Technical Memorandum

Refinement of Toxicity Values and Development of Critical Biota Residues and Biomagnification Factors (BMFs)
Conceptual Site Model/Problem Formulation
Lower Passaic River Restoration Project
March 3, 2006

This memorandum presents Toxicity Reference Values (TRVs) that will be used in the Baseline Human Health and Ecological Risk Assessments (BHHRA and BERA, respectively) for the Lower Passaic River Restoration Project (LPRRP) site. TRVs are identified for a subset of chemicals that have been detected at the site.

In addition, available information on Critical Body Residues (CBRs) that represent threshold levels for significant ecological effects associated with tissue residue concentrations in ecological receptors are presented. Finally, Biomagnification Factors (BMFs) that will be used in the BERA to estimate Contaminant of Potential Ecological Concern (COPEC) transfer from contaminated prey items to wildlife receptors are also presented.

This memorandum is organized into the following sections:

Section I – Human Health TRVs
Section II – Ecological TRVs
Section III – Ecological CBRs
Section IV – Ecological BMFs
Section V – References

In addition, data are available in the following appendices:

Appendix A – Human Health Toxicity Information
Appendix B – Ecological TRV data
Appendix C – CBR Data

I. Toxicity Values for Human Health

Table A-1 in Appendix A summarizes the Reference Dose (RfD) values and Cancer Slope Factors (CSFs) that will be used to characterize risks in the BHHRA for the LPRRP site.

The human health toxicity values for the tentative list of Contaminants of Potential Concern (COPCs) identified in the Pathways Analysis Report (PAR; Battelle, 2005) are summarized on Table A-1 in Attachment A. Toxicity values were selected according to the USEPA (2003a) OSWER Directive 9285.7-53 that recommends a hierarchy of human health toxicity values for use in risk assessments at Superfund sites. The hierarchy is as follows: 1) USEPA's Integrated Risk Information System (IRIS); 2) USEPA's (Office of Research and Development, National Center for Environmental Assessment, Superfund Health Risk Technical Support Center) Provisional Peer Reviewed Toxicity Values (PPRTVs), and 3) other sources of information such as the California EPA's toxicity values and the Agency for Toxic Substances Disease Registry (ATSDR) minimal risk levels (MRLs) for noncarcinogenic compounds. Provisional values will be used at the direction of USEPA. For compounds without toxicity values listed in the hierarchy of sources in the USEPA memorandum, surrogate compounds will be obtained from USEPA

Region 2 in conjunction with USEPA's National Center for Environmental Assessment (NCEA). COPCs for which no toxicity values were found are dibutyltin, monobutyltin, tetrabutyltin, 1-methylphenanthrene, 2,3,5-trimethylnapthalene, and 2,6-dimethylnapthalene. It is assumed that dioxin and non-dioxin like effects of PCBs will be evaluated in the HHRA based on current available USEPA guidance for PCB evaluation, the approach will be as follows:

1. For Total PCB risk, the Cancer-Dose Response Assessment and Application to Environmental Mixture (USEPA, 1996) and Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures (USEPA, 2000a) will be used;

2. For dioxin-like PCB congeners, the 1997 WHO Toxicity Equivalence Factor (TEF) scheme in Van den Berg *et al*., (1998) for each dioxin-like PCB congener will be adopted.

As such, PCB risk will be calculated as follows:

$$\text{Toxic equivalent concentration for dioxin-like PCB congeners} = \sum_{i=1}^{n} \left(\text{dioxin-like PCB congener conc}_i \times \text{TEF}_i\right) \quad (1)$$

$$\text{Dioxin-like PCB risk} = \frac{\text{toxic equivalent conc. for dioxin-like PCB congeners}}{\text{PRG for 2,3,7,8-TCDD}} \quad (2)$$

$$\text{Non-dioxin-like PCB risk} = \frac{\sum_{i=1}^{n} \text{non-dioxin-like PCB congener conc.}_i}{\text{PRG for Aroclor 1254}} \quad (3)$$

$$\text{Total PCB risk} = \left(\text{dioxin-like PCB risk}\right) + \left(\text{non-dioxin-like PCB risk}\right) \quad (4)$$

Note that this PCB evaluation methodology may change in the future based on revisions USEPA deems necessary after completion of the dioxin reassessment (anticipated for 2006).

II. Toxicity Reference Values for Ecological (Wildlife) Receptors

For the LPRRP site, appropriate TRVs are necessary for the 21 COPECs that were identified during the COPEC selection process including: copper, lead, mercury, nickel, silver, zinc, chlorobenzene, 1,4-dichlorobenzene, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, dibenzofuran, tributyltin, total PAHs, total PCBs, total DDT, aldrin, chlordane, dieldrin, endrin, endosulfan, and dioxin (2,3,7,8-tetrachlorodibenzo-*p*-dioxin [2,3,7,8-TCDD])[1]. This section describes the process that will be used to develop TRVs for these COPECs. Brief toxicological profiles are also provided for these COPECs to support the selection of endpoint and receptor appropriate studies on which to base the TRVs. This process is then applied to develop TRVs for five COPECs that will likely be among the ecological risk drivers at the LPRRP site based on preliminary screening results as documented in the PAR (Battelle, 2005) and professional

[1] The COPEC refinement process is described in a separate technical memorandum and is based on discussions held during the BERA Workshop held on 13-14 December 2005.

judgment; consideration was also given to contaminant class[2]. The selected COPECs that were selected for TRV development include lead, mercury, dieldrin, total PCBs, and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (herein after referred to as "TCDD")[3]. While developing a set of TRVs for the LPRRP BERA will rely, to the extent possible, on previous authoritative compilations (see following discussion on USEPA Ecological Soil Screening Levels [Eco-SSLs]) there will remain a need to develop specific values for the BERA as well.

The chemical- and receptor-specific TRVs will be compared to the ingestion dose estimates derived using an exposure based approach (models are provided in the PAR [Battelle, 2005]) to evaluate the potential effects to wildlife associated with exposure to COPECs in the Passaic River. In general, a TRV is defined as a dose level (based on laboratory toxicological investigations) above which a particular ecologically relevant effect may be expected to occur in an organism following chronic dietary exposure and below which it is reasonably expected that such effects will not occur (USEPA, 2005). TRV derivation may incorporate uncertainty (or extrapolation) factors (ept, 1996; Chapman et al., 1998) to account for a wide range of limitations, such as interspecies sensitivities. The TRVs presented in this memorandum are considered to be sufficiently conservative that the use of additional uncertainty factors is not scientifically warranted; the need to use uncertainty factors will be evaluated on a case by case basis as TRVs for the remaining COPECs are developed.

Rather than deriving a single point-estimate associated with specific adverse biological effects, both high and low TRVs are derived for each receptor and each COPEC to reflect the variability of risk potentials. The low TRV is a conservative value consistent with a chronic, no observed adverse effects level (NOAEL). It represents a level at which adverse effects are unlikely to occur, and is used to identify sites posing little or no risk. Conversely, the high TRV is a less conservative estimator of potential adverse effects, representing a level at which adverse effects are more likely to occur, and is consistent with a chronic lowest observed adverse effects level (LOAEL).

USEPA has initiated a process of acquiring toxicological literature for wildlife as part of the process of developing Eco-SSLs for mammals and birds for 23 contaminants (USEPA, 2005) and TRVs for lead and dieldrin are currently available having been developed using a transparent, ecologically relevant, and comprehensive process. These USEPA TRVs are proposed for use at the LPRRP site. Following a standard protocol, *The Acquisition of Literature to Support the Development of Toxicity Reference Values (TRVs) for Wildlife*, USEPA has identified over 44,000 records from toxicological literature (Attachment 4-2 EPA, 2005). The scope of the literature search consisted of toxicological data retrieval from electronic databases (*e.g.,* DIALOG, TOXNET) and hardcopy sources (*e.g.,* Agency for Toxic Substances and Disease Registry [ATSDR], USEPA, Oak Ridge National Laboratory [ORNL]). Records were reviewed for quality and applicability and entered into a database. Various exclusion criteria were implemented into the review process which excluded studies that only reported genotoxic, mutagenic, or carcinogenic effects; acute or non-oral exposures (injection, inhalation, dermal, etc.); or studies unrelated to the contaminant and receptor groups of interest. Additional

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[2] No semi-volatile organic compound (SVOC) COPECs were selected because USEPA is currently developing ecological benchmarks for total PAHs (USEPA, 2005) and this effort will likely be of value for the LPRRP BERA.

[3] As discussed in a separate technical memorandum (Exposure Point Concentration Development), the TRVs developed for TCDD, based on 2,3,7,8-TCDD, will be used to characterize the risks associated with all contaminants that exhibit "dioxin-like" toxicity, which is mediated through AhR binding and cytosolic transport to the cell nucleus (*i.e.*, a Toxic Equivalency or TEQ approach will be utilized).

exclusion criteria are described in detail in Attachment 4-3 USEPA, 2005. Relevant studies were then scored from one to ten for each of ten attributes:

- Data source;
- Dose route;
- Test substance concentrations;
- Contaminant form;
- Dose quantification;
- Endpoint;
- Dose range;
- Statistical power;
- Exposure duration; and,
- Test conditions.

The total score for each study was calculated by summing the results of the evaluation of each attribute. Studies with a score of 65 or less were not used in the development of TRVs (or Eco-SSLs). For each contaminant, summary plots of the NOAELs and LOAELs were produced and evaluated (Attachment 4-4 USEPA, 2005). The data plots were organized by general effect group: biochemical, behavior, physiology, pathology, reproduction, growth, and mortality. The TRV is equal to the geometric mean of the NOAEL values for growth and reproductive effects. In cases where the geometric mean NOAEL is higher than the lowest bounded (paired) LOAEL for growth, reproduction, or mortality, the TRV is equal to the highest bounded NOAEL below the lowest bounded LOAEL (Attachment 4-5, USEPA, 2005). This value represents the highest dose that did not cause any adverse effects in any test species. Because this value is consistent with a NOAEL, for the purposes of the LPRRP, LOAELs were selected from the same study from which the NOAEL was selected.

Using this methodology, USEPA has developed TRVs (and Eco-SSLs) for eleven metals, dieldrin, and pentachlorophenol, and is in the process of deriving values for six additional metals, DDT, cyclonite (RDX), 2,4,6-trinitrotoluene (TNT), and total PAHs. Of these, two are relevant to the LPRRP BERA: dieldrin and lead. General information important to understanding the fate and transport and toxicity of these two compounds is presented in the following paragraphs; Table 1, presents the wildlife TRVs selected for these two COPECs.

Lead

Lead (Pb) occurs naturally in the environment; however, most of the elevated levels found throughout the environment come from anthropogenic activities such as mining or factories that make or use lead, lead alloys, or lead compounds. Lead is also released into the air during burning of coal, oil, or waste.

Lead partitions primarily to sediments, but becomes more bioavailable under low pH, low hardness, and low organic matter content (among other factors). It can be bioconcentrated from water, but does not bioaccumulate and tends to decrease with increasing trophic levels in freshwater habitats (Eisler, 1988). Fish exposed to high levels of lead exhibit a wide-range of effects including muscular and neurological degeneration and destruction, growth inhibition, mortality, reproductive problems, and paralysis (Eisler, 1988; USEPA, 1976). Lead also adversely affects invertebrate reproduction.

At elevated levels in plants, lead can cause reduced growth, photosynthesis, mitosis, and water absorption (Eisler, 1988). Lead poisoning in higher organisms primarily affects hematologic and neurologic processes and has been associated with lead shot and organolead compounds, but not with food chain exposure to inorganic lead (other than lead shot, sinkers or paint) (Eisler, 1988). Birds and mammals suffer effects from lead poisoning such as damage to the nervous system, kidneys, liver, sterility, growth inhibition, developmental retardation, and detrimental effects in blood (Eisler, 1988; Amdur et al., 1991). Lead adversely affects reproduction, liver and thyroid function, and the immune system (Eisler, 1988).

Dieldrin/Aldrin

Dieldrin and aldrin are structurally similar and aldrin readily converts to dieldrin once it enters either the environment or is ingested or inhaled by organisms; they are discussed together since both are COPECs at the LPRRP. Dieldrin is an organochloride pesticide, belonging to the cyclodiene group of pesticides, which also includes endrin, endosulfan and aldrin. Dieldrin is no longer produced or used, but was once used extensively as insecticides on crops such as corn and cotton, and to control termites. Aldrin is a more effective pesticide than dieldrin and therefore was more extensively used as a soil insecticide (ATSDR, 2002a).

Many species of aquatic invertebrates concentrate dieldrin from very low water concentrations, yielding high concentration factors. The bioconcentration of dieldrin in aquatic organisms is principally from the water rather than by ingestion of food. Aldrin and dieldrin are both highly toxic to aquatic crustaceans and fish.

Additional effects on mammals include liver damage, central nervous system effects, and suppression of the immune system. Dieldrin and aldrin also disrupt the endocrine and reproductive systems (ATSDR, 2002a).

Table 1. TRVs for Lead and Dieldrin from USEPA Eco-SSL Documents.

COPEC	Test Species	Wildlife Receptors	Low TRV[a]	High TRV[a]	Reference
Lead	Chicken	Avifauna	1.6	3.3	Edens and Garlich, 1983
Lead	Rat	Mammals	4.7	8.9	Kimmel *et al.,* 1980
Dieldrin	Mallard	Avifauna	0.071	3.8	Nebeker *et al.,* 1992
Dieldrin	Rat	Mammals	0.015	0.030	Harr *et al.,* 1970

a. High TRVs are equivalent to the LOAEL from the study that the low TRV (NOAEL) was selected; units in μg COPEC/g body weight – day.

It is anticipated that as the LPRRP study proceeds, USEPA will develop additional TRVs as part of the process of developing additional Eco-SSLs. The website indicates that work is ongoing ("pending") for a number of additional contaminants that have been identified as COPECs for the LPRRP (*i.e.*, copper, nickel, silver, zinc, DDT, and total PAHs). Since SSL-type TRVs are not currently available for all COPECs, toxicity data were obtained from compilations of data from the ATSDR toxicological profiles, Sample et al. (1996), USEPA Region 9 (as defined in the PAR Battelle, 2005), USEPA Region 5, and USEPA's Integrated Risk Information System (IRIS), as well as from various primary literature sources for the purposes of deriving site-specific TRVs. The complete dataset including a summary of toxicity data presented in various compilations of ecotoxicological data is presented in Table B-1 (Appendix B).

Data were evaluated for applicability based on several criteria:

- Route of exposure – dietary exposures were considered over gavage exposures, which were preferred over dermal or inhalation exposures; volatile compounds (*e.g.*, 1,4-dichlorobenzene) also include some inhalation data;
- Length of study - chronic exposures were selected over acute or intermediate exposures;
- Dose range - studies with both a NOAEL and LOAEL were selected over studies with only one value; and,
- Endpoint – only studies that reported results on the general categories of reproductive, growth, and developmental effects were considered.

Table 2 is a summary of the TRVs that were identified for the remaining COPECs selected for TRV development (*i.e.*, mercury, total PCBs, and TCDD). Generally, two separate wildlife TRVs are developed for each COPEC to characterize risk to the two main categories of wildlife receptors (*i.e.*, birds and mammals). There may be value in establishing more than one TRV for a receptor group if available data suggests that potential receptors display a broad range of sensitivities to a specific COPEC or if there are a number of well conducted taxon-specific studies available. For instance, two mammalian TRVs for dioxin are presented in Table 2 – while the mink is a receptor of concern (ROC), it is also known to be extremely sensitive to dioxin exposure. Thus, a second set of TRVs (based on well-conducted, multiple generation reproductive studies with the rat) is provided for use in characterizing risks to other mammalian receptors (*e.g.*, raccoon, muskrat).

Table 2. TRVs selected from available literature for LPRRP COPECs

COPEC	Test Species	Wildlife Receptors	Low TRV[a]	High TRV[a]	Reference
Mercury[b]	Mallard	Avifauna	0.08[c]	0.8	Heinz, 1979
Mercury	Rat	Non- piscivorous mammals	0.032	0.16	Verschuuren *et al.*, 1976
Mercury[b]	Mink	Piscivorous mammals	0.055	0.18	Wobeser *et al.*, 1976a,b
Total PCBs	Chicken	Avifauna	0.1	0.4	Chapman, 2003
Total PCBs	Mink	Mammals	0.080	0.096	Chapman, 2003
TCDD	Pheasant	Avifauna	0.000014	0.00014	Nosek *et al.*, 1992a,b
TCDD	Rat	Non-piscivorous mammals	0.000001	0.00001	Murray *et al.*, 1979
TCDD	Mink	Piscivorous mammals	0.00000008	0.00000224	Tillet *et al.*, 1995

a. Units are µg COPEC/g body weight-day
b. TRV based on methylmercury.
c. The selected study did not identify a no observed adverse effect level (NOAEL), value based on applying a 10-fold LOAEL to NOAEL extrapolation factor.

The following section presents details of the specific studies along with the selection rationale (as informed by current understanding of specific receptor and contaminant characteristics) for the selected TRVs as well as brief toxicological profiles of these COPECs.

Mercury

Methylmercury (MeHg) is the organic, bioavailable fraction of elemental mercury (Hg), which comes from a variety of environmental sources including mine tailings, gaseous emissions, industrial effluent, and natural atmospheric deposition. The transformation of inorganic mercury to methylmercury occurs by anaerobic microorganisms in soils and sediment (ATSDR, 1999). When consumed by aquatic organisms such as fish and shellfish; mercury is capable of bioaccumulating and biomagnifying in successive upper-trophic level organisms who feed on contaminated prey.

Piscivorous mammals and birds who consume mercury-contaminated fish and water show signs of mercury toxicoses, including damage to nervous, excretory, and reproductive systems (RAIS, 1998). Although it exhibits a range of toxic effects in several target tissues (*e.g.*, liver, kidney), the primary effects of methylmercury are on the central nervous system. Methylmercury readily penetrates the blood/brain barrier producing brain lesions, spinal cord degeneration, and central nervous system dysfunctions (Wolfe et al., 1998).

Birds. Symptoms of acute MeHg poisoning in birds include reduced food intake, weight loss, weakness in wings and legs, difficult maneuvering, and inability to coordinate muscle movement (Wolfe et al., 1998). Methylmercury is a potent embryo and nervous system stressor in birds with chronic exposures characterized by symptoms that range from embryo lethality (*i.e.*, reduced egg hatchability), reduced clutch size, eggshell thinning, and aberrant juvenile behavior that may include auditory or visual impairment (Wolfe et al., 1998; Eisler, 1987a).

Several long term feeding studies have been conducted using a variety of bird species including mallards, black ducks, ring-necked pheasants, Japanese quail, chickens, and great egrets; the most relevant studies are summarized in Table 3.

Table 3. Summary of Chronic Feeding Studies with Methylmercury for Birds

Species	NOAEL (µg/g-d)	LOAEL (µg/g-d)	Effect	Reference
Chicken (*Gallus domesticus*)	-	1.1	Growth inhibition	Fimreite, 1970
Ring-necked pheasant (*Phasianus colchicus*)	-	0.18	Reduced survival, reduced egg production	Fimreite, 1971
Mallard (*Anas platyrhynchos*)	**-**	**0.078**	Reduced # viable eggs, reduced duckling growth, reduced chick survival to day 7	Heinz, 1974, 1975, 1976a,b, 1979
Great egret (*Ardea albus*)	-	0.5 µg/g (food)	Behavioral effects including reduced inclination to forage	Bouton et al., 1999
Black duck (*Anas rubripes*)	-	3 µg/g (food)	Reduced clutch size, egg production, hatchability and duckling survival	Finley and Stendell, 1978
Coturnix (Japanese) quail (*Coturnix japonica*)	8 µg/g food	32 µg/g food	Enzyme induction (AChE, LDH)	Hill and Soares, 1984

Note: Shaded cells indicate the study from which the TRV (bold) was selected.

The laboratory studies presented in Table 3 are consistent with a field study of the common loon in northwestern Ontario (Barr, 1986; as cited in Wolfe et al., 1998), which found that reduction in

egg laying and aberrant territorial and nest building behavior occurred when concentration of methylmercury in the diet exceeded 0.2-0.3 μg/g wet weight. There is reasonable consistency in the levels of methylmercury in the diet associated with the onset of significant reproductive effects in chronically exposed birds. Although the Heinz study with mallard ducks failed to identify a NOAEL value, it is selected as the recommended LOAEL (**0.078 μg MeHg/g – day**) because it is a well-designed study that evaluated the most sensitive endpoints over three generations. Results from the loon study indicate that piscivorous birds may be as sensitive to the effects of methylmercury intoxication as are ducks.

Mammals. Reproductive effects of MeHg in mammals include developmental alterations that produce behavioral deficits after birth, impaired fertility, and fetal death. Behavioral effects of low doses of MeHg were noted in swimming ability, operant learning, avoidance, maze learning, and development of reflexes. At higher doses, changes in spontaneous activity, visual function, vocalization, and convulsions may occur (Wolfe et al., 1998). Several long term feeding studies have been conducted using a variety of mammal species including river otter, mink, cat, rat, and laboratory mouse. Table 4 summarizes available long-term laboratory feed studies.

Wobeser's doctoral thesis work on long-term feeding studies with mink is the basis for the recommended mammalian wildlife TRV for methylmercury (**NOAEL - 0.055 μg MeHg/g – day; LOAEL – 0.18 μg MeHg/g – day**) because the mink is a receptor of concern at the site and the species is known to be sensitive to mercury. The neurological effects that are the basis for the suggested threshold do not relate directly to the typical ecological endpoint types (*i.e.*, mortality, growth, and reproduction); however, intoxicated animals are likely to be less successful at foraging, predator avoidance, and mating, all of which have population-level significance. The selected rat study suggests that chronic reproductive effects also occur at these low exposure levels.

Table 4. Summary of Chronic Feeding Studies with Methylmercury for Mammals

Species	NOAEL (μg/g-d)	LOAEL (μg/g-d)	Effect	Reference
Mink (*Mustela vison*)	**0.055**	**0.18**	Anorexia, ataxia; nerve tissue lesions	Wobeser et al., 1976a,b
River otter (L*utra canadensis*)		2 μg/g[a]	Anorexia and ataxia	O'Connor and Nielsen, 1981
Cat (*Felis domesticus*)	0.020	0.046	Ataxia, loss of balance, motor incoordination	Charbonneau et al., 1974
Rat (*Rattus norvegicus*)	0.032	0.16	Reproduction	Verschuuren et al., 1976
Mouse (*Mus musculus*)	0.15	0.73	Sensory neuropathy, cerebral and cerebellar neuronal necrosis	Hirano et al., 1986

Note: Shaded cells indicate the study from which the TRV (bold) was selected.
a. Concentration in diet (wet weight basis).

Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). Some commercial PCB mixtures are known in the United States by their industrial trade name, Aroclor. Because they do not burn easily and are good insulating materials, PCBs were used widely as coolants and lubricants in transformers, capacitors, and

other electrical equipment. The manufacture of PCBs stopped in the United States in 1977 because there was evidence that PCBs build up in the environment and may cause harmful effects. Once released into the environment, PCBs do not readily break down and therefore may remain for long periods of time, cycling between air, water, and soil. As a consequence, PCBs are ubiquitously found all over the world. The World Health Organization (WHO) has recognized 12 PCB congeners that are structurally similar to dioxins and have similar toxic effects.

PCBs are taken up into the bodies of small organisms and fish in water. They are also ingested by other animals who feed on these aquatic animals. PCBs especially accumulate in fish and marine mammals (such as seals and whales) reaching levels that may be many thousands of times higher than in water.

Animals exposed to PCBs show various kinds of health effects, including anemia, acne-like skin conditions, and liver, stomach, and thyroid gland injuries (ATSDR, 2000a). Other effects include reductions in the immune system function, behavioral alterations, and impaired reproduction (ATSDR, 2000a). Some PCBs can mimic or block the action of hormones from the thyroid and other endocrine glands. Because hormones influence the normal functioning of many organs, some of the effects of PCBs may result from endocrine changes. Inhalation and dermal exposure to PCBs may cause liver, kidney, and skin damage in animals (ATSDR, 2000a).

As discussed in Section I, a TEQ approach will be employed to evaluate the potential risks associated with wildlife exposure to compounds with dioxin-like toxicological properties (including certain PCB congeners). Consequently, the specific TRVs for PCBs will be used in the BERA to evaluate the non-dioxin like effects attributable to PCB compounds.

Birds. The selected avian TRVs for PCBs are based on an analysis conducted by USEPA Region 5 (Chapman, 2003) for the chicken, which is believed to be one of the most sensitive bird species. These results are summarized in Table 5. TRVs were developed individually for Aroclors 1242, 1248, and 1254 based on reported dose response data from multiple collated studies for Aroclor exposure and growth or reproductive effects in chickens. The interpolated no effect and low effect doses for Aroclor 1242 (**NOAEL - 0.1 μg PCB/g – day; LOAEL – 0.4 μg PCB/g – day**) were conservatively selected as the avian TRV for Total PCBs.

Table 5. Summary of Avian TRVs for PCB Mixture Based on Chicken Data

Aroclor Mixture	No Effect[a] (μg/g-d)	Low Effect[a] (μg/g-d)	Effect	Reference
Aroclor 1242[b]	**0.1**	**0.4**	Chick hatchability	Chapman, 2003
Aroclor 1248	0.4	0.5	Chick hatchability	Chapman, 2003
Aroclor 1254	0.6	1.2	Chick hatchability	Chapman, 2003

Note: Shaded cells indicate the study from which the TRV (bold) was selected.

a. These values are interpreted as the interpolated dose resulting in a 10% or 25% decrease in endpoint response relative to the control group for the NOAEL and LOAEL, respectively; see Chapman, 2003.

b. Chapman (2003) reports two dose-response patterns in the chicken studies for Aroclor 1242; this may be the due to difference in the batch tested, organisms, feed characteristics, or experimental design. Selected values are derived from the more sensitive response data.

Mammals. Table 6 summarizes the selected mammalian TRVs for PCBs that were derived as part of the Chapman (2003) analysis; no mink study for Aroclor 1248 was identified but the author concluded that this mixture is as toxic as Aroclor 1254 based on *in vitro* bioassay data. The interpolated no effect and low effect doses for Aroclor 1254 (**NOAEL - 0.080 μg PCB/g – day; LOAEL – 0.096 μg PCB/g – day**) were conservatively selected as the mammalian TRV for Total PCBs

Table 6. Summary of Mammalian TRVs for PCB Mixtures Based on Mink Data

Aroclor Mixture	No Effect[a] (μg/g-d)	Low Effect[a] (μg/g-d)	Effect	Reference
Aroclor 1242	0.208	0.224	Decrease in live kit production	Chapman, 2003
Aroclor 1254	**0.080**	**0.096**	Decrease in number of live kits per mated female; kit birth weight	Chapman, 2003

Note: Shaded cells indicate the study from which the TRV (bold) was selected.

a. These values are interpreted as the interpolated dose resulting in a 10% or 25% decrease in endpoint response relative to the control group for the NOAEL and LOAEL, respectively; see Chapman, 2003.

b. Data converted from diet based TRV to dose assuming that a female mink consumes 0.16 grams/gram body weight per day (average farm-raised individuals in Michigan [Bleavins & Aulerich, 1981])

2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)

2,3,7,8-TCDD (herein referred to as TCDD) belongs to a class of compounds known as chlorinated dibenzodioxins (dioxins) that are ubiquitous in the environment as a result of various industrial processes (*e.g.,* solid waste incineration; the production, use, and disposal of pesticides and PCBs; during the bleaching process of paper; and during the production and recycling of metals). Dioxins usually occur concurrently with other chemicals known as chlorinated dibenzofurans (furans), both of which are highly persistent and have been detected in all environmental media (*i.e*., air, water, soil, animal tissue.

Laboratory toxicity data show that fish are generally more sensitive to TCDD than plants, aquatic invertebrates, and other aquatic vertebrates (*e.g*., amphibians) (USEPA, 1993a). The high lipid content in fish makes them highly susceptible to bioaccumulation of TCDD in their tissues, which can essentially be transferred up the food chain to higher-trophic level organisms, such as birds and mammals (including humans). Effects of TCDD exposure to mammals and birds are similar to fish and include delayed mortality, a "wasting" syndrome characterized by reduced food intake and reduced body weight, reproductive toxicity, histopathological alterations, developmental abnormalities, and immunosupression (USEPA, 1993a).

Birds. The bird embryo is the most sensitive avian life stage and consequently, the reproductive endpoint was the basis for establishing the avian TRVs. Note that critical body residues (CBRs) based on TCDD egg concentrations associated with reduced hatchability and other similar effect measures related to embryotoxicity are presented in Section III.

Several long term feeding studies have been conducted using a variety of bird species; information on the two most relevant studies with chickens and ring-necked pheasants are summarized in Table 7. The Nosek et al. (1992a,b) study was selected as the basis for establishing a TCDD (TEQ) TRV for birds. A 10-fold subchronic to chronic extrapolation factor was applied to the pheasant NOAEL/LOAELs because the exposure duration was likely

inadequate to achieve steady state conditions in the laying hens (USEPA, 1993a); moreover, the dose-response function appears to be very steep. The recommended TRVs (**NOAEL - 0.0000014µg TCDD/g – day; LOAEL – 0.000014µg TCDD/g – day**) are consistent with the early life stage study with chickens exposed to 2,3,7,8-tetrachlorodibenzofuran (TCDF) conducted by McKinney et al. (1976).

Table 7. Summary of Chronic Feeding Studies with TCDD/TCDF for Birds

Species	NOAEL (µg/g-d)	LOAEL (µg/g-d)	Effect	Reference
Ring-necked pheasant (*Phasianus colchicus*)	**0.000014**[a]	**0.00014**[a]	Significant reduction in egg production; 100% embryotoxicity	Nosek et al., 1992a,b
Chicken (*Gallus domesticus*)	0.000001[b]	0.000010[b]	Survival of newly hatched chicks to 21 days	McKinney et al., 1976

Note: Shaded cells indicate the study from which the TRV (bold) was selected.

a. Reported doses were based on exposures via interperitoneal injection and converted to an ingestion dose (USEPA, 1993).
b. Based on dietary exposures to TCDF.

Mammals. Table 8 presents a summary of the available LD_{50} studies results for various mammal species. The guinea pig appears to be most sensitive mammal (USEPA, 2003), with the mink appearing to be only slightly less sensitive to the acute effects of TCDD exposure.

Table 8. Summary of Estimated Mammalian LD_{50} Benchmarks for Dioxin TEQs

Species	Estimated LD_{10} (µg/g)	LD_{50} (µg/g)	Reference
Guinea pig (*Cavia porcellus*)	-	0.0006 – 0.002	As cited in USEPA, 1993a
Mink (*Mustela vison*)	-	0.0042	Hochstein et al., 1988
Rat (*Rattus norvegicus*)	-	0.022 – 0.045	As cited in USEPA, 1993a
Rabbit (*Oryctolagus cuniculus*)	-	0.115	As cited in USEPA, 1993a
Mouse (*Mus musculus*)	-	0.114 – 0.284	As cited in USEPA, 1993a
Hamster (various species)	-	1.157 – 5.0	As cited in USEPA, 1993a

Table 9 summarizes the most relevant chronic feedings studies available for TCDD. A feeding study by Tillet et al. (1996) with mink is the basis for the recommended mammalian wildlife TRV for TCDD (**NOAEL - 0.00000008µg TCDD/g – day; LOAEL – 0.00000224µg TCDD/g – day**) because the mink is a receptor of concern at the site and the species is known to be sensitive to dioxin-like compounds. The rat NOAEL and LOAEL for TCDD from Murray et al. (1979) were selected as the TRVs for non-piscivorous mammalian receptors that do not appear to be as sensitive to TCDD as piscivorous mammalian receptors (*e.g.*, mink).

Table 9. Summary of Chronic Feeding Studies with TCDD for Mammals

Species	NOAEL (µg/g-d)	LOAEL (µg/g-d)	Effect	Reference
Rat (Sprague Dawley)	**0.000001**	**0.00001**	Decreases in fertility in F_1 and F_2 generations	Murray *et al.*, 1979
Mink (*Mustela vison*)	**0.00000008**	**0.00000224**	Reduced kit body weights (3 wks) and reduced 9survival (3 & 6 wks)	Tillet *et al.*, 1996

Note: Shaded cells indicate the study from which the TRV (bold) was selected.

Toxicity Profiles for other Inorganic COPECs[4]

Copper (Cu) is a reddish metal that occurs naturally in rock, water, soil, and sediment. It is an essential element at low levels for all organisms including humans and other animals; but at higher levels, toxic effects can occur. Copper can enter the environment through releases from the mining of copper and other metals, and from factories that make or use copper metal or compounds. Copper can also enter the environment through waste dumps, domestic waste water, combustion of fossil fuels, wood production, fertilizer production, and natural sources such as dust from soils, volcanoes, and forest fires.

Copper strongly adsorbs to organic matter, carbonates, and clay, which reduces its bioavailability. Copper is highly toxic in aquatic environments and causes adverse effects in fish, invertebrates, and amphibians, with all three groups equally sensitive to chronic toxicity (USEPA, 1993b; Horne and Dunson, 1995). Copper bioconcentrates in many different organs in both fish and mollusks (Owen, 1981). Toxic effects in birds include reduced growth rates, lowered egg production, and developmental abnormalities (USEPA Region 5). While mammals are not as sensitive to copper toxicity as aquatic organisms, toxicity in mammals includes a wide range of animals and effects such as liver cirrhosis, necrosis in kidneys and the brain, gastrointestinal distress, lesions, low blood pressure, and fetal mortality. (ATSDR, 2004a; Kabata-Pendias and Pendias, 1992; Ware, 1983; Vymazal, 1995).

Nickel (Ni) is a hard, silvery-white naturally-occurring metal that combines well with other metals (*e.g.*, iron, copper, chromium, and zinc) to form mixtures called alloys, which are used in making metal coins, jewelry, and industrial equipment. Most nickel, however, is used to make stainless steel. Nickel is primarily found in the environment combined with oxygen or sulfur as oxides or sulfides. It is released during nickel mining and by industries that make or use nickel, nickel alloys, or nickel compounds, such as oil-burning power plants, coal-burning power plants, and trash incinerators (ATSDR, 2005a).

In soil or sediment nickel strongly attaches to particles containing iron or manganese. Under acidic conditions, nickel is more mobile in soil and might seep into groundwater. Nickel does not appear to concentrate in fish. Studies show that some plants can take up and accumulate nickel. However, it has been shown that nickel does not accumulate in small animals living on land that has been treated with nickel-containing sludge (ATSDR, 2005a).

[4] TRVs for these other COPECs will be developed prior to preparation of the BERA.

A number of animal studies have assessed the toxicity of nickel following oral exposure. Significant decreases in body and organ weights (liver, kidney, pituitary) were consistently observed in rats exposed to nickel chloride (American Biogenics Corporation, 1988; RTI, 1988a, b), nickel acetate (Whanger, 1973), or nickel sulfate (Dieter et al., 1988). Other systemic effects included kidney damage and adverse lung effects at (American Biogenics Corporation, 1988; RTI 1988b). However, the primary targets of toxicity appear to be to the respiratory tract following inhalation exposure, the immune system following inhalation, oral, or dermal exposure, and the reproductive system and the fetus following oral exposure. The most consistently reported adverse effects resulting from exposure to nickel are contact dermatitis and respiratory effects, including cancer (ATSDR, 2005a).

Silver (Ag) Photographic materials and mining are the major anthropogenic sources of silver released into the environment (ATSDR, 1990a). It is also released naturally by the breakdown of silver-bearing rocks and soil by wind and rain.

Silver may biomagnify in some aquatic invertebrates (Adriano, 1986) and it is highly toxic to aquatic organisms (USEPA, 1992). Elevated concentrations can cause larval mortality, developmental abnormalities, and reduced larval growth in fish (Klein-MacPhee et al., 1984); growth reduction in juvenile mussels (Calabrese et al., 1984); and adverse effects on reproduction in gastropods (Nelson et al., 1983). Silver is toxic to soil microbes, thus inhibiting biotransformation (ATSDR, 1990a). Effects on mammals include pulmonary edema, congestion, and mortality (USEPA Region 5).

Tributyltin (TBT) is one of several organotin compounds containing one or more direct links between a carbon atom and a metal atom. Organotins are the main active ingredients in biocides used to control a broad spectrum of organisms. Uses include wood treatment and preservation, antifouling of boats (in marine paints), antifungal action in textiles and industrial water systems, wood pulp and paper mill systems, and breweries. Tributyltin is primarily used as a biocide in antifouling paints applied to ship hulls to keep organisms from attaching to the hull. Unless otherwise specified, all information presented is for tributyltin oxide, a representative compound.

TBT is extremely stable and resistant to natural degradation in water. Because of its low water solubility, it will strongly bind to suspended material such as organic material or inorganic sediments and precipitate to the bottom (EXOTOXNET, 1996). Reported half-life of the compound in freshwater is 6 to 25 days; in seawater and estuarine locations, it is 1 to 34 weeks, depending on the initial concentration (Clark et al., 1988). Because of its chemical properties and widespread use of TBT as an antifouling agent, concerns have been raised over the risks it poses to both freshwater and saltwater organisms. Tributyltin is extremely toxic to aquatic life, acting as an endocrine-disruptor that causes severe reproductive effects. It is especially toxic to bivalves, such as oysters and other mollusks. In addition, recent studies show that exposure to TBT makes oysters susceptible to infection and death from exposure to pathogens (EXTOXNET, 1996).

Under aerobic conditions, tributyltin takes one to three months to degrade into tin (EXTOXNET, 1996). But in anaerobic (airless) soils, it will persist for more than two years. Tributyltin compounds may be moderately to highly persistent, with degradation dependent on temperature and the presence of microorganisms. Prolonged exposure to organotin has produced bile duct damage in several mammalian species (EXOTOXNET, 1996) and TBT may be a potent immunotoxic agent (Boyer, 1989). Tributyltin is moderately toxic to mammals via both ingestion and dermal absorption. It can also be considered moderately toxic to birds due to reductions in egg production, eggshell thickness, fertility, and hatchability (Solectis et al., 1992).

Zinc (Zn) is one of the most common elements in the earth's crust. It is used for a variety of industrial purposes including as a coat to iron or other metals to prevent rust and corrosion or mixed with other metals to form alloys such as brass and bronze. Zinc sulfide and zinc oxide are used to make white paints, ceramics, rubber, and other products. Zinc compounds are used in preserving wood and in manufacturing and dyeing fabrics, as well as used by the drug industry in common products, such as vitamin supplements, sun blocks, deodorants, skin preparations, and antidandruff shampoos (ATSDR, 2005b).

Zinc enters the air, water, and soil as a result of both natural processes and human activities. Although zinc is an essential element in small amounts, elevated zinc levels can be toxic to many types of plants and animals, where growth, survival, and reproduction can all be adversely affected (Eisler 1993). In aquatic systems, zinc tends to be partitioned into sediment and less frequently dissolved as hydrated zinc ions and organic and inorganic complexes (MacDonald 1993). Zinc is toxic to plants and terrestrial invertebrates at elevated levels with reduced survival, growth, and reproduction (Eisler 1993). Elevated zinc levels can cause mortality, pancreatic degradation, reduced growth, and decreased weight gain in birds (Eisler 1993; NAS 1980). Elevated zinc concentrations can cause a wide range of problems in mammals' cardiovascular, developmental, immunological, neurological, hematological, and reproductive systems, as well as target organs including the pancreas, liver, and kidney (Eisler 1993; Domingo 1994).

Toxicity Profile for Polycyclic Aromatic Hydrocarbons (PAHs) COPECs

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of ubiquitous chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. There are more than 100 different PAHs, which generally occur as complex mixtures. PAHs mainly enter the environment as releases to air from volcanoes, forest fires, residential wood burning, and exhaust from automobiles and trucks. They can also enter surface water through discharges from industrial plants and waste water treatment plants.

PAHs have been demonstrated to be carcinogenic. Non-carcinogenic effects within an organism are widespread and have been found in many species including mammals, birds, invertebrates, plants, amphibians, fish, and humans. In aquatic systems, PAHs display increased toxicity with increased molecular weight (Eisler 1987b). In addition, although the rate of uptake from the environment is variable among species, bioaccumulation tends to be rapid. Effects on benthic invertebrates include inhibited reproduction, delayed emergence, sediment avoidance, and mortality. Fish exposed to PAHs have exhibited fin erosion, liver abnormalities, cataracts, and immune system impairments leading to increased susceptibility to disease (Fabacher et al., 1991; Weeks and Warinner, 1984; 1986; O'Conner and Huggett, 1988).

Bioaccumulation of PAHs has been shown in terrestrial invertebrates and mammals. Concentrations of PAHs in earthworms were found to be 30-60 times greater than soil concentrations (USEPA Region 5). Metabolism of PAHs, however, is sufficient to prevent biomagnification. Adsorption of PAHs in soil is directly proportional to the organic matter content in soil and the octanol-water partition coefficient (K_{ow}) of the PAH (greater in high molecular weight [HMW] PAHs than in low molecular weight [LMW] PAHs), and is inversely proportional to soil particle size (roughly two orders of magnitude greater on silts and clays as compared with sands) (USEPA Region 5).

Plants can absorb PAHs from soils through their roots, and translocate them to other plant parts such as developing shoots. Certain plants contain substances that can protect against PAH

effects, inactivating their carcinogenic and mutagenic potential. Uptake rates are generally governed by PAH concentration, PAH water solubility, soil type, and PAH physicochemical state (vapor or particulate). Lower molecular weight PAHs are absorbed more readily than higher molecular weight PAHs.

Mammals can absorb PAHs by inhalation, dermal contact, or ingestion (Eisler, 1987b). The oral toxicity of PAHs ranges from very to moderately toxic in rats. Many PAHs are carcinogenic, producing tumors in epithelial tissues in "practically all animal species tested" (Eisler, 1987b). Other effects in terrestrial organisms are not well known, but may include adverse effects on reproduction, development, and immunity (ATSDR, 1995).

Toxicity Profiles for Other Semivolatile Organic Compounds (SVOCs) COPECs

1,4-Dichlorobenzene is one member of a group of compounds (dichlorobenzenes) that includes 1,2- and 1,3-dichlorobenzene. 1,4-dichlorobenzene is one of two chemicals commonly used to make mothballs. It is also used to make deodorant blocks used in garbage cans and restrooms, and to help control odors in animal-holding facilities. It has been used as an insecticide on fruit and as an agent to control mold and mildew growth on tobacco seeds, leather, and some fabrics. Most of the 1,4-dichlorobenzene enters the environment when it is used in mothballs and in toilet-deodorizer blocks. Some is released to the air by factories that make or use it, and only a little is released to soil and water. Evidence suggests that plants and fish absorb dichlorobenzenes and 1,4-dichlorobenzene has been detected at concentrations of up to 470 parts per billion (ppb) in fish (ATSDR, 2004b).

Following inhalation or oral exposure, absorption of 1,4-dichlorobenzne is rapid and complete. Similar to the other dichlorobenzene isomers, 1,4-dichlorobenzene is distributed throughout the body, but tends to be found in greatest levels in fat, liver, and kidney. Animal studies have reported increased liver weights, liver cell proliferation, vacuolated cytoplasm, hepatocellular hypertrophy, and hepatic portal inflammation following exposure to 1,4-dichlorobenzene (ATSDR, 2004b). It has been shown to be carcinogenic in chronic animal studies by both the inhalation and oral routes. Liver and kidney effects are the most consistently observed, best characterized, and most sensitive findings in these studies.

Bis(2-Ethylhexyl)phthalate (BEHP) belongs to a class of manufactured chemicals called phthalates that are commonly added to plastics to make them flexible. BEHP is present in plastic products such as wall coverings, tablecloths, floor tiles, furniture upholstery, shower curtains, garden hoses, rainwear, toys, sheathing for wire and cable, medical tubing, and blood storage bags. BEHP can enter the environment through releases from factories that make or use it and from household items. Over long periods of time, it can move out of plastic materials into the environment. In the presence of oxygen, BEHP in water and soil can be degraded by microorganisms to carbon dioxide and other simple chemicals. Biodegradation is expected to occur under aerobic conditions, but it does not break down very easily when deep in the soil or at the bottom of lakes or rivers under anoxic conditions.

BEHP tends to sorb strongly to soils and sediments and to bioconcentrate in aquatic organisms. It can be found in small amounts in fish and other animals, and some uptake by plants has been reported (ATSDR, 2002b). Most BEHP that enters the body in food, water, or air is taken up into the blood from the intestines and lungs. Sorption, bioaccumulation, and biodegradation are likely to be competing processes, with the dominant fate being determined by local environmental conditions. The main targets of BEHP toxicity are the liver and testes. Toxicity of BEHP in

other tissues is less well characterized, although effects in the thyroid, ovaries, kidneys, and blood have been reported in a few studies (ATSDR, 2002b). Although no studies have demonstrated cancer effects in humans after oral exposure to BEHP, several chronic feeding studies in rodents indicate that BEHP can cause liver tumors in rats and mice (David et al., 1999; Kluwe et al., 1982a; Rao et al., 1987; 1990).

Butyl benzyl phthalate (BBP) is a clear, oily, combustible liquid with a slight odor. It is used as a plasticizer for polyvinyl and cellulosic resins and as an organic intermediate. The major use of butyl benzyl phthalate is in flooring materials with minor amounts being used in household products (HSDB, 1993). It is release into the atmosphere by various industries, such as paperboard container and box manufacturers, public and related furniture manufacturing, and commercial printing manufacturers (ARB, 1997). Exposure to butyl benzyl phthalate occurs during its production and use as a plasticizer, mainly in polyvinyl chloride products. It has been detected at low levels in indoor air, water and a few foods.

BBP is readily biodegraded in aerobic surface water, with a half-life of about one to seven days (WHO, 1999). It is expected to readily adsorb to suspended matter, sediments, and biota. It is very toxic to aquatic organisms, with 96-hr LC50 values as low as 510 g/L for the shiner perch (*Cymatogaster aggregate*) (Ozretich et al., 1983). Bioaccumulation of BBP may occur in fish. However, because BBP is readily metabolized, with a depuration half-life of less than two days, reported bioconcentration factors (BCFs) in oysters, microorganisms, and several species of fish are less than 1000 (Barrows et al., 1980; Veith et al., 1980).

Müller and Kördel (1993) demonstrated that plants grown on phthalate-enriched soil did not take up BBP from the soil through the roots. However, plants exposed to phthalate-treated dust did take up BBP through leaf cuticles (quantitative data not available).

Butyl benzyl phthalate has also caused adverse effects to the liver, thymus, and testes of animals (HSDB, 1995). The substance can be absorbed into the body by inhalation or ingestion. Malformations, embryonic deaths, and reproductive system effects were observed in both mice and rats following oral exposure of BBP, generally at maternally toxic doses. These animal tests show that this substance possibly causes toxicity to human reproduction or development.

Chlorobenzene is a colorless liquid with an almond-like odor. It does not occur in nature, but is manufactured for use as a solvent and is used in the production of other chemicals. It is produced by the chlorination of benzene in the presence of a catalyst (*e.g*., ferric chloride, aluminum chloride, or stannic chloride). This process yields a mixture of chlorobenzene, dichlorobenzenes, and higher analogs, which are distilled and crystallized to obtain pure products (USEPA, 1985; Hughes et al., 1983). Production of chlorobenzene in the United States has declined by nearly 60%, from 1960 to 1987. This decline is attributed primarily to the replacement of chlorobenzene by cumene in phenol production and the cessation of DDT production in the United States (ATSDR, 1990b).

Upon release to the environment, chlorobenzene persists in soil for several months, in air (3.5 days), and in water (less than one day) (ATSDR, 1990b). No information is available regarding biomagnification within aquatic or terrestrial food chains. Animal studies show that chlorobenzene is lethal following acute, intermediate, and chronic oral exposures. Clinical signs of toxicity were not observed, but histopathologic examination revealed dose-related chemical-induced changes to the liver, kidney, bone marrow, spleen, and thymus. Liver and kidney weights increased in mice and rats, while spleen weights decreased (NTP, 1985).

Toxicity Profiles for other Chlorinated Pesticide COPECs

Chlordane is a chemical belonging to the class of chlorinated pesticides. It was used as a pesticide in the United States from 1948 to 1988 when it was administered to crops, lawns, and gardens primarily as a termite control (ATSDR, 1994). Although it is no longer used in the U.S., it is still produced and exported for use in other countries.

Chlordane is very highly toxic to fresh water invertebrates and fish. It is also known to bioaccumulate in both marine and freshwater aquatic fish and subsequently be biomagnified up the food chain to higher-trophic level consumers (ATSDR, 1994). When ingested, chlordane is carcinogenic, toxic to the central nervous system, and toxic to the liver in experimental animals (ATSDR, 1994). Upon dermal contact, it is irritating to skin, eyes and mucous membranes. It is also a mutagen in mammalian cell systems and has been shown to cause reproductive effects in animals (ATSDR, 1994). Chronic exposure has resulted in degenerative changes in the liver, renal tubules, lungs, intestinal submucosa, and heart (ATSDR, 1994).

DDT (dichlorodiphenyltrichloroethane) and its primary metabolites (DDD and DDE) are manufactured organochloride pesticides (collaboratively referred to as DDx). DDT use in the United States was banned in 1972, but it was still manufactured for export until the mid-1980s. DDT is a broad spectrum insecticide that was very popular due its effectiveness, long residual persistence, low acute mammalian toxicity, and low cost. DDT has been widely used to control insects on agricultural crops such as peanuts, soybeans, and cotton, as well as sprayed to decrease the incidence and spread of diseases such as malaria by controlling mosquitoes.

Upon introduction into the environment, DDT will enter soil, water, or air. DDT and its metabolites are strongly adsorbed onto particulates in water and settle into sediments where they become essentially immobile. DDT is highly toxic to aquatic life, including both invertebrates (crustaceans) and vertebrates (fish). Furthermore, DDT and its analogues accumulate in lipid tissues of fish and other organisms, subsequently bioconcentrate up the food chain.

The best known effect of DDT toxicity is impairment of nerve impulse conduction. Effects of DDT on the nervous system have been observed in animals and can vary from mild altered sensations to tremors and convulsions. Death in animals following high exposure to DDT is usually caused by respiratory arrest. In addition to being a neurotoxicant, DDT is capable of inducing marked alterations on reproduction and development, which is attributed to hormone-altering actions of DDT isomers and/or its metabolites (ATSDR, 2002c). Egg-shelling thinning in upper trophic level birds is believed to have resulted in population crashes in the1960s and 1970s. Due to the ban on the production and use of DDT in the U.S. and other parts of the world, exposures of wildlife have been declining since the early 1970s, as evidenced by marked decreases in the levels of DDT compounds in fish, shellfish, aquatic mammals, and birds (ATSDR, 2002c).

Endosulfan is a categorical name for the technical-grade mixture of an organochloride pesticide consisting of two isomers, α- and β- endosulfan. Because there is very little difference in toxicity between endosulfan and its metabolite, endosulfan sulfate, it is also included in this sum as Total Endosulfan. Endosulfan is used to control various insects on food crops (*e.g.,* grains, fruits, vegetables) and non-food crops (*e.g*., tobacco, cotton). It is also used as a wood preservative. Once released into the environment, endosulfan attaches to soil particles, where it may stay for several years before it breaks down.

Results from animal studies show that exposure to large amounts of endosulfan for short periods of time can cause adverse nervous system effects including hyperexcitability, tremors, convulsions, lung and heart failure, and eventually death (ATSDR, 2000b). Longer exposure to endosulfan affects the kidneys, testes, and liver, even at low concentrations (ATSDR, 2000b). The seriousness of these effects is increased when animals are exposed to higher concentrations. Limited studies in animals show no evidence that endosulfan is carcinogenic; although it may cause damage to the genetic material within cells (ATSDR, 2000b).

Endrin is an organochloride pesticide that was once used to control insects, rodents and birds. It has not been produced or sold for general use in the United States since 1986. There are two breakdown products of endrin: endrin aldehyde and endrin ketone, but there is little information available regarding the properties of these products. Once released to the environment, endrin tends to persist mainly in forms sorbed to sediments and soil particles. When released to water, endrin strongly adsorbs to sediment and bioconcentrates significantly in aquatic organisms (ASTDR 1996; USEPA 1980; Metcalf et al. 1973). Endrin appears to be biomagnified only slightly through various levels of the food chain (Metcalf et al., 1973).

In animals, endrin primarily targets the nervous system. Ingestion of endrin can cause central nervous system effects as expressed by muscle contractions, hyperexcitability, and in severe cases, convulsions, and sometimes death (Curley et al. 1970; Runhaar et al. 1985; Weeks 1967). Nonspecific degeneration of the liver, kidney, and brain was also observed in animals exposed to lethal doses of endrin (Treon et al. 1955). Endrin can also cause abnormal bone formation, hyperactivity, and death in fetuses of females exposed during gestation (Chernoff et al. 1979a; Gray et al. 1981; Kavlock et al. 1985; Ottolenghi et al. 1974).

III. Critical Body Residues for Ecological Receptor Tissue

In addition to modeling exposure doses to wildlife using the equations presented in the PAR (Battelle, 2005), a chemical residue based approach (variously termed a critical body residue [CBR] or lethal body burden [LBB]) will also be used to evaluate potential hazards posed by LPRRP COPECs to ecological receptors. As developed herein, a CBR is a contaminant- and taxon-specific threshold concentration measured in biological tissue above which adverse effects of ecological relevance would be anticipated to occur.

The residue-based approach provides a number of distinct advantages over the exposure-based approach including the explicit consideration of contaminant bioavailability and metabolism (McCarty and MacKay, 1993). CBRs were developed for three broad categories of ecological receptors – aquatic invertebrates (including crustaceans, bivalves, gastropods, and insects), fish, and wildlife (primarily bird egg tissue).

The majority of the toxicological data used to develop CBRs for the LPRRP was obtained from downloads from the Army Corps of Engineers' Environmental Residue-Effects Database (ERED, available at http://el.erdc.usace.army.mil/ered; queried on 10 January 2006). This information was supplemented with data obtained from other compilations of residue effects data (*e.g.*, USEPA, 2000b; Jarvinen and Ankley, 1999) as well as journal articles. The electronic data for a given COPEC were stored in an electronic spreadsheet file, individual records were categorized taxonomically and by general habitat requirement (*i.e.*, freshwater and saltwater), and the files were pared down to include only those records reporting contaminant tissue concentrations associated with the following effect categories:

- Mortality (the effect category "survival" was renamed);
- Growth;
- Developmental effects in early life stages; and,
- Reproduction.

In addition, only studies reporting whole body, or in the case of early life stages (eggs, embryos) concentrations were retained. Finally, the datasets were filtered to obtain information for specific taxonomic groups. Tables C-1 through C-20 in Appendix C present the results of the data acquisition and sorting procedures for the LPRRP COPECs (copper, lead, mercury, methylmercury, silver, tributyltin, zinc, PAHs, BEHP, chlordane, DDx, dieldrin/aldrin, endosulfan, endrin, PCBs, and 2,3,76,8-TCDD). The data presented in these tables were sorted by habitat (freshwater/saltwater), taxonomic category (invertebrate/fish/bird [when available]), and effect category (mortality/growth/ development/reproduction) and then plotted in charts. Where at least one study for a given taxon reported an adverse effect, a benchmark toxicity threshold value was calculated as the geometric mean of the highest concentration where no response was reported (*i.e.*, a No Observed Effect Residue or NOER) and the lowest tissue concentration associated with an adverse effect (*i.e.*, a Lowest Observed Effect Residue or LOER); this geometric mean is termed a Maximum Allowable Toxicant Concentration (MATC). When no NOER value was reported or the reported LOER value is less than the reported NOERs (derived from different study), MATCs were calculated by assuming that a no-effect/low-effect extrapolation factor of 10 is appropriate for estimating the effect threshold.

It is recognized that there is uncertainty associated with this approach, the magnitude of which varies depending on the number, comparability, and taxonomic representativeness of the available studies. The lowest MATC identified for each COPEC will be initially identified as the CBR values for fish and aquatic invertebrate receptors (by pooling results across habitat and effect categories) and will be compared against site-specific tissue data in the BERA. For those COPECs retained for the biological medium, additional evaluation of the specific uncertainties associated with the screening MATC values will be conducted and revised if necessary.

For certain combinations of receptor categories and COPECs (*e.g.*, wildlife egg tissue data), there are numerous well conducted laboratory studies that present concentration-response data. For these, the study-specific NOER and LOERs are reported rather than MATCs because these data will not be used for COPEC screening but rather to establish measurement endpoints in the BERA.

In accordance with the preceding section, a detailed discussion of the CBRs for the five COPECs selected for TRV development (*i.e.*, lead, mercury/methylmercury, dieldrin, total PCBs, and TCDD) is presented followed by information obtained for the other identified COPECs. Values are based on MATCs in μg/g wet weight. In the following tables, the most sensitive taxon (with the lowest MATCs) is bolded within each effect category.

Lead

Fish. Tissue residue data for lead in fish are limited (only two species of salmonids are represented in the database); available data are summarized in Table 10 and presented graphically in Chart C-3. The screening CBR value selected (**0.088 μg lead/g**) is based on growth effects in rainbow trout.

Table 10. Summary of Estimated Fish Tissue Residue Benchmarks for Lead

Effect	Freshwater		Saltwater	
	Taxon	MATC (µg/g wet wt)	Taxon	MATC (µg/g wet wt)
Mortality	-		-	
Growth/Development	*Oncorhynchus*	**0.088**	-	
	Salvelinus	3.2		
Reproduction	*Oncorhynchus*	0.4	-	

Invertebrates. Invertebrate tissue residue data for lead are also limited (and no reproductive data were obtained). Table 11 summarizes available information; see Chart C-4 for a graphical display. The available information suggests that mortality is the most sensitive endpoint. In addition, there is no indication that freshwater and estuarine/marine species differ in their relative sensitivity to this COPEC. The amphipod MATC for mortality effects (**1.7 µg lead/g**) was selected as the screening benchmark level for this analyte.

Table 11. Summary of Estimated Macroinvertebrate Tissue Residue Benchmarks for Lead

Effect	Freshwater		Saltwater	
	Taxon	MATC (µg/g wet wt)	Taxon	MATC (µg/g wet wt)
Mortality	*Hyalella*	**1.7**	*Paracentrotus*	4.3
	Gammarus	12.6	*Calanus*	13
	Dreissena	84	*Themisto abyssorum*	20
			Themisto libellula	20
			Penaeus	90.9
Growth	*Chironomus tentans*	5.5	*Paracentrotus*	9.9
	Dreissena	84		
	Chironomus riparius	89		
Reproduction	-		-	

Mercury

Avian Tissue Residues (Egg). Available data that relate mercury concentrations in bird eggs with adverse developmental effects in summarized in Table 12. Heinz's study (1979) is the basis of the recommended egg residue threshold for ducks (**0.8 µg MeHg/g egg**) and the Newton and Haas study (1988) result (**0.2 µg** mercury/g egg) is the recommended value for predatory avifauna. Neither study identified a NOAEL value, resulting in uncertainty about the protective threshold levels; however, there is fairly good consistency in the reported effect concentrations for a variety of taxonomically different species. Based on the herring gull data (NOAEL of 16 µg/g), it is possible that these threshold values may be overly conservative for gulls which are a receptor of concern at the site.

Table 12. Summary of Avian Egg Residues Associated with Adverse Effects to Mercury

Species	NOAEL (µg/g)	LOAEL (µg/g)	Effect	Reference
Ring-necked pheasant (*Phasianus colchicus*)		0.5	Decreased hatchability	Fimreite, 1971
Mallard (*Anas platyrhynchos*)		**0.8**	Behavioral effects in ducklings	Heinz, 1979
Common loon (*Gavia immer*)		0.86	Aberrant nest behavior	Barr, 1976
Common tern (*Sterna hirundo*)	1.0	3.65	27% hatching success; 10-12% fledgling rate	Fimreite, 1974
Herring gull (*Larus argentatus*)	16		No decreased hatchability	Fimreite, 1974
Osprey (*Pandion haliaetus*)		0.3	Decrease in number of young fledged	Odsjo, 1982
Merlin (*Falco columbarius*)		**0.2**	Reduced productivity in half the population	Newton and Haas, 1988
Chicken (*Gallus domesticus*)	0.01	0.05	Significant decrease in percent hatching (71% to 65%)	Birge and Roberts, 1976

Mammalian Tissue Residues (Brain). As discussed in the preceding section, mercury is a potent neurological toxicant with mortality in mammals strongly correlated with levels of mercury in mammalian brain tissue (less strongly to liver and kidney concentrations). Table 13 summarizes the available brain tissue data. Wobeser's study (1976b) is the basis of the recommended brain residue threshold for mammals (**NOAEL – 3.4 µg MeHg/g ; LOAEL – 8.2 µg MeHg/g**) as it is based on the mink, which is a receptor of concern at the site.

Table 13. Summary of Mammalian Brain Tissue Residues Associated with Adverse Effects to Mercury

Species	NOAEL (µg/g)	LOAEL (µg/g)	Effect	Reference
Mink (*Mustela vison*)	**3.4**	**8.2**	Nerve tissue lesions, no clinical signs.	Wobeser, et al., 1976b.
River otter (*Lutra canadensis*)	0.38	13.3	Anorexia, ataxia in two of three day 168 to day 199	O'Connor and Nielsen, 1981
Domestic cat (*Felis catus*)	-	11.3	First convulsions 68 d after inception of dosing, mean survival 78 d	Eaton et al., 1980.
Harp seal (*Pagophilus groenlandicus*)	-	14.8	Decline in appetite	Ronald et al., 1977.

Fish. Tissue residue effect data for freshwater and saltwater fish species exposed to total mercury are summarized in Table 14. Table 15 presents the available methylmercury data. This information is graphically presented in Charts C-5 and C-7 (mercury and methylmercury, respectively).

MATC values for mercury range from 0.019 µg/g (mortality in catfish) to 29.0 µg/g (reproductive effects in medaka), with mortality and growth effects occurring over a similar range of effect concentrations; the catfish MATC is selected as the screening CBR value (**0.019 µg mercury/g).** For both freshwater and saltwater species, mortality is the most sensitive endpoint with available data suggesting that demersal species are among the most sensitive (catfish and winter flounder).

Mercury data for saltwater species are very limited (Chart C-5; a NOAEL for mortality (0.093 for the spiny dogfish) and a reported lethal residue value affecting 50 percent of the test population (*i.e.*, LR_{50}) of 5 µg/g (estimated MATC of 1.6 µg/g) in winter flounder (*Pleuronectes*).

MATC values for methylmercury range from 0.0032 µg/g to 2.5 µg/g, with mortality, growth, and reproductive effects occurring over a similar range of effect concentrations. For both freshwater and saltwater species, the egg stage appears to be the most sensitive life stage, although data are limited. Low residue levels of methylmercury in mummichog eggs affected F1 fecundities and altered sex ratios (Matta et al., 2001) and decreased egg hatchability in walleye (Latif et al., 2001).

Table 14. Summary of Estimated Fish Tissue Residue Benchmarks for Mercury

Effect	Freshwater		Saltwater	
	Taxon	**MATC (µg/g wet wt)**	**Taxon**	**MATC (µg/g wet wt)**
Mortality	*Ictalurus*	**0.019**	*Pleuronectes*	1.6
	Oncorhynchus	0.32		
	Thymallus	1.2		
	Carassius	1.8		
	Anguilla	2.9		
	Pimephales	3.4		
	Esox	4.7		
Growth	*Stizostedion*	0.079		
	Pimephales	0.65		
	Salmonidae	3.0		
	Cyprinidae	3.6		
Reproduction	*Thymallus*	1.2		
	Pimephales	3.6		
	Salmonidae	5.7		
	Oryzias	29.0		

Table 15. Summary of Estimated Fish Tissue Residue Benchmarks for Methylmercury

Effect	Freshwater		Saltwater	
	Taxon	**MATC (µg/g wet wt)**	**Taxon**	**MATC (µg/g wet wt)**
Mortality	-		*Fundulus*	0.15
Growth	*Thymallus*	0.085	*Fundulus* (eggs)	**0.0032**
	Pimephales	0.75		
	Oncorhynchus	2.5		
Reproduction	Stizostedion (egg)	0.11		
	Pimephales	0.22		

Invertebrates. Available invertebrate tissue residue data for mercury is summarized in Table 16; see Chart C-6 for a graphical presentation of the information (only total mercury data available).

MATC values range from 0.003 µg/g (growth effects in zooplankton) to 11.8 µg/g (mortality effects in the water flea), with growth and reproductive effects occurring at lower concentrations than mortality. A saltwater crustacean, *Arcatia tonsa*, experienced a 50% reduction in egg production associated with a mercury tissue residue of 0.95 µg/g (Hook and Fisher, 2002) and the freshwater mollusc, *Elliptio complanata*, exhibited reduced growth at a tissue concentration of 0.19 µg/g (Bekvar et al., 2000).

Table 16. Summary of Estimated Macroinvertebrate Tissue Residue Benchmarks for Mercury

Effect	Freshwater		Saltwater	
	Taxon	MATC (µg/g wet wt)	Taxon	MATC (µg/g wet wt)
Mortality	*Rangia*	6.3		
	Sparganophilus	9.2		
	Daphnia	11.8		
Growth	*Zooplankton*	**0.013**	*Crepidula*	2.5
	Elliptio	0.06	*Uca*	3.9
Reproduction	*Daphnia*	1.9	*Arcatia*	0.03
			Crepidula	9.3

Dieldrin/Aldrin

As previously discussed in Section II, dieldrin and aldrin are structurally similar and aldrin readily converts to dieldrin once it enters either the environment or is ingested or inhaled by organisms. Because they are both pesticides with similar properties and only limited data are available for either; relevant data for these two COPECs were combined to derive CBRs.

Fish. Table 17 presents a summary of the limited tissue effects data available for dieldrin. The rainbow trout (*Oncorhynchus mykiss*) appears to be the most sensitive fish species with an MATC value based on growth effects (**0.035 µg/g**) 2-3 orders of magnitude lower than those estimated for sunfish (*Lepomis* sp.) and the sheepshead minnow (*Cyprinodon variegatus*).

Table 17. Summary of Estimated Fish Tissue Residue Benchmarks for Dieldrin

Effect	Freshwater		Saltwater	
	Taxon	MATC (µg/g wet wt)	Taxon	MATC (µg/g wet wt)
Mortality	-		*Cyprinodon*	20.9
Growth/Development	*Oncorhynchus*	**0.035**	-	
	Lepomis	1.2		
	Salmo	1.6		
Reproduction	-		-	

Invertebrates. Table 18 summarizes available information on tissue residue levels associated with adverse effects in aquatic invertebrates; see Chart C-24 for a graphical presentation of the data. The limited invertebrate data include several genera that occur, or could occur in the

LPRRP. The MATC associated with lethal effect in shrimp (**0.028 μg dieldrin/g**) was selected as the benchmark value for screening analysis.

Table 18. Summary of Estimated Macroinvertebrate Tissue Residue Benchmarks for Dieldrin

Effect	Freshwater		Saltwater	
	Taxon	MATC (μg/g wet wt)	Taxon	MATC (μg/g wet wt)
Mortality	*Chironomus*	0.28	*Penaeus*	**0.028**
	Chlamydotheca	0.32	*Palaemonetes*	0.43
Growth	*Chironomus*	0.25	*Crassostrea*	0.46
Reproduction	-		-	

Polychlorinated Biphenyls (PCBs)

Avian Tissue Residues (Egg). Existing data are inadequate to attempt to discriminate the non dioxin-like embryotoxic effects of PCBs to birds from AhR-mediated effects, therefore a CBR for total PCB was not developed for this endpoint. As discussed in a separate technical memorandum, a TEQ approach will be used with either modeled or measured bird egg PCB, dioxin, and furan congener data to estimate the hazards posed by these bioaccumulating COPECs on avian receptors at the LPRRP.

Fish. Table 19 summarizes PCB egg tissue data from fish. Further details of all data are presented in Table C-17 (Appendix C). These data are presented graphically in Chart C-29.

MATCs derived from the tissue residue data range over several orders of magnitude (0.0079 – 107 μg/g). Although salmonids are clearly sensitive to early life stage exposures to PCB compounds (that sensitivity is likely attributable in part, if not primarily, to an AhR-mediated response), results suggest that other species including killifish (*e.g.*, *Fundulus* sp.), the sheepshead minnow (*Cyprinodon variegatus*), and medaka (*Oryzias*) exhibit adverse early life stage effects at comparable levels. The most sensitive freshwater endpoint (reproductive effects in medaka) is less than 10-fold lower than the lowest MATC for estuarine fish (development effects in the mummichog) and given the inequities in the relative number of non-freshwater species tested, it is reasonable to conclude that both sets of species may exhibit similar sensitivities to PCBs. Consequently, a single MATC was selected for screening of tissue residue data based on reproductive effects in medaka (**0.0079 μgPCBs/g**).

Table 19. Summary of Estimated Fish Egg Residue Benchmarks for PCBs

Effect	Freshwater		Saltwater	
	Taxon	MATC (µg/g wet wt)	Taxon	MATC (µg/g wet wt)
Mortality	*Oncorhynchus kisutch*	0.047	*Lagodon*	4.4
	Salvelinus namaycush	0.48	*Leiostomus*	5.4
	Oncorhynchus mykiss	1.1	*Cyprinodon*	107
	Oncorhynchus tshawytscha	1.9		
	Salvelinus fontinalis	94		
	Carassius	102		
Growth/Development	*Oncorhynchus kisutch*	1.2	*Fundulus*	0.056
	Salvelinus namaycush	1.2	*Pleuronectes*	2.2
	Ictalurus	4.5		
Reproduction	*Oryzias*	**0.0079**	*Cyprinodon*	2.1
	Salmo	0.17		
	Salvelinus namaycush	0.47		
	Salvelinus fontinalis	6.2		

Invertebrates. As with dioxins and furan compounds, invertebrates appear to be able to tolerate relatively high body burdens of total PCBs; pelagic crustaceans appear to be among the more sensitive taxa (Table 20). The grass shrimp (*Palaemonetes* sp.) is known to occur in the Lower Passaic River and the MATC derived for this species (**0.68 µg PCBs/g**) was selected for screening of invertebrate residue data.

Table 20. Summary of Estimated Macroinvertebrate Tissue Residue Benchmarks for PCBs

Effect	Freshwater		Saltwater	
	Taxon	MATC (µg/g wet wt)	Taxon	MATC (µg/g wet wt)
Mortality	*Hyalella*	9.2	*Palaemonetes*	**0.68**
	Lumbriculus	20	*Penaeus*	1.2
	Chironomus	65	*Penaeus*	4.6
			Ampelisca	51
Growth	*Daphnia*	7.2	*Crassostrea*	1.3
	Lumbriculus	20		
	Chironomus	59		
Reproduction	*Chironomus*	1.8	-	
	Gammarus	24		

TCDD

Avian Tissue Residues (Egg). A comprehensive literature search of the embryotoxicological effects of TCDD exposure in bird eggs is summarized in Table 21. Chart C-34 graphically presents these data.

Table 21. Summary of Avian Egg Residues Associated with Adverse Effects[a] to TCDD

Species	NOAEL (µg/g)	LOAEL (µg/g)	Effect	Reference[b]
Laboratory Studies				
Gallus domesticus	0.000066	0.00008	Embryo mortality; reduced hatchling weight	Henshel, et al., 1997a; Powell et al., 1996a,b; Brunstrom, 1988, 1989, 1990; Brunstrom et al., 1990; Zhao et al., 1997; Lipsitz et al., 1997; Brunstrom and Andersson, 1988; Brunstrom and Lund, 1988
Falco sparverius	0.00023	0.0034	Teratata, chick edema	Hoffman et al., 1998
Phasianus colchicus	0.00071	0.0079	Embryo mortality	Nosek et al., 1992; Brunstrom and Reutergardh, 1986
Phalacrocorax auritus	0.0037	0.0011	Embryo mortality	Powell et al., 1997a,b; Powell et al., 1998,
Meleagris gallopavo	0.010	0.010	Embryo mortality	Brunstrom and Lund, 1988
Anas platyrhynchos	0.035	-	Embryo mortality	Brunstrom and Reutergardh, 1986; Brunstrom, 1988
Anser anser	0.050	-	Embryo mortality	Brunstrom, 1988
Bucephala clangula	0.050	-	Embryo mortality	Brunstrom and Reutergardh, 1986;
Larus ridibundus	0.050	-	Embryo mortality	Brunstrom and Reutergardh, 1986;
Larus argentatus	0.050	-	Embryo mortality	Brunstrom, 1988
Sterna hirundo	-	0.0044	Embryo mortality	Hoffman et al., 1998
Field Studies				
Aix sponsa	0.000005	0.00002	Reproduction	White and Seginak, 1994
Ardea herodias	0.000013	0.0001	Terata, reduced fledging, and brain asymmetries	Hart et al., 1991; Henshel et al., 1995
Pandion haliaetus	0.00014	-	Reduced hatching/fledging	Woodford et al., 1998
Sterna forsteri	0.00035	-	Reduced hatching/fledging	Kubiak et al., 1989; Harris et al., 1993
Phalcrocorax auritus	-	0.00035	Terata	Yamashita et al., 1993
Sterna caspia	0.00144	0.00142	Wasting syndrome, terata	Yamashita et al., 1993, Ludwig et al., 1993; Ewins et al., 1994

a. Data on avian toxicity associated with compounds with dioxin-like effects as presented in USEPA (2003); values are Toxic Equivalencies (TEQs) and in the case of multiple studies, are based on geometric means.
b. As cited in USEPA, 2003.

USEPA developed Species Sensitivity Distributions (SSD) were developed using both available laboratory and field data; these distributions were then used to derive logistic regression models

to describe the relationship between TEQs in avian eggs and embryo mortality and developmental effects. A MATC value of **0.000094 μgTEQ/g** was derived based on the estimated NOAEL and LOAEL values protective of 95% of species from development effects (confidence intervals are not provided in the study but can readily be calculated). This value is only slightly greater than the geometric mean of available LOAEL values for the species believed to be the most sensitive to embryotoxicological effects attributable to dioxin exposure; however, based on USEPA's (2003) analysis there is no sound rationale for eliminating the chicken data (*i.e.*, on the grounds that there are no similarly sensitive wild analogues). Moreover, there are a number of avian species of special concern that warrant this more conservative approach.

Fish. For both freshwater and saltwater fish species, the egg stage appears to be the most sensitive life stage, and salmonids, in particular the lake trout (*Salvelinus namaycush*) the most sensitive. Table 22 summarizes available data that relate embryonic exposures to egg concentrations resulting in failure of 50 percent of the eggs to hatch. It is of interest that the LC_{50} for the mummichog (*Fundulus heteroclitus*) is less than five times greater than the lake trout (*i.e.*, 250 pg dioxin TEQ/g versus 65 pg dioxin TEQ/g). Although the Lower Passaic River does not support a cold water fishery, it is anticipated that some resident or migratory fauna components may exhibit early life stage sensitivities to dioxin-like compounds that are not much greater than salmonids species.

Table 22. Summary of Estimated Fish Egg Tissue Residue LC_{50} Benchmarks for Dioxin TEQs

Species	Estimated LC_{10} (μg/g)	LC_{50} (μg/g)	Reference
Salvelinus namaycush	0.000037	0.000065	Walker et al., 1991
Salvelinus fontinalis	0.000062	0.000138	Johnson et al., 1998
Oncorhynchus mykiss	-	0.000200	Walker et al., 1996
Fundulus heteroclitus	-	0.000250	Toomey et al., 2001
Pimephales promelas	0.000293	0.000539	Elonen et al., 1998
Ictalurus punctatus	0.000429	0.000644	Elonen et al., 1998
Coregonus artedii	0.000509	0.000902	Elonen et al., 1998
Oryzias latipes	0.000656	0.00111	Elonen et al., 1998
Catastomus commersoni	0.00159	0.00189	Elonen et al., 1998
Esox lucius	0.00153	0.00246	Elonen et al., 1998
Danio rerio	0.00161	0.00261	Elonen et al., 1998

In juvenile and adult fish, TCDD causes sublethal effects such as fin necrosis, lesion development, histopathological changes, enzyme induction, and immune suppression at concentrations that are ultimately lethal. TCDD is generally not toxic during standard acute test periods of 24 to 96 hours. Its adverse effects may not be seen until days, weeks, or months after exposure (USEPA, 1993a). Following exposure of fish eggs to TCDD, adverse effects were observed during the early life stages of development and included edema, hemorrhaging, and craniofacial malformations (Elonen et al., 1998). Table 23 summarizes the available fish tissue residue information in the ERED database for TCDD.

The ERED database query resulted in relatively few tissue effects data for fish eggs. MATC values range from 0.000044 to 0.0004 μg/g, with mortality and growth effects in fish embryos occurring over a similar range of effect concentrations. Interestingly, available data suggests that mummichog (the only non-freshwater species for which data are available) is only about an order

of magnitude less sensitive than lake trout to sublethal effects of early life stage exposure to TCDD.

Steevens et al. (2005) has recently developed several logistic regression models based on data derived from a comprehensive literature survey (covering most of the studies summarized above) of the effects of TCDD and dioxin-like PCBs on early life stage effects in fish. The benchmark value based on MATCs considered protective of 95% of all species is **0.00032 μg/g$_{lipid}$** (*i.e.*, on a lipid-normalized basis), with lower and upper 95% percent confidence intervals of 0.000088 and 0.00105 μg/g lipid, respectively. The regression model is highly significant ($p < 0.0001$; $F = 341$) (Steevens et al., 2005). The 95 percent value protective of non-lethal effects is only marginally lower than the similar value based on LC_{50} values (0.000386 μg/g lipid) due to the steep concentration-response function for this sensitive life stage.

Table 23. Summary of Estimated Fish Tissue Residue MATC Benchmarks for Dioxin TEQs

Effect	Freshwater		Saltwater	
	Taxon	**MATC (μg/g wet wt)**	**Taxon**	**MATC (μg/g wet wt)**
Mortality	*Salvelinus namaycush*	0.000044	*Fundulus*	0.0002
	S. fontinalis	0.00012		
	Oncorhynchus	0.00014		
Growth	*Salvelinus namaycush*	**0.000043**	*Fundulus*	0.0002

Invertebrates. There has been no convincing evidence that invertebrates possess the AhR receptor required for dioxin (and other compounds with similar toxicological properties) to exert its toxicological effect. Table 24 presents the limited residue effects data (with the exception of the oyster study) that were obtained from the ERED database.

The only literature result that identified both a NOAEL and LOAEL was a laboratory study with the crayfish species (*Pastifastacus leniusculus*) where 25 percent of individuals died in 40 days following injection of TCDD into the body cavity. The estimated MATC for lethal effects derived from this study is 0.00095 μg/g. A study conducted by researchers at Rutgers University provides the only residue data for a saltwater species, the eastern oyster; a concentration of 0.000002 μg/g (2 parts per trillion) resulted in a significant decrease in the percentage of eggs fertilized compared to the control. In addition, gonadal development was retarded relative to the control under both *in vivo* and *ex vivo* strip-spawning assays.

Table 24. Summary of Invertebrate Whole Body TCDD Residues Associated with Adverse Effects

Class/Species	NOAEL (µg/g)	LOAEL (µg/g)	Effect	Reference
Insecta				
Chironomus tentans	0.47	-	Growth	West et al., 1997
Chironomus tentans	0.47	-	Mortality	West et al., 1997
Crustacea				
Daphnia magna	2.08	-	Mortality	Isensee and Jones, 1975
Pastifastacus leniusculus	**0.0003**	**0.003**	Mortality (LC_{25})	Ashley et al., 1996
Mollusca				
Heliosoma sp.	0.0097	-	Mortality	Yockim et al., 1978
Physa sp.	1.02	-	Mortality	Isensee and Jones, 1975
Crassostrea virginica	-	**0.000002**	Egg fertilization rates reduced; impaired gonadal development	Wintermyer and Cooper, 2003

Other COPECs

Table 25 summarizes the compiled CBR data for the other COPECs for which tissue residue data are available (*i.e.*, copper, nickel, silver, tributyltin, zinc, PAHs, BEHP, chlordane, DDx, endosulfan, and endrin. Table 26 summarizes the screening CBR values for fish (including fish eggs where appropriate) and aquatic macroinvertebrate tissue.

Table 25. Summary of Derived Maximum Acceptable Toxicant Concentrations (MATCs) for Critical Body Residue Data for Selected COPECs

			Endpoint Category											
			Mortality				Growth/Development				Reproduction			
			Freshwater		Saltwater		Freshwater		Saltwater		Freshwater		Saltwater	
Reference	**COPEC**	**Receptor Category**	**Taxon**	**MATC**	**Taxon**	**MATC**	**Taxon**	**MATC**	**Taxon**	**MATC**	**Taxon**	**MATC**	**Taxon**	**MATC**
Table C-1; Chart C-1	Copper	Fish	*Oncorhynchus*	0.51	*Mugil*	0.47	***Ictalurus***	**0.0063**			*Cyprinus*	17.1		
			Nomacheilus	0.52			*Oncorhynchus*	0.44						
			Salvelinus	2.4										
			Cyprinus	10.1										
		# Taxa	4		1		2		0		1		0	
Chart C-2		Invertebrates	*Hyalella*	4.2	***Protothaca***	**0.27**	*Hydra*	1.3	*Mytilus*	3.7	*Hydra*	4.0		
			Chironomus	27.6	*Mysis*	1.9	*Daphnia*	1.8	*Allorchestes*	31	*Daphnia*	5.0		
					Mytilus	1.9	*Hyalella*	4.2						
					Soletellina	2.5	*Chironomus decorus*	15.3						
					Paracentrotus	3.4	*Dreissena*	16.7						
					Macoma	3.8	*Chironomus riparius*	69						
					Cirriformia	8.3								
					Mysella	15.5								
					Neanthes	17.1								
					Tellina	23.4								
		# Taxa	2		10		6		2		2		0	
Table C-5; Chart C-8	Nickel	Fish	***Cyprinus***	**37**										
		# Taxa												
Chart C-8		Invertebrates	***Hyalella***	**0.35**			*Hyalella*	0.36						
			Lamellidans	104										
			Cerastoderma	213										
		# Taxa	3		0		1		0		0		0	
Table C-6; Chart C-9	Silver	Fish	***Oncorhynchus***	**0.076**										
		# Taxa	1		0		0		0		0		0	
Chart C-10		Invertebrates	*Daphnia*	0.055			*Corbicula*	1149					***Acartia***	**0.006**
			Corbicula	2035									*Crepidula*	9.9
		# Taxa	2		0		1		0		0		2	

Table 25. Summary of Derived Maximum Acceptable Toxicant Concentrations (MATCs) for Critical Body Residue Data for Selected COPECs

			Endpoint Category											
			Mortality				Growth/Development				Reproduction			
			Freshwater		Saltwater		Freshwater		Saltwater		Freshwater		Saltwater	
Reference	COPEC	Receptor Category	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC
Table C-7; Chart C-11	Tributyltin	Fish	*Poecilia*	1.1							***Oryzias***	**0.097**		
		# Taxa	1		0		0		0		1		0	
Chart C-12		Invertebrates			*Neanthes*	0.0015			*Neanthes*	0.00065			***Neanthes***	**0.0003**
					Nucella	0.085			*Nucella*	0.0082			*Ilyanassa*	0.0089
					Ostrea	0.13			*Ostrea*	0.17			*Nucella*	0.019
					Rhepoxynus	1.9			*Venerupis decussata*	0.83			*Ostrea*	0.13
					Eohaustorius estuarius	2.2			*Venerupis semidecussata*	0.92			*Nassarius*	3.7
					Eohaustorius washingtonianus	2.9			*Mytilus*	1.2				
		# Taxa	0		6		0		6		0		5	
Table C-8; Chart C-13	Zinc	Fish	*Salvelinus*	4.2	*Mugil*	7.3	*Jordanella*	195			***Poecilia***	**0.28**		
			Jordanella	15.8										
		# Taxa	2		1		1		0		1		0	
Chart C-14		Invertebrates	*Hyalella*	6.2	*Haliotis*	8	*Chironomus*	11	*Mytilus*	7.9	***Acartia***	**0.41**		
			Orconectes	21.1	*Mytilus*	8.2	*Paracentrotus*	38.8	*Allorchestes*	8.9	*Daphnia*	3.5		
			Chironomus	58	*Allorchestes*	8.9	*Chironomus*	57						
			Dreissena	290	*Mysella*	9.5								
					Tellina	25								
					Soletellina	51								
					Paracentrotus	63								
					Nephytes	69								
					Thermisto abyssorum	301								
					Thermisto libellulum	301								
					Calanus	553								
		# Taxa	4		11		3		2		2		0	

Table 25. Summary of Derived Maximum Acceptable Toxicant Concentrations (MATCs) for Critical Body Residue Data for Selected COPECs

			Endpoint Category											
			Mortality				Growth/Development				Reproduction			
			Freshwater		Saltwater		Freshwater		Saltwater		Freshwater		Saltwater	
Reference	COPEC	Receptor Category	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC
Table C-9; Chart C-15	PAHs	Fish	*Oncorynchus*	3.9	*Psettichthys*	0.7	*Oncorhynchus*	3.9					***Psettichthys***	**0.7**
			Carassius	63										
		# Taxa	2		1		1		0		0		1	
Chart C-16		Invertebrates	*Hyalella*	0.18	*Rhepoxynus*	0.4	*Lumbriculus*	147	*Streblopsio*	0.07	*Lumbriculus*	12.2	***Mytilus***	**0.07**
			Chironomus	10.9	*Monopylephorus*	0.51			*Chloromytilus*	0.21	*Schizopera*	70	*Nereis*	0.25
			Diporeia	22.7	*Ampelisca*	7.3			*Nereis*	0.25	*Coullana*	179		
			Coullana	172	*Streblopsio*	23.1			*Capitella*	0.32				
			Schizopera	680	*Leptocheirus*	98								
		# Taxa	5		5		1		4		3		2	
Table C-10; Chart C-17	BEHP	Invertebrates	*Pacifasticus*	4.6							***Daphnia***	**2.0**		
			Gammarus	632										
		# Taxa	2		0		0		0		1		0	
Table C-11; Chart C-18	Chlordane	Fish			***Cyprinodon***	**0.0032**							*Cyprinodon*	2.1
					Leiostomus	0.04								
					Lagodon	5.2								
		# Taxa	0		3		0		0		0		1	
Chart C-19		Invertebrates			*Penaeus*	1.1			***Crassostrea***	**0.0063**				
					Palaemonetes	1.4								
		# Taxa	0		2		0		1		0		0	
Table C-12; Chart C-20	DDx	Fish	***Oryzias***	**0.0003**	*Oncorhynchus tshawytscha*	5.1	*Oncorhynchus*	0.038			*Oncorhynchus*	0.057	*Fundulus*	0.37
			Salvelinus namaycush	0.092	*Oncorhynchus kisutch*	31	*Salvelinus*	6.2			*Pimephales*	0.19		
			Salvelinus fontinalis	0.49			*Poecilia*	58			*Salvelinus*	0.92		
			Lepomis	7.6										
			Pimephales	13										
			Poecilia	58										
		# Taxa	6		2		3		0		3		1	
Chart C-21		Invertebrates	***Hyalella***	**0.0006**	*Callinectes*	0.36	*Lumbriculus*	56	*Callinectes*	0.26				
			Diporeia	0.0019	*Leptocheirus*	1.0								
			Lumbriculus	56										
		# Taxa	3		2		1		1		0		0	

Table 25. Summary of Derived Maximum Acceptable Toxicant Concentrations (MATCs) for Critical Body Residue Data for Selected COPECs

			Endpoint Category											
			Mortality				Growth/Development				Reproduction			
			Freshwater		Saltwater		Freshwater		Saltwater		Freshwater		Saltwater	
Reference	COPEC	Receptor Category	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC	Taxon	MATC
Table C-15; Chart C-25	Endosulfan	Fish	***Clarias gariepinus***	**0.022**	*Leiostomus*	0.01								
			Clarias ngamensis	0.022	*Mugil*	0.11								
			Pseudocreni-labrus	0.46	*Lagodon*	0.23								
		# Taxa	3		3		0		0		0		0	
Chart C-26		Invertebrates			***Penaeus***	**0.0032**								
					Palaemonetes	0.025								
		# Taxa	0		2		0		0		0		0	
Table C-16; Chart C-27	Endrin	Fish	***Micropterus***	**0.0036**	*Cyprinodon*	0.019	*Oncorhynchus*	0.16					*Cyprinodon*	0.49
			Pimephales	0.076										
			Ictalurus punctatus	0.095										
			Lepomis	0.15										
			Poecilia	0.25										
			Notemigonus	0.31										
			Ictalurus melas	0.51										
			Gambusia	1.8										
		# Taxa	8		1		1		0		0		1	
Chart C-28		Invertebrates	*Pteronarcys*	0.022	***Penaeus***	**0.0032**	*Limnodrilus*	41	*Palaeomonetes*	0.063			*Palaeomonetes*	0.016
			Limnodrilus	41	*Palaemonetes*	0.0063	*Stylodrilus*	49	*Crassostrea*	1.8			*Crassostrea*	0.12
			Stylodrilus	49	*Crassostrea*	2.1								
		# Taxa	3		3		2		2		0		2	

Bolded species and MATC values were selected to conduct the tissue residue screening in the BERA

Table 26. Summary of Screening CBRs for Fish and Aquatic Invertebrate Tissue Based on MATCs

COPEC	Fish Receptors		Aquatic Invertebrates	
	Species	MATC (µg/g wet wt)	Species	MATC (µg/g wet wt)
Copper	*Ictalurus*	0.0063	*Protothaca*	0.27
Lead	*Oncorhynchus*	0.088	*Hyalella*	1.7
Mercury	*Ictalurus*	0.019	zooplankton	0.013
Methymercury	*Fundulus* (eggs)	0.0032	NA	-
Nickel	*Cyprinus*	37	*Hyallela*	0.35
Silver	*Oncorhynchus*	0.076	*Acartia*	0.006
Tributyltin	*Oryzias*	0.097	*Neanthes*	0.0003
Zinc	*Poecilia*	0.28	*Acartia*	0.41
Total PAHs	*Psettichthys*	0.7	*Mytilus*	0.07
BEHP	NA	-	*Daphnia*	2.0
Chlordane	*Cyprinodon*	0.0032	*Crassostrea*	0.0063
DDx[a]	*Oryzias*	0.00026	*Hyallela*	0.00058
Dieldrin/Aldrin	*Oncorhynchus*	0.035	*Penaeus*	0.028
Endosulfan	*Clarias*	0.022	*Penaeus*	0.0032
Endrin	*Micropterus*	0.0036	*Penaeus*	0.0032
Total PCBs	*Oryzias* (eggs)	0.0079	*Palaemonetes*	0.68
TCDD	*Salvelinus* (eggs)	0.000043	*Crassostrea*	0.000002

Notes: NA – not available
The primary COPECs for which exposure-based TRVs were developed in this memorandum are shaded.
a. Indicates a combination of the DDD, DDE, and DDT isomers.

IV. Biomagnification Factors for Estimating Body Residues for Ecological Receptors

It is anticipated that current exposures to wildlife receptors will be quantified using measured analytical data specific to each of the evaluated exposure pathways (*e.g.*, incidental sediment ingestion, consumption of drinking water, consumption of contaminated prey items). In order to minimize exposure uncertainties, wildlife exposures in the BERA will be quantified to the extent possible[5] using COPEC concentrations measured in surface water, sediment, and prey tissue data (including forage fish and macroinvertebrates). As a result, uptake factors between abiotic media and prey tissue will not be required to conduct the exposure-based dose analysis for wildlife receptors[6].

A residue-based analysis will also be conducted as an additional line of evidence to evaluate the impacts of bioaccumulative compounds (*e.g.*, pesticides, PCBs, TCDD) on early life stages of sensitive organisms such as fish, birds, and mink. These COPECs have properties (are long-

[5] It is planned that analytical requirements (including analytical parameters, sample numbers and sampling locations) for additional data needs will be finalized as part of ongoing DQO process and will be incorporated into the Field Sampling Plan for the Lower Passaic River.
[6] HydroQual will be identifying a set of uptake factors for the modeled analytes to estimate contaminant concentrations in prey tissue; their modeling results will be validated using the measured tissue data that is collected to support the BERA.

lived, mobile, soluble in lipids, and biologically active) that enable them to biomagnify up the food chain, meaning they increase in concentration from one trophic level to the next. Therefore, concentrations in upper-trophic level receptors are quantified through biomagnification factors (BMFs). This approach presents a number of advantages including reduced sampling and analytical cost, the avoidance of methodological problems associated with quantifying concentrations in small samples, as well as not placing additional burden on already stressed populations such as the kingfisher or mink. For each selected bioaccumulative COPEC, three specific BMFs will be necessary to fully implement the residue-based analysis for the LPRRP:

- BMF based on the ratio of the concentration in fish eggs to measured tissue residue in adult female fish (female-to-ova transfer factor);
- BMF based on the ratio of concentrations in bird eggs to measured prey tissue concentrations in adult prey fish tissue (diet-to-egg transfer factor); and,
- BMF based on the ratio of the concentration in sensitive adult mammals (*e.g.*, mink) to measured concentrations in their diet (diet-to-tissue factor).

For fish, the BMF will be used to estimate egg tissue concentrations of TCDD from maternal transfer. For birds, a BMF will be used to determine egg tissue concentrations of TCDD, total PCBs, and pesticides (*e.g.*, DDx, dieldrin) from maternal exposure. For mink, a BMF will be used to estimate the body burden of dioxins and dioxin-like compounds (TCDD and PCBs) from measured concentrations in fish (their diet).

Fish Egg. A BMF for the transfer of TCDD between gravid fish and ova of 0.37 (lipid basis) will be used in the BERA to estimate egg tissue concentrations (Cook, 2002)[7]. The estimated concentrations will be compared to the information presented in Tables 22 and 23 to characterize the likelihood of early life stage effects in fish populations.

Bird Egg. Braune and Norstrom (1989) present data on uptake of various bioaccumulative COPECs (including various pesticides and individual PCB, dioxin, and furan congeners) by herring gulls (*Larus argentatus*) from their food (herring) and subsequent transfer to their eggs (Table 27). The BMF for TCDD, calculated using the Braune and Norstrom (1989) herring gull data, is in agreement with a separate study by Kubiak et al. (1989) who derived a BMF for the Forster's Tern (also diet-to-egg transfer). The Braune and Norstrom study results will be used to estimate piscivorous bird egg concentrations, which will be compared to the selected avian egg CBRs to characterize risk associated with this measurement endpoint.

[7] Cook, P.M. 2002. Personal communication with Battelle risk assessor Norman Richardson.

Table 27. Summary of Diet-to-Egg BMFs[a] for Adult Piscivorous Birds

COPEC	Receptor	Fish Tissue (µg/g wet wt)	Egg Tissue (µg/g wet wt)	BMF	Reference
Dieldrin	Herring Gull	0.017	0.12	7.1	Braune and Norstrom, 1989
Total PCBs	Herring Gull	0.505	16	31.7	Braune and Norstrom, 1989
TCDD	Herring Gull	0.000004	0.000083	20.8 ± 6	Braune and Norstrom,1989
TCDD	Forster's Tern	-	-	37 ± 13	Kubiak et al., 1989
COPEC	**Receptor**	**Lipid normalized fish tissue[a] ($\mu g/g_{lipid}$)**	**Lipid normalized egg tissue[b] ($\mu g/g_{lipid}$)**	**BMF**	**Reference**
Dieldrin	Herring Gull	0.61	1.6	**2.6**	Braune and Norstrom,1989
Total PCBs	Herring Gull	18	208	**11.5**	Braune and Norstrom,1989
TCDD	Herring Gull	0.00014	0.0011	**7.5**	Braune and Norstrom,1989

a. BMFs are presented on both a wet-weight and a lipid-normalized basis to facilitate comparison with historical information; however, it is proposed that the lipid-normalized BMFs be used to estimate bird egg tissue concentrations so as to incorporate available site-specific bioavailability data (*i.e.*, lipid content of bird egg and fish prey).

b. Estimated based on reported percent lipid 2.8 and 7.7 percent for fish and gull eggs, respectively (Braune and Norstrom,1989)

Mammal Tissue. Studies on the uptake of contaminants with dioxin-like properties (TCDD and PCBs) from diet to mammal (specifically mustelid) tissue have been conducted by various researchers (Tillet et al., 1996; Leaonard et al., 1997) (Table 28). The Tillet et al. (1996) study evaluated uptake to mink liver from fish diet and related liver concentrations to adverse reproductive effects. Over the range of liver tissue concentrations of 21-50 pg/g_{lipid} there was a significant decrease in the number of live kits whelped per female. These findings will be used to estimate mink body (liver) residues, which will then be compared to concentration response data.

Table 28. Summary of Diet-to-Liver BMFs for Adult Piscivorous Mammals

COPEC	Receptor	Fish Tissue ($\mu g/g_{lipid}$)	Liver Tissue ($\mu g/g_{lipid}$)	BMF	Reference
TCDD	Mink	0.000002	0.000021	10.5	Tillet et al., 1996
TCDD	Mink	0.000007	0.000050	7.1	Tillet et al., 1996
Total PCBs	Otter	-	-	14	Leonards et al., 1997
TEQs	Otter	0.00011[a]	0.014[a]	129	Leonards et al., 1997

a. Fish concentration is an average of the TEQs measured in three pike samples; otter liver concentration is an average of five specimens as reported in Table 1 of Leonards et al. (1997)

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APPENDIX A
HUMAN HEALTH TOXICITY DATA

Table A-1. Summary of Toxcity Data for Chemicals of Potential Concern for the Human Health Risk Assessment as Identified in the Lower Passaic River Restoration Project Pathways Analysis Report dated May 2005

	Toxicity Data																
	CSFo		RfDo		CSFd [1]	RfDd [1]	CSFi		RfDi		URF[2]		RfC[2]		ABS_{GI} [3]	ABS_d	
CHEMICAL	1/(mg/kg-d)		(mg/kg-d)		1/(mg/kg-d)	(mg/kg-d)	1/(mg/kg-d)		(mg/kg-d)		1/(µg/m^3)		(mg/m^3)		unitless	unitless	
1,4-Dichlorobenzene	2.4E-02	h	3.0E-02	n	2.4E-02	3.0E-02	2.2E-02	n	2.3E-01	i	6E-06	n	8.1E-01	i	1	0.1	e
2,4-Dichlorophenol	NA		3.0E-03	i	NA	3.0E-03	NA		3.0E-03	r	NA		1.1E-02	r	1	0.1	e
2,4-Dinitrotoluene	NA		2.0E-03	i	NA	2.0E-03	NA		2.0E-03	r	NA		7.0E-03	r	1	0.1	e
4-Methyl phenol	NA		5.0E-03	h	NA	5.0E-03	NA		5.0E-03	r	NA		1.8E-02	r	1	0.1	e
1-Methylnapthalene	NA		7.0E-02	a	NA	7.0E-02	NA		NA		NA		NA		1	0.13	e
2,3,7,8-TCDD	1.50E+05	h	NA		1.50E+05	NA	1.50E+05	h	NA		42.9	h	NA		1	0.03	e
2-Methylnaphthalene	NA		4E-03	i	NA	4.0E-03	NA		NA		NA		NA		1	0.13	e
Acenaphthene	NA		6.0E-02	i	NA	6.0E-02	NA		6.0E-02	r	NA		2.1E-01	r	1	0.13	e
Acenaphthylene	NA		6.0E-02	t	NA	6.0E-02	NA		NA		NA		NA		1	0.13	e
Aldrin	1.7E+01	i	3.0E-05	i	1.7E+01	3.0E-05	1.7E+01	i	3.0E-05	r	4.9E-03	i	1.1E-04	r	1	0.1	e
Aluminum	NA		1.0E+00	p	NA	1.0E+00	NA		1.4E-03	p	NA		4.9E-03	p	1		
Antimony and compounds	NA		4.0E-04	i	NA	6.0E-05	NA		NA		NA		NA		0.15		
Arsenic	1.5E+00	i	3.0E-04	i	1.5E+00	3.0E-04	1.5E+01	i	NA		4E-03	i	NA		1	0.03	e
Barium and compounds	NA		2.0E-01	i	NA	4.9E-03	NA		1.4E-04	h	NA		5.0E-04	h	0.07		
Benz[a]anthracene	7.3E-01	n	NA		7.3E-01	NA	7.3E-01	r	NA		2.1E-04	r	NA		1	0.13	e
Benzene	5.5E-02	i	4.0E-03	i	5.5E-02	4.0E-03	2.7E-02	i	8.6E-03	i	7.7E-06	i	3.0E-02	i	1		
Benzo(e)pyrene	NA		3.0E-02	t	NA	3.0E-02	NA		NA		NA		NA		1	0.13	e
Benzo(g,h,i)perylene	NA		3.0E-02	t	NA	3.0E-02	NA		NA		NA		NA		1	0.13	e
Benzo[a]pyrene	7.3E+00	i	NA		7.3E+00	NA	7.3E+00	r	NA		2E-03	r	NA		1	0.13	e
Benzo[b]fluoranthene	7.3E-01	n	NA		7.3E-01	NA	7.3E-01	r	NA		2E-04	r	NA		1	0.13	e
Benzo[k]fluoranthene	7.3E-02	n	NA		7.3E-02	NA	7.3E-02	r	NA		2E-05	r	NA		1	0.13	e
Beryllium and compounds	NA		2.0E-03	i	NA	1.4E-05	8.4E+00	i	5.7E-06	i	2E-03	i	2.0E-05	i	0.007		
Bis(2-ethylhexyl)phthalate	1.4E-02	i	2.0E-02	i	1.4E-02	2.0E-02	1.4E-02	r	2.0E-02	r	4E-06	r	7.0E-02	r	1	0.1	e
Butylbenzylphthalate	NA		2.0E-01	i	NA	2.0E-01	NA		2.0E-01	r	NA		7.0E-01	r	1	0.1	e
Cadmium and compounds (water)	NA		5.0E-04	i	NA	2.5E-05	6.3E+00	i	NA		2E-03	i	NA		0.05	0.001	e
Cadmium and compounds (food)	NA		1.0E-03	i	NA	2.5E-05	6.3E+00	i	NA		2E-03	i	NA		0.025	0.001	e
Chromium III (total chromium)	NA		1.5E+00	i	NA	2.0E-02	NA		NA		NA		NA		0.013		
Chromium VI	NA		3.0E-03	i	NA	7.5E-05	4.1E+01	i	3.0E-05	i	1E-02	i	1.0E-04	i	0.025		
Chrysene	7.3E-03	n	NA		7.3E-03	NA	7.3E-03	r	NA		2E-06	r	NA		1	0.13	e
Copper and compounds	NA		4.0E-02	h	NA	4.0E-02	NA		NA		NA		NA		1		
DDD	2.4E-01	i	NA		2.4E-01	NA	2.4E-01	r	NA		7E-05	r	NA		1	0.1	e
DDE	3.4E-01	i	NA		NA	NA	3.4E-01	r	NA		1E-04	r	NA		1	0.1	e
DDT	3.4E-01	i	5.0E-04	i	3.4E-01	5.0E-04	3.4E-01	i	5.0E-04	r	1E-04	i	1.8E-03	r	1	0.03	e
Dibenz[ah]anthracene	7.3E+00	n	NA		7.3E+00	NA	7.3E+00	r	NA		2E-03	r			1	0.13	e
Dibenzofuran	NA		2.0E-03	n	NA	2.0E-03	NA		2.0E-03	r	NA		7.0E-03	r	1		
Dibenzothiophene	NA		3.0E-03	t	NA	3.0E-03	NA		NA		NA				1		
Dieldrin	1.6E+01	i	5.0E-05	i	1.6E+01	5.0E-05	1.6E+01	i	5.0E-05	r	5E-03	i	1.8E-04	r	1	0.1	e
Endrin	NA		3.0E-04	i	NA	3.0E-04	NA		3.0E-04	r	NA		1.1E-03	r	1	0.1	e
Fluoranthene	NA		4.0E-02	i	NA	4.0E-02	NA		4.0E-02	r	NA		1.4E-01	r	1	0.1	e
Indeno[1,2,3-cd]pyrene	7.3E-01	n	NA		7.3E-01	NA	7.3E-01	r	NA		2.1E-04	r	NA		1	0.13	e
Iron	NA		3.0E-01	n	NA	3.0E-01	NA		NA		NA		NA		1		
Isophorone	9.5E-04	i	2.0E-01	i	9.5E-04	2.0E-01	9.5E-04	r	2.0E-01	r	3E-07	r	7.0E-01	r	1		
Manganese and compounds	NA		1.4E-01	i	NA	5.6E-03	NA		1.4E-05	i	NA		5.0E-05	i	0.04		
Mercury and compounds	NA		3.0E-04	i	NA	2.1E-05	NA		NA		NA		NA		0.07		
Methyl mercury	NA		1.0E-04	i	NA	1.0E-04	NA		NA		NA		NA		1		
Naphthalene	NA		2.0E-02	i	NA	2.0E-02	NA		8.6E-04	i	NA		3.0E-03	i	1		
Nickel (soluble salts)	NA		2.0E-02	i	NA	8.0E-04	NA		NA		NA		NA		0.04		
PCBs (unspeciated mixture, high risk, e.g. Aroclor 1254)	2.0E+00	i	2.0E-05	i	2.0E+00	2.0E-05	2.0E+00	i	2.0E-05	r	5.7E-04	i	7.0E-05	r	1	0.14	e
PCBs (unspeciated mixture, low risk, e.g. Aroclor 1016)	7.0E-02	i	7.0E-05	i	7.0E-02	7.0E-05	7.0E-02	i	7.0E-05	r	1.0E-04	i	2.5E-04	r	1	0.14	e
Perylene	NA		2.0E-02	t	NA	2.0E-02	NA		NA		NA		NA		1	0.13	e
Phenanthrene	NA		3.0E-02	t	NA	3.0E-02	NA		NA		NA		NA		1	0.13	e
Pyrene	NA		3.0E-02	i	NA	3.0E-02	NA		3.0E-02	r	NA		1.1E-01	r	1	0.13	e
Selenium	NA		5.0E-03	i	NA	5.0E-03	NA		NA		NA		NA		1	NA	
Silver and compounds	NA		5.0E-03	i	NA	2.0E-04	NA		NA		NA		NA		0.04	NA	
Technical Chlordane	3.50E-01	i	5.0E-04	i	NA	5.0E-04	3.5E-01	i	2.0E-04	i	1.0E-04	i	7.0E-04	i	1	0.04	e
Thallium and compounds	NA		6.6E-05	i	NA	6.6E-05	NA		NA		NA		NA		1	NA	
Vanadium and compounds	NA		1.0E-03	n2	NA	2.6E-05	NA		NA		NA		NA		0.026	NA	
Zinc	NA		3.0E-01	i	NA	3.0E-01	NA		NA		NA		NA		1	NA	
TPH - aliphatic high	NA		2.0E+00	f	NA	1.6E+00	NA		NA		NA		NA		0.8	0.01	f
TPH - aliphatic low	NA		6.0E-02	f	NA	4.8E-02	NA		5.7E-02	f	NA		2.0E-01	f	0.8	0.01	f
TPH - aliphatic medium	NA		1.0E-01	f	NA	8.0E-02	NA		2.9E-01	f	NA		1.0E+00	f	0.8	0.01	f
TPH - aromatic high	NA		3.0E-02	f	NA	2.4E-02	NA		NA		NA		NA		0.8	0.01	f
TPH - aromatic low	NA		2.0E-01	f	NA	1.6E-01	NA		1.1E-01	f	NA		4.0E-01	f	0.8	0.01	f
TPH - aromatic medium	NA		2.0E-02	f	NA	1.6E-02	NA		5.7E-02	f	NA		2.0E-01	f	0.8	0.01	f

Note:

CSFo = Cancer Slope Factor oral
CSFd = Cancer Slope Factor dermal
CSFi = Cancer Slope Factor inhalation
RfDo = Reference Dose oral
RfDd = Reference Dose dermal
NA = toxicity value not available

RfDi = Reference Dose inhalation
URF = Unit Risk Factor
RfC = Reference Concentration
ABS_{GI} = Gastrointestinal absorption factor
ABSd = Dermal absorption factor

IRIS = USEPA's Integrated Risk Information System
NCEA = USEPA's National Center for Environmental Assessment
HEAST = USEPA's Health Effects Assessment Summary Tables
ATSDR = Department of Health and Human Services Agency for Toxic Substances and Disease Registry

i = IRIS value obtained EPA website (http://www.epa.gov/iris/subst/index.html)

p = PPRTV value obtained from October 2004 Region IX Preliminary Remediation Goal (PRG) Table (http://www.epa.gov/region09/waste/sfund/prg/files/prgtable2004.xls). Note that the USEPA Region 3 RBC table was consulted but did not provide a value. These values are listed for presentation but are subject to USEPA Region 2 approval.

n = NCEA value, obtained from USEPA Region 3 Risk-Based Concentration (RBC) Table (http://www.epa.gov/reg3hwmd/risk/human/index.htm).

n2 = NCEA value, obtained from Region IX Preliminary Remediation Goal (PRG) Table (http://www.epa.gov/region09/waste/sfund/prg/files/prgtable2004.xls). **This value is subject to USEPA Region 2 approval.**

h = USEPA. 1997. Health Effects Assessment Summary Tables FY-1997 Update. Solid Waste and Emergency Response. EPA-540-R-97-036.

r = Route-Extrapolation value, obtained from Region IX Preliminary Remediation Goal (PRG) Table (http://www.epa.gov/region09/waste/sfund/prg/files/prgtable2004.xls). T**hese values were listed for presentation but are subject to USEPA Region 2 approval.**

a = Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRL) December 2005 (http://www.atsdr.cdc.gov/mrllist_12_05.pdf).

e = USEPA value obtained from Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Exhibit 3-4. Page 3-16

f - value obtained from the Risk Assessment Information System (http://risk.lsd.ornl.gov/cgi-bin/tox/TOX_9801) and PPRTV Derivation Support Document for Total Petroleum Hydrocarbons (SRC SF 01-031/10-16-2002)

t=Texas Natural Resources Conservation Committee (TNRCC) (http://www.tceq.state.tx.us/assets/public/remediation/rrr/rrrtoxchph.xls). T**hese values are listed for presentaiton but are subject to USEPA Region 2 approval.**

(1) The values were calculated as follows: CSFd (=CSF_0/ABS_{GI}) and RFDd(=RFDo*ABS_{GI})

(2) The URF and RfC values were converted to CSFi and RFDi values consistent with USEPA guidance based on standard parameters for the inhalation rate of 20m ^{3}/day and body weight of 70 kg.

(3) USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Exhibit 4-1.Page 4-2,4-5

List of Compounds for which no toxicity values were found:

Dibutyltin
Monobutyltin
Tetrabutyltin
1-Methylphenanthrene
2,3,5-Trimethylnapthalene
2,6-Dimethylnapthalene

APPENDIX B
TRV DATA

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Aldrin	Rat	diet	0.2	mg/kg/day	NOAEL	3 generations		Treon and Cleveland, 1955
Aldrin	Rat	diet	1	mg/kg/day	LOAEL	3 generations	reproduction	Treon and Cleveland, 1955
Aldrin	Dog	diet	0.04-0.09	mg/kg/day	NOAEL	15.7 months		Treon et al. 1955
Aldrin	Dog	diet	0.12-0.25	mg/kg/day	LOAEL	15.7 months	hepatic - hyaline droplet degeneration	Treon et al. 1955
Aldrin	Rat	diet	0.1	mg/kg/day	NOAEL	2 years		Fitzhugh et al., 1964; Reuber 1980
Aldrin	Rat	diet	2.5	mg/kg/day	LOAEL	2 years	bladder distension and hemorrhages	Fitzhugh et al., 1964; Reuber 1980
Aldrin	Rat	diet	0.025	mg/kg/day	LOAEL	2 years	hepatocellular enlargement and vacuolation, bile duct proliferation	Fitzhugh et al., 1964; Reuber 1980
Aldrin	Rat		0.1	mg/kg/day	NOAEL		neurobehavioral	Paul et al., 1992
Aldrin	Rat		1	mg/kg/day	LOAEL		neurobehavioral	Paul et al., 1992
Chlordane	Rat	diet	0.055	mg/kg/day	NOAEL	30 months		Velsicol Chemical Co.1983a; Khasawinah and Grutsch 1989a
Chlordane	Rat	diet	0.273	mg/kg/day	LOAEL	30 months	hepatocellular hypertrophy in females	Velsicol Chemical Co.1983a; Khasawinah and Grutsch 1989a
Chlordane	Rat	diet	2	mg/kg/day	NOAEL	407 days		Ambrose et al., 1953
Chlordane	Rat	diet	4	mg/kg/day	LOAEL	407 days	significant increase in liver weight, liver cell inclusion bodies, and liver cell hypertrophy	Ambrose et al., 1953
Chlordane	Mouse	diet	0.1	mg/kg/day	NOAEL	24 months		Veliscol Chemical Co. 1983b; Khasawinah and Grutsch 1989b
Chlordane	Mouse	diet	0.47	mg/kg/day	LOAEL	24 months	hepatocellular hypertrophy, fatty degeneration and necrosis in males; hepatocellular hypertorphy in females	Veliscol Chemical Co. 1983b; Khasawinah and Grutsch 1989b
Chlordane	Rat	diet	6	mg/kg/day	NOAEL	80 weeks		NCI, 1977
Chlordane	Rat	diet	12.1	mg/kg/day	LOAEL	80 weeks	tremors in females	NCI, 1977
Chlordane	Mouse	diet	3.9	mg/kg/day	NOAEL	80 weeks		NCI, 1977
Chlordane	Mouse	diet	8.3	mg/kg/day	LOAEL	80 weeks	tremors in females	NCI, 1977
Chlordane	Mouse	diet	3.9	mg/kg/day	NOAEL	80 weeks		NCI 1977
Chlordane	Mouse	diet	7.3	mg/kg/day	LOAEL	80 weeks	tremors in males	NCI 1977
Chlordane	Red-winged blackbird	diet	2.14	mg/kg/day	NOAEL	84 days		Stickel et al., 1983
Chlordane	Red-winged blackbird	diet	10.7	mg/kg/day	LOAEL	84 days	mortality	Stickel et al., 1983
Chlordane	Mouse	diet	4.6	mg/kg/day	NOAEL	6 generations		WHO, 1984
Chlordane	Mouse	diet	9.2	mg/kg/day	LOAEL	6 generations	reproduction	WHO, 1984
Chlordane	Rat	gavage	4	mg/kg	NOAEL	gestational days 6-19	dam mortality and convulsions	St. Omer et al., 2001
Chlordane	Rat	gavage	0.25	mg/kg	NOAEL	gestational days 6-19	gestational weight gain	St. Omer et al., 2001
Chlordane	Rat	gavage	2	mg/kg	LOAEL	gestational days 6-19	spleen/body weight ratio	St. Omer et al., 2001
Chlordane	Rat	gavage	8	mg/kg	LOAEL	gestational days 6-19	convulsions; thymic atrophy	St. Omer et al., 2001
Dieldrin	Barn Owl	diet	0.077	mg/kg/day	NOAEL	2 years	slight reduction in eggshell thickness	Mendenhall et al., 1983
Dieldrin	Rat	diet	0.02	mg/kg/day	NOAEL	3 generations		Treon and Cleveland, 1955
Dieldrin	Rat	diet	0.2	mg/kg/day	LOAEL	3 generations	reduced number of pregnancies	Treon and Cleveland, 1955
Dieldrin	Rat	diet	0.5	mg/kg/day	NOAEL	2 years		Fitzhugh et al., 1964; Reuber, 1980

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Dieldrin	Rat	diet	5	mg/kg/day	LOAEL	2 years	bladder distension and hemorrhages	Fitzhugh et al., 1964; Reuber, 1980
Dieldrin	Rat	diet	0.5	mg/kg/day	NOAEL	104-105 weeks		NCI, 1978
Dieldrin	Rat	diet	2.5	mg/kg/day	LOAEL	104-105 weeks	convulsions	NCI, 1978
Dieldrin	Rat	diet	0.05	mg/kg/day	NOAEL	2 years		Walker et al, 1969
Dieldrin	Rat	diet	0.5	mg/kg/day	LOAEL	2 years	tremors and occasional convulsions	Walker et al, 1969
Dieldrin	Rat	diet	0.005	mg/kg/day	NOAEL	2 years		Walker et al., 1969
Dieldrin	Rat	diet	0.05	mg/kg/day	LOAEL	2 years	increased absolute and relative liver weights	Walker et al., 1969
Dieldrin	Avian	NA	0.0709	mg/kg/day	NOAEL		derived TRV	EPA, 2005
Dieldrin	Mammal	NA	0.015	mg/kg/day	NOAEL		derived TRV	EPA, 2005
DDT	Brown Pelican	diet	0.003	mg/kg/day	NOAEL	5 years		Anderson et al., 1975
DDT	Brown Pelican	diet	0.03	mg/kg/day	LOAEL	5 years	reproductive	Anderson et al., 1975
DDT	Rat	diet	0.05	mg/kg/day	NOAEL	2 years		Fitzhugh 1948
DDT	Rat	diet	0.5	mg/kg/day	LOAEL	2 years	reproductive	Fitzhugh 1948
DDT	Rat	diet	0.05	mg/kg/day	NOAEL	15-27 weeks		Laug et al. 1950
DDT	Rat	diet	0.25	mg/kg/day	LOAEL	15-27 weeks	hepatocellular hypertrophy; liver lesions	Laug et al. 1950
DDT	Rat		0.8	mg/kg/day	NOAEL			
DDT	Rat		16	mg/kg/day	LOAEL		reproductive	USEPA (Great Lakes) 1995
DDT	Pelican		0.009	mg/kg/day	NOAEL		reproductive	USEPA (Great Lakes) 1995
DDT	Mallard		1.5	mg/kg/day	LOAEL		reproductive	USEPA (Great Lakes) 1995
DDT	Rat	diet	0.05	mg/kg/day	NOAEL	15-27 weeks		Laug et al., 1950
DDT	Rat	diet	0.25	mg/kg/day	LOAEL	15-27 weeks	cellular hypertrophy, cytoplasmic eosinophilia	Laug et al., 1950
DDT	Rat	diet	6	mg/kg/day	NOAEL	36 weeks		Jonsson et al., 1976
DDT	Rat	diet	12	mg/kg/day	LOAEL	36 weeks	sterility	Jonsson et al., 1976
DDT	Rat (gestation and lactation)	diet	1.7	mg/kg/day	NOAEL	42 days		Clement and Okey, 1974
DDT	Rat (gestation and lactation)	diet	42.1	mg/kg/day	LOAEL	42 days	pup death by ten days	Clement and Okey, 1974
DDT	Hamster	diet	20	mg/kg/day	NOAEL	lifetime		Cabral et al., 1982
DDT	Hamster	diet	40	mg/kg/day	LOAEL	lifetime	focal necrosis	Cabral et al., 1982
DDT	Dog	diet	16	mg/kg/day	NOAEL	39-40 months		Lehman 1965
DDT	Dog	diet	160	mg/kg/day	LOAEL	39-40 months	severe liver damage	Lehman 1965
DDT	Mouse	diet	1.7	mg/kg/day	NOAEL	130-140 weeks		Turusov et al., 1973
DDT	Mouse	diet	8.3	mg/kg/day	LOAEL	130-140 weeks	tremors	Turusov et al., 1973
DDT	Mouse	diet	10	mg/kg/day	NOAEL	2 generations		Tomatis et al., 1972
DDT	Mouse	diet	50	mg/kg/day	LOAEL	2 generations	increased preweanling death	Tomatis et al., 1972
DDT	Mouse	diet	8.3	mg/kg/day	NOAEL	lifetime		Turusov et al., 1973
DDT	Mouse	diet	41.3	mg/kg/day	LOAEL	lifetime	increased preweanling death	Turusov et al., 1973
Endrin	Dog	diet	0.025	mg/kg/day	NOAEL	2 years		Velsicol Chemical Corporation, 1969
Endrin	Dog	diet	0.05	mg/kg/day	LOAEL	2 years	increased liver weight; convulsions; histopathological liver effects	Velsicol Chemical Corporation, 1969
Endrin	Screech owl	diet	0.01	mg/kg/day	NOAEL	>83 days		Fleming et al., 1982
Endrin	Screech owl	diet	0.1	mg/kg/day	LOAEL	>83 days	reproductive	Fleming et al., 1982
Endrin	Mouse	diet	0.092	mg/kg/day	NOAEL	120 days		Good and Ware, 1969
Endrin	Mouse	diet	0.92	mg/kg/day	LOAEL	120 days	reproductive	Good and Ware, 1969
Endrin	Beagle dog	diet	0.15	mg/kg/day	NOAEL	18 d - 9.9 months		Treon et al, 1955
Endrin	Beagle dog	diet	0.2	mg/kg/day	LOAEL	18 d - 9.9 months	convulsions, tremors, diffuse degenerative brain lesions	Treon et al, 1955

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Endrin	Rat	diet	0.25	mg/kg/day	NOAEL	2 years		Treon et al., 1955
Endrin	Rat	diet	1.25	mg/kg/day	LOAEL	2 years	degeneration of liver, adrenal glands, and kidneys	Treon et al., 1955
Endrin	Beagle dog	diet	0.025	mg/kg/day	NOAEL	2 years		Kettering Laboratory, 1969
Endrin	Beagle dog	diet	0.05	mg/kg/day	LOAEL	2 years	hepatic cell vacuolation, increased liver weight	Kettering Laboratory, 1969
Endrin	Rat	diet	0.25	mg/kg/day	NOAEL	2 years		Treon et al., 1955
Endrin	Rat	diet	1.25	mg/kg/day	LOAEL	2 years	diffuse degeneration of brain	Treon et al., 1955
Endrin	Beagle dog	diet	0.025	mg/kg/day	NOAEL	2 years		Kettering Laboratory, 1969
Endrin	Beagle dog	diet	0.05	mg/kg/day	LOAEL	2 years	convulsions	Kettering Laboratory, 1969
Endosulfan	Rat	diet	0.15	mg/kg/day	NOAEL	30 days		Dikshith et al., 1984
Endosulfan	Gray partridge	diet	10	mg/kg/day	NOAEL	4 weeks		Abiola 1992
Copper	Mink	diet	11.7	mg/kg/day	NOAEL	357 days		Aulerich et al., 1982
Copper	Mink	diet	15.14	mg/kg/day	LOAEL	357 days	mortality of kits	Aulerich et al., 1982
Copper	1 day old chicks	diet	47	mg/kg/day	NOAEL	10 weeks		Mehring et al., 1960
Copper	1 day old chicks	diet	61.7	mg/kg/day	LOAEL	10 weeks	reduced growth, mortality	Mehring et al., 1960
Copper	Pig	diet	11	mg/kg/day	NOAEL	54 days		Kline et al., 1971
Copper	Pig	diet	24	mg/kg/day	LOAEL	54 days	decreased hemoglobin levels, decreased weight gain	Kline et al., 1971
Copper	Mouse	diet	138	mg/kg/day	NOAEL	1 mo + gestation		Lecyk 1980
Copper	Mouse	diet	208	mg/kg/day	LOAEL	1 mo + gestation	decreased mean litter size and fetal body weights	Lecyk 1980
Copper	Mouse		2.67	mg/kg/day	NOAEL			Pocino et al., 1991
Copper	Mouse		632	mg/kg/day	LOAEL		mortality, growth, water consumption	Hebert et al. 1993
Copper	Chicken		2.3	mg/kg/day	NOAEL			Norvell et al., 1975
Copper	Chicken		52.3	mg/kg/day	LOAEL		growth, gizzard erosion	Jensen and Maurice, 1978
Lead	Rat (male)	water	22	mg/kg/day	NOAEL	60 days		Chowdhury et al., 1984
Lead	Rat (male)	water	90	mg/kg/day	LOAEL	60 days	testicular atrophy, cellular degeneration	Chowdhury et al., 1984
Lead	Rat	water	0.0015	mg/kg/day	NOAEL	6-12 months		Krasovskii et al., 1979
Lead	Rat	water	0.05	mg/kg/day	LOAEL	6-12 months	decreased activity of AIDH, SDH, NAD, and NADPH-diaphorase in spermatogenic epithelium and swelling of follicular epithelial cells in males; decreased motility of speratozoa	Krasovskii et al., 1979
Lead	Rat	water	0.07	mg/kg/day	NOAEL	312 days		Fowler et al., 1980
Lead	Rat	water	0.7	mg/kg/day	LOAEL	312 days	elevated kidney weight; cytomegaly in male pups	Fowler et al., 1980
Lead	Rat	water	0.7	mg/kg/day	NOAEL	201-291 days		Grant et al., 1980
Lead	Rat	water	7	mg/kg/day	LOAEL	201-291 days	delayed righting reflex in pups	Grant et al., 1980
Lead	Rat	water	0.09	mg/kg/day	NOAEL	63 days		Hubermont et al., 1976
Lead	Rat	water	0.9	mg/kg/day	LOAEL	63 days	decreased ALAD activity, protoporphyrins in pups	Hubermont et al., 1976
Lead	Rat	water	42	mg/kg/day	NOAEL	gestation/postnatal		Ronis et al., 1998a, 1998b
Lead	Rat	water	377	mg/kg/day	LOAEL	gestation/postnatal	28% rate of stillbirth (compared to 4% in controls)	Ronis et al., 1998a, 1998b
Lead	Rat	diet	0.9	mg/kg/day	NOAEL	2 years		Azar et al., 1973
Lead	Rat	diet	3.1	mg/kg/day	LOAEL	2 years	decreased ALAD activity	Azar et al., 1973
Lead	Rat	water	1.4	mg/kg/day	NOAEL	18 months		Carmignani et al., 1988

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Lead	Rat	water	2.8	mg/kg/day	LOAEL	18 months	increased systolic and diastolic blood pressure	Carmignani et al., 1988
Lead	Beagle dog	diet	1.25	mg/kg/day	NOAEL	2 years		Azar et al., 1973
Lead	Beagle dog	diet	2.5	mg/kg/day	LOAEL	2 years	decreased ALAD activitiy	Azar et al., 1973
Lead	Beagle dog	diet	2.5	mg/kg/day	NOAEL	2 years		Azar et al., 1973
Lead	Beagle dog	diet	12.5	mg/kg/day	LOAEL	2 years	cytomegaly in males	Azar et al., 1973
Lead	Mammal	NA	4.7	mg/kg/day	NOAEL		derived TRV	EPA, 2005
Lead	Avian	NA	1.63	mg/kg/day	NOAEL		derived TRV	EPA, 2005
Lead	Rat	diet	8	mg/kg/day	NOAEL	3 generations		Azar et al., 1973
Lead	Rat	diet	80	mg/kg/day	LOAEL	3 generations	reduced offspring weights, kidney damage	Azar et al., 1973
Lead	American kestrel	diet	3.85	mg/kg/day	NOAEL	7 months		Pattee 1984
Lead	Japanese quail	diet	1.13	mg/kg/day	NOAEL	12 weeks		Edens et al., 1967
Lead	Japanese quail	diet	11.3	mg/kg/day	LOAEL	12 weeks	reduced egg hatching success	Edens et al., 1967
Lead	Rat		1	mg/kg/day	NOAEL			Fowler et al., 1980
Lead	Mouse		241	mg/kg/day	LOAEL		growth, liver, kidney	Wise, 1981
Lead	Quail		0.014	mg/kg/day	NOAEL			Edens et al., 1967
Lead	Chicken		8.75	mg/kg/day	LOAEL		reproductive	Edens and Garlich, 1983
Lead	Kestrel	diet	14.5	mg/kg/day	NOAEL	<5 months	none	Franson et al., 1983
Lead	Kestrel	gavage	25	mg/kg/day	NOAEL	10 days	none	Hoffman et al., 1985
Lead	Japanese quail	diet	0.19	mg/kg/day	NOAEL			Edens and Garlich, 1983
Methylmercury	Cat	diet	11.3	ug/g	LOAEL		convulsions 68 d after inception of dosing, mean survival 78 d	Eaton et al., 1980
Methylmercury	Harp seal	diet	14.8	ug/g	LOAEL		decline in apetite	Ronald et al., 1977
Methylmercury	Mink	diet	0.5	mg/kg	NOAEL	90 days	No signs of toxicity	Kirk 1971
Methylmercury	Mink	diet	1	mg/kg	concentration in fish tissue	90 days	Lethal after 2 months	Kirk 1971
Methylmercury	Mink	diet	0.08 to 0.36	mg/kg	No effects	6-11 months	(included 5 feeding studies)	Aulerich et al., 1973
Methylmercury	Mink	diet	5	mg/kg		37 days	Lethal within 30 days	Aulerich et al., 1974
Methylmercury	Osprey	diet	0.3	ug/g	LOAEL		reproductive	Odsjo, 1982
Methylmercury	Merlin	diet	0.2	ug/g	LOAEL		reproductive	Newton and Haas, 1988
Methylmercury	Chicken	diet	0.01	ug/g	NOAEL			Birge and Roberts, 1976
Methylmercury	Chicken	diet	0.05	ug/g	LOAEL		reproductive	Birge and Roberts, 1976
Methylmercury	Mink	diet	0.33	mg/kg	NOAEL	145 days	No clinical signs of disease; no mortality or growth impairment	Wobeser et al., 1976a
Methylmercury	Mink	diet	1.1	mg/kg	LOAEL - EPA; NOAEL - GLWQI	93 days	Nerve tissue lesions	Wobeser et al., 1976b
Methylmercury	Mink	diet	0.58	mg/kg		100 days	No symptoms of poisoning and behavior unchanged	Jernelov et al., 1976
Methylmercury	Mink	diet	1	mg/kg		704 days (2 generations)	Reproductive effects; lethal after 90 days; lower proportion of females giving birth	Dansereau et al., 1999
Methylmercury	Mink	diet	0.5	mg/kg		704 days (2 generations)	Reproductive effects; lethal after 330 days	Dansereau et al., 1999
Methylmercury	Mallard duck	diet	0.5	ug/g			reproductive effects of second generation	Heinz, 1976a,b
Methylmercury	Mallard duck	diet	78	ug/kg bw-d	LOAEL	3 generations	reproductive and behavioral	Heinz 1974, 1975
Methylmercury	River otter	diet	2	ug/g		6 months	anorexia, ataxia	O'Connor and Nielson, 1980

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Methylmercury	Mink	diet	27	ug/g		6 weeks	lethality in 40% of males and 31% of females	Borst and Lieshout, 1977
Methylmercury	Black duck	diet	3	ug/g	LOAEL		reproductive	Finley and Stendell, 1978
Methylmercury	Mink	diet	55	ug/kg/bw-d	NOAEL			Wobeser, 1973; Wobeser et al., 1976a,b
Methylmercury	Mink	diet	180	ug/kg/bw-d	LOAEL			Wobeser, 1973; Wobeser et al., 1976a,b
Methylmercury	Cat	diet	20	ug/kg/d	NOAEL			Charbonneau et al. 1974
Methylmercury	Cat		46	ug/kg/d	LOAEL		ataxia, loss of motor function	Charbonneau et al. 1974
Methylmercury	Ring-necked phesant	diet	0.18	ug/g/d	LOAEL		reproductive effects	Fimreite, 1971
Methylmercury	Chicken	diet	4.9	ug/g/d	LOAEL		reproductive effects	Scott, 1977
Methylmercury	Japanese quail	diet	8	ug/g	NOAEL			
	Japanese quail	diet	32	ug/g	LOAEL		enzyme induction	Hill and Soares, 1984
Methylmercury	Chicken	diet	1.1	ug/g/d	LOAEL		growth inhibition	Fimreite, 1970
Methylmercury	Great Egret (juvenile)	diet	0.5	mg/kg	methyl HgCL in food	12 weeks	affected activity, tendency to seek shade, and motivation to hunt prey	Bouton et al. 1999
Methylmercury	Wild common loon	diet	0.3 to 0.4	mg/kg			reduced egg laying and decreased territorial fidelity	Barr, 1986
Methylmercury	Mallard	diet	0.1	mg/kg			laid fewer eggs	Heinz 1979
Methylmercury	Mink	diet	1	mg/kg		6 months	lethal for females only	Wren et al. 1987
Methylmercury	Mink	diet	5	mg/kg			Ataxia, anorexia, paralysis, and death between day 30 and day 37	Aulerich et al., 1974
Methylmercury	Mink	diet	0.44	mg/kg	NOAEL	120 days	No clinical or pathological effect	Wobeser et al., 1976
Methylmercury	Mink	diet	0.1	mg/kg	NOAEL	93 days		Wobeser et al., 1976
Methylmercury	Mink	diet	1.1	mg/kg	LOAEL	93 days	nerve tissue lesions	Wobeser et al., 1976
Methylmercury	Mink	diet	1.8	mg/kg		93 days	anorexia, ataxia @ 50-80 d; death at 59-79 d	Wobeser et al., 1976
Methylmercury	Mink	diet	4.8	mg/kg		93 days	anorexia, ataxia @ 23-32 d; death at 26-36 d	Wobeser et al., 1976
Methylmercury	Otter	diet	0.09	mg/kg		181 days	anorexia, ataxia	O'Connor and Nielson, 1980
Methylmercury	Otter	diet	4	ppm		116 days	anorexia, ataxia, nephrotic and neurologic lesions	O'Connor and Nielson, 1980
Methylmercury	Otter		8	ppm		50 days	lethal	O'Connor and Nielson, 1980
Methylmercury	Rat	diet	0.02	mg/kg/day	NOAEL	2 years		Verschuuren et al., 1976
Methylmercury	Rat	diet	0.1	mg/kg/day	LOAEL	2 years	increased kidney weight, decreased kidney enzymes	Verschuuren et al., 1976
Methylmercury	Cat	diet	0.02	mg/kg/day	NOAEL	2 years		Charbonneau et al., 1976
Methylmercury	Cat		0.074	mg/kg/day	LOAEL	2 years	degeneration of dorsal root ganglia, cerebrellar granular cell degeneration	Charbonneau et al., 1976
Methylmercury	Monkey (female)	gavage	0.043	mg/kg/day	NOAEL	Not specified		Burbacher et al., 1984
Methylmercury	Monkey (female)	gavage	0.077	mg/kg/day	LOAEL	Not specified	intention tremor	Burbacher et al., 1984
Methylmercury	Mouse (male)	diet	0.14	mg/kg/day	NOAEL	104 weeks		Mitsumori et al., 1990
Methylmercury	Mouse (male)	diet	0.69	mg/kg/day	LOAEL	104 weeks	sensory neuropathy, cerebral and cerebellar neuronal necrosis, posterior paralysis	Mitsumori et al., 1990
Methylmercury	Mouse	diet	0.15	mg/kg/day	NOAEL	104 weeks		Hirano et al., 1986
Methylmercury	Mouse	diet	0.73	mg/kg/day	LOAEL	104 weeks	decreased spermatogenesis	Hirano et al., 1986
Methylmercury	Mouse	diet	0.14	mg/kg/day	NOAEL	104 weeks		Mitsumori et al., 1990

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Methylmercury	Mouse	diet	0.69	mg/kg/day	LOAEL	104 weeks	tubular atrophy of the testes	Mitsumori et al., 1990
Methylmercury	Mink	diet	1	mg/kg/day	NOAEL	6 months		Aulerich et al., 1974
Methylmercury	Mouse	diet	13.2	mg/kg/day	NOAEL	20 month		Revis et al. 1989
Methylmercury	Common tern	diet	1	ug/g	NOAEL			
Methylmercury	Common tern	diet	3.65	ug/g	LOAEL		reduced hatching success and fledgling rate	Fimreite, 1974
Methylmercury	Herring gull	diet	16	ug/g	NOAEL			Fimreite, 1974
Methylmercury	Mink	diet	0.015	mg/kg/day	NOAEL	93 days		Wobeser et al., 1976
Methylmercury	Mink	diet	0.025	mg/kg/day	LOAEL	93 days	mortality, weight loss, behavioral abnormalities	Wobeser et al., 1976
Methylmercury	Rat	diet	0.032	mg/kg/day	NOAEL	3 generations		Verschuuren et al., 1976
Methylmercury	Rat	diet	0.16	mg/kg/day	LOAEL	3 generations	reproduction	Verschuuren et al., 1976
Methylmercury	Mallard duck	diet	0.0064	mg/kg/day	NOAEL	3 generations		Heinz 1979
Methylmercury	Mallard duck	diet	0.064	mg/kg/day	LOAEL	3 generations	reproduction	Heinz 1979
Methylmercury	Mink		0.027	mg/kg/day	NOAEL			USEPA (Great Lakes), 1995
Methylmercury	Mink		0.27	mg/kg/day	LOAEL		mortality, anorexia, neurological	USEPA (Great Lakes), 1995
Methylmercury	Rat		0.25	mg/kg/day	NOAEL		reproductive, developmental	USEPA (Great Lakes), 1995
Methylmercury	Rat		4	mg/kg/day	LOAEL		reproductive, developmental	USEPA (Great Lakes), 1995
Methylmercury	Mallard		0.039	mg/kg/day	NOAEL		reproductive	USEPA (Great Lakes), 1995
Methylmercury	Mallard		0.18	mg/kg/day	LOAEL		mortality, neurological	USEPA (Great Lakes), 1995
Methylmercury	Mallard	diet	0.068	mg/kg/day	NOAEL			Heinz 1976a and Heinz and Hoffman 1998
Nickel	Rat (female)	water	7	mg/kg/day	NOAEL	27-30 weeks		RTI 1988a, 1988b
Nickel	Rat (female)	water	30	mg/kg/day	LOAEL	27-30 weeks	increased gestation length	RTI 1988a, 1988b
Nickel	Mouse (male)	gavage water	1.1	mg/kg/day	NOAEL	35 days		Pandey and Srivastava 2000
Nickel	Mouse (male)	gavage water	2.2	mg/kg/day	LOAEL	35 days	sperm abnormalitites	Pandey and Srivastava 2000
Nickel	Rat (female)	water	4	mg/kg/day	NOAEL	62 days		Kakela et al., 1999
Nickel	Rat (female)	water	13	mg/kg/day	LOAEL	62 days	decreased litter size and pup survival	Kakela et al., 1999
Nickel	Mouse	water	80	mg/kg/day	NOAEL	gestational days 2-17		Berman and Rehnberg, 1983
Nickel	Mouse	water	160	mg/kg/day	LOAEL	gestational days 2-17	increased spontaneous abortions	Berman and Rehnberg, 1983
Nickel	Rat	diet	7.5	mg/kg/day	NOAEL	2 years		Ambrose et al., 1976
Nickel	Rat	diet	75	mg/kg/day	LOAEL	2 years	decreases in body weight gain	Ambrose et al., 1976
Nickel	Beagle dog	diet	25	mg/kg/day	NOAEL	2 years		Ambrose et al., 1976
Nickel	Beagle dog	diet	62.5	mg/kg/day	LOAEL	2 years	blood, renal, respiratory, body weight effects	Ambrose et al., 1976
Nickel	Rat		0.133	mg/kg/day	NOAEL			Smith et al, 1993
Nickel	Rat		31.6	mg/kg/day	LOAEL		reproductive	Smith et al, 1993
Nickel	Mallard		1.38	mg/kg/day	NOAEL			Cain and Pafford, 1981
Nickel	Mallard		56.3	mg/kg/day	LOAEL		growth	Cain and Pafford, 1981
Nickel	Rat	diet	40	mg/kg/day	NOAEL	3 generations		Ambrose et al. 1976
Nickel	Rat	diet	80	mg/kg/day	LOAEL	3 generations	reproductive	Ambrose et al. 1976
Nickel	Mallard	diet	77.4	mg/kg/day	NOAEL	90 days		Cain and Pafford, 1981
Nickel	Mallard	diet	107	mg/kg/day	LOAEL	90 days	mortality, growth, behavior	Cain and Pafford, 1981
Nickel	Mallard duckling		17.6	mg/kg/day	NOAEL			Cain and Pafford, 1981
Silver	Rat	water	222.2	mg/kg/day	LOAEL	37 weeks	decreased weight gain; shortened life span; silver deposits in eyes	Matuk et al., 1981

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Silver	Mouse	water	18.1	mg/kg/day	LOAEL	125 days	hypoactivity	Rungby and Danscher 1984
Silver	Rat	water	89	mg/kg/day		218 days	advanced pigmentation observed in body organs	Olcott, 1950
Zinc	Rat	water	95	mg/kg/day	NOAEL	3 months		Llobet et al., 1988
Zinc	Rat	water	191	mg/kg/day	LOAEL	3 months	renal effects	Llobet et al., 1988
Zinc	Cow	diet	64	mg/kg/day	NOAEL	5 weeks		Jenkins and Hidiroglou, 1991
Zinc	Cow	diet	91	mg/kg/day	LOAEL	5 weeks	decreased body weight gain	Jenkins and Hidiroglou, 1991
Zinc	Ferret	diet	65	mg/kg/day	NOAEL	7-97 days		Straube et al. 1980
Zinc	Ferret	diet	195	mg/kg/day	LOAEL	7-97 days	anemia and renal effects	Straube et al. 1980
Zinc	Rat (female)	gavage water	3.5	mg/kg/day	NOAEL	20 weeks		Khan et al., 2001
Zinc	Rat (female)	gavage water	7	mg/kg/day	LOAEL	20 weeks	reduced number of live pups per litter	Khan et al., 2001
Zinc	Rat	diet	50	mg/kg/day	NOAEL	150 days		Sutton and Nelson 1937
Zinc	Rat	diet	250	mg/kg/day	LOAEL	150 days	no reproduction in females; increased stillbirths	Sutton and Nelson 1937
Zinc	Mouse		9.6	mg/kg/day	NOAEL			Aughey et al., 1977
Zinc	Rat		411	mg/kg/day	LOAEL		developmental	Schlicker and Cox, 1968
Zinc	Rat	diet	160	mg/kg/day	NOAEL	gestational days 1-16		Schlicker and Cox 1968
Zinc	Rat	diet	320	mg/kg/day	LOAEL	gestational days 1-16	reproductive	Schlicker and Cox 1968
Zinc	Leghorn hen	diet	14.5	mg/kg/day	NOAEL	44 weeks		Stahl et al. 1990
Zinc	Leghorn hen	diet	131	mg/kg/day	LOAEL	44 weeks	reproductive	Stahl et al. 1990
Tributyltin Oxide	Rat	diet	0.025	mg/kg/day	NOAEL	4.5 or 16.5 months		Vos et al., 1990
Tributyltin Oxide	Rat	diet	0.25	mg/kg/day	LOAEL	4.5 or 16.5 months	immunotoxicity	Vos et al., 1990
Tributyltin Oxide	Monkey	diet	0.14	mg/kg/day	LOAEL	22 weeks	decreased leukocyte levels	Karrer et al., 1992
Tributyltin Oxide	Rat	diet	0.19	mg/kg/day	NOAEL	2 years		Wester et al., 1990, 1988, 1987
Tributyltin Oxide	Rat	diet	2.1	mg/kg/day	LOAEL	2 years	degenerative changes in the kidney	Wester et al., 1990, 1988, 1987
Tributyltin Oxide	Rat	diet	0.29	mg/kg/day	NOAEL	2 generations		Schroeder, 1990
Tributyltin Oxide	Rat	diet	2.95	mg/kg/day	LOAEL	2 generations	decreased thymus weight	Schroeder, 1990
Tributyltin Oxide	Rat	diet	0.34	mg/kg/day	NOAEL	2 generations		Schroeder, 1990
Tributyltin Oxide	Rat	diet	3.43	mg/kg/day	LOAEL	2 generations	decreased pup weight during lactation	Schroeder, 1990
Tributyltin Oxide	Rat	gavage oil	5	mg/kg/day	LOAEL	gestational days 6-19	fetal skeletal ossification variations	Schroeder, 1981
Tributyltin Oxide	Rat	gavage oil	5	mg/kg/day	NOAEL	gestational days 6-20		Crofton et al., 1989
Tributyltin Oxide	Rat	gavage oil	10	mg/kg/day	LOAEL	gestational days 6-20	reduced litter size, decreased pup survival	Crofton et al., 1989
Tributyltin Oxide	Mice	gavage oil	20	mg/kg/day	NOAEL	gestational days 6-15		Baroncelli et al., 1990
Tributyltin Oxide	Mice	gavage oil	40	mg/kg/day	LOAEL	gestational days 6-15	decreased fetal weight gain	Baroncelli et al., 1990
Tributyltin Oxide	Mice	gavage oil	5.8	mg/kg/day	NOAEL	gestational days 6-15		Davis et al., 1987
Tributyltin Oxide	Mice	gavage oil	11.7	mg/kg/day	LOAEL	gestational days 6-15	reduced body weight in mothers, increased cleft palates in fetuses	Davis et al., 1987
Aroclor 1016	Monkey	diet	0.007	mg/kg/day	NOAEL	12 months		Barsotti and Van Miller, 1984
Aroclor 1016	Monkey	diet	0.03	mg/kg/day	LOAEL	12 months	18% reduced birth weight	Barsotti and Van Miller, 1984
Aroclor 1016	Monkey	diet	0.007	mg/kg/day	NOAEL	21.8 months		Levin et al., 1988
Aroclor 1016	Monkey	diet	0.03	mg/kg/day	LOAEL	21.8 months	18% reduced birth weight	Levin et al., 1988

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COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Aroclor 1016	Monkey	diet	0.007	mg/kg/day	NOAEL	18.2 months		Schantz et al., 1989
Aroclor 1016	Monkey	diet	0.03	mg/kg/day	LOAEL	18.2 months	18% lower birth weight	Schantz et al., 1989
Aroclor 1016	Monkey	diet	0.007	mg/kg/day	NOAEL	18.2 months		Schantz et al., 1989
Aroclor 1016	Monkey	diet	0.03	mg/kg/day	LOAEL	18.2 months	decreased discrimination performance in offspring	Schantz et al., 1989
Aroclor 1016	Mink	diet	1.37	mg/kg/d	NOAEL	18 months		
Aroclor 1016	Mink	diet	3.43	mg/kg/d	LOAEL	18 months	reproductive	Aulerich and Ringer, 1980
Aroclor 1242	Mink		1.3	mg/kg/ww	NOAEL	Recommended value		Chapman, 2003
Aroclor 1242	Mink		1.4	mg/kg/ww	LOAEL	Recommended value		Chapman, 2003
Aroclor 1242	Chicken		0.1-0.5	mg/kg bw-d	NOAEL	Recommended value		Chapman, 2003
Aroclor 1242	Chicken		0.4-0.8	mg/kg bw-d	LOAEL	Recommended value		Chapman, 2003
Aroclor 1242	Mink	diet	0.9	mg/kg/day	NOAEL	247 days		Bleavins et al., 1980
Aroclor 1242	Mink	diet	1.9	mg/kg/day	LOAEL	247 days	gastric ulcers	Bleavins et al., 1980
Aroclor 1242	Chicken egg		1	mg/kg egg ww	NOAEL	Recommended value		Chapman, 2003
Aroclor 1242	Chicken egg		1.5	mg/kg egg ww	LOAEL	Recommended value		Chapman, 2003
Aroclor 1242	Mink	diet	0.069	mg/kg/d	NOAEL	7 months		
Aroclor 1242	Mink	diet	0.69	mg/kg/d	LOAEL	7 months	reproductive	Bleavins et al., 1980
Aroclor 1242	Screech owl	diet	0.41	mg/kg/d	NOAEL	2 generations	reproductive	McLane and Huges, 1980
Aroclor 1248	Rhesus monkey	diet	0.01	mg/kg/d	NOAEL	14 months		
Aroclor 1248	Rhesus monkey	diet	0.1	mg/kg/d	LOAEL	14 months	reproductive	Barsotti et al., 1976
Aroclor 1248	Chicken		0.4	mg/kg bw-d	NOAEL	Recommended value		Chapman, 2003
Aroclor 1248	Chicken		0.5	mg/kg bw-d	LOAEL	Recommended value		Chapman, 2003
Aroclor 1248	Chicken egg		0.7	mg/kg egg ww	NOAEL	Recommended value		Chapman, 2003
Aroclor 1248	Chicken egg		1.3	mg/kg egg ww	LOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Chicken egg		9	mg/kg egg ww	NOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Chicken egg		12	mg/kg egg ww	LOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Chicken		0.6	mg/kg bw-d	NOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Chicken		1.2	mg/kg bw-d	LOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Mink		0.5	mg/kg/ww	NOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Mink		0.6	mg/kg/ww	LOAEL	Recommended value		Chapman, 2003
Aroclor 1254	Rat (female)	diet	0.05	mg/kg/day	NOAEL	5-7 months		Byrne et al., 1988
Aroclor 1254	Rat (female)	diet	0.25	mg/kg/day	LOAEL	5-7 months	decreased adrenal serum corticosterone, DHEA and DHS hormones	Byrne et al., 1988
Aroclor 1254	Rat (male)	gavage oil	0.1	mg/kg/day	NOAEL	15 weeks		Gray et al., 1993
Aroclor 1254	Rat (male)	gavage oil	1	mg/kg/day	LOAEL	15 weeks	increased liver weight, hypertrophy and vacuolar degeneration, cortical tubular protein casts (kidney)	Gray et al., 1993
Aroclor 1254	Rat	diet	0.025	mg/kg/day	NOAEL	5 weeks		Kasza et al., 1978
Aroclor 1254	Rat	diet	0.25	mg/kg/day	LOAEL	5 weeks	altered thyroid follicular structure	Kasza et al., 1978
Aroclor 1254	Mouse	diet	0.5	mg/kg/day	NOAEL	6 months		Koller 1977
Aroclor 1254	Mouse	diet	48.8	mg/kg/day	LOAEL	6 months	severe liver narcosis	Koller 1977
Aroclor 1254	Rat	diet	0.13	mg/kg/day	NOAEL	42 days		Overman et al., 1987
Aroclor 1254	Rat	diet	13.5	mg/kg/day	LOAEL	42 days	50% neonatal death	Overman et al., 1987
Aroclor 1254	Rat (Male)	gavage oil	10	mg/kg/day	NOAEL	15 weeks		Gray et al., 1993
Aroclor 1254	Rat (Male)	gavage oil	25	mg/kg/day	LOAEL	15 weeks	reduced seminal vesicle and epididymal weights, and epididymal sperm counts following weanling exposure	Gray et al., 1993
Aroclor 1254	Mouse	diet	1.25	mg/kg/day	NOAEL	108 days		Welsch 1985

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Aroclor 1254	Mouse	diet	12.5	mg/kg/day	LOAEL	108 days	55% decreased conception	Welsch 1985
Aroclor 1254	Mink	diet	0.2	mg/kg/day	NOAEL	21 weeks		Aulerich and Ringer, 1977
Aroclor 1254	Mink	diet	0.9	mg/kg/day	LOAEL	21 weeks	decreased reproduction rates and litter size	Aulerich and Ringer, 1977
Aroclor 1254	Rat	diet	7.2	mg/kg/day	NOAEL	186 days		Linder et al., 1974
Aroclor 1254	Rat	diet	37	mg/kg/day	LOAEL	186 days	significant increase in preweanling mortality rate, lipid accumulation in hepatocytes	Linder et al., 1974
Aroclor 1254	Rat	diet	0.32	mg/kg/day	NOAEL	129 days		Linder et al., 1974
Aroclor 1254	Rat	diet	1.5	mg/kg/day	LOAEL	129 days	decreased litter size, lipid accumulation in hepatocytes	Linder et al., 1974
Aroclor 1254	Rabbit	gavage oil	10	mg/kg/day	NOAEL	28 days		Villeneuve et al., 1971
Aroclor 1254	Rabbit	gavage oil	12.5	mg/kg/day	LOAEL	28 days	71% fetal death	Villeneuve et al., 1971
Aroclor 1254	Rat	diet	1	mg/kg/day	NOAEL	52 weeks		Phillips et al., 1972
Aroclor 1254	Rat	diet	10	mg/kg/day	LOAEL	52 weeks	significant increase in liver weight	Phillips et al., 1972
Aroclor 1254	Monkey	capsule	0.005	mg/kg/day	NOAEL	37 months		Arnold et al., 1995
Aroclor 1254	Monkey	capsule	0.02	mg/kg/day	LOAEL	37 months	42% reduced conception rate	Arnold et al., 1995
Aroclor 1254	Oldfield mouse	diet	0.068	mg/kg/d	NOAEL	12 months		
Aroclor 1254	Oldfield mouse	diet	0.68	mg/kg/d	LOAEL	12 months	reproductive	McCoy et al., 1995
Aroclor 1254	Ring-necked pheasant	diet	0.18	mg/kg/d	NOAEL	17 weeks		
Aroclor 1254	Ring-necked pheasant	diet	1.8	mg/kg/d	LOAEL	17 weeks	reproductive	Dahlgren et al., 1972
Aroclor 1260	Rat (male)	diet	1.4	mg/kg/day	NOAEL	8 months		Kimbrough et al., 1972
Aroclor 1260	Rat (male)	diet	6.5	mg/kg/day	LOAEL	8 months	increased liver weight; cytoplasmic vacuolation	Kimbrough et al., 1972
Aroclor 1260	Rat (female)	diet	6.9	mg/kg/day	NOAEL	67 days		Linder et al., 1974
Aroclor 1260	Rat (female)	diet	35.4	mg/kg/day	LOAEL	67 days	decreased litter size	Linder et al., 1974
Aroclor 1260	Rat	diet	6.9	mg/kg/day	NOAEL	67 days		Linder et al., 1974
Aroclor 1260	Rat	diet	35.4	mg/kg/day	LOAEL	67 days	significanlty reduced survival at weanling	Linder et al., 1974
PCB mixture	Mouse		0.36	mg/kg/day	NOAEL			Simmons and McKee, 1992
PCB mixture	Mouse		1.28	mg/kg/day	LOAEL		reproductive	Linzey, 1987
PCB mixture	Chicken		0.09	mg/kg/day	NOAEL			Plantonow and Reinhart, 1973
PCB mixture	Chicken		1.27	mg/kg/day	LOAEL		reproductive	Britton and Huston, 1973
PCB mixture	Mink	diet	16.1 (1.6)	pg TEQ/g (ug PCBs/g feed)	NOAEL	11 months	reproductive	Bursian et al., 2003
PCB mixture	Mink	diet	68.5 (3.7)	pg TEQ/g (ug PCBs/g feed)	LOAEL	11 months	reproductive	Bursian et al., 2003
PCB mixture	Mink	diet	2.4 (22)	ng TEQ/kg bw-day (pg TEQs/ g feed)	LOAEL	18 months	kit production and growth	Brunstrom et al., 2001
Benzo(a)pyrene	Mouse	diet	1	mg/kg/day	NOAEL	gestational days 7-16		Mackenzie and Angevine, 1981
Benzo(a)pyrene	Mouse	diet	10	mg/kg/day	LOAEL	gestational days 7-16	reproductive	Mackenzie and Angevine, 1981
Benzo(a)pyrene	Mouse	diet	1.31	mg/kg/day	NOAEL			Neal and Rigdon, 1967
Benzo(a)pyrene	Mouse	diet	32.8	mg/kg/day	LOAEL		cancer	Neal and Rigdon, 1967
Naphthalene	Rat	diet	50	mg/kg/day	NOAEL			Navarro et al., 1991
Naphthalene	Rat	diet	150	mg/kg/day	LOAEL		developmental	Navarro et al., 1991
Acenaphthene	Mouse (female)	gavage oil	350	mg/kg/day	NOAEL	13 weeks		USEPA 1989

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
Acenaphthene	Mouse (female)	gavage oil	700	mg/kg/day	LOAEL	13 weeks	decreased ovary weights; increased incidence and degree of inactivity of the ovary and uterus)	USEPA 1989
Benzo(a)pyrene	Mouse	diet	1.3	mg/kg/day	NOAEL	30-197 days		Neal and Rigdon, 1967
Benzo(a)pyrene	Mouse	diet	2.6	mg/kg/day	LOAEL	30-197 days	cancer; gastric tumor	Neal and Rigdon, 1967
Chlorobenzene	Rat	inhalation	50	ppm	NOAEL	2 generations		Nair et al., 1987
Chlorobenzene	Rat	inhalation	150	ppm	LOAEL	2 generations	hepatic and renal damage	Nair et al., 1987
Chlorobenzene	Rat	gavage	60	mg/kg/day	NOAEL	103 weeks		NTP 1985
Chlorobenzene	Rat	gavage	120	mg/kg/day	LOAEL	103 weeks	hepatic necrosis	NTP 1985
1,4-dichlorobenzene	Rat (female)	inhalation	20	ppm	NOAEL	104 weeks		Japan Bioassay Research Center, 1995
1,4-dichlorobenzene	Rat (female)	inhalation	75	ppm	LOAEL	104 weeks	eosinophilic changes in olfactory epithelium	Japan Bioassay Research Center, 1995
1,4-dichlorobenzene	Mouse (male)	inhalation	75	ppm	NOAEL	104 weeks		Japan Bioassay Research Center, 1995
1,4-dichlorobenzene	Mouse (male)	inhalation	300	ppm	LOAEL	104 weeks	hepatic	Japan Bioassay Research Center, 1995
1,4-dichlorobenzene	Mouse (male)	inhalation	20	ppm	NOAEL	104 weeks		Japan Bioassay Research Center, 1995
1,4-dichlorobenzene	Mouse (male)	inhalation	75	ppm	LOAEL	104 weeks	reproductive	Japan Bioassay Research Center, 1995
1,4-dichlorobenzene	Rat (male)	gavage oil	300	mg/kg/day	NOAEL	13 weeks		NTP 1987
1,4-dichlorobenzene	Rat (male)	gavage oil	600	mg/kg/day	LOAEL	13 weeks	renal tubular degeneration; increase in serum cholesterol	NTP 1987
1,4-dichlorobenzene	Mouse	gavage oil	300	mg/kg/day	NOAEL	13 weeks		Eldridge et al., 1992
1,4-dichlorobenzene	Mouse	gavage oil	600	mg/kg/day	LOAEL	13 weeks	hepatic	Eldridge et al., 1992
1,4-dichlorobenzene	Dog	capsule	50	mg/kg/day	NOAEL	1 year		Naylor and Stout, 1996
1,4-dichlorobenzene	Dog	capsule	75	mg/kg/day	LOAEL	1 year	reduced RBC	Naylor and Stout, 1996
1,4-dichlorobenzene	Dog	capsule	10	mg/kg/day	NOAEL	1 year		Naylor and Stout, 1996
1,4-dichlorobenzene	Dog	capsule	50	mg/kg/day	LOAEL	1 year	Hepatic and renal	Naylor and Stout, 1996
1,4-dichlorobenzene	Rat (female)	gavage oil	30	mg/kg/day	NOAEL	77-156 days		Bornatowicz et al., 1994
1,4-dichlorobenzene	Rat (female)	gavage oil	90	mg/kg/day	LOAEL	77-156 days	increased postnatal/preweaning mortality in pups	Bornatowicz et al., 1994
1,4-dichlorobenzene	Rat	gavage oil	150	mg/kg/day	NOAEL	2 years		NTP 1987
1,4-dichlorobenzene	Rat	gavage oil	300	mg/kg/day	LOAEL	2 years	decrease in body wt gain	NTP 1987
1,4-dichlorobenzene	Rat	inhalation	50	mg/m3	NOAEL	28 days		Klimisch et al., 1991
1,4-dichlorobenzene	Rat	inhalation	1000	mg/m3	LOAEL	28 days	increased liver weight	Klimisch et al., 1991
1,4-dichlorobenzene	Rat	diet	14	mg/kg/day	NOAEL	102 weeks		Ganning et al., 1991
1,4-dichlorobenzene	Rat	diet	140	mg/kg/day	LOAEL	102 weeks	decreased body weight	Ganning et al., 1991
1,4-dichlorobenzene	Mouse (female)	diet	117	mg/kg/day	NOAEL	104 weeks		David et al., 1999, 2000b
1,4-dichlorobenzene	Mouse (female)	diet	354	mg/kg/day	LOAEL	104 weeks	decreased kidney weight; increased progressive nephropathy	David et al., 1999, 2000b
1,4-dichlorobenzene	Guinea pig	diet	19	mg/kg/day	NOAEL	1 year		Carpenter et al., 1953
1,4-dichlorobenzene	Guinea pig	diet	64	mg/kg/day	LOAEL	1 year	increased liver weight	Carpenter et al., 1953
1,4-dichlorobenzene	Rat	diet	5.8	mg/kg/day	NOAEL	104 weeks		David et al., 2000a
1,4-dichlorobenzene	Rat	diet	29	mg/kg/day	LOAEL	104 weeks	reproductive	David et al., 2000a
1,4-dichlorobenzene	Rat	diet	322	mg/kg/day	NOAEL	2 years		Kluwe et al., 1982
1,4-dichlorobenzene	Rat	diet	674	mg/kg/day	LOAEL	2 years	reproductive	Kluwe et al., 1982
1,4-dichlorobenzene	Mouse	diet	98.5	mg/kg/day	NOAEL	104 weeks		David et al., 2000b

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
1,4-dichlorobenzene	Mouse	diet	292	mg/kg/day	LOAEL	104 weeks	reproductive	David et al., 2000b
1,4-dichlorobenzene	Mouse	diet	672	mg/kg/day	NOAEL	2 years		Kluwe et al., 1982
1,4-dichlorobenzene	Mouse	diet	1325	mg/kg/day	LOAEL	2 years	reproductive	Kluwe et al., 1982
1,4-dichlorobenzene	Mouse	diet	18.3	mg/kg/day	NOAEL	105 days		Lamb et al. 1987
1,4-dichlorobenzene	Mouse	diet	183	mg/kg/day	LOAEL	105 days	reproductive	Lamb et al. 1987
1,4-dichlorobenzene	Ringed dove	diet	1.1	mg/kg/day	NOAEL	4 weeks	reproductive	Peakall 1974
bis(2-ethylhexyl)phthalate	Rat	diet	14	mg/kg/day	NOAEL	102 weeks		Ganning et al., 1991
bis(2-ethylhexyl)phthalate	Rat	diet	140	mg/kg/day	LOAEL	102 weeks	decreased body wt	Ganning et al., 1991
bis(2-ethylhexyl)phthalate	Mouse (female)	diet	117	mg/kg/day	NOAEL	104 weeks		David et al., 1999, 2000b
bis(2-ethylhexyl)phthalate	Mouse (female)	diet	354	mg/kg/day	LOAEL	104 weeks	decreased kidney wt; increased progressive nephropathy	David et al., 1999, 2000b
bis(2-ethylhexyl)phthalate	Guinea pig	diet	19	mg/kg/day	NOAEL	1 year		Carpenter et al., 1953
bis(2-ethylhexyl)phthalate	Guinea pig	diet	64	mg/kg/day	LOAEL	1 year	increased liver wt	Carpenter et al., 1953
bis(2-ethylhexyl)phthalate	Rat	diet	5.8	mg/kg/day	NOAEL	104 weeks		David et al., 2000a
bis(2-ethylhexyl)phthalate	Rat	diet	29	mg/kg/day	LOAEL	104 weeks	reproductive	David et al., 2000a
bis(2-ethylhexyl)phthalate	Rat	diet	322	mg/kg/day	NOAEL	2 year		Kluwe et al., 1982
bis(2-ethylhexyl)phthalate	Rat	diet	674	mg/kg/day	LOAEL	2 year	reproductive	Kluwe et al., 1982
bis(2-ethylhexyl)phthalate	Mouse	diet	98.5	mg/kg/day	NOAEL	104 weeks		David et al., 2000b
bis(2-ethylhexyl)phthalate	Mouse	diet	292	mg/kg/day	LOAEL	104 weeks	reproductive	David et al., 2000b
bis(2-ethylhexyl)phthalate	Mouse	diet	672	mg/kg/day	NOAEL	2 year		Kluwe et al., 1982
bis(2-ethylhexyl)phthalate	Mouse	diet	1325	mg/kg/day	LOAEL	2 year	reproductive	Kluwe et al., 1982
bis(2-ethylhexyl)phthalate	Mouse	diet	18.3	mg/kg/day	NOAEL	105 days		Lamb et al. 1987
bis(2-ethylhexyl)phthalate	Mouse	diet	183	mg/kg/day	LOAEL	105 days	reproductive	Lamb et al. 1987
bis(2-ethylhexyl)phthalate	Ringed dove	diet	1.1	mg/kg/day	NOAEL	4 weeks	reproductive	Peakall 1974
2,3,7,8-TCDD	Mink	diet	8.00E-08	mg/kg/day	NOAEL			Tillitt et al., 1996
2,3,7,8-TCDD	Mink	diet	2.24E-08	mg/kg/day	LOAEL		reduced kit body weight and reduced survival	Tillitt et al., 1996
2,3,7,8-TCDD	Mink (newborn)	i.p injection	1000	pg/g daily for 12 days	mortality	133 days	100% mortality after 14-d	Aulerich et al., 1988
2,3,7,8-TCDD	Mink (newborn)	i.p injection	1000	pg/g daily for 12 days	mortality	133 days	62% mortality after 133-d	Aulerich et al., 1988
2,3,7,8-TCDD	Mink (adult male)	oral dose	4200	pg/g	LD50	28 days		Hochstein et al., 1988
2,3,7,8-TCDD	Mink (adult female)	oral dose	264	pg/g	LD50	28 days		Hochstein et al., 1998
2,3,7,8-TCDD	Mink (adult female)	oral dose	47	pg/g	LD50	125 days		Hochstein et al., 1998
2,3,7,8-TCDD	Ring-necked pheasant (eggs)	injection (yolk)	1000	pg/g	NOAEL	28-d post hatch		Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked pheasant (eggs)	injection (yolk)	10,000	pg/g	LOAEL	28-d post hatch	mortality	Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked pheasant (eggs)	injection (albumin)	100	pg/g	NOAEL	28-d post hatch		Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked pheasant (eggs)	injection (albumin)	1000	pg/g	LOAEL	28-d post hatch	mortality	Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked phesant (adult hen)	i.p. injection	100	pg/g	NOAEL	7-wk post dose		Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked phesant (adult hen)	i.p. injection	1000	pg/g	LOAEL	7-wk post dose	mortality, hen weight, egg production, embryo mortality	Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked pheasant (eggs)	injection	100	ng/kg	NOAEL		embryo mortality	Nosek et al., 1993
2,3,7,8-TCDD	Ring-necked pheasant (eggs)	injection	1000	ng/kg	LOAEL		embryo mortality	Nosek et al., 1993
2,3,7,8-TCDD	Chicken (egg)	injection	0.06	ug/kg	NOAEL		hatch weight	Henshel et al., 1997
2,3,7,8-TCDD	Chicken (egg)	injection	0.1	ug/kg	LOAEL		hatch weight	Henshel et al., 1997
2,3,7,8-TCDD	Chicken (egg)	injection	0.08	ug/kg	NOAEL		embryo mortality	Powell et al., 1996
2,3,7,8-TCDD	Chicken (egg)	injection	0.16	ug/kg	LOAEL		embryo mortality	Powell et al., 1996
2,3,7,8-TCDD	Chicken (egg)	injection	0.1	ug/kg	NOAEL		hatch weight	Henshel et al., 1997
2,3,7,8-TCDD	Chicken (egg)	injection	0.3	ug/kg	LOAEL		hatch weight	Henshel et al., 1997
2,3,7,8-TCDD	Chicken (egg)	injection	0.01	ug/kg	LOAEL		terata	Henshel et al., 1997
2,3,7,8-TCDD	Chicken (egg)	injection	0.32	ug/kg	LOAEL		terata	Walker et al., 1997
2,3,7,8-TCDD	Chicken (egg)	injection	9	ng/kg	LOAEL		cardiac malformations	Cheung et al., 1981
2,3,7,8-TCDD	Double-crested cormorant (egg)	injection	1	ug/kg	NOAEL		embryo mortality	Powell et al., 1997

Table B-1. Available Toxicity Data from Various Literature Sources Used to Derive TRVs

COPEC	Test species	Test Method	Concentration	Units	Endpoint	Observation	Effect	Reference[a]
2,3,7,8-TCDD	Double-crested cormorant (egg)	injection	4	ug/kg	LOAEL		embryo mortality	Powell et al., 1997
2,3,7,8-TCDD	Double-crested cormorant (egg)	injection	1.3	ug/kg	NOAEL		embryo mortality	Powell et al., 1998
2,3,7,8-TCDD	Double-crested cormorant (egg)	injection	5.4	ug/kg	LOAEL		embryo mortality	Powell et al., 1998
2,3,7,8-TCDD	Red-necked phesant (egg)	injection	0.1	ug/kg	NOAEL		embryo mortality	Nosek et al., 1992
2,3,7,8-TCDD	Red-necked phesant (egg)	injection	1	ug/kg	LOAEL		embryo mortality	Nosek et al., 1992
2,3,7,8-TCDD	Red-necked phesant (egg)	injection	10	ug/kg	LOAEL		embryo mortality	Nosek et al., 1992
2,3,7,8-TCDD	Rat	diet	1.00E-06	mg/kg/day	NOAEL	3 generations		Murray et al., 1979
2,3,7,8-TCDD	Rat	diet	1.00E-05	mg/kg/day	LOAEL	3 generations	reproductive	Murray et al., 1979
2,3,7,8-TCDD	Ring-necked phesant	diet	1.40E-05	mg/kg/day	NOAEL	10 weeks		Nosek et al., 1992
2,3,7,8-TCDD	Ring-necked phesant	diet	1.40E-04	mg/kg/day	LOAEL	10 weeks	reproductive	Nosek et al., 1992
2,3,7,8-TCDD	1 day old chick	diet	1.00E-06	mg/kg/day	NOAEL	21 days		McKinney et al., 1976
2,3,7,8-TCDD	1 day old chick	diet	1.00E-05	mg/kg/day	LOAEL	21 days	mortality	McKinney et al., 1976

[a] Although primary literature sources are listed, much of the data were obtained from secondary sources (see reference section); therefore, some of the details from the studies (e.g., observation, test method, effect) are lacking. All primary sources will be obtained and reviewed for the final BERA.

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APPENDIX C
CBR DATA

Table C-1. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Copper

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	4998	Mortality	LD100	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	532.5	Mortality	LD19	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	630.5	Mortality	LD35	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	725.5	Mortality	LD41	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	600	Mortality	LD50	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	775	Mortality	LD50	Injection	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	735.75	Mortality	LD52	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	1120.75	Mortality	LD73	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	1655.5	Mortality	LD84	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Chironomus decorus	Midge	FW	Copper Sulfate	7758-98-7	2895	Mortality	LD95	Water	Whole Body	Larval		1987	Kosalwat P, AW Knight
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	2.6	Mortality	LOED	Water	Whole Body	Fry		2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	2.6	Mortality	LD10	Water	Whole Body	Fry		2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	2	Mortality	NOED	Water	Whole Body	Fry		2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	2.6	Growth	ED33	Water	Whole Body	Fry	weight	2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	3.22	Mortality	LD45	Water	Whole Body	Fry		2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	3.22	Growth	ED48	Water	Whole Body	Fry	weight	2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	2	Growth	ED19	Water	Whole Body	Fry	weight	2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.96	Growth	LOED	Water	Whole Body	Fry	weight	2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.96	Growth	ED15	Water	Whole Body	Fry	weight	2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.68	Growth	NOED	Water	Whole Body	Fry	weight	2002	Hansen, JA, J Lipton, PG Welsh, J Morris, D Cacela, MJ Suedkamp
Daphnia magna	Water flea	FW	Copper	7440-50-8	26	Growth	NOED	Water	Whole Body	Juvenile		2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	4.4	Growth	NOED	Ingestion	Whole Body	Juvenile		2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	5.6	Growth	ED138	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Daphnia magna	Water flea	FW	Copper	7440-50-8	8.4	Growth	NOED	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Growth	ED175	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Growth	ED181	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Growth	ED181	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	26	Growth	NOED	Ingestion	Whole Body	Juvenile		2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12	Growth	NOED	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12.4	Growth	ED144	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	16	Growth	NOED	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	7.6	Reproduction	NOED	Ingestion	Whole Body	Juvenile	increased number of offspring	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	70	Reproduction	ED130	Ingestion	Whole Body	Juvenile	increased number of offspring	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12	Reproduction	NOED	Ingestion	Whole Body	Juvenile	increased number of offspring	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	4.4	Reproduction	NOED	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	5.6	Reproduction	ED140	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Reproduction	ED150	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Reproduction	ED160	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen

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Daphnia magna	Water flea	FW	Copper	7440-50-8	6	Reproduction	ED130	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12	Reproduction	ED140	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12.4	Reproduction	ED160	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	16	Reproduction	ED150	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Mysella anomala	Bivalve	SW	Copper	7440-50-8	60	Mortality	LD20	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Copper	7440-50-8	30	Mortality	LD25	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Copper	7440-50-8	52	Mortality	LD25	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Copper	7440-50-8	76	Mortality	LD50	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Tellina deltoidalis	Bivalve	SW	Copper	7440-50-8	74	Mortality	LD42	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Soletellina alba	Bivalve	SW	Copper	7440-50-8	16	Mortality	LD50	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Australonereis ehlersi	Polychaete	SW	Copper	7440-50-8	36	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Nephtys australiensis	Polychaete	SW	Copper	7440-50-8	38	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Copper	7440-50-8	8	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Soletellina alba	Bivalve	SW	Copper	7440-50-8	8	Mortality	LD78	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Chlorella sp.	Algae - Green	FW	Copper	7440-50-8	2.89E-14	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Chlorella sp.	Algae - Green	FW	Copper	7440-50-8	1.60E-14	Growth	ED10	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Chlorella sp.	Algae - Green	FW	Copper	7440-50-8	6.00E-15	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen

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Chlorella sp.	Algae - Green	FW	Copper	7440-50-8	1.43E-14	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	5.29E-14	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	1.69E-14	Growth	ED10	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	1.20E-14	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Scenedesmus subspicatus	unicellualr freshwater algae	FW	Copper	7440-50-8	3.80E-13	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Scenedesmus subspicatus	unicellualr freshwater algae	FW	Copper	7440-50-8	9.50E-13	Growth	ED50	Water	Whole Body	Other	Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Chlorella sp.	Algae - Green	FW	Copper	7440-50-8	4.00E-14	Growth	ED50	Water	Whole Body	Other	pH 6.0 Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Chlorella sp.	Algae - Green	FW	Copper	7440-50-8	2.50E-14	Growth	ED50	Water	Whole Body	Other	pH 6.5 Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	4.20E-14	Growth	ED50	Water	Whole Body	Other	pH 5.9 Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	5.80E-14	Growth	ED50	Water	Whole Body	Other	pH 6.5 Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	7.10E-14	Growth	ED50	Water	Whole Body	Other	pH 7.5 Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Selenastrum capricornutum	Selenastrum capricornutum	FW	Copper	7440-50-8	4.80E-14	Growth	ED50	Water	Whole Body	Other	pH 8.5 Internal measurement of Cu was a slightly more stable predictor of toxicity than the external measurement,	2005	De Schamphelaere KAC; JL Stauber; KL Wilde; SJ Markich; PL Brown; NM Franklin; NM Creighton; CR Janssen
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	4.48	Mortality	LOED	Combined	Whole Body	Immature		1994	Mount, D.R., A.K. Barth, T.D.Garrison, K.A. Barten, and J.R. Hockett

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Mytilus edulis	Mussel	SW	Copper	7440-50-8	22.1	Mortality	LOED	Water	Soft Tissue	Adult		1988	Kaitala S
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	40	Behavior	ED56	Absorption	Whole Body	Adult	56% Decrease in filtration rate.	1992	Kraak, M.H.S., D. Lavy, W.M.H. Peeters, and C. Davids
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	40	Behavior	ED67	Absorption	Whole Body	Adult	67% Decrease in filtration rate.	1992	Kraak, M.H.S., D. Lavy, W.M.H. Peeters, and C. Davids
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	80	Behavior	ED73	Absorption	Whole Body	Adult	73% Decrease in filtration rate.	1992	Kraak, M.H.S., D. Lavy, W.M.H. Peeters, and C. Davids
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	4	Behavior	NOED	Absorption	Whole Body	Adult	No difference in filtration rate.	1992	Kraak, M.H.S., D. Lavy, W.M.H. Peeters, and C. Davids
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	80	Mortality	NOED	Absorption	Whole Body	Adult	No increased mortality.	1992	Kraak, M.H.S., D. Lavy, W.M.H. Peeters, and C. Davids
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	4	Behavior	NOED	Absorption	Whole Body	Adult	No difference in filtration rate. Residue was determined from graph and is approximate.	1994	Kraak, M.H.S., M. Touissaint, D. Lavy, and C. Davids.
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	32	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality. Residue was determined from graph and is approximate.	1994	Kraak, M.H.S., M. Touissaint, D. Lavy, and C. Davids.
Salvelinus fontinalis	Trout - Brook	FW	Copper	7440-50-8	3.4	Growth	NOED	Absorption	Muscle	1-yr old	No significant difference in weight gain compared to controls. No significant residue accumulation due to treatment.	1974	McKim, J.M. and D.A. Benoit
Salvelinus fontinalis	Trout - Brook	FW	Copper	7440-50-8	3.4	Mortality	NOED	Absorption	Muscle	1-yr old	No increase in mortality. No significant residue accumulation due to treatment.	1974	McKim, J.M. and D.A. Benoit
Salvelinus fontinalis	Trout - Brook	FW	Copper	7440-50-8	5.6	Mortality	NOED	Absorption	Eggs	Egg-embryo	No significant decrease in hatchability.	1974	McKim, J.M. and D.A. Benoit
Salvelinus fontinalis	Trout - Brook	FW	Copper	7440-50-8	3.4	Reproduction	NOED	Absorption	Muscle	1-yr old	No significant difference in number of progeny or viable eggs/female. No significant residue accumulation due to treatment.	1974	McKim, J.M. and D.A. Benoit
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	48.86	Mortality	LD50	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	54	Mortality	LD50	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	55.68	Mortality	LD50	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	62.67	Mortality	LD50	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	64.36	Mortality	LD50	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	87.5	Mortality	LD50	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Anaitides maculata	Polychaete	SW	Copper	7440-50-8	95.5	Mortality	NOED	Water	Whole Body	NS		1975	McLusky DS, CNK Phillips
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	20	Behavior	LOED	Combined	Whole Body	NA	Significant decrease in filtration rate.	1993	Mersch, J., E. Morhain, and C. Mouvet.
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	14	Behavior	NOED	Combined	Whole Body	NA	No difference in filtration rate.	1993	Mersch, J., E. Morhain, and C. Mouvet.

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	20	Mortality	NOED	Combined	Whole Body	NA	No increase in mortality.	1993	Mersch, J., E. Morhain, and C. Mouvet.
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	15	Mortality	NOED		Soft Tissue	Adult	Population 2 Indigenous mussels, plus 3 populations from other areas in caged experiment]	1996	Mersch J, P Wagner, and J-C. Pihan
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	25	Mortality	NOED		Soft Tissue	Adult	Population 3 (Transferred Pont-a-Mousson) Indigenous mussels, plus 3 populations from other areas in caged experiment]	1996	Mersch J, P Wagner, and J-C. Pihan
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	26	Mortality	NOED		Soft Tissue	Adult	Population 1 (Indigenous) Indigenous mussels, plus 3 populations from other areas in caged experiment]	1996	Mersch J, P Wagner, and J-C. Pihan
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	26	Mortality	NOED		Soft Tissue	Adult	Population 1 Indigenous mussels, plus 3 populations from other areas in caged experiment]	1996	Mersch J, P Wagner, and J-C. Pihan
Dreissena polymorpha	Mussel - Zebra	FW	Copper	7440-50-8	42	Mortality	NOED		Soft Tissue	Adult	Population 4 (Transferred Schengen) Indigenous mussels, plus 3 populations from other areas in caged experiment]	1996	Mersch J, P Wagner, and J-C. Pihan
Macoma balthica	Baltic macoma	SW	Copper	7440-50-8	16.4	Mortality	LD18	Combined	Whole Body	Adult	400 uM Cu	1996	Absil MCP, M Berntssen, LJA Gerringa
Macoma balthica	Baltic macoma	SW	Copper	7440-50-8	13.8	Mortality	LD28	Water	Whole Body	Adult		1996	Absil MCP, M Berntssen, LJA Gerringa
Macoma balthica	Baltic macoma	SW	Copper	7440-50-8	12	Mortality	LD32	Combined	Whole Body	Adult	Day 40 post exposure 17d exposure	1996	Absil MCP, M Berntssen, LJA Gerringa
Macoma balthica	Baltic macoma	SW	Copper	7440-50-8	12	Mortality	LD45	Combined	Whole Body	Adult	Day 40 post exposure 17 d exposure	1996	Absil MCP, M Berntssen, LJA Gerringa
Macoma balthica	Baltic macoma	SW	Copper	7440-50-8	5	Mortality	NOED	Combined	Whole Body	Adult		1996	Absil MCP, M Berntssen, LJA Gerringa
Cerastoderma edule	Clam	SW	Copper	7440-50-8	5.6	Mortality	NOED	Combined	Whole Body	Adult		1996	Absil MCP, M Berntssen, LJA Gerringa
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	10.68	Mortality	LD50	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	11.72	Mortality	LD50	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	12.05	Mortality	LD50	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	12.81	Mortality	LD50	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	12.88	Mortality	LD50	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	13.96	Mortality	LD50	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Cirriformia spirabrancha	Polychaete	SW	Copper	7440-50-8	6.422	Mortality	NOED	Water	Whole Body	NS		1976	Milanovich FP, R Spies, MS Guram, EE Sykes
Ictalurus punctatus	Catfish-Channel	FW	Copper	7440-50-8	0.02	Growth	ED40	Ingestion	Muscle	Juvenile	Weight gain	1981	Murai T, JW Andrews, RG Smith Jr.
Ictalurus punctatus	Catfish-Channel	FW	Copper	7440-50-8	0.02	Growth	LOED	Ingestion	Muscle	Juvenile		1981	Murai T, JW Andrews, RG Smith Jr.

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Neanthes arenaceodentata	Neanthes	SW	Copper	7440-50-8	54	Mortality	LD100	Water	Whole Body	Adult	No sediment substrate. Sediment type does affect time to 50% mortality; in this study, there was not a relationship between body burden and toxicity.	1979	Pesch CE
Neanthes arenaceodentata	Neanthes	SW	Copper	7440-50-8	292.8	Mortality	LD95	Water	Whole Body	Adult	Mud substrate	1979	Pesch CE
Neanthes arenaceodentata	Neanthes	SW	Copper	7440-50-8	209.4	Mortality	LD97	Water	Whole Body	Adult	Mixture of sand and mud substrate	1979	Pesch CE
Neanthes arenaceodentata	Neanthes	SW	Copper	7440-50-8	198.8	Mortality	LD99	Water	Whole Body	Adult	Sand substrate	1979	Pesch CE
Protothaca staminea	Pacific littleneck clam	SW	Copper	7440-50-8	0.86	Mortality	LD11	Water	Muscle	Adult		1980	Roesijadi G
Protothaca staminea	Pacific littleneck clam	SW	Copper	7440-50-8	9.54	Mortality	LD11	Water	Whole Body	Adult		1980	Roesijadi G
Protothaca staminea	Pacific littleneck clam	SW	Copper	7440-50-8	7	Mortality	LD14	Water	Muscle	Adult		1980	Roesijadi G
Protothaca staminea	Pacific littleneck clam	SW	Copper	7440-50-8	9.34	Mortality	LD14	Water	Whole Body	Adult		1980	Roesijadi G
Nomacheilus barbatulus	Stone Loach	FW	Copper	7440-50-8	1.64	Mortality	LD50	Water	Muscle	NS		1976	Solbe JF de LG, VA Cooper
Nomacheilus barbatulus	Stone Loach	FW	Copper	7440-50-8	2.02	Mortality	NOED	Water	Muscle	NS		1976	Solbe JF de LG, VA Cooper
Hydra littoralis	Hydra	FW	Copper	7440-50-8	9.2	Reproduction	ED140	Water	Whole Body	Adult	Asexual reproduction	1978	Stebbing ARD and AJ Pomroy
Hydra littoralis	Hydra	FW	Copper	7440-50-8	4.4	Reproduction	ED50	Water	Whole Body	Adult	Asexual reproduction	1978	Stebbing ARD and AJ Pomroy
Hydra littoralis	Hydra	FW	Copper	7440-50-8	3.6	Reproduction	NOED	Water	Whole Body	Adult	Asexual reproduction	1978	Stebbing ARD and AJ Pomroy
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	11.44	Mortality	LD14	Water	Whole Body	Larval	pH 7.6	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	20.34	Mortality	LD29	Water	Whole Body	Egg	pH 6.3	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	8.9	Mortality	LD47	Water	Whole Body	Larval	pH 6.3	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	101.68	Mortality	LD81	Water	Whole Body	Larval	pH 6.3	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	11.44	Mortality	LOED	Water	Whole Body	Larval	pH 7.6	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	20.34	Mortality	LOED	Water	Whole Body	Egg	pH 6.3	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	5.08	Mortality	NOED	Water	Whole Body	Larval	pH 7.6	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	8.9	Mortality	NOED	Water	Whole Body	Egg	pH 6.3	1996	Stouthart XJHX, JLM Haans, RAC Lock, SE Wendelaar Bonga
Chironomus riparius	Midge	FW	Copper	7440-50-8	122	Growth	ED16	Water	Whole Body	Larval		1992	Timmermans KR, W Peeters, and M. Tonkes
Allorchestes compressa	Amphipod	SW	Copper	7440-50-8	98	Growth	LOED	Water	Whole Body	Juvenile	Weight	1991	Ahsanullah M, AR Williams

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Allorchestes compressa	Amphipod	SW	Copper	7440-50-8	104	Mortality	LOED	Water	Whole Body	Juvenile		1991	Ahsanullah M, AR Williams
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	12.1	Mortality	LOED	Combined	Whole Body	Egg	Larval Mort, Ph 6.3, Body Burd From Graph	1996	Stouthart, J.H.X., Haans, J.L.M., Lock, R.A.C., Bonga, S.E.W.
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	12.1	Mortality	LOED	Combined	Whole Body	Egg	Larval Mort, Ph 7.6, Body Burd From Graph	1996	Stouthart, J.H.X., Haans, J.L.M., Lock, R.A.C., Bonga, S.E.W.
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	24.1	Reproduction	LOED	Combined	Whole Body	Egg	Egg Mortality, Ph 6.3, Body Burd From Graph	1996	Stouthart, J.H.X., Haans, J.L.M., Lock, R.A.C., Bonga, S.E.W.
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	7.62	Mortality	NOED	Combined	Whole Body	Egg	Larval Mort, Ph 7.6, Body Burd From Graph	1996	Stouthart, J.H.X., Haans, J.L.M., Lock, R.A.C., Bonga, S.E.W.
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	12.1	Reproduction	NOED	Combined	Whole Body	Egg	Egg Mortality, Ph 7.6, Body Burd From Graph	1996	Stouthart, J.H.X., Haans, J.L.M., Lock, R.A.C., Bonga, S.E.W.
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	12.1	Reproduction	NOED	Combined	Whole Body	Egg	Egg Mortality, Ph 6.3, Body Burd From Graph	1996	Stouthart, J.H.X., Haans, J.L.M., Lock, R.A.C., Bonga, S.E.W.
Themisto libellula	Mesoplankton amphipod	SW	Copper	7440-50-8	374	Mortality	LD50	Water	Whole Body	Adult		1997	Ritterhoff, J., and G-P. Zauke
Themisto abyssorum	Mesoplankton amphipod	SW	Copper	7440-50-8	374	Mortality	LD50	Water	Whole Body	Adult		1997	Ritterhoff, J., and G-P. Zauke
Calanus hyperboreus	Calanoid copepod	SW	Copper	7440-50-8	1320	Mortality	LD50	Water	Whole Body	Adult	low concentration exposure	1997	Ritterhoff, J., and G-P. Zauke
Calanus hyperboreus	Calanoid copepod	SW	Copper	7440-50-8	2440	Mortality	LD50	Water	Whole Body	Adult	High concentration exposure	1997	Ritterhoff, J., and G-P. Zauke
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	20.6	Growth	ED10	Water	Whole Body	Fry		1996	Marr, J.C.A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J.S. Meyer, and C. Hogstrand
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	18.1	Growth	ED25	Water	Whole Body	Fry		1996	Marr, J.C.A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J.S. Meyer, and C. Hogstrand
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	20.5	Growth	ED25	Water	Whole Body	Fry		1996	Marr, J.C.A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J.S. Meyer, and C. Hogstrand
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	20.9	Growth	ED25	Water	Whole Body	Fry		1996	Marr, J.C.A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J.S. Meyer, and C. Hogstrand
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	18.1	Growth	ED45	Water	Whole Body	Fry		1996	Marr, J.C.A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J.S. Meyer, and C. Hogstrand
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	25.9	Growth	ED50	Water	Whole Body	Fry		1996	Marr, J.C.A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J.S. Meyer, and C. Hogstrand
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	13.3	Growth	ED25	Absorption	Whole Body	Juvenile	Growth as weight calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	81.2	Mortality	LD100	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	148	Mortality	LD100	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	13.3	Mortality	LD25	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	24.1	Mortality	LD25	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	41.7	Mortality	LD25	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	16.5	Mortality	LD50	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	51.8	Mortality	LD50	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	30.4	Mortality	NOED	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	49.4	Mortality	NOED	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Mytilus edulis	Mussel	SW	Copper	7440-50-8	34.2	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality in 14 days.	1983	Hvilsom, M.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	49.6	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality in 7-8 days.	1983	Hvilsom, M.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	49.6	Growth	LOED	Absorption	Whole Body	Adult	Significant decrease in shell length.	1983	Hvilsom, M.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	34.2	Growth	NOED	Absorption	Whole Body	Adult	No significant difference in shell length.	1983	Hvilsom, M.M.
Chironomus decorus	Midge	FW	Copper	7440-50-8	1000	Mortality	LD100	Absorption	Whole Body	Larval	100% Mortality	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	126	Mortality	LD25	Ingestion	Whole Body	Larval	25% Mortality in 72 hours.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	142	Mortality	LD50	Absorption	Whole Body	Larval	50% Mortality in 48 hours.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	155	Mortality	LD50	Ingestion	Whole Body	Larval	50% Mortality in 72 hours.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	190	Mortality	LD85	Ingestion	Whole Body	Larval	85% Mortality in 72 hours.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	87.2	Mortality	LOED	Absorption	Whole Body	Larval	10 to 15% Mortality in 48 hours.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	85.4	Mortality	NOED	Absorption	Whole Body	Larval	No Effect On Mortality	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	90	Mortality	NOED	Absorption	Whole Body	Larval	No Effect On Mortality	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	116	Mortality	NOED	Ingestion	Whole Body	Larval	No Effect On Mortality in 20 hours.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	18	Development	LOED	Ingestion	Whole Body	Larval	Significant increase in time to adult emergence by 10 days.	1987	Kosalwat, P. and A.W. Knight
Chironomus decorus	Midge	FW	Copper	7440-50-8	13	Development	NOED	Ingestion	Whole Body	Larval	No Effect On Time To Adult Emergence	1987	Kosalwat, P. and A.W. Knight
Meretrix casta	Clam - marine	SW	Copper	7440-50-8	201	Mortality	LOED	Absorption	Whole Body	NA	Average lethal body burden for all exposure concentrations up to 184 hours.	1980	Kumaraguru, A.K., D. Selvi and V.K. Venugopalan
Mytilus edulis	Mussel	SW	Copper	7440-50-8	12	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 15 days.	1979	Martin, J.L.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	12	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 27 days.	1979	Martin, J.L.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	12	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 8 days.	1979	Martin, J.L.M.

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Mytilus edulis	Mussel	SW	Copper	7440-50-8	15	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 7 days.	1979	Martin, J.L.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	23	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 6.5 days.	1979	Martin, J.L.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	36	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 6.25 days.	1979	Martin, J.L.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	56	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% Mortality in 6.25 days.	1979	Martin, J.L.M.
Mytilus edulis	Mussel	SW	Copper	7440-50-8	80	Mortality	LD100	Absorption	Whole Body	Adult	Lethal Body Burden. 100% mortality in 6 days.	1979	Martin, J.L.M.
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.6	Mortality	LD100	Absorption	Whole Body	Immature	100% Mortality	1981	Dixon, D.G. and J.B. Sprague
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	7	Mortality	NA	Absorption	Whole Body	Immature	Pre-exposure for 21 days produced increased tolerance to lethal concentration of copper -- 70% survival in 570 ug/L for 6 days after pre-exposure.	1981	Dixon, D.G. and J.B. Sprague
Orconectes rusticus	Crayfish	FW	Copper	7440-50-8	50	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Survivorship	1980	Evans, M.L.
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	2.22	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality In 7 Hours. Residue calculated at 6 hours exposure.	1992	Handy, R.D.
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	49.9	Mortality	NOED	Water	Eggs	Egg		2002	Flik, G., X.J.H.X. Stouthart, F.A.T. Spanings, R.A.C. Lock, J.C. Fenwick, S.E.W. Bonga
Cyprinus carpio	Common carp	FW	Copper	7440-50-8	11.7	Mortality	LOED	Water	Whole Body	Egg	Embryo whole body sampled.	2002	Flik, G., X.J.H.X. Stouthart, F.A.T. Spanings, R.A.C. Lock, J.C. Fenwick, S.E.W. Bonga
Mytilus edulis	Mussel	SW	Copper	7440-50-8	4	Growth	LOED	Water	Whole Body	Juvenile	LOED for growth is based on increase in length of juveniles as well as weight increases.	2001	Grout, J.A. C.D. Levings
Mytilus edulis	Mussel	SW	Copper	7440-50-8	8	Mortality	LOED	Water	Whole Body	Juvenile		2001	Grout, J.A. C.D. Levings
Paracentrotus lividus	Sea Urchin	SW	Copper	7440-50-8	8.74	Mortality	LOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Copper	7440-50-8	1.32	Mortality	NOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Copper	7440-50-8	30.36	Mortality	LD50	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Copper	7440-50-8	8.74	Mortality	LOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Mugil cephalus	Striped mullet	SW	Copper	7440-50-8	1.5	Mortality	LD10	Water	Whole Body	Juvenile	Short M&M with little information	2000	Zyadah, MA, E Abdel-Baky
Mugil cephalus	Striped mullet	SW	Copper	7440-50-8	7.5	Mortality	LD100	Water	Whole Body	Juvenile	Short M&M with little information	2000	Zyadah, MA, E Abdel-Baky
Mysis relicta	Shrimp -Opossum	SW	Copper	7440-50-8	9.7	Mortality	LD33	Water	Whole Body	Adult	Short M&M with little information	2000	Zyadah, MA, E Abdel-Baky

Table C-1. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Copper

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Mysis relicta	Shrimp -Opossum	SW	Copper	7440-50-8	5.9	Mortality	LD67	Water	Whole Body	Adult	Short M&M with little information	2000	Zyadah, MA, E Abdel-Baky
Mysis relicta	Shrimp -Opossum	SW	Copper	7440-50-8	7.4	Mortality	LD35	Water	Whole Body	Adult	Short M&M with little information	2000	Zyadah, MA, E Abdel-Baky
Mysis relicta	Shrimp -Opossum	SW	Copper	7440-50-8	7.8	Mortality	LD82	Water	Whole Body	Adult	Short M&M with little information	2000	Zyadah, MA, E Abdel-Baky
Hyalella azteca	Amphipod - Freshwater	FW	Copper	7440-50-8	151.239	Mortality	LD25	Water	Whole body	Adult	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used Imhoff cones instead.	2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.72	Growth	NOED	Ingestion	Whole Body	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	0.32	Growth	NOED	Ingestion	Muscle	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.72	Mortality	NOED	Ingestion	Whole Body	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	0.32	Mortality	NOED	Ingestion	Muscle	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	5.24	Growth	NOED	Ingestion	Whole Body	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	0.32	Growth	NOED	Ingestion	Muscle	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	5.24	Mortality	NOED	Ingestion	Whole Body	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	0.32	Mortality	NOED	Ingestion	Muscle	Juvenile		2001	Kamunda CN, M Grosell, JNA Lott, and CM Wood
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	19.79	Growth	NOED	Water	Whole Body	Fry	Length	2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	19.79	Growth	NOED	Water	Whole Body	Fry	Weight	2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	7.58	Mortality	LOED	Water	Whole Body	Fry		2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	7.58	Mortality	LD05	Water	Whole Body	Fry		2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	19.79	Mortality	LD05	Water	Whole Body	Fry		2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	19.79	Mortality	LOED	Water	Whole Body	Fry		2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Salvelinus confluentus	Bull Trout	FW	Copper	7440-50-8	19.79	Mortality	LOED	Water	Whole Body	Fry		2002	Hansen J.A., P.G. Welsh, J. Lipton, D. Cacela
Hydra littoralis	Hydra	FW	Copper	7440-50-8	3.6	Growth	NOED				Stebbing and Pomroy, 1978	1984	Dillon TM
Hydra littoralis	Hydra	FW	Copper	7440-50-8	4.2	Growth	LOED				Stebbing and Pomroy, 1978	1984	Dillon TM
Terapon jarbua	Grunt	SW	Copper	7440-50-8	5.12	Growth	NOED	Ingestion	Muscle	Juvenile		2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	3.56	Growth	NOED	Ingestion	Muscle	Juvenile		2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	3.56	Mortality	NOED	Ingestion	Muscle	Juvenile		2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	5.12	Mortality	NOED	Ingestion	Muscle	Juvenile		2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	3.56	Mortality	NOED	Ingestion	Muscle	Juvenile		2005	Long A; WX Wang

Table C-1. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Copper

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Terapon jarbua	Grunt	SW	Copper	7440-50-8	5.12	Mortality	NOED	Ingestion	Muscle	Juvenile		2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	3.44	Mortality	NOED	Water	Whole Body	Juvenile	Cu 1ug/l + Ag 0.2 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	2.36	Mortality	NOED	Water	Whole Body	Juvenile	Cu 1ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	4.36	Mortality	NOED	Water	Whole Body	Juvenile	Cu 10ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	5.62	Mortality	NOED	Water	Whole Body	Juvenile	Cu 10ug/l + Ag 0.2 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	3.44	Growth	NOED	Water	Whole Body	Juvenile	Cu 1ug/l + Ag 0.2 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	2.36	Growth	NOED	Water	Whole Body	Juvenile	Cu 1ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	4.36	Growth	NOED	Water	Whole Body	Juvenile	Cu 10ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Copper	7440-50-8	5.62	Growth	NOED	Water	Whole Body	Juvenile	Cu 10ug/l + Ag 0.2 ug/l	2005	Long A; WX Wang
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.4	Mortality	LD11	Water	Whole Body	Juvenile	HighSalt	2005	Kamonde CN, S Niyogi, CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.4	Growth	ED35	Water	Whole Body	Juvenile	HighSalt	2005	Kamonde CN, S Niyogi, CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.7	Mortality	LD26	Water	Whole Body	Juvenile	Low Salt	2005	Kamonde CN, S Niyogi, CM Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Copper	7440-50-8	1.7	Growth	ED56	Water	Whole Body	Juvenile	Low Salt	2005	Kamonde CN, S Niyogi, CM Wood
Daphnia magna	Water flea	FW	Copper	7440-50-8	26	Growth	NOED	Water	Whole Body	Juvenile		2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	4.4	Growth	NOED	Ingestion	Whole Body	Juvenile		2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	5.6	Growth	ED138	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8.4	Growth	NOED	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Growth	ED175	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Growth	ED181	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Growth	ED181	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	26	Growth	NOED	Ingestion	Whole Body	Juvenile		2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12	Growth	NOED	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12.4	Growth	ED144	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	16	Growth	NOED	Ingestion	Whole Body	Juvenile	The exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen

Table C-1. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Copper

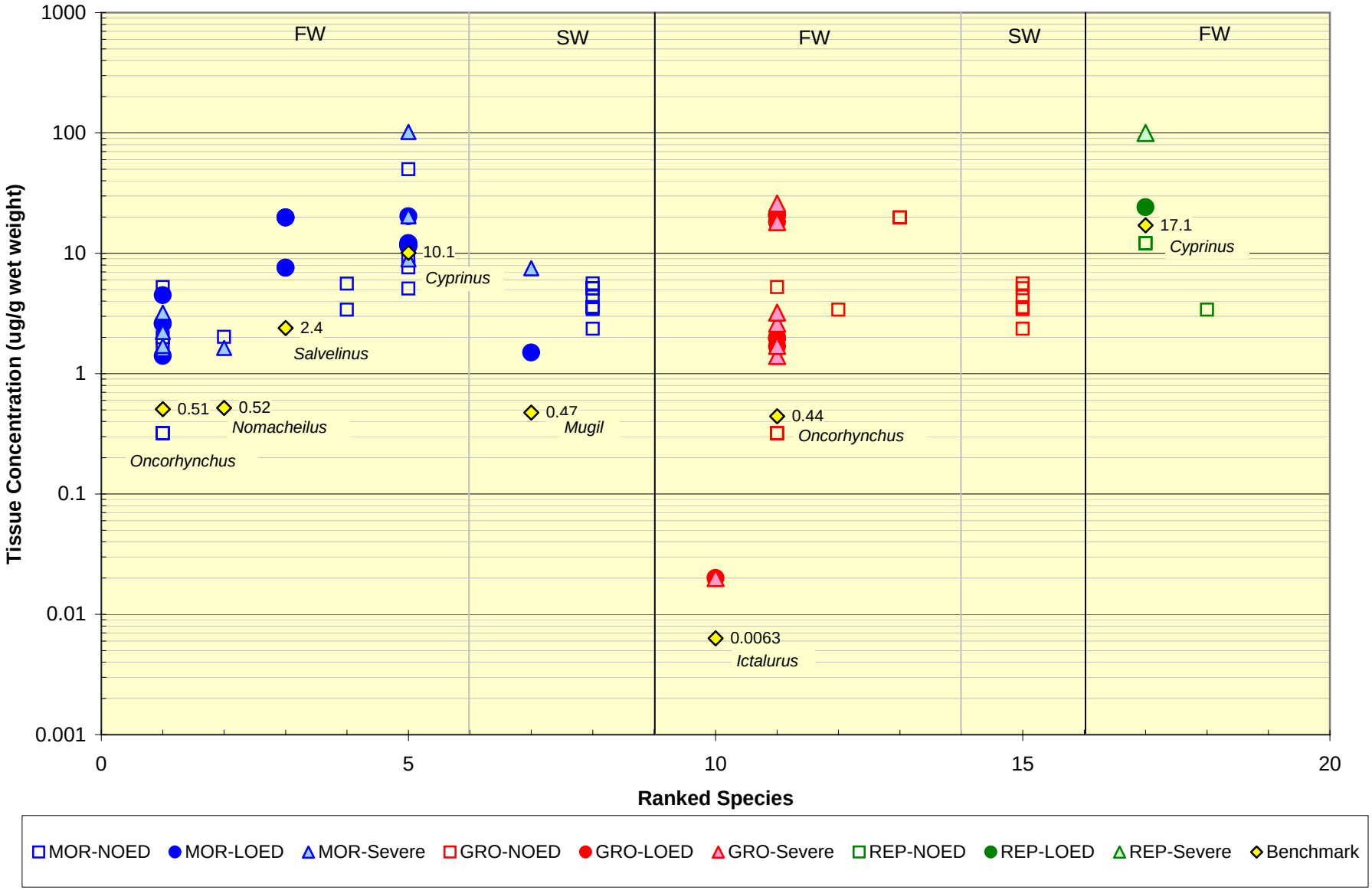
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Daphnia magna	Water flea	FW	Copper	7440-50-8	7.6	Reproduction	NOED	Ingestion	Whole Body	Juvenile	increased number of offspring	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	70	Reproduction	ED130	Ingestion	Whole Body	Juvenile	increased number of offspring	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12	Reproduction	NOED	Ingestion	Whole Body	Juvenile	increased number of offspring	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	4.4	Reproduction	NOED	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	5.6	Reproduction	ED140	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Reproduction	ED150	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	8	Reproduction	ED160	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	6	Reproduction	ED130	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12	Reproduction	ED140	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	12.4	Reproduction	ED160	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Daphnia magna	Water flea	FW	Copper	7440-50-8	16	Reproduction	ED150	Ingestion	Whole Body	Juvenile	increased number of offspringThe exposure is the water concentration of Cu used to dose the algae fed to Daphnia	2004	DeSchamphelaere, KAC; CR Janssen
Mytilus edulis	Mussel	SW	Copper	7440-50-8	6	Mortality	LD50	Water	Visceral Tissue	Adult		1986	Amiard-Triquet C, B Berthet, C Metayer, JC Amiard
Chironomus riparius	Midge	FW	Copper	7440-50-8	22.8	Growth	NOED	Absorption	Whole Body	Larval	Length- Silicate	2005	Pery ARR, A Bethune, J Gahau, R Mons, J Garric
Chironomus riparius	Midge	FW	Copper	7440-50-8	39.15	Growth	NOED	Absorption	Whole Body	Larval	Length - Artifical Peat	2005	Pery ARR, A Bethune, J Gahau, R Mons, J Garric
Chironomus riparius	Midge	FW	Copper	7440-50-8	21.9	Growth	NOED	Absorption	Whole Body	Larval	Length - Field collected in Beaujeu	2005	Pery ARR, A Bethune, J Gahau, R Mons, J Garric
Chironomus riparius	Midge	FW	Copper	7440-50-8	24.6	Growth	NOED	Absorption	Whole Body	Larval	Length - Field collected in Port-Galland	2005	Pery ARR, A Bethune, J Gahau, R Mons, J Garric

Table C-1. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Copper

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Mytilus edulis	Mussel	SW	Copper	7440-50-8	3.4	Mortality	NOED	Combined	Whole Body	Adult		2003	St-Jean SD, SC Courtenay, RW Parker
Mytilus edulis	Mussel	SW	Copper	7440-50-8	3.4	Growth	NOED	Combined	Whole Body	Adult	Length - Growth in test animals increased in direct proportion to proximity to pulpmill effluent plume which was deemed to reflect not the contaminants, but the increased amounts of nutrients.	2003	St-Jean SD, SC Courtenay, RW Parker

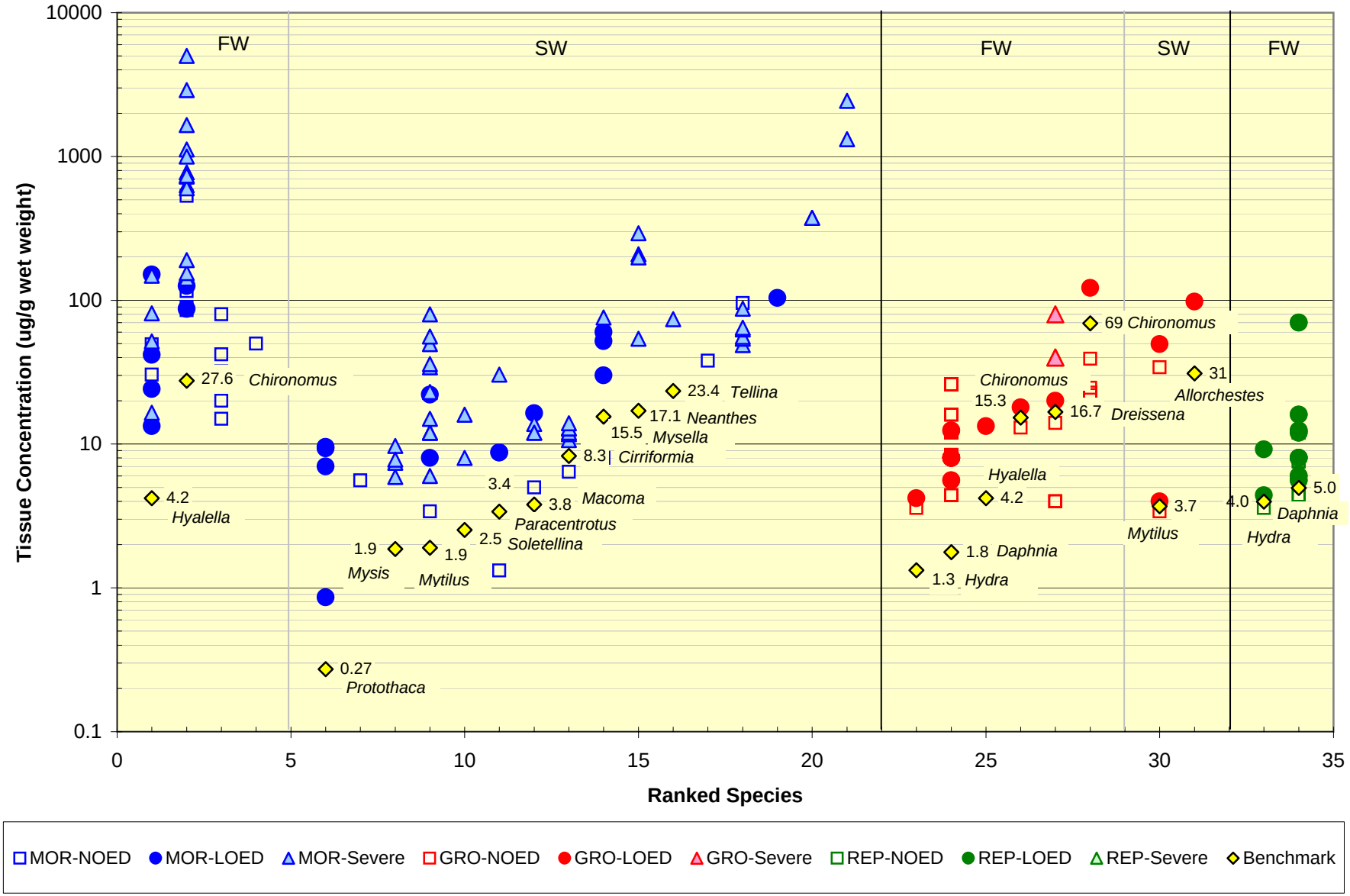
a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx = Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, injection, or water
NS = not specified
NA = not available

Chart C-1. Summary of Copper Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



2/3/2006

Chart C-2. Summary of Copper Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity



2/3/2006

Table C-2. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Lead

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED11	Ingestion	Whole Body	Fry	growth=length Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED30	Ingestion	Whole Body	Fry	growth=wt Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED19	Ingestion	Whole Body	Fry	Growth rate (%/d) Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED16	Ingestion	Whole Body	Fry	Growth rate (%/d) Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	4.02	Growth	NOED	Water	Whole Body	Egg	F2 Offspring with Spinal Deformations were counted as unsucessful, discarded and removed from the Growth calculations	1976	Holcombe GW, DA Benoit, EN Leonard, JM McKim
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	0.402	Reproduction	NOED	Water	Eggs	Egg	F2 Hatchabillity Offspring with Spinal Deformations were counted as unsucessful, discarded and removed from the Hatchability calculations	1976	Holcombe GW, DA Benoit, EN Leonard, JM McKim

Table C-2. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Lead

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	4.02	Mortality	NOED	Water	Eggs	Egg	F2 Hatchabillity Offspring with Spinal Deformations were counted as unsucessful, discarded	1976	Holcombe GW, DA Benoit, EN Leonard, JM McKim
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	34	Mortality	NOED	Water	Soft Tissue	NS	Mussel Bioconcentrations taken as Musssels dies during experiment.	1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal
Gammarus pseudolimnaeus	Amphipod	FW	Lead	7439-92-1	40	Mortality	LD61	Water	Whole Body	Adult	[log scale--difficult to interpret]	1978	Spehar RL, RL Anderson, JT Fiandt
Gammarus pseudolimnaeus	Amphipod	FW	Lead	7439-92-1	102	Mortality	LD61	Water	Whole Body	Adult	[log scale--difficult to interpret]; no residue data for stonefilies, caddisflies, and snails. Stated that Pb conc.to 565 ug/L did not decrease survival	1978	Spehar RL, RL Anderson, JT Fiandt
Chironomus riparius	Midge	FW	Lead	7439-92-1	280	Growth	ED29	Water	Whole Body	Larval		1992	Timmermans KR, W Peeters, and M. Tonkes
Chironomus riparius	Midge	FW	Lead	7439-92-1	280	Growth	ED29	Water	Whole Body	Larval		1992	Timmermans KR, W Peeters, and M. Tonkes
Crassostrea virginica	Eastern oyster	SW	Lead	7439-92-1	2.28	Growth	NOED	Absorption	Whole Body	Adult	No significant difference in weight gain.	1979	Zaroogian, G.E., G. Morrison, and J.F. Heltshe.
Crassostrea virginica	Eastern oyster	SW	Lead	7439-92-1	2.28	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality.	1979	Zaroogian, G.E., G. Morrison, and J.F. Heltshe.
Crassostrea virginica	Eastern oyster	SW	Lead	7439-92-1	2.6	Reproduction	NOED	Absorption	Whole Body	Adult	No effect on larva viability or development.	1979	Zaroogian, G.E., G. Morrison, and J.F. Heltshe.
Chironomus gr. thummi	Midge	FW	Lead	7439-92-1	2.56	Morphology	NOED	Combined	Whole Body	Egg-embryo	4th Instar Larvae	1992	Janssens De Bisthoven, L.G., Timmermans, K.R. and F. Ollevier
Monoporeia affinis	Amphipod	SW	Lead	7439-92-1	4	Mortality	NOED	Combined	Whole Body	Immature	Body Burden Est. From Graph	1984	Sundelin, B.
Monoporeia affinis	Amphipod	SW	Lead	7439-92-1	4	Mortality	NOED	Combined	Whole Body	Adult	Body Burden Est. From Graph	1984	Sundelin, B.
Calanus hyperboreus	Calanoid copepod	SW	Lead	7439-92-1	40.7	Mortality	LD50	Water	Whole Body	Adult	Clearly written paper	1997	Ritterhoff, J., and G-P. Zauke
Themisto libellula	Mesoplankton amphipod	SW	Lead	7439-92-1	63.3	Mortality	LD50	Water	Whole Body	Adult		1997	Ritterhoff, J., and G-P. Zauke
Themisto abyssorum	Mesoplankton amphipod	SW	Lead	7439-92-1	63.3	Mortality	LD50	Water	Whole Body	Adult		1997	Ritterhoff, J., and G-P. Zauke
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	0.4	Development	LOED	Absorption	Eggs	Egg-embryo	Reduced third generation embryo hatchability due to spine deformities. First and second generation exposed to 119 ug/L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	4	Growth	LOED	Absorption	Whole Body	Egg-embryo	Reduced weight gain in third generation. First and second generations exposed to 119 ug/L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim

Table C-2. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Lead

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	4.02	Morphology	LOED	Absorption	Whole Body	Egg-embryo	Deformed spine in third generation. First and second generation exposed to 119 ug/L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	0.34	Development	NOED	Absorption	Eggs	Egg-embryo	No effect on third generation embryo hatchability due to spinal deformities. First and second generation exposed to 58 ug/L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	2.55	Growth	NOED	Absorption	Whole Body	Egg-embryo	No effect on weight gain in third generation. First and second generation exposed to 58 ug/L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	2.54	Morphology	NOED	Absorption	Whole Body	Egg-embryo	No effect on skeletal deformities iin third generation. First and second generation exposed to 58 ug /L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim
Salvelinus fontinalis	Trout - Brook	FW	Lead	7439-92-1	4.02	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No effect on mortality after hatch in third generation. First and second generation exposed to 119 ug/L for up to 2 years.	1976	Holcombe, G.W., D.A. Benoit, E.N. Leonard and J.M. Mckim
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	200	Physiological	ED100	Absorption	Whole Body	Adult	Decreased filtration rate and eventual cessation of filtration at 9 weeks.	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	200	Growth	LOED	Absorption	Whole Body	Adult	Decreased weight gain in surviving mussels.	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	200	Mortality	LOED	Absorption	Whole Body	Adult	52% Mortality	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	35	Physiological	LOED	Absorption	Whole Body	Adult	19% Decrease in filtration rate.	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	35	Growth	NOED	Absorption	Whole Body	Adult	No effect on weight gain in surviving mussels.	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	35	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Mortality	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Lead	7439-92-1	7	Physiological	NOED	Absorption	Whole Body	Adult	No Effect On Filtration Rate	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	70	Mortality	LD50	Absorption	Whole Body	Immature	50% Mortality (estimate).	1993	Maclean, R.S., U. Borgmann and D.G. Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	90	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality (estimate).	1993	Maclean, R.S., U. Borgmann and D.G. Dixon

Table C-2. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Lead

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	115	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality (estimate). Pre-exposed to 100 nM Pb for 4 weeks.	1993	Maclean, R.S., U. Borgmann and D.G. Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	160	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality (estimate).	1993	Maclean, R.S., U. Borgmann and D.G. Dixon
Chironomus tentans	Midge	FW	Lead	7439-92-1	17.42	Development	LOED	Combined	Whole Body	Egg	8% Mouthpart deformities (3% abnormal in controls); Pb concentrations 10 times that of the LOED had fewer deformities.	2001	Martinez EA, BC Moore, J Schaumloffel, N Dasgupta
Penaeus indicus	copepod	SW	Lead	7439-92-1	118	Mortality	LD10	Water	Whole Body	Juvenile	BB that are significantly different from controls and that produce 10% mortality.	2002	Chinni, S., R.N. Khan, P.R. Yallapragada
Penaeus indicus	copepod	SW	Lead	7439-92-1	70	Mortality	NOED	Water	Whole Body	Juvenile	BB that are significantly different from control and that did not produce significant increase in mortality.	2002	Chinni, S., R.N. Khan, P.R. Yallapragada
Penaeus indicus	copepod	SW	Lead	7439-92-1	200	Mortality	LD25	Water	Whole Body	Juvenile	BB that are significantly different from control and that produced significant increase in mortality.	2002	Chinni, S., R.N. Khan, P.R. Yallapragada
Penaeus indicus	copepod	SW	Lead	7439-92-1	300	Mortality	LD50	Water	Whole Body	Juvenile	BB that are significantly different from control and that produced significant increase in mortality.	2002	Chinni, S., R.N. Khan, P.R. Yallapragada
Paracentrotus lividus	Sea Urchin	SW	Lead	7439-92-1	31.36	Mortality	LOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Lead	7439-92-1	0.58	Mortality	NOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Lead	7439-92-1	621.1	Mortality	ED50	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Lead	7439-92-1	167.1	Development	ED50	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Lead	7439-92-1	31.36	Development	LOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	26.107	Mortality	LD25	Water	Whole body	Adult	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used Imhoff cones instead.	2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	72.31	Mortality	LD50	Water	Whole Body	Immature	Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	150.84	Mortality	LD50	Water	Whole Body	Adult	Result of modelling mortality rates vs Pb conc. **10-16 wk old	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	48.277	Mortality	NOED	Water	Whole Body	Immature	Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	82.67	Mortality	LOED	Water	Whole Body	Immature	Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	82.88	Mortality	NOED	Water	Whole Body	Adult	Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon

Table C-2. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Lead

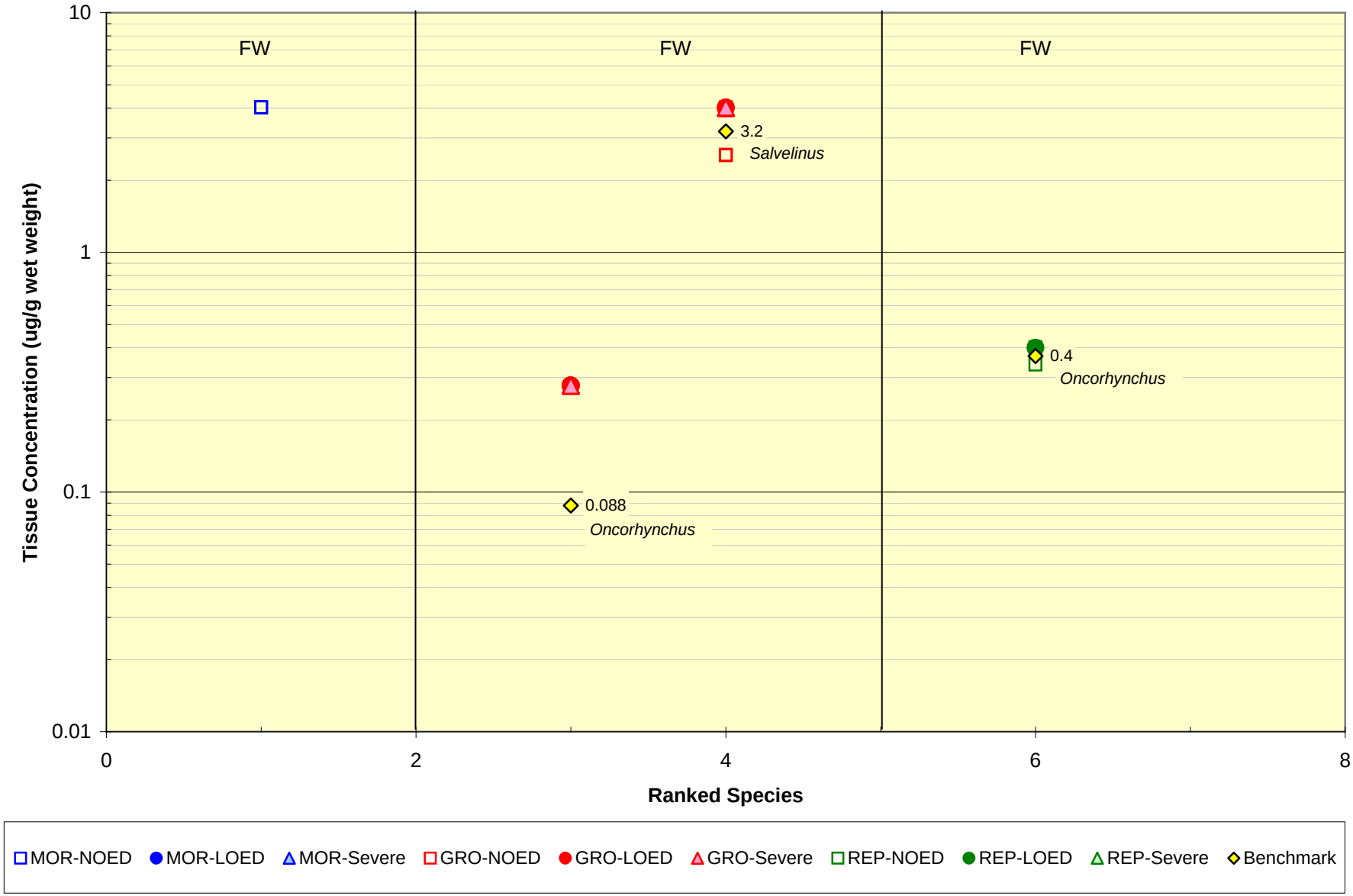
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	130.328	Mortality	LOED	Water	Whole Body	Adult	Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	89.92	Mortality	LD50	Water	Whole Body	Adult	Tests run with 4-5 wk old amphipods: Without pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	101.53	Mortality	LD50	Water	Whole Body	Adult	Tests run with 4-5 wk old amphipods: With pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	44.755	Mortality	NOED	Water	Whole Body	Adult	Tests run with 4-5 wk old amphipods: Without pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	58.844	Mortality	NOED	Water	Whole Body	Adult	Tests run with 4-5 wk old amphipods: With pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	68.376	Mortality	LOED	Water	Whole Body	Adult	Tests run with 4-5 wk old amphipods: Without pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	85.78	Mortality	LOED	Water	Whole Body	Adult	Tests run with 4-5 wk old amphipods: With pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.	1996	MacLean RS, U Borgmann, and DG Dixon
Chironomus tentans	Midge	FW	Lead	7439-92-1	481	Growth	NOED	Combined	Whole Body	Egg	Results are from a mixture of zinc and lead.	2004	Mann RM, M Grosell, A Bianchini, CM Wood
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	6.71	Mortality	LD50	Absorption	Whole Body	Immature	Field-collected sediment	1999	Borgmann U, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Lead	7439-92-1	5.22	Mortality	LD25	Absorption	Whole Body	Immature	Field-collected sediment	1999	Borgmann U, WP Norwood
Lumbriculus variegatus	Oligochaete	FW	Lead	7439-92-1	10	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Lumbriculus variegatus	Oligochaete	FW	Lead	7439-92-1	30	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Lumbriculus variegatus	Oligochaete	FW	Lead	7439-92-1	60	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Lumbriculus variegatus	Oligochaete	FW	Lead	7439-92-1	170	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Lumbriculus variegatus	Oligochaete	FW	Lead	7439-92-1	220	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Lumbriculus variegatus	Oligochaete	FW	Lead	7439-92-1	300	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Biomphalaria glabrata	Biomphalaria glabrata	FW	Lead	7439-92-1	5	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Biomphalaria glabrata	Biomphalaria glabrata	FW	Lead	7439-92-1	20	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero

Table C-2. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Lead

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Biomphalaria glabrata	Biomphalaria glabrata	FW	Lead	7439-92-1	32	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Biomphalaria glabrata	Biomphalaria glabrata	FW	Lead	7439-92-1	40	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Biomphalaria glabrata	Biomphalaria glabrata	FW	Lead	7439-92-1	85	Mortality	NOED	Water	Whole Body	Adult		2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED11	Ingestion	Whole Body	Fry	growth=length Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED30	Ingestion	Whole Body	Fry	growth=wt Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED19	Ingestion	Whole Body	Fry	Growth rate (%/d) Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell
Oncorhynchus mykiss	Trout - Rainbow	FW	Lead	7439-92-1	0.278	Growth	ED16	Ingestion	Whole Body	Fry	Growth rate (%/d) Fed trout oligochaetes reared in contaminated sediments. Exposed to As and/or Pb. Concluded As was primarily responsible for the toxicity exhibited. Histopathic measurements were taken but were not quantified.	2004	Hansen JA; J Lipton; PG Welsh; D Cacela; B MacConnell

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-3. Summary of Lead Concentrations in Freshwater Fish Tissue Associated with Toxicity



2/3/2006

Chart C-4. Summary of Lead Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity

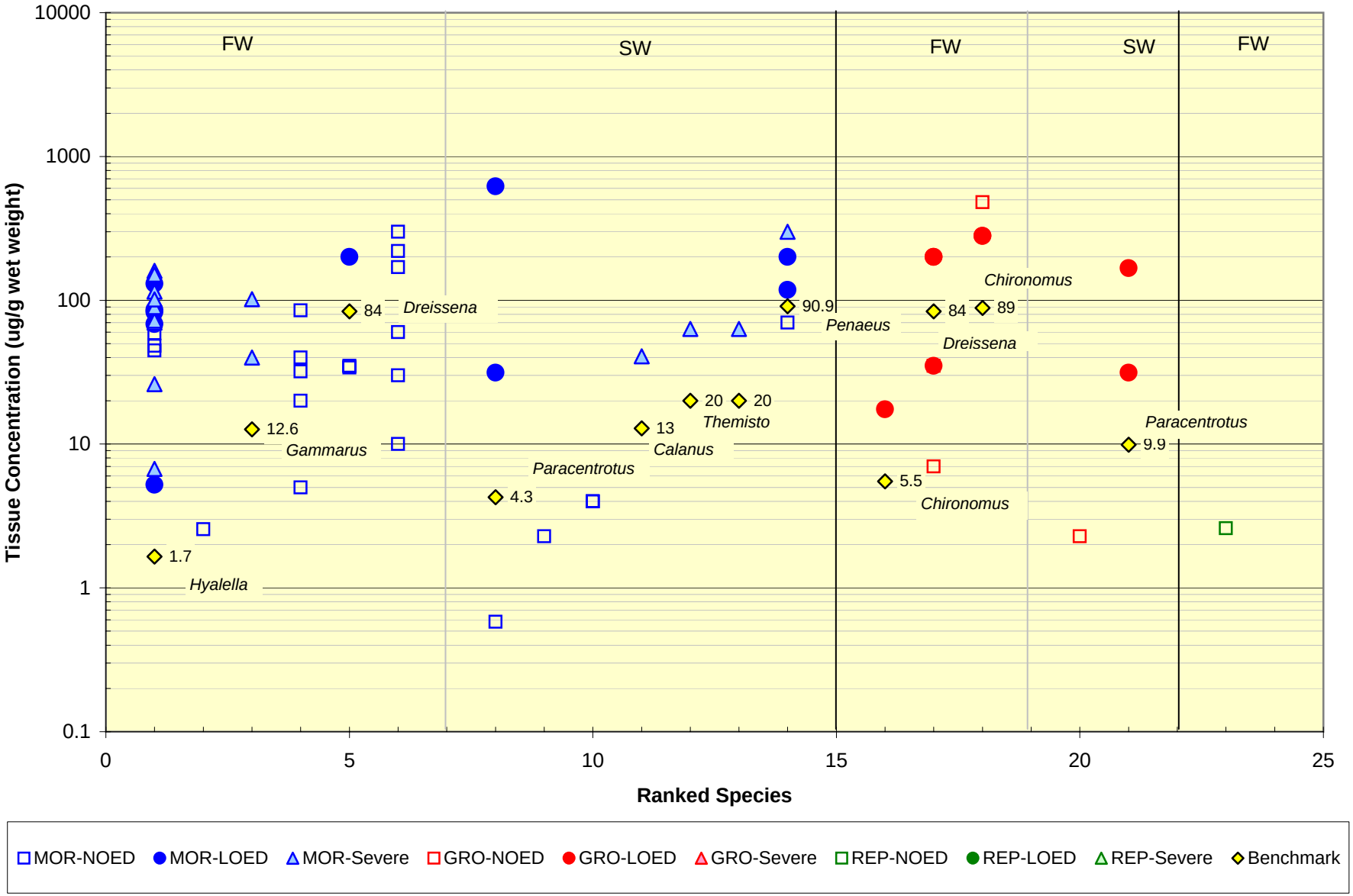


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Table C-3. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Mercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	1.02	Mortality	LD50	Injection	Whole Body	Juvenile	IP injection, anterior to pelvic fins.	1979	Hawryshyn, CW, WC Mackay
Carassius auratus	Goldfish	FW	Mercury	7439-97-6	7	Mortality	LD100	Absorption	Whole Body	Adult	No fish with residues above 7 mg/kg survived.	1979	Heisinger, J.F., C.D. Hansen, and J.H. Kim.
Carassius auratus	Goldfish	FW	Mercury	7439-97-6	5.6	Mortality	LD80	Absorption	Whole Body	Adult	Residues measured in surviving fish only.	1979	Heisinger, J.F., C.D. Hansen, and J.H. Kim.
Carassius auratus	Goldfish	FW	Mercury	7439-97-6	6.2	Mortality	NOED	Absorption	Whole Body	Adult	No significant increase in mortality.	1979	Heisinger, J.F., C.D. Hansen, and J.H. Kim.
Poecilia reticulata	Guppy	FW	Mercury	7439-97-6	0.2	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality.	1979	Kudo, A. and D.C. Mortimer.
Pyganodon grandis	Floater mussel	FW	Mercury	7439-97-6	0.116	Growth	NOED	Combined	Viscera	Adult	No significant difference in weight or length. Residue from mussels caged in wetland.	1996	Malley, D.F., A.R. Stewart, and B.D. Hall
Pyganodon grandis	Floater mussel	FW	Mercury	7439-97-6	0.14	Growth	NOED	Combined	Viscera	Adult	No significant difference in weight or length. Residues from mussels caged in wetland.	1996	Malley, D.F., A.R. Stewart, and B.D. Hall
Pyganodon grandis	Floater mussel	FW	Mercury	7439-97-6	0.116	Mortality	NOED	Combined	Viscera	Adult	No increase in mortality. Residue from mussels caged in wetland.	1996	Malley, D.F., A.R. Stewart, and B.D. Hall
Pyganodon grandis	Floater mussel	FW	Mercury	7439-97-6	0.14	Mortality	NOED	Combined	Viscera	Adult	No increase in mortality. Residues from mussels caged in wetland.	1996	Malley, D.F., A.R. Stewart, and B.D. Hall
Pyganodon grandis	Floater mussel	FW	Mercury	7439-97-6	0.116	Reproduction	NOED	Combined	Viscera	Adult	No significant difference fecundity or timing of reproduction. Residue from mussels caged in wetland.	1996	Malley, D.F., A.R. Stewart, and B.D. Hall
Pyganodon grandis	Floater mussel	FW	Mercury	7439-97-6	0.14	Reproduction	NOED	Combined	Viscera	Adult	No significant difference in fecundity or timing of reproduction. Residues from mussels caged in wetland.	1996	Malley, D.F., A.R. Stewart, and B.D. Hall
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	11.9	Mortality	LD50	Ingestion	Whole Body	NS	300g initial average weight	1970	Mieltinen, E Blankenstein, K Rissanen, M Valtonen
Esox lucius	Northern Pike	FW	Mercury	7439-97-6	15	Mortality	LD50	Ingestion	Whole Body	NS	300g initial average weight	1970	Mieltinen, E Blankenstein, K Rissanen, M Valtonen
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	12	Mortality	NOED	Water	Whole Body	NA		1984	Niimi AJ, L Lowe-Jinde
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	90.2	Mortality	LD100	Absorption	Whole Body	Embryo	Duration = 4d posthatch	1979	Birge WJ, JA Black, AG Westerman, JE Hudson
Ictalurus punctatus	Catfish-Channel	FW	Mercury	7439-97-6	0.06	Mortality	LD50	Water	Whole Body	Embryo	Duration = 4d posthatch	1979	Birge WJ, JA Black, AG Westerman, JE Hudson
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	26.9	Mortality	LD76	Absorption	Whole Body	Embryo	Duration = 4d posthatch	1979	Birge WJ, JA Black, AG Westerman, JE Hudson
Anguilla anguilla	European eel	FW	Mercury	7439-97-6	15.3	Mortality	LD25	Absorption	Whole Body	NA	No increase in mortality. Freshwater eel adapted to seawater for test.	1977	Noel-Lambot, F. and J.M. Bouquegneau.
Anguilla anguilla	European eel	FW	Mercury	7439-97-6	0.56	Mortality	NOED	Absorption	Whole Body	NA	No increase in mortality. Freshwater eel adapted to seawater for test.	1977	Noel-Lambot, F. and J.M. Bouquegneau.

Table C-3. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Mercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hexagenia rigida	Mayfly-Burrowing	FW	Mercury	7439-97-6	2	Growth	NOED	Combined	Whole Body	Nymph	No significant difference in weight gain. Residues ranged from 2 to 2.4 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.	1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou
Hexagenia rigida	Mayfly-Burrowing	FW	Mercury	7439-97-6	2.7	Growth	NOED	Combined	Whole Body	Nymph	No significant difference in weight gain. Residues ranged from 2.7 to 4.5 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.	1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou
Hexagenia rigida	Mayfly-Burrowing	FW	Mercury	7439-97-6	2	Mortality	NOED	Combined	Whole Body	Nymph	Residues ranged from 2 to 2.4 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.	1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou
Hexagenia rigida	Mayfly-Burrowing	FW	Mercury	7439-97-6	2.7	Mortality	NOED	Combined	Whole Body	Nymph	Residues ranged from 2.7 to 4.5 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.	1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	10.69	Growth	NOED	Water	Whole Body	Embryo		1975	Olson GF, DJ Mount, VM Snarski, TW Thorslund
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	10.69	Mortality	NOED	Water	Whole Body	Embryo		1975	Olson GF, DJ Mount, VM Snarski, TW Thorslund
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	0.99	Growth	NOED	Combined	Whole Body	Juvenile		1978	Phillips GR, DR Buhler
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	2.28	Growth	NOED	Water	Whole Body	Juvenile		1978	Phillips GR, DR Buhler
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	2.96	Growth	NOED	Combined	Whole Body	Juvenile		1978	Phillips GR, DR Buhler
Chironomus riparius	Midge	FW	Mercury	7439-97-6	40	Mortality	NOED	Absorption	Whole Body	Larval	No mortality. No effect on emergence of adults.	1986	Rossaro, B., G.F. Gaggino, and R. Marchetti.
Chironomus riparius	Midge	FW	Mercury	7439-97-6	107.6	Mortality	NOED	Absorption	Whole Body	Larval	No mortality in 4th instar larvae.	1986	Rossaro, B., G.F. Gaggino, and R. Marchetti.
Elliptio complanata	Eastern Elliptio	FW	Mercury	7439-97-6	3.4	Mortality	NOED	Water	Soft Tissue	NS	22 mm average shell height	1996	Tessier L, G Vaillancourt, L Pazdernik
Viviparus georgianus	Banded Mystery Snail	FW	Mercury	7439-97-6	6	Mortality	NOED	Water	Soft Tissue	NS	10 mm average shell height	1996	Tessier L, G Vaillancourt, L Pazdernik
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	10.8	Reproduction	ED20	Combined	Whole Body	Adult	Phaedactylum tricornutum (algae-food) Female concentrations 1st spawn fecundity	1984	Thain JE
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	23.4	Reproduction	ED34	Combined	Whole Body	Adult	Phaedactylum tricornutum (algae-food) Female concentrations 1st spawn fecundity	1984	Thain JE
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	5.4	Reproduction	NOED	Combined	Whole Body	Adult	Phaedactylum tricornutum (algae-food) Female concentrations 1st spawn fecundity	1984	Thain JE

Table C-3. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Mercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	6.9	Mortality	LOED	Absorption	Carcass	Immature	Increase in mortality.	1975	Wobeser, G.
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	4.8	Mortality	NOED	Absorption	Carcass	Immature	Increased in mortality.	1975	Wobeser, G.
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	10	Mortality	LOED	Ingestion	Whole Body	Juvenile	Increase in mortality. Residue is injected dose (i.p.).	1975	Wobeser, G.
Pelecanus occidentalis	Brown pelican	SW	Mercury	7439-97-6	0.203	Mortality	NA	Ingestion	Brain	Adult		1977	Young, D.R., and T.C. Heeson
Larus californicus	California gull	SW	Mercury	7439-97-6	0.404	Mortality	NA	Ingestion	Brain	Adult		1977	Young, D.R., and T.C. Heeson
Phalacrocorax penicillatus	Brandts cormorant	SW	Mercury	7439-97-6	0.649	Mortality	NA	Ingestion	Brain	Adult		1977	Young, D.R., and T.C. Heeson
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	1.31	Growth	LOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	1.36	Growth	LOED	Combined	Whole Body	Adult	30-day Exposure: Progeny Of Exposed Fish	1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	1.36	Growth	LOED	Combined	Whole Body	Adult	Weight Of Females	1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	4.76	Growth	LOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	18.8	Growth	LOED	Combined	Whole Body	Adult	Weight Of Males	1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	4.18	Mortality	LOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	0.32	Growth	NOED	Combined	Whole Body	Adult	30-day Exposure: Progeny Of Exposed Fish	1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	0.32	Growth	NOED	Combined	Whole Body	Adult	Weight Of Females	1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	0.8	Growth	NOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	2.64	Growth	NOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	9.41	Growth	NOED	Combined	Whole Body	Adult	Weight Of Males	1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	2.75	Mortality	NOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	7.6	Mortality	NOED	Combined	Whole Body	Adult		1982	Snarski, V.M., Olson, G.F.
Palaemonetes pugio	Shrimp - Grass	SW	Mercury	7439-97-6	1.64	Mortality	NOED	Absorption	Whole Body	Adult	No Statistically Significant Increase In Mortality	1977	Barthalmus, G.T.
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	15	Mortality	LD100	Injection	Whole Body	Immature	100% Mortality In 15 Days	1979	Hawryshyn, C.W. and W.C. Mackay
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	5.1	Mortality	LD50	Injection	Whole Body	Immature	15 Day LD50 For Single Intraperitoneal Injection	1979	Hawryshyn, C.W. and W.C. Mackay
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	2	Mortality	LOED	Injection	Whole Body	Immature	Increase in mortality.	1979	Hawryshyn, C.W. and W.C. Mackay
Pleuronectes americanus	Winter Flounder	SW	Mercury	7439-97-6	5	Mortality	LD50	Injection	Whole Body	Adult	50% Mortality in 16 hours.	1976	Manen, C.A., B. Schmidt-nielsen and D.N. Russell

Table C-3. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Mercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	8	Growth	ED25	Combined	Whole Body	Adult	25% Reduction in weight gain. Algal food source contaminated with mercury.	1984	Thain, J.E.
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	8	Development	LOED	Combined	Whole Body	Larval	Significant decrease in settlement of spat. Residue measured in parent exposed to 0.25 ug/L and mercury contaminated algae for up to 112 days.	1984	Thain, J.E.
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	16	Reproduction	LOED	Combined	Whole Body	Adult	Significant effect on fecundity (number of larva released). Algal food source contaminated with mercury.	1984	Thain, J.E.
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	8	Reproduction	NOED	Combined	Whole Body	Adult	No significant effect on fecundity (number of larva released). Algal food source contaminated with mercury.	1984	Thain, J.E.
Crepidula fornicata	Slipper Limpet	SW	Mercury	7439-97-6	22	Reproduction	NOED	Combined	Whole Body	Adult	No significant effect on time to maturity and spawning, spawning frequency, or egg incubation time. Algal food source contaminated with mercury.	1984	Thain, J.E.
Stizostedion vitreum	Walleye	FW	Mercury	7439-97-6	0.25	Development	LOED	Ingestion	Whole Body	Immature	Impaired testicular development. Significantly decreased ratio of gonad weight to total weight in males.	1996	Friedmann, A.S., M.C. Watzin, T. Brinck-Johnsen and J.C. Leiter
Stizostedion vitreum	Walleye	FW	Mercury	7439-97-6	2.37	Growth	LOED	Ingestion	Whole Body	Immature	Significant Reduction In Length And Weight Of Males, But Not Females	1996	Friedmann, A.S., M.C. Watzin, T. Brinck-Johnsen and J.C. Leiter
Stizostedion vitreum	Walleye	FW	Mercury	7439-97-6	2.37	Development	NOED	Ingestion	Whole Body	Immature	No significant difference in ratio of gonad weight to total weight in females.	1996	Friedmann, A.S., M.C. Watzin, T. Brinck-Johnsen and J.C. Leiter
Stizostedion vitreum	Walleye	FW	Mercury	7439-97-6	0.25	Growth	NOED	Ingestion	Whole Body	Immature	No Effect On Length Or Weight	1996	Friedmann, A.S., M.C. Watzin, T. Brinck-Johnsen and J.C. Leiter
Stizostedion vitreum	Walleye	FW	Mercury	7439-97-6	2.37	Mortality	NOED	Ingestion	Whole Body	Immature	No Statistically Significant Increase In Mortality	1996	Friedmann, A.S., M.C. Watzin, T. Brinck-Johnsen and J.C. Leiter
Perca flavescens	Yellow perch	FW	Mercury	7439-97-6	0.135	Growth	NOED	Combined	Whole Body	Adult	Controlled Field Study; Two Years But Only 1-year Old Fish Analyzed; Basin Treated By Reducing Ph From About 6 To 5.6	1990	Wiener, J.G., Fitzgerald, W.F., Watras, C.J., Rada, R.G.
Daphnia magna	Water flea	FW	Mercury	7439-97-6	18.4	Mortality	ED25	Absorption	Whole Body	Immature	25% Reduction In Survival Compared To Controls In 21 Days	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	1.64	Reproduction	ED35	Absorption	Whole Body	Immature	35% Reduction In Number Of Neonates Produced In 21 Days	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	4.67	Reproduction	ED62	Absorption	Whole Body	Immature	62% Reduction In Number Of Neonates Produced In 21 Days	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	7.57	Reproduction	ED63	Absorption	Whole Body	Immature	63% Reduction In Number Of Neonates Produced In 21 Days	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Daphnia magna	Water flea	FW	Mercury	7439-97-6	18.4	Reproduction	ED99	Absorption	Whole Body	Immature	99% Reduction In Number Of Neonates Produced In 21 Days	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	2.33	Reproduction	LOED	Absorption	Whole Body	Immature	32% Reduction In Number Of Neonates Produced In 21 Days	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	0.859	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	1.53	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	1.64	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	2.33	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	4.67	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	7.57	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	0.859	Reproduction	NOED	Absorption	Whole Body	Immature	No significant difference in number of neonates produced in 21 days.	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Daphnia magna	Water flea	FW	Mercury	7439-97-6	1.53	Reproduction	NOED	Absorption	Whole Body	Immature	No significant difference in number of neonates produced in 21 days.	1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	0.14	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality	1985	Boudou, A. and F. Ribeyre
Oncorhynchus mykiss	Trout - Rainbow	FW	Mercury	7439-97-6	0.47	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality	1985	Boudou, A. and F. Ribeyre
Uca pugnax	Crab - Fiddler	SW	Mercury	7439-97-6	12.3	Development	LOED	Absorption	Whole Body	Adult	Inhibition Of Limb Regeneration And Molting In Male Crabs	1983	Callahan, P. and J.S. Weis
Uca pugnax	Crab - Fiddler	SW	Mercury	7439-97-6	19.4	Development	LOED	Absorption	Whole Body	Adult	Inhibition Of Limb Regeneration And Molting In Female Crabs	1983	Callahan, P. and J.S. Weis
Rangia cuneata	Clam - Marsh	FW	Mercury	7439-97-6	20	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality in clams that had been pre-exposed to 1 ppb Hg for 2 weeks prior to test.	1977	Dillon, T.M.
Rangia cuneata	Clam - Marsh	FW	Mercury	7439-97-6	20	Mortality	LD50	Absorption	Whole Body	Adult	50% Mortality	1977	Dillon, T.M.
Rangia cuneata	Clam - Marsh	FW	Mercury	7439-97-6	73.1	Mortality	LOED	Absorption	Whole Body	Adult	Lethal Body Burden. Initial water concentration of 10 mg Hg/L. At 96 hr, 0.176 mg Hg/L.	1977	Dillon, T.M.
Squalus acanthias	Spiny Dogfish	SW	Mercury	7439-97-6	0.093	Mortality	NOED	Injection	Whole Body	NA	No Effect On Mortality In 24 Hours	1979	Guarino, A.M. and S.T. Arnold

Table C-3. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Mercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Acartia tonsa		SW	Mercury	7439-97-6	0.095	Reproduction	ED50	Combined	Whole Body	Adult	Used the kinetic modeling concentration of metal. Modeled concentration was approximately 1.4 fold higher than measured for the few measured values. Effect was 50% reduction in egg production 1 week after exposure. Food concentration=6.8 ug/g dry.	2002	Hook, Sharon and Nicholas Fisher
Elliptio complanata	Eastern Elliptio	FW	Mercury	7439-97-6	0.19	Growth	ED92	NS		Adult	Reduced growth rate. Ref station negated, using dnstream sta as comparison (sta 8) Elevated Cr and Pb; signif correlation Hg-Cr; moderately associated w organic C.	2000	Beckvar N, S Salazar, M Salazar, and K Finkelstein
Sparganophilus pearsei		FW	Mercury	7439-97-6	29.2	Mortality	LD50	Water	Whole Body	NS	Worms field collected in from 5 areas in San Francisco vicinity: Lake Anza	2003	Vidal DE, AJ Horne
Sparganophilus pearsei		FW	Mercury	7439-97-6	36.4	Mortality	LD50	Water	Whole Body	NS	Worms field collected in from 5 areas in San Francisco vicinity: San Pablo	2003	Vidal DE, AJ Horne
Sparganophilus pearsei		FW	Mercury	7439-97-6	90.6	Mortality	LD50	Water	Whole Body	NS	Worms field collected in from 5 areas in San Francisco vicinity: Lake Herman	2003	Vidal DE, AJ Horne
Sparganophilus pearsei		FW	Mercury	7439-97-6	127	Mortality	LD50	Water	Whole Body	NS	Worms field collected in from 5 areas in San Francisco vicinity: Guadalupe	2003	Vidal DE, AJ Horne
Thymallus thymallus	Grayling	FW	Mercury	7439-97-6	3.8	Reproduction	LOED	Water	Whole Body	Egg	Hatching Success	1998	Vollestad LA, E Fjeld, T Haugen, SA Oxnevad
Thymallus thymallus	Grayling	FW	Mercury	7439-97-6	3.8	Mortality	LD53	Water	Whole Body	Egg		1998	Vollestad LA, E Fjeld, T Haugen, SA Oxnevad
Thymallus thymallus	Grayling	FW	Mercury	7439-97-6	3.8	Growth	NOED	Water	Whole Body	Egg		1998	Vollestad LA, E Fjeld, T Haugen, SA Oxnevad
Salvelinus fontinalis	Trout - Brook	FW	Mercury	7439-97-6	3.4	Growth	NOED				McKim et al., 1976	1984	Dillon TM
Cyprinidae	Minnows	FW	Mercury	7439-97-6	2.84	Growth	NOED				Snarski and Olson, 1982	1984	Dillon TM
Salmonidae sp.		FW/SW	Mercury	7439-97-6	9.4	Growth	LOED				McKim et al., 1976	1984	Dillon TM
Cyprinidae	Minnows	FW	Mercury	7439-97-6	4.47	Growth	LOED				Snarski and Olson, 1982	1984	Dillon TM
Zooplankton		FW/SW	Mercury	7439-97-6	0.04	Growth	LOED		Whole Body		Brown and Parsons, 1978	1984	Dillon TM
Salmonidae sp.		FW/SW	Mercury	7439-97-6	3.4	Mortality	NOED				McKim et al., 1976	1984	Dillon TM
Salmonidae sp.		FW/SW	Mercury	7439-97-6	3.4	Reproduction	NOED				McKim et al., 1976	1984	Dillon TM
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	2.84	Reproduction	NOED				Snarski and Olson, 1982	1984	Dillon TM
Daphnia magna	Water flea	FW	Mercury	7439-97-6	15.26	Reproduction	NOED				Biesinger et al., 1982, # of young	1984	Dillon TM

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Daphnia magna	Water flea	FW	Mercury	7439-97-6	23.28	Reproduction	LOED				Biesinger et al., 1982, # of young	1984	Dillon TM
Salmonidae sp.		FW/SW	Mercury	7439-97-6	9.4	Reproduction	LOED				McKim et al., 1976, % hatched	1984	Dillon TM
Oryzias latipes	Japanese medaka	FW	Mercury	7439-97-6	29	Reproduction	LOED				Heisinger and Green, 1975, % hatched	1984	Dillon TM
Oryzias latipes	Japanese medaka	FW	Mercury	7439-97-6	54	Reproduction	ED100				Heisinger and Green, 1975, % hatched	1984	Dillon TM
Salmonidae sp.		FW/SW	Mercury	7439-97-6	9.4	Reproduction	LOED				McKim et al., 1976, spawning	1984	Dillon TM
Pimephales promelas	Fathead minnow	FW	Mercury	7439-97-6	4.47	Reproduction	ED100				Snarski and Olson, 1982, spawning	1984	Dillon TM
Daphnia magna	Water flea	FW	Mercuric Chloride	7487-94-7	4.656	Reproduction	ED32	Water	Whole Body	Juvenile		1983	Niimi, A.J. and C.Y. Cho.
Daphnia magna	Water flea	FW	Mercuric Chloride	7487-94-7	4.656	Mortality	NOED	Water	Whole Body	Juvenile		1983	Niimi, A.J. and C.Y. Cho.
Daphnia magna	Water flea	FW	Mercuric Chloride	7487-94-7	3.052	Reproduction	NOED	Water	Whole Body	Juvenile		1983	Niimi, A.J. and C.Y. Cho.

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Table C-4. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Methylmercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Thymallus thymallus	Grayling	FW	Methyl Mercury	22967-92-6	0.63	Growth	NOED	Absorption	Whole Body	Egg	Not stated whether residue is wet or dry wt. Test 1=Long term growth assessed after 3 yr from exposure as egg.	1998	Fjeld E, TO Haugen, LA Vollestad
Salvelinus fontinalis	Trout - Brook	FW	Methyl Mercury	22967-92-6	9.4	Mortality	NOED	Water	Whole Body	Other	1st generation data	1976	McKim JM, GF Olson, GW Holcombe, EP Hunt
Salvelinus fontinalis	Trout - Brook	FW	Methyl Mercury	22967-92-6	9.4	Reproduction	NOED	Water	Whole Body	Other	1st generation data	1976	McKim JM, GF Olson, GW Holcombe, EP Hunt
Oncorhynchus mykiss	Trout - Rainbow	FW	Methyl Mercury	22967-92-6	8	Growth	LOED	Ingestion	Whole Body	Juvenile	Growth significantly reduced. Fish fed the 25/2% diet and 75/2% diet were not significantly different in their wet weights.	1982	Rodgers DW, FWH Beamish
Oncorhynchus mykiss	Trout - Rainbow	FW	Methyl Mercury	22967-92-6	10	Growth	LOED	Ingestion	Whole Body	Juvenile	Growth significantly reduced. Fish fed the 25/ad lib diet and 45/ad lib diet were not significantly different in their wet weights.	1982	Rodgers DW, FWH Beamish
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	4.06	Reproduction	ED52	Ingestion	Whole Body	Neonate to adult	Body burden in females was consistently higher than males fed the same diet. Exposure in data base was for constant dietary exposure. Body burden is mean of male and female (18.4 and 22.2).	2002	Hammerschmidt, Chad, Mark Sandheinrich, James Wiener, and Ronald Rada
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	2.37	Reproduction	ED78	Ingestion	Whole Body	Neonate to adult	Body burden in females was consistently higher than males fed the same diet. Exposure in data base was for contaminated followed by control dietary exposure. Body burden is mean of male and female (11.6 and 12.1).	2002	Hammerschmidt, Chad, Mark Sandheinrich, James Wiener, and Ronald Rada
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	0.864	Reproduction	ED116	Ingestion	Carcass	Juvenile	Low exposure 0.87 ug/g dw in diet; males. Increased GSI (%)	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	0.917	Reproduction	NOED	Ingestion	Carcass	Juvenile	Low exposure 0.87 ug/g dw in diet; females. Increased GSI (%)	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	0.864	Reproduction	ED17	Ingestion	Carcass	Juvenile	Low exposure 0.87 ug/g dw in diet; decrease in male testostrone	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	0.917	Reproduction	ED62	Ingestion	Carcass	Juvenile	Low exposure 0.87 ug/g dw in diet; decrease in female 17b-estradiol	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	0.864	Reproduction	ED63	Ingestion	Carcass	Juvenile	Low exposure 0.87 ug/g dw in diet; spawning success	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.56	Reproduction	NOED	Ingestion	Carcass	Juvenile	Med. exposure 3.93 ug/g dw in diet; Mean GSI	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.56	Reproduction	NOED	Ingestion	Carcass	Juvenile	Med. exposure 3.93 ug/g dw in diet; Mean GSI; males	2003	Drevnick PE and MB Sanheinrich

Table C-4. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Methylmercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.842	Reproduction	ED41	Ingestion	Carcass	Juvenile	Med. exposure 3.93 ug/g dw in diet; Mean GSI; females	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.56	Reproduction	ED54	Ingestion	Carcass	Juvenile	Med. exposure 3.93 ug/g dw in diet; decrease in male testosterone	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.84	Reproduction	ED81	Ingestion	Carcass	Juvenile	Med. exposure 3.93 ug/g dw in diet; decrease in female 17b-estradiol	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.56	Reproduction	ED100	Ingestion	Carcass	Juvenile	Med. exposure 3.93 ug/g dw in diet; spawning success	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.84	Mortality	NOED	Ingestion	Carcass	Juvenile	Low/Med. exposure 0.87-3.93 ug/g dw in diet	2003	Drevnick PE and MB Sanheinrich
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	3.84	Growth	NOED	Ingestion	Carcass	Juvenile	Low/Med. exposure 0.87-3.93 ug/g dw in diet; length or weight	2003	Drevnick PE and MB Sanheinrich
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	11	Mortality	NOED	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effect is female survival	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Reproduction	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is fertilization success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	1.77	Reproduction	NOED	Ingestion	Whole Body	Neonate to adult	Body burden in females was consistently higher than males fed the same diet. Exposure in data base was for control followed by contaminated dietary exposure. Body burden is mean of male and female (6.48 and 11.2).	2002	Hammerschmidt, Chad, Mark Sandheinrich, James Wiener, and Ronald Rada
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	0.7	Reproduction	LOED	Ingestion	Whole Body	Egg	Daily number of eggs produced relative to carcass concentration of methyl mercury in female fish fed the same diet throughout exposure periods..	2002	Hammerschmidt, Chad, Mark Sandheinrich, James Wiener, and Ronald Rada
Pimephales promelas	Fathead minnow	FW	Methyl Mercury	22967-92-6	2.37	Development	ED100	Ingestion	Whole Body	Egg	Developmental success of eggs. Concentrations are mean of males and females (11.6 and 12.1). Diet is contaminated followed by control. All contaminated diet showed no relationship.	2002	Hammerschmidt, Chad, Mark Sandheinrich, James Wiener, and Ronald Rada
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.46	Mortality	LD43	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effect is male survival	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan

Table C-4. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Methylmercury

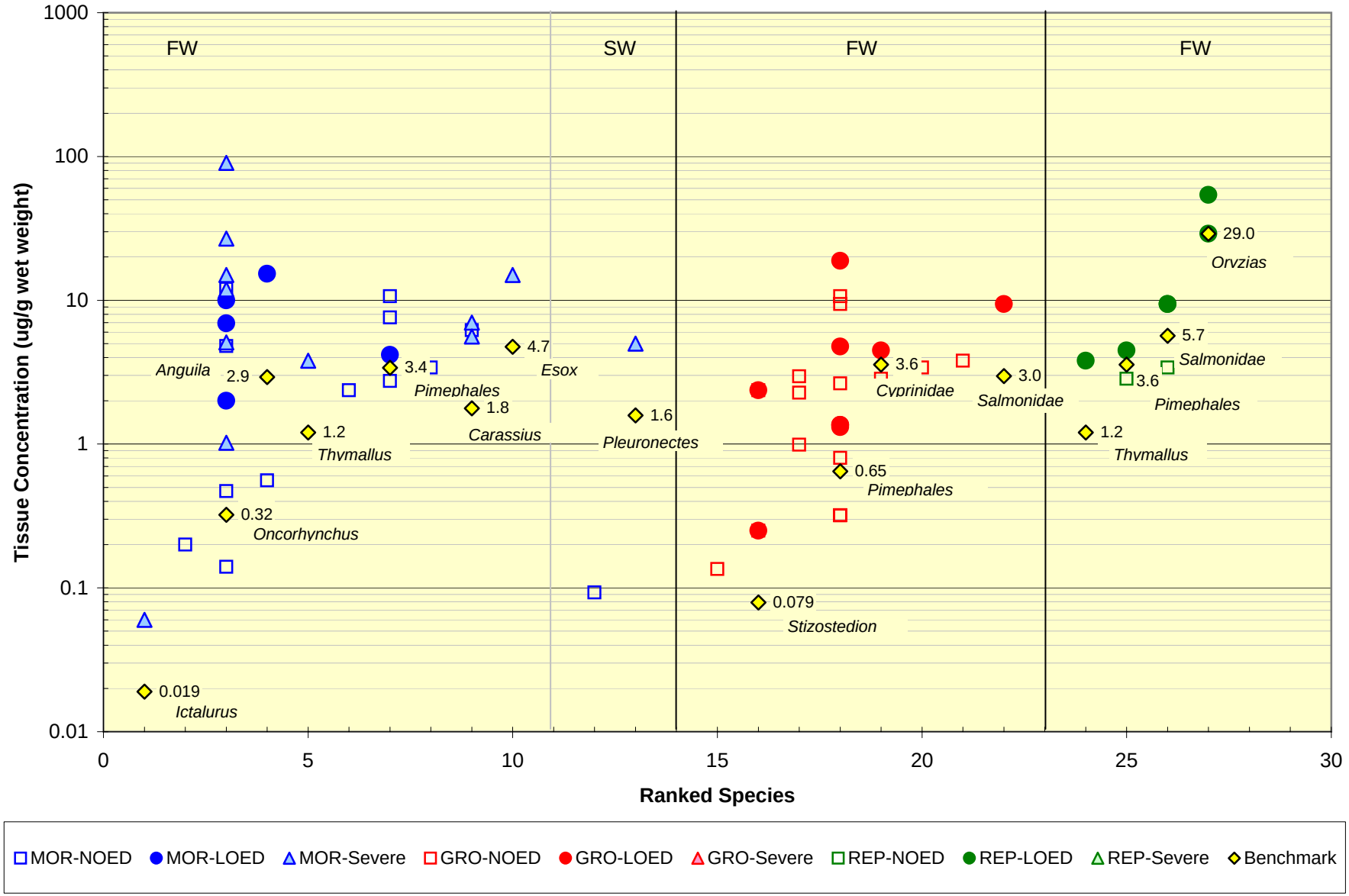
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	11	Growth	NOED	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effect is adult weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	11	Reproduction	NOED	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effect is fecundity	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Reproduction	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is hatch success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Mortality	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is larval survival	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.01	Growth	ED146	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is juvenile weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.02	Growth	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is juvenile weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.01	Development	ED190	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is sex ratio	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Development	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is F1 fecundity	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan

Table C-4. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Methylmercury

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Development	ED25	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is fertilization success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Development	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is F2 hatch success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Methyl Mercury	22967-92-6	0.63	Development	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of P1 generation, tissue concentration in F1 eggs, effect is F2 hatch success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Stizostedion vitreum	Walleye	FW	Methyl Mercury	22967-92-6	0.344	Reproduction	NOED	Water	Eggs	Egg	No change in fertilization rate (Conc in eggs from field collection=	2001	Latif MA, RA Bodaly, TA Johnston, RJP Fudge
Stizostedion vitreum	Walleye	FW	Methyl Mercury	22967-92-6	0.344	Reproduction	ED58	Water	Eggs	Egg	Reduced hatching success, Clay Lake 1997	2001	Latif MA, RA Bodaly, TA Johnston, RJP Fudge
Stizostedion vitreum	Walleye	FW	Methyl Mercury	22967-92-6	0.344	Reproduction	NOED	Water	Eggs	Egg	Larval Deformities, showed no relationship with waterborne MEHg. Fewer deformities among larvae from larger fish	2001	Latif MA, RA Bodaly, TA Johnston, RJP Fudge
Stizostedion vitreum	Walleye	FW	Methyl Mercury	22967-92-6	0.344	Reproduction	NOED	Water	Eggs	Egg	Larval length; showed no significant relationship with female size, female age, or egg MeHg concentration.	2001	Latif MA, RA Bodaly, TA Johnston, RJP Fudge
Thymallus thymallus	Grayling	FW	Methyl Mercury	22967-92-6	0.27	Development	ED	Water	Larvae	Larval	Impared feeding efficiencies and reduced competitive abilities even 3 years after exposure.	2001	Latif MA, RA Bodaly, TA Johnston, RJP Fudge
Elliptio complanata	Eastern Elliptio	FW	Methyl Mercury	22967-92-6	0.064	Growth	ED92	NS		Adult	Reduced growth rate;correlated w Hg, but not conclusive; may be due to unmeasured parameter eg., food availability. Ref sta negated, using dnstream sta as comparison (sta 8) Elevated Cr and Pb; signif correlation Hg-Cr; moderately associated w organic C.	2000	Beckvar N, S Salazar, M Salazar, and K Finkelstein

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-5. Summary of Mercury Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



MOR-NOED MOR-LOED MOR-Severe GRO-NOED GRO-LOED GRO-Severe REP-NOED REP-LOED REP-Severe Benchmark

2/3/2006

Chart C-6. Summary of Mercury Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity

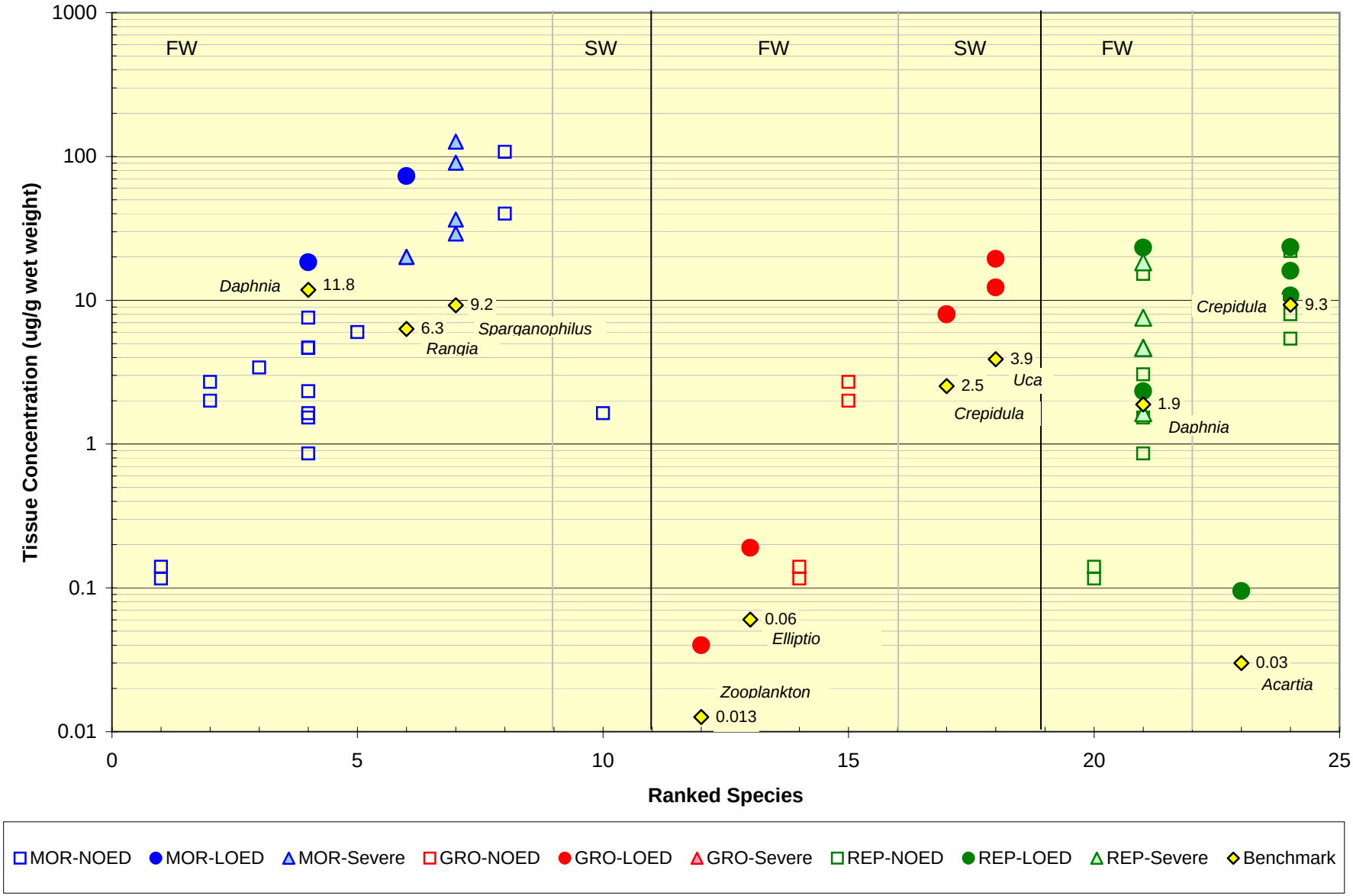


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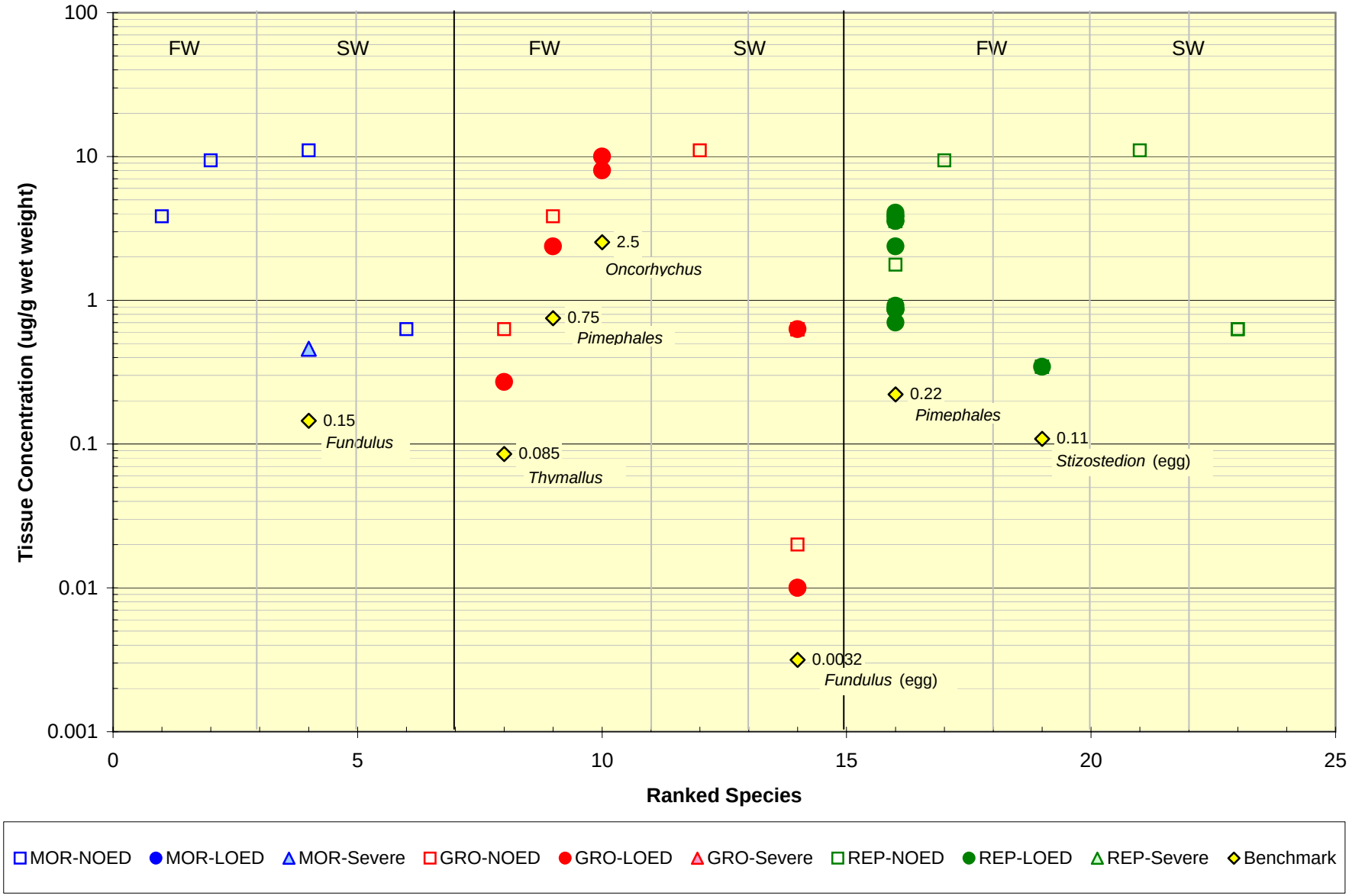
Chart C-7. Summary of Methylmercury Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



2/3/2006

Table C-5. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Nickel

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Cyprinus carpio	Common carp	FW	Nickel	7440-02-0	118.1	Mortality	LD50	Water	White Muscle	Other		1992	Sreedevi P, A Suresh, B Sivaramakrishna, B Prabhavathi, K Radhadkrishnaiah
Lamellidens marginalis	Indian Pearl Mussel	FW	Nickel	7440-02-0	328.4	Mortality	LD50	Water	Foot	Other		1992	Sreedevi P, A Suresh, B Sivaramakrishna, B Prabhavathi, K Radhadkrishnaiah
Lamellidens marginalis	Indian Pearl Mussel	FW	Nickel	7440-02-0	373.9	Mortality	LD50	Water	Muscle	Other	Abductor Muscle	1992	Sreedevi P, A Suresh, B Sivaramakrishna, B Prabhavathi, K Radhadkrishnaiah
Cerastoderma edule	Clam	SW	Nickel	7440-02-0	575	Mortality	LOED	Absorption	Whole Body	Adult	Significant increase in mortality. Mortality started after 8 days. Residue measured at 8 days.	1983	Wilson, J.G.
Cerastoderma edule	Clam	SW	Nickel	7440-02-0	575	Growth	NOED	Absorption	Whole Body	Adult	No significant difference in body condition measured as ratios of tissue weight and shell weight or volume. Residue measured at 8 days.	1983	Wilson, J.G.
Cerastoderma edule	Clam	SW	Nickel	7440-02-0	79	Mortality	NOED	Absorption	Whole Body	Adult	No significant increase in mortality. Residue measured at 16 days.	1983	Wilson, J.G.
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	2.23	Mortality	LD50	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.678	Mortality	LD25	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.678	Growth	ED25	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.209	Growth	ED25	Combined	Whole Body	Immature	Biomass Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood

Table C-5. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Nickel

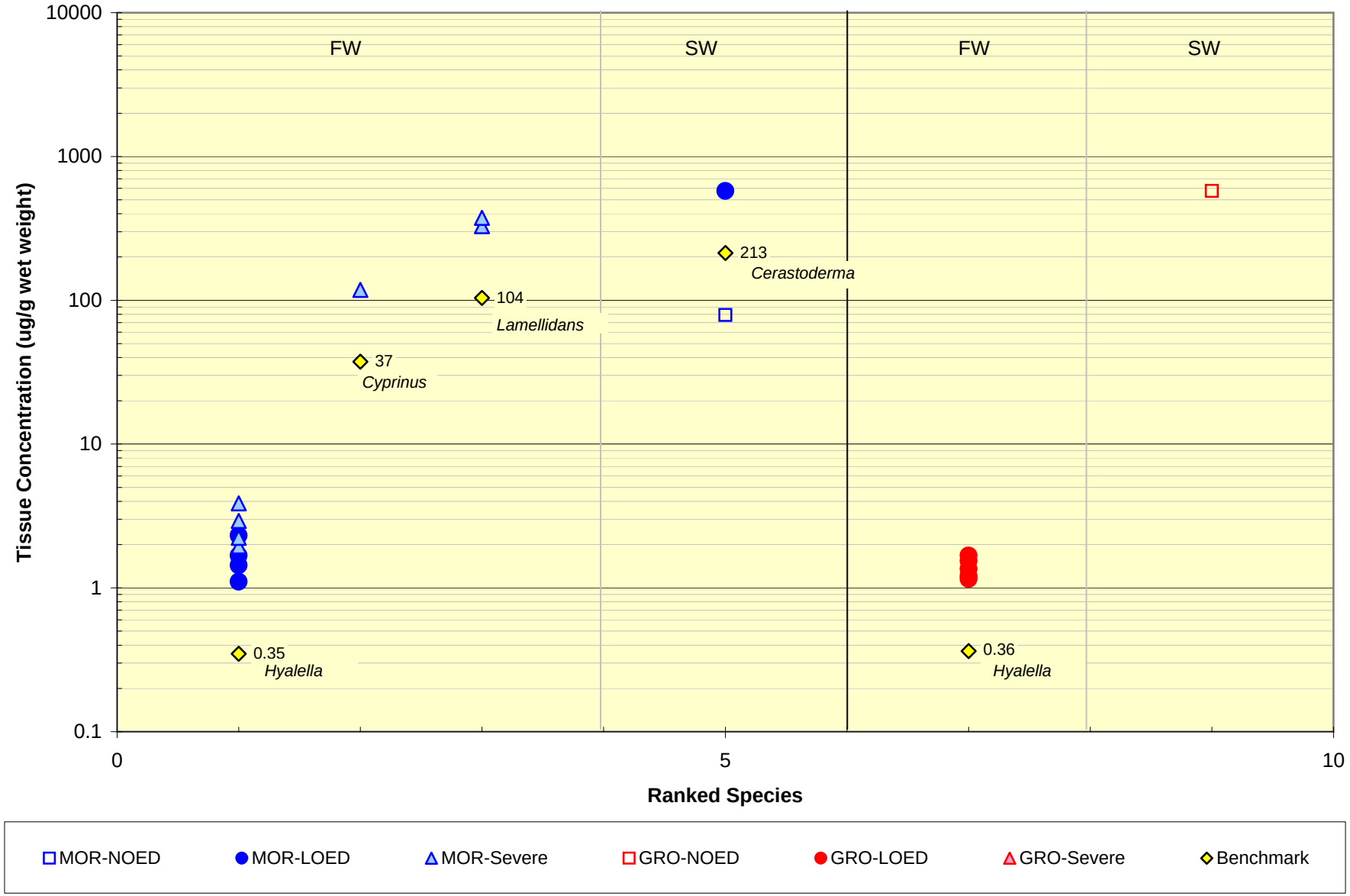
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.948	Mortality	LD50	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.432	Mortality	LD25	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.15	Growth	ED25	Combined	Whole Body	Immature	Biomass Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	2.922	Mortality	LD50	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.537	Growth	ED25	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.3498	Growth	ED25	Combined	Whole Body	Immature	Biomass Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed).	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	3.873	Mortality	LD50	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed). Test 4= Water only exposure, no depuration	2001	Borgmann U, R Neron, WP Norwood

Table C-5. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Nickel

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	2.31	Mortality	LD25	Combined	Whole Body	Immature	Test 1=Mean of 3 spiked sediment tests in both testing containers. Test 2= Mean of 3 spiked sed tests in beakers [4:1 water/sed]; Test 3= Mean 3 spiked sed tests in Imhoff cones (67:1 water/sed). Test 4= Water only exposure, no depuration	2001	Borgmann U, R Neron, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Nickel	7440-02-0	1.103	Mortality	LD25	Water	Whole body	Adult	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used Imhoff cones instead.	2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-8. Summary of Nickel Concentrations in Freshwater and Saltwater Organism Tissue Associated with Toxicity



2/3/2006

Table C-6. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Silver

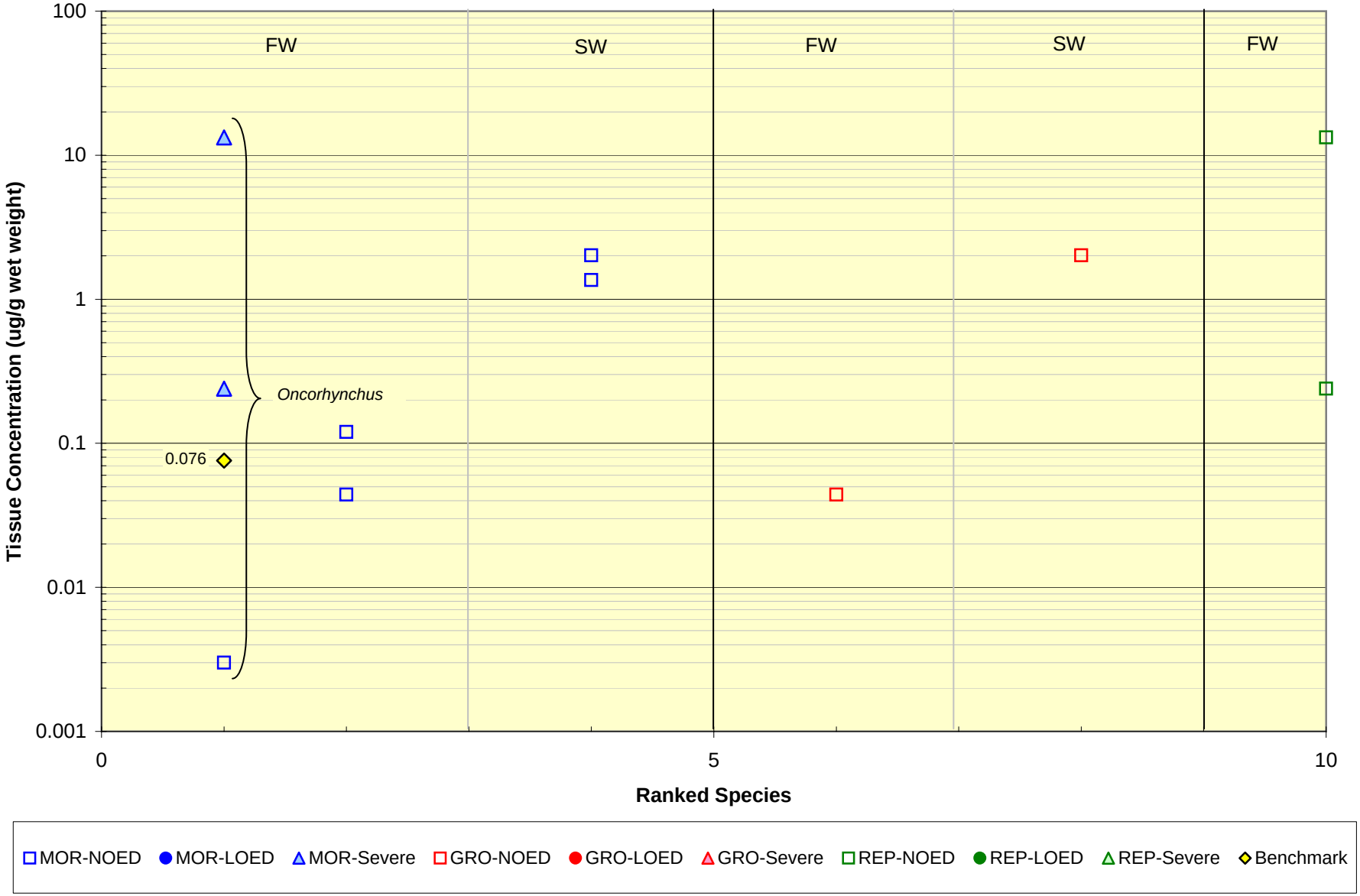
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	10.05	Reproduction	ED10	Water	Whole Body	Adult	F1 generation; generation time (egg-adult-1st spawning)	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	7.66	Reproduction	ED137	Water	Whole Body	Adult	P generation; # larval releases (female)	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	10.05	Reproduction	ED14	Water	Whole Body	Adult	F1 generation; generation time (egg-adult-1st spawning)	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	9.67	Reproduction	ED150	Water	Whole Body	Adult	F1 generation; # abortions	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	234	Reproduction	ED22	Water	Whole Body	Adult	F1 generation; females significantly smaller than controls @ 1st larval release	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	10.05	Reproduction	ED35	Water	Whole Body	Adult	F1 generation; mean # larvae released	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	6.44	Reproduction	ED43	Water	Whole Body	Adult	Parental generation; # larval releases (female)	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	10.05	Reproduction	ED517	Water	Whole Body	Adult	F1 generation; # releases/female	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	10.05	Reproduction	ED517	Water	Whole Body	Adult	F1 generation; inc. in % abortions	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	9.67	Reproduction	ED521	Water	Whole Body	Adult	F1 generation; inc. in % abortions	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	4.1	Reproduction	ED8	Water	Whole Body	Adult	F1 generation; generation time (egg-adult-1st spawning)	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	7.66	Reproduction	ED80	Water	Whole Body	Adult	F1 generation; generation time (egg-adult-1st spawning)	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Crepidula fornicata	Slipper Limpet	SW	Silver	7440-22-4	9.67	Reproduction	NOED	Water	Whole Body	Adult	F1 generation; # releases/female	1983	Nelson DA, A Calabrese, RA Greig, PP Yevich, and S Chang
Lepomis macrochirus	Bluegill	FW	Silver	7440-22-4	0.044	Growth	NOED	Water	Whole Body	Juvenile		1974	Coleman RL, JE Cearley
Lepomis macrochirus	Bluegill	FW	Silver	7440-22-4	0.044	Mortality	NOED	Water	Whole Body	Juvenile		1974	Coleman RL, JE Cearley
Lepomis macrochirus	Bluegill	FW	Silver	7440-22-4	0.12	Mortality	NOED	Water	Whole Body	Juvenile		1974	Coleman RL, JE Cearley
Corbicula fluminea	Clam - Asiatic	FW	Silver	7440-22-4	1650	Growth	LOED	Absorption	Whole Body	Immature	Reduction In Growth measured as weight	1990	Diamond, J.M., D.G. Mackler, M. Collins and D. Gruber
Corbicula fluminea	Clam - Asiatic	FW	Silver	7440-22-4	2510	Mortality	LOED	Absorption	Whole Body	Immature	Reduced Survival	1990	Diamond, J.M., D.G. Mackler, M. Collins and D. Gruber
Corbicula fluminea	Clam - Asiatic	FW	Silver	7440-22-4	800	Growth	NOED	Absorption	Whole Body	Immature	No Effect On Growth measured as weight.	1990	Diamond, J.M., D.G. Mackler, M. Collins and D. Gruber

Table C-6. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Silver

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Corbicula fluminea	Clam - Asiatic	FW	Silver	7440-22-4	1650	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival	1990	Diamond, J.M., D.G. Mackler, M. Collins and D. Gruber
Oncorhynchus mykiss	Trout - Rainbow	FW	Silver	7440-22-4	0.24	Reproduction	NOED	Water	Whole Body	Embryo	Time to 50% Hatching	2001	Guadagnolo, C.M., C.J. Brauner, C.M. Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Silver	7440-22-4	13.3	Mortality	LD33	Water	Chorion	Embryo		2001	Guadagnolo, C.M., C.J. Brauner, C.M. Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Silver	7440-22-4	13.3	Reproduction	NOED	Water	Chorion	Embryo	Time to 50% Hatching	2001	Guadagnolo, C.M., C.J. Brauner, C.M. Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Silver	7440-22-4	0.24	Mortality	LD33	Water	Whole Body	Embryo		2001	Guadagnolo, C.M., C.J. Brauner, C.M. Wood
Oncorhynchus mykiss	Trout - Rainbow	FW	Silver	7440-22-4	0.003	Mortality	NOED	Water	Whole Body	NS	Highest Body Burden	2002	Wood, C.M., M. Grosell, C. Hogstrand, H.Hansen
Daphnia magna	Water flea	FW	Silver	7440-22-4	2	Mortality	LD50	Water	Whole Body	Immature	Neonates, Residue from living and dead D.magna, Residue and LC50's calculated from different studies.	2002	Bianchini A., K.C. Bowles, C.J. Brauner, J.R. Kramer, C.M. Wood
Daphnia magna	Water flea	FW	Silver	7440-22-4	0.175	Mortality	LD50	Water	Whole Body	Juvenile	Addditional informationon the mode of toxicity was presented that showed the relationship of Ag uptake and interference with the Na, K, Cl and Atpase activity and uptake rates.	2003	Bianchini Adalto and Chris Wood
Acartia tonsa		SW	Silver	7440-22-4	0.07	Reproduction	ED50	Combined	Whole Body	Adult	Used the kinetic modeling concentration of metal. Modeled concentration was approximately 1.1 fold higher than measured for the few measured values. Effect was 50% reduction in egg production one week after exposure. Food concentrations=3.99 ug/g dry.	2002	Hook, Sharon and Nicholas Fisher
Acartia tonsa		SW	Silver	7440-22-4	0.033	Reproduction	ED31	Ingestion	Whole Body	Adult	Hatch Rate	2001	Hook SE, NS Fisher
Acartia tonsa		SW	Silver	7440-22-4	0.074	Reproduction	ED50	Ingestion	Whole Body	Adult	Hatch Rate	2001	Hook SE, NS Fisher
Acartia tonsa		SW	Silver	7440-22-4	0.074	Reproduction	ED42	Ingestion	Whole Body	Adult	Developed Ovaries	2001	Hook SE, NS Fisher
Acartia tonsa		SW	Silver	7440-22-4	0.019	Reproduction	ED78	Ingestion	Whole Body	Adult	Protien Per Egg	2001	Hook SE, NS Fisher
Acartia tonsa		SW	Silver	7440-22-4	0.033	Reproduction	ED56	Ingestion	Whole Body	Adult	Protien Per Egg	2001	Hook SE, NS Fisher
Acartia tonsa		SW	Silver	7440-22-4	0.019	Reproduction	ED68	Ingestion	Whole Body	Adult	Developed Ovaries	2001	Hook SE, NS Fisher
Terapon jarbua	Grunt	SW	Silver	7440-22-4	2.02	Mortality	NOED	Water	Whole Body	Juvenile	Cu 1ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Silver	7440-22-4	1.36	Mortality	NOED	Water	Whole Body	Juvenile	Cu 10ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Silver	7440-22-4	2.02	Growth	NOED	Water	Whole Body	Juvenile	Cu 1ug/l + Ag10.0 ug/l	2005	Long A; WX Wang
Terapon jarbua	Grunt	SW	Silver	7440-22-4	1.36	Growth	NOED	Water	Whole Body	Juvenile	Cu 10ug/l + Ag10.0 ug/l	2005	Long A; WX Wang

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-9. Summary of Silver Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



2/3/2006

Chart C-10. Summary of Silver Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity

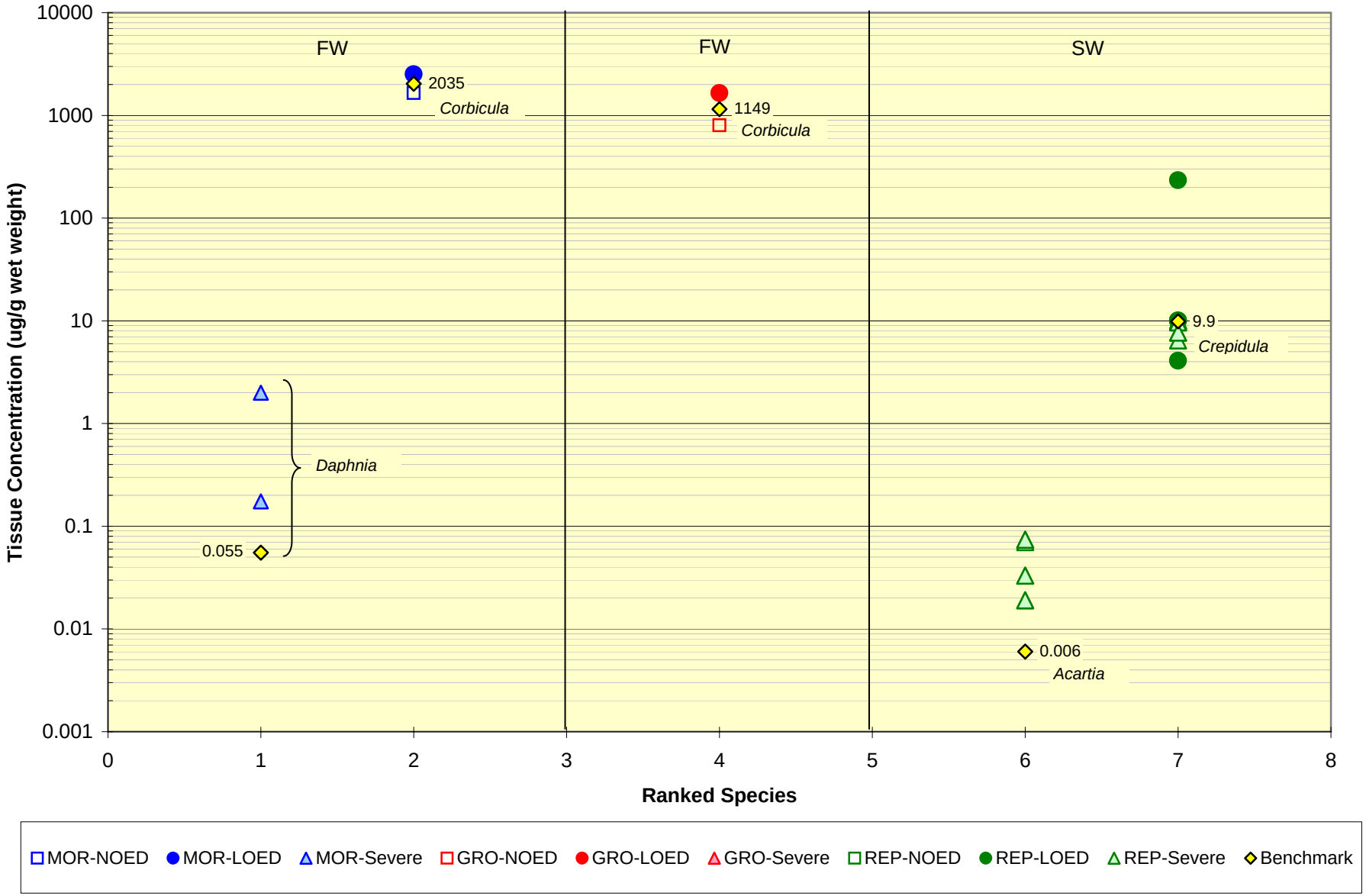


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Table C-7. Summary of Aquatic Organism Tissue Effects Data from ERED Database - Organotin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.123	Reproduction	ED28	Ingestion	Eggs	Adult	5ug/g TBT decrease in HATCHABILITY %	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.123	Reproduction	ED08	Ingestion	Eggs	Adult	5ug/g TBT decrease in HATCHABILITY %	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.123	Reproduction	ED08	Ingestion	Eggs	Adult	5ug/g TBT decrease in SWIMUP	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.076	Reproduction	NOED	Ingestion	Eggs	Adult	5ug/g TBT + 25 ug/g PCB % decrease in fertile	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.076	Reproduction	ED05	Ingestion	Eggs	Adult	5ug/g TBT + 25 ug/g PCB % decrease in hatchable	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.076	Reproduction	ED08	Ingestion	Eggs	Adult	5ug/g TBT + 25 ug/g PCB % failure to swim-up	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.265	Reproduction	ED16	Ingestion	Eggs	Adult	25ug/g TBT + 0 ug/g PCB % decrease in hatched	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.265	Reproduction	ED02	Ingestion	Eggs	Adult	25ug/g TBT + 0 ug/g PCB % failed in swim-up	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.255	Reproduction	ED06	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB % decrease in fertile	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.255	Reproduction	ED09	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB % decrease in swim-up	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.255	Reproduction	NOED	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB decrease in egg develoment	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.265	Reproduction	ED11	Ingestion	Eggs	Adult	25ug/g TBT + 0 ug/g PCB % decrease in fertile	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.255	Reproduction	ED03	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB % decrease in hatch	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	Tributyltin	56573-85-4	0.265	Reproduction	NOED	Ingestion	Eggs	Adult	25ug/g TBT + 0ug/g PCB decrease in egg develoment	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.18	Reproduction	ED100	Combined	Whole Body	Embryo	100% of females sterile due to imposex.	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.08	Development	LOED	Combined	Whole Body	Embryo	Malformation of female reproductive system, imposex.	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.24	Development	LOED	Combined	Whole Body	Egg	Females developed male internal sexual organs. Exposure to 9 to 19 ng/L in field.	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.08	Reproduction	LOED	Combined	Whole Body	Embryo	33% of females sterile due to imposex. Normal egg capsule	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.24	Reproduction	LOED	Combined	Whole Body	Egg	All females sterile due to imposex. Exposure to 9 to 19 ng/L in field.	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.6	Development	NA	Combined	Whole Body	Embryo	Development of testis, seminiferous tubules, and early spermatogenesis in	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.07	Reproduction	NOED	Combined	Whole Body	Egg	All females appeared capable of breeding. Imposex. Exposure to	1988	Gibbs, P.E., P.L. Pascoe, and G.R. Burt
Callinectes sapidus	Crab - Blue	SW	Tributyltin	56573-85-4	0.5	Behavior	NOED	Ingestion	Whole Body	Juvenile	Palaemonetes pugio were the prey species, exposed to 100 ug/l TBTfor a final concentration of 1.89 ug/g. Crabs ate 1.46g shimp/day, or 2.76 ug/g TBT per day. Feeding Rate.	1989	Rice SD, JW Short

Table C-7. Summary of Aquatic Organism Tissue Effects Data from ERED Database - Organotin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Callinectes sapidus	Crab - Blue	SW	Tributyltin	56573-85-4	0.5	Growth	NOED	Ingestion	Whole Body	Juvenile	Palaemonetes pugio were the prey species, exposed to 100 ug/l TBTfor a final concentration of 1.89 ug/g. Crabs ate 1.46g shimp/day, or 2.76 ug/g TBT per day.	1989	Rice SD, JW Short
Poecilia reticulata	Guppy	FW	Tributyltin	56573-85-4	3.492	Mortality	LD	Water	Whole Body	Adult	Warning: no data was given on specific percentages of the population affected by these dosages, only that it was lethal.	1996	Tas JW, A Keizer, A Opperhuizen
Poecilia reticulata	Guppy	FW	Tributyltin	56573-85-4	5.24	Mortality	LD	Water	Whole Body	Adult	Warning: no data was given on specific percentages of the population affected by these dosages, only that it was lethal.	1996	Tas JW, A Keizer, A Opperhuizen
Poecilia reticulata	Guppy	FW	Tributyltin	56573-85-4	7.57	Mortality	LD	Water	Whole Body	Adult	Warning: no data was given on specific percentages of the population affected by these dosages, only that it was lethal.	1996	Tas JW, A Keizer, A Opperhuizen
Ostrea edulis	Edible oyster	SW	Tributyltin	56573-85-4	0.4	Reproduction	ED100	Water	Whole Body	Adult	No larvae released; possibly due to retardation os sex change from male to female, "imposex"	1986	Thain JE
Ostrea edulis	Edible oyster	SW	Tributyltin	56573-85-4	1.23	Reproduction	ED100	Water	Whole Body	Adult	No larvae released; gonad development completely inhibited (possibly due to retardation os sex change from male to female, "imposex")	1986	Thain JE
Ostrea edulis	Edible oyster	SW	Tributyltin	56573-85-4	0.53	Development	ED21	Water	Whole Body	Adult	Length	1986	Thain JE
Mytilus edulis	Mussel	SW	Tributyltin	56573-85-4	2.2	Growth	ED25	Water	Whole Body	Adult	Weight gain and length inc.	1986	Thain JE
Venerupis decussata	Clam	SW	Tributyltin	56573-85-4	2.64	Growth	ED33	Water	Whole Body	Adult	Final meat weight	1986	Thain JE
Mytilus edulis	Mussel	SW	Tributyltin	56573-85-4	2.2	Growth	ED48	Water	Whole Body	Adult	Final meat weight	1986	Thain JE
Venerupis decussata	Clam	SW	Tributyltin	56573-85-4	2.64	Growth	ED49	Water	Whole Body	Adult	Weight gain and length inc.	1986	Thain JE
Venerupis decussata	Clam	SW	Tributyltin	56573-85-4	2.64	Growth	ED51	Water	Whole Body	Adult	Length	1986	Thain JE
Venerupis semidecussata	Clam	SW	Tributyltin	56573-85-4	2.91	Growth	ED64	Water	Whole Body	Adult	Length	1986	Thain JE
Venerupis semidecussata	Clam	SW	Tributyltin	56573-85-4	2.91	Growth	ED66	Water	Whole Body	Adult	Final meat weight	1986	Thain JE
Crassostrea gigas	Pacific oyster	SW	Tributyltin	56573-85-4	2.38	Growth	ED75	Water	Whole Body	Adult	weight gain and length inc.	1986	Thain JE
Mytilus edulis	Mussel	SW	Tributyltin	56573-85-4	2.2	Growth	ED79	Water	Whole Body	Adult	Length	1986	Thain JE
Crassostrea gigas	Pacific oyster	SW	Tributyltin	56573-85-4	2.38	Growth	ED90	Water	Whole Body	Adult	Length	1986	Thain JE
Venerupis semidecussata	Clam	SW	Tributyltin	56573-85-4	2.91	Growth	ED96	Water	Whole Body	Adult	Weight gain and length inc.	1986	Thain JE
Ostrea edulis	Edible oyster	SW	Tributyltin	56573-85-4	0.4	Mortality	LD4	Water	Whole Body	Adult		1986	Thain JE
Ostrea edulis	Edible oyster	SW	Tributyltin	56573-85-4	0.75	Mortality	LD67	Water	Whole Body	Adult		1986	Thain JE
Ostrea edulis	Edible oyster	SW	Tributyltin	56573-85-4	1.23	Mortality	LD8	Water	Whole Body	Adult		1986	Thain JE
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	2	Development	NA	Combined	Whole Body	Adult	Paint On Shell; Female Penis Length Increased; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone

Table C-7. Summary of Aquatic Organism Tissue Effects Data from ERED Database - Organotin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	1.97	Development	NOED	Combined	Whole Body	Adult	Paint On Shell; No Effect In Male Penis Length; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.01106	Reproduction	ED0	NS	Soft Tissue	NS	Imposex; less than 10% sterility in female mussels	1998	Ruiz JM, M Quintela, R Barreiro
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.0338	Reproduction	ED10	NS	Soft Tissue	NS	Imposex; sterility in female mussels	1998	Ruiz JM, M Quintela, R Barreiro
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.0601	Reproduction	ED20	NS	Soft Tissue	NS	Imposex; sterility in female mussels	1998	Ruiz JM, M Quintela, R Barreiro
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.0855	Reproduction	ED30	NS	Soft Tissue	NS	Imposex; sterility in female mussels	1998	Ruiz JM, M Quintela, R Barreiro
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.1059	Reproduction	ED40	NS	Soft Tissue	NS	Imposex; sterility in female mussels	1998	Ruiz JM, M Quintela, R Barreiro
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin	56573-85-4	0.127	Reproduction	ED50	NS	Soft Tissue	NS	Imposex; sterility in female mussels	1998	Ruiz JM, M Quintela, R Barreiro
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	50	Reproduction	ED80	NS	Soft Tissue	NA	Imposex; evaluated according to 5 stages: E0-E4 Data from Mira Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	74	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E4, range = 74-160 mg/kg; Evaluated according to 5 stages: E0-E4 Data from Mira	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	22	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E3, range 22-65 mg/kg; Evaluated according to 5 stages: E0-E4 Data from Mira	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	28	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E2, range 28-48 mg/kg; Evaluated according to 5 stages: E0-E4 Data from Mira	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	15	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E1, range 15-58 mg/kg; Evaluated according to 5 stages: E0-E4 Data from Mira	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	25	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E0, range 25-36 mg/kg; Evaluated according to 5 stages: E0-E4 Data from Mira	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	66	Reproduction	ED100	NS	Soft Tissue	NA	Imposex; range=5.456-208.8 mg/kg. Evaluated according to 5 stages: E0-E4 Data from Sado Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	42.48	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E0 Evaluated according to 5 stages: E0-E4 Data from Sado Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	19.35	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E1 Evaluated according to 5 stages: E0-E4 Data from Sado Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	11.75	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E2 Evaluated according to 5 stages: E0-E4 Data from Sado Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	21.77	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E3 Evaluated according to 5 stages: E0-E4 Data from Sado Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira
Hinia reticulata aka Nassarius reticulatus	Mussel	SW	Tributyltin	56573-85-4	55.04	Reproduction	ED100	NS	Soft Tissue	NA	Imposex: Stage E4 (range = 8.1 - 153.7 mg/kg ww) Evaluated according to 5 stages: E0-E4 Data from Sado Estuary, Portugal	2001	Pessoa MF, A Fernando, JS Oliveira

Table C-7. Summary of Aquatic Organism Tissue Effects Data from ERED Database - Organotin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Mytilus edulis	Mussel	SW	Tributyltin	56573-85-4	0.674	Growth	NOED	Combined	Whole Body	Adult	Weight-all TBT derivatives, exposure from sediment measurements	1997	Lundebye A-K, WJ Langston, MH Depledge
Mytilus edulis	Mussel	SW	Tributyltin	56573-85-4	0.23	Growth	NOED	Combined	Whole Body	Adult	Weight, exposure from sediment measurements	1997	Lundebye A-K, WJ Langston, MH Depledge
Nereis arenaceodentata	Polychaete	SW	Tributyltin chloride	1461-22-9	0.934	Growth	LOED	Combined	Whole Body	Immature	Nominal Exposure Conc	1991	Moore, D.W. and T.M. Dillon, and B.C. Suedel
Nereis arenaceodentata	Polychaete	SW	Tributyltin chloride	1461-22-9	0.538	Growth	NOED	Combined	Whole Body	Immature	Nominal Exposure Conc	1991	Moore, D.W. and T.M. Dillon, and B.C. Suedel
Nereis arenaceodentata	Polychaete	SW	Tributyltin chloride	1461-22-9	0.934	Mortality	NOED	Combined	Whole Body	Immature	Nominal Exposure Conc	1991	Moore, D.W. and T.M. Dillon, and B.C. Suedel
Ilyanassa obsoleta	Mud snail	SW	Tributyltin chloride	1461-22-9	0.02	Reproduction	LOED	Combined	Whole Body	Adult	40-50% Imposex.	1974	Hyde, K.M., S. Stokes, J.F. Fowler, J.B. Graves, and F.L. Bonner.
Rhepoxynius abronius	Amphipod	SW	Tributyltin chloride	1461-22-9	6	Mortality	LD50	Water	Whole Body	Adult	Animals held 68 d prior to test; significantly different than test w/shorter holding time. However, results not significant when lipid normalized	1993	Meador JP
Eohaustorius estuarius	Amphipod	SW	Tributyltin chloride	1461-22-9	7	Mortality	LD50	Water	Whole Body	Adult	Animals held 98 d prior to test; significantly different from test w/ shorter holding time. However, results not significant when lipid normalized	1993	Meador JP
Eohaustorius estuarius	Amphipod	SW	Tributyltin chloride	1461-22-9	12	Mortality	LD50	Water	Whole Body	Adult	Animals held 11 d prior to test	1993	Meador JP
Rhepoxynius abronius	Amphipod	SW	Tributyltin chloride	1461-22-9	14.4	Mortality	LD50	Water	Whole Body	Adult	Animals held 6 d in lab	1993	Meador JP
Eohaustorius estuarius	Amphipod	SW	Tributyltin chloride	1461-22-9	750	Mortality	LD50	Water	Whole Body	Adult	Animals held 11 d prior to test	1993	Meador JP
Eohaustorius estuarius	Amphipod	SW	Tributyltin chloride	1461-22-9	1100	Mortality	LD50	Water	Whole Body	Adult	Animals held 98 d prior to test; significantly different from test w/ shorter holding time. However, results not significant when lipid normalized	1993	Meador JP
Rhepoxynius abronius	Amphipod	SW	Tributyltin chloride	1461-22-9	1175	Mortality	LD50	Water	Whole Body	Adult	Animals held 6 d in lab	1993	Meador JP
Rhepoxynius abronius	Amphipod	SW	Tributyltin chloride	1461-22-9	1400	Mortality	LD50	Water	Whole Body	Adult	Animals held 68 d prior to test; significantly different than test w/shorter holding time. However, results not significant when lipid normalized	1993	Meador JP
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.9405	Reproduction	ED57	Ingestion	Whole Body	Adult	EJ(emergent juv.) production; all replicates	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Reproduction	ED100	Ingestion	Whole Body	Adult	Reduction in egg production (all replicates; not just reproducing pairs)	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00252	Reproduction	ED100	Ingestion	Whole Body	Adult	Reproductive success	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00252	Reproduction	ED100	Ingestion	Whole Body	Adult	# worms with eggs visible in coelom/#worms at day 70	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00252	Reproduction	ED100	Ingestion	Whole Body	Adult	# worms with eggs visible in coelom/#worms at day 70	1991	Moore DW, TM Dillon, and BC Suede

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	2.52	Reproduction	ED100	Ingestion	Whole Body	Adult	Reduced growth	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	2.52	Reproduction	ED100	Ingestion	Whole Body	Adult	egg development	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00095	Growth	ED32	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.9405	Growth	ED32	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Reproduction	ED60	Ingestion	Whole Body	Adult	All replicates: Emerging Juveniles (EJ) significantly different from controls	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00252	Growth	ED89	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	2.52	Growth	ED89	Ingestion	Whole Body	Adult	Reduced growth	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00252	Mortality	LD73	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	2.52	Mortality	LD73	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00045	Growth	NOED	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.4485	Growth	NOED	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Mortality	NOED	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.9405	Mortality	NOED	Ingestion	Whole Body	Adult		1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Reproduction	NOED	Ingestion	Whole Body	Adult	Reproducing pairs: Emerging Juveniles (EJ): not statistically significant	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Reproduction	NOED	Ingestion	Whole Body	Adult	Hatching success was not significantly different from controls	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Reproduction	NOED	Ingestion	Whole Body	Adult	No difference in egg size	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.00094	Reproduction	NOED	Ingestion	Whole Body	Adult	Emerging Juveniles (EJ) size was not significantly different from controls	1991	Moore DW, TM Dillon, and BC Suede
Neanthes arenaceodentata	Neanthes	SW	Tributyltin chloride	1461-22-9	0.9405	Reproduction	NOED	Ingestion	Whole Body	Adult	EJ(emergent juv.) production; reproductive pairs	1991	Moore DW, TM Dillon, and BC Suede
arenaceodentata	Neanthes	SW	chloride	1461-22-9	0.9405	Reproduction	NOED	Ingestion	Whole Body	Adult	egg size	1991	Moore DW, TM Dillon, and BC Suede
arenaceodentata	Neanthes	SW	chloride	1461-22-9	0.9405	Reproduction	NOED	Ingestion	Whole Body	Adult	egg size	1991	Moore DW, TM Dillon, and BC Suede
arenaceodentata	Neanthes	SW	chloride	1461-22-9	0.9405	Reproduction	NOED	Ingestion	Whole Body	Adult	Hatching success	1991	Moore DW, TM Dillon, and BC Suede
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.4	Development	ED100	Absorption	Whole Body	NA	100% Malformation of female reproductive organs. Dibutyltin residue of 0.17 mg/kg. Total tin residue of 0.56 mg/kg.	1988	Bryan, G.W., P.E. Gibbs, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.27	Mortality	LD50	Injection	Whole Body	NA	50% Mortality in females. Residue measured at 70 days after injection.	1988	Bryan, G.W., P.E. Gibbs, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.27	Development	LOED	Injection	Whole Body	NA	Increased malformation of female reproductive organs, imposex. Residue measured at 70 days after	1988	Bryan, G.W., P.E. Gibbs, and G.R. Burt

Table C-7. Summary of Aquatic Organism Tissue Effects Data from ERED Database - Organotin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.23	Reproduction	LOED	Injection	Whole Body	NA	Increased sterility in females due to imposex. Residue measured at 41 days after injection.	1988	Bryan, G.W., P.E. Gibbs, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.27	Reproduction	LOED	Injection	Whole Body	NA	Increased sterility in females due to imposex. Residue measured at 70 days after injection.	1988	Bryan, G.W., P.E. Gibbs, and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.4	Reproduction	LOED	Absorption	Whole Body	NA	Sterility in females due to imposex. Dibutyltin residue of 0.17 mg/kg. Total tin residue of 0.56 mg/kg.	1988	Bryan, G.W., P.E. Gibbs, and G.R. Burt
Ilyanassa obsoleta	Mud snail	SW	chloride	1461-22-9	0.124	Reproduction	ED100	Combined	Whole Body	Adult	100% Imposex.	1989	Curtis, D.S. Bailey, and D.M. Dauer.
Ilyanassa obsoleta	Mud snail	SW	Tributyltin chloride	1461-22-9	0.004	Reproduction	NOED	Combined	Whole Body	Immature	No imposex. Residue below detection limit.	1989	Bryan, G.W., P.E. Gibbs, R.J. Huggett, L.A. Curtis, D.S. Bailey, and D.M. Dauer.
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.0413	Development	LOED	Combined	Whole Body	Adult	Decreased (female/male Penis Length); Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.15	Development	LOED	Combined	Whole Body	Adult	Significantly Increased Penis Length; Equals 0.65 Ug/g Tbt+dbt; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.733	Reproduction	LOED	Combined	Whole Body	Adult	Sterility In Females; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	1.17	Reproduction	LOED	Combined	Whole Body	Adult	Sterility In Females; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	1.33	Development	NA	Combined	Whole Body	Adult	Paint On Shell; Female Penis Length Increased; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	1.82	Development	NA	Combined	Whole Body	Adult	Paint On Shell; No Effect In Male Penis Length; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.0666	Development	NOED	Combined	Whole Body	Adult	No Increase In Penis Length; Equals 0.5 Ug/g Tbt+dbt; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.909	Development	NOED	Combined	Whole Body	Adult	Paint On Shell; No Effect In Male Penis Length; Body Burden As Tin Not Tbt Or Dbt	1987	Bryan, G.W., Gibbs, P.E., Burt, G.R. and L.G. Hummerstone
Thais clavigera	Whelk	SW	Tributyltin chloride	1461-22-9	0.013	Reproduction	LOED	Injection	Whole Body	Adult	Degradation Products Present?	1997	Horiguchi, T., H. Shiraishi, M. Shimizu, M. and M. Morita
Littorina littorea	Periwinkle	SW	Tributyltin chloride	1461-22-9	0.1	Reproduction	NOED	Combined	Whole Body	Adult	Imposex - Intersex Response (prostate Length, Isi). Estimated Wet Weight	1995	Bauer, B., P. Fioroni, I. Ide, S. Liebe, J. Oehlmann, E. Stroben, and B. Watermann
washingtonianus	Amphipod	SW	chloride	1461-22-9	9.03	Mortality	LD50	Combined	Whole Body	Adult	Good paper	1997	Meador, J.P.
Eohaustorius estuarius	Amphipod	SW	Tributyltin chloride	1461-22-9	11.8	Mortality	LD50	Combined	Whole Body	Adult	From previous paper by Meador, J.	1997	Meador, J.P.
abronius	Amphipod	SW	chloride	1461-22-9	14.6	Mortality	LD50	Combined	Whole Body	Adult	good paper	1997	Meador, J.P.
Dreissena polymorpha	Mussel - Zebra	FW	Tributyltin chloride	1461-22-9	12.7	Growth	NOED	Absorption	Whole Body	Adult	No significant difference in length. Tributyltin residue and exposure concentration.	1994	Van Slooten, K.B., Tarradellas, J.
Dreissena polymorpha	Mussel - Zebra	FW	Tributyltin chloride	1461-22-9	12.7	Mortality	NOED	Absorption	Whole Body	Adult	No significant increase in mortality. Tributyltin residue and exposure concentration.	1994	Van Slooten, K.B., Tarradellas, J.

Table C-7. Summary of Aquatic Organism Tissue Effects Data from ERED Database - Organotin

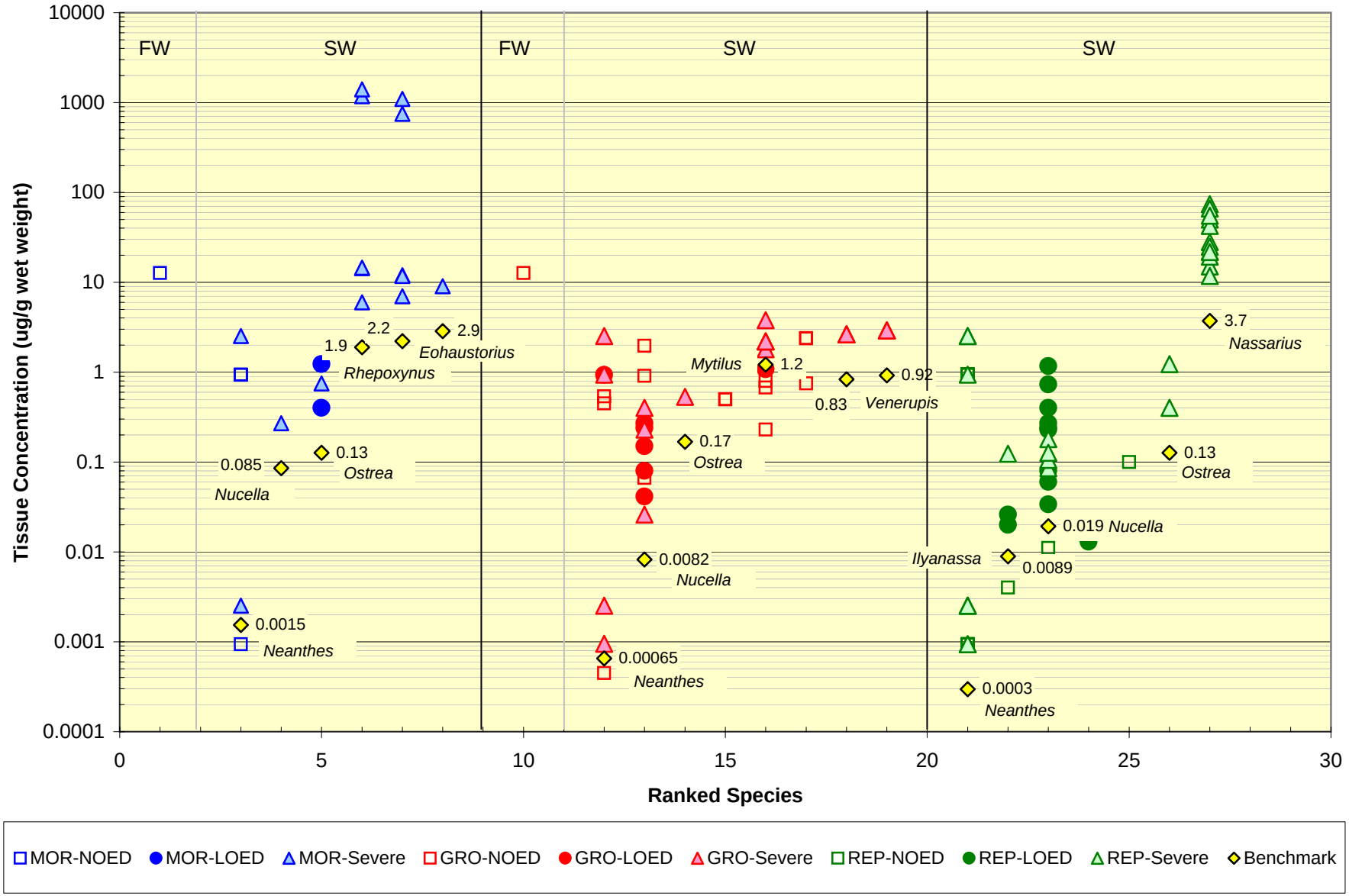
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Mytilus edulis	Mussel	SW	Tributyltin chloride	1461-22-9	3.8	Behavior	ED100	Absorption	Whole Body	Adult	Cessation of feeding, no faeces produced; Exposure concentrations variable because of rapid uptake by test organisms so not measured or reported	1993	Widdows, J., Page, D.S.
Mytilus edulis	Mussel	SW	Tributyltin chloride	1461-22-9	1.8	Behavior	ED50	Absorption	Whole Body	Adult	50% Reduction in clearance rate (feeding rate) compared to controls; Exposure concentrations variable because of rapid uptake by test organisms so not measured or	1993	Widdows, J., Page, D.S.
Mytilus edulis	Mussel	SW	Tributyltin chloride	1461-22-9	1.08	Behavior	LOED	Absorption	Whole Body	Adult	Significant decrease in clearance rate (feeding rate) compared to controls; Exposure concentrations variable because of rapid uptake by test organisms so not measured or	1993	Widdows, J., Page, D.S.
Mytilus edulis	Mussel	SW	Tributyltin chloride	1461-22-9	0.8	Behavior	NOED	Absorption	Whole Body	Adult	No significant difference in clearance rate (feeding rate) compared to controls; Exposure concentrations variable because of rapid uptake by test organisms so not measured or reported	1993	Widdows, J., Page, D.S.
Crassostrea gigas	Pacific oyster	SW	Tributyltin chloride	1461-22-9	0.75	Growth	LOED	Combined	Whole Body	Immature	Significant decrease in tissue weight:total weight ratio.	1987	Davies, I.M., J. Drinkwater, J.C. Mckie and P. Balls
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.026	Development	LOED	Absorption	Whole Body	Egg-embryo	Increased induction of imposex in females.	1987	Gibbs, P.E., G.W. Bryan, P.L. Pascoe and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.026	Reproduction	LOED	Absorption	Whole Body	Egg-embryo	Reduced reproductive capacity in females as a result of imposex development.	1987	Gibbs, P.E., G.W. Bryan, P.L. Pascoe and G.R. Burt
Nucella lapillus	Atlantic dogwinkle	SW	Tributyltin chloride	1461-22-9	0.23	Development	LOED	Injection	Whole Body	NA	reproductive organs, imposex. Residue measured at 41 days after injection.	1996	Ashley, C.M., M.G. Simpson, D.M. Holdich and D.R. Bell
Gobiocypris rarus	Chinese Rare Minnow	FW	chloride	1461-22-9	0.05	Mortality	NOED	Water	Muscle	Adult		2002	Qun-Fang, Z., J. Gui-Bin, L. Ji-Yan
Gobiocypris rarus	Chinese Rare Minnow	FW	chloride	1461-22-9	0.05	Behavior	NOED	Water	Muscle	Adult		2002	Qun-Fang, Z., J. Gui-Bin, L. Ji-Yan
Gobiocypris rarus	Chinese Rare Minnow	FW	chloride	1461-22-9	0.05	Behavior	NOED	Water	Muscle	Adult	Feeding	2002	Qun-Fang, Z., J. Gui-Bin, L. Ji-Yan

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-11. Summary of Tributytin Concentrations in Freshwater Fish Tissue Associated with Toxicity

2/3/2006

Chart C-12. Summary of Tributytin Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity



2/3/2006

Table C-8. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Zinc

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Nephtys australiensis	Polychaete	SW	Zinc	7440-66-6	100	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Nephtys australiensis	Polychaete	SW	Zinc	7440-66-6	80	Mortality	LD05	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Nephtys australiensis	Polychaete	SW	Zinc	7440-66-6	80	Mortality	LD07	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Zinc	7440-66-6	18	Mortality	LD28	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Zinc	7440-66-6	18	Mortality	LD62	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Zinc	7440-66-6	30	Mortality	LD65	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Tellina deltoidalis	Bivalve	SW	Zinc	7440-66-6	250	Mortality	LD65	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Tellina deltoidalis	Bivalve	SW	Zinc	7440-66-6	420	Mortality	LD65	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Soletellina alba	Bivalve	SW	Zinc	7440-66-6	160	Mortality	LD70	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Australonereis ehlersi	Polychaete	SW	Zinc	7440-66-6	20	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Nephtys australiensis	Polychaete	SW	Zinc	7440-66-6	60	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Mysella anomala	Bivalve	SW	Zinc	7440-66-6	5	Mortality	NOED	Combined	Whole Body	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Tellina deltoidalis	Bivalve	SW	Zinc	7440-66-6	80	Mortality	LD10	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Tellina deltoidalis	Bivalve	SW	Zinc	7440-66-6	180	Mortality	LD10	Combined	Soft tissue	Adult		2004	King CK, MC Dowse, SL Simpson, DF Jolley
Enteromorpha flexuosa	Enteromorpha flexuosa	SW	Zinc	7440-66-6	20	Growth	ED52	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Enteromorpha flexuosa	Enteromorpha flexuosa	SW	Zinc	7440-66-6	100	Growth	ED41	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Enteromorpha flexuosa	Enteromorpha flexuosa	SW	Zinc	7440-66-6	60	Growth	ED27	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Enteromorpha flexuosa	Enteromorpha flexuosa	SW	Zinc	7440-66-6	180	Growth	ED46	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Ulva lactuca	Ulva lactuca	SW	Zinc	7440-66-6	40	Growth	ED42	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Ulva lactuca	Ulva lactuca	SW	Zinc	7440-66-6	40	Growth	ED45	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Ulva lactuca	Ulva lactuca	SW	Zinc	7440-66-6	156	Growth	ED50	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Ulva lactuca	Ulva lactuca	SW	Zinc	7440-66-6	120	Growth	ED50	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Ulva lactuca	Ulva lactuca	SW	Zinc	7440-66-6	180	Growth	ED61	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	18	Growth	ED29	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	100	Growth	ED86	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	600	Growth	ED89	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	40	Growth	ED19	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	160	Growth	ED81	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	1600	Growth	ED92	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	100	Growth	ED26	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	180	Growth	ED83	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer

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Padina gymnospora	Padina gymnospora	SW	Zinc	7440-66-6	1800	Growth	ED91	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Sargassum filipendula	Sargassum filipendula	SW	Zinc	7440-66-6	400	Growth	ED53	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Sargassum filipendula	Sargassum filipendula	SW	Zinc	7440-66-6	140	Growth	ED31	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Sargassum filipendula	Sargassum filipendula	SW	Zinc	7440-66-6	400	Growth	ED62	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Sargassum filipendula	Sargassum filipendula	SW	Zinc	7440-66-6	160	Growth	ED36	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Sargassum filipendula	Sargassum filipendula	SW	Zinc	7440-66-6	400	Growth	ED73	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Hypnea musciformis	Hypnea musciformis	SW	Zinc	7440-66-6	14	Growth	ED80	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Hypnea musciformis	Hypnea musciformis	SW	Zinc	7440-66-6	60	Growth	ED90	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Hypnea musciformis	Hypnea musciformis	SW	Zinc	7440-66-6	140	Growth	ED88	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Hypnea musciformis	Hypnea musciformis	SW	Zinc	7440-66-6	160	Growth	ED86	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	60	Growth	ED45	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	200	Growth	ED70	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer

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Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	40	Growth	ED18	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	120	Growth	ED29	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	600	Growth	ED71	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	100	Growth	ED13	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	140	Growth	ED27	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Spyridia filamentosa	Spyridia filamentosa	SW	Zinc	7440-66-6	1000	Growth	ED73	Water	Whole Body	NA	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species	1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer
Salmo salar	Salmon - Atlantic	FW/SW	Zinc	7440-66-6	12	Growth	NOED	Water	Whole Body	Juvenile	2% Rations (dry body wt/dry rations)	1979	Farmer GJ, D Ashfield, HS Samant
Salmo salar	Salmon - Atlantic	FW/SW	Zinc	7440-66-6	23.6	Growth	NOED	Water	Whole Body	Juvenile	3.5% Rations (dry body wt/dry rations)	1979	Farmer GJ, D Ashfield, HS Samant
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	55.8	Mortality	NOED	Water	Soft Tissue	Adult		1988	Kaitala S
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	120	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality. Residue was determined from graph and is approximate.	1994	Kraak, M.H.S., M. Touissaint, D. Lavy, and C. Davids.
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	600	Mortality	LD100	Water	Soft Tissue	NS	Mussel Bioconcentrations taken as Musssels dies during experiment. Filtration Rate	1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	620	Mortality	LD50	Water	Soft Tissue	NS	Mussel Bioconcentrations taken as Musssels dies during experiment.	1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	120	Mortality	NOED	Water	Soft Tissue	NS	Mussel Bioconcentrations taken as Musssels dies during experiment. Filtration Rate	1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal
Orconectes virilis	Crayfish	FW	Zinc	7440-66-6	35.2	Mortality	LD23	Absorption	Whole Body	Adult	23% Significant increase in mortality.	1986	Mirenda, R.J.
Orconectes virilis	Crayfish	FW	Zinc	7440-66-6	37.8	Mortality	LD43	Absorption	Whole Body	Adult	43% Increase in mortality.	1986	Mirenda, R.J.
Orconectes virilis	Crayfish	FW	Zinc	7440-66-6	69.2	Mortality	LD61	Absorption	Whole Body	Adult	61% Increase in mortality.	1986	Mirenda, R.J.
Orconectes virilis	Crayfish	FW	Zinc	7440-66-6	12.7	Mortality	NOED	Absorption	Whole Body	Adult	No significant increase in mortality.	1986	Mirenda, R.J.

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Chironomus riparius	Midge	FW	Zinc	7440-66-6	180	Growth	ED44	Water	Whole Body	Larval	Delay in larval growth	1992	Timmermans KR, W Peeters, and M. Tonkes
Chironomus riparius	Midge	FW	Zinc	7440-66-6	183	Development	ED50	Water	Whole Body	Larval	Significant delay in larval development; almost no emergence	1992	Timmermans KR, W Peeters, and M. Tonkes
Chironomus riparius	Midge	FW	Zinc	7440-66-6	524	Development	ED50	Water	Whole Body	Larval	Significant delay in larval development; almost no emergence	1992	Timmermans KR, W Peeters, and M. Tonkes
Chironomus riparius	Midge	FW	Zinc	7440-66-6	183	Mortality	LD10	Water	Whole Body	Larval		1992	Timmermans KR, W Peeters, and M. Tonkes
Chironomus riparius	Midge	FW	Zinc	7440-66-6	524	Mortality	LD6	Water	Whole Body	Larval		1992	Timmermans KR, W Peeters, and M. Tonkes
Allorchestes compressa	Amphipod	SW	Zinc	7440-66-6	28	Growth	LOED	Water	Whole Body	Juvenile	Weight	1991	Ahsanullah M, AR Williams
Allorchestes compressa	Amphipod	SW	Zinc	7440-66-6	28	Mortality	LOED	Water	Whole Body	Juvenile		1991	Ahsanullah M, AR Williams
Poecilia reticulata	Guppy	FW	Zinc	7440-66-6	0.284	Mortality	NOED	Combined	Whole Body	Immature		1981	Pierson, K.B.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	220	Growth	LOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph, Total Length Of Females	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	300	Growth	LOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph, Total Length Of Males	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	220	Mortality	LOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	190	Growth	NOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph, Total Length Of Females	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	230	Growth	NOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph, Total Length Of Males	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	220	Mortality	NOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	300	Mortality	NOED	Combined	Whole Body	Immature	Body Burd. Est. From Graph	1976	Spehar, R.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	50	Mortality	LOED	Combined	Whole Body	Immature	Body Burden Est. From Graph	1978	Spehar, R.L., Leonard, E.N., Defoe, D.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	58	Growth	NOED	Combined	Whole Body	Immature	Body Burden Est. From Graph	1978	Spehar, R.L., Leonard, E.N., Defoe, D.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	50	Mortality	NOED	Combined	Whole Body	Immature	Body Burden Est. From Graph	1978	Spehar, R.L., Leonard, E.N., Defoe, D.L.
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	58	Reproduction	NOED	Combined	Whole Body	Immature	Body Burden Est. From Graph	1978	Spehar, R.L., Leonard, E.N., Defoe, D.L.

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Themisto libellula	Mesoplankton amphipod	SW	Zinc	7440-66-6	951	Mortality	LD50	Water	Whole Body	Adult		1997	Ritterhoff, J., and G-P. Zauke
Themisto abyssorum	Mesoplankton amphipod	SW	Zinc	7440-66-6	951	Mortality	LD50	Water	Whole Body	Adult		1997	Ritterhoff, J., and G-P. Zauke
Calanus hyperboreus	Calanoid copepod	SW	Zinc	7440-66-6	1750	Mortality	LD50	Water	Whole Body	Adult	low concentration exposure	1997	Ritterhoff, J., and G-P. Zauke
Calanus hyperboreus	Calanoid copepod	SW	Zinc	7440-66-6	2980	Mortality	LD50	Water	Whole Body	Adult	High concentration exposure	1997	Ritterhoff, J., and G-P. Zauke
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	105.8	Mortality	LD100	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	117.8	Mortality	LD100	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	19.5	Mortality	LD25	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	40.3	Mortality	LD25	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	72.7	Mortality	LD25	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	117.8	Mortality	LD40	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	50.2	Mortality	LD50	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	90.6	Mortality	LD50	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	60.8	Mortality	LD67	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	53.6	Mortality	NOED	Absorption	Whole Body	Juvenile	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	60.8	Mortality	NOED	Absorption	Whole Body	Adult	calc wet from dry using default % moisture	1997	Borgmann, U., and W.P. Norwood
Salvelinus fontinalis	Trout - Brook	FW	Zinc	7440-66-6	4.5	Mortality	LOED	Absorption	Whole Body	Egg-embryo	Reduction in percentage of hatchability in second generation eggs. Residue in newly hatched larva.	1979	Holcombe, G.W., Benoit,D.A. and E.N. Leonard
Salvelinus fontinalis	Trout - Brook	FW	Zinc	7440-66-6	3.9	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No reduction in percentage of eggs hatching in second generation. Residue in newly hatched larva.	1979	Holcombe, G.W., Benoit,D.A. and E.N. Leonard
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	621	Mortality	LOED	Absorption	Whole Body	Adult	56% Mortality	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	621	Growth	NOED	Absorption	Whole Body	Adult	No Effect On Weight Gain Of Surviving Mussels	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Dreissena polymorpha	Mussel - Zebra	FW	Zinc	7440-66-6	140	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Mortality	1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	130	Mortality	LD100	Combined	Whole Body	Adult	100% Mortality In 14 Days	1994	Burbidge, F.J., D.J. Macey, J. Webb and V. Talbot
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	71.4	Mortality	NA	Combined	Whole Body	Adult	7.5% Mortality In 14 Days	1994	Burbidge, F.J., D.J. Macey, J. Webb and V. Talbot

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Salmo salar	Salmon - Atlantic	FW/SW	Zinc	7440-66-6	60	Growth	NOED	Absorption	Whole Body	Immature	No Effect On Weight Gain	1979	Farmer, G.J., D. Ashfield and H.S. Samont
Salmo salar	Salmon - Atlantic	FW/SW	Zinc	7440-66-6	60	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survivorship	1979	Farmer, G.J., D. Ashfield and H.S. Samont
Chironomus tentans	Midge	FW	Zinc	7440-66-6	34.8	Development	LOED	Combined	Whole Body	Egg	12% Mouthpart deformities (3% abnormal in controls); Zn concentrations 10 times that of the LOED had fewer deformities.	2001	Martinez EA, BC Moore, J Schaumloffel, N Dasgupta
Acartia tonsa		SW	Zinc	7440-66-6	1.3	Reproduction	ED50	Combined	Whole Body	Adult	Used the kinetic modeling concentration of metal. Modeled concentration was approximately 3.6 fold higher than measured for the few measured values. Effect was 50% reduction in egg production one week after exposure. Food concentration=23.7 ug/g dry.	2002	Hook, Sharon and Nicholas Fisher
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	25	Growth	LOED	Water	Whole Body	Juvenile	LOED for growth is based on increase in length of juveniles as well as weight increases.	2001	Grout, J.A. C.D. Levings
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	26	Mortality	LOED	Water	Whole Body	Juvenile		2001	Grout, J.A. C.D. Levings
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	26	Development	LOED	Water	Whole Body	Juvenile	LOED for development is based on the condition index of the surviving juveniles.	2001	Grout, J.A. C.D. Levings
Paracentrotus lividus	Sea Urchin	SW	Zinc	7440-66-6	40.6	Development	LOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Zinc	7440-66-6	37	Development	NOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Zinc	7440-66-6	49.4	Mortality	NOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Zinc	7440-66-6	79.6	Mortality	LOED	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Zinc	7440-66-6	106.8	Mortality	LD50	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Paracentrotus lividus	Sea Urchin	SW	Zinc	7440-66-6	59.4	Development	ED50	Water	Whole Body	Larval		2001	Radenac, G. D. Fichet, P. Miramand
Mugil cephalus	Striped mullet	SW	Zinc	7440-66-6	51.3	Mortality	LD30	Water	Whole Body	Fry	Short M&M with little information Other=body without head	2000	Zyadah, MA, E Abdel-Baky
Mugil cephalus	Striped mullet	SW	Zinc	7440-66-6	28.1	Mortality	LD60	Water	Whole Body	Fry	Short M&M with little information Other=body without head	2000	Zyadah, MA, E Abdel-Baky
Mugil cephalus	Striped mullet	SW	Zinc	7440-66-6	33.3	Mortality	LD70	Water	Whole Body	Fry	Short M&M with little information Other=body without head	2000	Zyadah, MA, E Abdel-Baky
Mugil cephalus	Striped mullet	SW	Zinc	7440-66-6	30.8	Mortality	LD50	Water	Whole Body	Fry	Short M&M with little information Other=body without head	2000	Zyadah, MA, E Abdel-Baky
Mugil cephalus	Striped mullet	SW	Zinc	7440-66-6	23.1	Mortality	LD70	Water	Whole Body	Fry	Short M&M with little information Other=body without head	2000	Zyadah, MA, E Abdel-Baky

Table C-8. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Zinc

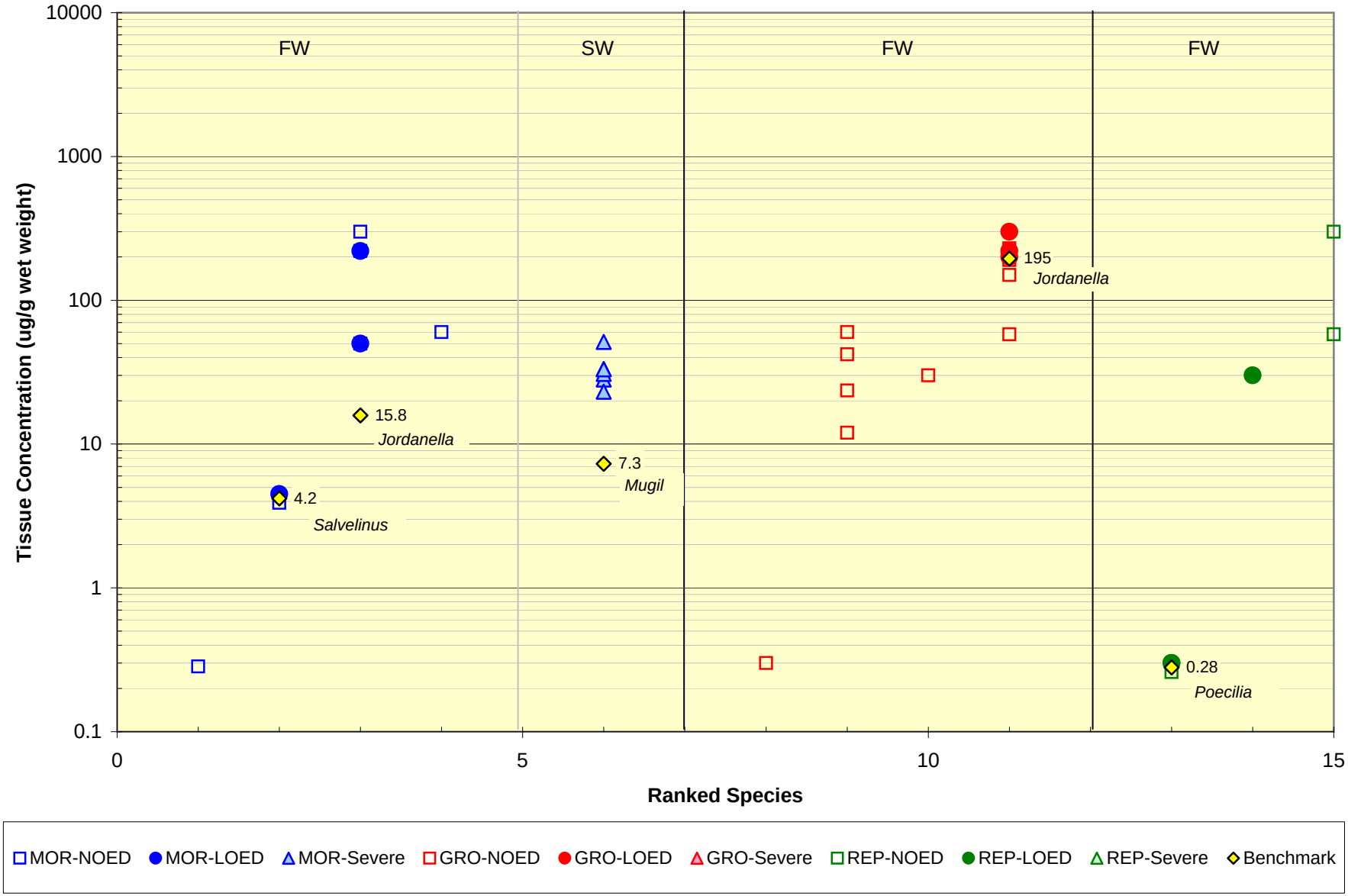
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Mugil cephalus	Striped mullet	SW	Zinc	7440-66-6	33.1	Mortality	LD100	Water	Whole Body	Fry	Short M&M with little information Other=body without head	2000	Zyadah, MA, E Abdel-Baky
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	289.023	Mortality	LD25	Water	Whole body	Adult	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used Imhoff cones instead.	2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa
Chironomus tentans	Midge	FW	Zinc	7440-66-6	1187	Growth	NOED	Combined	Whole Body	Egg	Results are from a mixture of zinc and lead.	2004	Mann RM, M Grosell, A Bianchini, CM Wood
Chironomus tentans	Midge	FW	Zinc	7440-66-6	745	Growth	NOED	Combined	Whole Body	Egg	Results are from a mixture of zinc and lead.	2004	Mann RM, M Grosell, A Bianchini, CM Wood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	117.1	Mortality	LD100	Combined	Whole Body	Immature	M2-Tapwater	1997	Borgmann U, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	49.04	Mortality	LD25	Combined	Whole Body	Immature	M1-Tapwater	1997	Borgmann U, WP Norwood
Hyalella azteca	Amphipod - Freshwater	FW	Zinc	7440-66-6	54.9	Mortality	LD45	Combined	Whole Body	Immature	M3-Tapwater	1997	Borgmann U, WP Norwood
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	150	Growth	NOED				Spehar, 1976	1984	Dillon TM
Salvelinus fontinalis	Trout - Brook	FW	Zinc	7440-66-6	30	Growth	NOED				Holcombe et al., 1979	1984	Dillon TM
Poecilia reticulata	Guppy	FW	Zinc	7440-66-6	0.3	Growth	NOED				Pierson, 1981	1984	Dillon TM
Salmo salar	Salmon - Atlantic	FW/SW	Zinc	7440-66-6	42	Growth	NOED				Farmer et al., 1979	1984	Dillon TM
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	200	Growth	LOED				Spehar, 1976, (females)	1984	Dillon TM
Jordanella floridae	American flagfish	FW	Zinc	7440-66-6	300	Reproduction	NOED				Spehar 1976	1984	Dillon TM
Poecilia reticulata	Guppy	FW	Zinc	7440-66-6	0.26	Reproduction	NOED				Pierson, 1981	1984	Dillon TM
Poecilia reticulata	Guppy	FW	Zinc	7440-66-6	0.3	Reproduction	LOED				Pierson, 1981, # spawnings	1984	Dillon TM
Salvelinus fontinalis	Trout - Brook	FW	Zinc	7440-66-6	30	Reproduction	LOED				Holcombe et al., 1979, % hatch	1984	Dillon TM
Poecilia reticulata	Guppy	FW	Zinc	7440-66-6	0.3	Reproduction	LOED				Pierson, 1981, time to spawn	1984	Dillon TM
Daphnia magna	Water flea	FW	Zinc	7440-66-6	16.8	Mortality	NOED	Water	Whole Body	NA	Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen

Table C-8. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - Zinc

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Daphnia magna	Water flea	FW	Zinc	7440-66-6	16.8	Growth	NOED	Water	Whole Body	NA	Growth weight - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Daphnia magna	Water flea	FW	Zinc	7440-66-6	16.8	Reproduction	NOED	Water	Whole Body	NA	time to brood - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Daphnia magna	Water flea	FW	Zinc	7440-66-6	11.12	Reproduction	LOED	Water	Whole Body	NA	# offspring/adult - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Daphnia magna	Water flea	FW	Zinc	7440-66-6	11.12	Reproduction	ED60	Water	Whole Body	NA	# offspring/adult - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Daphnia magna	Water flea	FW	Zinc	7440-66-6	16.8	Reproduction	ED62	Water	Whole Body	NA	# offspring/adult - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Pseudokirchneriella subcapitata		FW	Zinc	7440-66-6	98	Growth	NOED	Water	Whole Body	NA	Rate	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Pseudokirchneriella subcapitata		FW	Zinc	7440-66-6	98	Growth	NOED	Water	Whole Body	NA	weight	2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen
Haliotis diversicolor	Abalone	SW	Zinc	7440-66-6	275	Mortality	LD50	Water	Muscle	Adult		2002	Lino C-M, B-C Chen, M-C Lin, H-M Chiu, Y-H Chou
Haliotis diversicolor	Abalone	SW	Zinc	7440-66-6	239.76	Mortality	LD50	Water	Muscle	Adult		2002	Lino C-M, B-C Chen, M-C Lin, H-M Chiu, Y-H Chou
Haliotis diversicolor	Abalone	SW	Zinc	7440-66-6	307.66	Mortality	LD50	Water	Muscle	Adult		2002	Lino C-M, B-C Chen, M-C Lin, H-M Chiu, Y-H Chou
Haliotis diversicolor	Abalone	SW	Zinc	7440-66-6	25.33	Mortality	LD05	NA	Whole Body	NS	Zinc Exposure data comes from Lin and Liao (1999) and Liao et al. (2002a, 2002b, 2004). Effects are from Liao et al (2002b)	2005	Liao CM, BY-H Chou
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	26	Mortality	NOED	Combined	Whole Body	Adult		2003	St-Jean SD, SC Courtenay, RW Parker
Mytilus edulis	Mussel	SW	Zinc	7440-66-6	26	Growth	NOED	Combined	Whole Body	Adult	Length - Growth in test animals increased in direct proportion to proximity to pulpmill effluent plume which was deemed to reflect not the contaminants, but the increased amounts of nutrients.	2003	St-Jean SD, SC Courtenay, RW Parker

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-13. Summary of Zinc Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



2/3/2006

Chart C-14. Summary of Zinc Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity

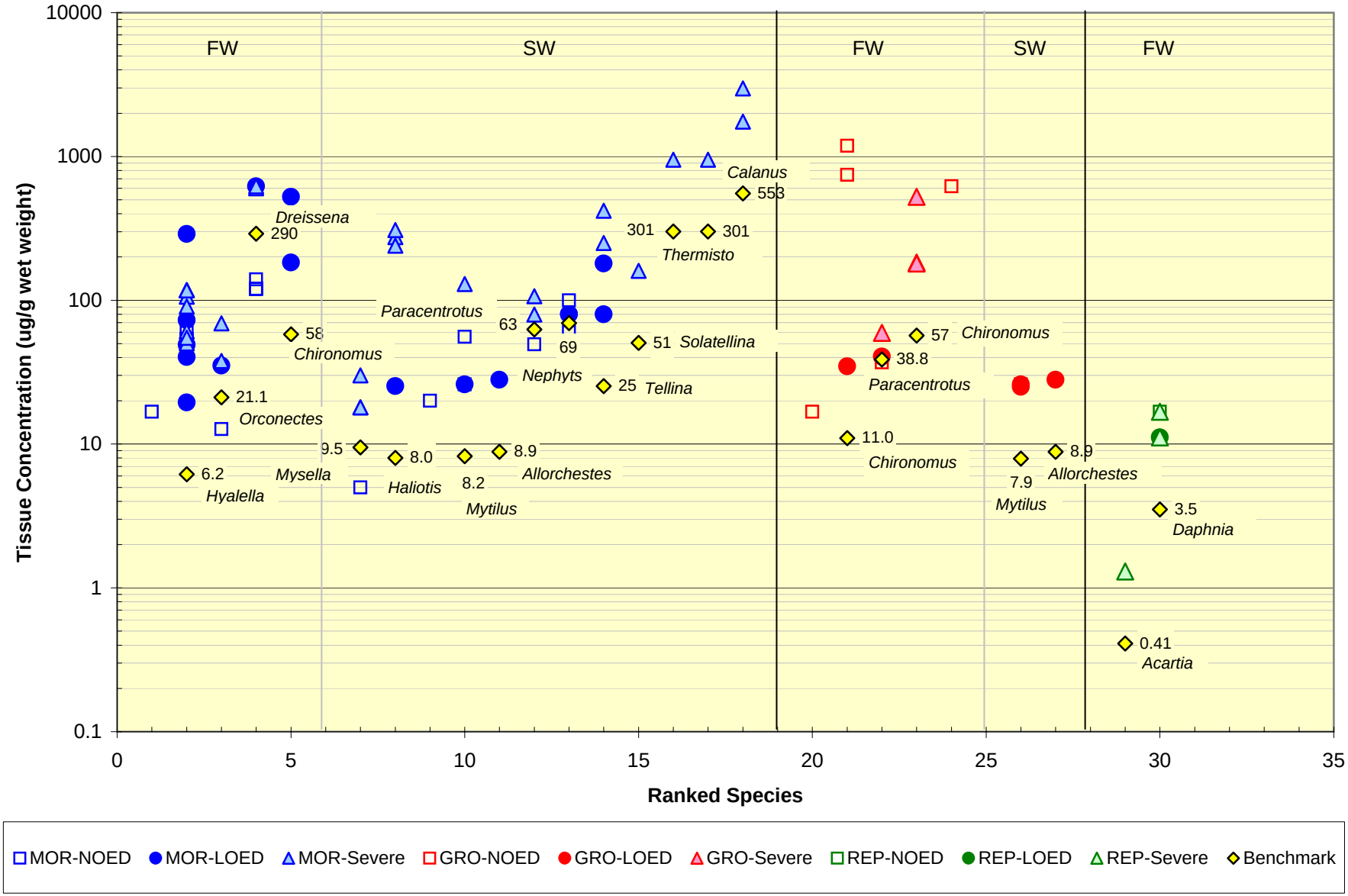


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Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	1-methylnaphthalene	90-12-0	2920	Mortality	LD50	Injection	Whole Body	NA	Median Lethal Dose	1988	Hodson, P.V., Dixon,D.G. and K.I.E. Kaiser
Lepomis macrochirus	Bluegill	FW	Acenaphthene	83-32-9	3.5	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1980	Barrows, M.E., S.R. Petrocelli, K.J. Macek and J.J. Carroll
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	21.25	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Fluoranthene (206-44-0).	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	21.25	Mortality	LD67	Absorption	Whole Body	Adult	After UV exposure. Mixed with Fluoranthene (206-44-0).	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	13.4	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	9.09	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	13.4	Mortality	LD49	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	9.09	Mortality	LD22	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	11.51	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	6.74	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	11.51	Mortality	LD87	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Anthracene	120-12-7	6.74	Mortality	LD83	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Diporeia spp.	Amphipod	FW	Anthracene	120-12-7	302.9961	Behavior	ED50	Water	Whole Body	Juvenile	=ER50. Diporeia were field collected; not fed during experiments.	2003	Landrum PF, GR Lotufo, DC Gossiaux, ML Gedeon, J-H Lee
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	14.15	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Fluoranthene (206-44-0).	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	14.15	Mortality	LD52	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Fluoranthene (206-44-0).	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	10.27	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	10.27	Mortality	LD49	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	8.26	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	8.26	Mortality	LD22	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	5.94	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	6.94	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	5.94	Mortality	LD87	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Rhepoxynius abronius	Amphipod	SW	Benz[a]anthracene	56-55-3	6.94	Mortality	LD83	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Dreissena polymorpha	Mussel - Zebra	FW	Benz[a]anthracene	56-55-3	0.6	Mortality	NOED	Combined	Whole Body	Adult	4th of 4 statistically significant compounds taken up	1997	Roper, J, D.S. Cherry, J. W. Simmers, and H. E. Tatem
Pisidium amnicum	Clam	FW	Benzo[a]pyrene	50-32-8	0.024	Mortality	NOED	Water	Whole Body	Adult	21 ug/l TCP and 4 ng/l BaP, Uninfected, 20 degrees C	1999	Heinonen J, JVK Kukkonen, IJ Holopainen
Pisidium amnicum	Clam	FW	Benzo[a]pyrene	50-32-8	0.028	Mortality	NOED	Water	Whole Body	Adult	21 ug/l TCP and 4 ng/l BaP Infected with Bunodera luciopercae, 20 degrees C	1999	Heinonen J, JVK Kukkonen, IJ Holopainen
Pisidium amnicum	Clam	FW	Benzo[a]pyrene	50-32-8	0.001	Mortality	NOED	Water	Whole Body	Adult	21 ug/l TCP and 4 ng/l BaP Uninfected, 4 degrees C	1999	Heinonen J, JVK Kukkonen, IJ Holopainen
Pisidium amnicum	Clam	FW	Benzo[a]pyrene	50-32-8	0.016	Mortality	NOED	Water	Whole Body	Adult	21 ug/l TCP and 4 ng/l BaP Infected with Palaeorchis crassus, 20 degrees C	1999	Heinonen J, JVK Kukkonen, IJ Holopainen
Pisidium amnicum	Clam	FW	Benzo[a]pyrene	50-32-8	0.016	Mortality	NOED	Water	Whole Body	Adult	21 ug/l TCP and 4 ng/l BaP Infected with Phyllodistomum elongatum, 4 degrees C	1999	Heinonen J, JVK Kukkonen, IJ Holopainen
Pisidium amnicum	Clam	FW	Benzo[a]pyrene	50-32-8	0.024	Mortality	NOED	Water	Whole Body	Adult	21 ug/l TCP and 4 ng/l BaP Infected with Bunodera luciopercae, 4 degrees C	1999	Heinonen J, JVK Kukkonen, IJ Holopainen
Ampelisca abdita	Ampelisca abdita	SW	Benzo[a]pyrene	50-32-8	43	Mortality	LD50	Absorption	Whole Body	Juvenile	BaP+TCB	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Ampelisca abdita	Ampelisca abdita	SW	Benzo[a]pyrene	50-32-8	23	Mortality	LD50	Absorption	Whole Body	Juvenile	BaP+NP	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Reproduction	ED11	Absorption	Whole Body	Egg	Fry gross abnormalities	1982	Hannah JB, JE Hose, ML Landolt, BS Miller, SP Felton, WT Iwaoka
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Growth	ED5	Absorption	Whole Body	Egg		1982	Hannah JB, JE Hose, ML Landolt, BS Miller, SP Felton, WT Iwaoka
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Mortality	LD46	Absorption	Whole Body	Egg		1982	Hannah JB, JE Hose, ML Landolt, BS Miller, SP Felton, WT Iwaoka
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Reproduction	NOED	Absorption	Whole Body	Egg	Hatching success	1982	Hannah JB, JE Hose, ML Landolt, BS Miller, SP Felton, WT Iwaoka
Psettichthys melanostictus	Sand Sole	SW	Benzo[a]pyrene	50-32-8	2.1	Mortality	LD51	Water	Whole Body	Egg	Hatching mortality	1982	Hose JE, JB Hannah, D DiJulio, ML Landholt, BS miller, WT Iwaoka, SP Felton
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.3	Development	NA	Absorption	Whole Body	Egg	Gross Abnormalities In Alevins Noted At All Test Concentrations 0.08 Mg/l And Above, Significant Increase Relative To The Control	1982	Hannah, J.B., Hose, J.E., Landolt, M.L., Miller, B.S., Felton, S.P., and W.T. Iwaoka
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	1.93	Reproduction	NA	Absorption	Whole Body	Egg	Hatchability Not Significantly Reduced	1982	Hannah, J.B., Hose, J.E., Landolt, M.L., Miller, B.S., Felton, S.P., and W.T. Iwaoka
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	7.18	Reproduction	NA	Absorption	Whole Body	Egg	Hatchability Not Significantly Reduced	1982	Hannah, J.B., Hose, J.E., Landolt, M.L., Miller, B.S., Felton, S.P., and W.T. Iwaoka
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	10.2	Reproduction	NA	Absorption	Whole Body	Egg	Hatchability Not Significantly Reduced	1982	Hannah, J.B., Hose, J.E., Landolt, M.L., Miller, B.S., Felton, S.P., and W.T. Iwaoka

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.3	Reproduction	NA	Absorption	Whole Body	Egg	Hatchability Not Significantly Reduced	1982	Hannah, J.B., Hose, J.E., Landolt, M.L., Miller, B.S., Felton, S.P., and W.T. Iwaoka
Psettichthys melanostictus	Sand Sole	SW	Benzo[a]pyrene	50-32-8	2.1	Mortality	LD50	Absorption	Whole Body	Egg-embryo	Reduced Hatching Success	1982	Hose, J.E., J.B. Hannah, D. Dijulio, M.L. Landolt, B.S. Miller, W.T. Iwaoka and S.P. Felton
Psettichthys melanostictus	Sand Sole	SW	Benzo[a]pyrene	50-32-8	2.1	Development	LOED	Absorption	Whole Body	Egg-embryo	5% of embryos showed developmental abnormalities.	1982	Hose, J.E., J.B. Hannah, D. Dijulio, M.L. Landolt, B.S. Miller, W.T. Iwaoka and S.P. Felton
Sphaerium corneum	Clam - Fingernail	FW	Benzo[a]pyrene	50-32-8	1.25	Mortality	NOED	Combined	Whole Body	Adult	No Effect On Survival. Residue measured at end of exposure period.	1997	Borchert, J., L. Karbe and J. Westendorf
Chironomus riparius	Midge	FW	Benzo[a]pyrene	50-32-8	1.9	Mortality	NOED	Combined	Whole Body	Larval	No Effect On Survival. Residue measured at end of exposure period.	1997	Borchert, J., L. Karbe and J. Westendorf
Mercenaria mercenaria	Clam - Quahog	SW	Benzo[a]pyrene	50-32-8	0.00221	Mortality	NOED	Combined	Whole Body	Adult	No Effect On Mortality, Exp_conc = <0.001	1981	Anderson, R.S., C.S. Giam, L.E. Ray and M.R. Tripp
Asterias rubens	Starfish	SW	Benzo[a]pyrene	50-32-8	10	Mortality	NOED	Injection	Whole Body	Adult	No Effect On Mortality	1993	Den Besten, P.J., P. Lemaire, D.R. Livingstone, B. Woodin, J.J. Stegeman, H.J. Herwin and W. Seinen
Asterias rubens	Starfish	SW	Benzo[a]pyrene	50-32-8	40	Mortality	NOED	Injection	Whole Body	Adult	No Effect On Mortality	1993	Den Besten, P.J., P. Lemaire, D.R. Livingstone, B. Woodin, J.J. Stegeman, H.J. Herwin and W. Seinen
Mytilus edulis	Mussel	SW	Benzo[a]pyrene	50-32-8	0.3	Reproduction	LOED	Absorption	Whole Body	NA	Abnormal Gametogenesis	1995	Eertman, R.H.M., C.L. Groenink, B. Sandee and H. Hummel
Epinephelus areolatus	yellowspotted rockcod	SW	Benzo[a]pyrene	50-32-8	0.014	Growth	NOED	Ingestion	Muscle	Juvenile	weight & length	2003	Wu, R.S.S., CA Pollino, DWT Au, GJ Zheng, BBH Yuen, PKS Lam
Epinephelus areolatus	yellowspotted rockcod	SW	Benzo[a]pyrene	50-32-8	0.014	Growth	NOED	Ingestion	Muscle	Juvenile	weight & length	2003	Wu, R.S.S., CA Pollino, DWT Au, GJ Zheng, BBH Yuen, PKS Lam
Epinephelus areolatus	yellowspotted rockcod	SW	Benzo[a]pyrene	50-32-8	0.014	Growth	NOED	Ingestion	Muscle	Juvenile	length & weight	2003	Wu, R.S.S., CA Pollino, DWT Au, GJ Zheng, BBH Yuen, PKS Lam
Epinephelus areolatus	yellowspotted rockcod	SW	Benzo[a]pyrene	50-32-8	0.028	Growth	NOED	Ingestion	Muscle	Juvenile	weight & length	2003	Wu, R.S.S., CA Pollino, DWT Au, GJ Zheng, BBH Yuen, PKS Lam
Epinephelus areolatus	yellowspotted rockcod	SW	Benzo[a]pyrene	50-32-8	0.012	Growth	NOED	Ingestion	Muscle	Juvenile	weight & length	2003	Wu, R.S.S., CA Pollino, DWT Au, GJ Zheng, BBH Yuen, PKS Lam
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Growth	LOED				Hannah et al., 1982	1984	Dillon TM
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Reproduction	NOED				Hannah et al., 1982, hatch time	1984	Dillon TM
Oncorhynchus mykiss	Trout - Rainbow	FW	Benzo[a]pyrene	50-32-8	12.34	Reproduction	NOED				Hannah et al., 1982, hatching success	1984	Dillon TM
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	1.28	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Fluoranthene (206-44-0).	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	2.01	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	3.15	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	2.01	Mortality	LD49	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	3.15	Mortality	LD22	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment, excluding Fluoranthrene, at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	1.28	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	2.56	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	1.28	Mortality	LD87	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Chrysene	218-01-9	2.56	Mortality	LD83	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Dreissena polymorpha	Mussel - Zebra	FW	Chrysene	218-01-9	0.93	Mortality	NOED	Combined	Whole Body	Adult		1997	Roper, J, D.S. Cherry, J. W. Simmers, and H. E. Tatem
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	94.21	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves.	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	142.79	Mortality	LD67	Absorption	Whole Body	Adult	After UV exposure. Mixed with Anthracene (120-12-7)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	128.88	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Benz(a)anthracene (56-55-3)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	142.79	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Anthracene (120-12-7)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	128.88	Mortality	LD52	Absorption	Whole Body	Adult	After UV exposure. Mixed with Benz(a)anthracene (56-55-3)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	124.39	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with 2-Methylanthracene (613-12-7)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	129.2	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Benzo(b)fluoranthene (205-99-2)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	44.5	Behavior	ED30	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with 3,6-Dimethylphenanthrene (1576-67-6)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	67.15	Mortality	LD87	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	20.75	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	20.75	Mortality	LD83	Absorption	Whole Body	Adult	After UV exposure. Mixture of all PAHs used in experiment at 25% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	124.39	Mortality	LD100	Absorption	Whole Body	Adult	After UV exposure. Mixed with 2-Methylanthracene (613-12-7)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	91.82	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixed with Chrysene(1576-67-6)	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Rhepoxynius abronius	Amphipod	SW	Fluoranthene	206-44-0	67.15	Behavior	ED100	Absorption	Whole Body	Adult	After UV exposure %Reburial Note: majority of R.abronius died a few hours after failing to rebury themselves. Mixture of all PAHs used in experiment at 100% solubility	1999	Boese BL, RJ Ozertich, JO Lamberson, RC Swartz, FA Cole, J Pelletier, J Jones
Leptocheirus plumulosus	Amphipod	SW	Fluoranthene	206-44-0	141	Mortality	LD50				Kane et al 1998	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Leptocheirus plumulosus	Amphipod	SW	Fluoranthene	206-44-0	485	Mortality	LD50				Kane et al 1998	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Streblospio benedicti	Polychaete	SW	Fluoranthene	206-44-0	0.22	Growth	ED158	Combined	Whole Body	Juvenile	study examined both settlement and growth but only had tissue resdiue data for the growth test. Results were unusual since the growth of the organisms increased with exposure through day 18, then was back to control growth by day28	1997	Chandler GT; MR Shipp; TL Donelan
Streblospio benedicti	Polychaete	SW	Fluoranthene	206-44-0	3.2	Growth	ED183	Combined	Whole Body	Juvenile	study examined both settlement and growth but only had tissue resdiue data for the growth test. Results were unusual since the growth of the organisms increased with exposure through day 18, then was back to control growth by day28	1997	Chandler GT; MR Shipp; TL Donelan
Streblospio benedicti	Polychaete	SW	Fluoranthene	206-44-0	6.58	Growth	ED131	Combined	Whole Body	Juvenile	study examined both settlement and growth but only had tissue resdiue data for the growth test. Results were unusual since the growth of the organisms increased with exposure through day 18, then was back to control growth by day28	1997	Chandler GT; MR Shipp; TL Donelan
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	645	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	327	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	173	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	426	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	242	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	161	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	87	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	50.6	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	34.4	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	52.6	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	2016	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	742	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	40.5	Mortality	LD50	Water	Whole Body	Adult	no significant differences between tissue concentrations measured in live and dead fish	2004	Schuler LJ; PF Landrum; MJ Lydy
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	84	Mortality	LD100	Absorption	Whole Body	Adult	100% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 33.5 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	250	Mortality	LD100	Absorption	Whole Body	Adult	100% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 16.6 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	41	Mortality	LD32	Absorption	Whole Body	Adult	32% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 33.5 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	131	Mortality	LD52	Absorption	Whole Body	Adult	52% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 16.6 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	25	Mortality	LD98	Absorption	Whole Body	Adult	98% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 75.2 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	25	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 33.5 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	84	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 16.6 uW/cm2 UV light for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	250	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality. Animals exposed in the dark for 4 days.	1995	Ankley, G.T., R.J. Erickson, G.L. Phipps, V.R. Mattson, P.A. Kosian, B.R. Sheedy, and J.S. Cox.
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	12.5	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 75.2 uW/cm2 UV light for 4 days.	1975	Freeman, H.C. and D.R. Idler
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	222	Mortality	LD50	Absorption	Whole Body	Adult	good paper but use of micromoles/g concentrations is non-standard	1997	Driscoll, S. K., and P.F.Landrum
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	1190	Mortality	NOED	Absorption	Whole Body	Adult		1997	Driscoll, S. K., and P.F.Landrum
Dreissena polymorpha	Mussel - Zebra	FW	Fluoranthene	206-44-0	1.29	Mortality	NOED	Combined	Whole Body	Adult	Rep count not in paper EPA method cited has standards	1997	Roper, J, D.S. Cherry, J. W. Simmers, and H. E. Tatem
Mytilus edulis	Mussel	SW	Fluoranthene	206-44-0	0.22	Reproduction	LOED	Absorption	Whole Body	NA	Abnormal Gametogenesis	1995	Eertman, R.H.M., C.L. Groenink, B. Sandee and H. Hummel
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	38.43	Reproduction	ED119	Water	Whole Body	Adult		2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	93.04	Reproduction	ED125	Water	Whole Body	Adult	with food. [Hormesis?] Higher exposures were compromised due to aeration failure; impact on reprod. not determined although neg. effect suggested	2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	107.2	Reproduction	NOED	Water	Whole Body	Adult		2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	107.2	Growth	NOED	Water	Whole Body	Adult		2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	93.04	Growth	NOED	Water	Whole Body	Adult		2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	107.2	Growth	NOED	Water	Whole Body	Adult		2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	93.04	Growth	NOED	Water	Whole Body	Adult	Exposure at 95 ug/g with food showed some enhanced biomass, but no relevant control (w YCT)	2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Lumbriculus variegatus	Oligochaete	FW	Fluoranthene	206-44-0	131.47	Growth	NOED	Water	Whole Body	Adult		2002	Landrum PF, ML Gedeon, GA Burton, MS Greenberg, CD Rowland
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	55.42	Mortality	LD50	Water	Whole Body	Adult	Toxicity tests occurred under gold ligts (0.10% of visible component of source	2003	Wilcoxen, SE, PG Meier, PF Landrum

Table C-9. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PAHs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	32.76	Mortality	LD50	Water	Whole Body	Adult	Toxicity tests occurred under gold ligts (0.10% of visible component of source	2003	Wilcoxen, SE, PG Meier, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	8.09	Mortality	LD50	Water	Whole Body	Adult	Toxicity tests occurred under fluorescent ligts (0.31% of visible component of source}	2003	Wilcoxen, SE, PG Meier, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	0.566	Mortality	LD50	Water	Whole Body	Adult	Toxicity tests occurred under UV ligts (2.611% of visible component of source}	2003	Wilcoxen, SE, PG Meier, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	38.63	Mortality	LD50	Combined	Whole Body	Adult	Toxicity tests occurred under fluorescent ligts (0.31% of visible component of source}	2003	Wilcoxen, SE, PG Meier, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	13.07	Mortality	LD50	Combined	Whole Body	Adult	Toxicity tests occurred under UV ligts (2.611% of visible component of source}	2003	Wilcoxen, SE, PG Meier, PF Landrum
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	546.1	Mortality	LD50	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden..	1998	Lotufo, G.R.
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	141.6	Reproduction	ED50	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden..	1998	Lotufo, G.R.
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	40.5	Reproduction	ED25	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden..	1998	Lotufo, G.R.
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	788.8	Mortality	LOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden. This is higher than the 50% lethal residue efffect?	1998	Lotufo, G.R.
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	586.6	Mortality	NOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden. This is higher than the 50% lethal residue efffect?	1998	Lotufo, G.R.
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	40.45	Reproduction	NOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden. This is equal to the ED25 residue efffect?	1998	Lotufo, G.R.
Coullana sp	copepod	FW	Fluoranthene	206-44-0	242.7	Mortality	LD50	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and survivors for measurement of body burden.	1998	Lotufo, G.R.
Coullana sp	copepod	FW	Fluoranthene	206-44-0	262.9	Mortality	LOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and survivors for measurement of body burden. LOED is higher than ED50 residue level?	1998	Lotufo, G.R.
Coullana sp	copepod	FW	Fluoranthene	206-44-0	121.4	Mortality	NOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and survivors for measurement of body burden.	1998	Lotufo, G.R.

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Coullana sp	copepod	FW	Fluoranthene	206-44-0	121.4	Reproduction	NOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and survivors for measurement of body burden.	1998	Lotufo, G.R.
Coullana sp	copepod	FW	Fluoranthene	206-44-0	262.9	Reproduction	LOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and survivors for measurement of body burden. LOED is higher than ED50 residue level?	1998	Lotufo, G.R.
Schizopera knabeni	copepod	FW	Fluoranthene	206-44-0	121.35	Reproduction	LOED	Combined	Whole Body	Adult	Mature, non-ovigerous females used at start of test and for measurement of body burden..	1998	Lotufo, G.R.
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1286.2	Mortality	LD50	NS	Whole Body	Adult	=LR50; normoxic	2003	Weinstein JE, DM Sanger
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1360.4	Mortality	LD50	NS	Whole Body	Adult	=LR50; moderately oxic	2003	Weinstein JE, DM Sanger
Streblospio benedicti	Polychaete	SW	Fluoranthene	206-44-0	73.14	Mortality	LD50	NS	Whole Body	Adult	=LR50; normoxic	2003	Weinstein JE, DM Sanger
Streblospio benedicti	Polychaete	SW	Fluoranthene	206-44-0	84.02	Mortality	LD50	NS	Whole Body	Adult	=LR50; Moderately oxic	2003	Weinstein JE, DM Sanger
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	19.96	Mortality	LD50	Water	Whole Body		Water exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	4.98	Mortality	LD50	Water	Whole Body		Water exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1.6	Mortality	LD50	Water	Whole Body		Water exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	257.8	Mortality	LD50	Water	Whole Body		Water exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	257.8	Mortality	LD50	Water	Whole Body		Water exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	257.8	Mortality	LD50	Water	Whole Body		Water exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1040	Mortality	LD50	Combined	Whole Body		Sed exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1080	Mortality	LD13	Combined	Whole Body		Sed exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1200	Mortality	LD13	Combined	Whole Body		Sed exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1280	Mortality	LD7	Combined	Whole Body		Sed exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1060	Mortality	NOED	Combined	Whole Body		Sed exposure with UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1040	Mortality	NOED	Combined	Whole Body		Sed exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1060	Mortality	NOED	Combined	Whole Body		Sed exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1080	Mortality	NOED	Combined	Whole Body		Sed exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1200	Mortality	NOED	Combined	Whole Body		Sed exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland

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Monopylephorus rubroniveus	Oligochaete	SW	Fluoranthene	206-44-0	1280	Mortality	NOED	Combined	Whole Body		Sed exposure without UV	2003	Weinstein JE, DM Sanger and AF Holland
Capitella		SW	Fluoranthene	206-44-0	1.012	Growth	ED64	Water	Whole Body	Adult	authors referred to this as only marginally sign	2003	Selck H, A Palmqvist, VE Forbes
Capitella		SW	Fluoranthene	206-44-0	9.04	Growth	ED64	Combined	Whole Body	Adult	authors referred to this as only marginally sign	2003	Selck H, A Palmqvist, VE Forbes
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	14.56	Mortality	NOED	Combined	Whole Body	Larval	no UV Other post exposure survival to UV+water and UV+sediment are also in this paper for 13h and 29h after residues were measured. In general the animals exposed to sed survived longer	2004	Bell HE; K Liber; DJ Call; GT Ankley
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	14.56	Mortality	LD100	Combined	Whole Body	Larval	UV for 60-min Other post exposure survival to UV+water and UV+sediment are also in this paper for 13h and 29h after residues were measured. In general the animals exposed to sed survived longer	2004	Bell HE; K Liber; DJ Call; GT Ankley
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	6.7	Mortality	NOED	Combined	Whole Body	Larval	no UV Other post exposure survival to UV+water and UV+sediment are also in this paper for 13h and 29h after residues were measured. In general the animals exposed to sed survived longer	2004	Bell HE; K Liber; DJ Call; GT Ankley
Chironomus tentans	Midge	FW	Fluoranthene	206-44-0	1.92	Mortality	NOED	Combined	Whole Body	Larval	no UV Other post exposure survival to UV+water and UV+sediment are also in this paper for 13h and 29h after residues were measured. In general the animals exposed to sed survived longer	2004	Bell HE; K Liber; DJ Call; GT Ankley
Leptocheirus plumulosus	Amphipod	SW	Fluoranthene	206-44-0	493.5	Mortality	LD50	Water	Whole Body	Adult		1998	Driscoll SBK, LC Schaffner, RM Dickhut
Leptocheirus plumulosus	Amphipod	SW	Fluoranthene	206-44-0	68.7	Mortality	NOED	Absorption	Whole Body	Adult		1998	Driscoll SBK, LC Schaffner, RM Dickhut
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	252.8	Mortality	LOED	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	252.8	Mortality	LD16	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	71.8	Mortality	LOED	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	71.8	Mortality	LD39	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Diporeia spp.	Amphipod	FW	Fluoranthene	206-44-0	182	Mortality	LD48	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	839.4	Mortality	LD17	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	839.4	Mortality	LD45	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum
Hyalella azteca	Amphipod - Freshwater	FW	Fluoranthene	206-44-0	161.8	Mortality	LD16	Absorption	Whole Body	Adult		1997	Driscoll SK, GA Harkey, PF Landrum

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Diporeia spp.	Amphipod	FW	Fluorene	86-73-7	2044.53	Mortality	LD50	Water	Whole Body	Juvenile	=LR50. Diporeia were field collected; not fed during experiments.	2003	Landrum PF, GR Lotufo, DC Gossiaux, ML Gedeon, J-H Lee
Oncorhynchus mykiss	Trout - Rainbow	FW	Fluorene	86-73-7	8	Mortality	NOED	Ingestion	Muscle	NS	More tissues concentrations reported in paper than recorded in ERED.	2002	Hellou, J., J. Leonard, C. Anstey
Hyalella azteca	Amphipod - Freshwater	FW	Fluorene	86-73-7	111.4	Mortality	LD50	Water	Whole Body	Juvenile	Lethal body burden to 50% of population converted from 0.67 mmol/kg wet.	2002	Lee Jong-Hyeon, Peter Landrum and Chul-Hwan Koh
Hyalella azteca	Amphipod - Freshwater	FW	Fluorene	86-73-7	111.37	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele
Hyalella azteca	Amphipod - Freshwater	FW	Fluorene	86-73-7	44.88	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele
Hyalella azteca	Amphipod - Freshwater	FW	Fluorene	86-73-7	191.16	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele
Choromytilus chorus	giant mussel	SW	PAH	61-78-9	0.676	Growth	ED100	Water	Soft Tissue	Adult	Field collected, lab experiments. Negative Scope for Growth @ San Vicente Bay; spring	2003	Toro B, JM Navarro, H Palma-Fleming
Choromytilus chorus	giant mussel	SW	PAH	61-78-9	0.676	Growth	ED116	Water	Soft Tissue	Adult	Field collected, lab experiments. Negative Scope for Growth @ San Vicente Bay; summer	2003	Toro B, JM Navarro, H Palma-Fleming
Diporeia spp.	Amphipod	FW	Phenanthrene	85-01-8	1497.1572	Mortality	LD50	Water	Whole Body	Juvenile	=LR50. Diporeia were field collected; not fed during experiments.	2003	Landrum PF, GR Lotufo, DC Gossiaux, ML Gedeon, J-H Lee
Diporeia spp.	Amphipod	FW	Phenanthrene	85-01-8	1354.5708	Mortality	LD50	Water	Whole Body	Juvenile	=LR50. Diporeia were field collected; not fed during experiments.	2003	Landrum PF, GR Lotufo, DC Gossiaux, ML Gedeon, J-H Lee
Nereis arenaceodentata	Polychaete	SW	Phenanthrene	85-01-8	0.78	Growth	LOED	Combined	Whole Body	Immature	35% Decrease in weight.	1996	Emery, V.L.Jr. and T.M. Dillon.
Nereis arenaceodentata	Polychaete	SW	Phenanthrene	85-01-8	0.78	Reproduction	LOED	Combined	Whole Body	Immature	35% Decrease in fecundity. Increased in time to pairing and reproduction. Two fold increase in egg lipids.	1996	Emery, V.L.Jr. and T.M. Dillon.
Nereis arenaceodentata	Polychaete	SW	Phenanthrene	85-01-8	0.78	Mortality	NOED	Combined	Whole Body	Immature	No increase in mortality.	1996	Emery, V.L.Jr. and T.M. Dillon.
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	79	Mortality	LD10	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	149	Mortality	LD10	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	164	Mortality	LD10	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	173	Mortality	LD15	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	349	Mortality	LD15	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi

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Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	75	Mortality	LD20	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	115	Mortality	LD20	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	215	Mortality	LD20	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	235	Mortality	LD20	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	152	Mortality	LD25	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	305	Mortality	LD25	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	313	Mortality	LD25	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	155	Mortality	LD30	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	244	Mortality	LD30	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	296	Mortality	LD30	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	299	Mortality	LD30	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	342	Mortality	LD30	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	200	Mortality	LD35	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	226	Mortality	LD35	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	236	Mortality	LD35	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	300	Mortality	LD40	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	313	Mortality	LD40	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	72	Mortality	LD5	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi

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Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	77	Mortality	LD5	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	149	Mortality	LD5	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	150	Mortality	LD5	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	150	Mortality	LD5	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	150	Mortality	LD5	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	301	Mortality	LD50	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	215	Mortality	LD70	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	245	Mortality	LD80	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	17	Mortality	NOED	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	18	Mortality	NOED	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	18	Mortality	NOED	Water	Whole Body	Adult	8 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	51	Mortality	NOED	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	75	Mortality	NOED	Water	Whole Body	Adult	6 pH	1995	Kishino T, K Kobayashi
Carassius auratus	Goldfish	FW	Phenanthrene	85-01-8	115	Mortality	NOED	Water	Whole Body	Adult	10 pH	1995	Kishino T, K Kobayashi
Diporeia spp.	Amphipod	FW	Phenanthrene	85-01-8	214	Mortality	LOED	Combined	Whole Body	Juvenile	12% Mortality. Residue at 17 days exposure.	1994	Landrum, P.F., W.S. Dupuis and J. Kukkonen
Oncorhynchus mykiss	Trout - Rainbow	FW	Phenanthrene	85-01-8	33800	Development	ED100	Water	Whole Body	Fry	Abnormal development from egg to fry	2002	Hawkins SA, SM Billiard, SP Tabash, RS Brown, PV Hudson
Hyalella azteca	Amphipod - Freshwater	FW	Phenanthrene	85-01-8	163.97	Mortality	LD50	Water	Whole Body	Juvenile	Lethal body burden to 50% of population converted from 0.92 mmol/kg wet.	2002	Lee Jong-Hyeon, Peter Landrum and Chul-Hwan Koh
Hyalella azteca	Amphipod - Freshwater	FW	Phenanthrene	85-01-8	163.97	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele
Hyalella azteca	Amphipod - Freshwater	FW	Phenanthrene	85-01-8	67.73	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele

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Hyalella azteca	Amphipod - Freshwater	FW	Phenanthrene	85-01-8	306.56	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele
Diporeia spp.	Amphipod	FW	Pyrene	129-00-0	1233.786	Mortality	LD50	Water	Whole Body	Juvenile	=LR50. Diporeia were field collected; not fed during experiments.	2003	Landrum PF, GR Lotufo, DC Gossiaux, ML Gedeon, J-H Lee
Diporeia hoyi	Amphipod - Deep water	FW	Pyrene	129-00-0	1273	Mortality	LD50				Landrum et al 1994	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Diporeia hoyi	Amphipod - Deep water	FW	Pyrene	129-00-0	1877	Mortality	LD50				Landrum et al 1994	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Lumbriculus variegatus	Oligochaete	FW	Pyrene	129-00-0	465	Growth	LOED	Combined	Whole Body	Adult	Increased weight loss.	1994	Kukkonen, J. and P.F. Landrum
Lumbriculus variegatus	Oligochaete	FW	Pyrene	129-00-0	465	Mortality	LOED	Combined	Whole Body	Adult	17% Increase in mortality.	1994	Kukkonen, J. and P.F. Landrum
Lumbriculus variegatus	Oligochaete	FW	Pyrene	129-00-0	0.0008	Mortality	NOED	Combined	Whole Body	Adult	No increase in mortality.	1994	Kukkonen, J. and P.F. Landrum
Lumbriculus variegatus	Oligochaete	FW	Pyrene	129-00-0	380	Mortality	NOED	Combined	Whole Body	Adult	No increase in mortality.	1994	Kukkonen, J. and P.F. Landrum
Dreissena polymorpha	Mussel - Zebra	FW	Pyrene	129-00-0	1.08	Mortality	NOED	Combined	Whole Body	Adult	Reps in EPA method. This is an individual PAH component (we need a "Total PAH" category as it is frequently used)	1997	Roper, J, D.S. Cherry, J. W. Simmers, and H. E. Tatem
Diporeia spp.	Amphipod	FW	Pyrene	129-00-0	1270	Mortality	LD50	Combined	Whole Body	Juvenile	50% Mortality (extrapolated).	1994	Landrum, P.F., W.S. Dupuis and J. Kukkonen
Hyalella azteca	Amphipod - Freshwater	FW	Pyrene	129-00-0	335.7	Mortality	LD50	Water	Whole Body	Juvenile	Lethal body burden to 50% of population converted from 1.66 mmol/kg wet.	2002	Lee Jong-Hyeon, Peter Landrum and Chul-Hwan Koh
Hyalella azteca	Amphipod - Freshwater	FW	Pyrene	129-00-0	335.75	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele
Hyalella azteca	Amphipod - Freshwater	FW	Pyrene	129-00-0	275.07	Mortality	LD50	Water	Whole Body	Adult		1996	Schwaiger J, K Fent, H Stecher, H Ferling, RD Negele

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-15. Summary of PAH Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity

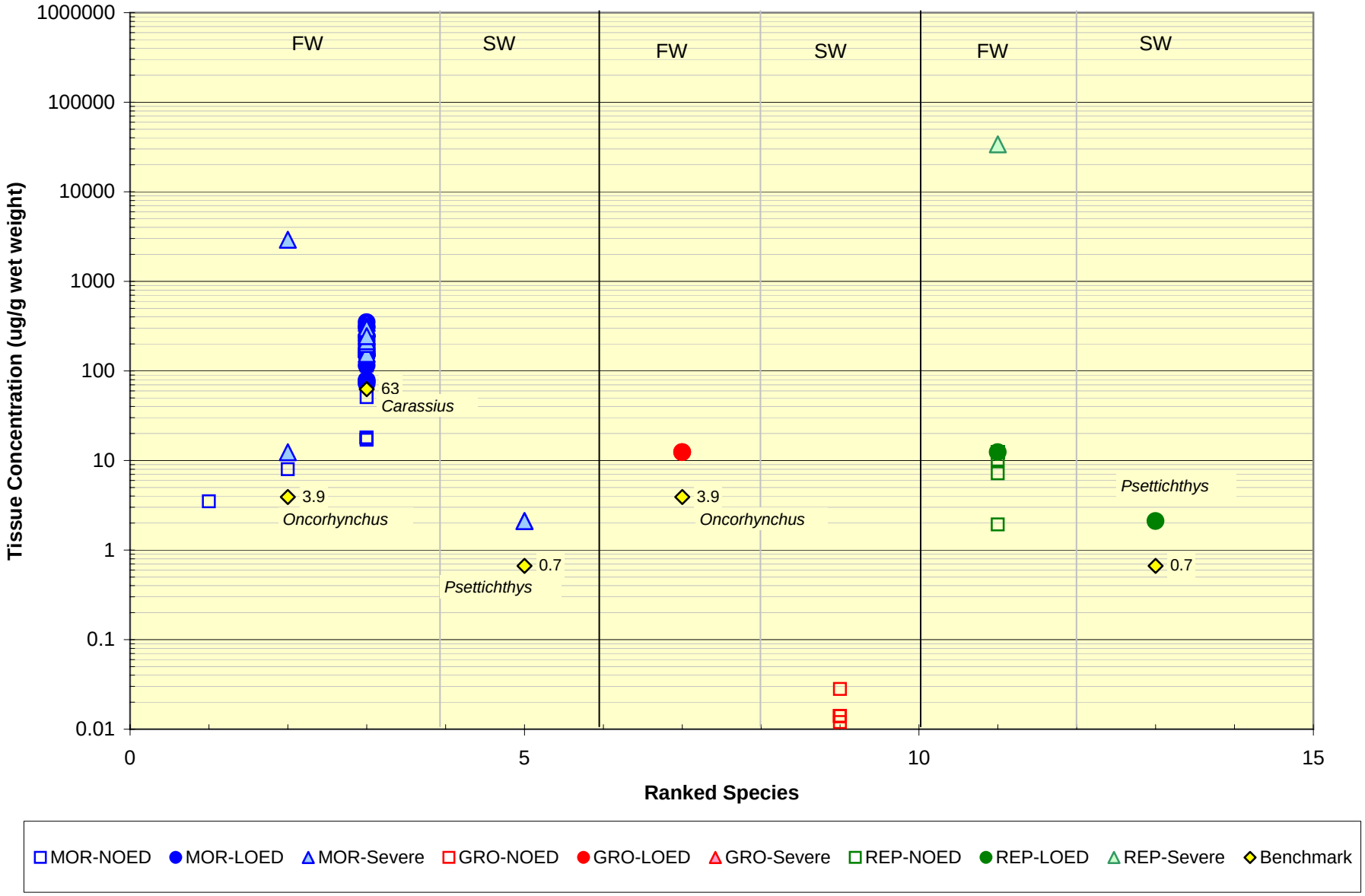

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Chart C-16. Summary of PAH Concentrations in Freshwater and Saltwater Aquatic Invertebrate Tissue Associated with Toxicity

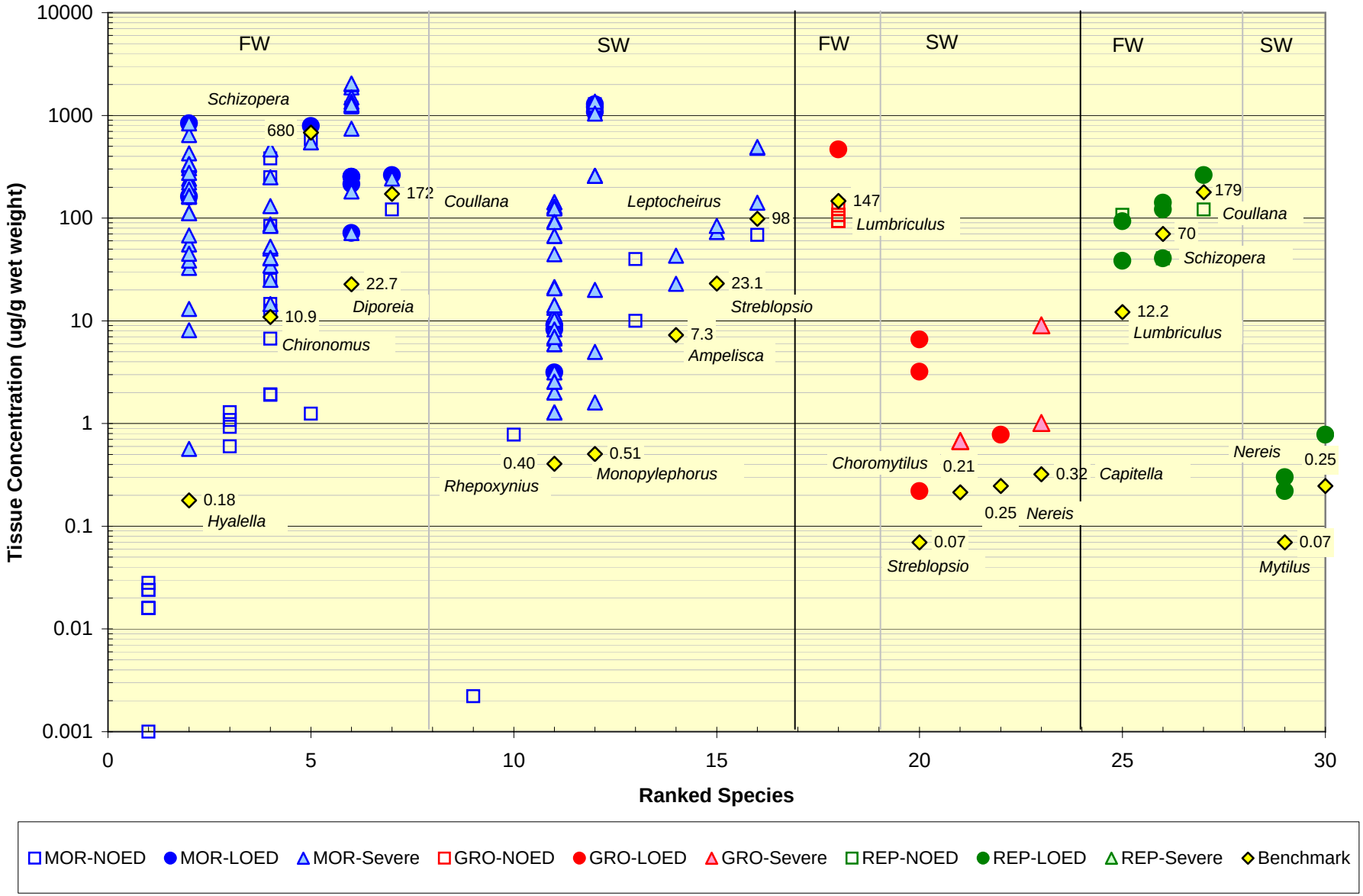

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Table C-10. Summary of Tissue Residue Effects Data from ERED Database - Phthalates

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Lepomis macrochirus	Bluegill	FW	Butylbenzyl phthalate	85-68-7	6.45	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1980	Barrows, M.E., S.R. Petrocelli, K.J. Macek and J.J. Carroll
Daphnia magna	Water flea	FW	DEHP	117-81-7	0.53	Reproduction	NOED	Water	Whole Body	Larval	Mean BCF = 209	1975	Wobeser, G.
Daphnia magna	Water flea	FW	DEHP	117-81-7	1.4	Reproduction	NOED	Water	Whole Body	Larval	Mean BCF = 209	1975	Wobeser, G.
Daphnia magna	Water flea	FW	DEHP	117-81-7	8.35	Reproduction	NOED	Water	Whole Body	Larval	Mean BCF = 209	1975	Wobeser, G.
Daphnia magna	Water flea	FW	DEHP	117-81-7	26.77	Reproduction	NOED	Water	Whole Body	Larval	Mean BCF = 209	1975	Wobeser, G.
Daphnia magna	Water flea	FW	DEHP	117-81-7	3	Reproduction	LOED	Combined	Whole Body	Mature	Used 50oo Mag Factor For Di-n-butyl Phthalate	1973	Sanders, H.O., Mayer, F.L., Walsh, D.F.
Lepomis macrochirus	Bluegill	FW	DEHP	117-81-7	0.66	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1980	Barrows, M.E., S.R. Petrocelli, K.J. Macek and J.J. Carroll
Palaemonetes pugio	Shrimp - Grass	SW	DEHP	117-81-7	0.5	Reproduction	NOED	Absorption	Whole Body	Larval	No significant difference in time from hatch to post-larval. Residues below detection limits of 0.5 to 2 ppm wet weight.	1978	Laughlin, R.B., Jr., J.M.Neff, Y.C. Hrung, T.C. Goodwin and C.S. Giam
Palaemonetes pugio	Shrimp - Grass	SW	DEHP	117-81-7	0.5	Mortality	NOED	Absorption	Whole Body	Larval	No significant difference in mortality. Residues below detection limits of 0.5 to 2 ppm wet weight.	1978	Laughlin, R.B., Jr., J.M.Neff, Y.C. Hrung, T.C. Goodwin and C.S. Giam
Gammarus pulex	Amphipod	FW	DEHP	117-81-7	2000	Behavior	LOED	Absorption	Whole Body	NA	Significant Reduction In Overall Locomotor Activity	1991	Thuren, A., Woin, P.
Gammarus pulex	Amphipod	FW	DEHP	117-81-7	87	Behavior	NOED	Absorption	Whole Body	NA	No Significant Reduction In Overall Locomotor Activity	1991	Thuren, A., Woin, P.
Gammarus pulex	Amphipod	FW	DEHP	117-81-7	2000	Mortality	NOED	Absorption	Whole Body	NA	No significant increase in mortality.	1991	Thuren, A., Woin, P.
Pacifastacus leniusculus	Crayfish	FW	DEHP	117-81-7	14.7	Behavior	LOED	Combined	Whole Body	Larval	Significant reduction (20%) in ability to capture prey. Residue at 9 weeks exposure.	1987	Woin, P., Larsson, P.
Daphnia magna	Water flea	FW	DEHP	117-81-7	26.8	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality In 21 Days	1982	Brown, D. and R.S. Thompson
Daphnia magna	Water flea	FW	DEHP	117-81-7	26.8	Reproduction	NOED	Absorption	Whole Body	Immature	No difference in number of young produced per adult compared to controls.	1982	Brown, D. and R.S. Thompson
Mytilus edulis	Mussel	SW	DEHP	117-81-7	123	Behavior	NOED	Absorption	Whole Body	Adult	No Effect On Feeding Activity. Residue measured at end of exposure period.	1982	Brown, D. and R.S. Thompson
Mytilus edulis	Mussel	SW	DEHP	117-81-7	123	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Mortality. Residue measured at end of exposure period.	1982	Brown, D. and R.S. Thompson
Squalus acanthias	Spiny Dogfish	SW	DEHP	117-81-7	1.1	Mortality	NOED	Injection	Whole Body	NA	No Effect On Mortality In 24 Hours	1979	Guarino, A.M. and S.T. Arnold
Lepomis macrochirus	Bluegill	FW	Dimethyl phthalate	131-11-3	0.5	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1980	Barrows, M.E., S.R. Petrocelli, K.J. Macek and J.J. Carroll

Table C-10. Summary of Tissue Residue Effects Data from ERED Database - Phthalates

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Palaemonetes pugio	Shrimp - Grass	SW	Dimethyl phthalate	131-11-3	0.5	Reproduction	LOED	Absorption	Whole Body	Larval	Significant increase in time from hatch to post-larval. Residues below detection limits of 0.5 to 2 ppm wet weight.	1978	Laughlin, R.B., Jr., J.M.Neff, Y.C. Hrung, T.C. Goodwin and C.S. Giam
Palaemonetes pugio	Shrimp - Grass	SW	Dimethyl phthalate	131-11-3	0.5	Mortality	LOED	Absorption	Whole Body	Larval	Significant increase in mortality. Residues below detection limits of 0.5 to 2 ppm wet weight.	1978	Laughlin, R.B., Jr., J.M.Neff, Y.C. Hrung, T.C. Goodwin and C.S. Giam
Lepomis macrochirus	Bluegill	FW	Diethylphthalate	84-66-2	1.1	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1980	Barrows, M.E., S.R. Petrocelli, K.J. Macek and J.J. Carroll

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-17. Summary of Di-ethylhexylphthalate Concentrations in Freshwater and Saltwater Aquatic Invertebrate Tissue Associated with Toxicity

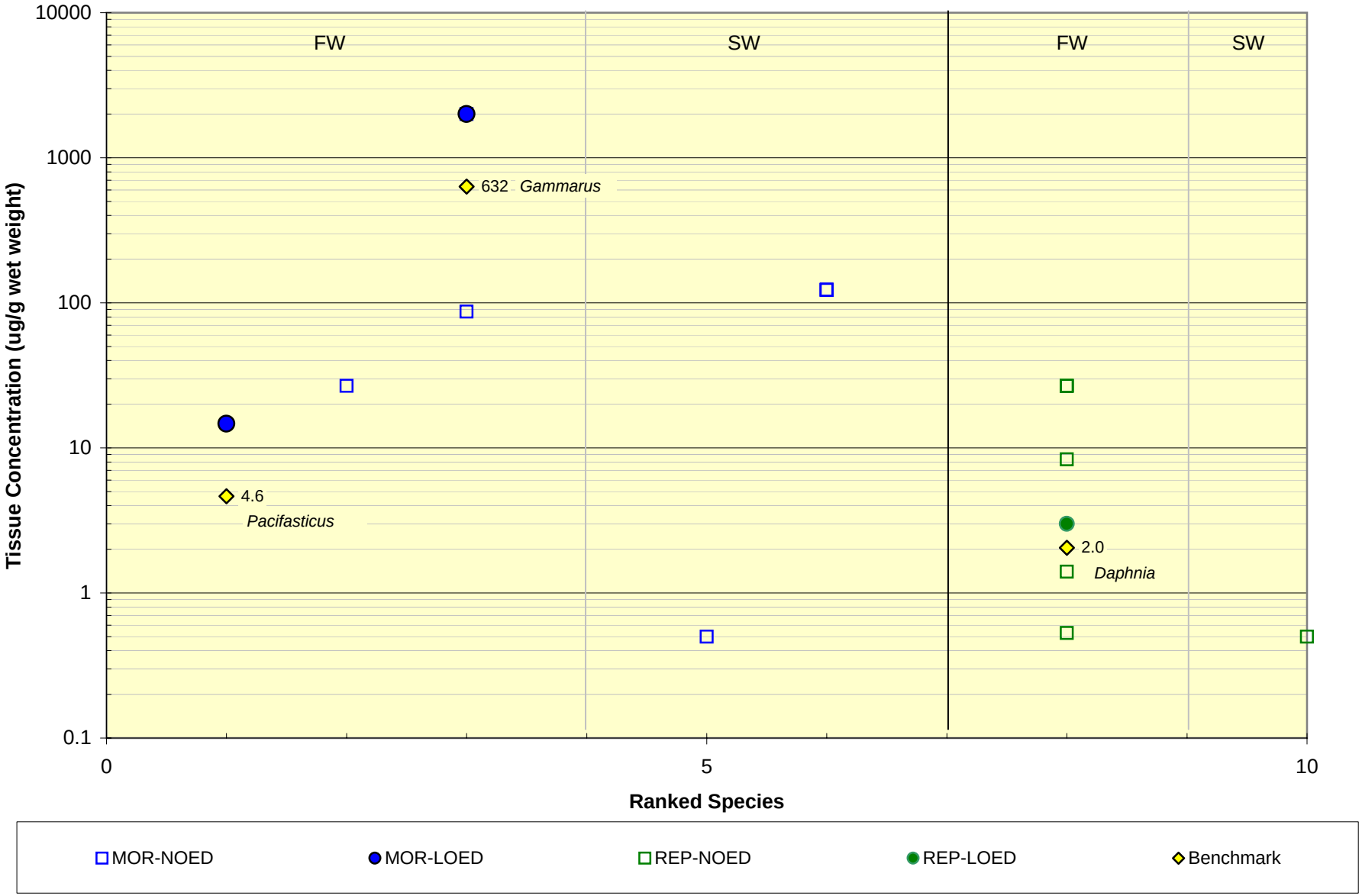

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Table C-11. Summary of Aquatic OrganismTissue Residue Data from ERED Database - Chlordane

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	0.02	Growth	ED18	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.16	Mortality	ED25	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.55	Mortality	ED25	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	0.3	Growth	ED28	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	2.2	Growth	ED28	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	0.075	Growth	ED30	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	0.6	Growth	ED30	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	0.78	Growth	ED33	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	6.5	Growth	ED33	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.22	Mortality	ED35	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.89	Mortality	ED35	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	1.2	Mortality	ED35	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	909	Mortality	ED35	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.94	Mortality	ED40	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	3.3	Mortality	ED40	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	0.01	Mortality	ED5	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	0.019	Mortality	ED5	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	2	Mortality	ED50	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	17.5	Mortality	ED50	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	3.9	Mortality	ED60	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	32	Mortality	ED60	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	1.6	Mortality	ED70	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	7.1	Mortality	ED70	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	1.9	Growth	ED78	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	14	Growth	ED78	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.7	Mortality	ED85	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.

Table C-11. Summary of Aquatic OrganismTissue Residue Data from ERED Database - Chlordane

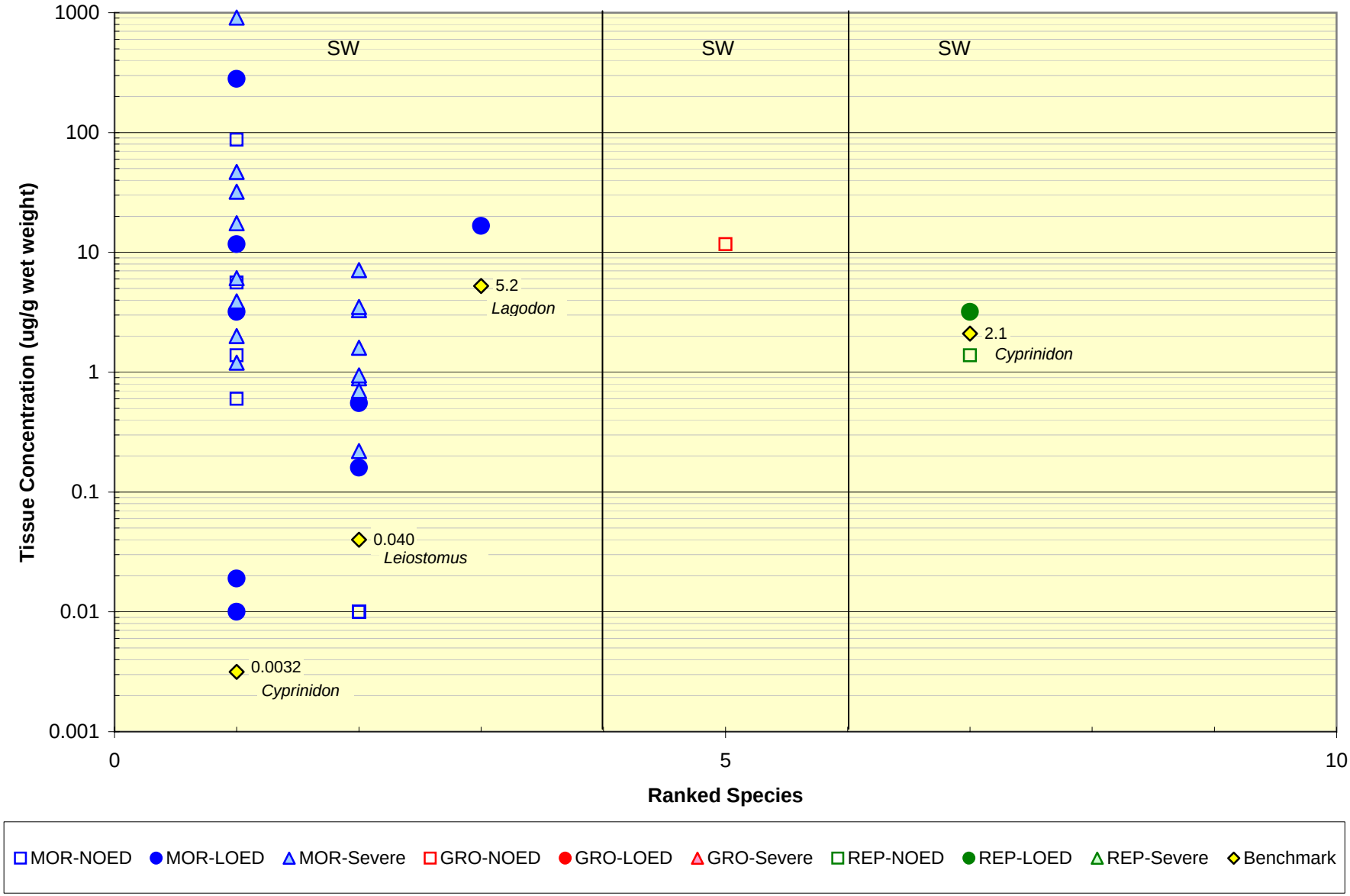
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	3.5	Mortality	ED85	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	6.1	Mortality	ED85	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	47	Mortality	ED85	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	5.6	Growth	ED95	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	47	Growth	ED95	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	0.022	Growth	NOED	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.01	Mortality	NOED	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.01	Mortality	NOED	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.01	Mortality	NOED	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Leiostomus xanthurus	Spot	SW	Chlordane	57-74-9	0.01	Mortality	NOED	Combined	Whole Body	Mature	Exposure Media 65% Heptachlor (technical Grade)	1976	Schimmel, S.C., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	27	Growth	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Penaeus duorarum	Shrimp - Pink	SW	Chlordane	57-74-9	1.7	Mortality	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	3.18	Mortality	LOED	Combined	Whole Body	Adult		1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Palaemonetes pugio	Shrimp - Grass	SW	Chlordane	57-74-9	4.5	Mortality	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Lagodon rhomboides	Pinfish	SW	Chlordane	57-74-9	16.6	Mortality	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	281	Mortality	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	3.18	Reproduction	LOED	Combined	Whole Body	Adult	Hatching Success Of Fry From Exposed Parents	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Crassostrea virginica	Eastern oyster	SW	Chlordane	57-74-9	11	Growth	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	0.6	Mortality	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Penaeus duorarum	Shrimp - Pink	SW	Chlordane	57-74-9	0.71	Mortality	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	1.38	Mortality	NOED	Combined	Whole Body	Adult		1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Palaemonetes pugio	Shrimp - Grass	SW	Chlordane	57-74-9	4.8	Mortality	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	87	Mortality	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	1.38	Reproduction	NOED	Combined	Whole Body	Adult	Hatching Success Of Fry From Exposed Parents	1976	Parrish, P.R., S.C. Schimmel, D.J. Hansen, J.M. Patrick, and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	11.7	Mortality	LOED	Absorption	Whole Body	Egg-embryo	39% Increase in mortality. Exposure to 2.2 ug/L technical grade heptachlor containing 65% heptachlor and 24% chlordane.	1977	Goodman, L.R., D.J. Hansen, J.A. Couch and J. Forester

Table C-11. Summary of Aquatic OrganismTissue Residue Data from ERED Database - Chlordane

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	11.7	Growth	NOED	Absorption	Whole Body	Egg-embryo	No significant difference in length. Exposure to 2.2 ug/L technical grade heptachlor containing 65% heptachlor and 24% chlordane.	1977	Goodman, L.R., D.J. Hansen, J.A. Couch and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Chlordane	57-74-9	5.6	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Significant Effect On Mortality. Exposure to 2 ug/L technical grade heptachlor containing 65% heptachlor and 24% chlordane.	1977	Goodman, L.R., D.J. Hansen, J.A. Couch and J. Forester

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx = Effective dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection;
NS = not specified
NA = not available

Chart C-18. Summary of Chlordane Concentrations in Saltwater Fish Tissue Associated with Toxicity



2/3/2006

Chart C-19. Summary of Chlordane Concentrations in Saltwater Invertebrate Tissue Associated with Toxicity

2/3/2006

Table C-12. Summary of Aquatic Organism Tissue Residue Data from ERED Database - DDx Compounds

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDD	72-54-8	0.3	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDD	72-54-8	0.46	Reproduction	ED100	Combined	Eggs	Egg	Hatching Success- ED100 indicates residue in entire nests which failed to hatch.	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Oncorhynchus mykiss	Trout - Rainbow	FW	4,4`-DDD	72-54-8	0.59	Reproduction	ED335	Water	Gonad	Egg	Failure of egg development Muscle = 0.27; male = 0.04	1969	Hopkins, CL, SRB Solly and AR Richie
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDD	72-54-8	5	Growth	NOED	Injection	Whole Body	Juvenile	No significant difference in total weight, liver/body weight ratio, or lipid content. 1.25 mg/kg injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT in fifth week.	1977	Addison, R.F. and M.E. Zinck
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDD	72-54-8	5	Mortality	NOED	Injection	Whole Body	Juvenile	1.25 mg/g injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT at fifth week..	1977	Addison, R.F. and M.E. Zinck
Pimephales promelas	Fathead minnow	FW	4,4`-DDD	72-54-8	0.6	Reproduction	LOED	Combined	Whole Body	Adult	Sig. Different From Control (p = 0.05)	1977	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Gambusia affinis	Mosquito fish	FW	4,4`-DDD	72-54-8	39.1	Mortality	NOED	Combined	Whole Body	NA	No mortality in 3 days in model ecosystem. Residue includes metabolites.	1974	Metcalf, R.L.
Pandion haliaetus	Osprey	FW	4,4`-DDD	72-54-8	0.18	Reproduction	NOED	NS	Eggs	Egg	Eggshell Thickness	2001	Clark, K.E., W. Stansley, L.J. Niles
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDT	50-29-3	0.17	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Lepomis cyanellus	Green sunfish	FW	4,4`-DDT	50-29-3	24	Mortality	LOED	Combined	Whole Body	Juvenile	Lethal body burden. Fish exposed in outdoor artificial pool.	1971	Hamelink, J.L., R.C. Waybrant, and R.C. Ball.
Lepomis gibbosus	Pumpkinseed	FW	4,4`-DDT	50-29-3	24	Mortality	LOED	Combined	Whole Body	Juvenile	Lethal body burden. Fish exposed in outdoor artificial pool.	1971	Hamelink, J.L., R.C. Waybrant, and R.C. Ball.
Oncorhynchus mykiss	Trout - Rainbow	FW	4,4`-DDT	50-29-3	0.18	Reproduction	ED335	Water	Gonad	Egg	p,p'-DDT Failure of egg development Muscle = 0.07; male = 0.01	1969	Hopkins, CL, SRB Solly and AR Richie
Oncorhynchus mykiss	Trout - Rainbow	FW	4,4`-DDT	50-29-3	1.48	Reproduction	ED335	Water	Gonad	Egg	Total DDT; Failure of egg development Muscle = 0.65; male = 0.09	1969	Hopkins, CL, SRB Solly and AR Richie
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	57	Mortality	LD25	Water	Whole Body	Juvenile	25% increase in mortality. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	86	Mortality	LD26	Combined	Whole Body	Juvenile	26% increase in mortality. Diet contained 45.6 ug/g DDT. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund

Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	160	Mortality	LD50	Absorption	Whole Body	Juvenile	50% increase in mortality. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	209	Mortality	LD79	Combined	Whole Body	Juvenile	79% increase in mortality. Diet contained 45.6 ug/g DDT. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	24	Mortality	LOED	Water	Whole Body	Embryo	Decreased hatchability. Parents exposed to 1.53 ug/L for up to 266 days. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	58.2	Growth	NOED	Combined	Whole Body	Larval	No difference in length. Diet contained 45.6 ug/g DDT. Parents exposed to 0.35 ug/L in water and 45.6 ug/g in food for up to 266 days. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	6.7	Mortality	NOED	Water	Whole Body	Embryo	No increase in mortality. No difference in hatchability. Parents exposed to 0.35 ug/L for up to 266 days. Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	40	Mortality	NOED	Water	Whole Body	Juvenile	Residue = DDT and metabolites.	1976	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	24	Reproduction	ED17	Water	Whole Body	Adult	2.0W Hatchability Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	87.9	Mortality	LD100	Water	Whole Body	Fry	2.0W Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	96	Mortality	LD100	Water	Whole Body	Fry	F + 2.0W F=45.6 ug/g Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	0.2	Mortality	LD88	Water	Whole Body	Fry	F + 2.0W (Parental dosage, fry placed in clean water and fed clean food) F=45.6 ug/g Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	68.9	Mortality	LOED	Ingestion	Whole Body	Adult	F F=45.6 ug/g Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	24	Reproduction	LOED	Water	Whole Body	Adult	2.0W Hatchability Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	46.4	Growth	NOED	Water	Whole Body	Fry	F+0.5W F=45.6 ug/g Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	58.2	Growth	NOED	Water	Whole Body	Fry	F+0.5W Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	12.2	Reproduction	NOED	Ingestion	Whole Body	Adult	F Hatchability F=45.6 ug/g Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	19	Reproduction	NOED	Combined	Whole Body	Adult	F + 0.5W Hatchability F=45.6 ug/g Fish initial age is 45d	1977	Jarvinen AW, MJ Hoffman, TW Thorslund
Callinectes sapidus	Crab - Blue	SW	4,4`-DDT	50-29-3	0.82	Growth	LOED	Ingestion	Whole Body	Juvenile	Decrease in carapace thickness:width ratio. Residue includes DDT and metabolites. Three weekly feedings of 3.2 ug DDT in diet.	1975	Leffler, C.W.
Callinectes sapidus	Crab - Blue	SW	4,4`-DDT	50-29-3	1	Mortality	LOED	Ingestion	Whole Body	Juvenile	Increase in mortality. Residue includes DDT and metabolites. Three weekly feedings of 3.2 ug DDT in diet.	1975	Leffler, C.W.

Callinectes sapidus	Crab - Blue	SW	4,4`-DDT	50-29-3	0.13	Mortality	NOED	Ingestion	Whole Body	Juvenile	No increase in mortality Residue includes DDT and metabolites. Four weekly feedings of 0.53 ug DDT in diet.	1975	Leffler, C.W.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	7.6	Growth	LOED	Ingestion	Whole Body	1-yr old	Males significantly longer than females. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues includes DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	1.55	Mortality	LOED	Ingestion	Eggs	Egg	Significant decrease in hatchability. Parental exposure to 1 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	2.9	Mortality	LOED	Ingestion	Whole Body	Larval	Significant increase in mortality of fry to 15 weeks post-hatch. Female parent only exposed to 2 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	7.6	Reproduction	LOED	Ingestion	Whole Body	1-yr old	Significant decrease in number of egg per female. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	2.9	Reproduction	NA	Ingestion	Whole Body	1-yr old	Significant increase in number of egg per female. DDT exposure in diet of 1 mg/kg/week. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	7.6	Growth	NOED	Ingestion	Whole Body	1-yr old	No significant difference in weight gain. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues includes DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	0.2	Mortality	NOED	Ingestion	Eggs	Egg	No difference in hatchability or mortality. Parental exposure to 0.05 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	0.26	Mortality	NOED	Ingestion	Whole Body	Larval	No difference in survival of fry to 15 weeks post-hatch. Male parent only exposed to 2 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.

Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	7.6	Mortality	NOED	Ingestion	Whole Body	1-yr old	No increase in mortality. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues include DDT and metabolites.	1968	Macek, K.J.
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	0.0256	Mortality	NOED	Absorption	Whole Body	Juvenile	No increase in mortality. Residues include DDT and metabolites. Radiotracer study. Assume wet weight.	1970	Macek, K.J. and S. Korn
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	1.92	Mortality	NOED	Ingestion	Whole Body	Juvenile	No increase in mortality. Residues include DDT and metabolites. Radiotracer study. Assume wet weight.	1970	Macek, K.J. and S. Korn
Heteromastus filiformis	Polychaete	SW	4,4`-DDT	50-29-3	5.9	Mortality	NOED	Ingestion	Whole Body	Adult	No increase in mortality. Residue includes DDT and metabolites.	1995	Mulsow, S.G. and P.F. Landrum
Ephemera danica	Mayfly	FW	4,4`-DDT	50-29-3	5.5	Mortality	NOED	Water	Whole Body	Juvenile		1973	Sodergren A, BJ Svensson
Brevoortia tyrannus	Atlantic menhaden	SW	4,4`-DDT	50-29-3	0.11	Growth	NOED	Ingestion	Whole Body	Larval	Accumulation was dose-dependent at each conc.; there was a "growth dilution" effect	1977	Warlen, SM, DA Wolfe, CW Lewis, DR Colby
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	5	Growth	NOED	Injection	Whole Body	Juvenile	No significant difference in total weight, liver/body weight ratio, or lipid content. 1.25 mg/kg injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT in fifth week.	1977	Addison, R.F. and M.E. Zinck
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDT	50-29-3	5	Mortality	NOED	Injection	Whole Body	Juvenile	1.25 mg/g injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT at fifth week.	1977	Addison, R.F. and M.E. Zinck
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	4,4`-DDT	50-29-3	11.6	Mortality	LD53	Ingestion	Whole Body	Juvenile		1969	Buhler DR, ME Rasmusson, WE Shanks
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	4,4`-DDT	50-29-3	21.7	Mortality	LD55	Ingestion	Whole Body	Juvenile		1969	Buhler DR, ME Rasmusson, WE Shanks
Oncorhynchus kisutch	Salmon-coho	FW/SW	4,4`-DDT	50-29-3	113	Mortality	LD85	Ingestion	Whole Body	Juvenile		1969	Buhler DR, ME Rasmusson, WE Shanks
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	4,4`-DDT	50-29-3	12.3	Mortality	LOED	Ingestion	Whole Body	Juvenile	6 days depuration	1969	Buhler DR, ME Rasmusson, WE Shanks
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	4,4`-DDT	50-29-3	2.2	Mortality	NOED	Ingestion	Whole Body	Juvenile	105 d Depuration	1969	Buhler DR, ME Rasmusson, WE Shanks
Oncorhynchus kisutch	Salmon-coho	FW/SW	4,4`-DDT	50-29-3	16.6	Mortality	NOED	Ingestion	Whole Body	Juvenile		1969	Buhler DR, ME Rasmusson, WE Shanks
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDT	50-29-3	2.95	Mortality	LOED	Combined	Whole Body	Egg	1962	1964	Burdick GE, EJ Harris, HJ Dean, TM Walker, J Skea, D Colby
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDT	50-29-3	2.67	Mortality	NOED	Combined	Whole Body	Egg	1962	1964	Burdick GE, EJ Harris, HJ Dean, TM Walker, J Skea, D Colby
Oncorhynchus kisutch	Salmon-coho	FW/SW	4,4`-DDT	50-29-3	56.1	Mortality	LD50	Ingestion	Whole Body	Juvenile	Median Survival Time.	1993	Cleveland L, EE Little, DR Buckler, and RH Wiedmeyer

Fundulus heteroclitus	Mummichog	SW	4,4`-DDT	50-29-3	0.85	Reproduction	ED20	Water	Eggs	Adult	% Fertilization	1976	Crawford RB, AM Guarino
Fundulus heteroclitus	Mummichog	SW	4,4`-DDT	50-29-3	0.85	Reproduction	ED28	Water	Eggs	Adult	% Fertilization	1976	Crawford RB, AM Guarino
Fundulus heteroclitus	Mummichog	SW	4,4`-DDT	50-29-3	0.85	Reproduction	ED82	Water	Eggs	Adult	% Fertilization	1976	Crawford RB, AM Guarino
Fundulus heteroclitus	Mummichog	SW	4,4`-DDT	50-29-3	0.16	Reproduction	NOED	Water	Eggs	Adult	% Fertilization 2 doses to maternal fish at @0.1 mg/l Some delay to late stages of organogenesis; development normal through hatching	1976	Crawford RB, AM Guarino
Fundulus heteroclitus	Mummichog	SW	4,4`-DDT	50-29-3	0.25	Mortality	NOED	Water	Eggs	Adult		1976	Crawford RB, AM Guarino
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	3.8	Reproduction	LOED	Combined	Whole Body	Adult	Sig. Different From Control (p = 0.05)	1977	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Pimephales promelas	Fathead minnow	FW	4,4`-DDT	50-29-3	24	Reproduction	LOED	Combined	Whole Body	Adult	Sig. Different From Control (p = 0.05)	1977	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Ephemera danica	Mayfly	FW	4,4`-DDT	50-29-3	6	Growth	NOED	Combined	Whole Body	Immature		1973	Sodergren, A., Svensson, B.
Ephemera danica	Mayfly	FW	4,4`-DDT	50-29-3	6	Mortality	NOED	Combined	Whole Body	Immature		1973	Sodergren, A., Svensson, B.
Libellula sp.	Dragonfly	FW	4,4`-DDT	50-29-3	0.0144	Mortality	NOED	Absorption	Whole Body	Naiad	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Orconectes nais	Crayfish	FW	4,4`-DDT	50-29-3	0.0466	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Ischnura verticalis	Damselfly	FW	4,4`-DDT	50-29-3	0.075	Mortality	NOED	Absorption	Whole Body	Naiad	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Palaemonetes kadiakensis	Shrimp - Grass	FW	4,4`-DDT	50-29-3	0.1	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Siphlonurus sp.	Mayfly	FW	4,4`-DDT	50-29-3	0.216	Mortality	NOED	Absorption	Whole Body	Nymph	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Gammarus fasciatus	Amphipod	FW	4,4`-DDT	50-29-3	0.336	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Hexagenia bilineata	Mayfly	FW	4,4`-DDT	50-29-3	0.336	Mortality	NOED	Absorption	Whole Body	Nymph	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Chironomus sp.	Midge	FW	4,4`-DDT	50-29-3	0.44	Mortality	NOED	Absorption	Whole Body	Larval	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Daphnia magna	Water flea	FW	4,4`-DDT	50-29-3	1.83	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Gambusia affinis	Mosquito fish	FW	4,4`-DDT	50-29-3	54.2	Mortality	NOED	Combined	Whole Body	NA	No mortality in 3 days in model ecosystem. Residue includes metabolites.	1974	Metcalf, R.L.
Salmo salar	Salmon - Atlantic	FW/SW	4,4`-DDT	50-29-3	5	Growth	NOED	Injection	Whole Body	Immature	Residue concentration approx. 3 ppm (wet weight) at 56 days. No significant difference in total body weight.	1976	Addison, R.F., M.E. Zinck and J.R. Leahy
Oncorhynchus kisutch	Salmon-coho	FW/SW	4,4`-DDT	50-29-3	95	Mortality	LD50	Ingestion	Whole Body	Immature	50% Mortality In 31 Days	1970	Buhler, D.R. and W.E. Shanks
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDT	50-29-3	2.93	Mortality	LOED	Combined	Whole Body	Egg	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.	1964	Burdick, G.E., Harris, E.J., Dean, H.J., Walker, T.M., Skea, J., Colby, D.

Salvelinus namaycush	Trout -Lake	FW	4,4`-DDT	50-29-3	2.95	Mortality	LOED	Combined	Whole Body	Egg	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.	1964	Burdick, G.E., Harris, E.J., Dean, H.J., Walker, T.M., Skea, J., Colby, D.
Squalus acanthias	Spiny Dogfish	SW	4,4`-DDT	50-29-3	0.1	Mortality	NOED	Injection	Whole Body	NA	No Effect On Mortality In 24 Hours	1979	Guarino, A.M. and S.T. Arnold
Leptocheirus plumulosus	Amphipod	SW	4,4`-DDT	50-29-3	47.9	Mortality	LOED	Absorption	Whole Body	Juvenile	Residues taken only from live animals.	2001	Lotufo, G.R., J.D. Farrar, B.M. Duke, T.S. Bridges
Leptocheirus plumulosus	Amphipod	SW	4,4`-DDT	50-29-3	2.69	Mortality	LD50	Absorption	Whole Body	Juvenile	Residues taken only from live animals.	2001	Lotufo, G.R., J.D. Farrar, B.M. Duke, T.S. Bridges
Leptocheirus plumulosus	Amphipod	SW	4,4`-DDT	50-29-3	47.9	Mortality	LD50	Absorption	Whole Body	Juvenile	Residues taken only from live animals.	2001	Lotufo, G.R., J.D. Farrar, B.M. Duke, T.S. Bridges
Leptocheirus plumulosus	Amphipod	SW	4,4`-DDT	50-29-3	2.12	Mortality	NOED	Absorption	Whole Body	Juvenile	Residues taken only from live animals.	2001	Lotufo, G.R., J.D. Farrar, B.M. Duke, T.S. Bridges
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.0054	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.005	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.0025	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.0029	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.0026	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.0018	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDT	50-29-3	0.0028	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Diporeia spp.	Amphipod	FW	4,4`-DDT	50-29-3	0.0066	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Diporeia spp.	Amphipod	FW	4,4`-DDT	50-29-3	0.006	Mortality	LD50	Combined	Whole Body	Juvenile		2001	Lotufo GR, PF Landrum, ML Gedeon
Sterna hirundo	Common tern	SW	4,4`-DDT	50-29-3	0.83	Reproduction	ED75	Combined	Eggs	Juvenile	Authors caution that there was no significant correlation between contaminant burden in eggs and abnormal gonad histology slides	2003	Hart CA, ICT Nisbet, SW Kennedy, ME Hahn
Salmo salar	Salmon - Atlantic	FW/SW	4,4`-DDT	50-29-3	0.031	Reproduction	NOED		Eggs		Zitko and Sanders, 1979, hatching success	1984	Dillon TM
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	3.23	Reproduction	ED100	Combined	Eggs	Egg	Hatching Success- ED100 indicates residue in entire nests which failed to hatch.	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	1.77	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Oryzias latipes	Japanese medaka	FW	4,4`-DDE	72-55-9	346	Mortality	LD50	Injection	Eggs	Egg		2003	Villalobos SA, DM papoulias, SD Pastva, AL Blankenship, J Meadow, DE Tillitt JP Giesy
Oryzias latipes	Japanese medaka	FW	4,4`-DDE	72-55-9	0.0018	Mortality	LOED	Injection	Eggs	Egg		2003	Villalobos SA, DM papoulias, SD Pastva, AL Blankenship, J Meadow, DE Tillitt JP Giesy
Oryzias latipes	Japanese medaka	FW	4,4`-DDE	72-55-9	######	Mortality	NOED	Injection	Eggs	Egg		2003	Villalobos SA, DM papoulias, SD Pastva, AL Blankenship, J Meadow, DE Tillitt JP Giesy
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.172	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger

Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	4.61	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.006	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.018	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	250.9	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	187.3	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	158.4	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	179.7	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	131	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	128.5	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	116.7	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	125	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	173.3	Mortality	LD50	Water	Whole Body	Adult	Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson

Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	314.8	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	155.2	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	251.6	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	214.7	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	171.7	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	177.1	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	295.8	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	140.3	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	189.9	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson

Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	126.6	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	152.7	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	146.9	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	113.9	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	139.6	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	104.9	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	110.4	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	192.7	Mortality	LD50	Water	Whole Body	Adult	Residue measured in live animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Hyalella azteca	Amphipod - Freshwater	FW	4,4`-DDE	72-55-9	181	Mortality	LD50	Water	Whole Body	Adult	Residue measured in dead animals Series of experiments conducted at different times and concentrations in order to develop lethal body residue data.	2005	Landurm PF; JA Steevens; M McElroy; DC Gossiaux; JS Lewis; SD Robinson
Oncorhynchus mykiss	Trout - Rainbow	FW	4,4`-DDE	72-55-9	0.71	Reproduction	ED335	Water	Gonad	Egg	Failure of egg development Muscle = 0.31; male = 0.04	1969	Hopkins, CL, SRB Solly and AR Richie

Salvelinus namaycush	Trout -Lake	FW	4,4`-DDE	72-55-9	0.29	Mortality	LOED	Combined	Whole Body	Fry	Significant increase in mortality. Exposure to 1.8 ng/L in water and 0.26 ug/g in diet.	1981	Berlin, W.H., R.J. Hesselberg, and M.J. Mac
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDE	72-55-9	2.68	Growth	NOED	Combined	Whole Body	Fry	No significant difference in weight gain. Exposure to 32.7 ng/L in water and 2.32 ug/g in diet.	1981	Berlin, W.H., R.J. Hesselberg, and M.J. Mac
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDE	72-55-9	5	Growth	NOED	Injection	Whole Body	Juvenile	No significant difference in total weight, liver/body weight ratio, or lipid content. 1.25 mg/kg injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT in fifth week.	1977	Addison, R.F. and M.E. Zinck
Salvelinus fontinalis	Trout - Brook	FW	4,4`-DDE	72-55-9	5	Mortality	NOED	Injection	Whole Body	Juvenile	1.25 mg/g injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT at fifth week.	1977	Addison, R.F. and M.E. Zinck
Gambusia affinis	Mosquito fish	FW	4,4`-DDE	72-55-9	150	Mortality	NOED	Combined	Whole Body	NA	No mortality in 3 days in model ecosystem. Residue includes metabolites.	1974	Metcalf, R.L.
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDE	72-55-9	0.74	Mortality	LOED	Combined	Whole Body	Egg	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.	1964	Burdick, G.E., Harris, E.J., Dean, H.J., Walker, T.M., Skea, J., Colby, D.
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDE	72-55-9	2.48	Mortality	LOED	Combined	Whole Body	Egg	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.	1964	Burdick, G.E., Harris, E.J., Dean, H.J., Walker, T.M., Skea, J., Colby, D.
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.19	Reproduction	NOED	NS	Eggs	Egg	Eggshell Thickness	2001	Clark, K.E., W. Stansley, L.J. Niles
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.575	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0026	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.706	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	2.904	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0102	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0648	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0112	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0097	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0185	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.778	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins

Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	3	Reproduction	LOED				hatching success Blue 1995	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Plegadis chihi		FW	4,4`-DDE	72-55-9	4	Reproduction	LOED				hatching success Henny and Herron 1989	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Phalacrocorax auritus	Double-Crested Cormorant	SW	4,4`-DDE	72-55-9	4	Reproduction	LOED				hatching success Custer et al 1999	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	0.46	Reproduction	NOED	Combined	Eggs	Egg	# rotten/addled eggs, Arapano NWR	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	0.46	Reproduction	NOED	Combined	Eggs	Egg	# young per nest, Arapano NWR	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	0.46	Reproduction	NOED	Combined	Eggs	Egg	# dead young, Arapano NWR	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED60	Combined	Eggs	Egg	# dead young, Latham Reservoir, Arapano NWR used as control	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED85	Combined	Eggs	Egg	# rotten/addled eggs, Latham Reservoir, Arapano NWR used as control	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED60	Combined	Eggs	Egg	# young per nest, Latham Reservoir, Arapano NWR used as control	1984	McEwen LC
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	5.45	Reproduction	ED15	Combined	Eggs	Egg	Eggshell Thickness- 1969 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	5.45	Reproduction	ED105	Combined	Eggs	Egg	Eggshell Shape (Length*Breadth)- 1969 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	0.87	Reproduction	ED08	Combined	Eggs	Egg	Eggshell Thickness- 1977 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	0.82	Reproduction	ED05	Combined	Eggs	Egg	Eggshell Thickness- 1980 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	2.11	Reproduction	ED09	Combined	Eggs	Egg	Eggshell Thickness- 1969 Florida	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	0.28	Reproduction	ED03	Combined	Eggs	Egg	Eggshell Thickness- 1974 Florida	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Salvelinus namaycush	Trout -Lake	FW	4,4`-DDE	72-55-9	2.68	Growth	NOED				Anonymous, 1981, plus 1.0 ug/g Mixed	1984	Dillon TM
Oncorhynchus mykiss	Trout - Rainbow	FW	4,4`-DDE	72-55-9	0.12	Growth	LOED				Poels et al., 1980, Rhine River Water	1984	Dillon TM
Lumbriculus variegatus	Oligochaete	FW	4,4`-DDE	72-55-9	178.4	Growth	ED29	Ingestion	Whole Body	Adult	mean decrease in Biomass	1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	4,4`-DDE	72-55-9	330.1	Growth	ED35	Ingestion	Whole Body	Adult	mean decrease in Biomass	1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	4,4`-DDE	72-55-9	178.4	Mortality	LD38	Ingestion	Whole Body	Adult		1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	4,4`-DDE	72-55-9	330.1	Mortality	LD94	Ingestion	Whole Body	Adult		1999	Fisher SW, SW Chordas III, PF Landrum
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED16	Combined	Eggs	Egg	Shell Thickness, Latham Reservior	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	NOED	Combined	Eggs	Egg	Shell volume, Latham Reservior	1984	McEwen LC
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.172	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger

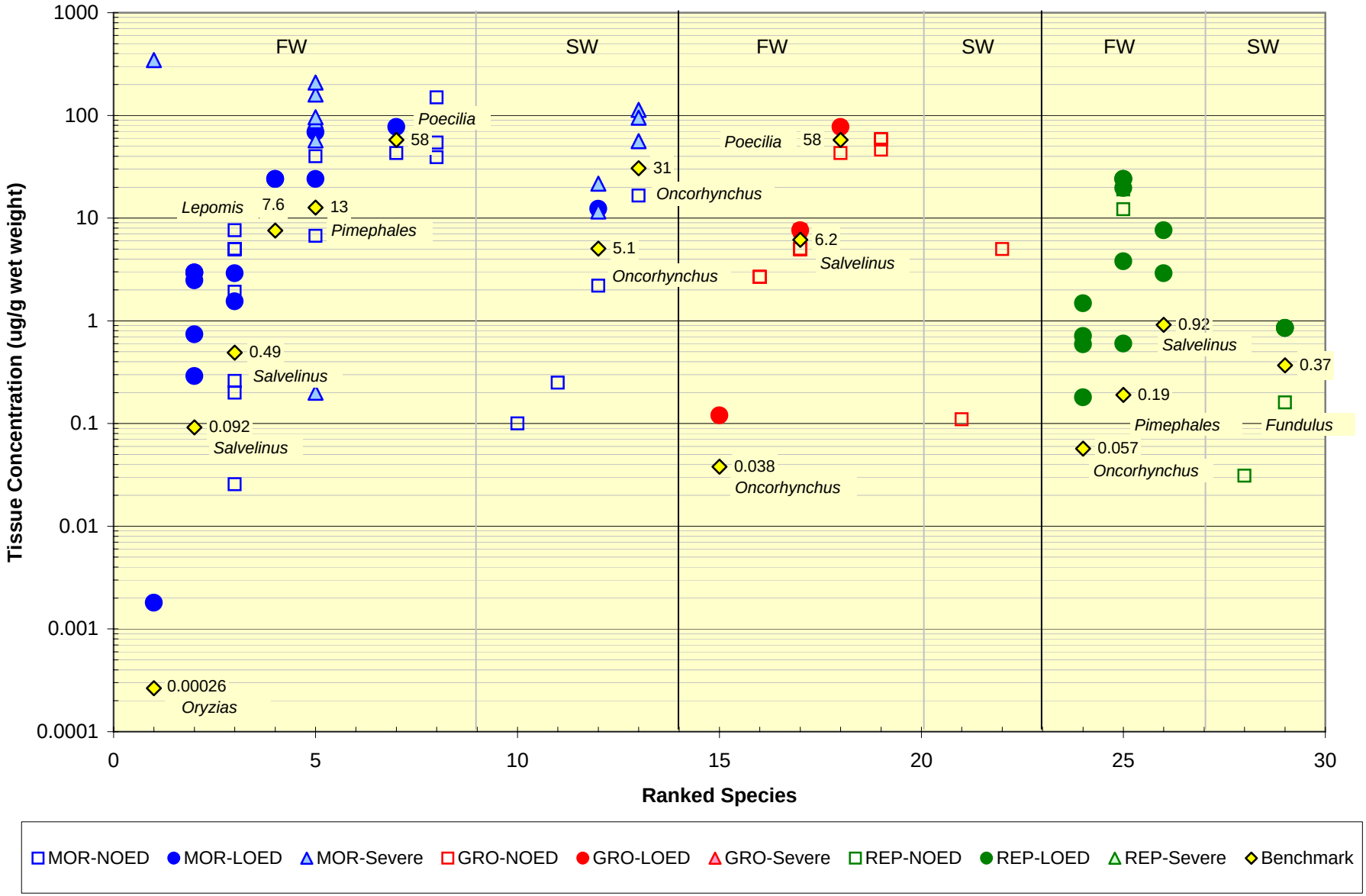
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	4.61	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.006	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.018	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pimephales promelas	Fathead minnow	FW	2,4`-DDE	3424-82-6	19.6	Reproduction	LOED	Combined	Whole Body	Adult	Sig. Different From Control (p = 0.05)	1977	Jarvinen, A.W., M.J. Hoffman, and T.W. Thorslund
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	0.5	Mortality	LD10	NS	Eggs	Egg	Reduced survival of young Findholt Sl & CH Trost 1979.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	6	Mortality	LD41	NS	Eggs	Egg	Reduced survival of young Findholt Sl & CH Trost 1979.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	8	Mortality	LD28	NS	Eggs	Egg	Reduced survival of young Findholt Sl & CH Trost 1979.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	0.5	Mortality	NOED	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	2.5	Mortality	LD14	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	6	Mortality	LD18	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	10	Mortality	LD25	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	14	Mortality	LD29	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	20.5	Mortality	LD29	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson

Table C-12. Summary of Aquatic Organism Tissue Residue Data from ERED Database - DDx Compounds

Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	37.5	Mortality	LD41	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Egretta thula	Snowy egret	FW	2,4`-DDE	3424-82-6	37.5	Mortality	LD9	NS	Eggs	Egg	Reduced survival of young Findholt SL 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	3.8	Reproduction	NOED	NS	Eggs	Egg	Hatching success Custer et al 1983	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Anseriformes	Water birds	FW	2,4`-DDE	3424-82-6	19	Reproduction	ED20	NS	Eggs	Egg	Calculated. Threshold effect of eggshell thickness which has an adverse effect on breeding success Keith & Gruchy 1972; this study data.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Anseriformes	Water birds	FW	2,4`-DDE	3424-82-6	15	Reproduction	ED13	NS	Eggs	Egg	Calculated. Threshold effect of eggshell thickness which has an adverse effect on breeding success Price 1977; this study data.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	1	Mortality	LOED	NS	Eggs	Egg	Calculated; mean threshold for survival of young [this study]. Would be associated w/ 9.4 % reduction in survival of young, minimal impact on eggshell thickness.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	2.5	Mortality	LD16	NS	Eggs	Egg	Calculated; reduced survival of young [this study]. Would be associated w/ 4.4 % reduction of eggshell thickness.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Anseriformes	Water birds	FW	2,4`-DDE	3424-82-6	5.7	Reproduction	ED17	NS	Eggs	Egg	Calculated. Threshold effect for fledgling success rate (survival of young, minimum required to sustain a Night heron population [Henny,1972]] applied to this study	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Poecilia latipinna	Sailfin molly	FW	o,p`-DDT	789-02-6	77.3	Growth	LOED	Absorption	Whole Body	Immature	Significant decrease in weight gain. Residue includes o,p'-DDT and metabolites.	1994	Benton, M.J., A.C. Nimrod and W.H. Benson.
Poecilia latipinna	Sailfin molly	FW	o,p`-DDT	789-02-6	77.3	Mortality	LOED	Absorption	Whole Body	Immature	78% Mortality. Residue includes o,p'-DDT and metabolites.	1994	Benton, M.J., A.C. Nimrod and W.H. Benson.
Poecilia latipinna	Sailfin molly	FW	o,p`-DDT	789-02-6	43	Growth	NOED	Absorption	Whole Body	Immature	No significant difference in weight gain. Residue includes o,p'-DDT and metabolites.	1994	Benton, M.J., A.C. Nimrod and W.H. Benson.
Poecilia latipinna	Sailfin molly	FW	o,p`-DDT	789-02-6	43	Mortality	NOED	Absorption	Whole Body	Immature	No increase in mortality. Residue includes o,p'-DDT and metabolites.	1994	Benton, M.J., A.C. Nimrod and W.H. Benson.

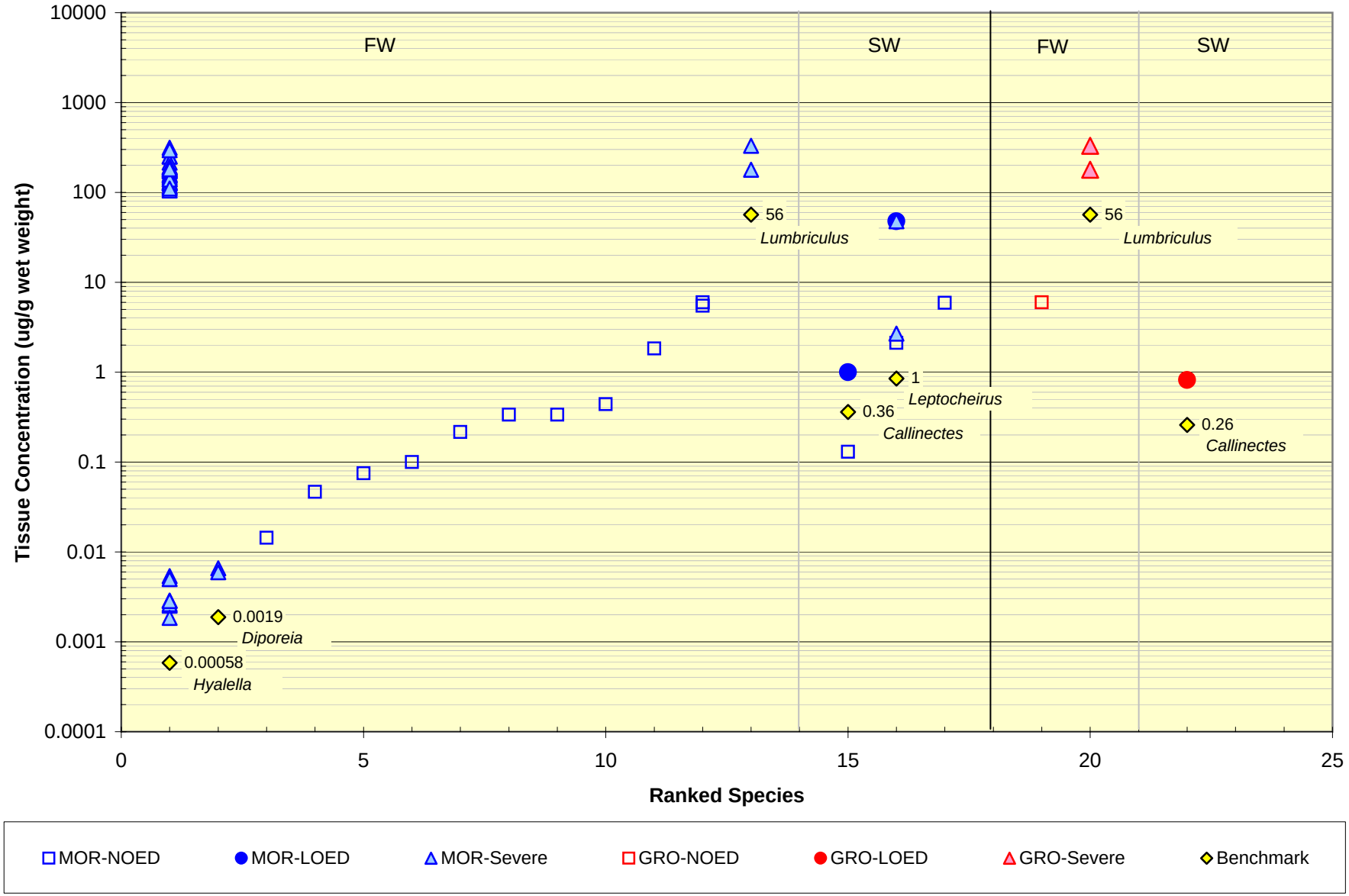
a FW = freshwater; SW= saltwater
b Wet weight concentration
c Edx or LDx = Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-20. Summary of DDT, DDE, and DDD Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



2/3/2006

Chart C-21. Summary of DDT, DDE, and DDD Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity



2/3/2006

Table C-13. Summary of Avian Egg Tissue Residue Data from ERED Database - DDx Compounds

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDD	72-54-8	0.3	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDD	72-54-8	0.46	Reproduction	ED100	Combined	Eggs	Egg	Hatching Success- ED100 indicates residue in entire nests which failed to hatch.	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pandion haliaetus	Osprey	FW	4,4`-DDD	72-54-8	0.18	Reproduction	NOED	NS	Eggs	Egg	Eggshell Thickness	2001	Clark, K.E., W. Stansley, L.J. Niles
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDT	50-29-3	0.17	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Sterna hirundo	Common tern	SW	4,4`-DDT	50-29-3	0.83	Reproduction	ED75	Combined	Eggs	Juvenile	Authors caution that there was no significant correlation between contaminant burden in eggs and abnormal gonad histology slides	2003	Hart CA, ICT Nisbet, SW Kennedy, ME Hahn
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	3.23	Reproduction	ED100	Combined	Eggs	Egg	Hatching Success- ED100 indicates residue in entire nests which failed to hatch.	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	1.77	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.172	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	4.61	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.006	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.018	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.19	Reproduction	NOED	NS	Eggs	Egg	Eggshell Thickness	2001	Clark, K.E., W. Stansley, L.J. Niles
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.575	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0026	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.706	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	2.904	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0102	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0648	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0112	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0097	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins

Table C-13. Summary of Avian Egg Tissue Residue Data from ERED Database - DDx Compounds

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.0185	Reproduction	NOED	Combined	Plasma	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	1.778	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	3	Reproduction	LOED				hatching success Blue 1995	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Plegadis chihi		FW	4,4`-DDE	72-55-9	4	Reproduction	LOED				hatching success Henny and Herron 1989	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Phalacrocorax auritus	Double-Crested Cormorant	SW	4,4`-DDE	72-55-9	4	Reproduction	LOED				hatching success Custer et al 1999	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	0.46	Reproduction	NOED	Combined	Eggs	Egg	# rotten/addled eggs, Arapano NWR	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	0.46	Reproduction	NOED	Combined	Eggs	Egg	# young per nest, Arapano NWR	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	0.46	Reproduction	NOED	Combined	Eggs	Egg	# dead young, Arapano NWR	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED60	Combined	Eggs	Egg	# dead young, Latham Reservoir, Arapano NWR used as control	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED85	Combined	Eggs	Egg	# rotten/addled eggs, Latham Reservoir, Arapano NWR used as control	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED60	Combined	Eggs	Egg	# young per nest, Latham Reservoir, Arapano NWR used as control	1984	McEwen LC
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	5.45	Reproduction	ED15	Combined	Eggs	Egg	Eggshell Thickness- 1969 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	5.45	Reproduction	ED105	Combined	Eggs	Egg	Eggshell Shape (Length*Breadth)- 1969 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	0.87	Reproduction	ED08	Combined	Eggs	Egg	Eggshell Thickness- 1977 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	0.82	Reproduction	ED05	Combined	Eggs	Egg	Eggshell Thickness- 1980 South Carolina	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	2.11	Reproduction	ED09	Combined	Eggs	Egg	Eggshell Thickness- 1969 Florida	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Pelecanus occidentalis	Brown pelican	SW	4,4`-DDE	72-55-9	0.28	Reproduction	ED03	Combined	Eggs	Egg	Eggshell Thickness- 1974 Florida	1997	Blus LJ, SN Wiemeyer, Cm Bunck
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	ED16	Combined	Eggs	Egg	Shell Thickness, Latham Reservior	1984	McEwen LC
Nycticorax nycticorax	Blact-crowned night-heron	FW	4,4`-DDE	72-55-9	1.52	Reproduction	NOED	Combined	Eggs	Egg	Shell volume, Latham Reservior	1984	McEwen LC
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.172	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	4.61	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.006	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	4,4`-DDE	72-55-9	0.018	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	0.5	Mortality	LD10	NS	Eggs	Egg	Reduced survival of young Findholt Sl & CH Trost 1979.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	6	Mortality	LD41	NS	Eggs	Egg	Reduced survival of young Findholt Sl & CH Trost 1979.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	8	Mortality	LD28	NS	Eggs	Egg	Reduced survival of young Findholt Sl & CH Trost 1979.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	0.5	Mortality	NOED	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	2.5	Mortality	LD14	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	6	Mortality	LD18	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	10	Mortality	LD25	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	14	Mortality	LD29	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	20.5	Mortality	LD29	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	37.5	Mortality	LD41	NS	Eggs	Egg	Reduced survival of young Henny et al. 1984	2003	Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Egretta thula	Snowy egret	FW	2,4`-DDE	3424-82-6	37.5	Mortality	LD9	NS	Eggs	Egg	Reduced survival of young Findholt SL 1984	2003	Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	3.8	Reproduction	NOED	NS	Eggs	Egg	Hatching success Custer et al 1983	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Anseriformes	Water birds	FW	2,4`-DDE	3424-82-6	19	Reproduction	ED20	NS	Eggs	Egg	Calculated. Threshold effect of eggshell thickness which has an adverse effect on breeding success Keith & Gruchy 1972; this study data.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Anseriformes	Water birds	FW	2,4`-DDE	3424-82-6	15	Reproduction	ED13	NS	Eggs	Egg	Calculated. Threshold effect of eggshell thickness which has an adverse effect on breeding success Price 1977; this study data.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	1	Mortality	LOED	NS	Eggs	Egg	Calculated; mean threshold for survival of young [this study]. Would be associated w/ 9.4 % reduction in survival of young, minimal impact on eggshell thickness.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	2,4`-DDE	3424-82-6	2.5	Mortality	LD16	NS	Eggs	Egg	Calculated; reduced survival of young [this study]. Would be associated w/ 4.4 % reduction of eggshell thickness.	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Anseriformes	Water birds	FW	2,4`-DDE	3424-82-6	5.7	Reproduction	ED17	NS	Eggs	Egg	Calculated. Threshold effect for fledgling success rate (survival of young, minimum required to sustain a Night heron population [Henny,1972]] applied to this study	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson

a FW = freshwater; SW= saltwater
b Wet weight concentration
c Edx or LDx = Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-22. Summary of DDT, DDE, and DDD Concentrations in Avian Egg Tissue Associated with Embryotoxicity

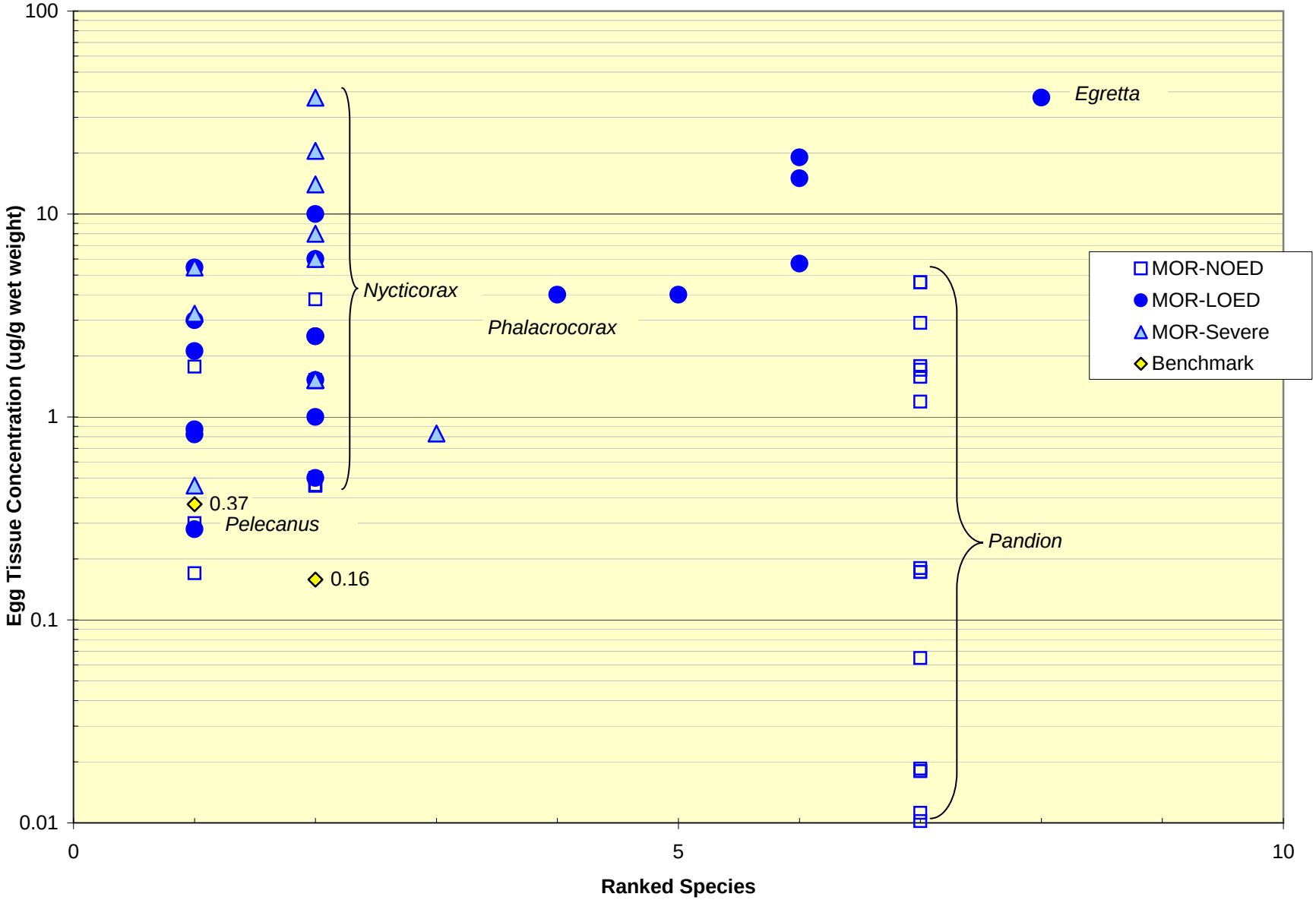

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Table C-14. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Aldrin/Dieldrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Chironomus sp.	Midge	FW	Aldrin	309-00-2	0.096	Mortality	NOED	Absorption	Whole Body	Larval	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Hexagenia bilineata	Mayfly	FW	Aldrin	309-00-2	0.132	Mortality	NOED	Absorption	Whole Body	Nymph	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Daphnia magna	Water flea	FW	Aldrin	309-00-2	0.48	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality in 3 days.	1971	Johnson, B.T., C.R. Saunders, H.O. Sanders and R.S. Campbell
Chlamydotheca arcuata	Ostracod	FW	Aldrin	309-00-2	1	Mortality	LOED	Absorption	Whole Body	NA	Immobility, Mortality. Residue less than 1 mg/kg.	1971	Kawatski, J.A. and J.C. Schmulbach
Gambusia affinis	Mosquito fish	FW	Aldrin	309-00-2	0.157	Mortality	NOED	Combined	Whole Body	NA	No mortality in 3 days in model ecosystem.	1974	Metcalf, R.L.
Salmo salar	Salmon - Atlantic	FW/SW	Aldrin	309-00-2	5	Growth	LOED	Injection	Whole Body	Immature	Residue concentration 0.1 to 0,5 ppm wet weight at 56 days. No significant difference in total body weight. Nonsignificant increase in proportion of liver weight to body weight on days 14 to 42.	1976	Addison, R.F., M.E. Zinck and J.R. Leahy
Mercenaria mercenaria	Clam - Quahog	SW	Aldrin	309-00-2	0.19	Behavior	NOED	Combined	Whole Body	Adult	No Effect On Feeding Activity Assume wet weight	1971	Butler, P.A.
Mya arenaria	Clam - Soft Shell	SW	Aldrin	309-00-2	2.3	Behavior	NOED	Combined	Whole Body	Adult	No Effect On Feeding Activity Assume wet weight	1971	Butler, P.A.
Chironomus riparius	Midge	FW	Aldrin	309-00-2	0.8	Behavior	LOED	Absorption	Whole Body	Larval	Impaired mobility. Residue 0.8 mg/kg aldrin and 1.1 mg/kg dieldrin. Assume wet weight.	1979	Estenik, J.F. and W.J. Collins
Chironomus riparius	Midge	FW	Aldrin	309-00-2	0.8	Mortality	LOED	Absorption	Whole Body	Larval	Increased mortality. Residues 0.8 mg/kg aldrin and 1.1 mg/kg dieldrin. Assume wet weight.	1979	Estenik, J.F. and W.J. Collins
Pelecanus occidentalis	Brown pelican	SW	Dieldrin	60-57-1	0.49	Reproduction	ED100	Combined	Eggs	Egg	Hatching Success- ED100 indicates residue in entire nests which failed to hatch.	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pelecanus occidentalis	Brown pelican	SW	Dieldrin	60-57-1	0.3	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Oncorhynchus mykiss	Trout - Rainbow	FW	Dieldrin	60-57-1	0.1096	Mortality	NOED	Water	Whole Body	Immature		1986	Shubat PJ, LR Curtis
Penaeus duorarum	Shrimp - Pink	SW	Dieldrin	60-57-1	0.23	Mortality	ED50	Combined	Whole Body	Adult	ED50 Via Spearman Karber 1.5 (msl)	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Cyprinodon variegatus	Sheepshead minnow	SW	Dieldrin	60-57-1	52.9	Mortality	ED50	Combined	Whole Body	Immature	ED50 Via Spearman Karber 1.5 (msl)	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Penaeus duorarum	Shrimp - Pink	SW	Dieldrin	60-57-1	0.08	Mortality	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Palaemonetes pugio	Shrimp - Grass	SW	Dieldrin	60-57-1	2.1	Mortality	LOED	Combined	Whole Body	Adult	Estimated Loed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook

Table C-14. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Aldrin/Dieldrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Cyprinodon variegatus	Sheepshead minnow	SW	Dieldrin	60-57-1	34	Mortality	LOED	Combined	Whole Body	Immature	Estimated Noed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Crassostrea virginica	Eastern oyster	SW	Dieldrin	60-57-1	13.9	Growth	NOED	Combined	Whole Body	Immature	Estimated Noed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Penaeus duorarum	Shrimp - Pink	SW	Dieldrin	60-57-1	0.01	Mortality	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Palaemonetes pugio	Shrimp - Grass	SW	Dieldrin	60-57-1	0.09	Mortality	NOED	Combined	Whole Body	Adult	Estimated Noed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Cyprinodon variegatus	Sheepshead minnow	SW	Dieldrin	60-57-1	12.8	Mortality	NOED	Combined	Whole Body	Immature	Estimated Noed - No Statistical Summary In Text	NS	Parrish, P.P., J.A. Couch, J. Forester, J.M. Patrick, and G.H. Cook
Oncorhynchus mykiss	Trout - Rainbow	FW	Dieldrin	60-57-1	0.14	Growth	ED40	Combined	Fat	Adult	40% Decrease In Growth Relative To Control	1980	Poels, C.L.M., van Der Gaag, M.A., van de Kerkhoff, J.F.J.
Chlamydotheca arcuata	Ostracod	FW	Dieldrin	60-57-1	1	Mortality	LOED	Absorption	Whole Body	NA	Immobility, mortality. Residue less than 1 mg/kg.	1971	Kawatski, J.A. and J.C. Schmulbach
Crassostrea virginica	Eastern oyster	SW	Dieldrin	60-57-1	1.44	Behavior	LOED	Absorption	Whole Body	Adult	Erratic Shell Movements, Extended Shell Closure Indicated Irritation	1976	Mason, J.W. and D.R. Rowe
Crassostrea virginica	Eastern oyster	SW	Dieldrin	60-57-1	18.6	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Mortality Within 168 Hours	1976	Mason, J.W. and D.R. Rowe
Gambusia affinis	Mosquito fish	FW	Dieldrin	60-57-1	28	Mortality	NOED	Combined	Whole Body	NA	No mortality in 3 days in model ecosystem.	1974	Metcalf, R.L.
Mercenaria mercenaria	Clam - Quahog	SW	Dieldrin	60-57-1	0.38	Behavior	NOED	Combined	Whole Body	Adult	No Effect On Feeding Activity Assume wet weight	1971	Butler, P.A.
Mya arenaria	Clam - Soft Shell	SW	Dieldrin	60-57-1	0.87	Behavior	NOED	Combined	Whole Body	Adult	No Effect On Feeding Activity Assume wet weight	1971	Butler, P.A.
Crassostrea virginica	Eastern oyster	SW	Dieldrin	60-57-1	107	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality.	1978	Emanuelsen, N., J.L. Lincer and K. Rifkin
Chironomus riparius	Midge	FW	Dieldrin	60-57-1	1.9	Mortality	LD100	Absorption	Whole Body	Larval	All Larvae Moribund In 2 Hours. Assume wet weight.	1979	Estenik, J.F. and W.J. Collins
Chironomus riparius	Midge	FW	Dieldrin	60-57-1	1.1	Behavior	LOED	Absorption	Whole Body	Larval	Impaired mobility. Exposure to aldrin at 20 ug/L. Residue 0.8 mg/kg aldrin and 1.1 mg/kg dieldrin. Assume wet weight.	1979	Estenik, J.F. and W.J. Collins
Chironomus riparius	Midge	FW	Dieldrin	60-57-1	1.1	Mortality	LOED	Absorption	Whole Body	Larval	Increased mortality. Exposure to 20 ug/L aldrin. Residues 0.8 mg/kg aldrin and 1.1 mg/kg dieldrin. Assume wet weight.	1979	Estenik, J.F. and W.J. Collins
Lepomis macrochirus	Bluegill	FW	Dieldrin	60-57-1	3.7	Behavior	LOED	Absorption	Whole Body	Immature	Severe symptoms of poisoning including loss of equilibrium and convulsions.	1967	Gakstatter, J.H. and C.M. Weiss
Squalus acanthias	Spiny Dogfish	SW	Dieldrin	60-57-1	1	Mortality	NOED	Injection	Whole Body	NA	No Effect On Mortality In 24 Hours	1979	Guarino, A.M. and S.T. Arnold
Oncorhynchus mykiss	Trout - Rainbow	FW	Dieldrin	60-57-1	0.11	Growth	LOED				Poels et al., 1980, Rhine River Water	1984	Dillon TM

Table C-14. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Aldrin/Dieldrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pleuronectiformes	Flounder	SW	Dieldrin	60-57-1	49000	Reproduction	NOED		Ovaries		Westernhagen et al., 1981, hatching success	1984	Dillon TM

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-23. Summary of Dieldrin/Aldrin Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity

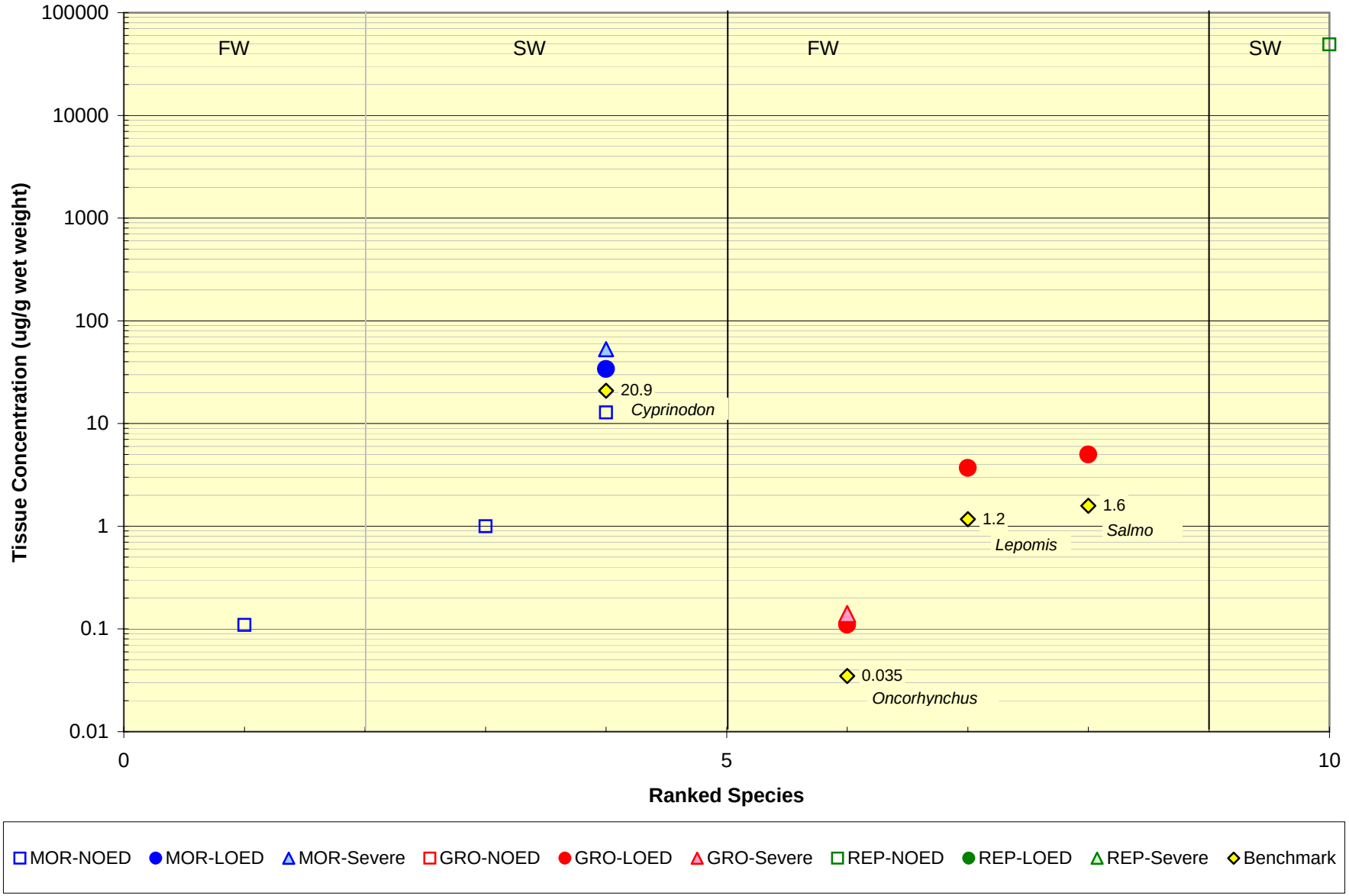

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Chart C-24. Summary of Dieldrin/Aldrin Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity

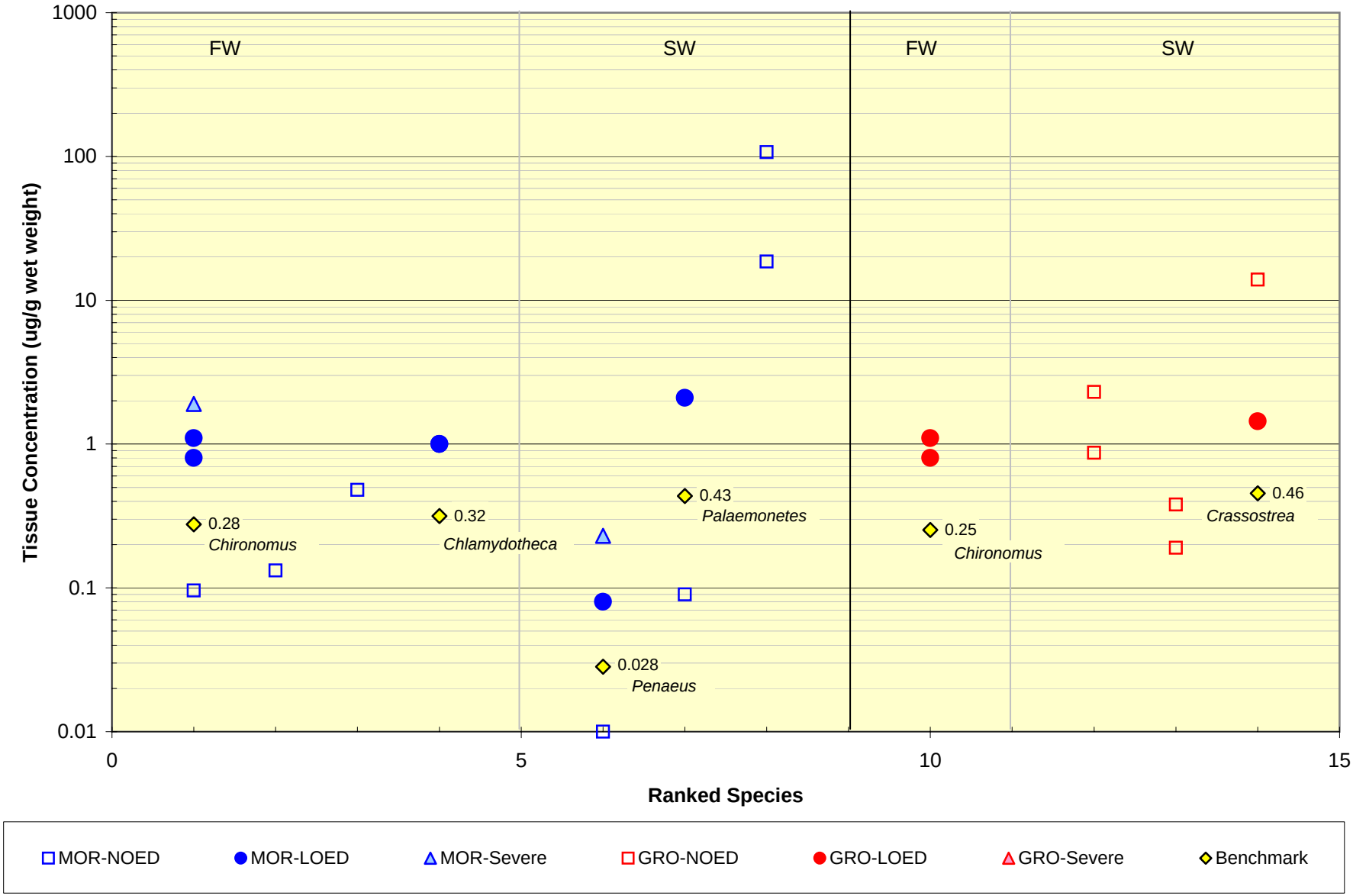

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Table C-15. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endosulfan

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Clarias ngamensis	Blunt-tooth Catfish	FW	Endosulfan	115-29-7	0.07	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Clarias gariepinus	Sharptooth Catfish	FW	Endosulfan	115-29-7	0.07	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Haplochromis sp.	Mouthbrooders	FW	Endosulfan	115-29-7	1.08	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Tilapia sp.	Tilapia	FW	Endosulfan	115-29-7	1.1	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Sarotherodon sp.	Cichlids	FW	Endosulfan	115-29-7	1.1	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Serranochromis sp.	Cichlids	FW	Endosulfan	115-29-7	1.15	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Pseudocrenilabrus philander	Dwarf Copper Mouth-Brooder	FW	Endosulfan	115-29-7	1.46	Mortality	LD	Water	Whole Body	NS		1982	Matthiessen P, PJ Fox, RJ Douthwaite, AB Wood
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	129	Mortality	LD10	Water	Whole Body	NS	172 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Leiostomus xanthurus	Spot	SW	Endosulfan	115-29-7	465	Mortality	LD28	Water	Whole Body	NS	620 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	282.15	Mortality	LD35	Water	Whole Body	NS	209 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Lagodon rhomboides	Pinfish	SW	Endosulfan	115-29-7	439.32	Mortality	LD35	Water	Whole Body	NS	1046 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Leiostomus xanthurus	Spot	SW	Endosulfan	115-29-7	120.8	Mortality	LD39	Water	Whole Body	NS	895 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Mugil cephalus	Striped mullet	SW	Endosulfan	115-29-7	360	Mortality	LD40	Water	Whole Body	NS	1000 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Lagodon rhomboides	Pinfish	SW	Endosulfan	115-29-7	311.76	Mortality	LD5	Water	Whole Body	NS	1299 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	588	Mortality	LD65	Water	Whole Body	NS	245 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Leiostomus xanthurus	Spot	SW	Endosulfan	115-29-7	369.9	Mortality	LD89	Water	Whole Body	NS	822 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Mugil cephalus	Striped mullet	SW	Endosulfan	115-29-7	650	Mortality	LD90	Water	Whole Body	NS	1000 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Mugil cephalus	Striped mullet	SW	Endosulfan	115-29-7	1169	Mortality	LD90	Water	Whole Body	NS	1344 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	68.88	Mortality	NOED	Water	Whole Body	NS	164 BCF	1977	Schimmel SC, JM Patrick, Jr., AJ Wilson Jr.
Mytilus edulis	Mussel	SW	Endosulfan	115-29-7	8.1	Mortality	NOED	Combined	Whole Body	Mature		1972	Roberts, D.
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	0.08	Mortality	ED10	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Leiostomus xanthurus	Spot	SW	Endosulfan	115-29-7	0.031	Mortality	ED35	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.

Table C-15. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endosulfan

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	0.207	Mortality	ED35	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Lagodon rhomboides	Pinfish	SW	Endosulfan	115-29-7	0.272	Mortality	ED35	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Mugil cephalus	Striped mullet	SW	Endosulfan	115-29-7	0.36	Mortality	ED40	Combined	Whole Body	Mature	Only Endosulfan Sulfate Detected In Tissues	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Leiostomus xanthurus	Spot	SW	Endosulfan	115-29-7	0.068	Mortality	ED45	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	0.48	Mortality	ED65	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Penaeus duorarum	Shrimp - Pink	SW	Endosulfan	115-29-7	0.01	Mortality	ED90	Combined	Whole Body	Mature	Detection limit of cmpd used, Sum of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Leiostomus xanthurus	Spot	SW	Endosulfan	115-29-7	0.255	Mortality	ED90	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Mugil cephalus	Striped mullet	SW	Endosulfan	115-29-7	0.49	Mortality	ED90	Combined	Whole Body	Mature	Only Endosulfan Sulfate Detected In Tissues	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Mugil cephalus	Striped mullet	SW	Endosulfan	115-29-7	0.49	Mortality	ED90	Combined	Whole Body	Mature	Only Endosulfan Sulfate Detected In Tissues	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Palaemonetes pugio	Shrimp - Grass	SW	Endosulfan	115-29-7	0.065	Mortality	NOED	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.
Lagodon rhomboides	Pinfish	SW	Endosulfan	115-29-7	0.195	Mortality	NOED	Combined	Whole Body	Mature	Sum Of Detected Endo I, II, and Sulfate	1977	Schimmel, S.C., Patrick, J.M., Wilson, A.J.

a FW = freshwater; SW= saltwater
b Wet weight concentration
c Edx or LDx = Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-25. Summary of Endosulfan Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity

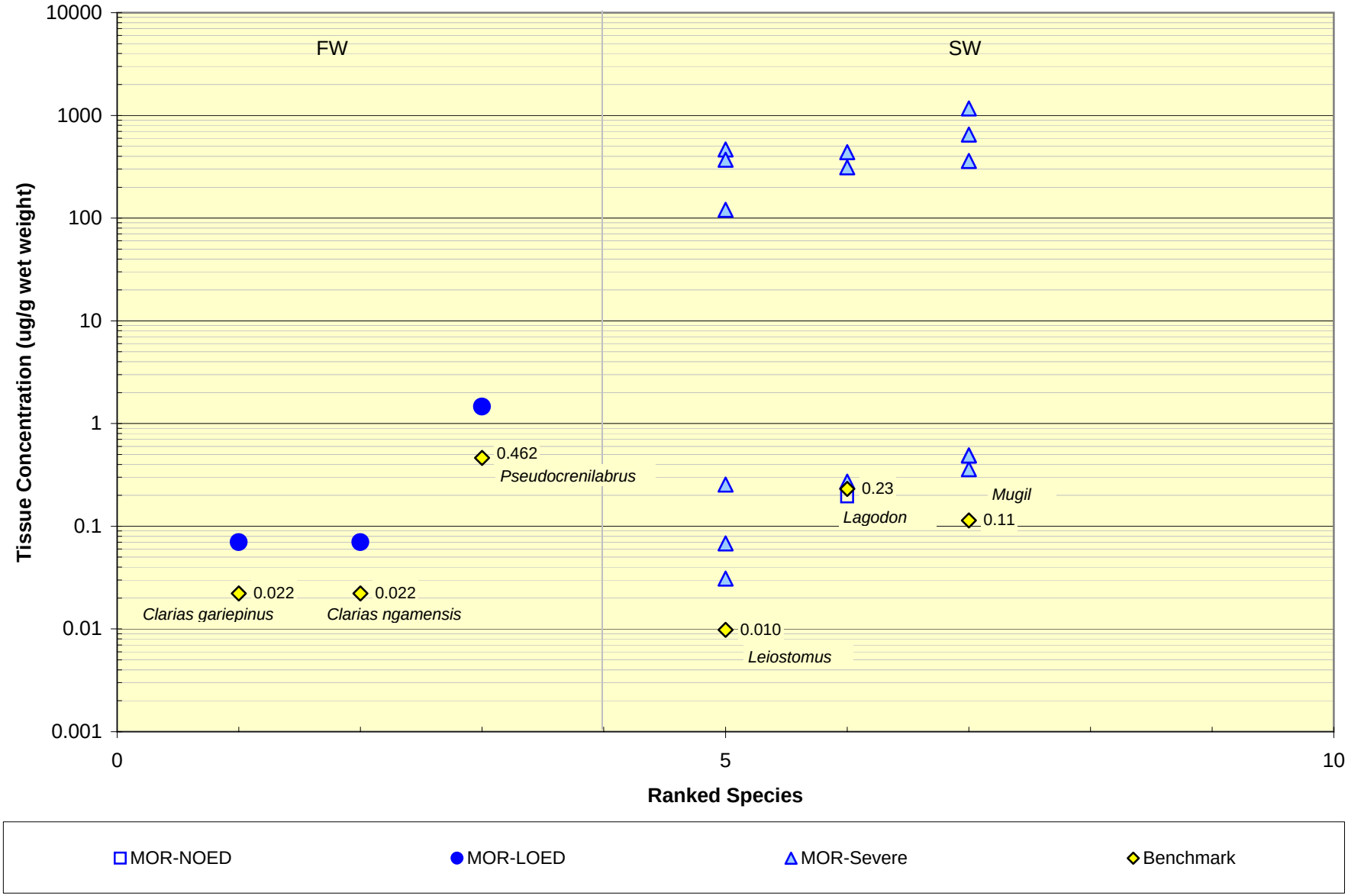

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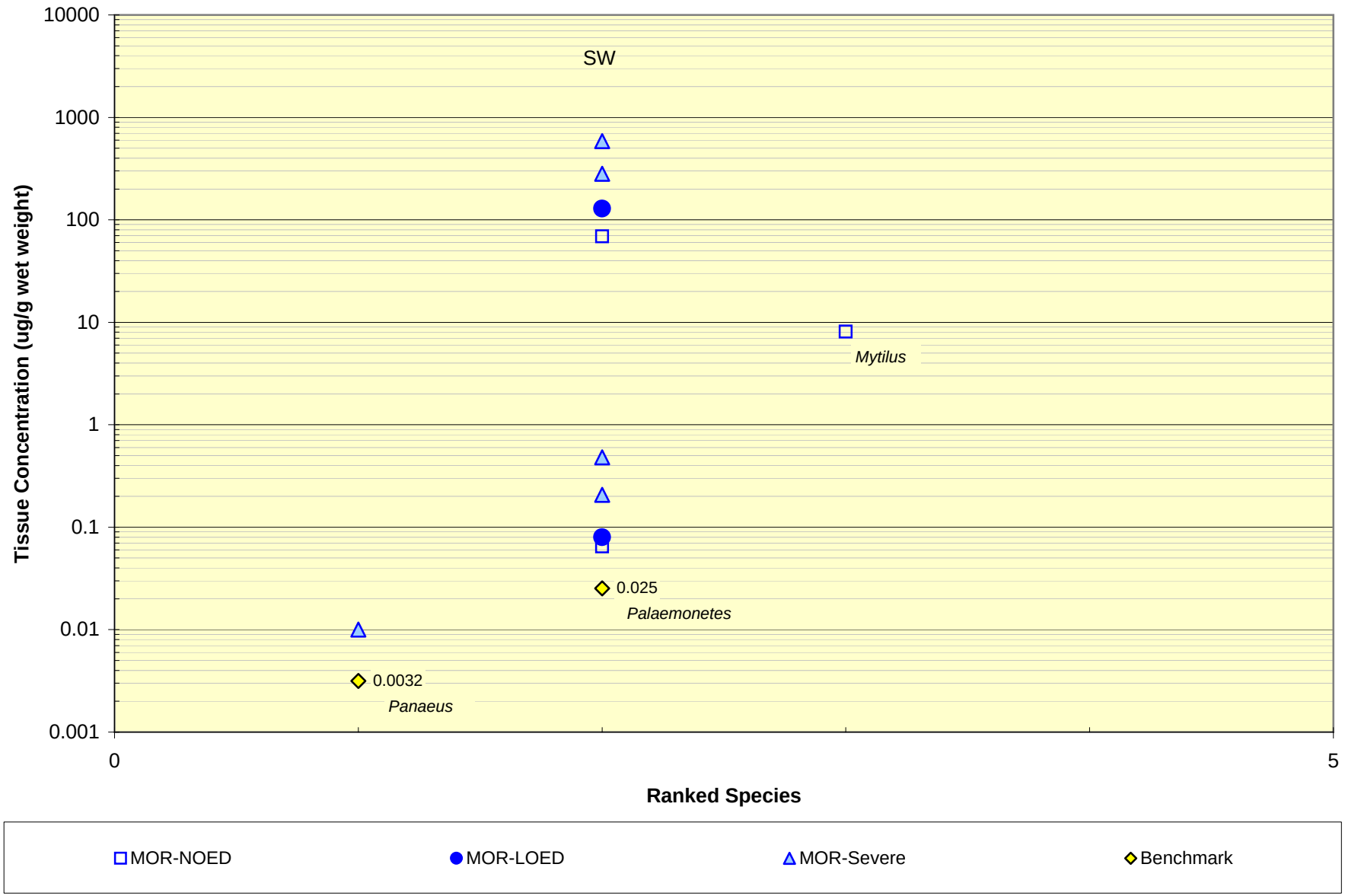
Chart C-26. Summary of Endosulfan Concentrations in Saltwater Invertebrate Tissue Associated with Toxicity



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EndosulfanInvertPlot

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Table C-16. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied[e]	Comments	Year	Author
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.307	Growth	NOED	Ingestion	Whole Body	Fingerling	Endrin not detected after 28d when fed non-contaminated diet.	1973	Argyle RL, GL Williams, HK Dupree
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.307	Growth	NOED	Ingestion	Whole Body	Immature	No Measureable Effect On Growth	1973	Argyle, R.L., Williams, G.C., and H.K. Dupree
Limnodrilus hoffmeisteri	Oligochaete	FW	Endrin	72-20-8	148	Growth	LOED	Combined	Whole Body	NA	Reduced weight gain.	1988	Keilty, T.J., D.S. White and P.F. Landrum
Limnodrilus hoffmeisteri	Oligochaete	FW	Endrin	72-20-8	11.6	Growth	NOED	Combined	Whole Body	NA	No Effect On Growth	1988	Keilty, T.J., D.S. White and P.F. Landrum
Oncorhynchus mykiss	Trout - Rainbow	FW	Endrin	72-20-8	0.22	Growth	ED50	Ingestion	Whole Body	Juvenile	50% Reduction in growth rate measured as weight. Whole body residue calculated from fat residue.	1973	Grant, B.F. and P.M. Mehrle
Oncorhynchus mykiss	Trout - Rainbow	FW	Endrin	72-20-8	0.12	Growth	NOED	Ingestion	Whole Body	Juvenile	No Effect On Growth measured as weight. Whole body residue calculated from fat residue.	1973	Grant, B.F. and P.M. Mehrle
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.87	Growth	NOED	Combined	Whole Body	Fry	0.28W + F F=0.63 ug/g Weight 6.8% of residue calculated from adult's diet	1978	Jarvinen AW, RWTyo
Stylodrilus heringianus	Freshwater worm	FW	Endrin	72-20-8	78.2	Growth	LOED	Combined	Whole Body	Adult	Significant decrease in weight. Calculated residue using BCF of 34. BCFs for study ranged from 34 to 67 (dry weight).	1988	Keilty, T.J., D.S. White and P.F. Landrum
Stylodrilus heringianus	Freshwater worm	FW	Endrin	72-20-8	30.8	Growth	NOED	Combined	Whole Body	Adult	No significant difference in weight. Calculated residue using BCF of 67. BCFs for study ranged from 34 to 67 (dry weight).	1988	Keilty, T.J., D.S. White and P.F. Landrum
Gambusia affinis	Mosquito fish	FW	Endrin	72-20-8	3.4	Mortality	LOED	Combined	Whole Body	NA	Violent Convulsions Within Minutes. Exposure in model ecosystem.	1973	Metcalf, R.L., I.P. Kapoor, P.Y. Lu, C.K. Schuth and P. Sherman
Gambusia affinis	Mosquito fish	FW	Endrin	72-20-8	3.4	Mortality	LOED	Combined	Whole Body	NA	Mortality within hours. Exposure in model ecosystem.	1973	Metcalf, R.L., I.P. Kapoor, P.Y. Lu, C.K. Schuth and P. Sherman
Ictalurus melas	Black Bullhead	FW	Endrin	72-20-8	1.6	Mortality	LD50	Water	Whole Body	Adult	Decrease in locomotor activity; LC50 = 0.10 ug/L	1974	Eaton, J.G.
Ictalurus melas	Black Bullhead	FW	Endrin	72-20-8	2.2	Mortality	LD50	Water	Whole Body	Adult	Decrease in locomotor activity; LC50 = 0.10 ug/L	1974	Eaton, J.G.
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	1	Mortality	LD100	Water	Whole Body	Fingerling	In Depuration, Endrin not detected after 23d.	1973	Argyle RL, GL Williams, HK Dupree
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.41	Mortality	NOED	Water	Whole Body	Fingerling	In Depuration, Endrin not detected after 23d.	1973	Argyle RL, GL Williams, HK Dupree
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.307	Mortality	NOED	Ingestion	Whole Body	Fingerling	Endrin not detected after 28d when fed non-contaminated diet.	1973	Argyle RL, GL Williams, HK Dupree
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.3	Mortality	LD100				Mount et al., 1966	1967	Brungs WA, DI Mount
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	1	Mortality	ED100	Absorption	Whole Body	Immature	100% Of Fish Died By Day 41	1973	Argyle, R.L., Williams, G.C., and H.K. Dupree
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.307	Mortality	NOED	Ingestion	Whole Body	Immature	No Measureable Effect On Mortality	1973	Argyle, R.L., Williams, G.C., and H.K. Dupree
Ictalurus punctatus	Catfish-Channel	FW	Endrin	72-20-8	0.41	Mortality	NOED	Absorption	Whole Body	Immature	No Significant Mortality Or Hypersensitivity	1973	Argyle, R.L., Williams, G.C., and H.K. Dupree

Table C-16. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied[e]	Comments	Year	Author
Lepomis macrochirus	Bluegill	FW	Endrin	72-20-8	0.3	Mortality	LOED	Absorption	Whole Body	NA	Increase in mortality.	1970	Bennett, H.J. and J.W. Day Jr.
Lepomis macrochirus	Bluegill	FW	Endrin	72-20-8	0.08	Mortality	NOED	Absorption	Whole Body	NA	No increase in mortality.	1970	Bennett, H.J. and J.W. Day Jr.
Limnodrilus hoffmeisteri	Oligochaete	FW	Endrin	72-20-8	148	Mortality	LOED	Combined	Whole Body	NA	77% Mortality	1988	Keilty, T.J., D.S. White and P.F. Landrum
Limnodrilus hoffmeisteri	Oligochaete	FW	Endrin	72-20-8	11.6	Mortality	NOED	Combined	Whole Body	NA	No Effect On Mortality	1988	Keilty, T.J., D.S. White and P.F. Landrum
Micropterus salmoides	Largemouth Bass	FW	Endrin	72-20-8	0.0115	Mortality	LOED	Water	Whole Body	Juvenile	40% Mortality. Residue in dead fish.	1976	Fabacher, D.L.
Notemigonus crysoleucas	Golden Shiner	FW	Endrin	72-20-8	0.97	Mortality	LD100	Absorption	Whole Body	Adult	100% Mortality in 8 hours. Sensitive population.	1968	Ludke, J.L., D.E. Ferguson and W.D. Burke
Notemigonus crysoleucas	Golden Shiner	FW	Endrin	72-20-8	35.4	Mortality	LD80	Absorption	Whole Body	Adult	80% Mortality in 9 hours. Resistant population.	1968	Ludke, J.L., D.E. Ferguson and W.D. Burke
Oncorhynchus mykiss	Trout - Rainbow	FW	Endrin	72-20-8	0.22	Mortality	NOED	Ingestion	Whole Body	Juvenile	No Effect On Mortality. Whole body residue calculated from fat residue.	1973	Grant, B.F. and P.M. Mehrle
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.64	Mortality	LD70	Combined	Whole Body	Fry	0.17W + F F=0.63 ug/g 30.4% of residue calculated from adult's diet	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.77	Mortality	LD70	Water	Whole Body	Fry	0.17W	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.24	Mortality	LD78	Ingestion	Whole Body	Fry	F F=0.63 ug/g 100% of residue calculated from adult's diet	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.96	Mortality	LD85	Combined	Whole Body	Fry	0.28W + F 9.3% of residue calculated from adult's diet	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	1.15	Mortality	LD85	Combined	Whole Body	Fry	0.28W	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.24	Mortality	LOED	Ingestion	Whole Body	Fry	F F=0.63 ug/g 100% of residue calculated from adult's diet	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	1.1	Mortality	NA	Combined	Whole Body	Adult	Survival Of Exposed Adults	1978	Jarvinen, A.W. and R.M. Tyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	1.6	Mortality	NA	Combined	Whole Body	Adult	Survival Of Exposed Adults	1978	Jarvinen, A.W. and R.M. Tyo
Poecilia latipinna	Sailfin molly	FW	Endrin	72-20-8	1.7	Mortality	ED47	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Poecilia latipinna	Sailfin molly	FW	Endrin	72-20-8	0.26	Mortality	NOED	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Pteronarcys dorsata	Giant Black Stonefly	FW	Endrin	72-20-8	0.07	Mortality	LD50	Water	Whole Body	Adult		1974	Eaton, J.G.
Rana sphenocephala	Southern Leopard Frog	FW	Endrin	72-20-8	0.43	Mortality	LOED	Absorption	Whole Body	Juvenile	Lethal body burden during 96 hours exposure.	1980	Hall, R.J. and D. Swineford.
Rana sphenocephala	Southern Leopard Frog	FW	Endrin	72-20-8	0.06	Mortality	NOED	Absorption	Whole Body	Juvenile	Residue in surviving animals.	1980	Hall, R.J. and D. Swineford.

Table C-16. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied[e]	Comments	Year	Author
Stylodrilus heringianus	Freshwater worm	FW	Endrin	72-20-8	78.2	Mortality	LOED	Combined	Whole Body	Adult	19% Increase in mortality. Calculated residue using BCF of 34. BCFs for study ranged from 34 to 67 (dry weight).	1988	Keilty, T.J., D.S. White and P.F. Landrum
Stylodrilus heringianus	Freshwater worm	FW	Endrin	72-20-8	30.8	Mortality	NOED	Combined	Whole Body	Adult	Calculated residue using BCF of 67. BCFs for study ranged from 34 to 67 (dry weight).	1988	Keilty, T.J., D.S. White and P.F. Landrum
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.67	Reproduction	NOED	Combined	Whole Body	Embryo	0.28W + F F=0.63 ug/g Hatchability 10.4% of residue calculated from adult's diet	1978	Jarvinen AW, RWTyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.05	Reproduction	NA	Ingestion	Whole Body	Adult	Adults Exposed, Embryo Hatchability And Body Burdens Tested	1978	Jarvinen, A.W. and R.M. Tyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.34	Reproduction	NA	Combined	Whole Body	Adult	Adults Exposed, Embryo Hatchability And Body Burdens Tested	1978	Jarvinen, A.W. and R.M. Tyo
Pimephales promelas	Fathead minnow	FW	Endrin	72-20-8	0.5	Reproduction	NA	Combined	Whole Body	Adult	Adults Exposed, Embryo Hatchability And Body Burdens Tested	1978	Jarvinen, A.W. and R.M. Tyo
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	5.8	Growth	ED40	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	20	Growth	ED47	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	52	Growth	ED67	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	124	Growth	ED87	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Growth	NA	Absorption	Whole Body	Egg-embryo	No Significant Effect On Growth At Highest Test Concentration	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Growth	NOED				Hansen et al., 1977b	1984	Dillon TM
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.08	Growth	LOED	Water	Whole Body	Larval	Dose received from adults + 0.05ug/L F1 generation	1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.05	Growth	NOED	Water	Whole Body	Larval	Dose received from adults + 0.03ug/L F1 generation	1993	Pawlisz AV, RH Peters
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	16.4	Mortality	LOED	Absorption	Whole Body	Adult	Average Residue In Dead Oysters	1976	Mason, J.W. and D.R. Rowe
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	0.26	Mortality	NOED	Absorption	Whole Body	Adult	Average Residue In Dead Oysters	1976	Mason, J.W. and D.R. Rowe
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.06	Mortality	LD50	Water	Whole Body	Embryo		1977	Hansen DJ, SC Schimmel, J Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.88	Mortality	LD85	Water	Whole Body	Embryo		1977	Hansen DJ, SC Schimmel, J Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.29	Mortality	NOED	Water	Whole Body	Embryo		1977	Hansen DJ, SC Schimmel, J Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.88	Mortality	LOED	Absorption	Whole Body	Egg-embryo	Greater Than One Life Cycle; Significantly Reduced Survival Of Juveniles With Exposure From Egg To Adult To Juvenile (28 Day Post Hatch); Tissue Burden From Juvenile	1977	Hansen, D.J., Schimmel, S.C., and J. Forester

Table C-16. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endrin

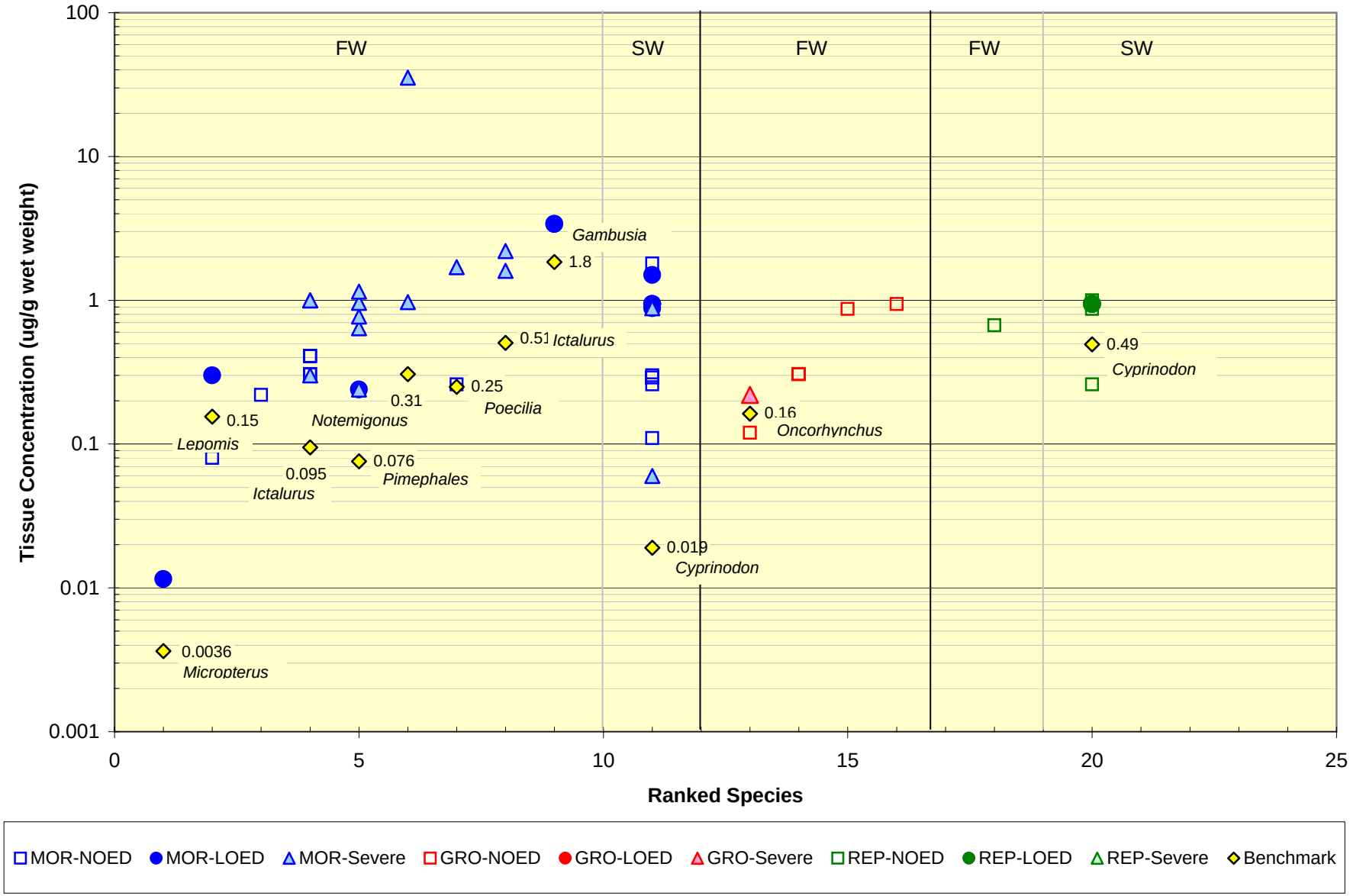
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied[e]	Comments	Year	Author
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Mortality	LOED	Absorption	Whole Body	Egg-embryo	Significantly Shorter Survival Duration	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Mortality	NA	Absorption	Whole Body	Egg-embryo	No Significant Effect On Survival At Highest Test Concentration	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.11	Mortality	NOED	Absorption	Whole Body	Egg-embryo	Greater Than One Life Cycle; No Significant Reduction In Survival Of Juveniles With Exposure From Egg To Adult To Juvenile (28 Day Post Hatch); Tissue Burden From Juvenile	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.26	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Significant Decrease In Survival Duration	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	1.8	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Significant Reduction In Survival Of Juveniles From Exposed Adults; Tissue Conc. Is From Eggs	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	1.5	Mortality	ED20	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.3	Mortality	NOED	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Mortality	LOED			adult	Hansen et al., 1977b	1984	Dillon TM
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Mortality	LOED			Egg	Hansen et al., 1977b	1984	Dillon TM
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.18	Mortality	LOED	Water	Whole Body	Larval	Dose received from adults + 0.11ug/L F1 generation	1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.61	Mortality	LOED	Water	Whole Body	Juvenile		1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.08	Mortality	NOED	Water	Whole Body	Larval	Dose received from adults + 0.05ug/L F1 generation	1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.18	Mortality	NOED	Water	Whole Body	Juvenile		1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.19	Mortality	ED25	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.07	Mortality	ED5	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.02	Mortality	ED60	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.02	Mortality	NOED	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Penaeus duorarum	Shrimp - Pink	SW	Endrin	72-20-8	0.01	Mortality	ED30	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Penaeus duorarum	Shrimp - Pink	SW	Endrin	72-20-8	0.025	Mortality	ED30	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Penaeus duorarum	Shrimp - Pink	SW	Endrin	72-20-8	0.067	Mortality	ED80	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	1.4	Reproduction	ED13	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.

Table C-16. Summary of Aquatic Organism Tissue Residue Data from ERED Database - Endrin

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied[e]	Comments	Year	Author
Crassostrea virginica	Eastern oyster	SW	Endrin	72-20-8	0.01	Reproduction	NOED	Combined	Whole Body	Mature	Residues From Animals Alive At End Of Test	1975	Schimmel, S.C., Parrish, P.R., Hansen, D.J., Patrick, J.M., Forester, J.
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Reproduction	LOED	Absorption	Whole Body	Egg-embryo	Significantly Reduced Egg Fertility (%) From Exposed Adults; Endrin Conc. In Eggs 1.8 Ug/g Wet	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.26	Reproduction	NOED	Absorption	Whole Body	Egg-embryo	No Significant Reduction In Egg Fertility (%) From Exposed Adults; Endrin Conc. In Eggs 0.87 Ug/g Wet	1977	Hansen, D.J., Schimmel, S.C., and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	1	Reproduction	NOED			adult	Hansen et al., 1977b	1984	Dillon TM
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Reproduction	LOED			adult	Hansen et al., 1977b, early hatching	1984	Dillon TM
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Reproduction	LOED			Egg	Hansen et al., 1977b, early hatching	1984	Dillon TM
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.87	Reproduction	NOED			Egg	Hansen et al., 1977b, hatch	1984	Dillon TM
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Reproduction	LOED			adult	Hansen et al., 1977b, reduced fertilization	1984	Dillon TM
Cyprinodon variegatus	Sheepshead minnow	SW	Endrin	72-20-8	0.94	Reproduction	LOED			Egg	Hansen et al., 1977b, reduced fertilization	1984	Dillon TM
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.05	Reproduction	LOED	Water	Whole Body	Juvenile	Spawning Delayed	1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	0.05	Reproduction	LOED	Water	Whole Body	Juvenile	Number of Females Spawning	1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	1.3	Reproduction	NOED	Water	Whole Body	Juvenile	Egg Production	1993	Pawlisz AV, RH Peters
Palaemonetes pugio	Shrimp - Grass	SW	Endrin	72-20-8	1.3	Reproduction	NOED	Water	Whole Body	Juvenile	Hatchability	1993	Pawlisz AV, RH Peters

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

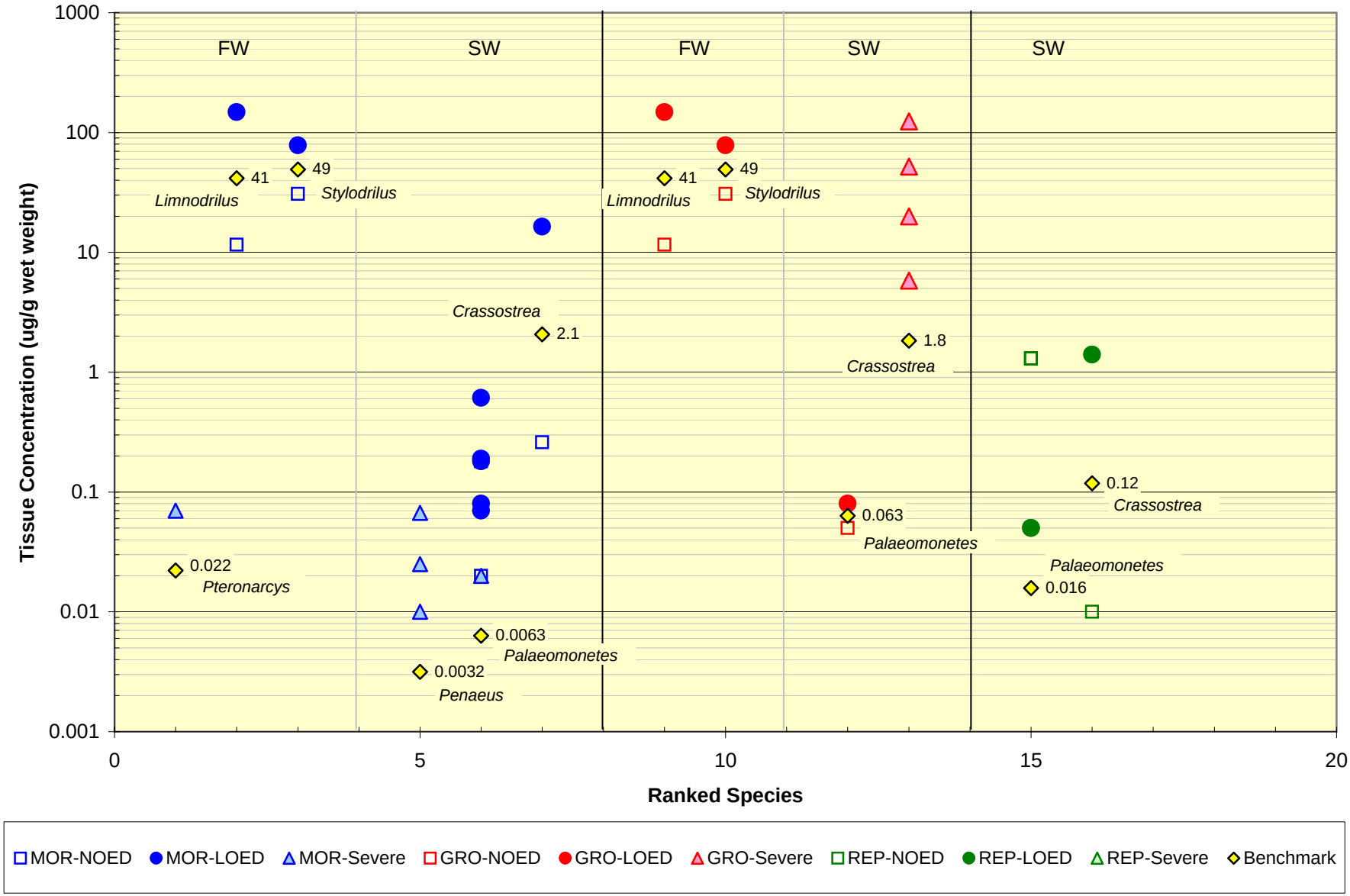
Chart C-27. Summary of Endrin Concentrations in Freshwater and Saltwater Fish Tissue Associated with Toxicity



MOR-NOED ● MOR-LOED △ MOR-Severe □ GRO-NOED ● GRO-LOED △ GRO-Severe □ REP-NOED ● REP-LOED △ REP-Severe ◇ Benchmark

2/3/2006

Chart C-28. Summary of Endrin Concentrations in Freshwater and Saltwater Invertebrate Tissue Associated with Toxicity



2/3/2006

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pimephales promelas	Fathead minnow	FW	PCB 138	35065-28-2	946	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 138	35065-28-2	946	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 138	35065-28-2	946	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 138	35065-28-2	3980	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 138	35065-28-2	3980	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 138	35065-28-2	3980	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 52	35693-99-3	1099	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 52	35693-99-3	1099	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 52	35693-99-3	1099	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 52	35693-99-3	3260	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 52	35693-99-3	3260	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 52	35693-99-3	3260	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Hyalella azteca	Amphipod - Freshwater	FW	PCB 52	35693-99-3	29	Mortality	LD50				Borgmann et al 1990	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 52	35693-99-3	1	Mortality	NOED	Absorption	Whole Body	Larval	No increase in mortality. Larva hatched from eggs with residue of 3.72 mg/kg.	1980	Guiney, P.D., J.J. Lech, and R.E. Peterson.
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 52	35693-99-3	1	Mortality	NOED	Absorption	Whole Body	Larval	No increase in mortality. Larva hatched from eggs with residue of 3.72 mg/kg.	1977	Guiney, P.D., R.E. Peterson, M.J. Melancon, Jr., and J.J. Lech.
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 52	35693-99-3	4.2	Mortality	NOED	Absorption	Whole Body	Adult	No increase in mortality. Residue at end of exposure period.	1977	Guiney, P.D., R.E. Peterson, M.J. Melancon, Jr., and J.J. Lech.
Hyalella azteca	Amphipod - Freshwater	FW	PCB 52	35693-99-3	54	Mortality	NOED	Absorption	Whole Body	Adult	Radiolabeled Compounds, Exp_conc = 3-100	1990	Borgmann, U., N.P. Norwood, and K.M. Ralph
Ampelisca abdita	Ampelisca abdita	SW	PCB 47	2437-79-8	394	Mortality	LD50	Absorption	Whole Body	Juvenile	BaP+TCB	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Ampelisca abdita	Ampelisca abdita	SW	PCB 47	2437-79-8	161	Mortality	LD50	Absorption	Whole Body	Juvenile	NP+TCB	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Ampelisca abdita	Ampelisca abdita	SW	PCB 47	2437-79-8	242	Mortality	LD50	Absorption	Whole Body	Juvenile		2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Ampelisca abdita	Ampelisca abdita	SW	PCB 47	2437-79-8	172	Mortality	LD50	Absorption	Whole Body	Juvenile		2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Lumbriculus variegatus	Oligochaete	FW	PCB 47	2437-79-8	112.71	Growth	ED23	Ingestion	Whole Body	Adult	Mean Decrease in Biomass	1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	PCB 47	2437-79-8	192.13	Growth	ED40	Ingestion	Whole Body	Adult	Mean Decrease in Biomass	1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	PCB 47	2437-79-8	112.71	Mortality	LD28	Ingestion	Whole Body	Adult		1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	PCB 47	2437-79-8	192.13	Mortality	LD82	Ingestion	Whole Body	Adult		1999	Fisher SW, SW Chordas III, PF Landrum

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 118	31508-00-6		Mortality	LD50	Injection	Whole Body	Fry	MC, EL Strain LC50 >6970	1991	Walker MK and RE Peterson
Asterias rubens	Starfish	SW	PCB 118	31508-00-6	3.26	Mortality	NOED	Injection	Whole Body	Adult	No effect on mortality.	1993	Den Besten, P.J., P. Lemaire, D.R. Livingstone, B. Woodin, J.J. Stegeman, H.J. Herwin and W. Seinen
Ephemera danica	Mayfly	FW	Clophen A50	8068-44-8	1.4	Mortality	NOED	Water	Whole Body	Juvenile		1973	Sodergren A, BJ Svensson
Phoxinus phoxinus	Minnow	FW	Clophen A50	8068-44-8	21	Growth	NOED				Bengtsson, 1980	1984	Dillon TM
Phoxinus phoxinus	Minnow	FW	Clophen A50	8068-44-8	180	Growth	LOED				Bengtsson, 1980, Increased	1984	Dillon TM
Phoxinus phoxinus	Minnow	FW	Clophen A50	8068-44-8	10	Mortality	LOED				Bengtsson, 1980, young post-hatch	1984	Dillon TM
Phoxinus phoxinus	Minnow	FW	Clophen A50	8068-44-8	1.3	Reproduction	NOED				Bengtsson, 1980	1984	Dillon TM
Phoxinus phoxinus	Minnow	FW	Clophen A50	8068-44-8	10	Reproduction	LOED				Bengtsson, 1980, % hatching	1984	Dillon TM
Hyalella azteca	Amphipod - Freshwater	FW	Aroclor 1242 or PCB 1242	53469-21-9	157	Mortality	LD50				Borgmann et al 1990	2000	Fay AA; BJ Brownawell; AA Elskus; AE McElroy
Ictalurus punctatus	Catfish-Channel	FW	Aroclor 1242 or PCB 1242	53469-21-9	2.172	Mortality	NOED	Ingestion	Whole Body	Fingerling	Whole Body Minus Stomach and Contents Fed 20 Ug/g dose at 3% body wt, 1x per day. Day 84, 12 control fish died due to pump/drain failure. Feeding of experimentals disrupted days 140-196 - all fed control food for this duration.	1976	Hansen LG, WB Wiekhurst, J Simon
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1242 or PCB 1242	53469-21-9	2.7	Mortality	ED75	Water	Whole Body	Egg	2.7 ug/g (Aroclor 1242) and 0.09 ug/g DDT (CAS 50-20-3) No control.	1975	Hogan JW, JL Brauhn
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	316	Reproduction	ED100	Water	Whole Body	Juvenile	#Young/surviving adult	1974	Nebeker AV and FA Puglishi
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	316	Reproduction	ED100	Water	Whole Body	Juvenile	#young produced	1974	Nebeker AV and FA Puglishi
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	409	Reproduction	ED100	Water	Whole Body	Juvenile	#Young/surviving adult	1974	Nebeker AV and FA Puglishi
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	409	Reproduction	ED100	Water	Whole Body	Juvenile	#young produced	1974	Nebeker AV and FA Puglishi
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	76	Reproduction	ED38	Water	Whole Body	Juvenile		1974	Nebeker AV and FA Puglishi
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	409	Mortality	LD100	Water	Whole Body	Juvenile	Juvenile thru reproduction; low survivals in control treatments	1974	Nebeker AV and FA Puglishi
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1242 or PCB 1242	53469-21-9	76	Reproduction	NOED	Water	Whole Body	Juvenile	#young produced	1974	Nebeker AV and FA Puglishi

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Hyalella azteca	Amphipod - Freshwater	FW	Aroclor 1242 or PCB 1242	53469-21-9	30	Mortality	NOED	Absorption	Whole Body	Adult	Radiolabeled Compounds, Exp_conc = 3-100	1990	Borgmann, U., N.P. Norwood, and K.M. Ralph
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1242 or PCB 1242	53469-21-9	1.3	Mortality	LOED	NA	Whole Body	Egg	10% Mortality	1975	Hogan, J.W., and J.L. Brauhn
Salmo salar	Salmon - Atlantic	FW/SW	Aroclor 1242 or PCB 1242	53469-21-9	0.54	Mortality	ED75	Combined	Eggs	Egg	Estimated Wet Weight Eggs Obtained From Hatchery Stock. 41 Ug.g Lipid	1979	Zitko, V., and R.L. Saunders
Sturnus vulgaris		FW	Aroclor 1242 or PCB 1242	53469-21-9	52	Reproduction	NOED				hatching success Arenal and Halbrook 1997	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Anas platyrhynchos	Mallard	FW	Aroclor 1242 or PCB 1242	53469-21-9	23.3	Reproduction	NOED				infertility of egg Haseltine and Prouty 1980	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Anas platyrhynchos	Mallard	FW	Aroclor 1242 or PCB 1242	53469-21-9	105	Reproduction	NOED				infertility of egg Custer and Heinz 1980	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Pelecanus occidentalis	Brown pelican	SW	PCBs	1336-36-3	7.94	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success- PCBs are Aroclor 1260 and similar PCBs	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	0.14	Mortality	NOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	1.1	Mortality	LD07	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - no significance calculated	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	1.9	Growth	NOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	2.7	Growth	ED59	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	0.14	Reproduction	NOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - Ovary weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	1.1	Reproduction	ED47	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - Ovary weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	1.1	Mortality	LOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - no significance calculated	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	2.7	Mortality	LD18	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - no significance calculated	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	0.14	Growth	LOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	1.9	Reproduction	NOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - Ovary weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	1.1	Reproduction	LOED	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - Ovary weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Danio rerio	Zebra Danio	FW	PCBs	1336-36-3	2.7	Reproduction	ED54	Ingestion	Whole Body	Adult	PCBs 41, 51, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184, 193 - Ovary weight	1998	Orn, S., P.L. Anderson, L. Forlin, M. Tysklind, L. Norrgren
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.025	Reproduction	NOED	Ingestion	Eggs	Adult	1ug/g TBT + 25ug/g PCB % decrease in fertility	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.031	Reproduction	NOED	Ingestion	Eggs	Adult	5ug/g TBT + 25ug/g PCB % decrease in fertility	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.03	Reproduction	ED06	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB % decrease in fertility	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.03	Reproduction	NOED	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB decrease in egg development	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.03	Reproduction	ED03	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB % decrease in hatch	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.025	Reproduction	ED11	Ingestion	Eggs	Adult	1ug/g TBT + 25ug/g PCB % decrease in swimup	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.031	Reproduction	ED08	Ingestion	Eggs	Adult	5ug/g TBT + 25ug/g PCB % decrease in swimup	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.03	Reproduction	ED09	Ingestion	Eggs	Adult	25ug/g TBT + 25ug/g PCB % decrease in swimup	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Oryzias latipes	Japanese medaka	FW	PCBs	1336-36-3	0.031	Reproduction	ED05	Ingestion	Eggs	Adult	5ug/g TBT + 25ug/g PCB % decrease in hatch	2005	Nakayama, K; Y Oshima; K Nagafuchi; T Hano; Y Shimasaki; T Honjo
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.00076	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was significantly decreased by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0008	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0012	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0013	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was significantly increased by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0018	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0028	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0028	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.004	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was significantly increased by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.011	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was significantly decreased by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider

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Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0116	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was significantly decreased by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0138	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0186	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0246	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.026	Growth	NOED	Water	Whole Body	Neonate to adult	Growth was not significantly affected by this congener concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.00076	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0008	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0012	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0013	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0018	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0028	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0028	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.004	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.011	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0116	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was significantly increased at this congenger concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0138	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was significantly increased at this congenger concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0186	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was significantly increased at this congenger concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider

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Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0246	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was significantly increaed at this congenger concentration.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.026	Reproduction	NOED	Water	Whole Body	Neonate to adult	Reproduction was not affected at this concentration or with this congenger.	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0004	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.00076	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0008	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0012	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0013	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0018	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0028	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.004	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.011	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0116	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0138	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0186	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.0246	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Daphnia magna	Water flea	FW	PCBs	1336-36-3	0.026	Mortality	NOED	Water	Whole Body	Neonate to adult	Although a great deal of absorption and retention of PCBs occured survival, growth, and reproduction were not adversely affected	1990	Dillon TM , WH Benson, RA Stackhouse, AM Crider
Salvelinus namaycush	Trout -Lake	FW	PCBs	1336-36-3	1.5	Reproduction	LOED	NA	Eggs	Adult		1992	Mac, M.J. and T.R. Swartz
Oncorhynchus kisutch	Salmon-coho	FW/SW	PCBs	1336-36-3	645	Mortality	ED100	Ingestion	Whole Body	Immature	Radiolabeled - Contam. Food Fed.	1977	Mayer, F.L., P.M. Mehrle, and H.O. Sanders
Ephemera danica	Mayfly	FW	PCBs	1336-36-3	1.5	Growth	NOED	Combined	Whole Body	Immature		1973	Sodergren, A., Svensson, B.
Ephemera danica	Mayfly	FW	PCBs	1336-36-3	1.5	Mortality	NOED	Combined	Whole Body	Immature		1973	Sodergren, A., Svensson, B.
Leiostomus xanthurus	Spot	SW	PCBs	1336-36-3	17	Mortality	LD17	Absorption	Whole Body	Juvenile	Aroclor 1254 25mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	109	Mortality	LD40	Absorption	Whole Body	Juvenile	Aroclor 1254 27mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Leiostomus xanthurus	Spot	SW	PCBs	1336-36-3	46	Mortality	LD50	Absorption	Whole Body	Juvenile	Aroclor 1254 24mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Leiostomus xanthurus	Spot	SW	PCBs	1336-36-3	120	Mortality	LD53	Absorption	Whole Body	Juvenile	Aroclor 1254 24mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Leiostomus xanthurus	Spot	SW	PCBs	1336-36-3	152	Mortality	LD64	Absorption	Whole Body	Juvenile	Aroclor 1254 74mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	14	Mortality	LD65	Absorption	Whole Body	Juvenile	Aroclor 1254 30mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Leiostomus xanthurus	Spot	SW	PCBs	1336-36-3	27	Mortality	NOED	Absorption	Whole Body	Juvenile	Aroclor 1254 40mm animal length	1971	Hansen, D.J., P.R. Parrish, J.I. Lowe, A.J. Wilson, Jr., and P.D. Wilson
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	5.1	Mortality	LD33	Absorption	Eggs	Egg	33% Mortality of second generation fry in first week after hatching. Parents exposed to 0.14 ug/L for 28 days.	1973	Hansen, D.J., S.C. Schimmel and J. Forester

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Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	11	Mortality	LD74	Absorption	Eggs	Egg	74% Mortality of second generation fry in first week after hatching. Parents exposed to 0.39 ug/L for 28 days.	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	170	Mortality	LOED	Absorption	Eggs	Egg	72% Decrease in hatchability of eggs. Parents exposed to 5.6 ug/L for 28 days.	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	0.88	Reproduction	LOED	Absorption	Whole Body	Adult	Increase in fecundity	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	0.56	Mortality	NOED	Absorption	Whole Body	Egg	Residues in surviving second generation fry ranged from 0.26 to 0.56 mg/kg. Parents exposed for 28 days.	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	0.88	Mortality	NOED	Absorption	Eggs	Egg	No increase in mortality in second generation. Parents exposed to 0.09 ug/L for 28 days.	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	27	Mortality	NOED	Absorption	Eggs	Egg	No decrease in hatchability of eggs. Parents exposed to 1.1 ug/L for 28 days.	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	49	Mortality	NOED	Absorption	Whole Body	Adult	No effect on mortality.	1973	Hansen, D.J., S.C. Schimmel and J. Forester
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	4	Growth	ED10	Absorption	Whole Body	Adult	10% Reduction In Shell Growth	1974	Hansen, D.J., P.R. Parrish and J. Forester
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	32	Growth	ED38	Absorption	Whole Body	Adult	38% Reduction In Shell Growth	1974	Hansen, D.J., P.R. Parrish and J. Forester
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	95	Growth	ED93	Absorption	Whole Body	Adult	93% Reduction In Shell Growth	1974	Hansen, D.J., P.R. Parrish and J. Forester
Palaemonetes pugio	Shrimp - Grass	SW	PCBs	1336-36-3	22	Mortality	LD38	Absorption	Whole Body	Adult	38% Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Penaeus aztecus	Shrimp - Brown	SW	PCBs	1336-36-3	42	Mortality	LD43	Absorption	Whole Body	NA	43% Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	620	Mortality	LD44	Absorption	Whole Body	Immature	44% Statistically Significant Increase In Mortality	1974	Hansen, D.J., P.R. Parrish and J. Forester
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	106	Mortality	LD50	Absorption	Whole Body	Immature	50% Mortality in 33 days.	1974	Hansen, D.J., P.R. Parrish and J. Forester
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	205	Mortality	LD50	Absorption	Whole Body	Immature	50% Mortality in 18 days.	1974	Hansen, D.J., P.R. Parrish and J. Forester
Palaemonetes pugio	Shrimp - Grass	SW	PCBs	1336-36-3	44	Mortality	LD93	Absorption	Whole Body	Adult	93% Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Palaemonetes pugio	Shrimp - Grass	SW	PCBs	1336-36-3	1.1	Mortality	LOED	Absorption	Whole Body	Adult	33% Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Penaeus aztecus	Shrimp - Brown	SW	PCBs	1336-36-3	3.8	Mortality	LOED	Absorption	Whole Body	NA	8% Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	65	Mortality	LOED	Absorption	Whole Body	Immature	18% Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	21	Mortality	NOED	Absorption	Whole Body	Immature	No Mortality In 96 Hours	1974	Hansen, D.J., P.R. Parrish and J. Forester
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	111	Mortality	NOED	Absorption	Whole Body	Immature	No Statistically Significant Increase In Mortality	1974	Hansen, D.J., P.R. Parrish and J. Forester

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	170	Mortality	NOED	Absorption	Whole Body	Immature	No Statistically Significant Increase In Mortality	1974	Hansen, D.J., P.R. Parrish and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	200	Mortality	LOED	Absorption	Whole Body	Egg-embryo	Lethal To 86% Of Fry In 28 Days	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	1100	Mortality	LOED	Absorption	Whole Body	Juvenile	88% Juvenile Mortality In 28 Days	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	57	Mortality	NOED	Absorption	Whole Body	Egg-embryo	No Effect On Fry Mortality In 28 Days	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	66	Mortality	NOED	Absorption	Eggs	Egg-embryo	No Effect on Survival Of Embryos To Hatching, And Survival Of Fry Two Weeks After Hatching. Parents exposed to 3.4 ug/L for 28 days.	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	110	Mortality	NOED	Absorption	Whole Body	Adult	No Effect On Adult Mortality In 28 Days	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	230	Mortality	NOED	Absorption	Whole Body	Juvenile	No Effect On Juvenile Mortality In 28 Days	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Cyprinodon variegatus	Sheepshead minnow	SW	PCBs	1336-36-3	110	Reproduction	NOED	Absorption	Whole Body	Adult	No effect on fertilization of eggs. Residue in eggs of 66 mg/kg.	1975	Hansen, D.J., S.C. Schimmel and J. Forester
Ictalurus punctatus	Catfish-Channel	FW	PCBs	1336-36-3	14.3	Growth	LOED	Ingestion	Whole Body	Immature	40% Reduction in body weight. Increased liver/body weight ratio.	1976	Hansen, L.G., W.B. Wiekhorst and J. Simon
Ictalurus punctatus	Catfish-Channel	FW	PCBs	1336-36-3	10.9	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality	1976	Hansen, L.G., W.B. Wiekhorst and J. Simon
Ictalurus punctatus	Catfish-Channel	FW	PCBs	1336-36-3	14.3	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality	1976	Hansen, L.G., W.B. Wiekhorst and J. Simon
Carassius auratus	Goldfish	FW	PCBs	1336-36-3	250	Mortality	LD50	Absorption	Whole Body	NA	50% mortality in 22 days.	1972	Hattula, M.I. and O. Karlog
Carassius auratus	Goldfish	FW	PCBs	1336-36-3	324	Mortality	LD50	Absorption	Whole Body	Immature	50% mortality in 5 days.	1972	Hattula, M.I. and O. Karlog
Phoxinus phoxinus	Minnow	FW	PCBs	1336-36-3	170	Reproduction	ED83	Ingestion	Whole Body	Adult	83% Reduction in hatchability of eggs. Residues measured 2 months before spawning.	1980	Bengtsson, B.E.
Phoxinus phoxinus	Minnow	FW	PCBs	1336-36-3	180	Growth	LOED	Ingestion	Whole Body	Adult	Significantly increased growth at 79 days. Residue measured at 82 days.	1980	Bengtsson, B.E.
Phoxinus phoxinus	Minnow	FW	PCBs	1336-36-3	70	Mortality	LOED	Ingestion	Whole Body	Adult	Doubling Of Mortality Rate Compared To Controls After 300 Days	1980	Bengtsson, B.E.
Phoxinus phoxinus	Minnow	FW	PCBs	1336-36-3	15	Reproduction	LOED	Ingestion	Whole Body	Adult	Reduction in time to hatch. Fry death within 1 week of hatching. Spawning induced at higher water temperatures. Residues measured 2 months before spawning.	1980	Bengtsson, B.E.
Phoxinus phoxinus	Minnow	FW	PCBs	1336-36-3	1.6	Reproduction	NOED	Ingestion	Whole Body	Adult	No significant reduction in time to hatch. Residues measured 2 months before spawning.	1980	Bengtsson, B.E.
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	425	Growth	LOED	Absorption	Whole Body	Immature	Reduced growth rate (weight and height).	1972	Lowe, J.I., P.R. Parrish, J.M. Patrick, Jr. and J. Forester

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Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	101	Growth	NOED	Absorption	Whole Body	Immature	No effect on growth rate.	1972	Lowe, J.I., P.R. Parrish, J.M. Patrick, Jr. and J. Forester
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	425	Mortality	NOED	Absorption	Whole Body	Immature	No increase in mortality.	1972	Lowe, J.I., P.R. Parrish, J.M. Patrick, Jr. and J. Forester
Salvelinus namaycush	Trout -Lake	FW	PCBs	1336-36-3	1.8	Growth	LOED	Combined	Whole Body	Fry	PCB With No Acetone Carrier; Enhanced Growth (weight and length). Concurrent exposure to 0.72 ug PCB/g food starting day 22.	1981	Mac, M.J. and J.G. Seelye
Salvelinus namaycush	Trout -Lake	FW	PCBs	1336-36-3	2.4	Growth	LOED	Combined	Whole Body	Fry	PCB Dosed With Acetone Carrier; Enhanced Growth (weight and length). Concurrent exposure to 0.72 ug PCB/g in food starting day 22.	1981	Mac, M.J. and J.G. Seelye
Salvelinus namaycush	Trout -Lake	FW	PCBs	1336-36-3	0.76	Growth	NOED	Absorption	Whole Body	Fry	Pcb Dosed With and Without Acetone Carrier; No Effect On Growth (weight or length)	1981	Mac, M.J. and J.G. Seelye
Salvelinus namaycush	Trout -Lake	FW	PCBs	1336-36-3	1.8	Mortality	NOED	Combined	Whole Body	Fry	PCB With No Acetone Carrier; No Effect On Mortality. Concurrent exposure to 0.72 ug PCB/g in food starting day 22.	1981	Mac, M.J. and J.G. Seelye
Salvelinus namaycush	Trout -Lake	FW	PCBs	1336-36-3	2.4	Mortality	NOED	Combined	Whole Body	Fry	PCB Dosed With Acetone Carrier; No Effect On Mortality. Concurrent exposure to 0.72 ug PCB/g in food starting day 22.	1981	Mac, M.J. and J.G. Seelye
Morone saxatilis	Striped Bass	SW	PCBs	1336-36-3	4.4	Growth	NOED	Ingestion	Whole Body	Larval	No significant difference in length and weight gain in larva. Parents exposed to PCBs in field. Residue in eggs of 8.1 mg/kg. PCB diet started after yolk absorption.	1983	Westin, D.T., Olney, C.E., Rogers, B.A.
Pleuronectes americanus	Winter Flounder	SW	PCBs	1336-36-3	7.1	Growth	LOED	NA	Whole Body	Egg-embryo	Residue measured in eggs from wild fish. Reduced length and weight of 67 day old larvae.	1988	Black, D.E., D.K. Phelps and R.L. Lapan
Macoma nasuta	Clam - Bent nose	SW	PCBs	1336-36-3	1.7	Growth	NOED	Ingestion	Whole Body	Adult	No difference in weight change.	1995	Boese, B.L., M. Winsor, H. Lee Li, S. Echols, J. Pelletier and R. Randall
Macoma nasuta	Clam - Bent nose	SW	PCBs	1336-36-3	1.7	Mortality	NOED	Ingestion	Whole Body	Adult	No Effect On Mortality	1995	Boese, B.L., M. Winsor, H. Lee Li, S. Echols, J. Pelletier and R. Randall
Salmo salar	Salmon - Atlantic	FW/SW	PCBs	1336-36-3	44	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality	1986	Carlberg, G.E., K. Martinsen, A. Kringstad, E. Gjessing, M. Grande, T. Kallqvist and J.U. Skare
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	8.1	Growth	ED19	Absorption	Whole Body	Immature	19% Reduction In Rate Of Shell Growth	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	33	Growth	ED41	Absorption	Whole Body	Immature	41% Reduction In Rate Of Shell Growth	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Penaeus duorarum	Shrimp - Pink	SW	PCBs	1336-36-3	3.9	Mortality	LD100	Absorption	Whole Body	Immature	100% Mortality In 48 Hours	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Penaeus duorarum	Shrimp - Pink	SW	PCBs	1336-36-3	16	Mortality	LD72	Absorption	Whole Body	Immature	72% Mortality in 20 days.	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.

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Penaeus duorarum	Shrimp - Pink	SW	PCBs	1336-36-3	1.3	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Lagodon rhomboides	Pinfish	SW	PCBs	1336-36-3	17	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 48 Hours	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Callinectes sapidus	Crab - Blue	SW	PCBs	1336-36-3	23	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 20 Days	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Crassostrea virginica	Eastern oyster	SW	PCBs	1336-36-3	33	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Survival In 96 Hours	1970	Duke, T.W., J.I. Lowe and A.J. Wilson, Jr.
Oncorhynchus kisutch	Salmon-coho	FW/SW	PCBs	1336-36-3	0.15	Mortality	LOED	Injection	Whole Body	Immature	Significant increase (6%) in mortality of smolts during seawater challenge. Residue is initial injection dose.	1982	Folmar, L.C., W.W. Dickhoff, W.S. Zaugg and H.O. Hodgins
Oncorhynchus kisutch	Salmon-coho	FW/SW	PCBs	1336-36-3	2.3	Growth	LOED	Ingestion	Whole Body	Juvenile	Significant increased rate of growth (weight gain).	1976	Gruger, E.H., T. Hurley and N.L. Karrick
Oncorhynchus kisutch	Salmon-coho	FW/SW	PCBs	1336-36-3	0.6	Growth	NOED	Ingestion	Whole Body	Juvenile	No Effect On Growth (weight gain)	1976	Gruger, E.H., T. Hurley and N.L. Karrick
Morone saxatilis	Striped Bass	SW	PCBs	1336-36-3	300	Reproduction	NOED	NS	Eggs	Adult	Effect: population between 1976-1997	2003	Barnthouse, LW, D Glaser, J Young
Fundulus heteroclitus	Mummichog	SW	PCBs	1336-36-3	2.4	Reproduction	NOED	Injection	Eggs	Adult	No effect: embryo hatching success, larval length, larval growh, or larval mortality. Field collected and depurated, then injected fish	1999	Elskus AA, E Morosson, AE McElroy, JJ Stegeman, DS Woltering
Fundulus heteroclitus	Mummichog	SW	PCBs	1336-36-3	14.9	Reproduction	NOED	Injection	Eggs	Adult	No effect: embryo hatching success, larval length, larval growh, or larval mortality. Field collected and depurated, then injected fish	1999	Elskus AA, E Morosson, AE McElroy, JJ Stegeman, DS Woltering
Fundulus heteroclitus	Mummichog	SW	PCBs	1336-36-3	2	Reproduction	NOED	Injection	Eggs	Adult	No effect: embryo hatching success, larval length, larval growh, or larval mortality. Field collected and analyzed.	1999	Elskus AA, E Morosson, AE McElroy, JJ Stegeman, DS Woltering
Micropterus salmoides	Largemouth Bass	FW	PCBs	1336-36-3	121	Mortality	NOED	Combined	Whole Body	Adult	Population effects - authors used 5 metrics to asssess population effect of PCBs: reproductive activity, relative abundance of YOY, YOY growth rate, adult growth rates, adult condition	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Micropterus salmoides	Largemouth Bass	FW	PCBs	1336-36-3	28	Mortality	NOED	Combined	Whole Body	Juvenile	Population effects - authors used 5 metrics to asssess population effect of PCBs: reproductive activity, relative abundance of YOY, YOY growth rate, adult growth rates, adult condition	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Morone saxatilis	Striped Bass	SW	PCBs	1336-36-3	1.8	Growth	NOED				Westin et al, 1983	1984	Dillon TM
Oncorhynchus mykiss	Trout - Rainbow	FW	PCBs	1336-36-3	1.6	Growth	LOED				Poels et al., 1980, Rhine River Water	1984	Dillon TM
Penaeus duorarum	Shrimp - Pink	SW	Aroclor 1254	11097-69-1	3.9	Mortality	LD100	Water	Whole Body	Juvenile		1970	Duke TW, JI Lowe, AJ Wilson, Jr.

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Lagodon rhomboides	Pinfish	SW	Aroclor 1254	11097-69-1	17	Mortality	NOED	Water	Whole Body	Juvenile		1970	Duke TW, Jl Lowe, AJ Wilson, Jr.
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	77.9	Mortality	LOED	Water	Eggs	Egg	22% Decrease in hatching of eggs. Parents exposed to 0.2 ppm Arochlor 1254 for 21 days.	1975	Freeman, H.C. and D.R. Idler
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	0.5	Mortality	NOED	Water	Eggs	Egg	92% of eggs hatched.. Egg residue below detection limit. Parents had muscle residue of 0.32 ppm.	1977	Hansen, D.J., Goodman, L.R., and A.J. Wilson Jr.
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1254	11097-69-1	8.2	Growth	NOED	Ingestion	Whole Body	Juvenile	No significant difference in total weight or in liver:body weight ratio.	1974	Lieb, A.J., D.D. Bills, and R.O. Sinnhuber.
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1254	11097-69-1	8.2	Mortality	NOED	Ingestion	Whole Body	Juvenile	No increase in mortality.	1974	Lieb, A.J., D.D. Bills, and R.O. Sinnhuber.
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	156	Growth	ED107	Combined	Whole Body	Larval	lenght increase additional 1 mg/kg PCB from food PCB without Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	202	Growth	ED112	Combined	Whole Body	Larval	weight increase additional 1 mg/kg PCB from food PCB with Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	206	Growth	ED113	Combined	Whole Body	Larval	lenght increase additional 1 mg/kg PCB from food PCB with Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	156	Growth	ED129	Combined	Whole Body	Larval	weight increase additional 1 mg/kg PCB from food PCB without Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	202	Growth	LOED	Combined	Whole Body	Larval	weight increase additional 1 mg/kg PCB from food PCBs with Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	182	Growth	NOED	Combined	Whole Body	Larval	weight additional 1 mg/kg PCB from food PCBs without Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	182	Growth	NOED	Combined	Whole Body	Larval	length additional 1 mg/kg PCB from food PCBs without Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	202	Growth	NOED	Combined	Whole Body	Larval	length additional 1 mg/kg PCB from food PCBs with Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	156	Mortality	NOED	Combined	Whole Body	Larval	Additional 1 mg/kg PCB from food PCB with Acetone	1981	Mac MJ, JC Seelye
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	206	Mortality	NOED	Combined	Whole Body	Larval	Additional 1 mg/kg PCB from food PCB without Acetone	1981	Mac MJ, JC Seelye
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	419	Mortality	LD100	Absorption	Whole Body	Embryo	100% Mortality in 127 days. Residue measured at 48 days after hatch.	1978	Mauck, W.L., P.M. Mehrle, and F.L. Mayer.
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	284	Mortality	LD50	Absorption	Whole Body	Embryo	50% Mortality.	1978	Mauck, W.L., P.M. Mehrle, and F.L. Mayer.
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	125	Mortality	LOED	Absorption	Whole Body	Embryo	18% Increase in mortality.	1978	Mauck, W.L., P.M. Mehrle, and F.L. Mayer.
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	31	Growth	NOED	Absorption	Whole Body	Embryo	No significant difference in weight gain throughout development.	1978	Mauck, W.L., P.M. Mehrle, and F.L. Mayer.
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	71	Mortality	NOED	Absorption	Whole Body	Embryo	No significant increase in mortality.	1978	Mauck, W.L., P.M. Mehrle, and F.L. Mayer.

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	1.53	Mortality	LOED	Combined	Whole Body	Fry	Significant increase in mortality. Exposure to 20.8 ng/L in water and 1.05 ug/g in diet.	1981	Berlin, W.H., R.J. Hesselberg, and M.J. Mac
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	26.3	Growth	NOED	Combined	Whole Body	Fry	No significant difference in weight gain. Exposure to 327 ng/L in water and 22.6 ug/g in diet.	1981	Berlin, W.H., R.J. Hesselberg, and M.J. Mac
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1254	11097-69-1	81	Growth	NOED	Ingestion	Whole Body	Juvenile		1975	Nestel H, Budd J
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1254	11097-69-1	81	Mortality	NOED	Ingestion	Whole Body	Juvenile		1975	Nestel H, Budd J
Oncorhynchus mykiss	Trout - Rainbow	FW	Aroclor 1254	11097-69-1	81	Mortality	NOED	Ingestion	Whole Body	Juvenile		1975	Nestel H, Budd J
Palaemonetes pugio	Shrimp - Grass	SW	Aroclor 1254	11097-69-1	65	Mortality	LD60	Absorption	Whole Body	NA	60% Mortality in 7 days.	1974	Nimmo, D.R., J. Forester, P.T. Heitmuller, and G.H. Cook.
Palaemonetes pugio	Shrimp - Grass	SW	Aroclor 1254	11097-69-1	27	Mortality	LOED	Absorption	Whole Body	NA	45% Increase in mortality in 16 days.	1974	Nimmo, D.R., J. Forester, P.T. Heitmuller, and G.H. Cook.
Palaemonetes pugio	Shrimp - Grass	SW	Aroclor 1254	11097-69-1	0.42	Mortality	NOED	Absorption	Whole Body	NA	No significant increase in mortality in 90 days in field	1974	Nimmo, D.R., J. Forester, P.T. Heitmuller, and G.H. Cook.
Palaemonetes pugio	Shrimp - Grass	SW	Aroclor 1254	11097-69-1	5.4	Mortality	NOED	Absorption	Whole Body	NA	No significant increase in mortality in 7 days.	1974	Nimmo, D.R., J. Forester, P.T. Heitmuller, and G.H. Cook.
Palaemonetes pugio	Shrimp - Grass	SW	Aroclor 1254	11097-69-1	16.5	Mortality	NOED	Absorption	Whole Body	NA	No significant increase in mortality in 35 days.	1974	Nimmo, D.R., J. Forester, P.T. Heitmuller, and G.H. Cook.
Palaemonetes pugio	Shrimp - Grass	SW	Aroclor 1254	11097-69-1	18	Mortality	NOED	Absorption	Whole Body	NA	No significant increase in mortality in 16 days.	1974	Nimmo, D.R., J. Forester, P.T. Heitmuller, and G.H. Cook.
Brachydanio rerio	Zebra Fish	FW	Aroclor 1254	11097-69-1	4240	Mortality	LD82	Water	Whole Body	NS		1989	Bouraly M, RJ Millischer.
Brachydanio rerio	Zebra Fish	FW	Aroclor 1254	11097-69-1	4240	Growth	NOED	Water	Whole Body	NS	Weight	1989	Bouraly M, RJ Millischer.
Orconectes nais	Crayfish	FW	Aroclor 1254	11097-69-1	0.04	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Corydalus cornutus	Midge	FW	Aroclor 1254	11097-69-1	1.02	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Chaoborus punctipennis	Midge	FW	Aroclor 1254	11097-69-1	1.2	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Pteronarcys dorsata	Giant Black Stonefly	FW	Aroclor 1254	11097-69-1	1.4	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Palaemonetes kadiakensis	Shrimp - Grass	FW	Aroclor 1254	11097-69-1	3.2	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Culex tarsalis	Mosquito	FW	Aroclor 1254	11097-69-1	5.4	Mortality	NOED	Combined	Whole Body	Immature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Gammarus pseudolimnaeus	Amphipod	FW	Aroclor 1254	11097-69-1	7.8	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.
Daphnia magna	Water flea	FW	Aroclor 1254	11097-69-1	10.4	Mortality	NOED	Combined	Whole Body	Mature	Radiolabeled Compound	1972	Sanders, H.O., Chandler, J.H.

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	956.44	Mortality	LOED	Water	Whole Body	Larval		2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	956.44	Mortality	LD27	Water	Whole Body	Larval		2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	1660.28	Mortality	LD83	Water	Whole Body	Larval		2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	4163.84	Mortality	LD96	Water	Whole Body	Larval		2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	114.09	Mortality	NOED	Water	Whole Body	Larval		2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	114.09	Growth	LOED	Water	Whole Body	Larval	Body size	2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Xenopus laevis	African Clawed Frog	FW	Aroclor 1254	11097-69-1	956.44	Growth	LOED	Water	Whole Body	Larval	Tail Size	2003	Fisher, M.A., A.M. Jelaso, A. Predenkiewicz, L. Schuster, J. Means, C.F. Ide
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	60	Mortality	NOED	Ingestion	Whole Body	Juvenile	Initial LD50 test at 3, 10.7, 40, 107, 400 & 800 mg/kg bw. No mortality; LD50 couln't be calculated. Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.16	Growth	NOED	Ingestion	Whole Body	Juvenile	Innate disease response. NOED growth - length or weight.Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.95	Growth	NOED	Ingestion	Whole Body	Juvenile	Innate disease response. NOED Condition factor (k).Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.98	Mortality	NOED	Ingestion	Whole Body	Juvenile	Bacterial challenge. Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.16	Growth	NOED	Ingestion	Whole Body	Juvenile	Vaccinated bacterial challenge. NOED growth (Length, weight)Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen

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Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.74	Growth	NOED	Ingestion	Whole Body	Juvenile	Vaccinated bacterial challenge. NOED condition factor. Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.95	Growth	NOED	Ingestion	Whole Body	Juvenile	Challenge #2: Aquired disease resistence. NOED growth (weight, length) Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	Aroclor 1254	11097-69-1	0.95	Growth	NOED	Ingestion	Whole Body	Juvenile	Challenge #2: Aquired disease resistence. NOED growth condition factor [k]. Testing conditions mimic field conditions of out-migration through Duwamish waterway through Puget Sound	2003	Powell DB, RC Palm Jr. A Skillman, K Godtfredsen
Anas platyrhynchos	Mallard	FW	Aroclor 1254	11097-69-1	23.3	Mortality	NOED	NS	Eggs	Egg	Barron et al. 1995	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Oncorhynchus kisutch	Salmon-coho	FW/SW	Aroclor 1254	11097-69-1	645	Mortality	LOED				Mayer et al 1977 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Pimephales promelas	Fathead minnow	FW	Aroclor 1254	11097-69-1	429	Mortality	LOED				decrease in spawning Nebeker et al 1974 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Pimephales promelas	Fathead minnow	FW	Aroclor 1254	11097-69-1	105	Mortality	NOED				decrease in spawning Nebeker et al 1974 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Oncorhynchus kisutch	Salmon-coho	FW/SW	Aroclor 1254	11097-69-1	54	Mortality	NOED				Mayer et al 1977 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Cyprinodon variegatus	Sheepshead minnow	SW	Aroclor 1254	11097-69-1	5.4	Mortality	NOED		Eggs		decrease in egg survival Hansen et al 1973 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Cyprinodon variegatus	Sheepshead minnow	SW	Aroclor 1254	11097-69-1	7	Mortality	LOED		Eggs		decrease in egg survival Hansen et al 1973 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	125	Mortality	LOED			Fry	decrease in survival Nebeker et al 1974 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins

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Salvelinus fontinalis	Trout - Brook	FW	Aroclor 1254	11097-69-1	71	Mortality	NOED			Fry	decrease in survival Nebeker et al 1974 Use literature and field measurements to assess population effects	2004	Reiser DW, ES Greenberg, TE Helser, M Branton, KD Jenkins
Salvelinus namaycush	Trout -Lake	FW	Aroclor 1254	11097-69-1	26.3	Growth	NOED				Anonymous, 1981	1984	Dillon TM
Salmonidae sp.		FW/SW	Aroclor 1254	11097-69-1	2.4	Growth	LOED				Mac and Seelye, 1981, Increased	1984	Dillon TM
Salmo salar	Salmon - Atlantic	FW/SW	Aroclor 1254	11097-69-1	0.42	Reproduction	NOED		Eggs		Zitko and Sanders, 1979, hatching success	1984	Dillon TM
Poecilia reticulata	Guppy	FW	PCB 197	33091-17-7	2.6	Mortality	LD22	Ingestion	Whole Body	Adult		1988	Opperhuizen A, SM Schrap
Poecilia reticulata	Guppy	FW	PCB 133	35694-04-3	2.6	Mortality	LD22	Ingestion	Whole Body	Adult		1988	Opperhuizen A, SM Schrap
Pimephales promelas	Fathead minnow	FW	PCB 153	35065-27-1	1120	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 153	35065-27-1	1120	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 153	35065-27-1	1120	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 153	35065-27-1	10940	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 153	35065-27-1	10940	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 153	35065-27-1	10940	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 153	35065-27-1		Mortality	LD50	Injection	Whole Body	Fry	MC, EL Strain LC50 >6970	1991	Walker MK and RE Peterson
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	PCB 153	35065-27-1	3.6	Mortality	LD100	Water	Whole Body	Larval		1979	Broyles RH, MI Noveck
Salvelinus namaycush	Trout -Lake	FW	PCB 153	35065-27-1	7.6	Mortality	LD91	Water	Whole Body	Larval		1979	Broyles RH, MI Noveck
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	205.7	Mortality	LD50	Ingestion	Whole Body	Larval		2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	267.05	Mortality	LD56	Ingestion	Whole Body	Larval		2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	404.19	Mortality	LD78	Ingestion	Whole Body	Larval		2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	483.58	Mortality	LD88	Ingestion	Whole Body	Larval		2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	5.774	Reproduction	LOED	Ingestion	Whole Body	Larval	Number of eggs 2nd to pupa exposure. 22 days was the term of the longest exposure/ developmental time.	2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	10.105	Reproduction	LOED	Ingestion	Whole Body	Larval	Number of eggs 2nd to adult exposure. 27 days was the term of the longest exposure/ developmental time for females.	2001	Hwang, H., S.W. Fisher, P.F. Landrum

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Chironomus riparius	Midge	FW	PCB 153	35065-27-1	111.87	Reproduction	LOED	Ingestion	Whole Body	Larval	number of eggs (2) 2nd to adult exposure. 27 days was the term of the longest exposure/ developmental time.	2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	38.3	Growth	NOED	Ingestion	Whole Body	Larval	Weight- Female 2nd to pupa exposure. 22 days was the term of the longest exposure/ developmental time.	2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	38.3	Growth	ED13	Ingestion	Whole Body	Larval	Number of ova 2nd to pupa exposure. 22 days was the term of the longest exposure/ developmental time.	2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	90.2	Growth	ED25	Ingestion	Whole Body	Larval	Number of ova 2nd to adult exposure. 27days was the term of the longest exposure/ developmental time.	2001	Hwang, H., S.W. Fisher, P.F. Landrum
Chironomus riparius	Midge	FW	PCB 153	35065-27-1	90.2	Growth	NOED	Ingestion	Whole Body	Larval	Weight 2nd to adult exposure. 27days was the term of the longest exposure/ developmental time.	2001	Hwang, H., S.W. Fisher, P.F. Landrum
Lumbriculus variegatus	Oligochaete	FW	PCB 153	35065-27-1	126.31	Mortality	LD38	Ingestion	Whole Body	Adult		1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	PCB 153	35065-27-1	126.31	Mortality	ED23	Ingestion	Whole Body	Adult	Mean decrease in Biomass	1999	Fisher SW, SW Chordas III, PF Landrum
Salvelinus namaycush	Trout -Lake	FW	2,4,6,2`-tetrachlorobiphenyl	62796-65-0	8.8	Mortality	LD17	Combined	Whole Body	Fry		1979	Broyles, R.H. and M.I. Noveck
Oncorhynchus tshawytscha	Salmon - Chinook	FW/SW	2,4,6,2`-tetrachlorobiphenyl	62796-65-0	3.7	Mortality	LD28	Combined	Whole Body	Fry		1979	Broyles, R.H. and M.I. Noveck
Salvelinus namaycush	Trout -Lake	FW	2,4,6,2`-tetrachlorobiphenyl	62796-65-0	9.2	Mortality	LD50	Combined	Whole Body	Fry		1979	Broyles, R.H. and M.I. Noveck
Salvelinus namaycush	Trout -Lake	FW	2,4,6,2`-tetrachlorobiphenyl	62796-65-0	8.6	Mortality	LD74	Combined	Whole Body	Fry		1979	Broyles, R.H. and M.I. Noveck
Salvelinus namaycush	Trout -Lake	FW	2,4,6,2`-tetrachlorobiphenyl	62796-65-0	8.4	Mortality	LD87	Combined	Whole Body	Fry		1979	Broyles, R.H. and M.I. Noveck
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	1115	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 101	37680-73-2	4690	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 126	57465-28-8	0.074	Mortality	LD50	Injection	Whole Body	Fry	AR Strain	1991	Walker MK and RE Peterson
Salvelinus namaycush	Trout -Lake	FW	PCB 126	57465-28-8	#######	Mortality	LD50	Water	Whole Body	Embryo	Congener combination of PCB 126 and 2,3,7,8-TCDD. LD50 based on total TEC.	1995	Zabel EW, PM Cook, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	PCB 126	57465-28-8	0.029	Mortality	LD50	Water	Whole Body	Embryo		1995	Zabel EW, PM Cook, RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 126	57465-28-8	2	Mortality	NOED	Injection	Whole Body	NA	Internal Dose Used As Tissue Concentration; No Mortality At 72 H At Highest Test Dose	1991	Janz, D.M. and C.D. Metcalfe
Asterias rubens	Starfish	SW	PCB 126	57465-28-8	3.26	Mortality	NOED	Injection	Whole Body	Adult	No effect on mortality.	1993	Den Besten, P.J., P. Lemaire, D.R. Livingstone, B. Woodin, J.J. Stegeman, H.J. Herwin and W. Seinen
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 77	32598-13-3	0.6	Mortality	LD100	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 77	32598-13-3	0.08	Mortality	LD15	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 77	32598-13-3		Mortality	LD50	Injection	Whole Body	Fry	MC, EL Strain LC50 >6970	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 77	32598-13-3	1.348	Mortality	LD50	Injection	Whole Body	Fry	ER Strain	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 77	32598-13-3	0.2	Mortality	LD65	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	PCB 77	32598-13-3	2	Mortality	NOED	Injection	Whole Body	NA	Internal Dose Used As Tissue Concentration; No Mortality At 72 H At Highest Test Dose	1991	Janz, D.M. and C.D. Metcalfe

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

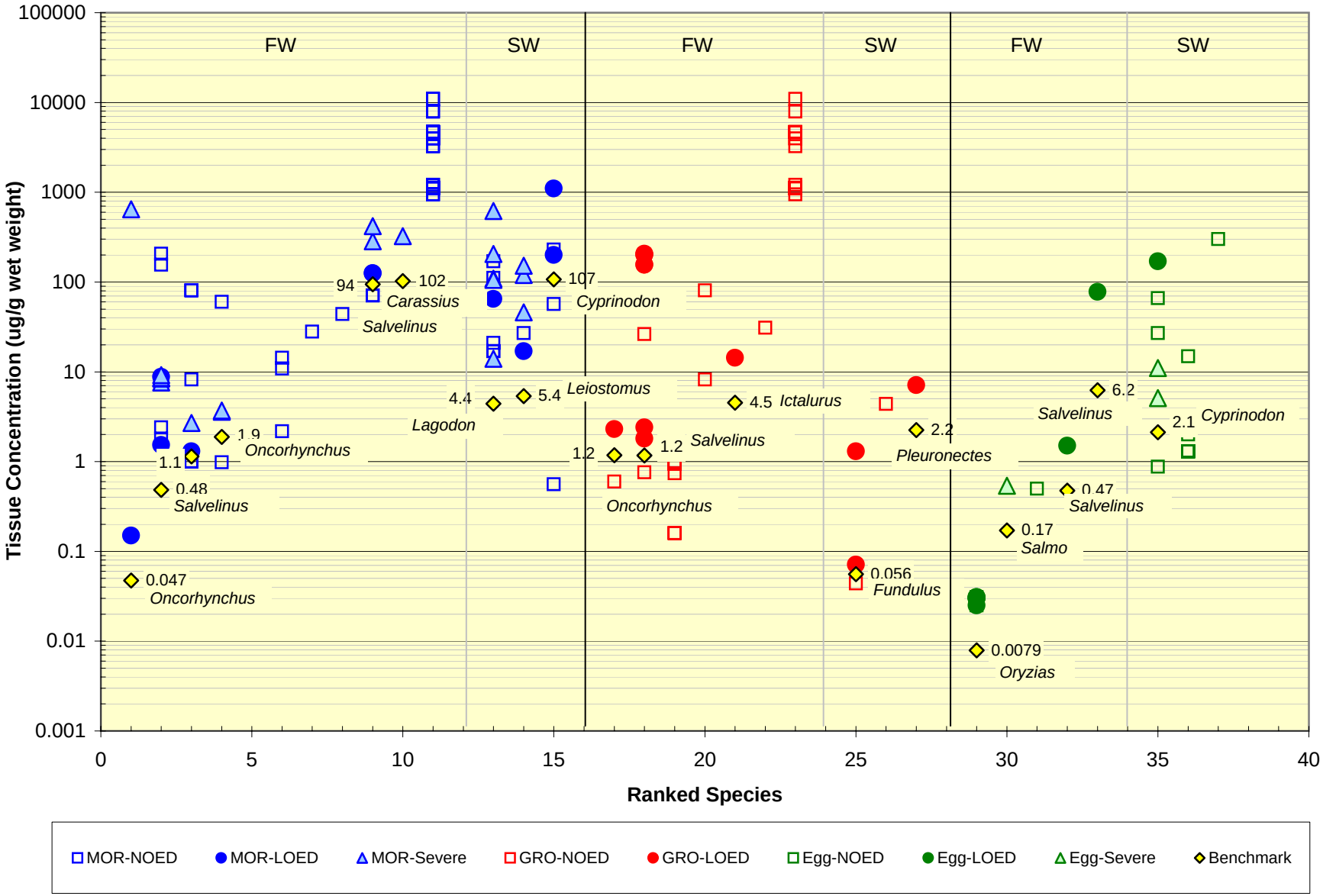
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Thymallus arcticus	Arctic Grayling	FW	PCB 77	32598-13-3	1.68	Growth	NOED	Ingestion	Whole Body	Juvenile	Length	2001	Palace, V.P., S.M. Allen-Gil, S.B. Brown, R.E. Evans, D.A. Metner, D.H. Landers, L.R. Curtis, J.F. Klaverkamp, C.L. Baron, W. L. Lockhart
Lumbriculus variegatus	Oligochaete	FW	PCB 77	32598-13-3	25.4	Reproduction	NOED	Ingestion	Whole Body	Adult	test conducted at 22 degrees C	2004	Landrum PF; M Leppanen, SD Robinson, DC Gossiaux, GA Burton, M Greenberg, JVK Kukkonen, BJ Eadie, MB Lansing
Lumbriculus variegatus	Oligochaete	FW	PCB 77	32598-13-3	27.4	Reproduction	NOED	Ingestion	Whole Body	Adult	test conducted at 10 degrees C	2004	Landrum PF; M Leppanen, SD Robinson, DC Gossiaux, GA Burton, M Greenberg, JVK Kukkonen, BJ Eadie, MB Lansing
Pimephales promelas	Fathead minnow	FW	PCB 180	35065-29-3	1210	Reproduction	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 180	35065-29-3	1210	Growth	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 180	35065-29-3	1210	Mortality	NOED	Water	Whole Body	Juvenile	PreSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 180	35065-29-3	7920	Reproduction	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 180	35065-29-3	7920	Growth	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Pimephales promelas	Fathead minnow	FW	PCB 180	35065-29-3	7920	Mortality	NOED	Water	Whole Body	Juvenile	PostSpawn	1997	Suedel BC, T Dillon, WH Benson
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	14	Reproduction	NOED	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	15	Mortality	NOED	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight,	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	15	Growth	NOED	Ingestion	Whole Body	Adult	Resd measurement basis not given, assumed to be wet weight,	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	1.3	Mortality	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, endpoint is fertilization success of F1 eggs, P1 exposed, tissue concentration is F1 eggs	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	1.3	Mortality	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, endpoint is larval survival of F1 eggs, P1 exposed, tissue concentration is F1 eggs	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	0.044	Growth	ED149	Ingestion	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is juvenile weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan

Table C-17. Summary of Aquatic Organism Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	0.071	Growth	ED126	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is juvenile weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	1.3	Growth	ED126	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is juvenile weight	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	1.3	Reproduction	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is fecundity	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	1.3	Reproduction	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is F2 hatch success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Fundulus heteroclitus	Mummichog	SW	Aroclor 1268	11100-14-4	1.3	Reproduction	NOED	NA	Eggs	Egg	Resd measurement basis not given, assumed to be wet weight, Exposure in food of F0 generation, effects on F1 generation, tissue concentration for F1 eggs, effect is F2 larval success	2001	Matta MB, J Linse, C Cairncross, L Francendese, RM Kocan
Lumbriculus variegatus	Oligochaete	FW	PCB 1	2051-60-7	64.71	Growth	ED23	Ingestion	Whole Body	Adult	Mean decrease in Biomass %	1999	Fisher SW, SW Chordas III, PF Landrum
Lumbriculus variegatus	Oligochaete	FW	PCB 1	2051-60-7	64.71	Mortality	LD23	Ingestion	Whole Body	Adult		1999	Fisher SW, SW Chordas III, PF Landrum

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-29. Summary of PCB Concentrations in Freshwater and Saltwater Fish Early Life Stage Tissue Associated with Toxicity



2/3/2006

Chart C-30. Summary of PCB Concentrations in Freshwater and Saltwater Aquatic Invertebrate Tissue Associated with Toxicity

2/3/2006

Table C-18. Summary of Avian Egg Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Anas platyrhynchos	Mallard	FW	Aroclor 1242 or PCB 1242	53469-21-9	23.3	Reproduction	NOED	Ingestion	Eggs	Adult	Hens exposed in diet (Custer and Heinz, 1980)	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Anas platyrhynchos	Mallard	FW	Aroclor 1242 or PCB 1242	53469-21-9	105	Reproduction	NOED	Ingestion	Eggs	Adult	Eggshell thickness decreased, hatching success not affected (Haseltine and Prouty, 1980)	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Pelecanus occidentalis	Brown pelican	SW	PCBs	1336-36-3	7.94	Reproduction	NOED	Combined	Eggs	Egg	Hatching Success- PCBs are Aroclor 1260 and similar PCBs	1974	Blus LJ, BS Neely, Jr., AA Belisle, RM Prouty
Pandion haliaetus	Osprey	FW	PCBs	1336-36-3	3.29	Reproduction	NOED	NS	Eggs	Egg	Eggshell Thickness	2001	Clark, K.E., W. Stansley, L.J. Niles
Ardea herodias	Great Blue Heron	FW	PCBs	1336-36-3	13	Reproduction	NOED	NS	Eggs	Egg	secondary source: Fitzner et al 1988	2003	Harris, ML, JE Elliiott, RW Butler, LK Wilson
Ardea herodias	Great Blue Heron	FW	PCBs	1336-36-3	33	Reproduction	NOED	NS	Eggs	Egg	secondary source: Thomas and Anthony 1999	2003	Harris, ML, JE Elliiott, RW Butler, LK Wilson
Gallus domesticus	Chicken	FW	PCBs	1336-36-3	0.36	Reproduction	NOED	NS	Eggs	Egg	Barron et al. 1995	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Ardea herodias	Great Blue Heron	FW	PCBs	1336-36-3	0.25	Reproduction	NOED	NS	Eggs	Egg	Mora MA,1996	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Egretta thula	Snowy egret	FW	PCBs	1336-36-3	0.07	Reproduction	NOED	NS	Eggs	Egg	Mora MA,1996	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Haliaeetus leucocephalus	Bald eagle	SW	PCBs	1336-36-3	4	Reproduction	NOED	NS	Eggs	Egg	Giesy et al 1995	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Nycticorax nycticorax	Blact-crowned night-heron	FW	PCBs	1336-36-3	10.9	Reproduction	ED	NS	Eggs	Egg	Field population Barron et al. 1995	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Pandion haliaetus	Osprey	FW	PCBs	1336-36-3	1.65	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	PCBs	1336-36-3	3.505	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	PCBs	1336-36-3	3.702	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	PCBs	1336-36-3	4.528	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Pandion haliaetus	Osprey	FW	PCBs	1336-36-3	7.089	Reproduction	NOED	Combined	Eggs	Egg		2003	Martin PA, S.R de Solla, P Ewins
Tachycineta bicolor	Tree swallow	FW	PCBs	1336-36-3	20	Reproduction	LOED	Ingestion	Eggs	Adult	Hatching success Varible reps	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Tachycineta bicolor	Tree swallow	FW	PCBs	1336-36-3	1.9	Reproduction	NOED	Ingestion	Eggs	Adult	hatching success Custer et al 1998	2003	Custer CM, TW Custer, PM Dummer, KL Munney

Table C-18. Summary of Avian Egg Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Tachycineta bicolor	Tree swallow	FW	PCBs	1336-36-3	3.3	Reproduction	NOED	Ingestion	Eggs	Adult	hatching success Custer et al 1998	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Tachycineta bicolor	Tree swallow	FW	PCBs	1336-36-3	0.9	Reproduction	NOED	Ingestion	Eggs	Adult	hatching success Bishop et al 1999	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Tachycineta bicolor	Tree swallow	FW	PCBs	1336-36-3	11.2	Reproduction	NOED	Ingestion	Eggs	Adult	hatching success Bishop et al 1999	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Tachycineta bicolor	Tree swallow	FW	PCBs	1336-36-3	50	Reproduction	LOED	Ingestion	Eggs	Adult	Hatching success Varible reps	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Cinclus cinclus	Dipper	SW	PCBs	1336-36-3	0.1	Reproduction	NOED	Ingestion	Eggs	Adult	hatching success Ormerod et al 2000	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Larus argentatus	Herring gull	SW	PCBs	1336-36-3	96	Reproduction	NOED	Injected	Eggs	Egg	hatching success Gilman et al 1978	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Cinclus cinclus	Dipper	SW	PCBs	1336-36-3	0.5	Reproduction	NOED	Ingestion	Eggs	Adult	hatching success Ormerod et al 2000	2003	Custer CM, TW Custer, PM Dummer, KL Munney
Sterna hirundo	Common tern	SW	PCBs	1336-36-3	75.1	Reproduction	ED75	Combined	Eggs	Juvenile	Authors caution that there was no significant correlation between contaminant burden in eggs and abnormal gonad histology slides	2003	Hart CA, ICT Nisbet, SW Kennedy, ME Hahn
Anas platyrhynchos	Mallard	FW	Aroclor 1254	11097-69-1	23.3	Reproduction	NOED	NS	Eggs	Egg	Barron et al. 1995	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Gallus domesticus	Chicken	FW	PCBs	1336-36-3	0.36	Reproduction	NOED	NS	Eggs	Egg	Barron et al. 1995	2003	Connell DW, CN Fung, TB Minh, S Tanabe, PKS Lam, BSF Wong, MHW Lam, LC Wong, RSS Wu, BJ Richardson
Gallus domesticus	Chicken	FW	Aroclor 1254	11097-69-1	5	Reproduction	LOED	Ingestion	Eggs	Adult	Hatching reduced; laying hens fed up to 50 ppm in diet (Platonow and Reinhart, 1973)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Gallus domesticus	Chicken	FW	Aroclor 1254	11097-69-1	13.2	Reproduction	NOED	Ingestion	Eggs	Adult	Did not affect hatching; laying hens fed up to 20 ppm in diet (Cecil et al., 1972)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Gallus domesticus	Chicken (white Leghorn)	FW	Aroclor 1254	11097-69-1	4	Reproduction	LOED	Ingestion	Eggs	Adult	Embryo mortality and teratogenic; laying hens exposed to 50 ppm in drinking water (Tumasonis et al.,	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue
Gallus domesticus	Chicken (white Leghorn)	FW	Aroclor 1242	53469-21-9	1	Reproduction	LOED	Ingestion	Eggs	Adult	Decreased hatching; laying hens fed up to 80 ppm in diet (Britton and Huston, 1973)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Gallus domesticus	Chicken (white Leghorn)	FW	Aroclor 1242	53469-21-9	10	Reproduction	ED64	Injection	Eggs	Egg	Embryonic mortality of 64%; injected into air cell of eggs (Blazak and Marcum, 1975)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations

Table C-18. Summary of Avian Egg Tissue Residue Effects Data from ERED Database - PCBs

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Gallus domesticus	Chicken	FW	Aroclor 1248	12672-29-6	23	Reproduction	LOED	Ingestion	Eggs	Adult	Decreased hatching; laying hens fed up to 10 ppm in diet (Scott, 1977)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Gallus domesticus	Chicken (white Leghorn)	FW	Aroclor 1248	12672-29-6	5	Reproduction	LOED	Injection	Eggs	Egg	Hatching reduced by 17%; injected into yolk sac (Brunstrom and Orberg, 1982)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Streptopelia risoria	Ringed turtle dove	FW	Aroclor 1254	11097-69-1	16	Reproduction	LD50	Ingestion	Eggs	Adult	Embryonic mortality of 50%, hens fed in diet (Peakall and Peakall, 1973)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Otus asio	Screech owl	FW	Aroclor 1248	12672-29-6	18	Reproduction	NOED	Ingestion	Eggs	Adult	In diet at 3ppm wet weight (McLane and Hughes, 1980)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations
Fratercula arctica	Atlantic puffin	FW	Aroclor 1254	11097-69-1	81	Reproduction	NOED	Implantation	Eggs	Adult	Dosed by implantation of 30-35 mg (Harris and Osborn, 1981)	1996	Beyer, WN, GH Heinz, and AW Redmon Norwood; Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations

a FW = freshwater; SW= saltwater
b Wet weight concentration
c EDx or LDx= Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-31. Summary of PCB Concentrations in Avian Egg Tissue Associated with Embryotoxicity

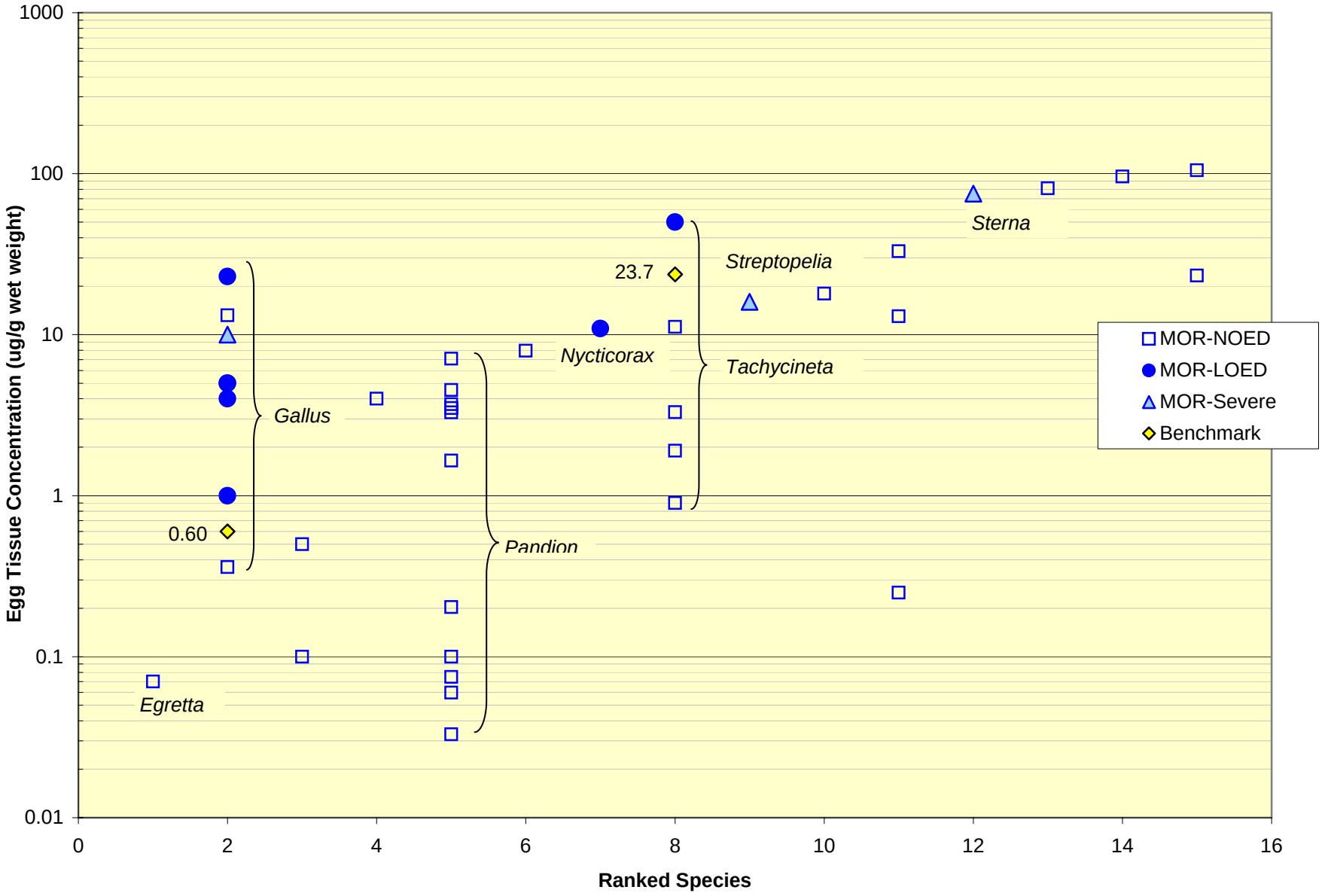


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Table C-19. Summary of Aquatic Organism Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus nerka	Sockeye salmon	FW/SW	2,3,7,8-TCDD	1746-01-6	3.00E-13	Mortality	LD05	NS	Eggs	Egg	Wright et al 1999	2004	Debruyn AM; MG Ikonomou; FAPC Gobas
Oncorhynchus nerka	Sockeye salmon	FW/SW	2,3,7,8-TCDD	1746-01-6	3.00E-12	Mortality	LD05	NS	Eggs	Egg	Giesy 2002 59:39-	2004	Debruyn AM; MG Ikonomou; FAPC Gobas
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.52E-03	Mortality	ED50	Combined	Whole Body	Immature	Exp Conc Is The Mean of Measured Tcdd Conc	1988	Mehrle, P.M., D.R. Buckler, E.E. Little, L.M. Smith, J.D. Petty, P.H. Peterman, D.L. Stalling, G.M. DeGraeve, J.J. Coyle and W.J. Adam
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.38E+00	Growth	LOED	Ingestion	Whole Body	Juvenile	Weight loss.	1977	Hawkes, C.L. and L.A. Norris.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.38E+00	Morphology	LOED	Ingestion	Whole Body	Juvenile	Fin erosion, fungal growths on caudal fin.	1977	Hawkes, C.L. and L.A. Norris.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.38E+00	Mortality	LOED	Ingestion	Whole Body	Juvenile	Over 90% mortality.	1977	Hawkes, C.L. and L.A. Norris.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.60E-03	Growth	NOED	Ingestion	Whole Body	Juvenile	No difference in growth (weight).	1977	Hawkes, C.L. and L.A. Norris.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.60E-03	Morphology	NOED	Ingestion	Whole Body	Juvenile	No evidence of fin erosion or fungal growth.	1977	Hawkes, C.L. and L.A. Norris.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.60E-03	Mortality	NOED	Ingestion	Whole Body	Juvenile	No increase in mortality.	1977	Hawkes, C.L. and L.A. Norris.
Gambusia affinis	Mosquito fish	FW	2,3,7,8-TCDD	1746-01-6	6.70E-03	Mortality	LD100	Combined	Whole Body	Adult	Mesocosm study. Sediment treated with TCDD. Exposure concentration measured in water.	1978	Isensee, A.R.
Physa sp.	Snail	FW	2,3,7,8-TCDD	1746-01-6	9.70E-02	Mortality	NOED	Combined	Whole Body	Adult	Mesocosm study. Sediment treated with TCDD. Exposure concentration measured in water.	1978	Isensee, A.R.
Daphnia magna	Water flea	FW	2,3,7,8-TCDD	1746-01-6	1.70E-01	Mortality	NOED	Combined	Whole Body	Adult	Mesocosm study. Sediment treated with TCDD. Exposure concentration measured in water.	1978	Isensee, A.R.
Lemna minor	Least Duckweed	FW	2,3,7,8-TCDD	1746-01-6	1.20E-02	Mortality	NOED	Absorption	Whole Body	NS		1975	Isensee AR, GE Jones
Daphnia magna	Water flea	FW	2,3,7,8-TCDD	1746-01-6	6.00E-02	Mortality	NOED	Absorption	Whole Body	NS		1975	Isensee AR, GE Jones
Ictalurus punctatus	Catfish-Channel	FW	2,3,7,8-TCDD	1746-01-6	1.90E-01	Mortality	NOED	Absorption	Whole Body	Juvenile		1975	Isensee AR, GE Jones
Gambusia affinis	Mosquito fish	FW	2,3,7,8-TCDD	1746-01-6	9.00E-01	Mortality	NOED	Absorption	Whole Body	NS		1975	Isensee AR, GE Jones
Oedogonium cardiacum	Algae - Green	FW	2,3,7,8-TCDD	1746-01-6	9.80E-01	Mortality	NOED	Absorption	Whole Body	NS		1975	Isensee AR, GE Jones
Physa sp.	Snail	FW	2,3,7,8-TCDD	1746-01-6	1.02E+00	Mortality	NOED	Absorption	Whole Body	NS		1975	Isensee AR, GE Jones
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.50E-01	Growth	NOED	Ingestion	Whole Body	Juvenile		1986	Kleeman JM, JR Olson, SM Chen, RE Peterson

Table C-19. Summary of Aquatic Organism Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.00E-05	Growth	ED13	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	5.00E-05	Growth	ED13	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.10E-04	Growth	ED20	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	8.70E-04	Growth	ED26	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.00E-05	Growth	ED27	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.10E-04	Growth	ED51	Water	Whole Body	Larval	measured at end of depuration period (56d)	1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	6.80E-04	Mortality	LD29	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.40E-04	Mortality	LD33	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.42E-03	Mortality	LD43	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.40E-04	Mortality	LD47	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	8.70E-04	Mortality	LD71	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	8.60E-04	Mortality	LD73	Water	Whole Body	Larval		1988	Mehrle PM, DR Buckler, EE Little, LM Smith, JD Petty, PH Peterman, DL Stalling, GM DeGraeve, JJ Coyle, and WJ Adams

Table C-19. Summary of Aquatic Organism Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	4.78E-03	Growth	ED60	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	4.78E-03	Growth	ED65	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.17E+00	Growth	ED84	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.17E+00	Growth	ED93	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	4.78E-03	Mortality	LD15	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	4.78E-03	Mortality	LD16	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.17E+00	Mortality	LD46	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.10E-03	Growth	NOED	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.10E-03	Mortality	NOED	Water	Whole Body	Juvenile		1979	Miller RA, LA Norris and BR Loper
Fundulus heteroclitus	Mummichog	SW	2,3,7,8-TCDD	1746-01-6	2.00E-03	Development	ED50	Absorption	Whole Body	Embryo	50% of embryos showed pericardial edema, hemorrhage in various regions of embryo. Calculated ED50.	1995	Prince, R. and K.R. Cooper
Fundulus heteroclitus	Mummichog	SW	2,3,7,8-TCDD	1746-01-6	6.80E-03	Mortality	LD100	Absorption	Whole Body	Embryo	Failure of eggs to hatch.	1995	Prince, R. and K.R. Cooper
Fundulus heteroclitus	Mummichog	SW	2,3,7,8-TCDD	1746-01-6	2.25E-03	Mortality	LD75	Absorption	Whole Body	Embryo	75% Decrease in hatchability.	1995	Prince, R. and K.R. Cooper
Fundulus heteroclitus	Mummichog	SW	2,3,7,8-TCDD	1746-01-6	6.35E-04	Development	LOED	Absorption	Whole Body	Embryo	Pericardial edema, hemorrhage in various regions of embryo.	1995	Prince, R. and K.R. Cooper
Fundulus heteroclitus	Mummichog	SW	2,3,7,8-TCDD	1746-01-6	6.35E-04	Mortality	LOED	Absorption	Whole Body	Embryo	28% Decrease in hatchability.	1995	Prince, R. and K.R. Cooper
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-05	Mortality	LD02	Water	Whole Body	Egg	Hatching Mortality	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-05	Mortality	LD02	Water	Whole Body	Egg	Hatching Mortality	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-05	Mortality	LD03	Water	Whole Body	Egg	Sac Fry Mortality	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-05	Mortality	LD05	Water	Whole Body	Egg	Cumulative percent mortality equaled 22.5% - Control cumulative mortality was 18%.	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-03	Mortality	LD09	Water	Whole Body	Egg	Egg mortality	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-03	Mortality	LD100	Water	Whole Body	Egg	Cumulative percent mortality equaled 100% - Control cumulative mortality was 18%.	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-03	Mortality	LD31	Water	Whole Body	Egg	Hatching Mortality	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-03	Mortality	LD45	Water	Whole Body	Egg	Sac Fry Mortality	1991	Spitsbergen JM, MK Walker, JR Olson, RE Peterson

Table C-19. Summary of Aquatic Organism Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.58E-03	Development	ED130	Water	Whole Body	Fry	Growth rate began declining about 50 d post exposure; tissue burden just after exposure = 0.00258 and was 0.00065 139 d post exposure; total body burden 1/2 life = 58 5 d	1985	Branson DR, It Takahashi, WM Parker and GE Blau
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.58E-03	Growth	ED130	Water	Whole Body	Fry	Size of liver increased compared to controls; 42 d post exposure	1985	Branson DR, It Takahashi, WM Parker and GE Blau
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.58E-03	Growth	ED136	Water	Whole Body	Fry	Size of liver increased compared to controls; 64 d post exposure	1985	Branson DR, It Takahashi, WM Parker and GE Blau
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.58E-03	Growth	ED186	Water	Whole Body	Fry	Size of liver increased compared to controls; 118d post exposure	1985	Branson DR, It Takahashi, WM Parker and GE Blau
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.19E-04	Mortality	LD100	Ingestion	Whole Body	Egg	Eggs groups recieved one injection out of 7 graded doses of TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.45E-04	Mortality	LD100	Ingestion	Whole Body	Egg	TCDD exposure resulted from feeding adult female trout for up to 149d prior to spawning. No significant differences were found between exp. dose and egg bioaccumulation.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.54E-04	Mortality	LD100	Ingestion	Whole Body	Egg	Eggs were treated with waterborne TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.80E-05	Mortality	LD50	Ingestion	Whole Body	Egg	TCDD exposure resulted from feeding adult female trout for up to 149d prior to spawning. No significant differences were found between exp. dose and egg bioaccumulation.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.90E-05	Mortality	LD50	Ingestion	Whole Body	Egg	Eggs groups recieved one injection out of 7 graded doses of TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	8.00E-05	Mortality	LD50	Ingestion	Whole Body	Egg	Eggs were treated with waterborne TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-05	Mortality	LOED	Ingestion	Whole Body	Egg	Eggs groups recieved one injection out of 7 graded doses of TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.00E-05	Mortality	LOED	Ingestion	Whole Body	Egg	TCDD exposure resulted from feeding adult female trout for up to 149d prior to spawning. No significant differences were found between exp. dose and egg bioaccumulation.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-05	Mortality	LOED	Ingestion	Whole Body	Egg	Eggs were treated with waterborne TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	2.30E-05	Mortality	NOED	Ingestion	Whole Body	Egg	TCDD exposure resulted from feeding adult female trout for up to 149d prior to spawning. No significant differences were found between exp. dose and egg bioaccumulation.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-05	Mortality	NOED	Ingestion	Whole Body	Egg	Egg groups received one injection out of 7 graded doses of TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.40E-05	Mortality	NOED	Ingestion	Whole Body	Egg	Eggs were treated with waterborne TCDD.	1994	Walker MK, PM Cook, AR Batterman, BC Butterworth, C Berini, JJ Libal, LC Hufnagle, RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	LD100	Injection	Eggs	Egg	Direct injection; effects on hatching onset to swim-up	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	LD100	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.00E-04	Mortality	LD25	Injection	Eggs	Egg	Direct injection; effects on hatching onset to swim-up	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.00E-04	Mortality	LD25	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.30E-04	Mortality	LD50	Injection	Whole Body	Fry	MC Strain	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.40E-04	Mortality	LD50	Injection	Whole Body	Fry	ER Strain	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.00E-04	Mortality	LD50	Injection	Eggs	Egg	Direct injection; effects on hatching onset to swim-up	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.00E-04	Mortality	LD50	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.74E-04	Mortality	LD50	Injection	Whole Body	Fry	AR Strain	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.88E-04	Mortality	LD50	Injection	Whole Body	Fry	EL Strain	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.00E-04	Mortality	LD75	Injection	Eggs	Egg	Direct injection; effects on hatching onset to swim-up	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.00E-04	Mortality	LD75	Injection	Whole Body	Fry	Hatching onset to swimup	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-04	Mortality	NOED	Injection	Eggs	Egg	Direct injection; no effects on early development	1991	Walker MK and RE Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-04	Mortality	NOED	Injection	Whole Body	Fry	Sac Fry and hatching fry	1991	Walker MK and RE Peterson
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	4.34E-04	Mortality	LD100	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	4.70E-04	Mortality	LD100	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	1.35E-04	Mortality	LD13	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson

Table C-19. Summary of Aquatic Organism Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	1.85E-04	Mortality	LD25	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	2.33E-04	Mortality	LD90	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	3.37E-04	Mortality	LD98	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	1.01E-04	Mortality	NOED	Water	Eggs	Egg		1994	Walker, MK, & RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.50E-04	Mortality	LD50	Water	Whole Body	Egg	95% Confidence interval 60-71ppt)	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-05	Growth	LOED	Water	Whole Body	Egg	Significant increase in sac fry weight at this TCDD concentration	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	2.26E-04	Growth	LOED	Water	Whole Body	Egg	Significant sac fry wet weight increase at this TCDD concentration. Significant decrease in sac fry length at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-05	Mortality	LOED	Water	Whole Body	Egg	Significant increase in mortality at this concentration - the lowest concentration to do so. (Called LOAEL in the paper.)	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-05	Mortality	LD50	Water	Whole Body	Egg	Elimination half-life for TCDD at this concentration was found to be 35d	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-05	Mortality	LD50	Water	Whole Body	Egg	Elimination half-life for TCDD at this concentration was found to be 37d	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.21E-04	Mortality	LD50	Water	Whole Body	Egg	Significant sac fry wet weight increase at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.02E-04	Mortality	LD50	Water	Whole Body	Egg	Significant sac fry wet weight increase at this TCDD concentration. Significant decrease in sac fry length at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.21E-04	Mortality	LD50	Water	Whole Body	Egg	Significant increase of sac fry mortality at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	2.26E-04	Mortality	LD50	Water	Whole Body	Egg	Fry ability to hatch significantly less at this TCDD concentration with 8.9%-10.5% of the embryos dying partially hatched. Significant increase of sac fry mortality at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson

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Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.02E-04	Mortality	LD50	Water	Whole Body	Egg	Fry ability to hatch significantly less at this TCDD concentration with 12.8%-20.8% of the embryos dying partially hatched. Significant increase of sac fry mortality at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-05	Growth	NOED	Water	Whole Body	Egg	No significant sac fry wet weight change at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-05	Mortality	NOED	Water	Whole Body	Egg	No significant mortality at this TCDD concentration.	1991	Walker MK, JM Spitsbergen, JR Olson, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	8.50E-05	Mortality	LD50	Water	Whole Body	Embryo		1995	Zabel EW, PM Cook, RE Peterson
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	2.20E-03	Mortality	LD50	Injection		Adult	Mortality and pathology Cook et al. 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.76E-01	Mortality	LD100	Ingestion		Fingerling	Hawkes and Norris, 1977	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.58E-03	Mortality	LD20	Water		Fingerling	Observation 42-139 d post exposure; Increased liver weight as well Branson et al., 1985	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Mortality	LD20	Injection	Eggs	Fingerling	From Table 4-1. Spitsbergen et al., 1988a	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Mortality	LD20	Injection		Fingerling	Increased liver weight as well van der Welden et al., 1990	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.00E-05	Mortality	LD23	Water		Egg	Mortality in sac fry Spitsbergen et al. 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.70E-05	Mortality	LD50	Injection		Egg	Mortality in sac fry Walker et al., 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.90E-05	Mortality	LD50	Ingestion		Egg	Mortality in sac fry Walker et al., 1991; Walker et al., 1993	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.50E-05	Mortality	LD50	Water		Egg	Mortality in sac fry Walker et al., 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.04E-04	Mortality	LD50	Ingestion		Egg	Mortality in sac fry Walker et al., 1991; Walker et al., 1993	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.30E-04	Mortality	LD50	Injection	Eggs	Egg	From Table 4-1. Sac fry of McConaughy strain Walker and Peterson, 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.40E-04	Mortality	LD50	Injection	Eggs	Egg	From Table 4-1. Sac fry of Erwin strain) Walker and Peterson, 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.79E-04	Mortality	LD50	Water	Eggs	Egg	From Table 4-1. Significant mortality in sac fry Walker et al., 1992	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.74E-04	Mortality	LD50	Injection	Eggs	Egg	From Table 4-1. Sac fry of Arlee strain) Walker and Peterson, 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.21E-04	Mortality	LD50	Injection	Eggs	Egg	From Table 4-1. Sac fry of Fish Lake strain) Walker et al., 1992	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.39E-04	Mortality	LD50	Water	Eggs	Egg	From Table 4-1. Significant mortality in sac fry Walker et al., 1992	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.88E-04	Mortality	LD50	Injection	Eggs	Egg	From Table 4-1. Sac fry of Eagle Lake strain) Walker and Peterson, 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	3.00E-03	Mortality	LD50	Injection		Juvenile	Kleeman et al., 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	3.00E-03	Mortality	LD50	Injection		Juvenile	Spitsbergen et al. 1988b; Kleeman et al., 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Ictalurus melas	Black Bullhead	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Mortality	LD50	Injection		Juvenile	Kleeman et al., 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-02	Mortality	LD50	Injection	Eggs	Fingerling	From Table 4-1. Spitsbergen et al., 1988a; Kleeman et al. 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Micropterus salmoides	Largemouth Bass	FW	2,3,7,8-TCDD	1746-01-6	1.10E-02	Mortality	LD50	Injection		Juvenile	Kleeman et al 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Lepomis macrochirus	Bluegill	FW	2,3,7,8-TCDD	1746-01-6	1.60E-02	Mortality	LD50	Injection		Juvenile	Kleeman et al 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.22E-03	Mortality	LD95	Water	Eggs	Fry	From Table 4-1. Mehrle et al., 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-05	Mortality	LOED	Water		Egg	Mortality in sac fry Walker et al., 1991	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	7.65E-04	Mortality	LOED	Water	Eggs	Fry	From Table 4-1. 45% Mortality Mehrle et al., 1988	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Rana catesbeiana	Bullfrog	FW	2,3,7,8-TCDD	1746-01-6	1.00E+00	Growth	NOED	Injection		Immature	Beatty et al., 1976	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.14E-04	Mortality	NOED	Injection		Fingerling	Hawkes and Norris, 1977	1993	PM Cook, RJ Erickson, RL Spehar, SP Bradbury, GT Ankley
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.06E-01	Mortality	LD100	Water	Eggs	Egg		1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.50E-02	Mortality	LD25	Water	Eggs	Egg		1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	2.22E+00	Mortality	LD37	Water	Whole Body	Yearling	140d Depuration	1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.50E-02	Mortality	LD50	Water	Eggs	Egg		1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	8.10E-02	Mortality	LD75	Water	Eggs	Egg		1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	1.02E-01	Mortality	LD95	Water	Eggs	Egg		1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-02	Mortality	LOED	Water	Eggs	Egg	Hatchability	1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	2.26E-01	Reproduction	LOED	Water	Eggs	Egg	Hatchability	1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-02	Mortality	NOED	Water	Eggs	Egg	Hatchability	1991	Cook, PM, DW Kuehl, MK Walker, RE Peterson

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Chironomus tentans	Midge	FW	2,3,7,8-TCDD	1746-01-6	4.70E-01	Growth	NOED	Combined	Whole Body	Early Juvenile	Concentrations Are Lipid Normalized - Lipid As Wet Weight	1997	West, C.W., G.T. Ankley, J.W. Nichols, G.E. Elonen, and D.E. Nessa
Chironomus tentans	Midge	FW	2,3,7,8-TCDD	1746-01-6	4.70E-01	Mortality	NOED	Combined	Whole Body	Early Juvenile	Concentrations Are Lipid Normalized - Lipid As Wet Weight	1997	West, C.W., G.T. Ankley, J.W. Nichols, G.E. Elonen, and D.E. Nessa
Coregonus clupeaformis	Lake Whitefish	FW	2,3,7,8-TCDD	1746-01-6	8.50E-02	Growth	NA	Ingestion	Whole Body	Early Juvenile	Growth study, see histological study	1997	Fisk, A. T., A. L. Yarechewski, D. A. Metner, R. E. Evans, W. L. Lockhart, and D. C. G. Muir
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.50E-01	Growth	NA	Ingestion	Whole Body	Early Juvenile	Growth study , see histologogical study	1997	Fisk, A. T., A. L. Yarechewski, D. A. Metner, R. E. Evans, W. L. Lockhart, and D. C. G. Muir
Ictalurus punctatus	Catfish-Channel	FW	2,3,7,8-TCDD	1746-01-6	1.40E-01	Mortality	NOED	Combined	Whole Body	Adult	No effect on survival. Model ecosystem.	1975	Isensee, A.R. and G.E. Jones
Gambusia affinis	Mosquito fish	FW	2,3,7,8-TCDD	1746-01-6	4.40E-01	Mortality	NOED	Combined	Whole Body	Adult	No effect on survival. Model ecosystem.	1975	Isensee, A.R. and G.E. Jones
Physa sp.	Snail	FW	2,3,7,8-TCDD	1746-01-6	5.60E-01	Mortality	NOED	Combined	Whole Body	NA	No Effect On Survival. Model ecosystem.	1975	Isensee, A.R. and G.E. Jones
Daphnia magna	Water flea	FW	2,3,7,8-TCDD	1746-01-6	2.08E+00	Mortality	NOED	Combined	Whole Body	NA	No effect on survival. Model ecosystem.	1975	Isensee, A.R. and G.E. Jones
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Mortality	NOED	Injection	Whole Body	NA	Internal Dose Used As Tissue Concentration; No Mortality At 72 H At Highest Test Dose	1991	Janz, D.M. and C.D. Metcalfe
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	3.00E-03	Mortality	LD50	Injection	Whole Body	NA	80 Day LD50 For Mortality	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	3.00E-03	Mortality	LD50	Injection	Whole Body	NA	80 Day LD50 For Mortality	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Ictalurus melas	Black Bullhead	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Mortality	LD50	Injection	Whole Body	NA	80 Day LD50 For Mortality	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-02	Mortality	LD50	Injection	Whole Body	NA	80 Day LD50 For Mortality	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Micropterus salmoides	Largemouth Bass	FW	2,3,7,8-TCDD	1746-01-6	1.10E-02	Mortality	LD50	Injection	Whole Body	NA	80 Day LD50 For Mortality	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Lepomis macrochirus	Bluegill	FW	2,3,7,8-TCDD	1746-01-6	1.60E-02	Mortality	LD50	Injection	Whole Body	NA	80 Day LD50 For Mortality	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Growth	LOED	Injection	Whole Body	NA	Significant Reduction In Body Weight	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	5.00E-03	Growth	LOED	Injection	Whole Body	NA	Significant Reduction In Body Weight	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Lepomis macrochirus	Bluegill	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Growth	LOED	Injection	Whole Body	NA	Significant Reduction In Body Weight	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Morphology	LOED	Injection	Whole Body	NA	Hyperpigmentation	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Morphology	LOED	Injection	Whole Body	NA	Fin Necrosis	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Micropterus salmoides	Largemouth Bass	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Morphology	LOED	Injection	Whole Body	NA	Fin Necrosis, Hyperpigmentation	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Lepomis macrochirus	Bluegill	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Morphology	LOED	Injection	Whole Body	NA	Fin necrosis, cutaneous hemorrhage.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Ictalurus melas	Black Bullhead	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Morphology	LOED	Injection	Whole Body	NA	Fin Necrosis	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Morphology	LOED	Injection	Whole Body	NA	Fin necrosis, cutaneous hemorrhage.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	2.50E-02	Morphology	LOED	Injection	Whole Body	NA	Fin necrosis, cutaneous hemorrhage.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	NOED	Injection	Whole Body	NA	No significant increase in mortality.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	NOED	Injection	Whole Body	NA	No significant increase in mortality.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Micropterus salmoides	Largemouth Bass	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	NOED	Injection	Whole Body	NA	No significant increase in mortality.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Lepomis macrochirus	Bluegill	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	NOED	Injection	Whole Body	NA	No significant increase in mortality.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Ictalurus melas	Black Bullhead	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	NOED	Injection	Whole Body	NA	No significant increase in mortality.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Cyprinus carpio	Common carp	FW	2,3,7,8-TCDD	1746-01-6	1.00E-03	Mortality	NOED	Injection	Whole Body	NA	No significant increase in mortality.	1988	Kleeman, J.M., J.R. Olson and R.E. Peterson
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	1.43E-04	Growth	NOED	Ingestion	Whole Body	Immature	No Effect On Growth. Residue measured at end of exposure period.	1986	Kleeman, J.M., J.R. Olson, S.M. Chen and R.E. Peterson
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	1.43E-04	Morphology	NOED	Ingestion	Whole Body	Immature	No Effect On Fin Necrosis Or Hemorrhage. Residue measured at end of exposure period.	1986	Kleeman, J.M., J.R. Olson, S.M. Chen and R.E. Peterson
Perca flavescens	Yellow perch	FW	2,3,7,8-TCDD	1746-01-6	1.43E-04	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality. Residue measured at end of exposure period.	1986	Kleeman, J.M., J.R. Olson, S.M. Chen and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.50E-04	Growth	NOED	Ingestion	Whole Body	Immature	No Effect On Growth. Residue measured at end of exposure period.	1986	Kleeman, J.M., J.R. Olson, S.M. Chen and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.50E-04	Morphology	NOED	Ingestion	Whole Body	Immature	No Effect On Fin Necrosis Or Hemorrhage. Residue measured at end of exposure period.	1986	Kleeman, J.M., J.R. Olson, S.M. Chen and R.E. Peterson
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.50E-04	Mortality	NOED	Ingestion	Whole Body	Immature	No Effect On Mortality. Residue measured at end of exposure period.	1986	Kleeman, J.M., J.R. Olson, S.M. Chen and R.E. Peterson
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.17E-03	Growth	LOED	Absorption	Whole Body	Immature	Reduced weight gain. Residue measured after 114 days in clean water.	1979	Miller, R.A., L.A. Norris and B.R. Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	2.17E-03	Mortality	LOED	Absorption	Whole Body	Immature	Reduced Survival. Residue measured after 114 days in clean water.	1979	Miller, R.A., L.A. Norris and B.R. Loper

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	1.25E-04	Growth	NOED	Absorption	Whole Body	Immature	No effect on weight gain. Residue measured after 114 days in clean water.	1979	Miller, R.A., L.A. Norris and B.R. Loper
Oncorhynchus kisutch	Salmon-coho	FW/SW	2,3,7,8-TCDD	1746-01-6	1.25E-04	Mortality	NOED	Absorption	Whole Body	Immature	No Effect On Mortality. Residue measured after 114 days in clean water.	1979	Miller, R.A., L.A. Norris and B.R. Loper
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	1.20E-03	Reproduction	LOED	Ingestion	Whole Body	Immature	Significant Delay In Spawning; TCDD-spiked Diet To Produce Desired Body Burden; Abstract With Minimal Information	1994	Tietge, J.E.
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	1.20E-03	Growth	NOED	Ingestion	Whole Body	Immature	No Significant Growth Effect At Highest Target Body Burden; TCDD-spiked Diet To Produce Desired Body Burden; Abstract With Minimal Information	1994	Tietge, J.E.
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	1.20E-03	Mortality	NOED	Ingestion	Whole Body	Immature	No Significant Mortality At Highest Target Body Burden; TCDD-spiked Diet To Produce Desired Body Burden; Abstract With Minimal Information	1994	Tietge, J.E.
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	6.00E-04	Reproduction	NOED	Ingestion	Whole Body	Immature	No Delay In Spawning; TCDD-spiked Diet To Produce Desired Body Burden; Abstract With Minimal Information	1994	Tietge, J.E.
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.50E-05	Mortality	LD50	Absorption	Eggs	Egg	LD50 for increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.21E-04	Mortality	LD50	Injection	Eggs	Egg	LD50 for increase in mortality from fertilization to swim-up. Residues measured in eggs at up to 19 days post injection.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.39E-04	Mortality	LD50	Absorption	Eggs	Egg	LD50 for increase in mortality from fertilization to swim-up. Residue measured in eggs at 5-days post exposure.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.50E-05	Mortality	LOED	Absorption	Eggs	Egg	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	5.80E-05	Mortality	LOED	Injection	Eggs	Egg	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs after injection.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.79E-04	Mortality	LOED	Absorption	Eggs	Egg	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs at 5-days post exposure.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.

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Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	4.37E-04	Mortality	LOED	Injection	Eggs	Egg	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs at up to 19 days post injection..	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-05	Mortality	NOED	Absorption	Eggs	Egg	No significant increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	2.91E-04	Mortality	NOED	Injection	Eggs	Egg	No significant increase in mortality from fertilization to swim-up. Residue measured in eggs at up to 19 days post injection.	1992	Walker, M.K., Hufnagle, L.C., Jr., Clayton, M.K., Peterson, R.E.
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.50E-05	Mortality	LD50	Absorption	Eggs	Egg-embryo	Estimated LD50 for sac-fry mortality.	1993	Walker, M.K., Zabel, E.W., Peterson, R.E.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	1.70E-04	Mortality	LD50	Injection	Eggs	Egg-embryo	Estimated LD50s for sac fry mortality in 6 strains of rainbow trout. Residues ranged from 170 to 488 pg/g.	1993	Walker, M.K., Zabel, E.W., Peterson, R.E.
Salvelinus fontinalis	Trout - Brook	FW	2,3,7,8-TCDD	1746-01-6	2.00E-04	Mortality	LD50	Absorption	Eggs	Egg-embryo	Estimated LD50 for sac-fry mortality.	1993	Walker, M.K., Zabel, E.W., Peterson, R.E.
Ictalurus punctatus	Catfish-Channel	FW	2,3,7,8-TCDD	1746-01-6	4.40E-03	Mortality	LD100	Absorption	Whole Body	NA	Model ecosystem exposure. 100% Mortality in 20 days.. Radiolabelled TCDD added to sediment and leached into water.	1978	Yockim, R.S., Isensee, A.R., Jones, G.E.
Gambusia affinis	Mosquito fish	FW	2,3,7,8-TCDD	1746-01-6	7.20E-03	Mortality	LD100	Absorption	Whole Body	NA	Model ecosystem exposure. 100% Mortality in 15 days.. Radiolabelled TCDD added to sediment and leached into water.	1978	Yockim, R.S., Isensee, A.R., Jones, G.E.
Daphnia magna	Water flea	FW	2,3,7,8-TCDD	1746-01-6	8.60E-03	Mortality	NOED	Absorption	Whole Body	NA	Model ecosystem exposure. No significant difference in population. Radiolabelled TCDD added to sediment and leached into water. Residue at 15 days.	1978	Yockim, R.S., Isensee, A.R., Jones, G.E.
Helisoma sp.	Snail	FW	2,3,7,8-TCDD	1746-01-6	9.70E-03	Mortality	NOED	Absorption	Whole Body	NA	Model ecosystem exposure. No significant difference in population. Radiolabelled TCDD added to sediment and leached into water. Residue at 15 days.	1978	Yockim, R.S., Isensee, A.R., Jones, G.E.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	6.50E-04	Growth	LOED	Absorption	Whole Body	Immature	Reduced Growth, Exposed Fish Weighed 50 G Vs. 130 G For Controls	1985	Branson, D.R., L.T. Takahashi, W.M. Parker and G.E. Blau
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	6.50E-04	Growth	LOED	Absorption	Whole Body	Immature	Liver/body weight ratio nearly twice that of controls.	1985	Branson, D.R., L.T. Takahashi, W.M. Parker and G.E. Blau
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	6.50E-04	Mortality	LOED	Absorption	Whole Body	Immature	Lethal To 7 Of 90 Fish Over 139 Days	1985	Branson, D.R., L.T. Takahashi, W.M. Parker and G.E. Blau

Table C-19. Summary of Aquatic Organism Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pacifastacus leniusculus	Crayfish	FW	2,3,7,8-TCDD	1746-01-6	3.00E-03	Mortality	LD25	Injection	Whole Body	Adult	25% Mortality After 40 Days	1996	Ashley, C.M., M.G. Simpson, D.M. Holdich and D.R. Bell
Pacifastacus leniusculus	Crayfish	FW	2,3,7,8-TCDD	1746-01-6	3.00E-02	Mortality	LD50	Injection	Whole Body	Adult	Lethargy, 50 - 66% Increase In Mortality	1996	Ashley, C.M., M.G. Simpson, D.M. Holdich and D.R. Bell
Pacifastacus leniusculus	Crayfish	FW	2,3,7,8-TCDD	1746-01-6	3.00E-04	Mortality	NOED	Injection	Whole Body	Adult	No Effect On Mortality	1996	Ashley, C.M., M.G. Simpson, D.M. Holdich and D.R. Bell
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.40E-05	Mortality	LD50	Absorption	Whole Body	Egg-embryo	50% Mortality of sac fry. LD50 range is 44 to 72 pg TCDD/g egg.	1993	Guiney, P., E. Zabel, R. Peterson, P. Cook, J. Casselman, J. Fitzsimons and H. Simonin
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.40E-05	Mortality	NOED	NA	Eggs	Egg-embryo	TCDD NOAEL for sac fry mortality.	1993	Guiney, P., E. Zabel, R. Peterson, P. Cook, J. Casselman, J. Fitzsimons and H. Simonin
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.31E-04	Mortality	LD50	Injection	Eggs		Walker et al 1992	2000	Grinwis GCM, HT Besselink, EJ van den Branhof, AS Bulder, MY Engelsma, RV Kuiper, PW Wester, MA Vaal, AD Vethaak, JG Vos.
Oncorhynchus mykiss	Trout - Rainbow	FW	2,3,7,8-TCDD	1746-01-6	3.46E-04	Mortality	LD50	Water	Eggs		Walker et al 1992	2000	Grinwis GCM, HT Besselink, EJ van den Branhof, AS Bulder, MY Engelsma, RV Kuiper, PW Wester, MA Vaal, AD Vethaak, JG Vos.
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.40E-05	Mortality	LD50	Water	Eggs	Egg	Concentrations of 2,3,7,8 TCDD are based on the TEC values. Egg dosed with success of hatching determined. Depuration is time for loss of adsorbed contaminant on egg surface. Lowest LD50 in data at 8 degrees C.	1996	Guiney. P.D., P.M. Cook, J.M. Casselman, J.D. Fitzsimmons, H. W. Simonin, E.W. Zabel, and R.E. Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	6.90E-05	Mortality	LD50	Water	Eggs	Egg	Concentrations of 2,3,7,8 TCDD are based on the TEC values. Egg dosed with success of hatching determined. Depuration is time for loss of adsorbed contaminant on egg surface. Highest LD50 in data at 8 degrees C.	1996	Guiney. P.D., P.M. Cook, J.M. Casselman, J.D. Fitzsimmons, H. W. Simonin, E.W. Zabel, and R.E. Peterson
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	4.50E-05	Mortality	NOED	Water	Eggs	Egg	Concentrations of 2,3,7,8 TCDD are based on the TEC values. Egg dosed with success of hatching determined. Depuration is time for loss of adsorbed contaminant on egg surface. Highest NOED in data at 8 degrees C.	1996	Guiney. P.D., P.M. Cook, J.M. Casselman, J.D. Fitzsimmons, H. W. Simonin, E.W. Zabel, and R.E. Peterson

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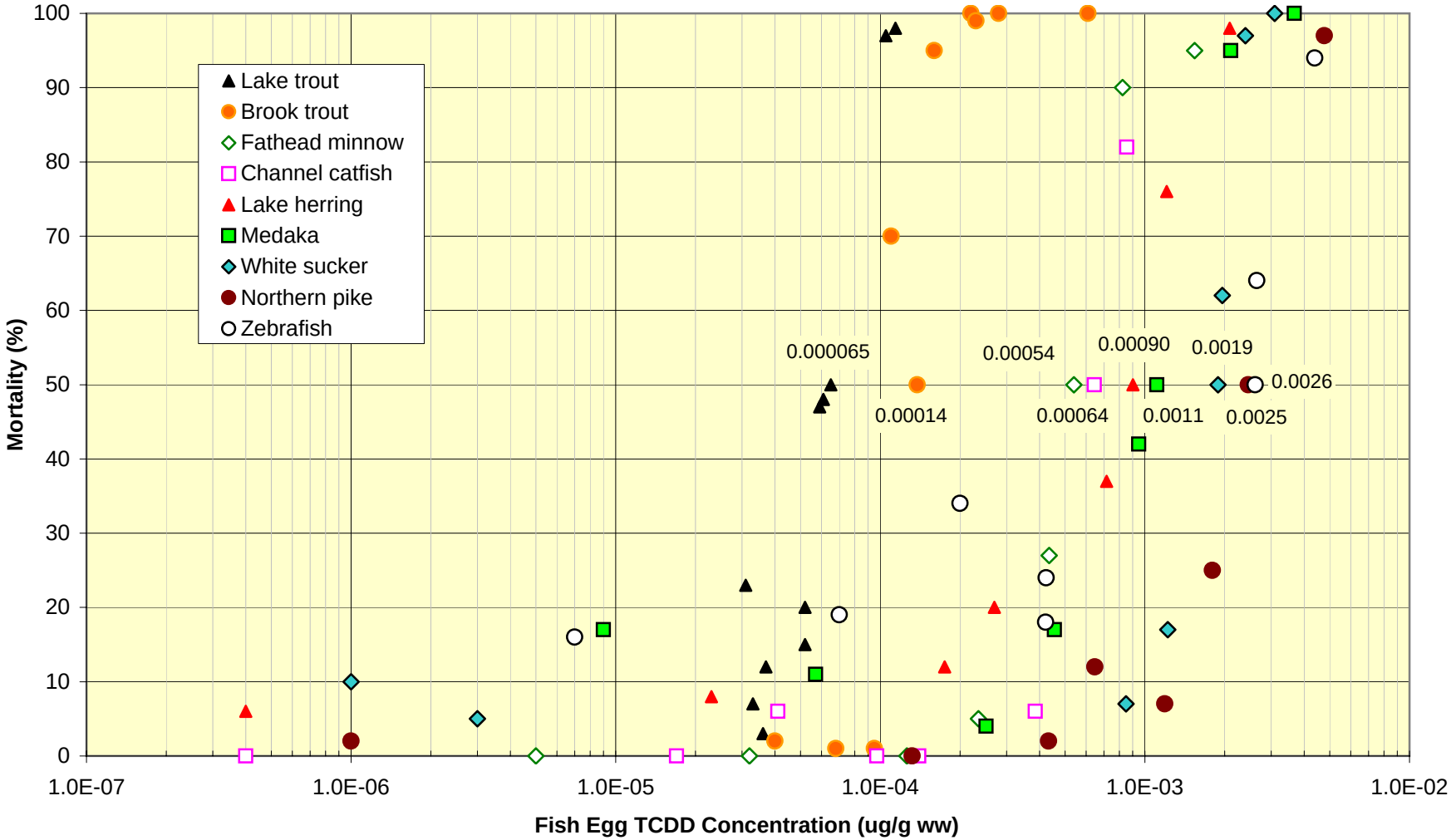
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Salvelinus namaycush	Trout -Lake	FW	2,3,7,8-TCDD	1746-01-6	3.00E-05	Mortality	NOED	Water	Eggs	Egg	Concentrations of 2,3,7,8 TCDD are based on the TEC values. Egg dosed with success of hatching determined. Depuration is time for loss of adsorbed contaminant on egg surface. Lowest NOED in data at 8 degrees C.	1996	Guiney. P.D., P.M. Cook, J.M. Casselman, J.D. Fitzsimmons, H. W. Simonin, E.W. Zabel, and R.E. Peterson

a FW = freshwater; SW= saltwater
b Wet weight concentration
c Edx or LDx = Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure = more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-32. Percent Mortality of Fish Embryos as a Function of TCDD Concentration in Egg Tissue



Non-salmonid data from Elonen et al. (1998); data for lake trout and brook trout estimated from information presented in Cook et al. (1991) and Johnson et al. (1998), respectively.

Chart C-33. Summary of 2,3,7,8-TCDD Concentrations in Freshwater and Saltwater Fish Egg Tissue Associated with Toxicity

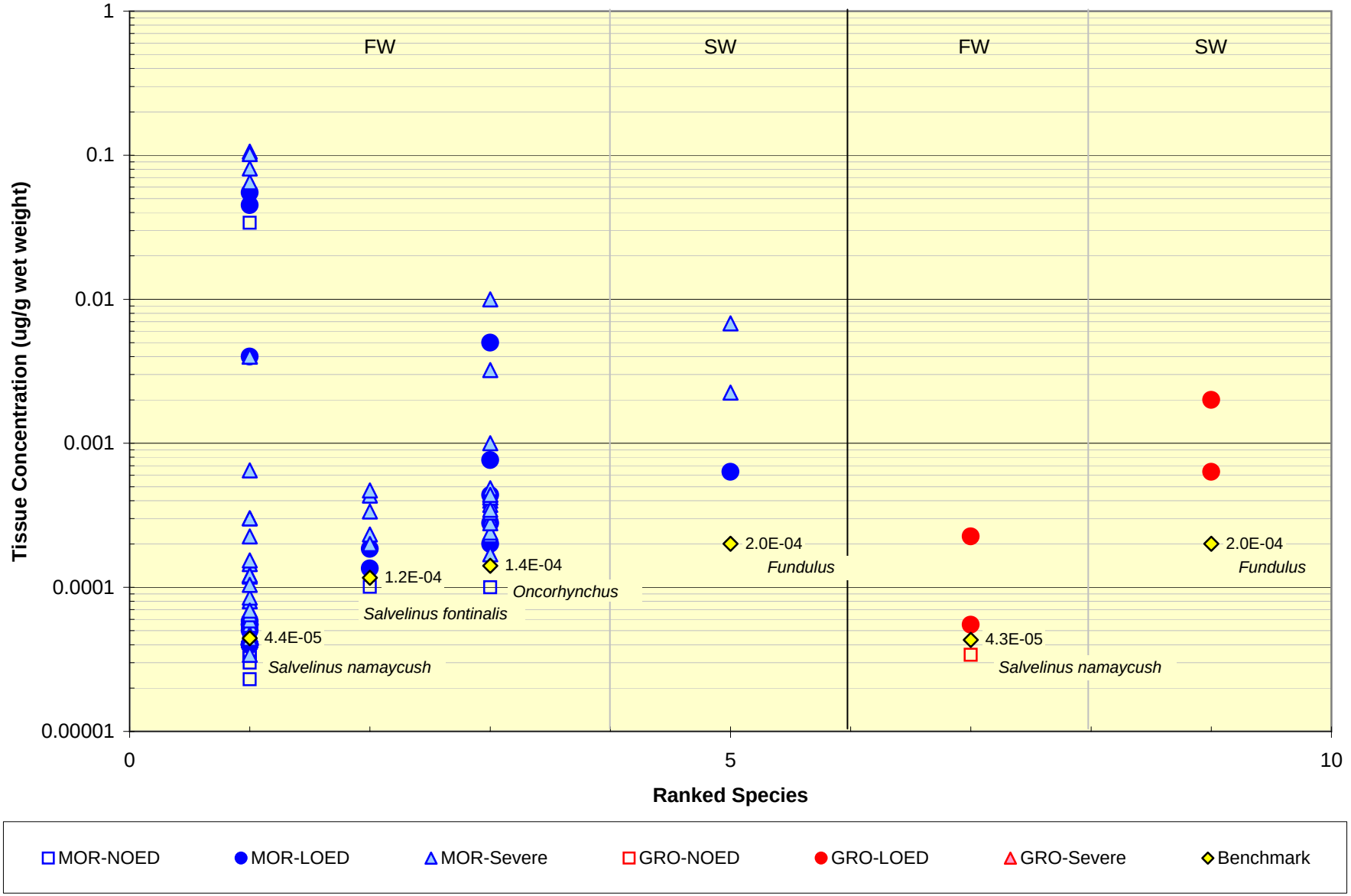


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Table C-20. Summary of Avian Egg Tissue Residue Effect Data from ERED Database - Dioxins

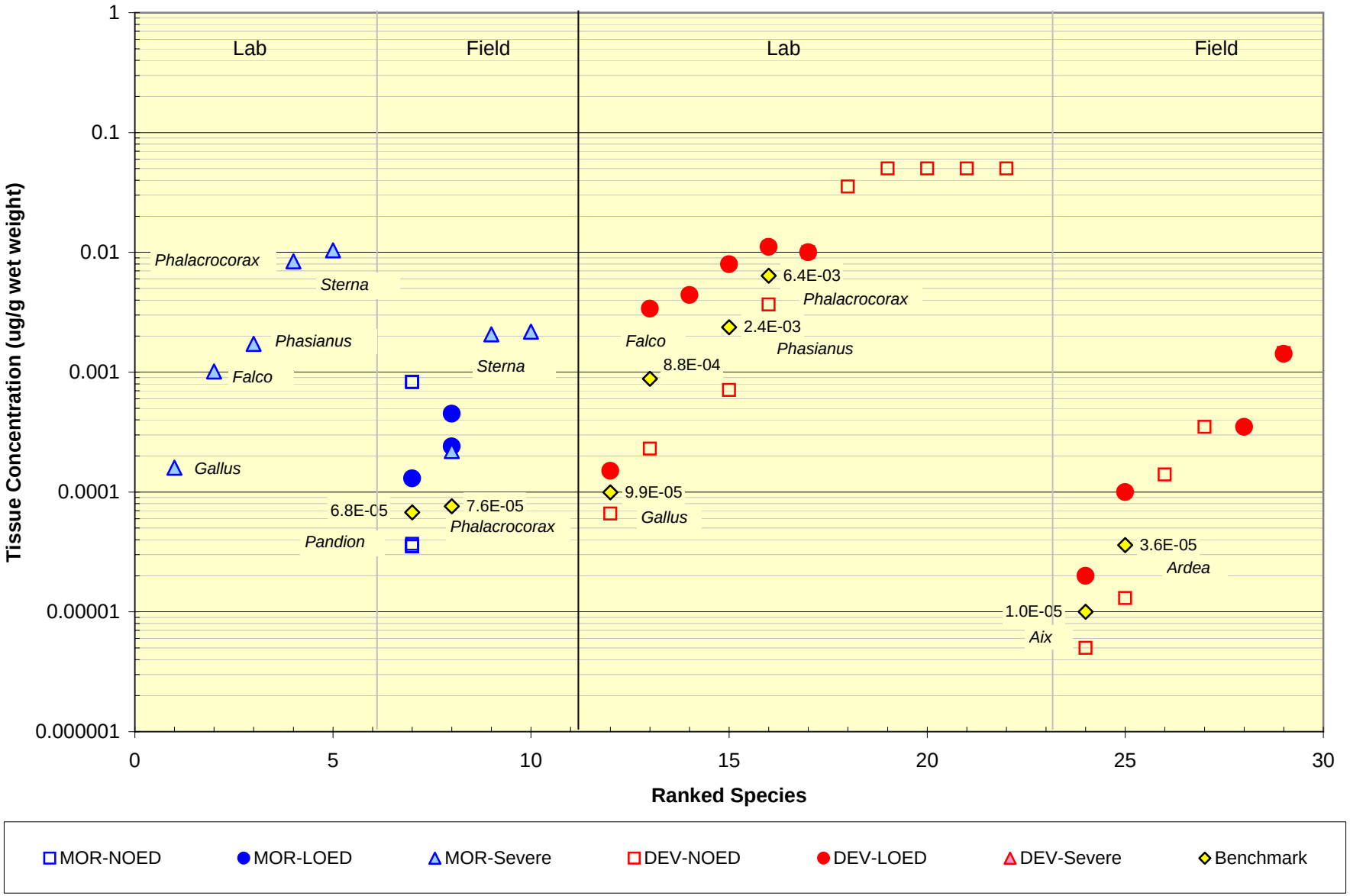
Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Pandion haliaetus	Osprey	FW	2,3,7,8-TCDD	1746-01-6	3.52E-05	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	2,3,7,8-TCDD	1746-01-6	8.28E-04	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Ardea cinera	Grey Heron	FW	2,3,7,8-TCDD	1746-01-6	9.32E-05	Physiological	NOED	Combined	Blood	Juvenile	No significant differences discovered in blood retinol concentrations with this mean level of TCDD equivalents in Yolk Sac.	2001	Jenssen, Bjorn, V. Nilssen, K. Murvoll, J.Skaare
Haliaeetus leucocephalus	Bald eagle	SW	2,3,7,8-TCDD	1746-01-6	1.00E-01	Development	NOED	NS	Eggs	NS	TEQ equivalents; Elliott et al 1996	2002	Kumar KS, D Kannan, S Corsolini, T Evans, JP Giesy, J Nakanishi, S Masunaga
Haliaeetus leucocephalus	Bald eagle	SW	2,3,7,8-TCDD	1746-01-6	2.00E-01	Development	LOED	NS	Eggs	NS	TEQ equivalents; Elliott et al 1996	2002	Kumar KS, D Kannan, S Corsolini, T Evans, JP Giesy, J Nakanishi, S Masunaga
Phalacrocorax carbo	Common commorant	SW	2,3,7,8-TCDD	1746-01-6	2.40E-04	Mortality	LD11	Combined	Eggs	Egg	decrease in population growth rate in common commorant between 1974-1986 Concentrations are in TEQ equivalents	2003	Murata M, N Iseki, S Masunaga, J Nakanishi
Phalacrocorax carbo	Common commorant	SW	2,3,7,8-TCDD	1746-01-6	4.50E-04	Mortality	LD21	Combined	Eggs	Egg	decrease in population growth rate in common commorant between 1974-1986 Concentrations are in TEQ equivalents	2003	Murata M, N Iseki, S Masunaga, J Nakanishi
Phalacrocorax carbo	Common commorant	SW	2,3,7,8-TCDD	1746-01-6	2.20E-04	Mortality	LD100	Combined	Eggs	Egg	decrease in population growth rate in common commorant between 1974-1986 Concentrations are in TEQ equivalents	2003	Murata M, N Iseki, S Masunaga, J Nakanishi
Haliaeetus leucocephalus	Bald eagle	SW	2,3,7,8-TCDD	1746-01-6	1.00E-04	Mortality	NOED			Juvenile	concentration are TEQ equivalents	2004	Tanabe S, M Watanabe, TB Minh, T Kunisue, S Nakanishi, H Ono, H Tanaka
Pandion haliaetus	Osprey	FW	2,3,7,8-TCDD	1746-01-6	1.30E-04	Mortality	LOED			Egg	concentration are TEQ equivalents	2004	Tanabe S, M Watanabe, TB Minh, T Kunisue, S Nakanishi, H Ono, H Tanaka
Sterna forsteri	Foster's tern	SW	2,3,7,8-TCDD	1746-01-6	2.20E-03	Mortality	LOED				hatching success concentration are TEQ equivalents	2004	Tanabe S, M Watanabe, TB Minh, T Kunisue, S Nakanishi, H Ono, H Tanaka

Table C-20. Summary of Avian Egg Tissue Residue Effect Data from ERED Database - Dioxins

Species Scientific Name	Species Common Name	FW/SW[a]	Analyte Name	CAS No	Conc (mg/kg)[b]	Effect Class	Toxicity Measure[c]	Exposure Route[d]	Body Part Analyzed	Age of Species Studied	Comments	Year	Author
Sterna hirundo	Common tern	SW	2,3,7,8-TCDD	1746-01-6	2.50E-03	Biochemical	LOED				CYP1A induction concentration are TEQ equivalents	2004	Tanabe S, M Watanabe, TB Minh, T Kunisue, S Nakanishi, H Ono, H Tanaka
Pandion haliaetus	Osprey	FW	2,3,7,8-TCDD	1746-01-6	3.70E-05	Mortality	NOED			Egg	concentration are TEQ equivalents	2004	Tanabe S, M Watanabe, TB Minh, T Kunisue, S Nakanishi, H Ono, H Tanaka
Pandion haliaetus	Osprey	FW	2,3,7,8-TCDD	1746-01-6	3.52E-05	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger
Pandion haliaetus	Osprey	FW	2,3,7,8-TCDD	1746-01-6	8.28E-04	Reproduction	NOED	Combined	Eggs	Egg		2005	Toschik, PC; BA Rattner; PC McGowan; MC Christman; DB Carter; RC Hale; CW Matson; MA Ottinger

a FW = freshwater; SW= saltwater
b Wet weight concentration
c Edx or LDx = Effective Dose or Lethal Dose to cause mortality to x percent of the population; NOED = no observed effects dose; LOED = lowest observed effect dose
d Combined exposure more than one of absorption, ingestion, water, or injection
NS = not specified
NA = not available

Chart C-34. Summary of 2,3,7,8-TCDD Concentrations in Laboratory and Field Avian Egg Tissue Associated with Toxicity



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