Water Quality Criteria Report for Cypermethrin

Updated Report

Prepared by:
Tessa L. Fojut, Ph.D.
Central Valley Regional Water Quality Control Board

Updated May 2015

Original Report

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

Tessa L. Fojut, Ph.D.,
Rebecca Mulligan,
and
Ronald S. Tjeerdema, Ph.D.

Department of Environmental Toxicology
University of California, Davis

Original September 2011

Disclaimer

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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: 5 Ecotoxicity data, 6 Data reduction, 7 Acute criterion calculation, 8 Chronic criterion calculation, 9.2 Mixtures, 10.1 Sensitive species, 12.1 Assumptions, limitations and uncertainties, 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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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
NEC	No-effect concentration
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 cypermethrin 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 cypermethrin water quality criteria were updated in 2015 to include additional data generated since the original report released in 2011.

2 Basic information

Chemical: Cypermethrin (Figure 1)

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

IUPAC: *RS*-α-cyano-3-phenoxybenzyl (1*RS,3RS;1RS,3SR*)-3-(2,2-dichlorvinyl)-2,2-dimethylcyclopropanecarboxylate

Chemical Formula: $C_{22}H_{19}Cl_2NO_3$

CAS Number: 52315-07-8

CA DPR Chem Code: 2171

USEPA PC Code: 109704

Trade names: Agrothrin, Ambush C, Barricade, CCN 52, Cymbush, Cyperkill, Demon, Flocord, Imperator, Kafil Super, Polytrin, Ripcord, Sherpa, Stocade, Toppel, NRDC 149, PP383, WL 43467, LE 79-600, FMC 30980, OMS 2002, FMC 45806, FMC Code 3765 (Laskowski 2002, Mackay et al. 2006, Tomlin 2003).

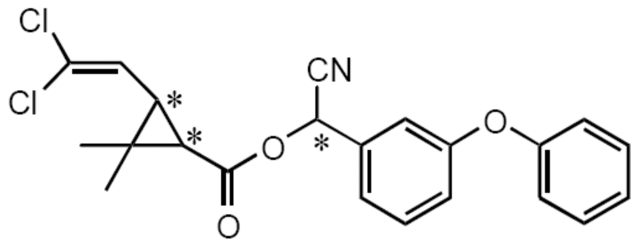

Figure 1 Structure of cypermethrin, a type II pyrethroid, asterisks indicate stereocenters.

3 Physical-chemical data

Molecular Weight
416.3 Laskowski 2002

Density
1.24 g/mL (20°C) Tomlin 2003

Water Solubility
0.004 mg/L at 20°C (mean, n=6) Laskowski 2002
0.004 mg/L at 20°C (pH 7) Tomlin 2003
Geomean: 0.004 mg/L

Melting Point
Semi-solid at room temperature (Tomlin 2003)
70°C (Mackay et al. 2006)
61-83°C (Tomlin 2003)
Geomean of extremes: 71.2°C

Vapor Pressure
2.0E-07 Pa (20°C, Tomlin 2003)
3.10E-09 mm Hg (4.13E-07 Pa, 25°C, Laskowski 2002)
Geomean: 2.87E-07 Pa

Henry's constant (K_H)
3.4 x 10^{-7} atm m^3 mol^{-1} (0.0344478 Pa m^3 mol^{-1}) Laskowski 2002
0.020 Pa m^3 mol^{-1} Tomlin 2003
0.0195 Pa m^3 mol^{-1} Mackay et al. 2006
Geomean: 0.0238 Pa m^3 mol^{-1}

Logistic Octanol-Water Partition Coefficient (Log K_{ow})
6.81 (slow-stir method – preferred) Dix 2014
6.54 Laskowski 2002
6.6 Tomlin 2003
Recommended: 6.81

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.

3,105,712	Chickering 2014
3,484,084	Chickering 2014
2,726,695	Chickering 2014
1,920,000	Yang et al. 2006
1,122,449	Yang et al. 2006
21,857,143	Yang et al. 2006
2,132,353	Yang et al. 2006

Median K_{oc}: 3,133,086 L/kg

Median log K_{oc}: 6.44

Environmental Fate

Table 1 Bioconcentration factors (BCF) for cypermethrin.

Species	**BCF (L/kg)**	**Exposure**	**Reference**
Chironomus tentans	34-238	Static, 24 h, water-sediment system	Muir et al. 1985
Chlorella fusca (alga)	3,280,000	Static, 24 h	Geyer et al. 1984
Lepomis macrochirus	372	Flow-through	Laskowski 2002
Oncorhynchus mykiss	821	Flow-through	Laskowski 2002
Oncorhynchus mykiss	180-438	96 h, Flow-through	Muir et al. 1994
Salmo salar	2.6-7.1	96 h, Static	McLeese et al. 1980

Table 2 Cypermethrin hydrolysis, photolysis, and biodegradation.

	Half- life (d)	**Water**	**Temp (°C)**	**pH**	**Reference**
Hydrolysis	619	Sterile buffer	25	5	Laskowski 2002
	274	Sterile buffer	25	7	Laskowski 2002
	1.90	Sterile buffer	25	9	Laskowski 2002
	1.8	Not reported	25	9	Tomlin 2003
Aqueous Photolysis	30.1	Sterile buffer	Not reported	Not reported	Laskowski 2002
Aqueous Biodegradation (aerobic)	7.44 (mean of 7 values)	Natural water and sediment system	15-25	Not reported	Laskowski 2002

4 Human and wildlife dietary values

There are no FDA action levels for cypermethrin (USFDA 2000). There are no food tolerances for human consumption of fish, but there are food tolerances for other meat products; there are tolerances of 0.05 mg/kg for the meat, fat and meat byproducts of cattle, goat, hog, horse, and sheep in the cypermethrin reregistration eligibility decision (USEPA 2008).

We were not able to acquire any acceptable dietary toxicity values for mallard ducks in order to assess toxicity of cypermethrin to terrestrial organisms with significant food sources in water. The EPA cypermethrin reregistration eligibility decision (USEPA 2008) reports a 5-d dietary LC_{50} of >2645 mg/kg feed and a reproductive NOEC of >50 mg/kg. No effects were reported in these studies at the highest concentrations tested, thus, definitive toxicity values could not be determined. It appears that cypermethrin has extremely low toxicity to birds.

5 Ecotoxicity data

Approximately 108 original studies on the effects of cypermethrin 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 of this report. Cypermethrin 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 8. 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 and 10.3 of this report, 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), 15 acute toxicity studies, yielding 49 toxicity values, were judged reliable and relevant (RR; Table 3 and Table 4). Three chronic toxicity studies, yielding two toxicity values, were judged reliable and relevant (RR; Table 6 and Table 7). Eighteen acute and seven chronic studies were rated RL, LL, or LR and were used as supplemental information for evaluation of the derived criteria in section 12 (Table 5 and Table 8, respectively).

Fifteen mesocosm, microcosm and ecosystem (field and laboratory) studies were identified and reviewed (Table 3.9, TenBrook et al. 2009a). Seven 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**).

6 Data reduction

Multiple toxicity values for cypermethrin 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 or static renewal tests and more appropriate or more sensitive test durations or endpoints 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 18 SMAVs, and the final chronic data set contains one SMCV.

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 do not appear to be bimodal.

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 cypermethrin data set (Table 3). The Burr Type III SSD procedure was used to derive the median 5th percentile and the median 1st percentile. The software could not provide lower 95% confidence limits for the 1st or 5th percentiles. The median 5th percentile is recommended for use in criteria derivation 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 did provided a satisfactory fit (χ^2_{2n} = 0.2144; Appendix A) according to the 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 data set does not appear to be bimodal and the data set was checked for erroneous data as proscribed by the method (section 3-3.2.5, TenBrook et al. 2009a).

Burr III distribution
Fit parameters: b=1.427370; c=3.694636; k=0.128565 (likelihood=4.113437)

5th percentile, 50% confidence limit: 0.002603 μg/L
1st percentile, 50% confidence limit: 0.000088 μg/L

Recommended acute value = 0.002603 μg/L (median 5th percentile)

Acute criterion = acute value ÷ 2
= 0.002603 μg/L ÷ 2
= 0.001302 μg/L

Acute criterion = 0.001 μg/L
= 1 ng/L

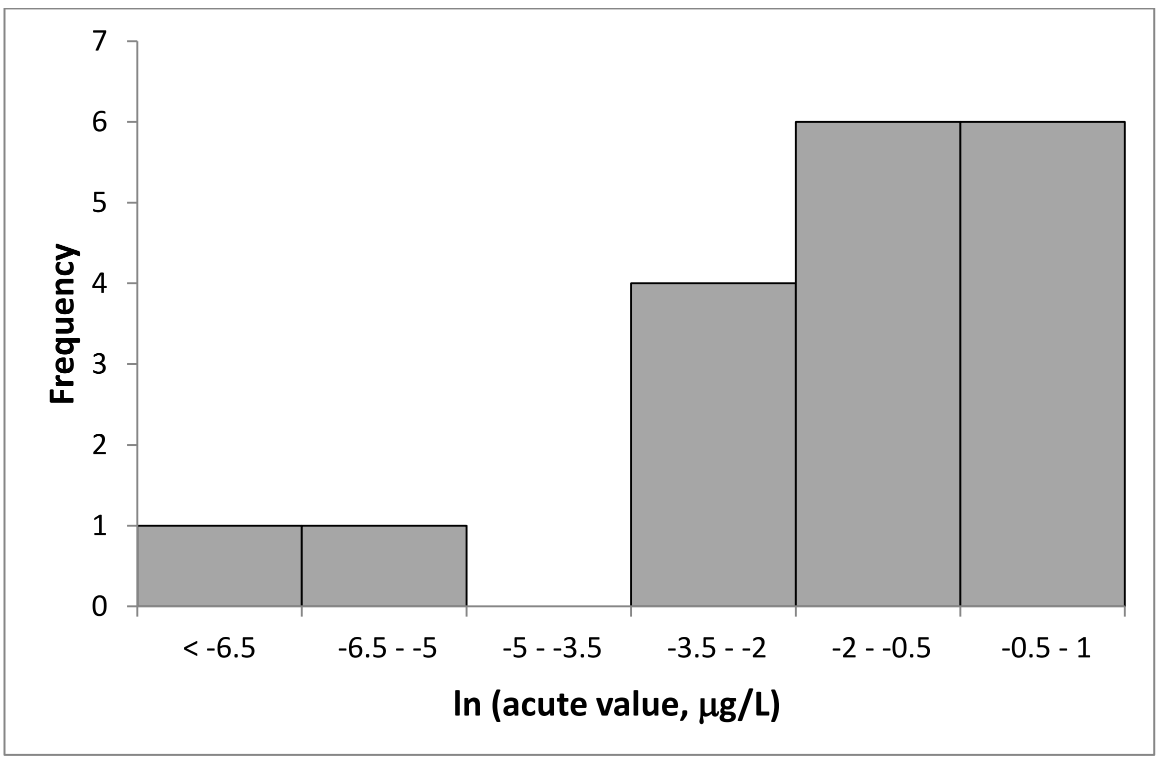

Figure 2 Histogram of the natural log of the cypermethrin species mean acute values.

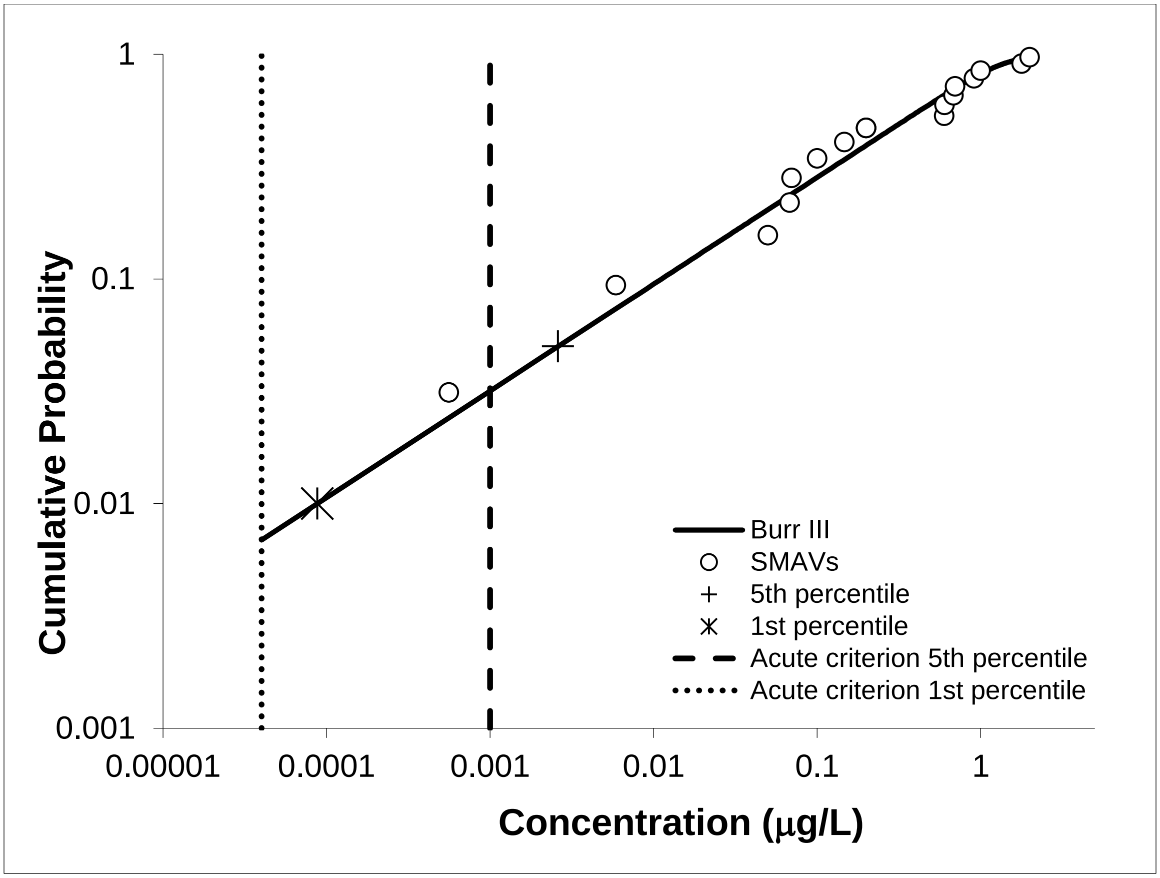

Figure 3 The fit of Burr III distribution to the cypermethrin acute data set.
The median 5th percentile and median 1st percentile acute values are each displayed. The acute water quality criteria calculated with the median 5th percentile and median 1st percentile values are displayed as vertical lines.

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). There is one SMCV in the acceptable (rated RR) data set (Table 6), satisfying one of the five taxa requirements (section 3-3.1, TenBrook et al. 2009a): a warm water fish (*Pimephales promelas)*.

The *Pimephales promelas* chronic data could not be paired with appropriate RR acute data, however there were acceptable saltwater paired acute and chronic toxicity values for *Americamysis bahia* (Jaber and Hawk 1981b). The *Americamysis bahia* data satisfy one of the three requirements for calculating a multi-species ACR (section 3-4.2.1, TenBrook et al. 2009). The *A. bahia* ACR was calculated by dividing the acute LC_{50} value (0.00475 µg/L) by the chronic MATC value (0.00078 µg/L), and resulted in an ACR of 6.1.

The final multi-species ACR was obtained by calculating the geometric mean of the *A. bahia* ACR 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 (6.1, 11.4, and 11.4) is 9.2 (Table 9). The chronic criterion was calculated using the recommended acute value, which was the acute median 5th percentile value, and the final multi-species ACR value as follows:

Chronic criterion = acute median 5th percentile ÷ ACR
= 0.002603 μg/L ÷ 9.2
= 0.0002829 μg/L

Chronic criterion = 0.0003 μg/L
= 0.3 ng/L

The chronic criterion is rounded to one significant figure because it was 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 cypermethrin 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. 2009a, Weston and Lydy 2010). This toxicity is believed to occur primarily from the fraction of the compound that is dissolved in the water, not from the fraction that is associated with the particulate phase.

Several studies suggest that the binding of cypermethrin and other pyrethroids to suspended solids, dissolved organic carbon (DOC), sediment, or plant matter will make the bound fraction unavailable and thus nontoxic to aquatic organisms. Yang et al. (2006b) found that toxicity of cypermethrin to *Ceriodaphnia dubia* decreased with increasing suspended sediment concentration, and that toxicity was well-predicted by a solid-phase microextraction (SPME) method using polydimethylsiloxane fibers. Another study demonstrated that particulates and DOC decreased the uptake and bioconcentration of cypermethrin in rainbow trout (Muir et al. 1994). Uptake of cypermethrin by *Chironomus dilutus* was 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 cypermethrin 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. Lajmanovich et al. (2003) reported reduced mortality of tadpoles (*Physalaemus biligonigerus*) when aquatic ferns were planted in test aquaria compared to aquaria with no ferns present. The authors measured aqueous concentrations of cypermethrin and concentrations decreased more rapidly when ferns were present, presumably due to sorption of cypermethrin to fern surfaces. There are many studies on pyrethroids, not necessarily including cypermethrin, that also demonstrate decreased toxicity of pyrethroids in the presence of sediment, DOC, and other natural sorbents (Day 1991, DeLorenzo et al. 2006, Hunter et al. 2008, 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 cypermethrin 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 aqueous 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 cypermethrin 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 cypermethrin 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 cypermethrin 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 a method detection limit of 2.0 ng/L for cypermethrin. Li et al. (2009) report a method detection limit of 1.0 ng/L for cypermethrin using SPME, so lower detection levels may be possible as analytical techniques progress. Analytical detection limits may create a problem for criteria compliance because it is possible that cypermethrin could be present in toxic amounts, yet be below the detection limit so that an excursion is not identified.

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 the tested pyrethroid (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 cypermethrin concentrations measured in whole water to the associated dissolved cypermethrin concentrations:

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

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 cypermethrin to suspended solids and dissolved organic matter depends on the physical and chemical properties of the suspended solids. 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 cypermethrin 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 cypermethrin, or they may also choose to base compliance on whole water concentrations.

9.2 Mixtures

Cypermethrin 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).

To examine if pyrethroid mixture toxicity is additive, 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.

Studies with pyrethroids not including cyfluthrin have also demonstrated approximately additive toxicity. 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. 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. PBO may remove this effect because the rate of metabolism of both pyrethroids is reduced in the presence of PBO. Barata et al. (2006) investigated the effects of a lambda-cyhalothrin – deltamethrin mixture on mortality and feeding in *Daphnia magna.* Most of the observed effects for survival were within a factor of two of the effects predicted by the concentration addition model. The researchers observed slight antagonism in several of the mixtures and they attributed this to a few unexpected extreme values for joint survival effects.

Piperonyl butoxide (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 pyrethroids (Brander et al. 2009, Hardstone et al. 2007, Kasai et al. 1998, Paul et al. 2006, Singh & Agarwal 1986, Xu et al. 2005). Rodriguez et al. (2005) tested cypermethrin toxicity to mosquitoes (*Aedes aegypti*) with and without PBO and reported an interaction coefficient (K) of 31.8 with a pyrethroid-resistant mosquito strain, but a K of 0.2 with a pyrethroid-susceptible strain, indicating antagonism rather than synergism. Because there is not enough data to calculate a multispecies interaction coefficient for cypermethrin and PBO, there is no accurate way to account for this interaction in compliance determination.

Norgaard & Cedergreen (2010) tested the toxicity of α-cypermethrin in binary combinations with six fungicides with *Daphnia magna* and found that equitoxic mixtures of the fungicides and α-cypermethrin demonstrated synergism with Ks ranging from 1.4-27. They also tested toxicity ratios of 75:25 and 25:75 with each fungicide and α-cypermethrin combination and reported Ks of 0.41-37 for these combinations. Another study also presents evidence that fungicides and cypermethrin, often found in combination in wood preservatives, are highly toxic to aquatic invertebrates and demonstrate synergism (Adam et al. 2009). The thiocarbamate pesticide cartap appears to be antagonistic when combined with cypermethrin as no toxicity was observed in tests with *Daphnia magna* and *Oryzias latipes* when the concentrations of each chemical tested in combination were higher than the reported EC/LC_{50} values for the single chemicals (Kim et al. 2008). Gartenstein et al. (2006) tested cypermethrin in binary combinations with diflubenzuron and diazinon with brine shrimp (*Artemia salina*). Synergism was demonstrated for both binary combinations, but the combination of all three compounds produced an antagonistic effect.

No studies on aquatic organisms were found in the literature that could provide a quantitative means to consider mixtures of cypermethrin with other classes of pesticides. Although there are examples of non-additive toxicity for cypermethrin and other chemicals, a multispecies interaction coefficient is not available for any chemical with cypermethrin, 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 cypermethrin 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. 2009b). 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).

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). No other aqueous toxicity studies were identified that tested cypermethrin, but temperature effects have been demonstrated with several other pyrethroids (Harwood et al. 2009, Kumaraguru and Beamish 1981). 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 cypermethrin) was more than twice as toxic when tested at 18 ˚C compared to 23 ˚C (Weston et al. 2009b). Weston et al. (2009b) 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 cypermethrin and temperature for water quality criteria at this time (section 3-5.3, TenBrook et al. 2009a). While there are no studies about the effects of pH on cypermethrin toxicity, it is likely that there is reduced risk at high pH levels because the hydrolysis half-life of cypermethrin is < 2 days at pH 9 (Table 2). Several studies that examined the effects of DOC and suspended solids on cypermethrin toxicity are discussed in the bioavailability section 9 above. No other studies on cypermethrin 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 (0.001 µg/L) is higher than one SMAV in the RR acute data set, 0.00056 µg/L for *Hyalella azteca* (Table 3). The *Hyalella azteca* SMAV is from a flow-through test based on measured concentrations (Bradley 2013). There is also an acute toxicity value for *Daphnia magna* of 0.0006 µg/L that is below the acute criterion from a study rated RL (Table 5). Because the *Hyalella Azteca* study is rated RR and is from a flow-through test based on measured concentrations, it is recommended that a lower estimate from the species sensitivity distribution is used to derive the criteria in order to be protective of all species represented in the data set. The next lowest estimate is the median 1st percentile of the Burr III distribution. The acute and chronic criteria are calculated with this estimate as follows:

1st percentile, 95% confidence limit: 0.000088 µg/L

Recommended acute value = 0.000088 µg/L (median 1st percentile)

Acute criterion = Recommended acute value ÷ 2
= 0.000088 µg/L ÷ 2
= 0.000044 µg/L

Adjusted acute criterion = 0.00004 µg/L
= 0.04 ng/L

Recommended chronic criterion = Recommended acute value ÷ ACR

$= 0.000088\ \mu g/L \div 9.2$
$= 0.000009565\ \mu g/L$

Adjusted chronic criterion $= 0.000010\ \mu g/L$
$= 0.01$ ng/L

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). Fifteen studies describing effects of cypermethrin on mesocosm, microcosm and model ecosystems were identified and rated for reliability according to the methodology (Table 3.9, TenBrook et al. 2009a). Three of the studies were rated as reliable (R; Farmer et al. 1995, Friberg-Jensen et al. 2003, Wendt-Rasch et al. 2003), and four were rated as less reliable (L; Crossland 1982, Lutnicka et al. 1999, Maund et al. 2009, Medina et al. 2004) and are used as supporting data. Eight studies rated as not reliable (N) and are not discussed in this report (Crossland et al. 1982, Dabrowski et al. 2005, Feng et al. 2009, Helson & Surgeoner 1986, Sherratt et al. 1999, Shires 1983, Stephenson et al. 1984, Walton et al. 1990). All of the studies are listed in Table 10. These studies included freshwater pond and stream micro- and mesocosms, a rice paddy, and marine environments. Two studies reported no-effect concentrations (NECs) for particular taxa groups to which the chronic criterion may be compared.

Several studies did single treatments of cypermethrin in pond mesocosms and measured the recovery of the invertebrate communities. Crossland (1982) sprayed outdoor ponds with a cypermethrin formulation at a much higher concentration (22-24 mg/L measured 1 h post-application) than is typically found in current environmental sampling. Some insects and crustaceans declined or disappeared in the 4 weeks following the treatment, but most species had re-colonized the treated pond by 10 weeks post-treatment. Farmer et al. (1995) sprayed pond mesocosms with one level of cypermethrin, at which *Gammarus* spp. abundance was completely eliminated, with no indication of recovery 3 months later. Unfortunately, measured concentrations were not reported in this study. Maund et al. (2009) performed a study with microcosm enclosures set in a pond that looked at macroinvertebrate recovery after treatment with cypermethrin at a nominal concentration of 0.070 μg/L (0.041-0.058 μg/L measured). In some microcosms, natural reinvasion was simulated by adding invertebrates to the enclosures post-treatment; in these microcosms there was general recovery of invertebrate populations in approximately 100 d. In contrast, the microcosms that received no additional organisms showed only limited recovery after 16 weeks of observation. These results indicate that small, isolated or heavily impacted water bodies will likely recover more slowly than water bodies that are only partially impacted or are near other unimpacted water bodies from which organisms can immigrate.

Friberg-Jensen et al. (2003) calculated cypermethrin NECs for crustaceans, copepods, and cladocerans ranging from 0.02-0.07 µg/L in enclosures set in a lake. These NECs are all significantly higher than the recommended chronic criterion of 0.00001 µg/L. They also reported that rotifers, protozoans, bacteria, periphyton plankton, and periphytic algae all proliferated after treatment with cypermethrin in response to the decreased populations of grazers. A sister paper describing effects for the same experiment reported a NEC of 0.01 µg/L for copepod nauplii (Wendt-Rasch et al. 2003). This paper also reported significant changes to species composition of the aforementioned communities at nominal concentrations greater than 0.13 µg/L.

Medina et al. (2004) reported reduced copepods and cladocerans in marine mesocosms moored in a bay treated with 5 µg/L cypermethrin (nominal). While cladocerans recovered after 2 weeks, copepod populations remained significantly reduced at 2 weeks post-treatment.

All of these studies reported adverse effects on aquatic invertebrates, which have also been demonstrated to be the most sensitive taxon in laboratory toxicity tests compared to fish or mollusks. The tested concentrations in these studies, ranging from 0.01-24,000 µg/L, were much higher than the chronic criterion. The NECs were also much higher than the criterion, indicating the derived criterion will likely be protective of aquatic ecosystems. It should be noted that nominal or whole water measured concentrations were reported in these studies, and that the truly dissolved concentrations were likely much lower, so it is not clear how close the truly dissolved concentrations were to the chronic criterion.

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). One California listed animal species is 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 0.90 µg/L, which is well above the acute criterion.

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 11summarizes the results of the ICE analyses. The estimated acute toxicity values range from 0.980 µg/L for Coho salmon to 1.31 µg/L for all other endangered *Oncorhynchus spp* (Table 11).

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 cypermethrin in food items (section 3-7.1, TenBrook et al. 2009a). Cypermethrin has a log K_{ow} of 6.81 and a molecular weight of 416.3 (section 3), which indicates it has bioaccumulative potential (section 3-7.1, TenBrook et al. 2009a). No biomagnification factors (BMFs) were found in the literature for cypermethrin, but bioconcentration of cypermethrin 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 821 L/kg for *Oncorhynchus mykiss* was used (Table 1) with a default BMF of 10, which was chosen based on the log K_{ow} of cypermethrin (Table 3.15, TenBrook et al. 2009a). 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), but the only dietary toxicity value available for mallard duck was > 50 mg/kg (USEPA 2008). Although this value is not definitive, it will be used in this calculation as an approximation because no other definitive values were available and it has been demonstrated that cypermethrin is very nontoxic to mallards.

$$NOEC_{water} = \frac{NOEC_{oral\_predator}}{BCF_{food\_item} * BMF_{food\_item}}$$

Mallard: $$NOEC_{water} = \frac{50\ {}^{mg}\!/_{kg}}{821\ {}^{L}\!/_{kg} * 10} = 0.00609\ {}^{mg}\!/_{L} = 6.09\ {}^{\mu g}\!/_{L}$$

In this example, the estimated $NOEC_{water}$ for the mallard (6.09 μg/L) is above the aqueous solubility of cypermethrin (4 μg/L). Consequently, food-web transfers would not occur because the cypermethrin concentrations required for such transfers would not occur in the environment.

11.2 Harmonization with air or sediment criteria

This section addresses how the maximum allowable concentration of cypermethrin 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 cypermethrin (CARB 2005, CDWR 1995, USEPA 2006a, USEPA 2006b) to enable this kind of extrapolation. For biota, the limited data on bioconcentration or biomagnification of cypermethrin was addressed in the bioaccumulation section (section 11.1).

12 Cypermethrin 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 cypermethrin criteria.

There was enough highly rated acute cypermethrin data to use a SSD to calculate the acute criterion, but one limitation in the acute criterion calculation was that not all of the data were from flow-through tests that used 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. Seven of the 18 SMAVs are based entirely or in part on flow-through tests and eight SMAVs are based entirely or in part on measured concentrations, so most of the data are from static or static renewal tests that calculated the toxicity values with nominal concentrations. Using nominal concentrations and static tests can overestimate the true exposure of test organisms, thus underestimating the toxicity of cypermethrin.

For cypermethrin, the major limitation was in the chronic toxicity data set. Three of five taxa requirements were not met (salmonid, benthic crustacean and insect), which precluded the use of a SSD; therefore, an ACR was used to derive the chronic criterion. There was one set of paired data available to calculate an empirical ACR for *Americamysis bahia*, so this ACR was used with default ACRs for the other two ACR requirements (as specified in section 3-4.2.2, TenBrook et al. 2009). Particularly of concern for the chronic toxicity data set was the lack of data on *Hyalella azteca* or another benthic organism, which is known to be a sensitive species for pyrethroids. Variability cannot be quantified for the chronic WQC because it was derived using an ACR, not an SSD, so a 95% confidence limit cannot be calculated.

Another concern that could not be accounted for quantitatively for criteria compliance is the increase in toxicity from lower temperatures. Half of the toxicity data were from tests performed at standard temperature (20-25 ˚C), including tests for the most sensitive species in the data set, *Hyalella azteca*. However, many streams in the California Central Valley often have lower water temperatures. If colder water bodies are impacted by concentrations of cypermethrin, it may be appropriate to apply an additional safety factor to the cypermethrin 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 cypermethrin 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 becomes 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 is 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 is available, the criteria should be recalculated to incorporate new research.

12.2 Comparison to national standard method

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 cypermethrin criteria were generated using the USEPA 1985 methodology with the data set generated in this cypermethrin criteria report.

The USEPA acute methods have three additional taxa requirement beyond the five required by the methodology used in this criteria report (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.

One out of three of these additional requirements are met as follows:

1. This requirement is met because there are only three chordates from different families in the data set.

2. This requirement is not met because all data are from organisms in the phylum Arthropoda or Chordata.
3. This requirement is met because there are insects from five different families.

Strictly speaking, the USEPA methodology cannot be used to calculate an acute criterion for cypermethrin. 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 taxa is known to be relatively insensitive to the chemical of interest, and this will be done here.

Using the log-triangular calculation (following the USEPA 1985 guidelines) and the cypermethrin data set from Table 3 containing 18 species 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. Genus mean acute values were calculated where appropriate for the data set prior to calculation.):

Example Acute value (5th percentile value) = 0.000493 μg/L

Example Acute Criterion = acute value ÷ 2
= 0.000493 μg/L ÷ 2 = 0.000247 μg/L
= 0.00025 μg/L
= 0.25 ng/L

According to the USEPA (1985) method, the criterion is rounded to two significant digits. The example acute criterion derived according to the US EPA methodology is a factor of 6.25 higher than the acute criterion derived using the UC-Davis methodology of 0.04 ng/L.

For the chronic criterion, the cypermethrin data set only has data from two species, which is 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 experimental ACRs are available. As there was only one experimental ACR, and no acute value, a chronic criterion cannot be calculated for cypermethrin 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 cypermethrin does not exceed 0.00001 μg/L (0.01 ng/L) more than once every three years on the average and if the one-hour average concentration does not exceed 0.00004 μg/L (0.04 ng/L) more than once every three years on the average. Mixtures of cypermethrin 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 1st percentile of the Burr III SSD (sections 7 and 10.1) and the acute data used in criterion calculation are shown in Table 3. The chronic criterion was derived by use of a combination of measured and default ACRs (sections 8 and 10.1); chronic data rated RR are shown in Table 6. It is recommended that the freely dissolved cypermethrin concentration is measured for criteria compliance because this appears to be the best predictor of the bioavailable fraction (section 9.1).

To date, there are no established criteria for cypermethrin to which the criteria calculated in this report can be compared. 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.

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Data Tables

Table 3 Final acute toxicity data set for cypermethrin.
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
Aedes aegypti	Insect	Culicidae	S	Nom	>85%	24 h	18	Mortality	Larvae	**1** (0.4-4)	Stephenson 1982
Asellus aquaticus	Crustacean	Asellidae	S	Nom	>85%	24 h	15	Mortality	3-8 mm	**0.2** (0.1-0.4)	Stephenson 1982
Baetis rhodani	Insect (mayfly)	Baetidae	FT	Meas	97.6%	96 h	12	Immobility	Early instar larvae	0.0073 (0.0023-0.0300)	Edwards et al. 1980b
Baetis rhodani	Insect (mayfly)	Baetidae	FT	Meas	97.6%	96 h	12	Immobility	Early instar larvae	0.0047 (0.0040-0.0056)	Edwards et al. 1980b
Baetis rhodani										**0.0059**	GEOMEAN
Ceriodaphnia dubia	Daphnid	Daphniidae	SR	Nom	>90%	48 hr	25	Mortality	< 24 h	**0.683** ± 0.072	Wheelock et al. 2004
Chaoborus crystallinus	Insect	Chaoboridae	S	Nom	>85%	24 h	15	Mortality	Larvae	**0.2** (0.03-0.4)	Stephenson 1982
Chironomus dilutus	Insect	Chironomidae	S	Meas	98%	96 h	23.7	Mortality	3rd instar larvae	0.532	Mehler et al. 2011
Chironomus dilutus	Insect	Chironomidae	S	Meas	98%	96 h	23.7	Mortality	3rd instar larvae	0.679	Mehler et al. 2011
Chironomus dilutus										**0.601**	GEOMEAN
Chironomus thummi	Insect	Chironomidae	S	Nom	>85%	24 h	15	Immobility	Larvae	**0.2 (0.1-0.3)**	Stephenson 1982
Cloeon dipterum	Mayfly (Insect)	Baetidae	S	Nom	>85%	24 h	15	Mortality	Larvae	**0.6 (0.3-1)**	Stephenson 1982
Corixa punctata	Insect	Corixidae	S	Nom	>85%	24 h	15	Immobility	Adults	**0.7 (0.4-2)**	Stephenson 1982

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Species	**Common Identifier**	**Family**	**Test type**	**Meas / Nom**	**Chemical grade**	**Duration**	**Temp (°C)**	**Endpoint**	**Age/ size**	**LC/EC$_{50}$ (µg/L) (95% CI)**	**Reference**
Daphnia magna	Daphnid	Daphniidae	SR	Meas	92.3%	48 hr	20	Mortality	<24 h old	0.134 (0.114-0.157)	Ward & Boeri 1991
Daphnia magna	Daphnid	Daphniidae	FT	Nom	95.7%	48 hr	20	Mortality	<24 h old	0.1615 (0.1344-0.1917)	Wheat & Evans 1994
Daphnia magna										**0.147**	GEOMEAN
Gammarus pulex	Amphipod (Crustacea)	Gammaridae	S	Nom	>85%	24 hr	15	Mortality	3-8 mm	**0.1** (0.08-0.2)	Stephenson 1982
Gyrinus natator	Coleoptera (Insect)	Gyrinidae	S	Nom	>85%	24 hr	15	Immobility	Adults	**0.07** (0.04-0.2)	Stephenson 1982
Hyalella azteca	Amphipod	Hyalellidae	FT	Meas	95.2%	96 h	23	Mortality	7 d	**0.00056**	Bradley 2013
Lepomis macrochirus	Bluegill sunfish	Centrachidae	FT	Meas	91.5%	96 h	22	Mortality	1.46 g, 41.95 mm	**1.78** (1.63-1.95)	Hill 1980a
Oncorhynchus mykiss	Rainbow Trout	Salmonidae	FT	Meas	91.5%	96 hr	12	Mortality	83-d old juvenile	0.90 (0.72-1.35)	Vaishnav & Yurk 1990
Oncorhynchus mykiss	Rainbow Trout	Salmonidae	FT	Meas	91.5%	96 hr	12	Mortality	Mean wt 1.94 g, Mean length 54.5 mm	0.92 (0.83-1.85)	Hill 1980b
Oncorhynchus mykiss										**0.91**	GEOMEAN
Orconectes sp.	Crayfish	Cambaridae	FT	Meas	91.69%	96 h	20	Mortality	Immature, 42 mm, 2.32 g	**0.068** (0.053-0.090)	Jaber & Hawk 1981a

Table 3 Final acute toxicity data set for cypermethrin.
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**
Oreochromis niloticus	Tilapia	Cichlidae	FT	Meas	98.4%	96 hr	25	Mortality	0.6-3.0 g	**2**	Stephenson et al. 1984
Piona carnea	Arachnid	Pionidae	S	Nom	>85%	24 h	15	Mortality	Adults	**0.05** (0.03-0.08)	Stephenson 1982

Table 4 Excluded acute data rated RR.
S: static; SR: static renewal; FT: flow-through.

Species	Common Identifier	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC$_{50}$ (µg/L) (95% CI)	Reference	Reason
Aedes aegypti	Insect	S	Nom	>85%	24 h	18	Immobility	Larvae	0.03	Stephenson 1982	C
Asellus aquaticus	Crustacean	S	Nom	>85%	24 h	15	Immobility	3-8 mm	0.02	Stephenson 1982	C
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	24 h	12	Immobility	Early instar larvae	0.0109	Edwards et al. 1980b	A
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	24 h	12	Immobility	Early instar larvae	0.0083 (0.0071-0.0098)	Edwards et al. 1980b	A
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	48 h	12	Immobility	Early instar larvae	0.0095 (0.0082-0.0110)	Edwards et al. 1980b	A
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	48 h	12	Immobility	Early instar larvae	0.0090 (0.0075-0.0109)	Edwards et al. 1980b	A
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	72 h	12	Immobility	Early instar larvae	0.0080 (0.0064-0.0103)	Edwards et al. 1980b	A
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	72 h	12	Mortality	Early instar larvae	0.0267 (0.0183-0.0562)	Edwards et al. 1980b	C
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	72 h	12	Mortality	Early instar larvae	0.0188 (0.0138-0.0322)	Edwards et al. 1980b	C
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	96 h	12	Mortality	Early instar larvae	0.0171 (0.0124-0.0281)	Edwards et al. 1980b	C
Baetis rhodani	Insect (mayfly)	FT	Meas	97.6%	96 h	12	Mortality	Early instar larvae	0.0090 (0.0068-0.0127)	Edwards et al. 1980b	C
Chaoborus crystallinus	Insect	S	Nom	>85%	24 h	15	Immobility	Larvae	0.03	Stephenson 1982	C
Cloeon dipterum	Mayfly (Insect)	S	Nom	>85%	24 h	15	Immobility	Larvae	0.07 (0.04-0.2)	Stephenson 1982	C
Daphnia magna	Daphnid	S	Nom	>85%	24 h	18	Mortality	< 24 h	2 (1-5)	Stephenson 1982	B
Daphnia magna	Daphnid	S	Nom	>85%	24 h	18	Immobility	< 24 h	2 (1-3)	Stephenson 1982	B,C

Table 4 Excluded acute data rated RR.
S: static; SR: static renewal; FT: flow-through.

Species	Common Identifier	Test type	Meas/ Nom	Chemical grade	Duration	Temp (°C)	Endpoint	Age/size	LC/EC_{50} (µg/L) (95% CI)	Reference	Reason
Daphnia magna	Daphnid	S	Nom	Tech.	48 h	21	Immobility	< 24 h	3.73	Demetrio et al. 2014	B
Gammarus pulex	Amphipod (Crustacea)	S	Nom	>85%	24 hr	15	Immobility	3-8 mm	0.04 (0.02-0.06)	Stephenson 1982	C
Hyalella azteca	Amphipod (Crustacea)	SR	Meas	> 98%	96 h	23	Mortality	7-14 d	0.0021 (0.0017-0.0025)	Weston & Jackson 2009	B
Hyalella azteca	Amphipod	SR	Meas	>98%	96 h	23	Mortality	7-14 d	0.0023 (0.0013-0.0035)	Weston & Jackson 2009	B
Hyalella azteca	Amphipod	SR	Meas	>98%	96 h	23	Mortality	7-14 d	0.0031 (0.0020-0.0044)	Weston & Jackson 2009	B
Hyalella azteca	Amphipod	SR	Nom	97.0%	96 h	23	Mortality	Adults	0.0036 (0.002-0.0049)	Hamer 1997	B
Oncorhynchus mykiss	Rainbow Trout	FT	Meas	91.50%	24 hr	12	Mortality	83-d old juveniles	1.74 (1.35-2.24)	Vaishnav & Yurk 1990	A
Oncorhynchus mykiss	Rainbow Trout	FT	Meas	91.50%	48 hr	12	Mortality	83-d old juveniles	1.03 (0.719-1.35)	Vaishnav & Yurk 1990	A
Oncorhynchus mykiss	Rainbow Trout	FT	Meas	91.50%	72 hr	12	Mortality	83-d old juveniles	0.95 (0.719-1.35)	Vaishnav & Yurk 1990	A
Oreochromis niloticus	Tilapia	FT	Meas	98.40%	24 hr	25	Mortality	0.6-3.0 g	4	Stephenson et al. 1984	A
Oreochromis niloticus	Tilapia	FT	Meas	98.40%	48 hr	25	Mortality	0.6-3.0 g	3	Stephenson et al. 1984	A
Piona carnea	Arachnid	S	Nom	>85%	24 hr	15	Immobility	Adults	0.02	Stephenson 1982	C

Exclusion Reasons

A. Not the most sensitive or appropriate duration

B. FT test preferred over S or SR

C. Not the most sensitive or appropriate endpoint

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidence 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
Acartia tonsa	Crustacean	SR	Meas	99.5%	5 d	20	Mortality	Adults	0.1081 (0.00704-0.1461)	Barata et al. 2002	LL (1,2,6)
Acartia tonsa	Crustacean	SR	Meas	99.5%	48 hr	20	Mortality	Eggs	0.1288 (0.0637-0.1972)	Barata et al. 2002	LL (1,2,6)
Acartia tonsa	Crustacean	SR	Meas	99.5%	96 hr	20	Mortality	Nauplii (< 2d old)	0.005	Medina et al. 2002	LL (1,2,6)
Acartia tonsa	Crustacean	SR	Meas	99.5%	96 hr	20	Mortality	Adults	0.142	Medina et al. 2002	LL (1,2,6)
Acartia tonsa	Crustacean	S	Meas	99.5%	24 hr	20	Mortality	Adults	0.75	Medina et al. 2004	LR (2)
Aedes aegypti	Mosquito	S	Nom	94.2%	24 hr	20	Mortality	3rd instar larvae	0.16 (0.13-0.18)	Cutkomp & Subramanyam 1986	RL (1,6)
Aedes aegypti	Mosquito	S	Nom	94.2%	24 hr	30	Mortality	3rd instar larvae	0.34 (0.29-0.39)	Cutkomp & Subramanyam 1986	RL (1,6)
Americamysis bahia	Mysid Shrimp	FT	Meas	95.9%	48 hr	22	Mortality	<24 hr	0.007 (0.006-0.010)	Ward et al. 1992	LR (2)
Americamysis bahia	Mysid Shrimp	FT	Meas	95.9%	72 hr	22	Mortality	<24 hr	0.006 (0.006-0.007)	Ward et al. 1992	LR (2)
Americamysis bahia	Mysid Shrimp	FT	Meas	95.9%	96 hr	22	Mortality	<24 hr	0.005 (0.005-0.006)	Ward et al. 1992	LR (2)
Americamysis bahia	Mysid Shrimp	FT	Meas	92.3%	48 hr	22	Mortality	<24 hr	0.0058 (0.0039-0.0079)	Ward & Boeri 1991	LR (2)
Americamysis bahia	Mysid Shrimp	FT	Meas	92.3%	72 hr	22	Mortality	<24 hr	0.0051 (0.0048-0.0057)	Ward & Boeri 1991	LR (2)
Americamysis bahia	Mysid Shrimp	FT	Meas	92.3%	96 hr	22	Mortality	<24 hr	0.0049 (0.0049-0.0054)	Ward & Boeri 1991	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% confidence 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
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.027 (0.024-0.031)	Cripe 1994	LR (2)
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.0128 (0.0117-0.0141)	Cripe et al. 1989	L,R (2)
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.0128 (0.0105-0.0158)	Cripe et al. 1989	LR (2)
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.0205 (0.0166-0.0252)	Cripe et al. 1989	LR (2)
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.0182 (0.0142-0.0232)	Cripe et al. 1989	LR (2)
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.0204 (0.0186-0.0225)	Cripe et al. 1989	LR (2)
Americamysis bahia	Mysid Shrimp	S	Nom	Technical	96 hr	25	Mortality	Juveniles, < 24 h old	0.0184 (0.0156-0.0216)	Cripe et al. 1989	LR (2)
Cyprinus carpio	Carp	SR	Nom	20.0%	1 hr	24	Mortality	Hatched Larvae	7.816 (2.829-33.652)	Aydin et al. 2005	LR (1,7)
Cyprinus carpio	Carp	SR	Nom	20.0%	24 hr	24	Mortality	Hatched Larvae	6.196 (2.481-22.897)	Aydin et al. 2005	LR (1,7)
Cyprinus carpio	Carp	SR	Nom	20.0%	48 hr	24	Mortality	Hatched Larvae	2.940 (1.327-8.125)	Aydin et al. 2005	LR (1,7)
Cyprinus carpio	Carp	SR	Nom	20.0%	72 hr	24	Mortality	Hatched Larvae	1.304 (0.612-3.389)	Aydin et al. 2005	LR (1,7)
Cyprinus carpio	Carp	SR	Nom	20.0%	96 hr	24	Mortality	Hatched Larvae	0.809 (0.530-1.308)	Aydin et al. 2005	LR (1,7)
Cyprinus carpio	Carp	FT	Meas	>85%	96 hr	10	Mortality	8-10 g	0.9 (0.6-1.7)	Stephenson 1982	LL (1,5,6)
Cyprinus carpio	Carp	FT	Meas	>85%	96 hr	20-25	Mortality	8-10 g	1.1 (0.6-2.8)	Stephenson 1982	LL (1,5,6)

Table 5 Supplemental acute data rated RL, LR, LL.
S: static; SR: static renewal; FT: flow-through. NR: not reported; 95% CI: 95% confidence 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
Cyprinodon variegatus	Sheepshead Minnow	FT	Meas	91.5%	96 hr	21	Mortality	87-107 d old juveniles	3.42 (1.87-4.07) OR 3.88 (2.41-4.61)	Chandler 1990	LR (1,2)
Daphnia magna	Daphnid	SR	Nom	99.0%	48 hr	21	Immobility	< 24 h neonates	0.10 (0.035-0.28)	Kim et al. 2008	RL (5,6)
Daphnia magna	Daphnid	SR	Nom	99.0%	72 hr	21	Immobility	< 24 h neonates	0.002 (0.0011-0.005)	Kim et al. 2008	RL (5,6)
Daphnia magna	Daphnid	SR	Nom	99.0%	96 hr	21	Immobility	< 24 h neonates	0.0006 (0.0003-0.0011)	Kim et al. 2008	RL (5,6)
Enellagma & Ishnura	Damselflies	S	Nom	99.4%	24 hr	20	Mortality	larvae	1.4 (0.92-2.0)	Siegfried 1993	RL (1,6)
Gammarus pulex	Arthropod	S	Meas	97.0%	24 hr	15	Mortality	Adults, > 6m	0.12 (0.116-0.135)	Adam et al. 2009	LL (1,5,6)
Gammarus pulex	Arthropod	S	Meas	97.0%	48 hr	15	Mortality	Adults, > 6m	0.11 (0.098-0.116)	Adam et al. 2009	LL (1,5,6)
Gammarus pulex	Arthropod	S	Meas	97.0%	72 hr	15	Mortality	Adults, > 6m	0.092 (0.084-0.103)	Adam et al. 2009	LL (1,5,6)
Gammarus pulex	Arthropod	S	Meas	97.0%	96 hr	15	Mortality	Adults, > 6m	0.09 (0.082-0.101)	Adam et al. 2009	LL (1,5,6)
Heptageniidae	Mayfly	S	Nom	99.4%	24 hr	20	Mortality	larvae	1.3 (0.78-2.1)	Siegfried 1993	RL (1,6)
Hyalella azteca	Amphipod	SR	Meas	>98%	96 hr	23	Impaired swimming	7-14 d	0.0016 (0.0014-0.0019)	Weston & Jackson 2009	LR (8)
Hyalella azteca	Amphipod	SR	Meas	>98%	96 hr	23	Impaired swimming	7-14 d	0.0017 (0.0014-0.0019)	Weston & Jackson 2009	LR (8)
Hyalella azteca	Amphipod	SR	Meas	>98%	96 hr	23	Impaired swimming	7-14 d	0.0018 (0.0009-0.0026)	Weston & Jackson 2009	LR (8)
Hydrophilus spp.	Diving beetle	S	Nom	99.4%	24 hr	20	Mortality	larvae	8.3 (5.9-11)	Siegfried 1993	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% confidence 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
Hydropsyche & Chematopsyche	Caddisflies	S	Nom	99.4%	24 hr	20	Mortality	larvae	1.4 (0.81-2)	Siegfried 1993	RL (1,6)
Labeo rohita	Carp	S	Nom	98.0%	96 hr	27	Mortality	NR	5.24	Philip et al. 1995	LL (1,5,6)
Oncorhynchus mykiss	Rainbow Trout	FT	Meas	>98%	96 hr	12-15	Mortality	Juveniles (1.1-2.5 g, 45-60 mm or 10-30 g, 100-150 mm)	1.47 (1.20-1.75)	Davies et al. 1994	LR (1,5)
Oncorhynchus mykiss	Rainbow Trout	FT	Meas	>85%	96 hr	10	Mortality	1-2 g	0.5	Stephenson 1982	LL (1,5,6)
Oncorhynchus mykiss	Rainbow Trout	FT	Meas	>85%	96 hr	15	Mortality	1-2 g	0.5	Stephenson 1982	LL (1,5,6)
Oreochromis niloticus	Tilapia	FT	Meas	>85%	96 hr	25	Mortality	1-3 g	2.2	Stephenson 1982	LL (1,5,6)
Palaemonetes argentinus	Arthropod	S	Nom	25.0%	24 hr	25	Mortality	Juveniles, average wt. 0.01 $\pm$ 0.006 g	0.0031	Collins & Cappello 2006	LL (1,5,6)
Palaemonetes argentinus	Arthropod	S	Nom	25.0%	48 hr	25	Mortality	Juveniles, average wt. 0.01 $\pm$ 0.006 g	0.00275	Collins & Cappello 2006	LL (1,5,6)
Palaemonetes argentinus	Arthropod	S	Nom	25.0%	72 hr	25	Mortality	Juveniles, average wt. 0.01 $\pm$ 0.006 g	0.0025	Collins & Cappello 2006	LL (1,5,6)
Palaemonetes argentinus	Arthropod	S	Nom	25.0%	96 hr	25	Mortality	Juveniles, average wt. 0.01 $\pm$ 0.006 g	0.002	Collins & Cappello 2006	LL (1,5,6)
Paratya australiensis	Arthropod	FT	Meas	>98%	12 hr	12-15	Mortality	0.05-0.15 g	0.09 (0.06-0.12)	Davies et al. 1994	LL (1,5,6)
Penaeus duorarum	Pink Shrimp	S	Nom	Technical	96 hr	25	Mortality	3-5 day old post larvae	0.11 (0.089-0.13)	Cripe 1994	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% confidence 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
Pseudaphritus urvillii	Fish	FT	Meas	>98%	96 hr	12-15	Mortality	Juveniles (6-30 g, 95-160 mm)	2.19 (1.80-2.65)	Davies et al. 1994	LL (1,5,6)
Salmo trutta	Brown trout	FT	Meas	>85%	96 hr	15	Mortality	5-8 g	1.2	Stephenson 1982	LL (1,5,6)
Scardinius erythrophthalmus	Common rudd	FT	Meas	>85%	96 hr	15	Mortality	8-10 g	0.4	Stephenson 1982	LL (1,5,6)
Trichodactylus borellianus	Freshwater crab	S	Nom	25.0%	24 hr	25	Mortality	Adults & Juveniles	0.0119 (0.0071-0.0234)	Veronica & Collins 2003	LL (3,6,7)
Trichodactylus borellianus	Freshwater crab	S	Nom	25.0%	48 hr	25	Mortality	Adults & Juveniles	0.0119 (0.0071-0.0234)	Veronica & Collins 2003	LL (3,6,7)
Trichodactylus borellianus	Freshwater crab	S	Nom	25.0%	72 hr	25	Mortality	Adults & Juveniles	0.0104 (0.0054-0.0249)	Veronica & Collins 2003	LL (3,6,7)
Trichodactylus borellianus	Freshwater crab	S	Nom	25.0%	96 hr	25	Mortality	Adults & Juveniles	0.0097 (0.0049-0.0231)	Veronica & Collins 2003	LL (3,6,7)

Exclusion Reasons

1. Not a standard method
2. Saltwater
3. Family not found in N. America
4. Unacceptable control response/response not reported
5. Control response not described
6. Low reliability score
7. Low chemical purity/purity not reported
8. Endpoint not linked to survival/growth/reproduction

Table 6 Final chronic toxicity data set for cypermethrin.
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
Daphnia magna	Daphnid	FT	Meas	93.5%	21 d	17	Growth (length)	1st instar (0-24 h old)	9.3	17.2	0.0126	Edwards et al. 1981
Daphnia magna	Daphnid	FT	Meas	93.5%	21 d	17	Growth (length)	1st instar (0-24 h old)	6.0	13.6	0.0090	Edwards et al. 1981
Daphnia magna											**0.0107**	
Pimephales promelas	Fathead minnow	FT	Meas	93.1%	60 d	25	Mortality	<48 hr	0.077	0.15	**0.11**	Tapp et al. 1988

Table 7 Acceptable reduced chronic 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	NOEC (µg/L)	LOEC (µg/L)	MATC (µg/L)	Reference	Reason for exclusion
Pimephales promelas	Fathead minnow	FT	Meas	93.1%	30 d	25	Mortality	<48 hr	0.077	0.15	0.11	Tapp et al. 1988	A

Reasons for Exclusion

A. Later time point available

Table 8 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
Acartia tonsa	SR	Meas	99.5%	32 d	20°C	Clutch size	<24 h	0.0893	0.2593	0.1522	Barata et al. 2002	LL (1,2,6)
Acartia tonsa	S	Meas	99.5%	1 hr exp. 144 hr obs.	20°C	Male survival	Adults	0.7	2.2	1.24	Medina et al. 2004	LR (2)
Americamysis bahia	FT	Meas	98.0%	28 d	26.1	Mortality	< 24 h	0.000781	0.001976	0.00124	Wheat 1993	LR (2)
Americamysis bahia	FT	Meas	98.0%	28 d	26.1	Growth	< 24 h	0.000781	0.001976	0.00124	Wheat 1993	LR (2)
Ceriodaphnia dubia	SR	Meas	95.8%	10 d	24	Population growth rate	< 12 h	--	--	EC_{50}=0.40	Barata et al. 2012	LR (1, 5)
Cyprinus carpio	SR	Nom	20.0%	96 hr	24	Larval mortality	eggs	< 0.0001	0.0001	--	Aydin et al. 2005	LR (1,3)
Daphnia magna	SR	Nom	99%	21 d	21	young/ female	< 24 h, neonates	0.0000002	0.000002	0.00000063	Kim et al. 2008	RL (6)
Daphnia magna	SR	Nom	99%	21 d	21	brood/ female	< 24 h, neonates	0.00002	0.0002	6.32E-05	Kim et al. 2008	RL (6)
Daphnia magna	SR	Nom	99%	21 d	21	brood/ female	7 d juveniles	0.02	0.2	0.0632	Kim et al. 2008	RL (6)
Daphnia magna	SR	Nom	99%	21 d	21	young/ female	7 d juveniles	0.00002	0.0002	6.32E-05	Kim et al. 2008	RL (6)
Lymnaea acuminata	S	Nom	NR	96 hr	23 ± 0.8°C	Number of eggs	Adults	<4.0	4	NC	Tripathi & Singh 2004	LL (1,3,6)
Lymnaea acuminata	S	Nom	NR	96 hr	23 ± 0.8°C	Number of eggs hatched	Adults	<4.0	4	NC	Tripathi & Singh 2004	LL (1,3,6)
Lymnaea acuminata	S	Nom	NR	14 d	23 ± 0.8°C	Survival of Hatchlings	Adults	<4.0	4	NC	Tripathi & Singh 2004	LL (1,3,6)

Table 8 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
Lymnaea acuminata	S	Nom	NR	21 d	23 ± 0.8°C	Survival of Hatchlings	Adults	<4.0	4	NC	Tripathi & Singh 2004	LL (1,3,6)
Lymnaea acuminata	S	Nom	NR	28 d	23 ± 0.8°C	Survival of Hatchlings	Adults	<4.0	4	NC	Tripathi & Singh 2004	LL (1,3,6)
Oncorhynchus mykiss	FT	Meas	>98%	10 d	12-15 °C	Hepatic GST activity	Juv (1.1-2.5 g, 45-60 mm or 10-30 g, 100-150 mm)	0.49	0.87	0.65	Davies et al. 1994	LR (1,4,5)

Exclusion Reasons
1. Not a standard method
2. Saltwater
3. Low chemical purity or purity not reported
4. Endpoint not linked to growth, reproduction or survival
5. Control response not reported/not acceptable
6. Low reliability score
7. Inappropriate test duration (Section 3-2.1.1)

Table 9 Acute-to-Chronic Ratios used for derivation of the cypermethrin chronic criterion.

Species	Common identifier	Test type	Meas/ Nom	Chemical grade	MATC (ug/L)	LC_{50} (ug/L)	SMACR (LC_{50}/MATC)	Chronic Reference	Acute Reference
Americamysis bahia	Mysid shrimp	FT	Meas	>97%	0.00078	0.00475	6.1	Jaber & Hawk 1981b	Jaber & Hawk 1981b
Default							11.4[a]		
Default							11.4[a]		
Multi-species ACR = geomean (individual ACRs)							**9.2**		

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

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

Reference	Habitat	Rating
Crossland 1982	Outdoor ponds	L
Crossland et al. 1982	Outdoor ponds and streams	N
Dabrowski et al. 2005	Indoor stream microcosm	N
Farmer et al. 1995	Outdoor pond mesocosms	R
Feng et al. 2009	Submerged in Tongan Bay, China	N
Friberg-Jensen et al. 2003	Outdoor pond enclosures	R
Helson & Surgeoner 1986	Outdoor simulated pools and natural pools	N
Lutnicka et al. 1999	Artificial river systems	L
Maund et al. 2009	Pond microcosms	L
Medina et al. 2004	Marine mesocosms	L
Sherratt et al. 1999	Outdoor mesocosms	N
Shires 1983	Outdoor pond enclosures	N
Stephenson et al. 1984	Rice paddies	N
Walton et al. 1990	Outdoor ponds	N
Wendt-Rasch et al. 2003	Outdoor pond enclosures	R

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)*	0.90	Chinook salmon *(O. tshawytscha)*	1.31
		Coho salmon (*O. kisutch)*	0.980
		Paiute cutthroat trout (*O. clarki seleniris)*	1.31
		Greenback cutthroat trout (*O. c. stomias*)	1.31
		Gila trout (*O. gilae*)	1.31
		Chum salmon (*O. keta*)	1.31
		Sockeye salmon (*O. nerka*)	1.31

Appendix A: Fit test calculations

SMAVs	Omit one 1	2	3	4	5	6	7	8	9	10	11	12	13
0.00056		0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056
0.00590	0.0059		0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059	0.0059
0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.068	0.068	0.068	0.068		0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
0.070	0.070	0.070	0.070	0.070		0.070	0.070	0.070	0.070	0.070	0.070	0.070	0.070
0.100	0.100	0.100	0.100	0.100	0.100		0.100	0.100	0.100	0.100	0.100	0.100	0.100
0.147	0.147	0.147	0.147	0.147	0.147	0.147		0.147	0.147	0.147	0.147	0.147	0.147
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2
0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6		0.6	0.6
0.601	0.601	0.601	0.601	0.601	0.601	0.601	0.601	0.601	0.601	0.601	0.601		0.601
0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683	0.683	
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
1	1	1	1	1	1	1	1	1	1	1	1	1	1
1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78
2	2	2	2	2	2	2	2	2	2	2	2	2	2

SMAVs	14	15	16	17	18
0.00056	0.00056	0.00056	0.00056	0.00056	0.00056
0.00590	0.0059	0.0059	0.0059	0.0059	0.0059
0.05	0.05	0.05	0.05	0.05	0.05
0.068	0.068	0.068	0.068	0.068	0.068
0.070	0.070	0.070	0.070	0.070	0.070
0.100	0.100	0.100	0.100	0.100	0.100
0.147	0.147	0.147	0.147	0.147	0.147
0.2	0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2	0.2
0.6	0.6	0.6	0.6	0.6	0.6
0.601	0.601	0.601	0.601	0.601	0.601
0.683	0.683	0.683	0.683	0.683	0.683
0.7		0.7	0.7	0.7	0.7
0.91	0.91		0.91	0.91	0.91
1	1	1		1	1
1.78	1.78	1.78	1.78		1.78
2	2	2	2	2	

Omitted point, xi:	0.00056	0.0059	0.05	0.068	0.070	0.100	0.147	0.2	0.2	0.2	0.6	0.601	0.683
median 5th percentile	0.0092	0.005064	0.003	0.002786	0.002766	0.0025	0.0023	0.0021	0.0021	0.0021	0.0017	0.0017	0.0018
percentile	99.11	94.57	80.61	77.18	76.83	72.19	66.35	61	61	61	35.23	35.17	30.54
F-i(xi)	0.9911	0.9457	0.8061	0.7718	0.7683	0.7219	0.6635	0.61	0.61	0.61	0.3523	0.3517	0.3054
1-F(xi)	0.0089	0.0543	0.1939	0.2282	0.2317	0.2781	0.3365	0.39	0.39	0.39	0.6477	0.6483	0.6946
Min of F-i(xi) or 1-F(xi)	0.0089	0.0543	0.1939	0.2282	0.2317	0.2781	0.3365	0.39	0.39	0.39	0.3523	0.3517	0.3054
p_i =2(min)	0.0178	0.1086	0.3878	0.4564	0.4634	0.5562	0.673	0.78	0.78	0.78	0.7046	0.7034	0.6108

Omitted point, xi:	0.683	0.7	0.91	1	1.78	2
median 5th percentile	0.0018	0.0019	0.0023	0.002400	0.002700	0.0026
percentile	30.54	29.57	18.88	15.60	2.42	1.08
F-i(xi)	0.3054	0.2957	0.1888	0.156	0.0242	0.0108
1-F(xi)	0.6946	0.7043	0.8112	0.844	0.9758	0.9892
Min of F-i(xi) or 1-F(xi)	0.3054	0.2957	0.1888	0.156	0.0242	0.0108
p_i =2(min)	0.6108	0.5914	0.3776	0.312	0.0484	0.0216

Fisher test statistic

p_i	$\ln(p_i)$	-2*Sum of ln (pi)	X^2_{2n}
0.0178	-4.0286	42.3993	0.21441853
0.1086	-2.2201		
0.3878	-0.9473		
0.4564	-0.7844		
0.4634	-0.7692		
0.5562	-0.5866		
0.6730	-0.3960		
0.7800	-0.2485		
0.7800	-0.2485		
0.78	-0.2485		
0.7046	-0.3501		
0.7034	-0.3518		
0.6108	-0.4930		
0.5914	-0.5253		
0.3776	-0.9739		
0.312	-1.1648		
0.0484	-3.0283		
0.0216	-3.8351		

0.2144 > 0.05 so the distribution does not have a significant lack of fit for the cypermethrin 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

Acartia tonsa

Study: Barata C, Medina M, Telfer T, Baird DJ. 2002. Determining demographic effects of cypermethrin in the marine copepod *Acartia tonsa*: Stage-specific short tests versus life-table tests. Arch Environ Contam Toxicol 43:373-378.

Relevance
Score: 75 (survival), 60 (feeding rate)
Rating: L (survival), N (feeding rate)

Reliability
Score: 64
Rating: L

*No standard method, saltwater, endpoint not linked to survival/reproduction/growth (feeding rate only)

	Barata et al. 2002	***A. tonsa***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Maxillopoda	
Order	Calanoida	
Family	Janiroidea	
Genus	*Acartia*	
Species	*tonsa*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Acute test: 20 d-old adult fertile female, eggs, 8-d old copepodids Chronic test: newborn nauplii (< 24 h)	
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	Acute adults: 5 d Acute eggs: 2 d Copepodid feeding: 2 d Chronic: 32 d	
Data for multiple times?	No	
Effect 1	Survival (acute test w/ adults, eggs)	
Control response 1	Adults ~90%, eggs ~78% (estimated from Figure 1A)	
Effect 2	Feeding by 8 d-old	

	Barata et al. 2002	*A. tonsa*
Parameter	**Value**	**Comment**
	copepodids (change in algal cell density)	
Control response 2	~2150 cell/animal/hr (estimated from Figure 1B)	
Effect 3	Egg production (acute)	
Control response 3	~25/female/d (estimated from Figure 1C)	
Temperature	NR for tests, culture condition was 20 °C	
Test type	Static renewal, 48 h renewal	
Photoperiod/light intensity	NR, culture condition was 16 L:8 D	
Dilution water	NR, culture medium was filtered natural seawater (30 psu)	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	fed every other day	
Purity of test substance	99.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	HPLC	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (ng/L)	Acute: Feeding: 4.2 Chronic: 0.4	Acute: 4 reps; 5 females, 1 male/rep or 100 eggs/rep or 20/rep (feeding) Chronic: 4 reps, 50/rep
Concentration 2 Meas (ng/L)	Acute: 29 Feeding: 7.4 Chronic: 0.7	Same as above
Concentration 3 Meas (ng/L)	Acute: 89.3 Feeding: 22.2 Chronic: 1.1	Same as above
Concentration 4 Meas (ng/L)	Acute: 259.3 Feeding: ~60 (estimated Fig	Same as above

	Barata et al. 2002	*A. tonsa*
Parameter	**Value**	**Comment**
	1B) Chronic: 2.2	
Concentration 5 Meas (ng/L)	Feeding: ~140 (estimated Fig 1B) Chronic: 4.1	Same as above
Concentration 6 Meas (ng/L)	Chronic: 7.4	Same as above
Control	Dilution water	Same as above
LC_{50} (95% confidence interval) (ng/L)	Eggs: 128.8 (63.7-197.2) Adults: 108.1 (70.4-146.1)	Method: nonlinear allosteric decay regression model
EC_{50} (95% confidence interval) (ng/L)	Feeding rate (8-d olds): 64.6 (40.6-89.1) Clutch size: 167.6 (120.4-217.2)	Method: same as above
NOEC (ng/L)	2 d egg survival: 29.3 5 d adult survival: 29.3 Feeding rate: 7.4 Clutch size: 89.3 (all values assumed as next lowest concentrations tested based on reported LOEC)	Method: 1way ANOVA, 1side Dunnett's multiple comparison test p: NR MSD: NR
LOEC (ng/L)	2 d egg survival: 89.3 5 d adult survival: 89.3 Feeding rate: 22.2 Clutch size: 259.3	Same as above
MATC (GeoMean NOEC,LOEC) (ng/L)	2 d egg survival: 51.2 5 d adult survival: 51.2 Feeding rate: 12.8 Clutch size: 152.2	
% of control at NOEC	2 d egg survival: 113% 5 d adult survival: 100% Feeding rate: 84% Clutch size: 88%	
% of control at LOEC	2 d egg survival: 71% 5 d adult survival: 56% Feeding rate: 83% Clutch size: 24%	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Significance level (2), Minimum significant difference (2). -30

Acceptability (Table 3.8): No 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), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Minimum significant difference (1). -42

Toxicity Data Summary

Acartia tonsa

Study: Medina M, Barata C, Telfer T, Baird DJ. 2002. Age- and sex-related variation in sensitivity to the pyrethroid cypermethrin in the marine copepod *Acartia tonsa* Dana. Arch Environ Contam Toxicol 42:17-22.

<u>Relevance</u>
Score: 75
Rating: L

<u>Reliability</u>
Score: 69
Rating: L

*No standard method, saltwater

	Medina et al. 2002	***A. tonsa***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Maxillopoda	
Order	Calanoida	
Family	Janiroidea	
Genus	*Acartia*	
Species	*tonsa*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Nauplii (< 2d old) or adults (mature)	
Source of organisms	Lab colony	
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?	Only on Figures (values could be estimated from graph)	
Effect 1	Mortality	
Control response 1	Nauplii: 12% Adults: 6%	
Temperature	20 °C	
Test type	Static renewal (48 h renewal)	
Photoperiod/light intensity	16 L:8 D	
Dilution water	Filtered seawater	30 psu
pH	NR	
Hardness	NR	
Alkalinity	NR	

	Medina et al. 2002	*A. tonsa*
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Food present during exposures (phytoplankton)	
Purity of test substance	99.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	HPLC	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (µg/L)	5 concentrations Nauplii: 0.004-0.1 ug/L Adults: 0.07-1.5 ug/L	3-4 reps Naup: 20/rep Adults: 15/rep
Concentration 2 Nom/Meas (µg/L)	NR	Same as above
Concentration 3 Nom/Meas (µg/L)	NR	Same as above
Concentration 4 Nom/Meas (µg/L)	NR	Same as above
Concentration 5 Nom/Meas (µg/L)	NR	Same as above
Control	Dilution water	Same as above
LC_{50} (µg/L)	96 h nauplii: 0.005 96 h adults: 0.142	Method: probit

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), Hypothesis tests (8). -27

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Feeding (3), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Random design (2), Dilution factor (2), Hypothesis tests (3). -35

Toxicity Data Summary

Acartia tonsa

Study: Medina M, Barata C, Telfer T, Baird DJ. 2004. Assessing the risks to zooplankton grazers of continuous versus pulsed cypermethrin exposures from marine cage aquaculture. Arch Environ Contam Toxicol 47:67-73.

Relevance
Score: 85
Rating: L

Reliability
Score: 77
Rating: R

*Saltwater

	Medina et al. 2004	***A. tonsa***
Parameter	**Value**	**Comment**
Test method cited	APHA 1989	
Phylum	Arthropoda	
Class	Maxillopoda	
Order	Calanoida	
Family	Janiroidea	
Genus	*Acartia*	
Species	*tonsa*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults	
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	24 h 1 h	
Data for multiple times?	Yes	
Effect 1	Survival	
Control response 1	24 h: 100% Males 144 h after 1 h pulse: 80%	
Temperature	20 °C	
Test type	Static	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	Filtered seawater	30 psu
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Medina et al. 2004	*A. tonsa*
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	Food (phytoplankton) present in dilution water	
Purity of test substance	99.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	87 ± 5.2%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	HPLC	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	0.5/0.2 0.5/0.2	3-4 reps, 40/rep
Concentration 2 Nom/Meas (μg/L)	0.4 0.7	3-4 reps, 40/rep
Concentration 3 Nom/Meas (μg/L)	0.5 5/2.2	3-4 reps, 40/rep
Concentration 4 Nom/Meas (μg/L)	0.9	3-4 reps, 40/rep
Concentration 5 Nom/Meas (μg/L)	3/1.3	3-4 reps, 40/rep
Control	Dilution water	3-4 reps, 40/rep
LC_{50} (μg/L)	24 h: 0.75*	Method: probit
NOEC (μg/L)	Survival 144 h after 24 h pulse: < 0.2 Male survival 144 h after 1 h pulse: 0.7	Method: 1 or 2 way ANOVA p: 0.05 MSD: NR
LOEC (μg/L)	Survival 144 h after 24 h pulse: 0.2 Male survival 144 h after 1 h pulse: 2.2	Same as above
MATC (GeoMean NOEC,LOEC) (μg/L)	Male survival 144 h after 1 h pulse: 1.24	
% of control at NOEC	100%	
% of control at LOEC	80%	

Notes:*estimated from Figure 3. Other LC50's are given in Figure 3 for mortality observed post-exposure

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), Minimum significant difference (2). -21

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Random design (2), Dilution factor (2), Minimum significant difference (1). -25

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	Reliability
Score: 90	Score: 62.5
Rating: R	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	3^{rd} 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	
Dissolved Oxygen	NR	
Feeding	None during test	

	Cutkomp & Subramanyam 1986	*A. aegypti*
Parameter	**Value**	**Comment**
Purity of test substance	94.2%	
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)	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: 0.16 (0.13-0.18) 30 °C: 0.34 (0.29-0.39)	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: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 76
Rating: R

*No standard method

	Stephenson 1982	***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	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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	18 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 $\pm$ 20 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Stephenson 1982	*A. aegypti*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (µg/L)	24 h: 1 (0.4-4)	Method: Probit
EC_{50} (µg/L)	2 h: 0.05 (0.01-0.09) 24 h: 0.03	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Asellus aquaticus (>90%)
Asellus meridianus (<10%)

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephanson1982	***A. aquaticus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Isopoda	
Family	Aselloidea	
Genus	*Asellus*	
Species	*auaticus, meridianus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3-8 mm	
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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	

	Stephanson1982	*A. aquaticus*
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (µg/L)	24 h: 0.2 (0.1-0.4)	Method: Probit
EC_{50} (µg/L)	2 h: 0.03 24 h: 0.02	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior Contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Americamysis bahia

Study: Jaber MJ, Hawk RE. 1981b. The acute and chronic toxicity of cypermethrin to mysid shrimp (*Mysidopsis bahia*). ICI Americas Inc. Agricultural Chemicals Division. Report series TMUE0005B. EPA MRID: 00089044 or 240259822.

Relevance
Score: 85*
Rating: L

Reliability
Score: Acute 79.5, chronic 79.5
Rating: R

*Saltwater (15)

	Jaber & Hawk 1981b	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	EG&G Bionomics protocol	Follows ASTM & EPA protocols
Phylum		
Class		
Order		
Family		
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Acute: 6-8 d old, 4-6 mm length Chronic: 24-48 h old, 1-2 mm length	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	Acute: 96 h Chronic 28 d	
Data for multiple times?	Acute: 24, 48, 72 h	
Effect 1	Acute: mortality	
Control response 1	0%	
Effect 2	Chronic: Mortality	
Control response 2	0%	
Effect 3	Chronic: Number of offspring per female	
Control response 3	Dilution water: 3.2 Solvent: 3.4	
Temperature	Acute: 25 ± 2°C	

	Jaber & Hawk 1981b	*A. bahia*
Parameter	**Value**	**Comment**
	Chronic: 25 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	Not reported	
Dilution water	Filtered seawater	
pH	Acute: 7.9-8.0 Chronic: 7.7-8.1	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Salinity Acute: 26 ± 1 o/oo Chronic: 28 ± 3 o/oo	
Dissolved Oxygen	Acute: ≥ 86% saturation Chronic: ≥ 76% saturation	
Feeding	Not reported	
Purity of test substance	>97%	
Concentrations measured?	Yes	
Measured is what % of nominal?	Acute: 40-56% Chronic: 53-73%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, LSC	
Concentration of carrier (if any) in test solutions	Not reported	
Concentration 1 Nom/Meas (ng/L)	Acute: 3; 1.7 Chronic: 0.60; 0.44	2 tests, 2 reps, 5/rep Chronic:
Concentration 2 Nom/Meas (ng/L)	Acute: 6; 2.5 Chronic: 1.2; 0.64	2 tests, 2 reps, 5/rep
Concentration 3 Nom/Meas (ng/L)	Acute: 12; 6.7 Chronic: 2.5; 1.5	2 tests, 2 reps, 5/rep
Concentration 4 Nom/Meas (ng/L)	Acute: 25; 10 Chronic: 5.0; 2.8	2 tests, 2 reps, 5/rep
Concentration 5 Nom/Meas (ng/L)	Acute: 50; 24 Chronic: 10; 5.6	2 tests, 2 reps, 5/rep
Control	Solvent & dilution water	2 tests, 2 reps, 5/rep
LC50 (95% confidence limit) (ng/L)	24 h: 44.7 48 h: 16.5 (8.44-42.5) 72 h: 9.27 (5.09-18.1) 96 h: 4.75 (4.01-5.67)	Method: probit, moving average or bionomical probability
NOEC (ng/L)	Survival: 0.5 Number of offspring/female: 2.5	Method: ANOVA & William's method p: 0.05 MSD: not reported

	Jaber & Hawk 1981b	*A. bahia*
Parameter	**Value**	**Comment**
LOEC (ng/L)	Survival:1.2 Number of offspring/female: 5.0	Same as above
MATC (GeoMean NOEC,LOEC) (ng/L)	Survival: 0.78 Number of offspring/female: 3.5	
% of control at NOEC	Survival: 95%/100%=95% Number of offspring/female: 3.1/3.4=91%	
% of control at LOEC	Survival: 50%/100%=50% Number of offspring/female: 2.5/3.4=74%	

Notes: Other chronic effects were reported but toxicity values were not calculated, nor results summarized in a way that they could be calculated.

Reliability points taken off for:
<u>Documentation (Table 3.7):</u>

<u>Acceptability (Table 3.8):</u>

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: 76.5
Rating: R

*Saltwater

	Cripe 1994	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	ASTM	
Phylum	Arthropoda	
Class	Crustacea (Malacostraca)	
Order	Mysida	
Family	Mysidae	
Genus	*Americamysis*	
Species	*bahia*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles, $\leq$ 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	
Purity of test substance	Technical grade	
Concentrations measured?	No	

	Cripe 1994	***A. bahia***
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	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)	0.027 (0.024-0.031)	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), Hypothesis tests (3). -23

Toxicity Data Summary

Americamysis bahia

Study: Cripe GM, Ingley-Guezou A, Goodman LR, Forester J. 1989. Effect of food availability on the acute toxicity of four chemicals to *Mysidopsis bahia* (Mysidacea) in static exposures. Environ Toxicol Chem 8:333-338.

Relevance
Score: 85
Rating: L

Reliability
Score: 77.5
Rating: R

*Saltwater

	Cripe et al. 1989	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1985	
Phylum	Arthropoda	
Class	Crustacea (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?	No	
Effect 1	Survival	
Control response 1	>90%	
Temperature	25 ± 1°C	
Test type	Static	
Photoperiod/light intensity	14 L:10 D	
Dilution water	Seawater, 20 o/oo salinity	
pH	7.4-8.0	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	4.8 ppm (range 2.9-6.4 ppm)	
Feeding	Yes, *Artemia* of varying nutritional contents	

	Cripe et al. 1989	*A. bahia*
Parameter	**Value**	**Comment**
Purity of test substance	94.5%	
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 (ng/L)	6.0	2 reps, 10/rep
Concentration 2 Nom/Meas (ng/L)	9.9	2 reps, 10/rep
Concentration 3 Nom/Meas (ng/L)	13.6	2 reps, 10/rep
Concentration 4 Nom/Meas (ng/L)	27.6	2 reps, 10/rep
Concentration 5 Nom/Meas (ng/L)	46.0	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95% confidence interval) (ng/L)	Low feed rate (10 *Artemia*/mysid/d) Test 1: 12.8 (11.7-14.1) Test 2: 12.8 (10.4-15.8) Mid feed rate (60 *Artemia*/mysid/d) Test 1: 20.5 (16.6-25.2) Test 2: 18.2 (14.2-23.2) High feed rate (110 *Artemia*/mysid/d) Test 1: 20.4 (18.6-22.5) Test 2: 18.4 (15.6-21.6)	Method: trimmed Spearman-Karber

Notes:

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

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Carrier solvent (4), Feeding (3), Exposure type (2), Hardness (2), Alkalinity (2), Conductivity (1), Hypothesis tests (3). -21

Toxicity Data Summary

Americamysis bahia

Study: Ward TJ, Boeri RL. 1991. Acute Toxicity of FMC 56701 Technical and Cypermethrin Technical to the Mysid, *Mysidopsis bahia.* FMC A90-3309. EnviroSystems Division: Hampton, NH. CDPR ID: 118793.

Relevance
Score: 85
Rating: L

Reliability
Score: 83.5
Rating: R

*Saltwater (15)

	Ward & Boeri 1991	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	Lab protocol based in EPA (1985, 1988)	
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 hrs	
Source of organisms	Lab Culture	EnviroSystems
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 hrs	
Data for multiple times?	0, 48,72 & 96 hours	
Effect 1	Mortality	
Control response 1 (based on measured concentrations)	0% over 96 hrs control and solvent	
Effect 2	Lethargic and/or displaying erratic swimming	
Control response 2 (based on measured concentrations)	0% over 96 hrs control and solvent	
Temperature	22± 1 °C	
Test type	Flow through	
Photoperiod/light intensity	16 Light: 8 dark	
Dilution water	Filtered sea water (11-17 parts per thousand salinity)	Hampton, New Hampshire

	Ward & Boeri 1991	*A. bahia*
Parameter	**Value**	**Comment**
	chemical analysis performed.	
pH	7.8-8.0	with salinity of 17 pp thousand
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	> 7.7 mg/L	
Feeding	2x per day during the test	
Purity of test substance	92.3%	
Concentrations measured?	Yes	
Measured is what % of nominal?	Between 40-264%	6 samples analyzed per loading (Analytical).
Toxicity values calculated based on nominal or measured concentrations?	Nominal and mean measured	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (ng/L)	Nom: 1.4 Meas: 3.7	2 reps, 10 organisms per rep
Concentration 2 Nom/Meas (ng/L)	Nom: 2.6 Meas: 3.4	2 reps, 10 organisms per rep
Concentration 3 Nom/Meas (ng/L)	Nom: 5.0 Meas: 3.9	2 reps, 10 organisms per rep
Concentration 4 Nom/Meas (ng/L)	Nom: 10 Meas: 5.4	2 reps, 10 organisms per rep
Concentration 5 Nom/Meas (ng/L)	Nom: 20 Meas: 7.9	2 reps, 10 organisms per rep
Control	Nom: 0.0 (dilution water & solvent) Meas (control): 2.6 Meas (solvent): 3.1	2 reps, 10 organisms per rep
LC_{50} 48 hr (ng/L)	Nom: 11.3 (10.0 to 20.0) Meas: 5.8 (3.9 to 7.9)	Method: Binomial/ non-linear interpolation
LC_{50} 72 hr (ng/L)	Nom: 8.6 (7.0 to 11.0) Meas: 5.1 (4.8 to 5.7)	Method: Moving average, Probit
LC_{50} 96 hr (ng/L)	Nom: 7.0 (5.5-9.1) Meas: 4.9 (4.9-5.4)	Method: Probit

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% nominal (4), carrier solvent ≤ 0.5mL/L acute (4), feeding (3), hardness (2), alkalinity (2), conductivity (1), Hypothesis tests (3). -19

Toxicity Data Summary

Americamysis bahia

Study: Ward TJ, Boeri RL, Palmieri MA. 1992. Acute toxicity of FMC 56701 technical and cypermethrin technical to mysid, *Mysidopsis bahia*. FMC study number A91-3454. EnviroSystems Division: Hampton, NH. EPA MRID: 42444601.

Relevance	Reliability
Score: 85	Score: 82.5
Rating: L	Rating: R

*Not Freshwater (15)

	Ward et al. 1992	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	Envirosystems Protocol based on EPA (1985, 1988)	
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	Juvenile < 24 hours old	
Source of organisms	Lab Culture (Envirosystems)	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 hours	
Data for multiple times?	24, 48, 72 & 96 hours	
Effect 1	Survival	
Control response 1	100% (both dilution water and solvent control)	
Effect 2	Sub-lethal effects (loss of equilibrium, erratic swimming, loss of reflex, excitability, discoloration or change in behavior)	
Control response 2	0% (no effects observed for dilution water or solvent control).	
Temperature	22 ± 1C	
Test type	Flow through	

	Ward et al. 1992	*A. bahia*
Parameter	**Value**	**Comment**
Photoperiod/light intensity	16: 8 light:dark	
Dilution water	Filtered natural seawater 11-17 ppt	Collected at Hampton, New Hampshire
pH	8.0	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	≥ 7.7 mg/L (≥ 78% saturation)	
Feeding	Once per day during testing	
Purity of test substance	95.9%	
Concentrations measured?	Yes	
Measured is what % of nominal?	40-83%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	NR	
Concentration 1 Nom/Meas (ng/L)	3.75/ 3.1	2 reps, 10/rep
Concentration 2 Nom/Meas (ng/L)	6.25/ 3.9	2 reps, 10/rep
Concentration 3 Nom/Meas (ng/L)	10/ 4.5	2 reps, 10/rep
Concentration 4 Nom/Meas (ng/L)	15/ 6.0	2 reps, 10/rep
Concentration 5 Nom/Meas (ng/L)	25/ 10.3	2 reps, 10/rep
Controls	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95 % confidence interval) (ng/L)	24 h: >10 48 h: 7 (6-10) 72 h: 6 (6-7) 96 h: 5 (5-6)	Method: Binomial/nonlinear interpolation or probit
NOEC	3.9 ng/L	

Notes:
Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis Test (6).
-12

Acceptability (Table 3.8): Measured concentrations within 20% nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms fed during acute test (3), Hardness (2), Alkalinity (2), Conductivity (1), Hypothesis test (3). -23

Toxicity Data Summary

Americamysis bahia

Study: Wheat J. 1993. FMC-30980 (^{14}C labeled cypermethrin): Chronic toxicity to the mysid, *Mysidopsis bahia,* under flow-through conditions. FMC Study Number A91-3480. Laboratory project ID: J9205004a. Toxikon Environmental Sciences: Jupiter, FL. EPA MRID 427253-01.

Relevance
Score: 85
Rating: L

Reliability
Score: 86
Rating: R

*Not Freshwater (15)

	Wheat 1993	***A. bahia***
Parameter	**Value**	**Comment**
Test method cited	Envirosystems Protocol based on EPA (1985, 1988)	
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	Juvenile < 24 hours old	
Source of organisms	Lab Culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	28 days	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	Mean: 8.75% (5-15%)	
Effect 2	Total # offspring/female reproductive day	
Control response 2	Dil: 1.43, Sol: 1.82	
Effect 3	Growth (length)	
Control response 3	7.0 mm	
Temperature	26.1 $\pm$ 1.1 ^{o}C	
Test type	Flow-through	

	Wheat 1993	*A. bahia*
Parameter	**Value**	**Comment**
Photoperiod/light intensity	16:8 light dark	
Dilution water	Natural sea water filtered salinity between 19-22o/oo	Collected at Hampton, New Hampshire
pH	8.1-8.5	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	≥ 4.4 – 7.0 mg/L (≥ 61- 95% saturation)	
Feeding	Brine Shrimp. Once per day during testing	
Purity of test substance	98.1%	
Concentrations measured?	Yes	
Measured is what % of nominal?	39-50%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	0.0004% DMF	
Concentration 1 Nom/Meas (ng/L)	0.250/ 0.125	2 reps, 20/rep
Concentration 2 Nom/Meas (ng/L)	0.500/ 0.233	2 reps, 20/rep
Concentration 3 Nom/Meas (ng/L)	1.00/ 0.411	2 reps, 20/rep
Concentration 4 Nom/Meas (ng/L)	2.00/ 0.781	2 reps, 20/rep
Concentration 5 Nom/Meas (ng/L)	4.00/ 1.976	2 reps, 20/rep
Controls	Solvent and dilution water	2 reps, 20/rep
NOEC (ng/L)	Mortality: 0.781 Length: 0.781	Method: student's t-test p: 0.05 MSD: NR
LOEC (ng/L)	Mortality: 1.976 Length: 1.976	
MATC (geomean NOEC, LOEC) (ng/L)	Mortality: 1.242 Length: 1.242	
% control at NOEC	Mortality: 15/8.75= 171% Length: 7.1/7.0= 101%	
% control at LOEC	Mortality: 35/8.75= 400% Length: 6.8/7.0= 97%	

Notes:
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% nominal (4), Hardness (2), Alkalinity (2), Conductivity (1), Point estimates (3). -12

Toxicity Data Summary

Baetis rhodani

Study: Edwards PJ, Brown SM, Hamer MJ, Bull JM. 1980a. Cypermethrin: Acute toxicity to the mayfly, *Baetis rhodani.* ICI Plant Protection Division, Report Series RJ 0173B. EPA MRID: 240259826.

Relevance	Reliability
Score: 100	Score: 89.5
Rating: R	Rating: R

	Edwards et al. 1980a	***B. rhodani***
Parameter	**Value**	**Comment**
Test method cited	Based on U.S. EPA 1975 – Methods for Acute Toxicity Tests with Fish, Macroinvertebrates, and Amphibians	
Phylum	Arthropoda	
Class	Insecta	
Order	Ephemeroptera	
Family	Baetidae	
Genus	*Baetis*	
Species	*rhodani*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Early instar larvae	
Source of organisms	Field collected in England	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes, 6 day acclimation	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	96 h	
Data for multiple times?	Yes, 48, 72 h	
Effect 1	Survival	
Control response 1	Test 1: 90% Test 2: 100%	
Effect 2	Immobility	
Control response 2	Test 1: 90% Test 2: 100%	
Temperature	12 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	16 h light:8 h dark, 370 lux	
Dilution water	Dechlorinated tap water	
pH	8.2-8.4	

	Edwards et al. 1980a	*B. rhodani*
Parameter	**Value**	**Comment**
Hardness	204 mg/L	
Alkalinity	250 mg/L	
Conductivity	540 uS	
Dissolved Oxygen	95-110% saturation	
Feeding	None during exposure	
Purity of test substance	97.6%	Radiolabeled, specific activity 52.8 mCi/mMol
Concentrations measured?	Yes	
Measured is what % of nominal?	57-109%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, liquid scintillation counting	
Concentration of carrier (if any) in test solutions	0.12% acetone	
Concentration 1 Nom/Meas (ng/L)	Test 1: 2.3; 1.7 Test 2: 2.3; 2.1	1 rep, 30/rep
Concentration 2 Nom/Meas (ng/L)	Test 1: 4.6; 2.7 Test 2: 4.6; 3.4	1 rep, 30/rep
Concentration 3 Nom/Meas (ng/L)	Test 1: 9.2; 6.2 Test 2: 9.2; 6.0	1 rep, 30/rep
Concentration 4 Nom/Meas (ng/L)	Test 1: 18.4; 12.4 Test 2: 18.4; 11.7	1 rep, 30/rep
Concentration 5 Nom/Meas (ng/L)	Test 1: 36.7; 25.2 Test 2: 36.7; 22.0	1 rep, 30/rep
Control	Solvent	1 rep, 30/rep
EC_{50} ng/L	Test 1 24 h: 10.9 48 h: 9.5 (8.2-11.0) 96 h: 7.3 (2.3-30.0) Test 2 24 h: 8.3 (7.1-9.8) 48 h: 9.0 (7.5-10.9) 72 h: 8.0 (6.4-10.3) 96 h: 4.7 (4.0-5.6)	Method: weighted linear regression
LC_{50} ng/L	Test 1 48 h: >25 72 h: 26.7 (18.3-56.2) 96 h: 17.1 (12.4-28.1) Test 2 24 h: >22 48 h: >22 72 h: 18.8 (13.8-32.2)	Method: weighted linear regression

	Edwards et al. 1980a	*B. rhodani*
Parameter	**Value**	**Comment**
	96 h: 9.0 (6.8-12.7)	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hypothesis tests (8). 100-8=92

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Prior contamination (4), Adequate replicates (2), Hypothesis tests (3). 100-13=87

Reliability score: mean(92, 87)=89.5

Toxicity Data Summary

Ceriodaphnia dubia

Study: Barata C, Fernandez-San Juan M, Feo ML, Eljarrat E, Soares AMVM, Barcelo D, Baird DJ. 2012. Population growth rate responses of *Ceriodaphnia dubia* to ternary mixtures of specific acting chemicals: Pharmalogical versus ecotoxicolgical modes of action. Environ Sci Technol 46:9663-9672.

Relevance	Reliability
Score: 82.5*	Score: 86
Rating: L	Rating: R

*No acceptable standard method (10), control response not reported (7.5).

	Barata et al. 2012	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	None cited	
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	<12 h old neonates	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Organisms acclimated and disease-free?	Yes	
Organisms randomized?	Yes	
Test vessels randomized?	Not reported	
Test duration	10 d	
Data for multiple times?	No	
Effect 1	Population growth rate (λ)	
Control response 1	Not reported	
Temperature	24 ± 0.5°C	
Test type	Static renewal	
Photoperiod/light intensity	12 h light: 12 h dark	
Dilution water	ASTM hard water	
pH	Mean: 8.1 ± 0.2	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	>91% saturation	

	Barata et al. 2012	*C. dubia*
Parameter	**Value**	**Comment**
Feeding	Yes, *Chlorella vulgaris* at 500,000 cells/ml	
Purity of test substance	95.8%	
Concentrations measured?	Yes	
Measured is what % of nominal?	76% on average	
Toxicity values calculated based on nominal or measured concentrations?	Measured (average of t_0 and t_{final} concentrations)	
Chemical method documented?	Yes, GC-NCI-MS	
Concentration of carrier (if any) in test solutions	< 0.5 mL/L acetone	
Concentration 1 Nom; Meas (µg/L)	7 concentrations ranging from 0.09-1 nmol/L	4 reps, 5/rep
Concentration 2 Nom; Meas (µg/L)	0.1; 0.0755	4 reps, 5/rep
Concentration 3 Nom; Meas (µg/L)	0.15; 0.111	4 reps, 5/rep
Concentration 4 Nom; Meas (µg/L)	0.3; 0.236	8 reps, 5/rep
Concentration 5 Nom; Meas (µg/L)	"	4 reps, 5/rep
Concentration 6 Nom; Meas (µg/L)	"	4 reps, 5/rep
Concentration 7 Nom; Meas (µg/L)	"	4 reps, 5/rep
Control	Solvent and dilution water	5 reps, 5/rep
EC_{50}	0.40	Method: nonlinear allosteric decay regression model

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). 100-14=86

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Hardness (2), Alkalinity (2), Conductivity (1), Random design (2), Hypothesis tests (3). 100-14=86

Reliability: mean(86,86)=86

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
Rating: R

	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-old	
Source of organisms	Lab cultures; obtained from AQUA-Science (Davis, CA, USA)	
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 °C	
Test type	Static	
Photoperiod/light intensity	16:8-h light : dark	
Dilution water	U.S. EPA moderately hard	Reverse osmosis–treated well water
pH	7.4–7.8	
Hardness	80–100 mg/L	
Alkalinity	60–70 mg/L	
Conductivity	Not reported	
Dissolved Oxygen	Not reported	

	Wheelock *et al.* 2004	***C. dubia***
Parameter	**Value**	**Comment**
Feeding	Prior to test but not during	
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	<0.1 %	
Concentration 1 Nom/Meas (μg/L)	5-7 concentrations	2-4 reps w/ 5 neonates each
Control	Water and methanol control	2-4 reps w/ 5 neonates each
LC_{50} (μg/L)	48 h: 0.683 $\pm$ 0.072	Calculated from the mortality data using ToxCalc Software.

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), Exposure type (2), Appropriate spacing between concentrations (2), Appropriate statistical method (2), Hypothesis tests (3)

Toxicity Data Summary

Chaoborus crystallinus (>85%)
Chaoborus flavicens (<15%)

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephenson1982	***C. crystallinus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Chaoboridae	
Genus	*Chaoborus*	
Species	*crystallinus, flavicens*	
Family in North America?	Yes	
Age/size at start of test/growth phase	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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	

	Stephenson1982	*C. crystallinus*
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (µg/L)	24 h: 0.2 (0.03-0.4)	Method: Probit
EC_{50} (µg/L)	2 h: 0.09 (0.02-0.2) 24 h: 0.03	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior Contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Chironomus dilutus

Study: Mehler WT, Du J, Lydy MJ, You J. 2011. Joint toxicity of a pyrethroid insecticide, cypermethrin, and a heavy metal, lead, to the benthic invertebrate *Chironomus dilutus.* Environ Toxicol Chem 30:2838-2845.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 77.5
Rating: R

*Control response not reported (7.5)

	Mehler et al. 2011	***C. dilutus***
Parameter	**Value**	**Comment**
Test method cited	Adapted from U.S. EPA 2000 (sediment exposure protocol)	
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 larvae	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	Not reported	
Temperature	23.7 ± 0.4°C	
Test type	Not reported, probably static	
Photoperiod/light intensity	16 h L:8 h D	
Dilution water	EPA reconstituted water	
pH	7.7 ± 0.25	
Hardness	~140 mg/L	
Alkalinity	Not reported	
Conductivity	416 ± 159 uS/cm	
Dissolved Oxygen	6.95 ± 1.23 mg/L	

	Mehler et al. 2011	*C. dilutus*
Parameter	**Value**	**Comment**
Feeding	Not reported	
Purity of test substance	98%	
Concentrations measured?	Yes	
Measured is what % of nominal?	10-30%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC/MS	
Concentration of carrier (if any) in test solutions	50 uL acetone /200mL	
Concentration 1 Nom; Meas (µg/L)	Test 1: 1; ~0.35 Test 2: 1; ~0.2	5 reps, 10/rep
Concentration 2 Nom; Meas (µg/L)	Test 1: 3; ~0.5 Test 2: 3; ~0.6	5 reps, 10/rep
Concentration 3 Nom; Meas (µg/L)	Test 1: 6; ~1.6 Test 2: 6; ~1.1	5 reps, 10/rep
Concentration 4 Nom; Meas (µg/L)	Test 1: 9; ~1.7 Test 2: 9; ~2	5 reps, 10/rep
Concentration 5 Nom; Meas (µg/L)	Test 1: 13; ~4 Test 2: 13; ~3.5	5 reps, 10/rep
Control	Solvent controls	5 reps, 10/rep
LC50 (95% confidence interval) µg/L	Test 1: 0.532 (0.142-0.935) Test 2: 0.679 (0.428-0.937)	Method: probit

Notes: All measured concentrations were estimated from Fig 1A, 1B.

Reliability points taken off for:
Documentation (Table 3.7): Exposure type (5), Alkalinity (2), Hypothesis tests (8). 100-15=85

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), Exposure type (2), Alkalinity (2), Random design (2), Hypothesis tests (3). 100-30=70

Reliability score: mean(85, 70)=77.5

Toxicity Data Summary

Chironomus thummi

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephenson 1982	***C. thummi***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family		
Genus	*Chironomus*	
Species	*thummi*	
Family in North America?	Yes	
Age/size at start of test/growth phase	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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	

	Stephenson 1982	***C. thummi***
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (μg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50}	24 h: $\geq$ 5	Method: Probit
EC_{50}	2 h: 0.1 (0.07-0.2) 24 h: 0.2 (0.1-0.3)	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Cloeon dipterum

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephenson 1982	***C. dipterum***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Ephemeroptera	
Family		
Genus	*Cloeon*	
Species	*dipterum*	
Family in North America?	Yes	
Age/size at start of test/growth phase	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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	

	Stephenson 1982	*C. dipterum*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (µg/L)	0.6 (0.3-1)	Method: Probit
EC_{50} (µg/L)	0.07 (0.04-0.2)	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Corixa punctata

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephenson1982	***C. punctata***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Hemiptera	
Family	Corixidae	
Genus	*Corixa*	
Species	*punctata*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults	
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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 $\pm$ 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	

	Stephenson1982	*C. punctata*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (µg/L)	24 h: $\geq$ 5	Method: Probit
EC_{50} (µg/L)	2 h: 0.5 (0.4-0.8) 24 h: 0.7 (0.4-2)	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior Contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Cyprinodon variegatus

Study: Chandler AB. 1990. FMC 45806: Acute toxicity to sheepshead minnow (*Cyprinodon variegatus*) under flow-through test conditions. Laboratory project ID: 3903026-0350-3140. ESE: Gainesville, FL. CDPR: 118791.

Relevance
Score: 75
Rating: L

Reliability
Score: 83.5
Rating: R

*No standard method, saltwater

	Chandler 1990	***C. variegatus***
Parameter	**Value**	**Comment**
Test method cited	Follows an FMC protocol sited but not included in report	Not Acceptable
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	2 lots of fish: Lot 1) 107 days old at start of test and Lot 2) 87 days old at start of test. Both lots within the 'juvenile' range for C. Variegatus. Average length: 20.5 ± 2.26mm,	
Source of organisms	Lab Culture	Aquatic Biosystems, Inc., Ft. Collins, CO)
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 Hours	
Data for multiple times?	24, 48, 72, 96 hours	
Effect 1	Mortality	
Control response 1	0%	
Effect 2	Non-lethal effects	
Control response 2	Surviving fish in 4.07 µg/L	

	Chandler 1990	*C. variegatus*
Parameter	**Value**	**Comment**
	exhibited loss of equilibrium after 48hrs.	
Temperature	20-22 C	
Test type	Flow-through	
Photoperiod/light intensity	16:8 hours Light: Dark	
Dilution water	Filtered sea water with salinity of 20 parts per thousand. Sea water collected from Atlantic Ocean near Marineland Florida and adjusted with well water. Chemical characterization performed.	
pH	7.9-8.3	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	≥ 6 mg/L (≥ 78% saturation)	
Feeding	Not During Test	
Purity of test substance	91.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	31-52%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	77µg DMF/L	
Concentration 1 Nom/Meas (µg/L)	0.78/ 0.391	2 reps, 10/rep
Concentration 2 Nom/Meas (µg/L)	1.30/ 0.532	2 reps, 10/rep
Concentration 3 Nom/Meas (µg/L)	2.16/ 0.675	2 reps, 10/rep
Concentration 4 Nom/Meas (µg/L)	3.60/ 1.87	2 reps, 10/rep
Concentration 5 Nom/Meas (µg/L)	6.0/ 4.07	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: >4.61 48 h: >2.14 72 h: > 2.14 96 h: 3.42 (1.87-4.07) Or 3.88 (2.14-4.61) ?	Method: non-linear interpolation

	Chandler 1990	*C. variegatus*
Parameter	**Value**	**Comment**
	Lower value is given in report body, while higher value is given in Table 3-4	

Notes:

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

Acceptability (Table 3.8): Acceptable standard method (5), Measured concentrations within 20% nominal (4), Hardness (2), Alkalinity (2), Conductivity (1), Random block design (2), Hypothesis test (3). -19

Toxicity Data Summary

Cyprinus carpio

Study: Aydin R, Koprucu K, Dorucu M, Koprucu SS, Pala M. 2005. Acute toxicity of synthetic pyrethroid cypermethrin on the common carp (*Cyprinus carpio* L.) embryos and larvae. Aquaculture International 13:451-458.

Relevance
Score: 75
Rating: L

Reliability
Score: 74.5
Rating: R

*No standard method, Low chemical purity

	Aydin et al. 2005	***C. carpio***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Cyprinus*	
Species	*carpio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Eggs Larvae (hatched eggs)	
Source of organisms	Fish hatchery in Turkey	
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	Larval mortality	
Control response 1	96 h: 11.9%	
Effect 2	Embryo hatching success	
Control response 2	95.1%	
Effect 3	Number of dead embryos	
Control response 3	4.9%	
Temperature	24 ± 1°C	
Test type	Static renewal, 12 h renewal	
Photoperiod/light intensity	12 L:12 D	
Dilution water	NR	
pH	7.3 ± 0.3	

	Aydin et al. 2005	*C. carpio*
Parameter	**Value**	**Comment**
Hardness	120.5 ± 3.4 mg/L	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	7.8 ± 0.2 mg/L	
Feeding	Initiated in larvae after yolk sack absorption	
Purity of test substance	20%	
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 (µg/L)	0.0001	5 reps, 200/rep
Concentration 2 Nom (µg/L)	0.001	5 reps, 200/rep
Concentration 3 Nom (µg/L)	0.01	5 reps, 200/rep
Concentration 4 Nom (µg/L)	0.1	5 reps, 200/rep
Concentration 5 Nom (µg/L)	1	5 reps, 200/rep
Concentration 6 Nom (µg/L)	2	5 reps, 200/rep
Concentration 7 Nom (µg/L)	4	5 reps, 200/rep
Concentration 8 Nom (µg/L)	8	5 reps, 200/rep
Control	Solvent	5 reps, 200/rep
LC_{50} (µg/L)	Larval mortality: 1 h: 7.816 (2.829-33.652) 24 h: 6.196 (2.481-22.897) 48 h: 2.940 (1.327-8.125) 72 h: 1.304 (0.612-3.389) 96 h: 0.809 (0.530-1.308)	Method: probit
NOEC (µg/L)	Larval mortality: <0.0001	Method: chi-square test p: 0.05 MSD: NR
LOEC (µg/L)	Larval mortality: 0.0001	Same as above
MATC (GeoMean NOEC,LOEC)	Not calculable	
% of control at NOEC	Not calculable	
% of control at LOEC	186/119=156%	

Notes:

Reliability points taken off for:

Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Dilution water (3), Alkalinity (2), Conductivity (2), Minimum significant difference (2), % control of NOEC/LOEC (2). -18

Acceptability (Table 3.8): No standard method (5), Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Dilution water (2), Alkalinity (2), Conductivity (1), Random design (2), NOEC response reasonable (1), Minimum significant difference (1). -33

Toxicity Data Summary

Cyprinus carpio

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 72
Rating: L

*No standard method, control response not reported

	Stephenson 1982	***C. carpio***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Cyprinus*	
Species	*carpio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	8-10 g	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes (10 d)	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	Test 1) 10 ± 1°C Test 2) 20-25°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>80% saturation	
Feeding	None during test	

	Stephenson 1982	***C. carpio***
Parameter	**Value**	**Comment**
Purity of test substance	85-95%	
Concentrations measured?	Yes	
Measured is what % of nominal?	>70%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	Test 1) 5 conc (0.44-1.1) Test 2) 6 conc (0.48-1.8)	1 rep, 5/rep
Control	Dilution water	1 rep, 5/rep
LC_{50} (μg/L)	Test 1) 0.9 (0.6-1.7) Test 2) 1.1 (0.6-2.8)	Method: probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Organisms/rep (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -35

Toxicity Data Summary

Daphnia magna

Study: Demetrio PM, Bonetto C, Ronco AE. 2014. The effect of cypermethrin, chlorpyrifos, and glyphosate active ingredients and formulations on *Daphnia magna* (Straus). Bull Environ Contam Toxicol 93:268-273.

Relevance	Reliability
Score: 100	Score: 74.5
Rating: R	Rating: R

	Demetrio et al. 2014	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	Mexican standard method (Diaz-Baez et al. 2004)	
Phylum	Arthropoda: Crustacea	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Neonates < 24 h	
Source of organisms	Lab culture	Watertox Bioassays Program of the International Development Research Center of Canada
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Lethality/immobilization	
Control response 1	<10% lethality	
Temperature	21 ± 2°C	
Test type	Static	
Photoperiod/light intensity	16 h light:8 h dark	
Dilution water	Not reported	
pH	7.8 ± 0.2	
Hardness	160-180 mg/L as $CaCO_3$	
Alkalinity	Not reported	
Conductivity	Not reported	

	Demetrio et al. 2014	*D. magna*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>6 mg/L	
Feeding	None during exposure	
Purity of test substance	Technical grade	
Concentrations measured?	Yes	
Measured is what % of nominal?	49.0%	
Toxicity values calculated based on nominal or measured concentrations?	Not clearly reported; assume nominal	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0.5% v/v ethanol	
Concentration 1 Nom/Meas (µg/L)	At least 5 concentrations ranging 0.9-11.5 µg/L	3 reps, #/rep not reported for exposures
Concentration 2 Nom/Meas (µg/L)	"	3 reps, #/rep not reported for exposures
Concentration 3 Nom/Meas (µg/L)	"	3 reps, #/rep not reported for exposures
Concentration 4 Nom/Meas (µg/L)	"	3 reps, #/rep not reported for exposures
Concentration 5 Nom/Meas (µg/L)	"	3 reps, #/rep not reported for exposures
Control	Solvent and dilution water	3 reps, #/rep not reported for exposures
LC_x (95% confidence interval) µg/L	LC_5: 1.24 (0.90-1.55) LC_{50}: 3.73 (3.25-4.29)	Method: probit

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Nominal concentrations (3), Measured concentrations (3), Dilution water (3), Alkalinity (2), Conductivity (2), Hypothesis tests (8). 100-21=79

<u>Acceptability (Table 3.8):</u> Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Dilution water (2), Alkalinity (2), Temperature (3), Conductivity (1), Random design (2), Dilution factor (2), Hypothesis tests (3). 100-30=70

Reliability score: mean(79,70)=74.5

Toxicity Data Summary

Daphnia magna

Study: Edwards PJ, Brown SM, Sapiets AS. 1980b. Cypermethrin (PP383): Toxicity of technical and formulated material to first instar *Daphnia magna.* ICI Plant Protection Division, Report series RJ 0110B. EPA MRID: 240139913.

Relevance
Score: 100
Rating: R

Reliability
Score: 82.5
Rating: R

	Edwards et al. 1980b	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	U.S. 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	1^{st} instar, 12 $\pm$ 12 h old	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	72 h	
Data for multiple times?	Yes, 24 h, 48 h	
Effect 1	Immobility	
Control response 1	Test 1: 3% Test 2: 0%	
Temperature	17 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 h light: 8 h dark, 2000 lux	
Dilution water	Reconstituted hard water	
pH	Test 1: 8.2-8.3 Test 2: 8.0-8.2	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	Test 1: 94-100% saturation Test 2: 99-100% saturation	
Feeding	None during test	

	Edwards et al. 1980b	*D. magna*
Parameter	**Value**	**Comment**
Purity of test substance	91.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	60-75%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0.5% acetone	
Concentration 1 Nom; Meas (µg/L)	Test 1: 0.06; 0.05 Test 2: 0.13; 0.12	2 tests, 3 reps, 10/rep
Concentration 2 Nom; Meas (µg/L)	Test 1: 0.13; 0.09 Test 2: 0.25	2 tests, 3 reps, 10/rep
Concentration 3 Nom; Meas (µg/L)	Test 1: 0.25; 0.17 Test 2: 0.5; 0.63	2 tests, 3 reps, 10/rep
Concentration 4 Nom; Meas (µg/L)	Test 1: 0.5; 0.38 Test 2: 1	2 tests, 3 reps, 10/rep
Concentration 5 Nom; Meas (µg/L)	Test 1: 1; 0.61 Test 2: 2; 1.4	2 tests, 3 reps, 10/rep
Concentration 6 Nom; Meas (µg/L)	Test 1: 2; 1.6 Test 2: 4	2 tests, 3 reps, 10/rep
Concentration 7 Nom; Meas (µg/L)	Test 1: 4; 2.8 Test 2: 8; 5.8	2 tests, 3 reps, 10/rep
Concentration 8 Nom; Meas (µg/L)	Test 1: 8; 5.9 Test 2: 16	2 tests, 3 reps, 10/rep
Concentration 9 Nom; Meas (µg/L)	Test 1: 16; 17 Test 2: 32; 24	2 tests, 3 reps, 10/rep
Concentration 10 Nom; Meas (µg/L)	Test 1: 32; 22 Test 2: 64	2 tests, 3 reps, 10/rep
Concentration 11 Nom; Meas (µg/L)	Test 1: 64; 40 Test 2: 128; 115	2 tests, 3 reps, 10/rep
Concentration 12 Nom; Meas (µg/L)	Test 1: not tested Test 2: 512; 476	1 test, 3 reps, 10/rep
Control	Solvent	2 tests, 3 reps, 10/rep
EC_{50} (95% confidence interval) µg/L	24 h: >476 48 h: 1.25 (1.02-1.54) 72 h: 0.20 (0.162-0.241)	Method: weighted linear regression

Notes: This study also documented toxicity tests with formulated products, but those results are not included here, only the results from the technical grade cypermethrin are summarized in this Toxicity Data Summary.

Reliability points taken off for:

Documentation (Table 3.7): Hardness (2), Alkalinity (2), Conductivity (2), Hypothesis tests (8). 100-14=86

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Organisms randomized (1), Exposure type (2), Hardness (2), Alkalinity (2), Conductivity (1), Random design (2), Hypothesis tests (3). 100-21=79

Reliability score: mean(86, 79)=82.5

Toxicity Data Summary

Daphnia magna

Study: Edwards PJ, Hamer MJ, Bull JM, Brown SM. 1981. Cypermethrin: 21 day *Daphnia magna* life cycle study. ICI Plant Protection Division, Report series RJ 0188B. MRID: 240259825.

Relevance
Score: 100
Rating: R

Reliability
Score: 96
Rating: R

	Edwards et al. 1981	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	U.S. 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	1^{st} instar, 12 $\pm$ 12 h old	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Yes	
Test duration	21 days	
Data for multiple times?	No	
Effect 1	Number of offspring per parthenogenic female	
Control response 1	Test 1: 56 Test 2: 43	
Effect 2	Length	
Control response 2	Test 1: 38.7 um eyepiece graticules Test 2: 39.4 um eyepiece graticules	
Temperature	17 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	16 h light: 16 h dark, 370 lux	
Dilution water	Dechlorinated tap water	
pH	7.9-8.5	
Hardness	Mean: 212 (184-230) mg/L	

	Edwards et al. 1981	*D. magna*
Parameter	**Value**	**Comment**
Alkalinity	Mean: 250 (240-260) mg/L	
Conductivity	Mean: 596 (540-690) m mhos	
Dissolved Oxygen	91-109% saturation	
Feeding	Twice daily, *Scenedesmus* alga cells	
Purity of test substance	93.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	71-76%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, LSC	
Concentration of carrier (if any) in test solutions	0.12% acetone	
Concentration 1 Nom/Meas (ng/L)	Test 1: 6.2; 4.7 Test 2: 8.3; 6.0	30 reps, 1/rep
Concentration 2 Nom/Meas (ng/L)	Test 1: 12.5; 9.3 Test 2:16.6; 13.6	30 reps, 1/rep
Concentration 3 Nom/Meas (ng/L)	Test 1: 24.9; 17.2 Test 2: 33.2; 23.0	30 reps, 1/rep
Concentration 4 Nom/Meas (ng/L)	Test 1: 49.8; 39.8 Test 2: 66.5; 44.3	30 reps, 1/rep
Concentration 5 Nom/Meas (ng/L)	Test 1: 99.6; 79.2 Test 2: 132.9; 83.4	30 reps, 1/rep
Control	Solvent	30 reps, 1/rep
EC_{50} (95% confidence interval) ng/L	Reproduction Test 1: 48.4 (37.8-58.9) Test 2: 62.9 (36.7-89.1)	Method: weighted linear regression
NOEC (ng/L)	Reproduction Test 1: 20.1 Test 2: 20.1 Length Test 1: 9.3 Test 2: 6.0	Method: ANOVA p: 0.05 MSD:
LOEC (ng/L)	Reproduction Test 1: 42.1 Test 2: 42.1 Length Test 1: 17.2 Test 2: 13.6	Same as above
MATC (GeoMean NOEC,LOEC) (ng/L)	Reproduction Test 1: 29.1 Test 2: 29.1 Length	

	Edwards et al. 1981	*D. magna*
Parameter	**Value**	**Comment**
	Test 1: 12.6 Test 2: 9.0	
% of control at NOEC	<u>Reproduction</u> Test 1: 42/56=75% Test 2: 34/43=79% <u>Length</u> Test 1: 3.76/3.67=102% Test 2: 3.68/3.74=98%	
% of control at LOEC	<u>Reproduction</u> Test 1: 38/56=38% Test 2: 26/43=60% <u>Length</u> Test 1: 3.53/3.67=96% Test 2: 3.42/3.74=91%	

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Minimum significant difference (2). 100-2=98

<u>Acceptability (Table 3.8):</u> Measured concentrations within 20% of nominal (4), Organisms randomized (1), Minimum significant difference (1). 100-6=94

Reliability score: mean(98, 94)=96

Toxicity Data Summary

Daphnia magna

Study: Friberg-Jensen U, Nachman G, Christoffersen KS. 2010. Early signs of lethal effects in *Dahpnia magna* (Branchiopoda, Cladocera) exposed to the insecticide cypermethrin and the fungicide azoxystrobin. Environmental Toxicology and Chemistry 29:2371-2378.

Relevance
Score: 92.5*
Rating: R

Reliability
Score: 65.5
Rating: L

*Controls not described

	Friberg-Jensen et al. 2010	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	ISO 1996	
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	8 d, mean length of 2.55 ± 0.22 mm	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Not reported	
Test duration	48 h	
Data for multiple times?	Yes, 24 h	
Effect 1	Immobility	
Control response 1	0%	
Temperature	20 ± 2°C	
Test type	Static	
Photoperiod/light intensity	Not reported	
Dilution water	Artificial freshwater	Aachener Daphnien Medium
pH	6.1-7.8	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	2.3-9.0 mg/L	

	Friberg-Jensen et al. 2010	*D. magna*
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	96.8%	
Concentrations measured?	No	
Measured is what % of nominal?	Not reported	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	0.04 mL/L acetone	
Concentration 1 Nom/Meas (μg/L)	7 concentrations ranging 0.25-16 μg/L	4 reps, 5/rep
Concentration 2 Nom/Meas (μg/L)		4 reps, 5/rep
Concentration 3 Nom/Meas (μg/L)		4 reps, 5/rep
Concentration 4 Nom/Meas (μg/L)		4 reps, 5/rep
Concentration 5 Nom/Meas (μg/L)		4 reps, 5/rep
Concentration 6 Nom/Meas (μg/L)		4 reps, 5/rep
Control	Not described	4 reps, 5/rep
EC_{50} (95% confidence interval) μg/L	24 h: 21.19 (7.83-47.50) 48 h: 0.65 (0.46-0.86)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). 100-32=68

Acceptability (Table 3.8): Control description (6), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), Photoperiod (2), Random design (2), Dilution factor (2), Hypothesis tests (3). 100-37=63

Toxicity Data Summary

Daphnia magna

Study: Kim Y, Jung J, Oh S, Choi K. 2008. Aquatic toxicity of cartap and cypermethrin to different life stages of *Daphnia magna* and *Oryzias latipes.* Journal of Environmental Science and Health B 43:56-64.

Relevance

Reliability

Score: acute: 92.5, chronic: 92.5
Rating: R

Score: acute: 68, chronic: 69
Rating: acute: L, chronic: L

*acute: control response not reported, chronic: control response not clearly reported, not clear if it is acceptable or not.

	Kim et al. 2008	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	USEPA 2002, OECD	
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	Acute & chronic: < 24 h neonates Chronic: 7 d old juveniles	
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	Acute: 96 h Chronic: 21 d	
Data for multiple times?	No	
Effect 1	Brood number/female	
Control response 1	Neonates: 5.1 Juveniles: 6	
Effect 2	Number of young/female (not clear if per brood or total)	
Control response 2	Neonates: 18 Juveniles: 14.5	
Effect 3	Immobility	
Control response 3	NR	
Temperature	21.0 ± 1.0 °C	
Test type	Static renewal, 48 h renewal	
Photoperiod/light intensity	NR	
Dilution water	Moderately hard water	
pH	7.9 ± 0.2	
Hardness	NR	
Alkalinity	NR	

	Kim et al. 2008	***D. magna***
Parameter	**Value**	**Comment**
Conductivity	325-338 uS	
Dissolved Oxygen	8.4-8.8	
Feeding	Daily for chronic; for acute, at 48 h before renewal to minimize sorption to food	
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	0.5% DMSO	
Concentration 1 Nom (µg/L)	Acute: 0.0003 Chronic neonate: 0.0000002 Chronic juvenile: 0.00002	Acute: 4 reps, 5/rep Chronic: 10 reps, 10/rep
Concentration 2 Nom (µg/L)	Acute: 0.003 Chronic neonate: 0.000002 Chronic juvenile: 0.0002	Acute: 4 reps, 5/rep Chronic: 8 reps, 10/rep
Concentration 3 Nom (µg/L)	Acute: 0.03 Chronic neonate: 0.00002 Chronic juvenile: 0.002	Acute: 4 reps, 5/rep Chronic: 9 reps, 10/rep
Concentration 4 Nom (µg/L)	Acute: 0.3 Chronic neonate: 0.0002 Chronic juvenile: 0.02	Acute: 4 reps, 5/rep Chronic: 6 reps, 10/rep
Concentration 5 Nom (µg/L)	Acute: 3 Chronic neonate: 0.002 Chronic juvenile: 0.2	Acute: 4 reps, 5/rep Chronic: 3 reps, 10/rep
Concentration 6 Nom (µg/L)	Acute: 30	Acute: 4 reps, 5/rep
Concentration 7 Nom (µg/L)	Acute: 62.5	Acute: 4 reps, 5/rep
Concentration 8 Nom (µg/L)	Acute: 125	Acute: 4 reps, 5/rep
Concentration 9 Nom (µg/L)	Acute: 250	Acute: 4 reps, 5/rep
Concentration 10 Nom (µg/L)	Acute: 500	Acute: 4 reps, 5/rep
Concentration 11 Nom (µg/L)	Acute: 1000	Acute: 4 reps, 5/rep
Control	Acute: Solvent and dilution water Chronic: probably dilution water, use of solvent control not reported	Acute: 4 reps, 5/rep Chronic: 9 reps, 10/rep
EC_{50} (95% confidence interval) (µg/L)	48 h: 0.10 (0.035-0.28) 72 h: 0.002 (0.0011-0.005) 96 h: 0.0006 (0.0003-0.0011)	Method: calculated with ToxStat program
NOEC (µg/L)	Neonates	Method: ANOVA

	Kim et al. 2008	*D. magna*
Parameter	**Value**	**Comment**
	Brood #/female: 0.00002 # young/female: 0.0000002 7 d juveniles Brood #/female: 0.02 # young/female: 0.00002	p: *<0.05, ** <0.01 MSD: NR
LOEC	Neonates Brood #/female: 0.0002* # young/female: 0.000002** 7 d juveniles Brood #/female: 0.2** # young/female: 0.0002**	Same as above
MATC (GeoMean NOEC,LOEC)	Neonates Brood #/female: 0.000063 # young/female: 0.00000063 7 d juveniles Brood #/female: 0.063 # young/female: 0.000063	
% of control at NOEC	Neonates Brood #/female: 4.8/5.1=94% # young/female: 17/18=94% 7 d juveniles Brood #/female: 5/6=83% # young/female: 12/14.5=83%	
% of control at LOEC	Neonates Brood #/female: 3.5/5.1=68% # young/female: 14/18=78% 7 d juveniles Brood #/female: 3.9/6=65% # young/female: 11/14.5=76%	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Statistical methods (5 – acute only), Hypothesis tests (8- acute only), Minimum significant difference (2 – chronic only), Point estimates (8 – chronic only). A: -27, C: -24

Acceptability (Table 3.8): Appropriate control (6 – chronic only), Control response (9), Measured concentrations within 20% of nominal (4), Concentrations > 2x aqueous solubility (4

– acute only), Carrier solvent (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Photoperiod (2), Random design (2), Dilution factor too large (2), Statistical method (2 – acute only), Hypothesis tests (3 – acute only), Minimum significant difference (1 – chronic only), Point estimates (3 – chronic only). A: -37, C: -38

Toxicity Data Summary

Daphnia magna

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 76
Rating: R

*No standard method

	Stephenson1982	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Crustacea	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	< 24 h	
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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	18 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 $\pm$ 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	

	Stephenson1982	*D. magna*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (μg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50}	24 h: 2 (1-5)	Method: Probit
EC_{50}	2 h: $\geq$ 5 24 h: 2 (1-3)	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Daphnia magna

Study: Ward TJ, Boeri RL. 1991. Acute toxicity of FMC 56701 technical and cypermethrin technical to daphnid, *Daphnia magna.* FMC Study: A90-3310. EnviroSystems Division: Hampton, NH. CDPR ID: 118786.

Relevance
Score: 100
Rating: R

Reliability
Score: 90
Rating: R

	Ward & Boeri 1991	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	US EPA (1985, 1988)	
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	Juvenile First Instar (<24hrs 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?	Yes	
Test duration	48 hrs	
Data for multiple times?	Yes (24 & 48 hr)	
Effect 1	Survival	
Control response 1	100% Survival (water and solvent control)	
Effect 2	Sublethal Effects (Immobilization & Loss of Equilibrium, Erratic swimming, loss of reflex, discoloration or change in behavior.)	
Control response 3	0% in solvent and water controls.	
Temperature	20 ± 1°C	
Test type	Static Renewal	
Photoperiod/light intensity	16:8 hour light: dark	

	Ward & Boeri 1991	***D. magna***
Parameter	**Value**	**Comment**
Dilution water	Filtered well water	
pH	6.8-7.7	
Hardness	180 mg/L	
Alkalinity	NR	
Conductivity	800 (umhos/cm)	
Dissolved Oxygen	6.9 mg/L	
Feeding	None during test	
Purity of test substance	92.3%	
Concentrations measured?	Yes	
Measured is what % of nominal?	20-60%	
Toxicity values calculated based on nominal or measured concentrations?	Mean measured	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	Acetone: 0.5mL/L	
Concentration 1 Nom/Meas (µg/L)	Nom.: 0.025 Meas: 0.040 ± 0.011	2 reps, 10 animals per rep
Concentration 2 Nom/Meas (µg/L)	Nom.: 0.040 Meas.: 0.061± 0.025	
Concentration 3 Nom/Meas (µg/L)	Nom.: 0.060 Meas.:0.067± 0.040	
Concentration 4 Nom/Meas (µg/L)	Nom.: 0.150 Meas.: 0.148 ± 0.051	
Concentration 5 Nom/Meas (µg/L)	Nom.: 0.250 Meas.: 0.249± 0.057	
Concentration 6 Nom/Meas (µg/L)	Nom.: 0.400 Meas.: 0.386 ± 0.102	
Control	0.01ug/L	
LC_{50} (95% confidence interval) (µg/L)	24 h: >0.386 48 h: 0.134 (0.114-0.157)	Method: probit

Notes: Points deducted for the % nominal as the lowest 2 loadings were greater than 20% and these values were used in the calculation of the LC50.

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Alkalinity (2), Hypothesis Test (8). -10

<u>Acceptability (Table 3.8):</u> Measured concentrations within 20% nominal (4), Organisms randomized (1), Alkalinity (2), Hypothesis tests (3). -10

Toxicity Data Summary

Daphnia magna

Study: Wheat J, Evans J. 1994. Zetacypermethrin technical and cypermethrin technical: Comparative acute toxicity to the water flea, *Daphnia magna,* under flow-through conditions. FMC Study No. A92-3636. Laboratory project ID: J9210001b. Toxikon Environmental Sciences: Jupiter, FL. EPA MRID 432935-01.

Relevance
Score: 100
Rating: R

Reliability
Score: 90
Rating: R

	Wheat & Evans 1994	***D. magna***
Parameter	**Value**	**Comment**
Test method cited	US EPA (1985, 1988)	
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	Juvenile First Instar (<24hrs old)	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	48 hrs	
Data for multiple times?	Yes (24 & 48 hr)	
Effect 1	Mortality	
Control response 1	5%	
Temperature	20 ± 1°C	
Test type	Flow Through	
Photoperiod/light intensity	16:8 hour light: dark	
Dilution water	Filtered tap water	
pH	6.8-7.0	
Hardness	Moderately Hard (80-84 mg $CaCO_3$/L)	
Alkalinity	13 m/L $CaCO_3$	
Conductivity	413 to 421 (umhos/cm)	
Dissolved Oxygen	69-80% saturation (6.2-7.7 mg/L)	
Feeding	None during test	
Purity of test substance	95.7%	

	Wheat & Evans 1994	*D. magna*
Parameter	**Value**	**Comment**
Concentrations measured?	Yes- control	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes	
Concentration of carrier (if any) in test solutions	11.3 uL/L DMF	
Concentration 1 Nom/Meas (µg/L)	0.084	2 reps, 10 animals per rep
Concentration 2 Nom/Meas (µg/L)	0.139	
Concentration 3 Nom/Meas (µg/L)	0.232	
Concentration 4 Nom/Meas (µg/L)	0.387	
Concentration 5 Nom/Meas (µg/L)	0.645	
Concentration 6 Nom/Meas (µg/L)	1.075	
Control	Solvent and dilution water	
LC_{50} (95% confidence interval) (µg/L)	48 h: 0.1615 (0.1344-0.1917)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Measured concentrations (3), Hypothesis tests (8). -11

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Dilution water source (2), Hypothesis test (3). -9

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(1): 177-186.

Relevance
Score: 90 (mortality only)*
Rating: R

Reliability
Score: 65
Rating: L

*No standard method

	DeMicco et al. 2010	***D. rerio***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Actinopterygii	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Danio*	
Species	*rerio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Eggs, 3 hours post fertilization	
Source of organisms	Lab cultures	Zebrafish International Resource Center
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Not reported	
Test duration	6 days (144 hours)	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0% (as shown in Fig. 3)	
Effect 2	Pericardial edema	
Control response 2	15%	Estimated from Fig. 4
Temperature	Not reported	
Test type	Static with some renewal	
Photoperiod/light intensity	Not reported for test (only for rearing adults)	
Dilution water	Not reported for test (only for rearing adults)	

	DeMicco et al. 2010	*D. rerio*
Parameter	**Value**	**Comment**
pH	Not reported for test (only for rearing adults)	
Hardness	Not reported for test (only for rearing adults)	
Alkalinity	Not reported for test (only for rearing adults)	
Conductivity	Not reported for test (only for rearing adults)	
Dissolved Oxygen	Not reported for test (only for rearing adults)	
Feeding	Not reported	
Purity of test substance	99%	
Concentrations measured?	No	
Measured is what % of nominal?	Not applicable	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Not applicable	
Concentration of carrier (if any) in test solutions	1 uL dimethylformamide/ 10 mL water	
Concentration 1 Nom (µg/L)	12.5 (estimated from Fig. 3)	3 reps, 5-25/rep
Concentration 2 Nom (µg/L)	50 (estimated from Fig. 3)	3 reps, 5-25/rep
Concentration 3 Nom (µg/L)	100 (estimated from Fig. 3)	3 reps, 5-25/rep
Concentration 4 Nom (µg/L)	200 (estimated from Fig. 3)	3 reps, 5-25/rep
Control	Solvent	3 reps, 5-25/rep
LC_{50} (µg/L)	65 (25-180)	Method: probit
NOEC (µg/L)	Pericardial edema: 12.5	Method: ANOVA or Bonferroni-corrected t-test or Mann-Whitney rank sum test p: <0.001 MSD: not reported
LOEC (µg/L)	Pericardial edema: 50	
MATC (GeoMean NOEC,LOEC) (µg/L)	Pericardial edema:	
% of control at NOEC	87%/85%=102%	Estimated from Fig. 4
% of control at LOEC	51%/85%=60%	Estimated from Fig. 4

Notes:
Reliability points taken off for:

Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Minimum significant difference (2). 100-32=68
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), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Minimum significant difference (1). 100-38=62

Reliability score: mean(68, 62)=65

Toxicity Data Summary

Danio rerio

Study: Yang Y, Ma H, Zhou J, Liu J, Liu W. 2014. Joint toxicity of permethrin and cypermethrin at sublethal concentrations to embryo-larval zebrafish. Chemosphere 96: 146-154.

Relevance
Score: 90*
Rating: R

Reliability
Score: 64
Rating: L

*No standard method (10).

	Yang et al. 2014	***D. rerio***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum		
Class		
Order		
Family		
Genus	*Danio*	
Species	*rerio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Eggs, 3 h post-fertilization	
Source of organisms	Commercial supplier	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	144 h	
Data for multiple times?		
Effect 1	Mortality	
Control response 1	<10% (Fig. 1B)	
Effect 2	Crooked body	
Control response 2	<10% (Fig. 1B)	
Effect 3	Spasms	
Control response 3	<10% (Fig. 1B)	
Effect 4	Pericardial edema	
Control response 4	<10% (Fig. 1B)	
Effect 5	Non-inflation of swimbladder	
Control response 5	<10% (Fig. 1B)	
Temperature	28 ± 1°C	rearing conditions, not specified for experiments

	Yang et al. 2014	*D. rerio*
Parameter	**Value**	**Comment**
Test type	Static renewal every 24 h	
Photoperiod/light intensity	14 h light: 10 h dark	rearing conditions, not specified for experiments
Dilution water	Hank's solution made with dechlorinated tapwater	Hank's solution: 0.137 M NaCl, 5.4 mM KCl, 0.25 mM Na2HPO4, 0.44 mM KH2PO4, 1.3 mM CaCl2, 1.0 mM MgSO4, 4.2 mM NaHCO3
pH	Not reported	
Hardness	Not reported mg/L	
Alkalinity	Not reported mg/L	
Conductivity	Not reported	
Dissolved Oxygen	Not reported	
Feeding	None	
Purity of test substance	97%	
Concentrations measured?	Yes	
Measured is what % of nominal?	64-111% (based on mean of 3 measurements per concentration)	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0.1 % ethanol	
Concentration 1 Nom; Meas (µg/L)	10; 11.1 (mean of 3 measurements)	3 reps; 5 eggs/rep
Concentration 2 Nom; Meas (µg/L)	20; 19.5 (mean of 3 measurements)	3 reps; 5 eggs/rep
Concentration 3 Nom; Meas (µg/L)	30; 26.9 (mean of 3 measurements)	3 reps; 5 eggs/rep
Concentration 4 Nom; Meas (µg/L)	50; 42.1 (mean of 3 measurements)	3 reps; 5 eggs/rep
Concentration 5 Nom; Meas (µg/L)	100; 64.2 (mean of 3 measurements)	3 reps; 5 eggs/rep
Concentration 6 Nom; Meas (µg/L)	150; 96 (mean of 3 measurements)	3 reps; 5 eggs/rep
Control	Solvent	3 reps; 5 eggs/rep
LC_{50} (95% confidence interval) µg/L	73.0 (42.6-88.5)	Method: probit

	Yang et al. 2014	*D. rerio*
Parameter	**Value**	**Comment**
EC_{50} (95% confidence interval) μg/L	Crooked body: 68.0 (53.6-81.6) Spasms: 64.5 (4.5-79.6) Pericardial edema: 84.2 (62.5-107.9) Non-inflation of swimbladder: 69.9 (47.1-87.1)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). 100-28=72
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), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Hypothesis tests (3). 100-44=56

Reliability score: mean(72,56)=64

Toxicity Data Summary

Duttaphrynus melanostictus

Study: David M, Marigoudar SR, Patil VK, Halappa R. 2012. Behavioral, morphological deformities and biomarkers of oxidative damage as indicators of sublethal cypermethrin intoxication on the tadpoles of *D. melanostictus* (Schneider, 1799). Pesticide Biochemistry and Physiology 103:127-134.

Relevance
Score: 100 (mortality only)
Rating: R

Reliability
Score: 65
Rating: L

	David et al. 2012	***D. melanostictus***
Parameter	**Value**	**Comment**
Test method cited	APHA 2005	
Phylum	Chordata	
Class	Amphibia	
Order	Anura	
Family	Bufonidae	
Genus	*Duttaphrynus*	
Species	*melanostictus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Tadpoles (Gosner stage 25)	
Source of organisms	Wild-collected during monsoon season in Karnataka, India	
Have organisms been exposed to contaminants?	Potentially	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	96 h	
Data for multiple times?	Yes, 24, 48, 72 h	
Effect 1	Mortality	
Control response 1	0%	
Temperature	20 °C	
Test type	Static renewal (every other day)	
Photoperiod/light intensity	11.5 h light: 10 h dark	
Dilution water	Not reported	
pH	Not reported	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	Not reported	

	David et al. 2012	*D. melanostictus*
Parameter	**Value**	**Comment**
Feeding	Not reported	
Purity of test substance	92.95%	
Concentrations measured?	No	
Measured is what % of nominal?	Not applicable	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Not applicable	
Concentration of carrier (if any) in test solutions	acetone 1:20 W/V	
Concentration 1 Nom (μg/L)	24 h: 4.95 48 h: 4.35 72 h: 3.75 96 h: 3.15	6 reps, 10/rep
Concentration 2 Nom (μg/L)	24 h: 5.0 48 h: 4.4 72 h: 3.8 96 h: 3.2	6 reps, 10/rep
Concentration 3 Nom (μg/L)	24 h: 5.05 48 h: 4.45 72 h: 3.85 96 h: 3.25	6 reps, 10/rep
Concentration 4 Nom (μg/L)	24 h: 5.1 48 h: 4.5 72 h: 3.9 96 h: 3.3	6 reps, 10/rep
Concentration 5 Nom (μg/L)	24 h: 5.15 48 h: 4.55 72 h: 3.95 96 h: 3.35	6 reps, 10/rep
Concentration 6 Nom (μg/L)	24 h: 5.2 48 h: 4.6 72 h: 4.0 96 h: 3.4	6 reps, 10/rep
Concentration 7 Nom (μg/L)	24 h: 5.25 48 h: 4.65 72 h: 4.05 96 h: 3.45	6 reps, 10/rep
Concentration 8 Nom (μg/L)	24 h: 5.3 48 h: 4.7 72 h: 4.1 96 h: 3.5	6 reps, 10/rep
Concentration 9 Nom (μg/L)	24 h: 5.35 48 h: 4.75 72 h: 4.15	6 reps, 10/rep

	David et al. 2012	*D. melanostictus*
Parameter	**Value**	**Comment**
	96 h: 3.55	
Control	Solvent	6 reps, 10/rep
LC50 (95% confidence interval) μg/L	24 h: 5.15 (5.11-5.19) 48 h: 4.55 (4.51-4.59) 72 h: 3.95 (3.91-3.99) 96 h: 3.34 (3.30-3.39)	Method: probit (Finney method)

Notes: Other effects were reported, but none all were tested with just a single concentration, thus dose-response toxicity values were not calculable.

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Analytical method (4), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). 100-31=69

<u>Acceptability (Table 3.8):</u> Measured concentrations within 20% of nominal (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Feeding (3), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Random design (2), Hypothesis tests (3). 100-39=61

Reliability score: mean(69, 61)=65

Toxicity Data Summary

Gammarus pulex

Study: Adam O, Badot P-M, Degiorgi F, Crini G. 2009. Mixture toxicity assessment of wood preservative pesticides in the freshwater amphipod *Gammarus pulex* (L.). Ecotoxicology and Environmental Safety 72:441-449.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 63
Rating: L

*No standard method, Control response not acceptable

	Adam et al. 2009	***G. pulex***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Amphipoda	
Family	Gammaridae	
Genus	*Gammarus*	
Species	*pulex*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults, >6 mm	
Source of organisms	Collected in field from an unpolluted stream	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Acclimated at least 10 d	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	Yes, but only estimated from Fig 2	
Effect 1	Mortality	
Control response 1	5-13.3%	
Temperature	15 °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Mineral water	
pH	6.99 ± 0.02	
Hardness	NR	
Alkalinity	NR	
Conductivity	252 ± 8 uS/cm	

	Adam et al. 2009	*G. pulex*
Parameter	**Value**	**Comment**
Dissolved Oxygen	49 ± 8% saturation at 96 h	
Feeding	NR	
Purity of test substance	97.0%	
Concentrations measured?	Yes	
Measured is what % of nominal?	Mean: 46% at 96 h	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC-ECD	
Concentration of carrier (if any) in test solutions	0.01% acetonitrile	
Concentration 1 Nom/Meas (μg/L)	0-0.2, # of concentrations NR	6 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	0.050/0.048 (meas. at t_0)	6 reps, 10/rep
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	6 reps, 10/rep
LC_{50} (95 % confidence interval) (μg/L)	24 h: 0.12* (0.116-0.135) 48 h: 0.11* (0.098-0.116) 72 h: 0.092* (0.084-0.103) 96 h: 0.09 (0.082-0.101)	Method: Hill's model

Notes: *LC50 values estimated from Fig. 2, but 95% confidence intervals are reported in Table 4.

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Hypothesis tests (8). -21

<u>Acceptability (Table 3.8):</u> No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organism size (3), Feeding (3), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Statistical method (2), Hypothesis tests (3). -53

Toxicity Data Summary

Gammarus pulex

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

<u>Relevance</u>
Score: 90
Rating: R

<u>Reliability</u>
Score: 74
Rating: R

*No standard method

	Stephenson1982	***G. pulex***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Crustacea (Malacostraca)	
Order	Amphipoda	
Family	Gammaridae	
Genus	*Gammarus*	
Species	*pulex*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3-8 mm	
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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>80% saturation	

	Stephenson1982	***G. pulex***
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50}	24 h: 0.1 (0.08-0.2)	Method: Probit
EC_{50}	2 h: 0.08 (0.06-0.1) 24 h: 0.04 (0.02-0.06)	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior Contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Toxicity Data Summary

Gyrinus natator

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephenson 1982	***G. natator***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Coleoptera	
Family	Gyrinidae	
Genus	*Gyrinus*	
Species	*natator*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults	
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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	

	Stephenson 1982	*G. natator*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (µg/L)	4.7 (stock) – 200x dilution # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (µg/L)	24 h: $\geq$ 5	Method: Probit
EC_{50} (µg/L)	2 h: 0.2 24 h: 0.07 (0.04-0.2)	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

Water Toxicity Data Summary

Hyalella azteca

Bradley MJ. 2013. Cypermethrin – 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. 13656.6171.

Relevance	Reliability
Score: 100	Score: 90.5
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	7 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	0%	
Temperature	23 ± 1^oC	
Test type	Flow-through	
Photoperiod/light intensity	16 h light: 8 h dark, 220-290 lux	
Dilution water	Laboratory well water	
pH	7.0-7.3	
Hardness	40-44 mg/L $CaCO_3$	

H. azteca	**Bradley 2013**	
Parameter	**Value**	**Comment**
Alkalinity	18-22 mg/L $CaCO_3$	
Conductivity	240 uS/cm	
Total organic carbon	0.31 mg/L	
Dissolved Oxygen	6.4-8.4 mg/L	$\geq$ 75% saturation
Feeding	1.0 mL YCT once daily	YCT: Yeast, cereal leaves, flaked fish food
Purity of test substance	95.2%	
Concentrations measured?	Yes	
Measured is what % of nominal?	52-85%	
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)	0.30; 0.21	2 reps, 10/rep
Concentration 2 Nom; Meas (ng/L)	0.60; 0.31	2 reps, 10/rep
Concentration 3 Nom; Meas (ng/L)	1.2; 0.68	2 reps, 10/rep
Concentration 4 Nom; Meas (ng/L)	2.4; 1.6	2 reps, 10/rep
Concentration 5 Nom; Meas (ng/L)	4.8; 4.1	2 reps, 10/rep
Control	Solvent and dilution water	2 reps, 10/rep
LC_{50} (95% CI) (ng/L)	0.56 (0.45-0.69)	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: Measured concentrations within 20% nominal (4), Random design (2), Adequate replication (2), Hypothesis tests (3). Total: 100-11=89
Reliability score: mean(92, 89)=90.5

Toxicity Data Summary

Hyalella azteca

Study: Weston DP, Jackson CJ. 2009. Use of Engineered Enzymes to Identify Organophosphate and Pyrethroid-Related Toxicity in Toxicity Identification Evaluations. Environ Sci Technol 43:5514-5520.

Relevance	Reliability
Score: 100, 85 (impaired swimming)	Score: 87.5
Rating: R, L (impaired swimming)	Rating: R

*Endpoint not linked to survival/growth/reproduction (impaired swimming only)

Reference	**Weston & Jackson 2009**	***H. azteca***
Parameter	**Value**	**Comment**
Test method cited	USEPA	Modified for H. azteca
Phylum	Arthropoda	
Class	Crustacea - Malacostraca	
Order	Amphipoda	
Family	Hyalellidae	
Genus	*Hyalella*	
Species	*azteca*	
Family in North America?	Yes	
Age/size at start of test/growth phase	7- 14 d†	
Source of organisms	Lab culture†	Weston Lab
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?	No	
Effect 1	Mortality	
Control response 1	median control survival was 95% (range 84-100%). Median solvent control survival for the acetone carrier was 98% (84-100%)	
Effect 2	Impaired swimming*	
Control response 2	Survivors never had impaired control response	
Temperature	23 °C	
Test type	Static renewal (48 h)	

Reference	Weston & Jackson 2009	*H. azteca*
Parameter	**Value**	**Comment**
Photoperiod/light intensity	16:8 (light:dark)	
Dilution water	EPA moderately hard water, from purified water	
pH	7.5†	
Hardness	90 mg/L as $CaCO_3$ †	
Alkalinity	60 mg/L as $CaCO_3$ †	
Conductivity	335 umhos/cm†	
Dissolved Oxygen	7.4 mg/L†	
Feeding	Yes, but appropriate	DO depletion & sorption minimized by feeding 6h prior to renewal
Purity of test substance	> 98%†	
Concentrations measured?	Yes, see notes	
Measured is what % of nominal?	median 114% of nominal; range 64-189%	Pyrethroid conc. declined to a median of 34% of initial nominal conc. within 48 h (range <12-72%, *n* = 9).
Chemical method documented?	Yes	GC-uECD
Concentration of carrier (if any) in test solutions	Acetone, < 32 μL/L	
Concentration 1 Nom	5-8 conc. separated by a factor of 0.5 (e.g., 20, 10, 5, 2.5, 1.3 ng/L)	3 reps and 10/rep
Control	solvent	3 reps and 10/rep
LC_{50} (95% confidence interval) (ng/L)	2.1 (1.7-2.5) 2.3 (1.3-3.5) 3.1 (2.0-4.4)	Probit
EC_{50} (95% confidence interval) (ng/L)	1.6 (1.4-1.9) 1.7 (1.4-1.9) 1.8 (0.9-2.6)	Probit

Other notes:

†Indicates information was gathered or clarified via email communication with the author Dr. Donald Weston (dweston@berkeley.edu).

*Most impaired organisms were lying on their sides, able only to twitch one or more appendages. For those few individuals still able to swim, movement was poorly coordinated and swimming limited to only a few body lengths. Therefore, we also recorded the proportion of animals able to swim normally, with results reported as the median effective concentration (EC_{50}).

When spiking water or sediment with pesticides, samples to determine the actual pesticide concentration were taken from one concentration step in the midpoint of the range used. For the water tests, the initial water concentration was determined at time 0 and again when fresh solutions were prepared at 48 h. The two samples were either analyzed separately or as a composite. Samples were also taken of water that had been in the beakers for the maximum period (at the end of the first and second 48 h intervals, combined as a composite).

The average pyrethroid concentrations to which *H. azteca* were exposed were approximated as the nominal concentration minus one-half of the 66% nonenzymatic loss over 48 h (i.e., average actual concentration equal to 33% less than nominal). All reported water concentrations are actual values, derived from nominal concentrations adjusted by this factor.

Reliability Scoring
Documentation points taken off for: Nominal concentrations (3), Measured concentrations (3), Hypothesis tests (8). -14

Acceptability points taken off for: Meas. conc. w/in 20% of nom. (4), Conc. not > 2x water solubility (4), Hypothesis tests (3). -11

Toxicity Data Summary

Hyalella azteca

Study: Hamer MJ. 1997. Cypermethrin: Acute toxicity of short-term exposures to *Hyalella azteca.* Zeneca Agrochemicals, Jealott's Hill Research Station: Bracknell (Berkshire), UK. Laboratory project ID: TMJ3904B. EPA MRID: 44423501.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

Reference	**Hamer 1997**	***H. azteca***
Parameter	**Value**	**Comment**
Test method cited	None	
Phylum	Arthropoda	
Class	Crustacea - Malacostraca	
Order	Amphipoda	
Family	Hyalellidae	
Genus	*Hyalella*	
Species	*azteca*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adult	
Source of organisms	Lab Culture	Jealott's Hill Research Station
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?	Exposure for different durations, but only calculated 96hr EC50	
Effect 1	Mortality	
Control response 1	10%	
Temperature	23 ± 2°C	
Test type	Static renewal (renewal 24 h)	
Photoperiod/light intensity	16:8 (light:dark)	
Dilution water	NR	
pH	NR	
Hardness	Hard 160-180 mg $CaCO_3$/L	

Reference	Hamer 1997	*H. azteca*
Parameter	**Value**	**Comment**
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Yes, but appropriate	
Purity of test substance	RADIO-CHMICAL 97%	^{14}C
Concentrations measured?	Yes, Liquid Scintillation Counting (LSC)	
Measured is what % of nominal?	~ 80% for concentrations above detection limits	
Chemical method documented?	Yes	LSC
Toxicity values calculated with measured or nominal concentrations?	Nominal	
Concentration of carrier (if any) in test solutions	Acetone, < 5 μL/L	
Concentration 1 Nom/Meas (ng/L)	25/ 24	1 rep, 10/rep
Concentration 2 Nom/Meas (ng/L)	12.5/ <10	
Concentration 3 Nom/Meas (ng/L)	6.25/ <10	
Concentration 4 Nom/Meas (ng/L)	3.13/ <10	
Concentration 5 Nom/Meas (ng/L)	1.56/ <10	
Concentration 6 Nom/Meas (ng/L)	0.78/ <10	
Control	Solvent	
EC_{50} (95% confidence interval) (ng/L)	Survival at 96 h after an exposure duration of: 1 h: 170 (110-230) 3 h: 87 (37-310) 6 h: 56 (38-81) 12 h: 23 (10-54) 96 h: 3.6 (2-4.9)	Method: Probit

Other notes:

Reliability Scoring

Documentation points taken off for: Dilution water source (3), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Hypothesis tests (8). -22

Acceptability points taken off for: Acceptable standard method (5), Appropriate size/age/growth (3), Organisms randomly assigned to test containers (1), Dilution water source

(2), Dissolved oxygen (6), Temperature held to +/- 1C (3), Conductivity (1), pH (2), Random block (2), Adequate replicates (2), Hypothesis tests (3). -30

Toxicity Data Summary

Hyalella curvispina

Study: Mugni H, Paracamp A, Marrochi N, Bonetto C. 2013. Acute toxicity of cypermethrin to the non target organism *Hyalella curvispina.* Environmental Toxicology and Pharmacology 35:88-92.

Relevance
Score: 100
Rating: R

Reliability
Score: 72
Rating: L

	Mugni et al. 2013	***H. curvispina***
Parameter	**Value**	**Comment**
Test method cited	U.S. EPA 2000	Followed protocols for *H. azteca*
Phylum	Arthropoda	
Class	Crustacea - Malacostraca	
Order	Amphipoda	
Family	Hyalellidae	
Genus	*Hyalella*	
Species	*curvispina*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults, 5-10 mm	
Source of organisms	Collected from an uncontaminated stream in Argentina	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Acclimated several weeks	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	0%	
Temperature	22 ± 2°C	
Test type	Static	
Photoperiod/light intensity	"natural photoperiod"	
Dilution water	Reconstituted moderately hard synthetic water	APHA 1995
pH	Not reported	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	Not reported	

	Mugni et al. 2013	***H. curvispina***
Parameter	**Value**	**Comment**
Feeding	None	
Purity of test substance	98%	
Concentrations measured?	3 highest doses only	
Measured is what % of nominal?	90-118%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0.3% methanol	
Concentration 1 Nom (µg/L)	0.005	3 reps, 10/rep
Concentration 2 Nom (µg/L)	0.01	3 reps, 10/rep
Concentration 3 Nom (µg/L)	0.025	3 reps, 10/rep
Concentration 4 Nom (µg/L)	0.05	3 reps, 10/rep
Concentration 5 Nom; Meas (µg/L)	0.1; 0.09	3 reps, 10/rep
Concentration 6 Nom; Meas (µg/L)	0.2; 0.236	3 reps, 10/rep
Concentration 7 Nom; Meas (µg/L)	0.3; 0.295	3 reps, 10/rep
Control	Solvent	3 reps, 10/rep
LC_{50} (95% confidence limit) µg/L	Test 1: 0.033 (0.025-0.046) Test 2: 0.064 (0.056-0.072) Test 3: 0.096 (0.087-0.108)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hardness (2), Alkalinity (2), Dissolved oxygen (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). 100-24=76

Acceptability (Table 3.8): Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Conductivity (1), pH (2), Photoperiod (2), Random design (2), Hypothesis tests (3). 100-32=68

Reliability score: mean(76, 68)=72

Toxicity Data Summary

Labeo rohita

Study: Marigoudar SR, Ahmed RN, David M. 2009. Cypermethrin induced respiratory and behavioural responses of the freshwater teleost, *Labeo rohita* (Hamilton). Veterinarshki Arhiv 79:583-590.

Relevance
Score: 75
Rating: L

Reliability
Score: 62
Rating: L

*No acceptable standard method, Controls not described, control response not reported.

	Marigoudar et al. 2009	***L. rohita***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Labeo*	
Species	*rohita*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Fingerlings, 3 $\pm$ 0.5 g, 6 cm	
Source of organisms	Laboratory culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	Not reported	
Temperature	24 ± 2°C	
Test type	Static renewal, renewed every 24 h	
Photoperiod/light intensity	12 h light: 12 h dark	
Dilution water	Dechlorinated tapwater	
pH	7.1 ± 0.2	
Hardness	23.4 ± 3.4 mg/L as $CaCO_3$	
Alkalinity	Not reported	
Conductivity	< 10 uS/cm	
Dissolved Oxygen	9.3 ± 0.8 mg/L	
Feeding	None during test	

	Marigoudar et al. 2009	*L. rohita*
Parameter	**Value**	**Comment**
Purity of test substance	92.95%	
Concentrations measured?	No	
Measured is what % of nominal?	Not available	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Not applicable	
Concentration of carrier (if any) in test solutions	Acetone, concentration not reported	
Concentration 1 Nom/Meas (μg/L)	# of concentrations not reported	6 reps, 10/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	Not described	Reps and # per
LC_{50} (95% confidence interval) μg/L	4.0 (3.668-4.231)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Alkalinity (2), Hypothesis tests (8). 100-28=72

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), Organisms randomized (1), Alkalinity (2), Temperature (3), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). 100-48=52

Reliability score: mean(72, 52)=62

Toxicity Data Summary

Lepomis macrochirus

Study: Hill RW. 1980a. Determination of the acute toxicity of cypermethrin (PP383) to bluegill sunfish (*Lepomis macrochirus*). ICI Limited, Brixham Laboratory. BL/B/2011. EPA MRID: 00065812 or 240178304.

Relevance
Score: 90
Rating: R

Reliability
Score: 75.5
Rating: R

*Acceptable standard method (10).

	Hill 1980a	***L. macrochirus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
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 wt: 1.46 g Mean length: 41.95 mm	
Source of organisms	Lab culture	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes (at least 3 days)	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	96 h	
Data for multiple times?	Yes, 24, 48, 72 h	
Effect 1	Mortality	
Control response 1	0%	
Temperature	22 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	Not reported	
Dilution water	Not described	
pH	7.25-7.70	
Hardness	34-46 mg/L	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	7.6-8.9 mg/L	
Feeding	Not reported	

	Hill 1980a	*L. macrochirus*
Parameter	**Value**	**Comment**
Purity of test substance	91.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	57-79%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	10 ppm (mg/L) DMSO	
Concentration 1 Nom/Meas (µg/L)	0.56; 0.35	20/conc
Concentration 2 Nom/Meas (µg/L)	1.0; 0.71	20/conc
Concentration 3 Nom/Meas (µg/L)	2.4; 1.44	20/conc
Concentration 4 Nom/Meas (µg/L)	3.2; 1.93	20/conc
Concentration 5 Nom/Meas (µg/L)	4.2; 2.38	20/conc
Concentration 6 Nom/Meas (µg/L)	5.6; 3.17	20/conc
Concentration 7 Nom/Meas (µg/L)	10; 6.66	20/conc
Concentration 8 Nom/Meas (µg/L)	18; 14.3	20/conc
Concentration 9 Nom/Meas (µg/L)	24; 16.1	20/conc
Concentration 10 Nom/Meas (µg/L)	32; 21.6	20/conc
Concentration 11 Nom/Meas (µg/L)	42; 32.3	20/conc
Control	Solvent & dilution control	20/conc
LC50 (95% confidence interval) (µg/L)	24 h: 3.07 (2.77-3.39) 48 h: 2.15 (1.99-2.33) 72 h: 1.85 (xx-2.02) 96 h: 1.78 (1.63-1.95)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Dilution water (3), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). 100-18=82

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). 100-31=69

Reliability score: mean(82, 69)=75.5

Toxicity Data Summary

Lymnaea acuminata

Study: Tripathi PK, Singh A. 2004. Toxic effects of cypermethrin and alphamethrin on reproduction and oxidative metabolism of the freshwater snail, *Lymnaea acuminata.* Ecotoxicology and Environmental Safety 58:227-235.

Relevance
Score: 75
Rating: L

Reliability
Score: 62.5
Rating: L

*No standard method, Chemical purity not reported

	Tripathi & Singh 2004	***L. acuminata***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Mollusca	
Class	Gastropoda	
Order	Pulmonata	
Family	Lymnaeidae	
Genus	*Lymnaea*	
Species	*acuminata*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults (37.2 mm shell height, 20.0 mm shell width at time of collection)	
Source of organisms	Collected from uncontaminated water bodies in Uttar Pradesh, India	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes, 7 d	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	28 d	
Data for multiple times?	Yes	
Effect 1	Number of eggs after 96 h	
Control response 1	288 ± 12.4	
Effect 2	Number of hatched eggs	
Control response 2	262 ± 10.5	
Effect 3	Survival of hatchlings	
Control response 3	7 d: 260 ± 10.2 (99%) 14 d: 255 ± 9.8 (97%) 21 d: 251 ± 8.3 (96%) 28 d: 248 ± 4.5 (95%)	
Temperature	23 ± 0.8°C	

	Tripathi & Singh 2004	*L. acuminata*
Parameter	**Value**	**Comment**
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Dechlorinated tapwater	
pH	7.2 ± 0.2	
Hardness	NR	
Alkalinity	106 ± 7.6 mg/L	
Conductivity	NR	
Dissolved Oxygen	7.2 ± 0.3 mg/L	
Feeding	None during test	
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 (μg/L)	4.0	6 reps, 10/rep
Concentration 2 Nom (μg/L)	8.0	6 reps, 10/rep
Concentration 3 Nom (μg/L)	12.0	6 reps, 10/rep
Control	Dilution water	6 reps, 10/rep
NOEC	Number of eggs after 96 h: <4.0* Number of hatched eggs 96 h: <4.0* Survival of hatchlings after 7 d: 8.0 * Survival of hatchlings after 14 d: <4.0 Survival of hatchlings after 21 d: <4.0 Survival of hatchlings after 28 d: < 4.0	Method: Student's t test p: 0.05 MSD: NR
LOEC	Number of eggs after 96 h: 4.0* Number of hatched eggs: 4.0* Survival of hatchlings after 7 d: 12* Survival of hatchlings after 14 d: 4.0* Survival of hatchlings after 21 d: 4.0	Same as above

	Tripathi & Singh 2004	***L. acuminata***
Parameter	**Value**	**Comment**
	Survival of hatchlings after 28 d: 4.0	
MATC (GeoMean NOEC,LOEC)	*Not appropriate to calculate	
% of control at NOEC	Given in Table 1	
% of control at LOEC	Given in Table 1	

Notes:*The number of eggs or snails at this concentration was significantly GREATER than in the controls – statistics were only done on raw data, not on % hatched or % surviving. It is therefore not clear if these data demonstrate a dose-response relationship between cypermethrin exposure and reproduction of snails.

Reliability points taken off for:
Documentation (Table 3.7): Chemical purity (5), Analytical method (4), Measured concentrations (3), Hardness (2), Conductivity (2), Photoperiod (3), Minimum significant difference (2), Point estimates (8). -29

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), Exposure type (2), Hardness (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Hypothesis tests (3), Point estimates (3). -46

Toxicity Data Summary

Labeo rohita

Study: Philip GH, Reddy PM, Sridevi G. 1995. Cypermthrin-induced *in vivo* alterations in the carbohydrate metabolism of freshwater fish, *Labeo rohita.* Ecotoxicology and Environmental Safety 31:173-178.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 64.5
Rating: L

*No standard method, control not described (Endpoints other than mortality were not linked to survival/growth/reproduction and are rated N and not reported)

	Philip et al. 1995	***L. rohita***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Labeo*	
Species	*rohita*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	Fish hatchery	Fisheries Dept. Anantapur, India
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	0%	
Temperature	27 ± 1°C	
Test type	Static	
Photoperiod/light intensity	16 L: 8 D	
Dilution water	Dechlorinated tapwater	
pH	7.4-7.6	
Hardness	160 mg/L as CaCO3	
Alkalinity	87 mg/L as CaCO3	
Conductivity	210 umol/cm	
Dissolved Oxygen	6-7 mg/L	

	Philip et al. 1995	*L. rohita*
Parameter	**Value**	**Comment**
Feeding	NR	
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	% NR, acetone	
Concentration 1 Nom (µg/L)	6 concentrations estimated from Fig 1 1	Reps and # per: NR
Concentration 2 Nom (µg/L)	2	Reps and # per: NR
Concentration 3 Nom (µg/L)	4	Reps and # per: NR
Concentration 4 Nom (µg/L)	6	Reps and # per: NR
Concentration 5 Nom (µg/L)	8	Reps and # per: NR
Concentration 6 Nom (µg/L)	12	Reps and # per: NR
Control	Not described	Reps and # per: NR
LC_{50} (µg/L)	96 h: 5.24	Method: probit

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Control type (8), Organism age (5), Analytical method (4), Measured concentrations (3), Hypothesis tests (8). -28

<u>Acceptability (Table 3.8):</u> No standard method (5), Control description (6), 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), Random design (2), Adequate replicates (2), Hypothesis tests (3). -43

Toxicity Data Summary

Oncorhynchus mykiss

Study: Davies PE, Cook LSJ, Goenarso D. 1994. Sublethal responses to pesticides of several species of Australian freshwater fish and crustaceans and rainbow trout. Environ Toxicol Chem 13:1341-1354.

Relevance
Score: acute: 82.5, chronic: 75
Rating: L

Reliability
Score: acute: 70.5, chronic: 74
Rating: acute: L, chronic: R

*No standard method (-10), endpoint not linked to survival/growth/reproduction (chronic only, -15), control response not reported (acute, -7.5)

	Davies et al. 1994	***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	Juveniles (1.1-2.5 g, 45-60 mm or 10-30 g, 100-150 mm)	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	10 d	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	NR	
Effect 2	Hepatic GST activity	
Control response 2	3.6 (0.91) mmol substrate/g tissue/ min	
Temperature	12-15 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Surface water	
pH	6.5-7	

	Davies et al. 1994	*O. mykiss*
Parameter	**Value**	**Comment**
Hardness	NR	
Alkalinity	NR	
Conductivity	50-120 uS/cm	
Dissolved Oxygen	>80% saturation	
Feeding	Fed commercial salmon food throughout exposures	Not acceptable – should be no feeding in acute test
Purity of test substance	>98%	
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	2-10 mg/L ethanol or acetone (~12.6-12.7 mL/L EtOH or acetone)	>0.5 mL/L, not acceptable
Concentration 1 Nom/Meas (μg/L)	NR/0.17	2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR/0.33	2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR/0.49	2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR/0.87	2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR/2.52	2 reps, 10/rep
Control	Dilution water	2 reps, 10/rep
LC_{50} (95% confidence limit) (μg/L)	12 h: >2.52 96 h: 1.47 (1.20-1.75) 10 d: 1.47 (1.20-1.75)	Method: probit
NOEC (μg/L)	Hepatic GST activity 10 d: 0.49	Method: Dunnett's t statistic, 2way ANOVA p: 0.005 MSD: NR
LOEC (μg/L)	Hepatic GST activity 10 d: 0.87	Same as above
MATC (GeoMean NOEC,LOEC) (μg/L)	Hepatic GST activity 10 d: 0.65	
% of control at NOEC	4.67/3.60= 130%	
% of control at LOEC	5.21/3.60=145%	

Notes:

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

Chronic: Nominal concentrations (3), Hardness (2), Alkalinity (2), Photoperiod (3), Point estimates (8), Minimum significant difference (2). -20

<u>Acceptability (Table 3.8):</u>
Acute: No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Feeding (3), Hardness (2), Alkalinity (2), Temperature (3), Photoperiod (2), Random design (2), Hypothesis tests (3). -40
Chronic: No standard method (5), Appropriate duration (2), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Hardness (2), Alkalinity (2), Temperature (3), Photoperiod (2), Random design (2), Minimum significant difference (1), NOEC response reasonable compared to control (1), Point estimates (3). -32

Toxicity Data Summary

Oncorhynchus mykiss

Study: Hill RW. 1980b. Determination of the acute toxicity of cypermethrin (PP 383) to Rainbow Trout (*Salmo gairdneri*). ICI Limited, Brixham Laboratory, BL/B/2006. EPA MRID: 00062792 or 240139912.

Relevance
Score: 90*
Rating: R

Reliability
Score: 77
Rating: R

*Acceptable standard method (10).

	Hill 1980b	***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: 1.94 g Mean length: 54.5 mm	
Source of organisms	Fish hatchery	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes (at least 14 d)	
Animals randomized?	Not reported	
Test vessels randomized?	Not reported	
Test duration	96 h	
Data for multiple times?	Yes, 24, 48, 72 h	
Effect 1	Mortality	
Control response 1	0%	
Temperature	12 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	Not reported	
Dilution water	Not described	
pH	7.45-8.0	
Hardness	38-52 mg/L	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	9.4-12.4 mg/L	
Feeding	Not reported	

	Hill 1980b	*O. mykiss*
Parameter	**Value**	**Comment**
Purity of test substance	91.5%	
Concentrations measured?	Yes	
Measured is what % of nominal?	43-79%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	10 mg/L DMSO	
Concentration 1 Nom/Meas (μg/L)	0.32; 0.14	20/conc
Concentration 2 Nom/Meas (μg/L)	0.56; 0.25	20/conc
Concentration 3 Nom/Meas (μg/L)	0.75; 0.43	20/conc
Concentration 4 Nom/Meas (μg/L)	1.0; 0.55	20/conc
Concentration 5 Nom/Meas (μg/L)	1.8; 1.08	20/conc
Concentration 6 Nom/Meas (μg/L)	2.4; 1.49	20/conc
Concentration 7 Nom/Meas (μg/L)	3.2; 1.95	20/conc
Concentration 8 Nom/Meas (μg/L)	4.2; 3.35	20/conc
Control	Solvent & dilution water	20/conc
LC50 (95% confidence interval) (μg/L)	24 h: 1.78 (1.50-2.12) 48 h: 1.10 (0.97-1.25) 72 h: 0.96 (0.86-1.09) 96 h: 0.92 (0.83-1.85)	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). 100-15=85

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Hypothesis tests (3). 100-31=69

Reliability score: mean(85, 69)= 77

Toxicity Data Summary

Oncorhynchus mykiss

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 72
Rating: L

*No standard method, control response not reported

	Stephenson 1982	***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	1-2 g	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes (10 d)	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	Test 1) 10 ± 1°C Test 2) 15 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>80% saturation	
Feeding	None during test	

	Stephenson 1982	*O. mykiss*
Parameter	**Value**	**Comment**
Purity of test substance	85-95%	
Concentrations measured?	Yes	
Measured is what % of nominal?	>70%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (µg/L)	Test 1) 4 conc (0.39-1.4) Test 2) 7 conc (0.45-1.1)	1 rep, 5/rep
Control	Dilution water	1 rep, 5/rep
LC_{50} (µg/L)	Test 1) 0.5 Test 2) 0.5	Method: probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Organisms/rep (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -35

Toxicity Data Summary

Oncorhynchus mykiss

Study: Vaishnav DD, Yurk JJ. 1990. Cypermethrin (FMC 45806): Acute toxicity to rainbow trout (*Oncorhynchus mykiss)* under flow-through test conditions. FMC Corporation study number A89-3109-01. Laboratory project ID: ESE No. 3903026-0750-3140. Environmental Science and Engineering, Inc. (ESE): Gainesville, FL. CDPR 118785.

Relevance
Score: 100
Rating: R

Reliability
Score: 90.5
Rating: R

	Vaishnav & Yurk 1990	***O. mykiss***
Parameter	**Value**	**Comment**
Test method cited	US EPA (1982), ASTM 1980	
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	83-day old juveniles	
Source of organisms	Lab Culture- Aquatic Research Organisms, Hampton NH	.
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	
Effect 1	Mortality	
Control response 1	0%	
Temperature	12± 1 C	
Test type	Flow-Through	
Photoperiod/light intensity	16:8 Hr Light: Dark	
Dilution water	Well water	
pH	7.9-8.1	.
Hardness	269 mg/L $CaCO_3$	EPA guidelines 40-180mg/L → not okay
Alkalinity	253 mg/L $CaCO_3$	

	Vaishnav & Yurk 1990	*O. mykiss*
Parameter	**Value**	**Comment**
Conductivity	390 umhos/cm	
Dissolved Oxygen	8.4-10.6 mg/L (>80% saturation)	
Feeding	Not during test (appropriate)	
Purity of test substance	91.5%	
Concentrations measured?	Yes for stock solution. Nominal exposure concentrations based on measured concentration of stock.	
Measured is what % of nominal?	56-75%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes. HPLC with UV Detection. 0 and 96 hour exposure samples.	
Concentration of carrier (if any) in test solutions	30µL DMF/L	
Concentration 1 Nom/Meas (µg/L)	0.39/ 0.219	2 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	0.65/0.366	2 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	1.08/ 0.719	2 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	1.80/ 1.35	2 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	3.00/ 2.24	2 reps, 20/rep
Control	Dilution water and solvent	2 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	24 h: 1.74 (1.35-2.24) 48 h: 1.03 (0.719-1.35) 72 h: 0.95 (0.719-1.35) 96 h: 0.90 (0.72-1.35)	Method: Binomial

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Hypothesis tests (8).

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Hardness (2), Random design (2), Hypothesis tests (3). -11

Toxicity Data Summary

Orconectes spp.

Study: Jaber MJ, Hawk RE. 1981a. The acute toxicity of cypermethrin to crayfish (*Orconectes sp.*). ICI Americas Inc. Agricultural Chemicals Division. Report series TMUE0008/B. EPA MRID 00089042 or 240259820.

Relevance
Score: 100
Rating: R

Reliability
Score: 87
Rating: R

	Jaber & Hawk 1981a	***Orconectes sp.***
Parameter	**Value**	**Comment**
Test method cited	Based on ASTM and EPA	
Phylum		
Class		
Order		
Family		
Genus	*Orconectes*	
Species	*spp.*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mean length: 42 mm Mean wt: 2.32 g	
Source of organisms	Wild-collected, Southampton, MA	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes, acclimated 96 h	
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	0%	
Temperature	20 ± 0.2°C	
Test type	Flow-through	
Photoperiod/light intensity	Not reported	
Dilution water	Unchlorinated well water	UV sterilized
pH	7.89-8.09	
Hardness	220 mg/L	
Alkalinity	160 mg/L	
Conductivity	600 umhos/cm	
Dissolved Oxygen	$\geq$ 91% saturation	
Feeding	None during test	
Purity of test substance	91.69%	

	Jaber & Hawk 1981a	*Orconectes sp.*
Parameter	**Value**	**Comment**
Concentrations measured?	Yes	
Measured is what % of nominal?	18-28%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	% not reported, DMF	
Concentration 1 Nom/Meas (μg/L)	0.06; 0.017	Reps and # per (cell density for single-celled organisms):
Concentration 2 Nom/Meas (μg/L)	0.13; 0.023	Reps and # per
Concentration 3 Nom/Meas (μg/L)	0.25; 0.044	Reps and # per
Concentration 4 Nom/Meas (μg/L)	0.50; 0.11	Reps and # per
Concentration 5 Nom/Meas (μg/L)	1.00; 0.21	Reps and # per
Control	Solvent & dilution water	Reps and # per
LC50 (95% confidence interval) (μg/L)	24 h: 0.30 (0.19-2.52) 48 h: 0.070 (0.044-0.11) 72 h: 0.068 (0.053-0.090) 96 h: 0.068 (0.053-0.090)	Method: probit, moving average, or binomial probability

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u>

<u>Acceptability (Table 3.8):</u>

Toxicity Data Summary

*Oreochromis niloticus (*formerly *Tilapia nilotica*)

Study: Stephenson RR, Choi SY, Olmos-Jerez A. 1984. Determining the toxicity and hazard to fish of a rice insecticide. Crop Protection 3:151-165.

Relevance
Score: 90
Rating: R

Reliability
Score: 74.5
Rating: R

*No standard method

	Stephenson et al. 1984	***O. niloticus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes (Actinopterygii)	
Order	Perciformes	
Family	Cichlidae	
Genus	*Oreochromis*	
Species	*niloticus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	0.6-3.0 g	
Source of organisms	Lab cultured	
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	25 ± 2°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Dechlorinated tapwater	
pH	7.1-8.1	
Hardness	230-270 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	7.5-8.5 mg/L	
Feeding	None during test	

	Stephenson et al. 1984	*O. niloticus*
Parameter	**Value**	**Comment**
Purity of test substance	98.4%	
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	HPLC	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	NR	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	Dilution water	10/rep
LC_{50} (μg/L)	24 h: 4 48 h: 3 96 h: 2	Method: probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Alkalinity (2), Temperature (3), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -30

Toxicity Data Summary

Oreochromis niloticus (formerly *Tilapia nilotica)*

Study: Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

<u>Relevance</u>
Score: 82.5
Rating: L

<u>Reliability</u>
Score: 70.5
Rating: L

*No standard method, control response not reported

	Stephenson 1982	***O. niloticus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes (Actinopterygii)	
Order	Perciformes	
Family	Cichlidae	
Genus	*Oreochromis*	
Species	*niloticus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1-3 g	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes (10 d)	
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	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	

	Stephenson 1982	*O. niloticus*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	85-95%	
Concentrations measured?	Yes	
Measured is what % of nominal?	>70%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	3 conc (0.7-6.7)	1 rep, 5/rep
Control	Dilution water	1 rep, 5/rep
LC_{50} (μg/L)	2.2	Method: graphical interpolation

Notes:

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

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Organisms/rep (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Number of concentrations (3), Dilution factor (2), Hypothesis tests (3). -38

Toxicity Data Summary

Palaemonetes argentinus

Study: Collins P, Cappello S. 2006. Cypermethrin toxicity to aquatic life: Bioassays for the freshwater prawn *Palaemonetes argentinus*. Arch Environ Contam Toxicol 51:79-85.

Relevance
Score: mortality: 85, growth: 60, ammonia excretion: 60
Rating: mortality: L, growth: N, ammonia excretion: N

Reliability
Score: mortality: 73
Rating: mortality: L

*Low chemical purity
Growth endpoint: no standard method, no toxicity value calculable
Ammonia-N excretion endpoint: no standard method, endpoint not linked to survival/growth/reproduction

	Collins & Cappello 2006	***P. argentinus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Decapoda	
Family	Palaemonoidea	
Genus	*Palaemonetes*	
Species	*argentinus*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Mortality: Juveniles, average wt. 0.01 ± 0.006 g	
Source of organisms	Collected from Parana River, Argentina	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Acclimated 7 d	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	Yes on Figure 2	
Effect 1	Mortality	
Control response 1	0%	
Temperature	25 ± 2°C (reported for acclimation period, not test)	
Test type	Static	
Photoperiod/light intensity	14 L:10 D (reported for acclimation period, not test)	
Dilution water	Artificial water	not clear what this means
pH	8.1 (reported for acclimation	

	Collins & Cappello 2006	*P. argentinus*
Parameter	**Value**	**Comment**
	period, not test)	
Hardness	83 mg/L (reported for acclimation period, not test)	
Alkalinity	NR	
Conductivity	410 umhos/cm (reported for acclimation period, not test)	
Dissolved Oxygen	5.5 mg/L (reported for acclimation period, not test)	
Feeding	None during test	
Purity of test substance	25%, contains 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	% NR, xylene	
Concentration 1 Nom (μg/L)	0.0250	3 reps, 10/rep
Concentration 2 Nom (μg/L)	0.0125	3 reps, 10/rep
Concentration 3 Nom (μg/L)	0.0062	3 reps, 10/rep
Concentration 4 Nom (μg/L)	0.0031	3 reps, 10/rep
Concentration 5 Nom (μg/L)	0.0012	3 reps, 10/rep
Concentration 6 Nom (μg/L)	0.0006	3 reps, 10/rep
Control	Solvent and dilution water	3 reps, 10/rep
LC_{50} (95% confidence interval) (μg/L)	24 h: 0.0031* 48 h: 0.00275* 72 h: 0.0025* 96 h: 0.0020	Method: probit

Notes: *Estimated from Figure 2. It is assumed that acclimation conditions are the same as the test conditions because acclimation implies that organisms are getting used to the test conditions.

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Measured concentrations (3), Alkalinity (2), Hypothesis tests (8). -17

Acceptability (Table 3.8): Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Exposure type (2), Dilution water (2), Alkalinity (2), Temperature (3), P Random design (2), 4 Hypothesis tests (3). -37

Toxicity Data Summary
Paratya australiensis

Study: Davies PE, Cook LSJ, Goenarso D. 1994. Sublethal responses to pesticides of several species of Australian freshwater fish and crustaceans and rainbow trout. Environ Toxicol Chem 13:1341-1354.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 72
Rating: L

*No standard method, control response not reported

	Davies et al. 1994	***P. australiensis***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Crustacea (Malacostraca)	
Order	Decapoda	
Family	Atyidae	
Genus	*Paratya*	
Species	*australiensis*	
Family in North America?	Yes	
Age/size at start of test/growth phase	0.05-0.15 g	
Source of organisms	Collected in field	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	10 d	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	NR	
Temperature	12-15 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Surface water	
pH	6.5-7	
Hardness	NR	
Alkalinity	NR	
Conductivity	50-120 uS/cm	
Dissolved Oxygen	>80% saturation	
Feeding	NR	
Purity of test substance	>98%	

	Davies et al. 1994	*P. australiensis*
Parameter	**Value**	**Comment**
Concentrations measured?	Yes	
Measured is what % of nominal?	NR	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	GC	
Concentration of carrier (if any) in test solutions	%NR, acetone	
Concentration 1 Nom/Meas (μg/L)	0.17	2 reps, 10-15/rep
Concentration 2 Nom/Meas (μg/L)	0.33	2 reps, 10-15/rep
Concentration 3 Nom/Meas (μg/L)	0.49	2 reps, 10-15/rep
Concentration 4 Nom/Meas (μg/L)	0.87	2 reps, 10-15/rep
Concentration 5 Nom/Meas (μg/L)	2.52	2 reps, 10-15/rep
Control	Dilution water	2 reps, 10-15/rep
LC_{50} (95% confidence limit) (μg/L)	12 h: 0.09 (0.06-0.12) 96 h: <0.09 10 d: <0.09	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Nominal concentrations (3), Hardness (2), Alkalinity (2), Conductivity (2), Photoperiod (3), Hypothesis tests (8). -20

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Feeding (3), Hardness (2), Alkalinity (2), Temperature (3), Conductivity (1), Photoperiod (2), Random design (2), Hypothesis tests (3). -36

Toxicity Data Summary

Piona carnea

Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 90
Rating: R

Reliability
Score: 74
Rating: R

*No standard method

	Stephenson1982	***P. carnea***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Hydracarina	
Family	Pionidae	
Genus	*Piona*	
Species	*carnea*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults	
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?	Yes, 2 h	
Effect 1	Mortality	
Control response 1	<10%	
Effect 2	Immobility	
Control response 2	<10%	
Temperature	15± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as $CaCO_3$	
Alkalinity	NR	
Conductivity	NR	

	Stephenson1982	*P. carnea*
Parameter	**Value**	**Comment**
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	Technical 85-95%	
Concentrations measured?	Stocks and some dilutions were measured, but they were not sampled from the tests	
Measured is what % of nominal?	>70% at 24 h	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	Stock was measured, nominal is calculated on dilution of stock
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Meas (μg/L)	4.7 (stock) – 200x dilution. # of concentrations NR Approx. logarithmic series	1 rep, 10/rep
Control	Dilution water	1 rep, 10/rep
LC_{50} (μg/L)	24 h: 0.05 (0.03-0.08)	Method: Probit
EC_{50} (μg/L)	2 h: 0.02 24 h: 0.02	Method: Probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Measured concentrations within 20% of nominal (4), Prior Contamination (4), Organisms randomized (1), Alkalinity (2), Conductivity (1), Photoperiod (2), Number of concentrations (3), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -31

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: 76.5
Rating: R

*Saltwater

	Cripe 1994	***P. duorarum***
Parameter	**Value**	**Comment**
Test method cited	ASTM	
Phylum	Arthropoda	
Class	Crustacea (Malacostraca)	
Order	Decapoda	
Family	Penaeidae	
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	
Purity of test substance	Technical grade	
Concentrations measured?	No	

	Cripe 1994	*P. duorarum*
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	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	2 reps, 10/rep
LC_{50} (95% confidence interval) (µg/L)	0.11 (0.089-0.13)	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), Hypothesis tests (3). -23

Toxicity Data Summary

Pimephales promelas

Study: Tapp JF, Hill RW, Maddock BG, Harland BJ, Stembridge HM, Bolygo E. 1988. Cypermethrin: Determination of chronic toxicity to fathead minnow (*Pimephales promelas*) full lifecycle. Laboratory project ID: BL/B/3173. ICI PLC, Brixham Laboratory: Brixham (Devon), UK. EPA MRID 40641701.

Relevance
Score: 100
Rating: R

Reliability
Score: 91
Rating: R

	Tapp et al. 1988	***P. promelas***
Parameter	**Value**	**Comment**
Test method cited	EPA 1986	
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	< 48 h	
Source of organisms	Brood stock at Brixham lab	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	Yes	
Test duration	300 d	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	30 d: Dil – 88%, Solv - 67% 60 d: Dil – 84%, Solv - 67%	
Effect 2	Egg production	
Control response 2	Dil – 379 eggs/female Solv – 856 eggs/female	
Effect 3	Growth (length)	
Control response 3	30 d: 19.7 mm 60 d: 32.2 mm	
Temperature	25 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	Varied over time, simulated Evansville, Indiana starting Dec 1	10 L: 14 D to 15 L: 9 D

	Tapp et al. 1988	*P. promelas*
Parameter	**Value**	**Comment**
Dilution water	Filtered dechlorinated tapwater	
pH	7.1-8.2	
Hardness	48.6-75.7 mg/L as CaCO3	
Alkalinity	21.1-32.7 mg/L as CaCO3	
Conductivity	134 uS/cm	
Dissolved Oxygen	7.46 mg/L (>60% saturation)	
Feeding	Yes, fish feed, brine shrimp	
Purity of test substance	93.1%	
Concentrations measured?	Yes	
Measured is what % of nominal?	62-85%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC	
Concentration of carrier (if any) in test solutions	0.00125% triethylene glycol	
Concentration 1 Nom/Meas (µg/L)	0.06/ 0.051	2 reps, 40 eggs/rep, then 15 fish/rep
Concentration 2 Nom/Meas (µg/L)	0.12/ 0.077	2 reps, 40 eggs/rep, then 15 fish/rep
Concentration 3 Nom/Meas (µg/L)	0.25/ 0.154	2 reps, 40 eggs/rep, then 15 fish/rep
Concentration 4 Nom/Meas (µg/L)	0.50/ 0.323	2 reps, 40 eggs/rep, then 15 fish/rep
Concentration 5 Nom/Meas (µg/L)	1.0/ 0.653	2 reps, 40 eggs/rep, then 15 fish/rep
Control	Solvent and dilution water	2 reps, 40 eggs/rep, then 15 fish/rep
NOEC (µg/L)	**30 d F0 survival: 0.077** **60 d F0 survival: 0.077** 150-300 d F0 egg production: 0.15 (significant increase at lower conc)	Method: ANOVA p: 0.05 or 0.01 MSD: NR
LOEC (µg/L)	**30 d F0 survival: 0.15** **60 d F0 survival: 0.15** 150-300 d F0 egg production: 0.32	Same as above
MATC (GeoMean NOEC,LOEC) (µg/L)	30/60 d F0 survival: 0.107	
% of control at NOEC	30 d: 76.3/88 = 87% 60 d: 70.0/84 = 84%	
% of control at LOEC	30 d: 72.0/88 = 82% 60 d: 69.5/84= 83%	

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Minimum significant difference (2), Point estimates (8). -10

Acceptability (Table 3.8): Measured concentrations within 20% of nominal (4), Minimum significant difference (1), Point estimates (3). -8

Toxicity Data Summary

Pseudacris regilla

Study: Biga LM, Blaustein AR. 2013. Variations in lethal and sublethal effects of cypermethrin among aquatic stages and species of anuran amphibians. Environ Toxicol Chem 32:2855-2860.

Relevance
Score: 90*
Rating: R

Reliability
Score: 66.5
Rating: L

*Acceptable standard method (10)

	Biga & Blaustein 2013	***P. regilla***
Parameter	**Value**	**Comment**
Test method cited	None reported	
Phylum	Chordata	
Class	Amphibia	
Order	Anura	
Family	Hylidae	
Genus	*Pseudacris*	
Species	*regilla*	
Family in North America?	Yes	
Age/size at start of test/growth phase	1) Embryo (stage 10-12) 2) Early larvae (<1wk post-hatch; stage 24-25) 3) Late larvae (stage 28-30)	
Source of organisms	Eggs wild-collected in Willamette Valley, Oregon	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Yes	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	Embryos: 90% Early larvae: 100% Late larvae: 100%	
Effect 2	Behavioral abnormalities	
Control response 2	Not reported	
Temperature	14 °C	
Test type	Static	
Photoperiod/light intensity	“natural” photoperiod	
Dilution water	Dechlorinated tapwater	

	Biga & Blaustein 2013	*P. regilla*
Parameter	**Value**	**Comment**
pH	Not reported	
Hardness	Not reported	
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	Not reported	
Feeding	None during exposure	
Purity of test substance	99.5%	
Concentrations measured?	No	
Measured is what % of nominal?	Not applicable	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Not applicable	
Concentration of carrier (if any) in test solutions	<0.05 mL/L	
Concentration 1 Nom (µg/L)	5.0	1) 5 reps, 10 embryos/rep 2) 5 reps, 10 early larvae/rep 3) 5 reps, 5 late larvae/rep
Concentration 2 Nom (µg/L)	0.5	1) 5 reps, 10 embryos/rep 2) 5 reps, 10 early larvae/rep 3) 5 reps, 5 late larvae/rep
Control	Dilution water	Reps and # per
NOEC (µg/L)	Embryo behavioral abnormalities: 0.5 Early larvae mortality: 0.5 Late larvae mortality: 0.5	Method: generalized linear mixed models using a logit link function p: <0.05 MSD:
LOEC (µg/L)	Embryo behavioral abnormalities: 5.0 Early larvae mortality: 5.0 Late larvae mortality: 5.0	Same as above
MATC (GeoMean NOEC,LOEC) µg/L	Embryo behavioral abnormalities: 1.6 Early larvae mortality: 1.6 Late larvae mortality: 1.6	
% of control at NOEC	Embryo behavioral	Estimated from

	Biga & Blaustein 2013	*P. regilla*
Parameter	**Value**	**Comment**
	abnormalities: not reported Early larvae mortality: 95%/100%=95% Late larvae mortality: 95%/100%=95%	Figure 1
% of control at LOEC	Embryo behavioral abnormalities: 19% increase Early larvae mortality: 45%/100%=45% Late larvae mortality: 25%/100%=25%	Estimated from Figure 1

Notes: Embryos were transferred to clean dilution water after the 48 h exposure until hatching, and then observed for 2 wk after hatching. Exposed larvae were also maintained in clean dilution water for 2 wk post-exposure and observed for effects.

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), Minimum significant difference (2), Point estimates (8). 100-30=70

Acceptability (Table 3.8): No standard method (5), 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), Number of concentrations (3), Minimum significant difference (1), Point estimates (3). 100-37=63

Toxicity Data Summary

Pseudaphritus urvillii

Study: Davies PE, Cook LSJ, Goenarso D. 1994. Sublethal responses to pesticides of several species of Australian freshwater fish and crustaceans and rainbow trout. Environ Toxicol Chem 13:1341-1354.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 71
Rating: L

*No standard method, control response not reported

	Davies et al. 1994	***P. urvillii***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes (Actinopterygii)	
Order	Perciformes	
Family	Pseudaphritidae	
Genus	*Pseudaphritis*	
Species	*urvillii*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Juveniles (6-30 g, 95-160 mm)	
Source of organisms	Collected in field	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	10 d	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	NR	
Temperature	12-15 °C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Surface water	
pH	6.5-7	
Hardness	NR	
Alkalinity	NR	
Conductivity	50-120 uS/cm	
Dissolved Oxygen	>80% saturation	

	Davies et al. 1994	*P. urvillii*
Parameter	**Value**	**Comment**
Feeding	Fed commercial salmon food throughout exposures	Not acceptable – should be no feeding in acute test
Purity of test substance	>98%	
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	2-10 mg/L ethanol or acetone (~12.6-12.7 mL/L EtOH or acetone based on density)	>0.5 mL/L, not acceptable
Concentration 1 Nom/Meas (μg/L)	NR/0.17	2 reps, 10/rep
Concentration 2 Nom/Meas (μg/L)	NR/0.33	2 reps, 10/rep
Concentration 3 Nom/Meas (μg/L)	NR/0.49	2 reps, 10/rep
Concentration 4 Nom/Meas (μg/L)	NR/0.87	2 reps, 10/rep
Concentration 5 Nom/Meas (μg/L)	NR/2.52	2 reps, 10/rep
Control	Dilution water	2 reps, 10/rep
LC_{50} (95% confidence limit) (μg/L)	12 h: >2.52 96 h: 2.19 (1.80-2.65) 10 d: 1.47 (1.20-1.75)	Method: probit

Notes:

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

<u>Acceptability (Table 3.8):</u> No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organisms randomized (1), Feeding (3), Hardness (2), Alkalinity (2), Temperature varied > $\pm$1°C (3), Photoperiod (2), Random design (2), Hypothesis tests (3). -40

Toxicity Data Summary

Rana cascadae

Study: Biga LM, Blaustein AR. 2013. Variations in lethal and sublethal effects of cypermethrin among aquatic stages and species of anuran amphibians. Environ Toxicol Chem 32:2855-2860.

Relevance
Score: 90*
Rating: R

Reliability
Score: 66.5
Rating: L

*Acceptable standard method (10)

	Biga & Blaustein 2013	***P. regilla***
Parameter	**Value**	**Comment**
Test method cited	None reported	
Phylum	Chordata	
Class	Amphibia	
Order	Anura	
Family	Ranidae	
Genus	*Rana*	
Species	*cascadae*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4) Embryo (stage 10-12) 5) Early larvae (<1wk post-hatch; stage 24-25) 6) Late larvae (stage 28-30)	
Source of organisms	Eggs wild-collected in Coast Range, Oregon	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Not reported	
Test vessels randomized?	Yes	
Test duration	48 h	
Data for multiple times?	No	
Effect 1	Survival	
Control response 1	Embryos: 100% Early larvae: 90% Late larvae: 100%	
Temperature	14 °C	
Test type	Static	
Photoperiod/light intensity	“natural” photoperiod	
Dilution water	Dechlorinated tapwater	
pH	Not reported	
Hardness	Not reported	

	Biga & Blaustein 2013	*P. regilla*
Parameter	**Value**	**Comment**
Alkalinity	Not reported	
Conductivity	Not reported	
Dissolved Oxygen	Not reported	
Feeding	None during exposure	
Purity of test substance	99.5%	
Concentrations measured?	No	
Measured is what % of nominal?	Not applicable	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Not applicable	
Concentration of carrier (if any) in test solutions	<0.05 mL/L	
Concentration 1 Nom (μg/L)	5.0	1) 5 reps, 10 embryos/rep 2) 5 reps, 10 early larvae/rep 3) 5 reps, 5 late larvae/rep
Concentration 2 Nom (μg/L)	0.5	1) 5 reps, 10 embryos/rep 2) 5 reps, 10 early larvae/rep 3) 5 reps, 5 late larvae/rep
Control	Dilution water	Reps and # per
NOEC (μg/L)	Early larvae mortality: 0.5	Method: generalized linear mixed models using a logit link function p: <0.05 MSD: not reported
LOEC (μg/L)	Early larvae mortality: 5.0	Same as above
MATC (GeoMean NOEC,LOEC) μg/L	Early larvae mortality: 1.6	
% of control at NOEC	Early larvae mortality: 90%/90%=100%	Estimated from Figure 1
% of control at LOEC	Early larvae mortality: 22%/90%=24%	Estimated from Figure 1

Notes: Embryos were transferred to clean dilution water after the 48 h exposure until hatching, and then observed for 2 wk after hatching. Exposed larvae were also maintained in clean dilution water for 2 wk post-exposure and observed for effects. Other effects were also investigated, but there were no significant differences between treatments and controls so the results are not reported here.

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), Minimum significant difference (2), Point estimates (8). 100-30=70

Acceptability (Table 3.8): No standard method (5), 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), Number of concentrations (3), Minimum significant difference (1), Point estimates (3). 100-37=63

Toxicity Data Summary

Salmo trutta

Study: Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 70.5
Rating: L

*No standard method, control response not reported

	Stephenson 1982	***S. trutta***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
Genus	*Salmo*	
Species	*trutta*	
Family in North America?	Yes	
Age/size at start of test/growth phase	5-8 g	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes (10 d)	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	15 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 $\pm$ 20 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>80% saturation	
Feeding	None during test	

	Stephenson 1982	*S. trutta*
Parameter	**Value**	**Comment**
Purity of test substance	85-95%	
Concentrations measured?	Yes	
Measured is what % of nominal?	>70%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (μg/L)	4 conc (1.0-1.5)	1 rep, 5/rep
Control	Dilution water	1 rep, 5/rep
LC_{50} (μg/L)	1.2	Method: probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Organisms/rep (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Number of concentrations (3), Dilution factor (2), Hypothesis tests (3). -38

Toxicity Data Summary

Scardinius erythrophthalmus

Study: Study: Stephenson RR. 1982. Aquatic toxicology of cypermethrin. I. Acute toxicity to some freshwater fish and invertebrates in laboratory tests. Aquatic Toxicology 2:175-185.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 72
Rating: L

*No standard method, control response not reported

	Stephenson 1982	***S. erythrophthalmus***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Scardinius*	
Species	*erythrophthalmus*	Common rudd
Family in North America?	Yes	
Age/size at start of test/growth phase	8-10 g	
Source of organisms	Commercial hatchery	
Have organisms been exposed to contaminants?	Not likely	
Animals acclimated and disease-free?	Yes (10 d)	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	15 ± 1°C	
Test type	Flow-through	
Photoperiod/light intensity	NR	
Dilution water	Filtered dechlorinated tapwater	
pH	7.5-8.5	
Hardness	260 ± 20 mg/L as CaCO3	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>80% saturation	
Feeding	None during test	
Purity of test substance	85-95%	

	Stephenson 1982	*S. erythrophthalmus*
Parameter	**Value**	**Comment**
Concentrations measured?	Yes	
Measured is what % of nominal?	>70%	
Toxicity values calculated based on nominal or measured concentrations?	Measured	
Chemical method documented?	Yes, GC-ECD	
Concentration of carrier (if any) in test solutions	0%	
Concentration 1 Nom/Meas (µg/L)	5 conc (0.33-0.56)	1 rep, 5/rep
Control	Dilution water	1 rep, 5/rep
LC_{50} (µg/L)	0.4	Method: probit

Notes:

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

Acceptability (Table 3.8): No standard method (5), Control response (9), Measured concentrations within 20% of nominal (4), Organisms randomized (1), Organisms/rep (2), Alkalinity (2), Conductivity (1), Photoperiod (2), Random design (2), Adequate replicates (2), Dilution factor (2), Hypothesis tests (3). -35

Toxicity Data Summary

Trichodactylus borellianus

Study: Veronica W, Collins PA. 2003. Effects of cypermethrin on the freshwater crab *Trichodactylus borellianus* (Crustacea: Decapoda: Braquiura). Bull Environ Contam Toxicol 71:106-113.

Relevance
Score: 70
Rating: L

Reliability
Score: 65.5
Rating: L

*Low chemical purity, Family does not reside in North America

	Veronica & Collins 2003	***T. borellianus***
Parameter	**Value**	**Comment**
Test method cited	USEPA 1975	
Phylum	Arthropoda	
Class	Crustacea	
Order	Decapoda	
Family	Trichodactylidae	
Genus	*Trichodactylus*	
Species	*borellianus*	
Family in North America?	No	
Age/size at start of test/growth phase	Adults: Mean carapace length 9.02 ± 1.85 mm, mean wt 0.38 ± 0.18 g Juvenile: mean carapace length 5.06 ± 1.24 mm, mean wt 0.07 ± 0.04 g	
Source of organisms	Collected from Salado River, Argentina	
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	0%	
Temperature	25 ± 2°C	
Test type	Static	
Photoperiod/light intensity	14 L: 10 D	
Dilution water	Artificial pond water	
pH	7.2	

	Veronica & Collins 2003	*T. borellianus*
Parameter	**Value**	**Comment**
Hardness	NR	
Alkalinity	NR	
Conductivity	450 umhos/L	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	25% in 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	%NR, xylene (in formulation)	
Concentration 1 Nom (μg/L)	0.0001	3 reps, 5/rep
Concentration 2 Nom (μg/L)	0.0005	3 reps, 5/rep
Concentration 3 Nom (μg/L)	0.001	3 reps, 5/rep
Concentration 4 Nom (μg/L)	0.005	3 reps, 5/rep
Concentration 5 Nom (μg/L)	0.01	3 reps, 5/rep
Concentration 6 Nom (μg/L)	0.1	3 reps, 5/rep
Control	Solvent and dilution water	3 reps, 5/rep
LC_{50} (95% confidence limit) (μg/L)	Juveniles and adults pooled because no sig. difference 24 h: 0.0119 (0.0071-0.0234) 48 h: 0.0119 (0.0071-0.0234) 72 h: 0.0104 (0.0054-0.0249) 96 h: 0.0097 (0.0049-0.0231)	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), Hypothesis tests (8). -23

Acceptability (Table 3.8): Chemical purity (10), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Prior contamination (4), Organisms randomized (1), Feeding (3), Exposure type (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (3), Random design (2), Hypothesis tests (3). -46

Toxicity Data Summary

Simulium vitattum, - Blackfly
Hydropsyche spp., *& Cheumatopsyche* spp., - Caddisfly
Heptageniidae spp.- Mayfly
Enellagma spp., *& Ishnura* spp.,- Damselfly
Hydrophilus spp., -Water scavenger beetle

Study: Siegfried, Blair D. 1993. Comparative Toxicity of Pyrethroid Insecticides to Terrestrial and Aquatic insects. Environ Toxicol Chem 12:1683-1689.

Relevance
Score: 90 (Standard Method (10)
Rating: R

Reliability
Score: 63.3
Rating: L

	Siegfried 1993	***Various***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera, Trichoptera, Ephemeroptera, Odonata, Coleoptera	
Family	various	
Genus	*Simulium, Hydropsyche, Ishnura, Enellagma, Hydrophilus, Cheumatopsyche, Heptageniidae*	
Species	*vitattum*, others unidentified	Terrestrial insects tested in this study were not included here.
Family in North America?	Yes	
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?	Possibly	Collected from environment
Animals acclimated and disease-free?	Acclimated-72 h	Health status not determined
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	24 hours	
Data for multiple times?	No	

	Siegfried 1993	*Various*
Parameter	**Value**	**Comment**
Effect 1	Mortality	
Control response 1	< 10 mortality, except black flies 14%, mayflies 16%	
Temperature	20 °C	
Test type	Static	
Photoperiod/light intensity	24 h Dark	
Dilution water	Distilled Water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None	
Purity of test substance	99.4%	
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	Diluted in Distilled Water	
Concentration 1 Nom/Meas (µg/L)	Concentrations NR- 3 concentrations per insecticide, 30 organisms per experiment, 3 replicates	
Control	Exposed to Diluted water	
LC_{50}	Black Fly (*S. vittatum*): 9.8 (1.8-15) µg/L* Caddisfly (*Hydropsyche* & *Chematopsyche)*: 1.4 (0.81-2) µg/L Mayfly (Hepatagenidae): 1.3 (0.78-2.1) µg/L Damselfly (*Enellagma* & *Ishnura sp.)*: 1.4 (0.92-2.0) µg/L Diving Beetle (*Hydrophilus spp)*: 8.3 (5.9-11) µg/L	Method: Probit Analysis

Notes: *value exceeds 2x the aqueous solubility of cypermethrin (4 ug/L).

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), 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 $\pm$ 1^{o}C (3), Conductivity (2), pH (3), Adequate number of concentrations (3), Random or block design (2), Appropriate spacing between concentrations (2), Hypothesis tests (3)

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

Aedes aegypti
Culex quinquefasciatus

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 C. quinquefasciatus***
Parameter	**Value**	**Comment**
Test method cited	WHO 1963	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	*Culex*
Species	*aegypti*	*quinquefasciatus*
Family in North America?	Yes	
Age/size at start of test/growth phase	Late 3^{rd}-early 4^{th} 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	

	Verma & Rahman 1984	*A. aegypti* *C. quinquefasciatus*
Parameter	**Value**	**Comment**
Feeding	NR	
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}	*A. aegypti*: 5 *C. quinquefasciatus*: 1	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: Zeichner BC, Perich MJ. 1999. Laboratory testing of a lethal ovitrap for *Aedes aegypti*. Medical and Veterinary Entomology 13:234-238.

<u>Relevance</u>	<u>Reliability</u>
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

Aedes aegypti

Study: Rodriguez MM, Bisset JA, Fernandez D. 2007. Levels of insecticide resistance and resistance mechanisms in *Aedes aegypti* from some Latin American countries. Journal of the American Mosquito Control Association. 23(4): 420-429.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

This test used beta-cypermethrin, not racemic cypermethrin, so the data cannot be used.

Toxicity Data Summary

Aedes aegypti

Study: Rodriguez MM, Bisset J, Molina de Fernandez D, Lauzan L, Soca A. 2001. Detection of insecticide resistance in *Aedes aegypti* (Diptera: Culicidae) from Cuba and Venezuela. J Med Entomol 38:623-628.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*Standard method not acceptable, Chemical purity not reported, Control response not reported.

Toxicity Data Summary

Aedes aegypti

Study: Rodriguez MM, Bisset J, Ruiz M, Soca A. 2002. Cross-resistance to pyrethroid and organophosphorus insecticides induced by selection with temephos in *Aedes aegypti* (Diptera: Culicidae) from Cuba. J. Med. Entomol. 39(6): 882-888.

Relevance
Score: 82.5 (Standard method, No control response)
Rating: L

Reliability
Score: 52.5
Rating: N

Reference	**Rodriguez *et al.* 2002**	***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	Larvae < 24 h	
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	Survival	
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	
Feeding	No	
Purity of test substance	90.5%	

Reference	Rodriguez *et al.* 2002	*A. aegypti*
Parameter	**Value**	**Comment**
Concentrations measured?	No	
Measured is what % of nominal?	NR	
Chemical method documented?	NR	
Concentration of carrier (if any) in test solutions	1 mL acetone /100 mL water	
Concentration 1 Nom/Meas (μg/L)	5 concentrations	20/rep x 2
Control	Water and methanol control	20/rep x 2
LC50 (95% Confidence interval) for 4 strains* in μg/L	Rockefellar (susceptible): 1.3 (0.76-1.8) Santiago de Cuba: 9.4 (8.7-10) SAN-F3: 18 (15-21) SAN-F6: 17 (15-20)	Method: Probit

*__Rockefellar__: laboratory susceptible strain of Caribbean origin, colonized in the early 1930s, provided by the CDC laboratory in San Juan, Puerto Rico.
Santiago de Cuba: natural population collected from Santiago de Cuba, Cuba in 1998 and bred for 6 generations with for temefos resistance
SAN-F3:
SAN-F6:

Reliability points taken off for:
Documentation: 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: Standard method (5), Control response (9), Meas. Concentrations 20% Nom (4), Concentrations not ≥ 2x water solubility (4), Carrier solvent ≤ 0.5 mL/L (4), Organisms randomized (1), Dilution water (2), Hardness (2), Alkalinity (2), Dissolved oxygen (6), Temperature (6), Conductivity (1), pH (2), Photoperiod (2), Test vessels randomized (2), Appropriate spacing between concentrations (2), Hypothesis tests (3). -57

Toxicity Data Summary

Aedes aegypti

Study: Rodriguez MM, Bisset JA, de Armas Y, Ramos F. 2005. Pyrethroid insecticide-resistant strain of *Aedes aegypti* from Cuba induced by deltamethrin selection. Journal of the American Mosquito Control Association 21:437-445.

Relevance
Score: 75
Rating: L

Reliability
Score: 44
Rating: N

*No standard method, appropriate controls not used

	Rodriguez et al. 2005	***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 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	
Dissolved Oxygen	NR	
Feeding	None during test	

	Rodriguez et al. 2005	*A. aegypti*
Parameter	**Value**	**Comment**
Purity of test substance	90.5%	
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	2 tests, 5 reps, 20/rep
Concentration 2 Nom/Meas (µg/L)	NR	2 tests, 5 reps, 20/rep
Concentration 3 Nom/Meas (µg/L)	NR	2 tests, 5 reps, 20/rep
Concentration 4 Nom/Meas (µg/L)	NR	2 tests, 5 reps, 20/rep
Concentration 5 Nom/Meas (µg/L)	NR	2 tests, 5 reps, 20/rep
Control	Not used	Reps and # per
LC_{50} (fiducial limits) (µg/L)	1.29 (0.76-1.8)	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), Random design (2), Dilution factor (2), Hypothesis tests (3). -66

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
Score: 42.5
Rating: N

Reliability
Score: n/a
Rating: n/a

*No standard method, Low chemical purity, No toxicity values, Control not described

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: 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	
Feeding	Yes, once at beginning of test	

	Ali et al. 1995	*A. albopictus*
Parameter	**Value**	**Comment**
Purity of test substance	92.3%	
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)	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)	2.6 (1.6-4.0)	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), 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

Acartia clausi
Oithona similis
Pseudocalanus elongatus
Temora longicomis

Study: Willis KJ, Ling N. 2004. Toxicity of the aquaculture pesticide cypermethrin to planktonic marine copepods. Aquaculture Research 35:263-270.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Control response not acceptable

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 (80-4720 ug/L) exceed 2x the aqueous solubility of cypermethrin (4 ug/L).

Toxicity Data Summary

Artemia salina

Study: Gartenstein S, Quinnell RG, Larkum AWD. 2006. Toxicity effects of diflubenzuron, cypermethrin and diazinon on the development of *Artemia salina* and *Heliocidaris tuberculata.* Australasian Journal of Ecotoxicology 12:83-90.

Relevance
Score: 75
Rating: L

Reliability
Score: 59
Rating: N

*No standard method, saltwater

	Gartenstein et al. 2006	***A. salina***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Crustacea (Branchiopoda)	
Order	Anostraca	
Family	Artemiidae	
Genus	*Artemia*	
Species	*salina*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adults	
Source of organisms	Reared in lab	
Have organisms been exposed to contaminants?	NR	
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	0%	
Temperature	± °C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	Technical grade	

	Gartenstein et al. 2006	*A. salina*
Parameter	**Value**	**Comment**
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 reps, 5/rep
Concentration 2 Nom/Meas (μg/L)	5	4 reps, 5/rep
Concentration 3 Nom/Meas (μg/L)	10	4 reps, 5/rep
Concentration 4 Nom/Meas (μg/L)	20	4 reps, 5/rep
Control	Solvent	4 reps, 5/rep
LC_{20} (95% confidence interval) (μg/L)	6.88	Method: probit

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Analytical method (4), Measured concentrations (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Hypothesis tests (8). -35

<u>Acceptability (Table 3.8):</u> No standard method (5), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Carrier solvent (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), Hypothesis tests (3). -47

Toxicity Data Summary

Aedes stimulans

Study: Helson BV, Surgeoner GA. 1986. Efficacy of cypermethrin for the control of mosquito larvae and pupae, and impact on non-target organisms, including fish. Journal of the American Mosquito Control Association 2:269-275.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 56.5
Rating: N

*No standard method, unacceptable control response

	Helson & Surgeoner 1986	***A. stimulans***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Aedes*	
Species	*stimulans*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4th instar larvae	
Source of organisms	Collected in field – natural breeding sites near Guelph, Canada	
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	20 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Helson & Surgeoner 1986	*A. stimulans*
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	92.7%	
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	0.5% acetone	
Concentration 1 Nom/Meas (µg/L)	# of concentrations NR	2 tests, 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	Solvent and dilution water	2 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	0.400 (0.351-0.456)	Method: probit

Notes:

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> 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

<u>Acceptability (Table 3.8):</u> No standard method (5), Control response (9), 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), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -53

Toxicity Data Summary

Amphiporeia virginiana
Gammarus spp.
Gasterosteus aculeatus

Study: Ernst W, Jackman P, Doe K, Page F, Julien G, Mackay K, Sutherland T. 2001. Dispersion and toxicity to nontarget aquatic organisms of pesticides used to treat sea lice on salmon in net pen enclosures. Marine Pollution Bulletin 42:433-444.

Relevance	Reliability
Score: 45	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Low chemical purity, Controls not described, response not reported

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

Bombina variegate
Rana arvalis

Study: Greulich K, Pflugmacher S. 2004. Uptake and effects on detoxication enzymes of cypermethrin in embryos and tadpoles of amphibians. Arch Environ Contam Toxicol 47:489-495.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, No toxicity values, Controls not described, response not reported

Toxicity Data Summary

Clarias batrachus

Study: Begum G. 2005. In vivo biochemical changes in liver and gill of *Clarias batrachus* during cypermethrin exposure and following cessation of exposure. Pesticide Biochemistry and Physiology 82:185-196.

Relevance	Reliability
Score: 45	Score: n/a
Rating: N	Rating: n/a

*No standard method, Endpoint not linked survival/growth/reproduction, Chemical purity not reported, Toxicity values not calculable.

Toxicity Data Summary

Cyprinus carpio

Study: David M, Mushigeri SB, Shivakumar R, Philip GH. 2004. Response of *Cyprinus carpio* (Linn) to sublethal concentration of cypermethrin: alteration in protein metabolic profiles. Chemosphere 56:347-352.

Relevance
Score: acute: 75, chronic: 60
Rating: acute: L, chronic: N

Reliability
Score: 34
Rating: N

*No standard method, Chronic endpoints not linked to survival/growth/reproduction, controls not described and response not reported.

	David et al. 2004	***C. carpio***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Chordata	
Class	Osteichthyes	
Order	Cypriniformes	
Family	Cyprinidae	
Genus	*Cyprinus*	
Species	*carpio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	NR	
Source of organisms	State fish hatchery, India	
Have organisms been exposed to contaminants?	Not likely	
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	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Dechlorinated tapwater	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	

	David et al. 2004	*C. carpio*
Parameter	**Value**	**Comment**
Purity of test substance	96%	
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)	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	Not described	
LC_{50} (µg/L)	6	Method: NR

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Control type (8), Organism age (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), Statistical methods (5), Hypothesis tests (8). -56

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), Organisms/rep (2), Feeding (3), 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). -76

Toxicity Data Summary

Cyprinus carpio

Study: Reddy PM, Bashamohideen M. 1995. Modulation in the levels of respiration oand ions in carp *Cyprinus carpio* (L.) exposed to cypermethrin. Environmental Monitoring and Assessment 35:221-226.

Relevance	Reliability
Score: n/a	Score:
Rating: N	Rating:

*Organisms were only exposed to one concentration (20 ug/L), which exceeded 2x the aqueous solubility of cypermethrin (4 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 (50-70 ug/L) exceeded 2x aqueous solubility of cypermethrin (4 ug/L).

Toxicity Data Summary

Chironomus decorus
Chironomus utahensis
Procladius spp.

Study: Ali 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
Score: 60
Rating: N

Reliability
Score: n/a
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 JJ, Lee S, Werner I. 2004. Isomer selectivity in aquatic toxicity and biodegradation of cypermethrin. J Agric Food Chem 52:6233-6238.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 50.5
Rating: N

*Control response not reported

	Liu et al. 2004	***C. dubia***
Parameter	**Value**	**Comment**
Test method cited	USEPA 2002	
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	Neonates, <20 h	
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	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Reconstituted moderately hard water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test, fed 4 h prior to test	

	Liu et al. 2004	*C. dubia*
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	0.0002 % acetone	
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	Solvent	4 reps, 5/rep
LC_{50} (µg/L)	0.889	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism source (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). -43

Acceptability (Table 3.8): Control response (9), Measured concentrations within 20% of nominal (4), Concentrations exceed 2x water solubility (4), Prior contamination (4), Organisms randomized (1), Organism acclimation (1), 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). -56

Toxicity Data Summary

Culex fuscocephala
Culex triaeniorhynchus

Study: Vijayan VA, Revanna MA, Vasudeva KS, Pushpalatha & Poornima N. 1993. Comparative susceptibility of two Japanese encephalitis vectors from Mysore to six insecticides. Indian J Med Res A 97:215-217.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Control response not acceptable (<20% mortality)

Toxicity Data Summary

Culex pipiens pallens

Study: Lee D-K, Shin E-H, Shim J-C. 1997. Insecticide susceptibility of *Culex pipiens pallens* (Culicidae, Diptera) larvae in Seoul. Korean Journal of Entomology 27:9-13.

Relevance
Score: 92.5
Rating: R

Reliability
Score: 59
Rating: N

*Control response not reported

	Lee et al. 1997	***C. pipiens pallens***
Parameter	**Value**	**Comment**
Test method cited	WHO 1981	
Phylum		
Class		
Order		
Family		
Genus	*Culex*	
Species	*pipiens pallens*	
Family in North America?	Yes	
Age/size at start of test/growth phase	3^{rd} –early 4^{th} instar larvae	
Source of organisms	Lab culture (parental generation collected in field)	
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	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	99%	

	Lee et al. 1997	*C. pipiens pallens*
Parameter	**Value**	**Comment**
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% (1mL EtOH/249 mL dil water)	
Concentration 1 Nom/Meas (μg/L)	5- 6 concentrations	3 reps, 25/rep
Concentration 2 Nom/Meas (μg/L)	NR	3 reps, 25/rep
Concentration 3 Nom/Meas (μg/L)	NR	3 reps, 25/rep
Concentration 4 Nom/Meas (μg/L)	NR	3 reps, 25/rep
Concentration 5 Nom/Meas (μg/L)	NR	3 reps, 25/rep
Concentration 6 Nom/Meas (μg/L)	NR	3 reps, 25/rep
Control	Solvent	3 reps, 25/rep
LC_{50} (μg/L)	0.791 (0.683-0.917)	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): Control response (9), Measured concentrations within 20% of nominal (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), Dilution factor (2), Hypothesis tests (3). -44

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	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
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	
Control response 1	NR	
Temperature	25°C	

	Hardstone et al. 2007	*C. pipiens quinquefasciatus*
Parameter	**Value**	**Comment**
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: 0.79 (0.74-0.85)	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

Study: Helson BV, Surgeoner GA. 1986. Efficacy of cypermethrin for the control of mosquito larvae and pupae, and impact on non-target organisms, including fish. Journal of the American Mosquito Control Association 2:269-275.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 56.5
Rating: N

*No standard method, unacceptable control response

	Helson & Surgeoner 1986	***C. pipiens***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*pipiens*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4^{th} instar larvae	
Source of organisms	Simulated pools at research center (plastic pools filled with water and leaf litter)	
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	14 ± 1°C 27 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	

	Helson & Surgeoner 1986	*C. pipiens*
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	92.7%	
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	0.5% acetone	
Concentration 1 Nom/Meas (μg/L)	# of concentrations NR	2 tests, 2 reps, 20/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	Solvent and dilution water	2 reps, 20/rep
LC_{50} (95% confidence interval) (μg/L)	14°C: 0.057 (0.050-0.065) 27°C: 0.175 (0.150-0.205)	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), 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). -53

Toxicity Data Summary

Channa punctatus

Study: Kumar A, Sharma B, Pandey RS. 2007. Preliminary evaluation of the acute toxicity of cypermethrin and lambda-cyhalothrin to *Channa punctatus.* Bull Environ Contam Toxicol, 79: 613-616.

Relevance
Score: n/a
Rating: N

Reliability
Score: n/a
Rating: n/a

*Reported LC50 (400 ug/L) > 2x aqueous solubility of cypermethrin (4 ug/L).

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	4^{th} 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	
Dissolved Oxygen	NR	
Feeding	Yes, once at beginning of	

	Ali et al. 1999	*C. quinquefasciatus*
Parameter	**Value**	**Comment**
	test	
Purity of test substance	92.3%	
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)	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)	0.17 (0.12-0.25)	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: Mulla MS, Darwazeh HA, Ede L. 1982. Evaluation of new pyrethroids against immature mosquitoes and their effects on nontarget organisms. Mosquito News 42:583-590.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 48
Rating: N

*No standard method, control response not reported

	Mulla et al. 1982	***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	4^{th} instar larvae	
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	24 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	Tap water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	Technical grade	
Concentrations measured?	No	

	Mulla et al. 1982	*C. quinquefasciatus*
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% acetone	
Concentration 1 Nom/Meas (μg/L)	3-4 concentrations	2-3 tests, 3 reps, 20/rep
Concentration 2 Nom/Meas (μg/L)	NR	2-3 tests, 3 reps, 20/rep
Concentration 3 Nom/Meas (μg/L)	NR	2-3 tests, 3 reps, 20/rep
Concentration 4 Nom/Meas (μg/L)	NR	2-3 tests, 3 reps, 20/rep
Control	Solvent	2-3 tests, 3 reps, 20/rep
LC_{50} (μg/L)	Larvae: 0.05 Pupae: 0.40	Method: probit

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Organism source (5), 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). -39

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), Conductivity (1), pH (2), Photoperiod (2), Number of concentrations (3), Random design (2), Dilution factor (2), Hypothesis tests (3). -65

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	
Conductivity	NR	

	Vijayan & Ningegowda 1993	*C. quinquefasciatus*
Parameter	**Value**	**Comment**
Dissolved Oxygen	NR	
Feeding	None during test	
Purity of test substance	1%	
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: 0.3890 Mandya: 0.4800	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	
Feeding	None during test	
Purity of test substance	94.5%	

	Weerasinghe et al. 2001	*C. quinquefasciatus*
Parameter	**Value**	**Comment**
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)	2.1 (1.9-2.4)	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 restuans

Study: Helson BV, Surgeoner GA. 1986. Efficacy of cypermethrin for the control of mosquito larvae and pupae, and impact on non-target organisms, including fish. Journal of the American Mosquito Control Association 2:269-275.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 56.5
Rating: N

*No standard method, unacceptable control response

	Helson & Surgeoner 1986	***C. restuans***
Parameter	**Value**	**Comment**
Test method cited	None cited	
Phylum	Arthropoda	
Class	Insecta	
Order	Diptera	
Family	Culicidae	
Genus	*Culex*	
Species	*restuans*	
Family in North America?	Yes	
Age/size at start of test/growth phase	4^{th} instar larvae	
Source of organisms	Collected in field – natural breeding sites near Guelph, Canada	
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	20 ± 1°C	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Distilled water	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	

	Helson & Surgeoner 1986	*C. restuans*
Parameter	**Value**	**Comment**
Feeding	None during test	
Purity of test substance	92.7%	
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	0.5% acetone	
Concentration 1 Nom/Meas (µg/L)	# of concentrations NR	2 tests, 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	Solvent and dilution water	2 reps, 20/rep
LC_{50} (95% confidence interval) (µg/L)	0.073 (0.066-0.080)	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), 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). -53

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

Callinectes sapidus

Study: Lee R, Oshima Y. 1998. Effects of selected pesticides, metals and organometallics on development of blue crab (*Callinectes sapidus*) embryos. Marine Environmental Research 46:479-482.

Relevance	Reliability
Score: 52.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, saltwater, chemical purity not reported

Toxicity Data Summary

Callinectes sapidus

Study: Lee RF, Steinert SA, Nakayama K, Oshima Y. 1999. Use of DNA strand damage (Comet assay) and embryo hatching effects to assess contaminant exposure in blue crab (*Callinectes sapidus*) embryos. In: Henshel DS, Black MC, Harrass MC. Environmental Toxicology and Risk Assessment: Standardization of Biomarkers for Endocrine Disruption and Environmental Assessment, 8th volume. ASTM STP 1364, West Conshohocken, PA. p. 341-349.

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

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	
Alkalinity	NR	

	Reza & Vijayan 2006	*C. tritaeniorhynchus*
Parameter	**Value**	**Comment**
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	NR	
Purity of test substance	93.7%	
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: 0.5-32	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: 2.62 (0.9-5.59) Type B: 2.71 (2.18-3.19)	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), 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: Overman MA, Barron MG, Vaishnav DD. 1990. Cypermethrin-S (FMC 56701): Acute toxicity to sheepshead minnow (*Cyprinodon variegatus*) under flow-through test conditions. FMC Study: A89-2937-01. Laboratory project ID: ESE No. 3903026-0600-3140. Environmental Science and Engineering, Inc. (ESE): Gainesville, FL. CDPR ID: 118787.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

This study uses cypermethrin-S, not racemic cypermethrin, therefore the data cannot be used.

Toxicity Data Summary

Daphnia magna

Study: Christensen BT, Lauridsen TL, Ravn HW, Bayley M. 2005. A comparison of feeding efficiency and swimming ability of *Daphnia magna* exposed to cypermethrin. Aquatic Toxicology 73:210-220.

Relevance
Score: 82.5
Rating: L

Reliability
Score: 44.5
Rating: N

*No standard method, control not described

	Christensen et al. 2005	***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	7-9 d 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	7 d	
Data for multiple times?	Yes	
Effect 1	Growth (freeze-dried weight)	
Control response 1	3 d: 170 ug/individual	
Temperature	NR	
Test type	Static	
Photoperiod/light intensity	NR	
Dilution water	Adam-zooplankton medium	
pH	NR	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	NR	
Feeding	Fed during test at least every 2^{nd} day	

	Christensen et al. 2005	*D. magna*
Parameter	**Value**	**Comment**
Purity of test substance	Analytical 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, acetone	
Concentration 1 Nom/Meas (µg/L)	1.0	Reps and # per: NR
Concentration 2 Nom/Meas (µg/L)	0.6	Reps and # per: NR
Concentration 3 Nom/Meas (µg/L)	0.3	Reps and # per: NR
Concentration 4 Nom/Meas (µg/L)	0.2	Reps and # per: NR
Concentration 5 Nom/Meas (µg/L)	0.1/0.085	Reps and # per: NR
Concentration 6 Nom/Meas (µg/L)	0.05/0.046	Reps and # per: NR
Control	Not described	Reps and # per: NR
NOEC	72 h: 0.2	Method: ANOVA p: NR MSD: NR
LOEC	72 h: 0.3	Same as above
MATC (GeoMean NOEC,LOEC)	72 h: 0.25	
% of control at NOEC*	168/170= 99%	
% of control at LOEC*	75/170= 44%	

Notes: *estimated from Fig 2

Reliability points taken off for:
<u>Documentation (Table 3.7):</u> Control type (8), Analytical method (4), Measured concentrations (3), Dilution water (3), Hardness (2), Alkalinity (2), Dissolved oxygen (4), Temperature (4), Conductivity (2), pH (3), Photoperiod (3), Significance level (2), Minimum significant difference (2), % control of NOEC/LOEC (2), Point estimates (8). -52

<u>Acceptability (Table 3.8):</u> No standard method (5), Control description (6), Measured concentrations within 20% of nominal (4), Carrier solvent (4), Organism size (3), Organisms randomized (1), Organisms/rep (2), 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), Minimum significant difference (1), Point estimates (3). -59

Toxicity Data Summary

Daphnia magna
Lepomis macrochirus

Study: Rand GM. 1984. Acute aquatic toxicity of Ammo (FMC 45806) oil vs. water. CDPR ID: 32854.

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

Daphnia magna

Study: Meems N, Steinberg CEW, Wiegand C. 2004. Direct and interacting toxicological effects on the waterflea (*Daphnia magna*) by natural organic matter, synthetic humic substances and cypermethrin. The Science of the Total Environment 319:123-136.

<u>Relevance</u>	<u>Reliability</u>
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Toxicity values not calculated

Toxicity Data Summary

Daphnia magna

Study: Palmieri MA. 1984. Acute toxicity of FMC 45806 diluted in soybean oil (0.1 pounds A.I./quart) and in water (0.1 pounds A.I./gallon) to *Daphnia magna*. Springborn Bionomics, Inc. study numbers A84-1446, A84-1447. CDPR ID: 32852.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method (10), low chemical purity (15), control response not reported (7.5)

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 65 ug/L > 2x aqueous solubility (4 ug/L)

Toxicity Data Summary

Gambusia affinis

Study: Bonner JC, Yarbrough JD. 1989. Role of the brain *t*-butylbicyclophosphorothionate receptor in vertebrate resistance to endrin, 1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane and cypermethrin. The Journal of Pharmacology and Experimental Therapeutics.

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

Galaxias maculatus

Study: Davies PE, Cook LSJ, Goenarso D. 1994. Sublethal responses to pesticides of several species of Australian freshwater fish and crustaceans and rainbow trout. Environ Toxicol Chem 13:1341-1354.

Relevance	Reliability
Score: 68.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, family not found in North America, control response not reported

Toxicity Data Summary

Homarus americanus

Study: Burridge LE, Haya K, Page FH, Waddy SL, Zitko V, Wade J. 2000. The lethality of the cypermethrin formulation Excis® to larval and post-larval stages of the Amercian lobster (*Homarus americanus*). Aquaculture 182:37-47.

Relevance	Reliability
Score: 52.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Low chemical purity, Control response not reported

Toxicity Data Summary

Homarus americanus

Study: Burridge LE, Haya K, Waddy SL, Wade J. 2000. The lethality of anti-sea lice formulations Salmosan® (Azamethiphos) and Excis® (Cypermethrin) to stage IV and adult lobsters (*Homarus americanus*) during repeated short-term exposures. Aquaculture 182:27-35.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Low chemical purity

Toxicity Data Summary

Homarus americanus

Study: Pahl BC, Opitz HM. 1999. The effects of cypermethrin (Excis) and azamethiphos (Salmosan) on lobster *Homarus americanus* H. Milne Edwards larvae in a laboratory study. Aquaculture Research 30:655-665.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Saltwater, Low chemical purity

Toxicity Data Summary

Heteropneustes fossilis

Study: Ansari BA, Kumar K. 1988. Cypermethrin toxicity: Effect on the carbohydrate metabolism of the Indian catfish, *Heteropneustes fossilis.* The Science of the Total Environment 72:161-166.

Relevance	Reliability
Score: 52.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Chemical purity not reported, Family of species does not reside in North America, Control response not reported

Toxicity Data Summary

Heteropneustes fossilis

Study: Saha S, Kaviraj A. 2003. Acute toxicity of synthetic pyrethroid cypermethrin to freshwater catfish *Heteropneustes fossilis* (Bloch). Internation Journal of Toxicology 22:325-328.

Relevance
Score: 62.5
Rating: N

Reliability
Score: n/a
Rating: n/a

*Low chemical purity, Species is not from a family that resides in North America, Control response not reported

Toxicity Data Summary

Hypsiboas pulchellus

Study: Agostini MG, Natale GS, Ronco AE. 2010. Lethal and sublethal effects of cypermethrin to *Hypsiboas pulchellus* tadpoles. Ecotoxicology 19:1545-1550.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*LC50 (479.7 ug/L) exceeds 2x the aqueous solubility of cypermethrin (4 ugL).

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 cypermethrin.

Toxicity Data Summary

Lesistes reticulatus

Study: Caliskan M, Erkmen B, Yerli SV. 2003. The effects of zeta cypermethrin on the gills of common guppy *Lebistes reticulatus.* Environ Toxicol Pharmacol 14:117-120.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Test with zeta-cypermethrin, not racemic cypermethrin.

Toxicity Data Summary

Labeo rohita

Study: Adhikari S, Sarkar B, Chatterjee A, Mahapatra CT, Ayyappan S. 2004. Effects of cypermethrin and carbofuran on certain hematological parameters and prediction of their recovery in a freshwater teleost, *Labeo rohita* (Hamilton). Ecotocicology and Environmental Safety 58:220-226.

Relevance	Reliability
Score: 60	Score: n/a
Rating: N	Rating: n/a

*No standard method, Endpoint not linked to survival/growth/reproduction, Low chemical purity

Toxicity Data Summary

Labeo rohita

Study: Das BK, Mukherjee SC. 2003. Toxicity of cypermethrin in *Labeo rohita* fingerlings: biochemical, enzymatic and haematological consequences. Comparative Biochemistry and Physiology C 134:109-121.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All LC50s (130-225 ug/L) exceed 2x the aqueous solubility of cypermethrin (4 ug/L).

Toxicity Data Summary

Labeo rohita

Study: Deshpande VY, Muley DV, Bhilave MP. 2007. Pyrethroid induced respiratory changes in *Labeo rohita*. Nature Environment and Pollution Technology 6:277-280.

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

Mytilus edulis

Study: Gowland B, Webster L, Fryer R, Davies I, Moffat C, Stagg R. 2002. Uptake and effects of the cypermethrin-containing sea lice treatment Excis® in the marine mussel, *Mytilus edulis*. Environmental Pollution 120:805-811.

Relevance
Score: n/a
Rating: N

Reliability
Score: n/a
Rating: n/a

*All concentrations tested (10-100 ug/L) exceeded 2x the aqueous solubility of cypermethrin (4 ug/L).

Toxicity Data Summary

Scenedesmus bijugatus
Synechococcus elongatus
Nostoc linckia
Phormidium tenue

Study: Megharaj M, Venkateswarlu K, Rao AS. 1987. Influence of cypermethrin and fenvalerate on a green alga and three cyanobacteria isolated from soil. Ecotoxicology and Environmental Safety 14:142-146.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All concentrations tested (5-50 mg/L) exceeded 2x the aqueous solubility of cypermethrin (4 ug/L)

Toxicity Data Summary

Nilaparvata lugens
Oreochromis niloticus
Poecilia reticulata

Study: Tejada AW, Bajet CM, Magbauna MG, Gambalan NB, Araez LC, Magallona ED. 1994. Toxicity of pesticides to target and non-target fauna of the lowland rice ecosystem. In: Widianarko B, Vink K, Van Straalen NM (eds). *Environmental Toxicology in South East Asia.* VU University Press: Amsterdam, Netherlands. p. 89-103.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All reported LC50s (31-10900 ug/L) exceed 2x the aqueous solubility of cypermethrin (4 ug/L).

Toxicity Data Summary

Oryzias latipes

Study: Kim Y, Jung J, Oh S, Choi K. 2008. Aquatic toxicity of cartap and cypermethrin to different life stages of *Daphnia magna* and *Oryzias latipes.* Journal of Environmental Science and Health B 43:56-64.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All toxicity values (18-111.4 ug/L) exceed 2x the aqueous solubility of cypermethrin (4 ug/L)

Toxicity Data Summary

Oncorhynchus mykiss

Study: Bradbury SP, Carlson RW, Niemi GJ, Henry TR. 1991. Use of respiratory-cardiovascular responses of rainbow trout (*Oncorhynchus mykiss*) in identifying acute toxicity syndromes in fish: Part 4. Central nervous system seizure agents. Environ Toxicol Chem 10:115-131.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*The reported toxicity values exceed 2x the aqueous solubility of cypermethrin.

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 55 ug/L > 2x aqueous solubility (4 ug/L)

Toxicity Data Summary

Oncorhynchus mykiss
Rana temporaria

Study: Edwards R, Millburn, Hutson DH. 1986. Comparative toxicity of cis-cypermethrin in rainbow trout, frog, mouse, and quail. Toxicology and Applied Pharmacology 84:512-522.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Uses cis-cypermethrin, not racemic cypermethrin, therefore data cannot be used.

Toxicity Data Summary

Oncorhynchus mykiss

Study: Shires SW. 1985. Toxicity of a new pyrethroid insecticide, WL85871, to rainbow trout. Bull Environ Contam Toxicol 34:134-137.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Study uses cis-cypermethrin (alpha-cypermethrin) not racemic cypermethrin, therefore it is not appropriate to include in the data base.

Toxicity Data Summary

Oreochromis niloticus

Study: Yilmaz M. 2005. Acute toxicity of alpha-cypermethrin on tilapia (*Oreochromis niloticus* L.) larvae. Bull Environ Contam Toxicol 74:880-885.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Study uses alpha-cypermethrin, not racemic cypermethrin, therefore the data is not appropriate for use.

Toxicity Data Summary

Oncorhynchus mykiss

Study: Overman MA, Barron MG, Vaishnav DD. 19990. Cypermethrin-S (FMC 56701): Acute toxicity to rainbow trout (*Oncorhynchus mykiss*) under flow-through conditions. FMC Corporation study number A89-2935-01. Laboratory project ID: ESE No. 3903026-0700-3140. Environmental Science and Engineering, Inc. (ESE): Gainesville, FL. CDPR ID: 118784.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*This study uses cypermethrin-S, not racemic cypermethrin, thus, the data cannot be used.

Toxicity Data Summary

Physalaemus biligonigerus

Study: Izaguirre MF, Lajmanovich RC, Peltzer PM, Soler AP, Casco VH. 2000. Cypermethrin-induced apoptosis in the telencephalon of *Physalaemus biligonigerus* tadpoles (Anura: Leptodactylidae). Bull Environ Contam Toxicol 65:501-507.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All reported LC50s (129-1012 ug/L) exceeded 2x the aqueous solubility of cypermethrin (4 ug/L)

Toxicity Data Summary

Physalaemus biligonigerus

Study: Lajmanovich R, Lorenzatti E, de la Sierra P, Marino F, Stringhini G, Peltzer P. 2003. Reduction in the mortality of tadpoles (*Physalaemus biligonigerus*; Amphibia: Leptodactylidae) exposed to cypermethrin in presence of aquatic ferns. Fresenius Environmental Bulletin 12:1558-1561.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*All concentrations tested (35-945 ug/L) exceeded 2x the aqueous solubility of cypermethrin (4 ug/L)

Toxicity Data Summary

Prochilodus lineatus

Study: Parma MJ, Loteste A, Campana M, Bacchetta C. 2007. Changes of hematological parameters in *Prochilodus lineatus* (Pisces, Prochilodontidae) exposed to sublethal concentration of cypermethrin. Journal of Environmental Biology 28:147-149.

Relevance	Reliability
Score: 30	Score: n/a
Rating: N	Rating: n/a

*No standard method, Endpoint not linked to survival/growth/reproduction, Chemical purity not reported, Species not in a family of North America, Toxicity values not calculable.

Toxicity Data Summary

Palaemonetes pugio

Study: Clark JR, Patrick JM, Moore JC, Lores EM. 1987. Waterborne and sediment-source toxicities of six organic chemicals to grass shrimp (*Palaemonetes pugio*) and Amphioxus (*Branchiostoma caribaeum*). Arch Environ Contam Toxicol 16:401-407.

Relevance
Score: 77.5
Rating: L

Reliability
Score: 52
Rating: N

*Saltwater, Control response not reported

	Clark et al. 1987	***P. pugio***
Parameter	**Value**	**Comment**
Test method cited	APHA 1985, USEPA 1978	
Phylum	Arthropoda	
Class	Malacostraca	
Order	Decapoda	
Family	Palaemonidea	
Genus	*Palaemonetes*	
Species	*pugio*	
Family in North America?	Yes	
Age/size at start of test/growth phase	Adult	
Source of organisms	Collected from shorelines in Florida	
Have organisms been exposed to contaminants?	Possibly	
Animals acclimated and disease-free?	Acclimated for 1 week	
Animals randomized?	NR	
Test vessels randomized?	NR	
Test duration	96 h	
Data for multiple times?	No	
Effect 1	Mortality	
Control response 1	NR	
Temperature	22 or 25 ± 1°C	
Test type	Flow through	
Photoperiod/light intensity	NR	
Dilution water	Filtered seawater	
pH	7.8-8.2	
Hardness	NR	
Alkalinity	NR	
Conductivity	NR	
Dissolved Oxygen	>70% saturation	
Feeding	NR	

	Clark et al. 1987	*P. pugio*
Parameter	**Value**	**Comment**
Purity of test substance	Reagent grade	
Concentrations measured?	Yes	
Measured is what % of nominal?	75-95%	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	No	
Concentration of carrier (if any) in test solutions	%NR, acetone or triethylene glycol	
Concentration 1 Nom/Meas (μg/L)	NR	1 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 and dilution water	1 rep
LC_{50} (μg/L)	0.016	Method: probit or binomial analysis

Notes:

Reliability points taken off for:
Documentation (Table 3.7): Analytical method (4), Nominal concentrations (3), Measured concentrations (3), Hardness (2), Alkalinity (2), Temperature (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), Prior contamination (4), Organisms randomized (1), Organisms/rep (2), Feeding (3), 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). -62

Toxicity Data Summary

Poecilia reticulata

Study: Polat H, Erkoc FU, Viran R, Kocak O. 2002. Investigation of acute toxicity of beta-cypermethrin on guppies *Poecilia reticulata.* Chemosphere 49:39-44.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Study tests beta-cypermethrin, not racemic cypermethrin, therefore data cannot be used.

Toxicity Data Summary

Scendesmus obliquus

Study: Li X, Ping X, Xiumei S, Zhenbin W, Liquiang X. 2005. Toxicity of cypermethrin on growth, pigments, and superoxide dismutase of *Scendesmus obliquus*. Ecotoxicology and Environmental Safety 60:188-192.

Relevance	Reliability
Score: n/a	Score: n/a
Rating: N	Rating: n/a

*Reported toxicity values (112 mg/L) exceed 2x the aqueous solubility of cypermethrin (4 ug/L)

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	Chordata	
Class	Osteichthyes	
Order	Salmoniformes	
Family	Salmonidae	
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	
Feeding	NR	
Purity of test substance	98.5%	

	McLeese et al. 1980	*S. salar*
Parameter	**Value**	**Comment**
Concentrations measured?	Yes	
Measured is what % of nominal?	68%	
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)	2.0	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: Moore A, Waring CP. 2001. The effects of a synthetic pyrethroid pesticide on some aspects of reproduction in Atlantic salmon (*Salmo salar* L.). Aquatic Toxicology 52:1-12.

Relevance	Reliability
Score: 45-52.5 depending on effect	Score: n/a
Rating: N	Rating: n/a

*Effect 1) Olfactory detection of $PGF_{2\alpha}$: No standard method, Endpoint not clearly linked to reproduction, Chemical purity not reported, Toxicity value not calculable.
*Effect 2) Priming response of males to $PGF_{2\alpha}$: No standard method, Endpoint not clearly linked to reproduction, Chemical purity not reported, Toxicity value not calculable.
*Effect 3) Egg fertilization: No standard method, Chemical purity not reported, Toxicity value not calculable, Control response not reported.

Toxicity Data Summary

Triops longicaudatus

Study: Walton WE, Darwazeh HA, Mulla MS, Schreiber ET. 1990. Impact of selected synthetic pyrethroids and organophosphorous pesticides on the tadpole shrimp, *Triops longicaudatus* (Le Conte) (Notostraca: Triopsidae). Bull Environ Contam Toxicol 45:62-68.

Relevance	Reliability
Score: 67.5	Score: n/a
Rating: N	Rating: n/a

*No standard method, Low chemical purity, Control response not reported