sediment Study	SD-HT	SD-HTB	7.82	0.307	45.9[e]	NA	9.30	NC [b]	50.2
2009-2011 Beach Sediment Study	SD-HT	SD-HTC	7.85	0.417	45.9[e]	NA	9.30	NC [b]	50.0
2009-2011 Beach Sediment Study	SD-HT	SD-HTD	7.91	0.279	45.9	NA	9.30	NC [b]	50.2
2009-2011 Beach Sediment Study	SD-HT	SD-HTE	8.70	0.0580	45.9[e]	NA	9.30	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-LY	SD-LYA	7.22	0.294	73.2[e]	NA	35.9	NC [b]	50.2
2009-2011 Beach Sediment Study	SD-LY	SD-LYB	7.36	0.373	73.2	NA	35.9	NC [b]	50.1
2009-2011 Beach Sediment Study	SD-LY	SD-LYC	7.09	0.606	73.2[e]	NA	35.9	NC [b]	49.6
2009-2011 Beach Sediment Study	SD-LY	SD-LYD	6.99	0.541	73.2[e]	NA	35.9	NC [b]	49.7
2009-2011 Beach Sediment Study	SD-LY	SD-LYE	7.03	0.506	73.2[e]	NA	35.9	NC [b]	49.8
2009-2011 Beach Sediment Study	SD-NZ	SD-NZA	7.98	0.130	47.9[e]	NA	11.3	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-NZ	SD-NZB	8.34	0.0530	47.9[e]	NA	11.3	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-NZ	SD-NZC	7.72	0.0520	47.9[e]	NA	11.3	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-NZ	SD-NZD	8.11	0.0830	47.9[e]	NA	11.3	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-NZ	SD-NZE	8.07	0.116	47.9	NA	11.3	NC [b]	50.6
2013 USGS Toxicity Evaluation	TRB-03-NRT	CERC 14_TRB-03_SD_2	7.32[c]	0.240	nm	60.6	23.6	NC [b]	50.3
2013 Phase 2 Sediment Study	TRIB-1	SE-TRIB-1	7.32	0.0625	nm	60.6	23.6	NC [b]	50.7
2013 Phase 2 Sediment Study	TRIB-3	SE-TRIB-3	8.44	0.314	nm	44.5	7.93	NC [b]	50.2
Middle Lacustrine									
2013 Phase 2 Sediment Study	7-C2	SE-7-C2	7.42	0.879	nm	59.2	22.3	NC [b]	49.0
2009-2011 Beach Sediment Study	CR-EN	CR-EN1-1	7.52	0.248	nm	57.7	20.8	NC [b]	50.3
2009-2011 Beach Sediment Study	CR-ENA	CR-ENA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-ENB	CR-ENB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-ENC	CR-ENC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-END	CR-END1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-ENE	CR-ENE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-HC	CR-HC1	8.24	0.0220	nm	47.3	10.7	NC [b]	50.8
2009-2011 Beach Sediment Study	CR-HCA	CR-HCA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-HCB	CR-HCB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-HCC	CR-HCC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-HCD	CR-HCD1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-HCE	CR-HCE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MG	CR-MG1-1	8.43	0.109	nm	44.6	8.03	NC [b]	50.6
2009-2011 Beach Sediment Study	CR-MGA	CR-MGA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MGB	CR-MGB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MGC	CR-MGC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MGD	CR-MGD1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MGE	CR-MGE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MP	CR-MP1	7.98	0.152	nm	51.1	14.4	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-MPA	CR-MPA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MPB	CR-MPB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MPC	CR-MPC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-MPD	CR-MPD1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2009-2011 Beach Sediment Study	CR-MPE	CR-MPE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-NA	CR-NA1	7.59	0.279	nm	56.7	19.8	NC [b]	50.2
2009-2011 Beach Sediment Study	CR-NAA	CR-NAA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-NAB	CR-NAB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-NAC	CR-NAC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-NAD	CR-NAD1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-NAE	CR-NAE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-SB	CR-SB1	7.48	0.0330	nm	58.3	21.4	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-SBA	CR-SBA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-SBB	CR-SBB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-SBC	CR-SBC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-SBD	CR-SBD1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-SBE	CR-SBE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-WC	CR-WC1	7.78	0.219	nm	54.0	17.2	NC [b]	50.4
2009-2011 Beach Sediment Study	CR-WCA	CR-WCA1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-WCB	CR-WCB1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-WCC	CR-WCC1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-WCD	CR-WCD1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2009-2011 Beach Sediment Study	CR-WCE	CR-WCE1	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2013 Phase 2 Sediment Study	REF-6	SE-REF-6	7.08	0.330	nm	64.0	27.0	NC [b]	50.1
2013 Phase 2 Sediment Study	REF-8	SE-REF-8	7.48	0.870	nm	58.3	21.4	NC [b]	49.1
2005 Phase 1 Sediment Sampling	RM628A1(X1)	5174415,J4FR6,MJ4FR6	7.92[c]	0.121	nm	52.0	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM628X3	5184418	7.92[c]	3.46	nm	52.0	15.3	NC [b]	43.9
2005 Phase 1 Sediment Sampling	RM631X1	5174485,J4G06,MJ4G06	7.92[c]	0.0300	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM631X3	5174487,J4G08,MJ4G08	7.92[c]	0.0353	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM633B1	5164403,J4FD3,MJ4FD3	7.92[c]	0.185	nm	52.0	15.3	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM633B2	5164404,J4FD4,MJ4FD4	7.92[c]	0.0582	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM633B3	5164405,J4FD5,MJ4FD5	7.92[c]	0.0543	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM634A1(X1)	5174407,J4FQ8,MJ4FQ8	7.92[c]	0.0658	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM634X3	5174484,J4G05,MJ4G05	7.92[c]	0.0384	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM637A1(X1)	5174406,J4FQ7,MJ4FQ7	7.92[c]	0.0366	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM637X5	5174480,J4G01,MJ4G01	7.92[c]	0.175	nm	52.0	15.3	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM637X6	5174481,J4G02,MJ4G02	7.92[c]	0.271	nm	52.0	15.3	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM637X7	5174482,J4G03,MJ4G03	7.92[c]	0.0657	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM640A1(X3)	5174414	7.92[c]	0.218	nm	52.0	15.3	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM640X1	5174437,J4FT8,MJ4FT8	7.92[c]	0.0297	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM641A1(X1)	5174412,J4FR3,MJ4FR3	7.92[c]	1.41	nm	52.0	15.3	NC [b]	48.0
2005 Phase 1 Sediment Sampling	RM641X3	5174453,J4FX4,MJ4FX4	7.92[c]	0.0402	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM642A1(X1)	5174408,J4FQ9,MJ4FQ9	7.92[c]	0.716	nm	52.0	15.3	NC [b]	49.4
2005 Phase 1 Sediment Sampling	RM642B1	5154500	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM642B1L	5154501,J4F89,MJ4F89	7.92[c]	0.481	nm	52.0	15.3	NC [b]	49.8
2005 Phase 1 Sediment Sampling	RM642B1R	5154502,J4F90,MJ4F90	7.92[c]	0.450	nm	52.0	15.3	NC [b]	49.9
2005 Phase 1 Sediment Sampling	RM642B1c	5154499,J4F88,MJ4F88	7.92[c]	0.0944	nm	52.0	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM642B2	5154504	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM642B2L	5154505,J4F92,MJ4F92	7.92[c]	0.347	nm	52.0	15.3	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM642B2R	5154506,J4F93,MJ4F93	7.92[c]	0.429	nm	52.0	15.3	NC [b]	49.9
2005 Phase 1 Sediment Sampling	RM642B2c	5154503,J4F91,MJ4F91	7.92[c]	0.642	nm	52.0	15.3	NC [b]	49.5
2005 Phase 1 Sediment Sampling	RM642B3	5154508	7.92[c]	0.331[c]	nm	52.0	15.3	NC [b]	50.1
2005 Phase 1 Sediment Sampling	RM642B3L	5154510	7.92[c]	0.440	nm	52.0	15.3	NC [b]	49.9
2005 Phase 1 Sediment Sampling	RM642B3R	5154511,J4F97,MJ4F97	7.92[c]	1.11	nm	52.0	15.3	NC [b]	48.6
2005 Phase 1 Sediment Sampling	RM642B3c	5154507,J4F94,MJ4F94	7.92[c]	0.705	nm	52.0	15.3	NC [b]	49.4
2005 Phase 1 Sediment Sampling	RM642BSF	5154512,J4F98,MJ4F98	7.92[c]	0.539	nm	52.0	15.3	NC [b]	49.7
2005 Phase 1 Sediment Sampling	RM642X2	5174428,J4FS9,MJ4FS9	7.92[c]	1.16	nm	52.0	15.3	NC [b]	48.5
2005 Phase 1 Sediment Sampling	RM642X7	5174451,J4FX2,MJ4FX2	7.92[c]	0.219	nm	52.0	15.3	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM643X1	5174421,J4FS2,MJ4FS2	7.92[c]	0.224	nm	52.0	15.3	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM643X3	5174425,J4FS6,MJ4FS6	7.92[c]	0.0755	nm	52.0	15.3	NC [b]	50.6

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2005 Phase 1 Sediment Sampling	RM644A1(X3)	5174405,J4FQ6,MJ4FQ6	7.92[c]	0.138	nm	52.0	15.3	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM644X1	5164499,J4FN9,MJ4FN9	7.92[c]	0.105	nm	52.0	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM646X1	5164506,J4FP6,MJ4FP6	7.92[c]	0.0340	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM646X3	5164501,J4FP1,MJ4FP1	7.92[c]	0.0746	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM649X1	5164480,J4FM0,MJ4FM0	7.92[c]	0.0353	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM649X3	5164509,J4FP9,MJ4FP9	7.92[c]	0.0388	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM652X1	5164482,J4FM2,MJ4FM2	7.92[c]	0.103	nm	52.0	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM652X3	5164429,J4FF9,MJ4FF9	7.92[c]	0.0885	nm	52.0	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM655X1	5164416,J4FE6,MJ4FE6	7.92[c]	0.0503	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM655X3	5164414,J4FE4,MJ4FE4	7.92[c]	0.0604	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM658B1	5154475,J4F64,MJ4F64	7.92[c]	0.0357	nm	52.0	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM658B2	5154476,J4F65,MJ4F65	7.92[c]	0.0789	nm	52.0	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM658B3	5154477,J4F66,MJ4F66	7.92[c]	0.0460	nm	52.0	15.3	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-EN	SD-ENA	8.56	0.0600	52.1[e]	NA	15.3	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-EN	SD-ENB	8.33	0.0990	52.1[e]	NA	15.3	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-EN	SD-ENC	8.65	0.103	52.1	NA	15.3	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-EN	SD-END	8.44	0.112	52.1[e]	NA	15.3	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-EN	SD-ENE	8.60	0.108	52.1[e]	NA	15.3	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-HC	SD-HCA	8.66	0.0280	32.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-HC	SD-HCB	8.69	0.115	32.5	NA	0.00	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-HC	SD-HCC	8.71	0.0450	32.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-HC	SD-HCD	8.65	0.0640	32.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-HC	SD-HCE	8.83	0.0440	32.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-MG	SD-MGA	8.50	0.124	41.2[e]	NA	4.71	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MG	SD-MGB	8.49	0.0780	41.2[e]	NA	4.71	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MG	SD-MGC	8.44	0.153	41.2[e]	NA	4.71	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-MG	SD-MGD	8.41	0.114	41.2[e]	NA	4.71	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MG	SD-MGE	8.35	0.109	41.2	NA	4.71	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MP	SD-MPA	8.07	0.0840	34.3[e]	NA	0.00	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MP	SD-MPB	8.23	0.0840	34.3[e]	NA	0.00	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MP	SD-MPC	8.16	0.100	34.3[e]	NA	0.00	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-MP	SD-MPD	8.46	0.0690	34.3[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-MP	SD-MPE	8.50	0.0830	34.3	NA	0.00	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-NA	SD-NAA	7.73	0.315	60.6[e]	NA	23.6	NC [b]	50.2
2009-2011 Beach Sediment Study	SD-NA	SD-NAB	7.15	0.329	60.6[e]	NA	23.6	NC [b]	50.1
2009-2011 Beach Sediment Study	SD-NA	SD-NAC	7.17	0.635	60.6[e]	NA	23.6	NC [b]	49.5
2009-2011 Beach Sediment Study	SD-NA	SD-NAD	6.78	0.396	60.6[e]	NA	23.6	NC [b]	50.0
2009-2011 Beach Sediment Study	SD-NA	SD-NAE	6.51	0.575	60.6	NA	23.6	NC [b]	49.6
2009-2011 Beach Sediment Study	SD-SB	SD-SBA	8.77	0.0360	44.7[e]	NA	8.13	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SB	SD-SBB	8.86	0.0500	44.7[e]	NA	8.13	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SB	SD-SBC	8.86	0.0400	44.7	NA	8.13	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SB	SD-SBD	8.75	0.0420	44.7[e]	NA	8.13	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SB	SD-SBE	8.97	0.0300	44.7[e]	NA	8.13	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-WC	SD-WCA	6.63	0.417	64.8[e]	NA	27.7	NC [b]	50.0
2009-2011 Beach Sediment Study	SD-WC	SD-WCB	7.66	0.589	64.8[e]	NA	27.7	NC [b]	49.6
2009-2011 Beach Sediment Study	SD-WC	SD-WCC	7.49	0.470	64.8	NA	27.7	NC [b]	49.9
2009-2011 Beach Sediment Study	SD-WC	SD-WCD	7.51	0.393	64.8[e]	NA	27.7	NC [b]	50.0
2009-2011 Beach Sediment Study	SD-WC	SD-WCE	7.57	0.477	64.8[e]	NA	27.7	NC [b]	49.8
Lower Lacustrine									
2013 Phase 2 Sediment Study	8-C2	SE-8-C2	6.83	0.446	nm	67.6	30.5	NC [b]	49.9
2009-2011 Beach Sediment Study	CR-CS	CR-CS1	8.24	0.0650	nm	47.3	10.7	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-CSA	CR-CSA1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-CSB	CR-CSB1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-CSC	CR-CSC1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-CSD	CR-CSD1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-CSE	CR-CSE1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2009-2011 Beach Sediment Study	CR-JB	CR-JB1	8.18	0.0710	nm	48.2	11.5	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-JBA	CR-JBA1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-JBB	CR-JBB1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-JBC	CR-JBC1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-JBD	CR-JBD1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-JBE	CR-JBE1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SC	CR-SC1-1	8.45	0.0650	nm	44.3	7.74	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-SCA	CR-SCA1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SCB	CR-SCB1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SCC	CR-SCC1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SCD	CR-SCD1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SCE	CR-SCE1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SW	CR-SW1	8.37	0.0480	nm	45.5	8.91	NC [b]	50.7
2009-2011 Beach Sediment Study	CR-SWA	CR-SWA1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SWB	CR-SWB1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SWC	CR-SWC1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SWD	CR-SWD1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-SWE	CR-SWE1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-WS	CR-WS1	7.40	0.0820	nm	59.4	22.5	NC [b]	50.6
2009-2011 Beach Sediment Study	CR-WSA	CR-WSA1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-WSB	CR-WSB1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-WSC	CR-WSC1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-WSD	CR-WSD1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	CR-WSE	CR-WSE1	7.91[c]	0.146[c]	nm	52.1	15.3	NC [b]	50.5
2013 Phase 2 Sediment Study	REF-10b	SE-REF-10b	7.74	0.195	nm	54.5	17.7	NC [b]	50.4
2013 Phase 2 Sediment Study	REF-9	SE-REF-9	7.29	0.108	nm	61.0	24.0	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM600B1	5164430,J4FG0,MJ4FG0	7.91[c]	0.0286	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM600B2	5164431,J4FG1,MJ4FG1	7.91[c]	0.0825	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM600B3	5164432,J4FG2,MJ4FG2	7.91[c]	0.0558	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM600X1	5174465,J4FY6,MJ4FY6	7.91[c]	0.0636	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM600X3	5174466,J4FY7,MJ4FY7	7.91[c]	0.0600	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM603A1(X1)	5174423,J4FS4,MJ4FS4	7.91[c]	0.0996	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM603X3	5174432,J4FT3,MJ4FT3	7.91[c]	0.145	nm	52.1	15.3	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM604X1	5174436,J4FT7,MJ4FT7	7.91[c]	0.0574	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM604X3	5174469,J4FZ0,MJ4FZ0	7.91[c]	0.0636	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM605A1(X1)	5174409,J4FR0,MJ4FR0	7.91[c]	0.0641	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM605A2(X8)	5174424,J4FS5,MJ4FS5	7.91[c]	0.413	nm	52.1	15.3	NC [b]	50.0
2005 Phase 1 Sediment Sampling	RM605X7	5174490,J4G11,MJ4G11	7.91[c]	0.136	nm	52.1	15.3	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM605X9	5174491,J4G12,MJ4G12	7.91[c]	0.0384	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM606A1(X3)	5174410,J4FR1,MJ4FR1	7.91[c]	0.273	nm	52.1	15.3	NC [b]	50.3
2005 Phase 1 Sediment Sampling	RM606X1	5174492,J4G13,MJ4G13	7.91[c]	0.0365	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM607X1	5174495,J4G16,MJ4G16	7.91[c]	0.0444	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM607X3	5174497,J4G18,MJ4G18	7.91[c]	0.0804	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM610X1	5174498,J4G19,MJ4G19	7.91[c]	0.0817	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM610X3	5174500,J4G21,MJ4G21	7.91[c]	0.0576	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM613X1	5174494,J4G15,MJ4G15	7.91[c]	0.0445	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM613X3	5184408,J4G30,MJ4G30	7.91[c]	0.517	nm	52.1	15.3	NC [b]	49.8
2005 Phase 1 Sediment Sampling	RM615B1	5164418,J4FE8,MJ4FE8	7.91[c]	0.0385	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM615B2	5164419,J4FE9,MJ4FE9	7.91[c]	0.0910	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM615B3	5164420,J4FF0,MJ4FF0	7.91[c]	0.133	nm	52.1	15.3	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM616A1(X3)	5174411,J4FR2,MJ4FR2	7.91[c]	0.121	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM616X1	5174470,J4FZ1,MJ4FZ1	7.91[c]	1.21	nm	52.1	15.3	NC [b]	48.4
2005 Phase 1 Sediment Sampling	RM619X1	5174464,J4FY5,MJ4FY5	7.91[c]	0.170	nm	52.1	15.3	NC [b]	50.5
2005 Phase 1 Sediment Sampling	RM619X3	5174473,J4FZ4,MJ4FZ4	7.91[c]	0.0262	nm	52.1	15.3	NC [b]	50.7
2005 Phase 1 Sediment Sampling	RM622A1(X3)	5174427,J4FS8,MJ4FS8	7.91[c]	0.119	nm	52.1	15.3	NC [b]	50.6
2005 Phase 1 Sediment Sampling	RM622X1	5174439,J4FW0,MJ4FW0	7.91[c]	0.0562	nm	52.1	15.3	NC [b]	50.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
2005 Phase 1 Sediment Sampling	RM625X1	5174440,J4FW1,MJ4FW1	7.91[c]	0.221	nm	52.1	15.3	NC [b]	50.4
2005 Phase 1 Sediment Sampling	RM625X3	5174443,J4FW4,MJ4FW4	7.91[c]	0.149	nm	52.1	15.3	NC [b]	50.5
2009-2011 Beach Sediment Study	SD-CS	SD-CSA	8.84	0.0300	29.4	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-CS	SD-CSB	8.73	0.0350	29.4[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-CS	SD-CSC	8.72	0.0360	29.4[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-CS	SD-CSD	8.83	0.0330	29.4[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-CS	SD-CSE	8.89	0.0890	29.4[e]	NA	0.00	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-JB	SD-JBA	8.55	0.0580	35.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-JB	SD-JBB	8.66	0.0400	35.5	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-JB	SD-JBC	7.93	0.0470	35.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-JB	SD-JBD	8.44	0.0260	35.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-JB	SD-JBE	8.64	0.0280	35.5[e]	NA	0.00	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SC	SD-SCA	8.20	0.0790	47.8[e]	NA	11.2	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-SC	SD-SCB	8.35	0.0830	47.8[e]	NA	11.2	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-SC	SD-SCC	8.11	0.105	47.8[e]	NA	11.2	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-SC	SD-SCD	8.36	0.0770	47.8[e]	NA	11.2	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-SC	SD-SCE	8.40	0.0720	47.8	NA	11.2	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SW	SD-SWA	8.84	0.0300	48.2[e]	NA	11.5	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SW	SD-SWB	7.78	0.0450	48.2[e]	NA	11.5	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SW	SD-SWC	8.33	0.0370	48.2	NA	11.5	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SW	SD-SWD	8.34	0.0540	48.2[e]	NA	11.5	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-SW	SD-SWE	8.45	0.0560	48.2[e]	NA	11.5	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-WS	SD-WSA	7.53	0.0620	44.0[e]	NA	7.44	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-WS	SD-WSB	7.50	0.112	44.0[e]	NA	7.44	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-WS	SD-WSC	7.48	0.0690	44.0[e]	NA	7.44	NC [b]	50.7
2009-2011 Beach Sediment Study	SD-WS	SD-WSD	7.62	0.0930	44.0	NA	7.44	NC [b]	50.6
2009-2011 Beach Sediment Study	SD-WS	SD-WSE	7.48	0.0910	44.0[e]	NA	7.44	NC [b]	50.6
Reference									
2013 Phase 2 Sediment Study	G-1	SE-G-1	7.46	0.0700	nm	58.6	21.7	45.1	50.7
2013 Phase 2 Sediment Study	G-2	SE-G-2	7.26	0.0620	nm	61.5	24.5	47.2	50.7
2013 Phase 2 Sediment Study	G-3	SE-G-3	7.00	0.0850	nm	65.2	28.1	49.9	50.6
2013 Phase 2 Sediment Study	G-4	SE-G-4	7.22	0.0610	nm	62.0	25.0	47.6	50.7
2013 Phase 2 Sediment Study	LAL-1	SE-LAL-1	7.22	2.62	nm	62.0	25.0	47.6	45.6
2013 Phase 2 Sediment Study	LAL-2	SE-LAL-2	5.27	2.67	nm	90.1	52.4	68.1	45.5
2013 Phase 2 Sediment Study	LAL-3	SE-LAL-3	7.43	0.136	nm	59.0	22.1	45.4	50.5
2013 Phase 2 Sediment Study	LAL-4	SE-LAL-4	6.39	0.947	nm	74.0	36.7	56.3	48.9
2013 Phase 2 Sediment Study	LAL-5	SE-LAL-5	6.65	1.73	nm	70.2	33.0	53.6	47.3
2013 Phase 2 Sediment Study	LAL-6	SE-LAL-6	6.83	0.533	nm	67.6	30.5	51.7	49.7
2019 Phase 3 Sediment Study	REF001	REF001-SE-1-092819	6.87[c]	0.0460	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF002	REF002-SE-1-092819	6.87[c]	0.0610	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF003	REF003-SE-1-092719	6.87[c]	0.0730	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF004	REF004-SE-1-092719	6.87[c]	0.166	nm	67.1	30.0	51.3	50.5
2019 Phase 3 Sediment Study	REF005	REF005-SE-1-100319	6.87[c]	0.0620	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF006	REF006-SE-1-100219	6.87[c]	0.225	nm	67.1	30.0	51.3	50.3
2019 Phase 3 Sediment Study	REF007	REF007-SE-1-093019	6.87[c]	0.161	nm	67.1	30.0	51.3	50.5
2019 Phase 3 Sediment Study	REF008	REF008-SE-1-093019	6.87[c]	0.0690	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF009A	REF009A-SE-1-100219	6.87[c]	0.0580	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF010	REF010-SE-1-100319	6.87[c]	0.0760	nm	67.1	30.0	51.3	50.6
2019 Phase 3 Sediment Study	REF011	REF011-SE-1-100119	6.87[c]	0.0645	nm	67.1	30.0	51.3	50.7
2019 Phase 3 Sediment Study	REF012	REF012-SE-1-100419	6.87[c]	0.231	nm	67.1	30.0	51.3	50.3
2019 Phase 3 Sediment Study	REF013	REF013-SE-1-092419	6.87[c]	0.489	nm	67.1	30.0	51.3	49.8
2019 Phase 3 Sediment Study	REF014	REF014-SE-1-092619	6.87[c]	0.780	nm	67.1	30.0	51.3	49.2
2019 Phase 3 Sediment Study	REF015	REF015-SE-1-092619	6.87[c]	2.92	nm	67.1	30.0	51.3	45.0
2019 Phase 3 Sediment Study	REF016	REF016-SE-1-092519	6.87[c]	1.00	nm	67.1	30.0	51.3	48.8
2019 Phase 3 Sediment Study	REF017	REF017-SE-1-092519	6.87[c]	1.39	nm	67.1	30.0	51.3	48.0
2019 Phase 3 Sediment Study	REF018	REF018-SE-1-092519	6.87[c]	7.07	nm	67.1	30.0	51.3	36.7

Table H3.A-3. Regression-based RBA Factors for Lead and Zinc

			Conventional Parameters Used for Calculating Lead and Zinc RBA Factors		Lead				Zinc
Study	Location ID	Sample ID(s)	pH	TOC (%)	Measured IVBA (%)[a]	Calculated IVBA (%)[a]	RBA Factor for Birds (%)[a]	RBA Factor for Mammals (%)[a]	IVBA and RBA Factor (%)[a] for Birds and Mammals
RFDAs and WSDAs									
2014 UCR Upland Soil Study	ADA-140	ADA-140	5.64	2.73	nm	84.8	47.3	64.2	45.3
2014 UCR Upland Soil Study	CBN-001	CBN-001	6.75	1.77	nm	68.8	31.6	52.5	47.3
2014 UCR Upland Soil Study	CBN-002	CBN-002	6.44	1.12	nm	73.3	36.0	55.8	48.6
2014 UCR Upland Soil Study	CBN-003	CBN-003-A	6.49	1.56	nm	72.5	35.3	55.2	47.7
2014 UCR Upland Soil Study	CBN-003	CBN-003-B	6.49	1.22	nm	72.5	35.3	55.2	48.4
2014 UCR Upland Soil Study	CBN-003	CBN-003-C	6.37	1.26	nm	74.3	37.0	56.6	48.3
2014 UCR Upland Soil Study	CBN-004	CBN-004	6.56	0.899	nm	71.5	34.3	54.5	49.0
2014 UCR Upland Soil Study	CBS-001	CBS-001	6.48	1.02	nm	72.7	35.5	55.4	48.8
2014 UCR Upland Soil Study	CBS-002	CBS-002	6.43	1.35	nm	73.4	36.1	55.9	48.1
2014 UCR Upland Soil Study	MFE-001	MFE-001	5.27	7.04	nm	90.1	52.4	68.1	36.7
2014 UCR Upland Soil Study	MFE-002	MFE-002	5.48	5.18	nm	87.1	49.5	65.9	40.4
2014 UCR Upland Soil Study	MFE-003	MFE-003	5.09	6.93	nm	92.7	55.0	70.0	36.9
2014 UCR Upland Soil Study	MFE-004	MFE-004	5.73	6.15	nm	83.5	46.0	63.3	38.5
2014 UCR Upland Soil Study	MFE-005	MFE-005	5.64	4.61	nm	84.8	47.3	64.2	41.6
2014 UCR Upland Soil Study	MFE-006	MFE-006	5.58	5.47	nm	85.6	48.0	64.8	39.9
2014 UCR Upland Soil Study	MFE-007	MFE-007-A	5.66	7.13	nm	84.5	47.0	64.0	36.5
2014 UCR Upland Soil Study	MFE-007	MFE-007-B	5.84	3.98	nm	81.9	44.4	62.1	42.8
2014 UCR Upland Soil Study	MFE-007	MFE-007-C	5.54	5.87	nm	86.2	48.6	65.2	39.1
2014 UCR Upland Soil Study	RFA-001	RFA-001-A	7.26	1.51	67.0	NA	29.9	51.2	43.4
2014 UCR Upland Soil Study	RFA-001	RFA-001-B	7.26	1.79	65.8	NA	28.7	50.4	44.1
2014 UCR Upland Soil Study	RFA-001	RFA-001-C	7.53	2.03	58.3	NA	21.4	44.9	43.5
2014 UCR Upland Soil Study	RFA-002	RFA-002	7.41	1.32	nm	59.3	22.4	45.6	48.2
2014 UCR Upland Soil Study	RFA-003	RFA-003	7.64	1.38	nm	56.0	19.2	43.2	48.0
2014 UCR Upland Soil Study	RFA-004	RFA-004	7.80	0.959	nm	53.7	16.9	41.5	48.9
2014 UCR Upland Soil Study	RFA-005	RFA-005	7.25	1.62	61.3	NA	24.3	47.1	42.7
2014 UCR Upland Soil Study	RFB-002	RFB-002	6.01	5.71	nm	79.5	42.1	60.4	39.4
2014 UCR Upland Soil Study	RFB-003	RFB-003-A	6.07	4.08	nm	78.6	41.2	59.7	42.6
2014 UCR Upland Soil Study	RFB-003	RFB-003-B	6.10	4.26	nm	78.2	40.8	59.4	42.3
2014 UCR Upland Soil Study	RFB-003	RFB-003-C	6.07	3.88	nm	78.6	41.2	59.7	43.0
2014 UCR Upland Soil Study	RFB-008	RFB-008	5.69	2.44	nm	84.1	46.6	63.7	45.9
2014 UCR Upland Soil Study	RFC-003	RFC-003	6.29	5.01	nm	75.4	38.1	57.4	40.8
2014 UCR Upland Soil Study	RFC-004	RFC-004	6.28	2.92	nm	75.6	38.3	57.5	45.0
2014 UCR Upland Soil Study	RFC-005	RFC-005-A	6.20	4.92	nm	76.7	39.4	58.3	41.0
2014 UCR Upland Soil Study	RFC-005	RFC-005-B	6.31	5.04	nm	75.1	37.8	57.1	40.7
2014 UCR Upland Soil Study	RFC-005	RFC-005-C	6.38	4.83	nm	74.1	36.8	56.4	41.1
2014 UCR Upland Soil Study	RFC-006	RFC-006	6.26	4.64	nm	75.9	38.6	57.7	41.5
2014 UCR Upland Soil Study	RFC-007	RFC-007	6.59	5.49	nm	71.1	33.9	54.2	39.8
2014 UCR Upland Soil Study	RFC-008	RFC-008	6.38	4.82	nm	74.1	36.8	56.4	41.2
2014 UCR Upland Soil Study	RFD-002	RFD-002	7.23	2.06	55.2	NA	18.4	42.6	53.0
2014 UCR Upland Soil Study	RFD-003	RFD-003-A	5.80	2.17	nm	82.5	45.0	62.5	46.5
2014 UCR Upland Soil Study	RFD-003	RFD-003-B	6.81	3.21	nm	67.9	30.8	51.9	44.4
2014 UCR Upland Soil Study	RFD-003	RFD-003-C	6.11	3.28	nm	78.0	40.6	59.3	44.2
2019 Northport Waterfront RI	XRF-26	XRF-26	6.34[d]	4.71[d]	nm	74.7	37.4	56.9	41.4

[a] IVBA and RBA factors in this table are for locations with a bird or mammal HQ and were calculated using the regression equations reported in Table 6 of Attachment H3.
[b] HQ not calculated because lead is not a dietary COPC for aquatic-dependent mammals in the Upper, Middle, or Lower Lacustrine CSM units.
[c] The parameter was not measured for this sample and the mean value for the given CSM unit was used for RBA calculations.
[d] The pH and TOC values for XRF-26 are estimated using the average from the RFC sampling area.
[e] IVBA was not measured in this specific sample; the measured IVBA value is populated using measured results from a different sample within the same location.
COPC - chemical of potential concern
CSM - conceptual site model
HQ - hazard quotient
IVBA - in vitro bioaccessibility
NA - not applicable
NC - not calculated.
nm - IVBA not measured or not detected
OU - operable unit
RBA - relative bioavailability
TOC - total organic carbon

Table H3.A-4. Summary Statistics for Calculated Lead and Zinc RBAs

Metal/Receptor	CSM Unit	N	RBA Factor (%)			
			Minimum	Maximum	Mean	Median
Zinc/Birds and Mammals	OU 1 North	202	40.6	50.7	49.8	49.9
	OU 1 South	180	39.9	50.8	48.7	49.0
	Transitional	69	44.1	50.7	49.0	49.2
	Upper Lacustrine	155	44.4	50.7	49.8	50.0
	Middle Lacustrine	128	43.9	50.8	50.2	50.2
	Lower Lacustrine	90	48.4	50.7	50.6	50.6
	Reference	28	36.7	50.7	49.1	50.5
	RFDAs and WSDAs	43	36.5	53.0	43.6	43.0
Lead/Birds	OU 1 North	202	0.00	44.3	17.8	16.0
	OU 1 South	180	0.319	44.5	22.8	18.6
	Transitional	69	15.6	36.8	25.9	26.6
	Upper Lacustrine	155	7.93	35.9	23.1	23.6
	Middle Lacustrine	128	0.00	27.7	14.5	15.3
	Lower Lacustrine	90	0.00	30.5	12.8	15.3
	Reference	28	21.7	52.4	30.0	30.0
	RFDAs and WSDAs	43	16.9	55.0	37.5	37.8
Lead/Mammals	OU 1 North	202	25.8	62.0	42.2	40.9
	OU 1 South	180	29.1	62.2	46.0	42.8
	Transitional	69	40.6	56.4	48.2	48.7
	Upper Lacustrine	NC[a]	NC[a]	NC[a]	NC[a]	NC[a]
	Middle Lacustrine	NC[a]	NC[a]	NC[a]	NC[a]	NC[a]
	Lower Lacustrine	NC[a]	NC[a]	NC[a]	NC[a]	NC[a]
	Reference	28	45.1	68.1	51.3	51.3
	RFDAs and WSDAs	43	41.5	70.0	56.9	57.1

Note: This table summarizes all selected RBAs for each CSM unit/area. RBAs were calculated using a variety of derivation methods: 1) using measured IVBA, 2) using a regression equation with pH or TOC, or 3) using a default value if measured IVBA, pH, or TOC are not available for a sample.

[a] HQ not calculated because lead is not a dietary COPC for aquatic-dependent mammals in the Upper, Middle, or Lower Lacustrine CSM units.

COPC - chemical of potential concern

CSM - conceptual site model

HQ - hazard quotient

IVBA - in vitro bioaccessibility

N - number of samples

NC - not calculated

OU - operable unit

RBA - relative bioavailability

RFDA - relict floodplain deposition area

TOC - total organic carbon

WSDA - windblown sediment deposition area