Water Quality Criteria Report for Permethrin

Updated Report

Prepared by:
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Central Valley Regional Water Quality Control Board

Updated May 2015

Original Report

Prepared for the Central Valley Regional Water Quality Control Board by:

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Original September 2011

Disclaimer

Funding for the original 2011 criteria report was provided by the California Regional Water Quality Control Board, Central Valley Region (CRWQCB-CVR). The contents of this document do not necessarily reflect the views and policies of the CRWQCB-CVR, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Note on the Updated Report

The original report (September 2011) was prepared by the listed authors at UC Davis. This report was updated in May 2015 by CRWQCB-CVR staff in order to include recently generated toxicity data. The updates to the report were not prepared by or reviewed by UC Davis. The majority of the original report was unchanged; the sections that include updates are as follows: 7 Acute criterion calculation, 8 Chronic criterion calculation, 9.2 Mixtures, 10.1 Sensitive species, 12.1 Assumptions, limitations and uncertainties, 12.2 Comparison to national standard methods, and 12.3 Final criteria statement. The recently generated toxicity data included in the update led to changes in the final criteria. In order to compare the original report and criteria to the updated report and criteria, the original report will remain available at: http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/criteria_method/index.shtml.

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Table of Contents

Disclaimer i
Note on the Updated Report i
List of Figures iv
List of Tables iv
List of acronyms and abbreviations v
1 Introduction 1
2 Basic information 1
3 Physical-chemical data 2
4 Human and wildlife dietary values 4
5 Ecotoxicity data 4
6 Data reduction 5
7 Acute criterion calculation 6
8 Chronic criterion calculation 8
9 Water Quality Effects 8
9.1 Bioavailability 8
9.2 Mixtures 11
9.3 Temperature, pH, other water quality effects 13
10 Comparison of ecotoxicity data to derived criteria 14
10.1 Sensitive species 14
10.2 Ecosystem and other studies 15
10.3 Threatened and endangered species 16
11 Harmonization with other environmental media 17
11.1 Bioaccumulation 17
11.2 Harmonization with air or sediment criteria 18
12 Permethrin criteria summary 18
12.1 Assumptions, limitations and uncertainties 18
12.2 Comparison to national standard methods 19
12.3 Final criteria statement 20
Acknowledgements 21
References 22
Data Tables 33
Appendix A: Fit test calculations A1
Appendix B: Data summary sheets B1
Appendix B1: Studies rated RR, RL, LR, LL B2
Appendix B2: Studies rated RN, LN, N B261

List of Figures

Figure 1 Structure of permethrin. 2
Figure 2 Histogram of the natural log of the permethrin species mean acute values. 7
Figure 3 The fit of the Burr Type III distribution to the permethrin acute data set. 7

List of Tables

Table 1 Bioconcentration factors (BCF) for permethrin. 3
Table 2 Permethrin hydrolysis, photolysis, and biodegradation. 4
Table 3 Final acute toxicity data set for permethrin. 34
Table 4 Reduced acute data rated RR. 37
Table 5 Supplemental acute data rated RL, LR, LL. 40
Table 6 Final chronic toxicity data set for permethrin. 50
Table 7 Acceptable reduced chronic data rated RR. 51
Table 8 Acute-to-Chronic Ratios used for derivation of the permethrin chronic criterion. 52
Table 9 Supplemental chronic toxicity data from studies rated RL, LR, or LL. 53
Table 10 Acceptable multispecies field, semi-field, laboratory, microcosm, mesocosm studies. 54
Table 11 Threatened, Endangered, or Rare Species Predicted values by ICE. 55
Table 12 Terrestrial wildlife studies of mallard ducks – permethrin. 56

List of acronyms and abbreviations

ACR	Acute-to-Chronic Ratio
APHA	American Public Health Association
ASTM	American Society for Testing and Materials
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factor
BMF	Biomagnification Factor
CA	Concentration Addition
CAS	Chemical Abstract Service
CDFG	California Department of Fish and Game
CDPR	California Department of Pesticide Regulation
CDWR	California Department of Water Resources
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CVRWQCB	Central Valley Regional Water Quality Control Board
DOC	Dissolved Organic Carbon
DOM	Dissolved Organic Matter
EC_x	Concentration that affects x% of exposed organisms
FDA	Food and Drug Administration
FT	Flow-through test
GMAV	Genus Mean Acute Value
IA	Independent Action
IC_x	Inhibition concentration; concentration causing *x*% inhibition
ICE	Interspecies Correlation Estimation
IUPAC	International Union of Pure and Applied Chemistry
K	Interaction Coefficient
K_H	Henry's law constant
K_{ow}	Octanol-Water partition coefficient
K_p or K_d	Solid-Water partition coefficient
LC_x	Concentration lethal to *x*% of exposed organisms
LD_x	Dose lethal to *x*% of exposed organisms
LL	Less relevant, Less reliable study
LOEC	Lowest-Observed Effect Concentration
LOEL	Lowest-Observed Effect Level
LR	Less relevant, Reliable study
MATC	Maximum Acceptable Toxicant Concentration
N	Not relevant or Not reliable study
n/a	Not applicable
NOAEL	No-Observed Adverse Effect Level
NOEC	No-Observed Effect Concentration
NR	Not reported
OC	Organic Carbon
OECD	Organization for Economic Co-operation and Development
PBO	Piperonyl butoxide

QSAR	Quantitative Structure Activity Relationship
pK_a	Acid dissociation constant
RL	Relevant, Less reliable study
RR	Relevant and Reliable study
S	Static test
SMAV	Species Mean Acute Value
SMCV	Species Mean Chronic Value
SPME	Solid-phase Microextraction
SR	Static renewal test
SSD	Species Sensitivity Distribution
TES	Threatened and Endangered Species
TIE	Toxicity Identification Evaluation
US	United States
USEPA	United States Environmental Protection Agency

1 Introduction

A new methodology for deriving freshwater water quality criteria for the protection of aquatic life was developed by the University of California, Davis (TenBrook et al. 2009a). The need for a new methodology was identified by the California Central Valley Regional Water Quality Control Board (CVRWQCB 2006) and findings from a review of existing methodologies (TenBrook & Tjeerdema 2006, TenBrook et al. 2009b). This new methodology is currently being used to derive aquatic life criteria for several pesticides of particular concern in the Sacramento River and San Joaquin River watersheds. The methodology report (TenBrook et al. 2009a) contains an introduction (Chapter 1); the rationale of the selection of specific methods (Chapter 2); detailed procedures for criteria derivation (Chapter 3); and a chlorpyrifos criteria report (Chapter 4). This criteria report for permethrin describes, section by section, the procedures used to derive criteria according to the UC-Davis methodology. Also included are references to specific sections of the methodology procedures detailed in Chapter 3 of the report so that the reader can refer to the report for further details (TenBrook et al. 2009a). The permethrin water quality criteria were updated in 2015 to include additional data generated since the original report released in 2011.

2 Basic information

Chemical: Permethrin (Figure 1)

CAS: (3-phenoxyphenyl)methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate

IUPAC: 3-phenoxybenzyl (RS)-cis-trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate

Chemical Formula: $C_{21}H_{20}Cl_2O_3$

CAS Number: 52645-53-1

CA DPR Chem Code: 2008

USEPA PC Code: 109701 (formerly 598600)

Trade names: Ambush, Dragnet, Ectiban, Exmin, FMC 33297, FMC 41665, ICI-PP 557, Kafil, Kestrel, NRDC-143, NIA 33297, Niagara 33297, Outflank, Outflank-stockade, Perthrine, Picket, Punce, Pramex, S 3151, SBP-1513, Talcord, WL 43479 (Mackay et al. 2006).

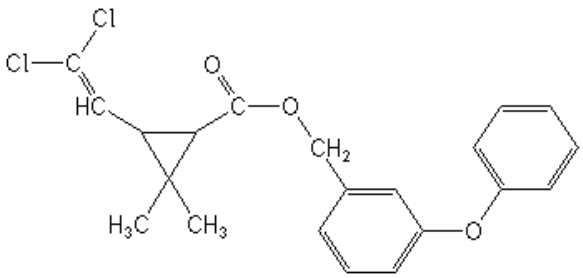

Figure 1 Structure of permethrin.
(http://www.alanwood.net/pesticides/permethrin.html)

3 Physical-chemical data

Molecular Weight
391.288 Mackay et al. 2006

Density
1.19-1.27 g/mL Mackay et al. 2006

Water Solubility
0.0055 mg/L at 20°C (mean, n=12) Laskowski 2002
0.006 mg/L at 20°C (pH 7) Tomlin 2003
Geomean: 0.0057 mg/L

Melting Point
Liquid at room temperature
34-39°C Worthing & Hance 1991
34-35°C Tomlin 2003
Geomean of extremes: 36.4°C

Vapor Pressure
4.5E-05 Pa (Mackay et al. 2006, Hartley & Kidd 1987)
1.3E-06 Pa (20°C, Mackay et al. 2006, Worthing & Hance 1991)
1.7E-06 Pa (20-25°C, Mackay et al. 2006, Wauchope et al. 1992, Hornsby et al. 1996)
1.48E-08 mm Hg (1.97E-06 Pa; 25°C, Laskowski 2002)
Geomean: 3.74E-06 Pa

Logistic Octanol-Water Partition Coefficient (Log K_{ow})
7.08 (slow-stir method – preferred) Dix 2014
6.1 at 20°C Laskowski 2002, Mackay et al. 2006, Tomlin 2003
6.5 recommended by Sangster 2010
Recommended: 7.08

Organic Carbon Sorption Partition Coefficients (K_{oc})
Limited to data from studies that used a batch equilibrium experimental design with natural sediment and measured the freely dissolved aqueous concentrations. All units are L/kg.

6,329,845	Chickering 2014
3,719,214	Chickering 2014
8,174,471	Chickering 2014
4,540,000	Yang et al. 2006b
697,959	Yang et al. 2006b
8,714,286	Yang et al. 2006b
1,301,471	Yang et al. 2006b
4,700,000	Cui & Gan 2013
2,545,000	Cui & Gan 2013
2,955,000	Cui & Gan 2013
1,235,000	Cui & Gan 2013
6,075,000	Cui & Gan 2013

Median K_{oc}: 4,129,607
Median log K_{oc}: 6.62

Henry's constant (K_H)

1.4×10^{-6} atm m^3 mol^{-1} at 20°C	Laskowski 2002
1.1×10^{-6} atm m^3 mol^{-1}	Mackay et al. 2006

Geomean: 1.2×10^{-6} atm m^3 mol^{-1}

Environmental Fate
Table 1 Bioconcentration factors (BCF) for permethrin.

Species	**BCF (L/kg)**	**Exposure**	**Reference**
Anabaena (cyanobacteria)	57-813	Static, 5 d	Kumar et al. 1988
Aulosira fertilissima (cyanobacteria)	46-2373	Static, 5 d	Kumar et al. 1988
Chironomus dilutus	87.2	Static, 96 h, 23°C	Harwood et al. 2009
Chironomus tentans	8-166	Static, 24 h, water-sediment system	Muir et al. 1985
Crassostrea virginica	1900	Flow-through	Schimmel et al. 1983
Cyprinodon variegatus	290-620	Flow-through, 28 d	Hansen et al. 1983
Helisoma trivolvis (snail)	800	Flow-through, 30 d	Spehar et al. 1983
Hydrophilus spp. (water scavenger beetle)	4.10 L/g	Static, 6 h	Tang & Siegfried 1996
Hydropsyche & *Chematapshyche* spp. (caddisfly)	30.4 L/g	Static, 6 h	Tang & Siegfried 1996
Ishnura & *Enallagma* spp. (damselfly)	6.87 L/g	Static, 6 h	Tang & Siegfried 1996

Lepomis macrochirus	558	Flow-through, 28 d	Burgess 1989
Lepomis macrochirus	681	Flow-through, 28 d	Tullman 1989
Lumbriculus variegatus	1466	Static renewal, 14 d	You et al. 2009
Oncorhynchus mykiss	328-631	Flow-through, 4 d	Muir et al. 1994
Pimephales promelas	2800	Flow-through, 30 d	Spehar et al. 1983
Salmo salar	14-73 L/g	Static, 96 h	McLeese et al. 1980
Salmo salar	55	Static, 96 h	Zitko et al. 1977
Simulium vittatum (black fly)	17.9 L/g	Static, 6 h	Tang & Siegfried 1996
Stenacron spp. (mayfly)	23.6 L/g	Static, 6 h	Tang & Siegfried 1996
Tetrahymena pyriformis (protozoa)	70-1110	2-12 h	Bhatnagar et al. 1988

Table 2 Permethrin hydrolysis, photolysis, and biodegradation.

	Half-life (d)	**Water**	**Temp (°C)**	**pH**	**Reference**
Hydrolysis	Stable	Sterile, buffered	25	5	Laskowski 2002
	Stable	Sterile, buffered	25	7	Laskowski 2002
	242	Sterile, buffered	25	9	Laskowski 2002
Aqueous Photolysis	110	Not reported	25	5	Amos & Donelan 1987, Laskowski 2002
Soil Biodegradation (aerobic)	39.5	3 soil types (n=8)	16-25	n/a	Laskowski 2002

4 Human and wildlife dietary values

There are no FDA action levels for permethrin (USFDA 2000). There are no food tolerances for human consumption of fish, but there are food tolerances for other meat products; tolerances of 0.05 mg/kg for the meat of poultry and hogs are the lowest recommended tolerances in the permethrin reregistration eligibility decision (USEPA 2006a).

Wildlife dietary NOECs for animals with significant food sources in water

A dietary NOEC of 125 mg/kg feed for 23-week old mallard ducks was determined over a 20 week period for the endpoints of hens with regressing ovary, food consumption, and number of eggs laid (Beavers et al. 1992). The LOEC was determined to be 500 mg/kg in this study.

5 Ecotoxicity data

Approximately 155 original studies on the effects of permethrin on aquatic life were identified and reviewed. In the review process, many parameters were rated for documentation and acceptability for each study, including, but not limited to: organism

source and care, control description and response, chemical purity, concentrations tested, water quality conditions, and statistical methods (see Tables 3.6, 3.7, 3.8 in TenBrook et al. 2009a). Single-species effects studies that were rated relevant (R) or less relevant (L) according to the method (Table 3.6) were summarized in data summary sheets. Information in these summaries was used to evaluate each study for reliability using the rating systems described in the methodology (Tables 3.7 and 3.8, section 3-2.2, TenBrook et al. 2009a), to give a reliability rating of reliable (R), less reliable (L), or not reliable (N). Copies of completed summaries for all studies are included in Appendix B: Data summary sheets. Permethrin studies deemed irrelevant from an initial screening were not summarized (e.g., studies involving rodents or *in vitro* exposures). All data rated as acceptable (RR) or supplemental (RL, LR, LL) for criteria derivation are summarized in Table 3, Table 4, Table 5, Table 6, Table 7 and Table 9. Acceptable studies rated as RR are used for numeric criteria derivation, while supplemental studies rated as RL, LR or LL are used for evaluation of the criteria to check that they are protective of particularly sensitive species and threatened and endangered species. These considerations are reviewed in sections 10.1 and 10.3, respectively. Studies that were rated not relevant (N) or not reliable (RN or LN) were not used for criteria derivation.

Using the data evaluation criteria (section 3-2.2, TenBrook et al. 2009a), 16 acute toxicity studies, yielding 68 toxicity values, were judged reliable and relevant (RR; Table 3 and Table 4). Three chronic toxicity studies, yielding five toxicity values, were judged reliable and relevant (RR; Table 6 and Table 7). Thirty four acute and three chronic studies were rated RL, LL, or LR and were used as supplemental information for evaluation of the derived criteria in sections 10.1 and 10.3 (Table 5 and Table 9, respectively).

Twelve mesocosm, microcosm and ecosystem (field and laboratory) studies were identified and reviewed using Table 3.9 (TenBrook et al. 2009a). Six of these studies were rated reliable (R) or less reliable (L) and were used as supporting data in section 10.2 to evaluate the derived criteria to ensure that they are protective of ecosystems (Table 10). Nine studies of permethrin effects on wildlife were identified and reviewed using Table 3.10 (TenBrook et al. 2009a) for consideration of bioaccumulation in section 11.1.

6 Data reduction

Multiple toxicity values for permethrin for the same species were reduced to one species mean acute toxicity value (SMAV) or one species mean chronic value (SMCV) according to procedures described in the methodology (section 3-2.4, TenBrook et al. 2009a). Acceptable acute and chronic data that were reduced, and the reasons for their exclusion, are shown in Table 4 and Table 7, respectively. Reasons for reduction of data included: flow-through tests are preferred over static tests, more sensitive endpoints were available, a test at standard (vs. non-standard) conditions was available, and more appropriate or more sensitive test durations were available for the same test. The final acute and chronic data sets are shown in Table 3 and Table 6, respectively. The final acute data set contains 20 SMAVs, and the final chronic data set contains three SMCVs.

7 Acute criterion calculation

At least five acceptable acute toxicity values were available and fulfilled the five taxa requirements of the species sensitivity distribution (SSD) procedure (section 3-3.1, TenBrook et al. 2009a). The five taxa requirements are a warm water fish, a fish from the family Salmonidae, a planktonic crustacean, a benthic crustacean, and an insect. Acute values were plotted in a histogram (Figure 2); the data could potentially be bimodal, as the invertebrates and fish are split, with the invertebrates encompassing the lower 7 SMAVs (with one duplicate value), and fish encompassing the upper 12 SMAVs.

The Burr Type III SSD procedure (section 3-3.2.1, TenBrook et al. 2009a) was used for the acute criterion calculation because more than eight acceptable acute toxicity values were available in the permethrin data set (Table 3). The Burr Type III SSD procedure was used to derive the median 5th percentile value and the median 1st percentile value. The software could not provide lower 95% confidence limits for the 1st or 5th percentiles. The median 5th percentile value is recommended for use in criteria derivation by the methodology because it is the most robust of the distributional estimates (section 3-3.2, TenBrook et al. 2009a).

The fit of the Burr III distribution from the BurrliOZ software (CSIRO 2001) is shown in Figure 3. This distribution provided a satisfactory fit (Appendix A: Fit test calculations) according to the fit test described in section 3-3.2.4 of TenBrook et al. (2009a). No significant lack of fit was found ($\chi^2_{2n} = 0.4371$) using a fit test based on cross validation and Fisher's combined test (section 3-3.2.4, TenBrook et al. 2009a), indicating that the data set is valid for criteria derivation. The final criterion is reported with one significant digit because there is variability in the first digit of the 5th percentile values generated in the fit test (Appendix A: Fit test calculations), as described in section 3-3.2.6 (TenBrook et al. 2009a).

Burr III distribution
Fit parameters: b= 7.979000; c= 6.973755; k= 0.065628 (likelihood= 35.692829)

5th percentile, 50% confidence limit: 0.011462 µg/L
1st percentile, 50% confidence limit: 0.000340 µg/L

Recommended acute value = 0.011462 µg/L (median 5th percentile value)

Acute criterion = acute value ÷ 2
= 0.011462 µg/L ÷ 2
= 0.005731 µg/L

Acute criterion = 0.006 µg/L
= 6 ng/L

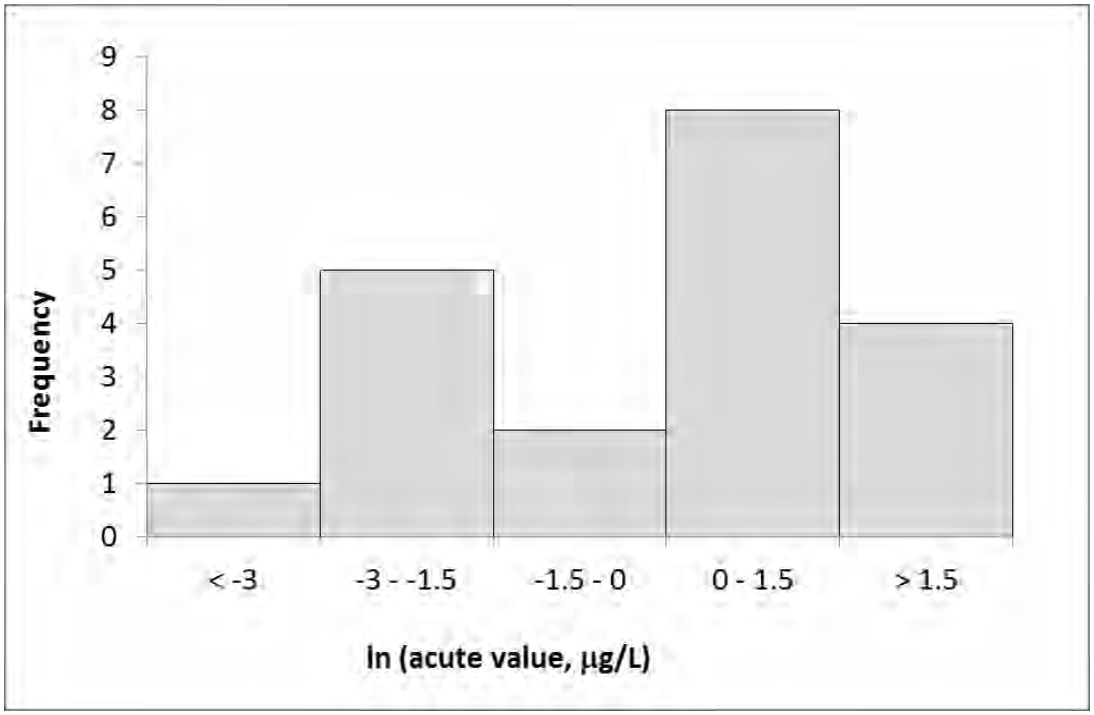

Figure 2 Histogram of the natural log of the permethrin species mean acute values.

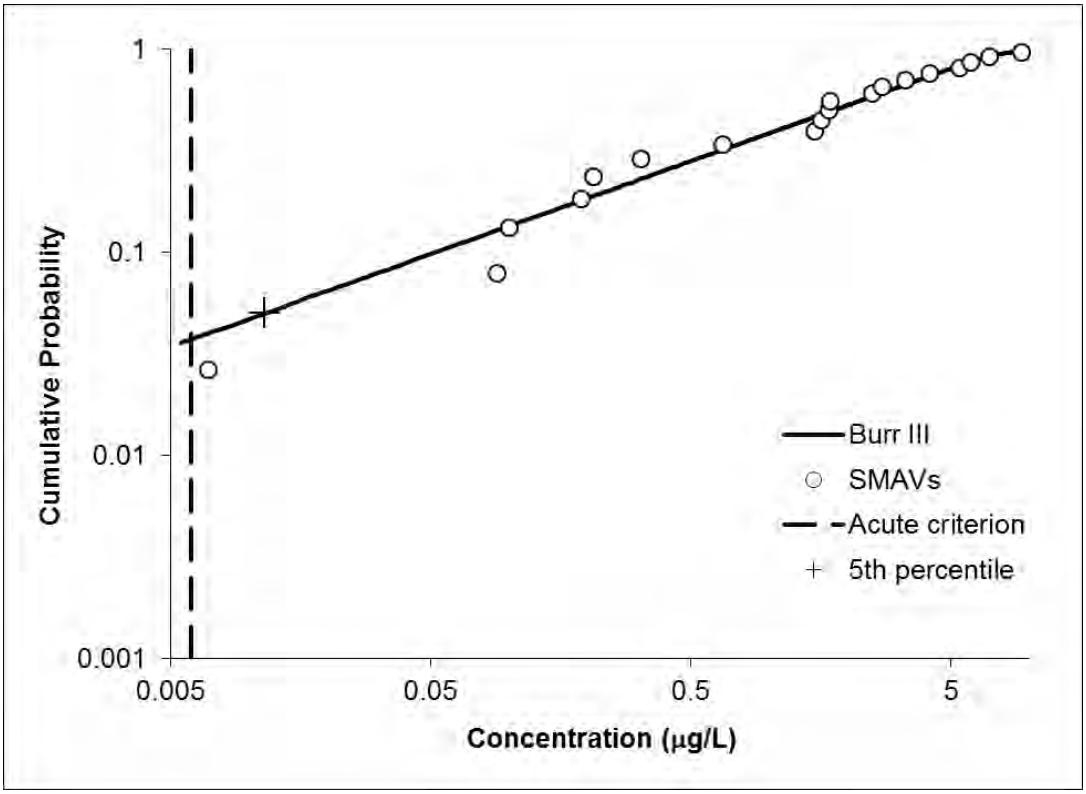

Figure 3 The fit of the Burr Type III distribution to the permethrin acute data set. The acute water quality criterion calculated with the median 5th percentile value is displayed as a vertical line.

8 Chronic criterion calculation

Chronic toxicity values from fewer than five different families were available, thus the acute-to-chronic ratio (ACR) method was used to calculate the chronic criterion (section 3-4.2, TenBrook et al. 2009a). Two SMCVs are in the acceptable (rated RR) data set (Table 6), satisfying two of the five taxa requirements (section 3-3.1, TenBrook et al. 2009a): warm water fish (*Pimephales promelas)* and planktonic crustacean (*Daphnia magna)*.

There were no appropriate acute data to pair with any of the chronic freshwater data. One saltwater chronic toxicity value could be paired with an appropriate corresponding acute toxicity value to calculate an ACR for *Americamysis bahia*, satisfying one of the three family requirements: an invertebrate (section 3-4.2.1, TenBrook et al. 2009a). The species mean ACR (SMACR) for *A. bahia* was calculated by dividing the acute LC_{50} (0.075 µg/L) by the chronic MATC (0.016 µg/L), and resulted in an SMACR of 4.6875.

The final multi-species ACR was obtained by calculating the geometric mean of the *A. bahia* SMACR with two default ACR values to account for the lack of other empirically derived ACRs (section 3-4.4.4, TenBrook et al. 2009a).The default ACR of the UCDM (TenBrook et al. 2009) was updated by Fojut et al. (2014) to include additional pesticide data sets, specifically for the pyrethroids cyfluthrin and λ-cyhalothrin. The updated default ACR calculated by Fojut et al. (2014) is 11.4. The final multi-species ACR value calculated as the geometric mean of three ACRs (4.6875, 11.4, and 11.4) is 8.5 (Table 8). The chronic criterion was calculated using the acute median 5th percentile and the final multi-species ACR as follows:

Chronic criterion = acute median 5th percentile ÷ ACR
= 0.011462 µg/L ÷ 8.5
= 0.001352 µg/L

Chronic criterion = 0.001 µg/L
= 1 ng/L

The chronic criterion is rounded to one significant figure because it is calculated with the acute value, so the same rounding used for the acute criterion was also used for the chronic criterion.

9 Water Quality Effects

9.1 Bioavailability

Although permethrin and other pyrethroids are not very soluble in water, aquatic organisms are very sensitive to pyrethroids and toxicity does occur. Pyrethroids have been identified as a cause of toxicity in surface waters in the California Central Valley

(Phillips et al. 2007, Weston et al. 2009, Weston and Lydy 2010). This toxicity is believed to occur primarily from the fraction of the pyrethroid that is dissolved in the water, not from the fraction that is associated with the particulate phase.

Several studies suggest that the binding of permethrin and other pyrethroids to suspended solids, dissolved organic matter (DOM), or sediment will make the bound fraction unavailable and thus nontoxic to aquatic organisms. Yang et al. (2006a, b) found uptake of permethrin by *Daphnia magna* and toxicity to *Ceriodaphnia dubia* decreased with increasing DOM concentration, and that the organism uptake was closely mimicked by a solid-phase microextraction (SPME) method using polydimethylsiloxane fibers. Regression analysis suggested that the portion of the pesticide sorbed to DOM was unavailable to organisms in the 24-96 hr study periods. Another study demonstrated that particulates and dissolved organic carbon (DOC) decreased the uptake and bioconcentration of permethrin in rainbow trout (Muir et al. 1994).

DeLorenzo et al. (2006) tested the toxicity of permethrin to grass shrimp larvae (*Palaemonetes pugio*) with and without sediment and the 24-h LC_{50} with sediment (0.22 μg/L) was a factor of 2.2 higher than when sediment was not present (0.10 μg/L). Hunter et al. (2008) found that the sediment organic carbon (OC)-normalized concentration of permethrin was highly correlated with the uptake of permethrin by *Chironomus dilutus* (formerly *C. tentans*), demonstrating a correlation between bioavailability of permethrin and sorption to OC. Uptake of permethrin by *C. dilutus* was also measured by Muir et al. (1985) in aquatic exposures with either sand, silt or clay and they found that uptake was most highly correlated to the dissolved concentration of permethrin in porewater, compared to concentrations in the sediment or whole water. They reported that sorption to sediments, suspended solids, and DOC, and hydrolysis all reduced bioavailability of pyrethroids. There are many studies on pyrethroids, not necessarily including permethrin, that also demonstrate decreased toxicity of pyrethroids in the presence of sediment, DOC, and other natural sorbents (Day 1991, Smith & Lizotte 2007, Xu et al. 2007). These studies indicate that the freely dissolved concentration will be the most accurate predictor of toxicity and that bound permethrin was unavailable to the organisms that were studied.

It can also be noted that bound pyrethroids can continue to desorb into the water column for long periods of time because pyrethroids have long equilibration times (~30 d, Bondarenko et al. 2006) and environmental systems are not likely at true equilibrium. The fraction of chemical that is potentially available to an organism is known as the bioaccessible fraction, and it has been linked to biological effects (Semple et al. 2004, You et al. 2011). Benthic organisms, such as *Hyalella azteca,* may be at greater risk because of their exposure to porewater and close proximity to sediments where dissolved concentrations may persist.

Additionally, the role of dietary exposure on bioavailability of pyrethroids has not been considered. Organisms living in contaminated waters are also ingesting food with sorbed hydrophobic compounds that can be desorbed by digestive juices (Mayer et al. 2001). The effects of dietary exposure may also be species-specific, depending on typical food sources; some species may have greater interaction with particles, increasing their

exposure. Palmquist et al. (2008) examined the effects due to dietary exposure of the pyrethroid esfenvalerate on three aquatic insects with different feeding functions: a grazing scraper (*Cinygmula reticulata* McDunnough), an omnivore filter feeder (*Brachycentrus americanus* Banks), and a predator (*Hesperoperla pacifica* Banks). The researchers observed adverse effects in *C. reticulata* and *B. americanus* after feeding on esfenvalerate-laced food sources and that none of the three insects avoided the contaminated food. The effects included reduced growth and egg production of *C. reticulata* and abandonment and mortality in *B. americanus*. Stratton and Corke (1981) tested toxicity of permethrin to *Daphnia magna* with and without feeding of algae, and found that mortality at 24 h was significantly increased when daphnids were fed, although mortality at 48 h was not affected. The authors propose that permethrin may have been ingested by the daphnids if it was sorbed on the algal cells, and caused increased toxicity, although the same effect was not seen when bacteria were provided as a food source. These limited studies indicate that ingestion may be an important exposure route, but it is not currently possible to incorporate this exposure route into criteria compliance assessment.

Section 3-5.1 of the methodology (TenBrook et al. 2009a) suggests that if studies indicate that fewer than three phases of the pesticide (sorbed to solids, sorbed to dissolved solids, or freely dissolved in the water) are bioavailable, then compliance may be based on the concentration in the bioavailable phase(s). The studies above suggest that the freely dissolved fraction of permethrin is the primary bioavailable phase, and that this concentration is the best indicator of toxicity, thus, it is recommended that the freely dissolved fraction of permethrin be directly measured or calculated based on site-specific information for compliance assessment. If environmental managers choose to measure whole water concentrations for criteria compliance assessment, the bioavailable fraction will likely be overestimated.

The most direct way to determine compliance would be to measure the permethrin concentration in the dissolved phase to determine the total bioavailable concentration. Solid-phase microextraction only measures the freely dissolved concentration and has shown to be the best predictor of pyrethroid toxicity in several studies (Bondarenko et al. 2007, Bondarenko & Gan 2009, Hunter et al. 2008, Xu et al. 2007, Yang et al. 2006a, 2006b, 2007). Bondarenko & Gan (2009) report method detection limits of 2.0 ng/L for cis-permethrin and 3.0 for trans-permethrin, and Li et al. (2009) report a method detection limit of 1.2 ng/L for permethrin using SPME.

Filtration of particles is another option. Glass fiber filters with a nominal pore size of 0.7 μm or 0.45 μm are often used to remove the suspended sediments or both suspended sediments and dissolved organic matter, but the filters can interfere with the detection of hydrophobic contaminants. Gomez-Gutierrez et al. (2007) found that adsorption to filters was positively correlated with the log K_{ow} and solubility values of the compounds, and that on average 58% of a 50 ng/L solution of permethrin was lost on the filter. House and Ou (1992) also tested several filter materials and found that glass fiber filters had the lowest losses of pyrethroids at 5-20%. This loss may be critical for determining compliance at environmental concentrations, thus syringe filters are not

recommended for sample handling. However, the U.S. Geological Survey (USGS) has developed a filtration sample handling method specifically for pyrethroids (Hladik et al. 2009). This method involves filtering water through a diaphragm pump, with equipment made from specified materials and flow rates, and for the least losses samples should be filtered in the field. Approximately 3-5% of pyrethroids were lost to surface association in the filtration apparatus, which is considered minimal and acceptable by USGS.

Alternately, the following equation can be used to translate total permethrin concentrations measured in whole water to the associated dissolved permethrin concentrations:

$$C_{dissolved} = \frac{C_{total}}{1 + ((K_{OC} \cdot [SS]) / foc) + (K_{DOC} \cdot [DOC])} \quad (1)$$

where: $C_{dissolved}$ = concentration of chemical in dissolved phase (µg/L);
C_{total} = total concentration of chemical in water (µg/L);
K_{OC} = organic carbon-water partition coefficient (L/kg);
$[SS]$ = concentration of suspended solids in water (kg/L);
f_{oc} = fraction of organic carbon in suspended sediment in water;
$[DOC]$ = concentration of dissolved organic carbon in water (kg/L);
K_{DOC} = organic carbon-water partition coefficient (L/kg) for DOC.

To determine compliance by this calculation, site-specific data are necessary, including: K_{OC}, K_{DOC}, the concentration of suspended solids, the concentration of DOC, and the fraction of organic carbon in the suspended solids. If all of these site-specific data, including the partition coefficients, are not available, then this equation should not be used for compliance determination. Site-specific data are required because the sorption of permethrin to suspended solids and dissolved organic matter depends on the physical and chemical properties of the suspended solids, and partition coefficients can vary by orders of magnitude. Such physical-chemical properties can vary both spatially and temporally, further complicating measurement of these properties and subsequent assessment of bioavailability using site-specific partition coefficients.

The freely dissolved permethrin concentration is recommended for determination of criteria compliance because the literature suggests that the freely dissolved concentrations are the most accurate predictor of toxicity. Environmental managers may choose an appropriate method for determination of the concentration of freely dissolved permethrin, or they may also choose to base compliance on whole water concentrations.

9.2 Mixtures

Permethrin often occurs in the environment with other pyrethroid pesticides (Trimble et al. 2009, Werner & Moran 2008), and the presence of chemicals in surface waters is ubiquitous. All pyrethroids have the same general toxicological mode of action, and several studies have demonstrated that the toxicity of pyrethroid mixtures is additive and is well-predicted by the concentration addition model (Barata et al. 2006, Brander et

al. 2009, Trimble et al. 2009). Overall, the concentration addition model should be used by following either the toxic unit or relative potency factor approach to determine criteria compliance when multiple pyrethroids are present. Definitions of additivity, synergism, antagonism, and non-additivity are available in the literature (Lydy and Austin 2004) and more detailed descriptions of mixture models can be found in the methodology (section 3-5.2, TenBrook et al. 2009a).

Brander et al. (2009) tested mixture toxicity of cyfluthrin and permethrin, and found that the combined toxicity was nearly additive. Although the binary mixture demonstrated slight antagonism, additivity was demonstrated when piperonyl butoxide (PBO) was added. Brander et al. (2009) offered several explanations for the observed antagonism between the two pyrethroids. Permethrin is a type I pyrethroid, and cyfluthrin is a type II pyrethroid, and type II pyrethroids might be able to outcompete type I pyrethroids for binding sites, which is known as competitive agonism; or binding sites may be saturated, so that complete additivity is not observed. They also note that cyfluthrin is metabolized more slowly than permethrin, so cyfluthrin can bind longer, and permethrin may be degraded when binding sites open. PBO may remove this effect because the rate of metabolism of both pyrethroids is reduced in the presence of PBO.

Callinan et al. (2012) tested pyrethroid mixtures with *Hyalella azteca* in aqueous exposures in the following binary combinations: type I-type I (bifenthrin-permethrin), type I-type II (bifenthrin-cyfluthrin, bifenthrin-lambda-cyhalothrin, permethrin-cyfluthrin, and permethrin-lambda-cyhalothrin) and type II-type II (cyfluthrin-lambda-cyhalothrin). These combinations were tested in 4-day exposures, and two of the combinations were also tested in 10-day chronic exposures. Both the concentration addition and the independent action models were fit to the observed toxicity data and the fits were compared with several statistical analyses. One way of comparing the fits indicated that all combinations of pyrethroids were additive following the concentration addition model. Another way of comparing the results indicated that there was slight antagonism in two of the pyrethroid combinations (bifenthrin-cyfluthrin and permethrin-cyfluthrin), but only in the 4-day tests, not in the 10-day tests.

To examine if pyrethroid mixture toxicity is additive with a comprehensive study design, Trimble et al. (2009) performed sediment toxicity tests with *Hyalella azteca* in three binary combinations: type I-type I (permethrin-bifenthrin), type II-type II (cypermethrin-λ-cyhalothrin), and type I-type II (bifenthrin-cypermethrin). The toxicity of these combinations were predicted with the concentration addition model, with model deviations within a factor of two, indicating that in general, pyrethroid mixture toxicity is additive.

PBO is commonly added to pyrethroid insecticide treatments because it is known to increase the toxic effects of pyrethroids (Weston et al. 2006). Many studies have demonstrated that the addition of PBO at a concentration that would be nonlethal on its own, increases the toxicity of permethrin for fish, insects, crustaceans and mollusks, with interaction coefficients ranging from 1.54-60, as summarized below. Brander et al. (2009) observed *Hyalella azteca* LC_{50}s decreased by a factor of 3.5 when a nonlethal concentration of PBO was mixed with permethrin. Paul and Simonin (2006) reported that

toxicity to crayfish increased by a factor of 2.1 when testing a formulation that contained 31.28% permethrin and 66% PBO compared to a product that was 92% permethrin (0% PBO) based on the 96-h LC_{50}. Paul et al. (2005) reported a significant difference between technical permethrin vs. PBO-synergized permethrin in toxicity to brook trout from 24-96 h and an interaction coefficient (K) of 2.9. The addition of a nonlethal concentration of PBO reduced the LC_{50} of permethrin to snails with a K of 60 at 96 h (Singh & Agarwal 1986).

Permethrin toxicity with and without PBO was tested with mosquitoes by Hardstone et al. (2007, 2008) with a permethrin-susceptible strain, resulting in an K of 1.54. Kasai et al. (1998) also did experiments with *Culex quinquefasciatus* mosquitoes and demonstrated that a nonlethal concentration of 0.5 mg/L PBO decreased the LC_{50} of permethrin from 4 ug/L to 0.44 ug/L in a permethrin-susceptible strain. Xu et al. (2005) tested permethrin toxicity to *C. quinquefasciatus* with and without PBO and reported a K of 4.5 for a permethrin-susceptible strain. Paul et al. (2006) tested *Aedes aegypti* mosquitoes and reported a K for permethrin and PBO of 11. While many studies report interaction coefficients for synergism of PBO, none of them reported Ks for multiple PBO concentrations, so a relationship between PBO concentration and K cannot be determined for any given species. Consequently, it is not possible to quantify this non-additive toxicity and there is no accurate way to account for this interaction in compliance determination.

Corbel et al. (2003) tested the toxicity of permethrin in combination with propoxur, a carbamate, with mosquito larvae and found that equitoxic mixtures of the two chemicals demonstrated synergism, which the authors propose is due to the complementary modes of action acting on different parts of the nervous system. Zhang et al. (2010) tested mixtures of permethrin with the organophosphates dichlorvos or phoxim with zebrafish and reported that the toxicity of binary combinations was additive.

No studies on aquatic organisms were found in the literature that could provide a quantitative means to consider mixtures of permethrin with other classes of pesticides. Although there are examples of non-additive toxicity for permethrin and other chemicals, a multispecies interaction coefficient is not available for any chemical with permethrin, and therefore the concentrations of non-additive chemicals cannot be used for criteria compliance (section 3-5.2.2, TenBrook et al. 2009a).

9.3 Temperature, pH, other water quality effects

Temperature, pH, and other water quality effects on the toxicity of permethrin were examined to determine if any effects are described well enough in the literature to incorporate into criteria compliance (section 3-5.3, TenBrook et al. 2009a). Temperature has been found to be inversely proportional to the aquatic toxicity and bioavailability of pyrethroids (Miller & Salgado 1985, Werner & Moran 2008). In fact, the increase of toxicity of pyrethroids with decreasing temperature has been used to implicate pyrethroids as the source of toxicity in environmental samples (Phillips et al. 2004, Weston et al. 2009). The inverse relationship between temperature and pyrethroid

toxicity is likely due to the increased sensitivity of an organism's sodium channels at low temperatures (Narahashi et al. 1998).

Harwood et al. (2009) tested permethrin toxicity to *Chironomus dilutus* in an aqueous exposure at 13˚C and 23˚C, and reported a 3.2-fold decrease of the 96-h LC_{50} at the lower temperature. The toxicities of six aqueous pyrethroids (cypermethrin, permethrin, fenvalerate, *d*-phenothrin, flucythrinate, and bioallethrin) were 1.33- to 3.63-fold greater at 20˚C compared to 30 ˚C for mosquito larvae (Cutkomp and Subramanyam 1986). Kumaraguru and Beamish (1981) reported that for small trout, toxicity of permethrin increased by a factor of 10 with a decrease in temperature from 20˚C to 5˚C, but showed little change from 10˚C to 5˚C. The enhanced toxic effects of pyrethroids at lower temperatures may not be as accurately represented by the results of typical laboratory toxicity tests, which tend to be run at warmer temperatures, 20-23 ˚C (USEPA 1996a, USEPA 1996b, USEPA 2000), than those of the habitats of coldwater fishes, about 15˚C or lower (Sullivan et al. 2000).

The toxicity of sediments contaminated with pyrethroids (including permethrin) was more than twice as toxic when tested at 18 ˚C compared to 23 ˚C (Weston et al. 2008). Weston et al. (2008) used a toxicity identification evaluation (TIE) procedure to determine the effect of temperature reduction (18 vs. 23 ˚C) on toxicity of a particular environmental sediment sample to *Hyalella azteca*. These results are not directly applicable for use in water quality criteria compliance because they were sediment exposures, and used environmental samples, instead of an exposure to a pure compound.

Unfortunately, there are limited data demonstrating increased toxicity at lower temperatures using aquatic exposures with relevant species, making it unfeasible to quantify the relationship between the toxicity of permethrin and temperature for water quality criteria at this time (section 3-5.3, TenBrook et al. 2009a). Several studies that examined the effects of DOC and suspended solids on permethrin toxicity are discussed in the bioavailability section 9.1. No other studies on permethrin were identified that examined the effects of pH or other water quality parameters on toxicity, thus, there is no way to incorporate any of these parameters into criteria compliance.

10 Comparison of ecotoxicity data to derived criteria

10.1 Sensitive species

The derived criteria are compared to toxicity values for the most sensitive species in both the acceptable (RR) and supplemental (RL, LR, LL) data sets to ensure that these species will be adequately protected (section 3-6.1, TenBrook et al. 2009a). The derived acute criterion (6 ng/L) is below all of the acute values in the available data sets. The lowest acute value in the data sets rated RR, RL, LR, or LL (Table 3, Table 4, Table 5) is 7.0 ng/L for the amphipod *Hyalella azteca* (Bradley 2013). This toxicity value is only slightly above the derived acute criterion, however guidance in the method recommends downward adjustment of the criterion only if a toxicity value is higher than the derived criterion. Therefore, downward adjustment of the acute criterion is not recommended.

The derived chronic criterion (1 ng/L) is below all of the chronic values in the available data sets. The lowest chronic value in the data sets rated RR, RL, LR, or LL (Table 6, Table 7, Table 9) is a MATC of 16 ng/L for *Americamysis bahia* (Thompson et al. 1989). Based on the current data sets, the derived criteria appear to be protective of the most sensitive species.

10.2 Ecosystem and other studies

The derived criteria are compared to acceptable laboratory, field, or semi-field multispecies studies (rated R or L) to determine if the criteria will be protective of ecosystems (section 3-6.2, TenBrook et al. 2009a). Twelve studies describing effects of permethrin on mesocosm, microcosm and model ecosystems were identified and rated for reliability according to the methodology (Table 3.9, TenBrook et al. 2009a). Six of the studies were rated as less reliable (L; Conrad et al. 1999, Coulon 1982, Lutnicka et al. 1999, Poirier & Surgeoner 1988, Werner & Hilgert 1992, Yasuno et al. 1988) and are used as supporting data. All of the studies are listed in Table 10 with their ratings. Six studies rated as not reliable (N) and are not discussed in this report (Feng et al. 2009, Helson et al. 1986, 1993, Jensen et al. 1999, Milam et al. 2000, Mulla et al. 1978). None of the studies report a community NOEC to which the calculated chronic criterion may be compared. All of the reported test concentrations were significantly higher than the chronic criterion of 0.001 μg/L, with concentrations ranging from 0.02-100 μg/L, and all studies were conducted with formulations of permethrin. All of these studies reported adverse effects on aquatic organisms, but since the tested concentrations were much higher than the criterion, these data do not provide clear guidance as to whether the derived criterion is under- or overprotective.

Two studies reported increased invertebrate drifting after exposure to permethrin. Werner & Hilgert (1992) reported residues of 0.02-0.14 μg/L permethrin had drifted into an Alaskan stream after spruce trees were sprayed, and drifting of aquatic invertebrates (Chironomidae, ephemeropteran and, trichopteran larvae) significantly increased after the treatment, but trout fry, periphyton, and benthic invertebrates were not affected. Poirier & Surgeoner (1988) exposed various aquatic invertebrates to flowing stream water in constructed troughs with 1-h application of a permethrin formulation (Ambush® EC) at 7-10 concentrations. LC_{50}s were reported for six invertebrates ranging from 2.0-7.1 μg/L, although invertebrate drift occurred at all concentrations greater than 0.5 μg/L permethrin. Lutnicka et al. (1999) also set up model riverine systems containing sediment and moderately contaminated river water and stocked them with lab cultures of water-thyme (*Elodea*), snails and carp (*Cyprinus carpio*). Permethrin was added at two concentrations (4 and 20 μg/L) and snails and water-thyme were both adversely affected at both concentrations.

Pond exposures also demonstrated adverse effects on various aquatic invertebrates, while fish were unaffected. Yasuno et al. (1988) tested permethrin in enclosures set in a pond and studied the effects on the naturally occurring species of the pond, including phytoplankton and various types of zooplankton. Daphnids and their

main predator, *Chaoborus*, where both seriously affected by permethrin, and both populations disappeared and did not seem to recover after two treatments of permethrin spaced 18 d apart at a nominal treatment level of 1.5 μg/L. Coulon (1982) tested the Ambush® formulation and reported no mortality of catfish reared in ponds at any of the exposures (0.53-11.09 μg/L measured at 24 h), but aquatic insects were temporarily eliminated. The insects reinhabited the ponds 10-d post-application. Conrad et al. (1999) dosed small artificial ponds with permethrin (nominal aqueous concentrations of 1, 10, 50, and 100 μg/L with the formulation Picket®) and conducted bioassays with chironomids and also observed aquatic invertebrate abundances. The field exposure data were compared to laboratory sediment toxicity tests with *Chironomus riparius*. The chironomid response in the ponds of reduced larval density and adult emergence was not predicted by bulk sediment chemistry, sediment toxicity tests or laboratory bioassay results – all three measurements underestimated the acute effects. Toxicity to *C. riparius* in the field was best predicted by acute water-only toxicity test data, indicating that the primary exposure route is via the water column. This study supports the use of the freely dissolved fraction for water quality criteria compliance and affirms the relevance of water quality criteria for highly sorptive pesticides like pyrethroids.

10.3 Threatened and endangered species

The derived criteria are compared to measured toxicity values for threatened and endangered species (TES), as well as to predicted toxicity values for TES, to ensure that they will be protective of these species (section 3-6.3, TenBrook et al. 2009a). Current lists of state and federally listed threatened and endangered plant and animal species in California were obtained from the California Department of Fish and Game (CDFG) website (http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf; CDFG 2008). Three California listed animal species are represented in the data set. Five Evolutionarily Significant Units of *Oncorhynchus mykiss* are listed as federally threatened or endangered throughout California. The acute data set includes a SMAV for *O. mykiss* of 7.0 μg/L. Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) is represented in the RR data set with a with an LC_{50} of 1.58 (1.1-2.2) μg/L, and the razorback sucker is also in the acute RR data set with an LC_{50} of 5.95 (4.6-7.7) μg/L. All three of these values in the data set were included in the acute criterion calculation and are well above the recommended acute criterion. The acute data set also contains SMAVs for five additional species that are federally listed (http://ecos.fws.gov/tess_public/pub/listedAnimals.jsp), but not specifically for California, including: *Etheostoma fonticola, Erimonax monachus, Notropis mekistocholas, Oncorhynchus apache,* and *Salmo salar.*

Some of the listed species are represented in the acute toxicity data set by members of the same family or genus. *Oncorhynchus mykiss* can serve as a surrogate in estimates for other species in the same family using the USEPA interspecies correlation estimation website (Web-ICE v. 2.0; Raimondo et al. 2007). Table 11 summarizes the results of the ICE analyses. The estimated acute toxicity values in Table 11 range from 3.48 μg/L for Greenback cutthroat trout to 11.88 μg/L for Chinook salmon.

No single-species plant studies were found in the literature for use in criteria derivation, so no estimation could be made for plants on the state or federal endangered, threatened or rare species lists. There are also no aquatic plants listed as state or federal endangered, threatened or rare species so they are not considered in this section. Based on the available data and estimated values for animals, there is no evidence that the calculated acute and chronic criteria will be underprotective of threatened and endangered species.

11 Harmonization with other environmental media

11.1 Bioaccumulation

Bioaccumulation was assessed to ensure that the derived criteria will not lead to unacceptable levels of permethrin in food items (section 3-7.1, TenBrook et al. 2009a). Permethrin has a log K_{ow} of 7.08 and a molecular weight of 391.3 (section 3), which indicates it has bioaccumulative potential (section 3-7.1, TenBrook et al. 2009a). No biomagnification factor (BMF) values were found in the literature for permethrin, but bioconcentration of permethrin has been measured in several studies (Table 1).

To check that these criteria are protective of terrestrial wildlife that may consume aquatic organisms, a bioaccumulation factor (BAF) was used to estimate the water concentration that would roughly equate to a reported toxicity value for consumption of fish by terrestrial wildlife. These calculations are further explained in section 3-7.1 of the methodology (TenBrook et al. 2009a). The BAF of a given chemical is the product of the bioconcentration factor (BCF) and a BMF, such that BAF=BCF*BMF. For a conservative estimate, the highest fish BCF of 2800 L/kg for *Pimephales promelas* (Table 1) and a default BMF of 10, chosen based on the log K_{ow} of permethrin (Table 3.15, TenBrook et al. 2009a), were used to calculate a BAF. A chronic dietary NOEC for an oral predator is preferred for this calculation because it is the most realistic value for extrapolation to bioaccumulation in the environment (section 3-7.1, TenBrook et al. 2009a), so the dietary NOEC for mallard duck of 125 mg/kg (Beavers et al. 1992) was used.

$$NOEC_{water} = \frac{NOEC_{oral_predator}}{BCF_{food_item} * BMF_{food_item}}$$

Mallard:

$$NOEC_{water} = \frac{125^{mg}/_{kg}}{2800^{L}/_{kg} * 10} = 0.00446^{mg}/_{L} = 4.46^{\mu g}/_{L}$$

In this example, the chronic criterion of 0.001 µg/L is 4,460-fold below the estimated $NOEC_{water}$ for mallard, and is not likely to cause adverse effects to terrestrial wildlife. Bioaccumulation of permethrin is not likely because the $NOEC_{water}$ is approaching the

aqueous solubility of permethrin (5.7 μg/L, section 3) and there would likely be acute toxicity to aquatic organisms at this concentration.

11.2 Harmonization with air or sediment criteria

This section addresses how the maximum allowable concentration of permethrin might impact life in other environmental compartments through partitioning (section 3-7.2, TenBrook et al. 2009a). However, there are no federal or state sediment or air quality standards for permethrin (CARB 2005, CDWR 1995, USEPA 2006b, USEPA 2006c) to enable this kind of extrapolation. For biota, the limited data on bioconcentration or biomagnification of permethrin were addressed in the bioaccumulation section (section 11.1).

12 Permethrin criteria summary

12.1 Assumptions, limitations and uncertainties

The assumptions, limitations and uncertainties involved in criteria derivation should be available to inform environmental managers of the accuracy and confidence in the derived criteria (section 3-8.0, TenBrook et al. 2009a). Chapter 2 of the methodology discusses these points for each section as different procedures were chosen, such as the list of assumptions associated with using a SSD (section 2-3.1.5.1), and there is a review of the assumptions in section 2-7.0 (TenBrook et al. 2009a). This section summarizes any data limitations that affected the procedure used to determine the final permethrin criteria.

There were enough highly rated acute permethrin data to use a SSD to calculate the acute criterion, but one limitation in the data set is that not all of the data are from flow-through tests that use measured concentrations to calculate the toxicity values. Flow-through tests and measurement of concentrations are particularly important in tests with pyrethroid pesticides because they are highly sorptive. Four of the 20 acute RR SMAVs are from flow-through tests, and only four SMAVs are based on measured concentrations. The lowest toxicity value in the acute data set (*Hyalella azteca* SMAV=7.0 ng/L) is from a flow-through test calculated with measured concentrations, and the acute criterion appears to be protective of this sensitive species.

For permethrin, the major limitation was in the chronic toxicity data set. Three of five taxa requirements were not met (the salmonid, benthic crustacean and insect), which precluded the use of a SSD; therefore, an ACR was used to derive the chronic criterion. There were no paired freshwater data available to calculate a multi-species ACR, so one data pair for a saltwater species was used with default ACRs for the other two ACR requirements (as specified in section 3-4.2.2, TenBrook et al. 2009a). Particularly of concern for the chronic toxicity data set was the lack of data on *Hyalella azteca* or another benthic organism, which was the most sensitive species in the acute toxicity data set. Uncertainty cannot be quantified for the chronic criterion because it was derived using an ACR, not an SSD.

Another factor that could not be accounted for quantitatively in criteria compliance is the increase in toxicity at lower temperatures. Most of the toxicity data were from tests performed at standard temperature, usually around 20 ˚C. Tests for seven of the 19 species in the acute data set used lower temperatures (*Erimonax monachus, Notropis mekistocholas, Oncorhynchus apache, O. clarki henshawi, O. mykiss, Orconectes immunis,* and *Salmo salar*). However, many streams in the California Central Valley often have lower water temperatures. If colder water bodies are impacted by concentrations of permethrin, it may be appropriate to apply an additional safety factor to the permethrin criteria for those areas, to ensure adequate protection. A rough factor of two could be estimated from a study by Weston et al. (2008), however, a study relating temperature to aqueous toxicity of permethrin in multiple species, including *Hyalella azteca,* would be ideal to derive such an adjustment factor. We do not recommend an additional safety factor to account for temperature effects at this time, but environmental managers may want to consider this application if the criteria do not appear to be protective of organisms in a colder water body. If aquatic exposure data for multiple species demonstrating temperature effects become available in the future, a regression equation describing the effect should be incorporated into criteria compliance.

Although greater than additive effects have been observed for mixtures of pyrethroids and PBO, there are insufficient data to account for this interaction for compliance determination. This is a significant limitation because formulations that contain both pyrethroids and PBO are now available on the market. When additional highly rated data are available, the criteria should be recalculated to incorporate new research.

12.2 Comparison to national standard methods

This section is provided as a comparison between the UC-Davis methodology for criteria calculation (TenBrook et al. 2009a) and the current USEPA (1985) national standard. The following example permethrin criteria were generated using the USEPA 1985 methodology with the data set generated in this permethrin criteria report.

The USEPA acute methods have three additional taxa requirement beyond the five required by the UC-Davis methodology (section 3-3.1, TenBrook et al. 2009a). They are:

1. A third family in the phylum Chordata (e.g., fish, amphibian);
2. A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca);
3. A family in any order of insect or any phylum not already represented.

Two out of the three of these additional requirements are met as follows:

1. The other fish/amphibian requirement is met with data from zebra fish or any of six other fish species available.

2. This requirement is not met because all data are from organisms in the phylum Arthropoda or Chordata.
3. This requirement is met because *Procloeon sp.* is an insect in a different family than *Chironomus dilutus*.

Strictly speaking, the USEPA methodology cannot be used to calculate an acute criterion for permethrin. However, since the California Department of Fish and Game have used data sets that met only seven of eight requirements in the USEPA methodology when the missing taxon is known to be insensitive to the chemical of interest, as is the case for permethrin, this will be done here.

Using the log-triangular calculation (following the USEPA 1985 guidelines) and the permethrin data set from Table 3, but calculating 17 genus mean values instead of 20 species mean values, the following criterion was calculated (Note: USEPA methodology uses *genus* mean acute values, while *species* mean acute values are used in this methodology and are reported in Table 3. There are several species from the same genus in Table 3, so the final data sets are not the same in the two schemes.):

Example Final Acute Value (5th percentile) = 0.008042 μg/L

Example Acute Criterion = final acute value ÷ 2
= 0.008042 μg/L ÷ 2
= 0.004021 μg/L
= 4.0 ng/L

According to the USEPA (1985) methodology, the criterion is rounded to two significant digits. This value is a factor of 1.5 lower than the acute criterion calculated by the UC-Davis methodology.

For the chronic criterion, the permethrin data set only has data from two species, which are not enough for use in a SSD by either method. The USEPA 1985 methodology contains a similar ACR procedure as in the UC-Davis methodology, to be used when three acceptable ACRs are available. There was only one ACR available, therefore a chronic criterion cannot be calculated for permethrin using the EPA method.

12.3 Final criteria statement

The final criteria statement is:

Aquatic life in the Sacramento River and San Joaquin River basins should not be affected unacceptably if the four-day average concentration of permethrin does not exceed 0.001 μg/L (1 ng/L) more than once every three years on the average and if the one-hour average concentration does not exceed 0.006 μg/L (6 ng/L) more than once every three years on the average. Mixtures of permethrin and other pyrethroids should be considered in an additive manner (see Mixtures section 9.2).

While the aim of this criteria report was to derive criteria protective of aquatic life in the Sacramento and San Joaquin Rivers, these criteria would be appropriate for any freshwater ecosystem in North America, unless species more sensitive than are represented by the species examined in the development of these criteria are likely to occur in those ecosystems.

The final acute criterion was derived using the Burr Type III SSD procedure (section 7) and the acute data used in criteria calculation are shown in Table 3. The chronic criterion was derived by use of an ACR calculated from a combination of measured data and default ACRs (section 8); chronic data rated RR are shown in Table 6, and the ACRs are shown in Table 8. It is recommended that the freely dissolved permethrin concentration is measured for criteria compliance because this appears to be the best predictor of the bioavailable fraction (section 9.1).

Several other jurisdictions have established water quality criteria for permethrin. The Netherlands' freshwater criterion is 0.3 ng/L (Crommentuijn et al. 1997), the freshwater environmental quality standard in the United Kingdom is 10 ng/L (Zabel et al. 1988), Quebec has an interim acute criterion of 44 ng/L and an interim chronic criterion of 13 ng/L (Guay et al. 2000), and Canada has an interim water quality guideline of 4 ng/L (CCME 2006). The acute and chronic criteria derived using the UC-Davis methodology are within the range of criteria reported by other jurisdictions, and are not far above or below these other criteria that have been derived. The example acute criterion calculated by the USEPA 1985 method is less than a factor of 2 different from the criterion derived using this new methodology. The derived criteria appear to be protective considering bioaccumulation, ecosystem level toxicity and threatened and endangered species as discussed above in the report, but the criteria calculations should be updated whenever new data are available.

Acknowledgements

The authors of the original 2011 criteria report thank the following reviewers of the original 2011 criteria report: Stella McMillan (CDFG), John P. Knezovich (Lawrence Livermore National Laboratory), and Xin Deng (CDPR). The original 2011 report was funded through a contract with the Central Valley Regional Water Quality Control Board of California. Mention of specific products, policies, or procedures do not represent endorsement by the Regional Board.

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Data Tables

Table 3 Final acute toxicity data set for permethrin.
All studies were rated RR. S: static; SR: static renewal; FT: flow-through.

Species	Common Identifier	Family	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/ size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.0%	48 hr	25	Mortality	< 24 hr	0.250 (± 119)	Wheelock et al. 2004
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.652 (0.484-0.856)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.788 (0.545-1.040)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.622 (0.427-0.824)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.772 (0.574-1.013)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.745 (0.568-0.957)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.858 (0.591-1.138)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.571 (0.427-0.740)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.580 (0.407-0.718)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.609 (0.486-0.747)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.570 (0.459-0.689)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.827 (0.669-1.012)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.585 (0.677-0.793)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.849 (0.655-1.085)	Yang et al. 2007
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.889 (0.666-1.120)	Yang et al. 2007

Table 3 Final acute toxicity data set for permethrin.
All studies were rated RR. S: static; SR: static renewal; FT: flow-through.

Species	Common Identifier	Family	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/ size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference
Ceriodaphnia dubia	Daphnid	Daphniidae	S	Nom	99.3%	96 hr	21	Mortality	< 24 hr	0.865 (0.672-1.098)	Yang et al. 2007
Ceriodaphnia dubia								Mortality		**0.664**	**GEOMEAN**
Chironomus dilutus	Midge	Chironomidae	S	Meas	>96%	96 hr	23	Mortality	4th instar larvae	**0.189** (0.131-0.295)	Harwood et al. 2009
Danio rerio	Zebra fish	Cyprinidae	SR	Nom	90.0%	96 hr	23	Mortality	3.0 cm, 0.3 g	**2.5** (1.7-3.2)	Zhang et al. 2010
Daphnia magna	Daphnid	Daphniidae	S	Nom	Technical	48 hr	22	Immobility	< 24 hr	**0.32** (0.24-0.44)	LeBlanc 1976
Erimonax monachus	Spotfin chub	Cyprinidae	S	Nom	95.2%	96 hr	17	Mortality	NR	**1.7**	Dwyer et al. 2005
Etheostoma fonticola	Fountain darter	Percidae	S	Nom	95.2%	96 hr	22	Mortality	62 mg, 20.2 mm	**3.34** (2.75-4.16)	Dwyer et al. 1999, 2005
Etheostoma lepidum	Greenthroat darter	Percidae	S	Nom	95.2%	96 hr	22	Mortality	NR	**2.71** (2.36-3.13)	Dwyer et al. 1999, 2005
Hexagenia bilineata	Mayfly		FT	Meas	91.5	96 h	22	Mortality	Early instar	**0.100** (0.085-0.120)	Forbis & McAllister 1980
Hyalella azteca	Amphipod	Hyalellidae	FT	Meas	96.4%	96 hr	23	Mortality	9 d	**0.0070** (0.0059-0.0082)	Bradley 2013
Ictalurus punctatus	Catfish	Ictaluridae	S	Nom	92.4%	96 hr	21	Mortality	1.2 g, 35 mm	**5.4** (3.9-7.4)	Buccafusco 1976a
Notropis mekistocholas	Cape Fear shiner	Cyprinidae	S	Nom	95.2%	96 hr	17	Mortality	NR	**4.16**	Dwyer et al. 2005
Oncorhynchus apache	Apache trout	Salmonidae	S	Nom	95.2%	96 hr	12	Mortality	0.615 g	**1.71** (1.3-2.2)	Dwyer et al. 1995, 2005, Sappington et al. 2001

Table 3 Final acute toxicity data set for permethrin.
All studies were rated RR. S: static; SR: static renewal; FT: flow-through.

Species	Common Identifier	Family	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/ size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	Salmonidae	S	Nom	95.2%	96 hr	12	Mortality	0.46 g	**1.58** (1.1-2.2)	Dwyer et al. 1995, 2005, Sappington et al. 2001
Oncorhynchus mykiss	Rainbow trout	Salmonidae	FT	Meas	91.9%	96 hr	15.6	Mortality	Juvenile	**7.0** (7.0-7.0)	Holcombe et al. 1982
Orconectes immunis	Crayfish	Astacidae	S	Nom	92.0%	96 hr	16.5	Mortality	Juvenile 2 g	**0.21** (0.17-0.25)	Paul & Simonin 2006
Pimephales promelas	Fathead minnow	Cyprinidae	S	Nom	95.2%	96 hr	22	Mortality	0.41 g	**9.38** (6.7-16)	Dwyer et al. 1995, 2005, Sappington et al. 2001
Procambarus blandingi	Crayfish	Cambaridae	FT	Nom	89.1%	96 hr	22	Mortality	24 g, 48 mm	**0.21** (0.13-0.33)	Buccafusco 1977
Procloeon sp.	Mayfly	Baetidae	S	Nom	100.0%	48 hr	23	Mortality	0.5-1 cm	**0.0896**	Anderson et al. 2006
Salmo salar	Atlantic Salmon	Salmonidae	S	Nom	92.4%	96 hr	12	Mortality	1 g, 35 mm	**1.5** (1.1-2.0)	Buccafusco 1976b
Xyrauchen texanus	Razorback sucker	Catostornidae	S	Nom	95.2%	96 hr	22	Mortality	0.32 g	**5.95** (4.6-7.7)	Dwyer et al. 1995, 2005, Sappington et a. 2001

Table 4 Reduced acute data rated RR.
S: static; SR: static renewal; FT: flow-through; NR: not reported.

Species	Common Identifier	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Reason
Chironomus dilutus	Midge	S	Meas	>96%	96 hr	13	Mortality	4th instar larvae	0.0585 (0.0426-0.0808)	Harwood et al. 2009	C
Chironomus dilutus	Midge	S	Nom	100.0%	96 hr	23	Mortality	3rd instar	10.450	Anderson et al. 2006	D
Danio rerio	Zebra fish	SR	Nom	90.0%	24 hr	23	Mortality	3.0 cm, 0.3 g	5.2 (4.1-6.6)	Zhang et al. 2010	A
Danio rerio	Zebra fish	SR	Nom	90.0%	48 hr	23	Mortality	3.0 cm, 0.3 g	3.0 (1.9-3.8)	Zhang et al. 2010	A
Danio rerio	Zebra fish	SR	Nom	90.0%	72 hr	23	Mortality	3.0 cm, 0.3 g	2.6 (1.8-3.3)	Zhang et al. 2010	A
Daphnia magna	Daphnid	S	Nom	NR	24 hr	22	Immobility	< 24 hr	0.93 (0.44-2.0)	LeBlanc 1976	A
Etheostoma fonticola	Fountain darter	S	Nom	95.2%	12 hr	22	Mortality	62 mg, 20.2 mm	5.60 (4.76-6.67)	Dwyer et al. 1999	A
Etheostoma fonticola	Fountain darter	S	Nom	95.2%	24 hr	22	Mortality	62 mg, 20.2 mm	4.26 (3.58-5.19)	Dwyer et al. 1999	A
Etheostoma fonticola	Fountain darter	S	Nom	95.2%	48 hr	22	Mortality	62 mg, 20.2 mm	3.34 (2.75-4.16)	Dwyer et al. 1999	A
Etheostoma fonticola	Fountain darter	S	Nom	95.2%	72 hr	22	Mortality	62 mg, 20.2 mm	3.34 (2.75-4.16)	Dwyer et al. 1999	A
Etheostoma lepidum	Greenthroat darter	S	Nom	95.2%	6 hr	22	Mortality	133 mg, 22.6 mm	4.31 (3.71-5.04)	Dwyer et al. 2005	A
Etheostoma lepidum	Greenthroat darter	S	Nom	95.2%	12 hr	22	Mortality	133 mg, 22.6 mm	3.10 (2.20-3.60)	Dwyer et al. 2005	A
Etheostoma lepidum	Greenthroat darter	S	Nom	95.2%	24 hr	22	Mortality	133 mg, 22.6 mm	2.71 (2.36-3.13)	Dwyer et al. 2005	A
Etheostoma lepidum	Greenthroat darter	S	Nom	95.2%	48 hr	22	Mortality	133 mg, 22.6 mm	2.71 (2.36-3.13)	Dwyer et al. 2005	A

Table 4 Reduced acute data rated RR.
S: static; SR: static renewal; FT: flow-through; NR: not reported.

Species	Common Identifier	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Reason
Etheostoma lepidum	Greenthroat darter	S	Nom	95.2%	72 hr	22	Mortality	133 mg, 22.6 mm	2.71 (2.36-3.13)	Dwyer et al. 2005	A
Hyalella azteca	Amphipod	S	Nom	100.0%	96 hr	23	Mortality	3rd instar	**0.0211**	Anderson et al. 2006	B, D
Ictalurus punctatus	Catfish	S	Nom	92.4%	24 hr	21	Mortality	1.2 g, 35 mm	6.0 (4.9-7.5)	Buccafusco 1976a	A
Ictalurus punctatus	Catfish	S	Nom	92.4%	48 hr	21	Mortality	1.2 g, 35 mm	5.4 (3.9-7.4)	Buccafusco 1976a	A
Oncorhynchus apache	Apache trout	S	Nom	95.2%	12 hr	12	Mortality	0.615 g	3.88 (3.7-4.1)	Dwyer et al. 1995, Sappington et al. 2001	A
Oncorhynchus apache	Apache trout	S	Nom	95.2%	24 hr	12	Mortality	0.615 g	2.27 (2.0-2.7)	Dwyer et al. 1995, Sappington et al. 2001	A
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	S	Nom	95.2%	12 hr	12	Mortality	0.46 g	3.3 (2.4-4.7)	Dwyer et al. 1995, 2005, Sappington et al. 2001	A
Oncorhynchus clarki henshawi	Lahontan cutthroat trout	S	Nom	95.2%	24 hr	12	Mortality	0.46 g	1.9 (1.4-2.6)	Dwyer et al. 1995, 2005, Sappington et al. 2001	A
Oncorhynchus mykiss	Rainbow trout	S	Nom	95.2%	12 hr	12	Mortality	0.71 g	5.75 (3.4-8.3)	Dwyer et al. 1995, Sappington et al. 2001	A, B
Oncorhynchus mykiss	Rainbow trout	S	Nom	95.2%	24 hr	12	Mortality	0.71 g	3.78 (3.4-8.3)	Dwyer et al. 1995, Sappington	A, B

Table 4 Reduced acute data rated RR.
S: static; SR: static renewal; FT: flow-through; NR: not reported.

Species	Common Identifier	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Reason
										et al. 2001	
Oncorhynchus mykiss	Rainbow trout	S	Nom	95.2%	96 hr	12	Mortality	0.71 g	3.31 (1.7-4.8)	Dwyer et al. 1995, 2005, Sappington et a. 2001	B
Orconectes immunis	Crayfish	S	Nom	92.0%	24 hr	16.5	Mortality	Juveniles, 2 g	0.53 (0.43-0.67)	Paul & Simonin 2006	A
Orconectes immunis	Crayfish	S	Nom	92.0%	48 hr	16.5	Mortality	Juveniles, 2 g	0.31 (0.26-0.36)	Paul & Simonin 2006	A
Pimephales promelas	Fathead minnow	S	Nom	95.2	24 hr	22	Mortality	0.41 g	9.73 (9.2-11)	Dwyer et al. 1995, Sappingtor et a. 2001	A
Procambarus blandingi	Crayfish	FT	Nom	89.1%	24 hr	22	Mortality	24 g, 48 mm	0.66 (0.16-2.6)	Buccafusco 1977	A
Procambarus blandingi	Crayfish	FT	Nom	89.1%	312 hr	22	Mortality	24 g, 48 mm	0.12 (0.071-0.20)	Buccafusco 1977	A
Salmo salar	Atlantic Salmon	S	Nom	92.4%	24 hr	12	Mortality	1 g, 35 mm	2.2 (1.7-2.8)	Buccafusco 1976b	A
Salmo salar	Atlantic Salmon	S	Nom	92.4%	48 hr	12	Mortality	1 g, 35 mm	1.8 (1.4-2.4)	Buccafusco 1976b	A
Xyrauchen texanus	Razorback sucker	S	Nom	95.2%	24 hr	22	Mortality	0.32 g	8.9	Dwyer et al. 1995, Sappingtor et al. 2001	A

Reduction Reasons

A. Not the most sensitive or appropriate duration
B. FT test preferred over S
C. Not standard conditions
D. Meas preferred over Nom

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
Acipensar brevirostrum	shortnose sturgeon	S	Nom	95.2%	48 hr	17	Mortality	0.74 g wet wt	>1.2	Dwyer et al. 2000	LL/8,6
Acipensar oxyrhynchus	atlantic sturgeon	S	Nom	95.2%	48 hr	17	Mortality	1.11 g wet wt	>1.2	Dwyer et al. 2000	LL/8,6
Aedes aegypti	mosquito	S	Nom	100.0%	24 hr	20	Mortality	3rd instar	0.27 (0.22-0.31)	Cutkomp & Subramanyam 1986	RL/1,6
Aedes aegypti	mosquito	S	Nom	100.0%	24 hr	30	Mortality	3rd instar	0.98 (0.90-1.06)	Cutkomp & Subramanyam 1986	RL/1,6
Aedes aegypti	mosquito	S	Nom	technical	24 hr	27	Mortality	late 3rd -early 4th instar	2.8 (2.7-3.0)	Canyon & Hii 1999	RL/6
Aedes aegypti	mosquito	S	Nom	technical	24 hr	27	Mortality	late 3rd -early 4th instar	2.5 (2.4-2.6)	Canyon & Hii 1999	RL/6
Aedes aegypti	mosquito	S	Nom	90.8%	2 x 1 hr pulses	25	Mortality	3rd instar	2.03 (Std error 0.06)	Parsons & Surgeoner 1991b	RL/1,6
Aedes aegypti	mosquito	S	Nom	90.8%	2 hr	25	Mortality	3rd instar	2.32 (Std error 0.46)	Parsons & Surgeoner 1991b	RL/1,6
Aedes aegypti	mosquito	S	Nom	90.8%	1 hr	25	Mortality	3rd instar	4.67 (Std error 0.59)	Parsons & Surgeoner 1991a	RL/1,6
Aedes aegypti	mosquito	S	Nom	90.8%	4 hr	25	Mortality	3rd instar	1.15 (Std error 0.13)	Parsons & Surgeoner 1991a	RL/1,6
Aedes aegypti	mosquito	S	Nom	90.8%	24 hr	25	Mortality	3rd instar	0.45 (Std error 0.08)	Parsons & Surgeoner 1991a	RL/1,6
Aedes aegypti	mosquito	S	Nom	90.8%	24 hr	25	Immobility	3rd instar	0.85	Parsons &	RL/1,6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
										Surgeoner 1991a	
Aedes atropalpus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	6.168 (5.688-6.671)	Cilek et al. 1995	RL/1,6
Aedes hendersoni	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	3.507 (3.166-3.870)	Cilek et al. 1995	RL/1,6
Aedes triseriatus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	8.39 (8.11-8.70)	Cilek et al. 1995	RL/1,6
Aedes triseriatus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	7.68 (7.40-7.98)	Cilek et al. 1995	RL/1,6
Aedes triseriatus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	7.38 (6.80-8.15)	Cilek et al. 1995	RL/1,6
Aedes triseriatus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	6.39 (5.61-6.93)	Cilek et al. 1995	RL/1,6
Aedes triseriatus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	6.23 (5.64-6.79)	Cilek et al. 1995	RL/1,6
Aedes triseriatus	mosquito	S	Nom	95.7%	24 hr	20	Mortality	late 3rd instar	4.46 (4.18-4.72)	Cilek et al. 1995	RL/1,6
Alonella sp.		S	Nom	42.0%	48 hr	21	Mortality	NR	4.0 (3.8-4.9)	Naqvi & Hawkins 1989	LL/1, 7
Alosa apidissima	American shad	S	Nom	95.2%	48 hr	22	Mortality	0.006 g dry wt	2.08 (1.78-2.37)	Dwyer et al. 2000	LL/4,6
Americamysis bahia	mysid shrimp	FT	Meas	90.8%	48 hr	25	Mortality	3-5 d	0.14 (0.12-0.19)	Thompson 1986	LR/2
Americamysis bahia	mysid shrimp	FT	Meas	90.8%	72 hr	25	Mortality	3-5 d	0.11 (0.090-0.14)	Thompson 1986	LR/2
Americamysis bahia	mysid shrimp	FT	Meas	90.8%	96 hr	25	Mortality	3-5 d	0.075 (0.059-	Thompson 1986	LR/2

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC50 (µg/L) (95% CI)	Reference	Rating/ Reason
									0.096)		
Americamysis bahia	mysid shrimp	FT	Nom	10.0%	24 hr	25	Mortality	<24 hr	0.82 (0.69-1.0)	Kent et al. 1992	LR/2,7
Americamysis bahia	mysid shrimp	FT	Nom	10.0%	48 hr	25	Mortality	<24 hr	0.59 (0.50-0.71)	Kent et al. 1992	LR/2,7
Americamysis bahia	mysid shrimp	FT	Nom	10.0%	72 hr	25	Mortality	<24 hr	0.49 (0.40-0.61)	Kent et al. 1992	LR/2,7
Americamysis bahia	mysid shrimp	FT	Nom	10.0%	96 hr	25	Mortality	<24 hr	0.47 (0.39-0.59)	Kent et al. 1992	LR/2,7
Americamysis bahia	mysid shrimp	FT	Nom	92.0%	96 hr	26	Mortality	<24 hr	0.02 (0.017-0.024)	Schimmel et al. 1983	LL/2,6
Americamysis bahia	mysid shrimp	S	Nom	Technical	96 hr	25	Mortality	<24 hr	0.095 (0.077-0.12)	Cripe 1994	LR/2
Bufo boreas	toad	S	Nom	95.2%	96 hr	22	Mortality	12 mg, 9.6 mm	>10	Dwyer et al. 1999	LL/8,6
Bufo boreas boreas	boreal toad	S	Nom	95.2%	96 hr	22	Mortality	NR	>10	Dwyer et al. 2005	LL/8,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.52 (0.38-0.65)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.57 (0.42-0.69)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.54 (0.43-0.66)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.74 (0.57-0.95)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.48 (0.39-0.58)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.52 (0.39-0.63)	Yang et al. 2006a	RL/4,6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.49 (0.388-0.60)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.59 (0.42-0.74)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.56 (0.41-0.68)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.51 (0.38-0.62)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.59 (0.48-0.72)	Yang et al. 2006a	RL/4,6
Ceriodaphnia dubia	Daphnid	S	Nom	99.3%	96 hr	21	Mortality	<24 hr	0.66 (0.49-0.81)	Yang et al. 2006a	RL/4,6
Culex pipiens pallens	mosquito	S	Nom	92.0%	24 hr	26	Mortality	late 3rd-early 4th instar	3.85 (3.47-4.27)	Song et al. 2007	RL/1,6
Culex pipiens pallens	mosquito	S	Nom	92.0%	24 hr	26	Mortality	late 3rd-early 4th instar	9.904 (5.341-18.37)	Song et al. 2007	RL/1,6
Culex pipiens pallens	mosquito	S	Nom	91.2%	24 hr	26	Mortality	early 4th instar	7.7 (7.3-8.2)	Kasai et al. 2007	LL/1,5, 6
Culex quinquefasciatus	mosquito	S	Nom	94.4%	24 hr	27	Mortality	late 3rd & 5th instar	1.2	Corbel et al. 2003	RL/1,6
Cypria sp.	ostracod	S	Nom	42.0%	48 hr	21	Mortality	NR	5.0 (4.8-6.4)	Naqvi & Hawkins 1989	LL/1,7, 6
Cyprinodon variegatus	sheepshead minnow	FT	Meas	93.0%	96 hr	30	Mortality	NR	7.8 (6.2-10)	Schimmel et al. 1983	LL/2,6
Daphnia magna	Daphnid	S	Nom	NR	48 hr	17	Immobility	< 20 hr	7.2 (5.8-8.9)	Aquatic Environmental Sciences 1976	LL/7,6
Daphnia magna	Daphnid	S	Nom	98.7%	24 hr	18	Immobility	1st instar	2.06 (1.65-2.58)	Doma & Evered 1977	RL/6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
Daphnia magna	Daphnid	S	Nom	98.7%	48 hr	18	Immobility	1st instar	0.6 (0.53-0.67)	Doma & Evered 1977	RL/6
Daphnia magna conditioned ephippia	Daphnid	S	Nom	25.0%	48 hr	20	Survival, 7 d post-exposure	2 mon old resting egg	0.034	Doma & Evered 1977	LL/4,6, 7
Daphnia magna unconditioned ephippia	Daphnid	S	Nom	25.0%	48 hr	20	Survival, 7 d post-exposure	2 mon old resting egg	0.108 (0.035-0.339)	Doma & Evered 1977	LL/4,6, 7
Daphnia magna	Daphnid	S	Nom	25.0%	24 hr	18	Immobility	1st instar	1.82 (1.54-2.15)	Doma & Evered 1977	LL/6,7
Daphnia magna	Daphnid	S	Nom	25.0%	48 hr	18	Immobility	1st instar	0.76 (0.66-0.88)	Doma & Evered 1977	LL/6,7
Daphnia magna	Daphnid	S	Nom	95.7%	24 hr	21	Immobility	<12 hr	0.258 (0.014-0.476)	Bentley 1975	RL/6
Daphnia magna	Daphnid	S	Nom	95.7%	48 hr	21	Immobility	<12 hr	0.075 (0.054-0.103)	Bentley 1975	RL/6
Daphnia magna	Daphnid	S	Nom	95.7%	96 hr	21	Immobility	<12 hr	0.039 (0.025-0.062)	Bentley 1975	RL/6
Daphnia magna	Daphnid	S	Meas	26.2%	48 hr	20	Immobility	<24 hr	3.2 (2.6-4.0)	Kent et al. 1995b	RL/7
Daphnia magna	Daphnid	S	Meas	98.0%	48 hr	20	Mortality	4-5 d old 4th instar	5.36 (2.5-10.6)	McWilliam & Baird 2002	LL/1,5, 6
Daphnia magna	Daphnid	S	Meas	98.0%	48 hr	20	Mortality	4-5 d old 4th instar	0.54 (0.03-19.3)	McWilliam & Baird 2002	LL/1,5, 6
Daphnia magna	Daphnid	S	Nom	NR	24 hr	18	Immobility	<24 hr	1.93 (1.76-2.12)	Hamer 1990	LL/7,6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
Daphnia magna	Daphnid	S	Nom	NR	48 hr	18	Immobility	<24 hr	1.31 (1.17-1.48)	Hamer 1990	LL/7,6
Eucyclops sp.	copepod	S	Nom	42.0%	48 hr	21	Mortality	NR	5.0 (4.3-5.5)	Naqvi & Hawkins 1989	LL/1,7, 6
Gambusia affinis	Mosquito fish	FT	Meas	93.0%	96 hr	19.1	Mortality	0.13 g	8.02 (6.09-10.6)	Thurston et al. 1985	LL/1,5, 6
Gambusia affinis	Mosquito fish	FT	Meas	93.0%	96 hr	17.9	Mortality	0.12 g	4.6 (3.45-6.19)	Thurston et al. 1985	LL/1,5, 6
Gambusia affinis	Mosquito fish	S	Nom	47.0%	96 hr	20	Mortality	2.76 cm, 0.289 g	12.0 (10.52-13.34)	Naqvi & Hawkins 1989	LL/1,7, 6
Gammarus pulex	amphipod	SR	Meas	99.0%	96 hr	15	Mortality	>5 mm	0.44	McLoughlin et al. 2000	LR/1,4
Gammarus pulex	amphipod	SR	Meas	99.0%	120 hr	15	Mortality	>5 mm	0.26	McLoughlin et al. 2000	LR/1,4
Gammarus pulex	amphipod	SR	Meas	99.0%	144 hr	15	Mortality	>5 mm	0.17	McLoughlin et al. 2000	LR/1,4
Gila elegans	Bonytail chub	S	Nom	95.2%	96 hr	22	Mortality	0.41 g	>25	Dwyer et al. 1995, Sappington et al. 2001	LL/8,6
Hyalella azteca	amphipod	S	Nom	99.0%	48 hr	25	Mortality	<24 hr	0.0658 (0.0605-.00782)	Wheelock et al. 2005	RL/5,6
Hyalella azteca	amphipod	S	Nom	99.0%	48 hr	25	Mortality	<24 hr	0.0742 (0.0554-0.1057)	Wheelock et al. 2005	RL/5,6
Hyalella azteca	amphipod	S	Nom	99.0%	48 hr	25	Mortality	<24 hr	0.0781 (0.0584-0.1070)	Wheelock et al. 2005	RL/5,6
Hyalella azteca	amphipod	S	Nom	99.0%	48 hr	25	Mortality	<24 hr	0.0893	Wheelock et	RL/5,6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
									(0.0575-0.1464)	al. 2005	
Hyalella azteca	amphipod	S	Nom	99.0%	48 hr	25	Mortality	<24 hr	0.1402 (0.1064-0.1679)	Wheelock et al. 2005	RL/5,6
Ictalurus punctatus	channel catfish	FT	Meas	93.0%	96 hr	19.1	Mortality	2.81 g	3.44 (3.04-3.90)	Thurston et al. 1985	LL/1,5, 6
Ictalurus punctatus	channel catfish	FT	Meas	93.0%	96 hr	17.8	Mortality	2.94 g	2.06 (1.16-3.65)	Thurston et al. 1985	LL/1,5, 6
Lepomis macrochirus	bluegill	FT	Meas	93.0%	96 hr	18.5	Mortality	0.34 g	5.81 (4.67-7.22)	Thurston et al. 1985	LL/1,5, 6
Lepomis macrochirus	bluegill	FT	Meas	93.0%	96 hr	18	Mortality	0.58 g	4.56 (3.46-6.01)	Thurston et al. 1985	LL/1,5, 6
Lepomis macrochirus	Bluegill	S	Nom	NR	24 hr	22	Mortality	0.29 g, 30 mm	5.64 (4.52-7.03)	Aquatic Environmental Sciences 1976	LL/7,6
Lepomis macrochirus	Bluegill	S	Nom	NR	48 hr	22	Mortality	0.29 g, 30 mm	3.36 (2.78-4.05)	Aquatic Environmental Sciences 1976	LL/7,6
Lepomis macrochirus	Bluegill	S	Nom	NR	96 hr	22	Mortality	0.29 g, 30 mm	2.52 (1.88-3.66)	Aquatic Environmental Sciences 1976	LL/7,6
Lepomis macrochirus	Bluegill	S	Nom	Technical	24 hr	20	Mortality	1.0 g, 37 mm	9.6 (8.1-11.3)	Bentley 1974	RL/1,6
Lepomis macrochirus	Bluegill	S	Nom	Technical	48 hr	20	Mortality	1.0 g, 37 mm	6.4 (5.4-7.6)	Bentley 1974	RL/1,6
Lepomis macrochirus	Bluegill	S	Nom	Technical	96 hr	20	Mortality	1.0 g, 37 mm	6.1 (5.1-7.3)	Bentley 1974	RL/1,6
Menidia beryllina	Inland silverside	FT	Meas	94.6%	72 hr	22	Mortality	juvenile, 0.035 g, 15 mm	8.3 (6.9-10.6)	Ward & Rabe 1989	LR/2

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
Menidia beryllina	Inland silverside	FT	Meas	94.6%	96 hr	22	Mortality	juvenile, 0.035 g, 15 mm	6.2 (5.2-7.5)	Ward & Rabe 1989	LR/2
Menidia menidia	Atlantic silverside	FT	Meas	93.0%	96 hr	25.5	Mortality	NR	2.2 (1.2-6.4)	Schimmel et al. 1983	LL/2,6
Mugil cephalus	mullet	FT	Meas	93.0%	96 hr	24.5	Mortality	NR	5.5 (4.1-7.4)	Schimmel et al. 1983	LL/2,6
Oncorhynchus clarki stomias	Greenback cutthroat trout	S	Nom	95.2%	96 hr	12	Mortality	0.31 g	>1.0	Dwyer et al. 1995, 2005, Sappington et al. 2001	LR/LL/ 8,6
Oncorhynchus mykiss	Rainbow trout	S	Nom	95.2%	12 hr	12	Mortality	0.71 g	5.8 (3.4-8.3)	Sappington et al. 2001	RL/6
Oncorhynchus mykiss	Rainbow trout	S	Nom	95.2%	24 hr	12	Mortality	0.71 g	3.8 (3.4-8.3)	Sappington et al. 2001	RL/6
Oncorhynchus mykiss	Rainbow trout	S	Nom	95.2%	96 hr	12	Mortality	0.71 g	3.3 (1.7-4.8)	Sappington et al. 2001	RL/6
Oncorhynchus mykiss	Rainbow trout	S	Nom	Technical	96 hr	10	Mortality	1.0 g, 50 mm	9.8 (7.7-12.6)	Bentley 1974	RL/1,6
Oncorhynchus mykiss	Rainbow trout	FT	Meas	93.0%	96 hr	9.5	Mortality	2.65 g	5.47 (4.22-7.10)	Thurston et al. 1985	LL/1,5, 6
Oryzias latipes	medaka	SR	Meas	88.0%	48 hr	25	Mortality	juvenile, 30 d, 12 mm	11 (10-12)	Rice et al. 1997	LR/3
Penaeus aztecus	brown shrimp	S	Nom	89.1%	48 hr	20	Mortality	15-25 mm	0.38 (0.26-0.57)	Heitmuller 1977	LL/2,6
Penaeus aztecus	brown shrimp	S	Nom	89.1%	96 hr	20	Mortality	15-25 mm	0.34 (0.23-0.51)	Heitmuller 1977	LL/2,6
Penaeus duorarum	pink shrimp	S	Nom	95.7%	96 hr	19	Mortality	25-40 mm	0.354 (0.287-	Heitmuller 1975	LL/2,6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
									0.440)		
Penaeus duorarum	pink shrimp	FT	Meas	93.0%	96 hr	24.9	Mortality	NR	0.22 (0.06-0.79)	Schimmel et al. 1983	LL/2,6
Penaeus duorarum	pink shrimp	S	Nom	Technical	96 hr	25	Mortality	3-5 d old postlarvae	0.17 (0.15-0.19)	Cripe 1994	LR/2
Pimephales promelas	fathead minnow	FT	Meas	93.0%	96 hr	17.7	Mortality	0.42 g	6.40 (4.19-9.77)	Thurston et al. 1985	LL/1,5, 6
Poeciliopsis occidentalis occidentalis	Gila topminnow	S	Nom	95.2%	96 hr	22	Mortality	219 mg, 27.2 mm	>10	Dwyer et al. 1999, 2005	LL/8,6
Procambarus clarki	Crayfish	S	Nom	25.6%	96 hr	21.8	Mortality	8-12 mm, 0.017 g	0.438 (0.382-0.507)	Jarboe & Romaire 1991	LR/7,4
Procambarus clarki	Crayfish	S	Nom	25.6%	96 hr	21.2	Mortality	25-35 mm, 0.64 g	0.854 (0.725-1.030)	Jarboe & Romaire 1991	LR/7,4
Procambarus clarki	Crayfish	S	Nom	25.6%	96 hr	22.7	Mortality	45-55 mm, 2.45 g	1.298 (1.163-1.469)	Jarboe & Romaire 1991	LR/7,4
Procambarus clarki	Crayfish	S	Nom	25.6%	96 hr	23.1	Mortality	65-75 mm, 8.98 g	0.813 (0.515-0.938)	Jarboe & Romaire 1991	LR/7,4
Salvelinus fontinalis	trout	S	Nom	>92%	24 hr	9.5	Mortality	35-42 d, 42 mm, 1 g	4.80 (4.16-5.54)	Paul et al. 2005	LR/1,4
Salvelinus fontinalis	trout	S	Nom	>92%	48 hr	9.5	Mortality	35-42 d, 42 mm, 1 g	3.03 (2.86-3.22)	Paul et al. 2005	LR/1,4
Salvelinus fontinalis	trout	S	Nom	>92%	72 hr	9.5	Mortality	35-42 d, 42 mm, 1 g	2.91 (2.73-3.11)	Paul et al. 2005	LR/1,4
Salvelinus fontinalis	trout	S	Nom	>92%	96 hr	9.5	Mortality	35-42 d, 42 mm, 1 g	2.86 (2.69-3.05)	Paul et al. 2005	LR/1,4
Scaphirhynchus	Shovelnose	S	Nom	95.2%	12 hr	22	Mortality	719 mg, 60.1	10	Dwyer et al.	RL/6

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidance interval.

Species	Common Identifier	Test type	Meas / Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Rating/ Reason
playtrynchus	sturgeon							mm		1999	
Uca pugilator	fiddler crab	S	Nom	95.7%	96 hr	19	Mortality	15-20 mm carapace width	2.39 (1.82-3.25)	Heitmuller 1975	LL/2,6
Uca pugilator	fiddler crab	S	Nom	89.1%	24 hr	20	Mortality	10-15 mm carpace width	5.3 (2.0-13)	Heitmuller 1977	LL/2,6
Uca pugilator	fiddler crab	S	Nom	89.1%	48 hr	20	Mortality	10-15 mm carpace width	2.8 (1.9-4.4)	Heitmuller 1977	LL/2,6
Uca pugilator	fiddler crab	S	Nom	89.1%	96 hr	20	Mortality	10-15 mm carpace width	2.2 (1.4-3.5)	Heitmuller 1977	LL/2,6

Exclusion Reasons
1. Not a standard method
2. Saltwater
3. Family not found in N. America
4. Unacceptable control response or NR
5. Control not described
6. Low reliability score
7. Low chemical purity or purity NR
8. No toxicity value calculable

Table 6 Final chronic toxicity data set for permethrin.
All studies were rated RR. S: static; SR: static renewal; FT: flow-through. NR: not reported.

Species	Common identifier	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	NOEC (µg/L)	LOEC (µg/L)	MATC (µg/L)	Reference
Brachycentrus americanus	Caddisfly	FT	Meas	Technical	21 d	15	Mortality	larvae	--	--	LC_{50}: 0.17 (0.09-0.34)	Anderson 1982
Daphnia magna	Daphnid	FT	Meas	98.6%	21 d	20	Reproduction	< 24 hr	0.03900	0.08400	**0.05700**	Kent et al. 1995a
Pimephales promelas	Fathead minnow	FT	Meas	92.0%	32 d	25	Mortality	4-5 d old larvae	0.66	1.4	**0.96**	Spehar et al. 1983

Table 7 Acceptable reduced chronic data rated RR.
S: static; SR: static renewal; FT: flow-through. NR: not reported

Species	Test type	Meas /Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	NOEC (µg/L)	LOEC (µg/L)	MATC (µg/L)	Reference	Reason
Daphnia magna	FT	Meas	98.6%	21 d	20	Length	< 24 hr	0.03900	0.08400	0.05700	Kent et al. 1995a	A
Daphnia magna	S	Meas	98.0%	48 h	20	feeding rate during exposure	4-5 d old 4th instar			EC_{50}: 1.09 (0.1-1.2)	McWilliam & Baird 2002	B
Daphnia magna	S	Meas	98.0%	48 h	20	feeding rate during exposure	4-5 d old 4th instar	0.48	0.85	0.64	McWilliam & Baird 2002	B

Reasons for Exclusion

A. Equally sensitive endpoint
B. Less sensitive endpoint

Table 8 Acute-to-Chronic Ratios used for derivation of the permethrin chronic criterion.

Species	Common identifier	Test type	Meas/ Nom	Chemical grade	MATC	LC_{50}	SMACR (LC_{50}/MATC)	Chronic Reference	Acute Reference
Americamysis bahia	Mysid shrimp	FT	Meas	90-95%	0.016	0.075	4.6875	Thompson et al. 1989	Thompson 1986
Default							11.4[a]		
Default							11.4[a]		
Multi-species ACR = geomean (individual ACR**s)**							**8.5**		

[a]The derivation and source data of the default ACR value of 11.4 are described in detail in Fojut et al. 2014.

Table 9 Supplemental chronic toxicity data from studies rated RL, LR, or LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported, NC: not calculable.

Species	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	NOEC (µg/L)	LOEC (µg/L)	MATC (µg/L) (95% CI)	Reference	Rating/ Reason
Americamysis bahia	FT	Meas	95.0%	30 d	25	Mortality	<24 h	0.011	0.024	0.016	Thompson et al. 1989	LR/2
Cyprinodon variegatus	FT	Meas	93.0%	28 d	30	Embryo/fry survival	1.5-24 h old embryos	10 (std dev 2.6)	>2x solubility	>2x solubility	Hansen et al. 1983	LR/1,2
Salvelinus fontinalis	S	Nom	92.0%	6 h exposure, swim 10 min max.	9.5	Time to swimming exhaustion against a current	28-34 d post feeding, 37 mm, 1 g	1.6	3.2	2.3	Paul et al. 2005	LR/1,3
Salvelinus fontinalis	S	Nom	92.0%	24 h	9.5	Intoxication	35-42 d post feeding, 42 mm, 1 g	-	-	EC50: 3.01 (2.81-3.22)	Paul et al. 2005	LR/1,3
Salvelinus fontinalis	S	Nom	92.0%	48 h	9.5	Intoxication	35-42 d post feeding, 42 mm, 1 g	-	-	EC50: 2.44 (2.24-2.65)	Paul et al. 2005	LR/1,3
Salvelinus fontinalis	S	Nom	92.0%	72 h	9.5	Intoxication	35-42 d post feeding, 42 mm, 1 g	-	-	EC50: 2.44 (2.24-2.65)	Paul et al. 2005	LR/1,3
Salvelinus fontinalis	S	Nom	92.0%	96 h	9.5	Intoxication	35-42 d post feeding, 42 mm, 1 g	-	-	EC50: 2.86 (2.69-3.05)	Paul et al. 2005	LR/1,3

Exclusion Reasons
1. Not a standard method
2. Saltwater
3. Endpoint not linked to growth, reproduction or survival (Ch. 3, Section 3-2.1.3)

Table 10 Acceptable multispecies field, semi-field, laboratory, microcosm, mesocosm studies.
R= reliable; L= less reliable; N= not reliable.

Reference	Habitat	Rating
Conrad et al. 1999	artificial pond	L
Coulon 1982	outdoor earthen ponds	L
Feng et al. 2009	Submerged in Tongan Bay, China	N
Helson et al. 1986	Outdoor artificial pools	N
Helson et al. 1993	Outdoor artificial pools	N
Jensen et al. 1999	Outdoor wetlands	N
Lutnicka et al. 1999	Indoor model river systems	L
Milam et al. 2000	Microcosms exposed in field	N
Mulla et al. 1978	Outdoor ponds and fields	N
Poirier & Surgeoner 1988	Model river systems	L
Werner & Hilgert 1992	Enclosures placed in natural stream	L
Yasuno et al. 1988	Enclosures placed in pond	L

Table 11 Threatened, Endangered, or Rare Species Predicted values by ICE.

Surrogate		**Predicted**	
Species	**LC_{50} (µg/L)**	**Species**	**LC_{50} (µg/L)**
Rainbow trout (*Oncorhynchus mykiss)*	7.0	Chinook salmon *(O. tshawytscha)*	11.88
		Coho salmon (*O. kisutch)*	8.41
		Paiute cutthroat trout (*O. clarki seleniris)*	8.93
		Greenback cutthroat trout (*O. c. stomias*)	8.93
		Gila trout (*O. gilae*)	3.48
		Chum salmon (*O. keta*)	9.4
		Sockeye salmon (*O. nerka*)	9.4

Table 12 Terrestrial wildlife studies of mallard ducks – permethrin.
R= reliable; L= less reliable, N= not reliable.

Reference	Exposure	Toxicity value	Rating
Beavers et al. 1992	chronic reproduction - dietary	NOEC 125 mg/kg, LOEC 500 mg/kg	R
Fink 1975a	8-d dietary	LC_{50} > 10000 mg/kg	L
Fink 1975b	acute oral	LD_{50} > 4640 mg/kg	L
Hakin et al. 1991a	subacute dietary	LC_{50} > 500 mg/kg	L
Hakin et al. 1991b	acute oral	LD_{50} > 2000 mg/kg	L
Ross et al. 1976a	subacute	LC_{50} > 23000 mg/kg	L
Ross et al. 1976b	acute oral	no mortality	L
Fink 1976	chronic reproduction - dietary	not calculable	L
Ross et al. 1977	acute oral	LD_{50} > 10327 mg/kg	L

Appendix A: Fit test calculations

	Omit one										
SMAVs	1	2	3	4	5	6	7	8	9	10	11
0.007		0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
0.0896	0.0896		0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896
0.1	0.100	0.100		0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
0.189	0.189	0.189	0.189		0.189	0.189	0.189	0.189	0.189	0.189	0.189
0.21	0.21	0.21	0.21	0.21		0.21	0.21	0.21	0.21	0.21	0.21
0.21	0.21	0.21	0.21	0.21	0.21		0.21	0.21	0.21	0.21	0.21
0.32	0.32	0.32	0.32	0.32	0.32	0.32		0.32	0.32	0.32	0.32
0.664	0.664	0.664	0.664	0.664	0.664	0.664	0.664		0.664	0.664	0.664
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		1.5	1.5
1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58		1.58
1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71
2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500	2.500
2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71
3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34
4.16	4.16	4.16	4.16	4.16	4.16	4.16	4.16	4.16	4.16	4.16	4.16
5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38

Omit one calculation continued from previous page

SMAVs	12	13	14	15	16	17	18	19	20
0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896	0.0896
0.1	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189
0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
0.664	0.664	0.664	0.664	0.664	0.664	0.664	0.664	0.664	0.664
1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58	1.58
1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
1.71		1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71
2.500	2.500		2.500	2.500	2.500	2.500	2.500	2.500	2.500
2.71	2.71	2.71		2.71	2.71	2.71	2.71	2.71	2.71
3.34	3.34	3.34	3.34		3.34	3.34	3.34	3.34	3.34
4.16	4.16	4.16	4.16	4.16		4.16	4.16	4.16	4.16
5.4	5.4	5.4	5.4	5.4	5.4		5.4	5.4	5.4
5.95	5.95	5.95	5.95	5.95	5.95	5.95		5.95	5.95
7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00		7.00
9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	

Omitted point, xi:	**0.007**	**0.0896**	**0.1**	**0.189**	**0.21**	**0.21**	**0.32**	**0.664**	**1.5**	**1.58**
median 5th percentile	0.027489	0.016487	0.016143	0.014291	0.014008	0.014008	0.012931	0.011265	0.009661	0.009567
percentile	97.59	88.64	87.94	83.06	82.11	82.11	77.81	68.19	53.36	52.24
F-i(xi)	0.9759	0.8864	0.8794	0.8306	0.8211	0.8211	0.7781	0.6819	0.5336	0.5224
1-F(xi)	0.0241	0.1136	0.1206	0.1694	0.1789	0.1789	0.2219	0.3181	0.4664	0.4776
Min of F-i(xi) or 1-F(xi)	0.0241	0.1136	0.1206	0.1694	0.1789	0.1789	0.2219	0.3181	0.4664	0.4776
p_i =2(min)	0.0482	0.2272	0.2412	0.3388	0.3578	0.3578	0.4438	0.9328	0.9552	0.8976

Omitted point, xi:	**1.7**	**1.71**	**2.500**	**2.71**	**3.34**	**4.16**	**5.4**	**5.95**	**7.00**	**9.38**
median 5th percentile	0.009436	0.009425	0.008775	0.008644	0.008324	0.008081	0.012202	0.01312	0.013474	0.010743
percentile	50.63	50.49	41.28	39.15	33.28	26.46	12.67	9.51	5.44	2.1
F-i(xi)	0.5063	0.5049	0.4128	0.3915	0.3328	0.2646	0.1267	0.0951	0.0544	0.021
1-F(xi)	0.4937	0.4951	0.5872	0.6085	0.6672	0.7354	0.8733	0.9049	0.9456	0.979
Min of F-i(xi) or 1-F(xi)	0.4937	0.4951	0.4128	0.3915	0.3328	0.2646	0.1267	0.0951	0.0544	0.021
p_i =2(min)	0.9874	0.9902	0.8256	0.783	0.6656	0.5292	0.2534	0.1902	0.1088	0.042

		Fisher test statistic	
p_i	$\ln(p_i)$	-2*Sum of ln (pi)	X^2_{2n}
0.0482	-3.0324	40.7549	0.437079823666
0.2272	-1.4819		
0.2412	-1.4221		
0.3388	-1.0823		
0.3578	-1.0278		
0.3578	-1.0278		
0.4438	-0.8124		
0.6362	-0.4522		
0.9328	-0.0696		
0.9552	-0.0458		
0.9874	-0.0127		
0.9902	-0.0098		
0.8256	-0.1916		
0.783	-0.2446		
0.6656	-0.4071		
0.5292	-0.6364		
0.2534	-1.3728		
0.1902	-1.6597		
0.1088	-2.2182		
0.042	-3.1701		

0.437 > 0.05 so there is not a significant lack of fit for the permethrin acute data set

if $X^2 < 0.05$ significant lack of fit

if $X^2 > 0.05$ fit (no significant lack of fit)

Appendix B: Data summary sheets

Appendix B1: Studies rated RR, RL, LR, LL

Abbreviations used in this appendix:
NR = Not Reported

Study Ratings:
RR = Relevant, Reliable
RL = Relevant, Less Reliable
LR =Less Relevant, Reliable
LL = Less Relevant, Less Reliable

Unused lines deleted from tables

Summary sheets are in alphabetical order according to species

Toxicity Data Summary

Aedes aegypti

Study: Canyon DV, Hii JLK. 1999. Insecticide susceptibility status of *Aedes aegypti* (Diptera: Culicidae) from Townsville. Australian J Entomol 38:40-43.

Relevance
Score: 100
Rating: R

Reliability
Score: 65
Rating: L

	Canyon & Hii 1999	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	WHO/VBC/81.807 & 81.806	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	Townsville 1989 strain Townsville 1995 strain
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd or early 4th instar larvae	
Source of organisms	Lab colonies	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	27 ± 2°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Canyon & Hii 1999	***A. aegypti***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1mL ethanol/250 mL dilution water	
Concentration 1 Nom/Meas (μg/L)	Possible range: 0.008-40	4 reps, 20-25/rep
Concentration 2 Nom/Meas (μg/L)	NR	
Concentration 3 Nom/Meas (μg/L)	NR	
Concentration 4 Nom/Meas (μg/L)	NR	
Concentration 5 Nom/Meas (μg/L)	NR	
Concentration 6 Nom/Meas (μg/L)	NR	
Control	Solvent	4 reps, 20-25/rep
LC_{50} (μg/L)	1989: 2.8 (2.7-3.0) 1995: 2.5 (2.4-2.6)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -36

Toxicity Data Summary

Aedes aegypti

Study: Cutkomp LK, Subramanyam B. 1986. Toxicity of pyrethroids to *Aedes aegypti* larvae in relation to temperature. Journal of the American Mosquito Control Association. 2:347-349.

Relevance
Score: 90
Rating: R

Reliability
Score: 62.5
Rating: L

*No standard method

	Cutkomp & Subramanyam 1986	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3rd instar larvae	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	< 7%	
Temperature	20 ± 1°C 30 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Cutkomp & Subramanyam 1986	***A. aegypti***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	100%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% ethanol	
Concentration 1 Nom/Meas (µg/L)	0.05	3-6 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3-6 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3-6 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3-6 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	3.75	3-6 reps, 10/rep
Control	Solvent	3-6 reps, 10/rep
LC_{50} (95% confidence limits) (µg/L)	20 °C: 0.27 (0.22-0.31) 30 °C: 0.98 (0.90-1.06)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -41

Toxicity Data Summary

Aedes aegypti

Study: Parsons JT, Surgeoner GA. 1991a. Effect of exposure time on the acute toxicities of permethrin, fenitrothion, carbaryl and carbofuran to mosquito larvae. Environ Toxicol Chem 10:1219-1227.

Relevance
Score: 90
Rating: R

Reliability
Score: 72.5
Rating: L

*No standard method

	Parsons & Surgeoner 1991	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3rd instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	Yes, 1 h, 4 h	
Effect 1	Immobility	
Control response 1	< 10%	
Effect 2	Emergence to adult stage	
Control response 2	< 10%	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L:8 D	
Dilution water	Dechlorinated tapwater	
pH	7.8-8.0	
Hardness	NR	
Alkalinity	NR	

	Parsons & Surgeoner 1991	***A. aegypti***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	90.8%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.5% acetone	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, log_2 series	3-5 reps, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 3 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 4 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 5 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 6 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Control	Solvent and dilution water	3-5 reps, 20/rep
LC_{50} (± standard error) (μg/L) For emergence to adults	1 h: 4.67 (0.59) 4 h: 1.15 (0.13) 24 h: 0.45 (0.08)	Method: probit
EC_{50} (μg/L) For larvae immobility	24 h: 0.85 (calculated from regression equation)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), Hypothesis tests (8). -28

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Random design (2), Hypothesis tests (3). -27

Toxicity Data Summary

Aedes aegypti

Study: Parsons JT, Surgeoner GA. 1991b. Acute toxicities of permethrin, fenitrothion, carbaryl and carbofuran to mosquito larvae during single- or multiple-pulse exposures. Environ Toxicol Chem 10:1229-1233.

Relevance
Score: 90
Rating: R

Reliability
Score: 71.5
Rating: L

*No standard method

	Parsons & Surgeoner 1991b	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3rd instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	2 h or 1 h followed by 6 h non-exposed followed by 1 h	
Data for multiple times?	Yes, 2 h, 1 + 1 h	
Effect 1	Immobility	
Control response 1	< 10%	
Effect 2	Survival to adult stage (168-192 h after start of exposure)	
Control response 2	< 10%	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L:8 D	
Dilution water	Dechlorinated tapwater	

	Parsons & Surgeoner 1991b	***A. aegypti***
Parameter	**Value**	**Comment**
pH	7.8-8.0	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	90.8%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.5% acetone	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, $\log_2$ series	3-5 reps, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 3 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 4 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 5 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Concentration 6 Nom/Meas (μg/L)	NR	3-5 reps, 20/rep
Control	Solvent and dilution water	3-5 reps, 20/rep
LC_{50} ($\pm$ standard error) (μg/L) For emergence to adults	1 +1 h: 2.03 (0.06) 2 h: 2.32 (0.46)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), Hypothesis tests (8). -28

Acceptability (Table 3.8): No standard method (5), Appropriate duration (2), Measured concentrations within 20% of nominal (4), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Random design (2), Hypothesis tests (3). -29

Toxicity Data Summary

Aedes atropalpus

Study: Cilek JE, Craig GB, Jr, Knapp FW. 1995. Comparative susceptibility of larvae of three *Aedes* species to malathion and permethrin. Journal of the American Mosquito Control Association 11:416-418.

Relevance
Score: 90
Rating: R

Reliability
Score: 62
Rating: L

*No standard method

	Cilek et al. 1995	***A. atropalpus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*atropalpus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd instar larvae	
Source of organisms	Laboratory cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	20 ± 1°C	
Test type	Static	
Photoperiod/light intensity	Continuous light	
Dilution water	Dechlorinated tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Cilek et al. 1995	***A. atropalpus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	95.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	4 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 3 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 4 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 5 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Control	Solvent and dilution water	4 reps, 25/rep
LC_{50} (95% confidence interval) (µg/L)	6.168 (5.688-6.671)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -45

Toxicity Data Summary

Americamysis bahia

Study: Cripe GM. 1994. Comparative acute toxicities of several pesticides and metals to *Mysidopsis bahia* and potlarval *Penaeus duorarum.* Environ Toxicol Chem 13:1867-1872.

Relevance
Score: 85
Rating: L

Reliability
Score: 75.5
Rating: R

*Saltwater

	Cripe 1994	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Mysida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles, ≤ 24 h old	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	3%	
Temperature	25 ± 0.5°C	
Test type	Static	
Photoperiod/light intensity	14 h light: 10 h light	
Dilution water	Filtered seawater	25 o/oo salinity
pH	7.8-8.1	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	5.9 mg/L	
Feeding	Yes at start of test	

	Cripe 1994	***A. bahia***
Parameter	**Value**	**Comment**
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	10 uL/L; 90% triethylene glycol/10% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations at 60% dilutions	2 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Control	Dilution water and solvent	Reps and # per
LC_{50} (95% confidence interval) (µg/L)	0.095 (0.077-0.12)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -24

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Feeding (3), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Random design (2), Adequate replicates (2), Hypothesis tests (3). -25

Toxicity Data Summary

Americamysis bahia

Study: Kent SJ, Williams TD, Sankey SA, Grinell AJ. 1992. Permethrin: Acute toxicity to mysid shrimp (*Mysidopsis bahia*) of a 10% EC formulation. Study performed by Imperial Chemical Industries, PLC Group Environmental Laboratory: Brixham, Devon, UK. EPA MRID 42584001.

Relevance
Score: 70
Rating: L

Reliability
Score: 83
Rating: R

*Saltwater, Low chemical purity

	Kent et al. 1992	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1989, USEPA 1978	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Mysida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h old	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	0%	
Temperature	25 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	Filtered seawater	Tor Bay, Devon Salinity 20 o/oo
pH	8.02-8.09	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Kent et al. 1992	***A. bahia***
Parameter	**Value**	**Comment**
Dissolved Oxygen	7.0-7.7 mg/L	
Feeding	Fed daily with *Artemia salina*	
Purity of test substance	10%	Emulsifiable concentrate
Concentrations measured?	Yes	
Measured is what % of nominal?	79-89%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (µg/L)	1.8/1.60	2 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	1.0/0.87	2 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	0.56/0.44	2 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	0.32/0.27	2 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	0.18/0.15	2 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	0.10/0.086	2 reps, 20/rep
Concentration 7 Nom/Meas (µg/L)	0.056/0.048	2 reps, 20/rep
Control	Dilution water	2 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 0.82 (0.69-1.0) 48 h: 0.59 (0.50-0.71) 72 h: 0.49 (0.40-0.61) 96 h: 0.47 (0.39-0.59)	Method: moving average angle
NOEC (µg/L)	0.32	Method: NR p: NR MSD: NR

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -14

Acceptability (Table 3.8): Chemical purity (10), Hardness (2), Alkalinity (2), Conductivity (1), Adequate replicates (2), Hypothesis tests (3). -20

Toxicity Data Summary

Americamysis bahia (formerly *Mysidopsis bahia*)

Study: Schimmel SC, Garnas RL, Patrick JM, Moore JC. 1983. Acute toxicity, bioconcentration, and persistence of AC 222,705, benthiocarb, chlorpyrifos, fenvalerate, methyl parathion, and permethrin in the estuarine environment. J Agric Food Chem 31:104-113.

Relevance
Score: 85
Rating: L

Reliability
Score: 63
Rating: L

*Saltwater

	Schimmel et al. 1983	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Mysida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Newly hatched, ≤ 24 h	
Source of organisms	Collected from estuarine waters near Gulf Breeze, FL or lab cultures	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	≤ 10%	
Temperature	26.0 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	22.6 o/oo salinity
pH	NR	
Hardness	NR	

	Schimmel et al. 1983	***A. bahia***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Fed brine shrimp to prevent starvation	
Purity of test substance	92%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	NR	4 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	Solvent and dilution water	4 reps, 5/rep
LC_{50} (µg/L)	0.02 (0.017-0.024)	Method: probit, moving average, or binomial test

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Feeding (3), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -40

Toxicity Data Summary

Americamysis bahia

Study: Thompson RS. 1986. Supplemental data in support of MRID 42584001. Permethrin: Determination of acute toxicity to mysid shrimps (*Mysidopsis bahia*). Laboratory project ID BL/B/2921. Brixham study no P131/B. Study performed by Brixham Environmental Laboratory: Devon, UK. EPA MRID 43492902.

Relevance
Score: 85
Rating: L

Reliability
Score: 86
Rating: R

*Saltwater

	Thompson 1986	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Mysida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3-5 d old	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	0%	
Temperature	25 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Filtered seawater diluted with freshwater	Tor Bay, Devon Salinity 20 o/oo
pH	8.22-8.32	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Thompson 1986	***A. bahia***
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.55-7.30 mg/L	
Feeding	Fed daily with *Artemia salina*	
Purity of test substance	90.8% radiochemical purity	
Concentrations measured?	Yes	
Measured is what % of nominal?	64-72%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, LSC	
Concentration of carrier (if any) in test solutions	0.00425% triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	0.32/0.20	1 rep, 20/rep
Concentration 2 Nom/Meas (µg/L)	0.18/0.13	1 rep, 20/rep
Concentration 3 Nom/Meas (µg/L)	0.1/0.069	1 rep, 20/rep
Concentration 4 Nom/Meas (µg/L)	0.056/0.037	1 rep, 20/rep
Concentration 5 Nom/Meas (µg/L)	0.032/0.21	1 rep, 20/rep
Concentration 6 Nom/Meas (µg/L)	0.018/0.012	1 rep, 20/rep
Control	Dilution water and solvent	1 rep, 20/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: > 0.20 48 h: 0.14 (0.12-0.19) 72 h: 0.11 (0.090-0.14) 96 h: 0.075 (0.059-0.96)	Method: probit
NOEC (µg/L)	0.012	Method: NR p: NR MSD: NR

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -14

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Conductivity (1), Adequate replicates (2), Hypothesis tests (3). -14

Toxicity Data Summary

Americamysis bahia

Thompson RS. 1986. Permethrin: determination of acute toxicity to mysid shrimps (*Mysidopsis bahia*). Brixham Environmental Laboratory, Brixham, UK, Rept No BL/B/2921. EPA MRID 43492902.

Relevance
Score: 85
Rating: L

Reliability
Score: 87
Rating: R

*Saltwater

Reference	**Thompson 1986**	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Peracarida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3-5 days old	
Source of organisms	Continuous lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	4 days (96 hr)	
Data for multiple times?	Yes	24, 48, 72, 96 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	25±1°C	
Test type	Continuous flow	
Photoperiod/light intensity	14:10 light:dark	
Dilution water	Filtered sea water	
pH	8.22-8.32	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

Reference	**Thompson 1986**	***A. bahia***
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.55 – 7.30 mg/L	
Feeding	Fed *A. salina* naupili daily	
Purity of test substance	90.8 %	
Concentrations measured?	Yes	
Measured is what % of nominal?	64-72%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	0.017 mL triethylene glycol/L	
Concentration 1 Nom/Meas (µg/L)	0.32 / 0.202	4 Reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	0.18 / 0.13	4 Reps, 5/rep
Concentration 3 Nom/Meas (µg/L)	0.1 / 0.0692	4 Reps, 5/rep
Concentration 4 Nom/Meas (µg/L)	0.056 / 0.0374	4 Reps, 5/rep
Concentration 5 Nom/Meas (µg/L)	0.032 / 0.0207	4 Reps, 5/rep
Concentration 6 Nom/Meas (µg/L)	0.018 / 0.011	4 Reps, 5/rep
Control	Dilution water and solvent control	4 Reps, 5/rep
LC_{50} (µg/L) (95% CI)	24 hr >0.20 48 hr 0.14 (0.12-0.19) 72 hr 0.11 (0.090-0.14) 96 hr 0.075 (0.059-0.096)	Probit Analysis

Reliability points taken off for:
Documentation: Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -14

Acceptability: Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Conductivity (1), Hypothesis tests (3). -12

Toxicity Data Summary

Americamysis bahia

Study: Thompson RS, Williams TD, Tapp JF. 1989. Permethrin: Determination f chronic toxicity to mysid shrimps (*Mysidopsis bahia*) (Run 2). Laboratory project ID: BL/B/3574. Study performed by Imperial Chemical Industries PLC Brixham Laboratory Freshwater Quarry: Brixham, Devon, UK. EPA MRID 41315701.

Relevance
Score: 85
Rating: L

Reliability
Score: 84.5
Rating: R

*Saltwater

	Thompson et al. 1989	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1987, USEPA 1978	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Mysida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h old	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	30 d	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	12.5%	
Effect 2	Number of offspring from male-female pair	
Control response 2	Dilution water: 13.5 Solvent: 0	
Effect 3	Dry weight	
Control response 3	Female: 0.7 mg Male: 0.64 mg	
Temperature	25 ± 1°C	
Test type	Flow-through	

	Thompson et al. 1989	***A. bahia***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Filtered seawater mixed with freshwater	Tor Bay, Devon salinity 20 o/oo
pH	8.12-8.30	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	7.2-7.7 mg/L	
Feeding	Fed daily with *Artemia*	
Purity of test substance	>95% w/w radiochemical purity	
Concentrations measured?	Yes	
Measured is what % of nominal?	46-62%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC, LSC	
Concentration of carrier (if any) in test solutions	0.00037% triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	0.04/0.024	2 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	0.02/0.011	2 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	0.01/0.0046	2 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	0.005/0.0031	2 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	0.0025/0.0013	2 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	0.0013/0.00075	2 reps, 20/rep
Control	Solvent and dilution water	2 reps, 20/rep
NOEC (µg/L)	Mortality: 0.011	Method: Dennett's procedure p: 0.05 MSD: NR
LOEC (µg/L)	Mortality: 0.024	Same as above
MATC (GeoMean NOEC,LOEC)	0.016 µg/L	
% of control at NOEC	15/12.5=120%	
% of control at LOEC	100/12.5=800%	

Notes: No significant effects on male or female dry weight.
Reproduction could not be statistically evaluated due to low numbers of offspring produced

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Minimum significant difference (2), Point estimates (8). -16

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Conductivity (1), Adequate replicates (2), Minimum significant difference (1), Point estimates (3). -15

Toxicity Data Summary

Aedes hendersoni

Study: Cilek JE, Craig GB, Jr, Knapp FW. 1995. Comparative susceptibility of larvae of three *Aedes* species to malathion and permethrin. Journal of the American Mosquito Control Association 11:416-418.

Relevance
Score: 90
Rating: R

Reliability
Score: 62
Rating: L

*No standard method

	Cilek et al. 1995	***A. hendersoni***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*hendersoni*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd instar larvae	
Source of organisms	Laboratory cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	20 ± 1°C	
Test type	Static	
Photoperiod/light intensity	Continuous light	
Dilution water	Dechlorinated tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Cilek et al. 1995	***A. hendersoni***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	95.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	4 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 3 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 4 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 5 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Control	Solvent and dilution water	4 reps, 25/rep
LC_{50} (95% confidence interval) (µg/L)	3.507 (3.166-3.870)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -45

Toxicity Data Summary

Acipensar brevirostrum (Shortnose sturgeon)
Acipenser oxyrhynchus (Atlantic sturgeon)
Alosa sapidissima (American shad)

Study: Dwyer FJ, Hardesty DK, Ingersoll CG, Kunz JL, Whites DW. 2000. Assessing contaminant sensitivity of American shad, Atlantic sturgeon and Shortnose sturgeon final report. U.S. Geological Survey, Columbia Environmental Research Center, Columbia, MS.

--Sturgeon results also reported in Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: Shad 92.5, sturgeons 85
Rating: Shad R, sturgeons L

Reliability
Score: shad 70.5, sturgeons 69.5
Rating: shad L, sturgeons L

*No toxicity values (sturgeons only), unacceptable control response (shad only)

	Dwyer et al. 2000	***A. brevirostrum*** ***A. oxyrhynchus*** ***A. sapidissima***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1998	
Phylum	Chordata	
Class	Osteichthyes	
Order	Clupeiformes	
Family	Clupeidae	
Genus	*Alosa*	
Species	*sapidissima*	shad
Family in North America?	Yes	
Age/size at start of test/growth phase	Shad: 0.006 g dry wt A. sturgeon: 1.11 g wet wt S. sturgeon: 0.74 g wet wt	
Source of organisms	Shad: Hudson River hatchery, College Station, PA Atlantic sturgeon: Hudson River hatchery, Lamar, PA Shortnose sturgeon: hatchery in Warm Springs, GA	

	Dwyer et al. 2000	***A. brevirostrum*** ***A. oxyrhynchus*** ***A. sapidissima***
Parameter	**Value**	**Comment**
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	48 h	
Data for multiple times?	no	
Effect 1	Shad mortality	
Control response 1	Dilution water: 20% Solvent: 25%	
Effect 2	Atlantic sturgeon mortality	
Control response 2	0%	
Effect 3	Shortnose sturgeon mortality	
Control response 3	0%	
Temperature	Shad: 22 °C Sturgeons: 17°C	
Test type	Static	
Photoperiod/light intensity	NR, "ambient light"	
Dilution water	Reconstituted ASTM hard water	
pH	Shad: 8.6 Sturgeons: 8.4	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Shad: 8.5 mg/L A. sturgeon: 8.6 mg/L S. sturgeon: 8.7 mg/L	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Only stocks	
Measured is what % of nominal?	88% for stock solution	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	Max. 0.05 mL/L acetone	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60 % dilution series	3 reps, 10 shad/rep, 7 S. sturgeon/rep, 9 A. sturgeon/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 7-10 fish/rep

	Dwyer et al. 2000	***A. brevirostrum*** ***A. oxyrhynchus*** ***A. sapidissima***
Parameter	**Value**	**Comment**
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 7-10 fish/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 7-10 fish/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 7-10 fish/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 7-10 fish/rep
Control	Dilution water and solvent	3 reps, 7-10 fish/rep
LC_{50} (95% confidence interval) (μg/L)	Shad: 2.08 (1.78-2.37) A. sturgeon: >1.2 S. sturgeon: >1.2	Method: probit or moving average or nonlinear interpolation

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8), Point estimates (8 – sturgeons only). -24 shad, -32 sturgeons

Acceptability (Table 3.8): Appropriate duration (2), Control response (9 – shad only), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Prior contamination (4), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replicates (2), Hypothesis tests (3), Point estimates (3- sturgeons only). –35 Shad, -29 sturgeons

Toxicity Data Summary

Aedes triseriatus

Study: Cilek JE, Craig GB, Jr, Knapp FW. 1995. Comparative susceptibility of larvae of three *Aedes* species to malathion and permethrin. Journal of the American Mosquito Control Association 11:416-418.

Relevance
Score: 90
Rating: R

Reliability
Score: 62
Rating: L

*No standard method

	Cilek et al. 1995	***A. triseriatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*triseriatus*	6 strains Walton (WAL) Vero Beach (VB) UNDERC Kentucky (UKEN) Salado (SAL) Alabama (ALA)
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd instar larvae	
Source of organisms	Laboratory cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	20 ± 1°C	
Test type	Static	
Photoperiod/light intensity	Continuous light	
Dilution water	Dechlorinated tapwater	

	Cilek et al. 1995	***A. triseriatus***
Parameter	**Value**	**Comment**
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	4 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 3 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 4 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 5 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Control	Solvent and dilution water	4 reps, 25/rep
LC_{50} (95% confidence interval) (µg/L)	WAL: 8.39 (8.11-8.70) VB: 7.68 (7.40-7.98) SAL: 7.38 (6.80-8.15) UKEN: 6.39 (5.61-6.93) UNDERC: 6.23 (5.64-6.79) ALA: 4.46 (4.18-4.72)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -45

Toxicity Data Summary

Alonella sp.

Study: Naqvi SM, Hawkins RH. 1989. Responses and LC50 values for selected microcrustaceans exposed to Spartan®, Malathion, Sonar®, Weedtrine-D®, and Oust® pesticides. Bull Environ Contam Toxicol 43:386-393.

Relevance
Score: 75
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, Low chemical purity

	Naqvi & Hawkins 1989	***Alonella* sp.**
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Crustacea (Branchiopoda)	
Order	Diplostraca	
Family	Chydoridae	
Genus	*Alonella*	
Species	NR	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected from Lake Kernan near Baton Rouge, LA	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0.3%	
Temperature	21 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Aged tapwater	
pH	8.0-8.5	
Hardness	26-28 mg/L, 4 mg/kg as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Naqvi & Hawkins 1989	***Alonella* sp.**
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.6-7.5 mg/kg	
Feeding	None during test	
Purity of test substance	42% (50.7% xylene)	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom (µg/L)	1.0	3 reps, 100-150/rep
Concentration 2 Nom (µg/L)	2.0	3 reps, 100-150/rep
Concentration 3 Nom (µg/L)	4.0	3 reps, 100-150/rep
Concentration 4 Nom (µg/L)	6.0	3 reps, 100-150/rep
Concentration 5 Nom (µg/L)	8.0	3 reps, 100-150/rep
Concentration 6 Nom (µg/L)	10.0	Reps and # per
Concentration 7 Nom (µg/L)	12.0	
Control	Dilution water	3 reps, 100-150/rep
LC_{50} (95% fiducial limits) (µg/L)	4.0 (3.8-4.9)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). - 27

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Dilution water (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). - 43

Toxicity Data Summary

Brachycentrus americanus

Study: Anderson RL. 1982. Toxicity of fenvalerate and permethrin to several nontarget aquatic invertebrates. Environ Entomol 11:1251-1257.

Relevance
Score: 90
Rating: R

Reliability
Score: 78.5
Rating: R

*No standard method

	Anderson 1982	***B. americanus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Trichoptera	
Family	Brachycentridae	
Genus	*Brachycentrus*	Caddisfly
Species	*americanus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Larvae, age/size NR	
Source of organisms	Collected from ponds and streams near Duluth, MN	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Acclimatized for 1 week	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	28 d	
Data for multiple times?	Yes, 21 d	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Behavioral effects	
Control response 2	0%	
Temperature	15 ± 0.6°C	
Test type	FT	
Photoperiod/light intensity	14 light: 10 dark	
Dilution water	Unfiltered Lake Superior water	
pH	7.6-7.8	
Hardness	46-48 mg/L	

	Anderson 1982	***B. americanus***
Parameter	**Value**	**Comment**
Alkalinity	42-44 mg/L	
Conductivity	NR	
Dissolved Oxygen	>95% saturation	
Feeding	Birch and poplar leaves	
Purity of test substance	Technical	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	0.52 ± 0.14	2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	0.22 ± 0.09	2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	0.12 ± 0.05	2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	0.064 ± 0.024	2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	0.030 ± 0.010	2 reps, 10/rep
Control	Dilution water	2 reps, 10/rep
LC_{50} (μg/L)	21 d: 0.17 (0.09-0.34)	Method: trimmed Spearman-Karber
EC_{50} (μg/L) behavior	48 h: 0.064	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Age/size (5), Nominal concentrations (3), Conductivity (2), Hypothesis tests (8).

Acceptability (Table 3.8): Standard method (5), Measure concentrations within 20% of nominal (4), Appropriate size/age (3), Prior contamination (4), Organisms randomized (1), Conductivity (1), Random design (2), Adequate replication (2), Hypothesis tests (3).

Toxicity Data Summary

Bufo boreas boreas

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 85
Rating: L

Reliability
Score: 70.5
Rating: L

*No toxicity value

	Dwyer et al. 2005	***B. boreas boreas***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Amphibia	
Order	Anura	
Family	Bufonidae	
Genus	*Bufo*	
Species	*boreas boreas*	Boreal toad
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected in wild by Colorado Division of Wildlife	From West Fork of Clear Creek near Georgetown, CO
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	

	Dwyer et al. 2005	***B. boreas boreas***
Parameter	**Value**	**Comment**
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (µg/L)	>10.0	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -43

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3), Point estimates (3). -16

Toxicity Data Summary

Bufo boreas

Study: Dwyer FJ, Hardesty DK, Henke CE, Ingersoll CG, Whites DW, Mount DR, Bridges CM. 1999. Assessing contaminant sensitivity of endangered and threatened species: toxicant classes. EPA/600/R-99/098.

Relevance
Score: 85
Rating: L

Reliability
Score: 73
Rating: L

*No toxicity value calculable

	Dwyer et al. 1999	***B. boreas***
Parameter	**Value**	**Comment**
Test method cited	EPA 1975, ASTM 1998	
Phylum	Chordata	
Class	Amphibia	
Order	Anura	
Family	Bufonidae	
Genus	*Bufo*	
Species	*boreas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Weight: 12 mg, Length: 9.6 ± 0.7 mm	
Source of organisms	National or state fish hatcheries	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 96 h acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	<10%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR – “ambient lighting”	
Dilution water	Reconstituted hard water	
pH	Mean: 8.4 ± 0.1	
Hardness	167 ± 5 mg/L as CaCO3	
Alkalinity	115 ± 1 mg/L as CaCO3	
Conductivity	NR	

	Dwyer et al. 1999	***B. boreas***
Parameter	**Value**	**Comment**
Dissolved Oxygen	>40% saturation at 96 h, >60% saturation at 48 h	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Only the stock solutions	
Measured is what % of nominal?	Stock: 160%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC (for stocks)	
Concentration of carrier (if any) in test solutions	0.005% acetone	
Concentration 1 Nom (µg/L)	6 concentrations	3 reps, 10/rep
Concentration 2 Nom (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	>10	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Hypothesis tests (8), Point estimates (8). -28

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Dissolved oxygen (6), Temperature (3), Conductivity (1), Dilution factor (2), Hypothesis tests (3), Point estimates (3). -26

Toxicity Data Summary

Chironomus dilutes

Study: Anderson, B.S., Phillips, B.M., Hunt, J.W., Connor, V., Richard, N., Tjeerdema, R.S., 2006. Identifying primary stressors impacting macroinvertebrates in the Salinas River (CA, USA): Relative effects of pesticides and suspended particles. Environmental Pollution 141:402-408

Relevance
Score: 90 (No standard method)
Rating: R

Reliability
Score: 74.5
Rating: R

	Anderson et al. 2006	***C. dilutus***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Chironomidae	
Genus	*Chironomus*	
Species	*dilutus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3rd instar	
Source of organisms	Chesapeake Culture, Hayes, VA.	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	No	
Test duration	96 hours	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	90% survival*	
Temperature	23°C ± 1*	
Test type	Static	
Photoperiod/light intensity	16 light: 8 dark*	
Dilution water	Well Water	
pH	NR	
Hardness	91.6 mg/L*	
Alkalinity	122.4 mg/L CaCO3*	

	Anderson et al. 2006	***C. dilutus***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Not fed	
Purity of test substance	100%	
Concentrations measured?	Meas. 2 reps of only some conc's	
Measured is what % of nominal?	61-75%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	Used 100mg/L methanol stock	
Concentration 1 Nom/Meas (µg/L)	0.5/ NR	10 reps/1per
Concentration 2 Nom/Meas (µg/L)	1/ 0.752, 0.654	10 reps/1per
Concentration 3 Nom/Meas (µg/L)	3.2/1.96, 2.25	10 reps/1per
Concentration 4 Nom/Meas (µg/L)	5/ NR	10 reps/1per
Concentration 5 Nom/Meas (µg/L)	20/ NR	10 reps/1per
Control	Solvent and dilution water	10 reps/1per
LC_{50} (µg/L)	10.450 µg/L (calculated with nominal conc)	Method: Spearman-Karber

Other notes: *Control survival, temp. variation and water chemistry obtained by personal communication with the testing laboratory.

Reliability points taken off for:
Documentation: Dissolved Oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -17
Acceptability: Standard method (5), Meas. Concentrations 20% Nom (4), Concentrations exceed 2x water solubility (4), Organisms randomly assigned to containers (1), Organisms properly acclimated (1), Dissolved oxygen (6), Conductivity (1), pH (2), Random / block design (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Chironomus dilutus

Study: Harwood AD, You J, Lydy MJ. 2009. Temperature as a toxicity identification evaluation tool for pyrethroid insecticides: Toxicokinetic confirmation. Environ Toxicol Chem 28:1051-1058.

Relevance
Score: 100
Rating: R

Reliability
Score: 80 (23°C), 78.5 (13°C)
Rating: R

	Harwood et al. 2009	***C. dilutus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 2000	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Chironomidae	
Genus	*Chironomus*	
Species	*dilutus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar	
Source of organisms	Laboratory cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	92%	
Temperature	23 ± 0.3°C 13 ± 0.5°C	
Test type	Static	
Photoperiod/light intensity	16 light:8 dark	
Dilution water	USEPA moderately hard water	
pH	6.7-7.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	275-396 uS/cm	
Dissolved Oxygen	6.39-7.41 mg/L	

	Harwood et al. 2009	***C. dilutus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	>96%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Meas	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	% acetone	
Concentration 1 Nom/Meas (µg/L)	0.0164	5 reps, 10 /rep
Concentration 2 Nom/Meas (µg/L)	NR	5 reps, 10 /rep
Concentration 3 Nom/Meas (µg/L)	NR	5 reps, 10 /rep
Concentration 4 Nom/Meas (µg/L)	NR	5 reps, 10 /rep
Concentration 5 Nom/Meas (µg/L)	NR	5 reps, 10 /rep
Concentration 6 Nom/Meas (µg/L)	0.419	5 reps, 10 /rep
Control	Solvent and dilution water	5 reps, 10 /rep
LC_{50} (fiducial limits) (µg/L)	13 °C: 0.0585 (0.0426-0.0808)* 23 °C: 0.189 (0.131-0.295)	Method: log-probit

Notes: water-only bioassays also contained ~ 10g Fisher sea sand to provide a substrate for the midges and prevent cannibalism.
*not the standard test temperature, significantly different from LC_{50} at 23°C

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Hypothesis tests (8). -18

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Carrier solvent (4), Temperature (3 – 13degC only), Organisms randomized (1), Organisms/rep (2), Hardness (2), Alkalinity (2), Random design (2), Dilution factor (2), Hypothesis tests (3). 23°C: -22, 13°C:-25

Toxicity Data Summary

Ceriodaphnia dubia

Study: Wheelock CE, Miller JL, Miller MJ, Gee SJ, Shan G, Hammock BD. 2004. Development of toxicity identification evaluation procedures for pyrethroid detection using esterase activity. Environmental Toxicology and Chemistry 23(11): 2699-2708

Relevance
Score: 100
Rating: R

Reliability
Score: 74.5
Rating: R

Reference	**Wheelock *et al.* 2004**	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	EPA	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Ceriodaphnia*	
Species	*dubia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h	
Source of organisms	Lab culture, AQUA-Science, Davis, CA	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	> 90%	
Temperature	25 +/- 1 ºC	
Test type	Static	
Photoperiod/light intensity	16:8 light: dark	
Dilution water	EPA moderately hard	
pH	7.4-7.8	
Hardness	80-100 mg/L	
Alkalinity	60-70 mg/L	
Conductivity	Measured but NR	

Reference	**Wheelock *et al.* 2004**	***C. dubia***
Parameter	**Value**	**Comment**
Dissolved Oxygen	Measured but NR	
Feeding	None	
Purity of test substance	99%	
Concentrations measured?	No	
Measured is what % of nominal?	NR	
Chemical method documented?	Yes	GC-MS
Concentration of carrier (if any) in test solutions	<1%	
Concentration 1 Nom/Meas (µg/L)	5-7 concentrations	2-4 w/ 5 neonates each
Control	Water and methanol control	2-4 w/ 5 neonates each
LC_{50}	48 h: 0.250 +/- 0.119 µg/L	ToxCal software, but no stat method reported

Reliability points taken off for:
Documentation: Nominal concentrations (3), Measured concentrations (3), Dissolved Oxygen (4), Conductivity (2), Statistical methods identified (5), Hypothesis tests (8)

Acceptability: Meas. Concentrations 20% Nom (4), Carrier solvent ≤ 0.5 mL/L (4), Dissolved oxygen (6), Conductivity (1), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3)

Toxicity Data Summary

Hyalella azteca

Study: Wheelock CE, Miller JL, Miller MJ, Phillips BM, Gee SJ, Tjeerdema RS, Hammock BD. 2005. Influence of container adsorption upon observed pyrethroid toxicity to *Ceriodaphnia dubia* and *Hyalella azteca.* Aquatic Toxicology 74:47-52.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 65.5
Rating: L

*Control not described

	Wheelock et al. 2005	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1993	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Diplostraca (Cladocera)	
Family	Daphniidae	
Genus	*Ceriodaphnia*	
Species	*dubia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes *	Info obtained from Wheelock et al. 2004
Test vessels randomized?	Yes *	Info obtained from Wheelock et al. 2004
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	≤ 5%	
Temperature	25 ± 1°C *	Info obtained from Wheelock et al. 2004
Test type	Static	
Photoperiod/light intensity	16 L:8 D*	Info obtained from Wheelock et al.

	Wheelock et al. 2005	***C. dubia***
Parameter	**Value**	**Comment**
		2004
Dilution water	EPA moderately hard *	Info obtained from Wheelock et al. 2004
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	99%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	<1% methanol *	Info obtained from Wheelock et al. 2004
Concentration 1 Nom/Meas (µg/L)	0	4 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	0.125	4 reps, 5/rep
Concentration 3 Nom/Meas (µg/L)	0.250	4 reps, 5/rep
Concentration 4 Nom/Meas (µg/L)	0.375	4 reps, 5/rep
Control	Not described	4 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	Time to test initiation (min) 15: 0.0658 (0.0605-0.0782) 30: 0.0742 (0.0554-0.1057) 60: 0.0781 (0.0584-0.1070) 120: 0.0893 (0.0575-0.1464) 240: 0.1402 (0.1064-0.1679)**	Method: Spearman-Karber

Notes:
* Info obtained from: Wheelock CE, Miller JL, Miller MJ, Gee SJ, Shan F, Hammock BD. 2004. Development of toxicity identification evaluation procedures for pyrethroid detection using esterase activity. Environ Toxicol Chem 23:2699-2708. – as cited in the article.
** statistically significant difference from the other time intervals

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -36

Acceptability (Table 3.8): Control description (6), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Number of concentrations (3), Hypothesis tests (3). -33

Toxicity Data Summary

Ceriodaphnia dubia

Study: Yang WC, Hunter W, Spurlock F, Gan J. 2007. Bioavailability of permethrin and cyfluthrin in surface waters with low levels of dissolved organic matter. *J. Environ. Qual.* 36:1678-1685.

Relevance
Score: 100
Rating: R

Reliability
Score: 76.5
Rating: R

Reference	**Yang *et al.* 2007**	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1993	Effluent toxicity tests
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Ceriodaphnia*	
Species	*dubia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Neonates, < 24 h	
Source of organisms	Lab cultures	Aquatic BioSystems, Fort Collins, CO
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, several months	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	<10% for all waters tested	
Temperature	21 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	15 filtered surface waters from Orange and Riverside Counties, CA	See notes below for key to numbered waters
pH	1) 7.30	

Reference	**Yang *et al.* 2007**	***C. dubia***
Parameter	**Value**	**Comment**
	2) 6.87 3) 6.85 4) 7.36 5) 7.76 6) 7.02 7) 7.14 8) 7.70 9) 7.24 10) 6.95 11) 7.05 12) 7.73 13) 7.29 14) 6.67 15) 6.85	
Hardness (mg/L)	1) 303 2) >1000 3) 200 4) 162 5) 223 6) >1000 7) >1000 8) 270 9) 365 10) 308 11) >1000 12) 440 13) 200 14) 302 15) 220	
Alkalinity (mg/L)	1) 323 2) 318 3) 180 4) 118 5) 204 6) 361 7) 317 8) 230 9) 269 10) 235 11) 470 12) 130 13) 223 14) 304 15) 198	

Reference	**Yang *et al.* 2007**	***C. dubia***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Yes, shortly before exposure and at 48 h	
Purity of test substance	99.3%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutionsd	≤ 0.1% acetone	
Concentration 1 Nom/Meas (µg/L)	0.2	5 org/rep
Concentration 2 Nom/Meas (µg/L)	0.5	5 org/rep
Concentration 3 Nom/Meas (µg/L)	1.0	5 org/rep
Concentration 4 Nom/Meas (µg/L)	2.0	5 org/rep
Concentration 5 Nom/Meas (µg/L)	4.0	5 org/rep
Control	Dilution waters, DI water	5 org/rep
LC_{50} (95% confidence interval) (µg/L)	0) 0.652 (0.484-0.856) 1) 0.788 (0.545-1.040) 2) 0.622 (0.427-0.824) 3) 0.772 (0.574-1.013) 4) 0.745 (0.568-0.957) 5) 0.858 (0.591-1.138) 6) 0.571 (0.427-0.740) 7) 0.580 (0.407-0.718) 8) 0.609 (0.486-0.747) 9) 0.570 (0.459-0.689) 10) 0.827 (0.669-1.012) 11) 0.585 (0.677-0.793) 12) 0.849 (0.655-1.085) 13) 0.889 (0.666-1.120) 14) 0.865 (0.672-1.098) 15) 0.996 (0.764-1.286)*	Method: Probit * indicates significantly different than DI water control (0), these values were excluded from the RR data set because they had high DOM concentrations.

Notes:

LC_{50} calculated based on nominal concentrations.

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (4), Dissolved oxygen (4), Conductivity (2), Hypothesis tests (8). -22
Acceptability: Measured concentrations w/in 20% nominal (4), Carrier solvent (4), Organisms randomized (1), Dissolved oxygen (6), Conductivity (1), Exposure type (2), Random design (2), Adequate replication (2), Hypothesis tests (3). -25

Toxicity Data Summary

Ceriodaphnia dubia

Study: Yang W, Spurlock F, Liu W, Gan J. 2006a. Effects of dissolved organic matter on permethrin bioavailability to *Daphnia* species. J Agric Food Chem 54:3967-3972.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 72
Rating: L

*Control response not reported

	Yang et al. 2006	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	US EPA	Effluent toxicity test
Phylum	Arthropoda	
Class	Crustacea (Branchiopoda)	
Order	Diplostraca (Cladocera)	
Family	Daphniidae	
Genus	*Ceriodaphnia*	
Species	*dubia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	21 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	Moderately hard water amended with 1) Lake water 2) Pond water 3) compost extract	
pH	NR	
Hardness	Lake: 418 mg/L Pond: 353 mg/L	

	Yang et al. 2006	***C. dubia***
Parameter	**Value**	**Comment**
	Compost: 209 mg/L	
Alkalinity	Lake: 458 mg/L Pond: 352 mg/L Compost: 181 mg/L	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Right before exposure and at 48 h, added so that partitioning effects were uniform among all treatments	
Purity of test substance	99.3%	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (μg/L)	0.2	4 reps, 5/rep
Concentration 2 Nom/Meas (μg/L)	0.4	4 reps, 5/rep
Concentration 3 Nom/Meas (μg/L)	0.8	4 reps, 5/rep
Concentration 4 Nom/Meas (μg/L)	1.2	4 reps, 5/rep
Concentration 5 Nom/Meas (μg/L)	2.4	4 reps, 5/rep
Concentration 6 Nom/Meas (μg/L)	4.8	4 reps, 5/rep
Control	Dilution water	4 reps, 5/rep
LC_{50} (μg/L)	Lake water DOC 0 mg/L: 0.52 (0.38-0.65) 1 mg/L: 0.57 (0.42-0.69) 5 mg/L: 0.54 (0.43-0.66) 10 mg/L: 0.74 (0.57-0.95) 20 mg/L: 0.78 (0.63-0.95)* 30 mg/L: 1.09 (0.81-1.39)* Compost extract DOC 0 mg/L: 0.48 (0.39-0.58) 1 mg/L: 0.52 (0.39-0.63) 5 mg/L: 0.49 (0.388-0.60) 10 mg/L: 0.59 (0.42-0.74) 20 mg/L: 0.73 (0.52-0.90)* 30 mg/L: 0.92 (0.71-1.19)* Pond water DOC 0 mg/L: 0.56 (0.41-0.68)	Method: probit

	Yang et al. 2006	*C. dubia*
Parameter	**Value**	**Comment**
	0.5 mg/L: 0.51 (0.38-0.62) 1 mg/L: 0.59 (0.48-0.72) 2 mg/L: 0.66 (0.49-0.81) 5 mg/L: 0.76 (0.57-0.95)* 10 mg/L: 1.03 (0.81-1.32)*	

Notes: *Significantly different from 0 mg/L DOC.

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -24

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dissolved oxygen (6), Conductivity (1), pH (2), Random design (2), Hypothesis tests (3). -32

Toxicity Data Summary

Culex pipiens pallens

Study: Kasai S, Shono T, Komagata O, Tsuda Y, Kobayashi M, Motoki M, Kashima I, Tanikawa T, Yoshida M, Tanaka I, Shinjo G, Hashimoto T, Ishikawa T, Takahashi T, Higa Y, Tomita T. 2007. Insecticide resistance in potential vector mosquitoes for west nile virus in Japan. Journal of Medical Entomology 44:822-829.

Relevance	Reliability
Score: 82.5	Score: 60
Rating: L	Rating: L

*Unacceptable standard method, Control response not reported

	Kasai et al. 2007	***C. pipiens pallens***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*pipiens pallens*	Horaana strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	26 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Kasai et al. 2007	***C. pipiens pallens***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	91.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.5% alcohol	
Concentration 1 Nom/Meas (μg/L)	NR	3 reps, 20-30/rep
Concentration 2 Nom/Meas (μg/L)	NR	
Concentration 3 Nom/Meas (μg/L)	NR	
Concentration 4 Nom/Meas (μg/L)	NR	
Concentration 5 Nom/Meas (μg/L)	NR	
Concentration 6 Nom/Meas (μg/L)	NR	
Control	Solvent	3 reps, 20-30/rep
LC_{50} (μg/L)	7.7 (7.3-8.2)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Unacceptable standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -46

Toxicity Data Summary

Culex pipiens pallens

Study: Song F, Cao X, Zhao T, Dong Y, Lu B. 2007. Pyrethroid resistance and distribution of kdr allele in *Culex pipiens pallens* in north China. International Journal of Pest Management 53:25-34.

Relevance
Score: 90
Rating: R

Reliability
Score: 62
Rating: L

*No standard method

	Song et al. 2007	***C. pipiens pallens***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*pipiens pallens*	Strains: Tanghekou (TH) Susceptible lab culture (Ss)
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd – early 4th instar larvae	
Source of organisms	Parent generation collected in field – 1st or 2nd generation Or lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	< 4%	
Temperature	26 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	

	Song et al. 2007	***C. pipiens pallens***
Parameter	**Value**	**Comment**
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	92%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.5% acetone	
Concentration 1 Nom/Meas (µg/L)	7 concentrations	3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Control	Solvent	3 reps, 20/rep
LC_{50} (95% confidence limit) (µg/L)	Ss: 3.85 (3.47-4.27) TH: 9.904 (5.341-18.37)	Method: probit

Notes: Other strains were tested but the toxicity values exceeded 2x the aqueous solubility of permethrin.

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -42

Toxicity Data Summary

Culex quinquefasciatus

Study: Corbel V, Raymond M, Chandre F, Darriet F, Hougard J-M. 2003. Efficacy of insecticide mixtures against larvae of *Culex quinquefasciatus* (Say) (Diptera:Culicidae) resistant to pyrethroids and carbamates. Pest Manag Sci 60:375-380.

Relevance	Reliability
Score: 90	Score: 63.5
Rating: R	Rating: L

*Unacceptable standard method

	Corbel et al. 2003	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1970	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	Say R-LAB strain (carbamate resistant)
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd and 5th instar larvae	
Source of organisms	Lab colony	
Have organisms been exposed to contaminants?	Not these organisms, but ancestors breed for carbamate resistance	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	< 5%	
Temperature	27 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Corbel et al. 2003	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	94.4%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1 mL ethanol/99 mL dilution water	
Concentration 1 Nom/Meas (μg/L)	5-8 concentrations	3 tests with 5 reps, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 tests with 5 reps, 20/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 tests with 5 reps, 20/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 tests with 5 reps, 20/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 tests with 5 reps, 20/rep
Control	Solvent	3 tests with 5 reps, 20/rep
LC_{50} (μg/L)	1.2	Method: log-probit

Notes: The results for the permethrin resistant strain were not reported because the LC50 of 400 ug/L exceeded 2x the water solubility (5.5 ug/L).
There are also results for mixtures with propoxur, a carbamate insecticide.

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Unacceptable standard method (5), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -39

Toxicity Data Summary

Cyprinodon variegatus

Study: Hansen DJ, Goodman LR, Moore JC, Higdon PK. 1983. Effects of the synthetic pyrethroids AC 222,705, permethrin and fenvalerate on sheepshead minnows in early life stage toxicity tests. Environ Toxicol Chem 2:251-258.

Relevance	Reliability
Score: 75	Score: 77
Rating: L	Rating: R

*No standard method, saltwater

	Hansen et al. 1983	***C. variegatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Actinopterygii	
Order	Cyprinodontiformes	
Family	Cyprinodontidae	
Genus	*Cyprinodon*	
Species	*variegatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1.5-24 h old embryos	
Source of organisms	Eggs from lab-cultured fish	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	28 d	
Data for multiple times?	No	
Effect 1	Embryo survival	
Control response 1	95%	
Effect 2	Fry survival	
Control response 2	97%	
Effect 3	Average length of hatched fish	
Control response 3	9.8 mm	
Temperature	30 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	12 h:12 h	
Dilution water	Seawater	25 o/oo salinity

	Hansen et al. 1983	***C. variegatus***
Parameter	**Value**	**Comment**
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	3.6-6.6 mg/L (58-100% saturation)	
Feeding	Fish fed 1-2 times daily with *Artemia salina* nauplii	
Purity of test substance	93%	From Schimmel et al. 1983
Concentrations measured?	Yes	
Measured is what % of nominal?	95-110%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC/MS	
Concentration of carrier (if any) in test solutions	% 9 mg/L triethylene glycol	
Concentration 1 Nom/Meas w/ std dev. (µg/L)	1.25/1.6 (0.13)	4 reps, 20/rep
Concentration 2 Nom/Meas w/ std dev. (µg/L)	2.5/2.4 (0.36)	4 reps, 20/rep
Concentration 3 Nom/Meas w/ std dev. (µg/L)	5.0/5.6 (0.93)	4 reps, 20/rep
Concentration 4 Nom/Meas w/ std dev. (µg/L)	10/10.0 (2.6)	4 reps, 20/rep
Concentration 5 Nom/Meas w/ std dev. (µg/L)	20/22.0 (2.9)	4 reps, 20/rep
Concentration 6 Nom/Meas w/ std dev. (µg/L)	40/42.0 (2.1)	4 reps, 20/rep
Control	Solvent	4 reps, 20/rep
NOEC w/ std dev. (µg/L)	Embryo/fry survival: 10 (2.6)	Method: ANOVA and Duncan's multiple range test p: 0.05 MSD: NR
LOEC w/ std dev. (µg/L)	Fry survival: 22.0 (2.9)*	Same as above
MATC (GeoMean NOEC,LOEC) (µg/L)	Fry survival: 14.8*	
% of control at NOEC	Fry survival: 102%	
% of control at LOEC	Fry survival: 1%	

Notes: *LOEC and MATC not valid because they exceed 2x the aqueous solubility of permethrin (5.5 ug/L)

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), pH (3), Minimum significant difference (2), Point estimates (8). -17

Acceptability (Table 3.8): No standard method (5), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Hardness (2), Alkalinity (2), Temperature (3), Conductivity (1), pH (2), Random design (2), Minimum significant difference (1), Point estimates (3). -29

Schimmel SC, Garnas RL, Patrick JM, Moore JC. 1983. Acute toxicity, bioconcentration, and persistence of AC 222,705, benthiocarb, chlorpyrifos, fenvalerate, methyl parathion, and permethrin in the estuarine environment. J Agric Food Chem 31:104-113.

Toxicity Data Summary

Cyprinodon variegatus

Study: Schimmel SC, Garnas RL, Patrick JM, Moore JC. 1983. Acute toxicity, bioconcentration, and persistence of AC 222,705, benthiocarb, chlorpyrifos, fenvalerate, methyl parathion, and permethrin in the estuarine environment. J Agric Food Chem 31:104-113.

Relevance
Score: 85
Rating: L

Reliability
Score: 61.5
Rating: L

*Saltwater

	Schimmel et al. 1983	***C. variegatus***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Chordata	
Class	Actinopterygii	
Order	Cyprinodontiformes	
Family	Cyprinodontidae	
Genus	*Cyprinodon*	
Species	*variegatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected from estuarine waters near Gulf Breeze, FL or lab cultures	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	$\leq$ 5%	
Temperature	30.0 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	22.1 o/oo salinity
pH	NR	
Hardness	NR	

	Schimmel et al. 1983	***C. variegatus***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0.05% triethylene glycol	
Concentration 1 Nom/Meas (μg/L)	NR	1 rep, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	
Concentration 3 Nom/Meas (μg/L)	NR	
Concentration 4 Nom/Meas (μg/L)	NR	
Concentration 5 Nom/Meas (μg/L)	NR	
Concentration 6 Nom/Meas (μg/L)	NR	
Control	Solvent and dilution water	1 rep, 20/rep
LC_{50} (μg/L)	7.8 (6.2-10)	Method: probit, moving average, or binomial test

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -42

Toxicity Data Summary

Cyprinus carpio

Hill RW, Maddock BG, Hart B & Cornish SK. (1976). "Determination of the Acute Toxicity of PP 557 to Mirror Caro (*Cyprinus carpio*)". Imperial Chemical Industries Limited, Brixham Laboratory.

Relevance
Score: 75
Rating: L

Reliability
Score: 63.5
Rating: L

Relevance Points taken off for: Standard Method (10), Controls (15)

Reference	**Hill et al, 1976**	*Cyprinus carpio*
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Chordata	
Class	Actinopterygii	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Cyprinus*	
Species	*carpio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Avg weight: 7.91 g Avg length:76.1 mm	
Source of organisms	Kerswell Priory, Cullompton, Devon	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1		
Temperature	23±0.5°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	reservoir	
pH	7.80-8.10	

Reference	**Hill et al, 1976**	*Cyprinus carpio*
Parameter	**Value**	**Comment**
Hardness	44.0-58.5 ppm as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>87% saturation	
Feeding	NR	
Purity of test substance	NR	
Concentrations measured?	Yes	
Measured is what % of nominal?	44-154%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	10 mg/L DMSO	
Concentration 1 Nom/Meas (mg/L)	0.47 / 0.370, 0.280	1 Reps and 10 organisms per rep, test repeated 2x
Concentration 2 Nom/Meas (mg/L)	0.22 / 0.2250, 0.2150	"
Concentration 3 Nom/Meas (mg/L)	0.10 / 0.074, 0.090, 0.076	"
Concentration 4 Nom/Meas (mg/L)	0.068 / 0.0655, 0.0530, 0.0396	"
Concentration 5 Nom/Meas (mg/L)	0.047 / 0.0500, 0.0475, 0.0412	"
Concentration 6 Nom/Meas (mg/L)	0.022 / 0.0340, 0.0265, 0.0255, 0.0116	"
Concentration 7 Nom/Meas (mg/L)	0.01 / 0.009, 0.010, 0.0044	"
Concentration 8 Nom/Meas (mg/L)	0.0033 / 0.0040, 0.00265	"
Control	Not described	1 Reps and 10 organisms per rep, test repeated 2x
LC50; (mg/L)	24 hr 0.098* 48 hr 0.385* 96 hr 0.015*	Concentration correlated with Geometric Mean Survival Periods

***LC50s exceed water solubility of permethrin (0.5-6 ug/L)**

Reliability points taken off for:
Documentation: Control type (8), Chemical purity (5), Alkalinity (2), Conductivity (2), Photoperiod (3), Statistical methods (5), Hypothesis tests (8).

Acceptability: No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Feeding (3), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3).

Toxicity Data Summary

Cypria sp.

Study: Naqvi SM, Hawkins RH. 1989. Responses and LC50 values for selected microcrustaceans exposed to Spartan®, Malathion, Sonar®, Weedtrine-D®, and Oust® pesticides. Bull Environ Contam Toxicol 43:386-393.

Relevance
Score: 75
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, Low chemical purity

	Naqvi & Hawkins 1989	***Cypria* sp.**
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Ostracoda	
Order	Podocopida	
Family	Cypridoidea	
Genus	*Cypria*	
Species	NR	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected from Lake Kernan near Baton Rouge, LA	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0.3%	
Temperature	21 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Aged tapwater	
pH	8.0-8.5	
Hardness	26-28 mg/L, 4 mg/kg as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Naqvi & Hawkins 1989	***Cypria* sp.**
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.6-7.5 mg/kg	
Feeding	None during test	
Purity of test substance	42% (50.7% xylene)	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom (µg/L)	1.0	3 reps, 100-150/rep
Concentration 2 Nom (µg/L)	2.0	3 reps, 100-150/rep
Concentration 3 Nom (µg/L)	4.0	3 reps, 100-150/rep
Concentration 4 Nom (µg/L)	6.0	3 reps, 100-150/rep
Concentration 5 Nom (µg/L)	8.0	3 reps, 100-150/rep
Concentration 6 Nom (µg/L)	10.0	3 reps, 100-150/rep
Concentration 7 Nom (µg/L)	12.0	3 reps, 100-150/rep
Control	Dilution water	3 reps, 100-150/rep
LC_{50} (95% fiducial limits) (µg/L)	5.0 (4.8-6.4)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). - 27

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Dilution water (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). - 43

Toxicity Data Summary

Daphnia magna (first instar)

Study: Doma S, Evered P. 1977. PP557: Acute toxicity and reproduction studies on first instar and ephippia of *Daphnia magna*. ICI Plant Protection Division. CDPR ID: study number 15139.

Relevance
Score: 85
Rating: L

Reliability
Score: 63
Rating: L

Chemical Purity (15)

Reference	**Doma et al, 1977**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	Daphnia	
Species	magna	
Family in North America?	Yes	
Age/size at start of test/growth phase	First Instar	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 hr	
Data for multiple times?	Yes	24 & 48 hr
Effect 1	Immobility	
Control response 1	0%	
Temperature	18±1°C	
Test type	Static	
Photoperiod/light intensity	30 watt, 3500 lux	
Dilution water	Reconstituted hard water	
pH	8.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

Reference	**Doma et al, 1977**	***D. magna***
Parameter	**Value**	**Comment**
Dissolved Oxygen	>85% saturation	
Feeding	Not Fed	
Purity of test substance	25% emulsifiable concentrate	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentrations Nom (µg/L)	100, 50, 10, 5, 1, 0.5, 0.1, 0.05, 0.01	3 Reps and 10 organisms per rep
Control	Solvent control and diluents control	3 Reps and 10 organisms per rep
LC50; (95% CI) (µg/L)	24 hr 1.82 (1.54-2.15) 48 hr 0.76 (0.66-0.88)	Logit transformation

Reliability points taken off for:
Documentation: Organism source (5), Chemical Grade (5), Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -34

Acceptability: Chemical Purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Hardness (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -40

Toxicity Data Summary

Daphnia Magna

Study: Aquatic Environmental Sciences. 1976. Acute toxicity of FMC 33297 ACT 29 .11, .12 to bluegill sunfish (*Lepomis macrochirus* Rafinesque) and the water flea (*Daphnia Magna* Straus). Aquatic Environmental Sciences: Tarrytown, NY. CDPR ID: study number 15099.

Relevance
Score: 85
Rating: L

Reliability
Score: 67.5
Rating: L

*Chemical purity not reported

Reference	**Aq. Envir. Sci., 1976**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1st instar, < 20 hr	
Source of organisms	Laboratory stock cultures	Original stock from National Water Quality Laboratory, Duluth, MN
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 28, 96 hr
Effect 1	Immobility	
Control response	0%	
Temperature	17 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered soft lake water	

Reference	**Aq. Envir. Sci., 1976**	***D. magna***
Parameter	**Value**	**Comment**
pH	7.30	
Hardness	44 mg/L $CaCO_3$	
Alkalinity	20 mg/L $CaCO_3$	
Conductivity	130 µmhos/cm	
Dissolved Oxygen	7.9-8.9 mg/L (84-95% saturation)	
Feeding	Not Fed	
Purity of test substance	NR	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	%NR, acteone	
Concentration 1 Nom (µg/L)	18.0	4 Reps and 5 organisms per rep
Concentration 2 Nom (µg/L)	10.0	4 Reps and 5 organisms per rep
Concentration 3 Nom (µg/L)	5.6	4 Reps and 5 organisms per rep
Concentration 4 Nom (µg/L)	3.2	4 Reps and 5 organisms per rep
Concentration 5 Nom (µg/L)	1.8	4 Reps and 5 organisms per rep
Control	Solvent and dilution water	4 Reps and 5 organisms per rep
EC_{50} (µg/L)	24 hr 22.1 (20.1-24.3)* 48 hr 7.2 (5.8-8.9)	Method: Spearman-Karber

*Exceeds 2x the aqueous solubility of permethrin (5.5-6 ug/L)

Reliability points received for:
Documentation: Results not signed, dated (6), Chemical purity (5), Analytical method (4), Measured concentrations (3), Photoperiod (3), Hypothesis tests (8). -29

Acceptability: Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dissolved oxygen (6), Photoperiod (2), Random design (2), Hypothesis tests (3). -36

.Toxicity Data Summary

Daphnia magna

Study: Bentley RE. 1975. Acute toxicity of FMC-33297 technical to water flea (*Daphnia magna*). EG&G, Bionomics: Wareham, MA. CDPR ID: study number 15076.

Relevance
Score: 100
Rating: R

Reliability
Score: 72.5
Rating: L

Reference	**Bentley 1975**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	US EPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Less than 12 hr	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Immobility	
Control response 1	10%	
Temperature	21±1.0°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Well water	
pH	7.1	
Hardness	35 mg/L $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Yes, after 48 hr	

Reference	**Bentley 1975**	***D. magna***
Parameter	**Value**	**Comment**
Purity of test substance	95.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	%NR, acetone	Solvent control performed
Concentration 1 Nom (µg/L)	0.140	3 Reps, 5/rep
Concentration 2 Nom (µg/L)	0.100	3 Reps, 5/rep
Concentration 3 Nom (µg/L)	0.075	3 Reps, 5/rep
Concentration 4 Nom (µg/L)	0.056	3 Reps, 5/rep
Concentration 5 Nom (µg/L)	0.042	3 Reps, 5/rep
Concentration 6 Nom (µg/L)	0.032	3 Reps, 5/rep
Control	Solvent and dilution water	3 Reps, 5/rep
LC50; (µg/L) (95% CI)	24 hr 0.258 (0.014-0.476) 48 hr 0.075 (0.054-0.103) 96 hr 0.039 (0.025-0.062)	Least squares regression

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -26

Acceptability: Measured concentrations within 20% of nominal (4), Carrier solvent (4), Feeding (3), Exposure type (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -29

Toxicity Data Summary

Daphnia magna

Study: Doma S, Evered P. 1977. PP557: Acute toxicity and reproduction studies on first instar and ephippia of *Daphnia magna*. ICI Plant Protection Division. CDPR ID: study number 15139.

Relevance
Score: 100
Rating: R

Reliability
Score: 70.5
Rating: L

Reference	**Doma & Evered 1977**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	First Instar	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 hr	
Data for multiple times?	Yes	24 & 48 hr
Effect 1	Immobility	
Control response 1	0%	
Temperature	18±1°C	
Test type	Static	
Photoperiod/light intensity	30 watt, 3500 lux	
Dilution water	Reconstituted hard water	
pH	8.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

Reference	**Doma & Evered 1977**	***D. magna***
Parameter	**Value**	**Comment**
Dissolved Oxygen	>85% saturation	
Feeding	Not Fed	
Purity of test substance	98.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentrations Nom 1 (µg/L)	100	3 Reps and 10/rep
Concentrations Nom 2 (µg/L)	50	3 Reps and 10/rep
Concentrations Nom 3 (µg/L)	10	3 Reps and 10/rep
Concentrations Nom 4 (µg/L)	5	3 Reps and 10/rep
Concentrations Nom 5 (µg/L)	1	3 Reps and 10/rep
Concentrations Nom 6 (µg/L)	0.5	3 Reps and 10/rep
Concentrations Nom 7 (µg/L)	0.1	3 Reps and 10/rep
Concentrations Nom 8 (µg/L)	0.05	3 Reps and 10/rep
Concentrations Nom 9 (µg/L)	0.01	3 Reps and 10/rep
Control	Solvent and dilution water	3 Reps and 10/rep
LC50; (95% CI) (µg/L)	24 hr 2.06 (1.65-2.58) 48 hr 0.6 (0.53-0.67)	Logit transformation

Reliability points taken off for:
Documentation: Organism source (5), Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -29

Acceptability: Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Hardness (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -30

Toxicity Data Summary

Daphnia magna (ephippia)

Study: Doma S, Evered P. 1977. PP557: Acute toxicity and reproduction studies on first instar and ephippia of *Daphnia magna*. ICI Plant Protection Division. CDPR ID: study number 15139.

Relevance
Score: 77.5
Rating: L

Reliability
Score: 61.5
Rating: L

Chemical Purity (15), Control response (7.5)

Note: This test studied "resting eggs" (ephippia) of *D. magna*. Two studies were performed: The first (Test A) exposed "conditioned" ephippia (dried out to push them out of dormancy). Test B exposed non-conditioned (dormant) ephippia. Exposure lasted 48 hours, conditioning 24 hours. These tests are best categorized as chronic, however, EC50's were reported rather than LOECs of NOECs.

Reference	**Doma & Evered 1977**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	Daphnia	
Species	magna	
Family in North America?	Yes	
Age/size at start of test/growth phase	2 month old ephippia	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	7 days and 20 days	
Data for multiple times?	Yes	24 & 48 hr
Effect 1	Hatched	On 7th Day
Effect 2	Lived	On 7th Day
Effect 3	2nd generation hatched	Experiment lasted 20 days

Reference	**Doma & Evered 1977**	***D. magna***
Parameter	**Value**	**Comment**
Control response 1	NR	
Temperature	20°C	
Test type	Static	
Photoperiod/light intensity	12 hr, 30 watt, 1000 lux	
Dilution water	Reconstituted hard water	
pH	8.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>85% saturation	
Feeding	Not Fed	
Purity of test substance	25% emulsifiable concentrate	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	1% acetone	
Test A Concentrations Nom (µg/L)	100, 30, 10, 3, 1, 0.5, 0.1, 0.01, 0.001	3 Reps and ~100 organisms per rep
Test A Control	Diluent water	5 reps
Test A LC50; (µg/L)	0.034*	Logit transformation *95% CI cut off
Test B Concentrations Nom (µg/L)	100, 30, 10, 3, 1, 0.5, 0.1, 0.01, 0.001	3 Reps and 20 organisms per rep
Test B Control	Diluent water	5 reps
Test B LC50; (µg/L)	0.108 (0.035-0.339)	Logit transformation

Reliability points taken off for:
Documentation: Organism source (5), Chemical Grade (5), Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -34

Acceptability: Chemical Purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Hardness (2), Alkalinity (2), Temperature not held to ± 1°C (3), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -43

Toxicity Data Summary

Daphnia magna

Study: Hamer MJ. 1990. Phase 3 summary of MRID 00042139. PP557: Acute toxicity of emulsifiable concentrate (JFU5054) to first instar *Daphnia magna.* Study performed by ICI Agrochemicals Jealott's Hill Research Station: Bracknell, Berkshire, UK. Report No: TMJ1504B. EPA MRID 42277004.

Relevance
Score: 85
Rating: L

Reliability
Score: 73.5
Rating: L

*Low chemical purity

	Hamer 1990	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Crustacea (Branchiopoda)	
Order	Diplostraca (Cladocera)	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h old	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	Yes	
Effect 1	Immobility	
Control response 1	0%	
Temperature	18 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	Standard reconstituted hard water	
pH	8.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Hamer 1990	***D. magna***
Parameter	**Value**	**Comment**
Dissolved Oxygen	>95% saturation	
Feeding	NR	
Purity of test substance	NR	
Concentrations measured?	No	
Measured is what % of nominal?	n/a%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal, but calculated based on % a.i.	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (µg/L)	20	3 tests, 3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	10	3 tests, 3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	5	3 tests, 3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	2.1	3 tests, 3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	0.5	3 tests, 3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	0.2	3 tests, 3 reps, 10/rep
Concentration 7 Nom/Meas (µg/L)	0.1	3 tests, 3 reps, 10/rep
Concentration 8 Nom/Meas (µg/L)	0.05	3 tests, 3 reps, 10/rep
Control	Dilution water	3 tests, 3 reps, 10/rep
EC_{50} (µg a.i./L)	24 h: 1.93 (1.76-2.12) 48 h: 1.31 (1.17-1.48)	Method: linear regression

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -21

Acceptability (Table 3.8): Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Feeding (3), Hardness (2), Alkalinity (2), Conductivity (1), Random design (2), Hypothesis tests (3). -32

Toxicity Data Summary

Daphnia magna

Study: Kent SJ, Morris DS, Banner AJ & Johnson PA. 1995. Permethrin: Acute toxicity to *Daphnia magna* of a 25% formulation. Report number BL5382/B. Brixham Environmental Laboratory: Brixham, UK. CDPR ID: 139554.

Relevance
Score: 85
Rating: L

Reliability
Score: 87.5
Rating: R

Relevance Points taken off for: Chemical Purity (15)

Reference	**Kent et al. 1995**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1986	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Less than 24 hours	
Source of organisms	Continuous lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	48 hr	
Data for multiple times?	Yes	24, 48 hr
Effect 1	Immobility	
Control response 1	0%	
Temperature	20±1°C	
Test type	Static	
Photoperiod/light intensity	16L:8D	
Dilution water	Elendt's M4 Daphnia medium	
pH	7.99	
Hardness	247 mg/L as $CaCO_3$	

Reference	**Kent et al. 1995**	***D. magna***
Parameter	**Value**	**Comment**
Alkalinity	43.6 mg/L as $CaCO_3$	
Conductivity	656 µS/cm	
Dissolved Oxygen	>60% saturation	
Feeding	Not fed	
Purity of test substance	26.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	70-81%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	none	
Concentration 1 Nom a.i./Meas a.i. (µg/L)	4.7/3.7	4 Reps and 5 per
Concentration 2 Nom a.i./Meas a.i. (µg/L)	2.6/2.1	4 Reps and 5 per
Concentration 3 Nom a.i./Meas a.i. (µg/L)	1.5/1.1	4 Reps and 5 per
Concentration 4 Nom a.i./Meas a.i. (µg/L)	0.84/0.64	4 Reps and 5 per
Concentration 5 Nom a.i./Meas a.i. (µg/L)	0.47/0.33	4 Reps and 5 per
Concentration 6 Nom a.i./Meas a.i. (µg/L)	0.26/0.19	4 Reps and 5 per
Concentration 7 Nom a.i./Meas a.i. (µg/L)	0.15/0.11	4 Reps and 5 per
Control	Dilution water	4 Reps and 5 per
EC_{50} (µg a.i./L)	24 hr: >3.7 48 hr: 0.84 (0.68-1.0)	Moving average angle method

EC50 calculated with measured concentration of active ingrediant

Reliability points taken off for:
Documentation: Hypothesis tests (8).

Acceptability: Chemical purity (10), Measured concentrations within 20% of nominal (4), Hypothesis tests (3). -17

Toxicity Data Summary

Daphnia magna

Study: Kent SJ, Williams NJ, Gillings E, Morris DS. 1995. Permethrin: chronic toxicity to *Daphnia magna*. Zeneca Brixham Environmental Laboratory: Brixham, UK. Laboratory project ID BL5443/B. EPA MRID 43745701.

Endpoint: Mortality

Relevance	Reliability
Score: 85 (Toxicity values)	Score: 88.5
Rating: L	Rating: R

Chronic endpoints:

Relevance	Reliability
Score: 100	Score: 90
Rating: R	Rating: R

Reference	**Kent et al. 1995**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	ASTM, Draft No. 6	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	<24 hours old	
Source of organisms	Continuous in lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	21 days	
Data for multiple times?	No	
Effect 1	Immobility	
Control response 1	0%	
Effect 2	Reproduction	
Control response 2	Mean: 68 ± 3.8 offspring/parent	Pooled control response
Effect 3	Length	

Reference	**Kent et al. 1995**	***D. magna***
Parameter	**Value**	**Comment**
Control Response 3	3.92 mm	Pooled control response
Effect 4	Dry weight	
Control Response 4	707 ± 125.2 µg	Pooled control response
Temperature	20±1°C	
Test type	Flow-through	
Photoperiod/light intensity	16:8 hour light:dark	
Dilution water	DI water with salts added	
pH	8.4-8.5	
Hardness	189 $CaCO_3$ mg/L	
Alkalinity	127 $CaCO_3$ mg/L	
Conductivity	679 µS/cm	
Dissolved Oxygen	8.4 - 9.4 mg/L	≥100% saturation
Feeding	Fed a cultured algae, 2x/day	
Purity of test substance	98.6%	^{14}C permethrin
Concentrations measured?	Yes	
Measured is what % of nominal?	48-59%	
Chemical method documented?	Yes	TLC
Concentration of carrier (if any) in test solutions	100 µL/L triethylene glycol in exposure conc and solvent control	
Concentration 1 Nom/Meas (ng/L)	640/340	4 Reps and 10/rep
Concentration 2 Nom/Meas (ng/L)	320/190	4 Reps and 10/rep
Concentration 3 Nom/Meas (ng/L)	160/84	4 Reps and 10/rep
Concentration 4 Nom/Meas (ng/L)	80/39	4 Reps and 10/rep
Concentration 5 Nom/Meas (ng/L)	40/19	4 Reps and 10/rep
Control	Dilution water and solvent	4 Reps and 10/rep
LC_{50}	>340 ng/L	
NOEC (ng/L)	Reproduction: 39 Length: 39 Weight: ≥ 340	Method: ANOVA
LOEC (ng/L)	Reproduction: 84 Length: 84 Weight: >340	Same as above
MATC (ng/L)	Reproduction: 57 Length: 57 Weight: >340	
% of control at NOEC	Repro: 71/68=104% Length: 3.92/3.92=100%	
% of control at LOEC	Repro: 60/68=88% Length: 3.84/3.92=98%	

Reliability points taken off for:
Documentation: Minimum significant difference (2), Point estimates (8). -10

Acceptability: Measured concentrations within 20% of nominal (4), Statistical method (2), Minimum significant difference (1), Point estimates (3). -10

Toxicity Data Summary

Daphnia magna

Study: LeBlanc GA. 1976. Acute toxicity of FMC-33297 technical to *Daphnia magna*. EG&G, Bionomics: Wareham, MA. CDPR ID: study number 15100.

Relevance
Score: 100
Rating: R

Reliability
Score: 80
Rating: R

Reference	**LeBlanc 1976**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	<24 hrs	
Source of organisms	Lab stocks	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	48 hr	
Data for multiple times?	Yes	24, 48 hr
Effect 1	Immobility	
Control response 1	0%	
Temperature	22 ± 1.0°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Well water	
pH	7.3-7.6	
Hardness	35 mg/L $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	85-94% saturation	

Reference	**LeBlanc 1976**	***D. magna***
Parameter	**Value**	**Comment**
Feeding	Not Fed	
Purity of test substance	Technical	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	%NR, acetone	Solvent control performed
Concentration 1 Nom (µg/L)	1.0	3 Reps, 5/rep
Concentration 2 Nom (µg/L)	0.75	3 Reps, 5/rep
Concentration 3 Nom (µg/L)	0.56	3 Reps, 5/rep
Concentration 4 Nom (µg/L)	0.42	3 Reps, 5/rep
Concentration 5 Nom (µg/L)	0.32	3 Reps, 5/rep
Concentration 6 Nom (µg/L)	0.24	3 Reps, 5/rep
Concentration 7 Nom (µg/L)	0.16	3 Reps, 5/rep
Concentration 8 Nom (µg/L)	0.10	3 Reps, 5/rep
Control	Solvent and dilution water	3 Reps, 5/rep
EC_{50} (µg/L) (95% CI)	24 hr 0.93 (0.44-2.0) 48 hr 0.32 (0.24-0.44)	Method: probit

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -22

Acceptability: Measured concentrations within 20% of nominal (4), Carrier solvent (4), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -18

Toxicity Data Summary

Daphnia magna

Study: McWilliam RA, Baird DJ. 2002. Postexposure feeding depression: A new toxicity endpoint for use in laboratory studies with *Daphnia magna*. Environ Toxicol Chem 21:1198-1205.

Relevance
Score: Acute: 82.5, Chronic: 75
Rating: L

Reliability
Score: Acute: 70, Chronic: 71
Rating: L

*Acute: No standard method, Control response not reported
Chronic: No standard method, Endpoint not related to survival/growth/reproduction

	McWilliam & Baird 2002	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Crustacea (Branchiopoda)	
Order	Diplostraca (Cladocera)	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4-5 d old 4th instar larvae	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	Feed rate: 24 h Mortality: 48 h	
Data for multiple times?	No	
Effect 1	Feeding rate a) During 24 h exposure b) During 4h postexposure	
Control response 1	4-6 x 10^5 cells/individual/h	
Effect 2	Mortality with feeding	
Control response 2	NR	
Effect 3	Mortality without feeding	
Control response 3	NR	
Temperature	20 ± 1°C	
Test type	Static	

	McWilliam & Baird 2002	***D. magna***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	14 L:10 D Feeding experiments in dark	
Dilution water	ASTM hard water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Feed rate: yes (5 x 10^5 cells/mL *Chlorella vulgaris*) Mortality w/ food: yes (same) Morality w/o food: no	
Purity of test substance	98%	
Concentrations measured?	Yes	
Measured is what % of nominal?	53 $\pm$ 2.0%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, HPLC	
Concentration of carrier (if any) in test solutions	No solvent used	
Concentration 1 Nom (µg/L)	Mortality w/food: 5 Mortality w/o food: 0.1 Feed rate: 0.5	5 reps, 5/rep
Concentration 2 Nom (µg/L)	Mortality w/food: 6.7 Mortality w/o food: 0.2 Feed rate: 0.9	5 reps, 5/rep
Concentration 3 Nom (µg/L)	Mortality w/food: 9 Mortality w/o food: 0.3 Feed rate: 1.6	5 reps, 5/rep
Concentration 4 Nom (µg/L)	Mortality w/food: 12 Mortality w/o food: 0.4 Feed rate: 2.8	5 reps, 5/rep
Concentration 5 Nom (µg/L)	Mortality w/food: 16 Mortality w/o food: 0.6 Feed rate: 5.0	5 reps, 5/rep
Concentration 6 Nom (µg/L)	Mortality w/food: 22 Mortality w/o food: 0.9	5 reps, 5/rep
Concentration 7 Nom (µg/L)	Mortality w/food: 29 Mortality w/o food: 1.4	5 reps, 5/rep
Concentration 8 Nom (µg/L)	Mortality w/food: 39 Mortality w/o food: 2.1	5 reps, 5/rep
Concentration 9 Nom (µg/L)	Mortality w/food: 52 Mortality w/o food: 3.2	5 reps, 5/rep

	McWilliam & Baird 2002	*D. magna*
Parameter	**Value**	**Comment**
Concentration 10 Nom (µg/L)	Mortality w/food: 70 Mortality w/o food: 5.0	5 reps, 5/rep
Control	Dilution water (w/ or w/o food)	5 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	Feeding: 5.36 (2.5-10.6) No feeding: 0.54 (0.03-19.3)	Method: probit
EC_{50} (95% confidence interval) (µg/L)	Feeding rate during exposure: 1.09 (0.1-1.2)	Method: allosteric regression by least-squares method
NOEC	Feeding rate during exposure: 0.48 Feeding rate postexposure: 0.48	Method: Williams test $P < 0.05$ MSD: NR
LOEC	Feeding rate during exposure: 0.85 Feeding rate postexposure: 0.85	Same as above
MATC (GeoMean NOEC,LOEC)	Feeding rate during exposure: 0.64 Feeding rate postexposure: 0.64	
% of control at NOEC	Feeding rate during exposure: 90% Feeding rate postexposure: 99%	
% of control at LOEC	Feeding rate during exposure: 65% Feeding rate postexposure: 82%	

Notes:

Reliability points taken off for:
Documentation (Table 3.7):
Acute: Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -24

Chronic: Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Minimum significant difference (2), Point estimates (8). -26

Acceptability (Table 3.8):
Acute: No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Random design (2), Hypothesis tests (3). -36

Chronic: No standard method (5), Appropriate duration (2), Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Minimum significant difference (1), Point estimates (3). -32

Toxicity Data Summary

Danio rerio

Study: Zhang X-Y, Yu X-Y, Wang D-L, Yan H-J, Liu X-J. 2010. Acute toxicity to zebrafish of two organophosphates and four pyrethroids and their binary mixtures. Pest Manag Sci 66:84-89.

Relevance
Score: 90
Rating: R

Reliability
Score: 75
Rating: R

*Unacceptable standard method (China EPA)

	Zhang et al. 2010	***D. rerio***
Parameter	**Value**	**Comment**
Test method cited	Chinese EPA method	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Danio*	
Species	*rerio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Length: 3.0 ± 0.5 cm, Weight: 0.3 ± 0.1 g	
Source of organisms	Local pet store in China	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	< 5%	
Temperature	23 ± 1°C	
Test type	Static renewal – 24 h renewal	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Dechlorinated tapwater	
pH	6.9-7.5	
Hardness	140-165 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Zhang et al. 2010	***D. rerio***
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.8-7.6 mg/L	
Feeding	None during test	
Purity of test substance	90%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Control	Solvent	3 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 5.2 (4.1-6.6) 48 h: 3.0 (1.9-3.8) 72 h: 2.6 (1.8-3.3) 96 h: 2.5 (1.7-3.2)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -22

Acceptability (Table 3.8): Unacceptable standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Random design (2), Dilution factor (2), Hypothesis tests (3). -28

Toxicity Data Summary

Diaptomus sp.

Study: Naqvi SM, Hawkins RH. 1989. Responses and LC50 values for selected microcrustaceans exposed to Spartan®, Malathion, Sonar®, Weedtrine-D®, and Oust® pesticides. Bull Environ Contam Toxicol 43:386-393.

Relevance
Score: 75
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, Low chemical purity

	Naqvi & Hawkins 1989	***Diaptomus* sp.**
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Diaptomus*	
Species	NR	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected from Lake Kernan near Baton Rouge, LA	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0.3%	
Temperature	21 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Aged tapwater	
pH	8.0-8.5	
Hardness	26-28 mg/L, 4 mg/kg as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Naqvi & Hawkins 1989	***Diaptomus* sp.**
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.6-7.5 mg/kg	
Feeding	None during test	
Purity of test substance	42% (50.7% xylene)	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom (µg/L)	1.0	3 reps, 100-150/rep
Concentration 2 Nom (µg/L)	2.0	3 reps, 100-150/rep
Concentration 3 Nom (µg/L)	4.0	3 reps, 100-150/rep
Concentration 4 Nom (µg/L)	6.0	3 reps, 100-150/rep
Concentration 5 Nom (µg/L)	8.0	3 reps, 100-150/rep
Concentration 6 Nom (µg/L)	10.0	Reps and # per
Concentration 7 Nom (µg/L)	12.0	
Control	Dilution water	3 reps, 100-150/rep
LC_{50} (95% fiducial limits) (µg/L)	7.0 (6.2-7.3)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). - 27

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Dilution water (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). - 43

Toxicity Data Summary

Etheostoma fonticola (reported as *E. rubrum*)

Study: Dwyer FJ, Hardesty DK, Henke CE, Ingersoll CG, Whites DW, Mount DR, Bridges CM. 1999. Assessing contaminant sensitivity of endangered and threatened species: toxicant classes. EPA/600/R-99/098.

Relevance
Score: 100
Rating: R

Reliability
Score: 77.5
Rating: R

*In this publication, the fish is referred to as *E. rubrum,* not *E. fonticola*, but the common name given is Fountain Darter, which is associated with *E. fonticola.* Another publication by these authors (Dwyer et al. 2005) also reports data for the Fountain Darter (*E. fonticola*) and says a more detailed account of the tests can be found in this publication, so it has been assumed that the data in the two publications are identical and that the species name was incorrectly reported in the earlier publication.

	Dwyer et al. 1999	***E. fonticola***
Parameter	**Value**	**Comment**
Test method cited	EPA 1975, ASTM 1998	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Percidae	
Genus	*Etheostoma*	
Species	*fonticola*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Weight: 62 ± 19 mg, Length: 20.2 ± 2.0 mm	
Source of organisms	National or state fish hatcheries	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 96 h acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	<10%	
Temperature	22 °C	
Test type	Static	

	Dwyer et al. 1999	***E. fonticola***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	NR – "ambient lighting"	
Dilution water	Reconstituted hard water	
pH	Mean: 8.4 ± 0.1	
Hardness	167 ± 5 mg/L as CaCO3	
Alkalinity	115 ± 1 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	>40% saturation at 96 h, >60% saturation at 48 h	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Only the stock solutions	
Measured is what % of nominal?	Stock: 160%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC (for stocks)	
Concentration of carrier (if any) in test solutions	0.005% acetone	
Concentration 1 Nom (µg/L)	6 concentrations	2 reps, 10/rep
Concentration 2 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 3 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 4 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 5 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 6 Nom (µg/L)	NR	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	6 h: >10 12 h: 5.60 (4.76-6.67) 24 h: 4.26 (3.58-5.19) 48 h: 3.34 (2.75-4.16) 72 h: 3.34 (2.75-4.16) 96 h: 3.34 (2.75-4.16)	Method: 12 & 24 h: probit. 48-96 h: moving average

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Hypothesis tests (8). -20

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Dissolved oxygen (6), Temperature (3), Conductivity (1), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -25

Toxicity Data Summary

Etheostoma fonticola

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 75
Rating: R

	Dwyer et al. 2005	***E. fonticola***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee n Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Percidae	
Genus	*Etheostoma*	
Species	*fonticola*	Fountain darter
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Commercial fishery	San Marcos NFH and Tech. Ctr. San Marcos, TX
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	

	Dwyer et al. 2005	***E. fonticola***
Parameter	**Value**	**Comment**
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution series	2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (μg/L)	3.34	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replicates (2), Hypothesis tests (3). -15

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Etheostoma lepidum

Study: Dwyer FJ, Hardesty DK, Henke CE, Ingersoll CG, Whites DW, Mount DR, Bridges CM. 1999. Assessing contaminant sensitivity of endangered and threatened species: toxicant classes. EPA/600/R-99/098.

Relevance
Score: 100
Rating: R

Reliability
Score: 77.5
Rating: R

	Dwyer et al. 1999	***E. lepidum***
Parameter	**Value**	**Comment**
Test method cited	EPA 1975, ASTM 1998	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Percidae	
Genus	*Etheostoma*	
Species	*lepidum*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Weight: 133 ± 19 mg, Length: 22.6 ± 0.4 mm	
Source of organisms	National or state fish hatcheries	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 96 h acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	<10%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR – "ambient lighting"	
Dilution water	Reconstituted hard water	
pH	Mean: 8.4 ± 0.1	
Hardness	167 ± 5 mg/L as CaCO3	
Alkalinity	115 ± 1 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	>40% saturation at 96 h,	

	Dwyer et al. 1999	*E. lepidum*
Parameter	**Value**	**Comment**
	>60% saturation at 48 h	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Only the stock solutions	
Measured is what % of nominal?	Stock: 160%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC (for stocks)	
Concentration of carrier (if any) in test solutions	0.005% acetone	
Concentration 1 Nom (µg/L)	6 concentrations	2 reps, 7/rep
Concentration 2 Nom (µg/L)	NR	2 reps, 7/rep
Concentration 3 Nom (µg/L)	NR	2 reps, 7/rep
Concentration 4 Nom (µg/L)	NR	2 reps, 7/rep
Concentration 5 Nom (µg/L)	NR	2 reps, 7/rep
Concentration 6 Nom (µg/L)	NR	2 reps, 7/rep
Control	Solvent and dilution water	2 reps, 7/rep
LC_{50} (95% confidence interval) (µg/L)	6 h: 4.31 (3.71-5.04) 12 h: 3.10 (2.20-3.60) 24 h: 2.71 (2.36-3.13) 48 h: 2.71 (2.36-3.13) 72 h: 2.71 (2.36-3.13) 96 h: 2.71 (2.36-3.13)	Method: probit except 12 h: linear interpolation

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Hypothesis tests (8). -20

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Dissolved oxygen (6), Temperature (3), Conductivity (1), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -25

Toxicity Data Summary

Etheostoma lepidum

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 75
Rating: R

	Dwyer et al. 2005	***E. lepidum***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Percidae	
Genus	*Etheostoma*	
Species	*lepidum*	Greenthroat darter
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Commercial fishery	San Marcos NFH and Tech. Ctr. San Marcos, TX
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	

	Dwyer et al. 2005	***E. lepidum***
Parameter	**Value**	**Comment**
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution series	2 reps, 7/rep
Concentration 2 Nom/Meas (μg/L)	NR	2 reps, 7/rep
Concentration 3 Nom/Meas (μg/L)	NR	2 reps, 7/rep
Concentration 4 Nom/Meas (μg/L)	NR	2 reps, 7/rep
Concentration 5 Nom/Meas (μg/L)	NR	2 reps, 7/rep
Concentration 6 Nom/Meas (μg/L)	NR	2 reps, 7/rep
Control	Solvent and dilution water	2 reps, 7/rep
LC_{50} (μg/L)	2.71	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replicates (2), Hypothesis tests (3). -15

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Eucyclops sp.

Study: Naqvi SM, Hawkins RH. 1989. Responses and LC50 values for selected microcrustaceans exposed to Spartan®, Malathion, Sonar®, Weedtrine-D®, and Oust® pesticides. Bull Environ Contam Toxicol 43:386-393.

Relevance
Score: 75
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, Low chemical purity

	Naqvi & Hawkins 1989	***Eucyclops* sp.**
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Maxillopoda	
Order	Cyclopoida	
Family	Cyclopidae	
Genus	*Eucyclops*	
Species	NR	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected from Lake Kernan near Baton Rouge, LA	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0.3%	
Temperature	21 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Aged tapwater	
pH	8.0-8.5	
Hardness	26-28 mg/L, 4 mg/kg as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Naqvi & Hawkins 1989	***Eucyclops* sp.**
Parameter	**Value**	**Comment**
Dissolved Oxygen	6.6-7.5 mg/kg	
Feeding	None during test	
Purity of test substance	42% (50.7% xylene)	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom (µg/L)	1.0	3 reps, 100-150/rep
Concentration 2 Nom (µg/L)	2.0	3 reps, 100-150/rep
Concentration 3 Nom (µg/L)	4.0	3 reps, 100-150/rep
Concentration 4 Nom (µg/L)	6.0	3 reps, 100-150/rep
Concentration 5 Nom (µg/L)	8.0	3 reps, 100-150/rep
Concentration 6 Nom (µg/L)	10.0	3 reps, 100-150/rep
Concentration 7 Nom (µg/L)	12.0	3 reps, 100-150/rep
Control	Dilution water	3 reps, 100-150/rep
LC_{50} (95% fiducial limits) (µg/L)	5.0 (4.3-5.5)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). - 27

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Dilution water (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). - 43

Toxicity Data Summary

Gambusia affinis

Study: Naqvi SM, Hawkins R. 1988. Toxicity of selected insecticides (Thiodan ®, Security®, Spartan®, and Sevin®) to mosquitofish, *Gambusia affinis.* Bull Environ Contam Toxicol 40:779-784.

Relevance
Score: 75
Rating: L

Reliability
Score: 63.5
Rating: L

*No standard method, low chemical purity

	Naqvi & Hawkins 1988	***G. affinis***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cyprinodontiformes	
Family	Poeciliidae	
Genus	*Gambusia*	
Species	*affinis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	2.76 ± 0.09 cm length, 0.289 ± 0.031 g wt	
Source of organisms	Collected from a ditch near Southern University campus	Baton Rouge, Louisiana
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	96 h acclimation, but many fish had nematode parasites	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	1.7%	
Temperature	20 ± 3°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Aged tapwater (not dechlorinated)	
pH	7.8	
Hardness	12 mg/L CaCO3/100mL	

	Naqvi & Hawkins 1988	***G. affinis***
Parameter	**Value**	**Comment**
	sample	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	6.5-7.0 mg/L	
Feeding	None during tests	
Purity of test substance	47% (53% xylene)	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom (µg/L)	5.0	6 reps, 10/rep
Concentration 2 Nom (µg/L)	10.0	6 reps, 10/rep
Concentration 3 Nom (µg/L)	15.0	6 reps, 10/rep
Concentration 4 Nom (µg/L)	20.0	6 reps, 10/rep
Concentration 5 Nom (µg/L)	25.0	6 reps, 10/rep
Control	Dilution water	6 reps, 10/rep
LC_{50} (95% fiducial limits) (µg/L)	12.0 (10.52-13.34)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -25

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Prior contamination (4), Organisms randomized (1), Organism acclimation/health (1), Exposure type (2), Dilution water (2), Alkalinity (2), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Hypothesis tests (3). -48

Toxicity Data Summary

Gambusia affinis

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, control description

	Thurston et al. 1985	***G. affinis***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cyprinodontiformes	
Family	Poeciliidae	
Genus	*Gambusia*	
Species	*affinis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Test 1: Mean wt. 0.13 g Test 2: Mean wt. 0.12 g	
Source of organisms	Stock cultures or fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	Test 1: 5% Test 2: 0%	
Temperature	Test 1: 19.1 ± 1°C Test 2: 17.9 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Ground water spring	
pH	8.00-8.02	
Hardness	NR	

	Thurston et al. 1985	***G. affinis***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	340 siemens	
Dissolved Oxygen	Test 1: 7.88 mg/L Test 2: 8.28 mg/L	
Feeding	None during tests	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Not clear, probably measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	%NR, dimethylformamide	
Concentration 1 Nom/Meas (μg/L)	5 concentrations	2 reps, #/rep NR
Concentration 2 Nom/Meas (μg/L)	NR	2 reps, #/rep NR
Concentration 3 Nom/Meas (μg/L)	NR	2 reps, #/rep NR
Concentration 4 Nom/Meas (μg/L)	NR	2 reps, #/rep NR
Concentration 5 Nom/Meas (μg/L)	NR	2 reps, #/rep NR
Control	Not clear	2 reps, #/rep NR
LC_{50} (95% confidence interval) (μg/L)	Test 1: 8.02 (6.09-10.6) Test 2: 4.62 (3.45-6.19)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Hypothesis tests (8). -29

Acceptability (Table 3.8): No standard method (5), Control description (6), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Hardness (2), Alkalinity (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -41

Toxicity Data Summary

Gila elegans

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 85
Rating: L

Reliability
Score: 70
Rating: L

*No toxicity values

	Dwyer et al. 1995	***G. elegans***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Gila*	
Species	*elegans*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Run 1) 0.29 ± 0.08 g Run 2) 0.52 ± 0.09 g	
Source of organisms	Fish hatchery	Dexter NFH, Dexter, NM
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.35 ± 0.29	

	Dwyer et al. 1995	***G. elegans***
Parameter	**Value**	**Comment**
Hardness	173 ± 9 mg/L as CaCO3	
Alkalinity	117 ± 4 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Generally ≥ 60% saturation, but several instances of <60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (μg/L)	12 h: >25 24 h: >25 96 h: >25	Method: n/a

Notes: LC50s are geometric means of the LC50s calculated for each run (n=2).

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -27

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized

(1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3), Point estimates (3). -33

Toxicity Data Summary

Gila elegans

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance
Score: 85
Rating: L

Reliability
Score: 65.5
Rating: L

*Toxicity value not calculable.

	Sappington et al. 2001	***G. elegans***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Gila*	
Species	*elegans*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.41 ± 0.09 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Mortality	
Control response 1	96.7%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	

	Sappington et al. 2001	***G. elegans***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	12 h: >25.0 24 h: >25 96 h: >25	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8) Point estimates (8). -38

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3), Point estimates (3). -31

Toxicity Data Summary

Gammarus pulex

Study: McLoughlin N, Yin D, Maltby L, Wood RM, Yu H. 2000. Evaluation of sensitivity and specificity of two crustacean biochemical biomarkers. Environ Toxicol Chem 19:2085-2092.

Relevance
Score: Acute: 82.5, Chronic: 75
Rating: L

Reliability
Score: Acute: 75.5, Chronic: 74
Rating: R

*No standard method, endpoint not related to survival/growth/reproduction (chronic only), control response not reported (acute only)

	McLoughlin et al. 2000	***G. pulex***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Amphipoda	
Family	Apoidea	
Genus	*Gammarus*	
Species	*pulex*	
Family in North America?	Yes	
Age/size at start of test/growth phase	> 5 mm	
Source of organisms	Collected in a stream	Crags Stream, Derbyshire, UK
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Acclimated 1 week	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	144 h	
Data for multiple times?	Yes, 24, 48, 72, 96, 120	
Effect 1	Mortality	
Control response 1	NR	
Effect 2	Feeding rate	Not related to survival/growth/ reproduction
Control response 2	~0.26 mg/mg/d (Fig 3)	
Effect 3	Glutathione-S-transferase (GST) activity	Not related to survival/growth/ reproduction
Control response 3	0.20 nmol/min/ug protein (?)	

	McLoughlin et al. 2000	***G. pulex***
Parameter	**Value**	**Comment**
Temperature	15 ± 1°C	
Test type	Static renewal (24 h)	
Photoperiod/light intensity	12:12	
Dilution water	Artificial pond water	
pH	7.3 ± 0.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	577 ± 11 uS/cm	
Dissolved Oxygen	7.75 ± 0.4 mg/L	
Feeding	None during test	
Purity of test substance	≥ 99%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC/MS	
Concentration of carrier (if any) in test solutions	None used	
Concentration 1 Nom/Meas (µg/L)	0.04	30 reps, 1/rep
Concentration 2 Nom/Meas (µg/L)	0.08	30 reps, 1/rep
Concentration 3 Nom/Meas (µg/L)	0.16/0.12	30 reps, 1/rep
Concentration 4 Nom/Meas (µg/L)	0.3	30 reps, 1/rep
Concentration 5 Nom/Meas (µg/L)	0.6/0.45	30 reps, 1/rep
Control	Dilution water	30 reps, 1/rep
LC_{50} (95% Cl) (µg/L)	24 h: >0.45 48 h: >0.45 72 h: >0.45 96 h: 0.44 (0.03) 120 h: 0.26 (0.03) 144 h: 0.17 (0.03)	Method: probit
NOEC	48 h GST: 0.06 (estimated from Fig 2) Feeding rate: 0.03	Method: 1way ANOVA, Tukey test p: 0.05 MSD:
LOEC	48 GST: 0.12 Feeding rate: 0.06	Same as above
MATC (GeoMean NOEC,LOEC)	48 h GST: 0.085 (estimated) Feeding rate: 0.04	
% of control at NOEC	48 GST: 0.17/0.20 (?) Feeding rate: 0.21/0.26	
% of control at LOEC	48 GST: 0.19/0.20 (?) Feeding rate: 0.17/0.26	

Notes:

Reliability points taken off for:
Documentation (Table 3.7):
Acute: Measured concentrations (3), Hardness (2), Alkalinity (2), Hypothesis tests (8). -15

Chronic: Measured concentrations (3), Hardness (2), Alkalinity (2), Minimum significant difference (2), % control of NOEC/LOEC (2), Point estimates (8). -19

Acceptability (Table 3.8):
Acute: No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Random design (2), Hypothesis tests (3). -34

Chronic: No standard method (5), Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Minimum significant difference (1), Point estimates (3). -33

Toxicity Data Summary

Hexagenia bilineata

Study: Forbis AD, McAllister WA. 1980. Dynamic acute toxicity of 14C-permethrin to mayfly nymphs (*Hexagenia bilineata*) in a flow-through diluter system. Analytical Bio Chemistry Laboratories, Inc. Columbia, MO. Final report no. 23648.

Relevance
Score: 100
Rating: R

Reliability
Score: 86.5
Rating: R

	Forbis & McAllister 1980	***H. bilineata***
Parameter	**Value**	**Comment**
Test method cited	U.S. EPA & ASTM	
Phylum	Arthropoda	
Class	Insecta	
Order	Ephemeroptera	
Family	Ephemeridae	
Genus	*Hexagenia*	
Species	*bilineata*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early instar Mean length: 13 mm Mean wt: 32 mg	
Source of organisms	F0 from wild-collected adults	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 24, 48, 72 h	
Effect 1	Mortality	
Control response 1	Solvent: 2.5% Dilution water: 5%	
Temperature	22 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	Not reported	
Dilution water	Well water	
pH	8.2	
Hardness	255 mg/L	
Alkalinity	368 mg/L	
Conductivity	50 umhos/cm	
Dissolved Oxygen	7.1-8.6 mg/L	

	Forbis & McAllister 1980	***H. bilineata***
Parameter	**Value**	**Comment**
Feeding	Not reported	
Purity of test substance	91.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	90-100%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, LSC	
Concentration of carrier (if any) in test solutions	0.57 mL/L acetone	
Concentration 1 Nom/Meas (ng/L)	22; 21	4 reps, 10/rep
Concentration 2 Nom/Meas (ng/L)	49; 45	4 reps, 10/rep
Concentration 3 Nom/Meas (ng/L)	98; 97	4 reps, 10/rep
Concentration 4 Nom/Meas (ng/L)	210; 190	4 reps, 10/rep
Concentration 5 Nom/Meas (ng/L)	470; 470	4 reps, 10/rep
Control	Solvent & dilution water	4 reps, 10/rep
LC50 (95% confidence interval) (ng/L)	24 h: 470 (350-1200) 48 h: 330 (250-480) 72 h: 160 (140-190) 96 h: 100 (85-120)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Photoperiod (3), Hypothesis tests (8). 100-11=89

Acceptability (Table 3.8): Carrier solvent (4), Prior contamination (4), Feeding (3), Photoperiod (2), Hypothesis tests (3). 100-16=84

Reliability score: mean(89, 84)=86.5

Toxicity Data Summary

Hyalella azteca

Study: Anderson BS, Phillips BM, Hunt JW, Connor V, Richard N, Tjeerdema RS. 2006. Identifying primary stressors impacting macroinvertebrates in the Salinas River (CA, USA): Relative effects of pesticides and suspended particles. Environmental Pollution 141:402-408.

Relevance
Score: 90 (No standard method)
Rating: R

Reliability
Score: 78
Rating: R

	Anderson et al. 2006	***H. azteca***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Amphipoda	
Family	Hyalellidae	
Genus	*Hyalella*	
Species	*azteca*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3rd instar	
Source of organisms	Aquatic Biosystems, Fort Collins, CO	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	No	
Test duration	96 hours	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	90% survival*	
Temperature	23°C ± 1*	
Test type	Static	
Photoperiod/light intensity	16 light: 8 dark*	
Dilution water	Well Water	
pH	NR	
Hardness	91.6 mg/L*	
Alkalinity	122.4 mg/L CaCO3*	
Conductivity	NR	

	Anderson et al. 2006	***H. azteca***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	Not fed	
Purity of test substance	100%	
Concentrations measured?	yes	
Measured is what % of nominal?	0-61%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	Used 100mg/L methanol stock	
Concentration 1 Nom/Meas (ng/L)	5.6/ NR 3 reps/5per	
Concentration 2 Nom/Meas (ng/L)	10/ NR 3 reps/5per	Meas. 2 reps of only some conc's
Concentration 3 Nom/Meas (ng/L)	18/ND, 11 3 reps/5per	
Concentration 4 Nom/Meas (ng/L)	32/ 16 3 reps/5per	
Concentration 5 Nom/Meas (ng/L)	56/ 29 3 reps/5per	
Control	0/ NR 3 reps/5per	
LC_{50}	21.1 ng/L	Spearman-Karber

Other notes: *Control survival, temp. variation and water chemistry obtained by personal communication with the testing laboratory.

Reliability points taken off for:
Documentation: Dissolved Oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8)
Acceptability: Standard method (5), Meas. Concentrations 20% Nom (4), Organisms randomly assigned to containers (1), Organisms properly acclimated (1), Dissolved oxygen (6), Conductivity (1), pH (2), Random / block design (2), Dilution factor (2), Hypothesis tests (3)

Water Toxicity Data Summary

Hyalella azteca

Bradley MJ. 2013. Permethrin – Acute toxicity to freshwater amphipods (*Hyalella azteca*) under flow-through conditions. Submitted to: Pyrethroid Working Group, FMC Corporation, Ewing, NJ, 08628. Performing laboratory: Smithers Viscient, 790 Main St, Wareham, MA, 02571-1037; lab project ID: Smithers Viscient Study No. 13656.6167.

Relevance	Reliability
Score: 100	Score: 92.5
Rating: R	Rating: R

H. azteca	**Bradley 2013**	
Parameter	**Value**	**Comment**
Test method cited	Smithers Viscient protocol, USEPA OCSPP 850.1000, OCSPP 850.1020	There is not yet a final EPA method for this test
Phylum/subphylum	Arthropoda	
Class	Crustacea	
Order	Malacostraca	
Family	Hyalellidae	
Genus	*Hyalella*	
Species	*azteca*	
Family native to North America?	Yes	
Age/size at start of test/growth phase	9 days	
Source of organisms	In-house lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Not reported	
Test duration	96 h	
Data for multiple times?	Yes, 24, 48, 72 h	
Effect 1	Mortality	
Control response 1	Dilution water: 5% Solvent: 0%	
Temperature	23 ± 1 ºC	
Test type	Flow-through	
Photoperiod/light intensity	16 h light: 8 h dark, 320-360 lux	
Dilution water	Laboratory well water	
pH	7.1-7.9	

H. azteca	**Bradley 2013**	
Parameter	**Value**	**Comment**
Hardness	52-56 mg/L $CaCO_3$	
Alkalinity	20-22 mg/L $CaCO_3$	
Conductivity	340-350 uS/cm	Measured week prior to test, not during exposure
Total organic carbon	0.57 mg/L	
Dissolved Oxygen	7.6-9.6 mg/L	$\geq$ 75% saturation
Feeding	1.0 mL YCT once daily	YCT: Yeast, cereal leaves, flaked fish food
Purity of test substance	96.4%	
Concentrations measured?	Yes	
Measured is what % of nominal?	77-97%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-MSD	
Concentration of carrier (if any) in test solutions	0.050 mL/L acetone	
Concentration 1 Nom; Meas (ng/L)	1.9; 1.8	2 reps, 10/rep
Concentration 2 Nom; Meas (ng/L)	3.8; 3.2	2 reps, 10/rep
Concentration 3 Nom; Meas (ng/L)	7.5; 5.8	2 reps, 10/rep
Concentration 4 Nom; Meas (ng/L)	15; 12	2 reps, 10/rep
Concentration 5 Nom; Meas (ng/L)	30; 27	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95% CI) (ng/L)	7.0 (5.9-8.2)	Method: Trimmed Spearman-Karber estimates

Notes: Typically organisms are not fed in acute exposures, but were fed daily in this test. EPA guidance recommends feeding at day 0 and day 2 in a static 96-h water only reference-toxicant test (USEPA 2000). Because this test was flow-through with 90% renewal of overlying water every 5 h, it is unlikely the particulate or dissolved organic matter was significantly increased in the tests, and unlikely that a significant amount of test chemical was adsorbed to the food and ingested by the organisms. Thus daily feeding was considered acceptable in this test.

Reliability points taken off for:
Documentation: Hypothesis tests (8). Total: 100-8=92

Acceptability: Random design (2), Adequate replication (2), Hypothesis tests (3). Total: 100-7=93
Reliability score: mean(92, 93)=92.5

Toxicity Data Summary

Hyalella azteca

Study: Brander SM. Werner I, White JW, Deanovic LA. 2009. Toxicity of a dissolved pyrethroid mixture to *Hyalella azteca* at environmentally relevant concentrations. Environmental Toxicology and Chemistry, 28:1493-1499.

Relevance - Mortality
Score: 92.5 (control response not reported)
Rating: R

Reliability
Score: 64.2
Rating: L

Relevance – Protein content
Score: 70 (toxicity values not calculable, endpoint)
Rating: L

Reliability
Score: 70
Rating: L

Reference	**Brander *et al.* 2009**	***H. azteca***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1994	WET test method
Phylum	Arthropoda	
Class	Malacostraca	
Order	Amphipoda	
Family	Dogielinotidae	
Genus	*Hyalella*	
Species	*azteca*	
Family in North America?	yes	
Age/size at start of test/growth phase	7-14 d old	
Source of organisms	Commercial supplier	Aquatic Research Organisms
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	10 d	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Effect 2	Protein content of organism	Not clearly linked to survival, growth, or repro. for adult organisms
Control response 2	Fig. 6 (~8.2 mg/mL protein)	
Temperature	23 ± 2°C	
Test type	Static renewal, renewed	

Reference	**Brander *et al.* 2009**	***H. azteca***
Parameter	**Value**	**Comment**
	every 5 d	
Photoperiod/light intensity	16 h L:8 h D	
Dilution water	USEPA moderately hard water	Made from deionized water
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Yes, every 2 d, and after water renewal	
Purity of test substance	99.2%	
Concentrations measured?	Yes, but some estimated values were used to calculate toxicity values in 2008 tests	
Measured is what % of nominal?	67-105%	
Chemical method documented?	Not reported, samples sent to lab for analysis	California Dept. of Fish and Game, Fish and Wildlife Water Pollution Control Lab.
Concentration of carrier (if any) in test solutions	0.025% methanol	
Concentration 1 Nom/Meas 2007/Est 2008 (µg/L)	0.0120/0.0119/0.004	6 reps, 10/rep
Concentration 2 Nom/Meas 2007/Est 2008 (µg/L)	0.0240/0.0254/0.008	6 reps, 10/rep
Concentration 3 Nom/Meas 2007/Est 2008 (µg/L)	0.0480/0.0573/0.016	6 reps, 10/rep
Control	Solvent and dilution water	6 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	10 d: 0.0489	Method: regression analysis
NOEC (µg/L)	Protein content: Not calculable	Method: NR p: 0.05 MSD: NR
LOEC (µg/L)	Protein content: Not calculable	Same as above
MATC (GeoMean NOEC,LOEC)	Protein content: Not calculable	
% control at NOEC	NR	
% of control LOEC	NR	

Notes:
The toxicity values of the protein content analysis could not be calculated because all of the surviving organisms from all concentrations tested were pooled together in a single group for analysis, thus, a dose-response relationship cannot be established for this endpoint. Although, there was a significant difference ($p<0.05$) in protein content between exposed organisms and control organisms (fig. 6).

Mortality Reliability points taken off for:
Documentation: Analytical method (4), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8).
Acceptability: Appropriate duration (2), Control response (9), Measured concentrations within 20% of nominal (4), Organism size (3), Organisms randomized (1), Organism acclimation (1), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Random design (2), Dilution factor (2), Hypothesis tests (3).

Protein content Reliability points taken off for:
Documentation: Analytical method (4), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Statistical methods (5), Point estimates (8), Minimum significant difference (2), % control of NOEC/LOEC (2).
Acceptability: Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Organism acclimation (1), Exposure type (2), Random design (2), Dilution factor (2), Hypothesis tests (3), Point estimates (3).

Toxicity Data Summary

Hybopsis monacha

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 75
Rating: R

	Dwyer et al. 2005	***H. monacha***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Hybopsis*	
Species	*monacha*	Spotfin chub
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Commercial fishery	Conservation Fisheries, Knoxville, TN
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	17 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	

	Dwyer et al. 2005	***H. monacha***
Parameter	**Value**	**Comment**
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution series	2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (μg/L)	1.70	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replicates (2), Hypothesis tests (3). -15

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Ictalurus punctatus

Study: Buccafusco RJ. 1976a. Acute Toxicity of PP-557 technical to channel catfish (*Ictalurus punctatus*). EG&G Bionomics: Wareham, MA. CDPR ID: study number 15147.

Relevance
Score: 100
Rating: R

Reliability
Score: 75
Rating: R

Reference	**Buccafusco 1976**	***I. punctatus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Chordata	
Class	Actinopterygii	
Order	Siluriformes	
Family	Ictaluridae	
Genus	*Ictalurus*	
Species	*punctatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean weight: 1.2 g Mean length: 35 mm	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	21±1.0°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Well water	
pH	7.1-6.9	
Hardness	35 mg/L $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	98-39% saturation	
Feeding	Not fed	

Reference	**Buccafusco 1976**	***I. punctatus***
Parameter	**Value**	**Comment**
Purity of test substance	92.4%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom (µg/L)	10	1 rep, 10 per
Concentration 2 Nom (µg/L)	7.5	1 rep, 10 per
Concentration 3 Nom (µg/L)	5.6	1 rep, 10 per
Concentration 4 Nom (µg/L)	4.2	1 rep, 10 per
Concentration 5 Nom (µg/L)	3.2	1 rep, 10 per
Control	Solvent and dilution water	1 rep, 10 per
LC_{50} (95% CI) (µg/L)	24 hr 6.0 (4.9-7.5) 48 hr 5.4 (3.9-7.4) 96 hr 5.4 (3.9-7.4)	Method: Log-dose-probit

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -22

Acceptability: Measured concentrations within 20% of nominal (4), Carrier solvent (4), Exposure type (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -28

Toxicity Data Summary

Ictalurus punctatus

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, control description

	Thurston et al. 1985	***I. punctatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Siluriformes	
Family	Ictaluridae	
Genus	*Ictalurus*	
Species	*punctatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Test 1: Mean wt. 2.81 g Test 2: Mean wt. 2.49 g	
Source of organisms	Stock cultures or fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	Test 1: 0% Test 2: 10%	
Temperature	Test 1: 19.1 ± 1°C Test 2: 17.8 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Ground water spring	
pH	8.02-8.03	

	Thurston et al. 1985	***I. punctatus***
Parameter	**Value**	**Comment**
Hardness	NR	
Alkalinity	NR	
Conductivity	340 siemens	
Dissolved Oxygen	Test 1: 7.88 mg/L Test 2: 8.72 mg/L	
Feeding	None during tests	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Not clear, probably measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	%NR, dimethylformamide	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	2 reps, #/rep NR
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Control	Not clear	2 reps, #/rep NR
LC_{50} (95% confidence interval) (µg/L)	Test 1: 3.44 (3.04-3.90) Test 2: 2.06 (1.16-3.65)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Hypothesis tests (8). -29

Acceptability (Table 3.8): No standard method (5), Control description (6), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Hardness (2), Alkalinity (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -41

Toxicity Data Summary

Lepomis macrochirus

Study: Aquatic Environmental Sciences. 1976. Acute toxicity of FMC 33297 ACT 29 .11, .12 to bluegill sunfish (*Lepomis macrochirus* Rafinesque) and the water flea (*Daphnia Magna* Straus). Aquatic Environmental Sciences: Tarrytown, NY. CDPR ID: study number 15099.

Relevance
Score: 85
Rating: L

Reliability
Score: 67.5
Rating: L

* Chemical purity not reported

Reference	**Aq. Envir. Sci, 1976**	***L. macrochirus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Chordata	
Class	Actinopterygii	
Order	Perciformes	
Family	Centrarchidae	
Genus	*Lepomis*	
Species	*macrchirus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	8 mos old, 30 mm, 0.29 g	
Source of organisms	Commercial hatchery in Nebraska	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 28, 96 hr
Effect 1	Mortality	
Control response	0%	
Temperature	22 ± 0.5 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted soft water	
pH	7.81	
Hardness	42 mg/L $CaCO_3$	
Alkalinity	21 mg/L $CaCO_3$	

Reference	**Aq. Envir. Sci, 1976**	***L. macrochirus***
Parameter	**Value**	**Comment**
Conductivity	199 µmhos/cm	
Dissolved Oxygen	2.4-8.3 mg/L (28-97% saturation)	
Feeding	Not Fed	
Purity of test substance	NR	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom (µg/L)	10.00	1 rep, 10 organisms per rep
Concentration 2 Nom (µg/L)	5.60	1 rep, 10 organisms per rep
Concentration 3 Nom (µg/L)	3.20	1 rep, 10 organisms per rep
Concentration 4 Nom (µg/L)	1.80	1 rep, 10 organisms per rep
Concentration 5 Nom (µg/L)	1.00	1 rep, 10 organisms per rep
Control	Solvent and dilution water	1 rep, 10 organisms per rep
LC_{50} (µg/L)	24 hr 5.64 (4.52-7.03) 48 hr 3.36 (2.78-4.05) 96 hr 2.52 (1.88-3.36)	Method: Spearman-Karber

Reliability points taken off for:
Documentation: Results not signed, dated (6), Chemical purity (5), Analytical method (4), Measured concentrations (3), Photoperiod (3), Hypothesis tests (8). -29

Acceptability: Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -36

Toxicity Data Summary

Lepomis macrochirus

Study: Bentley RE. 1974. Acute toxicity of FMC-33297 technical to bluegill (*Lepomis macrochirus)* and rainbow trout (*Salmo gairdneri)*. Bionomics EG&G Environmental Consultants: Wareham, MA. CDPR ID: study number: 15078.

Relevance	Reliability
Score: 90	Score: 70
Rating: R	Rating: L

Relevance Points taken off for: Standard method (10)

Reference	**Bentley 1974**	***L. macrochirus***
Parameter	**Value**	**Comment**
Test method cited	Methods for toxicity tests with aquatic organisms – Committee on methods for toxicity tests with aquatic organisms (in press)	
Phylum	Chordata	
Class	Actinopterygii	
Order	Perciformes	
Family	Centrarchidae	
Genus	*Lepomis*	
Species	*macrochirus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean weight: 1.0 g Mean length: 37 mm	
Source of organisms	Commercial hatchery in Nebraska	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	20±1°C	
Test type	Static	
Photoperiod/light intensity	NR	

Reference	**Bentley 1974**	***L. macrochirus***
Parameter	**Value**	**Comment**
Dilution water	Reconstituted water	
pH	7.1	
Hardness	35 ppm $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	4.4-8.6 mg/L	Less than 60% by end of test
Feeding	Not Fed	
Purity of test substance	Technical	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom (µg/L)	16.0	1 Rep, 10/ rep
Concentration 2 Nom (µg/L)	12.0	1 Rep, 10/ rep
Concentration 3 Nom (µg/L)	8.7	1 Rep, 10/ rep
Concentration 4 Nom (µg/L)	7.5	1 Rep, 10/ rep
Concentration 5 Nom (µg/L)	6.5	1 Rep, 10/ rep
Concentration 6 Nom (µg/L)	5.6	1 Rep, 10/ rep
Concentration 7 Nom (µg/L)	4.2	1 Rep, 10/ rep
Concentration 8 Nom (µg/L)	3.2	1 Rep, 10/ rep
Control	Solvent and dilution water	1 Rep, 10/ rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 9.6 (8.1-11.3) 48 h: 6.4 (5.4-7.6) 96 h: 6.1 (5.1-7.3)	Method: Probit, least squares regression

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -22

Acceptability: Unacceptable standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -38

Toxicity Data Summary

Lepomis macrochirus

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, control description

	Thurston et al. 1985	***L. macrochirus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Centrachidae	
Genus	*Lepomis*	
Species	*macrochirus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Test 1: mean wt. 0.34 g Test 2: mean wt. 0.58 g	
Source of organisms	Stock cultures or fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	Test 1: 18.5 ± 1°C Test 2: 18.0 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Ground water spring	
pH	7.90-7.92	
Hardness	NR	
Alkalinity	NR	

	Thurston et al. 1985	***L. macrochirus***
Parameter	**Value**	**Comment**
Conductivity	340 siemens	
Dissolved Oxygen	Test 1: 8.89 mg/L Test 2: 9.21 mg/L	
Feeding	None during tests	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Not clear, probably measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	%NR, dimethylformamide	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	2 reps, #/rep NR
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Control	Not clear	2 reps, #/rep NR
LC_{50} (95% confidence interval) (µg/L)	Test 1: 5.81 (4.67-7.22) Test 2: 4.56 (3.46-6.01)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Hypothesis tests (8). -29

Acceptability (Table 3.8): No standard method (5), Control description (6), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Hardness (2), Alkalinity (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -41

Toxicity Data Summary

Limnaea stagnalis

Doma S. 1976. PP557: Acute toxicity and reproduction studies on the large pond snail, *Limnaea stagnalis*. ICI Plant Protection Division. CDPR ID: study number 15135.

Relevance
Score: 70
Rating: L

Reliability
Score: 63
Rating: L

Relevance Points taken off for: Chemical Purity (15), Toxicity values (15)

Reference	**Doma 1976**	***L. stagnalis***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Mollusca	
Class	Gastropoda	
Order		
Family	Lymnaeidae	
Genus	*Limnaea*	*Lymnaea?*
Species	*stagnalis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	12-16 weeks, sexually mature	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	Exposure: 48 hour, Experiment 36 days	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	48 h: 0% 36 d: 33%	
Temperature	21-22°C	
Test type	Static	
Photoperiod/light intensity	12 hr diurnal	
Dilution water	DI H_2O, reconstituted to EPA specifications	
pH	NR	

Reference	**Doma 1976**	***L. stagnalis***
Parameter	**Value**	**Comment**
Hardness	$NaHCO_3$ 192 mg, $CaSO_4 \cdot 2H_2O$ 120 mg, $MgSO_4 \cdot 7H_2O$ 120 mg, KCl 8 mg/L	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Not fed	
Purity of test substance	25% EC Formulation	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (mg/L)	200, 100, 10, 3, 1, 0,3, 0.1, 0.01, 0.001	3 Reps and 10 organisms per rep
Control	Dilution water	3 Reps and 10 per

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Statistical methods (5), Hypothesis tests (8), Point estimates (8).

Acceptability: Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dissolved oxygen (6), Random design (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3), Point estimates (3).

Toxicity Data Summary

Limnaea stagnalis

Doma S. (1976). "PP557: Acute toxicity and reproduction studies on the large pond snail, *Limnaea stagnalis*". ICI Plant Protection Division.

Relevance	Reliability
Score: 62.5	Score:
Rating: N	Rating:

Relevance Points taken off for: Chemical Purity (15), Toxicity values (15), Control Response (7.5)

Reference	**Doma, 1976**	*Limnaea stagnalis*
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Mollusca	
Class	Gastropoda	
Order		Not classified
Family	Lymnaeidae	
Genus	*Limnaea*	*Lymnaea?*
Species	*stagnalis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	12-16 weeks, sexually mature	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	Exposure: 48 hour, Experiment 36 days	
Data for multiple times?	No	
Effect 1	Reproduction	
Effect 2	Egg Survival	
Temperature	21-22°C, 22-27°C	
Test type	Static	
Photoperiod/light intensity	12 hr diurnal, natural light	
Dilution water	DI H_2O, reconstituted to EPA specifications	
pH	NR	

Reference	**Doma, 1976**	*Limnaea stagnalis*
Parameter	**Value**	**Comment**
Hardness	$NaHCO_3$ 192 mg, $CaSO_4 \cdot 2H_2O$ 120 mg, $MgSO_4 \cdot 7H_2O$ 120 mg, KCl 8 mg/L	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Not fed	
Purity of test substance	25% EC Formulation	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (mg/L)	200, 100, 10, 3, 1, 0,3, 0.1, 0.01, 0.001	3 Reps and 10 organisms per rep
Control		3 Reps and 10 per

TABLE 2.

Acute toxicity of PP557 and its effects on reproduction of snails

Concentration PP557 (mg/l)	Number of snails at the end of experiment*	Average length in cm of snails	Average weight in g of snails	Number of egg clutches produced	Number of fertilized egg clutches	% of fertile egg clutches	Average number of egg clutches laid by a single snail
200	0	-	-	-	-	-	-
100	0	-	-	-	-	-	-
10	17	2.68	1.64	64	34	53	4
3	25	2.63	1.48	93	72	77	4
1	21	2.61	1.57	69	41	59	3
0.3	14	2.75	2.07	75	43	57	5
0.1	21	2.61	1.57	87	44	51	4
0.01	11	2.50	1.63	40	21	52	4
0.001	20	2.45	1.50	79	61	77	4
Control	20	2.52	1.60	69	41	59	4

* experiment lasted 36 days including the 2 days exposure to PP557.

10 snails per test vessel exposed, 3 vessels per treatment.

Effect of PP557 on egg mass development

Concentration PP557 (mg/l)	200	100	10	3	1	0.3	0.1	0.01	0.001	Control
Numbers of egg clutches which developed normally	10	10	10	10	10	10	10	10	10	10

10 egg clutches per test vessel exposed.

Toxicity Data Summary

Menidia beryllina

Study: Ward GS, Rabe BA. 1989. Acute toxicity of permethrin technical to inland silversides (*Menidia beryllina*) under flow-through conditions. FMC corporation study number A88-2747. Laboratory project ID: Hunter/ESE No. 93008-0200-2130. Study performed by HUNTER/ESE Inc.: Gainesville, FL. EPA MRID 41874901.

Relevance
Score: 85
Rating: L

Reliability
Score: 86
Rating: R

*Saltwater

	Ward & Rabe 1989	***M. beryllina***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1985	
Phylum	Chordata	
Class	Actinopterygii	
Order	Atheriniformes	
Family	Atherinopsidae	
Genus	*Menidia*	
Species	*beryllina*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles, 0.035 ± 0.010 g wet wt, 15 ± 1 mm standard length	
Source of organisms	Commercial supplier	Aquatic Indicator, St. Augustine, FL
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	Dilution water: 0% Solvent: 15%	
Temperature	22 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	16 L:8 D	
Dilution water	Natural filtered seawater diluted with well water	Salinity 20 o/oo

	Ward & Rabe 1989	***M. beryllina***
Parameter	**Value**	**Comment**
pH	7.9-8.0	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	≥ 5.7 ppm (≥ 74% saturation)	
Feeding	None during test	
Purity of test substance	94.6%	
Concentrations measured?	Yes	
Measured is what % of nominal?	84-114%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0.0016% dimethylformamide	
Concentration 1 Nom/Meas (µg/L)	16.0/13.5	2 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	9.6/9.1	Reps and # per
Concentration 3 Nom/Meas (µg/L)	5.8/5.0	Reps and # per
Concentration 4 Nom/Meas (µg/L)	3.4/3.5	Reps and # per
Concentration 5 Nom/Meas (µg/L)	2.1/2.4	Reps and # per
Control	Solvent and dilution water	Reps and # per
LC_{50} (95% confidence interval) (µg/L)	24 h: >13.5 48 h: 12.2 (0-infinity) 72 h: 8.3 (6.9-10.6) 96 h: 6.2 (5.2-7.5)	Method: moving average

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -14

Acceptability (Table 3.8): Concentrations exceed 2x water solubility (4), Hardness (2), Alkalinity (2), Conductivity (1), Adequate replicates (2), Hypothesis tests (3). -14

Toxicity Data Summary

Mugil cephalus

Study: Schimmel SC, Garnas RL, Patrick JM, Moore JC. 1983. Acute toxicity, bioconcentration, and persistence of AC 222,705, benthiocarb, chlorpyrifos, fenvalerate, methyl parathion, and permethrin in the estuarine environment. J Agric Food Chem 31:104-113.

Relevance
Score: 85
Rating: L

Reliability
Score: 61.5
Rating: L

*Saltwater

	Schimmel et al. 1983	***M. cephalus***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Mugilidae	
Genus	*Mugil*	
Species	*cephalus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Charleston, SC	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	≤ 5%	
Temperature	24.5 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	19.0 o/oo salinity
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Schimmel et al. 1983	***M. cephalus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0.05% triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	NR	1 rep, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	Solvent and dilution water	1 rep, 20/rep
LC_{50} (µg/L)	5.5 (4.1-7.4)	Method: probit, moving average, or binomial test

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -42

Toxicity Data Summary

Menidia menidia

Study: Schimmel SC, Garnas RL, Patrick JM, Moore JC. 1983. Acute toxicity, bioconcentration, and persistence of AC 222,705, benthiocarb, chlorpyrifos, fenvalerate, methyl parathion, and permethrin in the estuarine environment. J Agric Food Chem 31:104-113.

Relevance
Score: 85
Rating: L

Reliability
Score: 61.5
Rating: L

*Saltwater

	Schimmel et al. 1983	***M. menidia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Chordata	
Class	Actinopterygii	
Order	Atheriniformes	
Family	Atherinopsidae	
Genus	*Menidia*	
Species	*menidia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Charleston, SC	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	≤ 5%	
Temperature	25.5 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	25.0 o/oo salinity
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Schimmel et al. 1983	*M. menidia*
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0.05% triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	NR	1 rep, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	Solvent and dilution water	1 rep, 20/rep
LC_{50} (µg/L)	2.2 (1.2-6.4)	Method: probit, moving average, or binomial test

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -42

Toxicity Data Summary

Notropis mekistocholas

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 76
Rating: R

	Dwyer et al. 2005	***N. mekistocholas***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee n Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Notropis*	
Species	*mekistocholas*	Cape Fear shiner
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Commercial fishery	Conservation Fisheries, Knoxville, TN
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	17 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	

	Dwyer et al. 2005	***N. mekistocholas***
Parameter	**Value**	**Comment**
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution series	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (μg/L)	4.16	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), pH (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -13

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Oncorhynchus apache

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 100
Rating: R

Reliability
Score: 80.5
Rating: R

	Dwyer et al. 1995	***O. apache***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*apache*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Run 1) 0.38 ± 0.18 g Run 2) 0.85 ± 0.49 g	
Source of organisms	Fish hatchery	Williams Creek NFH, White River, AZ
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0-3.3%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	
Temperature	12 ± °C	
Test type	Static	
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.24 ± 0.29	
Hardness	169 ± 10 mg/L as CaCO3	

	Dwyer et al. 1995	***O. apache***
Parameter	**Value**	**Comment**
Alkalinity	117 ± 8 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Always ≥ 60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (µg/L)	12 h: 3.88 24 h: 2.27 96 h: 1.71	Method: probit

Notes: LC50s are geometric means of the LC50s calculated for each run (n=2).

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -19

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -20

Toxicity Data Summary

Oncorhynchus apache

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 80
Rating: R

	Dwyer et al. 2005	***O. apache***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee n Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*apache*	Apache trout
Family in North America?	Yes	
Age/size at start of test/growth phase	0.62 ± 0.33 g	From Sappington et al. 2001
Source of organisms	Fish hatchery	Williams Creek NFH, White River, AZ
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	

	Dwyer et al. 2005	***O. apache***
Parameter	**Value**	**Comment**
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	111% for stock solution, except one individual stock that was 308% - likely an error	From Sappington et al. 2001
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution series	2 tests, 3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	2 tests, 3 reps, 10/rep
Control	Solvent and dilution water	2 tests, 3 reps, 10/rep
LC_{50} (μg/L)	1.71	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -10

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Oncorhynchus apache

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance
Score: 100
Rating: R

Reliability
Score: 71
Rating: L

*This data reported in this study is identical to those reported in Dwyer et al. 1995, 2005, which are rated RR because more information about the study conditions are reported in those studies, therefore the data in this study will also be reported as RR.

	Sappington et al. 2001	***O. apache***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*apache*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.62 ± 0.33 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Mortality	
Control response 1	96.7%	
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	

	Sappington et al. 2001	***O. apache***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (μg/L)	12 h: 3.9 (3.7-4.1) 24 h: 2.3 (2.0-2.7) 96 h: 1.7 (1.3-2.2)	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3). -28

Toxicity Data Summary

Oncorhynchus clarki henshawi

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 100
Rating: R

Reliability
Score: 77.5
Rating: R

	Dwyer et al. 1995	***O. clarki henshawi***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*clarki henshawi*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Run 1) 0.34 ± 0.08 g Run 2) 0.57 ± 0.23 g	
Source of organisms	Fish hatchery	Lahontan NFH, Gardnerville, NV
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	
Temperature	12 ± °C	
Test type	Static	
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.24 ± 0.29	
Hardness	169 ± 10 mg/L as CaCO3	

	Dwyer et al. 1995	***O. clarki henshawi***
Parameter	**Value**	**Comment**
Alkalinity	117 ± 8 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Generally ≥ 60% saturation, but several instances of <60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (μg/L)	12 h: 3.33 24 h: 1.93 96 h: 1.58	Method: probit or nonlinear interpolation

Notes: LC50s are geometric means of the LC50s calculated for each run (n=6).

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -19

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -26

Toxicity Data Summary

Oncorhynchus clarki henshawi

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 79
Rating: R

	Dwyer et al. 2005	***O. clarki henshawi***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*clarki henshawi*	Lahontan cutthroat trout
Family in North America?	Yes	
Age/size at start of test/growth phase	0.46 ± 0.16 g	From Sappington et al. 2001
Source of organisms	Fish hatchery	Lahontan NFH, Gardnerville, NV
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	NR	

	Dwyer et al. 2005	***O. clarki henshawi***
Parameter	**Value**	**Comment**
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	111% for stock solution, except one individual stock that was 308% - likely an error	From Sappington et al. 2001
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	2 tests, 3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Control	Solvent and dilution water	2 tests, 3 reps, 10/rep
LC_{50} (µg/L)	1.58	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:

Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replicates (2), Hypothesis tests (3). -12

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Oncorhynchus clarki henshawi

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance	Reliability
Score: 100	Score: 71
Rating: R	Rating: L

*This data is also reported in Dwyer et al. 1995, 2005. More test conditions are reported in these other publications and are rated RR. The data in Sappington et al. 2001 will also be reported in the RR table because of this additional information.

	Sappington et al. 2001	***O. clarki henshawi***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*clarki henshawi*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.46 ± 0.16 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Mortality	
Control response 1	96.7%	
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	

	Sappington et al. 2001	***O. clarki henshawi***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (μg/L)	12 h: 3.3 (2.4-4.7) 24 h: 1.9 (1.4-2.6) 96 h: 1.6 (1.1-2.2)	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3). -28

Toxicity Data Summary

Oncorhynchus clarki stomias

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 85
Rating: L

Reliability
Score: 72
Rating: L

*No toxicity values

	Dwyer et al. 1995	***O. clarki stomias***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*clarki stomias*	
Family in North America?	Yes	
Age/size at start of test/growth phase	0.31 ± 0.17 g	
Source of organisms	Fish hatchery	Saratoga NFH, Saratoga, WY
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0-3.3%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	
Temperature	12 ± °C	
Test type	Static	
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.24 ± 0.29	
Hardness	169 ± 10 mg/L as CaCO3	

	Dwyer et al. 1995	***O. clarki stomias***
Parameter	**Value**	**Comment**
Alkalinity	117 ± 8 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Generally ≥ 60% saturation, but several instances of <60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (µg/L)	12 h: >1.0 24 h: >1.0 96 h: >1.0	Method: n/a

Notes: LC50s are geometric means of the LC50s calculated for each run (n=6).

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -27

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6),

Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3), Point estimates (3). -29

Toxicity Data Summary

Oncorhynchus clarki stomias

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 85
Rating: L

Reliability
Score: 74.5
Rating: R

*No toxicity value

	Dwyer et al. 2005	***O. clarki stomias***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*clarki stomias*	Greenback cutthroat trout
Family in North America?	Yes	
Age/size at start of test/growth phase	0.31 ± 0.17 g	From Sappington et al. 2001
Source of organisms	Fish hatchery	Saratoga NFH, Saratoga, WY
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	12 °C	

	Dwyer et al. 2005	***O. clarki stomias***
Parameter	**Value**	**Comment**
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (µg/L)	>1.0	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -38

Acceptability (Table 3.8): Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3), Point estimates (3). -13

Toxicity Data Summary

Oncorhynchus clarki stomias

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance
Score: 85
Rating: L

Reliability
Score: 65.5
Rating: L

*Toxicity values not calculable

	Sappington et al. 2001	***O. clarki stomias***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*clarki stomias*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.31 ± 0.17 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Mortality	
Control response 1	96.7%	
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	

	Sappington et al. 2001	***O. clarki stomias***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	12 h: >1.0 24 h: >1.0 96 h: >1.0	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -38

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3), Point estimates (3). -31

Toxicity Data Summary

Orconectes immunis

Study: Paul EA, Simonin HA. 2006. Toxicity of three mosquito insecticides to crayfish. Bull Environ Contam Toxicol 76:614-621.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 77.5
Rating: R

*Control response not reported

	Paul & Simonin 2006	***O. immunis***
Parameter	**Value**	**Comment**
Test method cited	USEPA 2002	
Phylum	Arthropoda	
Class	Crustacea (Malacostraca)	
Order	Decapoda	
Family	Astacidae	
Genus	*Orconectes*	
Species	*immunis*	crayfish
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles, Mean wt 2 g	
Source of organisms	Culture ponds at a fish hatchery	South Otselic Fish Hatchery, NY
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 2 week acclimation	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	3, 24, 48 h	
Effect 1	Mortality	
Control response 1	NR	
Effect 2	Intoxication/erratic swimming/crawling, inability to remain upright	
Control response 2	NR	
Temperature	16.5 ± 1.0°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Spring water	
pH	8.10	
Hardness	132 mg/L CaCO3	

	Paul & Simonin 2006	***O. immunis***
Parameter	**Value**	**Comment**
Alkalinity	117 mg/L CaCO3	
Conductivity	299 umho/L	
Dissolved Oxygen	>6.0 mg/L	
Feeding	None during test	
Purity of test substance	92%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	0.011	8 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	0.029	8 reps, 5/rep
Concentration 3 Nom/Meas (µg/L)	0.080	8 reps, 5/rep
Concentration 4 Nom/Meas (µg/L)	0.220	8 reps, 5/rep
Concentration 5 Nom/Meas (µg/L)	0.604	8 reps, 5/rep
Concentration 6 Nom/Meas (µg/L)	1.656	8 reps, 5/rep
Control	Solvent	8 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 0.53 (0.43-0.67) 48 h: 0.31 (0.26-0.36) 96 h: 0.21 (0.17-0.25)	Method: trimmed Spearman-Karber
EC_{50} (95% confidence interval) (µg/L)	3 h: 0.46 (0.39-0.53) 24 h: 0.17 (0.14-0.20) 48 h: 0.11 (0.09-0.13) 96 h: 0.08 (0.07-0.11)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Photoperiod (3), Hypothesis tests (8). -18

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Photoperiod (2), Random design (2), Hypothesis tests (3). -27

Toxicity Data Summary

Oryzias latipes

Study: Rice PJ, Drewes CD, Klubertanz TM, Bradbury SP, Coats JR. 1997. Acute toxicity and behavioral effects of chlorpyrifos, permethrin, phenol, strychnine, and 2,4-dinitrophenol to 30-day-old Japanese medaka (*Oryzias latipes*). Environ Toxicol Chem 16:696-704.

Relevance
Score: 85
Rating: L

Reliability
Score: 80.5
Rating: R

*Species not in a family that resides in North America

	Rice et al. 1997	***O. latipes***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1989	
Phylum	Chordata	
Class	Actinopterygii	
Order	Beloniformes	
Family	Adrianichthyidae	
Genus	*Oryzias*	
Species	*latipes*	
Family in North America?	No	
Age/size at start of test/growth phase	Juveniles, 30 d old, mean length 12 mm	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	Yes, 24 h	
Effect 1	Mortality	
Control response 1	≤ 10%	
Temperature	25 ± 1°C	
Test type	Static renewal	
Photoperiod/light intensity	16 L:8 D	
Dilution water	NR	
pH	7.3 ± 0.7	
Hardness	136 ±20 mg/L as CaCO3	
Alkalinity	9.1 ± 4.1 mg/L as CaCO3	
Conductivity	NR	

	Rice et al. 1997	*O. latipes*
Parameter	**Value**	**Comment**
Dissolved Oxygen	7.1 ± 1.3 mg/L	
Feeding	None during test	
Purity of test substance	88%	
Concentrations measured?	Yes	
Measured is what % of nominal?	95.0 ± 6.3%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	% NR	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	3 reps, 10-20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10-20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10-20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10-20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10-20/rep
Control	Solvent and dilution water	3 reps, 10-20/rep
LC_{50} (95% confidence limit) (µg/L)	24 h: 24 (23-25)* 48 h: 11 (10-12)	Method: probit

Notes:
*Exceeds 2x aqueous solubility of permethrin (5.5 ug/L)

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Conductivity (2), Hypothesis tests (8). -19

Acceptability (Table 3.8): Appropriate duration (2), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Dilution water (2), Conductivity (1), Random design (2), Dilution factor (2), Hypothesis tests (3). -20

Toxicity Data Summary

Oncorhynchus mykiss

Study: Bentley RE. 1974. Acute toxicity of FMC-33297 technical to bluegill (*Lepomis macrochirus)* and rainbow trout (*Salmo gairdneri)*. Bionomics EG&G Environmental Consultants: Wareham, MA. CDPR ID: study number: 15078.

Relevance	Reliability
Score: 90	Score: 70
Rating: R	Rating: L

Relevance Points taken off for: Standard method (10)

Reference	**Bentley 1974**	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	Methods for toxicity tests with aquatic organisms – Committee on methods for toxicity tests with aquatic organisms (in press)	
Phylum	Chordata	
Class	Actinopterygii	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean weight: 1.0 g Mean length: 50 mm	
Source of organisms	Commercial hatchery in Montana	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	10±1°C	
Test type	Static	

Reference	**Bentley 1974**	***O. mykiss***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	NR	
Dilution water	Reconstituted water	
pH	7.1	
Hardness	35 ppm $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	4.4-8.6 mg/L	Less than 60% by end of test
Feeding	Not fed	
Purity of test substance	Technical	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom (µg/L)	87.0	1 Rep, 10/ rep
Concentration 2 Nom (µg/L)	75.0	1 Rep, 10/ rep
Concentration 3 Nom (µg/L)	56.0	1 Rep, 10/ rep
Concentration 4 Nom (µg/L)	32.0	1 Rep, 10/ rep
Concentration 5 Nom (µg/L)	28.0	1 Rep, 10/ rep
Concentration 6 Nom (µg/L)	18.0	1 Rep, 10/ rep
Concentration 7 Nom (µg/L)	12.0	1 Rep, 10/ rep
Concentration 8 Nom (µg/L)	10.0	1 Rep, 10/ rep
Concentration 9 Nom (µg/L)	8.7	1 Rep, 10/ rep
Concentration 10 Nom (µg/L)	6.5	1 Rep, 10/ rep
Concentration 11 Nom (µg/L)	5.6	1 Rep, 10/ rep
Concentration 12 Nom (µg/L)	3.2	1 Rep, 10/ rep
Control	Solvent and blank	1 Rep, 10/ rep
LC50; (95% CI) µg/L	24 h: 31.0 (23.0-41.0) 48 h: 13.1 (10.5-16.5) 96 h: 9.8 (7.7-12.6)	Method: Probit, least squares regression

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -22

Acceptability: Unacceptable standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -38

Toxicity Data Summary

Oncorhynchus mykiss

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 100
Rating: R

Reliability
Score: 77.5
Rating: R

	Dwyer et al. 1995	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Run 1) 0.67 ± 0.35 g Run 2) 1.25 ± 0.57 g Run 3) 0.27 ± 0.07 g Run 4) 1.09 ± 0.38 g Run 5) 0.48 ± 0.08 g Run 6) 0.50 ± 0.21 g	
Source of organisms	Commercial fishery or hatchery	Beity's Enterprise, Valley, WA or Ennis National Fish Hatchery, Ennis, MT
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	

	Dwyer et al. 1995	***O. mykiss***
Parameter	**Value**	**Comment**
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.24 ± 0.29	
Hardness	169 ± 10 mg/L as CaCO3	
Alkalinity	117 ± 8 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Generally ≥ 60% saturation, but several instances of <60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (µg/L)	12 h: 5.75 24 h: 3.78 96 h: 3.31	Method: probit or moving average or nonlinear interpolative procedure

Notes: LC50s are geometric means of the LC50s calculated for each run (n=6).

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -19

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -26

Toxicity Data Summary

Oncorhynchus mykiss

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 80
Rating: R

	Dwyer et al. 2005	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee n Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	Rainbow trout
Family in North America?	Yes	
Age/size at start of test/growth phase	0.71 ± 0.38 g	From Sappington et al. 2001
Source of organisms	Commercial fishery or fish hatchery	Beity's Enterprise, Valley, WA & Ennis NFH, Ennis, MT
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	12 °C	
Test type	Static	

	Dwyer et al. 2005	***O. mykiss***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	"ambient laboratory lighting"	From Sappington et al. 2001
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	6 tests, 3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Control	Solvent and dilution water	6 tests, 3 reps, 10/rep
LC_{50} (µg/L)	3.31	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:

Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -10

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Oncorhynchus mykiss

Study: Holcombe GW, Phipps GL, Tanner DK. 1982. The acute toxicity of Kelthane, Dursban, disulfoton, Pydrin, and permethrin to fathead minnows *Pimephales promelas* and rainbow trout *Salmo gairdneri.* Environmental Pollution A 29:167-178.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 81
Rating: R

*Control response not reported

	Holcombe et al. 1982	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles	
Source of organisms	Fish hatchery	Fattig Hatcheries, Brady, NE
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 24, 48 72 h	
Effect 1	Mortality	
Control response 1	Not reported	
Effect 2	Equilibrium, behavior, coloration, deformities	
Control response 2	Not reported	
Temperature	15.6 ± 1.8°C	
Test type	Flow through	
Photoperiod/light intensity	16 h light:8 h dark, 28 lumens	
Dilution water	Lake Superior water	
pH	7.0-7.4	

	Holcombe et al. 1982	***O. mykiss***
Parameter	**Value**	**Comment**
Hardness	45.3 mg/L as CaCO3	
Alkalinity	41.8 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	9.3 mg/L	
Feeding	None during test	
Purity of test substance	91.9%	
Concentrations measured?	Yes	
Measured is what % of nominal?	90.3 ± 10.4%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	7.0 ± 2.6	2 reps, 10/rep
Concentration 2 Meas (µg/L)	14.7 ± 0.4	2 reps, 10/rep
Concentration 3 Meas (µg/L)	17.8 ± 3.4	2 reps, 10/rep
Concentration 4 Meas (µg/L)	29.8 ± 17.1	2 reps, 10/rep
Concentration 5 Meas (µg/L)	76.7 ± 32.0	2 reps, 10/rep
Control	Dilution water	2 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 25.8 (20.4-32.6)* 48 h: 17.4 (13.9-21.9)* 72 h: 11.4 (7.2-18.2)* 96 h: 7.0 (7.0-7.0)	Method: trimmed Spearman-Karber

Notes: The results for *Pimephales promelas* are not reported because the LC50 of 15.6 ug/L exceeds 2x the aqueous solubility.
* not valid because > 2x aqueous solubility of permethrin

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Conductivity (2), Hypothesis tests (8). -13

Acceptability (Table 3.8): Control response (9), Concentrations exceed 2x water solubility (4), Temperature (6), Conductivity (1), Adequate replicates (2), Hypothesis tests (3). -25

Toxicity Data Summary

Oncorhynchus mykiss

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance
Score: 100
Rating: R

Reliability
Score: 71
Rating: L

	Sappington et al. 2001	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.71 ± 0.38 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Survival	
Control response 1	96.7%	
Temperature	12 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	

	Sappington et al. 2001	***O. mykiss***
Parameter	**Value**	**Comment**
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	12 h: 5.8 (3.4-8.3) 24 h: 3.8 (3.4-8.3) 96 h: 3.3 (1.7-4.8)	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3). -28

Toxicity Data Summary

Oncorhynchus mykiss

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, control description

	Thurston et al. 1985	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt. 2.65 g	
Source of organisms	Stock cultures or fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	9.5 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Ground water spring	
pH	8.10 (8.08-8.11)	
Hardness	NR	
Alkalinity	NR	
Conductivity	340 siemens	

	Thurston et al. 1985	***O. mykiss***
Parameter	**Value**	**Comment**
Dissolved Oxygen	9.08 mg/L	
Feeding	None during tests	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Not clear, probably measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	%NR, dimethylformamide	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	2 reps, #/rep NR
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Control	Not clear	2 reps, #/rep NR
LC_{50} (95% confidence interval) (µg/L)	5.47 (4.22-7.10)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Hypothesis tests (8). -29

Acceptability (Table 3.8): No standard method (5), Control description (6), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Hardness (2), Alkalinity (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -41

Toxicity Data Summary

Penaeus aztecus

Heitmuller T. 1977. Acute toxicity of PP557 to brown shrimp (*Penaeus aztecus*) and fiddler crabs (*Uca pugilator*). EG&G, Bionomics Marine Research Laboratory: Pensacola, FL. CDPR ID: study number 15141.

Relevance
Score: 85
Rating: L

Reliability
Score: 72.5
Rating: L

Relevance Points taken off for: Freshwater (15)

Reference	**Heitmuller 1977**	***P. aztecus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Decapoda	
Family	Penaeidae	
Genus	*Penaeus*	
Species	*aztecus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juvenile 15-25 mm rostrum-telson length	
Source of organisms	Mississippi Sound	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	20±1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	20 o/oo salinity
pH	7.8-8.4	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

Reference	**Heitmuller 1977**	***P. aztecus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	18-88%	
Feeding	Not fed	
Purity of test substance	89.11%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	Under 0.5 ml/L acetone	
Concentration 1 Nom (µg/L)	0.09, 0.16, 0.29, 0.50, 0.89	2 Reps and 5 organisms per rep
Control	Solvent	2 Reps and 5 per
LC_{50} (95% CI) (µg/L)	48 hr 0.38 (0.26-0.57) 96 hr 0.34 (0.23-0.51)	Method: probit

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -24

Acceptability: Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -31

Toxicity Data Summary

Procambarus blandingi

Buccafusco RJ. 1977. Acute toxicity of permethrin technical (PP 557) to crayfish (*Procambarus blandingi*). EG&G Bionomics: Wareham, MA. CDPR ID study number 15140.

Relevance
Score: 100
Rating: R

Reliability
Score: 79
Rating: R

	Buccafusco 1977	***P.blandingi***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Decapoda	
Family	Cambaridae	
Genus	*Procambarus*	
Species	*blandingi*	
Family in North America?	Yes	
Age/size at start of test/growth phase	24±5 g wet wt. 48±5 mm	
Source of organisms	Commercial supplier	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	312 hr	
Data for multiple times?	Yes	24, 96, 312 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	22 ± 1.0°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Well water	
pH	7.0-7.1	
Hardness	35 mg/L $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>77% saturation	

	Buccafusco 1977	***P.blandingi***
Parameter	**Value**	**Comment**
Feeding	Not fed	
Purity of test substance	89.11%	
Concentrations measured?	no	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom (µg/L)	0.49	1 Reps and 20 organisms per rep
Concentration 2 Nom (µg/L)	0.37	1 Reps and 20 organisms per rep
Concentration 3 Nom (µg/L)	0.28	1 Reps and 20 organisms per rep
Concentration 4 Nom (µg/L)	0.21	1 Reps and 20 organisms per rep
Concentration 5 Nom (µg/L)	0.16	1 Reps and 20 organisms per rep
Concentration 6 Nom (µg/L)	0.12	1 Reps and 20 organisms per rep
Concentration 7 Nom (µg/L)	0.087	1 Reps and 20 organisms per rep
Control	Dilution water	1 Reps and 20 per
LC50; indicate calculation method	24 hr: 0.66 (0.16-2.6) 96 hr: 0.21 (0.13-0.33) 312 hr: 0.12 (0.071-0.20)	Method: Probit, least squares regression

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -22

Acceptability: Measured concentrations within 20% of nominal (4), Carrier solvent (4), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -20

Toxicity Data Summary

Procambarus clarkii

Study: Jarboe HH, Romaire RP. 1991. Acute toxicity of permethrin to four size classes of red swamp crayfish (*Procambarus clarkii*) and observations of post-exposure effects. Arch Environ Contam Toxicol 20:337-342.

Relevance
Score: 77.5
Rating: L

Reliability
Score: 81.5
Rating: R

*Low chemical purity, control response not reported

	Jarboe & Romaire 1991	***P. clarkii***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, APHA 1985	
Phylum		
Class		
Order		
Family		
Genus	*Procambarus*	
Species	*clarkii*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1) 8-12 mm, 0.017 g 2) 25-35 mm, 0.64 g 3) 45-55 mm, 2.45 g 4) 65-75 mm, 8.98 g	
Source of organisms	Pond at research station	Ben Hur Research Farm, Louisiana Agricultural Experiment Station, Baton Rouge, LA
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	10 d acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Effect 2	Growth/survival 28 d post-exposure	
Control response 2	Given in Table 3	

	Jarboe & Romaire 1991	*P. clarkii*
Parameter	**Value**	**Comment**
Effect 3	Reproduction 28 d post-exposure: a) onset of sexual maturity, b) reproduction of viable young	
Control response 3	Given in Table 3	
Temperature	1) 21.8 ± 0.5°C 2) 21.2 ± 0.4°C 3) 22.7 ± 0.6°C 4) 23.1 ± 0.2°C	
Test type	Static	
Photoperiod/light intensity	24 h light	
Dilution water	Dechlorinated filtered tapwater	
pH	7.9-8.8	
Hardness	98.0-99.4 mg/L as CaCO3	
Alkalinity	161.2-172.7 mg/L as CaCO3	
Conductivity	486-506 umhos/cm	
Dissolved Oxygen	≥ 60% saturation, 6.4 mg/L or greater	
Feeding	None during acute test, daily in post-exposure observation	
Purity of test substance	25.6%	emulsifiable concentrate
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	None	
Concentration 1 Nom/Meas (µg/L)	1) 0.099 2) 0.099 3) 0.495 4) 0.653	3 tests with 3 reps, 12-30/rep
Concentration 2 Nom/Meas (µg/L)	1) 0.158 2) 0.170 3) 0.653 4) 0.851	3 tests with 3 reps, 12-30/rep
Concentration 3 Nom/Meas (µg/L)	1) 0.247 2) 0.292 3) 0.861 4) 1.119	3 tests with 3 reps, 12-30/rep
Concentration 4 Nom/Meas (µg/L)	1) 0.396	3 tests with 3 reps,

	Jarboe & Romaire 1991	*P. clarkii*
Parameter	**Value**	**Comment**
	2) 0.503 3) 1.138	12-30/rep
Concentration 5 Nom/Meas (µg/L)	1) 0.624 2) 0.684 3) 1.495	3 tests with 3 reps, 12-30/rep
Concentration 6 Nom/Meas (µg/L)	2) 1.485	3 tests with 3 reps, 12-30/rep
Control	Dilution water	3 tests with 3 reps, 12-30/rep
LC_{50} (95% confidence intervals) (µg/L)	1) 0.438 (0.382-0.507) 2) 0.854 (0.725-1.030) 3) 1.298 (1.163-1.469) 4) 0.813 (0.515-0.938)	Method: probit

Notes: NOEC/LOEC values were not calculated for the 28 d post-exposure data, these exposures do not fit into the chronic category because the exposure was only 96 h.

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Hypothesis tests (8). -15

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Photoperiod (2), Hypothesis tests (3). -22

Toxicity Data Summary

Pteronarcys dorsata

Study: Anderson RL. 1982. Toxicity of fenvalerate and permethrin to several nontarget aquatic invertebrates. Environ Entomol 11:1251-1257.

Relevance
Score: 75
Rating: L

Reliability
Score: 73
Rating: L

*No standard method, no toxicity values

	Anderson 1982	***P. dorsata***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Plecoptera	
Family	Pteronarcyidae	
Genus	*Pteronarcys*	Stonefly
Species	*dorsata*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Larvae, age/size NR	
Source of organisms	Collected from ponds and streams near Duluth, MN	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Acclimatized for 1 week	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	28 d	
Data for multiple times?	Yes, 21 d	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Behavioral effects	
Control response 2	0%	
Temperature	15 ± 0.6°C	
Test type	FT	
Photoperiod/light intensity	14 light: 10 dark	
Dilution water	Unfiltered Lake Superior water	
pH	7.6-7.8	
Hardness	46-48 mg/L	

	Anderson 1982	***P. dorsata***
Parameter	**Value**	**Comment**
Alkalinity	42-44 mg/L	
Conductivity	NR	
Dissolved Oxygen	>95% saturation	
Feeding	Yes, Brine shrimp	
Purity of test substance	Technical	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	0.43 ± 0.20	2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	0.21 + 0.10	2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	0.12 + 0.04	2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	0.042 + 0.019	2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	0.029 + 0.016	2 reps, 10/rep
Control	Dilution water	2 reps, 10/rep
LC_{50} (μg/L)	Not calculable	Method:

Notes:
25% of animals were immobile within 2 h at 0.21 ug/L, 90% immobility within 5 h. 96 h, 65% immobile at 0.12 ug/L. 21d, 100% immobility at 0.042 ug/L. **no effect at 0.029 ug/L (NOEC?).**

Also determined BCF. Mean BCF: 183 + 171 (range 43-570).

Reliability points taken off for:
Documentation (Table 3.7): Age/size (5), Nominal concentrations (3), Conductivity (2), Hypothesis tests (8), Point estimates (8).

Acceptability (Table 3.8): Standard method (5), Measure concentrations within 20% of nominal (4), Appropriate size/age (3), Prior contamination (4), Organisms randomized (1), Conductivity (1), Random design (2), Adequate replication (2), Hypothesis tests (3), Point estimates (3).

Toxicity Data Summary

Penaeus duorarum

Study: Cripe GM. 1994. Comparative acute toxicities of several pesticides and metals to *Mysidopsis bahia* and potlarval *Penaeus duorarum.* Environ Toxicol Chem 13:1867-1872,

Relevance
Score: 85
Rating: L

Reliability
Score: 75.5
Rating: R

*Saltwater

	Cripe 1994	***P. duorarum***
Parameter	**Value**	**Comment**
Test method cited	ASTM	
Phylum		
Class		
Order		
Family		
Genus	*Penaeus*	
Species	*duorarum*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3-5 d old postlarvae	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	7.5%	
Temperature	25 ± 0.5°C	
Test type	Static	
Photoperiod/light intensity	14 h light: 10 h light	
Dilution water	Filtered seawater	25 o/oo salinity
pH	7.5-7.9	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	5.6 mg/L	
Feeding	Yes at start of test	

	Cripe 1994	*P. duorarum*
Parameter	**Value**	**Comment**
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	10 uL/L; 90% triethylene glycol/10% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations at 60% dilutions	2 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Control	Dilution water and solvent	Reps and # per
LC_{50} (95% confidence interval) (µg/L)	0.17 (0.15-0.19)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). -24

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Feeding (3), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Random design (2), Adequate replicates (2), Hypothesis tests (3). -25

Toxicity Data Summary

Penaeus duorarum

Heitmuller T. 1975. Acute toxicity of FMC 33297 technical (95.7%) to eastern oysters (*Crassostrea virginica*), pink shrimp (*Penaeus duorarum*), and fiddler crabs (*Uca pugilator*). Bionomincs - EG&G, Inc. Marine Research Laboratory: Pensacola, FL. CDPR ID: study number 15103.

Relevance
Score: 85
Rating: L

Reliability
Score: 72.5
Rating: L

Relevance Points taken off for:
Freshwater (15)

Reference	**Heitmuller 1975**	***P. duorarum***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Decapoda	
Family	Penaeidae	
Genus	*Penaeus*	
Species	*duorarum*	
Family in North America?	Yes	
Age/size at start of test/growth phase	25-40 mm rostrum-telson length	
Source of organisms	Big Lagoon, Pensacola, FL	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hour	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	19±1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered sea water	25 o/oo salinity
pH	8±0.5	
Hardness	NR	

Reference	**Heitmuller 1975**	***P. duorarum***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	Dropped to less than 60% saturation at end of test	
Feeding	Not Fed	
Purity of test substance	95.7%	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	0.0053% acetone	
Concentrations Nom (µg/L)	0.172, 0.306, 0.536, 0.718, 0.957	2 Reps and 5 organisms per rep
Control	Solvent	2 Reps and 5 per
LC_{50}; (µg/L)	0.354 (0.287-0.440)	Method: probit

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -24

Acceptability: Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -31

Toxicity Data Summary

Penaeus duorarum

Study: Schimmel SC, Garnas RL, Patrick JM, Moore JC. 1983. Acute toxicity, bioconcentration, and persistence of AC 222,705, benthiocarb, chlorpyrifos, fenvalerate, methyl parathion, and permethrin in the estuarine environment. J Agric Food Chem 31:104-113.

Relevance
Score: 85
Rating: L

Reliability
Score: 61.5
Rating: L

*Saltwater

	Schimmel et al. 1983	***P. duorarum***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Mysida	
Family	Mysidae	
Genus	*Penaeus*	
Species	*duorarum*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Collected from estuarine waters near Gulf Breeze, FL or lab cultures	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	$\leq$ 5%	
Temperature	24.9 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	25.0 o/oo salinity
pH	NR	
Hardness	NR	

	Schimmel et al. 1983	***P. duorarum***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0.05% triethylene glycol	
Concentration 1 Nom/Meas (μg/L)	NR	1 rep, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	
Concentration 3 Nom/Meas (μg/L)	NR	
Concentration 4 Nom/Meas (μg/L)	NR	
Concentration 5 Nom/Meas (μg/L)	NR	
Concentration 6 Nom/Meas (μg/L)	NR	
Control	Solvent and dilution water	1 rep, 20/rep
LC_{50} (μg/L)	0.22 (0.06-0.79)	Method: probit, moving average, or binomial test

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organism size (3), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -42

Toxicity Data Summary

Poeciliopsis occidentalis occidentalis

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 85
Rating: L

Reliability
Score: 69.5
Rating: L

*No toxicity value

	Dwyer et al. 2005	***P. occidentalis occidentalis***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes (Actinopterygii)	
Order	Cyprinodontiformes	
Family	Poeciliidae	
Genus	*Poeciliopsis*	
Species	*occidentalis occidentalis*	Gila topminnow
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Fish hatchery	NFH and Technology Ctr, Dexter, NM
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	

	Dwyer et al. 2005	***P. occidentalis occidentalis***
Parameter	**Value**	**Comment**
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	2 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (µg/L)	>10.0	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -43

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replication (2), Hypothesis tests (3), Point estimates (3). -18

Toxicity Data Summary

Poeciliopsis occidentalis

Study: Dwyer FJ, Hardesty DK, Henke CE, Ingersoll CG, Whites DW, Mount DR, Bridges CM. 1999. Assessing contaminant sensitivity of endangered and threatened species: toxicant classes. EPA/600/R-99/098.

Relevance
Score: 85
Rating: L

Reliability
Score: 72
Rating: L

*No toxicity value calculable

	Dwyer et al. 1999	***P. occidentalis***
Parameter	**Value**	**Comment**
Test method cited	EPA 1975, ASTM 1998	
Phylum	Chordata	
Class	Osteichthyes (Actinopterygii)	
Order	Cyprinodontiformes	
Family	Poeciliidae	
Genus	*Poeciliopsis*	
Species	*occidentalis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Weight: 219 ± 65 mg, Length: 27.2 ± 2.6 mm	
Source of organisms	National or state fish hatcheries	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 96 h acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	<10%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR – "ambient lighting"	
Dilution water	Reconstituted hard water	
pH	Mean: 8.4 ± 0.1	
Hardness	167 ± 5 mg/L as CaCO3	
Alkalinity	115 ± 1 mg/L as CaCO3	

	Dwyer et al. 1999	***P. occidentalis***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	>40% saturation at 96 h, >60% saturation at 48 h	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Only the stock solutions	
Measured is what % of nominal?	Stock: 160%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC (for stocks)	
Concentration of carrier (if any) in test solutions	0.005% acetone	
Concentration 1 Nom (µg/L)	6 concentrations	2 reps, 10/rep
Concentration 2 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 3 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 4 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 5 Nom (µg/L)	NR	2 reps, 10/rep
Concentration 6 Nom (µg/L)	NR	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	>10	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Hypothesis tests (8), Point estimates (8). -28

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Dissolved oxygen (6), Temperature (3), Conductivity (1), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3), Point estimates (3). -28

Toxicity Data Summary

Pimephales promelas

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 100
Rating: R

Reliability
Score: 75.5
Rating: R

	Dwyer et al. 1995	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Pimephales*	
Species	*promelas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Run 1) 0.32 ± 0.16 g Run 2) 0.56 ± 0.19 g Run 3) 0.45 ± 0.35 g Run 4) 0.40 ± 0.21 g Run 5) 0.34 ± 0.24 g Run 6) 0.39 ± 0.14 g	
Source of organisms	Lab or commercial cultures	MSC cultures or Osage Fisheries, Osage Beach, MO
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	
Temperature	22 °C	
Test type	Static	

	Dwyer et al. 1995	***P. promelas***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.35 ± 0.29	
Hardness	173 ± 9 mg/L as CaCO3	
Alkalinity	117 ± 4 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Generally ≥ 60% saturation, but several instances of <60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (µg/L)	12 h: 13.43 (>2x aqueous solubility) 24 h: 9.73 96 h: 9.38	Method: probit or moving average

Notes: LC50s are geometric means of the LC50s calculated for each run (n=6).

Reliability points taken off for:

Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -19

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -30

Toxicity Data Summary

Pimephales promelas

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 80
Rating: R

	Dwyer et al. 2005	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Pimephales*	
Species	*promelas*	Fathead minnow
Family in North America?	Yes	
Age/size at start of test/growth phase	0.41 ± 0.09 g	From Sappington et al. 2001
Source of organisms	USGS lab culture or Osage Fisheries commercial culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	"ambient laboratory lighting"	From Sappington et al. 2001

	Dwyer et al. 2005	***P. promelas***
Parameter	**Value**	**Comment**
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	111% for stock solution, except one individual stock that was 308% - likely an error	From Sappington et al. 2001
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	6 tests, 3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	6 tests, 3 reps, 10/rep
Control	Solvent and dilution water	6 tests, 3 reps, 10/rep
LC_{50} (µg/L)	9.38	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:

Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -10

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Pimephales promelas

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance	Reliability
Score: 100	Score: 71
Rating: R	Rating: L

*This study reports the same data as in Dwyer et al. 1995, 2005, which are rated RR because they report more information about test conditions, therefore the data in this study will be reported as RR with the data from the other 2 studies.

	Sappington et al. 2001	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Pimephales*	
Species	*promelas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.41 ± 0.09 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Mortality	
Control response 1	96.7%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	

	Sappington et al. 2001	***P. promelas***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (μg/L)	12 h: 13.4 (10.3-7.3) 24 h: 9.7 (9.2-11) 96 h: 9.4 (6.7-16)	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3). -28

Toxicity Data Summary

Pimephales promelas

Study: Spehar RL, Tanner DK, Nordling BR. 1983. Toxicity of the synthetic pyrethroids, permethrin and AC 222,705 and their accumulation in early life stages of fathead minnows and snails. Aquatic Toxicology 3:171-182.

Relevance
Score: 90
Rating: R

Reliability
Score: 82.5
Rating: R

*No standard method

	Spehar et al. 1983	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Pimephales*	
Species	*promelas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Hatch: embryos < 1 d old Larvae 4-5 d old	
Source of organisms	Lab culture	Environmental Research Laboratory-Duluth
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	32 d	
Data for multiple times?	No	
Effect 1	Embryo hatchability	
Control response 1	95 ± 3.8%	
Effect 2	Normal larvae at hatch	
Control response 2	94 ± 2.3%	
Effect 3	Survival	
Control response 3	92 ± 13.0%	
Effect 4	Mean weight	
Control response 4	96 ± 25 mg (N=55)	
Temperature	25 ± 2°C	

	Spehar et al. 1983	*P. promelas*
Parameter	**Value**	**Comment**
Test type	Flow through	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	Filtered, sterilized Lake Superior water	
pH	7.4-7.9	
Hardness	34-48 mg/L as CaCO3	
Alkalinity	37-46 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	5.3-7.8 mg/L	
Feeding	Yes, fed brine shrimp 1-3x/d	
Purity of test substance	92%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	0.11 ± 0.04	4 reps Hatch: 25/rep Survival: 15/rep
Concentration 2 Meas (µg/L)	0.18 ± 0.03	4 reps Hatch: 25/rep Survival: 15/rep
Concentration 3 Meas (µg/L)	0.33 ± 0.08	4 reps Hatch: 25/rep Survival: 15/rep
Concentration 4 Meas (µg/L)	0.66 ± 0.16	4 reps Hatch: 25/rep Survival: 15/rep
Concentration 5 Meas (µg/L)	1.40 ± 0.12	4 reps Hatch: 25/rep Survival: 15/rep
Control	Dilution water	4 reps Hatch: 25/rep Survival: 15/rep
NOEC (µg/L)	Survival: 0.66 ± 0.16	Method: 1way ANOVA, Dunnett's one-sided comparison p: 0.05 MSD:
LOEC (µg/L)	Survival: 1.40 ± 0.12	Same as above

	Spehar et al. 1983	***P. promelas***
Parameter	**Value**	**Comment**
MATC (GeoMean NOEC,LOEC)	0.96 µg/L	
% of control at NOEC	93/92 =101%	
% of control at LOEC	2/92 =2.1%	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Conductivity (2), Minimum significant difference (2), Point estimates (8). -15

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Temperature (3), Conductivity (1), Random design (2), Minimum significant difference (1), Point estimates (3). -20

Toxicity Data Summary

Pimephales promelas

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 65
Rating: L

*No standard method, control description

	Thurston et al. 1985	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Pimephales*	
Species	*promelas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt. 0.42 g	
Source of organisms	Stock cultures or fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	17.7 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Ground water spring	
pH	8.01	
Hardness	NR	
Alkalinity	NR	
Conductivity	340 siemens	

	Thurston et al. 1985	***P. promelas***
Parameter	**Value**	**Comment**
Dissolved Oxygen	8.94 mg/L	
Feeding	None during tests	
Purity of test substance	93%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Not clear, probably measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	%NR, dimethylformamide	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	2 reps, #/rep NR
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, #/rep NR
Control	Not clear	2 reps, #/rep NR
LC_{50} (95% confidence interval) (µg/L)	6.40 (4.19-9.77)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Hypothesis tests (8). -29

Acceptability (Table 3.8): No standard method (5), Control description (6), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Hardness (2), Alkalinity (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -41

Toxicity Data Summary

Procloeon sp.

Study: Anderson, B.S., Phillips, B.M., Hunt, J.W., Connor, V., Richard, N., Tjeerdema, R.S., 2006. Identifying primary stressors impacting macroinvertebrates in the Salinas River (CA, USA): Relative effects of pesticides and suspended particles. Environmental Pollution 141:402-408

Relevance
Score: 90 (No standard method)
Rating: R

Reliability
Score: 75
Rating: R

	Anderson et al. 2006	***Procloeon* sp.**
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Arthropoda	
Class	Insecta	
Order	Ephemeroptera	
Family	Baetidae	
Genus	*Procloeon*	
Species	NR	
Family in North America?	Yes	
Age/size at start of test/growth phase	0.5-1 cm	
Source of organisms	Salinas River	Reported as uncontaminated
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	No	
Animals randomized?	NR	
Test vessels randomized?	No	
Test duration	48 hours	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	90% survival*	
Temperature	23°C ± 1*	
Test type	Static	
Photoperiod/light intensity	16 light: 8 dark*	
Dilution water	Well Water	
pH	NR	
Hardness	91.6 mg/L*	
Alkalinity	122.4 mg/L CaCO3*	

	Anderson et al. 2006	***Procloeon* sp.**
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Not fed	
Purity of test substance	100%	
Concentrations measured?	Yes	
Measured is what % of nominal?	0-61%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	1% methanol	
Concentration 1 Nom/Meas (ng/L)	5.6/ NR	3 reps/5per
Concentration 2 Nom/Meas (ng/L)	10/ NR	Meas. 2 reps of only some conc's
Concentration 3 Nom/Meas (ng/L)	18/ND, 11	3 reps/5per
Concentration 4 Nom/Meas (ng/L)	32/ 16	3 reps/5per
Concentration 5 Nom/Meas (ng/L)	56/ 29	3 reps/5per
Control	Solvent and dilution water	3 reps/5per
LC_{50}	89.6 ng/L	Spearman-Karber

Other notes: *Control survival, temp. variation and water chemistry obtained by personal communication with the testing laboratory.

Reliability points taken off for:
Documentation: Dissolved Oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -17

Acceptability: Standard method (5), Meas. Concentrations 20% Nom (4), Carrier solvent (4), Prior contamination (4), Organisms randomly assigned to containers (1), Organism acclimation (1), Dissolved oxygen (6), Conductivity (1), pH (2), Random / block design (2), Hypothesis tests (3). -33

Toxicity Data Summary

Salvelinus fontinalis

Study: Paul EA, Simonin HA, Tomajer TM. 2005. A comparison of the toxicity of synergized and technical formulations of permethrin, sumithrin, and resmethrin to trout. Arch Environ Contam Toxicol 48:251-259.

Relevance
Score: Acute: 82.5, Chronic: 75
Rating: L

Reliability
Score: Acute 6h, 96 h: 75, Chronic: 77.5
Rating: R

*Acute: No standard method, Control response not reported
*Chronic: No standard method, Endpoint not linked to survival/growth/reproduction

	Paul et al. 2005	***S. fontinalis***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Salvelinus*	
Species	*fontinalis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mortality & intoxication: 6 h: 49 d post feeding, mean length 47 mm, mean wt 1g 96 h: 35-42 d post feeding, mean length 42 mm, mean wt 1 g Swimming time: 28-34 d post feeding, mean length 37 mm, mean wt 1 g	
Source of organisms	Lab strain from fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	Mortality & intoxication: - 6 h (+ 48h postexposure observation) - 96 h Swimming time: 6 h	

	Paul et al. 2005	***S. fontinalis***
Parameter	**Value**	**Comment**
	exposure followed by swim test until fish exhaustion (maximum 10 min.)	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	NR	
Effect 2	Intoxication	Linked to survival in some cases, not all
Control response 2	NR	
Effect 3	Time to swimming exhaustion against a current (after a 6h exposure)	Not directly linked to survival/growth/ reproduction
Control response 3	Median: 520 s, range: 197-600 s	
Temperature	9.5 ± 0.5°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Spring water	
pH	8.10	
Hardness	132 mg/L CaCO3	
Alkalinity	117 mg/L CaCO3	
Conductivity	299 umho/L	
Dissolved Oxygen	>8.0 mg/L	
Feeding	None during test	
Purity of test substance	>92%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	6h: 2.3 96h: 0.43 Swim: 1.6	6h: 3 reps, 10/rep 96h: 4 reps, 5/rep Swim: 7 tests, 2 reps, 1/rep
Concentration 2 Nom/Meas (µg/L)	6h: 3.2 96h: 0.60 Swim: 3.2	6h: 3 reps, 10/rep 96h: 4 reps, 5/rep Swim: 7 tests, 2 reps, 1/rep
Concentration 3 Nom/Meas (µg/L)	6h: 4.5 96h: 0.85	6h: 3 reps, 10/rep 96h: 4 reps, 5/rep

	Paul et al. 2005	***S. fontinalis***
Parameter	**Value**	**Comment**
	Swim: 6.3	Swim: 7 tests, 2 reps, 1/rep
Concentration 4 Nom/Meas (µg/L)	6h: 6.3 96h: 1.2	6h: 3 reps, 10/rep 96h: 4 reps, 5/rep
Concentration 5 Nom/Meas (µg/L)	6h: 8.9 96h: 1.6	6h: 3 reps, 10/rep 96h: 4 reps, 5/rep
Concentration 6 Nom/Meas (µg/L)	96h: 2.3	96h: 4 reps, 5/rep
Concentration 7 Nom	96h: 3.2	96h: 4 reps, 5/rep
Concentration 8 Nom	96h: 4.5	96h: 4 reps, 5/rep
Concentration 9 Nom	96h: 6.3	96h: 4 reps, 5/rep
Control	Solvent	6h: 3 reps, 10/rep 96h: 4 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	24h: 4.80 (4.16-5.54) 48h: 3.03 (2.86-3.22) 72h:2.91 (2.73-3.11) 96h: 2.86 (2.69-3.05)	Method: probit or trimmed Spearman-Karber
EC_{50} (95% confidence interval) (µg/L) Effect: intoxication during 96 h test	24h: 3.01 (2.81-3.22) 48h: 2.44 (2.24-2.65) 72h: 2.44 (2.24-2.65) 96h: 2.86 (2.69-3.05)	Method: probit or trimmed Spearman-Karber
NOEC (µg/L)	Swim time: 1.6	Method: swim time: nonparametric Mann-Whitney U test $p < 0.005$ MSD: NR
LOEC (µg/L)	Swim time: 3.2	Same as above
MATC (GeoMean NOEC,LOEC) (µg/L)	Swim time: 2.3	
% of control at NOEC	Swim time: 57%	
% of control at LOEC	Swim time: 44%	

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u>
Acute 96h: Analytical method (4), Measured concentrations (3), Photoperiod (3), Hypothesis tests (8). -18
Acute 6h: Analytical method (4), Measured concentrations (3), Photoperiod (3), Hypothesis tests (8). -18
Chronic swim time: Analytical method (4), Measured concentrations (3), Photoperiod (3), Minimum significant difference (2), Point estimates (8). -20

Acceptability (Table 3.8):
Acute 96 h: No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Photoperiod (2), Random design (2), Hypothesis tests (3). -32

Acute 6h: No standard method (5), Appropriate duration (2), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -32

Chronic swim time: No standard method (5), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Photoperiod (2), Number of concentrations (3), Random design (2), Minimum significant difference (1), Point estimates (3). -25

Toxicity Data Summary

Scaphirhynchus platorynchus

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 85
Rating: L

Reliability
Score: 69.5
Rating: L

*No toxicity value

	Dwyer et al. 2005	***S. platorynchus***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Acipenseriformes	
Family	Acipenseridae	
Genus	*Scaphirhynchus*	
Species	*platorynchus*	Shovelnose sturgeon
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Fish hatchery	Blind Pony Missouri State Fish Hatchery, Sweet Springs, MO
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	22 °C	

	Dwyer et al. 2005	***S. platorynchus***
Parameter	**Value**	**Comment**
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	119% for stock solution, except one individual stock that was 320% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution series	2 reps, 9/rep
Concentration 2 Nom/Meas (μg/L)	NR	2 reps, 9/rep
Concentration 3 Nom/Meas (μg/L)	NR	2 reps, 9/rep
Concentration 4 Nom/Meas (μg/L)	NR	2 reps, 9/rep
Concentration 5 Nom/Meas (μg/L)	NR	2 reps, 9/rep
Concentration 6 Nom/Meas (μg/L)	NR	2 reps, 9/rep
Control	Solvent and dilution water	2 reps, 9/rep
LC_{50} (μg/L)	Not calculable	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -43

Acceptability (Table 3.8): Organism size (3), Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Adequate replicates (2), Hypothesis tests (3), Point estimates (3). -18

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Scaphirhynchus platyrynchus

Study: Dwyer FJ, Hardesty DK, Henke CE, Ingersoll CG, Whites DW, Mount DR, Bridges CM. 1999. Assessing contaminant sensitivity of endangered and threatened species: toxicant classes. EPA/600/R-99/098.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 73
Rating: L

*Control response not acceptable

	Dwyer et al. 1999	***S. platyrynchus***
Parameter	**Value**	**Comment**
Test method cited	EPA 1975, ASTM 1998	
Phylum	Chordata	
Class	Osteichthyes	
Order	Acipenseriformes	
Family	Acipenseridae	
Genus	*Scaphirhynchus*	
Species	*platyrynchus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Weight: 719 ± 237 mg, Length: 60.1 ± 0.8 mm	
Source of organisms	National or state fish hatcheries	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 96 h acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	>10% in some cases	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR – "ambient lighting"	
Dilution water	Reconstituted hard water	
pH	Mean: 8.4 ± 0.1	
Hardness	167 ± 5 mg/L as CaCO3	
Alkalinity	115 ± 1 mg/L as CaCO3	
Conductivity	NR	

	Dwyer et al. 1999	***S. platyrynchus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	>40% saturation at 96 h, >60% saturation at 48 h	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Only the stock solutions	
Measured is what % of nominal?	Stock: 160%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC (for stocks)	
Concentration of carrier (if any) in test solutions	0.005% acetone	
Concentration 1 Nom (µg/L)	6 concentrations	2 reps, 9/rep
Concentration 2 Nom (µg/L)	NR	2 reps, 9/rep
Concentration 3 Nom (µg/L)	NR	2 reps, 9/rep
Concentration 4 Nom (µg/L)	NR	2 reps, 9/rep
Concentration 5 Nom (µg/L)	NR	2 reps, 9/rep
Concentration 6 Nom (µg/L)	NR	2 reps, 9/rep
Control	Solvent and dilution water	2 reps, 9/rep
LC_{50} (95% confidence interval) (µg/L)	6 h: >10 12 h: 10 24 h: not calculable 48 h: not calculable 72 h: not calculable 96 h: not calculable	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Hypothesis tests (8). -20

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Dissolved oxygen (6), Temperature (3), Conductivity (1), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -34

Toxicity Data Summary

Salmo salar

Buccafusco RJ. 1976b. Acute toxicity of PP-557 technical to Atlantic salmon (*Salmo salar*). EG&G Bionomics: Wareham, MA. CDPR ID: 00083085, study number 15150.

Relevance
Score: 100
Rating: R

Reliability
Score: 75
Rating: R

Reference	**Buccafusco 1976**	***S. salar***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Chordata	
Class	Actinopterygii	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Salmo*	
Species	*salar*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1.0 g 35 mm	
Source of organisms	New Hampshire Fish and Game Department	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	No	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	12 +/- 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Well water	
pH	6.9-7.1	
Hardness	35 mg/L	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	39-93% saturation	

Reference	**Buccafusco 1976**	***S. salar***
Parameter	**Value**	**Comment**
Feeding	Not fed	
Purity of test substance	92.4%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom (µg/L)	0.75	1 Rep and 10 organisms per rep
Concentration 2 Nom (µg/L)	1.0	1 Rep and 10 organisms per rep
Concentration 3 Nom (µg/L)	1.6	1 Rep and 10 organisms per rep
Concentration 4 Nom (µg/L)	2.4	1 Rep and 10 organisms per rep
Concentration 5 Nom (µg/L)	3.2	1 Rep and 10 organisms per rep
Concentration 6 Nom (µg/L)	4.2	1 Rep and 10 organisms per rep
Control	Solvent and dilution water	1 Rep and 10 organisms per rep
LC_{50} (95% confidence interval) (µg/L)	Time 24 hr: 2.2 (1.7-2.8) 48 hr: 1.8 (1.4-2.4) 96 hr: 1.5 (1.1-2.0)	Method: Least Squares Regression

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -22

Acceptability: Measured concentrations within 20% of nominal (4), Carrier solvent (4), Exposure type (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -28

Toxicity Data Summary

Salmo gairdneri

EG&G Environmental Consultants. (1974). "Acute toxicity of FMC-33297 Technical to Bluegill (*Lepomis macrochirus)* and Rainbow Trout (*Salmo gairdneri)*.

Relevance
Score: 90
Rating: R

Reliability
Score: 72.0
Rating: L

Relevance Points taken off for: Standard method (10)

Reference		
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Chordata	
Class	Actinopterygii	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Salmo*	
Species	*gairdnerii*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean weight: 1.0 g Mean length: 50 mm	
Source of organisms	Commercial hatchery in Montana	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1		
Temperature	10±1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	DI H_2O	
pH	7.1	

Reference		
Parameter	**Value**	**Comment**
Hardness	$CaCO_3$ 35 ppm	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	8.6-4.4 mg/L	Less than 60% by end of test
Feeding	Not fed	
Purity of test substance	NR	"tested as 100% active"
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	NR	Solvent control perfromed
Concentration 1 Nom/Meas (mg/L)	0.0870, 0.0750, 0.0560, 0.0320, 0.0280, 0.0180, 0.0120, 0.0100, 0.0087, 0.0065, 0.0056, 0.0032	3 Reps and 10 organisms per rep,
Control	Solvent and blank	3 Reps and 10 per
LC50; (95% CI) mg/L	24 - 0.0310 (0.0230-0.0410) 48 - 0.0131 (0.0105-0.0165) 96 – 0.0098(0.0077-0.0126)	Log-dose-probit **All LC50's exceed water solubility of per. (5.5-6 µg/L)**

Reliability points taken off for:
Documentation: Chemical purity (5), Analytical method (4), Measured concentrations (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8).

Acceptability: No standard method (5), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Random design (2), Hypothesis tests (3).

Toxicity Data Summary

Uca pugilator

Heitmuller T. 1975. Acute toxicity of FMC 33297 technical (95.7%) to eastern oysters (*Crassostrea virginica*), pink shrimp (*Penaeus duorarum*), and fiddler crabs (*Uca pugilator*). Bionomincs - EG&G, Inc. Marine Research Laboratory: Pensacola, FL. CDPR ID: study number 15103.

Relevance
Score: 85
Rating: L

Reliability
Score: 70.5
Rating: L

Relevance Points taken off for:
Freshwater (15)

Reference	**Heitmuller 1975**	***U. pugilator***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Malacotraca	
Order	Decapoda	
Family	Ocypodidae	
Genus	*Uca*	
Species	*pugilator*	
Family in North America?	Yes	
Age/size at start of test/growth phase	15-20 mm carapace width	
Source of organisms	Big Lagoon, Pensacola, FL	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hour	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	19±1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered sea water	25 o/oo salinity
pH	8±0.5	

Reference	**Heitmuller 1975**	***U. pugilator***
Parameter	**Value**	**Comment**
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	Dropped to less than 60% saturation at end of test	
Feeding	Not Fed	
Purity of test substance	95.7%	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	0.0632% Acetone	
Concentration 1 Nom/Meas (µg/L)	0.957, 1.72, 3.54, 7.18, 11.5	2 Reps and 5 organisms per rep
Control	Solvent	2 Reps and 5 per
LC50; (µg/L)	2.39 (1.82-3.25)	Method: probit

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -24

Acceptability: Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Prior contamination (4), Organisms randomized (1), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -35

Toxicity Data Summary

Uca pugilator

Heitmuller T. 1977. Acute toxicity of PP557 to brown shrimp (*Penaeus aztecus*) and fiddler crabs (*Uca pugilator*). EG&G, Bionomics Marine Research Laboratory: Pensacola, FL. CDPR ID: study number 15141.

Relevance
Score: 85
Rating: L

Reliability
Score: 72.5
Rating: L

Relevance Points taken off for: Freshwater (15)

Reference	**Heitmuller 1977**	***U. pugilator***
Parameter	**Value**	**Comment**
Test method cited	US EPA 1975	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Decapoda	
Family	Ocypodidae	
Genus	*Uca*	
Species	*pugilator*	
Family in North America?	Yes	
Age/size at start of test/growth phase	10-15 mm carpace width	
Source of organisms	Big Lagoon	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	0%	
Temperature	20±1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	20 o/oo salinity
pH	7.6-8.4	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

Reference	**Heitmuller 1977**	***U. pugilator***
Parameter	**Value**	**Comment**
Dissolved Oxygen	22-88%	
Feeding	Not fed	
Purity of test substance	89.11%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	Under 0.5 ml/L acetone	
Concentration 1 Nom/Meas (µg/L)	0.50, 0.89, 1.6, 2.9, 5.0, 8.0	2 Reps and 5 organisms per rep
Control	Positive control (acetone)	2 Reps and 5 per
LC_{50} (95% CI) (µg/L)	24 hr 5.3 (2.0-13) 48 hr 2.8 (1.9-4.4) 96 hr 2.2 (1.4-3.5)	Method: probit

Reliability points taken off for:
Documentation: Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -24

Acceptability: Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). -31

Toxicity Data Summary

Elliptio complanata
Lampsilis fasciola
Lampsilis siliquoidea
Villosa constricta
Villosa delumbis

Study: Bringolf RB, Cope WG, Eads CB, Lazaro PR, Barnhart MC, Shea D. 2007. Acute and chronic toxicity of technical-grade pesticides to Glochidia and juveniles of freshwater mussels (Unionidae). Environ Toxicol Chem 26:2086-2093.

Relevance
Score: 85
Rating: L

Reliability
Score: 72.5
Rating: L

*No toxicity values

	Bringolf et al. 2007a	***mussels***
Parameter	**Value**	**Comment**
Test method cited	ASTM	
Phylum		
Class		
Order		
Family		
Genus	*All listed above*	
Species		
Family in North America?	yes	
Age/size at start of test/growth phase	1) Glochidia (all 5 species) 2) Juveniles ≤ 2 months (*L. fasciola, L. siliquoidea, V. delumbis)*	
Source of organisms	Rivers and streams in North Carolina and Missouri	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	Glochidia: 48 h Juveniles: 96 h	
Data for multiple times?	No	
Effect 1	Survival of glochidia	
Control response 1	≥ 90%	
Effect 2	Survival of juveniles	

	Bringolf et al. 2007a	***mussels***
Parameter	**Value**	**Comment**
Control response 2	> 93%	
Temperature	21 ± 1°C	
Test type	Glochidia: Static Juveniles: Static Renewal	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	8.32-8.61	
Hardness	170-192 mg/L as CaCO3	
Alkalinity	116-130 mg/L as CaCO3	
Conductivity	523-625 uS/cm	
Dissolved Oxygen	> 80% saturation	
Feeding	None during tests	
Purity of test substance	99%	
Concentrations measured?	Yes	
Measured is what % of nominal?	Glochidia: 79.6% Juveniles: 86.5%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC/MS	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	5-6 conc	3 reps, 150-200 gloch/rep or 7 juv/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 150-200 gloch/rep or 7 juv/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 150-200 gloch/rep or 7 juv/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 150-200 gloch/rep or 7 juv/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 150-200 gloch/rep or 7 juv/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 150-200 gloch/rep or 7 juv/rep
Control	Dilution water and solvent	3 reps, 150-200 gloch/rep or 7 juv/rep
LC_{50}	Not calculable for either	Method: trimmed

	Bringolf et al. 2007a	*mussels*
Parameter	**Value**	**Comment**
		Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Photoperiod (3), Hypothesis tests (8), Point estimates (8). -25

Acceptability (Table 3.8): Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Organism acclimation (1), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3), Point estimates (3). -30

Toxicity Data Summary

Xyrauchen texanus

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance
Score: 100
Rating: R

Reliability
Score: 75.5
Rating: R

	Dwyer et al. 1995	***X. texanus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975, ASTM 1988	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Catostornidae	
Genus	*Xyrauchen*	
Species	*texanus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Run 1) 0.31 ± 0.04 g Run 2) 0.32 ± 0.07 g	
Source of organisms	Fish hatchery	Dexter NFH, Dexter, NM
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Acclimated for 96 h	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 12 h, 24 h	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Muscarinic cholinergic receptor binding	
Control response 2	NR	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	"ambient lighting"	
Dilution water	Reconstituted hard water	
pH	8.35 ± 0.29	
Hardness	173 ± 9 mg/L as CaCO3	

	Dwyer et al. 1995	***X. texanus***
Parameter	**Value**	**Comment**
Alkalinity	117 ± 4 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Generally ≥ 60% saturation, but several instances of <60% saturation	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Stocks only	
Measured is what % of nominal?	Tests in 1992: 93% (stocks) Tests in 1993: 128% (stocks)	One sample had recovery of 308% and was not included in average b/c value is thought to be incorrect b/c it did not show differing biological results
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (μg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (μg/L)	12 h: 13.05 (>2x aqueous solubility) 24 h: 8.87 96 h: 5.95	Method: probit or nonlinear interpolation

Notes: LC50s are geometric means of the LC50s calculated for each run (n=1-2).

Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -19

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized

(1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -30

Toxicity Data Summary

Xyrauchen texanus

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance
Score: 100
Rating: R

Reliability
Score: 80
Rating: R

	Dwyer et al. 2005	***X. texanus***
Parameter	**Value**	**Comment**
Test method cited	ASTM 2003, Committee on Methods for Toxicity Tests with Aquatic Organisms 1975	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Catostornidae	
Genus	*Xyrauchen*	
Species	*texanus*	Razorback sucker
Family in North America?	Yes	
Age/size at start of test/growth phase	0.32 ± 0.01 g	From Sappington et al. 2001
Source of organisms	Fish hatchery	NFH and Technology Center Dexter, NM
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	96 h acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	"ambient laboratory lighting"	From Sappington et

	Dwyer et al. 2005	***X. texanus***
Parameter	**Value**	**Comment**
		al. 2001
Dilution water	Reconstituted hard water	
pH	Slightly above 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	
Conductivity	NR	
Dissolved Oxygen	Above acceptable saturation limits	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	111% for stock solution, except one individual stock that was 308% - likely an error	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	GC for stocks only	
Concentration of carrier (if any) in test solutions	0.5 mL/L maximum	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution series	2 tests, 3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	2 tests, 3 reps, 10/rep
Control	Solvent and dilution water	2 tests, 3 reps, 10/rep
LC_{50} (µg/L)	5.95	Method: probit or moving-average or nonlinear interpolative procedure

Notes:

Reliability points taken off for:

Documentation (Table 3.7): Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Organisms randomized (1), Temperature (3), Conductivity (1), Photoperiod (2), Hypothesis tests (3). -10

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Toxicity Data Summary

Xyrauchen texanus

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance
Score: 100
Rating: R

Reliability
Score: 71
Rating: L

*This study reports the same data as in Dwyer et al. 1995, 2005, which are rated RR because they report more information about test conditions, therefore the data in this study will be reported as RR with the data from the other 2 studies.

	Sappington et al. 2001	***X. texanus***
Parameter	**Value**	**Comment**
Test method cited	USEPA, ASTM	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Catostornidae	
Genus	*Xyrauchen*	
Species	*texanus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean wt 0.32 ± 0.01 g	
Source of organisms	Fish hatchery or commercial source	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	4 d acclimation	
Animals randomized?	NR	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	12 h, 24 h	
Effect 1	Mortality	
Control response 1	96.7%	
Temperature	22 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted hard water	
pH	> 8.0	
Hardness	160-180 mg/L as CaCO3	
Alkalinity	110-120 mg/L as CaCO3	

	Sappington et al. 2001	***X. texanus***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone or triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	6 concentrations, 60% dilution factor	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	12 h: 13.1 24 h: 8.9 96 h: 6.0 (4.6-7.7)	Method: probit, moving average, untrimmed Spearman-Karber, or nonlinear interpolative procedure

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -30

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Hypothesis tests (3). -28

Appendix B2: Studies rated RN, LN, N

Abbreviations used in this appendix:
NR = Not Reported

Study Ratings:
RN = Relevant, Not Reliable
LN = Less Relevant, Not Reliable
N = Not Relevant

Unused lines deleted from tables

Summary sheets are in alphabetical order according to species

Toxicity Data Summary

Ampelisca abdita

Study: Anderson BD, Lowe S, Phillips BM, Hunt JW, Vorhees J, Clark S, Tjeerdema RS. 2008. "Relative sensitivities of toxicity test protocols with the amphipods *Eohaustorius estuaries* and *Ampelisca abdita*. Ecotoxicology and Environmental Safety **69** 24-31

Relevance	Reliability
Score:	Score: 32.4
Rating: N	Rating: N

Freshwater (15), Controls (15).

SEDIMENT ONLY, NOT RELEVANT.

Toxicity Data Summary

Aedes aegypti

Study: Beard CB, Kloter KO, Carroll MK, Magnuson LJ, Trapido H. 1985. Response of domestic and peridomestic strains of *Aedes aegypti* (Diptera:Culicidae) in New Orleans, Louisiana, USA, to organophosphate, organochlorine, and pyrethroid insecticides. J Med Entomol 22:276-280.

Relevance
Score: 85
Rating: L

Reliability
Score: 45.5
Rating: N

*Controls not mentioned

	Beard et al. 1985	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*aegypti*	3 strains Green/Eagle, NOMC, Rockefellar
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Green/Eagle: collected in New Orleans NOMC: lab colony since 1981 Rockefellar: lab colony since 1959	
Have organisms been exposed to contaminants?	Potentially Green/Eagle and NOMC	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 hr, 48 hr	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	NR	
Temperature	28°C	
Test type	Likely static	

	Beard et al. 1985	***A. aegypti***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	95%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, ethanol	
Concentration 1 Nom/Meas (µg/L)	NR	6-8 reps and 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	NR	
LC_{50} (95% confidence interval) (µg/L)	Green/Eagle strain 24 h: 0.24 (0.22-0.26) 48 h: 0.35 (0.31-0.39) NOMC strain 24 h: 0.30 (0.28-0.33) 48 h: 0.34 (0.31-0.38) Rockefellar strain (susceptible) 24 h: 0.29 (0.28-0.29) 48 h: 0.28 (0.26-0.31)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Exposure type (5), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -50

Acceptability (Table 3.8): Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Feeding (3), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -59

Toxicity Data Summary

Aedes aegypti

Study: Failloux A-B, Ung A, Raymond M, Pasteur N. 1994. Insecticide susceptibility in mosquitoes (Diptera: Culicidae) from French Polynesia. J Med Entomol 31:639-644.

Relevance
Score: 100
Rating: R

Reliability
Score: 58.5
Rating: N

	Failloux et al. 1994	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	WHO 1975	
Phylum		
Class		
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	99%	
Concentrations measured?	No	

	Failloux et al. 1994	***A. aegypti***
Parameter	**Value**	**Comment**
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1 mL/99 mL ethanol (1%)	
Concentration 1 Nom/Meas (µg/L)	5 concentrations, NR	2-4 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Concentration 3 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Concentration 4 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Concentration 5 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Control	solvent	2-4 reps, 25/rep
LC_{50} (95% confidence interval) (µg/L)	Rockefellar: 4.7 (4.3-5.1) AA-PAEA: 8.7 (7.0-12.2)	Method: log-probit

Notes: Results for *Aedes polynesiensis* not reported because LC50 value (31.7 ug/L) exceeds 2x the aqueous solubility (5.5 ug/L)

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -45

Toxicity Data Summary

Aedes aegypti

Study: Liu H, Cupp EW, Guo A, Liu N. 2004. Insecticide resistance in Alabama and Florida mosquito strains of *Aedes albopictus*. Journal of Medical Entomology 41:946-952.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All LC50s (90-800 ug/L) > 2x aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Aedes aegypti

Study: Mazzarri MB, Georghiou GP. 1995. Characterization of resistance to organophosphate, carbamate, and pyrethroid insecticides in field populations of *Aedes aegypti* from Venezuela. Journal of the American Mosquito Control Association 11:315-322.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Control response not reported.

Toxicity Data Summary

Aedes aeqypti

Study: Paul A, Harrington LC, Scott JG. 2006. Evaluation of novel insecticides for control of dengue vector *Aedes aegypti* (Diptera: Culicidae). J Med Entomol 43:55-60.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 57
Rating: N

*No standard method, control response not reported

	Paul et al. 2006	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*aegypti*	Rockefellar strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	72 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Paul et al. 2006	***A. aegypti***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	94.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	5 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Control	solvent	5 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	1.6 (1.5-1.8)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -52

Toxicity Data Summary

Aedes aegypti

Study: Ponlawat A, Scott JG, Harrington LC. 2005. Insecticide susceptibility of *Aedes aegypti* and *Aedes albopictus* across Thailand. J Med Entomol 42:821-825.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 56
Rating: N

*No standard method, control response not reported

	Ponlawat et al. 2005	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*aegypti*	Mae Sot (MS) strain Nakhon Ratchasima (NR) strain Rockefellar (Rock) lab strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	MS strain: parents collected in field NR strain: parents collected in field Rock: lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	26 °C	
Test type	Static	

	Ponlawat et al. 2005	***A. aegypti***
Parameter	**Value**	**Comment**
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	98%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (μg/L)	6 concentrations	3-7 tests, 2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 6 Nom/Meas (μg/L)	NR	3-7 tests, 2 reps, 10/rep
Control	Solvent	3-7 tests, 2 reps, 10/rep
LC_{50} (95% confidence interval) (μg/L)	MS: 7.0 (5.8-8.3) NR: 10 (8-16) Rock: 0.7 (0.5-0.9)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity

(2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -54

Toxicity Data Summary

Aedes aegypti

Study: Poupardin R, Reynaud S, Strode C, Ranson H, Vontas J, David J-P. 2008. Cross-induction of detoxification genes by environmental xenobiotics and insecticides in the mosquito *Aedes aegypti*: Impact on larval tolerance to chemical insecticides. Insect Biochemistry and Molecular Biology 38:540-551.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

* No standard method, Chemical purity not reported, Controls not described, response not reported

Toxicity Data Summary

Aedes aegypti

Study: Pridgeon JW, Becnel JJ, Clark GG, Linthicum KJ. 2009. A high-throughput screening method to identify potential pesticides for mosquito control. J Med Entomol 46:335-341.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 48.5
Rating: N

*No standard method, Control response not reported.

	Pridgeon et al. 2009	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*aegypti*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1st instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Deionized water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Pridgeon et al. 2009	***A. aegypti***
Parameter	**Value**	**Comment**
Feeding	Fed during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	6 concentrations	2 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 reps, 5/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 reps, 5/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 reps, 5/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 reps, 5/rep
Concentration 6 Nom/Meas (µg/L)	NR	2 reps, 5/rep
Control	Solvent	2 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	0.28 (0.25-0.31)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -65

Toxicity Data Summary

Aedes aegypti

Study: Riaz MA, Poupardin R, Reynaud S, Strode C, Ranson H, David J-P. 2009. Impact of glyphosate and Benzo[a]pyrene on the tolerance of mosquito larvae to chemical insecticides. Role of detoxification genes in response to xenobiotics. Aquatic Toxicology 93:61-69.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported. Controls not described, response not reported.

Toxicity Data Summary

Aedes aegypti

Study: Sfara V, de Licastro SA, Masuh HM, Seccacini EA, Alzogaray RA, Zerba EN. 2007. Synergism between cis-permethrin and benzoyl phenyl urea insect growth regulators against *Aedes aegypti* larvae. Journal of the American Mosquito Control Association 23:24-28.

Rating: N

*Test only with cis-permethrin, not racemic mixture, therefore it is not appropriate for the data set.

Toxicity Data Summary

Aedes aegypti

Study: Verma KVS, Rahman SJ. 1984. Determination of minimum lethal time of commonly used mosquito larvicides. J Com Dis 16:162-164.

Relevance
Score: 75
Rating: L

Reliability
Score: 33
Rating: N

*Unacceptable standard method, Controls not described, response not reported

	Verma & Rahman 1984	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	WHO 1963	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd-early 4th instar larvae	
Source of organisms	NR	
Have organisms been exposed to contaminants?	Unknown	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	

	Verma & Rahman 1984	***A. aegypti***
Parameter	**Value**	**Comment**
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, ethanol	
Concentration 1 Nom/Meas (µg/L)	NR	Reps and # per: NR
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	NR	
LC_{100}	7.5	Method: NR

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Organism source (5), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8). -55

Acceptability (Table 3.8): Unacceptable standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Organism acclimation (1), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3). -79

Toxicity Data Summary

Aedes aegypti

Study: Wan-Norafikah O, Nazni WA, Lee HL, Zainol-Ariffin P, Sofian-Azirun M. 2010. Permethrin resistance in *Aedes aegypti* (Linnaeus) collected from Kuala Lumpur, Malaysia. Journal of Asia-Pacific Entomology 13:175-182.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*The LC50s exceed 2x the aqueous solubility of permethrin.

Toxicity Data Summary

Aedes aegypti

Study: Wirth MC, Georghiou GP. 1999. Selection and characterization of temephos resistance in a population of *Aedes aegypti* from Tortola, British Virgin Islands. Journal of the American Mosquito Control Association 15:315-320.

Relevance	Reliability
Score: 82.5	Score: 51
Rating: L	Rating: N

*No standard method, control response not reported

	Wirth & Georghiou 1999	***A. aegypti***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*aegypti*	Rock strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Wirth & Georghiou 1999	***A. aegypti***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	94.6%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	5 concentrations	5 tests, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	5 tests, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	5 tests, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	5 tests, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	5 tests, 20/rep
Control	Solvent	5 tests, 20/rep
LC_{50} (fiducial limits) (µg/L)	1.01 (0.78-1.31)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -60

Toxicity Data Summary

Aedes aegypti

Study: Zeichner BC, Perich MJ. 1999. Laboratory testing of a lethal ovitrap for *Aedes aegypti*. Medical and Veterinary Entomology 13:234-238.

Relevance	Reliability
Score: 42.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, No toxicity values, Control not described

Toxicity Data Summary

Atherinops affinis
Menidia beryllina

Study: Hemmer MJ, Middaugh DP, Comparetta V. 1992. Comparative acute sensitivity of larval topsmelt, *Atherinops affinis,* and inland silverside, *Menidia beryllina,* to 11 chemicals. Environ Toxicol Chem 11:401-408.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*The LC50s of 25.3 and 27.5 ug/L both exceed 2x the aqueous solubility of permethrin of 5.5 ug/L

Toxicity Data Summary

Aedes albopictus

Study: Arshad Ali, J. K. Xue R-D. (1995) Comparative toxicity of selected larvicides and insect growth regulators to a Florida laboratory population of *Aedes albopictus*.

Relevance
Score: 82.5 (No std method, Control response)
Rating: L

Reliability
Score: 54.6
Rating: N

Reference	**Ali & Xue 1995**	***A. albopictus***
Parameter	**Value**	**Comment**
Test method cited	Ref to Mulla et al. 1982	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*albopictus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 4th instar	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	no	
Animals acclimated and disease-free?	yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	NR	
Effect 1	mortality	
Control response 1	NR	
Temperature	26 +- 2 C	
Test type	static	
Photoperiod/light intensity	14 h	
Dilution water	tap	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	once	

Reference	**Ali & Xue 1995**	***A. albopictus***
Parameter	**Value**	**Comment**
Purity of test substance	94.6%	
Concentrations measured?	No	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	1mL/100mL	
Concentration 1 Nom/Meas (µg/L)	4-9 conc	3Reps and 20 organisms per rep, test repeated 3x
Control	solvent	Reps and # per (cell density for single
LC50; indicate calculation method	0.95 ug/L (0.82-1.1)	Log-dose-probit
LC90	3.1 ug/L (2.5-4.0)	Log-dose-probit

Reliability points taken off for:
Documentation: Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved Oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8)

Acceptability: Acceptable standard method (5), Control response (9), Measured concentrations within 20% Nom (4), Concentrations do not exceed 2x water solubility (4), Carrier solvent ≤ 0.5 mL/L (4), Appropriate age/size (3), Organisms randomly assigned to containers (1), Feeding (3),), Exposure type (2), Dilution water source (2), Hardness (2), Alkalinity (2), Dissolved Oxygen (4), Temperature not held to ± 1ºC (3), Conductivity (2), pH (3), Random or block design (2), Appropriate spacing between concentrations (2), Hypothesis tests (3)

Toxicity Data Summary

Aedes albopictus

Study: Ali A, Nayar JK, Xue R-D. 1995. Comparative toxicity of selected larvicides and insect growth regulators to a Florida laboratory population of *Aedes albopictus.* Journal of the American Mosquito Control Association 11:72-76.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 57.5
Rating: N

*No standard method, control response not reported

	Ali et al. 1995	***A. albopictus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*albopictus*	
Family in North America?	yes	
Age/size at start of test/growth phase	Late 4th instar larvae	
Source of organisms	Laboratory colony	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	26 ± 2°C	
Test type	Static	
Photoperiod/light intensity	14 h light:10 h dark	
Dilution water	Tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Ali et al. 1995	***A. albopictus***
Parameter	**Value**	**Comment**
Feeding	Yes, once during test	1% beef liver + yeast
Purity of test substance	94.6%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone (1mL/100mL)	
Concentration 1 Nom/Meas (µg/L)	4-9 concentrations	3 tests, 3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Control	solvent	3 tests, 3 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	0.95 (0.82-1.1)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -54

Toxicity Data Summary

Aedes albopictus

Study: Ali A, Nayar JK, Xue R-D. 1995. Comparative toxicity of selected larvicides and insect growth regulators to a Florida laboratory population of *Aedes aegypti.* Journal of the American Mosquito Control Association 11:72-76.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 55
Rating: N

*No standard method, control response not reported

	Ali et al. 1995	***A. albopictus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*albopictus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	26 ± 2°C	
Test type	Static	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Ali et al. 1995	***A. albopictus***
Parameter	**Value**	**Comment**
Feeding	Yes, once at beginning of test	
Purity of test substance	94.6%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	6-9 concentrations	3 tests, 3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Control	Solvent	3 tests, 3 reps, 20/rep
LC_{50} (95% confidence limit) (µg/L)	0.95 (0.82-1.1)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -59

Toxicity Data Summary

Aedes albopictus

Study: Gill SS. 1977. Larvicidal activity of synthetic pyrethroids against *Aedes albopictus* (Skuse). The Southeast Asian Journal of Tropical Medicine and Public Health 8:510-514.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Controls not described and response not reported

Toxicity Data Summary

Aedes albopictus

Study: Ponlawat A, Scott JG, Harrington LC. 2005. Insecticide susceptibility of *Aedes aegypti* and *Aedes albopictus* across Thailand. J Med Entomol 42:821-825.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 56
Rating: N

*No standard method, control response not reported

	Ponlawat et al. 2005	***A. albopictus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*albopictus*	Nakhon Sawan (NS) strain Surat Thani (ST) strain Phatthalung (PT) strain Rockefellar (Rock) lab strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	NS strain: parents collected in field ST strain: parents collected in field PT strain: parents collected in field Rock: lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	

	Ponlawat et al. 2005	***A. albopictus***
Parameter	**Value**	**Comment**
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	26 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	98%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	6 concentrations	3-7 tests, 2 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3-7 tests, 2 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3-7 tests, 2 reps, 10/rep
Control	Solvent	3-7 tests, 2 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	NS: 4.1 (3.8-4.5) ST: 2 (1.8-2.2) PT: 9 (6-14) Rock: 0.7 (0.5-0.9)	Method: probit

Notes:

Reliability points taken off for:

Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -54

Toxicity Data Summary

Alburnus alburnus
Nitocra spinipes

Study: Linden E, Bengtsson B-E, Svanberg O, Sundstrom G. 1979. The acute toxicity of 78 chemicals and pesticide formulations against two brackish water organisms, the bleak (*Alburnus alburnus*) and the harpacticoid *Nitocra spinipes.* Chemosphere 11/12:843-851.

Relevance	Reliability
Score: 45	Score: n/a
Rating: N	Rating: n/a

*No standard method, not freshwater, low chemical purity, controls not specifically described and response not reported.

Toxicity Data Summary

Americamysis bahia

Study: Borthwick PW, Walsh GE. 1981. Initial toxicological assessment of Ambush ®, Bolero ®, Bux ®, Dursban ®, Fentrifanil ®, Larvin ®, and Pydrin ®: Static acute toxicity tests with selected estuarine algae, invertebrates, and fish. EPA-600/4-81-076. Environmental Research Laboratory, U.S. EPA, Gulf Breeze, FL.

Relevance
Score: 70
Rating: L

Reliability
Score: 52.5
Rating: N

*Saltwater, Controls not mentioned

	Borthwick et al. 1981	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1978	
Phylum		
Class		
Order		
Family		
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1 d old juvenile	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	20 o/oo salinity
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Borthwick et al. 1981	***A. bahia***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	During test to minimize cannibalism/starvation	Fed 48 h old *Artemia nauplii*
Purity of test substance	93%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (μg/L)	NR	Reps and # per: NR
Concentration 2 Nom/Meas (μg/L)	NR	
Concentration 3 Nom/Meas (μg/L)	NR	
Concentration 4 Nom/Meas (μg/L)	NR	
Concentration 5 Nom/Meas (μg/L)	NR	
Concentration 6 Nom/Meas (μg/L)	NR	
Control	NR	
LC_{50} (95% confidence interval) (μg/L)	96 h: 0.046 (0.032-0.056)	Method: either probit, binomial, or moving average

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8).

Acceptability (Table 3.8): Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3).

Toxicity Data Summary

Artemia franciscana
Brachionus plicatilis
Brachionus calyciflorus
Thamnocephalus platyurus

Study: Sanchez-Fortun S, Barahona MV. 2005. Comparative study on the environmental risk induced by several pyrethroids in esetuarine and freshwater invertebrate organisms. Chemosphere 59:553-559.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Reported LC50s (220-8210 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L).

Toxicity Data Summary

Anabaena inaequalis

Study: Stratton GW, Corke CT. 1982. Toxicity of the insecticide permethrin and some degradation products toward algae and cyanobacteria. Environmental Pollution A 29:71-80.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*The toxicity values reported exceeded 2x the aqueous solubility of permethrin.

Toxicity Data Summary

Anabaena inaequalis

Study: Stratton GW, Huber AL, Corke CT. 1980. The effect of pesticides and their metabolites, alone and in combination, on algal processes. Can Tech Rep Fish Aquat Sci 975:131-139.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity values exceed 2x the aqueous solubility of permethrin

Toxicity Data Summary

Acropora millepora

Study: Markey KL, Baird AH, Humphrey C, Negri AP. 2007. Insecticides and a fungicide affect multiple coral life stages. Mar Ecol Prog Ser 330:127-137.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Chemical purity not reported

Toxicity Data Summary

Anopheles pseudopunctipennis

Study: Ocampo CB, Brogdon WG, Orrego CM, Toro G, Montoya-Lerma J. 2000. Insecticide susceptibility in *Anopheles pseudopunctipennis* from Colombia: Comparison between bioassays and biochemical assays. Journal of the American Mosquito Control Association 16:331-338.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 47.5
Rating: N

*Unacceptable standard method, Control response not reported.

	Ocampo et al. 2000	***A. pseudopunctipennis***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Anopheles*	
Species	*pseudopunctipennis*	4 strains: Buga, Rozo, Florida, Tulua
Family in North America?	Yes	
Age/size at start of test/growth phase	3rd – early 4th instar larvae	
Source of organisms	Collected in field	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Dechlorinated tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	

	Ocampo et al. 2000	***A. pseudopunctipennis***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone or ethanol	
Concentration 1 Nom/Meas (μg/L)	4 concentrations	4 reps, 10-12/rep
Concentration 2 Nom/Meas (μg/L)	NR	4 reps, 10-12/rep
Concentration 3 Nom/Meas (μg/L)	NR	4 reps, 10-12/rep
Concentration 4 Nom/Meas (μg/L)	NR	4 reps, 10-12/rep
Control	Solvent	4 reps, 10-12/rep
LC_{50} (μg/L)	Buga: 0.77 (0.5-0.9) Rozo: 0.98 (0.7-1.2) Florida: 0.56 (0.5-0.6) Tulua: 1.41 (1.2-1.5)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): Unacceptable standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -67

Toxicity Data Summary

Anopheles quadrimaculatus

Study: Milam CD, Farris JL, Wilhide JD. 2000. Evaluating mosquito control pesticides for effect on target and nontarget organisms. Arch Environ Contam Toxicol 39:324-328.

Relevance
Score: 77.5
Rating: L

Reliability
Score: 56
Rating: N

*Low chemical purity, Control response not reported

	Milam et al. 2000	***A. quadrimaculatus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1993	
Phylum		
Class		
Order		
Family		
Genus	*Anopheles*	
Species	*quadrimaculatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	2nd and 3rd instar larvae	
Source of organisms	Collected in area ditches	Arkansas
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L:8 D	
Dilution water	EPA moderately hard synthetic water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Milam et al. 2000	***A. quadrimaculatus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	NR, formulation called Permanone	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	No carrier used	
Concentration 1 Nom/Meas (µg/L)	NR	4 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	Dilution water	4 reps, 5/rep
LC_{50} (µg/L)	1.0	Method: probit, trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Chemical purity (5), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -36

Acceptability (Table 3.8): Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -52

Toxicity Data Summary

Anopheles stephensi

Study: Kumar S, Thomas A, Sahgal A, Verma A, Samuel T, Pillai MKK. 2004. Variation in the insecticide-resistance spectrum of *Anopheles stephensi* after selection with deltamethrin or a deltamethrin-piperonyl-butoxide combination. Annals of Tropical Medicine and Parasitology 98:861-871.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 53.5
Rating: N

*Control response not reported

	Kumar et al. 2004	***A. stephensi***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum		
Class		
Order		
Family	Culicidae	
Genus	*Anopheles*	
Species	*stephensi*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Kumar et al. 2004	***A. stephensi***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	≥ 94%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.4% ethanol	
Concentration 1 Nom/Meas (µg/L)	NR	4 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	Solvent	4 reps, 25/rep
LC_{50} (95% confidence interval) (µg/L)	3.622 (3.106-4.255)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -41

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -52

Toxicity Data Summary

Anopheles stephensi

Study: Scott JG, Georghiou GP. 1986. Malathion-specific resistance in *Anopheles stephensi* from Pakistan. J Am Mosq Control Assoc 2:29-32.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity value exceeds 2x the aqueous solubility of permethrin.

Toxicity Data Summary

Aedes trivittatus

Study: Rubio-Moran R. 1979. Effect of permethrin and malathion on *Aedes trivittatus* and *Culex pipiens pipiens.* Master's thesis. Iowa State University, Ames, IA.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 54.5
Rating: N

*No standard method, control response not acceptable

	Rubio-Moran 1979	***A. trivittatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Aedes*	
Species	*trivittatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd-early 4th instar larvae	
Source of organisms	Lab reared	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	< 20%	
Temperature	21-26 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	

	Rubio-Moran 1979	***A. trivittatus***
Parameter	**Value**	**Comment**
Purity of test substance	98%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% acetone	
Concentration 1 Nom/Meas (μg/L)	2-4.5 ug/L	4 reps, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	
Concentration 3 Nom/Meas (μg/L)	NR	
Concentration 4 Nom/Meas (μg/L)	NR	
Concentration 5 Nom/Meas (μg/L)	NR	
Concentration 6 Nom/Meas (μg/L)		
Control	Solvent	4 reps, 20/rep
LC_{50} (μg/L)	3.0 (2.7-3.3)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -53

Toxicity Data Summary

Acanthocyclops vernalis
Macrocyclops albidus
Mesocyclops ruttneri

Study: Marten GG, Che W, Bordes ES. 1993. Compatibility of cyclopoid copepods with mosquito insecticides. Journal of the American Mosquito Control Association. 9:150-154.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All toxicity values (290-1900 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L).

Toxicity Data Summary

Balanus albicostatus

Study: Feng D, Ke C, Li S, Lu C, Guo F. 2009. Pyrethroids as promising marine antifoulants: Laboratory and field studies. Mar Biotechnol 11:153-160.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*EC50 and LC50 both exceed 2x aqueous solubility

Toxicity Data Summary

Bufo americanus
Rana clamitans
Rana pipiens
Rana sylvatica

Study: Berrill M, Bertram S, Wilson A, Louis S, Brigham D, Stromberg C. 1993. Lethal and sublethal impacts of pyrethroid insecticides on amphibian embryos and tadpoles. Environ Toxicol Chem 12:525-539.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All but lowest concentration tested exceeded 2x the aqueous solubility of permethrin (5.5 ug/L), and the lowest concentration (10 ug/L) was very near 2x the aqueous solubility. There were no acceptable acute or chronic toxicity values due to the high concentrations tested.

Toxicity Data Summary

Carassius auratus

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, toxicity value not calculable, control description

Toxicity Data Summary

Cyprinodon bovinus
Cyprinodon variegatus
Gila elegans
Ptychocheilus lucius

Study: Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. Arch Environ Contam Toxicol 48:143-154.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*The toxicity values reported for these species exceed 2x the aqueous solubility.

Toxicity Data Summary

Cyprinodon bovinus

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity values (18-21 ug/L) exceed 2x aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Cyprinus carpio

Study: Reddy PM, Naik SS, Bashamohideen MD. 1995. Toxicity of cypermethrin and permethrin to fish *Cyprinus carpio*. Environment & Ecology 13:30-33.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All concentrations tested (120-140 ug/L) exceeded 2x aqueous solubility of permethrin (5.5 ug/L).

Toxicity Data Summary

Chironomus decorus

Study: Ali A. 1981. Laboratory evaluation of organophosphate and new synthetic pyrethroid insecticides against pestiferous chironomid midges of Central Florida. 41:157-161.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 43.5
Rating: N

*No standard method, control response not reported

	Ali 1981	***C. decorus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Chironomidae	
Genus	*Chironomus*	
Species	*decorus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Collected from pond	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 ± 2°C	
Test type	Static	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Ali 1981	***C. decorus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	5-6 concentrations	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Dilution water	3 reps, 10/rep
LC_{50} (µg/L)	4.5	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Exposure type (5), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8). -51

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -62

Toxicity Data Summary

Chironomus decorus
Chironomus utahensis
Procladius spp.

Study: Arshad A, Mulla MS. 1978. Declining field efficacy of chlorpyrifos against Chironomid midges and laboratory evaluation of substitute larvicides. J Econ Entomol 71:778-782.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*These tests are with cis-permethrin and cis-cypermethrin, not the racemic mixtures of these compounds, and therefore are not included for criteria calculation.

No standard method, chemical purity not reported, controls not mentioned.

Toxicity Data Summary

Ceriodaphnia dubia

Study: Liu, W., Gan, J., Lee, S., Werner, I. 2005a. Isomer selectivity in aquatic toxicity and biodegradation of bifenthrin and permethrin. Environmental Toxicology & Chemistry 24: 1861-1866.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Tests performed with cis-permethrin or trans-permethrin, not racemic permethrin, therefore the data cannot be used.

Toxicity Data Summary

Ceriodaphnia dubia
Daphnia magna
6 species of mussels

Study: Milam CD, Farris JL, Dwyer FJ, Hardesty DK. 2005. Acute toxicity of six freshwater mussel species (Glochidia) to six chemicals: Implications for daphnids and *Utterbackia imbecillis* as surrogates for protection of freshwater mussels (Unionidae). Arch Environ Contam Toxicol 48:166-173.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All toxicity values exceed 2x the aqueous solubility of permethrin.

Toxicity Data Summary

Ceriodaphnia dubia

Study: Liu W, Gan J, Schlenk D, Jury WA. 2005b. Enantioselectivity in environmental safety of current chiral insecticides. Proceedings of the National Academy of Sciences, 102:701-706.

Same data as reported in Liu *et al.* 2005a.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*****Tests performed with cis-permethrin or trans-permethrin, not racemic permethrin, therefore the data cannot be used.

Toxicity Data Summary

Ceriodaphnia dubia

Study: Milam CD, Farris JL, Wilhide JD. 2000. Evaluating mosquito control pesticides for effect on target and nontarget organisms. Arch Environ Contam Toxicol 39:324-328.

Relevance	Reliability
Score: 77.5	Score: 56
Rating: L	Rating: N

*Low chemical purity, Control response not reported

	Milam et al. 2000	***G. species***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1993	
Phylum		
Class		
Order		
Family		
Genus	*Ceriodaphnia*	
Species	*dubia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h old	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L:8 D	
Dilution water	EPA moderately hard synthetic water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Milam et al. 2000	***G. species***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	NR, formulation called Permanone	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	No carrier used	
Concentration 1 Nom/Meas (µg/L)	NR	4 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	Dilution water	4 reps, 5/rep
LC_{50} (µg/L)	0.60	Method: probit, trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Chemical purity (5), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -36

Acceptability (Table 3.8): Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -52

Toxicity Data Summary

Ceriodaphnia dubia

Study: Wheelock CE, Miller JL, Miller MJ, Phillips BM, Huntley SA, Gee SJ, Tjeerdema RS, Hammock BD. 2006. Use of carboxylesterase activity to remove pyrethroid-associated toxicity to *Ceriodaphnia dubia* and *Hyalella azteca* in toxicity identification evaluations. Environ Toxicol Chem 25:973-984.

Relevance	Reliability
Score: 62.5	Score: n/a
Rating: N	Rating: n/a

*Chemical purity not reported, Toxicity value not calculable, Control not described

Toxicity Data Summary

Ceriodaphnia dubia

Study: Yang W, Spurlock F, Liu W, Gan J. 2006. Inhibition of aquatic toxicity of pyrethroid insecticides by suspended sediment. Environ Toxicol Chem 25:1913-1919.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Test with cis-permethrin, therefore data cannot be used.

Toxicity Data Summary

Cyprinodon macularius
Oncorhynchus mykiss (formerly *Salmo gairdeneri*)

Study: Mulla MS, Navvab-Gojrati HA, Darwazeh HA. 1978. Toxicity of mosquito larvicidal pyrethroids to four species of freshwater fishes. Environmental Entomology 7:428-430.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Controls not described, response not reported.

Other species were tested but the LC50s reported for them exceed 2x the aqueous solubility of permethrin, although a formulation was used.

Toxicity Data Summary

Culex pipiens pipiens

Study: Rubio-Moran R. 1979. Effect of permethrin and malathion on *Aedes trivittatus* and *Culex pipiens pipiens.* Master's thesis. Iowa State University, Ames, IA.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 54.5
Rating: N

*No standard method, control response not acceptable

	Rubio-Moran 1979	***C. pipiens pipiens***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Culex*	
Species	*pipiens pipiens*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd-early 4th instar larvae	
Source of organisms	Lab reared	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	< 20%	
Temperature	21-26 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	

	Rubio-Moran 1979	***C. pipiens pipiens***
Parameter	**Value**	**Comment**
Purity of test substance	98%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% acetone	
Concentration 1 Nom/Meas (µg/L)	2.25-6 ug/L	4 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)		
Control	Solvent	4 reps, 20/rep
LC_{50} (µg/L)	3.0 (2.7-3.3)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -53

Toxicity Data Summary

Culex pipiens quinquefasciatus

Study: Failloux A-B, Ung A, Raymond M, Pasteur N. 1994. Insecticide susceptibility in mosquitoes (Diptera: Culicidae) from French Polynesia. J Med Entomol 31:639-644.

Relevance
Score: 100
Rating: R

Reliability
Score: 58.5
Rating: N

	Failloux et al. 1994	***C. p. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1975	
Phylum		
Class		
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*pipiens quinquefasciatus* S-LAB	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	

	Failloux et al. 1994	***C. p. quinquefasciatus***
Parameter	**Value**	**Comment**
Purity of test substance	99%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1 mL/99 mL ethanol (1%)	
Concentration 1 Nom/Meas (µg/L)	5 concentrations, NR	2-4 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Concentration 3 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Concentration 4 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Concentration 5 Nom/Meas (µg/L)	NR	2-4 reps, 25/rep
Control	solvent	2-4 reps, 25/rep
LC_{50} (95% confidence interval) (µg/L)	C. p. quinquefasciatus S-LAB: 10.0 (8.6-14.0)	Method: log-probit

Notes: Results for CP-PAEA strain not reported because LC50 value (21.0 ug/L) exceeds 2x the aqueous solubility (5.5 ug/L)

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -45

Toxicity Data Summary

Culex pipiens quinquefasciatus

Study: Hardstone MC, Leichter C, Harrington LC, Kasai S, Tomita T, Scott JG. 2007. Cytochrome P450 monooxygenase-mediated permethrin resistance confers limited and larval specific cross-resistance in the southern house mosquito, *Culex pipiens quinquefasciatus.* Pestic Biochem Physiol 89:175-184.

and

Hardstone MC, Leichter C, Harrington LC, Kasai S, Tomita T, Scott JG. 2008. Corrigendum to "Cytochrome P450 monooxygenase-mediated permethrin resistance confers limited and larval specific cross-resistance in the southern house mosquito, *Culex pipiens quinquefasciatus*." [Pestic Biochem Physiol (2007) 89:175-184] Pestic Biochem Physiol 91:191.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 55
Rating: N

*No standard method, Control response not reported

	Hardstone et al. 2007	***C. pipiens quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Culex*	
Species	*pipiens quinquefasciatus* Say SLAB	SLAB: susceptible lab strain
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Laboratory cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	

	Hardstone et al. 2007	***C. pipiens quinquefasciatus***
Parameter	**Value**	**Comment**
Control response 1	NR	
Temperature	25°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during tests	
Purity of test substance	98%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	1% (1 mL/99 mL) acetone	
Concentration 1 Nom/Meas (µg/L)	At least 3 concentrations	At least 5 tests, at least 3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	At least 5 tests, at least 3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	At least 5 tests, at least 3 reps, 20/rep
Control	solvent	At least 5 tests, at least 3 reps, 20/rep
LC_{50} (µg/L)	SLAB: 1.7 (1.5-1.9)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Organism acclimation (1), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -56

Toxicity Data Summary

Culex pipiens quinquefasciatus

Hardstone MC, Leichter C, Harrington LC, Kasai S, Tomita T, Scott JG. 2008. Corrigendum to ‘‘Cytochrome P450 monooxygenase-mediated permethrin resistance confers limited and larval specific cross-resistance in the southern house mosquito, Culex pipiens quinquefasciatus.” *Pest Biochem Physiol* 91:191-191.

Previous citation it to correction with some corrected LC50s.Original article:

Hardstone MC, Leichter C, Harrington LC, Kasai S, Tomita T, Scott JG. 2007. Cytochrome P450 monooxygenase-mediated permethrin resistance confers limited and larval specific cross-resistance in the southern house mosquito, Culex pipiens quinquefasciatus. *Pest Biochem Physiol* 89:175.

Not relevant

Study reports LC50s of 3.5 and 5.2 ug/L for susceptible and resistant strains but these were not really aqueous exposures. From the methods section:

"Adult mosquito bioassays were conducted in glass jars (230 ml, internal surface area of 180 cm2) treated with 1 ml of insecticide solution (or 1 ml of acetone for controls), which was evenly coated on the inner walls."

Toxicity Data Summary

Culex pipiens

Study: Mansour SA, Messeha SS, El-Gengaihi SE. 2000. Botanical biocides 4. Mosquitocidal activity of certain *Thymus capitatus* constituents. Journal of Natural Toxins 9:49-62.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*Unacceptable standard method (WHO 1971), Low chemical purity, Controls not described.

Toxicity Data Summary

Culex pipiens

Study: Wirth MC, Georghiou GP. 1996. Organophosphate resistance in *Culex pipiens* from Cyprus. Journal of the American Mosquito Control Association 12:112-118.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 51
Rating: N

*No standard method, control response not reported.

	Wirth & Georghiou 1996	***C. pipiens***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Dipetera	
Family	Culicidae	
Genus	*Culex*	
Species	*pipiens*	3 strains S-lab Paphos Milas
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Wirth & Georghiou 1996	***C. pipiens***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	94.6%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	At least 5 concentrations	5 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	5 reps, 20/rep
Control	Solvent	5 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	S-lab: 0.88 Paphos:4.14 Milas: 8.65	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -60

Toxicity Data Summary

Culex quinquefasciatus

Study: Ali A, Chowdhury MA, Hossain MI, Ameen MU, Habiba DB, Aslam AFM. 1999. Laboratory evaluation of selected larvicides and insect growth regulators against field-collected *Culex quinquefasciatus* larvae from urban Dhaka, Bangladesh. Journal of the American Mosquito Control Association 15:43-47.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 53
Rating: N

*No standard method, control response not reported

	Ali et al. 1999	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar	
Source of organisms	Collected in field	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	28 ± 3°C	
Test type	Static	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Ali et al. 1999	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	Yes, once at beginning of test	
Purity of test substance	94.6%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	6-9 concentrations	3 tests, 3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 tests, 3 reps, 20/rep
Control	Solvent	3 tests, 3 reps, 20/rep
LC_{50} (95% confidence limit) (µg/L)	5 (3-9)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Feeding (3), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -63

Toxicity Data Summary

Culex quinquefasciatus

Study: Corbel V, Chandre F, Darriet F. Lardeux F, Hougard J-M. 2003. Synergism between permethrin and propoxur against *Culex quinquefasciatus* mosquito larvae. Medical and Veternary Entomology 17:158-164.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 58
Rating: N

*Control response not reported

	Corbel et al. 2003	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1970	
Phylum		
Class		
Order	Culicidae	
Family	Diptera	
Genus	*Culex*	
Species	*quinquefasciatus*	S-lab strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3rd and early 4th instar larvae	
Source of organisms	Lab colony	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Corbel et al. 2003	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	94.4%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	1 mL ethanol/99 mL dilution water	
Concentration 1 Nom/Meas (μg/L)	5-8 concentrations	5 tests with 3 reps each, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	5 tests with 3 reps each, 20/rep
Concentration 3 Nom/Meas (μg/L)	NR	5 tests with 3 reps each, 20/rep
Concentration 4 Nom/Meas (μg/L)	NR	5 tests with 3 reps each, 20/rep
Concentration 5 Nom/Meas (μg/L)	NR	5 tests with 3 reps each, 20/rep
Control	Solvent	5 tests with 3 reps each, 20/rep
LC_{50} (μg/L)	1.5	Method: log-probit

Notes: also tests mixtures with the carbamate propoxur

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -50

Toxicity Data Summary

Culex quinquefasciatus

Study: Kasai S, Weerashinghe IS, Shono T. 1998. P450 monooxygenases are an important mechanism of permethrin resistance in *Culex quinquefasciatus* Say larvae. Archives of Insect Biochemistry and Physiology 37:47-56.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 58
Rating: N

*Standard method not acceptable, Control response not reported

	Kasai et al. 1998	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Kasai et al. 1998	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Feeding	NR	
Purity of test substance	91.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	≤ 1% alcohol	
Concentration 1 Nom/Meas (µg/L)	NR	3reps, 20-30/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	Solvent	3reps, 20-30/rep
LC_{50} (µg/L)	4.0 (3.0-4.0)	Method: log-probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Unacceptable standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -50

Toxicity Data Summary

Culex quinquefasciatus

Study: Khayrandish A, Wood RJ. 1993. Organophosphorus insecticide resistance in a new strain of *Culex quinquefasciatus* (Diptera: Culicidae) from Tanga, Tanzania. Bulletin of Entomological Research 83:67-74.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 56
Rating: N

*Unacceptable standard method, control response not reported

	Khayrandish & Wood 1993	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1975	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	2 strains: TANGA RANGOON
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Lab colony	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	26 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Khayrandish & Wood 1993	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	96.9%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% ethanol	
Concentration 1 Nom/Meas (µg/L)	8-10 concentrations	10 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	10 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	10 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	10 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	10 reps, 20/rep
Concentration 6 Nom/Meas (µg/L)	NR	10 reps, 20/rep
Control	Solvent	10 reps, 20/rep
LC_{50} (µg/L)	TANGA: 4.4 RANGOON: 2.2	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Unacceptable standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -54

Toxicity Data Summary

Culex quinquefasciatus

Study: Li T, Lan Q, Liu N. 2009. Larvicidal activity of mosquito sterol carrier protein-2 inhibitors to the insecticide-resistant mosquito *Culex quinquefasciatus* (Diptera: Culicidae). Journal of Medical Entomology 46:1430-1435.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 54.5
Rating: N

*No standard method, control response not reported

	Li et al. 2009	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	-Say strain (susceptible) -MAmCq G2 strain (selected for permethrin resistance for 2 generations) -HAmCq G9 (selected for permethrin resistance for 9 generations)
Family in North America?	Yes	
Age/size at start of test/growth phase	2nd instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	Not clear, clarify with authors
Data for multiple times?	No	

	Li et al. 2009	*C. quinquefasciatus*
Parameter	**Value**	**Comment**
Effect 1	Mortality	
Control response 1	NR	
Temperature	25°C	
Test type	Static	
Photoperiod/light intensity	NR during test, reared at 12:12	
Dilution water	Tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.3%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	3-4 concentrations	4 reps, 30/rep
Concentration 2 Nom/Meas (µg/L)	NR	4 reps, 30/rep
Concentration 3 Nom/Meas (µg/L)	NR	4 reps, 30/rep
Concentration 4 Nom/Meas (µg/L)	NR	4 reps, 30/rep
Control	Solvent	4 reps, 30/rep
LC_{50} (95% confidence interval) (µg/L)	S-LAB strain: 0.6 (0.4-0.9) MAmCq G2 strain: 4 (2-5) BAmCq strain: 8 (4-20)	Method: probit

Notes: LC50 for HAmCq G9 strain (70 ug/L) was not reported because it was > 2x aqueous solubility of permethrin (5.5 ug/L)

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2),

Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3).
-57

Toxicity Data Summary

Culex quinquefasciatus

Study: Liu H, Cupp EW, Micher KM, Guo A, Liu N. 2004b. Insecticide resistance and cross-resistance in Alabama and Florida strains of *Culex quinquefasciatus.* J Med Entomol 41:408-413.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 54.5
Rating: N

*No standard method, control response not reported

	Liu et al. 2004b	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited		
Phylum		
Class		
Order		
Family		
Genus	*Culex*	
Species	*quinquefasciatus*	S-Lab strain (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Liu et al. 2004b	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	95.3%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	3-4 concentrations	3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Control	Solvent	3 reps, 20/rep
LC50 (95% confidence interval) (µg/L)	S-Lab: 8 (6-10)	Method: probit

Notes: Other strains were tested but those LC50s exceeded 2x the aqueous solubility of permethrin

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -57

Toxicity Data Summary

Culex quinquefasciatus

Study: Mulla MS, Navvab-Gojrati HA, Darwazeh HA. 1978. Biological activity and longevity of new synthetic pyrethroids against mosquitoes and some nontarget insects. Mosquito News 38:90-96.

Relevance
Score: 75
Rating: L

Reliability
Score: 41.5
Rating: N

*No standard method, Controls not described, response not reported

	Mulla et al. 1978	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Mulla et al. 1978	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	NR	2 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	NR	
LC_{50} (µg/L)	1.40	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -46

Acceptability (Table 3.8): No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -71

Toxicity Data Summary

Culex quinquefasciatus

Study: Scott JG, Mellon RB, Kirino O, Georghiou GP. 1986. Insecticidal activity of substituted benzyl dichlorovinylchyclopropanecarboxylates on susceptible and kdr-resistant strains of the southern house mosquito, *Culex quinquefasciatus.* J Pesticide Sci 11:475-477.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity value (16 ug/L) exceeds 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Culex quinquefasciatus

Study: Vijayan VA, Ningegowda N. 1993. Susceptibility difference in two populations of *Culex quinquefasciatus* Say (Diptera: Culicidae) to three synthetic pyrethroids. Southeast Asian J Trop Med Public Health 24:540-543.

Relevance
Score: 75
Rating: L

Reliability
Score: 54.5
Rating: N

*Unacceptable standard method, Low chemical purity

	Vijayan & Ningegowda 1993	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	Strains: Mysore Mandya
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Originally collected in field	
Have organisms been exposed to contaminants?	Not known	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	26 ± 2°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	

	Vijayan & Ningegowda 1993	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	25%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.08% acetone	
Concentration 1 Nom (μg/L)	2.0	4-6 reps, 25/rep
Concentration 2 Nom (μg/L)	4.0	4-6 reps, 25/rep
Concentration 3 Nom (μg/L)	6.0	4-6 reps, 25/rep
Concentration 4 Nom (μg/L)	8.0	4-6 reps, 25/rep
Control	Solvent	4-6 reps, 25/rep
LC_{50} (μg/L)	Mysore: 4.54 Mandya: 4.8	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): Unnacceptable standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Hypothesis tests (3). -60

Toxicity Data Summary

Culex quinquefasciatus

Study: Weerasinghe IS, Kasai S, Shono T. 2001. Correlation of pyrethroid structure and resistance level in *Culex quinquefasciatus* Say from Saudi Arabia. J Pesticide Sci 26:158-161.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 54
Rating: N

*Unacceptable standard method, No control response

	Weerasinghe et al. 2001	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	Not acceptable
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Weerasinghe et al. 2001	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	91.2%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	≤ 1% ethanol	
Concentration 1 Nom/Meas (µg/L)	Not reported	3 reps, 20-30/rep
Concentration 2 Nom/Meas (µg/L)	Not reported	
Concentration 3 Nom/Meas (µg/L)	Not reported	
Concentration 4 Nom/Meas (µg/L)	Not reported	
Concentration 5 Nom/Meas (µg/L)	Not reported	
Concentration 6 Nom/Meas (µg/L)	Not reported	
Control	Solvent	3 reps, 20-30/rep
LC_{50} (95% confidence limit) (µg/L)	4.0 (3.0-4.0)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): Unacceptable standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -58

Toxicity Data Summary

Culex quinquefasciatus

Study: Xu Q, Liu H, Zhang L, Liu N. 2005. Resistance in the mosquito, *Culex quinquefasciatus*, and possible mechanisms for resistance. Pest Manag Sci 61:1096-1102.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 53
Rating: N

*No standard method, Control response not reported

	Xu et al. 2005	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*quinquefasciatus*	Say (susceptible)
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	

	Xu et al. 2005	***C. quinquefasciatus***
Parameter	**Value**	**Comment**
Purity of test substance	95.3%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	4-5 concentrations	3 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 20/rep
Control	Solvent	3 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	Test 1: 8 (6-10) Test 2: 9 (7-10)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -60

Toxicity Data Summary

Chironomus riparius

Study: Conrad AU, Fleming RJ, Crane M. 1999. Laboratory and field response of *Chironomus riparius* to a pyrethroid insecticide. Water Research 33:1603-1610.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, low chemical purity, control response not reported

96 h LC50: 2.89 (std dev 0.18)

Toxicity Data Summary

Chironomus riparius

Study: Ibrahim H, Kheir R, Helmi S, Lewis J, Crane M. 1998. Effects of organophosphorus, carbamate, pyrethroid and organochlorine pesticides, and a heavy metal on survival and cholinesterase activity of *Chironomus riparius* Meigen. Bull Environ Contam Toxicol 60:448-455.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 of 16.6 ug/L exceeds 2x aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Chironomus salinarius

Study: Ali A, Majori G, Ceretti G, D'Andrea F, Scattolin M, Ferrarese U. 1985. A chironomid (Diptera:Chironomidae) midge population study and laboratory evaluation of larvicides against midges inhabiting the lagoon of Venice, Italy. J Am Mosq Control Assoc 1:63-68.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, saltwater, Controls not described, response not reported

Toxicity Data Summary

Crangon septemspinosa
Homarus americanus

Study: McLeese DW, Metcalfe CD, Zitko V. 1980. Lethality of permethrin, cypermethrin and fenvalerate to salmon, lobster and shrimp. Bull Environ Contam Toxicol 25:950-955.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Controls not described and response not reported.

Toxicity Data Summary

Culex tarsalis

Study: Whyard S, Downe AER, Walker VK. 1994. Isolation of an esterase conferring insecticide resistance in the mosquito *Culex tarsalis.* Insect Biochem Molec Biol 24:819-827.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Control response not reported.

Toxicity Data Summary

Culex tritaeniorhynchus

Study: Reza FM, Vijayan VA. 2006. Differential tolerance of two morphological variants of *Culex tritaeniorhynchus* (Diptera: Culicidae), a Japanese encephalitis vector, to pyrethroid insecticides in Mysore, India. Southeast Asian J Top Med Public Health 37:128-131.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 48
Rating: N

*Unacceptable standard method, unacceptable control response (<20%)

	Reza & Vijayan 2006	***C. tritaeniorhynchus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*tritaeniorhynchus*	2 strains: Type A Type B
Family in North America?	Yes	
Age/size at start of test/growth phase	Early 4th instar larvae	
Source of organisms	Collected in the field in Mysore, India area	
Have organisms been exposed to contaminants?	Unknown	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	<20%	
Temperature	Culture conditions: 28 ± 2°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Dechlorinated water	
pH	NR	
Hardness	NR	

	Reza & Vijayan 2006	***C. tritaeniorhynchus***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	94.7%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.08% absolute alcohol	
Concentration 1 Nom/Meas (µg/L)	Range: 0.2-11.2	3 reps, 25/rep
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	Solvent	
LC_{50}	Type A: 2.65 (1.46-4.67) Type B: 2.28 (1.93-2.63)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -38

Acceptability (Table 3.8): Unacceptable standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -66

Toxicity Data Summary

Cyprinodon variegatus

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity values (17-22 ug/L) exceed 2x aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Crassostrea virginica

Study: Borthwick PW, Walsh GE. 1981. Initial toxicological assessment of Ambush ®, Bolero ®, Bux ®, Dursban ®, Fentrifanil ®, Larvin ®, and Pydrin ®: Static acute toxicity tests with selected estuarine algae, invertebrates, and fish. EPA-600/4-81-076. Environmental Research Laboratory, U.S. EPA, Gulf Breeze, FL.

Relevance	Reliability
Score: 62.5	Score: n/a
Rating: N	Rating: n/a

*Saltwater, No toxicity value, Control response not reported
EC50 values > 2x aqueous solubility

Toxicity Data Summary

Crassostrea gigas

42723301. Thompson RS, Sankey SA. 1993. Permethrin: acute toxicity of a 10% EC formulation to larvae of the Pacific oyster (*Crassostrea gigas*) Brixham Environmental Laboratory, Brixham, UK, Rept No BL4689/B. Doc No. C834.

Relevance	Reliability
Score:	Score:
Rating: N	Rating:

This study is rated N because the calculate LC50 exceeds the water solubility of permethrin (Solubility: 5-6 µg/L, 48 hr EC50: 6.5 mg/L).

Toxicity Data Summary

Crassostrea gigas

Thompson RS, Hill RW & Cornish SK. (1977). "Investigation of the acute toxicity of PP 557 to the Pacific Oyster (*Crassostrea gigas*)". Brixham Laboratory.

Relevance	Reliability
Score: 60	Score:
Rating: N	Rating:

Relevance Points taken off for: Standard method (10), Freshwater (15), Toxicity values (15).

Toxicity Data Summary

Cyprinodon variegatus

42608201. Sankey SA, Morris DS, Caunter JE, Stanley RD. 1992. Permethrin: acute toxicity to sheepshead minnow (*Cyprinodon variegatus*) of a 10% EC formulation. Brixham Environmental Laboratory, Brixham, UK, Rept No BL4564/B. Doc No. C820.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

This study was rated N because LC50s found exceed the water solubility of permethrin. (LC50 for all time points (24-96 hr): >300 µg/L)

Toxicity Data Summary

Crassostrea virginica

Study: EG&G, Inc. 1975. Acute toxicity of FMC 33297 technical (95.7%) to eastern oysters (*Crassostrea virginica*), pink shrimp (*Penaeus duorarum*), and fiddler crabs (*Uca pugilator*).

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

Relevance Points taken off for:
Standard method (10), Freshwater (15), Toxicity values not calculable (15)

Toxicity Data Summary

Daphnia magna
Daphnia pulex
Hydropsyche spp.
Isonychia bicolor
Simulium vittatum

Study: Sibley PK, Kaushik NK. 1991. Toxicity of microencapsulated permethrin to selected nontarget aquatic invertebrates. Arch Environ Contam Toxicol 20:168-176.

Relevance	Reliability
Score: Acute: 67.5 Chronic: 60	Score: n/a
Rating: N	Rating: n/a

* Acute: No standard method, Low chemical purity, Control response not reported.
  Chronic: No standard method, Low chemical purity, Toxicity values not calculable.

Toxicity Data Summary

Daphnia magna

Kent SJ, Sankey SA & Grinell AJ. (1992). Permethrin: Acute toxicity to *Daphnia magna* of a 10% EC formulation. EPA MRID: 42584002

Relevance	Reliability
Score:	Score:
Rating: N	Rating:

LC50s exceed the water solubility of permethrin (5.5-6 µg/L).

Hr	LC50 (µg/L)
24	>37
48	9.9

Toxicity Data Summary

Daphnia magna

Study: Liu W, Gan J, Schlenk D, Jury WA. 2005b. Enantioselectivity in environmental safety of current chiral insecticides. Proceedings of the National Academy of Sciences, 102:701-706.

Same data as reported in Liu *et al.* 2005a.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Tests not performed with racemic permethrin, therefore the results cannot be used.

Toxicity Data Summary

Daphnia magna

Study: Stratton GW, Corke CT. 1981. Interaction of permethrin with *Daphnia magna* in the presence and absence of particulate material. Environmental Pollution A 24:135-144.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 57.5
Rating: N

*No standard method, control response not reported

	Stratton & Corke 1981	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Diplostraca (Cladocera)	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juvenile (1-2 mm long) or adult (3-5 mm long)	
Source of organisms	Collected from a small pond	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	20 ± 2°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered river water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Stratton & Corke 1981	***D. magna***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	0.05% acetone	
Concentration 1 Nom/Meas (µg/L)	Concentrations ranged 0-10 µg/L	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	Solvent	3 reps, 10/rep
LC_{50} (µg/L)	Juvenile: 0.2 Adult: 0.6	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -34

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -51

Toxicity Data Summary

Daphnia magna

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, toxicity value not calculable, control description

Toxicity Data Summary

Daphnia magna

Study: USEPA. 1979. Biological report of analysis. TN 2420.

Relevance
Score: 100
Rating: R

Reliability
Score: 51.5
Rating: N

	USEPA 1979	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	ASTM	
Phylum	Arthropoda	
Class	Crustacea (Branchiopoda)	
Order	Diplostraca (Cladocera)	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	TABU stock colonies	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	28 d	
Data for multiple times?	No	
Effect 1	Production of young/adult	
Control response 1	64.2	
Effect 2	Survival	
Control response 2	94.5%	
Temperature	NR	
Test type	NR	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	94.4%	

	USEPA 1979	*D. magna*
Parameter	**Value**	**Comment**
Concentrations measured?	NR	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom (µg/L)	0.017	4 reps, 5/rep
Concentration 2 Nom (µg/L)	0.035	4 reps, 5/rep
Concentration 3 Nom (µg/L)	0.07	4 reps, 5/rep
Concentration 4 Nom (µg/L)	0.14	4 reps, 5/rep
Concentration 5 Nom (µg/L)	0.28	4 reps, 5/rep
Concentration 6 Nom (µg/L)	0.56	4 reps, 5/rep
Control	Solvent and dilution water	4 reps, 5/rep
EC_{50} (µg/L)	48 hr: 0.70	Method: NR
NOEC (µg/L)	0.28	Method: NR p: 0.05 MSD: NR
LOEC (µg/L)	0.56	Same as above
MATC (GeoMean NOEC,LOEC) (µg/L)	0.40	
% of control at NOEC	62.8/64.2=98%	
% of control at LOEC	56.5/64.2=88%	

Notes: interrupted dose response

Reliability points taken off for:
Documentation (Table 3.7): Organism age (5), Analytical method (4), Measured concentrations (3), Exposure type (5), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Minimum significant difference (2). -47

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Feeding (3), Organism acclimation (1), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Statistical method (2), Minimum significant difference (1). -50

Toxicity Data Summary

Danio rerio

Study: DeMicco A, Cooper KR, Richardson JR, White LA. 2010. Developmental neurotoxicity of pyrethroid insecticides in zebrafish embryos. Toxicological Sciences 113:177-186.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 of 300 ug/L > 2x aqueous solubility (5.5. ug/L)

Toxicity Data Summary

Danio rerio

Study: Jin Y, Wang W, Xu C, Fu Z, Liu W. 2008. Induction f hepatic estrogen-responsive gene transcription by permethrin enantiomers in male adult zebrafish. Aquatic Toxicology 88:146-152.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Endpoint not linked to survival/growth/reproduction, Toxicity value not calculable

Toxicity Data Summary

Daphnia magna

Evered P & Doma S. (1977). "PP 557: Acute toxicity of emulsifiable concentrate (JFU 5054) to first instar *Daphnia magna*". ICI Plant Protection Division.

Relevance	Reliability
Score: 85	Score:
Rating: L	Rating: N

Relevance Points taken off for: Chemical purity (15), Control described (7.5)

Reference	**Evered et al, 1977**	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	First instar	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 hr	
Data for multiple times?	Yes	24, 48 hr
Effect 1	Immobility	
Control response 1		
Temperature	18±2°C	
Test type	Static	
Photoperiod/light intensity	30 watt warm white, 3500 lux	
Dilution water	NR	
pH	8.2	
Hardness	NR	
Alkalinity	NR	

Reference	**Evered et al, 1977**	***D. magna***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	>60% saturation	
Feeding	Not fed	
Purity of test substance	24% w/v	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	Highest - 20 mL/L	
Concentration 1 Nom (µg/L)	20, 10, 5, 2, 1, 0.5, 0.2, 0.1, 0.05	3 Reps and 10 organisms per rep, test repeated 3x
Control		3 Reps and 10 per
LC50; indicate calculation method	24 hr 1.93 (1.76-2.12) 48 hr 1.31 (1.17-1.48)	Log-dose-probit

Reliability points taken off for:
Documentation: Control type (8), Organism source (5), Analytical method (4), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8).

Acceptability: Control description (6), Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Temperature not held to ± 1.0°C (3), Conductivity (1), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3).

Toxicity Data Summary

Daphnia magna

Study: **00047033.** Forbis AD, McAllister WA. 1980. Chronic toxicity of 14C-permethrin to *Daphnia magna* under flow-through test conditions. Analytical Bio-ChemistryLaboratories Report #23647. Doc No. C859.

Location: caitlin1.pdf pg 142-143

Relevance
Score: 60
Rating: L

Reliability
Score: 17.5
Rating: N

Acceptable method (10), Purity (15), Control (15)

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	Daphnia	
Species	magna	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	3 weeks	
Data for multiple times?	NR	
Mortality		
Control response	NR	
Effect 2		
Temperature	NR	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	NR	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)		Reps and # per (cell density for single-celled organisms):
Concentration 2 Nom/Meas (µg/L)	.029	
Concentration 3 Nom/Meas (µg/L)	.06	
Concentration 4 Nom/Meas (µg/L)	.118	
Concentration 5 Nom/Meas (µg/L)	.271	
Concentration 6 Nom/Meas (µg/L)	.608	
Control	NR	
NOEC (µg/L)	0.060	
LOEC (µg/L)	0.118	
MATC (GeoMean NOEC,LOEC) (µg/L)	0.084	
% of control at NOEC	NR	
% of control at LOEC	NR	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Exposure duration (12), Control type (8), Organism source (5), Organism age (5), Chemical purity (5), Analytical method (4), Nominal concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8), Minimum significant difference (2), % control of NOEC/LOEC (2), Point estimates (8).

Acceptability (Table 3.8): No standard method (5), Control description (6), Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Organism acclimation (1), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2),

Dilution factor (2), Statistical method (2), Hypothesis tests (3), Minimum significant difference (1), Point estimates (3).

Toxicity Data Summary

Daphnia magna

Yang, W.; Gan, J.; Hunter, W.; Spurlock, F. Effect of suspended solids on bioavailability of pyrethroid insecticides; *Environ. Tox. & Chem.* **2006**, *6*, 1585-1591.

Relevance	Reliability
Score: 60	Score:
Rating: N	Rating:

Relevance Points taken off for: Acceptable standard (10), Endpoint (15), Toxicity values calculable (15).

Toxicity Data Summary

Gambusia affinis

Study: Milam CD, Farris JL, Wilhide JD. 2000. Evaluating mosquito control pesticides for effect on target and nontarget organisms. Arch Environ Contam Toxicol 39:324-328.

Relevance	Reliability
Score: 77.5	Score: 56
Rating: L	Rating: N

*Low chemical purity, Control response not reported

	Milam et al. 2000	***G. affinis***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1993	
Phylum		
Class		
Order		
Family		
Genus	*Gambusia*	
Species	*affinis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	7-14 d old	
Source of organisms	Collected in area ditches	Arkansas
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L:8 D	
Dilution water	EPA moderately hard synthetic water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Milam et al. 2000	***G. affinis***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	NR, formulation called Permanone	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	No carrier used	
Concentration 1 Nom/Meas (µg/L)	NR	4 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	Dilution water	4 reps, 5/rep
LC_{50} (µg/L)	2.7	Method: probit, trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Chemical purity (5), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -36

Acceptability (Table 3.8): Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -52

Toxicity Data Summary

Gambusia holbrooki

Study: Tietze NS, Hester PG, Shaffer KR. 1995. Acute effects of Permanone® 31-66 (permethrin-piperonyl butoxide) on nontarget minnows and grass shrimp. Journal of American Mosquito Control Association 11:476-479.

Relevance
Score: 75
Rating: L

Reliability
Score: 58.5
Rating: N

*No standard method, Low chemical purity

	Tietze et al. 1995	***G. holbrooki***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cyprinodontiformes	
Family	Poeciliidae	
Genus	*Gambusia*	
Species	*holbrooki*	
Family in North America?	Yes	
Age/size at start of test/growth phase	2-5 d old	
Source of organisms	Reared in field ponds at research lab	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	Yes, 24 h	
Effect 1	Mortality	
Control response 1	< 5%	
Temperature	27 ± 0.5°C	
Test type	Static	
Photoperiod/light intensity	16 L:8 D	
Dilution water	Unfiltered well water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Tietze et al. 1995	***G. holbrooki***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	31.28%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	1% acetone	
Concentration 1 Nom/Meas (µg/L)	6 concentrations	6 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	NR	6 reps, 5/rep
Concentration 3 Nom/Meas (µg/L)	NR	6 reps, 5/rep
Concentration 4 Nom/Meas (µg/L)	NR	6 reps, 5/rep
Concentration 5 Nom/Meas (µg/L)	NR	6 reps, 5/rep
Concentration 6 Nom/Meas (µg/L)	NR	6 reps, 5/rep
Control	Solvent	6 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 6.04 (5.77-6.27) 48 h: 4.29 (4.16-4.39)	Method: probit

Notes: the formulation used (Permanone) also contained piperonyl butoxide, which is known to synergize pyrethroid toxicity.

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -31

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Feeding (3), Organism acclimation (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -52

Toxicity Data Summary

Goeldichironomus holoprasinus

Study: Ali A. 1981. Laboratory evaluation of organophosphate and new synthetic pyrethroid insecticides against pestiferous chironomid midges of Central Florida. 41:157-161.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 43.5
Rating: N

*No standard method, control response not reported

	Ali 1981	***G.holoprasinus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Chironomidae	
Genus	*Goeldichironomus*	
Species	*holoprasinus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Collected from pond	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 ± 2°C	
Test type	Static	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Ali 1981	***G.holoprasinus***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	5-6 concentrations	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Dilution water	3 reps, 10/rep
LC_{50} (µg/L)	1.4	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Exposure type (5), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8). -51

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -62

Toxicity Data Summary

Glyptotendipes paripes

Study: Ali A. 1981. Laboratory evaluation of organophosphate and new synthetic pyrethroid insecticides against pestiferous chironomid midges of Central Florida. 41:157-161.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 43.5
Rating: N

*No standard method, control response not reported

	Ali 1981	***G. paripes***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Scarabaeoidea	
Genus	*Glyptotendipes*	
Species	*paripes*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Collected from pond	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	27 ± 2°C	
Test type	Static	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Ali 1981	***G. paripes***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical grade	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	% NR, acetone	
Concentration 1 Nom/Meas (µg/L)	5-6 concentrations	3 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Concentration 6 Nom/Meas (µg/L)	NR	3 reps, 10/rep
Control	Dilution water	3 reps, 10/rep
LC_{50} (µg/L)	2.4	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Exposure type (5), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8). -51

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -62

Toxicity Data Summary

Gammarus pulex

Study: Abel PD, Garner SM. 1986. Comparisons of median survival times and median lethal exposure times for *Gammarus pulex* exposed to cadmium, permethrin and cyanide. Wat Res 20:579-582.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*no standard method, no toxicity values, control response not reported, some test concentrations > 2x solubility

Toxicity Data Summary

Study: Gan J, Lee SJ, Liu WP, Haver DL, Kabashima JN. 2005. Distribution and persistence of pyrethroids in runoff sediments. J Environ Qual 34:836-841.

Relevance	Reliability
Score: 45	Score: n/a
Rating: N	Rating: n/a

Relevance Points taken off for: Standard method (10), Endpoint (15), Toxicity values (15), Controls (15).

Toxicity Data Summary

Gómez-Gutiérrez A.; Jover E.; Bayona J. M.; Albaigés J. Influence of water filtration on the determination of a wide range of dissolved contaminants at parts-per-trillion levels. *Analytica Chimica Acta,* **2007**, *583*, 202-209.

Relevance	Reliability
Score: 45	Score:
Rating: N	Rating:

Relevance Points taken off for: Standard method (10), Endpoint (15), Toxicity values (15), Controls (15).

Toxicity Data Summary

Homarus americanus
Salmo salar

Study: Zitko V, McLeese DW, Metcalfe CD, Carson WG. 1979. Toxicity of permethrin, decamethrin, and related pyrethroids to salmon and lobster. Bull Environm Contam Toxicol 21:338-343.

Relevance	Reliability
Score: 60 (salmon), 45 (lobster)	Score: n/a
Rating: N	Rating: n/a

*No standard method, saltwater (lobster), chemical purity not reported, Controls not described, response not reported

Toxicity Data Summary

Hyalella azteca

Study: Wheelock CE, Miller JL, Miller MJ, Phillips BM, Gee SJ, Tjeerdema RS, Hammock BD. 2005. Influence of container adsorption upon observed pyrethroid toxicity to *Ceriodaphnia dubia* and *Hyalella azteca.* Aquatic Toxicology 74:47-52.

Relevance	Reliability
Score: 85	Score: 53
Rating: L	Rating: N

*Control not described, Control response not within acceptable guidelines

	Wheelock et al. 2005	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1993, 2002	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Amphipoda	
Family	Hyalellidae	
Genus	*Hyalella*	
Species	*azteca*	
Family in North America?	Yes	
Age/size at start of test/growth phase	48 h	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	6-13%	
Temperature	23°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Wheelock et al. 2005	***C. dubia***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	99%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	% NR, methanol	
Concentration 1 Nom/Meas (µg/L)	0	3 reps, 5/rep
Concentration 2 Nom/Meas (µg/L)	0.025	3 reps, 5/rep
Concentration 3 Nom/Meas (µg/L)	0.050	3 reps, 5/rep
Concentration 4 Nom/Meas (µg/L)	0.075	3 reps, 5/rep
Control	Not described	3 reps, 5/rep
LC_{50} (95% confidence interval) (µg/L)	Time to test initiation (min) 15: 0.0395 (0.0342-0.0456) 30: 0.0354 (0.0278-0.0449) 60: 0.0354 (0.0328-0.0381) 120: 0.0375 (0.0293-0.0480) 240: 0.0477 (0.0411-0.0554)	Method: Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -42

Acceptability (Table 3.8): Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Hypothesis tests (3). -52

Toxicity Data Summary

Hexagenia bilineata

Study: **23648.** Forbis A, McAllister W. 1980. Dynamic acute toxicity of 14C-permethrin to mayfly nymphs (*Hexagenia bilineata*) in a flow-through diluter system. Analytical Bio-ChemistryLaboratories Rept. #23648. Doc No. C824.

Location: caitlin1.pdf pg 144-145

Relevance
Score: 75
Rating: L

Reliability
Score: 26.7
Rating: N

Acceptable method (10), Control (15)

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Arthropoda	
Class	Insecta	
Order	Ephemeroptera	
Family	Ephemeridae	
Genus	*Hexagenia*	
Species	*bilineata*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	NR	
Mortality		
Control response	NR	
Effect 2		
Temperature	NR	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	NR	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)		Reps and # per (cell density for single-celled organisms):
Concentration 2 Nom/Meas (µg/L)	.021	
Concentration 3 Nom/Meas (µg/L)	.045	
Concentration 4 Nom/Meas (µg/L)	.097	
Concentration 5 Nom/Meas (µg/L)	.190	
Concentration 6 Nom/Meas (µg/L)	.470	
Control	NR	
LC50	Day 1 470 ng/L 2 330 ng/L 3 160 ng/L 4 100 ng/L	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Organism source (5), Organism age (5), Chemical purity (5), Analytical method (4), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8).

Acceptability (Table 3.8): No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3).

Toxicity Data Summary

Hexagenia rigida

Study: Friesen MK, Galloway TD, Flannagan JF. 1983. Toxicity of the insecticide permethrin in water and sediment to nymphs of the burrowing mayfly *Hexagenia rigida* (Ephemeroptera: Ephemeridae). Can Ent 115:1007-1014.

Relevance	Reliability
Score: 52.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, No toxicity value calculable, Controls not described

Toxicity Data Summary

Helisoma trivolvis

Study: Spehar RL, Tanner DK, Nordling BR. 1983. Toxicity of the synthetic pyrethroids, permethrin and AC 222,705 and their accumulation in early life stages of fathead minnows and snails. Aquatic Toxicology 3:171-182.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, toxicity values not calculable, control response not reported

Toxicity Data Summary

Ictalurus punctatus

Study: Coulon DP. 1982. Toxicity of Ambush and Pydrin to red crawfish, *Procambarus clarkii* (Girard) and channel catfish, *Ictalurus punctatus* Rafinesque in laboratory and field studies and the accumulation and dissipation of associated residues. Ph.D. Thesis, Louisiana State University, Baton Rouge, LA.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Controls not described, response not reported

Toxicity Data Summary

Various insects: *Simulium vitattum, Hydrpsych* & *Chematapsychee* spp*., Stenacron* spp., *Ishnura* & *Enallagma* spp., *Hydrophilus* spp.

Tang J.-X.; Siegfried B. D. Comparative uptake of a pyrethroid and organophosphate insecticide by selected aquatic insects. Bull. Environ. Contam. Toxicol. **1995**, *55*, 130-135.

Relevance	Reliability
Score: 75	Score: 44.9
Rating: L	Rating: N

Relevance Points taken off for: Standard method (10), Controls (15).

Reference	**Tang & Siegfried, 1995**	***Various Insects***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum		
Class		
Order		
Family		
Genus		
Species		
Family in North America?	Yes	
Age/size at start of test/growth phase	Larva-adult	
Source of organisms	NR	"Nebraska"
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 hr	
Data for multiple times?	Yes	3, 6, 12. 24 hr
Effect 1	Immobility	
Control response 1	NR	
Temperature	20°C	
Test type	Static	
Photoperiod/light intensity	In dark	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	

Reference	**Tang & Siegfried, 1995**	***Various Insects***
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Not fed	
Purity of test substance	96%	
Concentrations measured?	No	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	NR	
Concentration Nom/Meas (µg/L)	NR	8 or 4 Reps and "5 or 10" organisms per rep (n=40)
Control	NR	
LC50; µg/L	Black fly 4.5 Caddisfly 5.9 Mayfly 2.9 Damselfly 45* Scavaging Diving Beetle 4.4	NR *Exceeds solubility of permethrin

Reliability points taken off for:
Documentation: Control type (8), Organism source (5), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Exposure type (5), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Statistical methods (5), Hypothesis tests (8).

Acceptability: No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Prior contamination (4), Organisms/rep (2), Organism acclimation (1), Exposure type (2), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature not held (3), Conductivity (1), pH (2), Number of concentrations (3), Random design (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3).

Toxicity Data Summary

Lymnaea acuminata

Study: Singh DK, Agarwal RA. 1986. Piperonyl butoxide synergism with two synthetic pyrethroids against *Lymnaea acuminata.* Chemosphere 15:493-498.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All concentrations tested exceeded 2x the aqueous solubility of permethrin.

Toxicity Data Summary

Lepomis macrochirus, Ictalurus punctatus

Exposure of fish to ^{14}C-FMC-33297: Accumulation, distribution and elimination of ^{14}C residues. EG&G Bionomics, 1976.
Location: "caitlin1.pdf" pg 53-82

Relevance	Reliability
Score: 45	Score:
Rating: N	Rating:

No acceptable method (10), Endpoint (15), Toxicity value (15), Control (15).

Toxicity Data Summary

Lepomis macrochirus

Study: Adams DS. 1980. Phase 3 summary of MRID 00110705. Permethrin (PP557): Determination of the acute toxicity of JFU 5054 a 24% w/w formulation to bluegill sunfish (*Lepomis macrochirus*). Report no. BL/B/1832 Study number: FT/1/77/C. Study performed by ICI Brixham Laboratory Freshwater Quarry: Brixham, Devon, UK. EPA MRID 42277001.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All toxicity values (20.5-26.8 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Lepomis machrochirus

Study: Hill RW, Maddock BG, Hart B, Bowles PF. 1976. Determination of the acute toxicity of PP 557 to bluegill sunfish (*Lepomis machrochirus*). Imperial Chemical Industries Limited, Brixham Laboratory. Report BL/B/1701. CDPR ID: study number 15148.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

Relevance Points taken off for: Standard method (10), Chemical purity NR (15), Controls (15).

Toxicity Data Summary

Lepomis macrochirus

Study: USEPA. 1978. Biological report of analysis. TN 2343.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All reported LC50s (13.3-32 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Lepomis macrochirus

Study: USEPA. 1978b. Biological report of analysis. TN 1127.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All reported LC50s (13.5-19.0 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Loligo pealei

Two different types of inhibitory effect of pyrethroids on Nerves Ca- and Ca+ Mg-ATPase activity in the squid, *Loligo pealei.* J Marshall Clark and F. Matsumura. 1982. Pesticide Biochemistry and Physiology, **18**, 180-190.

Relevance	Reliability
Score: 30	Score:
Rating: N	Rating:

No standard method (10), Endpoint linked to survival (15), Freshwater (15), Toxicity values (15), Control (15)

Toxicity Data Summary

Lampsilis siliquoidea

Study: Bringolf RB, Cope WG, Barnhart MC, Mosher S, Lazaro PR, Shea D. 2007b. Acute and chronic toxicity of pesticide formulations (atrazine, chlorpyrifos, and permethrin) to glochidia and juveniles of *Lampsilis siliquoidea.* Environ Toxicol Chem 26:2101-2107.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*all concentrations tested and EC50 values exceed 2x aqueous solubility

Toxicity Data Summary

Litopenaeus stylirostris

Study: Reyes JGG, Leyva NR, Millan OA, Lazcano GA. 2002. Effects of pesticides on DNA and protein of shrimp larvae *Litopenaeus stylirostris* of the California Gulf. Ecotoxicology and Environmental Safety 53:191-195.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*The reported LC50 of 291.7 ug/L exceeds 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Lepomis macrochirus

Hill RW, Maddock BG, Hart B, Cornish SK. 1977. "Determination of the acute toxicity of formulation JFU 5054 to bluegill sunfish (*Lepomis macrochirus)".* Imperial Chemical Industries Limited, Brixham Laboratory.

Relevance	Reliability
Score: 75	Score: 68.4
Rating: L	Rating: L

Relevance Points taken off for: Standard method (10), Chemical purity (15).

Reference	**Hill et al, 1977**	***L.macrochirus***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Chordata	
Class	Actinopterygii	
Order	Perciformes	
Family	Centrarchidae	
Genus	*Lepomis*	
Species	*macrochirus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Avg weight and length: 1.68 g, 44 mm	
Source of organisms	Sutchland Laboratory Animals Inc, Denver, Pennsylvania	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	NR	
Temperature	23 +/- 0.5°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	Reservoir	

Reference	**Hill et al, 1977**	***L.macrochirus***
Parameter	**Value**	**Comment**
pH	7.40 – 7.55	
Hardness	45-51 mg/L $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	96-100%	
Feeding	Not fed	
Purity of test substance	24%	
Concentrations measured?	Yes	
Measured is what % of nominal?	50-126%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (mg/L)	Measured / Nominal 0.0033 / 0.0019 0.0047 / 0.0031 0.0068 / 0.0056 0.01 / 0.0062 0.015 / 0.0075 0.022 / 0.0131 0.033 / 0.0210 0.047 / 0.0595 Control (0) / 0	10 organisms per rep
LC50; indicate calculation method	Hr LC50 (mg/L) 24 0.021 48 0.015 96 0.0108	Geometric mean survival period **LC50s exceed water solubility of permethrin**

Reliability points taken off for:
Documentation: Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8).

Acceptability: No standard method (5), Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Exposure type (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Statistical method (2), Hypothesis tests (3).

Toxicity Data Summary

Lepomis machrochirus

42584004. Sankey SA, Morris DS, Caunter JE, Stanley RD. 1992. Permethrin: acute toxicity to bluegill sunfish (*Lepomis machrochirus*) of a 10% EC formulation. Brixham Environmental Laboratory, Brixham, UK, Rept No BL4570/B. Doc No. C818.

Relevance	Reliability
Score:	Score:
Rating: N	Rating:

LC50s exceed the water solubility of permethrin (5.5-6 µg/L)

Hr	LC50 (µg/L)
24	110
48	34
72	24
96	24

Toxicity Data Summary

Menippe mercenaria

Study: Borthwick PW, Walsh GE. 1981. Initial toxicological assessment of Ambush ®, Bolero ®, Bux ®, Dursban ®, Fentrifanil ®, Larvin ®, and Pydrin ®: Static acute toxicity tests with selected estuarine algae, invertebrates, and fish. EPA-600/4-81-076. Environmental Research Laboratory, U.S. EPA, Gulf Breeze, FL.

Relevance
Score: 70
Rating: L

Reliability
Score: 52.5
Rating: N

*Saltwater, Controls not mentioned

	Borthwick et al. 1981	***M. mercenaria***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1978	
Phylum		
Class		
Order		
Family		
Genus	*Menippe*	
Species	*mercenaria*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Zoea larvae	
Source of organisms	Hatched from gravid females collected in field	Santa Rosa Sound, Sabine Island
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	20 o/oo salinity
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Borthwick et al. 1981	***M. mercenaria***
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	During test to minimize cannibalism/starvation	Fed 48 h old *Artemia nauplii*
Purity of test substance	93%	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)	NR	Reps and # per: NR
Concentration 2 Nom/Meas (µg/L)	NR	
Concentration 3 Nom/Meas (µg/L)	NR	
Concentration 4 Nom/Meas (µg/L)	NR	
Concentration 5 Nom/Meas (µg/L)	NR	
Concentration 6 Nom/Meas (µg/L)	NR	
Control	NR	
LC_{50} (95% confidence interval) (µg/L)	96 h: 0.018 (0.010-0.032)	Method: either probit, binomial, or moving average

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8).

Acceptability (Table 3.8): Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2Hardness (2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3).

Toxicity Data Summary

Mesocyclops sp.

Study: Manonmani AM, Vasuki V, Balaraman K. 1989. Establishment of a standard test method for determining susceptibility of *Mesocyclops* to different insecticides. Indian J Med Res 89:43-47.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Control response not reported.

Toxicity Data Summary

Notonecta indica L.

Study: Alexander TC, Meisch MV, Kottkamp WB, Anderson AL. 1982. Effect of notonectids on mosquito larvae and preliminary observations of insecticide toxicity. Arkansas Farm Research 31:5.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Controls and response not described.

Toxicity Data Summary

Oreochromis aureus

Study: Herzberg AM. 1988. Toxicity and accumulation of permethrin in the tilapia *Oreochromis aureus.* Israel Journal of Aquaculture 40:35-39.

Relevance	Reliability
Score: 70	Score: 44
Rating: L	Rating: N

*Chemical purity not reported, controls not described, response not reported

	Herzberg 1988	***O. aureus***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Chordata	
Class	Osteichthyes	
Order	Perciformes	
Family	Cichlidae	
Genus	*Oreochromis*	
Species	*aureus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	10.5 g average weight	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	24 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	

	Herzberg 1988	***O. aureus***
Parameter	**Value**	**Comment**
Purity of test substance	NR	
Concentrations measured?	Yes	
Measured is what % of nominal?	8-47%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Meas (µg/L)	Test 1: 4.19 Test 2: 4.20	2 tests, 10/rep
Concentration 2 Meas (µg/L)	Test 1: 7.34 Test 2: 4.83	2 tests, 10/rep
Concentration 3 Meas (µg/L)	Test 1: 9.10 Test 2: 6.57	2 tests, 10/rep
Concentration 4 Meas (µg/L)	Test 1: 11.8 Test 2: 6.95	2 tests, 10/rep
Concentration 5 Meas (µg/L)	Test 1: 10.5 Test 2: 8.31	2 tests, 10/rep
Concentration 6 Meas (µg/L)	Test 2: 10.5	10/rep
Control	NR	
LC50 (95% confidence limits) (µg/L)	Test 1: 6.23 (5.57-6.97) Test 2: 6.54 (5.95-7.00)	Method: trimmed Spearman-Karber

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Chemical purity (5), Nominal concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -43

Acceptability (Table 3.8): Control description (6), Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -69

Toxicity Data Summary

Orconectes immunis

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, toxicity value not calculable, control description

Toxicity Data Summary

Oryzias latipes

Study: Gonzalez-Doncel M, de la Pena E, Barrueco C, Hinton DE. 2003. Stage sensitivity of medaka (*Oryzias latipes*) eggs and embryos to permethrin. Aquatic Toxicology 62:255-268.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All concentrations tested exceeded 2x the aqueous solubility

Toxicity Data Summary

Oryzias latipes

Study: Kikuchi T, Nagashima Y, Chiba M. 1984. Accumulation and excretion of permethrin by the Himedaka *Oryzias latipes* and biological significance of accumulated permethrin. Bulletin of the Japanese Society of Scientific Fisheries 50:101-106.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Tested cis-permethirn and trans-permethirn, not the mixture; all LC50s > 2x aqueous solubility

Toxicity Data Summary

Oreochromis mossambicus

Study: Shafiei TM, Costa HH. 1990. The susceptibility and resistance of fry and fingerlings of *Oreochromis mossambicus* Peters to some pesticides commonly used in Sri Lanka. J Appl Ichthyol 6:73-80.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Control response not reported.

Toxicity Data Summary

Oncorhynchus mykiss (formerly *Salmo gairdneri*)

Study: Coats JR, O'Donnell-Jeffery NL. 1979. Toxicity of four synthetic pyrethroid insecticides to rainbow trout. Bull Environ Contam Toxicol 23:250-255.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 of 135 ug/L > 2x aqueous solubility (5.5 ug/L)

Notes: They measured the aqueous solubility in this study and report it to be 40 ug/L. The LC50 is still more than 2x their reported solubility.

Toxicity Data Summary

Oncorhynchus mykiss

Study: Glickman AH, Hamid AAR, Rickert DE, Lech JJ. 1981. Elimination and metabolism of permethrin isomers in rainbow trout. Toxicol Appl Pharmacol 57:88-98.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 of 18 ug/L exceeds 2x the aqueous solubility (5.5 ug/L)

Toxicity Data Summary

Oncorhynchus mykiss

Study: Glickman AH, Weitman SD, Lech JJ. 1982. Differential toxicity of trans-permethrin in rainbow trout and mice. I. Role of biotransformation. Toxicol Appl Pharmacol 66:153-161.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 of 18 ug/L exceeds 2x aqueous solubility (5.5 ug/L)

Toxicity Data Summary

Oncorhynchus mykiss (formerly *Salmo gairdneri*)

Study: Kumaraguru AK, Beamish FWH. 1981. Lethal toxicity of permethrin (NRDC-143) to rainbow trout, *Salmo gairdneri*, in relation to body weight and water temperature. Water Research 15:503-505.

Relevance
Score: 75
Rating: L

Reliability
Score: 52.5
Rating: N

*Unacceptable standard method, controls not described, response not reported.

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
Test method cited	Similar to Sprague (1969)	
Phylum		
Class		
Order		
Family		
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1) mean 0.89 g (0.8-1.2 g) 2) mean 5.1 g (4.6-5.4 g) 3) mean 19.3 g (18-23 g) 4) mean 48.2 g (47-53 g) 5) mean 202.1 g (196-205)	
Source of organisms	Commercial supplier	Goosen's Trout Farm, Otterville, Ontario
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	Yes on graph	
Effect 1	Mortality	
Control response 1	NR	
Temperature	1) 5, 10, 15, 20 °C 2) 15 °C 3) 15 °C	

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
	4) 15 °C 5) 15 °C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	NR for test, acclimation was in non-chlorinated well water	
pH	NR for test, acclimation was at 7.9-8.2	
Hardness	NR for test, acclimation had 358-363 mg/L (EDTA)	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	86.6%	
Concentrations measured?	Yes	
Measured is what % of nominal?	84-95%	
Toxicity values calculated based on nominal or measured concentrations?	Not clear	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	<0.001% ethanol	
Concentration 1 Nom (µg/L)	1) 5°C: 0.1 10°C: 0.1 15°C: 0.5 20°C: 2 2) 15°C: 0.1 3) 15°C: 200* 4) 15°C: 200* 5) 15°C: 200*	10/rep
Concentration 2 Nom (µg/L)	1) 5°C: NR 10°C: NR 15°C: NR 20°C: NR 2) 15°C: NR 3) 15°C: NR 4) 15°C: NR 5) 15°C: NR	10/rep
Concentration 3 Nom (µg/L)	1) 5°C: NR 10°C: NR 15°C: NR 20°C: NR 2) 15°C: NR 3) 15°C: NR	10/rep

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
	4) 15°C: NR 5) 15°C: NR	
Concentration 4 Nom (µg/L)	1) 5°C: NR 10°C: NR 15°C: NR 20°C: NR 2) 15°C: NR 3) 15°C: NR 4) 15°C: NR 5) 15°C: NR	10/rep
Concentration 5 Nom (µg/L)	1) 5°C: NR 10°C: NR 15°C: NR 20°C: NR 2) 15°C: NR 3) 15°C: NR 4) 15°C: NR 5) 15°C: NR	10/rep
Concentration 6 Nom (µg/L)	1) 5°C: NR 10°C: NR 15°C: NR 20°C: 32 2) 15°C: 20* 3) 15°C: 500* 4) 15°C: 500* 5) 15°C: 500*	10/rep
Concentration 7 Nom (µg/L)	1) 5°C: 2.5 10°C: 2.5 15°C: 8.0	10/rep
Control	Not described	10/rep
LC_{50} (95% confidence interval) (µg/L)	1) 5°C: 96h: 0.62 (0.49-0.97) 10°C: 96h: 0.69 (0.60-1.22) 15°C: 96h: 3.17 (2.79-5.78) 20°C: 96h: 6.43 (4.91-8.07) 2) 15°C: 96h: 6.43 4) 15°C: 96h: 287 (211-391)* 5) 15°C: 96h: 314 (218-454)*	Method: probit

Notes: Additional LC50s are displayed in Figure 1A and 1B, but they would be approximations from the graph so they are not reported here.
*indicates concentration > 2x aqueous solubility of permethrin (5.5 ug/L)

Reliability points taken off for:

Documentation (Table 3.7): Control type (8), Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -41

Acceptability (Table 3.8): No standard method (5), Control description (6), Control response (9), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -54

Toxicity Data Summary

Oncorhynchus mykiss

Study: Marking LL, Bills TD, Crowther JR. 1984. Effects of five diets on sensitivity of rainbow trout to eleven chemicals. Progressive Fish-Culturist 46:1-5.

Relevance
Score: 70
Rating: L

Reliability
Score: 39.5
Rating: N

*Chemical purity not reported, Controls not described, response not reported

	Marking et al. 1984	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	ASTM 1980	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Oncorhynchus*	
Species	*mykiss*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Average weight 1 g	
Source of organisms	Lab cultures	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	

	Marking et al. 1984	***O. mykiss***
Parameter	**Value**	**Comment**
Purity of test substance	NR	
Concentrations measured?	No	
Measured is what % of nominal?	n/a	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	n/a	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (µg/L)	NR	5 tests, 10/rep
Concentration 2 Nom/Meas (µg/L)		
Concentration 3 Nom/Meas (µg/L)		
Concentration 4 Nom/Meas (µg/L)		
Concentration 5 Nom/Meas (µg/L)		
Concentration 6 Nom/Meas (µg/L)		
Control	NR	
LC_{50} (95% confidence interval) (µg/L)	Test 1: 6.00 (5.24-6.36) Test 2: 4.54 (3.73-5.52) Test 3: 6.09 (5.40-6.87) Test 4: 5.15 (4.27-6.21) Test 5: 4.50 (3.84-5.27)	Method: Litchfield & Wilcoxon

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Chemical purity (5), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -51

Acceptability (Table 3.8): Control description (6), Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -70

Toxicity Data Summary

Oncorhynchus mykiss

42584003. Sankey SA, Morris DS, Caunter JE, Stanley RD. 1992. Permethrin: acute toxicity to rainbow trout (*Oncorhynchus mykiss*) of a 10% EC formulation. Brixham Environmental Laboratory, Brixham, UK, Rept No BL4529/B. Doc No. C813.

Relevance	Reliability
Score:	Score:
Rating: N	Rating:

LC50s exceed water solubility of permethrin (5.5-6 µg/L).

Hr	LC50 (µg/L)
24	>130
48	>130
72	77
96	73

Toxicity Data Summary

Oreochromis niloticus
Tilapia zillii

Study: Yameogo L, Traore K, Back C, Hougard J-M, Calamari D. 2001. Risk assessment of etofenprox (Vectron ®) on non-target aquatic fauna compared with other pesticides used as *Simulium* larvicides in a tropical environment. Chemosphere 42:965-974.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity values (27-75 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Oncorhynchus kisutch

Study: EG&G Bionomics. 1976. "Acute toxicity of PP557 technical to Coho Salmon (*Oncorhynchus kisutch)"*.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

LC50s exceed 2x water solubility of permethrin.

Toxicity Data Summary

Oncorhynchus mykiss

Kent SJ, Morris DS, Caunter JE & Johnson PA. (1995). "Permethrin: Acute toxicity to rainbow trout (*Oncorhynchus mykiss*) of a 25% formulation". Brixham Environmental Laboratory.

This study is rated N because the LC50's based on the active ingredient (permethrin) calculated exceed the water solubility of permethrin.

Toxicity Data Summary

Procambarus clarkii

Study: Coulon DP. 1982. Toxicity of Ambush and Pydrin to red crawfish, *Procambarus clarkii* (Girard) and channel catfish, *Ictalurus punctatus* Rafinesque in laboratory and field studies and the accumulation and dissipation of associated residues. Ph.D. Thesis, Louisiana State University, Baton Rouge, LA.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Controls not described, response not reported

Toxicity Data Summary

Procambarus clarkii

Study: Jolly AL, Avault JW, Graves JB, Koonce KL. 1977. Effects of Pounce® on newly hatched and juvenile Louisiana red swamp crayfish, *Procambarus clarkii* (Girard). Freshwater Crayfish 3:389-395.

Relevance	Reliability
Score: Acute: 60, Chronic: 45	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Toxicity value not calculable (chronic only), Controls not described, responses not acceptable/reported

Toxicity Data Summary

Pollimyrus isidori

Study: Yameogo L, Tapsoba J-M, Calamari D. 1991. Laboratory toxicity of potential blackfly larvicides on some African fish species in the onchocerciasis control programme area. Ecotoxicology and Environmental Safety 21:248-256.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity values (26-40 ug/L) exceed 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Ptychocheilus lucius

Study: Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 > 2x aqueous solubility

Toxicity Data Summary

Ptychochelius lucius

Study: Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ Toxicol Chem 20:2869-2876.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 of 24 ug/L exceeds 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Pimephales promelas

Study: Geiger DL, Call DJ, Brooke LT 1988. Acute toxicities of organic chemicals to fathead minnows (*Pimephales promelas*), Volume IV. Center for Lake Superior Environmental Studies, University of Wisconsin-Superior: Superior, WI.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Reported LC50 (16.0 ug/L) exceeds 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Palaemonetes pugio

Study: DeLorenzo ME, Serrano L, Chung KW, Hoguet J, Key PB. 2006. Effects of the insecticide permethrin on three life stages of the grass shrimp, *Palaemonetes pugio.* Ecotoxicol Environ Safety 64:122-127.

Relevance	Reliability
Score: Acute: 52.5, Chronic: 60	Score: n/a
Rating: Acute: N, Chronic: N	Rating: n/a

*No standard method, Saltwater, Chemical purity not reported, Control response not reported (acute only)

Toxicity Data Summary

Palaemonetes pugio

Study: Marshalonis D, Knowlton RE, Merchant H. 2006. Acute toxicity of permethrin to four populations of ovigerous grass shrimp, *Palaemonetes pugio* Holthuis. Bull Environ Contam Toxicol 77:543-550.

Relevance	Reliability
Score: 52.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Chemical purity not reported, Control response not reported.

Toxicity Data Summary

Poecilia reticulata

Study: Baser S, Erkoc F, Selvi M, Kocak O. 2003. Investigation of acute toxicity of permethrin on guppies *Poecilia reticulata.* Chemosphere 51:469-474.

Relevance	Reliability
Score: 100	Score: n/a
Rating: N	Rating: n/a

*LC50 of 245.7 ug/L is > 2x the aqueous solubility (5.5 ug/L)

Toxicity Data Summary

Pimpehales promelas

Hill RW, Maddock BG, Hart B & Gilbert JL. (1976). Determination of the acute toxicity of PP 557 to Fathead Minnows (*Pimpehales promelas*).

Relevance
Score: 75
Rating: L

Reliability
Score: 58.8
Rating: N

Relevance Points taken off for: Standard Method (15), Controls (15).

Reference	**EG&G, 1976**	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Chordata	
Class	Actinopterygii	
Order	Cypriniformes	
Family	Cyprindae	
Genus	*Pimperhales*	
Species	*Promelas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Avg weight: 1.60 g Avg length: 50.44 mm	
Source of organisms	Dutchland Laboratory Animals Inc, Denver Pennsylvania	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hour	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Temperature	23±0.5°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	reservoir	
pH	7.80-7.95	
Hardness	41.0-48.0 mg/L $CaCO_3$	
Alkalinity	NR	

Reference	**EG&G, 1976**	***P. promelas***
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	94% or higher	
Feeding	NR	
Purity of test substance	NR	
Concentrations measured?	Yes	
Measured is what % of nominal?	38-120%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	1 mg/L DMSO	
Concentration 1 Nom/Meas (mg/L)	0.68 / 0.26	1 Reps and 10 organisms per rep
Concentration 2 Nom/Meas (mg/L)	0.33 / 0.17	‘’
Concentration 3 Nom/Meas (mg/L)	0.10 / 0.0572	‘’
Concentration 4 Nom/Meas (mg/L)	0.068 / 0.038, 0.031	‘’
Concentration 5 Nom/Meas (mg/L)	0.033 / 0.0436, 0.0126	‘’
Concentration 6 Nom/Meas (mg/L)	0.010 / 0.0060, 0.0092, 0.0116	‘’
Concentration 7 Nom/Meas (mg/L)	0.0068 / 0.00480, 0.00672, 0.00454, 0.00630	‘’
Concentration 8 Nom/Meas (mg/L)	0.0033 / 0.00780, 0.00256, 0.00284, 0.00320	‘’
Concentration 9 Nom/Meas (mg/L)	0.0015 / 0.00136, 0.00122, 0.00044, 0.00180	‘’
Control	Not described	1 Reps and 10 per
LC50; mg/L	24 hr 0.015* 48 hr 0.0054 96 hr 0.0020	Concentration correlated with Geometric Mean Survival Periods

*Concentration exceeds water solubility of permethrin (0.006 mg/L)

Reliability points taken off for:
Documentation: Control type (8), Chemical purity (5), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8).

Acceptability: No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Feeding (3), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3).

Toxicity Data Summary

Pimpehales promelas

096699. EG&G Bionomics. 1977. Chronic toxicity of FMC 33297 to the fathead minnow (*Pimpephales promelas*). EG&G Bionomics. Doc No. C850.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 55.9
Rating: N

Acceptable Standard method (10), Toxicity Value Calcuable (15), Control Response (7.5)

	Study Name and Year	***G. species***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Chordata	
Class	Actinopterygii	
Order	Cypriniformes	
Family	Cyprindae	
Genus	*Pimperhales*	
Species	*Promelas*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	3 weeks	
Data for multiple times?	Y	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism source (5), Organism age (5), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Minimum significant difference (2), % control of NOEC/LOEC (2), Point estimates (8).

Acceptability (Table 3.8):
No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations Organism size (3), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), Exposure type (2), Dilution water (2), Hardness

(2), Alkalinity (2), Dissolved oxygen (6), Conductivity (1), pH (2), Dilution factor (2), Hypothesis tests (3), Point estimates (3).

Toxicity Data Summary

Pycnopsyche sp.
Ophiogomphus sp.
Simulium venustum

Study: Poirier DG, Surgeoner GA. 1987. Laboratory flow-through bioassays of four forestry insecticides against stream invertebrates. The Canadian Entomologist 119:755-763.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Controls not described, response not reported.

Toxicity Data Summary

Rana catesbiana

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity value (LC50=115 ug/L) exceeds 2x the aqueous solubility of permethrin (5.5 ug/L)

Toxicity Data Summary

Rana sphenocephala

Study: Bridges CM, Dwyer FJ, Hardesty DK, Whites DW. 2002. Comparative contaminant toxicity: Are amphibian larvae more sensitive than fish? Bull Environ Contam Toxicol 69:562-569.

Relevance	Reliability
Score: 85	Score: n/a
Rating: N	Rating: n/a

*LC50 of 18.2 ug/L > 2x aqueous solubility (5.5 ug/L)

Toxicity Data Summary

Rana temporaria

Study: Johansson M, Piha H, Kylin H, Merila J. 2006. Toxicity of six pesticides to common frog (*Rana temporaria*) tadpoles. Environ Toxicol Chem 25:3164-3170.

Relevance	Reliability
Score: 52.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, chemical purity not reported, no toxicity values, control response not reported

Toxicity Data Summary

Skeletonema costatum

Study: Walsh GE, Alexander SV. 1980. A marine algal bioassay method: Results with pesticides and industrial wastes. Water, Air, and Pollution 13:45-55.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Toxicity values exceed 2x aqueous solubility of permethrin

Toxicity Data Summary

Skeletonema costatum

Study: Borthwick PW, Walsh GE. 1981. Initial toxicological assessment of Ambush ®, Bolero ®, Bux ®, Dursban ®, Fentrifanil ®, Larvin ®, and Pydrin ®: Static acute toxicity tests with selected estuarine algae, invertebrates, and fish. EPA-600/4-81-076. Environmental Research Laboratory, U.S. EPA, Gulf Breeze, FL.

Relevance	Reliability
Score: 77.5	Score: n/a
Rating: N	Rating: n/a

*Saltwater, Control response not reported
EC50 values > 2x aqueous solubility

Toxicity Data Summary

Salmo salar

Study: McLeese DW, Metcalfe CD, Zitko V. 1980. Lethality of permethrin, cypermethrin and fenvalerate to salmon, lobster and shrimp. Bull Environ Contam Toxicol 25:950-955.

Relevance
Score: 75
Rating: L

Reliability
Score: 40
Rating: N

*No standard method, Controls not mentioned,

	McLeese et al. 1980	***S. salar***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Salmo*	
Species	*salar*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean length 6.2 cm, mean wt 5.3 g	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	10 °C	
Test type	Static renewal (48 h)	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	McLeese et al. 1980	*S. salar*
Parameter	**Value**	**Comment**
Feeding	NR	
Purity of test substance	92.1%	
Concentrations measured?	Yes	
Measured is what % of nominal?	74%	
Toxicity values calculated based on nominal or measured concentrations?	Not reported, probably measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	% NR, ethanol	
Concentration 1 Nom/Meas (µg/L)	6 concentrations	3/rep
Concentration 2 Nom/Meas (µg/L)	NR	3/rep
Concentration 3 Nom/Meas (µg/L)	NR	3/rep
Concentration 4 Nom/Meas (µg/L)	NR	3/rep
Concentration 5 Nom/Meas (µg/L)	NR	3/rep
Concentration 6 Nom/Meas (µg/L)	NR	3/rep
Control	Not described	3/rep
LC_{50} (µg/L)	12	Method: geometric mean of concentrations bracketing 50% mortality

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Organism source (5), Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -46

Acceptability (Table 3.8): No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3). -74

Toxicity Data Summary

Salmo salar

Study: Zitko V, Carson WG, Metcalfe CD. 1977. Toxicity of pyrethroids to juvenile Atlantic salmon. Bull Environ Contam Toxicol 18:35-41.

Relevance	Reliability
Score: 75	Score: 38
Rating: L	Rating: N

*No standard method, Controls not described, Control response not reported

	Zitko et al. 1977	***S. salar***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Salmo*	
Species	*salar*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles, mean length 10.0 cm, mean wt 11.07 g	
Source of organisms	NR	
Have organisms been exposed to contaminants?	NR	
Animals acclimated and disease-free?	NR	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	10°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	NR	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Zitko et al. 1977	***S. salar***
Parameter	**Value**	**Comment**
Feeding	NR	
Purity of test substance	92.1%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC/MS	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (µg/L)	NR	3/rep
Concentration 2 Nom/Meas (µg/L)		Reps and # per
Concentration 3 Nom/Meas (µg/L)		Reps and # per
Concentration 4 Nom/Meas (µg/L)		Reps and # per
Concentration 5 Nom/Meas (µg/L)		Reps and # per
Concentration 6 Nom/Meas (µg/L)		Reps and # per
Control	NR	Reps and # per
LC_{50} (µg/L)	8.8	Method: NR

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Organism source (5), Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Statistical methods (5), Hypothesis tests (8). -51

Acceptability (Table 3.8): No standard method (5), Control description (6), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Organism acclimation (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3). -73

Toxicity Data Summary

Simulium squamosum

Study: Hougard J-M, Escaffre H, Darriet F, Lochouarn L, Riviere F, Back C. 1992. An episode of resistance to permethrin in larvae of *Simulium squamosum* (Diptera: Simuliidae) from Cameroon, after 3½ years of control. Journal of the American Mosquito Control Association 8:184-186

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Control response not reported.

Toxicity Data Summary

Salmo gairdnerii

ESG-1. Hill RW, Maddock BG, Hart B. 1976. PP557: determination of the acute toxicity of PP557 to rainbow trout (*Salmo gairdneri*). Brixham Environmental Laboratory, Brixham, UK, Report No BL/B/1700. Doc No. C801.

Location: caitlin3.pdf p.29-49

Relevance
Score: 75
Rating: L

Reliability
Score: 55.6
Rating: N

Standard method (10), Controls (15).

Reference	**Hill et al., 1976**	***Salmo gairdnerii***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Chordata	
Class	Actinopterygii	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Salmo*	
Species	*gairdnerii*	
Family in North America?	Yes	
Age/size at start of test/growth phase	0.305 g 26 mm	
Source of organisms	Samaki Trout Farm, Wiltershire	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 hr	
Data for multiple times?	Yes	24, 48, 96 hr
Effect 1	Mortality	
Control response 1	NR	
Temperature	13 +/- 0.5°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	“20,000 gallon reservoir”	

Reference	**Hill et al., 1976**	***Salmo gairdnerii***
Parameter	**Value**	**Comment**
pH	~7.8	
Hardness	24.5-31 mg/L	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	At least 96% saturation	
Feeding	None	
Purity of test substance	NR	
Concentrations measured?	Yes	
Measured is what % of nominal?	42.8-91.1%	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	50 mg/L, 10 mg/L	
Concentration 1 Nom/Meas (µg/L)	0.33 / ND	1 Reps and 10 organisms per rep
Concentration 2 Nom/Meas (µg/L)	0.47 / ND, 0.28, ND	1 Reps and 10 organisms per rep
Concentration 3 Nom/Meas (µg/L)	0.68 / ND, 0.20, ND	1 Reps and 10 organisms per rep
Concentration 4 Nom/Meas (µg/L)	1.0 / 0.58, ND, ND	1 Reps and 10 organisms per rep
Concentration 5 Nom/Meas (µg/L)	2.2 / 0.46/ND	1 Reps and 10 organisms per rep
Concentration 6 Nom/Meas (µg/L)	4.7 / 0.51, 0.64	1 Reps and 10 organisms per rep
Concentration 7 Nom/Meas (µg/L)	10 / 4.8	1 Reps and 10 organisms per rep
Control	NR	
LC50; indicate calculation method	Time 24 hr 0.0125 mg/L 48 hr 0.0054 mg/L 96 hr 0.0025 mg/L	"geometric median survival periods"

Reliability points taken off for:
Documentation: Control type (8), Chemical purity (5), Hardness (2), Conductivity (2), Photoperiod (3), Statistical methods (5), Hypothesis tests (8).

Acceptability: No standard method (5), Appropriate duration (2), Control description (6), Control response (9), Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3), Point estimates (3).

Toxicity Data Summary

Salmo gairdnerii

Hill RW, Maddock BG, Hart B & Bowles, PF. (1977). JFU 5054: Determination of the Acute Toxicity of formulation JFU 5054 to Rainbow Trout (*Salmo gairdnerii*). Brixham Laboratory.

Relevance	Reliability
Score: 60	Score:
Rating: N	Rating:

Relevance Points taken off for: Standard method (10), Chemical purity (15), Controls (15)

Toxicity Data Summary

Tanytarsus dissimilis

Study: Thurston RV, Gilfoil TA, Meyn EL, Zajdel RK, Aoki TI, Veith GD. 1985. Comparative toxicity of ten organic chemical to ten common aquatic species. Water Res 19:1145-1155.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, toxicity value not calculable, control description

Toxicity Data Summary

Ambystoma maculatum
Bufo americanus
Rana clamitans
Rana pipiens
Rana sylvatica

Study: Berrill M, Bertram S, Wilson A, Louis S, Brigham D, Stromberg C. 1993. Lethal and sublethal impacts of pyrethroid insecticides on amphibian embryos and tadpoles. Environ Toxicol Chem 12:525-539.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All test concentrations were > 2x aqueous solubility.

Simulium vitattum, - Blackfly
Hydropsyche spp*., & Cheumatopsyche* spp*.,* - Caddisfly
Heptageniidae spp.- Mayfly
Enellagma spp*., & Ishnura* spp*.,*- Damselfly
Hydrophilus spp*.,* -Water scavenger beetle

Toxicity Data Summary

Siegfried BD. 1993. Comparative toxicity of pyrethroid insecticides to terrestrial and aquatic insects. Environmental Toxicology and Chemistry 12: 1683-1689.

AQUATIC exposures only, TOPICAL exposures not summarized here

Relevance	Reliability
Score: 90 (no std method)	Score: 59.3
Rating: R	Rating: N

Parameter	Value	Comment
Test method cited	No standard method cited	
Phylum/subphylum	Arthropoda	
Class	Insecta	
Order	Diptera, Trichoptera, Ephemeroptera, Odonata, Coleoptera	
Family	various	
Genus	*Simulium, Hydropsyche, Ishnura, Enellagma, Hydrophilus, Cheumatopsyche, Heptageniidae*	Terrestrial insects tested in this study were not included here.
Species	*vitattum*, others unidentified	
Native to	Nebraska, USA	
Age/size at start of test/growth phase	Larva (Black fly & Caddisfly), nymph (Mayfly & Damselfly), adult (beetles)	
Source of organisms	Collected from field, Lancaster County, NE	Various ponds and lakes
Have organisms been exposed to contaminants?	Yes-probably	Collected from environment
Animals acclimated and disease-free?	Acclimated-72 h	Health status not determined
Animals randomized?	NR	

Parameter	Value	Comment
Test vessels randomized?	NR	
Test duration	24 hours	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	< 10 mortality, except black flies 14%, mayflies 16%	
Temperature	20 ºC	
Test type	Acute Static	
Photoperiod/light intensity	24 hr dark	
Dilution water	states only 'distilled'	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None	
Purity of test substance	96%	
Concentrations measured?	NR	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	states diluted in water	
Concentrations	NR, at least three concentrations used	3 reps, 5-10 insects per rep
Control	acetone	
LC50 ug/L	Black fly 4.5 ug/L Caddisfly 5.9 ug/L Mayfly 4.4 ug/L Damselfly 2.9 ug/L Diving beetle 45 ug/L	probit

Reliability points taken off for:
Documentation: Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved Oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8)

Acceptability: Acceptable standard method (5), Measured concentrations within 20% Nom (4), Carrier solvent (4) Organism size (3), Prior contamination (4), Organisms randomized (1), No prior contaminant exposure (4), Organisms randomly assigned to containers (1), Dilution water source (2), Hardness (2), Alkalinity (2), Dissolved Oxygen (4), Temperature not held to ± 1ºC (3), Conductivity (2), pH (3), Adequate number of concentrations (3), Random or block design (2), Appropriate spacing between concentrations (2), Hypothesis tests (3)

Toxicity Data Summary

Various
Procambarus clarkii
Ictalurus punctatus
Micropterus salmoides
Gambusia affinis
Rana catesbeiana

Study: Jolly AL, Avault JW, Koonce KL, Graves JB. 1978. Acute toxicity of permethrin to several aquatic animals. Trans Am Fish Soc 107:825-827.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Controls not described, response not reported