Pesticide Toxicity Index for Freshwater Aquatic Organisms

by Mark D. Munn *and* Robert J. Gilliom

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FOREWORD

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. (http://www.usgs.gov/). Information on the quality of the Nation s water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity and quality, even more critical to the long-term sustainability of our communities and ecosystems.

The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. (http://water.usgs.gov/nawqa). Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation s streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues and priorities. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation s most important river basins and aquifers, referred to as Study Units. (http://water.usgs.gov/nawqa/nawqamap.html). Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation s major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation s diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings. (http://water.usgs.gov/nawqa/natsyn.html).

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation s waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation s water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch
Associate Director for Water

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ACRONYMS AND ABBREVIATIONS

AQUIRE, AQUatic Toxicity Information REtrieval (EPA database)
BCF, bioconcentration factor
EC, effect concentration (behavioral change)
CAS, Chemical Abstracts Service
CRS, chemical ranking and scoring (system)
EC_{50}, concentration at which 50 percent of test organisms exhibited nonlethal responses (an effect on behavior)
EPA, U.S. Environmental Protection Agency
LC, lethal concentration (mortal)
LC_{50}, concentration lethal to 50 percent of test organisms (mortality)
N, number of bioassays
NAWQA, National Water-Quality Assessment (Program)
NOEL, no observed effect level
ppb, part per billion
PTI, Pesticide Toxicity Index
MTC, median toxicity concentration for a pesticide
USGS, U.S. Geological Survey

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ABSTRACT

The U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program is designed to assess current water-quality conditions, changes in water quality over time, and the effects of natural and human factors on water quality for the Nation's streams and ground-water resources. For streams, one of the most difficult parts of the assessment is to link chemical conditions to effects on aquatic biota, particularly for pesticides, which tend to occur in streams as complex mixtures with strong seasonal patterns.

A Pesticide Toxicity Index (PTI) was developed that combines pesticide exposure of aquatic biota (measured concentrations of pesticides in stream water) with toxicity estimates (standard endpoints from laboratory bioassays) to produce a single index value for a sample or site. The development of the PTI was limited to pesticide compounds routinely measured in NAWQA studies and to toxicity data readily available from existing databases. Qualifying toxicity data were found for one or more types of test organisms for 75 of the 83 pesticide compounds measured in NAWQA samples, but with a wide range of bioassays per compound (1 to 65). There were a total of 2,824 bioassays for the 75 compounds, including 287 48-hour EC_{50} values (concentration at which 50 percent of test organisms exhibit a nonlethal response) for freshwater cladocerans, 585 96-hour LC_{50} values (concentration lethal to 50 percent of test organisms) for freshwater benthic invertebrates, and 1,952 96-hour LC_{50} values for freshwater fish. The PTI for a particular sample is the sum of toxicity quotients (measured concentration divided by the median toxicity concentration from bioassays) for each detected pesticide. The PTI can be calculated for specific groups of pesticides and for specific taxonomic groups.

While the PTI does not determine whether water in a sample is toxic, its values can be used to rank or compare the toxicity of samples or sites on a relative basis for use in further analysis or additional assessments. The PTI approach may be useful as a basis for comparing the potential significance of pesticides in different streams on a common basis, for evaluating relations between pesticide exposure and observed biological conditions, and for prioritizing where further studies are most needed.

INTRODUCTION

Background

The U.S. Geological Survey's (USGS) National Water-Quality Assessment (NAWQA) Program is designed to assess current water-quality conditions, changes in water quality over time, and the effects of natural and human factors on water quality for the Nation's streams and ground-water resources (Hirsch and others, 1988; Leahy and others, 1990; Gilliom and others, 1995). In 1991, the NAWQA Program began investigating physical, chemical, and biological characteristics of water resources in more than 50 major hydrologic systems in the Nation, referred to as study units. Integrating these different aspects of water quality and understanding cause-and-effect relations is one of the principle challenges for the NAWQA Program. For streams, one of the most difficult parts of the assessment is to link chemical conditions to effects on aquatic biota, particularly for pesticides, which tend to occur in streams as complex mixtures with strong seasonal patterns.

The most common way of assessing the potential effects of pesticides on the aquatic environment in a controlled manner is by standardized laboratory bioassays that expose a single species to a single compound for a predetermined time period at specified concentration levels. Depending on the effects measured, specific endpoints can be calculated. Common toxicological endpoints include lethal concentrations (LC), effect concentrations that result in a nonlethal response (EC), and no observed effect levels (NOEL). Laboratory bioassays are commonly used to assess single compounds for registration, effluent permits, and toxicological research, but laboratory results cannot reliably be extrapolated directly to field conditions. For example, species used in bioassays are rarely the same species that reside in a particular system, tested life-history stages do not include all the exposed life stages, test duration does not match the predicted exposure duration, physical and chemical test conditions are not the same as the expected field conditions, reported responses do not include all the responses of concern, and test endpoints are at a different level of biological organization (organism) than the assessment endpoints (population to ecosystem) (Sutter, 1995). However, even with these well-known limitations, bioassays remain a useful tool for quantifying toxicological effects of specific contaminants on aquatic life in a consistent relatively reproducible manner. Furthermore, standardized bioassay tests are constantly being improved with the development of new tests.

One type of ecological risk-assessment method presently being used to address the complexity of pesticide exposure and effects is chemical ranking and scoring (CRS) systems (Swanson and Socha, 1997), which are based on the potential toxicity of chemicals to the environment or human health. The selection of a particular CRS system depends on the goals of the evaluation, the level of information needed, the degree of acceptable uncertainty, and the available resources. CRS is a tool for assessing chemicals that may incorporate health effects, environmental effects or other hazards, persistence, and exposure. Many CRS systems take a nonrisk-based approach using single endpoints as in published toxicity, fate, or exposure data. A more realistic method, however, is to use a risk-based approach that integrates measured exposure (stream concentrations) with biological effects (bioassays) (Davis and others 1997).

Purpose and Scope

This report describes the development and potential applications of a Pesticide Toxicity Index (PTI), which can be used to evaluate the relative risk of pesticides to aquatic organisms in streams. The PTI is a variation of a risk-based scoring system described by Kimerle and others (1997). The PTI was developed for use with data collected as part of the NAWQA Program studies of pesticide concentrations in stream water. The PTI can be applied to samples collected at NAWQA sites, and PTI values for individual water samples then can be used to rank stream sites according to their expected relative toxicity caused by pesticides or to assess changes in potential toxicity over time at a single site. PTI values for samples, seasons, or sites also can be used as explanatory variables in multivariate analysis designed to determine which environmental variables best explain spatial patterns in the structure of a biological community.

Acknowledgments

This project was funded by the NAWQA Program. While many people provided ideas for this report, we would particularly like to thank Robert Stuart (Pentac Consulting), Karsten Liber (University of Saskatchewan), and Brian Montague (U.S. Environmental Protection Agency [EPA]). We also thank Thomas Cuffney (USGS) and William Clemens (Colorado State University) for technical reviews.

DEVELOPMENT OF THE PESTICIDE TOXICITY INDEX

The PTI is a ranking system based on the exposure and toxicity of pesticides to freshwater aquatic organisms. The development of the PTI was limited to pesticide compounds routinely measured by the NAWQA Program and to LC_{50} (concentration at which 50 percent mortality occurred) and EC_{50} (concentration at which 50 percent of test organisms exhibited nonlethal responses) toxicity data readily available from existing databases.

The PTI is the sum of toxicity quotients for each pesticide compound measured in a stream:

$$PTI = \sum_{i=1}^{n} \frac{E_i}{MTC_{x,i}} \quad (1)$$

where

E_i = concentration of pesticide i

$MTC_{x,i}$ = median toxicity concentration for the pesticide i for taxonomic group x

n = number of pesticides, and

E and MTC are expressed in the same units.

In most cases, the PTI should be calculated for a single taxonomic group as appropriate for the specific application. In addition, the most meaningful values of PTI may be for groups of chemicals with similar modes of toxicity.

NAWQA Program pesticide data evaluated for the PTI include 76 pesticides and 7 degradation products (table 1). Of the 76 parent compounds, the majority are herbicides (68 percent) and insecticides (30 percent); only one fungicide and one nematocide were evaluated. Pesticide data were collected at various levels of intensity throughout the year at stream sites in each NAWQA study unit (Shelton, 1994).

Toxicity data for each compound were obtained primarily from two EPA databases—AQUIRE (AQUatic Toxicity Information REtrieval) and the Pesticide Ecotoxicity Database. AQUIRE (http://www.epa.gov/ecotox/), a database developed by the EPA National Health and Environmental Effects Research Laboratory, is one of the primary resources for aquatic toxicity information and is commonly used to evaluate and prioritize the hazards of industrial chemicals and pesticides for impact assessments of effluent and leachate discharges (U.S. Environmental Protection Agency, accessed December 12, 2000). The second EPA database is the Pesticide Ecotoxicity Database, which was developed by the EPA Office of Pesticide Programs. Some of the toxicity data are in both databases.

The toxicity databases contain a wide range of toxicological data that are highly variable in nature and quality. Criteria were established to ensure that the data were relatively comparable; however, many factors in a bioassay could not be accounted for, any of which can greatly increase the variability of results for a particular compound. Criteria used to screen data for the PTI are:

- Species: Bioassays used are for freshwater invertebrates or fish, or at least species that completed part of their life cycle in the freshwater environment (for example, salmon).
- Endpoint: Two endpoints were selected from the toxicity databases, LC_{50} and EC_{50}.
- Duration: The LC_{50} test was for 96 hours, and the EC_{50} test was for 48 hours.
- Concentrations: Discreet values were required; therefore, results reported as "greater than" a particular value, or as ranges, were not included.

Qualifying toxicity data were found for 75 of the 83 compounds measured in water samples from the NAWQA Program, but with a wide range of bioassays per compound (1 to 165). The review resulted in a total of 2,824 bioassays divided into three data sets: 48-hour EC_{50} values for freshwater cladocerans (commonly referred to as waterfleas), 96-hour LC_{50} for freshwater benthic invertebrates (including a few invertebrates that are benthic dwellers for only a short time), and 96-hour LC_{50} values for freshwater fish. All values are summarized by species in table 2.

The EC_{50} data set for cladocerans, a related group of crustaceans commonly used in laboratory bioassays, includes 287 bioassays (table 3). There are five genera and nine species; however, most tests were run using *Daphnia magna* (70 percent), *Daphnia pulex* (13 percent), and *Simocephalus serrulatus* (11 percent). Of the 287 bioassays included, data were available for 61 of the 83 pesticide compounds analyzed by the NAWQA Program. The median number of bioassays per compound was 3 with a range of 1 to 24. Data from three or more bioassays were available for only 38 of the compounds. The combined EC_{50} toxicity data for cladoceran species are summarized in table 4.

The LC_{50} data set for benthic invertebrates includes toxicity data from 585 bioassays and encompasses 46 of the 83 compounds analyzed in the NAWQA stream studies (table 3). The median number of bioassays per pesticide was five, with only 30 compounds having three or more bioassays. This data set includes a wide range of benthic invertebrates (91 taxa) consisting of Insecta (49 percent), Custacea (34 percent), Mollusca (8 percent), Oligochaetae (5 percent), Turbullaria (2 percent), and Nematoda (1 percent) (table 3). The combined LC_{50} data for the benthic invertebrates are summarized in table 5.

Most bioassays found in the toxicity databases (1,952) were for freshwater fish (table 3), with toxicity data for 90 percent of the pesticides routinely measured by NAWQA. This higher number resulted in a median of 13 bioassays per compound with 67 compounds having greater than 3 bioassays. The fish data set includes bioassays from 61 different taxa, including warm and cold water species. Approximately 50 percent of the fish bioassay data came from three species: bluegill (20 percent), rainbow trout (19 percent), and fathead minnow (11 percent). The combined toxicity data for freshwater fish are summarized in table 6.

The relative toxicity of the compounds within each of the three taxonomic groups is summarized in table 7. Relative toxicity was estimated by setting the most toxic compound to 1, and then calculating the relative toxicity of all other compounds in the data set in comparison to the toxicity value of this compound. For example, the most toxic compound for cladocerans is chlorpyrifos, with the next compound, ethyl parathion, 62 percent as toxic. This approach is used by the U.S. Environmental Protection Agency for summarizing the toxicity of dioxins and furans (U.S. Environmental Protection Agency, 1990).

APPLICATIONS OF THE PESTICIDE TOXICITY INDEX

The PTI combines pesticide exposure of aquatic biota (measured pesticide concentrations in stream water) with toxicity (laboratory bioassays) to produce a toxicity index value for a sample or site. While the PTI is not a direct measure of toxicity to biological communities, it is a method for weighting and aggregating pesticide concentrations in a biologically relevant manner. The PTI was developed for use with data collected as part of the NAWQA Program studies of pesticide concentrations in stream water and thus method development was limited to the 83 pesticide compounds that are analyzed in most NAWQA stream samples (qualifying toxicity data were found for 75 compounds). The approach also can be applied to otherwise appropriate non-NAWQA data for the same pesticide compounds.

Most commonly, the application of the PTI to assessing stream quality begins with the computation of PTI values for detected chemicals and appropriate taxa groups for individual water samples. Given the relatively short time periods for the bioassay tests upon which the PTI is based (48 or 96 hours), each individual water sample reasonably represents a similar time interval as the bioassay test. Typical sampling at NAWQA pesticide sites, for example, is two to four samples per month during high use and runoff periods and one to two samples per month during the rest of the year. Routine monitoring data is often more sparse than the NAWQA Program design because of the high expense. With only two to four instantaneous samples collected during a 30-day span, the probability of sampling short-lived conditions, such as peak concentrations due to runoff events, is relatively low. There is a general tendency toward sampling the conditions that are relatively common and thus potential acute toxicity is likely underestimated. In applying the PTI to monitoring data of this nature, PTI values computed for individual samples are the most appropriate basis for evaluating potential for toxicity in the stream. This may not be the most appropriate approach for other data, however, such as very frequently collected samples during a short-lived storm. In these cases, concentrations may need to be averaged over an appropriate time interval before computing the PTI.

The PTI can be calculated with toxicity values from any of the three major taxonomic groups or a specific subgroup. Of the three, the EC_{50} data set for cladocerans is the least variable and most consistent because it is based on a small number of cladoceran species, with *Daphnia* the most common taxa. The advantage of using the *Daphnia* data is that the responses to the various compounds should be more similar because the taxa are closely related. The other two data sets were both based on 96-hour LC_{50} values, with the fish data set the most complete because it contains the bioassay data for the most compounds.

Rank correlations between the relative toxicity values (table 7) for the three taxa groups are significant for all combinations, but generally indicate the independent information value of each. The correlation of relative toxicities (r^2) for cladocerans and the benthic invertebrates was greatest, with an r^2 of 71 percent (one outlier, pendamethalin, was excluded), but r^2 values for correlations between fish and cladocerans and between fish and benthic invertebrates were much lower at 47 percent and 45 percent, respectively.

PTI values for multiple individual water samples can be used to assess changes in potential toxicity over time at a single site or, if statistically aggregated by year or season, to rank stream sites according to their expected relative toxicity caused by pesticides. PTI values for samples or sites also can be used as explanatory variables in multivariate analysis aimed at determining which environmental variables best explain spatial patterns in the structure of biological communities.

Although the PTI relies on measured water concentrations and laboratory bioassays, the index could be modified to include other variables. For example, one could develop an index that includes a combination of toxicity, persistence (half-life), and bioconcentration factor (BCF). One could also combine results for organisms from multiple trophic levels, including primary producers (algae), primary consumers and prey species (invertebrates), and predators (invertebrates and fish) (Kimerle and others 1997).

EXAMPLE APPLICATION

The potential applications of the PTI include evaluating the temporal distribution of relative toxicity in a waterbody and identification of which compounds or groups of compounds are most likely to cause adverse effects. To illustrate the application of the PTI to these objectives, the seasonal distribution of pesticide levels in Little Buck Creek, an urban stream in the Indianapolis area, which also has some cropland in its drainage basin, was examined. The data used are NAWQA results from analysis of pesticides in 33 samples during 1993. Methods for sample collection and analysis are described by Larson and others (1999).

Throughout the year, most water samples from Little Buck Creek contain several pesticides—typically 6 to 10 were detectable at any particular time and 18 different pesticides were found in more than 10 percent of the samples. This pattern is typical of many urban streams. The complex and varying mixtures of herbicides and insecticides make interpretation of potential effects on aquatic biota particularly difficult. Figure 1 shows concentrations of the 18 most common pesticides during 1993. The total concentration of the 18 pesticides was usually dominated by atrazine, simazine, prometon, metolachlor, alachlor, and diazinon, and reached the highest levels from late May through mid July.

Pesticide concentrations in Little Buck Creek were evaluated using the PTI (equation 1) for bluegills, a common species in that area, with MTC from table 6, for each of the 12 most commonly found pesticides for which there are toxicity values for bluegills. Figure 2 shows the PTI for the combination of all 12 pesticides during 1993 and the individual contributions of each pesticide to the index value. Figure 3 shows PTI results for bluegills compared to total pesticide concentration. The PTI indicates a period of highest potential toxicity during June and July, when total pesticide concentrations are highest. However, the PTI also indicates potential toxicity during parts of autumn, winter, and early spring when pesticide concentrations are low. Results indicate that inference of potential biological effects from pesticide concentration data alone may be misleading. In Little Buck Creek, the greatest contributor to the PTI is usually the organophosphate insecticide chlorpyrifos, even though its concentration is usually low compared to other compounds. Other major contributors to high PTI values are diazinon and malathion, which are also organophosphate insecticides.

Little Buck Creek illustrates one type of analysis and insight that can be gained through application of the PTI. The PTI provides a simple means to evaluate the potential toxicity, based on an additive model, of complex mixtures of pesticides on a sample by sample basis. The relation of PTI values, which are strictly relative, to actual biological effects remains to be tested. In evaluating such relations, however, the PTI provides a specific quantitative basis for hypotheses that can be tailored to many different situations. For example, individual PTI can be computed for different compound groups with similar modes of toxicity (e.g. organophosphates) and for the specific type of organism being studied in the field. Information on the seasonal timing of high PTI values can be used in the design of effects studies.

LIMITATIONS OF THE PESTICIDE TOXICITY INDEX

The PTI has several limitations, which must be carefully considered in applications:

- The PTI is a relative ranking system that indicates that one sample is likely to be more or less toxic than another sample, but does not necessarily demonstrate actual toxicity.
- Toxicity values are based on short-term laboratory experiments with EC_{50} (nonlethal response) or

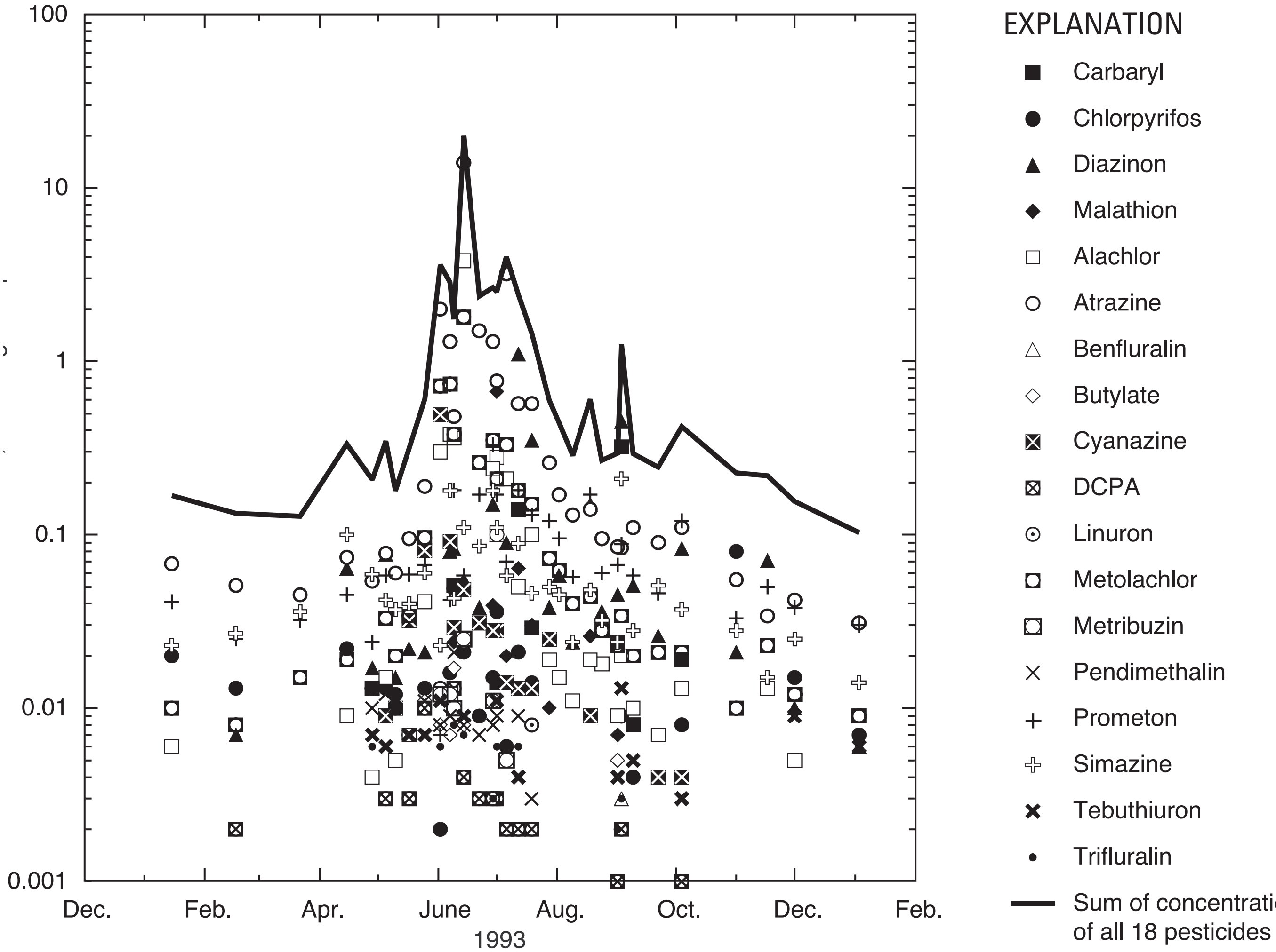

Figure 1. Concentrations of the 18 most common pesticides found in Little Buck Creek, Indiana show the complexity of mixtures that occur in this stream.

LC_{50} (mortality) endpoints; therefore, the PTI does not incorporate long-term chronic endpoints.

- Several environmental factors, which are not accounted for by the PTI, can modify the toxicity and bioavailability of pesticides, including dissolved organic carbon, particulates, and temperature.
- This PTI is based on the simplifying assumption that pesticide toxicity is additive and there is no chemical interaction (synergism, antagonism), which may not be the case in the environment.

One of the primary limitations of the PTI is the uncertainty in the relative toxicity of compounds that have a low number of comparable bioassays. Whereas 2,824 bioassays appear to be a large data set, the data are divided into three categories of endpoints (EC_{50} for cladocerans, LC_{50} for benthic invertebrates, and LC_{50} for fish), 83 pesticide compounds, and 162 species, making the number in each group relatively small. Many taxa only have a single bioassay per compound, although a few taxa have numerous bioassays per compound. Even when species are combined within each of the three major taxonomic groups, the median number of bioassays per compound is relatively low, ranging from 3 for the EC_{50} data set to 13 for the LC_{50} fish data set. While this does not preclude the use of the data as the best available, it demonstrates the sparseness of available data on the toxicity of many of the pesticides presently applied.

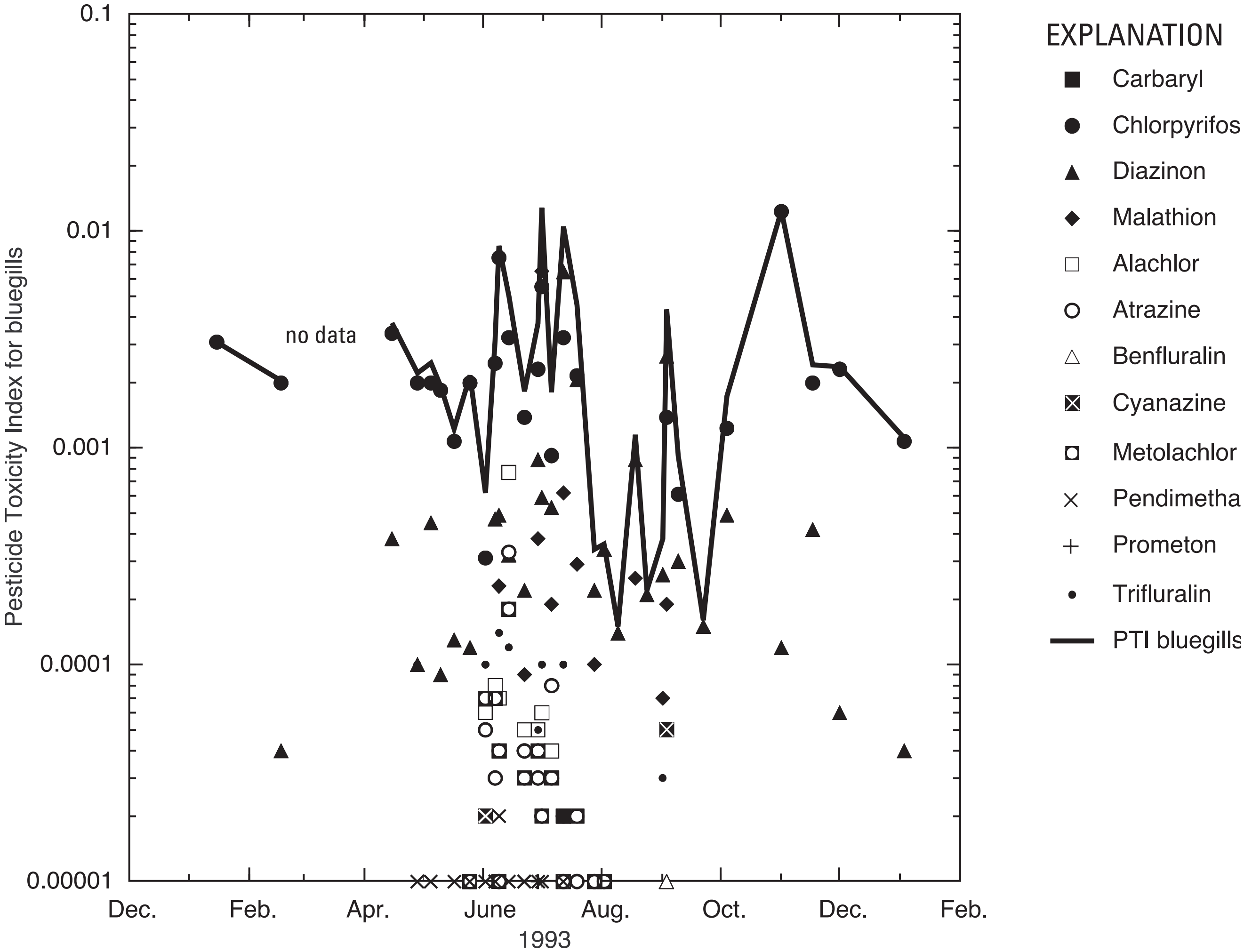

Figure 2. Pesticide Toxicity Index (PTI) for bluegills in Little Buck Creek, Indiana, and the contributions of selected pesticides. Nondetections and other individual values less than a PTI of 0.00001 are not plotted.

The high variability in toxicity data should be considered when using data from this report or any database. For example, the malathion LC_{50} toxicity values for fish (n=146) ranged from 0.19 to 50,200 ppb. The range of malathion toxicity decreases when the data is restricted to a single species like bluegills (n=13, 20 to 1,200 ppb) or rainbow trout (n=17, 2.8 to 234 ppb). The high variation in laboratory toxicity tests is due to different factors, including (1) formula of pesticide tested, (2) species tested and condition of individual organisms used, (3) water conditions (pH, temperature) during the testing period, (4) testing environment (flow through or static), and (5) individual operator of the test. These factors all contribute to the overall variability observed when combining data from multiple sources. For applications in which certain individual compounds are particularly important, special attention should be given to the variability in toxicity test results for those compounds. Adjustment of the approach may be merited, such as examining results with other percentiles of the test results, or according to a subset of test results that most closely match the needs of a particular assessment.

The problem of limited data can be addressed in two ways. First, the toxicity data can be expanded to include published data from other databases and reports; however, it would be essential to carefully cross-reference to prevent the duplication of data and to verify that the bioassays are as comparable as

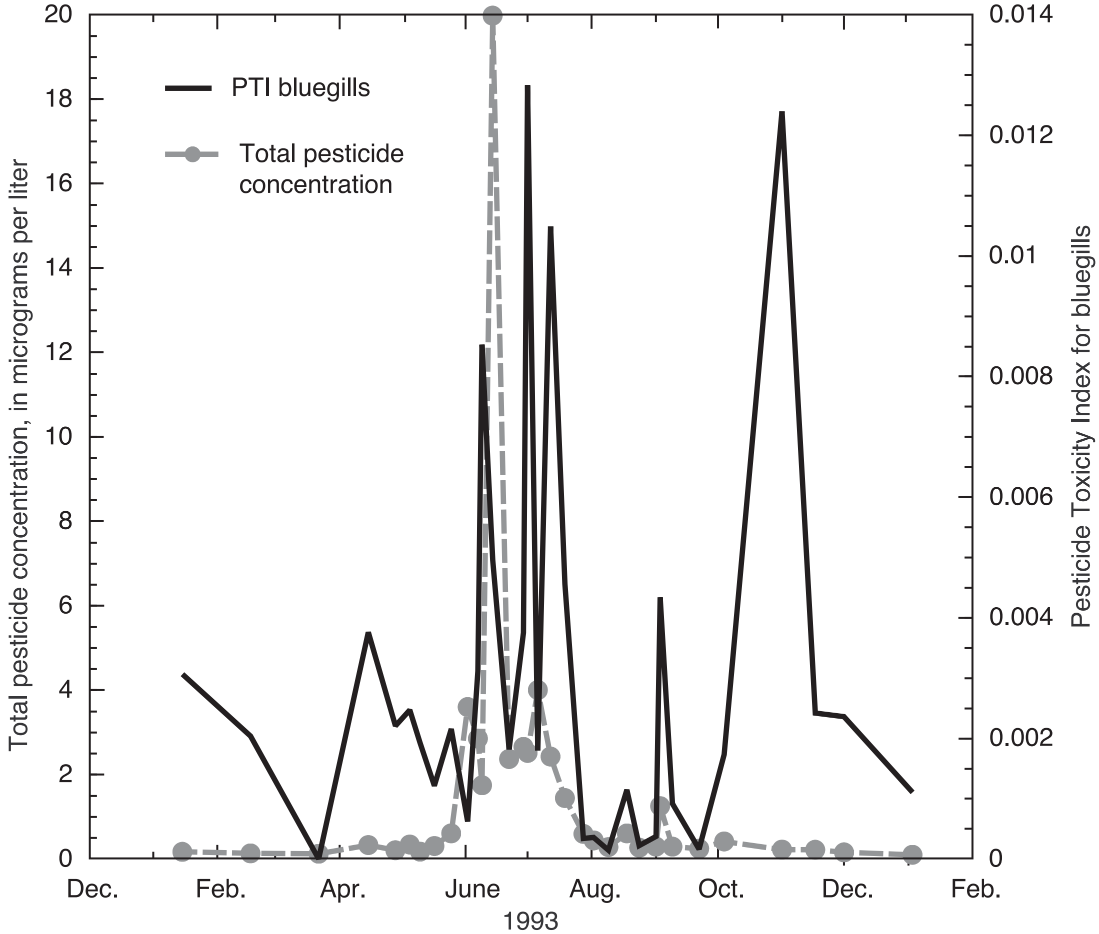

Figure 3. Pesticide Toxicity Index (PTI) for bluegills in Little Buck Creek, Indiana, compared with total pesticide concentration.

possible, a task that could prove difficult. A second approach is to reduce the data to a subset of species with more data that is most relevant to a particular problem. The PTI, for example, can be calculated using only warm or cold water species in areas where only one of the two groups resides.

SUMMARY AND CONCLUSIONS

The Pesticide Toxicity Index (PTI) for a particular sample is the sum of toxicity quotients (measured concentration divided by the median toxicity concentration from bioassays) for each detected pesticide. Qualifying toxicity data were found for one or more types of test organisms for 75 of the 83 pesticide compounds measured in NAWQA samples, but with a wide range of bioassays per compound (1 to 65). There were a total of 2,824 bioassays for the 75 compounds, including 287 48-hour EC_{50} values for freshwater cladocerans, 585 96-hour LC_{50} values for freshwater benthic invertebrates, and 1,952 96-hour LC_{50} values for freshwater fish.

While the PTI does not determine whether water in a sample is toxic, it can be used to rank or compare the toxicity of samples or sites on a relative basis for use in further analysis or additional assessments. In particular, the PTI may be useful as a basis for comparing the potential significance of pesticides in different streams on a common basis, for evaluating relations between pesticide exposure and observed biological conditions, and prioritizing where further studies are needed. Initial example applications indicate that high relative toxicity may sometimes occur during seasons when total pesticide concentrations are not particularly high.

The PTI has several limitations, which must be carefully considered in applications:

- The PTI is a relative ranking system that indicates that a sample is likely to be more or less toxic than another sample, but does not necessarily demonstrate actual toxicity.

- Toxicity values are based on short-term laboratory experiments with EC_{50} or LC_{50} endpoints; therefore, the PTI does not incorporate long-term chronic endpoints.
- Several environmental factors, which are not accounted for by the PTI, can modify the toxicity and bioavailability of pesticides, including dissolved organic carbon, particulates, and temperature.
- This PTI is based on the simplifying assumption that pesticide toxicity is additive and there is no chemical interaction (synergism, antagonism), which may not be the case in the environment.

The actual utility of the PTI for evaluating effects of pesticides on aquatic biota in streams can only be determined by testing the correlation of PTI values with various measures of the nature and health of aquatic biota.

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TABLES

Table 1. Pesticides analyzed in streams for the National Water-Quality Assessment (NAWQA) Program

[do., ditto; CAS, Chemical Abstracts Service; blank cells, not applicable]

Compound	Chemical class	Use	CAS number
2-(2,4,5-Trichlorophenoxy) propionic acid	Chlorophenoxy acid	Herbicide	93-72-1
2,4,5-T	do.	Herbicide	93-76-5
2,4-D	do.	Herbicide	94-75-7
2,4-DB	do.	Herbicide	94-82-6
2,6-Diethylaniline	Alachlor degradate		579-66-8
3-Hydroxycarbofuran	Carbofuran degradate		16655-82-6
4,6-Dinitro-2-methylphenol	Miscellaneous	Herbicide	534-52-1
Acetochlor	Acetanilide	Herbicide	34256-82-1
Acifluorfen	Benzoic acid derivative	Herbicide	50594-66-6
Alachlor	Acetanilide	Herbicide	15972-60-8
Aldicarb	Carbamate	Insecticide	116-06-3
Aldicarb sulfone	Carbamate, aldicarb degradate		1646-88-4
Aldicarb sulfoxide	Aldicarb degradate		1646-87-3
α-HCH	Organochlorine	Insecticide	319-84-6
Atrazine	Triazine	Herbicide	1912-24-9
Azinphos-methyl	Organophophorus	Insecticide	86-50-0
Benfluralin	Dinitroaniline	Herbicide	1861-40-1
Bentazon	Miscellaneous	Herbicide	25057-89-0
Bromacil	Uracil	Herbicide	314-40-9
Bromoxynil	Miscellaneous	Herbicide	1689-84-5
Butylate	Thiocarbamate	Herbicide	2008-41-5
Carbaryl	Carbamate	Insecticide	63-25-2
Carbofuran	do.	Insecticide	1563-66-2
Chloramben	Chlorobenzoic acid	Herbicide	133-90-4
Chlorothalonil	Organochlorine	Fungicide	1897-45-6
Chlorpyrifos	Organophophorus	Insecticide	2921-88-2
cis-Permethrin	Pyrithroid	Insecticide	54774-45-7
Clopyralid	Organochlorine	Herbicide	1702-17-6
Cyanazine	Triazine	Herbicide	21725-46-2
Dacthal	Chlorobenzoic acid	Herbicide	1861-32-1
Dacthal monoacid (MTP)	Dacthal degradate		887-54-7
Deethylatrazine	Atrazine degradate		6190-65-4
Diazinon	Organophosphorus	Insecticide	333-41-5
Dicamba	Chlorobenzoic acid	Herbicide	1918-00-9
Dichlobenil	Organochlorine	Herbicide	1194-65-6
Dichlorprop (2,4-DP)	Chlorophenoxy acid derivate	Herbicide	120-36-5
Dieldrin	Organochlorine	Insecticide	60-57-1
Dinoseb	Nitrophenol	Herbicide	88-85-7
Disulfoton	Organophosphorus	Insecticide	298-04-4
Diuron	Urea	Herbicide	330-54-1
EPTC (Eptam)	Thiocarbamate	Herbicide	759-94-4
Ethalfluralin	Dinitroaniline	Herbicide	55283-68-6
Ethoprop	Organophosphorus	Nematocide	13194-48-4
Fenuron	Urea	Herbicide	101-42-8
Fluometuron	do.	Herbicide	2164-17-2
Fonofos	Organophosphorus	Insecticide	944-22-9
Lindane (γ-HCH)	Organochlorine	Insecticide	58-89-9

Table 1. Pesticides analyzed in streams for the National Water-Quality Assessment (NAWQA) Program—*Continued*

Compound	Chemical class	Use	CAS number
Linuron	Urea	Herbicide	330-55-2
Malathion	Organophosphorus	Insecticide	121-75-5
MCPA	Chlorophenoxy acid	Herbicide	94-74-6
MCPB	do.	Herbicide	94-81-5
Methiocarb	Carbamate	Insecticide	2032-65-7
Methomyl	do.	Insecticide	16752-77-5
Metolachlor	Acetamilide	Herbicide	51218-45-2
Metribuzin	Trazine	Herbicide	21087-64-9
Molinate	Thiocarbamate	Herbicide	2212-67-1
Napropamide	Amide	Herbicide	15299-99-7
Neburon	Uraea	Herbicide	555-37-3
Norflurazon	Amine	Herbicide	27314-13-2
Oryzalin	Dinitroaniline	Herbicide	19044-88-3
Oxamyl	Carbamate	Insecticide	23135-22-0
p,p′-DDE	*p,p′*-DDT degradate	Insecticide	72-55-9
Parathion	Organophophorus	Insecticide	56-38-2
Parathion-methyl	do.	Insecticide	298-00-0
Pebulate	Thiocarbamate	Herbicide	1114-71-2
Pendimethalin	Dinitroaniline	Herbicide	40487-42-1
Phorate	Organophosphorus	Insecticide	298-02-2
Picloram	Amine	Herbicide	1918-02-1
Prometon	Triazine	Herbicide	1610-18-0
Propachlor	Acetanilide	Herbicide	1918-16-7
Propanil	Amide	Herbicide	709-98-8
Propargite	Sulfite ester	Insecticide	2312-35-8
Propham	Carbamate	Herbicide	122-42-9
Propoxur	do.	Insecticide	114-26-1
Propyzamide (Pronamide)	Amide	Herbicide	23950-58-5
Simazine	Triazine	Herbicide	122-34-9
Tebuthiuron	Urea	Herbicide	34014-18-1
Terbacil	Uracil	Herbicide	5902-51-2
Terbufos	Organophosphorus	Insecticide	13071-79-9
Thiobencarb	Thiocarbamate	Herbicide	28249-77-6
Triallate	do.	Herbicide	2303-17-5
Triclopyr	Organochlorine	Herbicide	55335-06-3
Trifluralin	Dinitroaniline	Herbicide	1582-09-8

Table 2. Summary of toxicity values by species

[do., ditto; EC_{50}, concentration at which 50 percent of test organisms exhibited nonlethal responses; LC_{50}, concentration at which 50 percent mortality occurred; N, number of bioassays; ppb, part per billion; —, no data]

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
EC_{50}	Crustacea	*Ceriodaphnia dubia*	Water flea	Carbaryl	1	—	3.1	—
	do.	do.	do.	Carbofuran	1	—	2.0	—
	do.	*Chydorus ovalis*	do.	Lindane	1	—	1,100.0	—
	do.	*Daphnia carinata*	do.	Carbaryl	1	—	35.0	—
	do.	do.	do.	Dieldrin	1	—	130.0	—
	do.	do.	do.	Lindane	1	—	100.0	—
	do.	do.	do.	Malathion	1	—	100.0	—
	do.	*Daphnia laevis*	do.	Aldicarb	2	51.0	58.0	65.0
	do.	do.	do.	Aldicarb sulfone	2	369.0	462.5	556.0
	do.	do.	do.	Aldicarb sulfoxide	2	43.0	50.0	57.0
	do.	*Daphnia magna*	do.	2,4-D	1	—	25,000.0	—
	do.	do.	do.	2,4-DB	1	—	25,000.0	—
	do.	do.	do.	2,6-Dinitro-2-methylphenol	1	—	2,700.0	—
	do.	do.	do.	Dichlorprop (2,4-DP)	2	5,400.0	5,825.0	6,250.0
	do.	do.	do.	Acetochlor	3	7,200.0	8,200.0	14,000.0
	do.	do.	do.	Alachlor	6	7,700.0	21,500.0	35,000.0
	do.	do.	do.	Aldicarb	1	—	410.7	—
	do.	do.	do.	Aldicarb sulfone	1	—	280.0	—
	do.	do.	do.	Atrazine	2	6,900.0	60,950.0	115,000.0
	do.	do.	do.	Azinphos-methyl	4	1.1	1.6	4.4
	do.	do.	do.	Benfluralin	1	—	2,186.0	—
	do.	do.	do.	Bromacil	1	—	121,000.0	—
	do.	do.	do.	Bromoxynil	24	41.0	126.5	74,000.0
	do.	do.	do.	Butylate	2	11,900.0	85,250.0	158,600.0
	do.	do.	do.	Carbaryl	9	2.8	7.2	7,100.0
	do.	do.	do.	Carbofuran	5	29.0	41.0	86.1
	do.	do.	do.	Chlorothalonil	4	70.0	97.0	172.0
	do.	do.	do.	Chlorpyrifos	2	0.1	0.9	1.7
	do.	do.	do.	Cyanazine	9	35,500.0	84,000.0	106,000.0
	do.	do.	do.	DCPA (Dacthal)	2	27,000.0	82,500.0	138,000.0
	do.	do.	do.	Diazinon	10	0.5	1.2	1.5

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
EC_{50}	Crustacea	*Daphnia magna*	Water flea	Dicamba	2	110,700.0	430,350.0	750,000.0
	do.	do.	do.	Dichlobenil	1	—	6,200.0	—
	do.	do.	do.	Disulfoton	1	—	13.0	—
	do.	do.	do.	Diuron	1	—	8,400.0	—
	do.	do.	do.	EPTC	3	6,400.0	7,500.0	14,150.0
	do.	do.	do.	Ethalfluralin	1	—	60.0	—
	do.	do.	do.	Ethoprop	3	43.9	93.0	690,000.0
	do.	do.	do.	Ethyl parathion	7	0.7	1.3	7.2
	do.	do.	do.	Fonofos	3	2.0	8.4	15.5
	do.	do.	do.	Lindane	8	516.0	4,145.0	8,000.0
	do.	do.	do.	Linuron	4	120.0	240.0	1,100.0
	do.	do.	do.	Malathion	7	1.0	1.7	2.2
	do.	do.	do.	Methiocarb	1	—	19.0	—
	do.	do.	do.	Methomyl	6	7.6	8.8	3,200.0
	do.	do.	do.	Methyl parathion	8	0.1	8.3	28.2
	do.	do.	do.	Metolachlor	3	23,500.0	25,100.0	26,000.0
	do.	do.	do.	Metribuzin	3	4,180.0	4,200.0	98,500.0
	do.	do.	do.	Molinate	3	4,700.0	19,400.0	24,000.0
	do.	do.	do.	Napropamide	2	14,300.0	19,500.0	24,700.0
	do.	do.	do.	Oryzalin	1	—	1,500.0	—
	do.	do.	do.	Oxamyl	5	420.0	1,950.0	5,700.0
	do.	do.	do.	Pebulate	1	—	6,830.0	—
	do.	do.	do.	Pendimethalin	2	280.0	2,690.0	5,100.0
	do.	do.	do.	Phorate	4	18.2	21.8	37.0
	do.	do.	do.	Prometon	3	25,700.0	38,000.0	59,800.0
	do.	do.	do.	Propachlor	3	6,900.0	7,800.0	13,000.0
	do.	do.	do.	Propanil	2	1,200.0	3,950.0	6,700.0
	do.	do.	do.	Propargite	2	74.0	82.5	91.0
	do.	do.	do.	Propoxur	2	11.0	19.1	27.2
	do.	do.	do.	Simazine	2	1,100.0	1,100.0	1,100.0
	do.	do.	do.	Tebuthiuron	1	—	297,000.0	—
	do.	do.	do.	Terbacil	1	—	65,000.0	—
	do.	do.	do.	Terbufos	4	0.3	3.4	13.0
	do.	do.	do.	Thiobencarb	4	101.0	335.0	1,200.0
	do.	do.	do.	Triallate	2	91.0	260.5	430.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
EC_{50}	Crustacea	*Daphnia magna*	Water flea	Trifluralin	1	—	560.0	—
	do.	do.	do.	α-HCH	2	800.0	900.0	1,000.0
	do.	*Daphnia pulex*	do.	2,4-D	1	—	3,200.0	—
	do.	do.	do.	2,6-Dinitro-2-methylphenol	1	—	145.0	—
	do.	do.	do.	Alachlor	2	9,000.0	9,700.0	10,400.0
	do.	do.	do.	Atrazine	2	36,500.0	41,500.0	46,500.0
	do.	do.	do.	Carbaryl	3	6.4	6.4	6.4
	do.	do.	do.	Carbofuran	2	35.0	40.0	45.0
	do.	do.	do.	Diazinon	3	0.8	0.8	0.9
	do.	do.	do.	Dichlobenil	2	3,700.0	3,700.0	3,700.0
	do.	do.	do.	Dieldrin	3	190.0	250.0	251.0
	do.	do.	do.	Diuron	3	1,400.0	1,400.0	1,400.0
	do.	do.	do.	Ethyl parathion	3	0.6	0.6	0.6
	do.	do.	do.	Lindane	3	460.0	460.0	460.0
	do.	do.	do.	Malathion	3	1.8	1.8	1.8
	do.	do.	do.	Propanil	1	—	11,400.0	—
	do.	do.	do.	Propham	2	8,000.0	9,000.0	10,000.0
	do.	do.	do.	Trifluralin	3	240.0	625.0	625.0
	do.	*Moina australiensis*	do.	Molinate	1	—	2,400.0	—
	do.	*Simocephalus serrulatus*	do.	2,4-D	1	—	4,900.0	—
	do.	do.	do.	Carbaryl	2	7.6	7.6	7.6
	do.	do.	do.	Diazinon	3	1.4	1.4	1.8
	do.	do.	do.	Dichlobenil	3	5,800.0	5,800.0	5,800.0
	do.	do.	do.	Dieldrin	3	190.0	240.0	240.0
	do.	do.	do.	Diuron	2	2,000.0	2,000.0	2,000.0
	do.	do.	do.	Ethyl parathion	4	0.4	0.4	0.5
	do.	do.	do.	Lindane	4	520.0	520.0	880.0
	do.	do.	do.	Malathion	4	0.6	3.5	6.2
	do.	do.	do.	Methyl parathion	2	0.4	0.4	0.4
	do.	do.	do.	Propham	2	10,000.0	10,000.0	10,000.0
	do.	do.	do.	Trifluralin	3	450.0	900.0	900.0
	do.	*Simocephalus* sp.	do.	Diazinon	1	—	1.4	—
	do.	do.	do.	Diuron	1	—	2,000.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Crustacea	*Simocephalus vetulus*	do.	Chlorpyrifos	1	—	0.4	—
	Annelida	*Branchiura sowerbyi*	Oligochaete	Malathion	1	—	4,570.0	—
	do.	*Lumbriculus variegatus*	do.	Diazinon	1	—	6,160.0	—
	do.	do.	do.	Propoxur	1	—	146,000.0	—
	do.	*Tubificidae*	do.	Dieldrin	1	—	6,710.0	—
	do.	do.	do.	Ethyl parathion	1	—	5,230.0	—
	do.	do.	do.	Malathion	1	—	16,700.0	—
	Crustacea	*Acartia tonsa*	Calanoid copepod	Atrazine	1	—	94.0	—
	do.	do.	do.	Lindane	1	—	17.0	—
	do.	do.	do.	Methomyl	1	—	410.0	—
	do.	*Artemia salina*	Brine shrimp	Dieldrin	2	65.0	82.5	100.0
	do.	do.	do.	α-HCH	1	—	500.0	—
	do.	*Asellus aquaticus*	Aquatic sowbug	Lindane	1	—	375.0	—
	do.	*Asellus brevicaudus*	do.	Azinphos-methyl	3	21.0	21.0	21.0
	do.	do.	do.	Carbaryl	3	240.0	280.0	280.0
	do.	do.	do.	Dichlobenil	2	35,000.0	35,000.0	35,000.0
	do.	do.	do.	Dieldrin	2	5.0	5.0	5.0
	do.	do.	do.	Diuron	1	—	15,500.0	—
	do.	do.	do.	EPTC	2	23,000.0	23,000.0	23,000.0
	do.	do.	do.	Ethyl parathion	3	213.0	600.0	2,130.0
	do.	do.	do.	Lindane	3	10.0	10.0	10.0
	do.	do.	do.	Malathion	3	3,000.0	3,000.0	3,000.0
	do.	do.	do.	Oryzalin	1	—	400.0	—
	do.	*Asellus communis*	do.	Diazinon	1	—	21.0	—
	do.	*Caridina rajadhari*	Freshwater prawn	Carbofuran	1	—	0.3	—
	do.	do.	do.	Lindane	1	—	31.3	—
	do.	*Cyclops strenuus*	Copepod	Methomyl	1	—	190.0	—
	do.	*Cypridopsis vidua*	Seed shrimp	Lindane	1	—	3.2	—
	do.	*Gammarus fasciatus*	Scud	2,4-D	1	—	2,400.0	—
	do.	do.	do.	2,6-Dinitro-2-methylphenol	1	—	1,100.0	—
	do.	do.	do.	Azinphos-methyl	4	0.1	0.1	0.4
	do.	do.	do.	Benfluralin	2	1,100.0	1,100.0	1,100.0
	do.	do.	do.	Butylate	4	10,000.0	11,000.0	15,000.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Crustacea	*Gammarus fasciatus*	Scud	Carbaryl	3	26.0	26.0	26.0
	do.	do.	do.	Chlorpyrifos	1	—	0.3	—
	do.	do.	do.	Cyanazine	2	2,000.0	2,000.0	2,000.0
	do.	do.	do.	Diazinon	2	0.2	0.2	0.2
	do.	do.	do.	Dichlobenil	1	—	10,000.0	—
	do.	do.	do.	Dieldrin	3	600.0	640.0	640.0
	do.	do.	do.	Dinoseb	1	—	1,800.0	—
	do.	do.	do.	Disulfoton	5	21.0	52.0	27,000.0
	do.	do.	do.	Diuron	3	160.0	160.0	700.0
	do.	do.	do.	EPTC	4	23,000.0	44,500.0	66,000.0
	do.	do.	do.	Ethyl parathion	10	0.3	1.3	4.5
	do.	do.	do.	Lindane	4	10.0	10.0	11.0
	do.	do.	do.	Malathion	5	0.5	0.8	0.9
	do.	do.	do.	Methyl parathion	2	3.8	3.8	3.8
	do.	do.	do.	Molinate	2	300.0	2,400.0	4,500.0
	do.	do.	do.	Oryzalin	1	—	190.0	—
	do.	do.	do.	Pebulate	2	10,000.0	10,000.0	10,000.0
	do.	do.	do.	Phorate	6	0.6	0.7	4.0
	do.	do.	do.	Picloram	1	—	27.0	—
	do.	do.	do.	Propanil	1	—	16,000.0	—
	do.	do.	do.	Propham	1	—	19,000.0	—
	do.	do.	do.	Propoxur	1	—	50.0	—
	do.	do.	do.	Trifluralin	3	1,000.0	2,200.0	2,200.0
	do.	*Gammarus fossarum*	do.	Ethyl parathion	1	—	2.5	—
	do.	*Gammarus italicus*	do.	Alachlor	1	—	19,700.0	—
	do.	do.	do.	Aldicarb	1	—	420.0	—
	do.	do.	do.	Atrazine	1	—	10,100.0	—
	do.	do.	do.	Azinphos-methyl	1	—	0.2	—
	do.	do.	do.	Carbaryl	1	—	28.0	—
	do.	do.	do.	Carbofuran	1	—	12.0	—
	do.	do.	do.	Lindane	1	—	26.0	—
	do.	do.	do.	Methomyl	1	—	47.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Crustacea	*Gammarus italicus*	Scud	Methyl parathion	1	—	2.9	—
	do.	do.	do.	Molinate	1	—	2,200.0	—
	do.	do.	do.	Oxamyl	1	—	220.0	—
	do.	do.	do.	Propoxur	1	—	50.0	—
	do.	*Gammarus lacustris*	do.	Azinphos-methyl	4	0.1	0.1	0.2
	do.	do.	do.	Carbaryl	3	16.0	22.0	22.0
	do.	do.	do.	Chlorpyrifos	3	0.1	0.1	0.1
	do.	do.	do.	Diazinon	2	170.0	185.0	200.0
	do.	do.	do.	Dicamba	2	3,900.0	3,900.0	3,900.0
	do.	do.	do.	Dichlobenil	3	11,000.0	11,000.0	11,000.0
	do.	do.	do.	Dieldrin	3	460.0	700.0	700.0
	do.	do.	do.	Disulfoton	3	52.0	240.0	240.0
	do.	do.	do.	Diuron	1	—	160.0	—
	do.	do.	do.	Ethyl parathion	5	3.5	3.5	12.8
	do.	do.	do.	Lindane	3	48.0	88.0	88.0
	do.	do.	do.	Malathion	3	1.6	1.6	1.8
	do.	do.	do.	Molinate	1	—	4,500.0	—
	do.	do.	do.	Phorate	2	9.0	9.0	9.0
	do.	do.	do.	Propham	1	—	10,000.0	—
	do.	do.	do.	Propoxur	3	34.0	34.0	34.0
	do.	do.	do.	Simazine	2	13,000.0	13,000.0	13,000.0
	do.	do.	do.	Trifluralin	1	—	2,200.0	—
	do.	*Gammarus pseudolimnaeus*	do.	Carbaryl	5	7.0	13.0	16.0
	do.	do.	do.	Chlorpyrifos	1	—	0.2	—
	do.	do.	do.	DCPA (Dacthal)	1	—	6,200.0	—
	do.	do.	do.	Diazinon	1	—	2.0	—
	do.	do.	do.	Methomyl	6	720.0	920.0	1,050.0
	do.	do.	do.	Permethrin	1	—	0.2	—
	do.	do.	do.	Terbufos	3	0.2	0.2	1.3
	do.	do.	do.	Thiobencarb	3	720.0	1,000.0	1,000.0
	do.	*Gammarus pulex*	do.	Atrazine	1	—	14,900.0	—
	do.	do.	do.	Carbofuran	1	—	9.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Crustacea	*Gammarus pulex*	Scud	Chlorpyrifos	1	—	0.1	—
	do.	do.	do.	Ethyl parathion	1	—	3.2	—
	do.	do.	do.	Lindane	8	5.5	18.8	225.0
	do.	do.	do.	Methomyl	1	—	760.0	—
	do.	*Hyalella azteca*	Scud	Atrazine	1	—	14,700.0	—
	do.	do.	do.	Azinphos-methyl	1	—	0.3	—
	do.	do.	do.	Chlorpyrifos	2	0.0	0.1	0.1
	do.	do.	do.	Diazinon	1	—	6.5	—
	do.	*Macrobrachium dayanum*	Freshwater prawn	Carbaryl	1	—	35.2	—
	do.	*Macrobrachium rosenbergii*	Giant river prawn	Malathion	2	9.0	11.0	13.0
	do.	*Neomysis mercedis*	Opposum Shrimp	Carbofuran	4	2.7	12.9	27.0
	do.	do.	do.	Malathion	4	1.4	1.9	3.8
	do.	do.	do.	Methyl parathion	2	0.2	0.2	0.2
	do.	*Orconectes immunis*	Crayfish	Carbaryl	1	—	2,870.0	—
	do.	do.	do.	Chlorpyrifos	1	—	6.0	—
	do.	*Orconectes nais*	do.	Carbaryl	2	8.6	504.3	1,000.0
	do.	do.	do.	Dieldrin	2	740.0	740.0	740.0
	do.	do.	do.	Ethyl parathion	4	0.0	0.0	15.0
	do.	do.	do.	Malathion	3	50.0	180.0	180.0
	do.	do.	do.	Methyl parathion	2	15.0	15.0	15.0
	do.	do.	do.	Phorate	2	50.0	50.0	50.0
	do.	do.	do.	Thiobencarb	1	—	2,000.0	—
	do.	*Palaemonetes kadiakensis*	Grass shrimp	Azinphos-methyl	5	0.1	0.2	1.2
	do.	do.	do.	Carbaryl	4	5.6	5.6	120.0
	do.	do.	do.	Dieldrin	1	—	20.0	—
	do.	do.	do.	Disulfoton	3	3.9	3.9	38.0
	do.	do.	do.	Ethyl parathion	4	1.5	1.5	5.0
	do.	do.	do.	Malathion	4	12.0	51.0	90.0
	do.	do.	do.	Methiocarb	2	110.0	110.0	110.0
	do.	do.	do.	Molinate	1	—	15,900.0	—
	do.	do.	do.	Trifluralin	1	—	37.0	—
	do.	*Palaemonetes pugio*	Daggerblade grass shrimp	Atrazine	1	—	9,000.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Crustacea	*Palaemonetes pugio*	Daggerblade grass shrimp	Azinphos-methyl	1	—	1.3	—
	do.	do.	do.	Chlorpyrifos	4	0.4	0.6	83.0
	do.	do.	do.	Lindane	2	4.4	4.4	4.4
	do.	do.	do.	Malathion	1	—	10.4	—
	do.	do.	do.	Propargite	1	—	101.0	—
	do.	do.	do.	Thiobencarb	1	—	380.0	—
	do.	do.	do.	Trifluralin	1	—	638.5	—
	do.	*Palaemonetes* sp.	Grass shrimp	Terbufos	12	4.6	5.7	12.0
	do.	*Palaemonetes vulgaris*	Marsh grass shrimp	Dieldrin	1	—	50.0	—
	do.	do.	do.	Lindane	1	—	10.0	—
	do.	do.	do.	Malathion	1	—	82.0	—
	do.	do.	do.	Methomyl	1	—	49.0	—
	do.	do.	do.	Methyl parathion	1	—	3.0	—
	do.	*Procambarus acutus acutus*	Crayfish	Methiocarb	1	—	1,300.0	—
	do.	do.	White river crayfish	Azinphos-methyl	1	—	40.0	—
	do.	do.	do.	Carbaryl	1	—	500.0	—
	do.	do.	do.	Carbofuran	1	—	500.0	—
	do.	do.	do.	Chlorpyrifos	1	—	2.0	—
	do.	do.	do.	Malathion	1	—	50,000.0	—
	do.	do.	do.	Methiocarb	1	—	1,300.0	—
	do.	do.	do.	Methomyl	1	—	1,000.0	—
	do.	do.	do.	Methyl parathion	1	—	3.0	—
	do.	*Procambarus blandingii*	Crayfish	Permethrin	1	—	210.0	—
	do.	*Procambarus clarkii*	Red swamp crayfish	Carbaryl	1	—	1,000.0	—
	do.	do.	do.	Chlorpyrifos	1	—	21.0	—
	do.	do.	do.	Malathion	1	—	49,170.0	—
	do.	do.	do.	Molinate	2	6,130.0	10,065.0	14,000.0
	do.	do.	do.	Propoxur	1	—	1,430.0	—
	do.	do.	do.	Terbufos	1	—	5.9	—
	do.	do.	do.	Thiobencarb	3	200.0	6,500.0	9,240.0
	do.	do.	do.	Trifluralin	3	12,000.0	13,000.0	26,000.0
	do.	*Procambarus simulans*	Crayfish	Carbaryl	1	—	2,430.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Crustacea	*Procambarus simulans*	Crayfish	Molinate	1	—	21,800.0	—
	do.	*Procambarus* sp.	do.	Alachlor	1	—	19,500.0	—
	do.	do.	do.	Azinphos-methyl	2	56.0	56.0	56.0
	do.	do.	do.	Carbaryl	2	1.9	951.0	1,900.0
	do.	do.	do.	Terbufos	1	—	8.0	—
	Fish	*Ameiurus melas*	Black bullhead	Atrazine	1	—	35,000.0	—
	do.	do.	do.	Azinphos-methyl	3	3,500.0	3,500.0	3,500.0
	do.	do.	do.	Carbaryl	3	20,000.0	20,000.0	20,000.0
	do.	do.	do.	Diazinon	1	—	8,000.0	—
	do.	do.	do.	Fluometuron	1	—	55,000.0	—
	do.	do.	do.	Lindane	3	64.0	64.0	64.0
	do.	do.	do.	Malathion	3	11,700.0	12,900.0	12,900.0
	do.	do.	do.	Methyl parathion	3	6,640.0	6,640.0	6,640.0
	do.	do.	do.	Prometon	1	—	20,000.0	—
	do.	do.	do.	Simazine	1	—	65,000.0	—
	do.	*Ameiurus natalis*	Yellow bullhead	do.	1	—	110,000.0	—
	do.	*Ameiurus nebulosus*	Brown bullhead	Molinate	1	—	34,000.0	—
	do.	*Ameiurus* sp.	Bullhead catfish	Atrazine	2	7,600.0	21,300.0	35,000.0
	do.	do.	do.	Diazinon	1	—	8,000.0	—
	do.	do.	do.	Fluometuron	2	44,000.0	49,500.0	55,000.0
	do.	do.	do.	Prometon	1	—	20,000.0	—
	do.	do.	do.	Simazine	1	—	65,000.0	—
	do.	*Anguilla anguilla*	European eel	Chlorpyrifos	1	—	540.0	—
	do.	do.	do.	Diazinon	6	80.0	82.5	86.0
	do.	do.	do.	Lindane	10	320.0	545.0	680.0
	do.	do.	do.	Methyl parathion	1	—	4,120.0	—
	do.	*Anguilla rostrata*	American eel	2,4,5-T	1	—	43,700.0	—
	do.	do.	do.	2,4-D	1	—	300,600.0	—
	do.	do.	do.	Dieldrin	1	—	0.9	—
	do.	do.	do.	Lindane	1	—	56.0	—
	do.	do.	do.	Malathion	2	82.0	291.0	500.0
	do.	do.	do.	Methyl parathion	2	6,300.0	11,600.0	16,900.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Carassius auratus*	Goldfish	Aldicarb	1	—	7,400.0	—
	do.	do.	do.	Atrazine	1	—	60,000.0	—
	do.	do.	do.	Azinphos-methyl	7	1,040.0	2,400.0	4,270.0
	do.	do.	do.	Benfluralin	2	800.0	805.0	810.0
	do.	do.	do.	Carbaryl	3	13,200.0	13,200.0	16,700.0
	do.	do.	do.	Carbofuran	1	—	10,250.0	—
	do.	do.	do.	Diazinon	1	—	9,000.0	—
	do.	do.	do.	Dichlobenil	2	7,680.0	7,740.0	7,800.0
	do.	do.	do.	Dieldrin	2	1.8	21.4	41.0
	do.	do.	do.	Disulfoton	2	7,200.0	7,200.0	7,200.0
	do.	do.	do.	EPTC	1	—	26,670.0	—
	do.	do.	do.	Ethalfluralin	1	—	260.0	—
	do.	do.	do.	Ethoprop	2	7,700.0	10,650.0	13,600.0
	do.	do.	do.	Ethyl parathion	4	1,830.0	2,215.0	2,700.0
	do.	do.	do.	Lindane	4	131.0	131.0	152.0
	do.	do.	do.	Malathion	6	790.0	6,925.0	10,700.0
	do.	do.	do.	Methyl parathion	4	9,000.0	9,000.0	12,000.0
	do.	do.	do.	Molinate	1	—	30,300.0	—
	do.	do.	do.	Oxamyl	1	—	27,500.0	—
	do.	do.	do.	Pronamide	1	—	350,000.0	—
	do.	do.	do.	Propoxur	1	—	50,000.0	—
	do.	do.	do.	Trifluralin	2	145.0	145.0	145.0
	do.	*Centrarchidae*	Sunfish family	Simazine	5	14,300.0	56,000.0	695,000.0
	do.	*Clarias batrachus*	Walking catfish	2,4-D	1	—	60,000.0	—
	do.	do.	do.	Carbaryl	3	20,000.0	46,850.0	107,660.0
	do.	do.	do.	Diazinon	1	—	4,791.6	—
	do.	do.	do.	Dieldrin	1	—	1.0	—
	do.	do.	do.	Lindane	2	1.1	8,000.6	16,000.0
	do.	do.	do.	Malathion	2	47.0	6,023.5	12,000.0
	do.	*Coregonus lavaretus*	Whitefish	Atrazine	2	11,200.0	18,750.0	26,300.0
	do.	*Ctenopharyngodon idella*	Grass carp	Dichlobenil	1	—	9,400.0	—
	do.	do.	do.	Diuron	1	—	31,000.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Cyprinella lutrensis*	Red shiner	Carbaryl	1	—	9,200.0	—
	do.	do.	do.	Malathion	1	—	25.0	—
	do.	*Cyprinodon variegatus*	Sheepshead minnow	Acetochlor	2	2,100.0	3,000.0	3,900.0
	do.	do.	do.	Aldicarb	2	41.0	105.5	170.0
	do.	do.	do.	Atrazine	4	2,000.0	7,850.0	16,200.0
	do.	do.	do.	Azinphos-methyl	2	1.9	2.3	2.7
	do.	do.	do.	Bromacil	1	—	162,800.0	—
	do.	do.	do.	Butylate	1	—	2,700.0	—
	do.	do.	do.	Carbaryl	3	1,200.0	2,200.0	2,600.0
	do.	do.	do.	Carbofuran	1	—	386.0	—
	do.	do.	do.	Chlorothalonil	1	—	32.0	—
	do.	do.	do.	Chlorpyrifos	4	136.0	205.0	270.0
	do.	do.	do.	Diazinon	3	150.0	1,470.0	1,470.0
	do.	do.	do.	Disulfoton	1	—	1,000.0	—
	do.	do.	do.	Diuron	1	—	6,700.0	—
	do.	do.	do.	Ethalfluralin	1	—	240.0	—
	do.	do.	do.	Ethoprop	2	180.0	569.0	958.0
	do.	do.	do.	Fluometuron	2	48,000.0	51,650.0	55,300.0
	do.	do.	do.	Lindane	2	100.0	102.0	103.9
	do.	do.	do.	Linuron	1	—	890.0	—
	do.	do.	do.	Malathion	3	33.0	51.0	55.0
	do.	do.	do.	Methomyl	2	960.0	1,060.0	1,160.0
	do.	do.	do.	Methyl parathion	2	3,400.0	7,700.0	12,000.0
	do.	do.	do.	Metolachlor	2	7,900.0	8,850.0	9,800.0
	do.	do.	do.	Metribuzin	1	—	85,000.0	—
	do.	do.	do.	Molinate	1	—	12,000.0	—
	do.	do.	do.	Napropamide	1	—	14,000.0	—
	do.	do.	do.	Norflurazon	1	—	9,580.0	—
	do.	do.	do.	Oxamyl	1	—	2,600.0	—
	do.	do.	do.	Pendimethalin	2	710.0	1,205.0	1,700.0
	do.	do.	do.	Permethrin	2	7.8	47.9	88.0
	do.	do.	do.	Phorate	3	1.3	4.0	8.2

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Cyprinodon variegatus*	Sheepshead minnow	Prometon	1	—	47,300.0	—
	do.	do.	do.	Propanil	1	—	4,600.0	—
	do.	do.	do.	Propargite	1	—	60.0	—
	do.	do.	do.	Terbacil	1	—	108,000.0	—
	do.	do.	do.	Terbufos	9	1.6	4.0	4.6
	do.	do.	do.	Thiobencarb	5	658.0	1,370.0	1,400.0
	do.	do.	do.	Trifluralin	1	—	160.0	—
	do.	*Cyprinus carpio*	Carp	2,4,5-T	2	5,300.0	23,200.0	41,100.0
	do.	do.	do.	2,4-D	9	5,100.0	21,450.0	270,000.0
	do.	do.	do.	Alachlor	1	—	4,600.0	—
	do.	do.	do.	Atrazine	1	—	18,800.0	—
	do.	do.	do.	Azinphos-methyl	3	695.0	695.0	695.0
	do.	do.	do.	Bentazon	1	—	978,000.0	—
	do.	do.	do.	Carbaryl	11	1,190.0	3,300.0	5,280.0
	do.	do.	do.	Carbofuran	7	160.0	1,290.0	3,000.0
	do.	do.	do.	Diazinon	2	3,430.0	4,200.0	4,970.0
	do.	do.	do.	Dichlobenil	1	—	10,900.0	—
	do.	do.	do.	Dieldrin	1	—	600.0	—
	do.	do.	do.	Diuron	1	—	2,900.0	—
	do.	do.	do.	Ethoprop	1	—	640.0	—
	do.	do.	do.	Ethyl parathion	1	—	850.0	—
	do.	do.	do.	Fonofos	1	—	88.0	—
	do.	do.	do.	Lindane	6	90.0	145.0	13,000.0
	do.	do.	do.	MCPA	1	—	59,000.0	—
	do.	do.	do.	Malathion	14	2.0	6,590.0	13,800.0
	do.	do.	do.	Methyl parathion	4	7,130.0	7,130.0	14,800.0
	do.	do.	do.	Molinate	2	29,000.0	35,900.0	42,800.0
	do.	do.	do.	Permethrin	1	—	15.0	—
	do.	do.	do.	Propoxur	5	3,300.0	7,340.0	10,100.0
	do.	do.	do.	Thiobencarb	2	110.0	765.0	1,420.0
	do.	do.	do.	Trifluralin	1	—	660.0	—
	do.	*Esox lucius*	Northern pike	Azinphos-methyl	2	0.4	0.4	0.4

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Esox lucius*	Northern pike	Phorate	2	110.0	110.0	110.0
	do.	*Fundulus diaphanus*	Banded killifish	2,4,5-T	1	—	17,400.0	—
	do.	do.	do.	2,4-D	1	—	26,700.0	—
	do.	do.	do.	Malathion	1	—	240.0	—
	do.	do.	do.	Methyl parathion	1	—	15,200.0	—
	do.	*Fundulus heteroclitus*	Mummichog	Azinphos-methyl	6	22.7	41.2	85.1
	do.	do.	do.	Chlorpyrifos	1	—	4.7	—
	do.	do.	do.	Dieldrin	3	5.0	5.0	16.0
	do.	do.	do.	Lindane	2	20.0	40.0	60.0
	do.	do.	do.	Malathion	5	22.5	70.0	400.0
	do.	do.	do.	Methyl parathion	2	8,000.0	33,000.0	58,000.0
	do.	*Gambusia affinis*	Western mosquitofish	2-(2,4,5-Trichlorophenoxy) propionic acid	1	—	350.0	—
	do.	do.	do.	Azinphos-methyl	1	—	78.0	—
	do.	do.	do.	Bentazon	1	—	3,874,000.0	—
	do.	do.	do.	Butylate	1	—	8,500.0	—
	do.	do.	do.	Carbaryl	3	1,400.0	31,800.0	204,000.0
	do.	do.	do.	Carbofuran	1	—	300.0	—
	do.	do.	do.	Chlorpyrifos	2	280.0	425.0	570.0
	do.	do.	do.	Dicamba	1	—	465,000.0	—
	do.	do.	do.	Dieldrin	3	1.5	3.7	31.0
	do.	do.	do.	EPTC	1	—	16,370.0	—
	do.	do.	do.	Ethyl parathion	2	320.0	1,180.5	2,041.0
	do.	do.	do.	Lindane	4	130.0	440.6	1,350.0
	do.	do.	do.	Malathion	2	200.0	430.0	660.0
	do.	do.	do.	Methyl parathion	1	—	5.0	—
	do.	do.	do.	Molinate	1	—	16,400.0	—
	do.	do.	do.	Pebulate	1	—	10,000.0	—
	do.	do.	do.	Picloram	1	—	120,000.0	—
	do.	do.	do.	Trifluralin	1	—	12,000.0	—
	do.	*Gambusia* sp.	Western mosquitofish	Ethyl parathion	1	—	320.0	—
	do.	*Gasterosteus aculeatus*	Threespine stickleback	Azinphos-methyl	2	4.8	8.5	12.1

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Gasterosteus aculeatus*	Threespine stickleback	Carbaryl	2	399.0	2,194.5	3,990.0
	do.	do.	do.	Chlorothalonil	1	—	69.0	—
	do.	do.	do.	Chlorpyrifos	1	—	8.5	—
	do.	do.	do.	Dieldrin	2	13.1	14.2	15.3
	do.	do.	do.	Lindane	2	44.0	47.0	50.0
	do.	do.	do.	Malathion	2	76.9	85.5	94.0
	do.	*Gila elegans*	Bonytail	Carbaryl	3	650.0	2,020.0	3,310.0
	do.	do.	do.	Malathion	1	—	1,530.0	—
	do.	*Ictalurus punctatus*	Channel catfish	2,4-D	1	—	7,000.0	—
	do.	do.	do.	2-(2,4,5-Trichlorophenoxy) propionic acid	1	—	19,400.0	—
	do.	do.	do.	Alachlor	1	—	6,500.0	—
	do.	do.	do.	Azinphos-methyl	4	3,220.0	3,290.0	3,290.0
	do.	do.	do.	Carbaryl	8	140.0	10,095.0	15,800.0
	do.	do.	do.	Carbofuran	2	248.0	248.0	248.0
	do.	do.	do.	Chlorothalonil	3	43.0	52.0	430.0
	do.	do.	do.	Chlorpyrifos	3	280.0	280.0	806.0
	do.	do.	do.	Cyanazine	6	10,400.0	11,300.0	17,400.0
	do.	do.	do.	Dieldrin	2	4.5	11.8	19.0
	do.	do.	do.	Dinoseb	6	28.0	53.5	118.0
	do.	do.	do.	Disulfoton	2	4,700.0	4,700.0	4,700.0
	do.	do.	do.	Ethyl parathion	4	2,650.0	2,975.0	3,300.0
	do.	do.	do.	Fluometuron	4	600.0	6,070.0	22,500.0
	do.	do.	do.	Lindane	4	44.0	44.0	450.0
	do.	do.	do.	Linuron	2	1,800.0	2,350.0	2,900.0
	do.	do.	do.	Malathion	5	7,620.0	8,970.0	52,200.0
	do.	do.	do.	Methomyl	9	300.0	320.0	1,800.0
	do.	do.	do.	Methyl parathion	3	5,240.0	5,240.0	5,710.0
	do.	do.	do.	Metolachlor	1	—	4,900.0	—
	do.	do.	do.	Metribuzin	1	—	3,400.0	—
	do.	do.	do.	Molinate	1	—	34,000.0	—
	do.	do.	do.	Oxamyl	2	13,500.0	15,500.0	17,500.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Ictalurus punctatus*	Channel catfish	Pendimethalin	2	418.0	1,159.0	1,900.0
	do.	do.	do.	Permethrin	2	5.4	6.3	7.2
	do.	do.	do.	Phorate	3	2.2	280.0	280.0
	do.	do.	do.	Picloram	6	1,400.0	14,750.0	74,800.0
	do.	do.	do.	Propachlor	2	230.0	255.0	280.0
	do.	do.	do.	Propham	1	—	86,500.0	—
	do.	do.	do.	Propoxur	1	—	1,300.0	—
	do.	do.	do.	Simazine	1	—	85,000.0	—
	do.	do.	do.	Terbufos	2	9.6	904.8	1,800.0
	do.	do.	do.	Thiobencarb	4	1,800.0	2,285.0	2,300.0
	do.	do.	do.	Trifluralin	3	210.0	417.0	2,200.0
	do.	*Jordanella floridae*	Flagfish	Diazinon	3	1,500.0	1,600.0	1,800.0
	do.	do.	do.	Malathion	1	—	349.0	—
	do.	do.	do.	Picloram	1	—	26,100.0	—
	do.	*Lagodon rhomboides*	Pinfish	Lindane	1	—	30.6	—
	do.	*Leiostomus xanthurus*	Spot	Atrazine	1	—	8,500.0	—
	do.	*Lepomis cyanellus*	Green sunfish	Azinphos-methyl	2	52.0	52.0	52.0
	do.	do.	do.	Carbaryl	2	9,460.0	10,330.0	11,200.0
	do.	do.	do.	Dichlobenil	2	5,700.0	5,700.0	5,700.0
	do.	do.	do.	Dieldrin	3	6.2	8.5	11.0
	do.	do.	do.	Ethyl parathion	3	395.0	930.0	1,700.0
	do.	do.	do.	Lindane	2	70.0	76.5	83.0
	do.	do.	do.	Malathion	3	175.0	600.0	1,460.0
	do.	do.	do.	Methyl parathion	2	6,860.0	6,860.0	6,860.0
	do.	*Lepomis gibbosus*	Pumpkinseed	2,4,5-T	1	—	20,000.0	—
	do.	do.	do.	2,4-D	1	—	94,600.0	—
	do.	do.	do.	Malathion	1	—	480.0	—
	do.	do.	do.	Methyl parathion	1	—	3,600.0	—
	do.	do.	do.	Simazine	1	—	27,000.0	—
	do.	*Lepomis macrochirus*	Bluegill	2,4-D	4	7,400.0	221,500.0	263,000.0
	do.	do.	do.	2,4-DB	3	7,500.0	7,500.0	16,800.0
	do.	do.	do.	2,6-Dinitro-2-methylphenol	2	230.0	295.0	360.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Lepomis macrochirus*	Bluegill	2-(2,4,5-Trichlorophenoxy) propionic acid	4	9,600.0	12,200.0	86,000.0
	do.	do.	do.	Dichlorprop (2,4-DP)	3	830.0	2,400.0	2,400.0
	do.	do.	do.	*p,p*'-DDE	1	—	240.0	—
	do.	do.	do.	Acetochlor	3	1,300.0	1,500.0	1,600.0
	do.	do.	do.	Alachlor	10	2,800.0	4,950.0	12,400.0
	do.	do.	do.	Aldicarb	4	50.0	51.0	450.0
	do.	do.	do.	Aldicarb sulfone	1	—	53,000.0	—
	do.	do.	do.	Atrazine	7	6,700.0	42,000.0	69,000.0
	do.	do.	do.	Azinphos-methyl	17	4.1	7.4	120.0
	do.	do.	do.	Benfluralin	3	65.0	420.0	600.0
	do.	do.	do.	Bromacil	1	—	127,000.0	—
	do.	do.	do.	Bromoxynil	2	4,000.0	13,500.0	23,000.0
	do.	do.	do.	Butylate	6	210.0	7,050.0	202,500.0
	do.	do.	do.	Carbaryl	26	760.0	6,760.0	290,000.0
	do.	do.	do.	Carbofuran	8	80.0	240.0	3,100.0
	do.	do.	do.	Chlorothalonil	5	26.3	62.0	386.0
	do.	do.	do.	Chlorpyrifos	10	1.3	6.5	108.0
	do.	do.	do.	Cyanazine	2	22,500.0	22,500.0	22,500.0
	do.	do.	do.	Diazinon	21	22.0	170.0	530.0
	do.	do.	do.	Dicamba	2	135,300.0	157,650.0	180,000.0
	do.	do.	do.	Dichlobenil	7	6,720.0	10,000.0	14,700.0
	do.	do.	do.	Dieldrin	20	2.8	12.5	79.0
	do.	do.	do.	Disulfoton	11	8.2	77.0	1,300.0
	do.	do.	do.	Diuron	8	2,800.0	6,750.0	84,000.0
	do.	do.	do.	EPTC	3	22,400.0	24,800.0	26,700.0
	do.	do.	do.	Ethalfluralin	2	32.0	67.0	102.0
	do.	do.	do.	Ethoprop	3	300.0	2,070.0	8,900.0
	do.	do.	do.	Ethyl parathion	12	18.0	210.5	710.0
	do.	do.	do.	Fluometuron	5	13,500.0	48,000.0	96,000.0
	do.	do.	do.	Fonofos	9	5.1	6.8	320.0
	do.	do.	do.	Lindane	22	25.0	66.5	810.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Lepomis macrochirus*	Bluegill	Linuron	3	9,200.0	9,600.0	16,200.0
	do.	do.	do.	MCPA	1	—	97,000.0	—
	do.	do.	do.	MCPB	1	—	3,300.0	—
	do.	do.	do.	Malathion	13	20.0	103.0	1,200.0
	do.	do.	do.	Methiocarb	5	110.0	210.0	754.0
	do.	do.	do.	Methomyl	18	370.0	850.0	7,700.0
	do.	do.	do.	Methyl parathion	9	1,000.0	2,434.0	13,300.0
	do.	do.	do.	Metolachlor	1	—	10,000.0	—
	do.	do.	do.	Metribuzin	3	75,960.0	92,000.0	131,300.0
	do.	do.	do.	Molinate	7	320.0	19,670.0	29,000.0
	do.	do.	do.	Napropamide	2	12,000.0	12,650.0	13,300.0
	do.	do.	do.	Norflurazon	1	—	16,300.0	—
	do.	do.	do.	Oryzalin	1	—	2,880.0	—
	do.	do.	do.	Oxamyl	4	5,600.0	6,415.0	10,000.0
	do.	do.	do.	Pebulate	1	—	7,900.0	—
	do.	do.	do.	Pendimethalin	4	199.0	980.0	90,400.0
	do.	do.	do.	Permethrin	14	0.8	9.9	33.4
	do.	do.	do.	Phorate	6	1.0	3.4	12.0
	do.	do.	do.	Picloram	10	14,500.0	28,450.0	86,100.0
	do.	do.	do.	Prometon	3	15,500.0	40,000.0	41,500.0
	do.	do.	do.	Propanil	2	5,400.0	9,700.0	14,000.0
	do.	do.	do.	Propargite	2	31.0	99.0	167.0
	do.	do.	do.	Propham	2	29,000.0	29,000.0	29,000.0
	do.	do.	do.	Propoxur	7	4,800.0	6,200.0	180,000.0
	do.	do.	do.	Simazine	6	16,000.0	95,000.0	118,000.0
	do.	do.	do.	Tebuthiuron	1	—	106,000.0	—
	do.	do.	do.	Terbacil	2	102,900.0	107,450.0	112,000.0
	do.	do.	do.	Terbufos	7	0.8	1.7	13.3
	do.	do.	do.	Thiobencarb	6	560.0	1,700.0	2,500.0
	do.	do.	do.	Triallate	3	1,300.0	1,330.0	2,400.0
	do.	do.	do.	Trifluralin	7	8.4	58.0	190.0
	do.	do.	Red ear sunfish	Azinphos-methyl	1	—	52.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Lepomis microlophus*	Red ear sunfish	Carbaryl	1	—	11,200.0	—
	do.	do.	do.	Lindane	1	—	83.0	—
	do.	do.	do.	Malathion	3	62.0	62.0	170.0
	do.	do.	do.	Methyl parathion	1	—	5,170.0	—
	do.	do.	do.	Simazine	1	—	54,000.0	—
	do.	*Leuciscus idus*	Ide	Azinphos-methyl	1	—	120.0	—
	do.	do.	Ide	Diazinon	2	150.0	150.0	150.0
	do.	*Menidia beryllina*	Inland silverside	2,4-D	1	—	175,000.0	—
	do.	do.	do.	Azinphos-methyl	1	—	22.8	—
	do.	do.	do.	Chlorpyrifos	3	4.2	4.2	10.2
	do.	do.	do.	Malathion	2	0.2	0.2	0.3
	do.	do.	do.	Terbufos	1	—	4.7	—
	do.	*Micropterus dolomieu*	Smallmouth bass	2,4-D	1	—	3,100.0	—
	do.	*Micropterus salmoides*	Largemouth bass	Azinphos-methyl	3	4.8	4.8	5.0
	do.	do.	do.	Carbaryl	3	6,400.0	6,400.0	6,400.0
	do.	do.	do.	Dichlobenil	1	—	12,500.0	—
	do.	do.	do.	Dieldrin	1	—	3.5	—
	do.	do.	do.	Disulfoton	2	60.0	60.0	60.0
	do.	do.	do.	Ethyl parathion	3	620.0	620.0	760.0
	do.	do.	do.	Lindane	3	32.0	32.0	32.0
	do.	do.	do.	Malathion	4	250.0	267.5	285.0
	do.	do.	do.	Methomyl	4	760.0	1,005.0	1,250.0
	do.	do.	do.	Methyl parathion	3	5,220.0	5,220.0	5,220.0
	do.	do.	do.	Phorate	2	5.0	5.0	5.0
	do.	do.	do.	Simazine	1	—	46,000.0	—
	do.	do.	do.	Trifluralin	2	75.0	75.0	75.0
	do.	*Morone americana*	White perch	2,4,5-T	1	—	16,400.0	—
	do.	do.	do.	2,4-D	1	—	40,000.0	—
	do.	do.	do.	Malathion	1	—	1,100.0	—
	do.	do.	do.	Methyl parathion	1	—	14,000.0	—
	do.	*Morone saxatilis*	Striped bass	2,4,5-T	1	—	14,600.0	—
	do.	do.	do.	2,4-D	1	—	70,100.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Morone saxatilis*	Striped bass	Carbaryl	3	760.0	1,000.0	2,300.0
	do.	do.	do.	Carbofuran	6	130.0	170.0	370.0
	do.	do.	do.	Chlorpyrifos	1	—	0.6	—
	do.	do.	do.	Dichlobenil	1	—	6,200,000.0	—
	do.	do.	do.	Dieldrin	3	1.0	19.7	500.0
	do.	do.	do.	Diuron	3	500.0	3,100.0	6,000.0
	do.	do.	do.	Ethyl parathion	3	17.8	1,000.0	2,000.0
	do.	do.	do.	Lindane	2	7.3	203.7	400.0
	do.	do.	do.	Malathion	11	12.0	39.0	240.0
	do.	do.	do.	Methyl parathion	4	790.0	4,750.0	14,000.0
	do.	do.	do.	Molinate	4	8,100.0	9,400.0	12,000.0
	do.	do.	do.	Simazine	2	250.0	411,125.0	822,000.0
	do.	do.	do.	Thiobencarb	17	430.0	760.0	1,000.0
	do.	*Mugil cephalus*	Striped mullet	Chlorpyrifos	1	—	5.4	—
	do.	do.	do.	Dieldrin	1	—	23.0	—
	do.	do.	do.	Lindane	1	—	66.0	—
	do.	do.	do.	Malathion	1	—	550.0	—
	do.	do.	do.	Methyl parathion	1	—	5,200.0	—
	do.	do.	do.	Trifluralin	1	—	32.0	—
	do.	*Notropis atherinoides*	Emerald shiner	Atrazine	1	—	15,600.0	—
	do.	do.	do.	Propanil	1	—	7,500.0	—
	do.	*Oncorhynchus clarki*	Cutthroat trout	2,4-D	2	24,500.0	44,250.0	64,000.0
	do.	do.	do.	Carbaryl	9	970.0	3,950.0	7,100.0
	do.	do.	do.	Chlorpyrifos	2	5.4	11.7	18.0
	do.	do.	do.	Diazinon	4	1,700.0	2,230.0	3,850.0
	do.	do.	do.	Dieldrin	3	6.0	6.4	12.0
	do.	do.	do.	Dinoseb	13	41.0	87.0	1,350.0
	do.	do.	do.	Diuron	3	710.0	1,400.0	1,400.0
	do.	do.	do.	EPTC	3	12,500.0	17,000.0	23,300.0
	do.	do.	do.	Ethyl parathion	2	1,560.0	1,560.0	1,560.0
	do.	do.	do.	Malathion	4	150.0	240.5	1,740.0
	do.	do.	do.	Methomyl	2	4,050.0	5,425.0	6,800.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Oncorhynchus clarki*	Cutthroat trout	Methyl parathion	2	1,850.0	1,850.0	1,850.0
	do.	do.	do.	Phorate	2	6.0	36.0	66.0
	do.	do.	do.	Picloram	13	1,475.0	4,700.0	8,600.0
	do.	*Oncorhynchus gorbuscha*	Pink salmon	Dichlorprop (2,4-DP)	2	600.0	700.0	800.0
	do.	do.	do.	Triclopyr	2	500.0	2,900.0	5,300.0
	do.	*Oncorhynchus keta*	Chum salmon	Dichlorprop (2,4-DP)	1	—	1,100.0	—
	do.	do.	do.	Triclopyr	2	300.0	3,900.0	7,500.0
	do.	*Oncorhynchus kisutch*	Coho salmon	2-(2,4,5-Trichlorophenoxy) propionic acid	1	—	600.0	—
	do.	do.	do.	Dichlorprop (2,4-DP)	3	1,500.0	1,800.0	2,200.0
	do.	do.	do.	Azinphos-methyl	4	4.2	6.1	17.0
	do.	do.	do.	Carbaryl	5	764.0	1,300.0	4,340.0
	do.	do.	do.	Carbofuran	2	530.0	530.0	530.0
	do.	do.	do.	Dieldrin	1	—	10.8	—
	do.	do.	do.	Lindane	4	23.0	32.0	50.0
	do.	do.	do.	Malathion	4	101.0	170.0	265.0
	do.	do.	do.	Methyl parathion	3	5,300.0	5,300.0	5,300.0
	do.	do.	do.	Permethrin	1	—	17.0	—
	do.	do.	do.	Triclopyr	6	260.0	1,150.0	9,600.0
	do.	*Oncorhynchus mykiss*	Rainbow trout	2,4,5-T	2	150.0	4,425.0	8,700.0
	do.	do.	do.	2,4-D	8	1,400.0	27,300.0	358,000.0
	do.	do.	do.	2,4-DB	4	2,000.0	3,700.0	14,300.0
	do.	do.	do.	2,6-Dinitro-2-methylphenol	1	—	66.0	—
	do.	do.	do.	2-(2,4,5-Trichlorophenoxy) propionic acid	2	14,800.0	16,000.0	17,200.0
	do.	do.	do.	Dichlorprop (2,4-DP)	3	900.0	1,400.0	1,800.0
	do.	do.	do.	do.	4	500.0	3,960.0	6,100.0
	do.	do.	do.	*p,p*'-DDE	1	—	32.0	—
	do.	do.	do.	Acetochlor	3	380.0	420.0	1,200.0
	do.	do.	do.	Alachlor	10	240.0	2,100.0	4,200.0
	do.	do.	do.	Aldicarb	3	560.0	560.0	560.0
	do.	do.	do.	Aldicarb sulfone	1	—	42,000.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Oncorhynchus mykiss*	Rainbow trout	Atrazine	6	4,500.0	11,750.0	24,000.0
	do.	do.	do.	Azinphos-methyl	10	3.2	7.0	28.0
	do.	do.	do.	Benfluralin	2	81.0	184.5	288.0
	do.	do.	do.	Bromacil	2	36,000.0	50,500.0	65,000.0
	do.	do.	do.	Bromoxynil	2	2,090.0	10,045.0	18,000.0
	do.	do.	do.	Butylate	6	2,100.0	4,700.0	202,500.0
	do.	do.	do.	Carbaryl	25	800.0	1,470.0	5,400.0
	do.	do.	do.	Carbofuran	4	362.0	380.0	420.0
	do.	do.	do.	Chlorothalonil	14	7.6	17.6	250.0
	do.	do.	do.	Chlorpyrifos	9	7.1	8.0	51.0
	do.	do.	do.	Cyanazine	2	9,000.0	9,000.0	9,000.0
	do.	do.	do.	DCPA (Dacthal)	2	6,600.0	18,300.0	30,000.0
	do.	do.	do.	Diazinon	11	90.0	400.0	3,200.0
	do.	do.	do.	Dicamba	5	28,000.0	130,000.0	153,000.0
	do.	do.	do.	Dichlobenil	3	4,930.0	6,300.0	18,000.0
	do.	do.	do.	Dieldrin	10	0.6	2.7	10,000.0
	do.	do.	do.	Disulfoton	6	1,850.0	3,010.0	13,900.0
	do.	do.	do.	Diuron	6	1,950.0	16,000.0	23,800.0
	do.	do.	do.	EPTC	3	19,960.0	20,720.0	21,840.0
	do.	do.	do.	Ethalfluralin	2	37.0	86.5	136.0
	do.	do.	do.	Ethoprop	5	1,100.0	7,800.0	13,800.0
	do.	do.	do.	Ethyl parathion	6	750.0	1,415.0	10,000.0
	do.	do.	do.	Fenuron	1	—	204,000.0	—
	do.	do.	do.	Fluometuron	10	2,960.0	25,200.0	47,000.0
	do.	do.	do.	Fonofos	5	19.0	20.0	2,800.0
	do.	do.	do.	Lindane	11	18.0	30.0	120.0
	do.	do.	do.	Linuron	2	3,000.0	9,700.0	16,400.0
	do.	do.	do.	MCPA	2	91,000.0	91,000.0	91,000.0
	do.	do.	do.	Malathion	17	2.8	122.0	234.0
	do.	do.	do.	Methiocarb	7	0.8	800.0	4,700.0
	do.	do.	do.	Methomyl	19	860.0	1,600.0	32,000.0
	do.	do.	do.	Methyl parathion	8	2,200.0	3,700.0	161,000.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Oncorhynchus mykiss*	Rainbow trout	Metolachlor	1	—	3,900.0	—
	do.	do.	do.	Metribuzin	5	42,000.0	76,770.0	147,000.0
	do.	do.	do.	Molinate	10	200.0	11,150.0	20,000.0
	do.	do.	do.	Napropamide	3	9,400.0	10,100.0	13,400.0
	do.	do.	do.	Norflurazon	1	—	8,100.0	—
	do.	do.	do.	Oryzalin	2	3,260.0	3,355.0	3,450.0
	do.	do.	do.	Oxamyl	4	3,700.0	4,450.0	12,400.0
	do.	do.	do.	Pebulate	1	—	7,400.0	—
	do.	do.	do.	Pendimethalin	4	138.0	760.0	86,600.0
	do.	do.	do.	Permethrin	7	2.1	5.6	72.0
	do.	do.	do.	Phorate	4	13.0	16.0	45.0
	do.	do.	do.	Picloram	11	4,000.0	19,300.0	310,000.0
	do.	do.	do.	Prometon	5	12,000.0	16,000.0	20,000.0
	do.	do.	do.	Pronamide	1	—	72,000.0	—
	do.	do.	do.	Propachlor	2	170.0	295.0	420.0
	do.	do.	do.	Propanil	2	2,300.0	7,550.0	12,800.0
	do.	do.	do.	Propargite	3	118.0	143.0	455.0
	do.	do.	do.	Propham	1	—	38,000.0	—
	do.	do.	do.	Propoxur	6	3,700.0	8,200.0	92,000.0
	do.	do.	do.	Simazine	5	40,500.0	56,000.0	70,500.0
	do.	do.	do.	Tebuthiuron	1	—	143,000.0	—
	do.	do.	do.	Terbacil	3	46,200.0	54,000.0	79,000.0
	do.	do.	do.	Terbufos	7	7.6	10.2	68.0
	do.	do.	do.	Thiobencarb	6	790.0	1,175.0	1,500.0
	do.	do.	do.	Triallate	2	1,200.0	1,350.0	1,500.0
	do.	do.	do.	Triclopyr	3	1,100.0	2,200.0	7,500.0
	do.	do.	do.	Trifluralin	8	10.0	41.5	210.0
	do.	*Oncorhynchus nerka*	Sockeye salmon	Dichlorprop (2,4-DP)	1	—	700.0	—
	do.	do.	do.	Triclopyr	4	400.0	1,300.0	7,500.0
	do.	*Oncorhynchus tshawytscha*	Chinook salmon	2,4-D	1	—	4,800.0	—
	do.	do.	do.	Dichlorprop (2,4-DP)	1	—	600.0	—
	do.	do.	do.	Azinphos-methyl	1	—	4.3	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Oncorhynchus tshawytscha*	Chinook salmon	Carbaryl	2	2,400.0	2,400.0	2,400.0
	do.	do.	do.	Dieldrin	1	—	6.1	—
	do.	do.	do.	Lindane	1	—	42.0	—
	do.	do.	do.	Malathion	2	23.0	71.5	120.0
	do.	do.	do.	Molinate	2	13,000.0	13,000.0	13,000.0
	do.	do.	do.	Thiobencarb	1	—	760.0	—
	do.	do.	do.	Triclopyr	2	1,100.0	5,400.0	9,700.0
	do.	*Perca flavescens*	Yellow perch	Atrazine	1	—	50,000.0	—
	do.	do.	do.	Azinphos-methyl	5	2.4	13.0	40.0
	do.	do.	do.	Carbaryl	3	350.0	745.0	5,100.0
	do.	do.	do.	Carbofuran	3	120.0	147.0	147.0
	do.	do.	do.	Fluometuron	1	—	70,000.0	—
	do.	do.	do.	Lindane	4	23.0	68.0	68.0
	do.	do.	do.	Malathion	3	263.0	263.0	263.0
	do.	do.	do.	Methyl parathion	3	3,060.0	3,060.0	3,060.0
	do.	do.	do.	Simazine	1	—	90.0	—
	do.	*Pimephales notatus*	Bluntnose minnow	do.	1	—	66,000.0	—
	do.	*Pimephales promelas*	Fathead minnow	2,4-D	6	2,400.0	70,700.0	320,000.0
	do.	do.	do.	2,4-DB	2	18,000.0	18,000.0	18,000.0
	do.	do.	do.	2,6-Dinitro-2-methylphenol	5	1,540.0	1,950.0	2,720.0
	do.	do.	do.	2-(2,4,5-Trichlorophenoxy) propionic acid	2	13,000.0	43,000.0	73,000.0
	do.	do.	do.	Alachlor	3	5,000.0	5,000.0	5,000.0
	do.	do.	do.	Aldicarb	4	861.0	1,285.0	1,370.0
	do.	do.	do.	Atrazine	2	15,000.0	15,000.0	15,000.0
	do.	do.	do.	Azinphos-methyl	18	37.0	202.5	1,900.0
	do.	do.	do.	Bromacil	1	—	186,000.0	—
	do.	do.	do.	Bromoxynil	3	11,500.0	13,800.0	13,800.0
	do.	do.	do.	Carbaryl	15	5,010.0	9,470.0	41,000.0
	do.	do.	do.	Carbofuran	5	844.0	872.0	1,990.0
	do.	do.	do.	Chlorpyrifos	12	120.0	155.0	542.0
	do.	do.	do.	Cyanazine	6	16,300.0	17,500.0	21,300.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Pimephales promelas*	Fathead minnow	Diazinon	11	3,700.0	6,800.0	10,300.0
	do.	do.	do.	Dichlobenil	2	6,000.0	6,000.0	6,000.0
	do.	do.	do.	Dieldrin	9	3.8	24.0	47.0
	do.	do.	do.	Dinoseb	12	88.0	155.0	700.0
	do.	do.	do.	Disulfoton	9	1,870.0	3,980.0	4,300.0
	do.	do.	do.	Diuron	2	14,200.0	14,200.0	14,200.0
	do.	do.	do.	Ethyl parathion	14	500.0	1,505.0	3,600.0
	do.	do.	do.	Fonofos	1	—	1,090.0	—
	do.	do.	do.	Lindane	8	56.0	82.0	130.0
	do.	do.	do.	MCPB	1	—	12,500.0	—
	do.	do.	do.	Malathion	10	8,650.0	11,650.0	25,000.0
	do.	do.	do.	Methomyl	10	1,500.0	1,800.0	2,800.0
	do.	do.	do.	Methyl parathion	13	4,460.0	8,170.0	9,500.0
	do.	do.	do.	Metolachlor	2	8,000.0	8,200.0	8,400.0
	do.	do.	do.	Molinate	1	—	27,000.0	—
	do.	do.	do.	Oxamyl	2	5,480.0	6,890.0	8,300.0
	do.	do.	do.	Permethrin	2	3.0	4.4	5.7
	do.	do.	do.	Phorate	1	—	250.0	—
	do.	do.	do.	Picloram	2	55,300.0	68,400.0	81,500.0
	do.	do.	do.	Propoxur	3	8,800.0	25,000.0	25,000.0
	do.	do.	do.	Simazine	3	5,000.0	6,400.0	510,000.0
	do.	do.	do.	Terbufos	3	13.3	150.0	390.0
	do.	do.	do.	Trifluralin	2	105.0	105.0	105.0
	do.	*Poecilia reticulata*	Guppy	2,4,5-T	1	—	28,100.0	—
	do.	do.	do.	2,4-D	2	8,356.0	39,528.0	70,700.0
	do.	do.	do.	Atrazine	1	—	4,300.0	—
	do.	do.	do.	Azinphos-methyl	2	120.0	375.0	630.0
	do.	do.	do.	Carbaryl	5	3,840.0	4,700.0	9,740.0
	do.	do.	do.	Diazinon	4	800.0	3,000.0	3,400.0
	do.	do.	do.	Dieldrin	14	1.0	6.8	300.0
	do.	do.	do.	Disulfoton	2	280.0	280.0	280.0
	do.	do.	do.	Ethyl parathion	1	—	56.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Poecilia reticulata*	Guppy	Fluometuron	1	—	46,000.0	—
	do.	do.	do.	Lindane	4	16.0	95.0	360.0
	do.	do.	do.	Malathion	3	840.0	1,200.0	3,100.0
	do.	do.	do.	Methyl parathion	2	6,200.0	8,000.0	9,800.0
	do.	do.	do.	Metolachlor	1	—	8,600.0	—
	do.	do.	do.	Prometon	2	12,000.0	12,000.0	12,000.0
	do.	do.	do.	Pronamide	1	—	150,000.0	—
	do.	do.	do.	Propoxur	3	1,400.0	1,740.0	2,980.0
	do.	do.	do.	Simazine	2	49,000.0	49,000.0	49,000.0
	do.	do.	do.	α-HCH	1	—	1,490.0	—
	do.	*Pomoxis nigromaculatus*	Black crappie	Azinphos-methyl	2	3.0	3.0	3.0
	do.	do.	do.	Carbaryl	2	2,600.0	2,600.0	2,600.0
	do.	*Ptychocheilus lucius*	Colorado squawfish	do.	2	1,310.0	2,245.0	3,180.0
	do.	do.	do.	Malathion	1	—	9,140.0	—
	do.	*Pungitius pungitius*	Ninespine stickleback	Chlorpyrifos	1	—	4.7	—
	do.	*Salmo salar*	Atlantic salmon	*p,p*'-DDE	1	—	96.0	—
	do.	do.	do.	Azinphos-methyl	4	1.8	2.1	2.5
	do.	do.	do.	Carbaryl	2	250.0	2,375.0	4,500.0
	do.	do.	do.	Methomyl	6	560.0	1,200.0	1,400.0
	do.	do.	do.	Permethrin	1	—	1.5	—
	do.	*Salmo trutta*	Brown Trout	Carbaryl	1	—	700.0	—
	do.	do.	do.	Propoxur	1	—	2,110.0	—
	do.	do.	do.	Azinphos-methyl	3	3.5	4.0	4.6
	do.	do.	do.	Carbaryl	3	1,950.0	6,300.0	6,300.0
	do.	do.	do.	Carbofuran	3	280.0	560.0	560.0
	do.	do.	do.	Diazinon	1	—	602.0	—
	do.	do.	do.	Lindane	4	1.7	1.9	22.0
	do.	do.	do.	Malathion	3	101.0	101.0	200.0
	do.	do.	do.	Methyl parathion	3	4,700.0	4,700.0	4,740.0
	do.	do.	do.	Terbufos	1	—	20.0	—
	do.	*Salmonidae*	Trout family	2,4,5-T	1	—	9,400.0	—
	do.	do.	do.	Diazinon	1	—	8,000.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Salmonidae*	Trout family	Diuron	1	—	1,100.0	—
	do.	do.	do.	MCPA	1	—	25,000.0	—
	do.	*Salvelinus fontinalis*	Brook trout	Atrazine	3	4,900.0	4,900.0	6,300.0
	do.	do.	do.	Azinphos-methyl	1	—	1.2	—
	do.	do.	do.	Carbaryl	13	900.0	2,500.0	5,400.0
	do.	do.	do.	Diazinon	4	450.0	785.0	1,050.0
	do.	do.	do.	Ethyl parathion	2	1,510.0	1,755.0	2,000.0
	do.	do.	do.	Lindane	1	—	44.3	—
	do.	do.	do.	Malathion	2	120.0	125.0	130.0
	do.	do.	do.	Methomyl	5	1,200.0	1,500.0	2,200.0
	do.	do.	do.	Permethrin	4	2.3	3.6	5.2
	do.	do.	do.	Propoxur	1	—	3,550.0	—
	do.	*Salvelinus namaycush*	Lake trout	2,4-D	2	44,500.0	44,750.0	45,000.0
	do.	do.	do.	Carbaryl	2	690.0	690.0	690.0
	do.	do.	do.	Carbofuran	2	164.0	164.0	164.0
	do.	do.	do.	Chlorpyrifos	2	73.0	85.5	98.0
	do.	do.	do.	Diazinon	2	600.0	601.0	602.0
	do.	do.	do.	Dinoseb	11	32.0	79.0	1,400.0
	do.	do.	do.	Diuron	3	1,200.0	2,700.0	2,700.0
	do.	do.	do.	EPTC	2	11,500.0	13,850.0	16,200.0
	do.	do.	do.	Ethyl parathion	2	1,920.0	1,920.0	1,920.0
	do.	do.	do.	Lindane	3	24.0	32.0	32.0
	do.	do.	do.	Malathion	2	76.0	76.0	76.0
	do.	do.	do.	Methyl parathion	2	3,780.0	3,780.0	3,780.0
	do.	do.	do.	Picloram	11	1,550.0	2,350.0	4,950.0
	do.	*Sciaenops ocellatus*	Red drum	Azinphos-methyl	2	6.2	6.7	7.1
	do.	*Stizostedion vitreum v.*	Walleye	Malathion	2	64.0	64.0	64.0
	do.	do.	do.	Phorate	1	—	57.0	—
	do.	*Tilapia mossambica*	Mozambique tilapia	Carbaryl	1	—	8,500.0	—
	do.	do.	do.	Carbofuran	3	460.0	480.0	540.0
	do.	do.	do.	Chlorothalonil	1	—	120.0	—
	do.	do.	do.	Dieldrin	2	8.4	9.2	10.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Fish	*Tilapia mossambica*	Mozambique tilapia	Lindane	4	57.0	1,889.0	4,000.0
	do.	do.	do.	Malathion	5	140.0	500.0	2,000.0
	do.	do.	do.	Propoxur	2	7,800.0	7,900.0	8,000.0
	do.	*Tinca tinca*	Tench	2,4,5-T	1	—	8,300.0	—
	do.	do.	do.	Diuron	1	—	15,500.0	—
	do.	do.	do.	MCPA	1	—	45,000.0	—
	do.	do.	do.	Propoxur	4	3,700.0	8,650.0	13,300.0
	do.	*Umbra pygmaea*	Eastern mudminnow	Malathion	1	—	240.0	—
	Insecta	*Acroneuria ruralis*	Stonefly	Diazinon	1	—	16.0	—
	do.	*Acroneuria* sp.	do.	Atrazine	1	—	6,700.0	—
	do.	*Arctopsyche grandis*	Caddisfly	Ethyl parathion	2	7.0	7.0	7.0
	do.	do.	do.	Malathion	2	32.0	32.0	32.0
	do.	*Atherix variegata*	Snipefly	do.	2	385.0	385.0	385.0
	do.	*Baetis intermedius*	Mayfly	Diazinon	1	—	24.0	—
	do.	*Brachythemis contaminata*	Dragonfly	Carbaryl	1	—	6,933.0	—
	do.	do.	do.	Carbofuran	1	—	0.1	—
	do.	*Chaoborus flavicans*	Midge	Lindane	1	—	4.0	—
	do.	do.	do.	Chlorpyrifos	1	—	6.6	—
	do.	*Chaoborus* sp.	Phantom midge	Lindane	1	—	3.3	—
	do.	*Chironomus plumosus*	Midge	Lindane	3	12.7	13.5	51.2
	do.	do.	do.	Methomyl	1	—	32.0	—
	do.	*Chironomus riparius*	do.	Lindane	5	1.6	6.9	235.0
	do.	*Chironomus tentans*	do.	Azinphos-methyl	1	—	0.4	—
	do.	do.	do.	Chlorpyrifos	1	—	0.5	—
	do.	do.	do.	Diazinon	2	0.0	5.4	10.7
	do.	do.	do.	Ethyl parathion	1	—	31.0	—
	do.	*Claassenia sabulosa*	Stonefly	Carbaryl	3	5.6	5.6	5.6
	do.	do.	do.	Chlorpyrifos	3	0.6	0.6	0.6
	do.	do.	do.	Dieldrin	2	0.6	0.6	0.6
	do.	do.	do.	Ethyl parathion	3	1.5	1.5	1.5
	do.	do.	do.	Malathion	4	2.8	2.8	56.0
	do.	*Cloeon dipterum*	Mayfly	Chlorpyrifos	1	—	0.3	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Insecta	*Cloeon* sp.	Mayfly	Lindane	1	—	50.0	—
	do.	*Corixa punctata*	Water boatman	Chlorpyrifos	2	1.9	2.0	2.0
	do.	*Drunella grandis*	Mayfly	Azinphos-methyl	1	—	14.0	—
	do.	do.	do.	Dieldrin	1	—	8.0	—
	do.	do.	do.	Disulfoton	1	—	78.0	—
	do.	do.	do.	Ethyl parathion	1	—	3.0	—
	do.	do.	do.	Malathion	1	—	100.0	—
	do.	*Hesperoperla pacifica*	Golden stonefly	Azinphos-methyl	2	8.5	8.5	8.5
	do.	do.	do.	Dieldrin	2	24.0	24.0	24.0
	do.	do.	do.	Disulfoton	3	8.2	8.2	9.4
	do.	do.	do.	Ethyl parathion	4	1.0	2.8	3.0
	do.	do.	do.	Malathion	4	7.0	7.1	7.7
	do.	*Hexagenia bilineata*	Mayfly	Ethyl parathion	2	15.0	15.0	15.0
	do.	do.	do.	Permethrin	1	—	0.1	—
	do.	*Hexagenia* sp.	do.	Phorate	1	—	65.0	—
	do.	*Hydropsyche angustipennis*	Caddisfly	Lindane	1	—	330.0	—
	do.	do.	do.	Ethyl parathion	2	0.4	0.4	0.4
	do.	do.	do.	Malathion	2	22.5	22.5	22.5
	do.	*Hydropsyche* sp.	do.	do.	2	5.0	5.0	5.0
	do.	do.	do.	Methiocarb	1	—	14.0	—
	do.	*Ischnura* sp.	Damselfly	Methyl parathion	1	—	33.0	—
	do.	*Ischnura verticalis*	do.	Dieldrin	1	—	12.0	—
	do.	do.	do.	Ethyl parathion	2	0.6	0.6	0.6
	do.	do.	do.	Methyl parathion	1	—	33.0	—
	do.	*Isogenus* sp.	Stonefly	Carbaryl	1	—	3.6	—
	do.	do.	do.	Methomyl	2	29.0	186.0	343.0
	do.	*Isonychia* sp.	Mayfly	Methiocarb	1	—	7.0	—
	do.	*Isoperla* sp.	Stonefly	Malathion	2	0.7	0.7	0.7
	do.	*Leptoceridae*	Longhorn caddisfly	Chlorpyrifos	1	—	0.8	—
	do.	*Lestes congener*	Damselfly	Diazinon	1	—	50.0	—
	do.	do.	do.	Dieldrin	1	—	3.0	—
	do.	do.	do.	Ethyl parathion	1	—	3.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Insecta	*Lestes congener*	Damselfly	Lindane	1	—	20.0	—
	do.	do.	do.	Malathion	2	10.0	10.0	10.0
	do.	do.	do.	Propoxur	1	—	300.0	—
	do.	*Limnephilus bipunctatus*	Caddisfly	Ethyl parathion	1	—	37.9	—
	do.	do.	do.	do.	1	—	2.4	—
	do.	do.	do.	Lindane	1	—	9.6	—
	do.	*Limnephilus* sp.	do.	Malathion	2	1.3	1.3	1.3
	do.	*Neoplea striola*	Pygmy backswimmer	Chlorpyrifos	2	1.2	1.4	1.6
	do.	*Notonecta undulata*	Backswimmer	Carbaryl	1	—	200.0	—
	do.	do.	do.	Dieldrin	1	—	1.0	—
	do.	do.	do.	Ethyl parathion	1	—	7.0	—
	do.	do.	do.	Lindane	1	—	3.0	—
	do.	do.	do.	Malathion	1	—	80.0	—
	do.	do.	do.	Propoxur	1	—	160.0	—
	do.	*Ophiogomphus sp*	Dragonfly	Carbofuran	1	—	220.0	—
	do.	*Paraleptophlebia pallipes*	Mayfly	Diazinon	1	—	44.0	—
	do.	*Peltodytes sp*	Beetle	Carbaryl	1	—	3,300.0	—
	do.	do.	do.	Chlorpyrifos	1	—	0.8	—
	do.	do.	do.	Dieldrin	1	—	2.0	—
	do.	do.	do.	Ethyl parathion	1	—	7.0	—
	do.	do.	do.	Lindane	1	—	20.0	—
	do.	do.	do.	Malathion	1	—	1,000.0	—
	do.	do.	do.	Propoxur	1	—	8,000.0	—
	do.	*Pteronarcella badia*	Stonefly	Carbaryl	6	1.7	6.4	29.0
	do.	do.	do.	Chlorpyrifos	1	—	0.4	—
	do.	do.	do.	Dieldrin	2	0.5	0.5	0.5
	do.	do.	do.	Ethyl parathion	3	4.2	4.2	4.2
	do.	do.	do.	Malathion	3	1.1	1.1	1.1
	do.	do.	do.	Methomyl	3	60.0	60.0	69.0
	do.	*Pteronarcys californica*	do.	2,4-D	2	1,600.0	8,300.0	15,000.0
	do.	do.	do.	2,4-DB	2	15,000.0	15,000.0	15,000.0
	do.	do.	do.	2,6-Dinitro-2-methylphenol	2	320.0	320.0	320.0

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Insecta	*Pteronarcys californica*	Stonefly	2-(2,4,5-Trichlorophenoxy) propionic acid	1	—	340.0	—
	do.	do.	do.	Azinphos-methyl	5	1.5	1.9	22.0
	do.	do.	do.	Carbaryl	4	2.0	4.8	4.8
	do.	do.	do.	Chlorpyrifos	3	10.0	10.0	10.0
	do.	do.	do.	Diazinon	3	25.0	25.0	25.0
	do.	do.	do.	Dichlobenil	4	6,600.0	7,000.0	7,000.0
	do.	do.	do.	Dieldrin	4	0.5	19.8	39.0
	do.	do.	do.	Disulfoton	6	5.0	14.5	28.5
	do.	do.	do.	Diuron	2	1,200.0	1,200.0	1,200.0
	do.	do.	do.	Ethyl parathion	8	5.1	18.7	100.0
	do.	do.	do.	Lindane	5	1.0	4.5	4.5
	do.	do.	do.	Malathion	5	10.0	50.0	100.0
	do.	do.	do.	Methiocarb	4	5.0	5.4	5.4
	do.	do.	do.	Molinate	3	340.0	340.0	370.0
	do.	do.	do.	Phorate	1	—	4.0	—
	do.	do.	do.	Picloram	2	48.0	24,024.0	48,000.0
	do.	do.	do.	Propoxur	3	13.0	18.0	18.0
	do.	do.	do.	Simazine	1	—	1,900.0	—
	do.	do.	do.	Trifluralin	4	2,800.0	2,900.0	3,000.0
	do.	*Pteronarcys* sp.	do.	2,4-DB	1	—	15,000.0	—
	do.	do.	do.	Diazinon	1	—	25.0	—
	do.	do.	do.	Diuron	1	—	1,200.0	—
	do.	*Ranatra elongata*	Water scorpion	Carbaryl	1	—	624.0	—
	do.	*Sigara striata*	Water bug	Lindane	1	—	3.9	—
	do.	*Skwala* sp.	Stonefly	Carbaryl	2	3.6	6.4	9.2
	do.	do.	do.	Methomyl	3	29.0	29.0	34.0
	Invert	*Eudiaptomus gracilis*	Calanoid copepod	2,4-D	1	—	144,100.0	—
	do.	*Eurytemora affinis*	do.	Atrazine	3	500.0	2,600.0	13,200.0
	do.	do.	do.	Methomyl	1	—	290.0	—
	Mollusca	*Corbicula fluminea*	Asiatic clam	Methiocarb	1	—	8,800.0	—
	do.	*Corbicula manilensis*	do.	do.	1	—	8,800.0	—

Table 2. Summary of toxicity values by species—*Continued*

Endpoint	Taxa	Species	Name	Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
LC_{50}	Mollusca	*Lamellidens corrianus*	Bivalve	Malathion	4	118.6	184.5	284.1
	do.	do.	Pond snail	Aldicarb	1	—	11,500.0	—
	do.	do.	do.	Carbaryl	2	4,400.0	4,450.0	4,500.0
	do.	do.	do.	Carbofuran	1	—	3,097.0	—
	do.	do.	do.	Lindane	1	—	2,685.0	—
	do.	do.	do.	Phorate	2	15,000.0	18,500.0	22,000.0
	do.	*Anodonta anatina*	Fresh-water mussel	Malathion	1	—	80.0	—
	do.	*Egeria radiata*	Freshwater Clam	Lindane	1	—	145,000.0	—
	do.	*Lymnaea stagnalis*	Great pond snail	Lindane	1	—	3,300.0	—
	Nematoda	*Monhystera disjuncta*	Nematode	Lindane	1	—	6,700.0	—
	Oligochaeta	*Limnodrilus hoffmeisteri*	Oligochaeta	Carbofuran	1	—	5,294.0	—
	do.	do.	do.	Lindane	1	—	6,233.0	—
	do.	*Tubifex tubifex*	do.	Carbaryl	1	—	50.0	—
	do.	do.	do.	Lindane	2	3,500.0	3,700.0	3,900.0
	do.	do.	do.	Methyl parathion	1	—	500.0	—
	Turbellaria	*Dugesia tigrina*	Turbellaria	Diazinon	1	—	630.0	—
	do.	do.	do.	Malathion	1	—	4,400.0	—
	do.	do.	do.	Methyl parathion	2	2,600.0	3,350.0	4,100.0
	do.	*Polycelis felina*	do.	*p,p*'-DDE	1	—	1,050.0	—

Table 3. Summary of taxa included in bioassay data set and number of bioassays and compounds

[do., ditto; EC_{50}, concentration at which 50 percent of test organisms exhibited nonlethal responses; LC_{50}, concentration at which 50 percent mortality occurred; sp., species]

Endpoint	Taxa	Species	Common name	Bioassays	Compounds
		Cladocerans			
EC_{50}	Crustacea	*Ceriodaphnia dubia*	Water flea	2	2
	do.	*Chydorus ovalis*	do.	1	1
	do.	*Daphnia carinata*	do.	4	4
	do.	*Daphnia laevis*	do.	6	3
	do.	*Daphnia magna*	do.	200	58
	do.	*Daphnia pulex*	do.	37	16
	do.	*Moina australiensis*	do.	1	1
	do.	*Simocephalus serrulatus*	do.	33	12
	do.	*Simocephalus* sp.	do.	2	2
	do.	*Simocephalus vetulus*	do.	1	1
				287	61
		Benthic invertebrates			
LC_{50}	Crustacea	*Acartia tonsa*	Calanoid copepod	3	3
	do.	*Artemia salina*	Brine shrimp	3	2
	do.	*Asellus aquaticus*	Aquatic sowbug	1	1
	do.	*Asellus brevicaudus*	do.	23	10
	do.	*Asellus communis*	do.	1	1
	do.	*Caridina rajadhari*	Freshwater prawn	2	2
	do.	*Cyclops strenuus*	Copepod	1	1
	do.	*Cypridopsis vidua*	Seed shrimp	1	1
	do.	*Eudiaptomus gracilis*	Calanoid copepod	1	1
	do.	*Eurytemora affinis*	do.	4	2
	do.	*Gammarus fasciatus*	Scud	76	28
	do.	*Gammarus fossarum*	do.	1	1
	do.	*Gammarus italicus*	do.	12	12
	do.	*Gammarus lacustris*	do.	45	18
	do.	*Gammarus pseudolimnaeus*	do.	21	9
	do.	*Gammarus pulex*	do.	13	6
	do.	*Hyalella azteca*	do.	5	4
	do.	*Macrobrachium dayanum*	Freshwater prawn	1	1
	do.	*Macrobrachium rosenbergii*	Giant river prawn	2	1
	do.	*Neomysis mercedis*	Opposum Shrimp	10	3
	do.	*Orconectes immunis*	Crayfish	2	2
	do.	*Orconectes nais*	do.	16	7
	do.	*Palaemonetes kadiakensis*	Glass shrimp	25	15
	do.	*Palaemonetes pugio*	Daggerblade grass shrimp	12	8
	do.	*Palaemonetes* sp.	Grass shrimp	12	1
	do.	*Palaemonetes vulgaris*	Marsh grass shrimp	5	5
	do.	*Procambarus acutus acutus*	White river crayfish	9	9
	do.	*Procambarus blandingii*	Crayfish	1	1
	do.	*Procambarus clarkii*	Red swamp crayfish	13	8
	do.	*Procambarus simulans*	Crayfish	2	2
	do.	*Procambarus* sp.	do.	6	4

Table 3. Summary of taxa included in bioassay data set and number of bioassays and compounds—*Continued*

Endpoint	Taxa	Species	Common name	Bioassays	Compounds
		Benthic invertebrates—*Continued*			
LC_{50}	Insecta	*Acroneuria ruralis*	Stonefly	1	1
	do.	*Acroneuria* sp.	do.	1	1
	do.	*Arctopsyche grandis*	Caddisfly	4	2
	do.	*Atherix variegata*	Snipefly	2	1
	do.	*Baetis intermedius*	Mayfly	1	1
	do.	*Brachythermis contaminata*	Dragonfly	2	2
	do.	*Chaoborus flavicans*	Midge	1	1
	do.	*Chaoborus obscuripes*	do.	1	1
	do.	*Chaoborus* sp.	Phantom midge	1	1
	do.	*Chironomus plumosus*	Midge	4	2
	do.	*Chironomus riparius*	do.	5	1
	do.	*Chironomus tentans*	do.	5	4
	do.	*Claassenia sabulosa*	Stonefly	15	5
	do.	*Cloeon dipterum*	Mayfly	1	1
	do.	*Cloeon* sp.	do.	1	1
	do.	*Corixa punctata*	Water boatman	2	1
	do.	*Drunella grandis*	Mayfly	5	5
	do.	*Hesperoperla pacifica*	Golden stonefly	15	5
	do.	*Hexagenia bilineata*	Mayfly	3	2
	do.	*Hexagenia* sp.	do.	1	1
	do.	*Hydropsyche angustipennis*	Caddisfly	1	1
	do.	*Hydropsyche californica*	do.	4	2
	do.	*Hydropsyche* sp.	do.	3	2
	do.	*Ischnura* sp.	Damselfly	1	1
	do.	*Ischnura verticalis*	do.	4	3
	do.	*Isogenus* sp.	Stonefly	3	2
	do.	*Isonychia* sp.	Mayfly	1	1
	do.	*Isoperla* sp.	Stonefly	2	2
	do.	*Leptoceridae*	Longhorn caddisfly family	1	1
	do.	*Lestes congener*	Damselfly	7	6
	do.	*Limnephilus* sp.	Caddisfly	2	1
	do.	*Limnephilus bipunctatus*	do.	1	1
	do.	*Limnephilus lunatus*	do.	2	2
	do.	*Neoplea striola*	Pygmy backswimmer	2	1
	do.	*Notonecta undulata*	Backswimmer	6	6
	do.	*Ophiogomphus* sp.	Dragonfly	1	1
	do.	*Paraleptophlebia pallipes*	Mayfly	1	1
	do.	*Peltodytes* sp.	Beetle	7	7
	do.	*Pteronarcella badia*	Stonefly	18	6
	do.	*Pteronarcys californica*	do.	74	22
	do.	*Pteronarcys* sp.	do.	3	3
	do.	*Ranatra elongata*	Water scorpion	1	1
	do.	*Sigara striata*	Water bug	1	1
	do.	*Skwala* sp.	Stonefly	5	2
	Mollusca	*Anodonta anatina*	Freshwater mussel	1	1
	do.	*Corbicula fluminea*	Asiatic clam	1	1
	do.	*Corbicula manilensis*	do.	1	1
	do.	*Egeria radiata*	Freshwater clam	1	1

Table 3. Summary of taxa included in bioassay data set and number of bioassays and compounds—*Continued*

Endpoint	Taxa	Species	Common name	Bioassays	Compounds
		Benthic invertebrates—*Continued*			
LC_{50}	Mollusca	*Lamellidens corrianus*	Bivalve	4	1
	do.	*Lymnaea acuminata*	Pond snail	7	5
	do.	*Lymnaea stagnalis*	Great pond snail	1	1
	Nematode	*Monhystera disjuncta*	Nematode	1	1
	Oligochaeta	*Branchiura sowerbyi*	Oligochaete	1	1
	do.	*Limnodrilus hoffmeisteri*	Oligochaeta	2	2
	do.	*Lumbriculus variegatus*	do.	2	2
	do.	*Tubifex tubifex*	do.	4	3
	do.	*Tubificidae*	do.	3	3
	Turbellaria	*Dugesia tigrina*	Turbellaria	4	3
	do.	*Polycelis felina*	do.	1	1
				585	46
		Fish			
	Fish	*Ameiurus melas*	Black bullhead	20	10
	do.	*Ameiurus natalis*	Yellow bullhead	1	1
	do.	*Ameiurus nebulosus*	Brown bullhead	1	1
	do.	*Ameiurus* sp.	Bullhead catfish	7	5
	do.	*Anguilla anguilla*	European eel	18	4
	do.	*Anguilla rostrata*	American eel	8	6
	do.	*Carassius auratus*	Goldfish	50	22
	do.	*Centrarchidae*	Sunfish family	5	1
	do.	*Clarias batrachus*	Walking catfish	10	6
	do.	*Coregonus lavaretus*	Whitefish	2	1
	do.	*Ctenopharyngodon idella*	Grass carp	2	2
	do.	*Cyprinella lutrensis*	Red shiner	2	2
	do.	*Cyprinodon variegatus*	Sheepshead minnow	74	37
	do.	*Cyprinus carpio*	Carp	79	24
	do.	*Esox lucius*	Northern pike	4	2
	do.	*Fundulus diaphanus*	Banded killifish	4	4
	do.	*Fundulus heteroclitus*	Mummichog	19	6
	do.	*Gambusia affinis*	Western mosquitofish	28	18
	do.	*Gambusia* sp.	do.	1	1
	do.	*Gasterosteus aculeatus*	Threespine stickleback	12	7
	do.	*Gila elegans*	Bonytail	4	2
	do.	*Ictalurus punctatus*	Channel catfish	102	34
	do.	*Jordanella floridae*	Flagfish	5	3
	do.	*Lagodon rhomboides*	Pinfish	1	1
	do.	*Leiostomus xanthurus*	Spot	1	1
	do.	*Lepomis cyanellus*	Green sunfish	19	8
	do.	*Lepomis gibbosus*	Pumpkinseed	5	5
	do.	*Lepomis macrochirus*	Bluegill	399	65
	do.	*Lepomis microlophus*	Red ear sunfish	8	6
	do.	*Leuciscus idus*	Ide	3	2
	do.	*Menidia beryllina*	Inland silverside	8	5
	do.	*Micropterus dolomieui*	Smallmouth bass	1	1
	do.	*Micropterus salmoides*	Largemouth bass	32	13
	do.	*Morone americana*	White perch	4	4

Table 3. Summary of taxa included in bioassay data set and number of bioassays and compounds—*Continued*

Endpoint	Taxa	Species	Common name	Bioassays	Compounds
		Fish—*Continued*			
LC_{50}	Fish	*Morone saxatilis*	Striped bass	62	15
	do.	*Mugil cephalus*	Striped mullet	6	6
	do.	*Notropis atherinoides*	Emerald shiner	2	2
	do.	*Oncorhynchus clarki*	Cutthroat trout	64	14
	do.	*Oncorhynchus gorbuscha*	Pink salmon	4	2
	do.	*Oncorhynchus keta*	Chum salmon	3	2
	do.	*Oncorhynchus kisutch*	Coho salmon	34	11
	do.	*Oncorhynchus mykiss*	Rainbow trout	373	73
	do.	*Oncorhynchus nerka*	Sockeye salmon	5	2
	do.	*Oncorhynchus tshawytscha*	Chinook salmon	14	10
	do.	*Perca flavescens*	Yellow perch	24	9
	do.	*Pimephales notatus*	Bluntnose minnow	1	1
	do.	*Pimephales promelas*	Fathead minnow	207	37
	do.	*Poecilia reticulata*	Guppy	52	19
	do.	*Pomoxis nigromaculatus*	Black crappie	4	2
	do.	*Ptychocheilus lucius*	Colorado squawfish	3	2
	do.	*Pungitius pungitius*	Ninespine stickleback	1	1
	do.	*Salmo salar*	Atlantic salmon	14	5
	do.	*Salmo trutta*	Brown Trout	22	10
	do.	*Salmonidae*	Trout family	4	4
	do.	*Salvelinus fontinalis*	Brook trout	36	10
	do.	*Salvelinus namaycush*	Lake trout	47	13
	do.	*Sciaenops ocellatus*	Red drum	2	1
	do.	*Stizostedion vitreum* v.	Walleye	3	2
	do.	*Tilapia mossambica*	Mozambique tilapia	18	7
	do.	*Tinca tinca*	Tench	7	4
	do.	*Umbra pygmaea*	Eastern mudminnow	1	1
				1,952	75

Table 4. Summary of EC_{50} median toxicity concentrations for cladocerans

[EC_{50}, concentration at which 50 percent of test organisms exhihbited nonlethal responses; N, number of bioassays; —, no data ; ppb, part per billion]

Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
2,4-D	3	3,200.00	4,900.00	25,000.00
2,4-DB	1	—	25,000.00	—
2,6-Dinitro-2-methylphenol	2	145.00	1,422.50	2,700.00
Acetochlor	3	7,200.00	8,200.00	14,000.00
Alachlor	8	7,700.00	15,700.00	35,000.00
Aldicarb	3	51.00	65.00	410.70
Aldicarb sulfone	3	280.00	369.00	556.00
Aldicarb sulfoxide	2	43.00	50.00	57.00
Atrazine	4	6,900.00	41,500.00	115,000.00
Azinphos-methyl	4	1.10	1.55	4.40
Benfluralin	1	—	2,186.00	—
Bromacil	1	—	121,000.00	—
Bromoxynil	24	41.00	126.50	74,000.00
Butylate	2	11,900.00	85,250.00	158,600.00
Carbaryl	16	2.77	6.93	7,100.00
Carbofuran	8	2.00	39.80	86.10
Chlorothalonil	4	70.00	97.00	172.00
Chlorpyrifos	3	0.10	0.40	1.70
Cyanazine	9	35,500.00	84,000.00	106,000.00
DCPA (Dacthal)	2	27,000.00	82,500.00	138,000.00
Diazinon	17	0.50	1.22	1.80
Dicamba	2	110,700.00	430,350.00	750,000.00
Dichlobenil	6	3,700.00	5,800.00	6,200.00
Dichlorprop(2,4-DP)	2	5,400.00	5,825.00	6,250.00
Dieldrin	7	130.00	240.00	251.00
Disulfoton	1	—	13.00	—
Diuron	7	1,400.00	2,000.00	8,400.00
EPTC	3	6,400.00	7,500.00	14,150.00
Ethalfluralin	1	—	60.00	—
Ethoprop	3	43.90	93.00	690,000.00
Ethyl parathion	14	0.37	0.65	7.20
Fonofos	3	2.00	8.37	15.50
Lindane	17	100.00	656.00	8,000.00
Linuron	4	120.00	240.00	1,100.00
Malathion	15	0.59	1.80	100.00
Methiocarb	1	—	19.00	—
Methomyl	6	7.60	8.80	3,200.00
Methyl parathion	10	0.14	7.90	28.20
Metolachlor	3	23,500.00	25,100.00	26,000.00
Metribuzin	3	4,180.00	4,200.00	98,500.00
Molinate	4	2,400.00	12,050.00	24,000.00
Napropamide	2	14,300.00	19,500.00	24,700.00
Oryzalin	1	—	1,500.00	—
Oxamyl	5	420.00	1,950.00	5,700.00
Pebulate	1	—	6,830.00	—
Pendimethalin	2	280.00	2,690.00	5,100.00

Table 4. Summary of EC_{50} median toxicity concentrations for cladocerans —*Continued*

Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
Phorate	4	18.23	21.75	37.00
Prometon	3	25,700.00	38,000.00	59,800.00
Propachlor	3	6,900.00	7,800.00	13,000.00
Propanil	3	1,200.00	6,700.00	11,400.00
Propargite	2	74.00	82.50	91.00
Propham	4	8,000.00	10,000.00	10,000.00
Propoxur	2	11.00	19.10	27.20
Simazine	2	1,100.00	1,100.00	1,100.00
Tebuthiuron	1	—	297,000.00	—
Terbacil	1	65,000.00	65,000.00	65,000.00
Terbufos	4	0.31	3.35	13.00
Thiobencarb	4	101.00	335.00	1,200.00
Triallate	2	91.00	260.50	430.00
Trifluralin	7	240.00	625.00	900.00
α-HCH	2	800.00	900.00	1,000.00

Table 5. Summary of LC_{50} median toxicity concentrations for benthic invertebrates

[LC_{50}, concentration at which 50 percent mortality occurred in test organisms; N, number of bioassays; —, no data]

Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
2,4-D	4	1,600.00	8,700.00	144,100.00
2,4-DB	3	15,000.00	15,000.00	15,000.00
2,6-Dinitro-2-methylphenol	3	320.00	320.00	1,100.00
2-(2,4,5-Trichlorophenoxy) propionic acid	1	—	340.00	—
Alachlor	2	19,500.00	19,600.00	19,700.00
Aldicarb	2	420.00	5,960.00	11,500.00
Atrazine	9	94.00	9,000.00	14,900.00
Azinphos-methyl	31	0.10	1.20	56.00
Benfluralin	2	1,100.00	1,100.00	1,100.00
Butylate	4	10,000.00	11,000.00	15,000.00
Carbaryl	51	1.70	16.00	6,933.00
Carbofuran	12	0.12	16.50	5,294.00
Chlorpyrifos	31	0.04	0.57	83.00
Cyanazine	2	2,000.00	2,000.00	2,000.00
DCPA (Dacthal)	1	—	6,200.00	—
Diazinon	19	0.03	25.00	6,160.00
Dicamba	2	3,900.00	3,900.00	3,900.00
Dichlobenil	10	6,600.00	10,500.00	35,000.00
Dieldrin	30	0.50	24.00	6,710.00
Dinoseb	1	—	1,800.00	—
Disulfoton	21	3.90	27.00	27,000.00
Diuron	8	160.00	950.00	15,500.00
EPTC	6	23,000.00	23,000.00	66,000.00
Ethyl parathion	62	0.04	3.50	5,230.00
Lindane	55	1.00	12.90	145,000.00
Malathion	69	0.50	12.00	50,000.00
Methiocarb	12	5.00	62.00	8,800.00
Methomyl	22	29.00	240.00	1,050.00
Methyl parathion	14	0.20	9.40	4,100.00
Molinate	11	300.00	4,500.00	21,800.00
Oryzalin	2	190.00	295.00	400.00
Oxamyl	1	—	220.00	—
Pebulate	2	10,000.00	10,000.00	10,000.00
Permethrin	3	0.10	0.17	210.00
Phorate	14	0.60	6.50	22,000.00
Picloram	3	27.00	48.00	48,000.00
Propanil	1	—	16,000.00	—
Propargite	1	—	101.00	—
Propham	2	10,000.00	14,500.00	19,000.00
Propoxur	13	13.00	50.00	146,000.00
Simazine	3	1,900.00	13,000.00	13,000.00
Terbufos	17	0.17	5.60	12.00
Thiobencarb	8	200.00	1,000.00	9,240.00
Trifluralin	13	37.00	2,800.00	26,000.00
α-HCH	1	—	500.00	—
p,p′-DDE	1	—	1,050.00	—

Table 6. Summary of LC_{50} median toxicity concentrations for freshwater fish

[LC_{50}, concentration at which 50 percent mortality occurred; N, number of bioassays; ppb, part per billion; —, no data]

Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
2,4,5-T	12	150.00	15,500.00	43,700.00
2,4-D	43	1,400.00	44,500.00	358,000.00
2,4-DB	9	2,000.00	7,500.00	18,000.00
2,6-Dinitro-2-methylphenol	8	66.00	1,720.00	2,720.00
2-(2,4,5-Trichlorophenoxy) propionic acid	11	350.00	14,000.00	86,000.00
Acetochlor	8	380.00	1,400.00	3,900.00
Alachlor	25	240.00	4,200.00	12,400.00
Aldicarb	14	41.00	560.00	7,400.00
Aldicarb sulfone	2	42,000.00	47,500.00	53,000.00
Atrazine	33	2,000.00	15,000.00	69,000.00
Azinphos-methyl	107	0.36	22.80	4,270.00
Benfluralin	7	65.00	420.00	810.00
Bentazon	2	978,000.00	2,426,000.00	3,874,000.00
Bromacil	5	36,000.00	127,000.00	186,000.00
Bromoxynil	7	2,090.00	13,800.00	23,000.00
Butylate	14	210.00	6,200.00	202,500.00
Carbaryl	165	140.00	4,330.00	290,000.00
Carbofuran	48	80.00	380.00	10,250.00
Chlorothalonil	25	7.60	51.00	430.00
Chlorpyrifos	53	0.58	38.00	806.00
Cyanazine	16	9,000.00	16,850.00	22,500.00
DCPA (Dacthal)	2	6,600.00	18,300.00	30,000.00
Diazinon	79	22.00	602.00	10,300.00
Dicamba	8	28,000.00	135,350.00	465,000.00
Dichlobenil	20	4,930.00	8,850.00	6,200,000.00
Dichlorprop (2,4-DP)	18	500.00	1,450.00	6,100.00
Dieldrin	83	0.62	10.00	10,000.00
Dinoseb	42	28.00	96.50	1,400.00
Disulfoton	35	8.20	1,850.00	13,900.00
Diuron	30	500.00	5,400.00	84,000.00
EPTC	13	11,500.00	20,720.00	26,700.00
Ethalfluralin	6	32.00	119.00	260.00
Ethoprop	13	180.00	2,070.00	13,800.00
Ethyl parathion	60	17.80	1,400.00	10,000.00
Fenuron	1	—	204,000.00	—
Fluometuron	26	600.00	36,500.00	96,000.00
Fonofos	16	5.10	20.00	2,800.00
Lindane	116	1.10	68.00	16,000.00
Linuron	8	890.00	6,100.00	16,400.00
MCPA	6	25,000.00	75,000.00	97,000.00
MCPB	2	3,300.00	7,900.00	12,500.00
Malathion	146	0.19	200.00	52,200.00
Methiocarb	12	0.75	538.00	4,700.00
Methomyl	75	300.00	1,250.00	32,000.00
Methyl parathion	81	5.00	5,360.00	161,000.00
Metolachlor	8	3,900.00	8,200.00	10,000.00

Table 6. Summary of LC_{50} median toxicity concentrations for freshwater fish—*Continued*

Compound	N	Minimum (ppb)	Median (ppb)	Maximum (ppb)
Metribuzin	10	3,400.00	80,885.00	147,000.00
Molinate	31	200.00	14,000.00	42,800.00
Napropamide	6	9,400.00	12,650.00	14,000.00
Norflurazon	3	8,100.00	9,580.00	16,300.00
Oryzalin	3	2,880.00	3,260.00	3,450.00
Oxamyl	14	2,600.00	6,415.00	27,500.00
Pebulate	3	7,400.00	7,900.00	10,000.00
Pendimethalin	12	138.00	960.00	90,400.00
Permethrin	34	0.79	6.80	88.00
Phorate	24	1.00	10.10	280.00
Picloram	55	1,400.00	8,600.00	310,000.00
Prometon	13	12,000.00	19,600.00	47,300.00
Pronamide	3	72,000.00	150,000.00	350,000.00
Propachlor	4	170.00	255.00	420.00
Propanil	6	2,300.00	6,450.00	14,000.00
Propargite	6	31.00	130.50	455.00
Propham	4	29,000.00	33,500.00	86,500.00
Propoxur	34	1,300.00	6,970.00	180,000.00
Simazine	32	90.00	56,000.00	822,000.00
Tebuthiuron	2	106,000.00	124,500.00	143,000.00
Terbacil	6	46,200.00	90,950.00	112,000.00
Terbufos	30	0.77	6.15	1,800.00
Thiobencarb	41	110.00	910.00	2,500.00
Triallate	5	1,200.00	1,330.00	2,400.00
Triclopyr	19	260.00	1,300.00	9,700.00
Trifluralin	28	8.40	95.50	12,000.00
α-HCH	1	—	1,490.00	—
p,p′-DDE	3	32.00	96.00	240.00

Table 7. Relative toxicity of the pesticides within each of three taxanomic groups: cladocerans, benthic invertebrates, and fish

[EC_{50}, concentration at which 50 percent of test organisms exhibited nonlethal responses; LC_{50}, concentration at which 50 percent mortality occurred in test organisms]

Cladocerans		Benthic invertebrates		Fish	
Compound	Rrelative toxicity (EC_{50})	Compound	Relative toxicity (LC_{50})	Compound	Relative toxicity (LC_{50})
Chlorpyrifos	1.000000	Permethrin	1.000000	Terbufos	1.000000
Ethyl parathion	0.615385	Chlorpyrifos	0.298246	Permethrin	0.904412
Diazinon	0.327869	Azinphos-methyl	0.141667	Dieldrin	0.615000
Azinphos-methyl	0.258065	Ethyl parathion	0.048571	Phorate	0.608911
Malathion	0.222222	Terbufos	0.030357	Fonofos	0.307500
Terbufos	0.119403	Phorate	0.026154	Azinphos-methyl	0.269737
Carbaryl	0.057720	Methyl parathion	0.018085	Chlorpyrifos	0.161842
Methyl parathion	0.050633	Malathion	0.014167	Chlorothalonil	0.120588
Fonofos	0.047790	Lindane	0.013178	Lindane	0.090441
Methomyl	0.045455	Carbaryl	0.010625	Trifluralin	0.064398
Disulfoton	0.030769	Carbofuran	0.010303	*p,p′*-DDE	0.064063
Methiocarb	0.021053	Dieldrin	0.007083	Dinoseb	0.063731
Propoxur	0.020942	Diazinon	0.006800	Ethalfluralin	0.051681
Phorate	0.018391	Disulfoton	0.006296	Propargite	0.047126
Carbofuran	0.010050	Picloram	0.003542	Malathion	0.030750
Aldicarb sulfoxide	0.008000	Propoxur	0.003400	Propachlor	0.024118
Ethalfluralin	0.006667	Methiocarb	0.002742	Carbofuran	0.016184
Aldicarb	0.006154	Propargite	0.001683	Benfluralin	0.014643
Propargite	0.004848	Oxamyl	0.000773	Methiocarb	0.011431
Ethoprop	0.004301	Methomyl	0.000708	Aldicarb	0.010982
Chlorothalonil	0.004124	Oryzalin	0.000576	Diazinon	0.010216
Bromoxynil	0.003162	2,6-Dinitro-2-methylphenol	0.000531	Thiobencarb	0.006758
Dieldrin	0.001667	2-(2,4,5-Trichlorophenoxy) propionic acid	0.000500	Pendimethalin	0.006406
Linuron	0.001667	α-HCH	0.000340	Dichlorprop (2,4-DP)	0.005591
Triallate	0.001536	Diuron	0.000179	Methomyl	0.004920
Thiobencarb	0.001194	Thiobencarb	0.000170	Triclopyr	0.004731
Aldicarb sulfone	0.001084	p,p′-DDE	0.000162	Triallate	0.004624
Trifluralin	0.000640	Benfluralin	0.000155	Acetochlor	0.004393
Lindane	0.000610	Dinoseb	0.000094	Ethyl parathion	0.004393
α-HCH	0.000444	Cyanazine	0.000085	α-HCH	0.004128

Table 7. Relative toxicity of the pesticides within each of three taxanomic groups: cladocerans, benthic invertebrates, and fish—*Continued*

Cladocerans		Benthic invertebrates		Fish	
Compound	Rrelative toxicity (EC_{50})	Compound	Relative toxicity (LC_{50})	Compound	Relative toxicity (LC_{50})
Simazine	0.000364	Trifluralin	0.000061	2,6-Dinitro-2-methylphenol	0.003576
2,6-Dinitro-2-methylphenol	0.000281	Dicamba	0.000044	Disulfoton	0.003324
Oryzalin	0.000267	Molinate	0.000038	Ethoprop	0.002971
Oxamyl	0.000205	Aldicarb	0.000029	Dichlorprop(2,4-DP)	0.002563
Diuron	0.000200	DCPA (Dacthal)	0.000027	Oryzalin	0.001887
Benfluralin	0.000183	2,4-D	0.000020	Alachlor	0.001464
Pendimethalin	0.000149	Atrazine	0.000019	Carbaryl	0.001420
Metribuzin	0.000095	Pebulate	0.000017	Methyl parathion	0.001147
2,4-D	0.000082	Dichlobenil	0.000016	Diuron	0.001139
Dichlobenil	0.000069	Butylate	0.000015	Linuron	0.001008
Dichlorprop(2,4-DP)	0.000069	Simazine	0.000013	Butylate	0.000992
Propanil	0.000060	Propham	0.000012	Oxamyl	0.000959
Pebulate	0.000059	2,4-DB	0.000011	Propanil	0.000953
EPTC	0.000053	Propanil	0.000011	Propoxur	0.000882
Propachlor	0.000051	Alachlor	0.000009	2,4-DB	0.000820
Acetochlor	0.000049	EPTC	0.000007	MCPB	0.000778
Propham	0.000040			Pebulate	0.000778
Molinate	0.000033			Metolachlor	0.000750
Alachlor	0.000025			Picloram	0.000715
Napropamide	0.000021			Dichlobenil	0.000695
2,4-DB	0.000016			Norflurazon	0.000642
Metolachlor	0.000016			Napropamide	0.000486
Prometon	0.000011			Bromoxynil	0.000446
Atrazine	0.000010			2-(2,4,5-Trichlorophenoxy) propionic acid	0.000439
Terbacil	0.000006			Molinate	0.000439
DCPA (Dacthal)	0.000005			Atrazine	0.000410
Cyanazine	0.000005			2,4,5-T	0.000397
Butylate	0.000005			Cyanazine	0.000365
Bromacil	0.000003			DCPA (Dacthal)	0.000336
Tebuthiuron	0.000001			Prometon	0.000314
Dicamba	0.000001			EPTC	0.000297
				Propham	0.000184
				Fluometuron	0.000168

Table 7. Relative toxicity of the pesticides within each of three taxanomic groups: cladocerans, benthic invertebrates, and fish—*Continued*

Cladocerans		Benthic invertebrates		Fish	
Compound	Rrelative toxicity (EC_{50})	Compound	Relative toxicity (LC_{50})	Compound	Relative toxicity (LC_{50})
				2,4-D	0.000138
				Aldicarb sulfone	0.000129
				Simazine	0.000110
				MCPA	0.000082
				Metribuzin	0.000076
				Terbacil	0.000068
				Tebuthiuron	0.000049
				Bromacil	0.000048
				Dicamba	0.000045
				Pronamide	0.000041
				Fenuron	0.000030
				Bentazon	0.000003