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The National Study of Chemical Residues in Lake Fish Tissue

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U.S. Environmental Protection Agency
Office of Water
Office of Science and Technology

September 2009

Notice

This report was prepared by the U.S. Environmental Protection Agency (EPA), Office of Water, Office of Science and Technology. It has been subjected to the Agency's peer review and administrative review processes. The EPA Project Manager for preparation of this document was Leanne Stahl who provided overall project coordination and technical direction. Tetra Tech, Inc. provided primary support for the development of this document under Contract Numbers EP-C-04-030 and EP-C-09-019. Blaine Snyder was the Tetra Tech Project Manager. Additional support was provided by Computer Sciences Corporation under Contract Number ET-W-06-046.

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Table of Contents

Figures

Tables

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Maryland Department of the Environment
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Minnesota Chippewa Tribe
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Mississippi Department of Environmental Quality
Missouri Department of Conservation
Missouri Department of Natural Resources
Montana Department of Fish, Wildlife and Parks
Nebraska Department of Environmental Quality
Nevada Division of Wildlife
New Hampshire Department of Environmental Services
New Jersey Department of Environmental Protection
New Mexico Environment Department
New York Department of Environmental Conservation
North Carolina Department of Environment and Natural Resources
North Dakota Department of Health
Ohio Department of Natural Resources
Oklahoma Conservation Commission
Oklahoma Department of Environmental Quality
Oregon Department of Environmental Quality
Pennsylvania Department of Environmental Protection
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List of Acronyms and Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BHC	benzene hexachloride
CAS	Chemical Abstracts Service
CD	compact disc
CDF	cumulative distribution function
CEC	containment of emerging concern
CFR	Code of Federal Regulations
COC	chain of custody
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DMA	dimethylarsinic acid
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency (U.S.)
FDA	Food and Drug Administration
GC/FPD	gas chromatography/flame photometric detector
GC/HSD	gas chromatography/halide specific detector
GC/MS	gas chromatography/mass spectrometry
GIS	geographic information system
HpCB	heptachlorobiphenyl
HpCDD	heptachlorodibenzodioxin
HpCDF	heptachlorodibenzofuran
HxCB	hexachlorobiphenyl
HxCDD	hexachlorodibenzodioxin
HxCDF	hexachlorodibenzofuran
IRIS	Integrated Risk Information System
MDL	method detection limit
ML	minimum level
MMA	monomethylarsonic acid
NOAA	National Oceanic and Atmospheric Administration
OCDD	octachlorodibenzodioxin
OCDF	octachlorodibenzofuran

OPPTS	Office of Pesticides, Prevention, and Toxic Substances
ORD	Office of Research and Development
OST	Office of Science and Technology
OW	Office of Water
PAH	polycyclic aromatic hydrocarbon
PBT	persistent, bioaccumulative, and toxic
PCB	polychlorinated biphenyl
PeCB	pentachlorobiphenyl
PeCDD	pentachlorodibenzodioxin
PeCDF	pentachlorodibenzofuran
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RF3	River Reach File Version 3
SCC	sample control center
SOP	standard operating procedure
SV	screening value
TeCB	tetrachlorobiphenyl
TEF	toxicity equivalency factor
TEQ	toxic equivalency concentration
TCDD	tetrachlorodibenzodioxin
TCDF	tetrachlorodibenzofuran
USEPA	United States Environmental Protection Agency
WQC	water quality criterion

Executive Summary

Environmental monitoring provides crucial data for describing the condition of the environment and for assessing the effectiveness of pollution control activities. In the 1990s, EPA identified a lack of information necessary to accurately characterize the condition of the Nation's surface waters and responded by designing a series of statistically-based surveys to produce information on the condition of lakes, streams, rivers, and coastal waters in the United States. The National Study of Chemical Residues in Lake Fish Tissue (or National Lake Fish Tissue Study) is one of the statistically-based surveys conducted by EPA since the late 1990s. This study is a national screening-level survey of chemical residues in fish tissue from lakes and reservoirs in the conterminous United States (lower 48 states), excluding the Laurentian Great Lakes and Great Salt Lake. It is unique among earlier fish monitoring efforts in the United States because the sampling sites were selected according to a statistical (random) design. Study results allow EPA to estimate the percentage of lakes and reservoirs in the United States with chemical concentrations in fish tissue that are above levels of potential concern for humans or for wildlife that eat fish. This survey also includes the largest set of chemicals ever studied in fish. Whole fish and fillets were analyzed for 268 persistent, bioaccumulative, and toxic (PBT) chemicals, including mercury, arsenic, dioxins and furans, the full complement of polychlorinated biphenyl (PCB) congeners, and a large number of pesticides and semivolatile organic compounds.

Partnerships made this study possible. Prior to beginning field sampling for the study, EPA built a national network of partners that included 47 states, three tribes, and two other federal agencies. Fisheries staff from more than 50 agencies worked for nearly five years to evaluate the suitability of lakes for sampling and to collect fish for the study. This study provides an excellent example of state, federal, and tribal collaboration. Participating agencies made a critical contribution to the success of this study through their voluntary commitments and dedicated efforts.

Fire Lake, Michigan - (Target Lake Number 0309)

Study Objective

The objective of the National Lake Fish Tissue Study is to estimate the national distribution of selected persistent, bioaccumulative, and toxic (PBT) chemical residues in fish tissue from lakes and reservoirs of the conterminous United States. Results from this study provided EPA with the first opportunity to:

- Develop national estimates of the median concentrations of PBT chemicals in lake fish;
- Estimate the percentage of lakes and reservoirs with fish tissue concentrations above specified thresholds related to human health; and
- Define national baseline information for tracking changes in concentrations of PBT chemicals in freshwater fish as a result of the combined effects of pollution control activities and natural degradation.

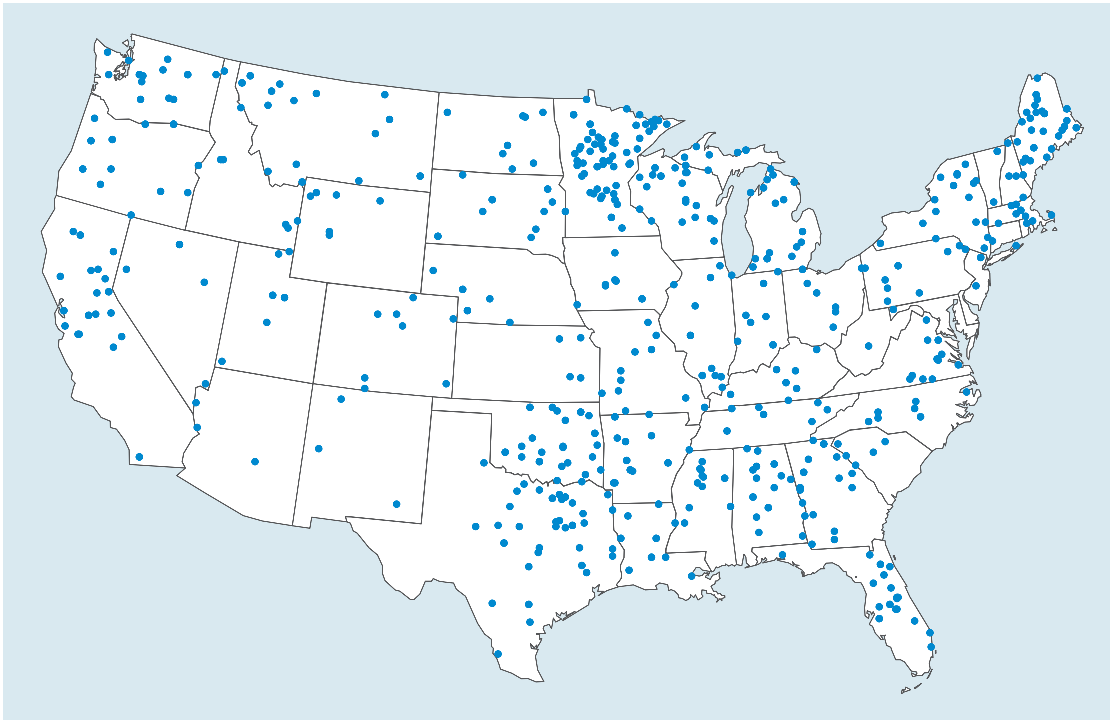
Study Design and Approach

The National Lake Fish Tissue Study focused on lakes and reservoirs (hereafter referred to collectively as lakes) for two reasons: they occur in a variety of landscapes where they can receive and accumulate contaminants from several sources (including direct discharges into water, air deposition, and agricultural or urban runoff) and there is usually limited dilution of contaminants compared to flowing streams and rivers. Monitoring fish for chemical contamination in lakes is also important because these areas are frequently used for sport fishing. According to EPA's National Listing of Fish Advisories, 43% of the Nation's lake acres are under fish consumption advisories.

This study applied a statistical or probability-based sampling approach so that results could be used to describe fish tissue contaminant concentrations in lakes on a national basis. The Nation's lakes were divided into six size categories based on surface area. Assigning different probabilities to each category prevented small lakes from dominating the group of lakes selected for sampling. It also allowed a similar number of lakes to be selected in each size category.

For this study, a lake is defined as a permanent body of water with a permanent fish population that has a surface area of at least one hectare (2.47 acres), a depth of at least one meter (3.28 feet), and at least 1,000 square meters of open, unvegetated water. The lower 48 states contain an estimated 147,000 lakes meeting these criteria (i.e., the target population). A list of candidate lakes was randomly selected from the target population for this study. From this list, EPA identified 500 sites that were accessible and appropriate for fish collection.

The target population consists of all lakes in the lower 48 states that met the study definition of a lake (147,000 lakes). The sampled population consists of all target lakes that were accessible for fish collection. Under ideal circumstances, the target and sampled populations



National Lake Fish Tissue Study Sampling Sites (500 lakes)

should coincide. However, for this study, the sampled population is a subset of the target population. A large number of target lakes were not accessible to field sampling teams because the lakes were either located in remote wilderness areas or on private property where landowners denied EPA permission to sample them. There is a different sampled population for each composite type based on differences in the occurrence of predators and bottom dwellers at the 500 sampling locations. The sampled population for predators is an estimated 76,559 lakes, and the sampled population for bottom dwellers is an estimated 46,190 lakes. All predator and bottom-dweller results presented in this report apply to these sampled populations of lakes.

Target Chemical Selection

The National Lake Fish Tissue Study includes the largest number of chemicals ever studied in fish. EPA developed the list of target chemicals for this study from the agency's multimedia list of 451 PBT chemicals, along with a list of 130 chemicals referenced in several contemporary fish tissue and bioaccumulation studies. EPA selected chemicals that had detailed information available, were known to accumulate, and were identified as important in one or more EPA programs. The final list contains 268 chemicals, including mercury, five forms of arsenic, 17 dioxins and furans, 159 PCB congener measurements, 46 pesticides, and 40 semivolatile organic compounds.

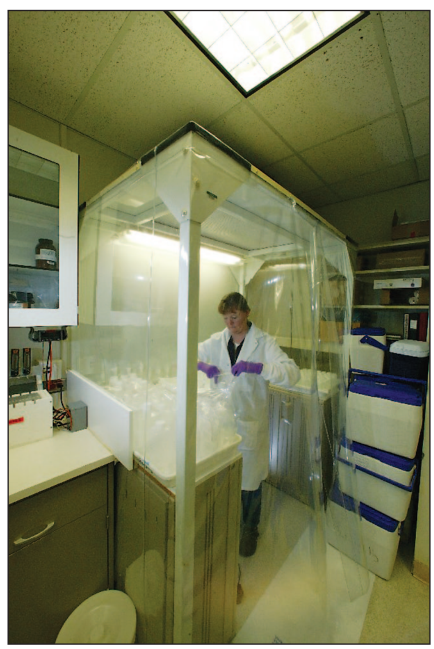
Sample Collection

EPA planned four years of field sampling for the National Lake Fish Tissue Study. After a brief pilot in the fall of 1999 to test sampling logistics, EPA and its partners began full-scale fish sampling in 2000 and continued sampling annually through 2003. Each year of the study, field sampling teams collected fish from about 125 different lakes distributed across the lower 48 states. These teams applied consistent methods nationwide to collect composite samples of a predator fish species (e.g., bass or trout) and a bottom-dwelling species (e.g., carp or catfish) from each lake or reservoir. EPA identified twelve target predator species and six target bottom-dwelling species to limit the number of species included in the study. Predator and bottom-dweller composites each consisted of five adult fish of the same species and similar size (i.e., the smallest individual in a composite was no less than 75% of the total length of the largest individual). Field teams re-sampled more than 10% of the lakes to allow EPA to evaluate any possible sampling variability.

Sampling at Norvell Lake, Michigan – (Target Lake Number 0664)

Sample Analysis

EPA analyzed different tissue fractions for predator composites (fillets) and bottom-dweller composites (whole bodies) to obtain chemical residue data for the 268 target chemicals. Analyzing fish fillets provides information for human health, while whole-body analysis produces information for ecosystem health. A single laboratory prepared all fish samples in a strictly-controlled, contamination-free environment. This laboratory distributed fish tissue samples to four laboratories that specialize in analysis of metals, pesticides, semivolatile organic chemicals, and PCBs, dioxins, and furans. To minimize variability among sample results, EPA used the same laboratory for each type of analysis, and these laboratories applied the same analytical method for each chemical for the duration of the study. Resulting fish tissue concentrations were reported on a wet weight basis.



Analytical Chemistry Laboratory Clean Room

Statistical Analysis

The data analyzed for the National Lake Fish Tissue Study include tissue concentrations for each target chemical (e.g., mercury) or chemical group (e.g., PCBs) and fish composite type (i.e., predator and bottom-dweller composites). Analysis of the fish tissue data incorporated elements of the survey design, along with information from the field sampling operations and laboratory analyses. Statistical analysis included evaluating information to determine the status of each lake, adjusting the sample weights based on the lake status, estimating the number and proportion of lakes in the sampled population, and estimating the cumulative distribution and percentile concentrations of the target chemicals in fillets for predators and whole bodies for bottom dwellers.

Results

The National Lake Fish Tissue Study is the first national assessment of freshwater fish contamination in the United States for which sampling sites were selected according to a statistical (random) design. To interpret the results, it is essential to understand the following important points about this design:

Lake 79, Wyoming – (Target Lake Number 0052)

- During the four-year sampling period, field teams collected 486 predator composites and 395 bottom-dweller composites from the 500 sampling locations. Predator and bottom-dweller species did not occur together at every sampling site; however, if either a predator or bottom-dweller species was present, the target lake was sampled.
- The 486 predator composites and the 395 bottom-dweller composites collected during the study each comprise nationally-representative samples for the lower 48 states whose results can be extrapolated to an estimated 76,559 lakes for predators and an estimated 46,190 lakes for bottom-dwellers.
- The unequal probability design makes it necessary to apply sample weights (derived from the various probabilities assigned to each of the lake size categories) to the fish tissue data to develop national estimates of fillet (predator) and whole-body (bottom-dweller) fish tissue concentrations for each of the 268 target chemicals.

Results from the National Lake Fish Tissue Study indicate that mercury, PCBs, and dioxins and furans are widely distributed in lakes and reservoirs in the lower 48 states. Mercury and PCBs were detected in all the fish samples collected from the 500 sampling sites. Dioxins and furans were detected in 81% of the predator samples (fillet composites) and 99% of the bottom-dweller samples (whole-fish composites). In contrast, there were a number of chemicals that were not detected in any of the fish samples collected during the study. Forty-three of the 268 target chemicals were not detected in any samples, including all nine organophosphate pesticides (e.g., chlorpyriphos and diazinon), one PCB congener (PCB-161), and 16 of the 17 polycyclic aromatic hydrocarbons (PAHs) analyzed as semivolatile organic chemicals. There were also seventeen other semivolatile organic chemicals that were not detected.

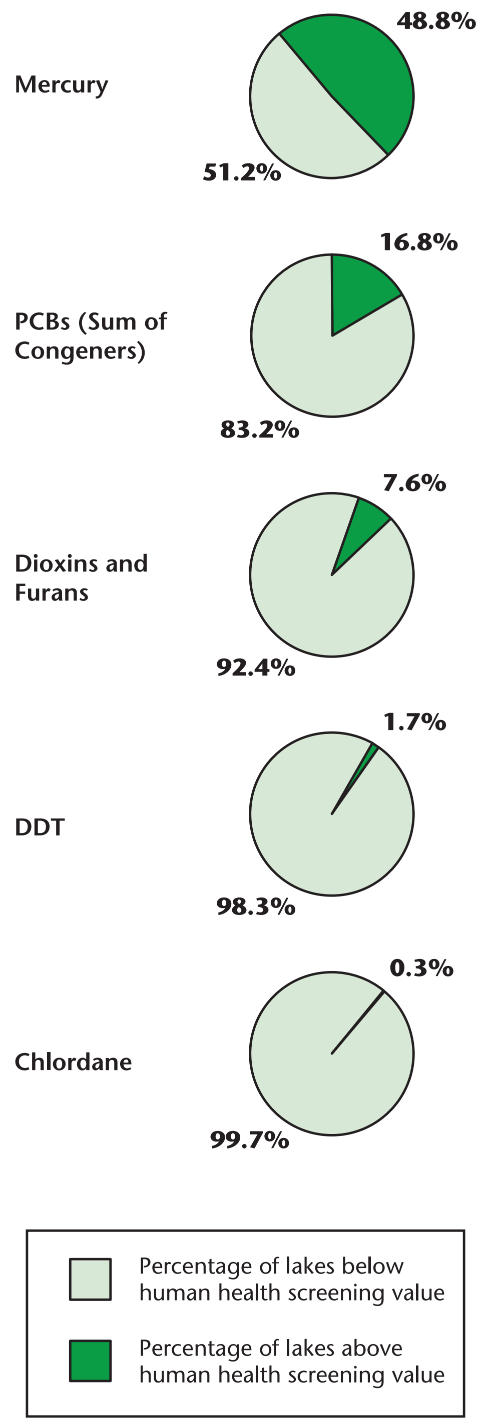
In reporting the analytical results for this study, it is important to distinguish between detection and presence of a chemical in a fish tissue sample. Estimates of fish tissue concentrations ranging from the method detection limit (MDL) to the minimum level of quantitation (ML) are reported as being present with a 99% level of confidence. However, if a chemical is reported as "not detected" at the MDL level, there is a 50% possibility that the chemical may be present. Therefore, results for chemicals not detected in the fish tissue samples are reported as less than the MDL rather than zero. In interpreting the results, it is also important to know the MDL for each chemical (Appendix B).

According to EPA's 2008 Biennial National Listing of Fish Advisories, mercury, PCBs, dioxins and furans, DDT, and chlordane accounted for 97% of the advisories in effect at the end of 2008. These five chemicals were also commonly detected in fish samples collected for the National Lake Fish Tissue Study. Since human health screening values (SVs) were readily available, they were applied to total concentrations of mercury, PCBs,

Snowbank Lake, Minnesota – (Target Lake Number 0235)

Percentage of Lakes Above or Below Human Health Screening Values

(Predator Results: Sampled Population = 76,559 Lakes)



dioxins and furans, DDT, and chlordane found in predator fillets. The mercury SV is the tissue-based water quality criterion published by EPA in 2001. All other SVs are risk-based consumption limits published in 2000 in EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Consumption Limits, Third Edition*. Specifically, the applied SVs are the upper limit of the four-meal-per-month concentration range for the conservative consumption limit (where tissue concentrations are available for both cancer and noncancer health endpoints). If available, wildlife criteria could be applied in the same manner to interpret the whole-body data from analysis of bottom-dweller samples.

Predator results for the five commonly-detected chemicals indicate that:

- 48.8% of the sampled population of lakes had mercury tissue concentrations that exceeded the 300 ppb (0.3 ppm) human health SV for mercury, which represents a total of 36,422 lakes.
- 16.8% of the sampled population of lakes had total PCB tissue concentrations that exceeded the 12 ppb human health SV, which represents a total of 12,886 lakes.
- 7.6% of the sampled population of lakes had dioxin and furan tissue concentrations that exceeded the 0.15 ppt [toxic equivalency or TEQ] human health SV, which represents a total of 5,856 lakes.
- 1.7% of the sampled population of lakes had DDT tissue concentrations that exceeded the 69 ppb human health SV, which represents a total of 1,329 lakes.
- 0.3% of the sampled population of lakes had fish tissue concentrations that exceeded the 67 ppb human health SV for chlordane, which represents a total of 235 lakes.

This report provides national baseline information to track changes in PBT chemical concentrations in freshwater fish resulting from pollution control activities and chemical degradation. The results of the National Lake Fish Tissue Study are presented to inform the public, water quality specialists, natural resource managers, and government officials of the distribution and prevalence of selected PBT chemicals in fish tissue from lakes and reservoirs of the conterminous United States. The findings should also be useful to aid in the design and focus of future fish tissue contaminant studies. National Lake Fish Tissue Study sampling design information and results have also been published in peer-reviewed journal articles by Olsen et al. (2009) and Stahl et al. (2009). Additional information, including instructions for obtaining study data and links to related study literature, is posted on the Internet at ***http://www.epa.gov/waterscience/fishstudy/***.

1.0 Introduction

1.1 Program History and Development

The U.S. Environmental Protection Agency's (EPA's) Office of Science and Technology (OST) within the Office of Water (OW) conducted a national screening-level study of contamination in freshwater fish tissue called the National Study of Chemical Residues in Lake Fish Tissue (or National Lake Fish Tissue Study). This study was a priority activity sponsored under the agency-wide Persistent, Bioaccumulative, and Toxic (PBT) Chemical Program. PBT pollutants are highly toxic, long-lasting chemicals that can build up in the food chain to levels that are harmful to human and ecosystem health. In 1998, EPA developed the *Multimedia Strategy for Priority Persistent, Bioaccumulative, and Toxic (PBT) Pollutants*. The purpose of this multimedia strategy was to identify actions to address risks posed by PBT chemicals in the environment. One of the priority actions in the strategy was to evaluate the occurrence of PBT chemicals in fish from U.S. waters. In response to the strategy, the Office of Water committed to conducting a comprehensive study of PBT chemical contamination in fish tissue as an indication of the extent of this contamination in the Nation's waters.

At the time of this commitment, OW recognized that there were critical national data gaps that prevented EPA from characterizing the condition of the nation's surface waters. Based on earlier environmental assessment work conducted by the Environmental Monitoring and Assessment Program (EMAP) in EPA's Office of Research and Development (ORD), OW determined that probabilistic (random) surveys would be appropriate to address these national data gaps. The National Lake Fish Tissue Study is one in a series of five probabilistic surveys undertaken by EPA since the late 1990s to provide statistically-based data to characterize the national condition of lakes, streams, rivers, and coastal waters.[a] OW has partnered with ORD to design and implement these surveys.

Planning for the National Lake Fish Tissue Study began in the fall of 1998. In October 1998, EPA convened a two-day workshop of more than 50 scientists from state, federal, and tribal agencies to obtain technical input on the sampling design, target chemicals, sampling methods, and data management. EPA used input from scientists that attended this workshop and from technical experts that participated in a series of study planning meetings to develop the final study design (USEPA 1999). During the year-long planning effort, EPA also completed the random lake selection process and identified the PBT chemicals to be included in the study.

[a] EPA's other four national-scale probabilistic surveys include: the National Coastal Assessment (***http://www.epa.gov/emap/nca/***), the Wadeable Streams Assessment (***http://www.epa.gov/owow/streamsurvey/***), the National Lakes Assessment (***http://www.epa.gov/owow/lakes/lakessurvey/***), and the National Rivers and Streams Assessment (***http://www.epa.gov/owow/riverssurvey/***).

Lakes and reservoirs became the focus of this study because they are environments where contamination accumulates. These waterbodies occur in a variety of landscapes (e.g., urban, agricultural, and wilderness), and they can receive contaminants from several sources, including direct discharges into the water, air deposition, and agricultural or urban runoff. Monitoring fish contamination in lakes and reservoirs is a critical activity for protecting human and ecosystem health because lakes and reservoirs provide important sports fisheries and other recreational opportunities. Lake ecosystems also provide critical habitat for aquatic species, and they support wildlife populations that depend on aquatic species for food. EPA's 2008 Biennial National Listing of Fish Advisories (USEPA 2009) reports that 43% of the Nation's lake acres are under fish consumption advisories.

The National Lake Fish Tissue Study is the first national freshwater fish tissue survey to be based on a probabilistic sampling design, and it includes data on the largest set of PBT chemicals ever studied in fish. EPA worked with partner agencies in states, tribes, and other federal organizations over a four-year period (2000–2003) to collect fish from 500 lakes and reservoirs selected randomly from the estimated 147,000 target lakes and reservoirs in the conterminous United States (i.e., lower 48 states). The information provided in this report documents the national distribution of 268 PBT chemicals in predator fish species (e.g., bass and trout) and in bottom-dwelling fish species (e.g., carp and catfish) from lakes and reservoirs in the lower 48 states. National Lake Fish Tissue Study sampling design information and results have also been published in peer-reviewed journal articles by Olsen et al. (2009) and Stahl et al. (2009).

1.2 Study Objective

The specific objective of the National Lake Fish Tissue Study is ***to estimate the national distribution of the mean levels*** (i.e., composite average concentrations or "lake means") ***of selected persistent, bioaccumulative, and toxic chemical residues in fish tissue from lakes and reservoirs of the conterminous United States.***

The study design developed to support this objective generated a ground-breaking data set for EPA. Data from the National Lake Fish Tissue Study provided the agency with the first opportunity to:

- Develop national estimates of the median concentrations of PBT chemicals in lake fish;
- Estimate the percentage of lakes and reservoirs with fish tissue concentrations above a specified threshold related to human health; and
- Define a national baseline for tracking changes in concentrations of PBT chemicals in freshwater fish as a result of pollution control activities.

2.0 Study Design and Approach

2.1 Background

The National Lake Fish Tissue Study was conducted in four phases over a period of eight years. The initial planning phase began during the summer of 1998 and lasted for a year. Key activities during this phase included conducting a national study design workshop, applying a statistical approach to select lakes, and developing a list of target chemicals. It took another year to mobilize for the study. The second phase, mobilization, consisted of building a national network of partners, conducting orientation and training workshops for study participants, mapping and evaluating the lakes to determine their suitability for the study, and preparing standard operating procedures to guide implementation of the study. Implementation (the third phase of the study) included fish sample collection and tissue analysis. EPA and its partners began collecting fish samples in October 1999 and completed sampling in November 2003. All fish tissue samples were analyzed by May 2005. The final phase of the study involved statistical analysis of the fish tissue data and production of the final report.

2.2 Study Design Development

Probability sampling provides the basis for estimating resource extent and condition, for characterizing trends in extent or condition, and for representing spatial pattern, all with known certainty. A probability sampling design has some inherent characteristics that distinguish it from other sampling designs. First, the population being sampled is explicitly described. Second, every element in the population has the opportunity to be sampled with known probability. Third, the selection process includes an explicit random element. Since the specific purpose of the National Lake Fish Tissue Study is to describe the condition of resources on a national basis, a probability-based design was an essential component of the study.

EPA's Office of Research and Development (ORD) created an unequal probability survey design for the National Lake Fish Tissue Study that addresses the objective of the study. The unequal weighting prevented small lakes from dominating the representative sample drawn from the population of lakes. To support development of the final study design, EPA completed critical planning activities, which included hosting a study design workshop and selecting lakes and chemicals for the study.

2.2.1 Study Design Workshop

In October 1998, EPA invited over 50 scientists from state, federal, and tribal agencies to participate in a two-day national study design workshop. Prior to the workshop, a workgroup of agency staff and contractors developed a draft study design to distribute to workshop participants for review. Technical experts at the workshop provided input on fundamental elements of the study design, including the sampling design, chemicals of concern, and data management. The workgroup used recommendations from these experts to prepare the final study design prior to submitting it for external peer review in 1999.

2.2.2 Statistical Selection of Lakes

The target population for this study was all lakes and reservoirs within the conterminous United States with a permanent fish population that met minimum size requirements, excluding the Laurentian Great Lakes and the Great Salt Lake. Use of the term "lakes" in this report refers collectively to lakes and reservoirs. A lake was defined as a permanent body of water of at least one hectare (2.47 acres) in surface area with a minimum of 1,000 m^2 of open (unvegetated) water and a depth of at least one meter. Since the lakes in this study also needed to have a permanent fish population, lakes subject to annual fish winterkill or recently stocked with fingerlings were rejected during the lake evaluation process. Stocked lakes with adult fish introduced at least three years prior to sampling were accepted as having a permanent fish population.

The sample frame used to generate the list of lakes was River Reach File Version 3 (RF3). When lake selection took place in early 1999, RF3 provided the best available GIS coverage for lakes and reservoirs in the United States. One important exception in the coverage was newly-constructed reservoirs. EPA obtained this information from the states and updated RF3 before initiating lake selection.

Statisticians from ORD selected an unequal probability sample of lakes according to procedures described by Stevens and Olsen et al. (2004). To obtain this sample, they divided the lakes into the following six size categories based on surface area of the lake expressed in hectares (ha), where one hectare is approximately 2.47 surface acres: 1–5 ha, >5–10 ha, >10–50 ha , >50–500 ha, >500–5,000 ha, and >5,000 ha. Table 1 lists the number of lakes available in RF3 by size category when lakes were selected for the study. Note that lakes in the smallest category (1–5 ha) accounted for more than 60% of the lakes available to be drawn, while lakes in the two largest categories (>500–5,000 ha and >5,000 ha) represented less than 1% of the lakes in RF3. The probability of selection for a lake depended on its surface area identified in the sample frame. Assigning varying probabilities for selection in each lake size category allowed a similar number of lakes to be drawn from each size category.

EPA established a goal of sampling 500 lakes in a period of four years. To insure that sufficient lakes were available to meet this target, ORD statisticians generated two statistically drawn sets of lakes: an initial list of 900 lakes and a reserve list of 900 lakes. Tables 2 and 3 provide a breakdown of the number of lakes selected by size category and year for the initial and reserve lake lists. These tables highlight another important feature of the study design. The lakes selected for each sampling year comprise an annual statistical subset that provides a nationally-representative sample. Since the initial list of 900 lakes contained a larger than expected number of lakes that did not meet the criteria for inclusion in the study, reserve lakes were added in the final year of field sampling. During the four years of sampling, field teams collected fish from 443 lakes on the initial lake list and 57 lakes on the reserve lake list to meet the sampling goal of 500 lakes. Appendix A provides a list of the 500 lakes and reservoirs sampled for the study. The *National Study of Chemical Residues in Lake Fish Tissue: Study Design* (USEPA 1999) and *Quality Assurance Project Plan for Data Analysis Activities for the National Study of Chemical Residues in Lake Fish Tissue* (USEPA 2005a) contain more detailed descriptions of the statistical lake selection process.

Table 1. Numbers of Lakes by Size Category in the Sample Frame (from RF3).

Lake area (ha)	Number of Lakes	Frequency (%)	Cumulative Number of Lakes	Cumulative Frequency (%)
>1–5	172,747	63.8	172,747	63.8
>5–10	44,996	16.6	217,743	80.4
>10–50	40,016	14.8	257,759	95.2
>50–500	11,228	4.1	268,987	99.3
>500–5000	1,500	0.6	270,387	99.9
>5000	274	0.1	270,761	100.0

Table 2. Number of Lakes Selected for Potential Sampling by Size Category and Year.

Lake area (ha)	Year 1	Year 2	Year 3	Year 4	All Years
>1–5	39	41	47	47	174
>5–10	44	40	47	46	177
>10–50	32	47	46	25	150
>50–500	34	37	29	34	134
>500–5000	36	30	31	41	138
>5000	40	30	25	32	127
Total	**225**	**225**	**225**	**225**	**900**

Table 3. Number of Reserve Lakes Selected for Potential Sampling by Size Category and Year.

Lake area (ha)	Year 1	Year 2	Year 3	Year 4	All Years
>1–5	47	48	48	49	192
>5–10	45	52	40	42	179
>10–50	36	39	42	41	158
>50–500	36	26	40	22	124
>500–5000	38	29	30	37	134
>5000	23	31	25	34	113
Total	**225**	**225**	**225**	**225**	**900**

2.2.3 Target Chemical Selection

EPA considered candidate chemicals for this study from two primary sources: the Agency's persistent, bioaccumulative, and toxic (PBT) list of 451 chemicals and an integrated list of 130 chemicals developed from several contemporary fish tissue and bioaccumulation studies (USEPA 1992, NOAA 1993, USEPA 1995, USEPA 1997, and USEPA 1998). Scientists participating in the 1998 study design workshop discussed the lists of candidate chemicals and provided comments on method availability and relevance for fish tissue. In March 1999, a team of analytical experts convened to review these lists of chemicals and select a list of chemicals for the study. They used the following criteria, along with input from study design workshop participants, to develop a target chemical list:

- Detailed information is available for the chemical.
- The chemical is of immediate concern and known to accumulate.
- One or more EPA programs consider the chemical to be important.

The final target chemical list consists of 268 PBT chemicals. This count includes individual and co-eluting PCB congeners (i.e., groups of two to six congeners that cannot be resolved to an individual level during chemical analysis), as well as multiple forms of a particular chemical (e.g., the six isomers of DDT, DDD, and DDE). Following is a summary of the target chemicals by chemical group:

- 2 metals (mercury and five forms of arsenic)
- 17 dioxins and furans
- 159 PCB individual and co-eluting congener measurements
- 46 pesticides
- 40 semivolatile organic chemicals (e.g., phenols, PAHs, and chlorobenzenes)

Table 4 lists the target chemicals for the National Lake Fish Tissue Study. Appendix B provides additional information about the chemicals, such as the Chemical Abstracts Service (CAS) numbers, method detection limits, and quantitation limits, which are also referred to as minimum levels (MLs).

Table 4. Target Chemicals and Analytical Methods for the National Lake Fish Tissue Study.

ANALYTICAL METHOD	TARGET CHEMICAL	
Total Mercury by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry *(Method 1631, Revision B with Appendix A - Digestion procedures for Total Mercury in Tissue, Sludge, Sediment, and Soil)*	Mercury	
Arsenic Speciation by Arsine Generation, Chromatography, and Atomic Absorption Spectrometry (*Method 1632, Revision A*)	Arsenic (III) Arsenic (V) Dimethylarsinic acid (DMA)	Monomethylarsonic acid (MMA) Total inorganic arsenic
Polychlorinated Biphenyls by Isotope Dilution High-resolution Gas Chromatography/Mass Spectrometry (GC/MS) *(Method 1668, Revision A)*	209 congeners, including the following 12 "dioxin-like" congeners: 3,3',4,4'-TeCB 3,4,4',5-TeCB 2,3,3',4,4'-PeCB 2,3,4,4',5-PeCB 2,3',4,4',5-PeCB 2',3,4,4',5-PeCB	 3,3',4,4',5-PeCB 2,3,3',4,4',5-HxCB 2,3,3',4,4',5'-HxCB 2,3',4,4',5,5'-HxCB 3,3',4,4',5,5'-HxCB 2,3,3',4,4',5,5'-HpCB
Dioxins and Furans by Isotope Dilution High-resolution GC/MS *(Method 1613, Revision B)*	2,3,7,8-TCDD 1,2,3,7,8-PeCDD 1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD 1,2,3,4,6,7,8-HpCDD OCDD	2,3,7,8-TCDF 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF 2,3,4,6,7,8-HxCDF 1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF OCDF
Organochlorine Pesticides by Gas Chromatography/Halide Specific Detector (GC/HSD) (*Method 1656, Revision A*)*	2,4'-DDD (TDE) ‡ 2,4'-DDE ‡ 2,4'-DDT ‡ 4,4'-DDD (TDE) 4,4'-DDE 4,4'-DDT Aldrin *cis*- and *trans*-Nonachlor Dicofol Dieldrin Endosulfan sulfate Endosulfan I Endosulfan II Endrin Ethalfluralin (Sonalan) Heptachlor Heptachlor epoxide Isodrin	Kepone (Chlordecone) Methoxychlor Mirex Octachlorostyrene Oxychlordane Pendimethalin (Prowl) Pentachloronitrobenzene (PCNB) *cis*-Permethrin and *trans*-Permethrin Toxaphene Trifluralin α -BHC α -Chlordane (*cis*-Chlordane) β -BHC γ -BHC (Lindane) γ -Chlordane (*trans*-Chlordane) δ BHC Pentachloroanisole
	‡ Chemicals were added to the target chemical list after Year 1 of the study.	

*PCB Aroclors were not target chemicals for this study, but seven Aroclors were analyzed incidentally using Method 1656, Revision A, including Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260.

Table 4. *(continued)*

Analytical Method	Target Chemical	
Organophosphorus Pesticides by Gas Chromatography/Flame Photometric Detector (GC/FPD) (*Method 1657, Revision A*)	Chlorpyrifos Diazinon Disulfoton Disulfoton sulfone Ethion	Paraoxon Parathion (ethyl) Terbufos Terbufos sulfone
Semivolatile Organic Chemicals by Isotope Dilution GC/MS (*Method 1625, Revision C with modifications for tissue*)	3,3'-dichlorobenzidine 1,2,4,5-Tetrachlorobenzene 1,2,4-Trichlorobenzene 1,2-Dichlorobenzene 1,3-Dichlorobenzene 1,4-Dichlorobenzene 2,4,5-Trichlorophenol 4,4'-Methylenebis (2-chloroaniline) 4-Bromophenyl phenyl ether 4-Nonylphenol Acenaphthene (PAH) Acenaphthylene Anthracene (PAH) Benzo(a)anthracene (PAH) Benzo(a)pyrene (PAH) Benzo(b)fluoranthene (PAH) Benzo(g,h,i)perylene (PAH) Benzo(j)fluoranthene (PAH) Benzo(k)fluoranthene (PAH) Bis(2-ethylhexyl) phthalate	Butyl benzyl phthalate Chrysene (PAH) Dibenzo(a,h)anthrancene (PAH) Di-n-butyl phthalate Diethylstilbestrol (DES) Fluoranthene (PAH) Fluorene (PAH) Hexachlorobenzene Hexachlorobutadiene Indeno(1,2,3-cd)pyrene (PAH) Naphthalene (PAH) Nitrobenzene Pentachlorobenzene Pentachlorophenol Perylene (PAH) Phenanthrene (PAH) Phenol Phenol, 2,4,6-tris(1,1 dimethylethyl)- Pyrene (PAH) Tetrabromobisphenol A

2.3 Mobilization

August 1999 marked the beginning of the mobilization phase of the National Lake Fish Tissue Study. EPA initiated this phase by conducting orientation and training workshops for states and other potential fish study participants. These workshops were a key activity in building a national network of partners to support the study. Another activity closely tied to the workshops was the mapping and reconnaissance of the 900 lakes on the initial list of statistically drawn candidate lakes for the study. Lake lists were distributed to the states prior to the workshops, allowing discussion of lake reconnaissance during the workshops. A final activity completed during this phase of the study was the development of quality assurance and field sampling plans. Preparation of these plans provided the basis for successful implementation of the study.

2.3.1 Orientation and Training Workshops

EPA introduced study participants to the National Lake Fish Tissue Study design, scope, and procedures through regional orientation and training workshops. Nearly 100 representatives from state, tribal, and other federal agencies attended a series of ten workshops held at the Agency's Regional Offices between August 1999 and June 2000 (Figure 1). Presentations at the workshops included an overview of the study design, a description of the sampling program, and instruction on the standard operating procedures (SOPs) and quality assurance/quality control (QA/QC) requirements for fish collection, handling and shipping. Workshop activities also included a discussion about lake reconnaissance (e.g., sampling site assessments and lake access issues) and a forum for planning field sampling (e.g., addressing scheduling questions and discussing personnel needs). Study participants received a variety of materials at the workshops, including training slides, a copy of the Sample Collection Activities Quality Assurance Project Plan (QAPP) (USEPA 2000a), and maps of the lakes selected in their jurisdictions. Sampling coordinators from each participating office or agency viewed the training materials, read the QAPP, and verified that they read all the information and understood the procedures and requirements.

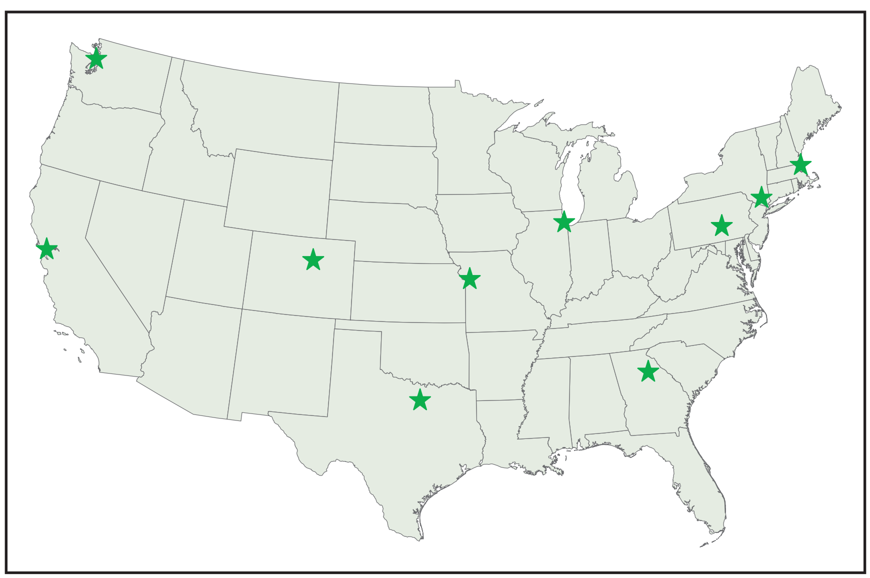


Figure 1. Locations of 10 regional orientation and training workshops.

2.3.2 Partnerships

A national network of partners provided critical support for the planning, mobilization, and implementation phases of the study. Figure 2 presents an organizational chart for key participants in the study. The Office of Science and Technology (OST) relied on fish study coordinators in each EPA Region to recruit study participants from states, tribes and other federal agencies in their geographic areas. These regional coordinators were also instrumental in planning logistics for the orientation and training workshops (Section 2.3.1). The workshops served as the primary vehicle to obtain formal commitments to participate in the study. The external network of partners that provided long-term support for the study consisted of 47 states, three tribes, and two other federal agencies (the National Park Service and Tennessee Valley Authority). Through their combined efforts, they accomplished the majority of the lake evaluations and fish collection from the 500 lakes and reservoirs across the country.

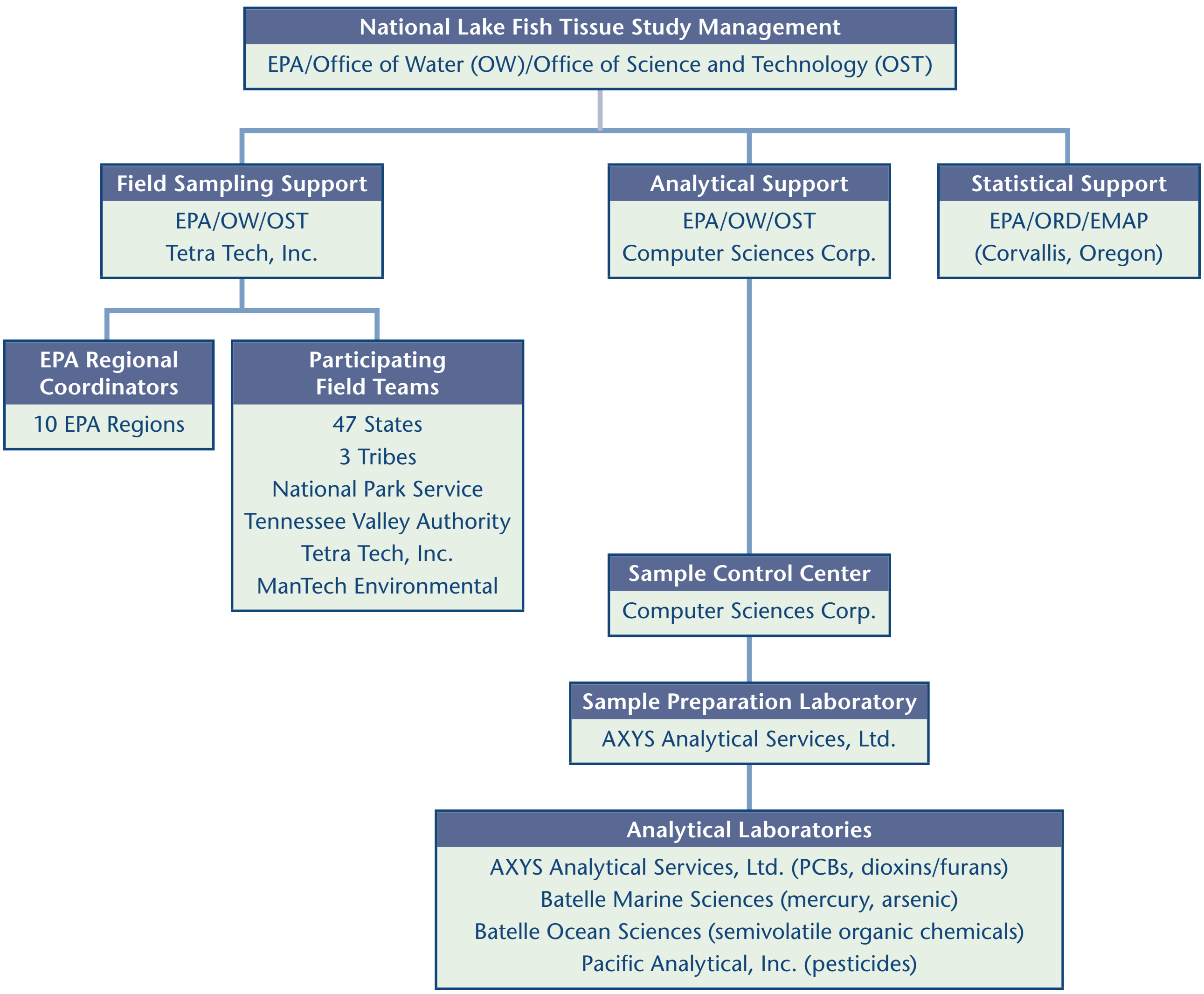


Figure 2. National Lake Fish Tissue Study participants.

Within EPA, OST received significant support from ORD, the Office of Pesticides, Prevention, and Toxic Substances (OPPTS), and the ten Regional Offices. ORD's Environmental Monitoring and Assessment Program (EMAP) developed the statistical framework for the study, implemented the lake selection process, managed the target lake list throughout the study, and performed the statistical analysis of the data. Support from OPPTS focused on study planning, particularly in identifying the target chemicals. The Office of Pollution Prevention and Toxics within OPPTS also provided Agency leadership and coordination for activities conducted under the PBT Initiative, including this study (the largest project sponsored under the Initiative). Besides organizing workshop logistics and recruiting partners, the EPA Regions were actively involved in evaluating lakes and collecting fish for the study. In areas where external or regional resources were not available to complete these tasks, OST provided national contractor support for lake reconnaissance and fish collection.

2.3.3 Lake Evaluations

A critical component in mobilizing for the study was reconnaissance of the candidate lakes. Section 2.2.2 describes the statistical selection of lakes for the study, which resulted in an initial list of 900 candidate lakes and a reserve list of another 900 lakes. Study participants evaluated each of the initial 900 lakes to determine if they met the definition of a lake for the study (Section 2.2.2), if they were physically accessible, and if landowners would grant permission to access lakes on private property. They furnished a complete record of the reconnaissance information, including reasons why sites failed to meet the lake criteria and information regarding physical barriers or landowner denials that prevented access to lakes that did meet the criteria.

The lake reconnaissance process involved both desktop and ground truth exercises. National contractors used mapping software to generate maps for each of the initial 900 lakes and distributed these maps to study participants. The maps were used to identify any obvious issues regarding lake access. A site visit was necessary to determine lake status if regional, state, or local agencies had no information on record for a candidate lake. During the final sampling year (2003), participants repeated this process to evaluate an additional 101 lakes from the reserve list. Assessment of 1001 lakes resulted in the identification of 500 viable sampling sites. All reconnaissance information was tracked and tabulated on a national lake spreadsheet. Appendix A contains the final list of 500 lakes and reservoirs sampled for the study.

2.3.4 Quality Assurance and Field Sampling Plans

During the mobilization phase, EPA developed two quality assurance project plans (QAPPs). The Sample Collection Activities QAPP (USEPA 2000a) describes all requirements and procedures related to the field sampling program, along with the roles and responsibilities of staff supporting the field program. The Analytical Control and Assessment Activities QAPP (USEPA 2000b) describes all the requirements and procedures for sample preparation, fish tissue analysis, and analytical data review, as well as roles and responsibilities for analytical activities staff. EPA also developed an abbreviated version of the Sample Collection Activities QAPP to serve as a field manual for the fish sampling teams. Copies of this Field Sampling Plan (USEPA 2000c) and both QAPPs are available online at ***www.epa.gov/waterscience/fishstudy/***.

2.4 Sample Collection

Fish sampling and fish tissue analysis comprised the implementation phase of the National Lake Fish Tissue Study. EPA designed the study to include four years of fish collection. After a brief pilot in the fall of 1999 to test sampling logistics, participants conducted full-scale fish sampling from 2000 through 2003. Each year, field sampling teams collected fish from approximately 125 lakes distributed across the lower 48 states. These field teams collected the majority of the fish samples during the summer and fall of each sampling year. This schedule coincided with the peak period for recreational fishing activity and allowed sampling teams to avoid the spawning period for most target species.

2.4.1 Sampling Locations

The potential sampling locations were limited to the target population of approximately 147,000 lakes in the lower 48 states that met the study's definition of a lake (Section 2.2.2). Due to resource and study design constraints, Alaska and Hawaii were not included in the study. EPA worked with study partners to collect fish from 500 lakes randomly selected from the target population. The 500 sampling locations included both private and public access lakes that ranged in size from one to about 384,615 hectares (or from 2.5 to about 950,000 surface acres). Figure 3 shows the locations of the 500 lakes sampled for the study, and Appendix A provides a list of these locations. Sampling sites occurred in each of the lower 48 states except Delaware because no lakes or reservoirs were randomly drawn in Delaware.

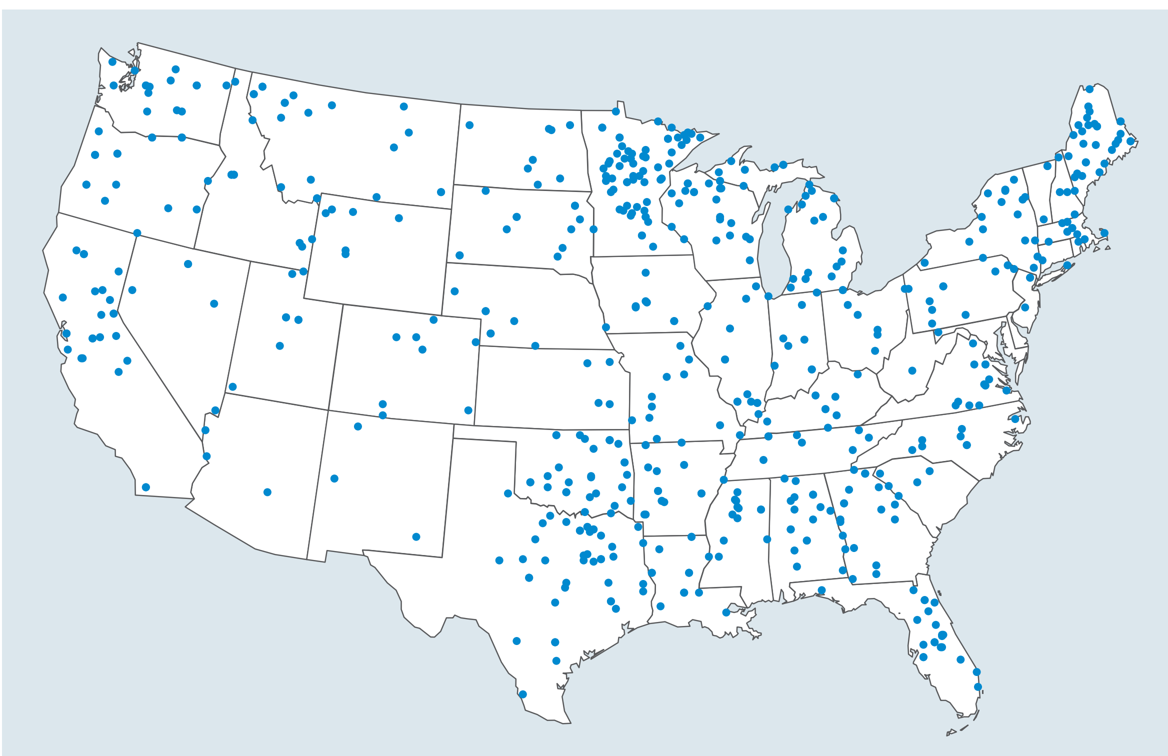


Figure 3. National Lake Fish Tissue Study sampling locations (500 lakes).

2.4.2 Target Species

The National Lake Fish Tissue Study included two distinct ecological groups of fish, predators (e.g., bass or trout) and bottom dwellers (e.g., carp or catfish). This permitted monitoring of a variety of habitats, feeding strategies, and physiological factors that might result in differences in the bioaccumulation of chemicals. Predators were included because they are good indicators of persistent contaminants that may be biomagnified through several trophic levels of the food web. Bottom dwellers were included because they may accumulate high contaminant concentrations through direct contact with contaminated sediments or by consuming benthic organisms that live in contaminated sediments. Twelve predator species and six bottom-dwelling species were targeted to limit the number of fish species included in the study. Table 5 lists the recommended target species for the study.

Table 5. Recommended Target Species for Lakes and Reservoirs (in Order of Preference).

	Family name	Common name	Scientific name
Predator/Gamefish Species *(in order of preference)*	Centrarchidae	Largemouth bass	*Micropterus salmoides*
		Smallmouth bass	*Micropterus dolomieu*
		Black crappie	*Pomoxis nigromaculatus*
		White crappie	*Pomoxis annularis*
	Percidae	Walleye	*Sander vitreus*
		Yellow perch	*Perca flavescens*
	Percichthyidae	White bass	*Morone chrysops*
	Esocidae	Northern pike	*Esox lucius*
	Salmonidae	Lake trout	*Salvelinus namaycush*
		Brown trout	*Salmo trutta*
		Rainbow trout	*Oncorhynchus mykiss*
		Brook trout	*Salvelinus fontinalis*
Bottom-dwelling Species *(in order of preference)*	Cyprinidae	Common carp	*Cyprinus carpio*
	Ictaluridae	Channel catfish	*Ictalurus punctatus*
		Blue catfish	*Ictalurus furcatus*
		Brown bullhead	*Ameiurus nebulosus*
		Yellow bullhead	*Ameiurus natalis*
	Catostomidae	White sucker	*Catostomus commersoni*

To select target fish species, EPA used the following criteria from *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis, Third Edition* (USEPA 2000d):

- The species is abundant and commonly consumed in the study area.
- It may potentially accumulate high concentrations of chemicals.
- The species is easy to identify, and it has a wide geographic distribution.
- Adult specimens are large enough to provide adequate tissue for analysis.

In areas where the recommended target species were not available, field teams applied these criteria to identify additional target species. Appendix C provides a summary of the fish species collected for the study.

2.4.3 Composite Samples

The sampling goal for field teams was to collect separate composite samples of a predator fish species and a bottom-dwelling species from each lake or reservoir. Composite samples consisted of multiple adult fish (five preferred) of the same species and similar size (i.e., lengths of all fish in the composite were within 75% of the length of the largest fish). Collecting composite samples served as a form of physical averaging and offered a cost-effective approach for obtaining an estimate of the mean chemical concentrations in fish tissue for a lake or reservoir. Compositing also ensured that an adequate amount of tissue was available for analysis of all the target chemicals.

During the four-year sampling period, field teams collected 486 predator composites and 395 bottom-dweller composites from the 500 sampling locations. Predator and bottom-dwelling species did not occur together at every sampling site; however, if either a predator or bottom- dweller species were present, the target lake was sampled. In addition, field teams collected replicate composite samples from about 10% of the lakes to allow evaluation of sampling variability. This sampling effort produced 70 replicate predator composites and 52 replicate bottom-dweller composites.

2.4.4 Sampling Methods

Field sampling procedures developed for the National Lake Fish Tissue Study followed the recommendations in *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis, Third Edition* (USEPA 2000d). Specific sampling protocols for this study are detailed in the Field Sampling Plan (USEPA 2000c) and Sample Collection Activity QAAP (USEPA 2000a).

Fish sampling teams used active (e.g., electrofishing) and passive (e.g., gill netting) collection methods to obtain the desired target numbers and species of fish. Experienced fisheries biologists determined the appropriate type of fishing gear for a particular target lake and identified the species available for compositing. After collecting the fish, team members measured total body length of each fish in a composite, wrapped whole fish in contaminant-free materials, packed them on dry ice in shipping coolers, and used overnight delivery to ship the fish samples (under Chain of Custody) to the laboratory responsible for sample preparation. Field teams recorded all site and sampling information on a standard Field Record Form and enclosed it with the samples in the shipping coolers.

2.4.5 Sample Collection Quality Assurance/Quality Control (QA/QC)

EPA emphasized experience and consistency in recruiting, training, and coordinating field sampling support for the National Lake Fish Tissue Study. To initiate this effort, detailed Standard Operating Procedures were developed to establish consistent methods and requirements for fish collection, handling, and shipping. These study-specific procedures were presented to study participants during the orientation and training workshops. EPA also distributed a Field Sampling Plan (USEPA 2000c) to every field sampling team. This field manual contained a project description, the comprehensive SOPs for sample collection, and instructions for completing fish labels and field and shipping forms. In the field, highly qualified fisheries biologists led the sampling teams. Under their leadership, every fish sample collected during the four sampling years of the study arrived intact at the sample preparation laboratory. The fact that no fish samples were lost throughout the four field seasons demonstrates how carefully the field teams adhered to the sampling and shipping protocols.

EPA employed additional measures to maintain quality control for fish sampling. Each year, the Sample Control Center distributed identical field sampling supplies to every field team across the country. These supplies included materials for wrapping and packaging fish specimens (e.g., solvent-rinsed foil and food-grade plastic tubing), coolers for shipping, and standard forms and labels to document sample collection and shipping. To reduce the risk of introducing contamination, field teams shipped whole fish to the laboratory where fish tissue samples were prepared in a strictly-controlled environment. Another provision for quality control was centralizing the daily coordination and tracking of sample shipments at the national level. This process prevented coolers from becoming lost or delayed to an extent that would compromise the condition of the samples during transit to the laboratory. When each cooler reached the laboratory, staff inspected it for damage and contacted the Sample Control Center to verify that the samples it contained arrived frozen and in good condition. The laboratory forwarded all associated paperwork (e.g., Field Record Forms and Chain-of-Custody Forms) to the national sampling support contractor to verify completeness and accuracy. A final QA activity involved collecting replicate samples at a minimum of 10% of the lakes to provide data for developing estimates of sampling variability (Section 3.5).

2.5 Sample Analysis

Laboratories analyzed different fish tissue fractions for the two types of composite samples collected for the study: fillets for the predator composites and whole bodies for the bottom-dweller composites. This approach allowed development of data relevant to both human and ecosystem health. A network of four commercial laboratories (Figure 2) applied seven standard EPA methods to analyze the fish tissue for the 268 target chemicals (Table 4). One of these laboratories was also responsible for sample preparation, which involved filleting and grinding fish samples, dividing the tissue into sub-samples (i.e., aliquots), and shipping the fish tissue samples to the other laboratories for analysis. A large tissue volume was necessary to complete all the chemical analyses. The sample preparation laboratory processed and distributed 560 grams (about 20 ounces) of tissue for each fish composite sample. This volume provided sufficient tissue for measuring the lipid content of each sample and running required portions of the sample through the series of analytical methods. It also provided reserve tissue for the option of re-analyzing samples and archiving frozen fish tissue for future use.

2.5.1 Non-routine Samples

This study defined a composite sample as one containing five fish of the same species. An additional requirement for each composite was that the smallest fish in the composite be at least 75% of the length of the largest fish (Section 2.4.3). Composite samples that did not meet either of these requirements were designated as non-routine samples. Prior to making a decision about whether to retain and analyze a non-routine sample, EPA evaluated species, number of specimens, and specimen lengths. This evaluation resulted in one of the following decisions: accept non-routine composites that had less than five specimens, but provided sufficient tissue for analysis; accept composites of more than five specimens in order to provide enough tissue for analysis; or reject individual specimens or entire composites that fell outside of study parameters. Non-routine samples that met the first two decision criteria were accepted for analysis. Individual specimens that did not meet the 75% length rule were eliminated (with rare exceptions for fish whose lengths were less than 5mm shorter than the minimum allowable length).

Over the four-year sampling period, about 24% of the composite samples were non-routine samples. EPA rejected about 2% of the total composite samples submitted by the field teams. Rejection of these samples was based on submission of composites containing inappropriate species or insufficient tissue, predator specimens mistakenly filleted in the field, or fish collected from the wrong lake (i.e., a lake not on the target lake list).

2.5.2 Sample Preparation

AXYS Analytical Services, Ltd. in Sidney, British Columbia served as the sample preparation laboratory for the duration of the study. In accordance with EPA specifications, the laboratory prepared bottom-dwelling species as whole fish composites. This involved grinding the entire specimen, including the head, skin, internal organs, muscle, and bones. Laboratory staff combined ground tissue from each whole fish in the composite and thoroughly homogenized the fish tissue before extracting sub-samples for analysis. Predator species were prepared as skin-on fillet composites (scales removed and belly flap attached). In preparing predator composites, the entire fillet was removed from both sides of each fish in the composite and all the fillets were ground together. Laboratory staff ensured that the tissue was completely homogenized before preparing sample aliquots for analysis. AXYS distributed sample aliquots to three other laboratories for analysis, and they shipped additional aliquots to a sample repository for archiving.

All sample preparation activities (e.g., filleting and tissue homogenization) were performed according to procedures in EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Fish Sampling and Analysis (Third Edition, November 2000)* (USEPA 2000d). The National Lake Fish Tissue Study Analytical Control and Assessment Activities QAPP describes study-specific procedures for sample preparation (USEPA 2000b).

2.5.3 Laboratory Network

Four laboratories analyzed samples for this study: AXYS Analytical Services, Ltd., Sidney, British Columbia; Battelle Marine Sciences, Sequim, Washington; Battelle Ocean Sciences, Duxbury, Massachusetts; and Pacific Analytical, Inc., Carlsbad, California. EPA used multiple laboratories to access their expertise for specific chemical analyses. AXYS Analytical Services analyzed fish tissue samples for PCBs and dioxins and furans, in addition to serving as the sample preparation laboratory. Battelle Marine Sciences performed the metals analyses (mercury and arsenic), whereas Battelle Ocean Sciences performed the analyses for semivolatile organic chemicals (e.g., phenols, phthalates, and polycyclic aromatic hydrocarbons or PAHs). Pacific Analytical analyzed the tissue samples for pesticides.

2.5.4 Analytical Methods

Laboratories analyzed fish tissue samples using seven standard EPA methods: two methods for metals (mercury and arsenic), two methods for pesticides (organochlorine and organophosphate pesticides), and a single method for each of the three other chemical groups (PCBs, dioxins and furans, and semivolatile organic chemicals). Each method specifies procedures for analysis, QA/QC requirements, and reporting limits. Table 4 lists the method number and title, along with the number and group of target chemicals covered by the method. At EPA's direction, laboratories made study-specific modifications to two of the methods to achieve lower detection limits: Method 1613B for dioxins and furans and Method 1656A for organochlorine pesticides. Appendix D provides more detailed information for each of the methods and describes the modifications to Methods 1613B and 1656A to achieve lower detection limits. Method-specific information is also available in the *QAPP for Analytical Control and Assessment Activities in the National Study of Chemical Residues in Lake Fish Tissue* (USEPA 2000b) and in the *Quality Assurance Report for the National Study of Chemical Residues in Lake Fish Tissue: Analytical Data for Years 1 through 4* (USEPA 2005b). Both documents are posted online at ***www.epa.gov/waterscience/fishstudy/.***

2.5.5 Sample Analysis QA/QC

EPA stressed consistency and comparability in planning and implementing QA/QC measures for sample analysis. An initial step in promoting consistency for fish tissue analysis was centralizing sample filleting (predator composites only) and the grinding and homogenization of tissue in a strictly-controlled, contaminant-free environment at a single laboratory. Using the same laboratory for each type of analysis throughout the study was also crucial for maintaining consistency in generating results. Comparability of study results was achieved by using a single set of methods to analyze all fish samples collected during the study. Applying consistent method detection limits (MDLs) and QC acceptance criteria also insured comparable results.

EPA maintained quality control through a number of other laboratory and data review activities. Prior to initiating sample analysis, EPA's Sample Control Center (SCC) verified that each laboratory participating in the study could achieve the specified detection limits and quantitation levels. The SCC also required laboratories to analyze initial and ongoing QC samples to demonstrate their ability to obtain precise and accurate results with the standard methods. In addition, the laboratories used pure and traceable reference standards during sample analysis, analyzed sample preparation and analysis blanks to demonstrate the absence of contamination, and submitted data reports in standard formats. The SCC received and reviewed the analytical data from the laboratories using a standard process for data quality assessment. The *Quality Assurance Report for the National Study of Chemical Residues in Lake Fish Tissue: Analytical Data for Years 1 through 4* (USEPA 2005b) provides detailed descriptions of all the standard procedures for sample analysis, data reporting, and data review.

2.6 Statistical Analysis of Study Data

Tissue concentrations for each target chemical (e.g., mercury) or chemical group (e.g., PCBs) and fish composite type comprise the series of national data sets analyzed for the National Lake Fish Tissue Study. Statistical analysis of these fish tissue data sets involved application of R statistical software (R Development Core Team 2004) to estimate percentiles (Section 3.0) and the cumulative distribution of tissue concentrations (Section 3.1.4) for the sampled population of lakes. This statistical package was selected for tissue data analysis because it is readily available, it has robust capabilities, and statisticians in EPA's Office of Research and Development (ORD) have extensive experience using this software for analysis of unequal probability survey data (e.g., Environment Monitoring and Assessment Program (EMAP) survey data). Analysis of the fish tissue data incorporated elements of the survey design, along with information from the field sampling operations and laboratory analyses. The statistical analysis process included the following essential steps:

- compiling lake evaluation information to determine the status for each lake in the study (Section 2.3.3),
- adjusting the survey design (sample) weights based on lake status,
- estimating the number of lakes within the conterminous United States that meet the project definition of a lake (i.e., the target population),

- estimating the number and proportion of lakes in the sampled population, and
- estimating the cumulative distribution and percentile concentrations of the target chemicals in each fish tissue fraction (i.e., fillets for predator composites and whole bodies for bottom-dweller composites).

Activities in the last four steps are summarized in Sections 2.6.1 through 2.6.4. Section 2.6.5 contains a brief description of statistical analysis QA/QC.

2.6.1 Calculating the Sample Weights

A critical activity for analyzing data from a study with an unequal probability survey design is deriving the sample weights. For this study, lake size (surface area) was used to assign a probability of selection, or inclusion probability, to each lake. The lakes were divided into six size categories with inclusion probabilities assigned to each to allow a similar number of lakes to be selected from each size category (Section 2.2.2). Statistical analysis of data for this unequal probability sample of lakes is more complex, and it requires that all analyses use weights derived from the unequal probability of selection (Thompson 1992).

The statistical weight of each lake is the inverse of its probability of selection or inclusion probability. The inclusion probability was determined by the goal of obtaining approximately an equal number of lakes to sample in each size category. During the lake selection process, the inclusion probability was adjusted for the three smaller size categories to account for the larger number of lakes that would not meet the study definition of a lake. These adjustments were as follows: increase by 40% for 1–5 hectares (ha), increase by 30% for 5–10 ha, and increase by 20% for 10–50 ha. No adjustment was required for the remaining size categories (50–500 ha, 500–5,000 ha, and >5,000 ha). Initial sample weights were calculated for each lake based on the unequal probabilities of selection. The inclusion probabilities for the smallest to the largest lake size categories were as follows: 0.001065142, 0.003822562, 0.003898441, 0.011756323, 0.088000000, and 0.452554745. These probabilities resulted in expected total sample sizes of 184, 172, 156, 132, 132, and 124 lakes, respectively. They also resulted in initial design weights of 938.84, 261.60, 256.51, 85.06, 11.36, and 2.21, respectively. Note that the sample weights are expressed as numbers of lakes. The final sample weights were derived from adjusted inclusion probabilities based on the total number of lakes identified for potential sampling at the conclusion of the lake evaluation process. This weight adjustment was made individually for each lake size category. The adjusted weight is the initial weight multiplied by the ratio of the number of lakes in the sample frame divided by the product of the number of lakes evaluated and their initial weight. For example, the adjustment for lakes in the >5000 ha size category is:

$$2.21 \quad \frac{274}{(139 \quad 2.21)} = 1.971223$$

2.6.2 Estimating the Size of the Target Population of Lakes

The data necessary for estimating the number of target lakes are the evaluation status results compiled for all lakes statistically drawn for potential field sampling. Diaz-Ramos et al. (1996) describe the statistical procedure used to estimate the total (target) population from the unequal probability sample of lakes. An associated variance estimate, called a local neighborhood variance estimate, is described by Stevens and Olsen (2003). Procedures for estimating both the target population size and variance are available online at ***http://www.epa.gov/nheerl/arm/analysispages/r_design_guide.htm*** in the R library for the Office of Research and Development's National Health and Environmental Effects Research Laboratory in Corvallis, Oregon. An option also exists to complete the same estimates for sub-regions of the conterminous United States. However, unless the sample size is sufficiently large, the confidence intervals of the sub-region estimates may be so large that the estimates provide little information. Sub-region estimates were not derived for this study because the sample size was insufficient to develop estimates with reasonable confidence intervals.

2.6.3 Estimating the Size of the Sampled Population of Lakes

The target population of lakes for this study included lakes on both public and private lands. All target lakes met the study definition of a lake (Section 2.2.2), but some of these lakes could not be sampled. Landowner denial to access lakes on private property was a major factor in preventing field teams from sampling privately-owned target lakes. Another important factor was physical barriers that made some target lakes inaccessible (e.g., remote locations with no road access or reservoir draw downs). EPA used the number of inaccessible target lakes to develop an estimate of the sampled population of lakes (i.e., the number of target lakes that could be sampled). Table 6 in Section 3.0 presents the estimated number of lakes by evaluation status (e.g., non-target, target, and inaccessible target), lake size category, and composite type.

2.6.4 Estimating Fish Tissue Concentrations

EPA developed national estimates of fish tissue concentrations in each fish composite type (i.e., predator fillets and bottom-dweller whole bodies) for all the target chemicals. Tissue concentration data from laboratory analysis of the fish composite samples, along with the final sample weights associated with each lake, were required to derive these estimates. The tissue concentrations are reported as percentiles, including the 50^{th} percentile or median concentration, for each target chemical and composite type. EPA estimated the cumulative distribution of fish tissue concentrations for the sampled population of lakes using a procedure described by Diaz-Ramos et al. (1996) entitled, "Estimation Method 1: Cumulative Distribution Function for Proportion of a Discrete or an Extensive Resource." The estimated proportion (p_C) below a specific value for a concentration (C) is:

$$p_C = \frac{\sum_{i=1}^{n} w_i * x_i}{\sum_{i=1}^{n} w_i}$$

where: x_i = 1 if concentration for i^{th} lake is below C and equals 0 otherwise,
w_i = the adjusted weight for i^{th} lake, and
n = total number of lakes sampled.

Variance estimates were derived using the local neighborhood variance estimator described by Stevens and Olsen (2003 and 2004). To complete these analyses, EPA utilized the R statistical software (R Development Core Team 2004) and an R contributed library for probability survey population estimation (spsurvey) that is available online at the following Internet address: ***http://www.epa.gov/nheerl/arm/analysispages/software***.

2.6.5 Statistical Analysis QA/QC

EPA focused on QA/QC activities to achieve accuracy and reproducibility during statistical analysis of the fish tissue data and review of the results. These activities began with a series of internal checks of the input data files to verify the consistency and completeness of the data. For example, the composite sample identification numbers were compared to the lake site identification numbers and the sample (composite) types to ensure that no miscoding occurred. National study management team members also checked the consistency of the output files. Any inconsistencies identified by the team were traced to errors in the input files and resolved by correcting these files and repeating the analyses. The final step in reviewing statistical analysis of the data involved re-analyzing a subset of the data to verify the reproducibility of the results. A QAPP describing data analysis activities for the National Lake Fish Tissue Study (USEPA 2005a) provides additional information about statistical analysis QA/QC. It is available online at ***www.epa.gov/waterscience/fishstudy/***.

3.0 Results

The National Lake Fish Tissue Study is the first statistically-based national assessment of freshwater fish contamination to be completed in the United States. The study applies an unequal probability design. It is essential to understand two important points about this design:

- The 486 predator composites and the 395 bottom-dweller composites collected during the study from the 500 sampling locations (Section 2.4.3) each comprise nationally-representative samples whose results can be extrapolated to tens of thousands of lakes and reservoirs in the lower 48 states.
- The unequal probability design requires application of sample weights (Section 2.6.1) to the fish tissue data to develop national estimates of fillet (predators) and whole-body (bottom dwellers) tissue concentrations for each of the 268 target chemicals. The sample weights are derived from the various probabilities assigned to each of the six lake size categories in the study design (Section 2.2.2).

Two statistical sets of lakes, the target population and the sampled population, define how broadly the fish tissue concentration results apply to lakes and reservoirs in the United States. The target population consists of all lakes and reservoirs in the lower 48 states with a permanent fish population that met the study lake size requirements. There are an estimated 147,000 lakes in the target population for this study. The sampled population consists of all target lakes that were accessible for fish collection. Under ideal circumstances, the target and sampled populations should coincide. However, for this study, the sampled population is a subset of the target population. A number of target lakes were not accessible to field sampling teams because the lakes were either located in remote wilderness areas or on private property where landowners denied EPA permission to sample them (Table 6). There is a different sampled population for each composite type based on differences in the occurrence of predators and bottom dwellers in the 500 sampled lakes. The sampled population for predators contains an estimated 76,559 lakes, and the sampled population for bottom dwellers consists of an estimated 46,190 lakes. All predator and bottom-dweller results presented in this report apply to these sampled populations of lakes.

Table 6. Estimated Number of Lakes by Evaluation Status, Lake Size Category, and Composite Type

Estimated Number of Lakes By Evaluation Status	Lake area (hectares)						Total (95% Confidence Interval)
	>1–5	>5–10	>10–50	>50–500	>500–5000	>5000	
Lakes in RF3 (Actual)	172,747	44,996	40,016	11,228	1,500	274	**270,761**
Non-Target Lakes							**123,418±8%**
Saline Lake	1,809	466	710	217	29	8	3,240±66%
Not a Lake	47,031	15,620	11,365	2,898	380	6	77,300±12%
Lake <1 hectare	5,427	-	-	-	-	-	5,427±63%
No Fish in Lake	17,184	3,031	1,657	72	-	2	21,947±28%
No Permanent Fish	9,044	3,730	2,368	362	-	-	15,505±30%
Target Population of Lakes							**147,343±7%**
Inaccessible Target Lakes							
Land Owner Denied Access	39,795	5,595	5,209	724	-	-	**51,424**±16%
Lake Physically Inaccessible	9,948	4,430	2,605	362	10	-	**17,355**±29%
Sampled Population of Lakes							
Predator Sampled Population	41,604	16,101	11,191	6,375	1,032	256	**76,559**±12%
Bottom Dweller Sampled Population	19,898	11,602	8,160	5,360	935	235	**46,190**±17%
Total Sampled Population*	42,508	12,123	16,101	6,592	1,081	258	**78,664**±12%

*The total sampled population of lakes includes lakes that yielded either predator or bottom-dweller species.

Data analysis focused on the study objective to develop estimates of the national distribution of the mean levels (i.e., "lake means" or composite average concentrations) of the target chemicals (Section 2.2.3) in predator fillets and whole bodies of bottom dwellers. These national distributions of fillet and whole-body tissue residue data are described by percentiles (5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles) for each of the target chemicals. The 50th percentile is the median tissue concentration. Section 3.4 provides percentile tables by composite type for five target chemicals that occurred in a large percentage of the fish tissue samples. Appendix E provides percentile tables by composite type for all target chemicals detected in the fish samples.

Since the study design included analysis of fillets for predator composites and whole bodies for bottom-dweller composites, this study generated data relevant to both human and ecosystem health. In this report, however, predator results are highlighted because human health screening values were readily available to interpret the fillet data for chemicals that occurred frequently in the edible tissue (Section 3.4). If available, wildlife criteria could be applied in the same manner to interpret the whole-body data from analysis of the bottom-dweller composites.

Familiarity with certain technical information is critical for understanding the results. Section 3.1 provides a description of key technical elements and how they apply to the study data. Sections 3.2, 3.3, and 3.4 present the fish tissue results by respective composite type based on three levels of occurrence of target chemicals: not detected, rarely detected, and commonly detected. The five chemicals highlighted as commonly detected in Section 3.4 are mercury, polychlorinated biphenyls (PCBs), dioxins and furans, DDT, and chlordane. According to EPA's 2008 Biennial National Listing of Fish Advisories (USEPA 2009), these five chemicals accounted for 97% of the advisories in effect at the end of 2008.

3.1 Technical Elements

3.1.1 Reporting Units

All fish tissue results are reported as wet weight concentrations. These concentrations are expressed as the mass of the chemical per unit of fish tissue mass. Each analytical method specifies the reporting units for a particular chemical or chemical group. Table 7 lists the reporting units for the seven EPA standard analytical methods used to generate fish tissue results.

Table 7. Reporting Units for EPA Standard Analytical Methods

EPA Method	Chemical(s)	Reporting Units
1631B	Mercury	ng/g (ppb)
1632A	Arsenic	µg/g (ppm)
1668A	PCBs	ng/kg (ppt)
1613B	Dioxins and Furans	ng/kg (ppt)
1656A	Organochlorine Pesticides	µg/kg (ppb)
1657A	Organophosphate Pesticides	µg/kg (ppb)
1625C	Semivolatile Organic Chemicals	µg/kg (ppb)

3.1.2 Detection and Quantitation Limits

The Code of Federal Regulations (CFR) provides a definition and description of the method detection limit (MDL) in 40 CFR, part 136. The MDL varies for different chemicals, matrices (e.g., water, sediment, or tissue), and analytical methods. Appendix B contains a table that lists the MDL for each of the target chemicals. Other factors can influence the MDL, such as increasing the sample size (e.g., the amount of tissue) used for analysis. In this study, EPA modified Method 1613B by increasing the volume of tissue analyzed from 10 grams to 100 grams to allow detection of dioxins and furans at levels ten times lower than those specified in the method.

The MDL is designed to provide a 99% level of confidence that when a chemical is reported as being present, it really is present. The opposite is not true, however. If a chemical is reported as not being present at the MDL level, there is a 50% possibility that the chemical is really present (i.e., the result is a false negative).

The minimum level of quantitation (ML) is the lowest concentration at which the analytical system gives a quantitative result. Generally speaking, the ML is approximately three times greater than the MDL, and it is comparable to the American Chemical Society's Limit of Quantitation. The table in Appendix B lists the MLs for all of the target chemicals.

For this study, laboratories reported all positive results that met the method-specified criteria down to the MDL. They also applied a "J" flag to any results reported at or above the MDL (detection limit), but below the ML (quantitation limit). The "J" flag indicates that the chemical was present, but the reported value is an estimate of the true concentration since it was detected below the quantitation limit. Appendix F provides a breakdown by composite type and chemical of the concentrations that occurred below the MDL, between the MDL and ML (and inclusive of the MDL), and at or above the ML. The "J" flagged values were included in all analyses of the fish tissue data.

3.1.3 Total Toxicity Equivalency and Summed Chemicals

The tissue concentrations for dioxins and furans are reported as toxicity-weighted total concentrations. They are derived by multiplying an individual toxicity equivalency factor (TEF) by the concentrations of each of the seven dioxins and ten furans, then summing the 17 results. This sum is referred to as the total toxicity equivalency or total TEQ. *EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis, Third Edition* (USEPA 2000d) includes a discussion of the method for estimating total TEQ, and it provides a list of the toxicity equivalency factors for the 17 dioxins and furans.

In addition to the 17 dioxins and furans, fish tissue samples were analyzed for multiple forms of other chemicals, such as PCBs, chlordane, DDT and endosulfan. Analysis of tissue samples for PCBs included all 209 congeners (individual PCB compounds), which produced 159 congener measurements due to co-elution of up to six individual congeners (Section 2.2.3). Results for the 12 coplanar ("dioxin-like") PCBs were converted to toxic equivalents, added to toxicity-weighted concentrations for dioxins and furans, and reported as a total TEQ in accordance with EPA guidance (USEPA 2000d). Tissue analysis for the three organochlorine pesticides involved multiple isomers, including five for chlordane, six for DDT, and two for endosulfan. Results for these chemical groups are reported as individual congener or isomer concentrations and as summed concentrations for each group. In developing the summed concentrations, non-detected components of the chemical were assigned a value of zero for this report. The summed concentrations from the predator fillet results are compared to human health screening values published in Volume 2 of *EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories* (USEPA 2000e).

3.1.4 Cumulative Distribution Functions

A cumulative distribution function (CDF) offers an approach to displaying statistical data that correlates the results to the sampled population. In technical terms, a CDF characterizes the probability distribution of a random variable (Zar 1999). For this study, the random variable is the concentration of a particular chemical in fish tissue. Each chemical and composite type has a unique probability distribution.

The probability distributions for fillet and whole-body fish tissue concentrations are presented by chemical and composite type as plots of chemical concentration (x-axis) versus the cumulative percentage of lakes (y-axis) (Section 3.4 and Appendix G). Every point on the plot is a mean tissue concentration measured for a fillet composite or a whole-body composite, and each of these points corresponds to a sampling site where the chemical was detected in the tissue composite. The maximum number of points for a CDF displaying predator (fillet) data is 486 because predator composites were collected from 486 of the 500 sampling locations. Similarly, the maximum number of points for a CDF presenting bottom-dweller (whole-body) data is 395 because bottom dwellers were only sampled from 395 of the 500 locations. The points are plotted in order of increasing tissue concentration. An important point of reference on the CDFs is the median, or the tissue concentration corresponding to 50% of the lakes.

Many target chemicals did not have sufficient tissue data to develop a CDF with adequate resolution. The CDFs included in Appendix G represent chemicals that had published human health screening values and at least 50 data points (i.e., tissue concentrations above the MDL). Five chemicals or chemical groups met these criteria, including mercury, PCBs, dioxins and furans, DDT, and chlordane. Predator and bottom-dweller CDFs for these commonly-occurring chemicals are displayed and described in Section 3.4. Human health screening values are most commonly applicable to fillet data, not whole-body data; therefore, bottom-dweller (whole-body) CDFs do not include human health thresholds.

Each CDF contains a horizontal (x) axis for tissue concentrations and two vertical (y) axes. The left y-axis presents the cumulative percentage of lakes, and the right y-axis shows the corresponding number of lakes in the sampled population. The human health screening value appears on the predator CDFs as a dashed green line. The point of intersection of the human health screening concentration on the left y-axis indicates the point where the percentage of lakes is below this threshold. The intersection on the right y-axis provides an estimate of the number of lakes with tissue concentrations below the human health screening value. Subtracting these points of intersection from the maximum values on each y-axis (e.g., 100% for the left y-axis and 76,559 for the right y-axis on predator CDFs) will give the percentage of lakes and the corresponding number of lakes that exceed the human health screening value (Section 3.1.5).

3.1.5 Human Health Screening Values

The human health screening value applied to predator results for mercury is EPA's tissue-based water quality criterion published in January 2001 (USEPA 2001b). EPA has no other tissue-based water quality criteria available, so all other human health screening values applied to predator results in this report are risk-based consumption limits published in *EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* (USEPA 2000e). Section 3 of the guidance describes the methods and assumptions (e.g., body weight and acceptable risk level) used to derive the consumption limits. Section 4 of the guidance provides tables of risk-based consumption limits. The screening values include consumption limits for both carcinogenic and noncarcinogenic health effects. Following the recommendation in the guidance, this report uses the more conservative consumption limit as a screening value to account for both types of health effects.

The screening value for mercury in this report is EPA's tissue-based water quality criterion of 0.3 ppm (or 300 ppb) (USEPA 2001b). Consistent with the recommendation issued by the Food and Drug Administration (FDA) and EPA for instances where no fish consumption advice is available, all other screening values in this report are based on consumption limits for four meals per month (or one meal per week). Specifically, the report screening values are the upper limit of the four-meal-per-month concentration range for the more conservative consumption limit where tissue concentrations are available for both cancer and noncancer health endpoints. Table 8 provides a list of the screening values (SVs) used to interpret predator results for this study.

Table 8. Human Health Screening Values (SV)[a] for Interpreting National Lake Fish Tissue Study Predator Results

CHEMICAL	VOL. 2 TABLE	HEALTH ENDPOINT	SV FISH TISSUE CONCENTRATION	UNITS
Mercury	WQC[b]	Noncancer	300	ppb
Arsenic (inorganic)	4-1	Cancer	0.016	ppm
PCBs	4-24	Cancer	12	ppb
Dioxins/Furans	4-25	Cancer	0.15	ppt
Chlordane	4-6	Cancer	67	ppb
DDT	4-7	Cancer	69	ppb
Dicofol	4-8	Noncancer	700	ppb
Dieldrin	4-9	Cancer	1.5	ppb
Endosulfan	4-10	Noncancer	14000	ppb
Endrin	4-11	Noncancer	700	ppb
Heptachlor epoxide	4-12	Cancer	2.6	ppb
Lindane (gamma BHC)	4-14	Cancer	18	ppb
Mirex	4-15	Noncancer	470	ppb
Toxaphene	4-16	Cancer	21	ppb

[a] Taken from *EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition.*

[b] Screening value for mercury is the tissue-based water quality criterion (WQC) published by EPA in January 2001 (USEPA 2001b).

3.2 Chemicals Not Detected

In reporting the analytical results for this study, it is important to distinguish between detection and presence of a chemical in a fish tissue sample. As discussed in Section 3.1.2, estimates of fish tissue concentrations ranging from the MDL (method detection limit) to the ML (minimum level or quantitation limit) are reported as being present with a 99% level of confidence. However, if a chemical is reported as "not detected" at the MDL level, there is a 50% possibility that the chemical may be present. Therefore, results for chemicals not detected in the fish tissue samples are reported as less than the MDL rather than zero.

Forty-three of the 268 target chemicals were not detected in any of the fish samples collected during this study. Table 9 provides a list of these chemicals. No detections were reported for any of the nine organophosphate pesticides (e.g., chlorpyriphos and diazinon), for one of the 209 PCB congeners, or for 16 of the 17 polycyclic aromatic hydrocarbons (PAHs) analyzed as semivolatile organic chemicals. Seventeen other semivolatile organic chemicals were not detected in the fish samples, including hexachlorobenzene, which was a priority chemical under EPA's Persistent, Bioaccumulative, and Toxic Chemicals Initiative.

The choice of methods determines detection limits that can be achieved for each chemical or chemical group. Methods with lower detection limits often involve greater costs. External

Table 9. Chemicals Not Detected in Any Samples.

Category	Chemical	
PCBs	PCB-161	
Organophosphate Pesticides	Chlorpyrifos Diazinon Disulfoton Disulfoton sulfone Ethion	Ethyl parathion Paraoxon Terbufos Terbufos sulfone
PAHs	Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(ghi)perylene Benzo(j)fluoranthene	Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Fluoranthene Fluorene Indeno (1,2,3-cd) pyrene Perylene Phenanthrene
Other Semivolatile Organic Chemicals	1,2,4,5-Tetrachlorobenzene 1,2,4-Trichlorobenzene 1,2-Dichlorobenzene 1,3-Dichlorobenzene 1,4-Dichlorobenzene 2,4,5-Trichlorophenol 2,4,6-Tris(1,1-dimethylethyl) phenol 3,3'-dichlorobenzidine 4,4'-Methylenebis (2-chloroaniline)	4-Bromophenyl phenyl ether Diethylstilbestrol Hexachlorobenzene Hexachlorobutadiene Nitrobenzene Pentachlorobenzene Pentachlorophenol Tetrabromobisphenol A

peer reviewers of the study design identified analytical methods with lower detection limits that were available for some of the semivolatile organic chemicals, including PAHs and Tetrabromobisphenol A (a chemical linked to endocrine disruption). EPA did not use these methods in the study due to resource constraints. However, applying methods with lower detection limits may have produced different results.

3.3 Rarely-detected Chemicals

Thirty-four target chemicals occurred infrequently in the fish tissue samples (excluding individual congeners or isomers of summed chemicals). Most of these chemicals were either organochlorine pesticides or semivolatile organic compounds. Tables 10 and 11 provide a list of these chemicals and their frequency of occurrence for predator samples and bottom-dweller samples, respectively. The tables present frequency of occurrence for the chemical groups as a percentage of total sampling locations. These percentages are divided into four intervals for predator samples (<1%, 1–5%, 5–10%, 10–15%) and six intervals for bottom-dweller samples (<1%, 1–5%, 5–10%, 10–15%, 15–20%, and 20–35%).

Thirty-two of the 34 rarely-detected chemicals occurred in the predator samples, including three forms of arsenic, 24 organochlorine pesticides, and five semivolatile organic compounds. Total inorganic arsenic and DMA (an organic arsenic compound) occurred in predator samples at less than 1% of the sampling sites, while MMA (another form of organic arsenic found only in predators) occurred at less than 5% of the sites. Twenty-two of the organochlorine pesticides were detected in predator samples at less than 10% of the sites, and eight of these pesticides were found at less than 1% of the sites. The two remaining pesticides, kepone and pentachloroanisole, were both detected at 12% of the sites. Three semivolatile organic compounds occurred in predator samples at less than 1% of the sites, including nonylphenol, pyrene, and a phthalate. Two other phthalates, bis(2-ethylhexyl) phthalate and di-n-butyl phthalate, were detected in predator samples at 1% and 7% of the sites, respectively.

Thirty-three of the 34 rarely-detected chemicals occurred in the bottom-dweller samples, including two forms of arsenic, 25 organochlorine pesticides, and six semivolatile organic compounds. Three of these chemicals were found only in bottom dwellers: naphthalene, phenol, and toxaphene. The other rarely-detected chemicals generally occurred more frequently in the bottom-dweller samples than in the predator samples. Total inorganic arsenic was detected in bottom-dweller samples at 9% of the sampling locations, and DMA was detected at less than 5% of the locations. Nineteen of the organochlorine pesticides were found in bottom dwellers at less than 10% of the locations, and three pesticides were present at 10% to 20% of the locations. The other three pesticides were detected in bottom-dweller samples at more than 20% of the sampling sites. Kepone occurred in bottom dwellers at 26% of the sites, while pentachloroanisole and trifluralin occurred at 27% and 32% of the sites, respectively. Four semivolatile organic chemicals were detected in bottom dwellers at less than 1% of the sites. Two remaining phthalates, bis (2-ethylhexy1) phthalate and di-n-butyl phthalate, were present in bottom-dweller samples at 3% and 7% of the sites, respectively.

Table 10. Infrequent Chemical Occurrences in Predators (Fillets).

Chemical Group	Percentage of Total Sampling Locations			
	<1%	1–5%	5–10%	10–15%
Metals	Arsenic (total inorganic) Dimethylarsinic acid (DMA)	Monomethylarsonic acid (MMA)		
Organochlorine Pesticides	Endosulfan sulfate Endrin Pendimethalin Aldrin Permethrin, cis- Permethrin, trans- Hexachlorocyclohexane (BHC), alpha- Hexachlorocyclohexane (BHC), delta-	Dicofol Endosulfan (total) Ethalfluralin Heptachlor Heptachlor epoxide Isodrin Methoxychlor Mirex Octachlorostyren	Dieldrin Hexachlorocyclohexane (BHC), beta- Hexachlorocyclohexane (BHC), gamma- Pentachloronitrobenzene Trifluralin	Kepone (12%) Pentachloroanisole (12%)
Semivolatile Organic Chemicals	4-Nonylphenol Butyl benzyl phthalate Pyrene	Bis (2-ethylhexyl) phthalate	Di-n-butyl phthalate	

Table 11. Infrequent Chemical Occurrences in Bottom Dwellers (Whole Bodies).

Chemical Group	Percentage of Total Sampling Locations					
	<1%	1–5%	5–10%	10–15%	15–20%	20–35%
Metals		Dimethylarsinic acid (DMA)	Arsenic (total inorganic)			
Organochlorine Pesticides	Toxaphene	Aldrin Dicofol Endosulfan (total) Endosulfan sulfate Endrin Hexachlorocyclohexane (BHC), alpha- Hexachlorocyclohexane (BHC), delta- Isodrin Methoxychlor Pendimethalin Permethrin, trans- Octachlorostyrene	Heptachlor Heptachlor epoxide Hexachlorocyclohexane (BHC), beta- Hexachlorocyclohexane (BHC), gamma- Mirex Permethrin, cis-	Pentachloronitro-benzene	Ethalfluralin Dieldrin	Kepone (26%) Pentachloroanisole (27%) Trifluralin (32%)
Semivolatile Organic Chemicals	4-Nonylphenol Butyl benzyl phthalate Naphthalene Phenol	Bis(2-ethylhexyl) phthalate	Di-n-butyl phthalate			

3.4 Commonly-detected Chemicals

3.4.1 Mercury

Mercury Overview

Mercury is widely distributed in the environment due to both natural and anthropogenic processes (USEPA 2000e). A major source of atmospheric mercury is the natural degassing of the earth's crust; however, mercury releases are also attributable to anthropogenic sources such as mining and smelting, industrial processes, and the combustion of fossil fuels (ATSDR 1999). In the United States, primary sources of mercury emissions include coal-burning power plants, hazardous waste incineration, chlorine production, and mercury product breakage and spillage (USEPA 2001a). Mercury is generally released as elemental mercury or divalent mercury, but it may form mercury compounds through chemical processes in the air, soil, and water (ATSDR 1999). In the aquatic environment, microorganisms convert deposited (inorganic) mercury to toxic methylmercury that accumulates in fish, shellfish, and animals that eat fish. Nearly all fish and shellfish contain traces of mercury (USEPA 2005c), and methylmercury in fish is known to bind to amino acids in fish muscle tissue (USEPA 2000e). Generally, the amount of mercury in fish tissue increases with fish age and size (USEPA 2000e). Mercury accumulation varies among fish species; however, piscivorous (fish-eating) species typically accumulate higher concentrations of mercury than non-piscivorous species.

Mercury Fish Advisory Information

According to EPA's 2008 Biennial National Listing of Fish Advisories (USEPA 2009), fish consumption advisories involving mercury account for 80% of all advisories in effect during 2008. In 2008, a total of 16,808,032 lake acres (representing 40% of the Nation's total lake acres) were under advisory for mercury in the United States. ***Mercury is highlighted in this report as a chemical of special interest because mercury advisories are widespread, and all fish samples collected for this study contained mercury at concentrations above the quantitation limit.***

Mercury Analytical Notes and Human Health Thresholds

All National Lake Fish Tissue Study samples were analyzed for total mercury using Method 1631B. EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1, Third Edition* (USEPA 2000d) recommends monitoring for total mercury concentrations (rather than methylmercury) in state fish contaminant monitoring programs. EPA also recommends applying the conservative assumption that all mercury is present in fish tissue as methylmercury in order to be most protective of human health (USEPA 2006a). EPA's tissue-based criterion for methylmercury was applied to predator (fillet) mercury results to identify the number (and percentage) of the sampled population of the Nation's lakes that exceed this human health screening value. The *Water Quality Criterion for the Protection of Human Health: Methylmercury* (USEPA 2001b) regulations identified a fish tissue-based criterion of 0.3 mg methylmercury per kg (300 ppb) of fish tissue (wet weight). This represents the concentration in fish tissue that should not be exceeded based on a total consumption-weighted rate of 0.0175 kg of fish/day (assuming a human adult body weight default value of 70 kg and a reference dose of 0.0001 mg/kg-day).

National Mercury Results

Mercury was detected in all predator and bottom-dweller composite samples collected for this study at concentrations above the quantitation limit of 2 ng/g (ppb). Mercury tissue concentrations are reported as percentiles, including the median concentration (or 50th percentile), for each composite type in Tables 12 and 13. Concentrations in predators ranged from 23 ppb to a maximum of 6,605 ppb, and the median concentration was 285 ppb (Figure 4). Mercury concentrations in bottom dwellers were generally lower than concentrations for predators. This is consistent with the findings of other studies in that piscivorous predator species typically accumulate higher concentrations of mercury than non-predators (USEPA 2000e). Concentrations in bottom-dweller composites ranged from 5 ppb to a maximum of 596 ppb, with a median concentration of 69 ppb. The mean mercury concentration was 352 ppb in predator composite samples and 96 ppb in bottom-dweller composite samples. National means were calculated for mercury only. A statistically valid mean could be calculated for mercury because the chemical was found in every sample above the quantitation limit.

Mercury Detections

- Mercury was detected in 100% of predator and bottom-dweller composite samples.
- The mean mercury concentration was 352 ppb in predator composite samples and 96 ppb in bottom-dweller composite samples.

Table 12. **Percentiles for Mercury Concentrations in Predator Samples.**

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	59.17	89.33	176.67	284.60	432.08	561.79	833.41
Lower Confidence Bound (95%) (ppb)	36.39	70.88	154.20	241.63	386.94	532.10	634.69
Upper Confidence Bound (95%) (ppb)	87.06	117.38	202.19	313.52	481.77	745.41	1018.68
Maximum Amount Detected	6605 ppb						

Table 13. **Percentiles for Mercury Concentrations in Bottom-dweller Samples.**

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	18.61	20.10	39.27	68.56	124.17	219.58	247.31
Lower Confidence Bound (95%) (ppb)	16.26	18.66	35.69	52.61	109.46	154.05	221.48
Upper Confidence Bound (95%) (ppb)	18.87	27.41	42.72	85.17	135.87	247.70	380.89
Maximum Amount Detected	596 ppb						

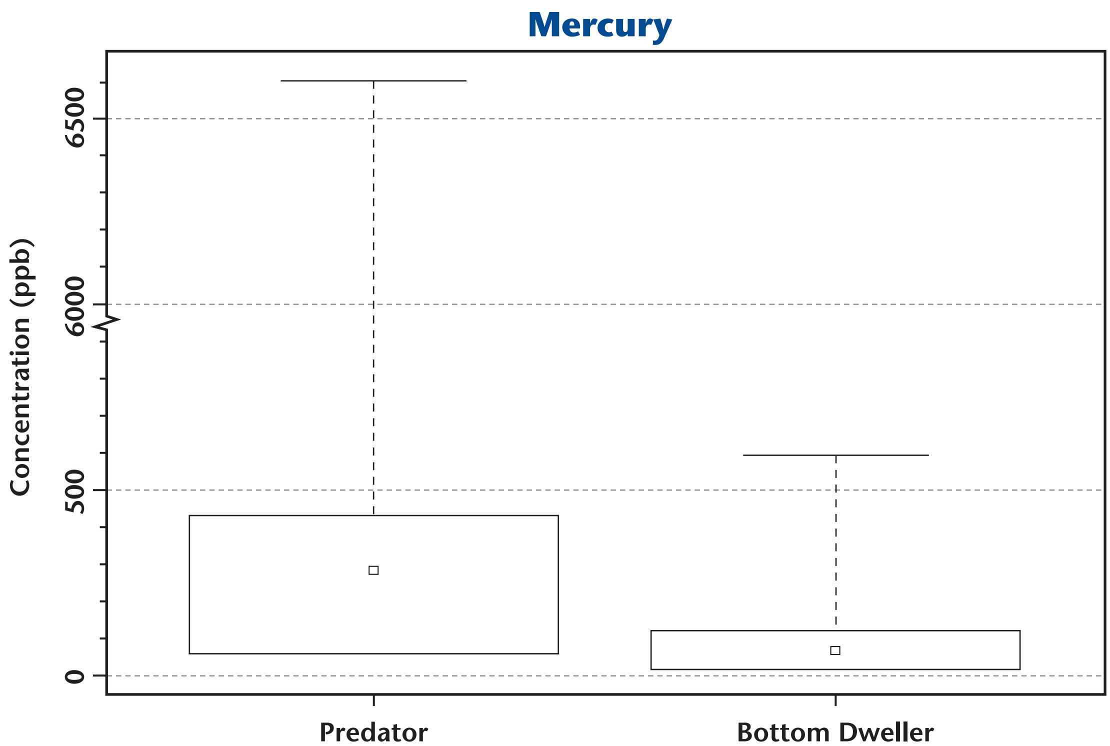


Figure 4. Box-and-whisker plot of mercury concentrations in predator and bottom-dweller samples. (The small box denotes the median or 50th percentile, the large box encloses the data between the 25th and 75th percentiles, and the whiskers indicate minimum and maximum values.)

Prevalence of Mercury in the Sampled Population of Lakes

Cumulative distribution function (CDF) graphs (Figures 5 and 6) are used to illustrate the mercury concentrations that correspond to the percentage and number of the sampled population of lakes. For predator results, the human health screening value is overlaid on the CDF to identify the number and percentage of lakes with fish tissue mercury concentrations that are above or below the criterion. The percentage of lakes below this threshold can be read directly from the graph, while the percentage of lakes above this threshold can be derived by subtracting the percentage of lakes below the threshold from 100%. The CDF (Figure 5) shows that edible portions (fillets) of predators in 48.8% of the sampled population of lakes had tissue concentrations that exceeded the 300 ppb human health screening value for mercury, representing a total of 36,422 lakes nationwide.

Prevalence of Mercury in Predators

- Mercury concentrations exceeded the human health screening value of 300 ppb in 36,422 of the Nation's lakes (48.8% of the sampled population).

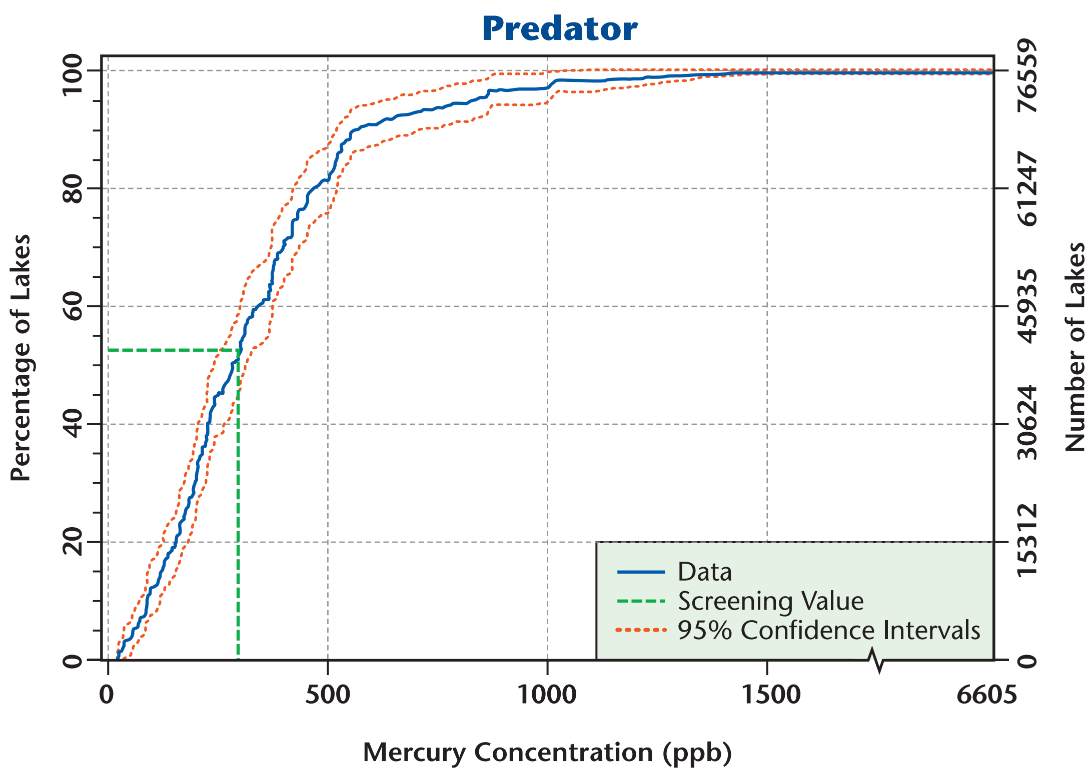


Figure 5. Cumulative distribution function of mercury concentrations in predator samples.

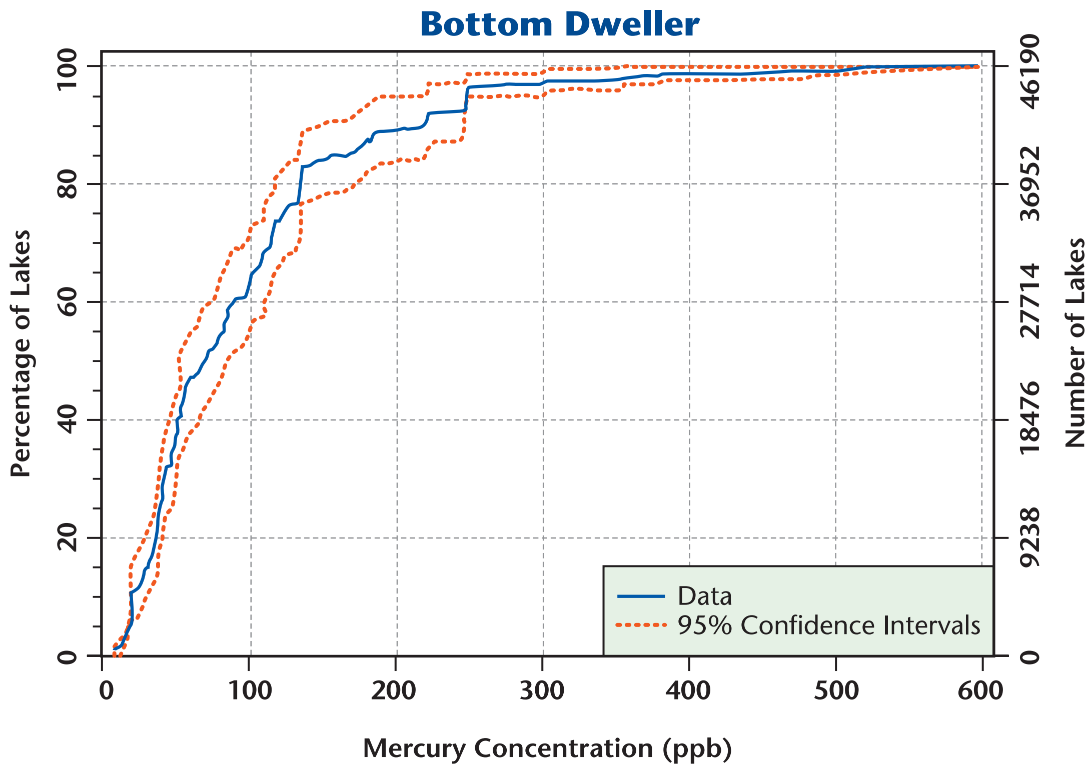


Figure 6. Cumulative distribution function of mercury concentrations in bottom-dweller samples.

For more information on mercury, visit the following websites:

http://www.epa.gov/waterscience/fishadvice/advice.html

http://epa.gov/waterscience/fish/advisories/index.html

http://www.epa.gov/waterscience/fishadvice/mercupd.pdf

http://www.epa.gov/mercury/effects.htm

http://www.epa.gov/mercury/about.htm

http://www.atsdr.cdc.gov/tfacts46.html

3.4.2 Total Polychlorinated Biphenyls (PCBs)

PCB Overview

Polychlorinated biphenyls (PCBs) are manufactured chemicals that exist as mixtures of up to 209 individual compounds known as congeners. Although they were once utilized extensively by industry, the production and use of PCBs was banned in the United States in 1979 because of evidence that they accumulate in the environment and can pose human health risks. Mixtures of various PCB congeners were developed for commercial use in the United States under the trade name Aroclor (ATSDR 2000). The Aroclors were labeled on the basis of their chlorine content, e.g., Aroclor 1254 has an average chlorine content of 54% by weight (USEPA 2000d). PCBs were never intended to be released into the environment, but rather were manufactured to be used in closed industrial systems. Their thermal stability, fire resistance, and solubility in organic compounds led to their use as coolants or lubricants. PCBs were included as insulating fluids in electrical transformers and capacitors, as fluids in vacuum pumps and compressors, and as hydraulic fluids.

Individual PCB congeners have widely varying potencies for producing a variety of adverse biological effects. PCB mixtures have been shown to cause adverse developmental effects in experimental animals (ATSDR 2000), and EPA has classified PCBs as probable human carcinogens (USEPA 2000e). PCBs can still be released into the air, soil, or water from illegal or improper disposal of industrial wastes, leaks from old electrical transformers or hazardous waste sites, and burning of some wastes in incinerators (ATSDR 2000). PCBs are extremely persistent in the environment, and they can be widely dispersed by atmospheric transport. After deposition on land, they bind strongly to soil particles. In water, some PCBs may remain dissolved, but most partition into bottom sediments and adhere to organic particles. PCBs bioaccumulate through the food chain, and humans can be exposed to elevated concentrations of PCBs through fish consumption.

PCB Fish Advisory Information

EPA's 2008 Biennial National Listing of Fish Advisories (USEPA 2009) identified 1,025 fish consumption advisories for PCBs in 2008. Altogether, the PCB advisories affect 6,049,506 lake acres (representing nearly 15% of the Nation's total lake acres). ***PCBs are highlighted in this report as a chemical group of special interest because PCB advisories continue to be widespread, and because they were detected in 100% of all samples collected for this study.***

PCB Analytical Notes and Human Health Thresholds

All National Lake Fish Tissue Study samples were analyzed for the full complement of 209 congeners, which produced 159 congener measurements. These measurements included results for 126 individual congeners and 33 groups of 2 to 6 congeners. For a complete listing of the individual congeners and congener groups, refer to the target chemical list in Appendix B. PCBs were analyzed using Method 1668A, and results are presented as the sum of congeners following recommendations in EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1, Third Edition* (USEPA 2000d).

EPA recommends the reporting of total PCB concentrations (calculated as the sum of the concentrations of the congeners or homologues, i.e., co-eluting groups), since Aroclor analysis does not adequately represent bioconcentrated PCB mixtures found in fish tissue. An EPA risk-based tissue residue health endpoint for total PCBs was applied to predator (fillet) PCB results to identify the number (and percentage) of the sampled population of the Nation's lakes that exceed this human health screening value. Table 4-24 in EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* (USEPA 2000e) lists a cancer health endpoint of 0.012 ppm (12 ppb) PCBs (wet weight) in fish tissue. This threshold represents the fish tissue concentration that should not be exceeded based on a total consumption-weighted rate of four 8-ounce (0.227 kg) fish meals per month (assuming a human adult body weight default value of 70 kg, a cancer slope factor of $2(mg/kg\text{-}d)^{-1}$, and a 1 in 100,000 risk level) (USEPA 2000e).

National PCB Results

PCBs were detected in 100% of both predator and bottom-dweller composite samples collected for the National Lake Fish Tissue Study. PCB tissue concentrations are reported as percentiles, including the median concentration (or 50^{th} percentile), for each composite type in Tables 14 and 15. Total PCB concentrations (sum of the congeners) in predators ranged from 0.061 ppb to 704.92 ppb, and the median concentration was 2.16 ppb (Figure 7). Concentrations in bottom dwellers were generally higher than levels detected in predators. This may be linked to the lipophilic nature of PCBs, which tend to accumulate in fatty tissues and organs (USEPA 2000e). Bottom-dweller results ranged from 0.598 ppb to 1,266.25 ppb, and the median PCB concentration in bottom-dweller composites was 13.90 ppb. [Results for individual PCB congeners are reported in Appendix E (percentiles) and Appendix F (occurrence)].

PCB Detections

- PCBs were detected in 100% of predator and bottom-dweller composite samples.

Table 14. Percentiles for PCB Concentrations in Predator Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	0.35	0.49	1.00	2.16	8.13	18.17	33.16
Lower Confidence Bound (95%) (ppb)	0.19	0.35	0.89	1.65	5.26	16.51	23.43
Upper Confidence Bound (95%) (ppb)	0.41	0.64	1.20	2.62	10.30	30.10	59.60
Maximum Amount Detected	704.92 ppb						

Table 15. Percentiles for PCB Concentrations in Bottom-dweller Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	1.58	2.31	5.15	13.90	70.87	130.79	198.32
Lower Confidence Bound (95%) (ppb)	1.50	1.58	3.87	9.05	41.95	113.70	133.83
Upper Confidence Bound (95%) (ppb)	2.20	3.24	5.75	20.29	92.07	196.97	435.57
Maximum Amount Detected	1266.25 ppb						

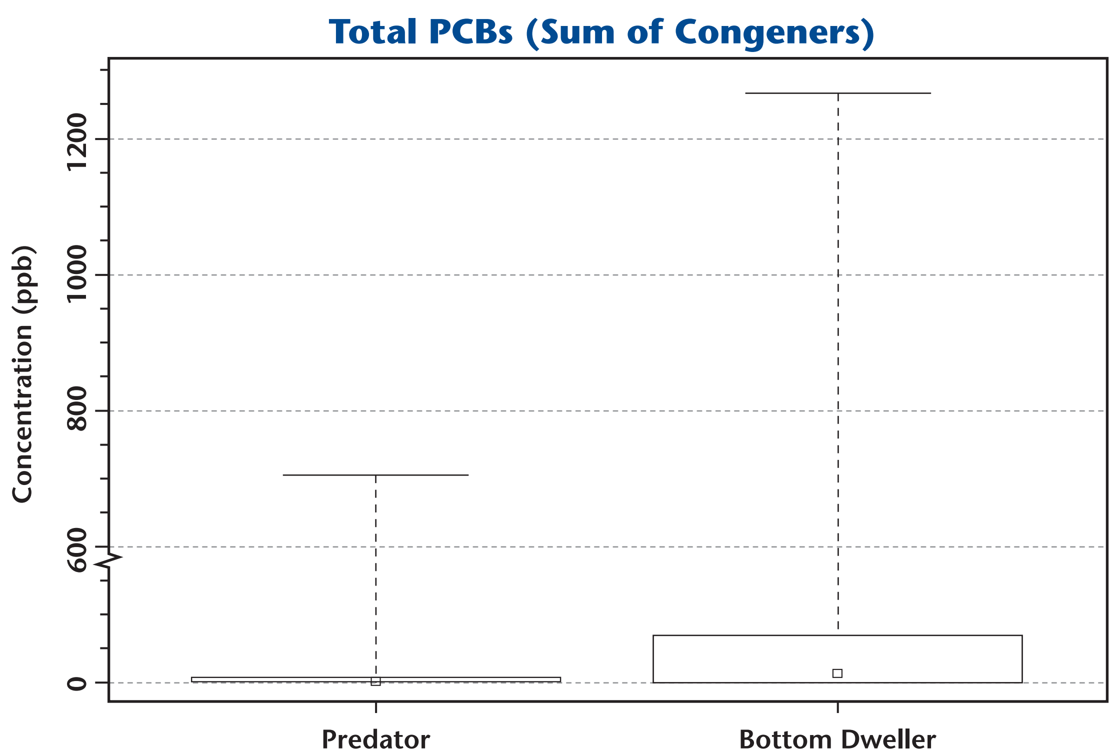


Figure 7. Box-and-whisker plot of PCB (sum of congeners) concentrations in predator and bottom-dweller samples. (The small box denotes the median or 50th percentile, the large box encloses data between the 25th and 75th percentiles, and the whiskers indicate minimum and maximum values.)

Prevalence of PCBs in the Sampled Population of Lakes

Cumulative distribution function (CDF) results for PCBs are presented in Figures 8 and 9. The CDF graphs depict PCB concentrations that correspond to the percentage and/or number of the sampled population of lakes. The human health screening value is plotted on the predator composite CDF to delineate between the number and percentage of lakes with fish tissue total PCB concentrations that are above or below the human health endpoint. The percentage of lakes below this threshold can be read directly from the graph, while the percentage of lakes above this threshold can be derived by subtracting the percentage of lakes below the threshold from 100%. Figure 8 indicates that edible portions (fillets) of predators in 16.8% of the sampled population of lakes had total PCB tissue concentrations that exceeded the 12 ppb human health screening value, representing a total of 12,886 lakes nationwide.

Prevalence of PCBs in Predators

- Total PCB concentrations exceeded the human health screening value of 12 ppb in 12,886 of the Nation's lakes (16.8% of the sampled population).

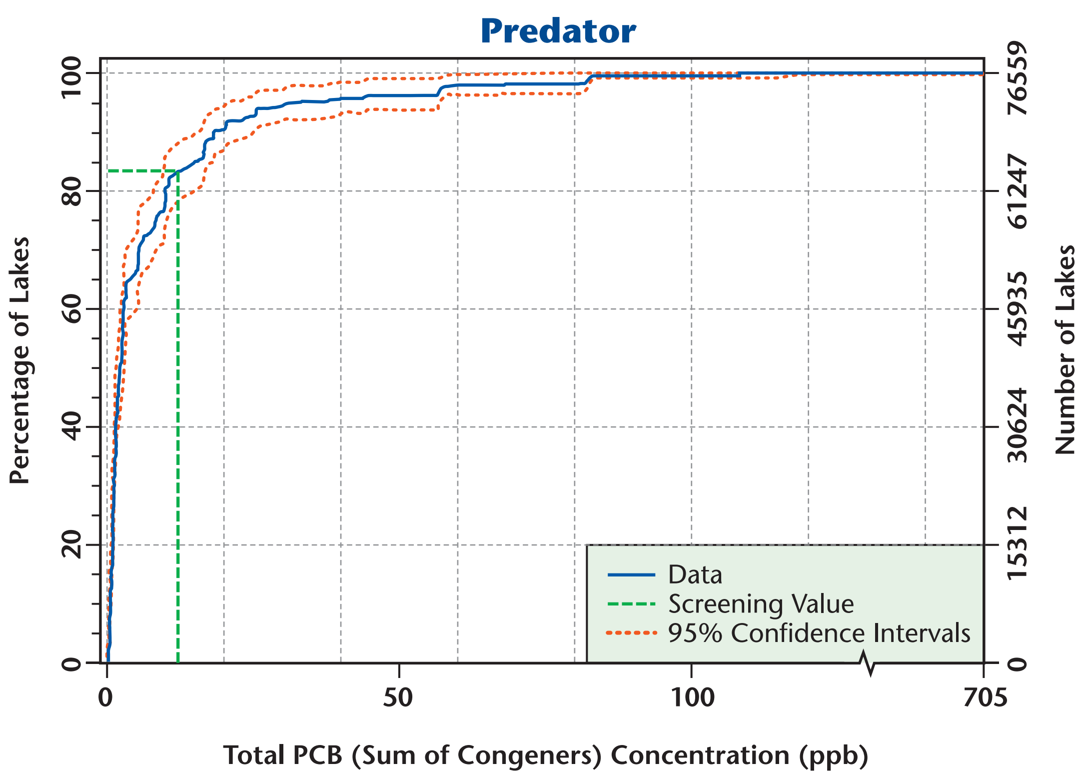


Figure 8. Cumulative distribution function of total PCB concentrations in predator samples.

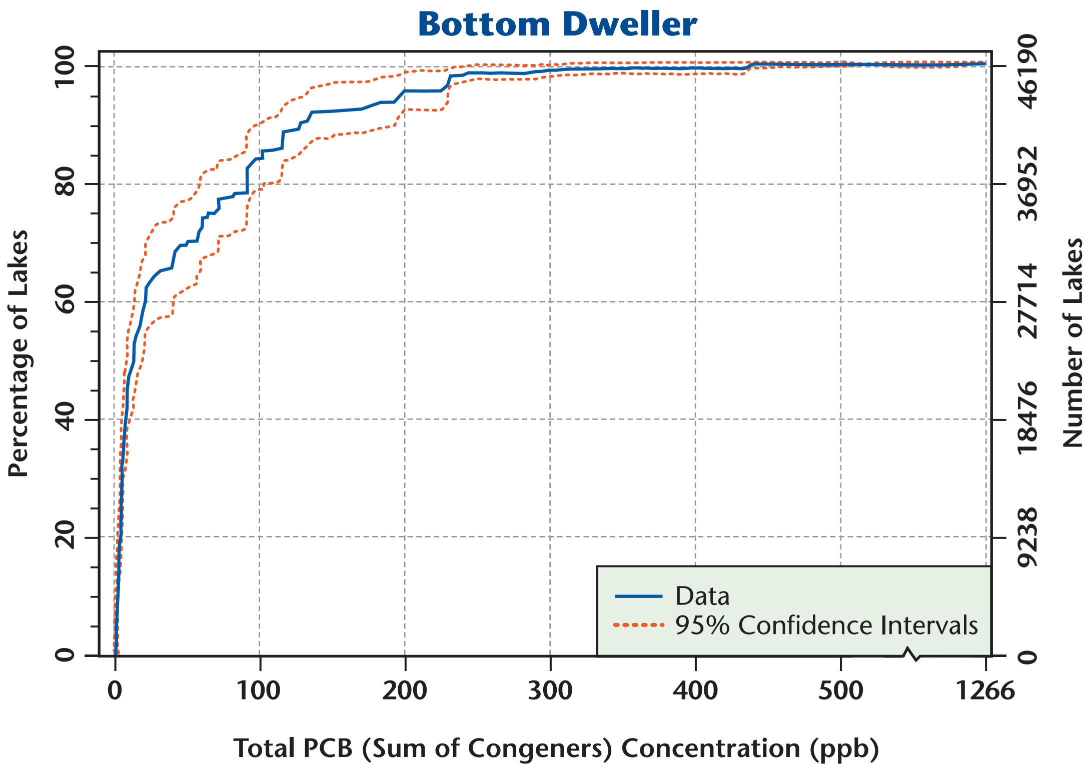


Figure 9. Cumulative distribution function of total PCB concentrations in bottom-dweller samples.

For more information on PCBs, visit the following websites:

http://www.epa.gov/pbt/pubs/pcbs.htm

http://www.atsdr.cdc.gov/tfacts17.html

3.4.3 Total Dioxins and Furans

Dioxin and Furan Overview

Dioxins and furans commonly refer to a group of synthetic organic chemicals that includes 210 structurally-related chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans (USEPA 2000e). The generic term dioxin is used here to refer to the aggregate of this group of compounds. Dioxins are not produced commercially, but rather are unintentional byproducts of combustion and certain industrial chemical processes. They may be formed during the chlorine bleaching process at pulp and paper mills, during chlorination by water treatment plants, or during the manufacture of certain organic chemicals. Dioxins can be released in emissions from solid waste and industrial incinerators (ATSDR 1998). Dioxin levels in the environment have been declining since the early 1970s; however, they are widely distributed in low concentrations, and current exposure levels still remain a concern (USEPA 2006b). Extremely low doses of the homologue 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) have been found to elicit a wide range of toxic responses in animals (USEPA 2000d). Concerns over the health effects of 2,3,7,8-TCDD continue because of its persistence in the environment and its potential to bioaccumulate (USEPA 2000d). Dioxins have been characterized by EPA as likely human carcinogens, and are anticipated to increase the risk of cancer even at low background levels of exposure (USEPA 2006b). When released into the atmosphere, dioxins may be transported long distances. When discharged to surface water, some dioxins adhere to suspended solids and bottom sediments. Dioxins can be absorbed by fish through the gastrointestinal tract and skin, build up in fat and the liver, and bioaccumulate through the food chain (ATSDR 1998).

Dioxin and Furan Fish Advisory Information

EPA's 2008 Biennial National Listing of Fish Advisories (USEPA 2009) lists 123 active fish consumption advisories involving dioxins in the United States. In 2008, a total of 35,400 lake acres or 0.1% of the Nation's total lake acres were under a dioxin advisory. The geographic extent of dioxin advisories is limited compared to that for the other four commonly-detected chemicals. This may be due in part to the relatively limited monitoring of dioxins throughout the country because of the high cost of analysis (USEPA 2007). ***Dioxins are highlighted in this report as a chemical group of special interest because a number of advisories are still in effect, and because they were detected in 89% of all samples collected for this study.***

Dioxin and Furan Analytical Notes and Human Health Thresholds

All National Lake Fish Tissue Study samples were analyzed for 17 dioxins and furans using Method 1613B. Results were reported as toxicity-weighted total concentrations derived by multiplying results for each chemical by an individual toxicity equivalency factor (TEF), then summing the 17 results. This sum is referred to as the total toxicity equivalency or total TEQ (Section 3.1.3). EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* (USEPA 2000e) recommends analyzing the 17 dioxins and furans together as a simplifying and interim approach until further guidance is available on this chemical group. An EPA risk-based tissue residue health endpoint for dioxins and furans was applied to predator (fillet) dioxin and furan results to identify the number (and percent) of the sampled population of the Nation's lakes that exceed this human health screening value. This same screening value was applied to results for the 12 coplanar PCB congeners, as recommended by EPA (USEPA 2000d). EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* (USEPA 2000e) identified a cancer health endpoint of 0.15 ppt for dioxins and furans (TEQ-wet weight) in fish tissue. This represents the concentration in fish tissue that should not be exceeded based on a total consumption-weighted rate of four 8-ounce (0.227 kg) fish meals per month (assuming a human adult body weight default value of 70 kg, a cancer slope factor of 1.56×10^{-5} $[mg/kg\text{-}d]^{-1}$, and a 1 in 100,000 risk level) (USEPA 2000e).

National Dioxin and Furan Results

Dioxin and Furan Detections

- Dioxins and furans were detected in 81% of predator and 99% of bottom-dweller composite samples.

Dioxins and furans were detected in 395 (of 486) predator and 393 (of 395) bottom-dweller samples collected for the National Lake Fish Tissue Study. Dioxin and furan tissue concentrations are reported as percentiles, including the median concentration (or 50th percentile), for each composite type in Tables 16 and 17. Concentrations in predators ranged from 0.00002 ppt [TEQ] to 7.545 ppt [TEQ], and the median concentration was 0.006 ppt [TEQ] (Figure 10). Dioxin and furan concentrations in bottom-dwellers (Figure 10) were generally higher than concentrations for predators, which may be linked to their lipophilic nature. Dioxins tend to accumulate in fat and the liver (USEPA 2000e). Concentrations in bottom-dwellers ranged from 0.0008 ppt [TEQ] to a maximum of 23.814 ppt [TEQ], and the median concentration was 0.406 ppt [TEQ]. [Appendix E and Appendix F present percentiles and occurrence data for the 17 individual dioxins and furans.]

Results for the 12 coplanar ("dioxin-like") PCBs were derived by multiplying an individual toxicity equivalency factor (TEF) by the concentrations of each of the 12 congeners. Predator results ranged from 0.0003 ppt [TEQ] to 38.666 ppt [TEQ], with a median concentration of 0.030 ppt [TEQ]. Bottom dweller results ranged from 0.006 ppt [TEQ] to 20.018 ppt [TEQ], with a median concentration of 0.154 ppt [TEQ]. Results for Total TEQ, which includes dioxins and furans plus the 12 coplanar PCBs, ranged from 0.0003 ppt [TEQ] to 46.211 ppt [TEQ] for predators, with a median concentration of 0.042 ppt [TEQ]. Total TEQ concentrations in bottom dwellers ranged from 0.011 ppt [TEQ] to 27.062 ppt [TEQ], with a median concentration of 0.677 ppt [TEQ]. [Appendix E and Appendix F present percentiles and occurrence data for the TEQ of the 12 coplanar PCBs and Total TEQ of dioxins and furans combined with the coplanar PCBs.]

Table 16. Percentiles for Dioxin and Furan Concentrations (D/F TEQ) in Predator Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppt)	<MDL	<MDL	<MDL	0.006	0.05	0.11	0.32
Lower Confidence Bound (95%) (ppt)	<MDL	<MDL	<MDL	0.004	0.03	0.09	0.14
Upper Confidence Bound (95%) (ppt)	<MDL	<MDL	<MDL	0.008	0.07	0.20	0.70
Maximum Amount Detected	7.545 ppt						

Table 17. Percentiles for Dioxin and Furan Concentrations (D/F TEQ) in Bottom-dweller Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppt)	0.020	0.06	0.16	0.41	1.07	1.77	2.01
Lower Confidence Bound (95%) (ppt)	0.005	0.02	0.13	0.33	0.68	1.49	1.93
Upper Confidence Bound (95%) (ppt)	0.057	0.11	0.22	0.52	1.35	2.00	2.84
Maximum Amount Detected	23.814 ppt						

Table 18. Percentiles for Dioxin, Furan, and Coplanar PCB Concentrations (Total TEQ) in Predator Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppt)	0.004	0.006	0.013	0.042	0.14	0.51	1.24
Lower Confidence Bound (95%) (ppt)	0.002	0.004	0.012	0.035	0.11	0.27	0.87
Upper Confidence Bound (95%) (ppt)	0.006	0.009	0.018	0.077	0.19	1.16	2.20
Maximum Amount Detected	46.211 ppt						

Table 19. Percentiles for Dioxin, Furan, and Coplanar PCB Concentrations (Total TEQ) in Bottom-dweller Samples.

PERCENTILE	5TH	10TH	25TH	50TH	75TH	90TH	95TH
Concentration (ppt)	0.073	0.108	0.291	0.677	2.89	5.30	5.83
Lower Confidence Bound (95%) (ppt)	0.036	0.068	0.195	0.490	2.33	4.59	5.61
Upper Confidence Bound (95%) (ppt)	0.082	0.157	0.362	1.273	4.00	5.83	9.59
Maximum Amount Detected	27.062 ppt						

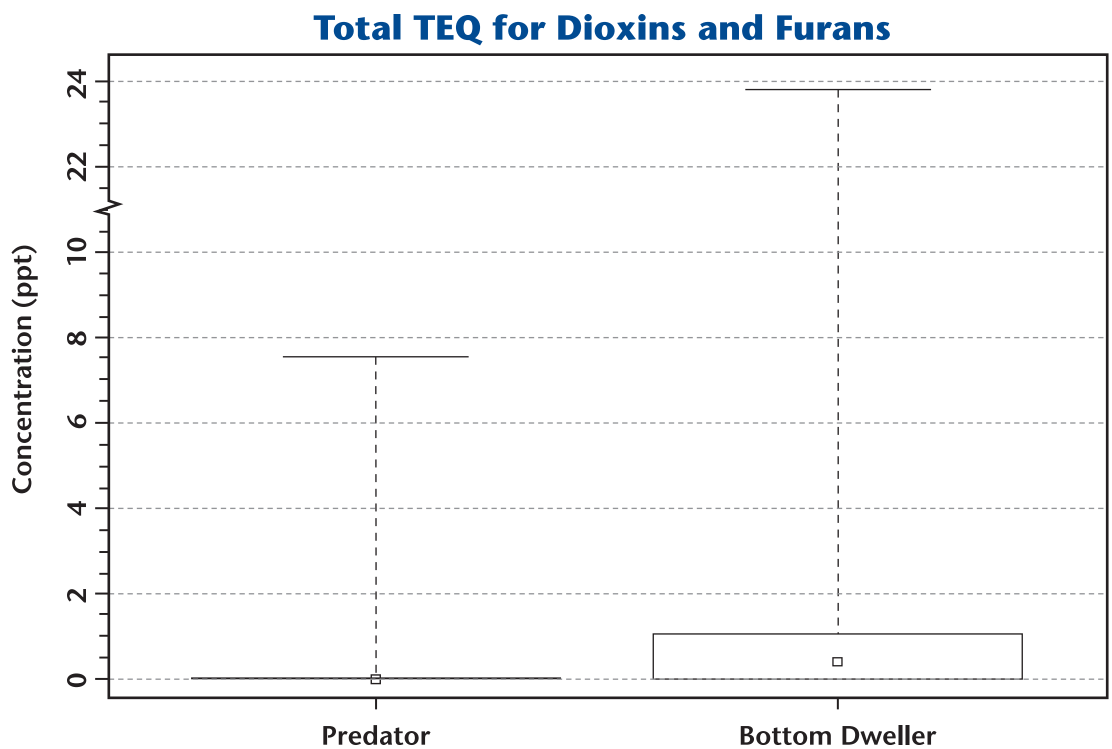


Figure 10. Box-and-whisker plot of total dioxin and furan concentrations in predator and bottom-dweller samples. (The small box denotes the median or 50th percentile, the large box encloses data between the 25th and 75th percentiles, and the whiskers indicate minimum and maximum values.)

Prevalence of Dioxins and Furans in the Sampled Population of Lakes

Cumulative distribution functions (CDFs) (Figures 11 and 12) are used to identify the dioxin and furan concentrations that correspond to the percentage and number of the sampled population of lakes. For predator results, the human health screening value is plotted on the CDF to identify the number and percentage of lakes with fish tissue total dioxin and furan concentrations that are above or below the screening value. The percentage of lakes below this threshold can be read directly from the graph, while the percentage of lakes above this threshold can be derived by subtracting the percentage of lakes below the threshold from 100%. Figure 11 shows that edible portions (fillets) of predators in 7.6% of the sampled population of lakes had tissue concentrations that exceeded the 0.15 ppt [TEQ] human health screening value for dioxins and furans, representing a total of 5,856 lakes nationwide.

Prevalence of Dioxins and Furans in Predators

- Dioxin and furan concentrations exceeded the human health screening value of 0.15 ppt [TEQ] in 5856 of the Nation's lakes (7.6% of the sampled population).

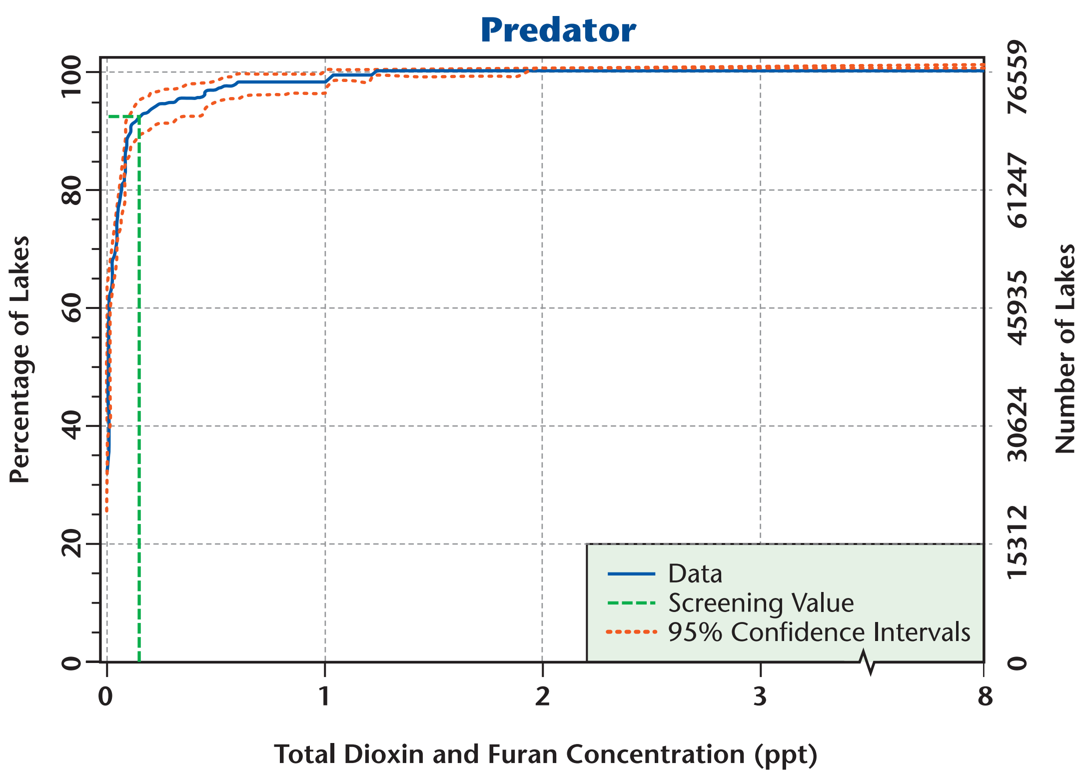


Figure 11. **Cumulative distribution function of total dioxin and furan concentrations in predator samples.**

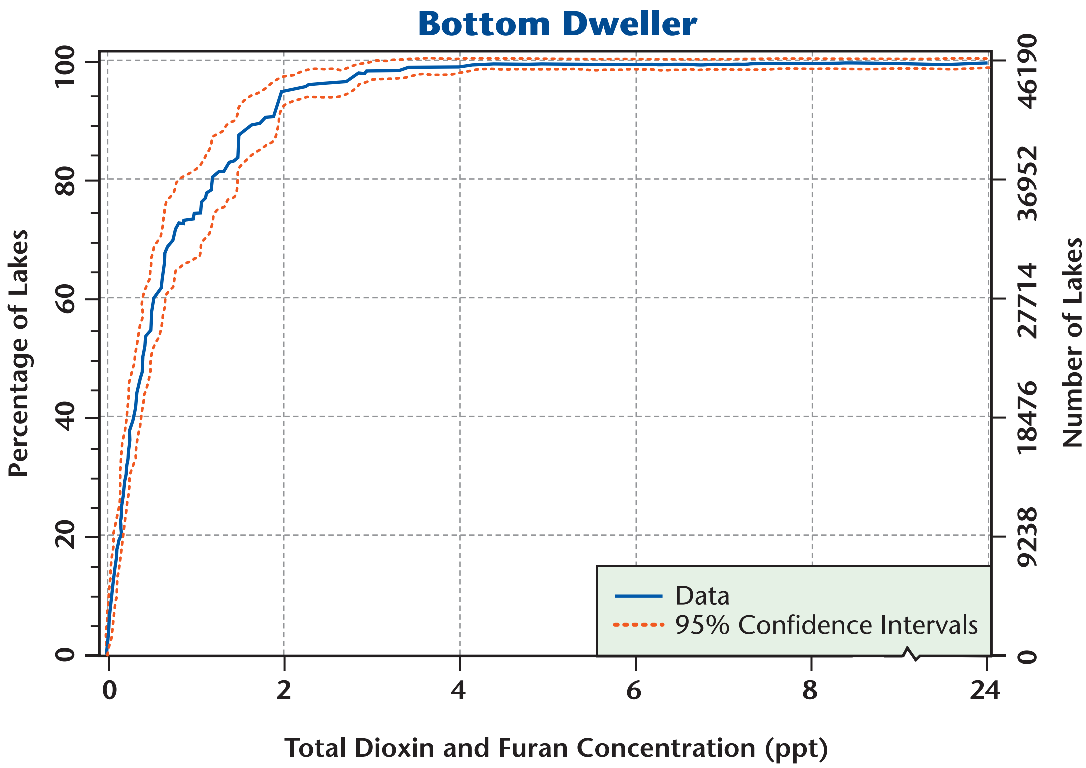


Figure 12. Cumulative distribution function of total dioxin and furan concentrations in bottom-dweller samples.

For more information on dioxin and furans, visit the following websites:

http://www.epa.gov/pbt/pubs/dioxins.htm

http://www.atsdr.cdc.gov/tfacts104.html

http://www.atsdr.cdc.gov/tfacts32.html

3.4.4 Total DDT

DDT Overview

DDT (dichlorodiphenyltrichloroethane) is an organochlorine pesticide that was commonly used to control insects in agricultural applications between the mid-1940s and the early 1970s. Its use was banned in the United States in 1972, primarily due to its toxic effects on wildlife (ATSDR 2002). Limited use of DDT continues throughout the tropics, as a means of controlling insects that carry disease (e.g., malaria) (USEPA 2000e). Commercial DDT preparations often included the DDT metabolites DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane). As a result, fish, wildlife, and humans have been typically exposed to a mixture of DDT, DDE, and DDD. DDT continues to be ubiquitous in the environment due to its widespread use prior to 1972 and its relatively long half-life. It breaks down fairly rapidly in air, but it adheres strongly to soil where its half-life ranges from 2 to 15 years (depending upon soil type) (ATSDR 2002). DDT in soil can enter groundwater and surface waters, and once it reaches aquatic environments, it can build up in fatty tissues of fish, birds, and other animals (USEPA 2000e). DDT and its metabolites continue to persist in the environment, are known to bioaccumulate, and have been classified by EPA as probable human carcinogens (USEPA 2000d).

DDT Fish Advisory Information

Although the use of DDT has been banned since 1972, there were 76 advisories still in effect for DDT (and its degradation products, DDE and DDD) in 2008 (USEPA 2009). These advisories affect 876,520 lake acres and represent 2% of the Nation's total lake acres. ***DDT is highlighted in this report as a chemical of special interest because DDT advisories are in effect in several areas of the country, and because it was detected in 87% of all samples collected for this study.***

DDT Analytical Notes and Human Health Thresholds

Fish, wildlife, and humans are typically exposed to a mixture of DDT, DDE, DDD, and their degradation and metabolic products. EPA recommends reporting total DDT fish tissue results, based on the sum of the 4,4'- and 2,4' isomers of DDT, DDE, and DDD (USEPA 2000e). Fish samples for this study were analyzed for the 4,4'- and 2,4' isomers of DDT, DDE, and DDD using Method 1656A, and those values were summed to provide total DDT results for each sample. (Note that no data for 2,4' isomers of DDT, DDE, and DDD are available for fish samples collected during the first year of the study.) An EPA risk-based tissue residue health endpoint for total DDT was applied to predator (fillet) results to identify the number (and percent) of the sampled population of the Nation's lakes that exceed this human health screening value. EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* (USEPA 2000e) identified a cancer health endpoint of 0.069 ppm (69 ppb) DDT (wet weight) in fish tissue. This represents the concentration in fish tissue that should not be exceeded based on a total consumption-weighted rate of four 8-ounce (0.227 kg) fish meals per month (assuming a human adult body weight default value of 70 kg, a cancer slope factor of 0.34 $[mg/kg\text{-}d]^{-1}$, and a 1 in 100,000 risk level) (USEPA 2000e).

National DDT Results

DDT was detected in 378 (of 486) predator and 388 (of 395) bottom-dweller samples collected for the National Lake Fish Tissue Study. Total DDT tissue concentrations are reported as percentiles, including the median concentration (or 50th percentile), for each composite type in Tables 20 and 21. Total concentrations in predators ranged from 0.77 ppb to 1,481.4 ppb, and the median concentration was 1.47 ppb (Figure 13). Bottom-dweller values were generally higher than concentrations detected in predators. DDT and its analogs are stored in fat, liver, kidney, and brain tissue (USEPA 2000e), which may explain the tendency for higher values in bottom-dweller samples. Total DDT concentrations in bottom-dwellers ranged from 0.82 ppb to 1,760.57 ppb, with a median concentration of 12.68 ppb. [Percentiles and occurrence data for individual DDT isomers are reported in Appendix E and Appendix F.]

DDT Detections

- DDT was detected in 78% of predator and 98% of bottom-dweller composite samples.

Table 20. Percentiles for Total DDT Concentrations in Predator Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	<MDL	<MDL	<MDL	1.47	6.95	19.68	30.57
Lower Confidence Bound (95%) (ppb)	<MDL	<MDL	<MDL	1.29	3.51	15.20	22.05
Upper Confidence Bound (95%) (ppb)	<MDL	<MDL	0.85	2.30	11.48	24.31	70.21
Maximum Amount Detected	1481.40 ppb						

Table 21. Percentiles for Total DDT Concentrations in Bottom-dweller Samples.

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	1.08	1.82	4.23	12.68	35.35	153.92	218.63
Lower Confidence Bound (95%) (ppb)	0.92	1.30	2.72	8.79	30.03	84.15	158.39
Upper Confidence Bound (95%) (ppb)	1.37	2.18	5.33	18.80	57.02	218.67	414.77
Maximum Amount Detected	1760.57 ppb						

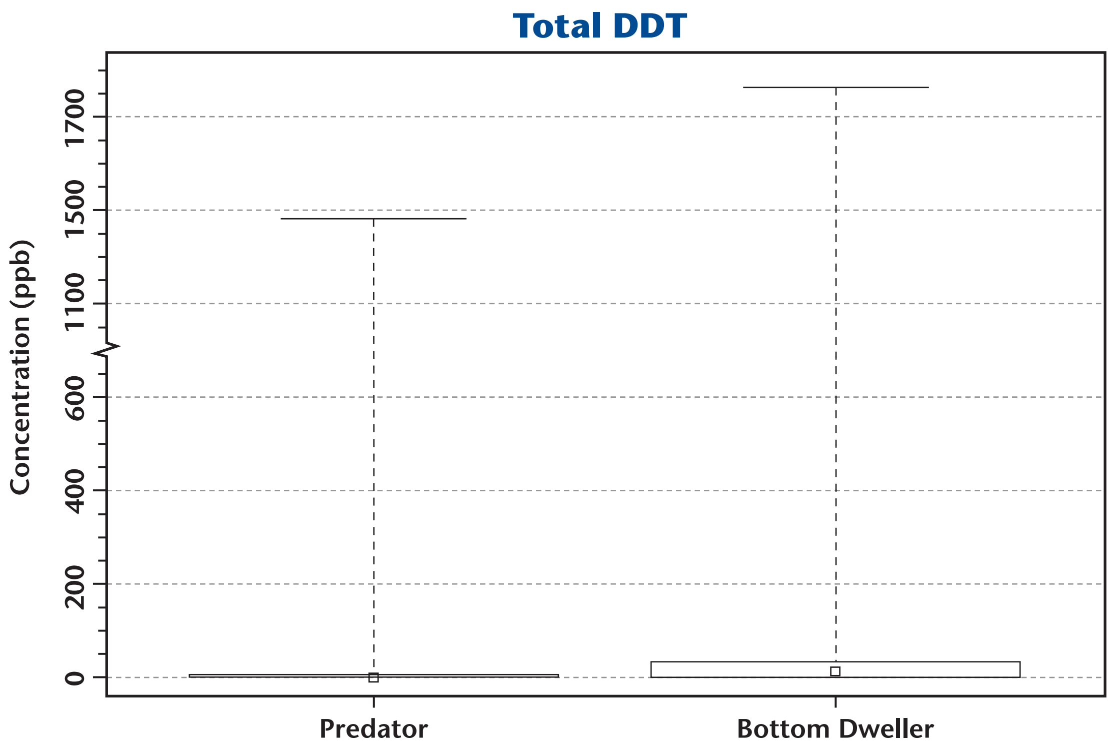


Figure 13. Box-and-whisker plot of total DDT concentrations in predator and bottom-dweller samples. (The small box denotes the median or 50th percentile, the large box encloses data between the 25th and 75th percentiles, and the whiskers indicate minimum and maximum values.)

Prevalence of DDT in the Sampled Population of Lakes

Figures 14 and 15 illustrate the DDT concentrations that correspond to the percentage and number of the sampled population of lakes. For predator results, the human health screening value is plotted on the CDF to identify the number and percentage of lakes with fish tissue total DDT concentrations that are above or below the screening value. The percentage of lakes below this threshold can be read directly from the graph, while the percentage of lakes above this threshold can be derived by subtracting the percentage of lakes below the threshold from 100%. Figure 14 shows that edible portions (fillets) of predators in 1.7% of the sampled population of lakes had tissue concentrations that exceeded the 69 ppb human health screening value for DDT, representing a total of 1,329 lakes nationwide.

Prevalence of DDT in Predators

- DDT concentrations exceeded the human health screening value of 69 ppb in 1329 of the Nation's lakes (1.7% of the sampled population).

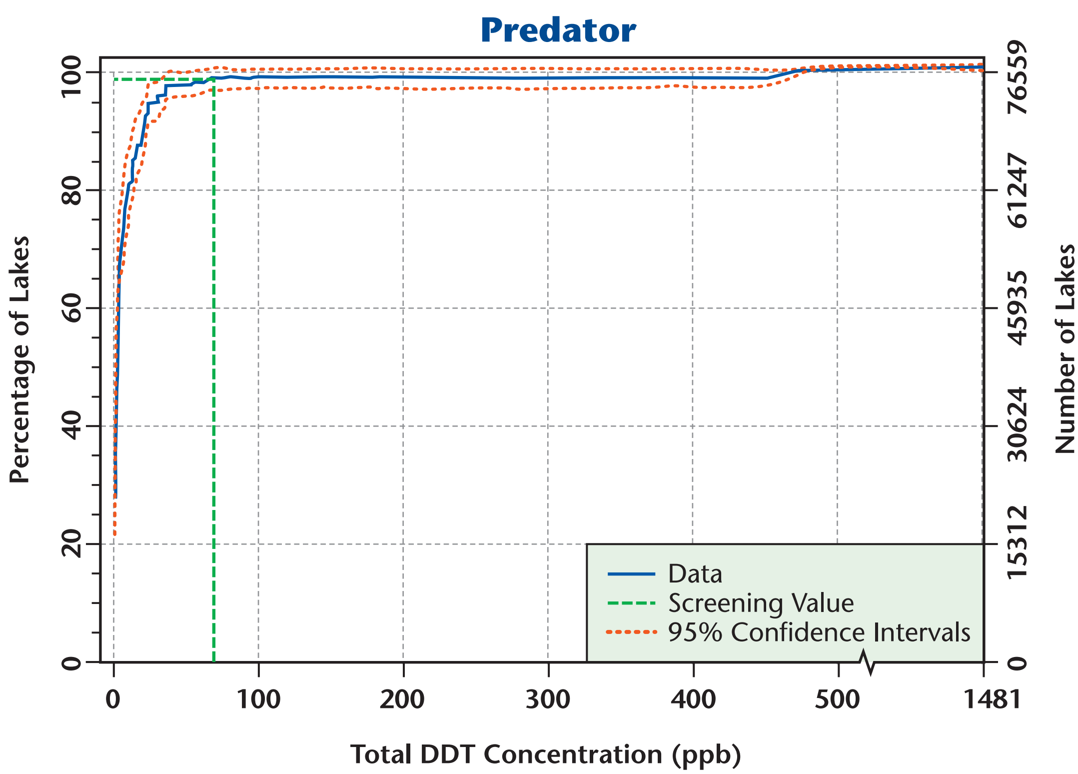


Figure 14. Cumulative distribution function of total DDT concentrations in predator samples.

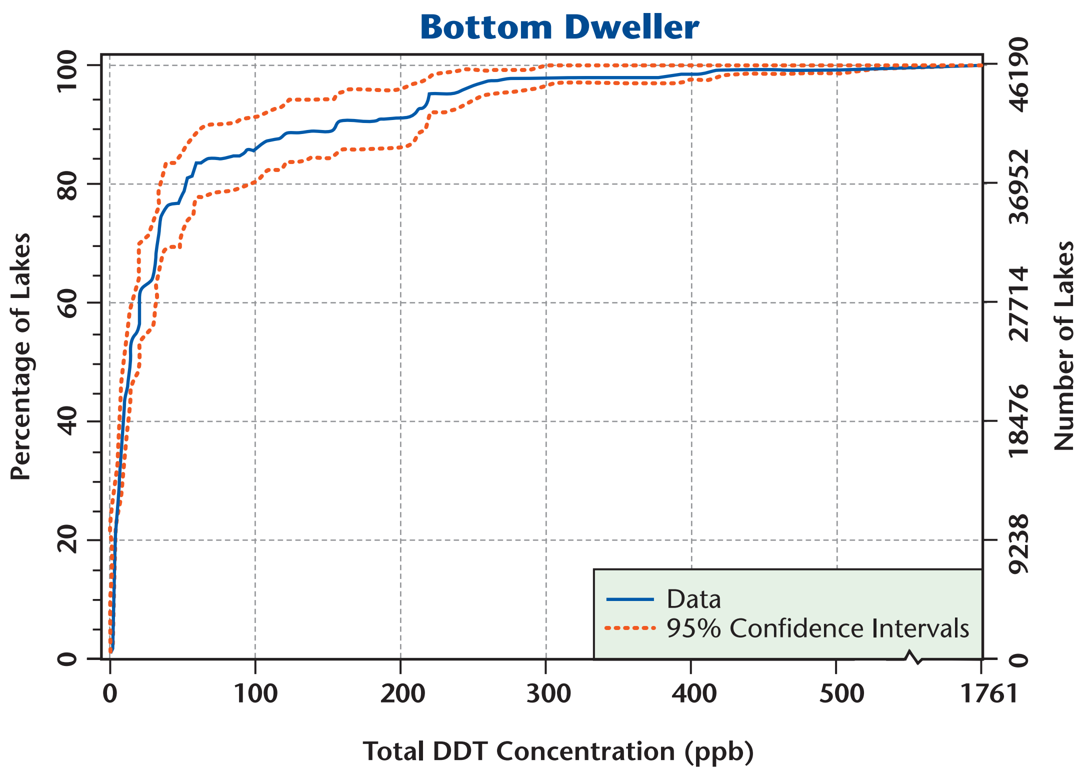


Figure 15. Cumulative distribution function of total DDT concentrations in bottom-dweller samples.

For more information on DDT, visit the following websites:

http://www.epa.gov/pbt/pubs/ddt.htm

http://www.atsdr.cdc.gov/tfacts35.html

3.4.5 Total Chlordane

Chlordane Overview

Chlordane is a multipurpose organochlorine insecticide that has been used extensively in home and agricultural applications in the United States for the control of termites and other insects (USEPA 2000d). It is a manufactured chemical and does not occur naturally in the environment. Chlordane was first introduced in 1947, but most chlordane uses were banned in 1978, and all uses were banned by EPA in 1998 due to human and wildlife exposure concerns (USEPA 2000b). Chlordane is known to be extremely lipid soluble, is moderately to highly toxic, and has been classified as a probable human carcinogen by EPA (IRIS 1998). For the purposes of health advisory development, this organochorine insecticide is considered by EPA to be comprised of the sum of *cis-* and *trans-* isomers of chlordane, *cis-* and *trans-* isomers of nonachlor, and oxychlordane (the major metabolite of chlordane). Most people in the United States have been exposed to low levels of chlordane due to its widespread use (USEPA 2006b). Chlordane can be found in soils surrounding structures where it was applied to control for termites, and it can be transported to soils and waters by atmospheric deposition. It can linger in soils for over 20 years following application or deposition (ATSDR 1994). In the aquatic environment, chlordane is bound to particles in the water column and in substrate sediments. It has been widely detected in freshwater fish (both predators and bottom-feeding species), estuarine and marine fish, and marine bivalves (e.g., clams) at concentrations of human health concern (USEPA 2000d). Because it has a long half-life and it is a bioaccumulative chemical, chlordane continues to be commonly detected in fish in the United States (USEPA 2000b).

Chlordane Fish Advisory Information

According to EPA's 2008 Biennial National Listing of Fish Advisories (USEPA 2009), there are 67 active fish consumption advisories involving chlordane in the United States. In 2008, a total of 842,913 lake acres (representing 2% of the Nation's total lake acres) were under advisory for chlordane. ***Chlordane is highlighted in this report as a chemical of special interest because chlordane advisories remain relatively widespread, and because it was detected in 33% of all fish samples collected for this study.***

Chlordane Analytical Notes and Human Health Thresholds

All National Lake Fish Tissue Study samples were analyzed for *cis*-chlordane, *trans*-chlordane, *cis*-nonachlor, *trans*-nonachlor, and oxychlordane using Method 1656A. Results for these five major degradation products of chlordane were summed to yield values for total chlordane (Section 3.1.3). EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, Third Edition* (USEPA 2000e) recommends monitoring for total chlordane concentrations for fish contaminant and health advisory monitoring. An EPA risk-based tissue residue health endpoint for total chlordane was applied to predator (fillet) chlordane results to identify the number (and percent) of the sampled population of the Nation's lakes that exceed this human health screening value. EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits,* *Third Edition* (USEPA 2000e) identified a cancer health endpoint of 67 ppb chlordane (wet weight) in fish tissue. This represents the concentration in fish tissue that should not be exceeded based on a total consumption-weighted rate of four 8-ounce (0.227 kg) fish meals per month (assuming a human adult body weight default value of 70 kg, a cancer slope factor of 0.35 $(mg/kg\text{-}d)^{-1}$, and a 1 in 100,000 risk level) (USEPA 2000e).

National Chlordane Results

Chlordane Detections

- Chlordane was detected in 20% of predator and 50% of bottom-dweller composite samples.

Chlordane was detected in 96 (of 486) predator and 197 (of 395) bottom-dweller samples. Total chlordane tissue concentrations are reported as percentiles, including the median concentration (or 50th percentile), for each composite type in Tables 22 and 23. Predator concentrations ranged from 0.59 ppb to 99.99 ppb, and the median concentration was less than the MDL for total chlordane (Figure 16). Bottom-dweller chlordane concentrations (Figure 16) were generally higher than levels detected in predators, which may be due to their tendency to partition to fatty tissues and organs (USEPA 2000e). Total concentrations in bottom-dwellers ranged from 0.50 ppb to 377.98 ppb, with a median concentration of 1.65 ppb. [Percentiles and occurrence data for each chlordane compound are reported in Appendix E and Appendix F.]

Table 22. **Percentiles for Total Chlordane Concentrations in Predator Samples.**

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	<MDL	<MDL	<MDL	<MDL	<MDL	3.62	8.27
Lower Confidence Bound (95%) (ppb)	<MDL	<MDL	<MDL	<MDL	<MDL	2.13	4.43
Upper Confidence Bound (95%) (ppb)	<MDL	<MDL	<MDL	<MDL	<MDL	8.14	9.26
Maximum Amount Detected	99.99 ppb						

Table 23. **Percentiles for Total Chlordane Concentrations in Bottom-dweller Samples.**

Percentile	5th	10th	25th	50th	75th	90th	95th
Concentration (ppb)	<MDL	<MDL	<MDL	1.65	9.31	25.96	30.93
Lower Confidence Bound (95%) (ppb)	<MDL	<MDL	<MDL	<MDL	6.81	16.31	25.98
Upper Confidence Bound (95%) (ppb)	<MDL	<MDL	<MDL	3.35	15.27	30.99	78.74
Maximum Amount Detected	377.98 ppb						

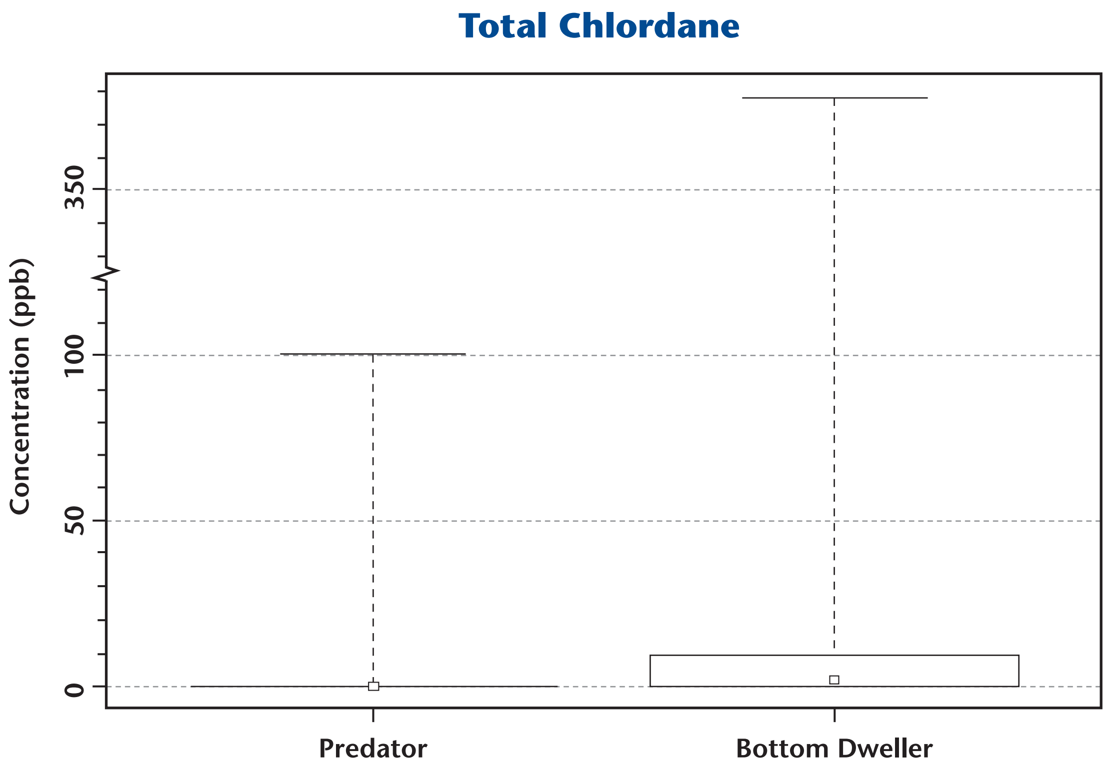


Figure 16. Box-and-whisker plot of total chlordane concentrations in predator and bottom-dweller samples. (The small box denotes the median or 50th percentile, the large box encloses data between the 25th and 75th percentiles, and the whiskers indicate minimum and maximum values.)

Prevalence of Chlordane in the Sampled Population of Lakes

Prevalence of Chlordane in Predators

- Chlordane concentrations exceeded the human health screening value of 67 ppb in 235 of the Nation's lakes (0.3% of the sampled population).

Figures 17 and 18 are cumulative distribution function (CDF) graphs that illustrate the chlordane concentrations corresponding to the percentage (and number) of the sampled population of lakes. The human health screening value is plotted on the CDF for predators to delineate between those lakes with fish tissue total chlordane concentrations that are above the cancer health endpoint versus those that are below the endpoint. The percentage of lakes below this threshold can be read directly from the graph, while the percentage of lakes above this threshold can be derived by subtracting the percentage of lakes below the threshold from 100%. Figure 17 shows that edible portions (fillets) of predators in 0.3% of the sampled population of lakes had fish tissue concentrations that exceeded the 67 ppb human health screening value for total chlordane, representing a total of 235 lakes nationwide.

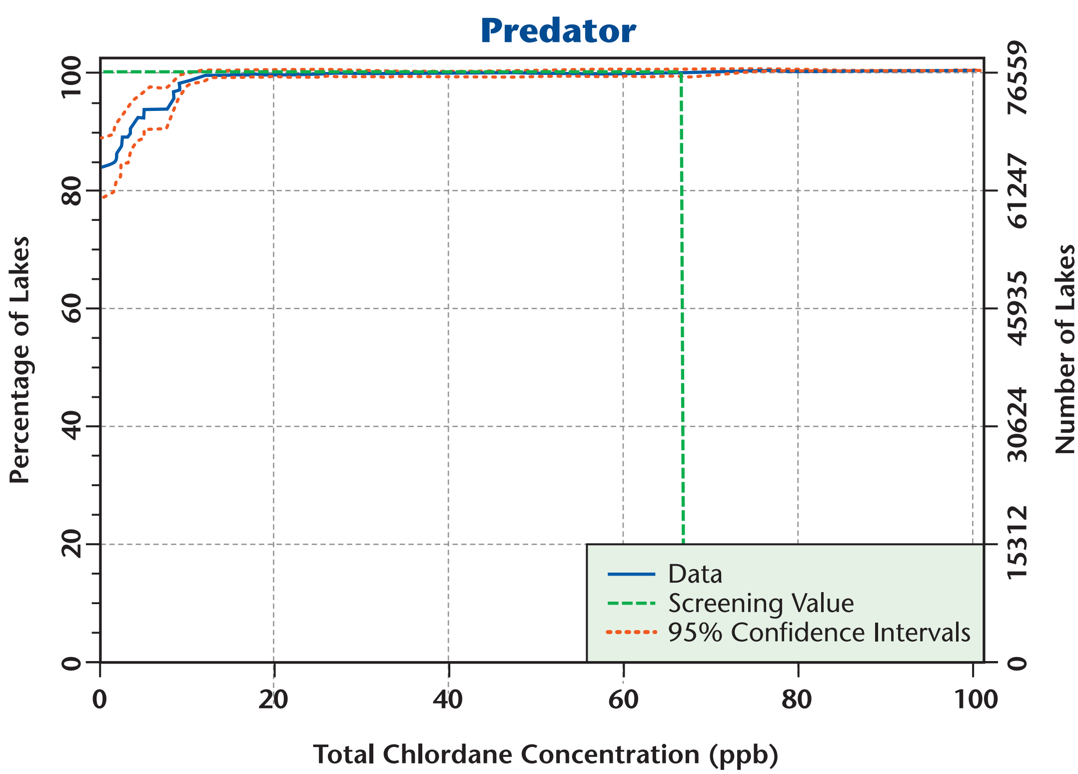


Figure 17. **Cumulative distribution function of total chlordane concentrations in predator samples.**

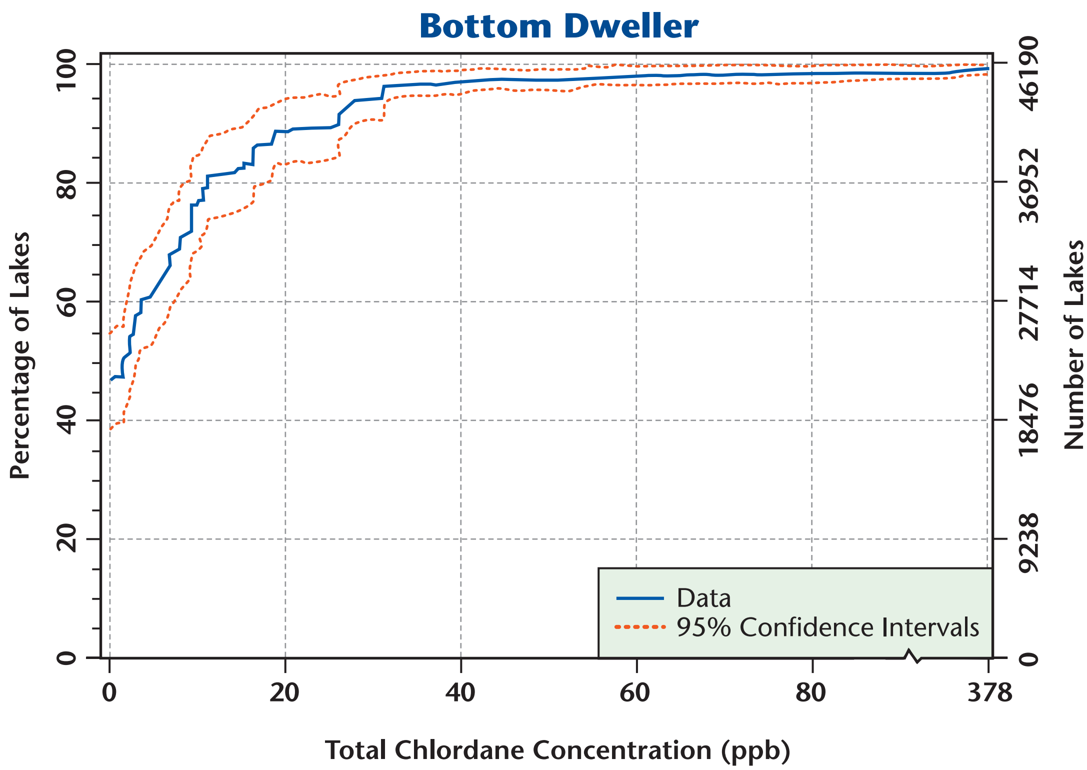


Figure 18. Cumulative distribution function of total chlordane concentrations in bottom-dweller samples.

For more information on chlordane, visit the following websites:

http://epa.gov/waterscience/fish/advisories/index.html

http://www.epa.gov/pbt/pubs/chlordane.htm

http://www.atsdr.cdc.gov/tfacts31.html

3.5 Sampling Variability

Field teams collected replicate samples of predators from 70 lakes and bottom dwellers from 52 lakes (simultaneously with standard sample collection) to provide estimates of sampling variability. For this study, a replicate sample consisted of a second composite of fish containing the same species and number of fish and specimens with similar size ranges as the original (standard) sample. A representative set of lakes was selected for collection of replicate samples. Measuring sampling variability involved analyzing a standard composite sample and a replicate composite sample and comparing the results.

EPA applied a tiered approach to compare the results from standard and replicate samples. The first tier involved a simple comparison of agreement between the sample pairs using detection limits. The paired sample results were divided into three categories: sample results with both below detection, those with both above detection, and those with one below detection and one above detection. This was the only comparison possible for the large group of non-detected target chemicals (43 of the 268 total target chemicals). Appendix H provides the data for detection agreement between replicate sample pairs.

Comparisons of detections for the 70 predator and 52 bottom-dweller sample pairs showed perfect agreement in the results for mercury (i.e., mercury occurred in all sample pairs above detection). Sample pair comparisons also showed perfect agreement in detections for each of the 43 chemicals not detected in any of the fish samples, including organophosphate pesticides (i.e., all sample pair results were below detection). There was a high level of agreement between standard and replicate samples for arsenic detections, with 99–100% agreement for predator sample pairs and 88–100% agreement for bottom-dweller sample pairs. For the 159 PCB congener results, 75% of the predator sample pairs and 80% of the bottom-dweller sample pairs showed 90–100% detection agreement. Detection results varied the most for dioxins and furans, ranging from 71–100% agreement for both the predator and bottom-dweller sample pairs. For DDT and chlordane, differences are apparent in the level of agreement for detection between predator and bottom-dweller sample pairs. Predator detection agreement ranged from 87–100% for DDT and 94–100% for chlordane, while agreement in detections for bottom dwellers ranged from 75–100% for DDT and 88–96% for chlordane. The high level of agreement for detections of semivolatile organic chemicals (94–100% for both predator and bottom-dweller sample pairs) reflects the large number of non-detected chemicals in this group.

The second tier for estimating sampling variability involved comparisons of measured concentrations when both samples were above detection or when one sample (standard or replicate) was above detection and the other was below detection. In the first case, the two concentrations were compared directly. In the second case, the measured concentration was compared to the method detection limit. Appendix I contains the results for these comparisons. Differences between standard and replicate sample concentrations are summarized as minimum and maximum values and percentiles (10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th}) for all detected target chemicals.

4.0 Conclusions and Recommendations

For the first time in its history, EPA has freshwater fish contamination data available to draw statistically valid conclusions about the occurrence of persistent, bioaccumulative, and toxic chemicals in lakes and reservoirs of the conterminous United States. Obtaining, analyzing, and reporting these data required an agency investment of over eight years to complete the National Lake Fish Tissue Study. To succeed, it also required the long-term support (about five years) of more than 50 state, tribal, and other federal agencies contributing in-kind services. Given the inherent challenges in conducting a national-scale environmental assessment, the conclusions in this report cover technical (Section 4.1) and programmatic (Section 4.2) aspects of the study. The final sections of the report provide information about data availability (Section 4.3) and discuss recommendations for future national monitoring of freshwater fish contamination (Section 4.4).

4.1 Chemical Occurrences

4.1.1 Mercury

Elevated mercury concentrations in fish are the leading cause of fish advisories. In 2008, 43% of the total lake acres in the United States were under advisory for mercury. Results from the National Lake Fish Tissue Study confirm that mercury is widely distributed in lakes and reservoirs across the country. Study data show that mercury was detected at quantifiable levels (i.e., concentrations at or above the quantitation limit) in every fish sample collected from all 500 locations sampled for the study. Statistical analysis of the mercury data revealed that mercury concentrations in the predator samples occurred above the 300 ppb human health screening value for mercury at nearly half of the lakes in the sampled population. These elevated mercury concentrations in predators apply to more than 36,000 lakes in the lower 48 states. Overall, the results from this statistically-based study underscore the pervasive nature of mercury deposition on lakes and their surrounding watersheds in the conterminous United States.

4.1.2 PCBs

Although the U.S. banned the production and use of PCBs in 1979, study results show that PCBs are still widely distributed in the environment. Like mercury, PCBs were detected in 100% of both the predator and bottom-dweller samples. However, PCBs occurred at elevated concentrations to a lesser extent than mercury. Total PCB concentrations exceeded the human health screening value of 12 ppb at about 17% of the lakes in the sampled population, which represents nearly 13,000 lakes in the lower 48 states. Results from individual PCB congeners are more difficult to interpret. Information about the relative toxicities of the individual congeners is incomplete, and no screening values exist for the individual congeners.

The set of PCB data for the National Lake Fish Tissue Study includes results for PCB congeners and Aroclors. However, only the PCB congeners are officially counted and listed as target chemicals (Table 4 and Appendix B). In addition, the discussion about PCB results (Section 3.4.2) is limited to the congener data. Nonetheless, EPA also obtained Aroclor data from the analytical method for organochlorine pesticides (Method 1656A). Results from the statistical analyses of the Aroclor data are provided in Appendix E (percentiles). These results may be useful for agencies that have historical Aroclor tissue data or for agencies that are continuing to use the Aroclor method for PCB analysis because it is more economical. In the past, most laboratories used Aroclor methods to report PCB concentrations because few laboratories had the capability or expertise to perform congener analyses. For the Aroclor analysis, the laboratories assumed that the distribution of PCB congeners and parent Aroclors in environmental samples was similar, but current data indicate that PCBs are more persistent, bioaccumulative, and toxic than the original Aroclor mixtures. Therefore, congener analysis should provide a more conservative and accurate determination of total PCB concentrations than Aroclor analysis.

4.1.3 Dioxins and Furans

Even though dioxins and furans are widely dispersed in the environment, results from this study indicate that they were somewhat less prevalent in lake fish than PCBs. Since dioxins tend to accumulate in fat rather than in muscle tissue, there was a distinct difference in the number of dioxin and furan detections between predator and bottom-dweller samples. Dioxins and furans were detected in 99% of the bottom-dweller samples and in 81% of the predator samples. Higher concentrations of dioxins and furans occurred in the whole-body tissue of bottom dwellers than in the fillets of predators, confirming that these chemicals collect in fatty tissue. The median concentration of 0.41 ppt (total TEQ) for bottom dwellers was nearly two orders of magnitude higher than the predator median concentration of 0.006 ppt (total TEQ). Total dioxin and furan concentrations in predator samples exceeded the 0.15 ppt (TEQ) human health screening value at less than 10% of the lakes in the sampled population or about 5800 lakes. Detailed information about dioxin exposure and associated human health effects is available online through EPA's dioxin reassessment (***http://cfpub.epa.gov/ncea/***).

4.1.4 DDT and Chlordane

During the 1970s and 1980s, the U.S. banned the manufacture and use of most of the organochlorine pesticides included in the study. The low percentages of detections for the majority of these pesticides suggest that they are being effectively sequestered in lake environments. Two notable exceptions are DDT and chlordane. For this study, total DDT was more prevalent in the fish tissue than total chlordane. DDT was detected in 98% of the bottom-dweller samples and 78% of the predator samples, while chlordane was detected in 50% of the bottom-dweller samples and 20% of the predator samples. Like PCBs and dioxins and furans, DDT and chlordane had higher concentrations in the whole-body tissue of the bottom dwellers than in the predator fillets. However, the differences in the median concentrations between composite types for total DDT were less than an order of magnitude.

Total concentrations of DDT and chlordane rarely exceeded their respective human health screening values of 69 ppb and 67 ppb. Concentrations of total DDT in predator samples exceeded the screening value at less than 2% of the lakes in the sampled population (about 1300 lakes). Total chlordane concentrations in predator samples occurred above the screening value at less than 1% of the lakes in the sampled population (about 230 lakes). These results suggest a tendency toward declining concentrations for both DDT and chlordane.

4.2 Lessons Learned

Environmental monitoring on a national scale is a formidable challenge. EPA's experience in conducting the National Lake Fish Tissue Study revealed that certain factors were crucial in successfully meeting this challenge. Foremost among these were broad cooperation, careful planning, and meticulous attention to detail in addressing the technical and logistical requirements of the study. More specifically, the three most critical factors that contributed to the success of this study included:

- Obtaining voluntary commitments and maintaining the support of a large network of partners among states, tribes, and other federal agencies,
- Allowing two years to plan the study design and mobilize for national-scale implementation of the study, and
- Establishing and maintaining a high degree of quality assurance/quality control to develop scientifically-defensible data.

4.2.1 Importance of Partnerships

A study of this magnitude cannot be conducted effectively in isolation. Instead, it requires the involvement of a large group of experts that have the knowledge and experience necessary to plan and implement the study on the local level. During workshops held around the country, EPA sought the participation of states, tribes, and other federal agencies to plan the study and provide long-term support for lake reconnaissance and fish collection. These workshops allowed EPA's study management team to meet scientists from states, tribes, and various federal agencies, and to present study-specific information for evaluating lakes and collecting fish samples. It also allowed EPA to build a national network of partners that consisted of 47 states, three tribes, and two other federal agencies. These partnerships were crucial to the technical and financial success of the study. Completing the fish tissue analysis required 80% of the resources EPA allocated for the study. The in-kind contributions of partner agencies made fish collection for this study possible.

Maintaining voluntary participation in the National Lake Fish Tissue Study over the five-year period for lake reconnaissance and fish collection required some EPA actions or commitments in return. To allow greater participation in the study, EPA identified where flexibility was possible in the sampling design. Examples include allowing states to sample lakes in different years than they were scheduled in the study design and extending the field sampling season to provide more time for participants to complete fish collection. EPA's commitment to simplifying procedures to reduce the burden on partner agencies also facilitated their continued participation. Finally, EPA's agreement to distribute the fish tissue data to states and other participants on an annual basis for four years maintained their interest in the study.

4.2.2 Adequate Time for Planning and Mobilizing

Allowing adequate time for planning and organizing project logistics was vital to the success of this study. Too often schedules for project planning are compressed to a point where there is insufficient time to adequately explore design options or to access the full range of technical expertise available to support planning efforts. Project schedules also generally short-change the time allowed for organizing project logistics. EPA management recognized how critical these study components were by providing budgetary support for one year of planning and an additional year for mobilizing. For planning, this made it possible to carefully consider all the elements of the study design (e.g., lake selection process and target chemical selection), to involve technical experts around the country in a study design workshop, and to conduct peer review of the study design. The additional year for mobilizing allowed EPA to establish a full national network of effective partnerships, to provide orientation and training for partners during workshops held in the ten EPA Regions over a period of ten months, to complete mapping and reconnaissance of 900 lakes, and to conduct pilot sampling in ten states to test project logistics prior to full-scale implementation of the study.

4.2.3 Commitment to Rigorous QA/QC

The National Lake Fish Tissue Study set a high QA/QC standard for scientific studies conducted by EPA. From the study's inception, QA/QC activities became an integral part of all program operations. The national study management team developed an unprecedented number of quality assurance project plans (three) to thoroughly document all QA/QC procedures for fish sample collection (USEPA 2000a), fish tissue preparation and analysis (USEPA 2000b), and statistical analysis of the study data (USEPA 2005a). Documenting all study-specific procedures was crucial for establishing consistency among participants in field and laboratory operations across the country. Making a serious commitment to follow these procedures was critical for maintaining this consistency. EPA estimates about one-third of the combined efforts of agency staff, support contractors, and voluntary participants were devoted directly to QA/QC activities. This level of investment in QA/QC paid important dividends as evidenced by the fact that EPA did not lose a single fish sample during the four years of field sampling.

4.3 Data Availability

EPA released the four years of National Lake Fish Tissue Study data to the public in October 2005. These data are available on CDs at no charge. The CDs contain field sampling information and analytical results (raw data) for fish samples collected at all 500 sampling locations, a data dictionary that defines each of the fields in the data files, and a report that summarizes analysis of the fish samples and results of the data quality review. Instructions for obtaining the study data are posted on the Internet at ***http://www.epa.gov/waterscience/fishstudy/***.

4.4 Future Monitoring

The full complement of data from this study defines a national baseline of fish contamination in lakes and reservoirs of the lower 48 states. Future monitoring will be necessary to determine trends in occurrence of the target chemicals in lake fish and to track changes in concentrations of PBT chemicals in freshwater fish in response to pollution control activities. EPA's PBT Monitoring Strategy identifies the National Lake Fish Tissue Study as an agency monitoring effort that should continue in the future.

With the completion of this study, EPA recognizes the importance of conducting further studies to obtain representative chemical residue data for fish in other surface waters, to investigate the occurrence of contaminants of emerging concern (CECs) in fish tissue, and to generate data that define temporal trends in fish contaminant concentrations. The following future fish tissue monitoring activities would enhance the Agency's current fish assessment program:

- Analysis of archived tissue from the National Lake Fish Tissue Study to investigate the occurrence of CECs in lake fish
- Analytical method development to expand the suite of methods available for quantifying concentrations of CECs in fish tissue
- Development of trend data for priority chemicals by repeating the National Lake Fish Tissue Study or a similar statistically-designed national study of lakes at an appropriate fixed interval (e.g., 5 or 10 years)
- Assessment of fish contamination in other surface waters, such as the fish tissue indicator work currently being conducted under EPA's National Rivers and Streams Assessment.

Since national-scale studies are resource intensive, collaborative efforts similar to the support EPA received for the National Lake Fish Tissue Study would be necessary to implement the last two recommendations. Agency budget commitments over multiple years would also be necessary to fund these recommendations.

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Appendix A

National Lake Fish Tissue Study Sampling Locations

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
ALABAMA: 16 Lakes												
AL	Bankhead Reservoir	Walker	0272	R	2003	33	37	17.76	87	12	11.52	1346.43
AL	Candles Lake	Talladega	1497	4	2003	33	10	9.84	86	23	45.24	25.75
AL	Choccolocco Lake	Calhoun	1436	4	2003	33	36	47.52	85	59	37.68	6.97
AL	Clark's Lake	Russell	0560	2	2001	32	26	55.32	85	8	22.56	2.68
AL	Jones Bluff Lake	Lowndes	1072	3	2002	32	23	20.4	86	45	8.64	5063
AL	Lake Martin	Tallapoosa	0236	R	2003	33	26	27.96	85	34	42.456	15783
AL	Lewis Smith Lake	Cullman/Walker/ Winston	0136	1	2000	34	4	51.24	87	7	55.2	8793.13
AL	Payne Lake	Hale	0947	3	2002	32	53	10.68	87	26	34.08	46.02
AL	Pine Lake	Houston	0622	2	2001	31	9	14.04	85	19	28.2	3.25
AL	Unnamed lake	Walker	0022	1	2000	33	56	55.32	87	19	53.4	4.37
AL	Unnamed lake	Monroe	0923	3	2002	31	26	51	87	17	45.96	1.87
AL	Unnamed lake	Marshall	0961	3	2002	34	7	22.44	86	17	52.08	3.37
AL	Walter F. George Reservoir	Henry/Barbour	0072	1	2000	31	56	3.84	85	5	48.84	15281.91
AL	Wheeler Lake	Lauderdale	0161	1	2000	34	39	49.932	87	2	23.208	27143
AL	William "Bill" Dannelly Reservoir	Wilcox	0197	1	2000	32	5	53.88	87	22	56.28	4738.41
AL	Wilson Reservoir	Colbert	0311	R	2003	34	49	27.084	87	30	14.328	6272.6
ARIZONA: 3 Lakes												
AZ	Apache Lake	Maricopa	0045	1	2000	33	35	15.36	111	17	32.28	888.11
AZ	Lake Havasu	Mohave	1520	4	2002	34	30	3.24	114	21	56.52	7223
AZ	Lake Mohave	Mohave	1020	3	2001	35	27	14.04	114	38	10.32	10446.12
ARKANSAS: 11 Lakes												
AR	Beaver Reservoir	Benton	1493	4	2002	36	22	1.20	93	56	58.56	8310.84
AR	Greers Ferry Lake	Cleburne	0571	2	2000	35	33	39.60	92	9	47.16	4803
AR	Horseshoe Lake	Crittenden	1522	4	2001	34	55	50.16	90	20	13.20	872.26

Appendix A: National Lake Fish Tissue Study Sampling Locations

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
AR	Lake Dardanelle	Logan	0247	R	2003	35	21	7.92	93	24	21.6	12640.98
AR	Lake DeGray	Clark	1449	4	2002	34	15	25.56	93	14	14.64	4575.86
AR	Lake Ouachita	Garland	1371	4	2002	34	37	0.84	93	23	22.20	15815.64
AR	Lake Terkington	Arkansas	1396	4	2002	34	27	58.68	91	23	35.88	23.57
AR	Millwood Lake	Little River	1398	4	2002	33	45	2.16	94	0	14.40	9667.69
AR	Norfolk Lake	Baxter	0143	1	1999	36	24	22.68	92	14	31.20	7546.18
AR	Ozark City Lake	Franklin	0497	2	2000	35	31	54.84	93	49	57.00	166.23
AR	ReReg Lake	Clark	0623	2	2000	34	11	4.92	93	6	13.32	151.71
CALIFORNIA: 18 Lakes												
CA	Claire Engle Reservoir	Trinity	1426	4	2003	40	53	42.36	122	46	10.56	6757.19
CA	Clear Lake	Lake	0126	1	2000	39	1	35.76	122	46	13.8	15956.2
CA	Crag Lake	El Dorado	1026	3	2002	38	59	27.96	120	9	18.36	8.38
CA	El Capitan Reservoir	San Diego	0468	2	2002	32	54	44.64	116	46	51.6	589.97
CA	Finnon Reservoir	El Dorado	1526	4	2003	38	47	53.52	120	44	54.6	8.58
CA	Guadalupe Reservoir	Santa Clara	0303	R	2003	37	11	33	121	52	21.72	25.64
CA	Jewelry Lake	Tuolumne	0027	1	2001	38	9	45.72	119	46	52.32	2.61
CA	Lake Oroville	Butte	0151	1	2001	39	34	47.64	121	21	35.64	1730.03
CA	Lake Thomas Edison	Fresno	0977	3	2003	37	22	46.92	118	58	39.36	755.47
CA	Little Grass Valley Reservoir	Plumas	0301	R	2003	39	43	44.4	120	59	36.6	564.03
CA	Meadow Lake	Nevada	1351	4	2003	39	24	41.04	120	29	34.08	89.41
CA	New Melones Reservoir	Calaveras	0227	R	2003	37	59	30.84	120	30	26.64	726.39
CA	Pete's Valley Reservoir	Lassen	0077	1	2003	40	32	40.56	120	26	56.04	10.86
CA	Pine Flat Reservoir	Fresno	0002	1	2001	36	52	28.92	119	14	5.64	2336.88

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
CA	San Leandro Reservoir	Alameda	0051	1	2002	37	47	9.96	122	6	58.68	309.21
CA	San Luis Reservoir	Merced	0503	2	2002	37	2	38.04	121	7	39	5214.08
CA	Shasta Lake	Shasta	0476	2	2002	40	49	31.08	122	23	51	5467.73
CA	Woodward Reservoir	Stanislaus	1002	3	2002	37	51	10.44	120	50	58.56	718.84
COLORADO: 8 Lakes												
CO	Cherry Creek Reservoir	Arapahoe	1569	4	2000	39	38	22.92	104	51	15.48	347.28
CO	Fuchs Reservoir	Rio Grande	0969	3	2001	37	28	23.16	106	31	1.92	6.1
CO	Left Hand Valley	Boulder	0228	R	2003	40	5	49.92	105	15	56.88	45.82
CO	Stalker Lake	Yuma	0469	2	2001	40	5	7.44	102	16	34.68	6.63
CO	Trujillo Meadows Reservoir	Conejos	0319	R	2003	37	3	2.88	106	27	9	29.16
CO	Turk's Pond	Baca	0019	1	2000	37	29	10.32	102	22	56.28	22.13
CO	Williams Fork Reservoir	Grand	0552	2	2001	40	1	3.72	106	12	22.68	546.12
CO	Willow Creek Reservoir	Weld	0903	3	2000	40	48	8.64	104	27	47.16	1.21
CONNECTICUT: 2 Lakes												
CT	Barkhamsted Reservoir	Litchfield	1117	3	2001	41	58	13.44	72	57	17.64	890.54
CT	Rainbow Lake	Fairfield	0938	3	2001	41	20	27.24	73	29	45.24	15.25
FLORIDA: 16 Lakes												
FL	Brown Lake	Osceola	1425	4	2003	28	9	38.16	81	25	55.2	57.37
FL	Chipco Lake	Putnam	1060	3	2002	29	37	42.24	81	53	31.92	18.28
FL	Crescent Lake	Putnam/Flagler	0260	R	2003	29	27	11.628	81	29	34.296	6459
FL	Eagle Lake	Polk	1575	4	2002	27	59	16.08	81	46	3.72	259.22
FL	Lake Apopka	Orange	0500	2	2001	28	37	8.76	81	37	19.56	12439.41

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
FL	Lake Butler	Union	0060	1	2000	30	2	12.12	82	20	21.84	362.69
FL	Lake Manatee	Manatee	1050	3	2002	27	28	46.2	82	18	27	593.3
FL	Lake Okeechobee	Palm Beach/Hendry	0150	1	2001	27	10	30.72	80	47	45.6	4830.28
FL	Lake Reedy	Polk	0975	3	2002	27	44	16.8	81	29	58.2	1399.66
FL	Lake Tohopekaliga	Osceola	1000	3	2002	28	13	57	81	22	20.28	7642.87
FL	Lake Tsala Apopka	Citrus	0100	1	2000	28	55	27.228	82	21	2.52	7733.98
FL	Long Pond	Hillsborough	0600	2	2001	27	57	57.96	82	15	57.24	22.39
FL	Mill Dam Lake	Marion	0135	1	2000	29	10	49.44	81	50	37.32	140.03
FL	Unnamed lake	Walton	0498	2	2001	30	28	57.36	86	19	40.44	1.53
FL	Unnamed lake	Broward	0625	2	2001	26	1	34.32	80	15	39.6	5.43
FL	Unnamed lake	Palm Beach	0325	R	2003	26	35	5.64	80	11	10.68	2.32
GEORGIA: 15 Lakes												
GA	Allatoona Lake	Bartow/Cherokee	1035	3	2000	34	8	12.48	84	37	54.84	4661.32
GA	Boatright Lake	Washington	0661	2	2000	32	48	40.32	82	42	29.52	12.58
GA	Demott Lake	Colquitt	1411	4	2003	31	11	7.08	83	49	23.16	4
GA	J. Strom Thurmond Reservoir	Columbia	1461	4	2000	33	39	32.04	82	23	53.88	10306.7
GA	Johnson's Lake	Warren	0286	R	2003	33	21	54.72	82	38	8.52	25.72
GA	Lake Ashley ("Fishing Lake")	Carroll	1360	4	2003	33	39	14.76	84	55	21.72	6.2
GA	Lake Blue Ridge	Fannin	0261	R	2003	34	50	29.04	84	15	57.6	1339.82
GA	Lake Seminole	Seminole	1547	4	2003	30	47	6.72	84	54	48.96	5137.63
GA	Lake Sinclair	Putnam	1561	4	2001	33	13	50.52	83	17	8.88	2070.71
GA	Qualatchee Lake	White	0061	1	2002	34	38	56.04	83	48	3.6	15.64
GA	Reservoir 29	Madison	0636	2	2001	34	3	52.56	83	13	38.64	32.62
GA	Unnamed lake	Elbert	0186	1	2000	34	5	3.12	82	46	48.72	1.94
GA	Unnamed lake	Stewart	0036	1	2003	31	57	21.6	84	40	42.24	1.39

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
GA	Unnamed lake	Thomas	1097	3	2003	30	52	22.08	83	49	57.36	4.77
GA	West Point Lake	Troup	0086	1	2002	33	3	44.28	85	8	0.6	9215.38
IDAHO: 7 Lakes												
ID	Bear Lake	Bear Lake	0627	2	2000	42	0	13.32	111	19	58.476	28329
ID	Blackfoot Reservoir	Caribou	1452	4	2002	42	54	15.012	111	35	9.672	6475.2
ID	Brownlee Reservoir	Washington	0079	1	2000	44	40	32.736	117	4	42.348	6070.5
ID	Enos Lake #1	Valley	1028	3	2002	45	5	58.452	115	50	48.876	3.01
ID	Loon Creek Lake #2	Valley	0904	3	2002	45	5	37.5	115	55	14.808	2.62
ID	Palisades Reservoir	Bonneville	0127	1	2000	43	14	36.96	111	6	40.68	6061.57
ID	Priest Lake	Bonner	0554	2	2000	48	34	4.368	116	51	27.504	9453.8
ILLINOIS: 10 Lakes												
IL	Buck Lake	De Kalb	0041	1	2000	41	38	51	88	39	36	3.56
IL	Kincaid Lake	Jackson	1565	4	2002	37	49	7.32	89	28	42.24	972.39
IL	Lake Inverness	Cook	0241	R	2003	42	5	39.48	88	5	3.12	6.57
IL	Otter Lake	Macoupin	0115	1	2001	39	27	4.32	89	53	35.16	126.16
IL	Rend Lake	Franklin	1065	3	2001	38	4	52.32	88	58	26.76	832.64
IL	Shook's Pond	Rock Island	0140	1	2000	41	27	17.64	90	36	11.16	1.67
IL	Unnamed lake	Williamson	0015	1	2000	37	46	23.88	88	47	0.6	6.2
IL	Unnamed lake	Tazewell	0515	2	2000	40	35	1.68	89	35	7.8	17.48
IL	Unnamed lake	Saline	1465	4	2002	37	44	13.2	88	30	28.08	7.87
IL	Wolf Lake	Cook	0491	2	2001	41	39	52.2	87	31	57.72	323
INDIANA: 7 Lakes												
IN	Baire Lake	Putnam	0141	1	2000	39	43	58.8	86	45	17.64	3.03
IN	Fox Lake	Steuben	1516	4	2003	41	37	36.48	85	1	24.96	53.2
IN	Geist Reservoir	Hamilton	0616	2	2001	39	55	41.52	85	56	33	683.06
IN	Hardy Lake	Scott	0941	3	2002	38	46	21.36	85	41	20.04	315.77

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
IN	Turtle Creek Reservoir	Sullivan	0590	2	2001	39	4	1.92	87	31	42.96	605.95
IN	Unnamed lake	Montgomery	1541	4	2003	40	2	5.64	86	57	10.8	5.24
IN	Winona Lake	Kosciusko	0466	2	2001	41	13	22.44	85	50	0.96	216.43
IOWA: 5 Lakes												
IA	Diamondhead Lake	Guthrie	1090	3	2002	41	32	59.28	94	15	33.84	40.03
IA	Morse Lake	Wright	0165	1	2000	42	50	20.04	93	41	41.28	41.11
IA	Percival Lake	Fremont	0615	2	2001	40	46	37.56	95	48	36.72	6.39
IA	Saylorville Lake	Polk	1040	3	2002	41	45	11.52	93	43	53.76	2041.2
IA	Unnamed lake	Wapello	0965	3	2002	40	58	26.4	92	22	25.68	12.99
KANSAS: 4 Lakes												
KS	Tuttle Creek Lake	Pottawatomie	0119	1	2000	39	27	25.2	96	42	4.68	2152.55
KS	Unnamed lake	Jackson	1119	3	2002	39	30	8.64	95	36	3.6	5.43
KS	Unnamed lake	Greenwood	0293	R	2003	37	56	5.28	96	10	45.84	1.53
KS	Unnamed lake	Woodson	1568	4	2003	37	53	13.56	95	36	43.2	1.81
KENTUCKY: 7 Lakes												
KY	Barkley Lake	Lyon	1361	4	2003	37	1	24.24	88	7	18.48	7.75
KY	Green River Lake	Adair	1012	3	2002	37	14	0.6	85	16	15.6	3190.89
KY	Herrington Lake	Boyle	0641	2	2001	37	41	6	84	42	52.56	1084.43
KY	Lake Cumberland	Pulaski	1062	3	2003	36	58	26.4	84	46	44.76	231.04
KY	Unnamed lake	Livingston	0465	2	2001	37	16	55.92	88	29	39.12	13.42
KY	Unnamed lake	Nelson	0640	2	2001	37	47	52.08	85	38	50.28	2.56
KY	Unnamed lake	Fleming	0266	R	2003	38	23	12.84	83	31	20.64	7.11
LOUISIANA: 7 Lakes												
LA	Catahoula Lake	LaSalle	0274	R	2002	31	30	20.34	92	7	30.72	10846
LA	Lac des Allemands	St. John the Baptist	0999	3	2000	29	55	14.95	90	34	18.05	5957.2
LA	Lake Bistineau	Webster	0173	1	1999	32	26	17.16	93	23	12.48	6282.91

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
LA	Lake Bussey Brake	Morehouse	1548	4	2002	32	51	52.20	91	55	44.04	848.31
LA	Miller's Lake	Evangeline	1374	4	2002	30	45	6.84	92	21	18.00	1245.69
LA	Salt Lake	Calcasieu	1074	3	2001	30	15	23.40	93	24	56.88	63.59
LA	Unnamed lake	Pointe Coupee	1474	4	2003	30	42	43.20	91	43	56.64	16.31
MAINE: 25 Lakes												
ME	Chandler Pond	Piscataquis	1460	4	2003	46	18	23.04	69	3	46.08	51.83
ME	Cuxabexis Lake	Piscataquis	0660	2	2001	46	6	22.68	69	17	54.24	247.09
ME	Green Lake	Hancock	0566	2	2001	44	38	53.88	68	29	53.52	1267.24
ME	Hadley Lake	Washington	0917	3	2002	44	47	10.68	67	26	56.04	680.2
ME	Hale Pond	Piscataquis	0285	R	2003	45	48	36	68	58	35.76	64.84
ME	Heald Ponds	Somerset	0042	1	2000	45	11	4.2	69	51	48.6	8.72
ME	Little Pond	Oxford	0192	1	2000	44	9	11.88	70	35	16.44	10.67
ME	Little River Lake	Washington	0516	2	2001	45	9	33.84	67	49	14.52	29.41
ME	McCurdy Pond	Lincoln	0642	2	2001	44	0	35.28	69	27	11.88	79.6
ME	Megunticook Pond	Waldo	1366	4	2003	44	15	46.08	69	6	47.52	573.61
ME	Middle Range Pond	Androscoggin	0617	2	2001	44	1	16.32	70	23	57.12	14.61
ME	Moose Pond	Cumberland	0217	1	2000	44	3	14.04	70	48	17.64	679.43
ME	Moosehead Lake	Piscataquis	0492	2	2001	45	40	43.104	69	43	19.092	30308
ME	Mooselookmeguntic Lake	Oxford	0667	2	2001	44	53	12.48	70	49	43.68	6597
ME	Parker Pond	Kennebec	1067	3	2002	44	29	8.88	70	1	49.44	611.44
ME	Peaked Mountain Pond	Piscataquis	0935	3	2002	46	30	27.36	69	5	14.64	5.01
ME	Pemadumcook Lake	Piscataquis	1041	3	2002	45	41	15	68	54	5.4	7453.06
ME	Puffer's Pond	Penobscot	0242	R	2003	45	0	56.88	69	15	37.08	46.36
ME	Ragged Lake	Piscataquis	0210	1	2000	45	49	13.08	69	22	4.08	1046.61
ME	Seboomook Lake	Somerset	1560	4	2003	45	54	54	69	52	13.44	2571.1

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
ME	Spednik Lake	Washington	0966	3	2002	45	37	17.76	67	38	32.28	5570.94
ME	Stiles Lake	Hancock	0166	1	2000	44	58	23.16	68	0	34.2	16.99
ME	Upper Middle Branch Pond	Hancock	0092	1	2000	44	52	34.32	68	13	37.2	103.76
ME	Wallagrass Lakes	Aroostook	0635	2	2001	47	6	20.16	68	42	51.48	100.43
ME	Wood Pond	Somerset	1442	4	2003	45	37	9.12	70	16	58.44	819.41
MARYLAND: 1 Lake												
MD	Deep Creek Lake	Garrett	1439	4	2002	39	30	15.48	79	19	17.4	1449.35
MASSACHUSETTS: 7 Lakes												
MA	Bent's Pond	Worcester	0493	2	2001	42	31	37.92	71	59	55.68	8.72
MA	Carbuncle Pond	Worcester	0592	2	2001	42	8	7.08	71	52	7.32	3.94
MA	North Watuppa Pond	Bristol	0017	1	2000	41	42	11.16	71	6	27	673.72
MA	Quabbin Reservoir	Worcester	0567	2	2001	42	24	5.4	72	18	31.32	9535.65
MA	Rockwell Pond	Worcester	1443	4	2003	42	31	37.92	71	46	9.12	3.68
MA	Seymour Pond	Barnstable	0467	2	2001	41	43	26.04	70	5	34.08	68.75
MA	Westboro Reservoir	Worcester	0992	3	2002	42	14	36.6	71	36	16.92	1.33
MICHIGAN: 21 Lakes												
MI	Burt Lake	Cheboygan	0459	2	2001	45	27	35.784	84	39	55.584	6928.25
MI	Chenango Lake	Livingston	1564	4	2003	42	30	13.68	83	53	41.28	12.35
MI	Cloverleaf Lake	Alger	0934	3	2002	46	33	32.4	86	5	13.92	4.79
MI	Fire Lake	Baraga	0309	R	2003	46	29	57.12	88	11	29.76	10.83
MI	Glen Lake	Leelanau	1459	4	2003	44	52	14.88	86	1	5.16	559.97
MI	Gogebic Lake	Gogebic	1534	4	2003	46	30	29.556	89	35	10.5	5170
MI	Haney Lake	Van Buren	0591	2	2003	42	15	8.64	86	7	29.28	11.9
MI	Horseshoe Lake	Ogemaw	0589	2	2001	44	24	57.96	84	16	49.8	14.45
MI	Houghton Lake	Roscommon	0639	2	2001	44	20	59.64	84	42	59.4	8067.91

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MI	Lake Chapin	Berrien	0016	1	2000	41	55	37.56	86	20	52.8	220.36
MI	Lake Paradise	Emmet	0659	2	2001	45	41	6.72	84	45	2.52	767.18
MI	Lake Roland	Houghton	0534	2	2001	46	53	18.24	88	51	5.4	107.27
MI	Long Lake	Kalamazoo	1116	3	2002	42	11	41.28	85	31	14.16	198.23
MI	Miner's Lake	Alger	0284	R	2003	46	28	50.52	86	32	16.8	6.01
MI	Norvell Lake	Jackson	0664	2	2001	42	8	48.12	84	12	29.52	12.38
MI	Seven Mile Pond	Alpena	0984	3	2002	45	5	48.48	83	30	34.92	555.78
MI	Torch Lake	Antrim	0634	2	2001	44	58	41.52	85	18	54.72	7503.08
MI	Walloon Lake	Emmet	0009	1	2000	45	18	1.8	85	0	41.4	1832.12
MI	West Lake	Lapeer	0014	1	2000	43	5	56.76	83	24	53.64	1.12
MI	White Lake	Oakland	0464	2	2001	42	40	8.76	83	33	51.48	198.12
MI	Wintergreen Lake	Kalamazoo	0116	1	2000	42	23	51.36	85	23	5.64	13.49
MINNESOTA: 58 Lakes												
MN	Agate Lake	Crow Wing	0630	2	2001	46	29	45.96	93	54	46.8	65.74
MN	Bass Lake	Wright	0507	2	2001	45	19	18.12	94	6	7.92	86.47
MN	Belle Lake	Meeker	1357	4	2003	44	58	53.04	94	25	33.24	361.91
MN	Blind Lake	Aitkin	1455	4	2000	46	39	0.72	93	44	45.96	119.92
MN	Cantlin Lake	Sherburne	0033	1	2000	45	29	9.24	93	35	13.2	41.26
MN	Cass Lake	Beltrami	0205	1	1999	47	25	23.484	94	31	53.94	12050
MN	Charlotte	Wright	1508	4	2000	45	9	3.24	93	44	48.12	94.11
MN	Cork Lake	Douglas	0257	R	2003	45	52	25.68	95	29	2.76	41.04
MN	Dead Lake	Otter Tail	1431	4	2000	46	28	45.48	95	44	58.2	2987.93
MN	Diamond Lake	Kandiyohi	1382	4	2003	45	10	59.52	94	50	33.72	626.23
MN	Dick Lake	Cook	0085	1	2001	47	51	54.72	90	29	39.48	52.8
MN	East Leaf Lake	Otter Tail	0906	3	1999	46	23	54.96	95	25	19.92	170.1
MN	First Lake	Pine	0633	2	2001	46	18	52.56	92	49	11.64	31.02

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MN	Fish Lake Reservoir	St. Louis	0605	2	1999	46	56	20.76	92	16	25.32	1214.34
MN	Flat Lake	Becker	1506	4	2003	46	58	44.4	95	39	17.28	741.28
MN	Florida Lake	Kandiyohi	0957	3	2001	45	14	10.32	95	3	49.68	210.53
MN	Fox Lake	Becker	0081	1	1999	46	46	49.8	95	54	30.24	55.54
MN	Fox Lake	Beltrami	0655	2	2001	47	36	33.48	94	50	30.48	63.87
MN	Hendricks Lake	Lincoln	0457	2	2000	44	29	43.8	96	27	44.64	616
MN	Hubert Lake	Crow Wing	0155	1	2000	46	29	13.92	94	16	7.32	510.95
MN	Isabella Lake	Lake	0985	3	2003	47	48	39.6	91	17	29.04	666.76
MN	Kabekona Lake	Hubbard	1480	4	2003	47	10	0.48	94	45	26.28	974.89
MN	Kekekabic Lake	Lake	0035	1	2002	48	4	7.68	91	10	26.4	690.72
MN	La Salle Lake	Hubbard	0005	1	2000	47	20	29.4	95	9	52.92	90.11
MN	Lac La Croix	St. Louis	0485	2	1999	48	17	33.72	92	4	40.08	5768.93
MN	Lake Carlos	Douglas	1532	4	2000	45	57	50.76	95	21	22.32	1039.76
MN	Lake Geneva	Freeborn	0207	1	2000	43	47	31.2	93	16	26.76	693.82
MN	Lake Minnetonka	Hennepin	1032	3	2002	44	54	34.2	93	38	10.68	1699.75
MN	Lake of the Woods	Lake of the Woods	1430	4	2003	48	58	12.072	95	12	13.248	384622
MN	Lake Pepin	Goodhue	1457	4	2003	44	30	55.8	92	18	25.56	5075
MN	Lake Washington	Le Sueur	1057	3	2002	44	15	15.12	93	52	38.64	582.48
MN	Lake Washington	Meeker	0307	R	2003	45	4	15.6	94	22	20.64	979.68
MN	Lake Winona	Winona	0932	3	2003	44	2	29.4	91	39	22.32	32.22
MN	Leech Lake	Cass	1055	3	2002	47	9	20.484	94	23	29.688	44280
MN	Linwood Lake	St. Louis	0130	1	2000	47	19	10.92	92	6	20.52	2.5
MN	Long Lake	Hubbard	0031	1	2000	46	53	10.68	94	59	57.84	783.5
MN	Many Point Lake	Becker	0481	2	2001	47	4	39	95	32	17.16	676.86
MN	Mille Lacs	Mille Lacs	0933	3	2003	46	14	17.16	93	38	35.16	51699.73
MN	Moberg Lake	St. Louis	0530	2	2001	46	48	48.96	92	54	40.32	13.94

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MN	Mora Lake	Cook	0010	1	2001	48	1	17.4	90	56	33.36	94.49
MN	Mud Lake	Traverse	0905	3	2002	48	19	45.552	95	58	18.48	9591
MN	Namakan Lake	St. Louis	0110	1	1999	48	33	28.512	92	49	25.932	5686
MN	North Turtle Lake	Otter Tail	1380	4	2001	46	18	22.68	95	47	57.48	600.51
MN	O'Dowd Lake	Scott	0182	1	2000	44	44	28.32	93	31	0.48	118.14
MN	Pokegama Lake	Itasca	0055	1	2000	47	10	51.6	93	34	37.2	6313
MN	Portage Lake	Cass	0280	R	2003	47	20	35.16	94	18	42.12	605.98
MN	Red Lake	Beltrami	0980	3	2002	47	57	43.02	95	1	30.288	61512.47
MN	Rice Lake	Stearns	0157	1	2000	45	22	29.64	94	36	56.52	617.62
MN	Rice Lake	Itasca	0255	R	2003	47	12	48.24	93	40	56.64	276.63
MN	Shamineau Lake	Morrison	0908	3	2002	46	15	13.32	94	36	1.8	547.87
MN	Snowbank Lake	Lake	0235	R	2003	47	59	3.48	91	25	9.12	1889.88
MN	South McDougal Lake	Lake	0460	2	2000	47	36	51.48	91	33	29.16	112.64
MN	Spider Lake	Itasca	1530	4	2003	47	29	27.6	93	34	36.84	546.03
MN	Sturgeon Lake	Pine	0183	1	2000	46	22	48.72	92	45	22.32	666.38
MN	Vermilion Lake	St. Louis	1110	3	2002	47	52	5.196	92	18	26.172	19875
MN	White Iron Lake	St. Louis/Lake	1010	3	2001	47	53	53.88	91	45	13.32	2404.36
MN	White Sand Lake	Crow Wing	0083	1	2000	46	21	6.48	94	17	12.48	158.52
MN	Woman Lake	Cass	0180	1	2000	46	57	30.96	94	16	21.72	2395.76
MISSISSIPPI: 9 Lakes												
MS	Bailey Lake	Carroll	0146	1	2000	33	28	37.2	89	50	15	50.29
MS	Ben Lilly Pond	Monroe	1122	3	2002	33	43	17.4	88	42	40.32	4.76
MS	Enid Lake	Yalobusha	0997	3	2002	34	8	50.676	89	51	43.452	11230
MS	Grenada Lake	Grenada	1096	3	2002	33	49	54.804	89	44	2.364	26154
MS	H Johnson Pond	Yazoo	0322	R	2003	32	37	41.16	90	28	49.8	5.53
MS	Hollis Lee's Lake	Claiborne	0624	2	2001	32	1	49.44	90	46	57.36	37

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MS	Lake Lucille	Lauderdale	0098	1	2000	32	34	30	88	32	38.76	12
MS	Sardis Reservoir	Panola	0672	2	2001	34	26	55.032	89	42	46.476	23684
MS	Unnamed lake	Carroll	1546	4	2003	33	35	58.2	90	1	49.44	8.1
MISSOURI: 11 Lakes												
MO	Lake Wapapello	Wayne	0290	R	2003	36	58	3.72	90	21	15.12	2523.23
MO	Mark Twain Lake	Ralls	1440	4	2003	39	30	46.44	91	42	36	3551.37
MO	Table Rock Lake	Stone	0543	2	2003	36	33	32.4	93	23	45.96	12409.59
MO	Tressle Hole	New Madrid	1437	4	2003	36	33	12.6	89	26	58.92	9.93
MO	Truman Reservoir	St Clair	1393	4	2003	38	10	12	93	34	18.84	9246.25
MO	Unnamed lake	Dade	0618	2	2002	37	22	33.6	93	41	24	3
MO	Unnamed lake	Jasper	1068	3	2002	37	17	22.92	94	31	58.08	14.27
MO	Unnamed lake	Cooper	0240	R	2003	38	54	46.44	92	47	36.96	4.83
MO	Unnamed lake	Polk	0318	R	2003	37	46	16.32	93	33	17.28	5.54
MO	Unnamed lake	Knox	1490	4	2003	40	1	54.12	92	4	6.96	4.27
MO	Unnamed lake	Callaway	1515	4	2003	38	57	54.36	91	58	57.72	9.35
MONTANA: 16 Lakes												
MT	Bighorn Lake	Big Horn	0053	1	2001	45	10	14.16	108	6	14.04	6942.75
MT	Bynum Reservoir	Teton	1429	4	2003	47	56	45.6	112	26	0.6	1295.69
MT	Clear Lake	Mineral	1104	3	2001	47	16	9.12	115	24	24.84	3.09
MT	Cliff Lake	Flathead	1079	3	2002	48	9	46.08	113	53	22.92	9.3
MT	Ennis Lake	Madison	1504	4	2003	45	25	51.24	111	40	55.56	1490.89
MT	Fort Peck Reservoir	Valley	0084	1	2000	47	44	0.6	106	44	36.6	98766.25
MT	Frenchman Pond	Phillips	1434	4	2003	48	42	19.8	107	13	33.24	231.25
MT	Hebgen Lake	Gallatin	0952	3	2002	44	47	13.02	111	14	58.74	4856.25
MT	Krieder's Pond	Garfield	0104	1	2000	47	7	47.28	107	28	39.36	5.88
MT	Laird Pond	Carter	0178	1	2000	45	37	24.24	104	40	28.92	7.75

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MT	Lake Elwell	Liberty	0029	1	2000	48	22	39	111	12	15.84	1075.54
MT	Lake Koocanusa	Lincoln	0604	2	2002	48	35	11.04	115	14	5.28	11462.51
MT	Leigh Lake	Lincoln	1029	3	2002	48	13	15.6	115	39	55.08	52
MT	Rape Creek Reservoir	Beaverhead	0153	1	2000	44	59	50.28	113	11	42	9.64
MT	Upper Cold Lake	Missoula	0454	2	2001	47	33	25.2	113	54	4.32	22.84
MT	Upper Two Medicine Lake	Glacier	0254	R	2003	48	27	54.72	113	27	27	61.42
NEBRASKA: 5 Lakes												
NE	Enders Reservoir	Chase	1444	4	2002	40	25	55.92	101	33	14.04	652.43
NE	Harlan County Reservoir	Harlan	0244	R	2003	40	3	30.6	99	18	12.96	5185.54
NE	Jeffrey Reservoir	Lincoln	0494	2	2000	40	56	27.6	100	24	34.2	226.1
NE	Lake McConaughy	Keith	1403	4	2002	41	15	1.08	101	50	53.16	11464.25
NE	Lake Minatare	Scotts Bluff	0453	2	2000	41	56	1.32	103	29	42	784.3
NEVADA: 4 Lakes												
NV	Chimney Reservoir	Humboldt	1451	4	2002	41	24	52.56	117	9	11.88	880.93
NV	Lake Mead	Clark	0652	2	2000	36	16	57.36	114	22	23.16	39372.55
NV	Pyramid Lake	Washoe	0902	3	2003	40	1	19.2	119	33	11.88	44232.8
NV	Ruby Lake	Elko	0926	3	2001	40	10	20.64	115	28	10.2	38.43
NEW HAMPSHIRE: 5 Lakes												
NH	Big Diamond Pond	Coos	0292	R	2003	44	57	11.16	71	18	44.28	67.92
NH	Horn Pond	Carroll	0317	R	2003	43	33	39.6	70	57	41.4	91.56
NH	Lake Winnipesaukee	Carroll/Belknap	0167	1	2000	43	36	9.36	71	20	27.6	18545.11
NH	Little Island Pond	Hillsborough	0243	R	2003	42	43	39.72	71	17	16.08	64.89
NH	Newfound Lake	Grafton	0517	2	2001	43	39	34.2	71	46	2.64	1717.53

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New Jersey: 2 Lakes												
NJ	Unnamed lake	Camden	0013	1	2000	39	47	5.28	74	51	45.72	4
NJ	Verona Lake	Essex	1063	3	2002	40	49	36.84	74	14	50.28	5.47
New Mexico: 2 Lakes												
NM	Brantley Reservoir	Eddy	1369	4	2001	32	36	46.19	104	21	3.46	8498
NM	Navajo Reservoir	Rio Arriba	0169	1	2000	36	31	4.08	107	36	37.80	1892.41
New York: 17 Lakes												
NY	Brant Lake	Warren	0593	2	2000	43	42	55.44	73	42	25.2	571.85
NY	Chautauqua Lake	Chautauqua	0114	1	1999	42	7	59.196	79	22	40.116	5438
NY	Colgate Lake	Greene	0488	2	2000	42	14	8.16	74	7	8.4	10.67
NY	Copake Lake	Columbia	0138	1	2000	42	8	38.76	73	35	47.4	157.5
NY	Goldfish Pond	Suffolk	1463	4	2003	40	56	31.2	72	19	45.12	1.34
NY	Grizzle Ocean	Essex	1518	4	2002	43	49	13.8	73	35	42.72	7.6
NY	Jamesville Reservoir	Onondaga	0238	R	2003	42	58	23.52	76	4	9.12	87.71
NY	Lake DeForest	Rockland	1488	4	2002	41	9	42.12	73	57	31.32	93.52
NY	Little Wolf Pond	Franklin	0542	2	2000	44	15	13.32	74	28	47.64	65.08
NY	Moose Lake	Herkimer	1513	4	2003	43	50	0.96	74	50	41.64	507.45
NY	Mud Pond	Clinton	1542	4	2002	44	33	42.12	73	55	21.36	45.43
NY	Northville Pond	Fulton	1013	3	2001	43	13	44.76	74	10	13.44	7.6
NY	Seneca Lake	Yates	0088	1	2003	42	37	39.72	76	55	6.96	17413.27
NY	Southern South Lake	Putnam	0613	2	2001	41	30	9.36	73	42	14.76	4.26
NY	Sylvia Lake	St. Lawrence	0113	1	1999	44	15	9.72	75	24	50.04	124.86
NY	Tupper Lake	Franklin	0067	1	2001	44	11	29.04	74	30	0.72	2583.95
NY	Whitney Pond	Oswego	0913	3	2001	43	26	0.96	75	59	23.28	32.07

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NORTH CAROLINA: 8 Lakes												
NC	B. Everett Jordan Lake	Chatham	0162	1	2000	35	46	23.52	79	0	59.4	5787
NC	Kings Mountain Reservoir	Cleveland	0062	1	2000	35	18	3.6	81	27	21.24	551.51
NC	Lake Gaston	Warren	0164	1	2000	36	32	27.6	78	1	8.4	7951
NC	Lake Norman	Catawba	0262	R	2003	35	37	35.4	80	56	40.2	13211.68
NC	Lake Phelps	Washington	0139	1	2000	35	46	7.356	76	27	36.18	6718
NC	Mountain Island Reservoir	Gaston/ Mecklenburg	0537	2	2001	35	21	2.88	80	58	11.28	1403.92
NC	San-Lee Park Lake	Lee	0312	R	2003	35	28	53.04	79	7	31.08	7.29
NC	Smith Lake	Cumberland	0612	2	2002	35	8	9.6	78	55	38.64	34.07
NORTH DAKOTA: 8 Lakes												
ND	Devils Lake	Ramsey	0030	1	2001	48	13	15.6	98	48	19.08	7119.61
ND	Dry Lake	Mcintosh	1456	4	2000	46	7	5.88	99	28	20.28	203.78
ND	Dry Lake	Ramsey	0105	1	2001	48	15	8.64	98	58	27.12	2196.46
ND	Epping - Springbrook Dam	Williams	0484	2	2001	48	15	43.92	103	25	0.48	59.85
ND	Homme Lake	Walsh	0230	R	2003	48	24	24.84	97	48	4.68	75.74
ND	Horsehead Lake	Kidder	0956	3	2001	47	2	34.8	99	47	2.76	1355.91
ND	Long Lake	Kidder	0006	1	2000	46	44	20.4	100	3	46.8	1299.72
ND	Twin Lakes South	La Moure	0281	R	2003	46	24	8.28	98	15	45.72	108.46
OHIO: 7 Lakes												
OH	Clouse Lake	Perry	1491	4	2003	39	46	1.56	82	17	56.4	13.14
OH	Darrell Rose's Pond	Marion	0541	2	2001	40	37	20.28	83	7	39.36	2.16
OH	Lake Rupert	Vinton	0066	1	2000	39	11	23.28	82	31	19.56	133.07
OH	Tom Porter's Pond	Licking	0513	2	2001	39	57	9.36	82	14	1.68	1.52
OH	Unnamed lake	Lucas	1114	3	2002	41	36	25.92	83	40	48.72	5.3

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OH	Unnamed lake	Trumbull	1514	4	2003	41	18	24.84	80	34	16.68	2.38
OH	Unnamed lake	Hancock	0963	3	2002	41	3	4.32	83	34	28.56	1.18
OKLAHOMA: 21 Lakes												
OK	Broken Bow Lake	Mccurtain	0499	2	2000	34	16	49.08	94	40	46.92	5342.04
OK	Camp Simpson Lake	Johnston	1123	3	2001	34	25	7.32	96	32	49.20	41.33
OK	Coalgate City Lake	Coal	0924	3	2001	34	34	40.80	96	14	16.80	159.1
OK	Fort Cobb Lake	Caddo	0069	1	1999	35	11	53.52	98	29	27.24	1654.07
OK	Great Salt Plains Lake	Alfalfa	1544	4	2002	36	44	1.32	98	10	39.36	4041.26
OK	Hugo Lake	Choctaw	0099	1	2000	34	5	8.52	95	25	26.04	4950.45
OK	Keystone Lake	Creek/Pawnee	0219	1	1999	36	14	53.16	96	22	4.80	5454.54
OK	Lake Altus-Lugert	Kiowa	1494	4	2002	34	55	32.52	99	18	42.12	1810.44
OK	Lake El Reno	Canadian	0944	3	2001	35	31	19.56	97	59	31.56	62.72
OK	Lake Hudson	Mayes	1093	3	2001	36	26	2.04	95	11	30.12	8.22
OK	Lake Lawtonka	Comanche	0269	R	2003	34	45	28.44	98	30	50.04	959.22
OK	Lake Ponca	Kay	0294	R	2003	36	44	19.68	97	2	4.56	184.84
OK	Oologah Lake	Rogers	0068	1	2000	36	34	55.56	95	35	31.92	6099.87
OK	Sardis Lake	Latimer	0249	R	2003	34	46	21	95	4	9.84	63.2
OK	Tenkiller Ferry Lake	Cherokee	1468	4	2002	35	42	41.76	94	57	21.24	5350.48
OK	Unnamed lake	Mcclain	0544	2	2000	34	59	12.48	97	31	44.76	12.21
OK	Unnamed lake	Osage	0669	2	2000	36	36	48.60	96	47	36.60	2.18
OK	Unnamed lake	Stephens	1423	4	2002	34	35	12.12	97	38	8.52	14.67
OK	Unnamed lake	Le Flore	1524	4	2002	35	16	8.76	94	48	20.52	1.18
OK	Unnamed lake	Rogers	1543	4	2002	36	32	46.32	95	38	43.80	99.47
OK	Wewoka Lake	Seminole	1469	4	2002	35	11	49.20	96	31	1.92	144.51

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
OREGON: 9 Lakes												
OR	Barney Reservoir	Washington	1454	4	2003	45	26	42.612	123	23	19.968	81.14
OR	Crater Lake	Klamath	0451	2	2001	42	56	57.84	122	5	41.1	5318.03
OR	Denley Reservoir	Douglas	1001	3	2002	43	22	22.476	123	14	38.724	5.91
OR	Elk Lake	Marion	0901	3	2002	44	49	22.872	122	7	7.968	25.95
OR	Lake Owyhee	Malheur	1353	4	2003	43	29	57.084	117	21	3.672	4576.85
OR	Lake Umatilla	Klickitat	0629	2	2002	45	43	32.916	120	31	53.544	11697.92
OR	Malheur Lake	Harney	0326	R	2003	43	18	35.24	118	47	32.03	5961.67
OR	Unnamed lake	Linn	0076	1	2002	44	33	9.54	123	14	20.112	7.23
OR	Wickiup Reservoir	Deschutes	1501	4	2003	43	41	29.868	121	43	19.668	4110.44
PENNSYLVANIA: 9 Lakes												
PA	Crooked Creek Lake	Armstrong	0489	2	2000	40	40	55.92	79	29	8.52	151.44
PA	Francis Slocum State Park Lake	Luzerne	0288	R	2003	41	20	12.48	75	53	40.56	66.62
PA	Keystone Lake	Westmoreland	0239	R	2003	40	22	24.96	79	22	58.08	23.52
PA	Lake Sabula	Clearfield	0039	1	2002	41	9	29.16	78	39	57.24	13.36
PA	Pike Lake #3	Pike	0188	1	1999	41	15	1.44	74	57	5.04	5.61
PA	Shenango River Lake	Mercer	1014	3	2001	41	17	34.08	80	25	28.92	1490.57
PA	Unnamed lake	Franklin	0089	1	1999	39	56	42.36	77	48	43.56	1.6
PA	Unnamed lake	Bradford	0213	1	2000	41	56	39.48	76	23	19.68	9.65
PA	Whitney Lake	Wayne	1088	3	2001	41	28	9.12	75	15	0.72	46.01
RHODE ISLAND: 2 Lakes												
RI	Arnold Mills Reservoir	Providence	1567	4	2003	41	59	2.04	71	24	23.4	6.44
RI	Gorton Pond	Kent	1517	4	2003	41	42	18.72	71	27	33.84	21.82

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
SOUTH CAROLINA: 3 Lakes												
SC	Hartwell Reservoir	Oconee	1486	4	2001	34	34	42.24	83	6	6.12	6881.09
SC	Lake Murray	Newberry	0987	3	2000	34	5	15.72	81	28	0.12	19601.57
SC	Lake Wateree	Kershaw	1562	4	2001	34	25	9.48	80	48	32.04	5548.26
SOUTH DAKOTA: 9 Lakes												
SD	Angostura Reservoir	Fall River	1553	4	2002	43	18	28.08	103	25	4.44	1741.5
SD	Corsica Lake	Douglas	1031	3	2001	43	24	53.64	98	17	31.2	37.99
SD	Hayes Lake	Stanley	0982	3	2000	44	21	57.6	101	0	44.64	24.6
SD	Lake Mitchell	Davison	0007	1	2000	43	45	23.04	98	3	21.6	283.62
SD	Lake Oahe	Dewey	1056	3	2002	44	52	26.76	100	31	59.16	61520.39
SD	Mud Lake	Kingsbury	1107	3	2001	44	28	44.76	97	35	33	119.08
SD	Pelican Lake	Codington	0107	1	2001	44	52	4.08	97	10	48.36	1124.44
SD	Shadehill Reservoir	Perkins	0056	1	2000	45	46	11.64	102	15	16.92	958.83
SD	South Waubay Lake	Day	1507	4	2002	45	22	49.08	97	27	5.04	940.18
TENNESSEE: 8 Lakes												
TN	Dale Hollow Lake	Clay	0487	2	2001	36	33	54.36	85	16	29.28	10725.65
TN	Douglas Reservoir	Jefferson	1487	4	2003	35	59	50.28	83	21	54.36	11138.56
TN	J. Percy Priest Lake	Davidson	0087	1	2000	36	5	56.76	86	33	37.08	5369.73
TN	Kentucky Lake	Henry/Stewart	1036	3	2002	36	25	53.76	88	4	45.12	46342.27
TN	Norris Lake	Union	0187	1	2000	36	18	40.68	83	49	58.8	3749.23
TN	Pine Lake	Henderson	0561	2	2001	35	33	29.16	88	24	54	184.41
TN	Ridgetop Lake	Robertson	0587	2	2001	36	24	46.08	86	45	51.84	5.41
TN	Tellico Lake	Monroe	1536	4	2003	35	36	30.96	84	13	4.8	6638.63
TEXAS: 41 Lakes												
TX	Arnold Lake	Houston	0220	1	1999	31	10	9.84	95	41	0.24	23.46
TX	ASCS Lake Riser 638	Collin	0598	2	2002	33	18	28.08	96	40	9.48	6.77

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude Deg	Latitude Min	Latitude Sec	Longitude Deg	Longitude Min	Longitude Sec	Lake Area (ha)
TX	B.A. Steinhagen Lake	Tyler/Jasper	0524	2	2000	30	50	56.29	94	11	30.59	5549
TX	Bardwell Reservoir	Ellis	0246	R	2003	32	17	11.04	96	40	10.92	1125.31
TX	Caddo Lake	Marion	1373	4	2003	32	44	56.76	94	7	32.16	10794
TX	E.V. Spence Reservoir	Coke	0021	1	2000	31	56	13.56	100	34	39.72	6055
TX	Hubbard Creek Reservoir	Stephens	0596	2	2000	32	46	31.08	99	0	24.48	5960.07
TX	Lake Arrowhead	Clay	0048	1	2000	33	42	37.08	98	22	44.40	6561
TX	Lake Belton	Bell	0921	3	2001	31	9	59.40	97	34	25.68	1052.24
TX	Lake Caballo	Zavala	0196	1	2000	28	54	23.40	99	38	57.84	4.95
TX	Lake Childress	Childress	0495	2	2000	34	27	40.68	100	20	57.12	120.72
TX	Lake Coleman	Coleman	0471	2	2000	32	2	13.20	99	30	50.40	705.13
TX	Lake Conroe	Montgomery	1570	4	2002	30	28	4.08	95	35	8.52	8029.64
TX	Lake Corpus Christi	Live Oak	0221	1	1999	28	12	4.68	97	55	42.24	7831
TX	Lake Falcon	Zapata	1571	4	2003	26	55	17.76	99	19	7.68	15801.88
TX	Lake Lavon	Collin	0948	3	2001	33	7	49.44	96	32	39.84	80.66
TX	Lake Lewisville	Denton	1473	4	2002	33	8	57.84	96	59	12.48	8589.78
TX	Lake Logan	Navarro	0496	2	2000	32	0	52.20	96	49	37.92	12.44
TX	Lake Palestine	Henderson	0673	2	2000	32	11	9.60	95	29	17.16	9533.34
TX	Lake Pat Mayse	Lamar	0573	2	2001	33	49	37.20	95	35	54.24	2389.57
TX	Lake Proctor	Comanche	1045	3	2001	32	1	8.04	98	30	18.36	1913.14
TX	Lake Sam Rayburn	Nacogdoches	0324	R	2003	31	7	0.516	94	9	37.332	46336.7
TX	Lake Tawakoni	Hunt	0223	1	2000	32	56	57.12	96	0	38.52	15333.32
TX	Lake Texoma	Grayson	0473	2	2001	33	51	21.96	96	47	23.64	23548.87
TX	Lake Travis	Travis	0070	1	2000	30	24	55.44	98	1	32.88	7239.69
TX	Richland Reservoir	Navarro/Freestone	1446	4	2003	31	58	47.14	96	13	1.92	18124

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
TX	Rogers Lake	Montgomery	0020	1	1999	30	11	6.36	95	23	14.64	9.31
TX	Stillhouse Hollow Reservoir	Bell	0645	2	2000	31	0	22.32	97	36	31.32	2663.76
TX	Toledo Bend Reservoir	Panola	0974	3	2002	32	1	39.72	94	9	57.24	4.96
TX	Toledo Bend Reservoir	Sabine	1399	4	2002	31	31	22.80	93	46	16.32	67141.13
TX	Unnamed lake	Young	1021	3	2001	33	23	43.80	98	40	37.56	8.72
TX	Unnamed lake	Smith	1098	3	2001	32	34	5.52	95	30	57.96	6.07
TX	Unnamed lake	Henderson	0998	3	2002	32	4	54.48	96	2	20.40	10.27
TX	Unnamed lake	Nacogdoches	1049	3	2002	31	33	15.12	94	33	7.92	3.24
TX	Unnamed lake	Hopkins	1073	3	2002	33	6	4.32	95	31	55.20	5.18
TX	Unnamed lake	Karnes	1395	4	2002	28	56	11.40	98	0	58.32	8.01
TX	Unnamed lake	Mcculloch	1421	4	2002	31	18	57.24	99	14	0.60	5.97
TX	Unnamed lake	Collin	1498	4	2002	33	11	22.56	96	21	46.08	8.58
TX	Unnamed lake	Ellis	1370	4	2003	32	14	28.32	96	49	17.40	9.12
TX	Unnamed lake	Montague	1523	4	2003	33	29	19.32	97	36	39.60	5.38
TX	Wright Patman Lake	Bowie	0973	3	2003	33	17	3.84	94	19	55.56	11360.46
UTAH: 5 Lakes												
UT	Gunlock Reservoir	Washington	0102	1	2000	37	15	42.48	113	46	31.8	100.83
UT	Olsen Slough	Sanpete	0526	2	2003	39	4	14.52	111	50	15.72	14.5
UT	Strawberry Reservoir	Wasatch	1051	3	2002	40	11	13.56	111	8	41.64	3171.67
UT	Unnamed lake	Cache	0927	3	2003	41	49	53.4	111	53	17.88	6.96
UT	Utah Lake	Utah	1476	4	2002	40	12	8.856	111	48	26.208	39231
VERMONT: 2 Lakes												
VT	Lake Whitingham	Windham	0093	1	2000	42	49	41.52	72	53	29.4	1564.85
VT	Lake Willoughby	Orleans	0942	3	2002	44	44	52.8	72	3	33.12	670.01

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
VIRGINIA: 10 Lakes												
VA	Banister Lake	Halifax	1089	3	2001	36	47	14.28	78	57	14.76	154.42
VA	Big Lake	Halifax	0512	2	2000	36	40	55.2	79	5	25.08	10.42
VA	Griggs Pond	Henrico	0614	2	2000	37	25	23.88	77	18	37.44	5.81
VA	John H. Kerr Reservoir	Mecklenburg	0314	R	2003	36	33	54.72	78	28	36.48	16907.08
VA	Lake Anna	Louisa	0064	1	1999	38	3	51.84	77	50	37.68	5254.27
VA	Lake Caroline	Caroline	0264	R	2003	37	59	23.28	77	31	35.4	111.22
VA	Lake Chesdin	Chesterfield	1539	4	2002	37	15	43.2	77	36	8.64	1315.57
VA	Lone Star Lake	Suffolk	0964	3	2001	36	52	1.56	76	34	13.44	13.14
VA	Unnamed lake	Caroline	0090	1	2001	37	58	1.92	77	18	43.92	10.88
VA	Unnamed lake	Prince William	0914	3	2001	38	49	14.52	77	42	14.04	2.99
WASHINGTON: 14 Lakes												
WA	Buffalo Lake	Okanogan	1379	4	2002	48	3	47.016	118	53	14.496	226.24
WA	Calligan Lake	King	1554	4	2002	47	36	18.54	121	39	57.168	116.96
WA	Crescent Lake	Clallam	0202	1	1999	48	5	5.316	123	46	2.712	1995.24
WA	Dorothy Lake	King	0654	2	2000	47	35	3.408	121	22	59.88	101.93
WA	Frenchman Hills Lake	Grant	0179	1	1999	46	58	54.876	119	35	17.772	138.34
WA	Keechelus Lake	Kittitas	0004	1	2001	47	20	2.94	121	21	34.056	955.35
WA	Lake Chelan	Chelan	0504	2	2000	48	1	33.96	120	19	55.38	13091
WA	Lake Nahwatzel	Mason	0279	R	2003	47	14	35.34	123	19	56.532	111.16
WA	Lake Wallula	Benton	1479	4	2003	46	0	17.208	118	58	54.156	12960.93
WA	Lone Lake	Island	0979	3	2001	48	1	17.472	122	27	34.812	34.21
WA	Patterson Lake	Okanogan	0304	R	2003	48	27	31.896	120	14	40.308	51.6
WA	Pend Oreille River	Pend Oreille	1354	4	2002	48	25	48	117	17	33.072	935.8
WA	Potholes Reservoir	Grant	1054	3	2001	46	59	12.48	119	19	19.992	11333

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
WA	Rimrock Lake	Yakima	0529	2	2000	46	38	25.08	121	9	42.444	951.97
WEST VIRGINIA: 1 Lake												
WV	Summersville Lake	Nicholas	0637	2	2003	38	14	27.24	80	51	15.12	843.74
WISCONSIN: 18 Lakes												
WI	Big Gibson Lake	Vilas	1084	3	2002	46	8	15.36	89	33	9.72	48.45
WI	Castle Rock Lake	Adams/Juneau	0458	2	2001	43	56	6.72	89	59	9.6	5010.01
WI	Hatch Lake	Waupaca	0983	3	2003	44	31	50.52	89	6	52.56	46.13
WI	Irogami (Fish) Lake	Waushara	0008	1	2001	44	3	57.24	89	13	56.28	116.45
WI	Keyes Lake	Florence	0259	R	2003	45	53	58.2	88	18	23.76	76.26
WI	Lake DuBay/Big Eau Pleine Reservoir	Marathon	0208	1	2002	44	42	0	89	40	48	5356.14
WI	Lake Winnebago	Winnebago	0666	2	2003	44	0	7.2	88	24	56.52	53756.72
WI	Lake Winter	Sawyer	0133	1	2001	45	48	42.12	90	59	3.48	110.43
WI	Pacwawong Lake	Sawyer	0958	3	2002	46	9	1.8	91	20	21.84	76.05
WI	Pewaukee Lake	Waukesha	1566	4	2003	43	4	22.44	88	18	25.92	984.62
WI	Rainbow Flowage	Oneida	0308	R	2003	45	51	32.4	89	30	51.84	1291.37
WI	Spirit River Flowage	Lincoln	0283	R	2003	45	26	38.76	89	49	24.24	640.24
WI	Sweeney Lake	Oneida	0134	1	2003	45	51	42.84	89	35	21.84	77.73
WI	Turtle Flambeau Flowage	Iron	0608	2	2001	46	5	8.52	90	10	8.724	7648.59
WI	Warner Lake	Burnett	0058	1	2002	45	47	49.2	92	13	19.56	71.36
WI	Whitefish Lake	Sawyer	0258	R	2003	45	51	47.52	91	26	36.24	322.36
WI	Wolf Lake	Fond Du Lac	0291	R	2003	43	51	51.48	88	12	28.44	33.84
WI	Yellow River Barron Flowage #3	Barron	1058	3	2002	45	24	48.6	91	51	57.24	20.56

State	Lake Name	County	Lake ID	Statistical Year*†	Sampling Year*	Latitude			Longitude			Lake Area (ha)
						Deg	Min	Sec	Deg	Min	Sec	
Wyoming: 6 Lakes												
WY	Baptiste Lake	Fremont	0527	2	2001	42	52	21.36	109	18	18	73.34
WY	Buffalo Bill Reservoir	Park	0528	2	2000	44	29	33	109	15	30.96	1384.63
WY	Lake 79	Fremont	0052	1	2001	43	0	30.24	109	19	58.8	4.04
WY	Lake DeSmet	Johnson	1478	4	2001	44	29	3.48	106	45	12.24	821.12
WY	Lewis Lake	Teton	0602	2	2003	44	17	59.28	110	37	39.72	1115.92
WY	Yellowstone Lake	Teton	1078	3	2003	44	27	17.532	110	21	58.428	35223.98

* "Statistical Year" indicates the annual statistical subset that provides a nationally-representative sample (Sec. 2.2.2.). "Sampling Year" indicates the calendar year during which the samples were collected.

† "R" indicates a reserve lake. Reserve lakes were added in the final year of sampling, since the initial list of 900 lakes contained a larger than expected number of lakes that did not meet the criteria for inclusion in the study.

Appendix B

Target Chemicals

Chemical Group/ Method	Chemicals	CAS Number	Method Detection Limit (MDL)[1]	Minimum Level (ML) (Quantitation Limit)[1]
Mercury Method 1631B (1 chemical)	Mercury	7439-97-6	0.521 ng/g (ppb)	2 ng/g (ppb)
Arsenic Method 1632A (5 chemicals)	Arsenate	17428-41-0	0.03 µg/g (ppm)	0.1 µg/g (ppm)
	Arsenite	22569-72-8	0.02 µg/g (ppm)	0.1 µg/g (ppm)
	Total Inorganic Arsenic		0.03 µg/g (ppm)	0.1 µg/g (ppm)
	Dimethylarsonic Acid (DMA)	75-60-5	0.04 µg/g (ppm)	0.1 µg/g (ppm)
	Monomethylarsonic Acid (MMA)	124-58-3	0.01 µg/g (ppm)	0.05 µg/g (ppm)
PCBs Method 1668A (126 individual congeners plus 33 congener groups of 2 to 6 congeners)	PCB-1		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-2		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-3		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-4		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-5		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-6		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-7		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-8		1.3 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-9		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-10		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-11		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-12+13		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-14		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-15		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-16		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-17		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-18+30		1.8 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-19		0.1 ng/kg (ppt)	0.5 ng/kg (ppt)
	PCB-20+28		4.2 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-21+33		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-22		0.2 ng/kg (ppt)	0.5 ng/kg (ppt)
	PCB-23		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-24		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-25		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-26+29		3.5 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-27		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-31		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-32		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-34		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-35		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-36		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-37		0.2 ng/kg (ppt)	0.5 ng/kg (ppt)
	PCB-38		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-39		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-40+41+71		1.6 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-42		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-43		1.4 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-44+47+65		4.3 ng/kg (ppt)	10.0 ng/kg (ppt)

Chemical Group/ Method	Chemicals	CAS Number	Method Detection Limit (MDL)[1]	Minimum Level (ML) (Quantitation Limit)[1]
PCBs Method 1668A (126 individual congeners plus 33 congener groups of 2 to 6 congeners) *(continued)*	PCB-45+51		2.2 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-46		1.2 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-48		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-49+69		1.4 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-50+53		3.2 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-52		4.3 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-54		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-55		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-56		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-57		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-58		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-59+62+75		2.0 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-60		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-61+70+74+76		2.3 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-63		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-64		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-66		5.2 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-67		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-68		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-72		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-73		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-77		4.9 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-78		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-79		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-80		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-81		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-82		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-83+99		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-84		0.9 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-85+116+117		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-86+87+97+108+119+125		4.5 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-88+91		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-89		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-90+101+113		3.7 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-92		0.1 ng/kg (ppt)	0.5 ng/kg (ppt)
	PCB-93+95+98+100+102		2.1 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-94		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-96		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-103		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-104		3.6 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-105		5.3 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-106		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-107+124		1.0 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-109		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-110+115		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-111		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)

Chemical Group/ Method	Chemicals	CAS Number	Method Detection Limit (MDL)[1]	Minimum Level (ML) (Quantitation Limit)[1]
PCBs Method 1668A (126 individual congeners plus 33 congener groups of 2 to 6 congeners) *(continued)*	PCB-112		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-114		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-118		4.9 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-120		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-121		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-122		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-123		1.1 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-126		5.1 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-127		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-128+166		3.7 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-129+138+160+163		5.4 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-130		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-131		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-132		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-133		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-134+143		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-135+151+154		4.0 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-136		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-137		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-139+140		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-141		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-142		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-144		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-145		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-146		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-147+149		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-148		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-150		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-152		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-153+168		4.1 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-155		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-156+157		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-158		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-159		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-161		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-162		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-164		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-165		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-167		0.2 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-169		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-170		5.0 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-171+173		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-172		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-174		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-175		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-176		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)

Chemical Group/ Method	Chemicals	CAS Number	Method Detection Limit (MDL)[1]	Minimum Level (ML) (Quantitation Limit)[1]
PCBs Method 1668A (126 individual congeners plus 33 congener groups of 2 to 6 congeners) *(continued)*	PCB-177		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-178		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-179		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-180+193		4.5 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-181		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-182		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-183+185		1.1 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-184		0.6 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-186		0.7 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-187		4.3 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-188		4.6 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-189		0.4 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-190		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-191		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-192		0.3 ng/kg (ppt)	1.0 ng/kg (ppt)
	PCB-194		1.1 ng/kg (ppt)	5.0 ng/kg (ppt)
	PCB-195		4.9 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-196		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-197+200		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-198+199		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-201		4.9 ng/kg (ppt)	20.0 ng/kg (ppt)
	PCB-202		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-203		0.8 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-204		0.9 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-205		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-206		4.5 ng/kg (ppt)	10.0 ng/kg (ppt)
	PCB-207		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-208		0.5 ng/kg (ppt)	2.0 ng/kg (ppt)
	PCB-209		5.0 ng/kg (ppt)	20.0 ng/kg (ppt)
Dioxins/ Furans[2] Method 1613B (17 chemicals)	2,3,7,8-TCDD	1746-01-6	0.01 ng/kg (ppt)	0.1 ng/kg (ppt)
	1,2,3,7,8-PeCDD	40321-76-4	0.06 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,4,7,8-HxCDD	39227-28-6	0.06 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,6,7,8-HxCDD	57653-85-7	0.04 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,7,8,9-HxCDD	19408-74-3	0.04 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,4,6,7,8-HpCDD	35822-46-9	0.03 ng/kg (ppt)	0.5 ng/kg (ppt)
	OCDD	3268-87-9	0.09 ng/kg (ppt)	1.0 ng/kg (ppt)
	2,3,7,8-TCDF	51207-31-9	0.03 ng/kg (ppt)	0.1 ng/kg (ppt)
	1,2,3,7,8-PeCDF	57117-41-6	0.04 ng/kg (ppt)	0.5 ng/kg (ppt)
	2,3,4,7,8-PeCDF	57117-31-4	0.06 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,4,7,8-HxCDF	70648-26-9	0.04 ng.kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,6,7,8-HxCDF	57117-44-9	0.04 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,7,8,9-HxCDF	72918-21-9	0.04 ng/kg (ppt)	0.5 ng/kg (ppt)
	2,3,4,6,7,8-HxCDF	60851-34-5	0.06 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,4,6,7,8-HpCDF	67562-39-4	0.05 ng/kg (ppt)	0.5 ng/kg (ppt)
	1,2,3,4,7,8,9-HpCDF	55673-89-7	0.05 ng/kg (ppt)	0.5 ng/kg (ppt)
	OCDF	39001-02-0	0.2 ng/kg (ppt)	1.0 ng/kg (ppt)

Chemical Group/ Method	Chemicals	CAS Number	Method Detection Limit (MDL)[1]	Minimum Level (ML) (Quantitation Limit)[1]
Organochlorine Pesticides[3] Method 1656A (37 chemicals)	2,4'-DDD	53-19-0	0.38 µg/kg (ppb)	2.0 µg/kg (ppb)
	2,4'-DDE	3424-82-6	0.52 µg/kg (ppb)	2.0 µg/kg (ppb)
	2,4'-DDT	789-02-6	0.74 µg/kg (ppb)	2.0 µg/kg (ppb)
	4,4'-DDD	72-54-8	0.66 µg/kg (ppb)	2.0 µg/kg (ppb)
	4,4'-DDE	72-55-9	2.178 µg/kg (ppb)	4.0 µg/kg (ppb)
	4,4'-DDT	50-29-3	1.814 µg/kg (ppb)	4.0 µg/kg (ppb)
	Aldrin	309-00-2	0.38 µg/kg (ppb)	2.0 µg/kg (ppb)
	Chlordane, alpha-	5103-71-9	0.82 µg/kg (ppb)	2.0 µg/kg (ppb)
	Chlordane, gamma-	5566-34-7	0.488 µg/kg (ppb)	2.0 µg/kg (ppb)
	Dicofol	115-32-2	16.24 µg/kg (ppb)	40.0 µg/kg (ppb)
	Dieldrin	60-57-1	0.44 µg/kg (ppb)	1.0 µg/kg (ppb)
	Endosulfan I	959-98-8	1.22 µg/kg (ppb)	4.0 µg/kg (ppb)
	Endosulfan II	33213-65-9	10.3 µg/kg (ppb)	40.0 µg/kg (ppb)
	Endosulfan Sulfate	1031-07-8	4.16 µg/kg (ppb)	10.0 µg/kg (ppb)
	Endrin	72-20-8	2.86 µg/kg (ppb)	10.0 µg/kg (ppb)
	Ethalfluralin	55283-68-6	1.67 µg/kg (ppb)	4.0 µg/kg (ppb)
	Heptachlor	76-44-8	1.79 µg/kg (ppb)	2.0 µg/kg (ppb)
	Heptachlor Epoxide	1024-57-3	0.52 µg/kg (ppb)	2.0 µg/kg (ppb)
	Hexachlorocyclohexane (BHC), alpha-	319-84-6	4.7 µg/kg (ppb)	10.0 µg/kg (ppb)
	Hexachlorocyclohexane (BHC), beta-	319-85-7	1.13 µg/kg (ppb)	4.0 µg/kg (ppb)
	Hexachlorocyclohexane (BHC), delta-	319-86-8	1.5 µg/kg (ppb)	4.0 µg/kg (ppb)
	Hexachlorocyclohexane (BHC), gamma-	58-89-9	0.606 µg/kg (ppb)	2.0 µg/kg (ppb)
	Isodrin	465-73-6	1.58 µg/kg (ppb)	4.0 µg/kg (ppb)
	Kepone	143-50-0	12.23 µg/kg (ppb)	40.0 µg/kg (ppb)
	Methoxychlor	72-43-5	7.106 µg/kg (ppb)	20.0 µg/kg (ppb)
	Mirex	2385-85-5	1.52 µg/kg (ppb)	4.0 µg/kg (ppb)
	Nonachlor, cis-	5103-73-1	1.95 µg/kg (ppb)	4.0 µg/kg (ppb)
	Nonachlor, trans-	39765-80-5	1.48 µg/kg (ppb)	4.0 µg/kg (ppb)
	Octachlorostyrene	29082-74-4	0.83 µg/kg (ppb)	2.0 µg/kg (ppb)
	Oxychlordane	26880-48-8	1.94 µg/kg (ppb)	4.0 µg/kg (ppb)
	Pendimethalin	40487-42-1	6.21 µg/kg (ppb)	20.0 µg/kg (ppb)
	Pentachloroanisole	1825-21-4	1.312 µg/kg (ppb)	4.0 µg/kg (ppb)
	Pentachloronitrobenzene	82-68-8	0.76 µg/kg (ppb)	2.0 µg/kg (ppb)
	Permethrin I	61949-76-6	25 µg/kg (ppb)	100.0 µg/kg (ppb)
	Permethrin II	61949-77-7	21 µg/kg (ppb)	40.0 µg/kg (ppb)
	Toxaphene	8001-35-2	20 µg/kg (ppb)	100.0 µg/kg (ppb)
	Trifluralin	1582-09-8	2.98 µg/kg (ppb)	10.0 µg/kg (ppb)
Organo-phosphate Pesticides Method 1657A (9 chemicals)	Chlorpyriphos	2921-88-2	59 µg/kg (ppb)	200.0 µg/kg (ppb)
	Diazinon	333-41-5	40 µg/kg (ppb)	100.0 µg/kg (ppb)
	Disulfoton	298-04-4	161 µg/kg (ppb)	500.0 µg/kg (ppb)
	Disulfoton Sulfone	2497-06-5	275 µg/kg (ppb)	1000.0 µg/kg (ppb)
	Ethion	563-12-2	254 µg/kg (ppb)	1000.0 µg/kg (ppb)
	Paraoxon	311-45-5	121 µg/kg (ppb)	500.0 µg/kg (ppb)
	Parathion, Ethyl-	56-38-2	125 µg/kg (ppb)	500.0 µg/kg (ppb)
	Terbufos	13071-79-9	286 µg/kg (ppb)	1000.0 µg/kg (ppb)
	Terbufos Sulfone	56070-16-7	73 µg/kg (ppb)	200.0 µg/kg (ppb)

Chemical Group/ Method	Chemicals	CAS Number	Method Detection Limit (MDL)[1]	Minimum Level (ML) (Quantitation Limit)[1]
Other Semivolatile Organics Method 1625 (40 chemicals)	1,2,4,5-Tetrachlorobenzene	95-94-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	1,2,4-Trichlorobenzene (TCB)	120-82-1	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	1,2-Dichlorobenzene	95-50-1	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	1,3-Dichlorobenzene	541-73-1	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	1,4-Dichlorobenzene(p)	106-46-7	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	2,4,5-Trichlorophenol	95-95-4	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	2,4,6-Tris (1,1-Dimethylethyl) Phenol	732-26-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	3,3'-Dichlorobenzidine	91-94-1	555 µg/kg (ppb)	1665.0 µg/kg (ppb)
	4-Bromophenyl Phenyl Ether	101-55-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	4,4'-Methylene bis (2-Chloroaniline)	101-14-4	222 µg/kg (ppb)	666.0 µg/kg (ppb)
	Acenaphthene (PAH)	83-32-9	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Acenaphthylene	208-96-8	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Anthracene (PAH)	120-12-7	111 µg/kg (ppb)	1665.0 µg/kg (ppb)
	Benzo[a]Anthracene (PAH)	56-55-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Benzo[a]Pyrene (PAH)	50-32-8	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Benzo(b)Fluoranthene (PAH)	205-99-2	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Benzo(ghi)Perylene (PAH)	191-24-2	222 µg/kg (ppb)	666.0 µg/kg (ppb)
	Benzo(j)Fluoranthene (PAH)	205-82-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Benzo(k)Fluoranthene (PAH)	207-08-9	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Bis (2-ethylhexyl) Phthalate	117-81-7	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Butyl Benzyl Phthalate	85-68-7	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Chrysene (PAH)	218-01-9	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Di-n-Butyl Phthalate	84-74-2	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Dibenz[a,h]Anthrancene (PAH)	53-70-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Diethylstilbestrol (DES)	56-53-1	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Fluoranthene (PAH)	206-44-0	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Fluorene (PAH)	86-73-7	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Hexachlorobenzene	118-74-1	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Hexachlorobutadiene	87-68-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Indeno(1,2,3-cd)Pyrene (PAH)	193-39-5	222 µg/kg (ppb)	666.0 µg/kg (ppb)
	Naphthalene (PAH)	91-20-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Nitrobenzene	98-95-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Nonylphenol[4]	25154-52-3	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Pentachlorobenzene	608-93-5	222 µg/kg (ppb)	666.0 µg/kg (ppb)
	Pentachlorophenol	87-86-5	555 µg/kg (ppb)	1665.0 µg/kg (ppb)
	Perylene (PAH)	198-55-0	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Phenanthrene (PAH)	85-01-8	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Phenol	108-95-2	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Pyrene (PAH)	129-00-0	111 µg/kg (ppb)	333.0 µg/kg (ppb)
	Tetrabromobisphenol A	79-94-7	5550 µg/kg (ppb)	16650.0 µg/kg (ppb)

Notes:

1. See Section 3.1.2 for more information on detection and quantitation limits.
2. Reporting levels for dioxins and furans in this study are ten (10) times lower than the ML specified in Method 1613B.
3. Hexachlorocyclohexane is reported as its individual components: alpha, beta, delta, and gamma BHC. See notation in list. Note that gamma BHC is also known as Lindane.
4. Nonylphenol is calibrated, calculated, and integrated as a group of nonylphenol isomers, rather than as the single 4-nonylphenol isomer.

Appendix C

Target Species

TABLE C-1. PREDATOR COMPOSITE SUMMARY.

Common Name	Scientific Name	Length Range (mm)	Weight Range (g)	Number of Composites	Percent of Total
Bowfins	**Amiidae**				
bowfin	*Amia calva*	431 - 525	777 - 1423	2	<1
Gars	**Lepisosteidae**				
spotted gar	*Lepisosteus oculatus*	385 - 486	217 - 383	1	<1
Perches	**Percidae**				
sauger	*Stizostedion canadense*	310 - 360	230 - 403	1	<1
saugeye	*Stizostedion canadense x Stizostedion vitreum*	386 - 601	446 - 2007	3	1
walleye	*Stizostedion vitreum*	190 - 685	51 - 3750	49	10
yellow perch	*Perca flavescens*	170 - 346	45 - 530	18	4
Pikes	**Esocidae**				
chain pickerel	*Esox niger*	338 - 460	211 - 535	3	1
northern pike	*Esox lucius*	260 - 840	94 - 4425	34	7
Sunfishes	**Centrarchidae**				
black crappie	*Pomoxis nigromaculatus*	174 - 340	77 - 648	6	1
bluegill	*Lepomis macrochirus*	122 - 216	33 - 252	5	1
largemouth bass	*Micropterus salmoides*	175 - 570	71 - 3200	246	50
rock bass	*Ambloplites rupestris*	172 - 240	86 - 319	2	<1
smallmouth bass	*Micropterus dolomieu*	201 - 488	107 - 1745	23	5
spotted bass	*Micropterus punctulatus*	244 - 415	152 - 1005	5	1
white crappie	*Pomoxis annularis*	192 - 400	83 - 1010	13	3
Temperate basses	**Percichthydae**				
striped bass	*Morone saxatilis*	394 - 770	574 - 4822	5	1
white bass	*Morone chrysops*	253 - 441	232 - 1253	5	1
white bass hybrid	*Morone spp.*	325 - 360	318 - 463	2	<1
white perch	*Morone americana*	253 - 340	205 - 702	5	1
Trouts	**Salmonidae**				
Atlantic salmon	*Salmo salar*	310 - 391	256 - 526	1	<1
brook trout	*Salvelinus fontinalis*	189 - 470	61 - 1925	12	2
brown trout	*Salmo trutta*	199 - 700	91 - 2625	6	1
cutthroat trout	*Oncorhynchus clarki*	233 - 588	105 - 2370	10	2
cutthroat trout x rainbow trout	*Oncorhynchus clarki X Oncorhynchus mykiss*	392 - 436	494 - 684	1	<1
kokanee	*Oncorhynchus nerka*	206 - 243	55 - 87	1	<1
lake trout	*Salvelinus namaycush*	318 - 825	231 - 4460	10	2
lake whitefish	*Coregonus clupeaformis*	361 - 465	454 - 1215	1	<1
mountain whitefish	*Prosopium williamsoni*	264 - 356	135 - 410	1	<1
rainbow trout	*Oncorhynchus mykiss*	254 - 434	129 - 734	14	3
splake	*Salvelinus namaycush x Salvelinus fontinalis*	383 - 445	432 - 696	1	<1
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	213 - 271	90 - 175	1	<1

TABLE C-2. BOTTOM-DWELLER COMPOSITE SUMMARY.

Common Name	Scientific Name	Length Range (mm)	Weight Range (g)	Number of Composites	Percent of Total
Bullhead catfishes	**Ictaluridae**				
black bullhead	*Ameiurus melas*	135 - 385	20 - 920	19	5
blue catfish	*Ictalurus furcatus*	340 - 708	253 - 4798	6	2
brown bullhead	*Ameiurus nebulosus*	169 - 430	54 - 1071	30	8
bullhead catfish	*Ameiurus spp*	325 - 405	533 - 1152	2	1
channel catfish	*Ictalurus punctatus*	255 - 750	119 - 5575	64	16
flathead catfish	*Pylodictis olivaris*	345 - 545	336.5 - 1550	3	1
white catfish	*Ameiurus catus*	254 - 345	219 - 490	2	1
yellow bullhead	*Ameiurus natalis*	200 - 400	107 - 870	23	6
Carps and Minnows	**Cyprinidae**				
common carp	*Cyprinus carpio*	255 - 765	244 - 7821	104	26
goldfish	*Carassius auratus*	324 - 410	760 - 1769	2	1
grass carp	*Ctenopharyngodon idella*	505 - 850	1627 - 10005	2	1
Drums	**Sciaenidae**				
freshwater drum	*Aplodinotus grunniens*	308 - 445	346 - 959	3	1
Suckers	**Catostomidae**				
black redhorse	*Moxostoma duquesnei*	337 - 343	366 - 426	1	<1
blacktail redhorse	*Moxostoma poecilurum*	320 - 375	329 - 497	1	<1
buffalo	*Ictiobus spp.*	490 - 565	2609 - 3571	1	<1
creek chubsucker	*Erimyzon oblongus*	270 - 310	290 - 450	1	<1
golden redhorse	*Moxostoma erythrurum*	360 - 384	536 - 647	1	<1
lake chubsucker	*Erimyzon sucetta*	215 - 378	116 - 829	9	2
largescale sucker	*Catostomus macrocheilus*	380 - 558	473 - 2097	8	2
longnose sucker	*Catostomus catostomus*	323 - 420	292 - 757	3	1
northern redhorse sucker	*Moxostoma spp.*	371 - 402	535 - 737	1	<1
redhorse sucker	*Moxostoma spp.*	314 - 339	319 - 427	1	<1
Sacramento sucker	*Catostomus occidentalis*	352 - 468	996 - 1183	2	1
shorthead redhorse	*Moxostoma macrolepidotum*	234 - 276	125 - 205	1	<1
silver redhorse	*Moxostoma anisurum*	270 - 564	210 - 2000	3	1
smallmouth buffalo	*Ictiobus bubalus*	381 - 680	770 - 5111	11	3
spotted sucker	*Minytrema melanops*	320 - 526	439 - 1761	5	1
Utah sucker	*Catostomus ardens*	353 - 528	422 - 1997	4	1
white sucker	*Catostomus commersoni*	213 - 570	99 - 2200	81	20

Appendix D

Analytical Methods

Analytical Methods

Mercury (Total) by EPA Method 1631B

Total mercury (Hg) concentrations were determined by EPA Method 1631, Revision B (*Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry*) and its Appendix (*Digestion Procedures for the Determination of Total Mercury in Tissue, Sludge, Sediment, and Soil*).

Analysis of total mercury in fish tissue samples by Method 1631B involved the following steps:

1) digesting 0.5 g to 1.5 g of tissue sample and refluxing with 10 mL of concentrated nitric acid,
2) diluting the digestate to volume (50 or 100 mL) with 0.02N BrCl to ensure complete oxidation of methylmercury,
3) pipetting aliquots of the diluted digestate into pre-purged $SnCl_2$-containing water,
4) purging Hg(0) from solution onto a gold trap, and
5) thermally desorbing Hg(0) from the gold trap and transferring it to a cold vapor atomic fluorescence spectrometer for quantification.

The chemical concentration in the fish tissue sample was calculated on a mass basis (i.e., relative to the mass of the sample extracted).

Arsenic by EPA Method 1632A

Total inorganic arsenic, arsenic (III), monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA) were directly determined by EPA Method 1632, Revision A (*Chemical Speciation of Arsenic in Water and Tissue using Hydride Generation Quartz Furnace Atomic Absorption Spectrometry*). Arsenic (V) was determined by mathematically subtracting the measured concentration of arsenic (III) from the measured concentration of total inorganic arsenic. Total arsenic (which includes organic forms such as arsenobetaine) was not measured.

Analysis of the fish tissue samples by Method 1632A involved the following steps:

1) volatilizing Arsenic (III), arsenic (V), MMA, and DMA from solution at a specific pH after reduction to the corresponding arsines with sodium borohydride,
2) sweeping the volatilized arsines onto a liquid nitrogen cooled chromatographic trap which, upon warming, allows for a separation of species based on boiling points,
3) sweeping the released arsines by helium carrier gas into a quartz cuvette burner cell, where they are decomposed to atomic arsenic, and
4) determining arsenic concentrations by atomic absorption spectroscopy.

Strictly speaking, this technique determines the valence states of arsenate (V) and arsenite (III) rather than the species of inorganic arsenic. The actual species of inorganic arsenic are assumed to be those predicted by a geochemical equilibrium model.

Polychlorinated Biphenyls (PCBs) by EPA Method 1668A

EPA Method 1668, Revision A (*Chlorinated Biphenyls Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS*, EPA-821-R-00-002) was used to determine PCB congener concentrations in tissue samples collected during the study. There are 209 possible congeners, 12 of which have toxicological significance (i.e., the "toxic" PCBs identified by the World Health Organization). Method 1668A can unambiguously determine 126 of the 209 congeners as separate chromatographic peaks. The remaining 83 congeners do not appear as separate peaks, but elute from the gas chromatograph in groups of 2 to 6 congeners that cannot be completely resolved by the instrumentation. Ten of the 12 "toxic" congeners are resolved, and the remaining two congeners (PCB 156 and PCB 157) elute as a congener pair. Because PCB 156 and 157 have identical toxicity equivalency factors, however, it is possible to accurately calculate PCB toxic equivalence based on the 12 toxic congeners.

Analysis of the full complement of PCB congeners in fish tissue samples by Method 1668A involved the following steps:

1) drying a 10-g aliquot of a homogenized fish tissue sample with sodium sulfate,
2) spiking the dried fish sample with a labeled standard solution,
3) performing soxhlet extraction of the dried fish sample using 1:1 methylene chloride/hexane as the extraction solvent,
4) drying the extract with sodium sulfate and concentrating the extract to dryness (to measure lipid content) using Kuderna-Danish and nitrogen blow-down techniques,
5) re-dissolving the extract and removing lipids by passing the extract through a layered column of silica gel, potassium silicate, and acid silica gel,
6) completing further clean-up of the extract using back-extraction with a strong base, acid and/or sodium chloride solution, gel-permeation chromatography, silica gel, carbon, or Florisil chromatography,
7) re-concentrating the extract using Kuderna-Danish and nitrogen blow-down techniques, and
8) quantifying the target chemicals in the extract using a gas chromatograph equipped with a high-resolution mass spectrometer.

The target chemicals were identified by comparing their chromatographic retention times with those of authentic standards and by comparing the ratio of the abundance of two ions specific to each chemical with the theoretical ion abundance ratio for that chemical. Concentrations were calculated from selected ion current profile areas using either an isotope dilution or internal standard technique. The efficiency of the clean-up process was monitored by spiking the extract prior to clean-up with labeled standards (PCBs 81 and 111) and tracking the final recovery of these standards. The chemical concentration in the fish tissue sample can be calculated on a mass basis (i.e., relative to the mass of the sample extracted), or lipid basis (i.e., relative to the lipid content of the sample extracted).

Dioxins and Furans by EPA Method 1613B

The presence and concentration of seventeen 2,3,7,8-substituted chlorinated dibenzo-*p*-dioxins and dibenzofurans in each sample was determined by a slightly modified version of EPA Method 1613, Revision B (*Tetra- through Octa- Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS*, EPA-821-B-94-005). Modifications were made to the procedures in order to allow for determination of dioxins and furans at levels ten times lower than those specified in the method. Specifically, the method was modified to increase the tissue sample size used for analysis and to add a sixth calibration solution that contained all the method-specified chemicals at levels lower than the levels specified in the method to verify linearity at the lower concentrations targeted.

Determination of dioxins and furans in tissue samples by Method 1613B involved the following steps:

1) drying a 100-g aliquot of a homogenized fish tissue sample with sodium sulfate,
2) spiking the dried fish sample with a labeled standard solution,
3) preparing extracts either by soxhlet extraction using 1:1 methylene chloride/hexane as the extraction solvent or by acid digestion using hydrochloric acid and 1:1 methylene chloride/hexane,
4) drying with sodium sulfate and concentrating the extract to dryness (to measure lipid content) using Kuderna-Danish and nitrogen blow-down techniques,
5) re-dissolving the extract and removing lipids by passing the extract through a layered column of silica gel, potassium silicate, and acid silica gel,
6) completing further clean-up of the extract using back-extraction with a strong base, acid and/or sodium chloride solution, gel-permeation chromatography, silica gel, alumina, or Florisil chromatography,
7) re-concentrating the extract using Kuderna-Danish and nitrogen blow-down techniques, and
8) quantifying the target chemicals in the extract using a gas chromatograph equipped with a high-resolution mass spectrometer.

The target chemicals were identified by comparing their chromatographic retention times with those of authentic standards and by comparing the ratio of the abundance of two ions specific to each chemical with the theoretical ion abundance ratio for that chemical. Concentrations were calculated from selected ion current profile areas using either an isotope dilution or internal standard technique. The efficiency of the clean-up process was monitored by spiking the extract prior to clean-up with a labeled standard (37Cl4- labeled 2,3,7,8 TCDD) and tracking the final recovery of this standard. The chemical concentration in the fish tissue sample can be calculated on a mass basis (i.e., relative to the mass of the sample extracted), or lipid basis (i.e., relative to the lipid content of the sample extracted).

For more information on this Method, visit ***www.epa.gov/waterscience/methods/1613.pdf.***

Organochlorine Pesticides by EPA Method 1656A

Organochlorine pesticides (e.g., DDT and chlordane) and were determined by Method 1656, Revision A (*Organo-Halide Pesticides in Wastewater, Soil, Sludge, Sediment, and Tissue by GC/HSD*). The following modification was made to the procedure listed below: the tissue sample extracts were concentrated by a factor of five beyond method-specified levels before instrumental analysis. This modification ensured that all target pesticides could be quantified at levels equal to or lower than the human health screening values for recreational fishers published in Table 5-3 of EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1: Risk Assessment and Fish Consumption Limits, Third Edition* (EPA 2000d).

Analysis of the target pesticides in fish tissue samples by Method 1656A involved the following steps:

1) drying a 10-g aliquot of a homogenized fish tissue sample with sodium sulfate,
2) preparing a soxhlet extraction of the dried fish sample using 1:1 methylene chloride/hexane as the extraction solvent,
3) drying the extract with sodium sulfate and concentrating the extract to dryness (to measure lipid content) using Kuderna-Danish and nitrogen blow-down techniques,
4) re-dissolving the extract and removing lipids by gel-permeation chromatography and/or solid-phase extraction (SPE cartridges),
5) re-concentrating the extract using Kuderna-Danish and nitrogen blow-down techniques, and
6) quantifying the target chemicals in the extract using a gas chromatograph equipped with dual capillary columns and an electron capture detector.

Target chemical identification is performed by comparing the GC retention times of each chemical on two different columns with the respective retention times of an authentic standard. Quantitative analysis (e.g., determining the concentration of each chemical) was performed using an authentic standard to produce a calibration factor or calibration curve, and using the calibration data to determine the concentration of a pollutant in the extract. The chemical concentration in the fish tissue sample can be calculated on a mass basis (i.e., relative to the mass of the sample extracted), or lipid basis (i.e., relative to the lipid content of the sample extracted).

Organophosphorus Pesticides by EPA Method 1657A

EPA Method 1657, Revision A (*Organophosphorus Pesticides in Water, Soil, and Tissue by GC/FPD*) was used to determine the presence and concentration of organophosphorus pesticides (e.g., chlorpyrifos and diazinon).

Analysis of the fish tissue samples by Method 1657A involved the following steps:

1) drying a 10-g aliquot of a homogenized fish tissue sample with sodium sulfate,
2) preparing a soxhlet extraction of the dried fish sample using 1:1 methylene chloride/hexane as the extraction solvent,
3) drying the extract with sodium sulfate and concentrating the extract to dryness (to measure lipid content) using Kuderna-Danish and nitrogen blow-down techniques,
4) re-dissolving the extract and removing lipids by gel-permeation chromatography and/or solid-phase extraction (SPE cartridges),
5) re-concentrating the extract using Kuderna-Danish and nitrogen blow-down techniques, and
6) quantifying the target chemicals in the extract using a gas chromatograph equipped with dual capillary columns and a flame photometric detector.

Target chemical identification was performed by comparing the GC retention times of each chemical on two different columns with the respective retention times of an authentic standard. Quantitative analysis (e.g., determining the concentration of each chemical) was performed using an authentic standard to produce a calibration factor or calibration curve, and using the calibration data to determine the concentration of a chemical in the extract. The chemical concentration in the fish tissue sample can be calculated on a mass basis (i.e., relative to the mass of the sample extracted), or lipid basis (i.e., relative to the lipid content of the sample extracted).

Semivolatile Organic Chemicals by Method 1625C

The remainder of the target organic chemicals were analyzed by a modified version of EPA Method 1625, Revision C (*Semivolatile Organic Compounds by Isotope Dilution GC/MS*). The modifications made to this method involved fractionating the samples by gel permeation chromatography (GPC) to yield a fraction containing the phthalates and some of the lower molecular weight lipids and a lipid-free fraction containing the polar target compounds. The phthalate/lipid fraction was further cleaned using Alumina and then recombined with the lipid-free fraction so that all target chemicals could be determined in a single run.

Analysis of the target chemicals by Method 1625C involved the following steps:

1) homogenizing and spiking isotopically labeled analogs of each target chemical into the sample,
2) extracting the sample at pH 12-13 and then at pH <2 with methylene chloride using continuous extraction techniques,
3) drying each extract over sodium sulfate,
4) concentrating the extract to five mL,
5) cleaning the extract with gel permeation chromatography,
6) concentrating the extract to 0.5 mL,
7) adding internal standards to the extract, and
8) injecting a one µL aliquot of the extract into a gas chromatograph (GC).

At this point, the target chemicals are separated by GC and detected by a mass spectrometer (MS). The labeled compounds serve to correct the variability of the analytical technique. Chemical identification was performed by comparing mass spectrum and retention time to calibration standards (for most chemicals) or through reference libraries using forward search or reverse search techniques. Quantitative analysis was performed in one of the following ways using extracted ion current profile (EICP) areas:

- for compounds in which standards and labeled analogs were available, the concentration was determined using isotope dilution techniques,
- for compounds in which standards were available but labeled analogs were not, the concentration was determined using an internal standard technique, and
- for compounds in which neither standards nor known response factors were available, concentrations were determined using the sum of the EICP areas relative to the sum of the EICP areas of the internal standard.

During analysis of the samples collected in the fourth year of the study only, the laboratory employed a Florisil cleanup instead of an Alumina cleanup. This change was initiated to mitigate lipid interferences that were resulting in an excessive number of re-extractions and re-analyses in the samples collected during previous years of the study. The use of Florisil did reduce the number of re-analyses required, suggesting that this approach should be considered in any further studies.

Appendix E

Percentile Tables for Detected Target Chemicals

TABLE E-1. METALS

Tissue Concentration Estimates for Predators (Fillets)

Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Mercury											
Mercury	486	486	6605	ppb	59.17	89.33	176.67	284.60	432.08	561.79	833.41
Arsenic											
Arsenate	486	2	0.035	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Arsenite	486	0	Not Applicable	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Inorganic Arsenic (Total)	486	2	0.035	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Dimethylarsonic Acid	486	4	0.107	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Monomethylarsonic Acid	486	6	0.016	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies)

Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Mercury											
Mercury	395	395	596	ppb	18.61	20.10	39.27	68.56	124.17	219.58	247.31
Arsenic											
Arsenate	395	4	0.117	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Arsenite	395	61	0.464	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	0.03	0.05
Inorganic Arsenic (Total)	395	36	0.275	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.04
Dimethylarsonic Acid	395	9	0.054	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Monomethylarsonic Acid	395	0	Not Applicable	ppm	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

TABLE E-2. PCBs—SUM OF CONGENERS

Tissue Concentration Estimates for Predators (Fillets)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 1	486	32	7	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.83
PCB 2	486	8	3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 3	486	131	8	ppt	< MDL	< MDL	< MDL	< MDL	0.90	1.77	2.22
PCB 4	486	213	266	ppt	< MDL	< MDL	< MDL	< MDL	0.71	1.89	5.75
PCB 5	486	4	4	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 6	486	172	401	ppt	< MDL	< MDL	< MDL	< MDL	0.28	0.87	2.09
PCB 7	486	92	11	ppt	< MDL	< MDL	< MDL	< MDL	0.14	0.81	2.11
PCB 8	486	174	467	ppt	< MDL	< MDL	< MDL	< MDL	1.51	4.14	8.65
PCB 9	486	37	28	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.59
PCB 10	486	15	9	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 11	486	264	185	ppt	< MDL	< MDL	< MDL	1.02	1.46	2.57	4.51
PCB 12 + PCB 13	486	14	20	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 14	486	1	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 15	486	258	820	ppt	< MDL	< MDL	< MDL	0.17	0.70	1.93	3.47
PCB 16	486	287	298	ppt	< MDL	< MDL	< MDL	< MDL	1.71	3.82	12.65
PCB 17	486	339	487	ppt	< MDL	< MDL	< MDL	1.02	2.19	8.20	23.85
PCB 18 + PCB 30	486	370	1470	ppt	< MDL	< MDL	< MDL	2.29	4.57	14.31	37.52
PCB 19	486	287	142	ppt	< MDL	< MDL	< MDL	0.11	0.39	1.53	2.33
PCB 20 + PCB 28	486	428	7910	ppt	< MDL	< MDL	4.78	8.60	21.90	72.20	163.61
PCB 21 + PCB 33	486	401	699	ppt	< MDL	< MDL	< MDL	1.64	3.41	10.11	24.50
PCB 22	486	439	584	ppt	< MDL	< MDL	0.81	1.84	4.94	14.73	36.04
PCB 23	486	8	2	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 24	486	31	16	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 25	486	262	200	ppt	< MDL	< MDL	< MDL	< MDL	0.96	3.94	7.24
PCB 26 + PCB 29	486	146	577	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	7.94	17.04
PCB 27	486	140	136	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	1.46	3.62
PCB 31	486	434	2020	ppt	< MDL	< MDL	2.63	4.88	12.76	45.26	79.92
PCB 32	486	286	282	ppt	< MDL	< MDL	< MDL	< MDL	1.07	3.04	7.77
PCB 34	486	72	27	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.19	0.99
PCB 35	486	1	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 36	486	2	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 37	486	438	1170	ppt	< MDL	< MDL	0.37	0.84	2.33	5.32	9.43
PCB 38	486	22	7	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 39	486	52	12	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.76
PCB 40 + PCB 41 + PCB 71	486	407	1690	ppt	< MDL	< MDL	< MDL	2.84	10.33	32.62	72.78
PCB 42	486	455	1230	ppt	< MDL	< MDL	1.05	2.61	6.99	25.88	59.03
PCB 43	486	151	96	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	3.33	6.86
PCB 44 + PCB 47 + PCB 65	486	452	10700	ppt	< MDL	< MDL	5.71	13.17	39.33	123.13	271.61
PCB 45 + PCB 51	486	190	327	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	6.44	15.49
PCB 46	486	93	97	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	1.18	2.68
PCB 48	486	389	405	ppt	< MDL	< MDL	< MDL	1.30	3.75	11.53	22.65
PCB 49 + PCB 69	486	478	9940	ppt	1.58	2.33	4.03	9.62	27.09	104.02	211.89
PCB 50 + PCB 53	486	123	678	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	4.92	10.38
PCB 52	486	469	12500	ppt	< MDL	< MDL	8.18	18.67	52.45	214.56	380.53
PCB 54	486	34	15	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 55	486	63	81	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.86
PCB 56	486	467	1230	ppt	< MDL	0.70	1.93	4.90	13.71	46.11	67.74
PCB 57	486	113	57	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	1.21	2.06
PCB 58	486	131	71	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	1.15	2.50
PCB 59 + PCB 62 + PCB 75	486	286	480	ppt	< MDL	< MDL	< MDL	< MDL	3.85	14.02	30.82
PCB 60	486	479	1560	ppt	0.60	0.80	1.98	4.37	15.03	45.82	71.90
PCB 61 + PCB 70 + PCB 74 + PCB 76	486	485	11700	ppt	4.83	7.28	16.35	35.35	101.65	338.62	617.78
PCB 63	486	405	616	ppt	< MDL	< MDL	< MDL	1.51	3.77	13.99	25.67
PCB 64	486	484	2320	ppt	0.90	1.48	2.56	6.26	17.07	57.64	119.54
PCB 66	486	460	8000	ppt	< MDL	5.37	10.75	26.64	66.25	265.50	467.23
PCB 67	486	295	131	ppt	< MDL	< MDL	< MDL	< MDL	1.52	5.18	8.05
PCB 68	486	378	317	ppt	< MDL	< MDL	< MDL	0.69	1.46	5.53	8.80
PCB 72	486	325	389	ppt	< MDL	< MDL	< MDL	0.54	1.42	6.25	10.34
PCB 73	486	20	78.4	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 77	486	181	275	ppt	< MDL	< MDL	< MDL	< MDL	5.01	14.03	22.03
PCB 78	486	1	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 79	486	284	458	ppt	< MDL	< MDL	< MDL	< MDL	1.99	8.17	11.81
PCB 80	486	2	11	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 81	486	104	28	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.49	1.36
PCB 82	486	456	1890	ppt	< MDL	< MDL	1.00	2.90	10.55	38.89	65.48
PCB 83 + PCB 99	486	484	24300	ppt	10.03	14.32	33.79	67.91	240.62	765.55	1277.17
PCB 84	486	449	2320	ppt	< MDL	< MDL	0.97	3.02	10.01	31.61	85.04

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 85 + PCB 116 + PCB 117	486	485	7980	ppt	2.84	3.81	8.76	17.97	64.98	179.65	300.95
PCB 86 + PCB 87 + PCB 97 + PCB 108 + PCB 119 + PCB 125	486	476	18900	ppt	1.96	6.86	14.89	37.03	126.15	418.07	660.55
PCB 88 + PCB 91	486	469	4770	ppt	< MDL	0.77	1.72	4.33	14.31	73.43	113.10
PCB 89	486	121	22.3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.76	1.26
PCB 90 + PCB 101 + PCB 113	486	484	36500	ppt	10.30	15.72	38.92	80.10	262.84	884.10	1420.95
PCB 92	486	481	8620	ppt	1.83	2.94	6.99	15.23	54.77	187.79	303.98
PCB 93 + PCB 95 + PCB 98 + PCB 100 + PCB 102	486	470	17200	ppt	2.21	3.56	7.68	17.54	68.54	208.27	416.02
PCB 94	486	76	62	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.85
PCB 96	486	47	31	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 103	486	326	365	ppt	< MDL	< MDL	< MDL	0.41	1.38	6.82	11.34
PCB 104	486	1	4	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 105	486	470	12100	ppt	5.61	7.72	16.65	36.93	120.78	285.44	536.10
PCB 106	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 107 + PCB 124	486	449	1430	ppt	< MDL	< MDL	1.71	3.88	13.09	31.21	58.52
PCB 109	486	478	4090	ppt	1.19	2.04	5.05	10.46	34.83	88.70	152.94
PCB 110 + PCB 115	486	485	31800	ppt	6.51	10.95	25.72	52.96	203.68	684.32	1095.40
PCB 111	486	214	90	ppt	< MDL	< MDL	< MDL	< MDL	0.63	1.57	3.31
PCB 112	486	1	40	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 114	486	458	950	ppt	< MDL	< MDL	0.82	1.92	8.23	18.91	33.90
PCB 118	486	483	26300	ppt	15.39	24.78	50.19	108.39	367.92	976.25	1790.44

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 120	486	407	392	ppt	< MDL	< MDL	0.62	1.39	4.31	11.00	16.28
PCB 121	486	105	85	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.61	1.30
PCB 122	486	281	74	ppt	< MDL	< MDL	< MDL	0.40	2.51	5.80	8.88
PCB 123	486	400	764	ppt	< MDL	< MDL	< MDL	2.38	7.20	18.39	31.06
PCB 126	486	51	296	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	5.57
PCB 127	486	174	97	ppt	< MDL	< MDL	< MDL	< MDL	0.08	1.94	4.49
PCB 128 + PCB 166	486	477	12500	ppt	5.01	7.33	14.64	30.83	101.87	259.56	496.43
PCB 129 + PCB 138 + PCB 160 + PCB 163	486	485	91600	ppt	35.77	55.98	103.72	247.24	859.74	1908.97	3487.52
PCB 130	486	481	4360	ppt	1.55	1.87	5.43	11.18	33.93	98.55	177.30
PCB 131	486	315	272	ppt	< MDL	< MDL	< MDL	< MDL	2.18	7.99	12.04
PCB 132	486	485	9020	ppt	1.21	1.90	4.27	10.51	42.80	165.36	293.00
PCB 133	486	476	1940	ppt	0.75	1.03	2.13	4.59	13.09	36.60	60.17
PCB 134 + PCB 143	486	434	1530	ppt	< MDL	< MDL	0.92	2.11	8.56	27.22	40.55
PCB 135 + PCB 151 + PCB 154	486	472	13000	ppt	3.87	5.82	13.46	30.00	83.78	262.98	612.12
PCB 136	486	435	2670	ppt	< MDL	< MDL	< MDL	1.65	7.02	29.84	76.80
PCB 137	486	480	4190	ppt	1.32	1.93	4.53	9.97	39.19	75.26	149.88
PCB 139 + PCB 140	486	445	1260	ppt	< MDL	< MDL	1.46	3.07	10.50	29.31	61.34
PCB 141	486	485	9440	ppt	3.22	4.97	10.38	22.45	85.87	242.08	362.95
PCB 142	486	1	14	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 144	486	444	1290	ppt	< MDL	< MDL	1.20	3.67	13.97	36.80	80.89
PCB 145	486	7	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 146	486	485	18100	ppt	7.69	11.91	23.48	49.74	194.63	417.63	649.23

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 147 + PCB 149	486	483	25500	ppt	8.82	12.68	26.44	59.54	206.12	716.30	1294.18
PCB 148	486	253	143	ppt	< MDL	< MDL	< MDL	< MDL	1.09	3.20	8.41
PCB 150	486	174	50	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	1.05	2.77
PCB 152	486	37	21	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 153 + PCB 168	486	485	101000	ppt	44.73	63.16	125.97	284.22	984.90	2225.10	4059.53
PCB 155	486	199	417	ppt	< MDL	< MDL	< MDL	< MDL	0.20	0.88	2.38
PCB 156 + PCB 157	486	483	7640	ppt	3.24	4.38	9.54	19.92	73.05	166.30	299.28
PCB 158	486	484	5190	ppt	2.90	3.92	8.41	18.09	61.08	152.97	239.37
PCB 159	486	398	277	ppt	< MDL	< MDL	< MDL	0.94	2.46	10.63	16.14
PCB 161	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 162	486	410	723	ppt	< MDL	< MDL	0.54	1.52	5.01	10.60	15.77
PCB 164	486	480	3070	ppt	1.20	1.55	3.67	8.04	23.91	71.99	136.55
PCB 165	486	170	108	ppt	< MDL	< MDL	< MDL	< MDL	0.21	1.19	1.97
PCB 167	486	482	3540	ppt	1.60	2.72	5.05	10.69	34.19	83.32	143.99
PCB 169	486	103	70	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.36	0.92
PCB 170	486	473	18200	ppt	6.89	12.50	22.85	45.53	154.78	415.39	819.93
PCB 171 + PCB 173	486	480	4920	ppt	1.88	3.29	6.04	12.88	44.81	141.13	216.60
PCB 172	486	480	5540	ppt	1.90	2.85	6.47	13.17	44.07	104.81	187.30
PCB 174	486	483	5490	ppt	2.01	2.32	6.83	19.83	55.67	203.52	285.75
PCB 175	486	435	1040	ppt	< MDL	< MDL	0.99	2.49	9.01	24.54	36.04
PCB 176	486	412	580	ppt	< MDL	< MDL	< MDL	0.92	3.83	17.08	30.17
PCB 177	486	484	11100	ppt	1.90	2.41	7.88	18.22	50.06	187.04	314.28
PCB 178	486	481	6540	ppt	1.86	2.30	6.45	13.84	32.59	118.27	197.31

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 179	486	466	2170	ppt	< MDL	0.22	1.22	3.51	13.77	52.13	120.61
PCB 180 + PCB 193	486	483	55800	ppt	20.52	34.49	65.54	137.70	457.03	1350.45	2146.57
PCB 181	486	308	255	ppt	< MDL	< MDL	< MDL	0.09	2.04	4.51	8.08
PCB 182	486	326	494	ppt	< MDL	< MDL	< MDL	0.84	3.05	8.49	13.48
PCB 183 + PCB 185	486	478	14800	ppt	5.31	9.98	18.13	38.14	132.23	397.73	618.98
PCB 184	486	213	536	ppt	< MDL	< MDL	< MDL	< MDL	0.71	1.87	3.62
PCB 186	486	1	4	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 187	486	483	39700	ppt	18.55	26.49	47.22	109.52	341.65	1058.04	1407.33
PCB 188	486	49	207	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	5.87
PCB 189	486	447	978	ppt	< MDL	0.49	1.12	2.26	7.03	19.71	27.67
PCB 190	486	481	4290	ppt	1.77	3.02	5.56	12.41	36.40	94.99	215.13
PCB 191	486	436	646	ppt	< MDL	< MDL	0.90	1.96	6.79	18.89	37.26
PCB 192	486	17	30	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 194	486	482	9780	ppt	4.21	6.85	14.15	30.29	90.97	290.49	397.81
PCB 195	486	390	2900	ppt	< MDL	< MDL	< MDL	10.35	30.60	96.29	153.79
PCB 196	486	479	5650	ppt	2.41	3.62	8.00	16.80	54.96	174.55	205.69
PCB 197 + PCB 200	486	435	783	ppt	< MDL	< MDL	1.16	2.56	7.81	21.78	42.31
PCB 198 + PCB 199	486	485	16100	ppt	7.09	11.22	20.78	46.92	136.26	360.44	725.42
PCB 201	486	296	1930	ppt	< MDL	< MDL	< MDL	< MDL	11.97	37.56	68.67
PCB 202	486	471	4250	ppt	< MDL	1.73	4.52	8.83	22.75	75.08	116.91
PCB 203	486	481	9480	ppt	4.94	6.98	13.94	30.24	91.06	278.36	388.84
PCB 204	486	67	72	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	1.72
PCB 205	486	424	666	ppt	< MDL	< MDL	0.72	1.74	4.70	14.40	23.18

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Predators (Fillets) *(continued)*											
Chemical	**Number of Samples**	**Number of Detects**	**Maximum Concentration**	**Units**	**5th Percentile**	**10th Percentile**	**25th Percentile**	**50th Percentile**	**75th Percentile**	**90th Percentile**	**95th Percentile**
PCB 206	486	458	5490	ppt	< MDL	5.50	13.95	26.80	64.17	158.24	338.96
PCB 207	486	469	1450	ppt	0.80	1.35	3.08	6.04	13.31	30.48	61.95
PCB 208	486	477	3000	ppt	1.03	2.05	3.72	8.77	17.43	52.77	136.02
PCB 209	486	419	3450	ppt	< MDL	< MDL	7.33	18.06	35.01	78.51	147.97
PCBs (Sum of Congeners)	486	486	704921	ppt	350.81	494.43	999.94	2161.20	8132.51	18173.83	33160.98

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies)											
Chemical	**Number of Samples**	**Number of Detects**	**Maximum Concentration**	**Units**	**5th Percentile**	**10th Percentile**	**25th Percentile**	**50th Percentile**	**75th Percentile**	**90th Percentile**	**95th Percentile**
PCB 1	395	81	33	ppt	< MDL	< MDL	< MDL	< MDL	0.74	1.19	2.63
PCB 2	395	74	40	ppt	< MDL	< MDL	< MDL	< MDL	0.58	0.98	1.56
PCB 3	395	98	23	ppt	< MDL	< MDL	< MDL	< MDL	0.63	1.10	1.25
PCB 4	395	263	608	ppt	< MDL	< MDL	< MDL	1.27	4.93	17.00	28.33
PCB 5	395	37	19	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	1.04
PCB 6	395	296	601	ppt	< MDL	< MDL	0.39	1.07	2.91	9.85	13.14
PCB 7	395	129	49	ppt	< MDL	< MDL	< MDL	< MDL	0.58	1.68	2.79
PCB 8	395	311	1500	ppt	< MDL	< MDL	< MDL	4.84	11.55	42.57	70.40
PCB 9	395	154	140	ppt	< MDL	< MDL	< MDL	0.03	1.22	3.11	6.11
PCB 10	395	59	47	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.88	1.86
PCB 11	395	289	1520	ppt	< MDL	< MDL	< MDL	2.78	9.55	19.96	27.85
PCB 12 + PCB 13	395	78	469	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	1.98	3.91
PCB 14	395	16	7	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 15	395	312	526	ppt	< MDL	< MDL	< MDL	1.91	5.87	18.45	37.74

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 16	395	364	2270	ppt	< MDL	1.04	2.09	5.12	16.75	43.80	83.25
PCB 17	395	369	2820	ppt	< MDL	1.31	2.30	6.61	21.66	81.53	117.01
PCB 18 + PCB 30	395	383	11900	ppt	2.08	3.23	5.79	13.21	48.04	135.81	313.45
PCB 19	395	316	431	ppt	< MDL	< MDL	0.12	1.08	3.49	16.97	26.46
PCB 20 + PCB 28	395	394	51600	ppt	15.95	19.87	34.67	94.42	262.21	721.87	1668.94
PCB 21 + PCB 33	395	373	16200	ppt	< MDL	1.07	3.05	7.58	27.36	92.93	176.09
PCB 22	395	386	13800	ppt	2.54	3.59	6.63	16.63	51.87	150.97	325.33
PCB 23	395	38	87	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.70	1.49
PCB 24	395	122	167	ppt	< MDL	< MDL	< MDL	< MDL	0.91	2.93	4.84
PCB 25	395	340	1170	ppt	< MDL	< MDL	0.92	2.66	10.79	33.98	109.24
PCB 26 + PCB 29	395	291	7500	ppt	< MDL	< MDL	< MDL	7.49	23.02	76.41	183.76
PCB 27	395	278	976	ppt	< MDL	< MDL	< MDL	1.09	5.40	17.76	28.74
PCB 31	395	388	27300	ppt	7.61	9.63	18.79	44.73	128.98	422.14	1100.16
PCB 32	395	365	5990	ppt	< MDL	0.66	1.34	3.18	10.32	41.55	76.23
PCB 34	395	216	248	ppt	< MDL	< MDL	< MDL	0.43	1.61	4.59	11.76
PCB 35	395	9	350	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 36	395	3	47	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 37	395	365	989	ppt	< MDL	< MDL	1.03	3.83	14.74	57.29	94.66
PCB 38	395	68	80	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.40	1.02
PCB 39	395	176	442	ppt	< MDL	< MDL	< MDL	< MDL	0.97	3.55	7.52
PCB 40 + PCB 41 + PCB 71	395	382	45400	ppt	1.26	3.18	5.86	20.59	85.46	343.06	618.81
PCB 42	395	394	28200	ppt	1.52	3.16	7.43	20.01	79.78	248.58	689.02
PCB 43	395	278	4070	ppt	< MDL	< MDL	< MDL	2.58	10.90	30.66	88.44

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 44 + PCB 47 + PCB 65	395	391	90500	ppt	13.16	20.49	43.77	131.79	503.18	1171.52	3016.97
PCB 45 + PCB 51	395	314	9940	ppt	< MDL	< MDL	< MDL	5.46	21.57	81.96	169.93
PCB 46	395	245	2190	ppt	< MDL	< MDL	< MDL	1.28	5.08	15.24	32.24
PCB 48	395	376	22100	ppt	< MDL	0.93	2.82	9.96	32.81	91.10	220.45
PCB 49 + PCB 69	395	395	69000	ppt	9.01	17.70	30.99	93.78	365.25	978.47	2411.89
PCB 50 + PCB 53	395	239	6760	ppt	< MDL	< MDL	< MDL	2.94	12.11	70.35	143.36
PCB 52	395	395	92900	ppt	13.14	18.42	41.98	101.96	402.61	1693.88	3972.16
PCB 54	395	93	126	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.67	2.13
PCB 55	395	85	135	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	3.09	10.39
PCB 56	395	389	26900	ppt	1.71	2.84	6.44	28.06	107.72	410.30	691.27
PCB 57	395	203	364	ppt	< MDL	< MDL	< MDL	< MDL	1.76	5.18	19.54
PCB 58	395	245	281	ppt	< MDL	< MDL	< MDL	0.90	4.80	16.80	26.36
PCB 59 + PCB 62 + PCB 75	395	370	9330	ppt	< MDL	0.83	4.36	12.12	48.35	107.02	301.12
PCB 60	395	394	40200	ppt	5.14	6.51	13.87	35.50	111.30	311.93	639.48
PCB 61 + PCB 70 + PCB 74 + PCB 76	395	395	152000	ppt	22.88	44.23	93.26	253.74	888.24	2836.54	4635.03
PCB 63	395	389	5880	ppt	1.17	1.76	3.92	11.10	44.52	104.51	248.10
PCB 64	395	394	48700	ppt	7.29	12.36	21.95	50.99	183.51	505.63	1453.43
PCB 66	395	395	136000	ppt	24.12	31.66	72.61	196.61	752.96	2157.40	4293.67
PCB 67	395	331	789	ppt	< MDL	< MDL	0.64	2.42	8.39	34.77	67.44
PCB 68	395	380	1090	ppt	< MDL	0.53	1.71	4.11	15.30	50.34	80.58
PCB 72	395	369	809	ppt	< MDL	0.66	1.64	4.09	16.29	64.65	91.70
PCB 73	395	44	385	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.98	2.37

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*											
PCB 77	395	279	1060	ppt	< MDL	< MDL	< MDL	7.29	22.97	98.29	166.85
PCB 78	395	5	15	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 79	395	337	571	ppt	< MDL	< MDL	1.05	3.39	22.36	50.04	83.16
PCB 80	395	26	34	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 81	395	251	260	ppt	< MDL	< MDL	< MDL	0.74	3.13	5.87	13.12
PCB 82	395	383	7950	ppt	0.56	2.83	6.17	20.49	81.53	284.70	490.43
PCB 83 + PCB 99	395	395	35100	ppt	47.62	72.07	173.50	466.40	2075.17	6028.56	7224.01
PCB 84	395	386	10300	ppt	1.54	3.50	7.78	28.68	119.14	405.09	722.83
PCB 85 + PCB 116 + PCB 117	395	395	12500	ppt	15.18	23.20	44.55	108.19	540.02	1133.28	1661.74
PCB 86 + PCB 87 + PCB 97 + PCB 108 + PCB 119 + PCB 125	395	395	39400	ppt	30.14	40.64	86.46	246.65	1326.16	3200.10	4985.40
PCB 88 + PCB 91	395	393	9240	ppt	3.29	5.25	11.18	38.63	212.09	467.11	847.05
PCB 89	395	254	1300	ppt	< MDL	< MDL	< MDL	0.57	2.87	11.66	21.17
PCB 90 + PCB 101 + PCB 113	395	395	43700	ppt	51.54	72.76	159.87	473.64	2289.08	6047.76	7853.01
PCB 92	395	395	9080	ppt	9.43	12.65	34.52	96.53	417.99	1263.82	1945.24
PCB 93 + PCB 95 + PCB 98 + PCB 100 + PCB 102	395	392	22400	ppt	17.42	26.03	47.06	126.75	564.78	1971.32	3334.05
PCB 94	395	216	502	ppt	< MDL	< MDL	< MDL	< MDL	3.23	8.33	13.83
PCB 96	395	143	542	ppt	< MDL	< MDL	< MDL	< MDL	1.38	6.05	8.14
PCB 103	395	362	811	ppt	< MDL	< MDL	0.86	3.04	16.19	54.39	59.06
PCB 104	395	15	34	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 105	395	395	19600	ppt	28.34	33.66	66.53	181.74	897.11	2082.81	2853.02

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 106	395	1	11	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 107 + PCB 124	395	392	1210	ppt	2.30	2.89	5.66	17.76	71.20	183.54	258.45
PCB 109	395	394	4460	ppt	8.47	10.48	22.05	59.18	275.82	713.09	871.56
PCB 110 + PCB 115	395	395	37200	ppt	49.85	67.46	134.92	385.20	2125.15	4923.92	7759.69
PCB 111	395	302	120	ppt	< MDL	< MDL	0.41	1.60	5.19	10.68	17.71
PCB 112	395	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 114	395	392	1960	ppt	1.54	2.19	4.91	12.03	57.28	146.87	196.81
PCB 118	395	395	34300	ppt	84.00	109.17	214.61	599.83	2829.83	7664.96	9118.27
PCB 120	395	383	829	ppt	0.69	1.22	2.69	7.27	28.82	68.87	93.72
PCB 121	395	240	128	ppt	< MDL	< MDL	< MDL	0.64	1.69	3.57	8.11
PCB 122	395	365	538	ppt	< MDL	0.30	1.63	4.63	22.57	48.40	61.61
PCB 123	395	390	1410	ppt	1.78	2.66	4.87	13.40	62.42	131.34	168.30
PCB 126	395	158	132	ppt	< MDL	< MDL	< MDL	< MDL	12.11	20.64	25.84
PCB 127	395	257	147	ppt	< MDL	< MDL	< MDL	1.22	7.96	15.44	22.84
PCB 128 + PCB 166	395	395	10100	ppt	20.64	29.68	56.35	153.78	774.58	1863.88	2402.66
PCB 129 + PCB 138 + PCB 160 + PCB 163	395	395	97200	ppt	169.45	243.36	421.71	1252.21	6629.91	14288.36	19684.69
PCB 130	395	395	5720	ppt	8.59	12.49	24.34	53.51	364.17	693.06	1108.07
PCB 131	395	340	525	ppt	< MDL	< MDL	0.98	3.52	18.73	56.52	83.17
PCB 132	395	395	10100	ppt	8.64	13.96	32.12	83.52	654.34	1392.59	2016.03
PCB 133	395	393	2490	ppt	3.76	4.76	9.97	23.96	122.32	258.02	296.33
PCB 134 + PCB 143	395	384	2230	ppt	< MDL	2.34	4.77	15.00	97.30	248.00	400.98
PCB 135 + PCB 151 + PCB 154	395	394	19600	ppt	26.00	31.18	68.63	158.35	1218.02	3024.69	3680.68

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*

Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 136	395	392	3200	ppt	1.36	2.46	5.78	13.37	96.18	314.98	420.22
PCB 137	395	393	4210	ppt	4.67	8.86	16.15	42.74	216.78	611.13	964.42
PCB 139 + PCB 140	395	393	1310	ppt	1.74	2.60	6.01	14.42	83.57	178.60	240.54
PCB 141	395	394	9890	ppt	15.87	22.75	37.91	111.74	795.88	1864.34	2199.33
PCB 142	395	1	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 144	395	383	1760	ppt	< MDL	2.49	5.16	15.26	92.22	305.75	333.72
PCB 145	395	48	11	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.59	0.85
PCB 146	395	395	27700	ppt	38.22	51.30	88.81	239.60	1348.14	3122.14	3858.50
PCB 147 + PCB 149	395	395	42000	ppt	47.23	65.26	140.27	391.02	2393.07	4917.49	8596.63
PCB 148	395	328	351	ppt	< MDL	< MDL	0.65	2.00	9.40	18.10	31.88
PCB 150	395	279	200	ppt	< MDL	< MDL	< MDL	0.71	3.38	8.23	13.46
PCB 152	395	161	44	ppt	< MDL	< MDL	< MDL	< MDL	0.90	2.67	3.91
PCB 153 + PCB 168	395	395	167000	ppt	181.43	245.54	455.22	1355.59	7417.12	16229.49	19430.50
PCB 155	395	275	2080	ppt	< MDL	< MDL	< MDL	0.40	1.52	4.93	9.42
PCB 156 + PCB 157	395	395	7290	ppt	11.68	18.99	37.47	105.29	543.48	1088.51	1631.64
PCB 158	395	395	6550	ppt	11.48	19.92	34.38	91.22	518.81	1214.94	1454.81
PCB 159	395	362	444	ppt	< MDL	0.61	2.05	6.15	34.45	73.37	103.30
PCB 161	395	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 162	395	374	395	ppt	< MDL	0.97	2.42	6.15	29.53	64.03	86.03
PCB 164	395	395	2660	ppt	5.70	8.59	17.62	44.82	284.79	542.66	810.31
PCB 165	395	250	190	ppt	< MDL	< MDL	< MDL	0.71	3.63	7.95	21.01
PCB 167	395	395	3540	ppt	7.07	10.84	19.00	59.80	282.11	578.58	755.05
PCB 169	395	278	12	ppt	< MDL	< MDL	< MDL	0.85	1.95	2.70	4.59

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 170	395	395	27800	ppt	26.84	50.82	86.35	219.15	1262.04	2537.83	4520.81
PCB 171 + PCB 173	395	395	10600	ppt	8.26	13.95	23.35	66.46	390.10	784.06	1418.42
PCB 172	395	395	8530	ppt	7.68	14.10	23.23	71.55	297.28	671.19	1071.29
PCB 174	395	395	12900	ppt	15.01	21.12	44.86	110.35	735.15	1679.90	2346.55
PCB 175	395	393	1400	ppt	1.47	2.26	4.64	11.58	61.26	123.34	208.23
PCB 176	395	385	2140	ppt	< MDL	1.41	3.36	9.66	59.27	191.60	249.36
PCB 177	395	395	17800	ppt	12.97	21.62	43.35	107.91	618.33	1831.74	2448.54
PCB 178	395	395	7430	ppt	9.40	15.44	26.78	74.13	428.19	824.26	1358.00
PCB 179	395	391	5500	ppt	4.69	7.06	16.80	40.49	252.40	674.36	850.58
PCB 180 + PCB 193	395	395	105000	ppt	76.16	161.15	253.40	660.50	3757.41	7914.49	12915.10
PCB 181	395	350	219	ppt	< MDL	0.15	1.01	2.88	12.65	30.26	36.38
PCB 182	395	334	445	ppt	< MDL	< MDL	1.32	4.13	16.03	38.27	68.35
PCB 183 + PCB 185	395	391	28800	ppt	19.78	36.62	68.04	168.01	1109.79	2480.11	3676.59
PCB 184	395	310	2960	ppt	< MDL	< MDL	0.60	1.23	3.48	7.60	11.57
PCB 186	395	4	3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 187	395	395	55600	ppt	59.60	108.19	186.28	558.26	3031.01	6548.66	10617.91
PCB 188	395	135	194	ppt	< MDL	< MDL	< MDL	< MDL	6.12	13.51	26.17
PCB 189	395	390	1160	ppt	1.24	2.59	4.68	11.05	50.01	113.50	171.79
PCB 190	395	395	7720	ppt	7.08	12.23	20.31	52.64	291.78	580.17	982.03
PCB 191	395	391	1600	ppt	1.21	2.31	3.91	8.78	51.99	109.70	175.62
PCB 192	395	45	15	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.13	0.75
PCB 194	395	395	17500	ppt	16.81	30.53	57.08	155.75	666.36	1630.24	2552.66
PCB 195	395	377	6510	ppt	< MDL	9.70	18.07	50.89	238.13	520.39	954.87

TABLE E-2. PCBs—SUM OF CONGENERS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies) *(continued)*											
Chemical	**Number of Samples**	**Number of Detects**	**Maximum Concentration**	**Units**	**5th Percentile**	**10th Percentile**	**25th Percentile**	**50th Percentile**	**75th Percentile**	**90th Percentile**	**95th Percentile**
PCB 196	395	392	10100	ppt	9.03	15.75	30.71	90.41	338.94	825.66	1275.23
PCB 197 + PCB 200	395	389	1680	ppt	1.86	3.19	7.51	17.81	82.38	170.72	304.37
PCB 198 + PCB 199	395	392	19300	ppt	22.77	46.04	94.48	306.71	939.61	2429.55	4326.00
PCB 201	395	354	1800	ppt	< MDL	< MDL	9.85	24.23	104.29	185.48	342.83
PCB 202	395	392	2840	ppt	5.10	9.99	21.97	62.00	246.60	431.36	778.99
PCB 203	395	391	14400	ppt	11.48	26.58	55.71	173.29	635.83	1378.73	2349.98
PCB 204	395	169	45	ppt	< MDL	< MDL	< MDL	< MDL	1.56	2.98	3.79
PCB 205	395	386	856	ppt	0.83	1.65	3.56	9.69	32.66	87.98	136.70
PCB 206	395	393	8660	ppt	11.46	27.96	75.30	150.55	468.49	785.51	1289.77
PCB 207	395	395	1920	ppt	2.86	4.87	12.47	30.35	86.84	122.39	214.88
PCB 208	395	395	6000	ppt	6.17	12.28	32.79	74.89	194.61	374.16	637.41
PCB 209	395	388	29200	ppt	9.11	14.55	45.05	106.51	263.89	519.56	730.76
PCBs (Sum of Congeners)	395	395	1266249	ppt	1581.27	2314.73	5146.35	13902.31	70870.03	130787.45	198323.80

TABLE E-3. PCBs—SUM OF AROCLORS

Tissue Concentration Estimates for Predators (Fillets)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 1016	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1221	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1232	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1242	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1248	486	2	33	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1254	486	8	182	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1260	486	109	421	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	14.82	22.10
PCBs (Sum of Aroclors)	486	111	421	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	14.88	22.15
Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
PCB 1016	395	1	16	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1221	395	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1232	395	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1242	395	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1248	395	12	1562	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1254	395	10	446	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
PCB 1260	395	208	1004	ppt	< MDL	< MDL	< MDL	< MDL	39.81	84.71	118.06
PCBs (Sum of Aroclors)	395	214	1562	ppb	< MDL	< MDL	< MDL	< MDL	39.84	85.12	122.98

TABLE E-4. DIOXINS AND FURANS

Tissue Concentration Estimates for Predators (Fillets)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5^{th} Percentile	10^{th} Percentile	25^{th} Percentile	50^{th} Percentile	75^{th} Percentile	90^{th} Percentile	95^{th} Percentile
2,3,7,8-TCDD	486	188	2	ppt	< MDL	< MDL	< MDL	< MDL	0.03	0.08	0.10
1,2,3,7,8-PeCDD	486	83	3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.07
1,2,3,4,7,8-HxCDD	486	15	0.3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
1,2,3,6,7,8-HxCDD	486	136	5	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.06	0.09
1,2,3,7,8,9-HxCDD	486	26	0.4	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
1,2,3,4,6,7,8-HpCDD	486	74	11	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.04	0.09
OCDD	486	18	10	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
2,3,7,8-TCDF	486	347	7	ppt	< MDL	< MDL	< MDL	0.002	0.06	0.10	0.18
1,2,3,7,8-PeCDF	486	33	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
2,3,4,7,8-PeCDF	486	66	5	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.07
1,2,3,4,7,8-HxCDF	486	28	0.2	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
1,2,3,6,7,8-HxCDF	486	12	0.3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
1,2,3,7,8,9-HxCDF	486	3	0.07	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
2,3,4,6,7,8-HxCDF	486	8	0.4	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
1,2,3,4,6,7,8-HpCDF	486	12	2	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
1,2,3,4,7,8,9-HpCDF	486	0	Not Applicable	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
OCDF	486	10	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Dioxins and Furans TEQ	486	395	8	ppt	< MDL	< MDL	< MDL	0.006	0.05	0.11	0.32
12 Coplanar PCBs TEQ	486	485	38.7	ppt	0.004	0.006	0.01	0.03	0.09	0.23	0.92
Total TEQ	486	485	46.2	ppt	0.004	0.006	0.01	0.04	0.14	0.51	1.24

TABLE E-4. DIOXINS AND FURANS *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
2,3,7,8-TCDD	395	319	17	ppt	< MDL	< MDL	0.04	0.09	0.24	0.53	0.78
1,2,3,7,8-PeCDD	395	299	10	ppt	< MDL	< MDL	< MDL	0.10	0.30	0.56	0.66
1,2,3,4,7,8-HxCDD	395	229	13	ppt	< MDL	< MDL	< MDL	0.06	0.20	0.39	0.49
1,2,3,6,7,8-HxCDD	395	340	24	ppt	< MDL	0.04	0.09	0.16	0.62	1.11	1.43
1,2,3,7,8,9-HxCDD	395	222	19	ppt	< MDL	< MDL	< MDL	0.05	0.11	0.27	0.44
1,2,3,4,6,7,8-HpCDD	395	260	142	ppt	< MDL	< MDL	< MDL	0.28	1.19	3.22	3.88
OCDD	395	186	480	ppt	< MDL	< MDL	< MDL	0.30	6.42	17.21	28.52
2,3,7,8-TCDF	395	374	12	ppt	< MDL	0.02	0.09	0.17	0.44	1.28	1.99
1,2,3,7,8-PeCDF	395	219	8	ppt	< MDL	< MDL	< MDL	0.04	0.09	0.14	0.19
2,3,4,7,8-PeCDF	395	301	3	ppt	< MDL	< MDL	0.06	0.09	0.22	0.37	0.46
1,2,3,4,7,8-HxCDF	395	170	20	ppt	< MDL	< MDL	< MDL	< MDL	0.05	0.09	0.10
1,2,3,6,7,8-HxCDF	395	148	5	ppt	< MDL	< MDL	< MDL	< MDL	0.06	0.09	0.10
1,2,3,7,8,9-HxCDF	395	10	0.3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
2,3,4,6,7,8-HxCDF	395	89	1	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.08	0.10
1,2,3,4,6,7,8-HpCDF	395	159	7	ppt	< MDL	< MDL	< MDL	< MDL	0.09	0.19	0.34
1,2,3,4,7,8,9-HpCDF	395	4	3	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
OCDF	395	35	9	ppt	< MDL	< MDL	< MDL	< MDL	< MDL	0.18	0.33
Dioxins and Furans TEQ	395	393	24	ppt	0.02	0.06	0.16	0.41	1.07	1.77	2.01
12 Coplanar PCBs TEQ	395	395	20.0	ppt	0.02	0.03	0.06	0.15	1.92	4.01	4.65
Total TEQ	395	395	27.1	ppt	0.07	0.11	0.29	0.68	2.89	5.30	5.83

TABLE E-5. ORGANOCHLORINE PESTICIDES

Tissue Concentration Estimates for Predators (Fillets)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Aldrin	486	6	8	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Dicofol	486	15	1235	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Dieldrin	486	24	18	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	1.19
Endosulfan Sulfate	486	1	11	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Endrin	486	3	12	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Ethalfluralin	486	20	12	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Heptachlor	486	17	8	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Heptachlor epoxide	486	6	3	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Hexachlorocyclohexane (BHC), alpha-	486	5	8	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Hexachlorocyclohexane (BHC), beta-	486	39	9	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	1.78
Hexachlorocyclohexane (BHC), delta-	486	7	4	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Isodrin	486	16	5	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Kepone (Chlordecone)	486	60	129	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	16.29	24.92
Lindane (Hexachlorocyclohexane, gamma-BHC)	486	28	3	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.99
Methoxychlor	486	9	370	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Mirex	486	10	9	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Octachlorostyrene	486	6	19	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Pendimethalin	486	1	13	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Pentachloroanisole	486	57	4	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	1.45	2.16
Pentachloronitrobenzene	486	29	4	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	1.07
Permethrin, cis-	486	5	325	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

TABLE E-5. ORGANOCHLORINE PESTICIDES *(continued)*

Tissue Concentration Estimates for Predators (Fillets)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Permethrin, trans-	486	4	131	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Toxaphene	486	0	Not Applicable	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Trifluralin	486	36	11	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	3.16
Tissue Concentration Estimates for Bottom Dweller (Whole Bodies)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Aldrin	395	9	22	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Dicofol	395	8	269	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Dieldrin	395	73	392	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	3.44	24.61
Endosulfan Sulfate	395	19	22	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Endrin	395	14	20	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Ethalfluralin	395	90	16	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	3.38	4.93
Heptachlor	395	24	17	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	2.43
Heptachlor epoxide	395	25	14	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.68
Hexachlorocyclohexane (BHC), alpha-	395	8	6	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Hexachlorocyclohexane (BHC), beta-	395	38	39	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	2.1
Hexachlorocyclohexane (BHC), delta-	395	21	15	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Isodrin	395	19	12	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Kepone (Chlordecone)	395	92	2008	ppb	< MDL	< MDL	< MDL	< MDL	13.91	69.89	84.94
Lindane (Hexachlorocyclohexane, gamma-BHC)	395	31	9	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	0.73	1.54

TABLE E-5. ORGANOCHLORINE PESTICIDES *(continued)*

Tissue Concentration Estimates for Bottom Dweller (Whole Bodies) *(continued)*											
Chemical	**Number of Samples**	**Number of Detects**	**Maximum Concentration**	**Units**	**5th Percentile**	**10th Percentile**	**25th Percentile**	**50th Percentile**	**75th Percentile**	**90th Percentile**	**95th Percentile**
Methoxychlor	395	23	107	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Mirex	395	19	29	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	1.87
Octachlorostyrene	395	8	3	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Pendimethalin	395	19	33	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Pentachloroanisole	395	92	9	ppb	< MDL	< MDL	< MDL	< MDL	1.37	4.02	4.63
Pentachloronitrobenzene	395	50	5	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	1.34	1.59
Permethrin, cis-	395	27	441	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	40.39
Permethrin, trans-	395	12	264	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Toxaphene	395	1	91	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Trifluralin	395	144	96	ppb	< MDL	< MDL	< MDL	< MDL	3.76	7.26	13.88

TABLE E-6. SUMMED ORGANOCHLORINE PESTICIDES

Tissue Concentration Estimates for Predators (Fillets)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Total Chlordane											
Chlordane, alpha-	486	33	20	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Chlordane, gamma-	486	13	6	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Nonachlor, cis-	486	23	10	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Nonachlor, trans-	486	56	70	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	1.79	4.04
Oxychlordane	486	23	10	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Total Chlordane	486	96	100	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	3.62	8.27
Total DDT											
2,4'-DDD	352	5	3	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
2,4'-DDE	352	34	9	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
2,4'-DDT	352	18	10	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
4,4'-DDD	486	46	41	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	3.8
4,4'-DDE	486	374	1394	ppb	< MDL	< MDL	< MDL	1.38	4	16.87	30.03
4,4'-DDT	486	43	50	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	2.23
Total DDT	486	378	1481	ppb	< MDL	< MDL	< MDL	1.47	6.95	19.68	30.57
Total Endosulfan											
Endosulfan I	486	18	59	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Endosulfan II	486	0	Not Applicable	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Total Endosulfan	486	18	59	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

TABLE E-6. SUMMED ORGANOCHLORINE PESTICIDES *(continued)*

Tissue Concentration Estimates for Bottom Dwellers (Whole Bodies)											
Chemical	Number of Samples	Number of Detects	Maximum Concentration	Units	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
Total Chlordane											
Chlordane, alpha-	395	122	178	ppb	< MDL	< MDL	< MDL	< MDL	3.75	6.17	10.44
Chlordane, gamma-	395	48	80	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	0.63	1.15
Nonachlor, cis-	395	68	68	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	7.14	9.71
Nonachlor, trans-	395	159	87	ppb	< MDL	< MDL	< MDL	< MDL	4.08	5.77	12.05
Oxychlordane	395	45	12	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	3.6	6.25
Total Chlordane	395	197	378	ppb	< MDL	< MDL	< MDL	1.65	9.31	25.96	30.93
Total DDT											
2,4'-DDD	274	27	13	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.82
2,4'-DDE	274	112	41	ppb	< MDL	< MDL	< MDL	< MDL	1.32	3.01	3.7
2,4'-DDT	274	28	20	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	0.84
4,4'-DDD	395	147	159	ppb	< MDL	< MDL	< MDL	< MDL	5.17	11.68	23.89
4,4'-DDE	395	387	1743	ppb	1.02	1.43	3.77	9.66	32.12	99.89	198.67
4,4'-DDT	395	60	42	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	1.41	3.02
Total DDT	395	388	1761	ppb	1.08	1.82	4.23	12.68	35.35	153.92	218.63
Total Endosulfan											
Endosulfan I	395	23	38.6	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Endosulfan II	395	0	Not Applicable	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL
Total Endosulfan	395	23	38.6	ppb	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

Appendix F

Occurrence of Target Chemicals

Metal Results for Predators						
Chemical	MDL ng/g (ppb)	ML ng/g (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Mercury	0.521	2	0	0	486	486
Chemical	MDL µg/g (ppm)	ML µg/g (ppm)	< MDL	≥ MDL & < ML	≥ ML	Total
Arsenate	0.03	0.1	484	2	0	486
Arsenite	0.02	0.1	486	0	0	486
Total Inorganic Arsenic	0.03	0.1	484	2	0	486
Dimethylarsonic Acid	0.04	0.1	482	3	1	486
Monomethylarsonic Acid	0.01	0.05	480	6	0	486

Metal Results for Bottom Dwellers						
Chemical	MDL µg/g (ppb)	ML µg/g (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Mercury	0.521	2	0	0	395	395
Chemical	MDL µg/g (ppm)	ML µg/g (ppm)	< MDL	≥ MDL & < ML	≥ ML	Total
Arsenate	0.03	0.1	391	3	1	395
Arsenite	0.02	0.1	334	53	8	395
Total Inorganic Arsenic	0.03	0.1	359	30	6	395
Dimethylarsonic Acid	0.04	0.1	386	9	0	395
Monomethylarsonic Acid	0.01	0.05	395	0	0	395

Polychlorinated Biphenyl (PCB) Results for Predators						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-1	0.8	2.0	449	26	7	482*
PCB-2	0.8	2.0	474	5	3	482*
PCB-3	0.6	2.0	353	113	19	485*
PCB-4	0.5	2.0	272	148	66	486
PCB-5	0.7	2.0	482	2	2	486
PCB-6	0.3	1.0	313	124	49	486
PCB-7	0.4	1.0	394	59	33	486
PCB-8	1.3	5.0	311	129	46	486
PCB-9	0.5	2.0	448	30	8	486
PCB-10	0.7	2.0	471	10	5	486

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Polychlorinated Biphenyl (PCB) Results for Predators *(continued)*						
			Number of Concentration Values			
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	< MDL	≥ MDL & < ML	≥ ML	Total
PCB-11	1.0	2.0	221	156	109	486
PCB-12+PCB-13	1.0	2.0	472	9	5	486
PCB-14	0.5	2.0	485	1	0	486
PCB-15	0.4	1.0	227	135	124	486
PCB-16	1.0	2.0	198	115	173	486
PCB-17	1.0	2.0	146	120	220	486
PCB-18+PCB-30	1.8	5.0	115	185	186	486
PCB-19	0.1	0.5	198	130	158	486
PCB-20+PCB-28	4.2	10.0	57	115	314	486
PCB-21+PCB-33	1.0	2.0	84	115	287	486
PCB-22	0.2	0.5	46	8	432	486
PCB-23	0.6	2.0	478	7	1	486
PCB-24	0.8	2.0	455	17	14	486
PCB-25	0.6	2.0	223	146	117	486
PCB-26+PCB-29	3.5	10.0	339	83	64	486
PCB-27	0.7	2.0	345	78	63	486
PCB-31	0.5	2.0	51	17	418	486
PCB-32	0.6	2.0	199	176	111	486
PCB-34	0.5	2.0	413	49	24	486
PCB-35	0.4	1.0	485	1	0	486
PCB-36	0.5	2.0	484	2	0	486
PCB-37	0.2	0.5	47	69	370	486
PCB-38	0.4	1.0	464	13	9	486
PCB-39	0.5	2.0	434	35	17	486
PCB-40+PCB-41+PCB-71	1.6	5.0	78	141	267	486
PCB-42	0.7	2.0	30	98	358	486
PCB-43	1.4	5.0	334	88	64	486
PCB-44+PCB-47+PCB-65	4.3	10.0	33	86	367	486
PCB-45+PCB-51	2.2	5.0	295	81	110	486
PCB-46	1.2	5.0	392	64	30	486
PCB-48	0.8	2.0	96	113	277	486
PCB-49+PCB-69	1.4	5.0	7	69	410	486
PCB-50+PCB-53	3.2	10.0	362	75	49	486
PCB-52	4.3	10.0	16	66	404	486
PCB-54	0.3	1.0	452	16	18	486
PCB-55	0.5	2.0	423	38	25	486
PCB-56	0.5	2.0	18	67	401	486
PCB-57	0.6	2.0	372	66	48	486

Polychlorinated Biphenyl (PCB) Results for Predators *(continued)*						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-58	0.5	2.0	354	77	55	486
PCB-59+PCB-62+PCB-75	2.0	5.0	199	127	160	486
PCB-60	0.4	1.0	6	19	461	486
PCB-61+PCB-70+PCB-74+PCB-76	2.3	10.0	0	25	461	486
PCB-63	0.7	2.0	80	141	265	486
PCB-64	0.6	2.0	1	31	454	486
PCB-66	5.2	20.0	25	107	354	486
PCB-67	0.6	2.0	190	153	143	486
PCB-68	0.4	1.0	107	135	244	486
PCB-72	0.5	2.0	160	179	147	486
PCB-73	0.7	2.0	466	8	12	486
PCB-77	4.9	20.0	304	128	54	486
PCB-78	0.7	2.0	485	1	0	486
PCB-79	0.8	2.0	201	105	180	486
PCB-80	0.8	2.0	484	1	1	486
PCB-81	0.5	2.0	381	80	25	486
PCB-82	0.6	2.0	29	61	396	486
PCB-83+PCB-99	1.0	2.0	1	0	485	486
PCB-84	0.9	2.0	36	48	402	486
PCB-85+PCB-116+PCB-117	1.0	2.0	0	5	481	486
PCB-86+PCB-87+PCB-97+ PCB-108+PCB-119+PCB-125	4.5	20.0	9	65	412	486
PCB-88+PCB-91	0.8	2.0	16	43	427	486
PCB-89	0.6	2.0	364	77	45	486
PCB-90+PCB-101+PCB-113	3.7	10.0	1	9	476	486
PCB-92	0.1	0.5	4	0	482	486
PCB-93+PCB-95+PCB-98+ PCB-100+PCB-102	2.1	5.0	15	21	450	486
PCB-94	0.6	2.0	409	40	37	486
PCB-96	1.0	2.0	438	22	26	486
PCB-103	0.4	1.0	159	90	237	486
PCB-104	3.6	10.0	485	1	0	486
PCB-105	5.3	20.0	15	82	389	486
PCB-106	0.4	1.0	486	0	0	486
PCB-107+PCB-124	1.0	2.0	36	55	395	486
PCB-109	0.5	2.0	7	20	459	486
PCB-110+PCB-115	0.5	2.0	0	0	486	486
PCB-111	0.4	1.0	271	105	110	486
PCB-112	0.6	2.0	485	0	1	486
PCB-114	0.4	1.0	27	47	412	486

Polychlorinated Biphenyl (PCB) Results for Predators *(continued)*						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-118	4.9	20.0	2	21	463	486
PCB-120	0.5	2.0	78	166	242	486
PCB-121	0.6	2.0	381	74	31	486
PCB-122	0.3	1.0	204	70	212	486
PCB-123	1.1	2.0	85	83	318	486
PCB-126	5.1	20.0	435	47	4	486
PCB-127	0.5	2.0	312	97	77	486
PCB-128+PCB-166	3.7	10.0	8	39	439	486
PCB-129+PCB-138+ PCB-160+PCB-163	5.4	20.0	0	5	481	486
PCB-130	0.4	1.0	4	5	477	486
PCB-131	0.6	2.0	170	129	187	486
PCB-132	0.8	2.0	0	19	467	486
PCB-133	0.5	2.0	9	59	418	486
PCB-134+PCB-143	0.8	2.0	51	78	357	486
PCB-135+PCB-151+PCB-154	4.0	10.0	13	31	442	486
PCB-136	0.6	2.0	50	73	363	486
PCB-137	0.4	1.0	5	7	474	486
PCB-139+PCB-140	0.8	2.0	40	68	378	486
PCB-141	0.7	2.0	0	4	482	486
PCB-142	0.5	2.0	485	0	1	486
PCB-144	0.7	2.0	41	51	394	486
PCB-145	0.5	2.0	479	7	0	486
PCB-146	0.4	1.0	0	0	486	486
PCB-147+PCB-149	0.6	2.0	2	0	484	486
PCB-148	0.6	2.0	232	126	128	486
PCB-150	0.4	1.0	311	84	91	486
PCB-152	0.4	1.0	448	22	16	486
PCB-153+PCB-168	4.1	10.0	0	2	484	486
PCB-155	0.3	1.0	287	116	83	486
PCB-156+PCB-157	0.5	2.0	2	11	473	486
PCB-158	0.4	1.0	1	2	483	486
PCB-159	0.4	1.0	87	77	322	486
PCB-161	0.5	2.0	486	0	0	486
PCB-162	0.4	1.0	75	64	347	486
PCB-164	0.3	1.0	5	7	474	486
PCB-165	0.4	1.0	315	77	94	486
PCB-167	0.2	1.0	3	6	477	486
PCB-169	0.3	1.0	383	65	38	486

Polychlorinated Biphenyl (PCB) Results for Predators *(continued)*						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-170	5.0	20.0	12	62	412	486
PCB-171+PCB-173	0.8	2.0	5	15	466	486
PCB-172	0.5	2.0	5	18	463	486
PCB-174	0.6	2.0	2	9	475	486
PCB-175	0.6	2.0	50	91	345	486
PCB-176	0.5	2.0	73	119	294	486
PCB-177	0.3	1.0	1	1	484	486
PCB-178	0.8	2.0	4	13	469	486
PCB-179	0.4	1.0	19	22	445	486
PCB-180+PCB-193	4.5	10.0	2	3	481	486
PCB-181	0.5	2.0	177	153	156	486
PCB-182	0.8	2.0	159	117	210	486
PCB-183+PCB-185	1.1	5.0	7	7	472	486
PCB-184	0.6	2.0	272	122	92	486
PCB-186	0.7	2.0	485	0	1	486
PCB-187	4.3	10.0	2	8	476	486
PCB-188	4.6	10.0	437	33	16	486
PCB-189	0.4	1.0	38	47	401	486
PCB-190	0.3	1.0	4	3	479	486
PCB-191	0.5	2.0	49	117	320	486
PCB-192	0.3	1.0	469	12	5	486
PCB-194	1.1	5.0	3	18	465	486
PCB-195	4.9	20.0	95	193	198	486
PCB-196	0.8	2.0	6	12	468	486
PCB-197+PCB-200	0.8	2.0	50	77	359	486
PCB-198+PCB-199	0.8	2.0	0	2	484	486
PCB-201	4.9	20.0	189	180	117	486
PCB-202	0.5	2.0	14	18	454	486
PCB-203	0.8	2.0	4	8	474	486
PCB-204	0.9	2.0	419	40	27	486
PCB-205	0.5	2.0	61	145	280	486
PCB-206	4.5	10.0	27	54	405	486
PCB-207	0.5	2.0	16	54	416	486
PCB-208	0.5	2.0	8	25	453	486
PCB-209	5.0	20.0	66	197	223	486

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Polychlorinated Biphenyl (PCB) Results for Bottom Dwellers						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-1	0.8	2.0	313	58	23	394*
PCB-2	0.8	2.0	320	55	19	394*
PCB-3	0.6	2.0	296	87	11	394*
PCB-4	0.5	2.0	132	84	179	395
PCB-5	0.7	2.0	358	27	10	395
PCB-6	0.3	1.0	99	104	192	395
PCB-7	0.4	1.0	266	71	58	395
PCB-8	1.3	5.0	84	132	179	395
PCB-9	0.5	2.0	241	115	39	395
PCB-10	0.7	2.0	336	33	26	395
PCB-11	1.0	2.0	106	52	237	395
PCB-12+PCB-13	1.0	2.0	317	38	40	395
PCB-14	0.5	2.0	379	14	2	395
PCB-15	0.4	1.0	83	44	268	395
PCB-16	1.0	2.0	31	45	319	395
PCB-17	1.0	2.0	26	48	321	395
PCB-18+PCB-30	1.8	5.0	12	56	327	395
PCB-19	0.1	0.5	79	31	285	395
PCB-20+PCB-28	4.2	10.0	1	2	392	395
PCB-21+PCB-33	1.0	2.0	22	25	348	395
PCB-22	0.2	0.5	9	0	386	395
PCB-23	0.6	2.0	357	30	8	395
PCB-24	0.8	2.0	273	61	61	395
PCB-25	0.6	2.0	55	94	246	395
PCB-26+PCB-29	3.5	10.0	104	119	172	395
PCB-27	0.7	2.0	117	106	172	395
PCB-31	0.5	2.0	7	0	388	395
PCB-32	0.6	2.0	30	101	264	395
PCB-34	0.5	2.0	179	126	90	395
PCB-35	0.4	1.0	386	5	4	395
PCB-36	0.5	2.0	392	2	1	395
PCB-37	0.2	0.5	30	7	358	395
PCB-38	0.4	1.0	327	32	36	395
PCB-39	0.5	2.0	219	103	73	395
PCB-40+PCB-41+PCB-71	1.6	5.0	13	37	345	395
PCB-42	0.7	2.0	1	16	378	395
PCB-43	1.4	5.0	117	116	162	395
PCB-44+PCB-47+PCB-65	4.3	10.0	4	4	387	395
PCB-45+PCB-51	2.2	5.0	81	82	232	395
PCB-46	1.2	5.0	150	132	113	395
PCB-48	0.8	2.0	19	27	349	395

Polychlorinated Biphenyl (PCB) Results for Bottom Dwellers *(continued)*						
Chemical	**MDL** ng/kg (ppt)	**ML** ng/kg (ppt)	**Number of Concentration Values**			
			< MDL	**≥ MDL & < ML**	**≥ ML**	**Total**
PCB-49+PCB-69	1.4	5.0	0	2	393	395
PCB-50+PCB-53	3.2	10.0	156	106	133	395
PCB-52	4.3	10.0	0	11	384	395
PCB-54	0.3	1.0	302	46	47	395
PCB-55	0.5	2.0	310	30	55	395
PCB-56	0.5	2.0	6	12	377	395
PCB-57	0.6	2.0	192	86	117	395
PCB-58	0.5	2.0	150	88	157	395
PCB-59+PCB-62+PCB-75	2.0	5.0	25	73	297	395
PCB-60	0.4	1.0	1	0	394	395
PCB-61+PCB-70+PCB-74+PCB-76	2.3	10.0	0	1	394	395
PCB-63	0.7	2.0	6	25	364	395
PCB-64	0.6	2.0	1	0	394	395
PCB-66	5.2	20.0	0	8	387	395
PCB-67	0.6	2.0	64	84	247	395
PCB-68	0.4	1.0	15	28	352	395
PCB-72	0.5	2.0	26	87	282	395
PCB-73	0.7	2.0	351	16	28	395
PCB-77	4.9	20.0	116	141	138	395
PCB-78	0.7	2.0	390	1	4	395
PCB-79	0.8	2.0	58	58	279	395
PCB-80	0.8	2.0	369	19	7	395
PCB-81	0.5	2.0	144	117	134	395
PCB-82	0.6	2.0	12	9	374	395
PCB-83+PCB-99	1.0	2.0	0	0	395	395
PCB-84	0.9	2.0	9	4	382	395
PCB-85+PCB-116+PCB-117	1.0	2.0	0	0	395	395
PCB-86+PCB-87+PCB-97+ PCB-108+PCB-119+PCB-125	4.5	20.0	0	5	390	395
PCB-88+PCB-91	0.8	2.0	2	4	389	395
PCB-89	0.6	2.0	141	105	149	395
PCB-90+PCB-101+PCB-113	3.7	10.0	0	0	395	395
PCB-92	0.1	0.5	0	0	395	395
PCB-93+PCB-95+PCB-98+ PCB-100+PCB-102	2.1	5.0	3	0	392	395
PCB-94	0.6	2.0	179	92	124	395
PCB-96	1.0	2.0	252	48	95	395
PCB-103	0.4	1.0	33	46	316	395
PCB-104	3.6	10.0	380	11	4	395
PCB-105	5.3	20.0	0	9	386	395
PCB-106	0.4	1.0	394	0	1	395
PCB-107+PCB-124	1.0	2.0	3	8	384	395

Polychlorinated Biphenyl (PCB) Results for Bottom Dwellers *(continued)*						
Chemical	**MDL** ng/kg (ppt)	**ML** ng/kg (ppt)	**Number of Concentration Values**			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-109	0.5	2.0	1	0	394	395
PCB-110+PCB-115	0.5	2.0	0	0	395	395
PCB-111	0.4	1.0	93	60	242	395
PCB-112	0.6	2.0	395	0	0	395
PCB-114	0.4	1.0	3	4	388	395
PCB-118	4.9	20.0	0	1	394	395
PCB-120	0.5	2.0	12	53	330	395
PCB-121	0.6	2.0	155	147	93	395
PCB-122	0.3	1.0	30	22	343	395
PCB-123	1.1	2.0	5	17	373	395
PCB-126	5.1	20.0	237	107	51	395
PCB-127	0.5	2.0	138	75	182	395
PCB-128+PCB-166	3.7	10.0	0	2	393	395
PCB-129+PCB-138+PCB-160+ PCB-163	5.4	20.0	0	0	395	395
PCB-130	0.4	1.0	0	0	395	395
PCB-131	0.6	2.0	55	50	290	395
PCB-132	0.8	2.0	0	1	394	395
PCB-133	0.5	2.0	2	3	390	395
PCB-134+PCB-143	0.8	2.0	11	11	373	395
PCB-135+PCB-151+PCB-154	4.0	10.0	1	0	394	395
PCB-136	0.6	2.0	3	12	380	395
PCB-137	0.4	1.0	2	0	393	395
PCB-139+PCB-140	0.8	2.0	2	15	378	395
PCB-141	0.7	2.0	1	0	394	395
PCB-142	0.5	2.0	394	1	0	395
PCB-144	0.7	2.0	12	5	378	395
PCB-145	0.5	2.0	347	35	13	395
PCB-146	0.4	1.0	0	0	395	395
PCB-147+PCB-149	0.6	2.0	0	0	395	395
PCB-148	0.6	2.0	67	93	235	395
PCB-150	0.4	1.0	116	77	202	395
PCB-152	0.4	1.0	234	61	100	395
PCB-153+PCB-168	4.1	10.0	0	0	395	395
PCB-155	0.3	1.0	120	116	159	395
PCB-156+PCB-157	0.5	2.0	0	0	395	395
PCB-158	0.4	1.0	0	0	395	395
PCB-159	0.4	1.0	33	13	349	395
PCB-161	0.5	2.0	395	0	0	395
PCB-162	0.4	1.0	21	15	359	395
PCB-164	0.3	1.0	0	0	395	395

Polychlorinated Biphenyl (PCB) Results for Bottom Dwellers *(continued)*						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
PCB-165	0.4	1.0	145	46	204	395
PCB-167	0.2	1.0	0	0	395	395
PCB-169	0.3	1.0	117	63	215	395
PCB-170	5.0	20.0	0	10	385	395
PCB-171+PCB-173	0.8	2.0	0	0	395	395
PCB-172	0.5	2.0	0	0	395	395
PCB-174	0.6	2.0	0	0	395	395
PCB-175	0.6	2.0	2	26	367	395
PCB-176	0.5	2.0	10	25	360	395
PCB-177	0.3	1.0	0	0	395	395
PCB-178	0.8	2.0	0	0	395	395
PCB-179	0.4	1.0	4	0	391	395
PCB-180+PCB-193	4.5	10.0	0	0	395	395
PCB-181	0.5	2.0	45	80	270	395
PCB-182	0.8	2.0	61	49	285	395
PCB-183+PCB-185	1.1	5.0	4	0	391	395
PCB-184	0.6	2.0	85	137	173	395
PCB-186	0.7	2.0	391	2	2	395
PCB-187	4.3	10.0	0	0	395	395
PCB-188	4.6	10.0	260	66	69	395
PCB-189	0.4	1.0	5	9	381	395
PCB-190	0.3	1.0	0	0	395	395
PCB-191	0.5	2.0	4	30	361	395
PCB-192	0.3	1.0	350	28	17	395
PCB-194	1.1	5.0	0	0	395	395
PCB-195	4.9	20.0	18	73	304	395
PCB-196	0.8	2.0	3	0	392	395
PCB-197+PCB-200	0.8	2.0	6	16	373	395
PCB-198+PCB-199	0.8	2.0	3	0	392	395
PCB-201	4.9	20.0	41	111	243	395
PCB-202	0.5	2.0	3	1	391	395
PCB-203	0.8	2.0	4	0	391	395
PCB-204	0.9	2.0	226	82	87	395
PCB-205	0.5	2.0	9	35	351	395
PCB-206	4.5	10.0	2	9	384	395
PCB-207	0.5	2.0	0	7	388	395
PCB-208	0.5	2.0	0	1	394	395
PCB-209	5.0	20.0	7	49	339	395

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

PCB Aroclor Results for Predators						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Aroclor-1016	0.68	20	486	0	0	486
Aroclor-1221	0.76	20	486	0	0	486
Aroclor-1232	0.76	20	486	0	0	486
Aroclor-1242	0.76	20	486	0	0	486
Aroclor-1248	0.76	20	484	1	1	486
Aroclor-1254	0.76	20	480	1	7	486
Aroclor-1260	0.76	20	377	69	40	486

PCB Aroclor Results for Bottom Dwellers						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Aroclor-1016	0.68	20	394	1	0	395
Aroclor-1221	0.76	20	395	0	0	395
Aroclor-1232	0.76	20	395	0	0	395
Aroclor-1242	0.76	20	395	0	0	395
Aroclor-1248	0.76	20	383	1	11	395
Aroclor-1254	0.76	20	385	0	10	395
Aroclor-1260	0.76	20	187	49	159	395

Dioxin and Furan Results for Predators						
Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
2,3,7,8-TCDD	0.01	0.1	297	142	47	486
1,2,3,7,8-PeCDD	0.06	0.5	403	75	8	486
1,2,3,4,7,8-HxCDD	0.06	0.5	471	15	0	486
1,2,3,6,7,8-HxCDD	0.04	0.5	350	128	8	486
1,2,3,7,8,9-HxCDD	0.04	0.5	460	26	0	486
1,2,3,4,6,7,8-HpCDD	0.03	0.5	412	65	9	486
OCDD	0.09	1.0	467	9	10	486
2,3,7,8-TCDF	0.03	0.1	138	189	159	486
1,2,3,7,8-PeCDF	0.04	0.5	453	32	1	486
2,3,4,7,8-PeCDF	0.06	0.5	420	61	5	486
1,2,3,4,7,8-HxCDF	0.04	0.5	458	28	0	486
1,2,3,6,7,8-HxCDF	0.04	0.5	474	12	0	486
1,2,3,7,8,9-HxCDF	0.04	0.5	483	3	0	486
2,3,4,6,7,8-HxCDF	0.06	0.5	478	8	0	486
1,2,3,4,6,7,8-HpCDF	0.05	0.5	474	11	1	486
1,2,3,4,7,8,9-HpCDF	0.05	0.5	486	0	0	486
OCDF	0.2	1.0	476	10	0	486

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Chemical	MDL ng/kg (ppt)	ML ng/kg (ppt)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Dioxin and Furan Results for Bottom Dwellers						
2,3,7,8-TCDD	0.01	0.1	76	133	186	395
1,2,3,7,8-PeCDD	0.06	0.5	96	226	73	395
1,2,3,4,7,8-HxCDD	0.06	0.5	166	193	36	395
1,2,3,6,7,8-HxCDD	0.04	0.5	55	209	131	395
1,2,3,7,8,9-HxCDD	0.04	0.5	173	201	21	395
1,2,3,4,6,7,8-HpCDD	0.03	0.5	135	74	186	395
OCDD	0.09	1.0	209	22	164	395
2,3,7,8-TCDF	0.03	0.1	21	67	307	395
1,2,3,7,8-PeCDF	0.04	0.5	176	211	8	395
2,3,4,7,8-PeCDF	0.06	0.5	94	264	37	395
1,2,3,4,7,8-HxCDF	0.04	0.5	225	168	2	395
1,2,3,6,7,8-HxCDF	0.04	0.5	247	147	1	395
1,2,3,7,8,9-HxCDF	0.04	0.5	385	10	0	395
2,3,4,6,7,8-HxCDF	0.06	0.5	306	88	1	395
1,2,3,4,6,7,8-HpCDF	0.05	0.5	236	146	13	395
1,2,3,4,7,8,9-HpCDF	0.05	0.5	391	2	2	395
OCDF	0.2	1.0	360	32	3	395

Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Organochloride Pesticide Results for Predators						
2,4'-DDD	0.38	2.0	347	3	2	352†
2,4'-DDE	0.82	2.0	318	17	17	352†
2,4'-DDT	0.38	2.0	334	10	8	352†
4,4'-DDD	0.52	2.0	440	5	41	486
4,4'-DDE	0.74	2.0	112	117	257	486
4,4'-DDT	0.66	2.0	443	10	33	486
Aldrin	2.178	4.0	480	5	1	486
Chlordane, alpha-	1.814	4.0	453	16	17	486
Chlordane, gamma-	0.488	2.0	473	10	3	486
Dicofol	16.24	40.0	471	1	14	486
Dieldrin	0.44	1.0	462	2	22	486
Endosulfan I	1.22	4.0	468	7	11	486
Endosulfan II	10.3	40.0	486	0	0	486

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Organochloride Pesticide Results for Predators *(continued)*						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Endosulfan Sulfate	4.16	10.0	469	0	1	470*
Endrin	2.86	10.0	483	1	2	486
Ethalfluralin	1.67	4.0	466	16	4	486
Heptachlor	1.79	2.0	469	0	17	486
Heptachlor Epoxide	0.52	2.0	480	3	3	486
Hexachlorocyclohexane (BHC), alpha-	4.7	10.0	481	5	0	486
Hexachlorocyclohexane (BHC), beta-	1.13	4.0	447	26	13	486
Hexachlorocyclohexane (BHC), delta-	1.5	4.0	479	6	1	486
Hexachlorocyclohexane (BHC), gamma-	0.606	2.0	458	27	1	486
Isodrin	1.58	4.0	470	15	1	486
Kepone	12.23	40.0	426	45	15	486
Methoxychlor	7.106	20.0	477	3	6	486
Mirex	1.52	4.0	476	8	2	486
Nonachlor, cis-	1.95	4.0	463	18	5	486
Nonachlor, trans-	1.48	4.0	430	39	17	486
Octachlorostyrene	0.83	2.0	480	3	3	486
Oxychlordane	1.94	4.0	463	20	3	486
Pendimethalin	6.21	20.0	485	1	0	486
Pentachloroanisole	1.312	4.0	429	56	1	486
Pentachloronitrobenzene	0.76	2.0	457	22	7	486
Permethrin, cis-	25	100.0	481	4	1	486
Permethrin, trans-	21	40.0	481	1	4	486
Toxaphene	20	100.0	486	0	0	486
Trifluralin	2.98	10.0	450	35	1	486

Organochlorine Pesticide Results for Bottom Dwellers						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
2,4'-DDD	0.38	2.0	247	17	10	274†
2,4'-DDE	0.82	2.0	162	55	57	274†
2,4'-DDT	0.38	2.0	246	10	18	274†
4,4'-DDD	0.52	2.0	248	24	123	395
4,4'-DDE	0.74	2.0	8	41	346	395
4,4'-DDT	0.66	2.0	335	20	40	395

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Organochlorine Pesticide Results for Bottom Dwellers *(continued)*						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Aldrin	2.178	4.0	386	4	5	395
Chlordane, alpha-	1.814	4.0	273	64	58	395
Chlordane, gamma-	0.488	2.0	347	26	22	395
Dicofol	16.24	40.0	387	2	6	395
Dieldrin	0.44	1.0	322	13	60	395
Endosulfan I	1.22	4.0	372	7	16	395
Endosulfan II	10.3	40.0	395	0	0	395
Endosulfan Sulfate	4.16	10.0	376	17	2	395
Endrin	2.86	10.0	381	13	1	395
Ethalfluralin	1.67	4.0	305	36	54	395
Heptachlor	1.79	2.0	371	2	22	395
Heptachlor Epoxide	0.52	2.0	370	16	9	395
Hexachlorocyclohexane (BHC), alpha-	4.7	10.0	387	8	0	395
Hexachlorocyclohexane (BHC), beta-	1.13	4.0	357	26	12	395
Hexachlorocyclohexane (BHC), delta-	1.5	4.0	374	11	10	395
Hexachlorocyclohexane (BHC), gamma-	0.606	2.0	364	20	11	395
Isodrin	1.58	4.0	376	9	10	395
Kepone	12.23	40.0	303	47	45	395
Methoxychlor	7.106	20.0	372	14	9	395
Mirex	1.52	4.0	376	14	5	395
Nonachlor, cis-	1.95	4.0	327	22	46	395
Nonachlor, trans-	1.48	4.0	236	85	74	395
Octachlorostyrene	0.83	2.0	387	7	1	395
Oxychlordane	1.94	4.0	350	27	18	395
Pendimethalin	6.21	20.0	376	13	6	395
Pentachloroanisole	1.312	4.0	303	67	25	395
Pentachloronitrobenzene	0.76	2.0	345	34	16	395
Permethrin, cis-	25	100.0	368	17	10	395
Permethrin, trans-	21	40.0	383	4	8	395
Toxaphene	20	100.0	394	1	0	395
Trifluralin	2.98	10.0	251	84	60	395

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Organophosphorus Pesticide Results for Predators						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Chlorpyriphos	59	200.0	486	0	0	486
Diazinon	40	100.0	486	0	0	486
Disulfoton	161	500.0	484	0	0	484*
Disulfoton Sulfone	275	1000.0	486	0	0	486
Ethion	254	1000.0	486	0	0	486
Paraoxon	121	500.0	486	0	0	486
Parathion, Ethyl-	125	500.0	486	0	0	486
Terbufos	286	1000.0	486	0	0	486
Terbufos Sulfone	73	200.0	486	0	0	486

Organophosphorus Pesticide Results for Bottom Dwellers						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total
Chlorpyriphos	59	200.0	395	0	0	395
Diazinon	40	100.0	395	0	0	395
Disulfoton	161	500.0	373	0	0	373*
Disulfoton Sulfone	275	1000.0	395	0	0	395
Ethion	254	1000.0	395	0	0	395
Paraoxon	121	500.0	395	0	0	395
Parathion, Ethyl-	125	500.0	395	0	0	395
Terbufos	286	1000.0	395	0	0	395
Terbufos Sulfone	73	200.0	395	0	0	395

Semivolatile Organic Compound Results for Predators						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total‡
1,2,4,5-Tetrachlorobenzene	111	333.0	485	0	0	485
1,2,4-Trichlorobenzene	111	333.0	485	0	0	485
1,2-Dichlorobenzene	111	333.0	485	0	0	485
1,3-Dichlorobenzene	111	333.0	485	0	0	485
1,4-Dichlorobenzene	111	333.0	485	0	0	485
2,4,5-Trichlorophenol	111	333.0	485	0	0	485
2,4,6-Tris (1,1-Dimethylethyl) Phenol	111	333.0	485	0	0	485
3,3′-Dichlorobenzidine	555	1665.0	265	0	0	265*
4-Bromophenyl Phenyl Ether	111	333.0	485	0	0	485

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Semivolatile Organic Compound Results for Predators *(continued)*						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total‡
4,4'-Methylene bis (2-Chloroaniline)	222	666.0	432	0	0	432*
Acenaphthene	111	333.0	485	0	0	485
Acenaphthylene	111	333.0	485	0	0	485
Anthracene	111	1665.0	485	0	0	485
Benzo(a)Anthracene	111	333.0	485	0	0	485
Benzo(a)Pyrene	111	333.0	485	0	0	485
Benzo(b)Fluoranthene	111	333.0	485	0	0	485
Benzo(ghi)Perylene	222	666.0	485	0	0	485
Benzo(j)Fluoranthene	111	333.0	485	0	0	485
Benzo(k)Fluoranthene	111	333.0	485	0	0	485
Bis (2-ethylhexyl) Phthalate	111	333.0	479	3	3	485
Butyl Benzyl Phthalate	111	333.0	482	1	2	485
Chrysene	111	333.0	485	0	0	485
Di-n-Butyl Phthalate	111	333.0	451	29	5	485
Dibenz(a,h)Anthracene	111	333.0	485	0	0	485
Diethylstilbestrol	111	333.0	435	0	0	485
Fluoranthene	111	333.0	485	0	0	485
Fluorene	111	333.0	485	0	0	485
Hexachlorobenzene	111	333.0	485	0	0	485
Hexachlorobutadiene	111	333.0	485	0	0	485
Indeno(1,2,3-cd)Pyrene	222	666.0	485	0	0	485
Naphthalene	111	333.0	485	0	0	485
Nitrobenzene	111	333.0	485	0	0	485
Nonylphenol	111	333.0	479	6	0	485
Pentachlorobenzene	222	666.0	485	0	0	485
Pentachlorophenol	555	1665.0	481	0	0	481*
Perylene	111	333.0	485	0	0	485
Phenanthrene	111	333.0	484	0	0	484*
Phenol	111	333.0	485	0	0	485
Pyrene	111	333.0	484	1	0	485
Tetrabromobisphenol A	5550	16650.0	429	0	0	429*

‡ There were only 485 predator samples analyzed for the semivolatile organics.

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

† These chemicals were not analyzed during the first year of the study.

Semivolatile Organic Compound Results for Bottom Dwellers						
Chemical	MDL µg/kg (ppb)	ML µg/kg (ppb)	Number of Concentration Values			
			< MDL	≥ MDL & < ML	≥ ML	Total‡
1,2,4,5-Tetrachlorobenzene	111	333.0	395	0	0	395
1,2,4-Trichlorobenzene	111	333.0	395	0	0	395
1,2-Dichlorobenzene	111	333.0	395	0	0	395
1,3-Dichlorobenzene	111	333.0	395	0	0	395
1,4-Dichlorobenzene	111	333.0	395	0	0	395
2,4,5-Trichlorophenol	111	333.0	395	0	0	395
2,4,6-Tris(1,1-Dimethylethyl) Phenol	111	333.0	395	0	0	395
3,3′-Dichlorobenzidine	555	1665.0	131	0	0	131*
4-Bromophenyl Phenyl Ether	111	333.0	395	0	0	395
4,4′-Methylene bis(2-Chloroaniline)	222	666.0	377	0	0	377*
Acenaphthene	111	333.0	395	0	0	395
Acenaphthylene	111	333.0	395	0	0	395
Anthracene	111	1665.0	395	0	0	395
Benzo(a)Anthracene	111	333.0	395	0	0	395
Benzo(a)Pyrene	111	333.0	395	0	0	395
Benzo(b)Fluoranthene	111	333.0	394	0	0	394*
Benzo(ghi)Perylene	222	666.0	395	0	0	395
Benzo(j)Fluoranthene	111	333.0	395	0	0	395
Benzo(k)Fluoranthene	111	333.0	394	0	0	394*
Bis (2-ethylhexyl) Phthalate	111	333.0	384	11	0	395
Butyl Benzyl Phthalate	111	333.0	394	1	0	395
Chrysene	111	333.0	395	0	0	395
Di-n-Butyl Phthalate	111	333.0	368	21	6	395
Dibenz(a,h)Anthracene	111	333.0	395	0	0	395
Diethylstilbestrol	111	333.0	308	0	0	308*
Fluoranthene	111	333.0	395	0	0	395
Fluorene	111	333.0	395	0	0	395
Hexachlorobenzene	111	333.0	395	0	0	395
Hexachlorobutadiene	111	333.0	395	0	0	395
Indeno(1,2,3-cd)Pyrene	222	666.0	395	0	0	395
Naphthalene	111	333.0	394	1	0	395
Nitrobenzene	111	333.0	395	0	0	395
Nonylphenol	111	333.0	394	1	0	395
Pentachlorobenzene	222	666.0	395	0	0	395
Pentachlorophenol	555	1665.0	373	0	0	373*
Perylene	111	333.0	395	0	0	395
Phenanthrene	111	333.0	395	0	0	395
Phenol	111	333.0	387	5	0	387*
Pyrene	111	333.0	395	0	0	395
Tetrabromobisphenol A	5550	16650.0	261	0	0	261*

* Some results were excluded from the database due to QC failures. Therefore, the total number may be less for some target chemicals within the same analytical class.

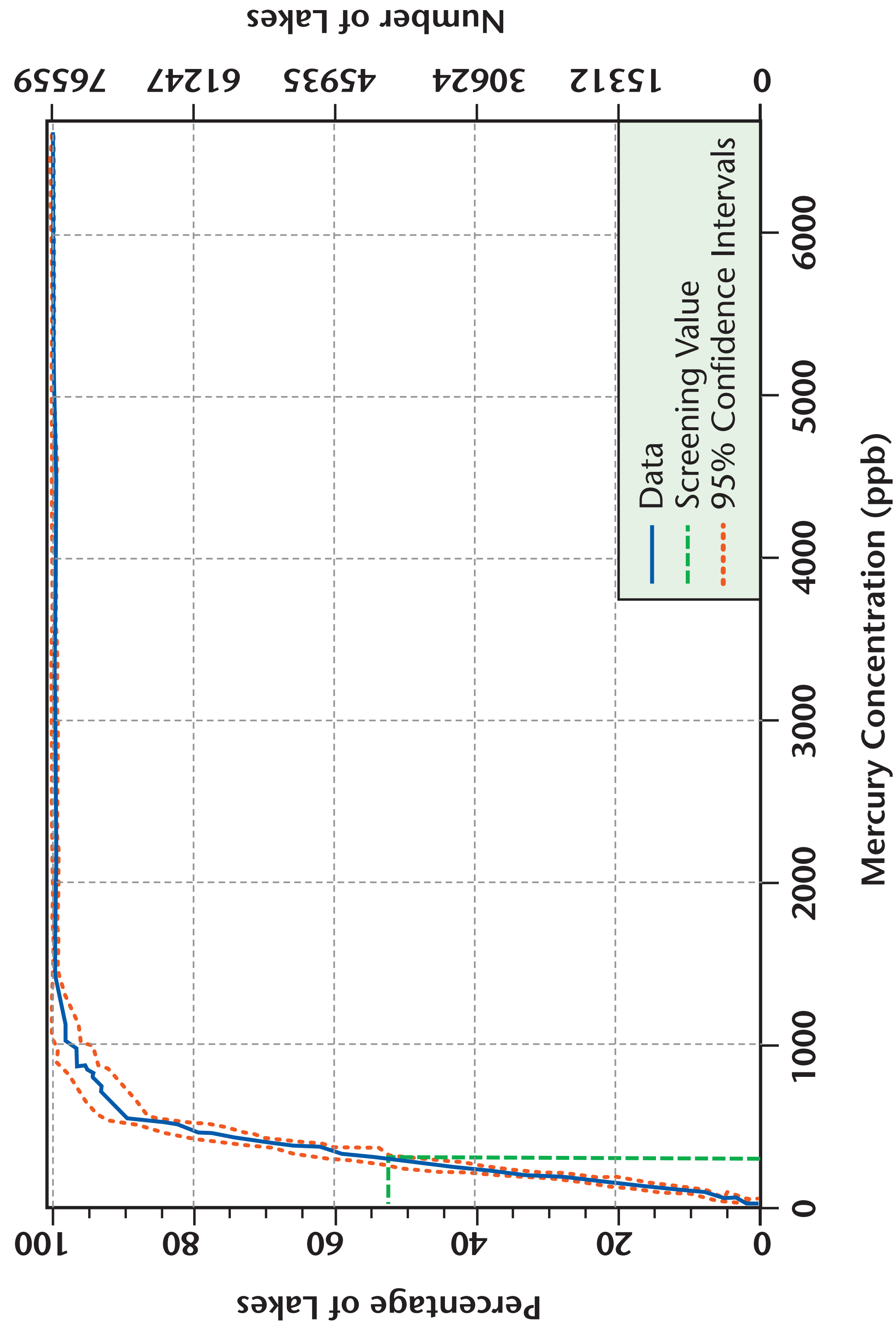
† These chemicals were not analyzed during the first year of the study.

Appendix G

Cumulative Distribution Functions

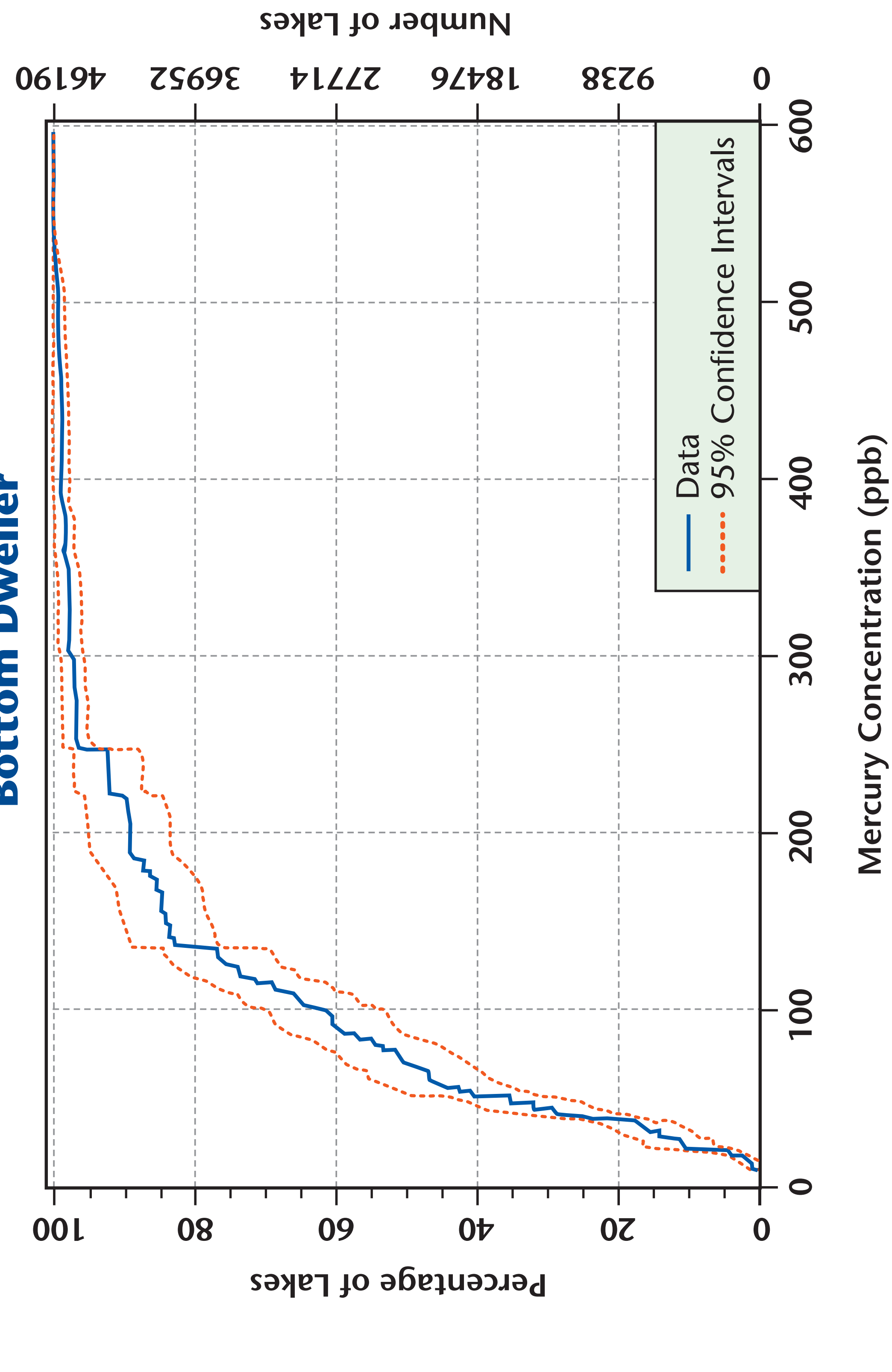
Mercury CDFs

Predator



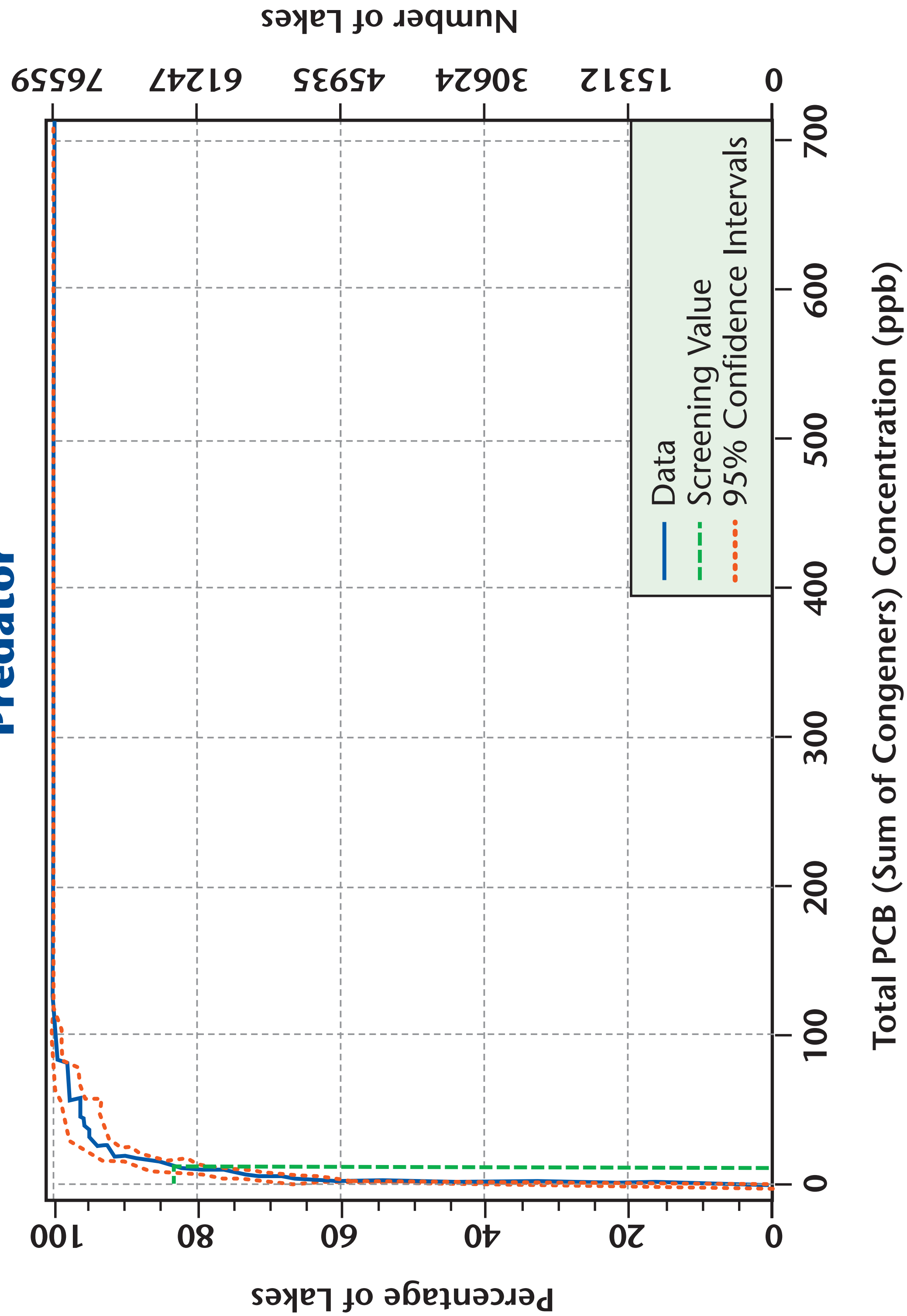
Mercury CDFs

Bottom Dweller



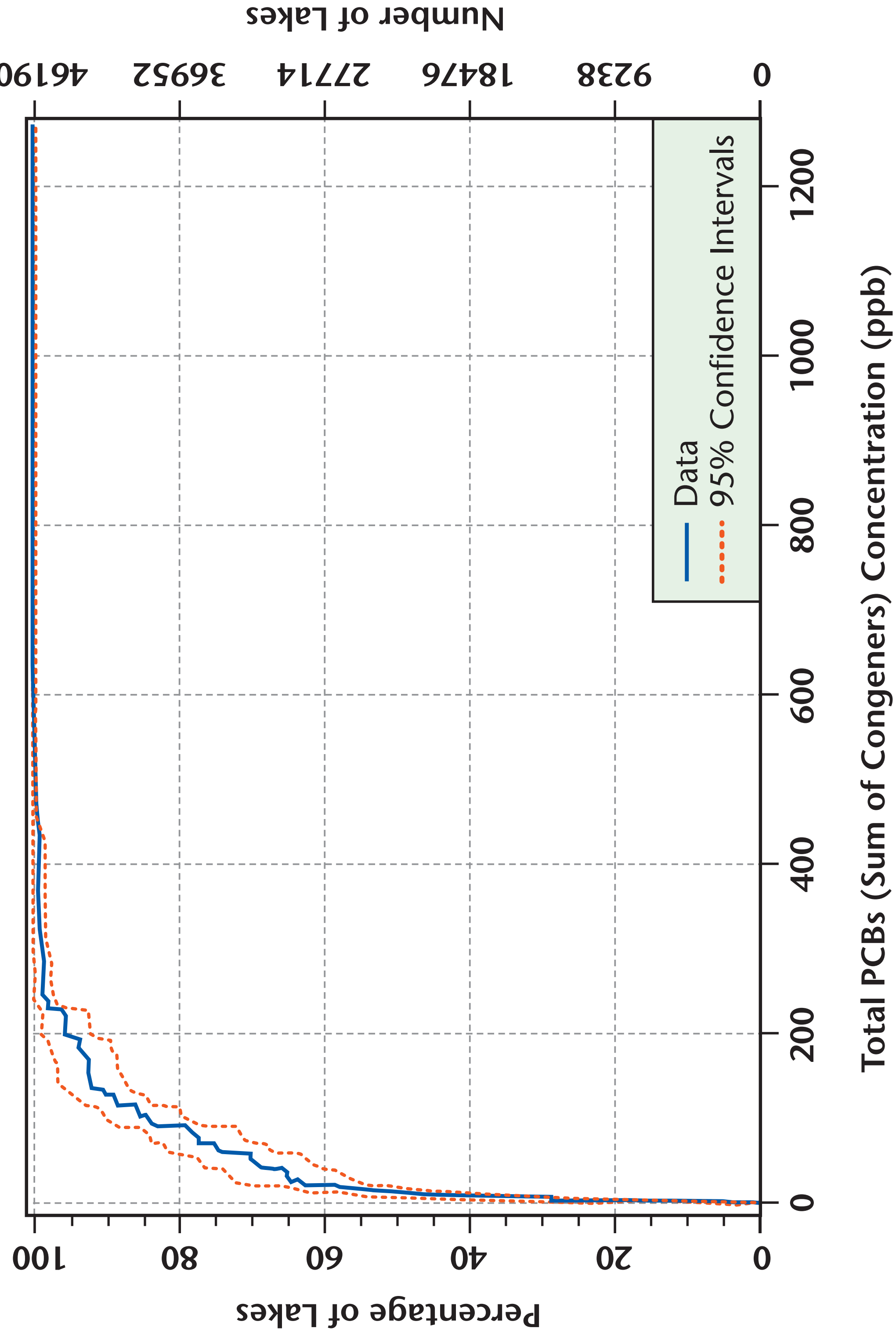
PCB CDFs

Predator



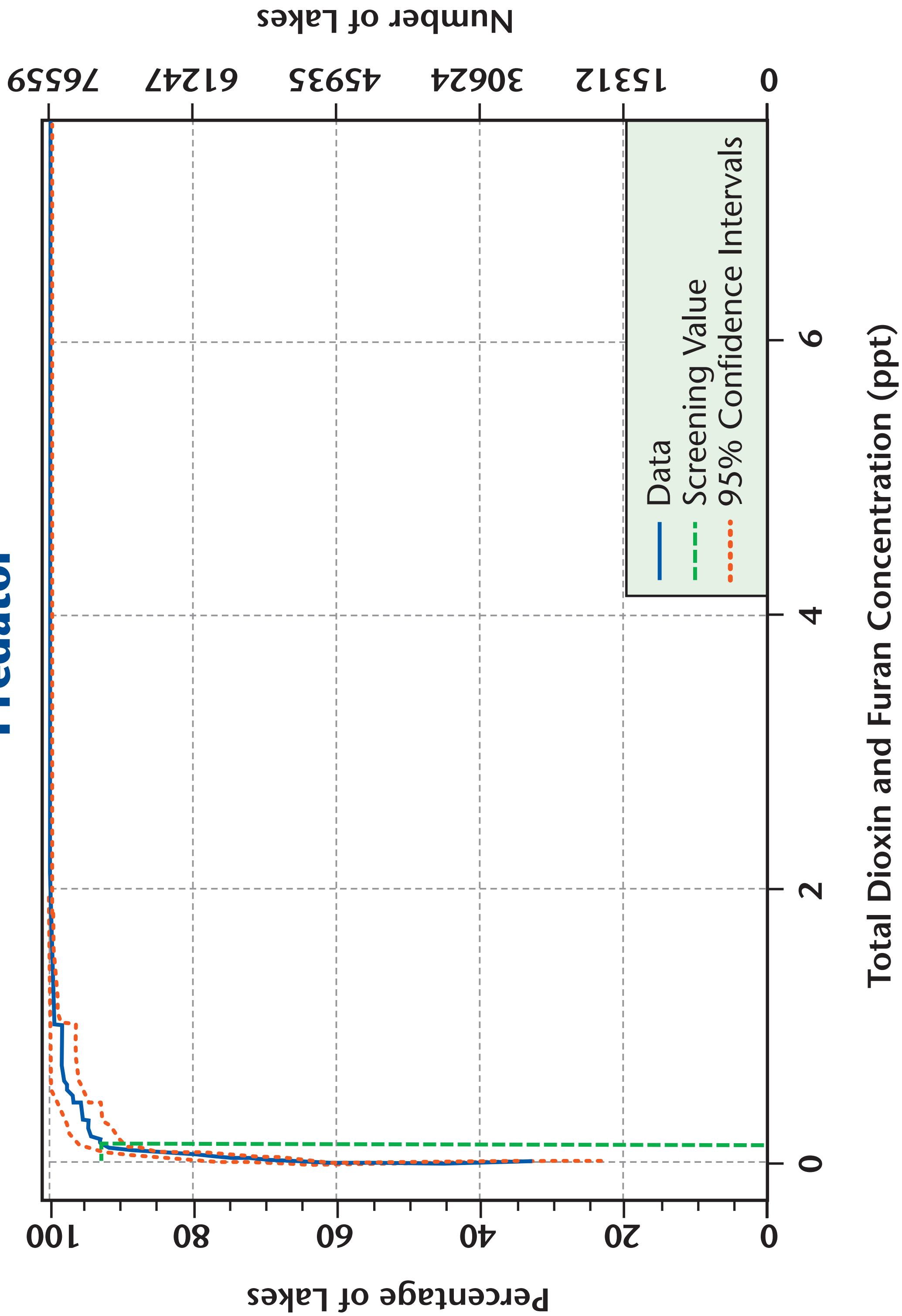
PCB CDFs

Bottom Dweller



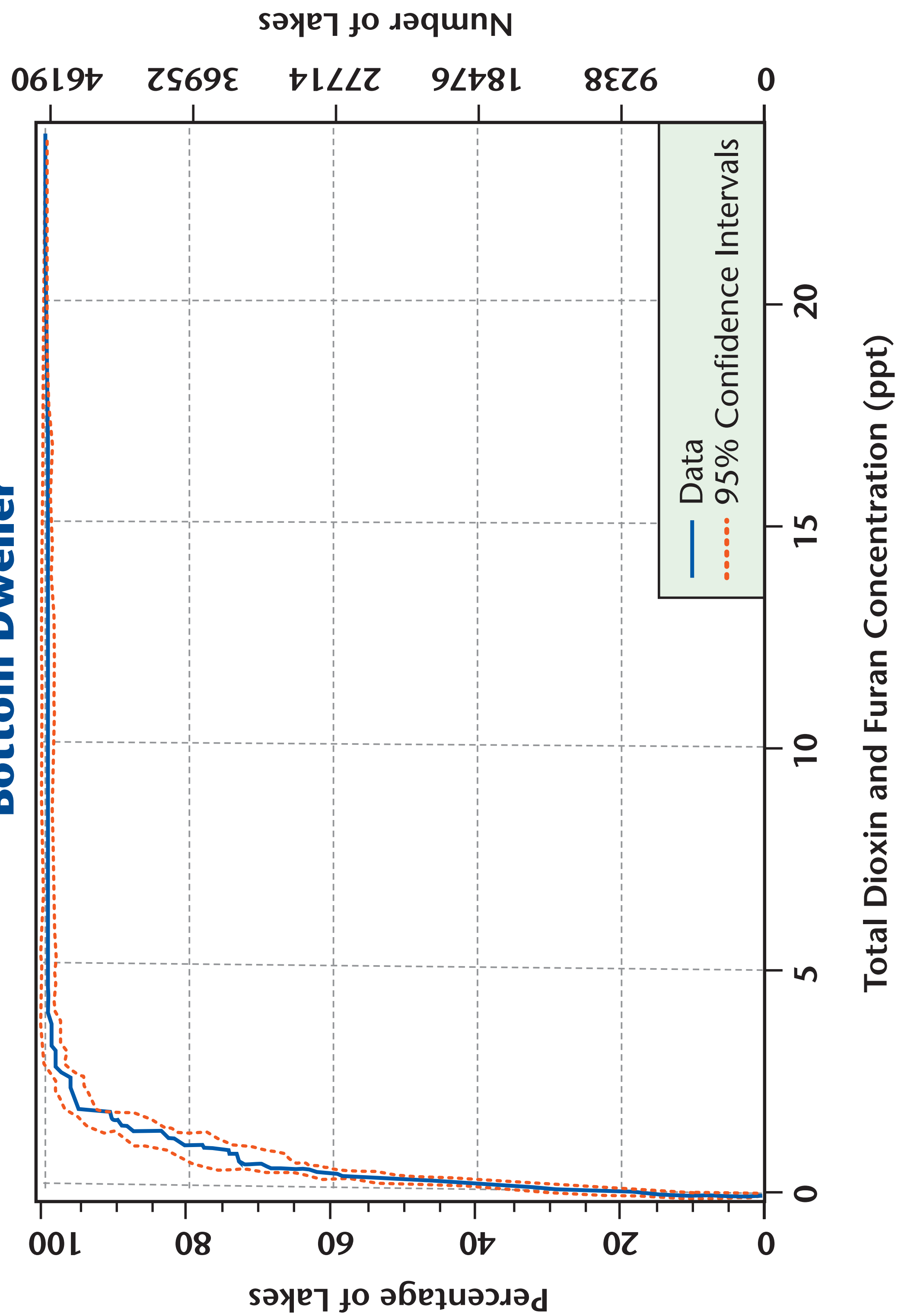
Dioxin and Furan CDFs

Predator



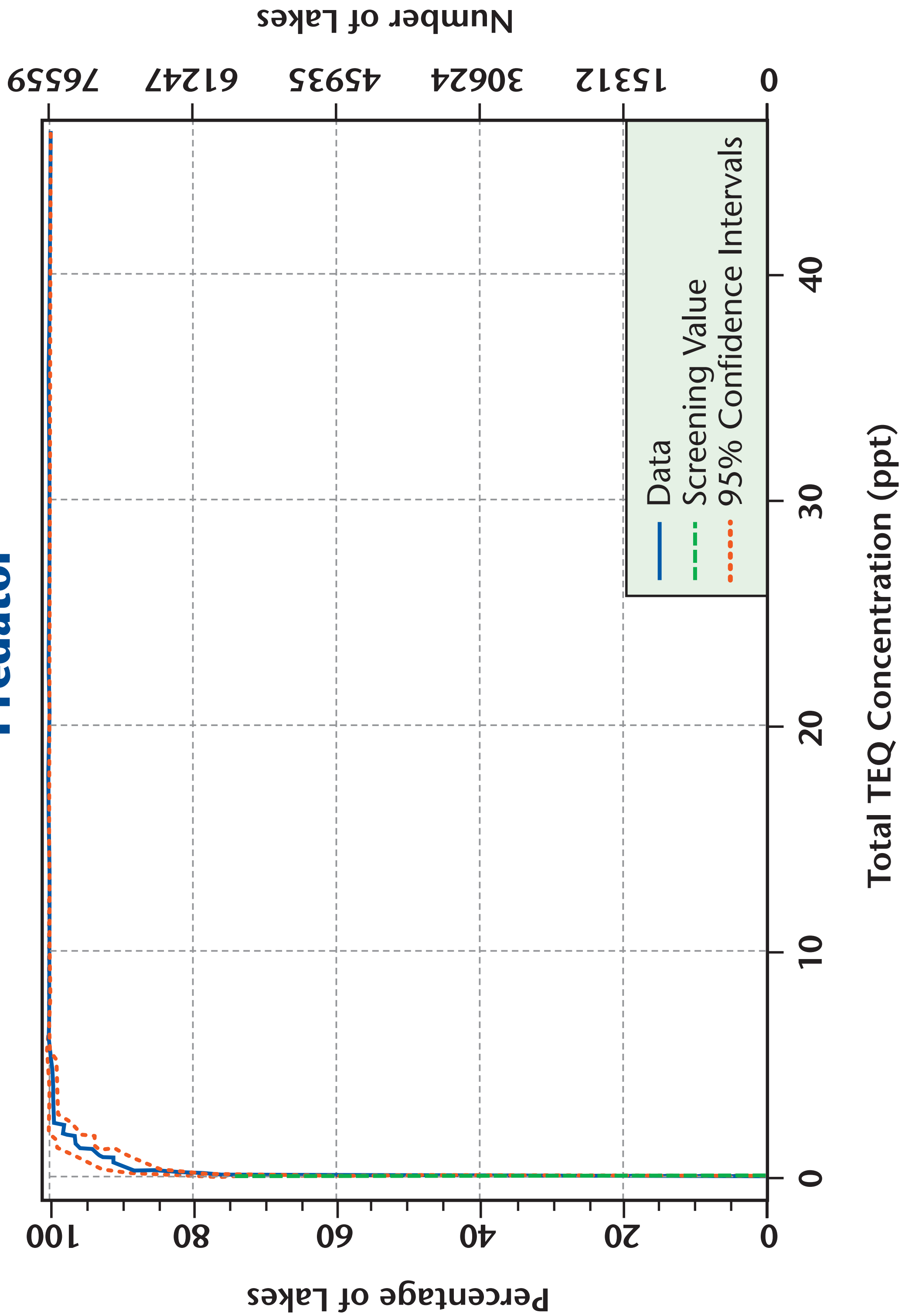
Dioxin and Furan CDFs

Bottom Dweller



Dioxin and Furan CDFs

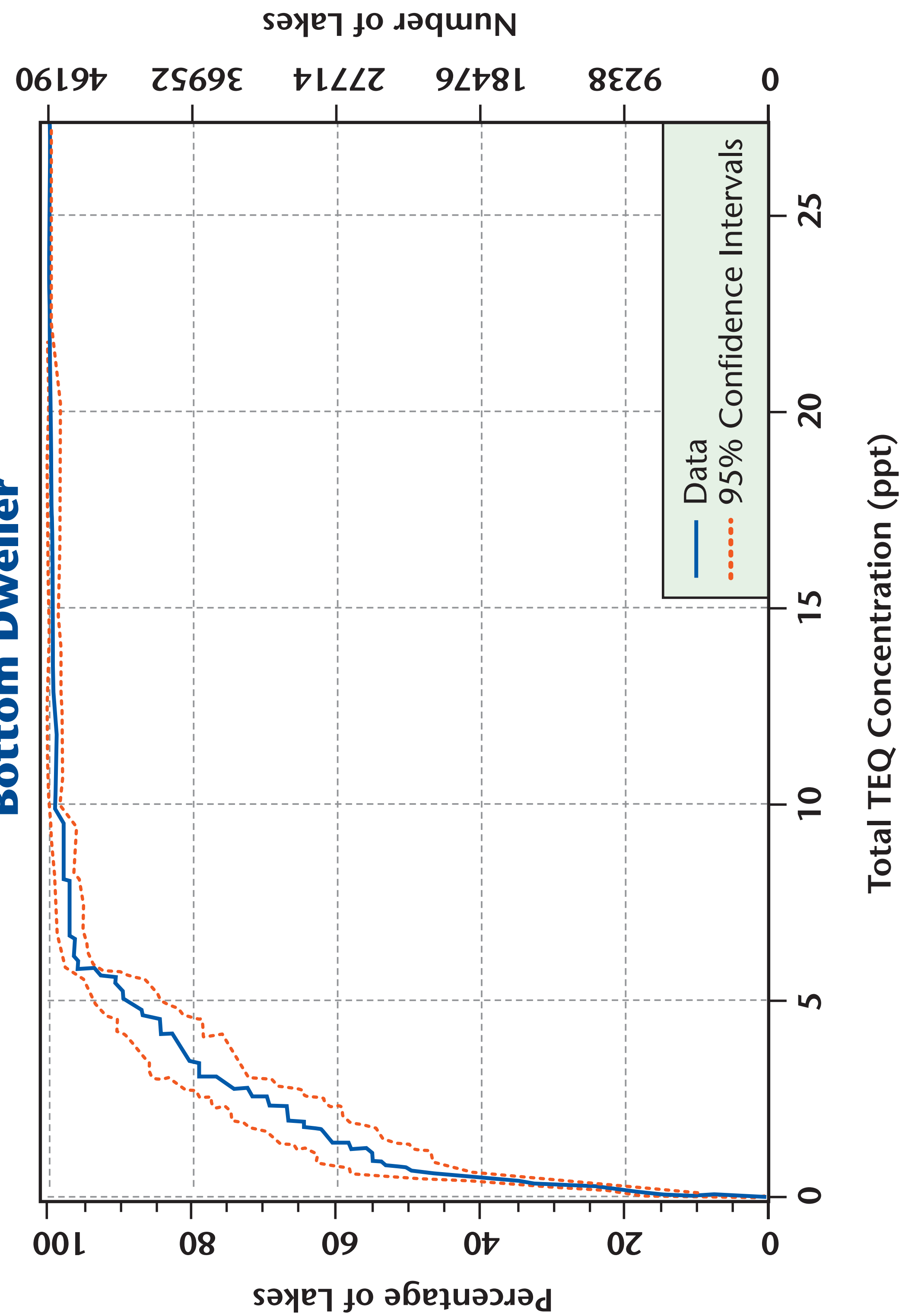
Predator



NOTE: Total TEQ includes Total Dioxin and Furan plus 12 Coplanar PCBs.

Dioxin and Furan CDFs

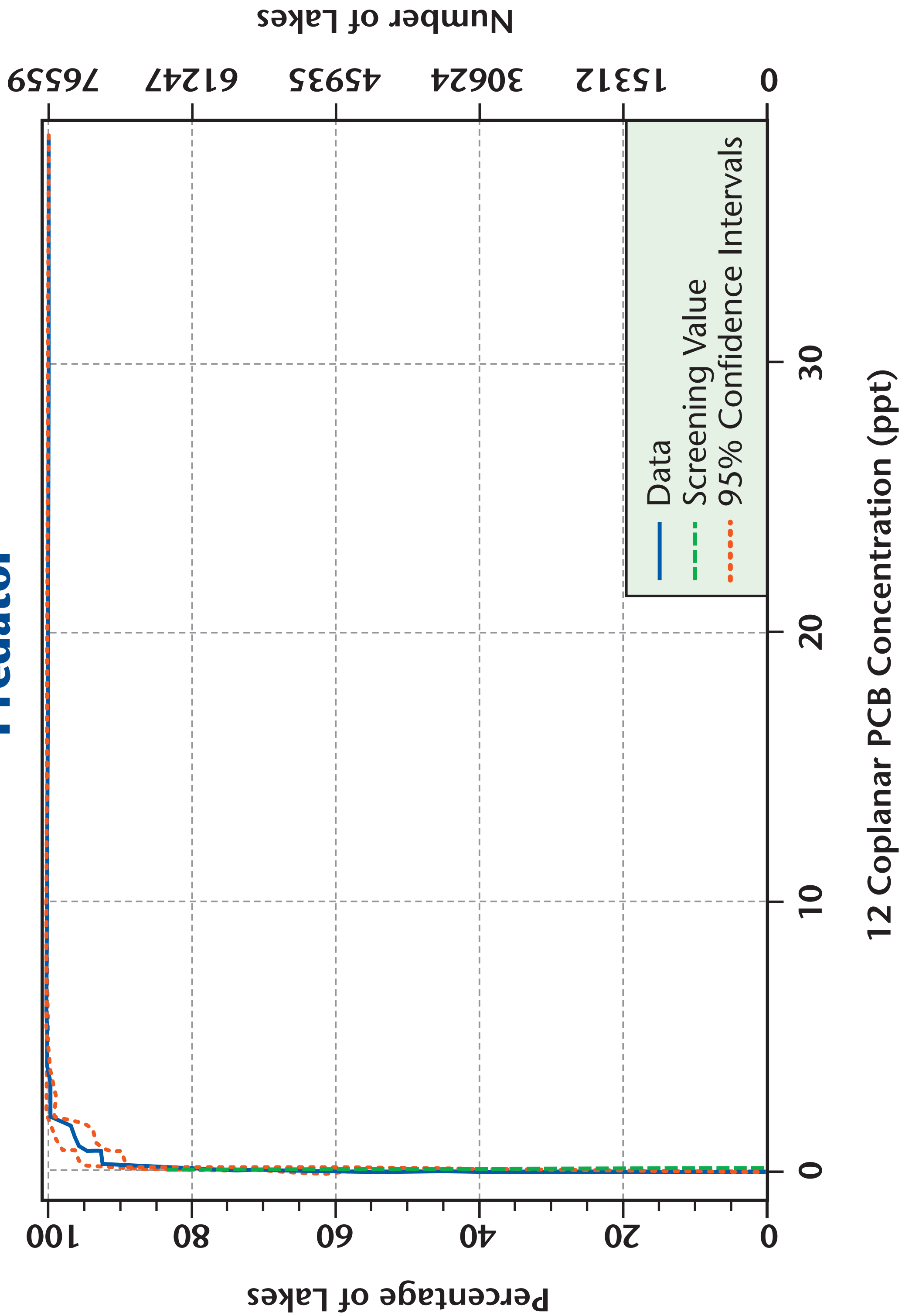
Bottom Dweller



NOTE: Total TEQ includes Total Dioxin and Furan plus 12 Coplanar PCBs.

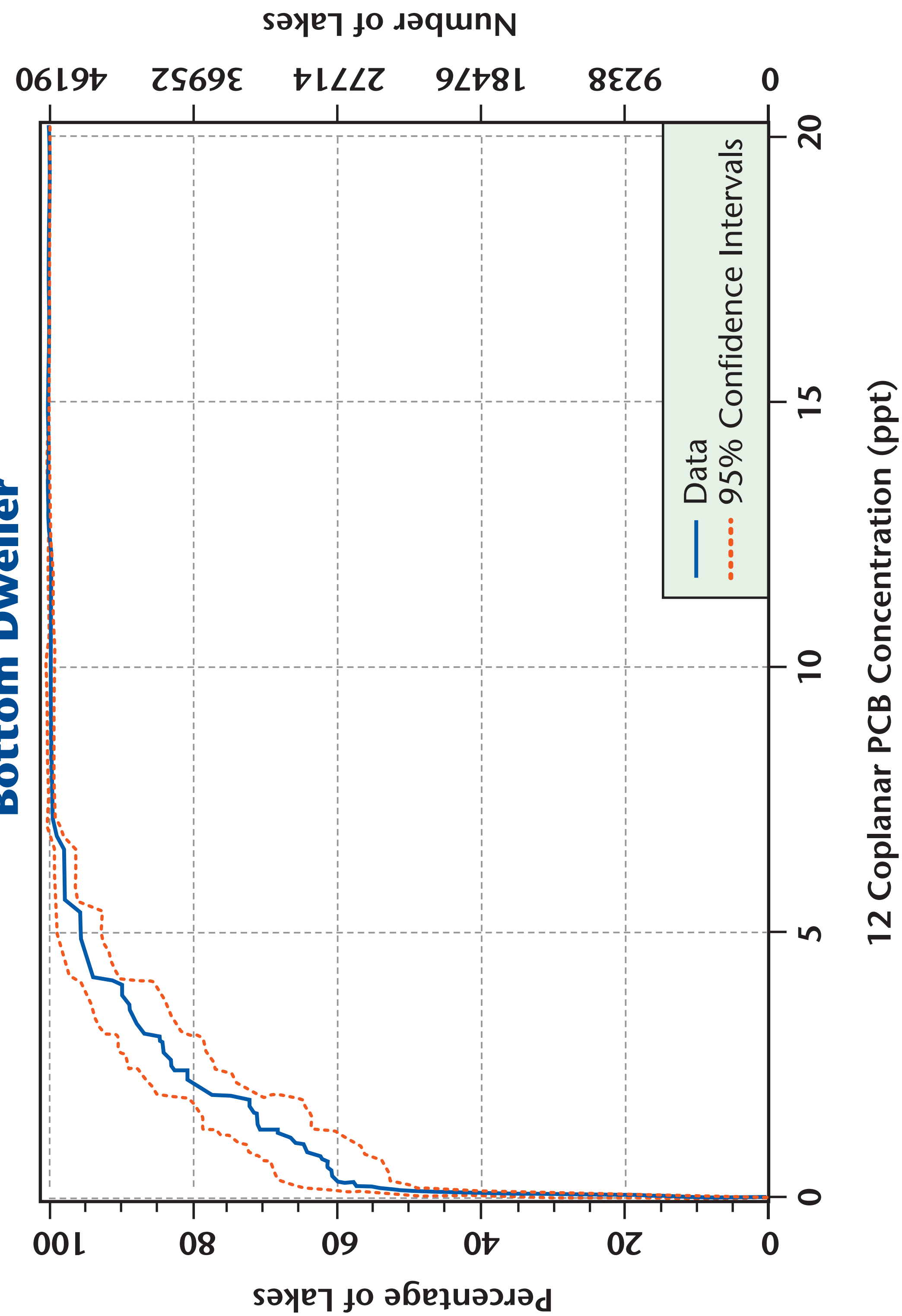
Dioxin and Furan CDFs

Predator



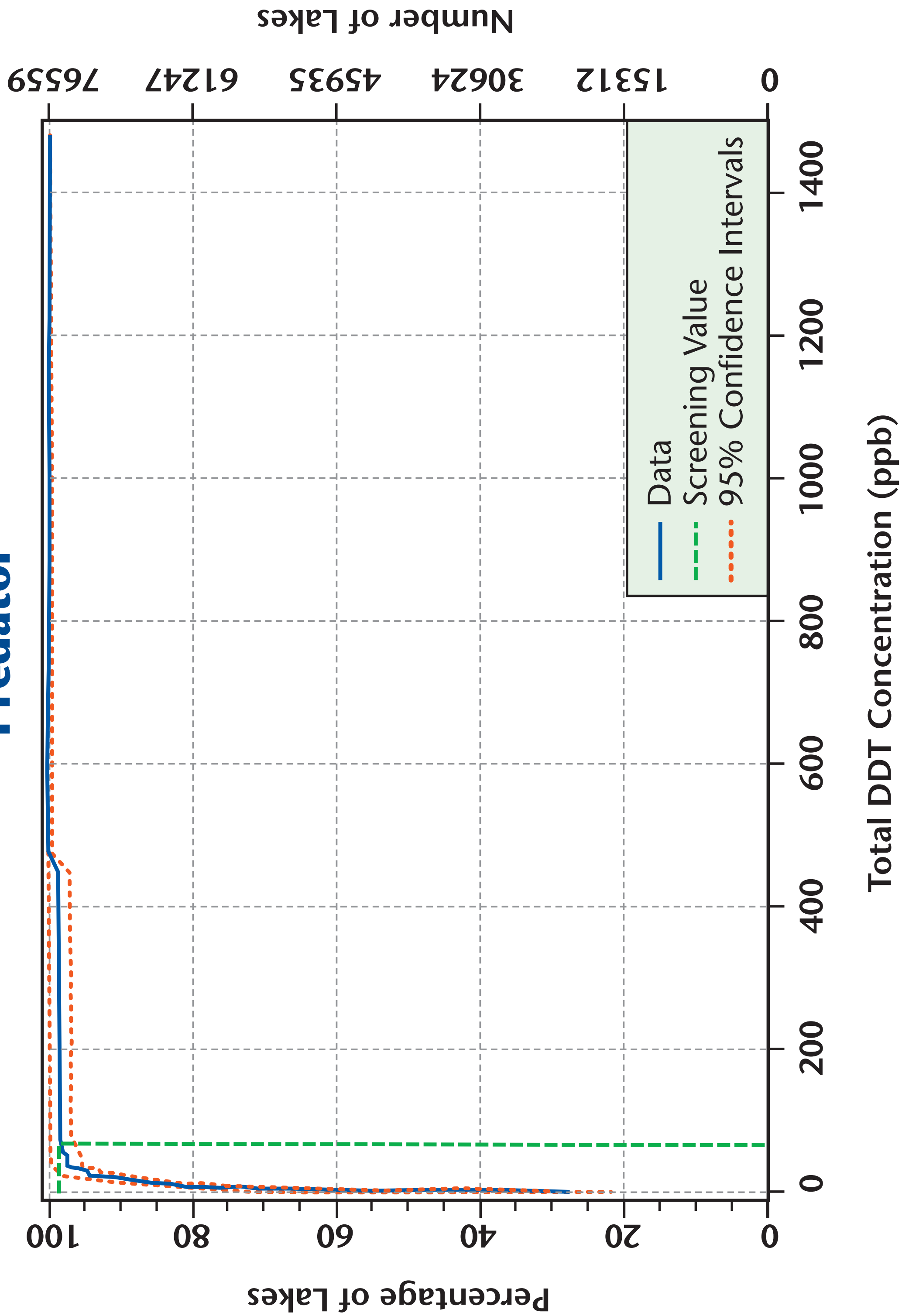
Dioxin and Furan CDFs

Bottom Dweller



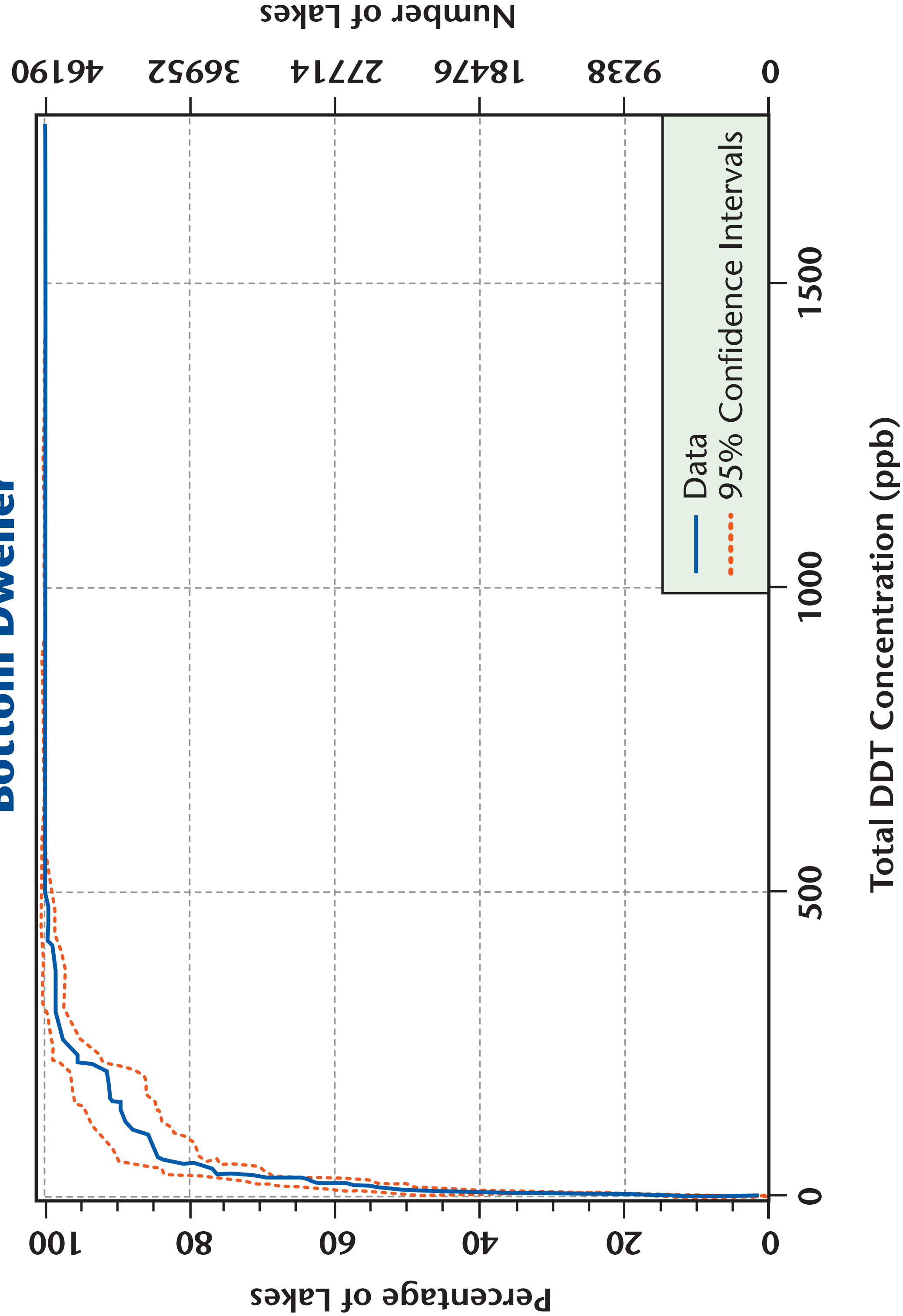
DDT CDFs

Predator



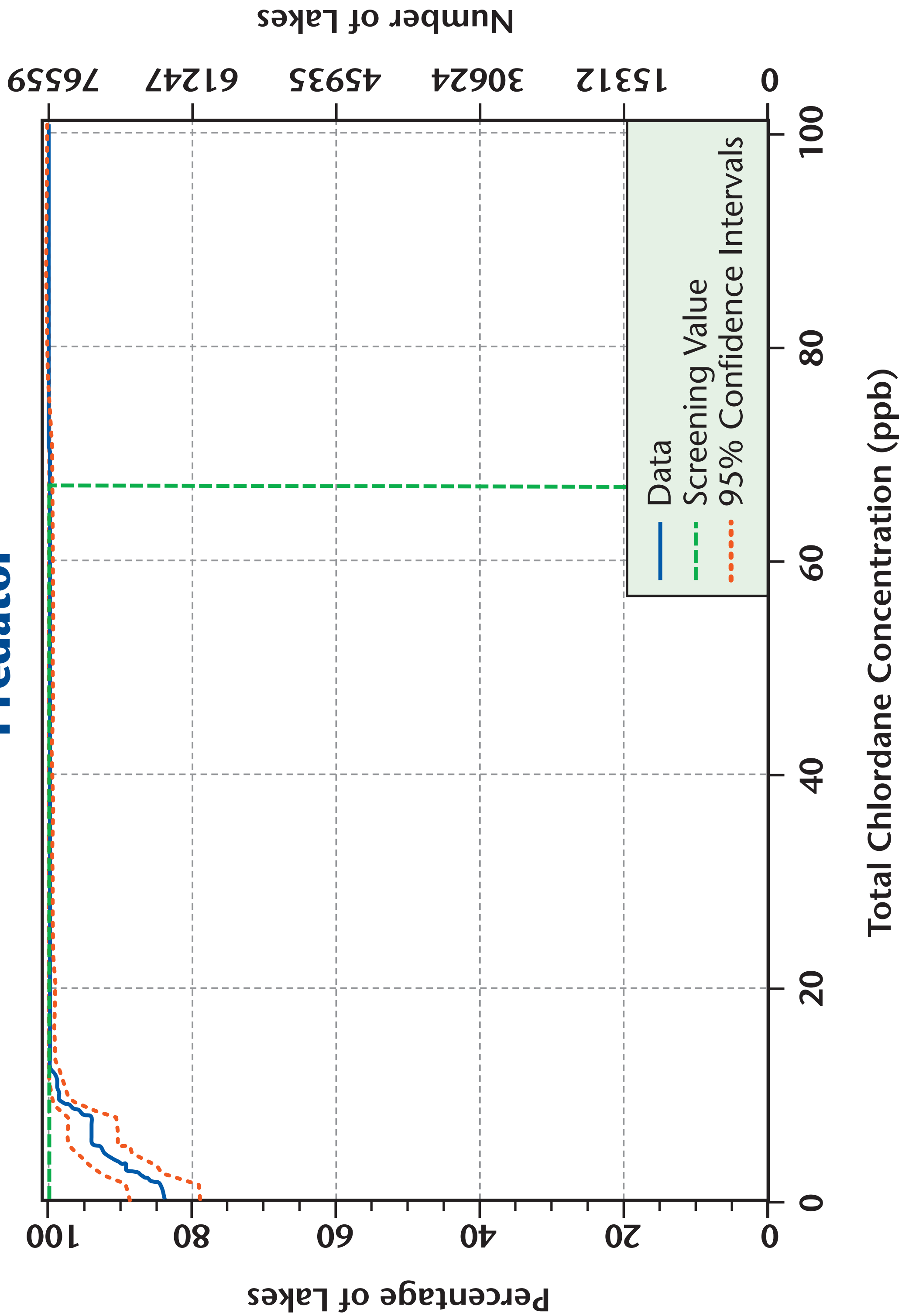
DDT CDFs

Bottom Dweller



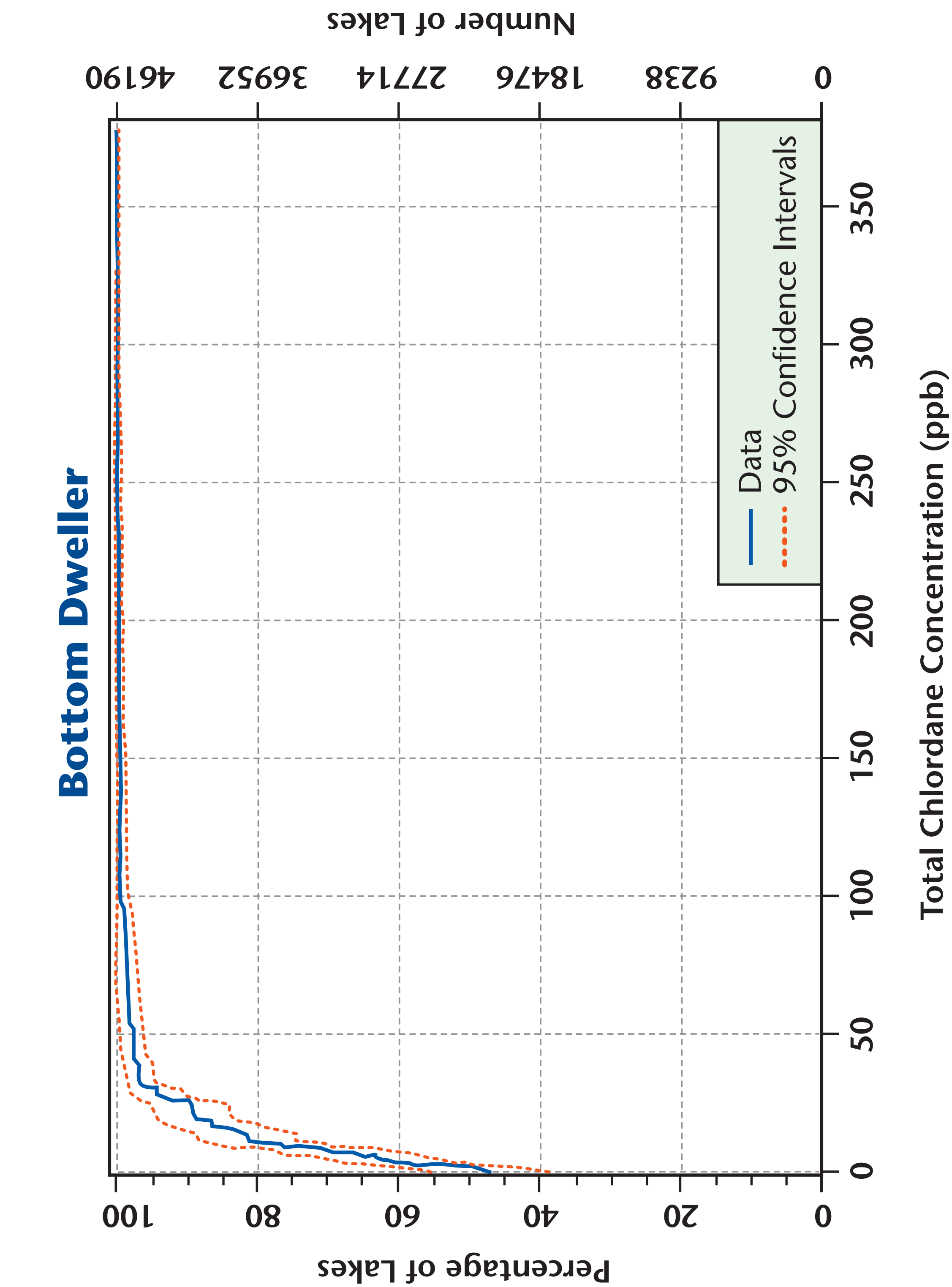
Chlordane CDFs

Predator



Chlordane CDFs

Bottom Dweller



Appendix H

Detection Agreement between Replicate Sample Pairs

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
Metals								
Mercury								
Mercury	70	0	0	100	52	0	0	100
Arsenic								
Arsenate	0	69	1	99	0	52	0	100
Arsenite	0	70	0	100	7	39	6	88
Total Inorganic Arsenic	0	70	0	100	3	43	6	88
Dimethylarsonic Acid	1	68	1	99	0	52	0	100
Monomethylarsonic Acid	0	69	1	99	0	52	0	100
PCBs								
PCB-1	3	64	3	96	4	39	9	83
PCB-2	2	67	1	99	8	39	5	90
PCB-3	15	40	15	79	7	32	13	75
PCB-4	27	32	11	84	33	14	5	90
PCB-5	0	68	2	97	4	45	3	94
PCB-6	16	39	15	79	36	11	5	90
PCB-7	5	53	12	83	15	24	13	75
PCB-8	19	36	15	79	40	7	5	90
PCB-9	2	67	1	99	16	25	11	79
PCB-10	0	67	3	96	4	45	3	94
PCB-11	30	30	10	86	32	15	5	90
PCB-12+PCB-13	0	66	4	94	6	41	5	90
PCB-14	0	70	0	100	0	51	1	98
PCB-15	35	28	7	90	45	6	1	98
PCB-16	38	21	11	84	47	2	3	94

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both Above Detection	Both Below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-17	49	15	6	91	46	3	3	94
PCB-18+PCB-30	50	14	6	91	49	0	3	94
PCB-19	38	16	16	77	43	5	4	92
PCB-20+PCB-28	59	8	3	96	52	0	0	100
PCB-21+PCB-33	55	10	5	93	48	1	3	94
PCB-22	62	4	4	94	50	2	0	100
PCB-23	0	67	3	96	3	47	2	96
PCB-24	4	64	2	97	14	30	8	85
PCB-25	34	25	11	84	44	6	2	96
PCB-26+PCB-29	13	50	7	90	38	9	5	90
PCB-27	12	51	7	90	35	12	5	90
PCB-31	58	5	7	90	50	2	0	100
PCB-32	33	23	14	80	44	1	7	87
PCB-34	5	58	7	90	28	18	6	88
PCB-35	0	70	0	100	1	51	0	100
PCB-36	0	70	0	100	1	51	0	100
PCB-37	61	2	7	90	48	4	0	100
PCB-38	1	67	2	97	6	39	7	87
PCB-39	3	60	7	90	18	25	9	83
PCB-40+PCB-41+PCB-71	59	8	3	96	49	1	2	96
PCB-42	61	6	3	96	51	0	1	98
PCB-43	14	45	11	84	36	12	4	92
PCB-44+PCB-47+PCB-65	60	4	6	91	51	0	1	98
PCB-45+PCB-51	22	39	9	87	39	6	7	87

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-46	9	57	4	94	31	16	5	90
PCB-48	56	10	4	94	48	2	2	96
PCB-49+PCB-69	65	1	4	94	52	0	0	100
PCB-50+PCB-53	10	53	7	90	29	15	8	85
PCB-52	65	3	2	97	52	0	0	100
PCB-54	2	66	2	97	6	40	6	88
PCB-55	5	58	7	90	5	35	12	77
PCB-56	66	2	2	97	51	0	1	98
PCB-57	10	52	8	89	26	18	8	85
PCB-58	12	46	12	83	33	13	6	88
PCB-59+PCB-62+PCB-75	39	20	11	84	45	3	4	92
PCB-60	67	1	2	97	52	0	0	100
PCB-61+PCB-70+PCB-74+ PCB-76	70	0	0	100	52	0	0	100
PCB-63	54	8	8	89	51	1	0	100
PCB-64	67	0	3	96	52	0	0	100
PCB-66	64	6	0	100	52	0	0	100
PCB-67	41	21	8	89	43	6	3	94
PCB-68	49	12	9	87	50	0	2	96
PCB-72	46	18	6	91	46	4	2	96
PCB-73	0	67	3	96	2	49	1	98
PCB-77	21	40	9	87	34	12	6	88
PCB-78	0	69	1	99	1	51	0	100
PCB-79	36	22	12	83	43	5	4	92

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-80	0	70	0	100	1	49	2	96
PCB-81	7	51	12	83	28	12	12	77
PCB-82	63	5	2	97	51	1	0	100
PCB-83+PCB-99	70	0	0	100	52	0	0	100
PCB-84	62	5	3	96	50	1	1	98
PCB-85+PCB-116+PCB-117	69	0	1	99	52	0	0	100
PCB-86+PCB-87+PCB-97+ PCB-108+PCB-119+PCB-125	65	2	3	96	52	0	0	100
PCB-88+PCB-91	65	4	1	99	51	0	1	98
PCB-89	9	52	9	87	30	14	8	85
PCB-90+PCB-101+PCB-113	69	0	1	99	52	0	0	100
PCB-92	68	0	2	97	52	0	0	100
PCB-93+PCB-95+PCB-98+ PCB-100+PCB-102	68	1	1	99	51	0	1	98
PCB-94	3	59	8	89	24	19	9	83
PCB-96	3	65	2	97	15	31	6	88
PCB-103	45	16	9	87	44	3	5	90
PCB-104	0	69	1	99	2	50	0	100
PCB-105	65	4	1	99	52	0	0	100
PCB-106	0	70	0	100	0	52	0	100
PCB-107+PCB-124	61	4	5	93	51	1	0	100
PCB-109	66	2	2	97	52	0	0	100
PCB-110+PCB-115	69	0	1	99	52	0	0	100
PCB-111	27	35	8	89	37	8	7	87
PCB-112	0	70	0	100	0	52	0	100

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-114	62	4	4	94	52	0	0	100
PCB-118	67	1	2	97	52	0	0	100
PCB-120	56	8	6	91	48	2	2	96
PCB-121	13	52	5	93	25	18	9	83
PCB-122	32	24	14	80	48	2	2	96
PCB-123	54	9	7	90	51	1	0	100
PCB-126	4	63	3	96	16	32	4	92
PCB-127	21	39	10	86	29	13	10	81
PCB-128+PCB-166	65	4	1	99	52	0	0	100
PCB-129+PCB-138+PCB-160 +PCB-163	70	0	0	100	52	0	0	100
PCB-130	68	1	1	99	52	0	0	100
PCB-131	39	21	10	86	43	5	4	92
PCB-132	66	0	4	94	52	0	0	100
PCB-133	62	3	5	93	51	1	0	100
PCB-134+PCB-143	58	6	6	91	51	1	0	100
PCB-135+PCB-151+PCB-154	65	4	1	99	52	0	0	100
PCB-136	59	5	6	91	51	1	0	100
PCB-137	67	1	2	97	52	0	0	100
PCB-139+PCB-140	60	6	4	94	51	0	1	98
PCB-141	69	0	1	99	51	0	1	98
PCB-142	0	70	0	100	0	52	0	100
PCB-144	55	5	10	86	50	1	1	98
PCB-145	0	69	1	99	5	44	3	94

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both Above Detection	Both Below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-146	70	0	0	100	52	0	0	100
PCB-147+PCB-149	69	0	1	99	52	0	0	100
PCB-148	33	29	8	89	37	10	5	90
PCB-150	22	40	8	89	33	12	7	87
PCB-152	1	67	2	97	16	28	8	85
PCB-153+PCB-168	70	0	0	100	52	0	0	100
PCB-155	28	35	7	90	30	15	7	87
PCB-156+PCB-157	67	0	3	96	52	0	0	100
PCB-158	69	0	1	99	52	0	0	100
PCB-159	49	11	10	86	44	0	8	85
PCB-161	0	70	0	100	0	52	0	100
PCB-162	55	10	5	93	45	2	5	90
PCB-164	67	0	3	96	52	0	0	100
PCB-165	18	40	12	83	26	14	12	77
PCB-167	68	0	2	97	52	0	0	100
PCB-169	10	52	8	89	30	12	10	81
PCB-170	66	4	0	100	52	0	0	100
PCB-171+PCB-173	66	2	2	97	52	0	0	100
PCB-172	67	2	1	99	52	0	0	100
PCB-174	68	0	2	97	52	0	0	100
PCB-175	56	6	8	89	52	0	0	100
PCB-176	55	9	6	91	51	0	1	98
PCB-177	69	0	1	99	52	0	0	100
PCB-178	66	3	1	99	52	0	0	100

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-179	63	2	5	93	49	0	3	94
PCB-180+PCB-193	67	2	1	99	52	0	0	100
PCB-181	40	17	13	81	42	4	6	88
PCB-182	45	17	8	89	41	2	9	83
PCB-183+PCB-185	68	0	2	97	52	0	0	100
PCB-184	28	37	5	93	32	10	10	81
PCB-186	0	70	0	100	0	52	0	100
PCB-187	67	2	1	99	52	0	0	100
PCB-188	5	62	3	96	15	33	4	92
PCB-189	63	6	1	99	51	1	0	100
PCB-190	65	2	3	96	52	0	0	100
PCB-191	55	7	8	89	52	0	0	100
PCB-192	1	69	0	100	4	44	4	92
PCB-194	67	2	1	99	52	0	0	100
PCB-195	53	11	6	91	47	4	1	98
PCB-196	66	3	1	99	51	0	1	98
PCB-197+PCB-200	56	7	7	90	50	0	2	96
PCB-198+PCB-199	69	0	1	99	51	0	1	98
PCB-201	36	25	9	87	43	5	4	92
PCB-202	64	3	3	96	51	0	1	98
PCB-203	66	1	3	96	51	1	0	100
PCB-204	6	59	5	93	21	28	3	94
PCB-205	57	8	5	93	51	1	0	100
PCB-206	63	6	1	99	51	0	1	98

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
PCBs *(continued)*								
PCB-207	65	3	2	97	52	0	0	100
PCB-208	66	1	3	96	52	0	0	100
PCB-209	55	7	8	89	50	1	1	98
Dioxins and Furans								
2,3,7,8-TCDD	14	36	20	71	39	4	9	83
1,2,3,7,8-PeCDD	11	54	5	93	38	6	8	85
1,2,3,4,7,8-HxCDD	1	65	4	94	24	16	12	77
1,2,3,6,7,8-HxCDD	13	46	11	84	46	2	4	92
1,2,3,7,8,9-HxCDD	4	60	6	91	24	21	7	87
1,2,3,4,6,7,8-HpCDD	4	56	10	86	28	13	11	79
OCDD	0	68	2	97	18	28	6	88
2,3,7,8-TCDF	48	15	7	90	50	2	0	100
1,2,3,7,8-PeCDF	4	63	3	96	16	21	15	71
2,3,4,7,8-PeCDF	5	58	7	90	36	7	9	83
1,2,3,4,7,8-HxCDF	0	64	6	91	10	28	14	73
1,2,3,6,7,8-HxCDF	0	66	4	94	13	29	10	81
1,2,3,7,8,9-HxCDF	0	69	1	99	0	52	0	100
2,3,4,6,7,8-HxCDF	0	70	0	100	8	39	5	90
1,2,3,4,6,7,8-HpCDF	0	67	3	96	12	25	15	71
1,2,3,4,7,8,9-HpCDF	0	69	1	99	0	51	1	98
OCDF	0	70	0	100	2	48	2	96
Organochlorine Pesticides: Total DDT								
2,4'-DDD	0	57	0	100	1	36	2	95
2,4'-DDE	1	52	4	93	13	21	5	87

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
Organochlorine Pesticides: Total DDT *(continued)*								
2,4'-DDT	2	54	1	98	3	34	2	95
4,4'-DDD	1	68	1	99	12	27	13	75
4,4'-DDE	45	16	9	87	51	1	0	100
4,4'-DDT	1	61	8	89	4	36	12	77
Organochlorine Pesticides: Total Chlordane								
Chlordane, alpha-	1	65	4	94	15	32	5	90
Chlordane, gamma-	1	69	0	100	4	44	4	92
Nonachlor, cis-	1	68	1	99	8	38	6	88
Nonachlor, trans-	1	64	5	93	20	29	3	94
Oxychlordane	1	66	3	96	3	45	4	92
Other Organochlorine Pesticides								
Aldrin	0	69	1	99	0	52	0	100
Dicofol	1	68	1	99	0	49	3	94
Dieldrin	2	67	1	99	11	39	2	96
Endosulfan I	0	66	4	94	1	49	2	96
Endosulfan II	0	70	0	100	0	52	0	100
Endosulfan Sulfate	0	70	0	100	0	50	2	96
Endrin	0	69	1	99	3	47	2	96
Ethalfluralin	0	66	4	94	1	38	13	75
Heptachlor	1	64	5	93	4	44	4	92
Heptachlor Epoxide	1	69	0	100	2	46	4	92
Hexachlorocyclohexane (BHC), alpha-	0	70	0	100	0	50	2	96
Hexachlorocyclohexane (BHC), beta-	1	59	10	86	1	41	10	81

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both Above Detection	Both Below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
Other Organochlorine Pesticides *(continued)*								
Hexachlorocyclohexane (BHC), delta-	0	69	1	99	1	48	3	94
Hexachlorocyclohexane (BHC), gamma-	3	63	4	94	2	44	6	88
Isodrin	0	65	5	93	0	49	3	94
Kepone	3	56	11	84	8	36	8	85
Methoxychlor	0	69	1	99	1	49	2	96
Mirex	0	68	2	97	2	49	1	98
Octachlorostyrene	0	69	1	99	0	49	3	94
Pendimethalin	0	70	0	100	2	46	4	92
Pentachloroanisole	3	50	17	76	9	37	6	88
Pentachloronitrobenzene	0	63	7	90	5	45	2	96
Permethrin, cis-	0	68	2	97	1	48	3	94
Permethrin, trans-	0	70	0	100	0	49	3	94
Toxaphene	0	70	0	100	0	52	0	100
Trifluralin	2	63	5	93	7	31	14	73
Organophosphorous Pesticides								
Chlorpyriphos	0	70	0	100	0	52	0	100
Diazinon	0	70	0	100	0	52	0	100
Disulfoton	0	70	0	100	0	52	0	100
Disulfoton Sulfone	0	70	0	100	0	52	0	100
Ethion	0	70	0	100	0	52	0	100
Paraoxon	0	70	0	100	0	52	0	100
Parathion, Ethyl-	0	70	0	100	0	52	0	100
Terbufos	0	70	0	100	0	52	0	100

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both above Detection	Both below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
Organophosphorous Pesticides *(continued)*								
Terbufos Sulfone	0	70	0	100	0	52	0	100
Semivolatile Organic Compounds: PAHs								
Acenaphthene	0	70	0	100	0	52	0	100
Anthracene	0	70	0	100	0	52	0	100
Benzo(a)Anthracene	0	70	0	100	0	52	0	100
Benzo(a)Pyrene	0	70	0	100	0	52	0	100
Benzo(b)Fluoranthene	0	70	0	100	0	52	0	100
Benzo(ghi)Perylene	0	70	0	100	0	52	0	100
Benzo(j)Fluoranthene	0	70	0	100	0	52	0	100
Benzo(k)Fluoranthene	0	70	0	100	0	52	0	100
Chrysene	0	70	0	100	0	52	0	100
Dibenzo(a,h)Anthracene	0	70	0	100	0	52	0	100
Fluoranthene	0	70	0	100	0	52	0	100
Fluorene	0	70	0	100	0	52	0	100
Indeno(1,2,3-cd)Pyrene	0	70	0	100	0	52	0	100
Naphthalene	0	69	1	99	0	52	0	100
Perylene	0	70	0	100	0	52	0	100
Phenanthrene	0	70	0	100	0	52	0	100
Pyrene	0	70	0	100	0	52	0	100
Other Semivolatile Organic Compounds								
1,2,4,5-Tetrachlorobenzene	0	70	0	100	0	52	0	100
1,2,4-Trichlorobenzene	0	70	0	100	0	52	0	100
1,2-Dichlorobenzene	0	70	0	100	0	52	0	100
1,3-Dichlorobenzene	0	70	0	100	0	52	0	100

Chemical	Predators (N=70 Samples)				Bottom Dwellers (N=52 Samples)			
	Both Above Detection	Both Below Detection	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement	Detection Results Differ	Percent Agreement
Other Semivolatile Organic Compounds *(continued)*								
1,4-Dichlorobenzene	0	70	0	100	0	52	0	100
2,4,5-Trichlorophenol	0	70	0	100	0	52	0	100
2,4,6-Tris(1,1-Dimethylethyl) Phenol	0	70	0	100	0	52	0	100
*3,3'-dichlorobenzidine**								
4-Bromophenyl Phenyl Ether	0	70	0	100	0	52	0	100
4,4′-Methylene bis (2-Chloroaniline)	0	70	0	100	0	52	0	100
Acenaphthylene	0	70	0	100	0	52	0	100
Bis (2-ethylhexyl) Phthalate	0	69	1	99	0	50	2	96
Butyl Benzyl Phthalate	0	70	0	100	0	52	0	100
Di-n-Butyl Phthalate	0	66	4	94	2	47	3	94
Diethylstilbestrol	0	70	0	100	0	52	0	100
Hexachlorobenzene	0	70	0	100	0	52	0	100
Hexachlorobutadiene	0	70	0	100	0	52	0	100
Nitrobenzene	0	70	0	100	0	52	0	100
Nonylphenol	1	69	0	100	0	52	0	100
Pentachlorobenzene	0	70	0	100	0	52	0	100
Pentachlorophenol	0	70	0	100	0	52	0	100
Phenol	0	70	0	100	0	52	0	100
Tetrabromobisphenol A	0	70	0	100	0	52	0	100

* 3,3′-dichlorobenzidine was originally included as a target analyte in this study. However, the nature of this compound often results in poor recoveries from tissue samples and Ongoing Precision and Recovery (OPR) samples. Historically, the recovery problems have led to exclusion of large numbers of analytical results for 3,3′-dichlorobenzidine. Therefore, rather than exclude a large percentage of these results and include other results for this compound with recoveries that are very disparate from the other target analytes, EPA decided not to report results for 3,3′-dichlorobenzidine.

Appendix I

Tissue Concentration Differences between Replicate Sample Pairs

TABLE I-1. METALS

Tissue Concentration Differences for Predators (Fillets)

Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Mercury									
Mercury	ppb	70	1.7	410.0	11.00	21.75	48.50	84.75	162.50
Arsenic									
Arsenate	ppm	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Arsenite	ppm	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Inorganic arsenic (Total)	ppm	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Dimethylarsonic Acid	ppm	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Monomethylarsonic Acid	ppm	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies)

Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Mercury									
Mercury	ppb	52	0.1	130.9	3.81	5.32	11.80	37.43	90.83
Arsenic									
Arsenate	ppm	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Arsenite	ppm	52	0.0	0.1	0.00	0.00	0.00	0.00	0.02
Inorganic arsenic (Total)	ppm	52	0.0	0.1	0.00	0.00	0.00	0.00	0.01
Dimethylarsonic Acid	ppm	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Monomethylarsonic Acid	ppm	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00

TABLE I-2. PCBs

Tissue Concentration Differences for Predators (Fillets)									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 1	ppt	70	0.0	6.0	0.00	0.00	0.00	0.00	0.00
PCB 2	ppt	70	0.0	1.8	0.00	0.00	0.00	0.00	0.00
PCB 3	ppt	70	0.0	5.6	0.00	0.00	0.00	0.20	1.01
PCB 4	ppt	70	0.0	265.5	0.00	0.00	0.00	0.28	0.72
PCB 5	ppt	70	0.0	3.1	0.00	0.00	0.00	0.00	0.00
PCB 6	ppt	70	0.0	400.6	0.00	0.00	0.00	0.10	0.31
PCB 7	ppt	70	0.0	9.6	0.00	0.00	0.00	0.00	0.40
PCB 8	ppt	70	0.0	465.7	0.00	0.00	0.00	0.48	1.11
PCB 9	ppt	70	0.0	27.0	0.00	0.00	0.00	0.00	0.00
PCB 10	ppt	70	0.0	8.4	0.00	0.00	0.00	0.00	0.00
PCB 11	ppt	70	0.0	128.0	0.00	0.00	0.00	0.40	2.43
PCB 12 + PCB 13	ppt	70	0.0	18.5	0.00	0.00	0.00	0.00	0.00
PCB 14	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 15	ppt	70	0.0	817.5	0.00	0.00	0.05	0.30	1.10
PCB 16	ppt	70	0.0	188.0	0.00	0.00	0.15	0.60	2.41
PCB 17	ppt	70	0.0	485.7	0.00	0.10	0.40	1.08	3.91
PCB 18 + PCB 30	ppt	70	0.0	1465.7	0.00	0.13	0.60	1.85	5.15
PCB 19	ppt	70	0.0	120.7	0.00	0.00	0.10	0.20	0.62
PCB 20 + PCB 28	ppt	70	0.0	7842.7	0.00	0.80	2.85	8.90	34.33
PCB 21 + PCB 33	ppt	70	0.0	650.3	0.00	0.10	0.55	2.00	4.50
PCB 22	ppt	70	0.0	504.2	0.09	0.20	0.90	2.08	5.24
PCB 23	ppt	70	0.0	2.8	0.00	0.00	0.00	0.00	0.00
PCB 24	ppt	70	0.0	10.9	0.00	0.00	0.00	0.00	0.00
PCB 25	ppt	70	0.0	145.4	0.00	0.00	0.10	0.40	3.00
PCB 26 + PCB 29	ppt	70	0.0	573.5	0.00	0.00	0.00	0.20	4.64

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 27	ppt	70	0.0	97.9	0.00	0.00	0.00	0.00	0.70
PCB 31	ppt	70	0.0	2012.7	0.10	0.93	2.60	7.00	21.30
PCB 32	ppt	70	0.0	223.6	0.00	0.00	0.10	0.50	2.05
PCB 34	ppt	70	0.0	14.0	0.00	0.00	0.00	0.00	0.10
PCB 35	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 36	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 37	ppt	70	0.0	1162.5	0.00	0.10	0.30	0.88	2.18
PCB 38	ppt	70	0.0	3.5	0.00	0.00	0.00	0.00	0.00
PCB 39	ppt	70	0.0	11.6	0.00	0.00	0.00	0.00	0.20
PCB 40 + PCB 41 + PCB 71	ppt	70	0.0	841.0	0.00	0.23	1.30	3.38	14.65
PCB 42	ppt	70	0.0	628.0	0.00	0.33	1.10	2.60	12.72
PCB 43	ppt	70	0.0	132.6	0.00	0.00	0.00	0.18	1.91
PCB 44 + PCB 47 + PCB 65	ppt	70	0.0	2660.0	0.47	3.00	5.10	14.48	62.57
PCB 45 + PCB 51	ppt	70	0.0	209.6	0.00	0.00	0.00	0.75	5.11
PCB 46	ppt	70	0.0	44.0	0.00	0.00	0.00	0.00	0.63
PCB 48	ppt	70	0.0	403.2	0.00	0.13	0.50	1.70	6.46
PCB 49 + PCB 69	ppt	70	0.0	2059.0	0.30	1.53	4.00	16.68	51.61
PCB 50 + PCB 53	ppt	70	0.0	248.8	0.00	0.00	0.00	0.00	2.87
PCB 52	ppt	70	0.0	4151.0	0.60	3.35	7.50	22.90	83.80
PCB 54	ppt	70	0.0	7.9	0.00	0.00	0.00	0.00	0.00
PCB 55	ppt	70	0.0	30.1	0.00	0.00	0.00	0.00	0.64
PCB 56	ppt	70	0.0	473.0	0.19	0.33	1.40	5.28	11.80
PCB 57	ppt	70	0.0	13.6	0.00	0.00	0.00	0.00	0.51
PCB 58	ppt	70	0.0	32.5	0.00	0.00	0.00	0.18	0.60

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 59 + PCB 62 + PCB 75	ppt	70	0.0	373.0	0.00	0.00	0.40	1.38	6.05
PCB 60	ppt	70	0.0	1108.8	0.19	0.80	1.70	4.78	12.73
PCB 61 + PCB 70 + PCB 74 + PCB 76	ppt	70	0.1	3870.8	1.24	6.00	16.85	47.05	131.00
PCB 63	ppt	70	0.0	115.7	0.00	0.20	0.70	1.78	4.97
PCB 64	ppt	70	0.0	1226.0	0.20	0.73	2.20	6.43	28.89
PCB 66	ppt	70	0.0	3911.0	0.00	3.93	12.35	28.75	74.22
PCB 67	ppt	70	0.0	80.5	0.00	0.00	0.20	0.60	1.83
PCB 68	ppt	70	0.0	82.2	0.00	0.10	0.30	0.80	3.01
PCB 72	ppt	70	0.0	93.0	0.00	0.00	0.30	0.98	3.11
PCB 73	ppt	70	0.0	0.5	0.00	0.00	0.00	0.00	0.00
PCB 77	ppt	70	0.0	270.1	0.00	0.00	0.00	0.98	4.62
PCB 78	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
PCB 79	ppt	70	0.0	64.6	0.00	0.00	0.20	0.88	3.18
PCB 80	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 81	ppt	70	0.0	19.7	0.00	0.00	0.00	0.00	0.30
PCB 82	ppt	70	0.0	286.0	0.09	0.33	1.50	4.23	12.07
PCB 83 + PCB 99	ppt	70	0.0	5910.0	3.76	12.05	32.10	90.00	293.10
PCB 84	ppt	70	0.0	569.0	0.10	0.43	1.50	5.85	17.11
PCB 85 + PCB 116 + PCB 117	ppt	70	0.0	1070.0	0.80	3.00	8.40	21.78	74.14
PCB 86 + PCB 87 + PCB 97 + PCB 108 + PCB 119 + PCB 125	ppt	70	0.0	2850.0	1.09	4.75	19.70	50.75	162.89
PCB 88 + PCB 91	ppt	70	0.0	991.0	0.10	0.45	2.25	6.25	35.34
PCB 89	ppt	70	0.0	18.5	0.00	0.00	0.00	0.00	0.53

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
PCB 90 + PCB 101 + PCB 113	ppt	70	0.1	5370.0	3.94	14.08	34.85	110.50	311.50
PCB 92	ppt	70	0.0	1970.0	0.79	2.63	5.75	25.30	71.54
PCB 93 + PCB 95 + PCB 98 + PCB 100 + PCB 102	ppt	70	0.0	3210.0	0.68	2.75	7.25	36.00	132.70
PCB 94	ppt	70	0.0	12.4	0.00	0.00	0.00	0.00	0.21
PCB 96	ppt	70	0.0	10.3	0.00	0.00	0.00	0.00	0.00
PCB 103	ppt	70	0.0	160.3	0.00	0.00	0.30	0.80	4.11
PCB 104	ppt	70	0.0	3.9	0.00	0.00	0.00	0.00	0.00
PCB 105	ppt	70	0.0	881.0	0.58	4.45	16.70	38.55	119.39
PCB 106	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 107 + PCB 124	ppt	70	0.0	109.5	0.10	0.40	1.50	3.90	9.94
PCB 109	ppt	70	0.0	528.0	0.50	1.60	4.80	13.03	27.77
PCB 110 + PCB 115	ppt	70	0.0	4680.0	1.77	4.30	23.40	87.15	253.90
PCB 111	ppt	70	0.0	20.1	0.00	0.00	0.00	0.30	0.63
PCB 112	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 114	ppt	70	0.0	76.0	0.00	0.30	1.10	3.25	8.67
PCB 118	ppt	70	0.0	3860.0	5.60	15.70	48.00	117.25	342.30
PCB 120	ppt	70	0.0	151.6	0.00	0.20	0.75	2.05	4.41
PCB 121	ppt	70	0.0	14.0	0.00	0.00	0.00	0.00	0.31
PCB 122	ppt	70	0.0	39.9	0.00	0.00	0.30	0.70	1.81
PCB 123	ppt	70	0.0	67.8	0.00	0.30	1.05	3.38	5.98
PCB 126	ppt	70	0.0	13.9	0.00	0.00	0.00	0.00	0.00
PCB 127	ppt	70	0.0	6.9	0.00	0.00	0.00	0.20	0.73
PCB 128 + PCB 166	ppt	70	0.0	1027.0	0.70	3.43	12.65	34.93	94.53

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
PCB 129 + PCB 138 + PCB 160 + PCB 163	ppt	70	0.1	11730.0	9.99	34.50	111.00	242.00	705.20
PCB 130	ppt	70	0.0	706.0	0.20	1.38	5.10	15.20	28.09
PCB 131	ppt	70	0.0	48.1	0.00	0.00	0.25	0.90	2.24
PCB 132	ppt	70	0.0	1340.0	0.57	1.65	6.95	18.68	51.12
PCB 133	ppt	70	0.0	383.0	0.19	0.60	1.95	5.40	19.31
PCB 134 + PCB 143	ppt	70	0.0	214.0	0.09	0.23	1.30	2.88	8.81
PCB 135 + PCB 151 + PCB 154	ppt	70	0.0	5140.0	1.44	4.03	14.45	37.70	122.00
PCB 136	ppt	70	0.0	467.0	0.00	0.30	1.50	4.28	14.85
PCB 137	ppt	70	0.0	275.0	0.58	1.23	4.30	9.85	26.33
PCB 139 + PCB 140	ppt	70	0.0	241.0	0.09	0.40	1.50	4.08	8.88
PCB 141	ppt	70	0.0	1081.0	1.18	4.00	9.00	23.25	54.16
PCB 142	ppt	70	0.0	4.5	0.00	0.00	0.00	0.00	0.00
PCB 144	ppt	70	0.0	319.0	0.00	0.53	1.95	4.90	10.96
PCB 145	ppt	70	0.0	4.5	0.00	0.00	0.00	0.00	0.00
PCB 146	ppt	70	0.0	4380.0	2.91	9.43	24.65	57.70	143.90
PCB 147 + PCB 149	ppt	70	0.0	9150.0	3.08	8.68	34.30	87.75	228.20
PCB 148	ppt	70	0.0	84.6	0.00	0.00	0.10	0.50	2.01
PCB 150	ppt	70	0.0	30.3	0.00	0.00	0.00	0.20	0.80
PCB 152	ppt	70	0.0	3.6	0.00	0.00	0.00	0.00	0.00
PCB 153 + PCB 168	ppt	70	0.0	18400.0	11.52	44.53	122.50	277.48	776.20
PCB 155	ppt	70	0.0	103.7	0.00	0.00	0.00	0.28	0.70
PCB 156 + PCB 157	ppt	70	0.0	543.0	0.94	2.65	8.25	21.78	48.20
PCB 158	ppt	70	0.0	714.0	0.69	2.55	8.30	16.65	39.40

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*

Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 159	ppt	70	0.0	86.8	0.00	0.10	0.65	1.73	3.16
PCB 161	ppt	70	0.0	4.5	0.00	0.00	0.00	0.00	0.00
PCB 162	ppt	70	0.0	44.5	0.00	0.20	0.75	1.40	3.07
PCB 164	ppt	70	0.0	604.0	0.39	0.93	3.20	11.00	23.17
PCB 165	ppt	70	0.0	14.6	0.00	0.00	0.00	0.28	0.83
PCB 167	ppt	70	0.0	351.0	0.30	1.35	4.70	9.95	25.71
PCB 169	ppt	70	0.0	2.2	0.00	0.00	0.00	0.00	0.20
PCB 170	ppt	70	0.0	2710.0	1.63	7.40	19.45	56.28	112.50
PCB 171 + PCB 173	ppt	70	0.0	931.0	0.68	1.63	5.65	14.00	32.19
PCB 172	ppt	70	0.0	663.0	0.59	1.90	5.40	14.60	29.05
PCB 174	ppt	70	0.1	2105.0	0.69	2.65	8.55	23.05	60.50
PCB 175	ppt	70	0.0	171.1	0.00	0.30	1.05	3.20	6.36
PCB 176	ppt	70	0.0	257.0	0.00	0.10	0.70	1.78	6.66
PCB 177	ppt	70	0.0	1303.0	1.09	2.90	6.70	27.65	64.14
PCB 178	ppt	70	0.0	1100.0	0.46	1.60	5.55	18.00	43.82
PCB 179	ppt	70	0.0	772.0	0.20	0.73	2.25	6.43	26.61
PCB 180 + PCB 193	ppt	70	0.0	8680.0	4.94	22.98	60.50	177.25	375.10
PCB 181	ppt	70	0.0	21.4	0.00	0.00	0.30	0.77	2.01
PCB 182	ppt	70	0.0	64.2	0.00	0.00	0.30	1.10	3.11
PCB 183 + PCB 185	ppt	70	0.0	2820.0	2.18	4.68	19.20	53.75	109.20
PCB 184	ppt	70	0.0	96.6	0.00	0.00	0.00	0.38	1.26
PCB 186	ppt	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 187	ppt	70	0.0	7990.0	4.25	16.25	47.50	118.25	307.50
PCB 188	ppt	70	0.0	13.9	0.00	0.00	0.00	0.00	0.23
PCB 189	ppt	70	0.0	107.8	0.09	0.30	1.05	2.08	6.31

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 190	ppt	70	0.0	643.0	0.66	1.63	5.30	14.35	26.05
PCB 191	ppt	70	0.0	130.0	0.00	0.30	0.90	1.93	4.77
PCB 192	ppt	70	0.0	0.2	0.00	0.00	0.00	0.00	0.00
PCB 194	ppt	70	0.0	1683.0	0.80	3.85	11.90	37.53	87.23
PCB 195	ppt	70	0.0	610.0	0.00	0.75	4.45	12.83	25.45
PCB 196	ppt	70	0.0	1006.0	0.38	1.93	7.85	20.05	46.04
PCB 197 + PCB 200	ppt	70	0.0	177.1	0.00	0.33	1.25	3.15	7.65
PCB 198 + PCB 199	ppt	70	0.0	2206.0	1.47	5.35	18.50	51.00	113.90
PCB 201	ppt	70	0.0	263.0	0.00	0.00	0.95	6.65	17.53
PCB 202	ppt	70	0.0	490.0	0.10	1.35	4.20	12.75	30.74
PCB 203	ppt	70	0.0	1556.0	0.58	3.03	11.95	33.90	75.34
PCB 204	ppt	70	0.0	3.6	0.00	0.00	0.00	0.00	0.22
PCB 205	ppt	70	0.0	90.7	0.00	0.20	0.70	1.63	4.13
PCB 206	ppt	70	0.0	530.0	0.09	2.08	10.45	20.15	57.10
PCB 207	ppt	70	0.0	100.0	0.10	0.40	1.80	4.28	11.17
PCB 208	ppt	70	0.0	222.0	0.20	0.80	3.10	8.03	20.12
PCB 209	ppt	70	0.0	609.0	0.09	0.88	4.15	10.80	30.80
Tissue Concentration Differences for Bottom Dwellers (Whole Bodies)									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 1	ppt	52	0.0	32.6	0.00	0.00	0.00	0.00	0.20
PCB 2	ppt	52	0.0	10.7	0.00	0.00	0.00	0.00	0.40
PCB 3	ppt	52	0.0	22.2	0.00	0.00	0.00	0.10	0.40
PCB 4	ppt	52	0.0	57.9	0.00	0.00	0.75	1.95	7.92
PCB 5	ppt	52	0.0	6.1	0.00	0.00	0.00	0.00	0.09

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 6	ppt	52	0.0	48.7	0.00	0.10	0.40	1.10	4.06
PCB 7	ppt	52	0.0	13.1	0.00	0.00	0.00	0.20	0.76
PCB 8	ppt	52	0.0	321.0	0.00	0.45	1.60	5.85	12.97
PCB 9	ppt	52	0.0	19.1	0.00	0.00	0.00	0.23	1.00
PCB 10	ppt	52	0.0	2.8	0.00	0.00	0.00	0.00	0.20
PCB 11	ppt	52	0.0	310.0	0.00	0.00	0.85	2.60	5.49
PCB 12 + PCB 13	ppt	52	0.0	4.1	0.00	0.00	0.00	0.00	0.58
PCB 14	ppt	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
PCB 15	ppt	52	0.0	53.8	0.01	0.28	0.85	2.23	4.60
PCB 16	ppt	52	0.0	213.0	0.10	0.80	2.05	7.43	20.50
PCB 17	ppt	52	0.0	469.0	0.21	0.95	2.70	10.48	43.75
PCB 18 + PCB 30	ppt	52	0.1	828.0	0.70	1.38	4.65	21.85	67.35
PCB 19	ppt	52	0.0	47.8	0.01	0.20	0.60	1.80	5.46
PCB 20 + PCB 28	ppt	52	0.0	4470.0	3.00	9.08	37.50	122.50	275.20
PCB 21 + PCB 33	ppt	52	0.0	1169.0	0.71	1.80	4.80	13.20	48.05
PCB 22	ppt	52	0.0	1085.0	0.42	1.85	6.10	17.60	53.98
PCB 23	ppt	52	0.0	4.5	0.00	0.00	0.00	0.00	0.00
PCB 24	ppt	52	0.0	13.7	0.00	0.00	0.00	0.23	1.69
PCB 25	ppt	52	0.0	188.0	0.00	0.28	1.25	2.63	12.00
PCB 26 + PCB 29	ppt	52	0.0	533.0	0.00	0.60	2.75	5.45	28.80
PCB 27	ppt	52	0.0	59.6	0.00	0.07	0.35	1.88	7.28
PCB 31	ppt	52	0.0	2960.0	1.08	5.38	17.15	42.95	125.20
PCB 32	ppt	52	0.0	282.0	0.20	0.40	1.15	4.83	29.38
PCB 34	ppt	52	0.0	14.8	0.00	0.00	0.10	0.63	1.89
PCB 35	ppt	52	0.0	0.5	0.00	0.00	0.00	0.00	0.00

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 36	ppt	52	0.0	0.3	0.00	0.00	0.00	0.00	0.00
PCB 37	ppt	52	0.0	188.0	0.10	0.68	1.65	6.10	15.53
PCB 38	ppt	52	0.0	4.7	0.00	0.00	0.00	0.00	0.20
PCB 39	ppt	52	0.0	27.7	0.00	0.00	0.00	0.55	1.81
PCB 40 + PCB 41 + PCB 71	ppt	52	0.0	1666.0	0.63	3.50	11.45	30.73	130.91
PCB 42	ppt	52	0.0	1298.0	0.51	2.40	11.75	30.00	103.20
PCB 43	ppt	52	0.0	166.7	0.00	0.07	1.40	3.98	11.50
PCB 44 + PCB 47 + PCB 65	ppt	52	0.7	4250.0	4.15	13.58	57.50	131.50	452.50
PCB 45 + PCB 51	ppt	52	0.0	426.0	0.01	0.48	2.45	7.48	32.64
PCB 46	ppt	52	0.0	65.6	0.00	0.00	0.45	1.63	7.04
PCB 48	ppt	52	0.0	1054.0	0.41	1.35	5.75	20.98	63.88
PCB 49 + PCB 69	ppt	52	0.0	3340.0	2.80	8.30	38.95	131.58	393.80
PCB 50 + PCB 53	ppt	52	0.0	279.0	0.00	0.00	1.25	6.65	30.50
PCB 52	ppt	52	0.2	4080.0	1.94	12.55	62.50	144.25	705.20
PCB 54	ppt	52	0.0	3.0	0.00	0.00	0.00	0.00	0.29
PCB 55	ppt	52	0.0	51.0	0.00	0.00	0.00	0.60	3.78
PCB 56	ppt	52	0.1	1428.0	1.66	4.30	14.00	30.38	117.82
PCB 57	ppt	52	0.0	36.9	0.00	0.00	0.30	0.90	2.40
PCB 58	ppt	52	0.0	32.2	0.00	0.00	0.30	1.08	2.85
PCB 59 + PCB 62 + PCB 75	ppt	52	0.0	418.0	0.20	1.20	5.50	16.50	43.67
PCB 60	ppt	52	0.1	1275.0	1.62	3.98	9.95	29.35	99.14
PCB 61 + PCB 70 + PCB 74 + PCB 76	ppt	52	0.3	9140.0	7.22	24.28	92.50	360.25	867.60
PCB 63	ppt	52	0.0	301.5	0.40	1.05	3.75	13.75	42.20

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 64	ppt	52	0.4	2266.0	1.13	6.68	23.05	63.30	199.10
PCB 66	ppt	52	0.5	5690.0	4.30	24.45	55.00	285.50	921.10
PCB 67	ppt	52	0.0	150.3	0.00	0.30	1.25	2.70	11.59
PCB 68	ppt	52	0.0	64.0	0.20	0.50	1.20	5.08	17.17
PCB 72	ppt	52	0.0	58.0	0.00	0.30	1.45	3.50	12.68
PCB 73	ppt	52	0.0	5.3	0.00	0.00	0.00	0.00	0.00
PCB 77	ppt	52	0.0	125.0	0.00	0.17	2.90	8.15	18.13
PCB 78	ppt	52	0.0	4.8	0.00	0.00	0.00	0.00	0.00
PCB 79	ppt	52	0.0	55.0	0.01	0.63	2.20	5.33	22.56
PCB 80	ppt	52	0.0	4.2	0.00	0.00	0.00	0.00	0.00
PCB 81	ppt	52	0.0	15.3	0.00	0.00	0.40	1.25	2.59
PCB 82	ppt	52	0.0	237.0	0.53	2.70	7.50	24.20	44.30
PCB 83 + PCB 99	ppt	52	1.3	7200.0	15.35	45.55	110.00	513.75	1721.00
PCB 84	ppt	52	0.0	311.0	1.06	4.08	10.80	28.83	101.31
PCB 85 + PCB 116 + PCB 117	ppt	52	0.4	711.0	4.10	9.38	28.00	125.00	481.90
PCB 86 + PCB 87 + PCB 97 + PCB 108 + PCB 119 + PCB 125	ppt	52	0.3	2000.0	6.16	23.15	103.00	289.50	1272.00
PCB 88 + PCB 91	ppt	52	0.1	600.0	1.41	3.23	15.90	39.33	230.60
PCB 89	ppt	52	0.0	32.4	0.00	0.00	0.20	1.43	4.84
PCB 90 + PCB 101 + PCB 113	ppt	52	1.5	5200.0	14.08	46.15	134.50	492.50	1619.00
PCB 92	ppt	52	0.6	1170.0	3.20	8.08	16.75	80.50	338.40
PCB 93 + PCB 95 + PCB 98 + PCB 100 + PCB 102	ppt	52	0.3	1420.0	4.96	16.60	60.35	182.68	413.80
PCB 94	ppt	52	0.0	13.1	0.00	0.00	0.25	0.83	3.28

TABLE I-2. PCBS *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 96	ppt	52	0.0	16.2	0.00	0.00	0.00	0.25	1.97
PCB 103	ppt	52	0.0	100.0	0.10	0.30	1.00	3.68	13.75
PCB 104	ppt	52	0.0	1.5	0.00	0.00	0.00	0.00	0.00
PCB 105	ppt	52	0.0	1399.0	5.15	18.90	58.00	151.08	683.80
PCB 106	ppt	52	0.0	1.6	0.00	0.00	0.00	0.00	0.00
PCB 107 + PCB 124	ppt	52	0.0	130.0	0.72	1.88	4.90	12.85	31.84
PCB 109	ppt	52	0.1	630.0	1.22	5.90	15.15	53.13	213.50
PCB 110 + PCB 115	ppt	52	0.8	3500.0	19.10	34.63	123.00	349.00	1497.00
PCB 111	ppt	52	0.0	21.8	0.00	0.18	0.40	1.60	3.54
PCB 112	ppt	52	0.0	2.4	0.00	0.00	0.00	0.00	0.00
PCB 114	ppt	52	0.0	98.8	0.53	1.18	3.30	11.90	53.11
PCB 118	ppt	52	0.0	5870.0	20.75	47.40	147.50	605.00	1747.70
PCB 120	ppt	52	0.0	236.0	0.21	0.40	1.05	4.90	21.35
PCB 121	ppt	52	0.0	13.7	0.00	0.00	0.20	0.80	1.49
PCB 122	ppt	52	0.0	39.6	0.20	0.50	1.35	4.18	13.03
PCB 123	ppt	52	0.0	90.6	0.41	0.98	3.45	11.23	34.57
PCB 126	ppt	52	0.0	25.3	0.00	0.00	0.00	1.80	6.58
PCB 127	ppt	52	0.0	8.2	0.00	0.00	0.30	1.33	4.06
PCB 128 + PCB 166	ppt	52	0.6	2220.0	7.34	15.95	70.00	127.50	478.40
PCB 129 + PCB 138 + PCB 160 + PCB 163	ppt	52	4.0	25200.0	45.60	138.25	327.00	882.25	3459.00
PCB 130	ppt	52	0.1	1280.0	1.55	4.83	25.75	57.20	210.60
PCB 131	ppt	52	0.0	49.0	0.01	0.48	2.30	5.70	14.02
PCB 132	ppt	52	0.0	1080.0	4.04	8.40	50.00	122.25	310.60
PCB 133	ppt	52	0.0	620.0	0.60	2.78	6.80	18.38	74.37

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 134 + PCB 143	ppt	52	0.0	186.0	0.42	1.58	9.30	16.65	49.40
PCB 135 + PCB 151 + PCB 154	ppt	52	1.2	3600.0	7.64	19.23	66.00	154.00	614.20
PCB 136	ppt	52	0.0	247.0	0.90	2.83	8.90	19.73	80.68
PCB 137	ppt	52	0.0	530.0	1.30	4.75	14.25	47.78	152.20
PCB 139 + PCB 140	ppt	52	0.0	286.0	0.51	1.70	5.50	22.78	55.90
PCB 141	ppt	52	0.7	2450.0	1.91	12.83	38.30	108.75	349.90
PCB 142	ppt	52	0.0	2.0	0.00	0.00	0.00	0.00	0.00
PCB 144	ppt	52	0.0	263.0	0.31	1.98	5.70	18.30	55.24
PCB 145	ppt	52	0.0	2.0	0.00	0.00	0.00	0.00	0.29
PCB 146	ppt	52	1.6	8400.0	6.68	20.75	58.00	227.00	749.10
PCB 147 + PCB 149	ppt	52	4.2	11500.0	21.00	36.20	182.00	389.25	1367.00
PCB 148	ppt	52	0.0	98.1	0.00	0.10	0.65	1.73	7.26
PCB 150	ppt	52	0.0	30.0	0.00	0.00	0.30	0.93	2.54
PCB 152	ppt	52	0.0	2.0	0.00	0.00	0.00	0.23	0.89
PCB 153 + PCB 168	ppt	52	4.0	56000.0	22.90	151.75	435.00	1500.00	5400.00
PCB 155	ppt	52	0.0	118.2	0.00	0.00	0.10	0.43	10.95
PCB 156 + PCB 157	ppt	52	0.1	1300.0	2.01	9.75	31.10	80.50	342.30
PCB 158	ppt	52	0.3	1850.0	2.24	7.85	37.00	82.50	319.20
PCB 159	ppt	52	0.0	118.0	0.31	0.85	2.45	7.05	19.69
PCB 161	ppt	52	0.0	2.0	0.00	0.00	0.00	0.00	0.00
PCB 162	ppt	52	0.0	135.0	0.30	0.95	2.10	7.30	16.20
PCB 164	ppt	52	0.0	740.0	1.21	4.18	11.80	41.28	155.90
PCB 165	ppt	52	0.0	22.1	0.00	0.00	0.25	0.80	2.66
PCB 167	ppt	52	0.0	1170.0	1.14	4.08	17.90	40.28	163.90

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*

Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 169	ppt	52	0.0	2.7	0.00	0.00	0.20	0.60	0.79
PCB 170	ppt	52	0.2	9100.0	3.92	26.25	78.20	230.50	771.30
PCB 171 + PCB 173	ppt	52	0.1	3820.0	1.02	5.08	24.65	85.25	225.25
PCB 172	ppt	52	0.1	3880.0	1.12	5.93	19.65	62.25	151.37
PCB 174	ppt	52	0.5	3640.0	6.24	14.70	47.40	99.43	449.00
PCB 175	ppt	52	0.0	431.0	0.21	1.33	4.10	9.93	32.74
PCB 176	ppt	52	0.1	470.0	0.61	1.18	3.00	12.38	38.71
PCB 177	ppt	52	0.0	5200.0	2.47	10.28	53.20	118.13	450.60
PCB 178	ppt	52	0.5	1780.0	2.04	6.33	17.55	45.48	208.90
PCB 179	ppt	52	0.1	907.0	2.03	5.33	14.75	42.50	165.60
PCB 180 + PCB 193	ppt	52	0.1	47100.0	14.54	72.00	229.50	647.50	1981.40
PCB 181	ppt	52	0.0	69.0	0.00	0.30	1.10	2.85	8.77
PCB 182	ppt	52	0.0	153.0	0.10	0.48	1.95	4.93	8.15
PCB 183 + PCB 185	ppt	52	0.8	10600.0	5.19	20.80	69.35	145.83	621.50
PCB 184	ppt	52	0.0	63.0	0.00	0.10	0.45	1.20	4.08
PCB 186	ppt	52	0.0	2.8	0.00	0.00	0.00	0.00	0.00
PCB 187	ppt	52	0.0	15400.0	7.43	45.48	176.50	309.25	1459.90
PCB 188	ppt	52	0.0	57.0	0.00	0.00	0.00	1.18	4.24
PCB 189	ppt	52	0.0	493.0	0.31	1.18	3.60	8.85	26.95
PCB 190	ppt	52	0.0	3060.0	0.76	5.03	15.15	55.25	180.66
PCB 191	ppt	52	0.0	699.0	0.10	0.98	3.20	10.23	27.34
PCB 192	ppt	52	0.0	1.2	0.00	0.00	0.00	0.00	0.09
PCB 194	ppt	52	1.5	8470.0	4.12	10.75	33.40	131.55	348.80
PCB 195	ppt	52	0.0	2770.0	0.52	3.48	13.15	47.00	123.20
PCB 196	ppt	52	0.4	4860.0	1.64	6.08	17.70	75.08	177.80

TABLE I-2. PCBs *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
PCB 197 + PCB 200	ppt	52	0.0	560.0	0.72	1.65	5.60	15.15	30.34
PCB 198 + PCB 199	ppt	52	0.4	8000.0	5.48	27.68	67.50	202.00	446.50
PCB 201	ppt	52	0.0	570.0	0.21	1.92	7.38	17.75	53.52
PCB 202	ppt	52	0.3	936.0	1.84	7.08	16.40	36.25	93.67
PCB 203	ppt	52	0.0	6280.0	1.43	9.05	45.00	116.08	314.30
PCB 204	ppt	52	0.0	5.5	0.00	0.00	0.00	0.33	1.32
PCB 205	ppt	52	0.0	353.0	0.30	0.70	2.60	7.45	21.60
PCB 206	ppt	52	1.2	1430.0	4.49	7.13	47.95	132.03	292.00
PCB 207	ppt	52	0.2	253.0	0.71	1.75	5.85	22.25	56.70
PCB 208	ppt	52	0.0	660.0	1.50	4.38	20.00	54.55	120.18
PCB 209	ppt	52	0.0	839.0	1.02	3.90	20.85	65.25	216.89

TABLE I-3. DIOXINS AND FURANS

Tissue Concentration Differences for Predators (Fillets)									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
2,3,7,8-TCDD	ppt	70	0.0	0.5	0.00	0.00	0.00	0.02	0.04
1,2,3,7,8-PeCDD	ppt	70	0.0	0.3	0.00	0.00	0.00	0.00	0.04
1,2,3,4,7,8-HxCDD	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
1,2,3,6,7,8-HxCDD	ppt	70	0.0	0.5	0.00	0.00	0.00	0.01	0.03
1,2,3,7,8,9-HxCDD	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.02
1,2,3,4,6,7,8-HpCDD	ppt	70	0.0	0.6	0.00	0.00	0.00	0.00	0.04
OCDD	ppt	70	0.0	1.8	0.00	0.00	0.00	0.00	0.00
2,3,7,8-TCDF	ppt	70	0.0	1.3	0.00	0.00	0.01	0.03	0.10
1,2,3,7,8-PeCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.01
2,3,4,7,8-PeCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.02
1,2,3,4,7,8-HxCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
1,2,3,6,7,8-HxCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
1,2,3,7,8,9-HxCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
2,3,4,6,7,8-HxCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
1,2,3,4,6,7,8-HpCDF	ppt	70	0.0	0.2	0.00	0.00	0.00	0.00	0.00
1,2,3,4,7,8,9-HpCDF	ppt	70	0.0	0.1	0.00	0.00	0.00	0.00	0.00
OCDF	ppt	70	0.0	0.3	0.00	0.00	0.00	0.00	0.00
Tissue Concentration Differences for Bottom Dwellers (Whole Bodies)									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
2,3,7,8-TCDD	ppt	52	0.0	1.3	0.00	0.00	0.02	0.10	0.20
1,2,3,7,8-PeCDD	ppt	52	0.0	0.8	0.00	0.00	0.04	0.10	0.20
1,2,3,4,7,8-HxCDD	ppt	52	0.0	0.3	0.00	0.00	0.01	0.10	0.14
1,2,3,6,7,8-HxCDD	ppt	52	0.0	1.3	0.00	0.00	0.08	0.20	0.50
1,2,3,7,8,9-HxCDD	ppt	52	0.0	0.3	0.00	0.00	0.00	0.06	0.10

TABLE I-3. DIOXINS AND FURANS *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
1,2,3,4,6,7,8-HpCDD	ppt	52	0.0	3.5	0.00	0.00	0.14	0.38	0.90
OCDD	ppt	52	0.0	31.5	0.00	0.00	0.00	1.55	7.35
2,3,7,8-TCDF	ppt	52	0.0	2.3	0.00	0.00	0.04	0.11	0.34
1,2,3,7,8-PeCDF	ppt	52	0.0	0.1	0.00	0.00	0.00	0.01	0.04
2,3,4,7,8-PeCDF	ppt	52	0.0	0.6	0.00	0.00	0.01	0.10	0.19
1,2,3,4,7,8-HxCDF	ppt	52	0.0	0.1	0.00	0.00	0.00	0.01	0.03
1,2,3,6,7,8-HxCDF	ppt	52	0.0	0.1	0.00	0.00	0.00	0.01	0.03
1,2,3,7,8,9-HxCDF	ppt	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
2,3,4,6,7,8-HxCDF	ppt	52	0.0	0.1	0.00	0.00	0.00	0.00	0.03
1,2,3,4,6,7,8-HpCDF	ppt	52	0.0	0.3	0.00	0.00	0.00	0.01	0.05
1,2,3,4,7,8,9-HpCDF	ppt	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
OCDF	ppt	52	0.0	0.1	0.00	0.00	0.00	0.00	0.00

TABLE I-4. ORGANOCHLORINE PESTICIDES

Tissue Concentration Differences for Predators (Fillets)									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
Total DDT									
2,4'-DDD	ppb	57	0.0	0.0	0.00	0.00	0.00	0.00	0.00
2,4'-DDE	ppb	57	0.0	4.1	0.00	0.00	0.00	0.00	0.00
2,4'-DDT	ppb	57	0.0	4.5	0.00	0.00	0.00	0.00	0.00
4,4'-DDD	ppb	70	0.0	1.8	0.00	0.00	0.00	0.00	0.00
4,4'-DDE	ppb	70	0.0	17.0	0.00	0.05	0.54	1.68	4.96
4,4'-DDT	ppb	70	0.0	17.9	0.00	0.00	0.00	0.00	1.16
Total Chlordane									
Chlordane, alpha-	ppb	70	0.0	6.5	0.00	0.00	0.00	0.00	0.00
Chlordane, gamma-	ppb	70	0.0	0.3	0.00	0.00	0.00	0.00	0.00
Nonachlor, cis-	ppb	70	0.0	8.9	0.00	0.00	0.00	0.00	0.00
Nonachlor, trans-	ppb	70	0.0	21.2	0.00	0.00	0.00	0.00	0.00
Oxychlordane	ppb	70	0.0	2.1	0.00	0.00	0.00	0.00	0.00
Other Organochlorine Pesticides									
Aldrin	ppb	70	0.0	1.0	0.00	0.00	0.00	0.00	0.00
Dicofol	ppb	70	0.0	48.6	0.00	0.00	0.00	0.00	0.00
Dieldrin	ppb	70	0.0	5.8	0.00	0.00	0.00	0.00	0.00
Endosulfan I	ppb	70	0.0	2.0	0.00	0.00	0.00	0.00	0.00
Endosulfan II	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Endosulfan Sulfate	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Endrin	ppb	70	0.0	2.1	0.00	0.00	0.00	0.00	0.00
Ethalfluralin	ppb	70	0.0	1.3	0.00	0.00	0.00	0.00	0.00
Heptachlor	ppb	70	0.0	4.8	0.00	0.00	0.00	0.00	0.00
Heptachlor epoxide	ppb	70	0.0	2.2	0.00	0.00	0.00	0.00	0.00

TABLE I-4. ORGANOCHLORINE PESTICIDES *(continued)*

Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Hexachlorocyclohexane (BHC), alpha-	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Hexachlorocyclohexane (BHC), beta-	ppb	70	0.0	5.7	0.00	0.00	0.00	0.00	0.84
Hexachlorocyclohexane (BHC), delta-	ppb	70	0.0	1.0	0.00	0.00	0.00	0.00	0.00
Isodrin	ppb	70	0.0	1.4	0.00	0.00	0.00	0.00	0.00
Kepone (Chlordecone)	ppb	70	0.0	130.8	0.00	0.00	0.00	0.00	7.69
Methoxychlor	ppb	70	0.0	5.5	0.00	0.00	0.00	0.00	0.00
Mirex	ppb	70	0.0	0.7	0.00	0.00	0.00	0.00	0.00
Octachlorostyrene	ppb	70	0.0	0.4	0.00	0.00	0.00	0.00	0.00
Pendimethalin	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Pentachloroanisole	ppb	70	0.0	2.5	0.00	0.00	0.00	0.03	0.42
Pentachloronitrobenzene	ppb	70	0.0	1.9	0.00	0.00	0.00	0.00	0.04
Permethrin, cis-	ppb	70	0.0	41.6	0.00	0.00	0.00	0.00	0.00
Permethrin, trans-	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Toxaphene	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Trifluralin	ppb	70	0.0	8.3	0.00	0.00	0.00	0.00	0.01
Tissue Concentration Differences for Bottom Dwellers (Whole bodies)									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
Total DDT									
2,4'-DDD	ppb	39	0.0	1.5	0.00	0.00	0.00	0.00	0.00
2,4'-DDE	ppb	39	0.0	6.3	0.00	0.00	0.00	0.49	1.37
2,4'-DDT	ppb	39	0.0	10.1	0.00	0.00	0.00	0.00	0.06
4,4'-DDD	ppb	52	0.0	61.0	0.00	0.00	0.00	1.26	4.01

TABLE I-4. ORGANOCHLORINE PESTICIDES *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole bodies) *(continued)*

Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
4,4'-DDE	ppb	52	0.0	641.6	0.21	0.54	2.58	6.50	20.27
4,4'-DDT	ppb	52	0.0	29.4	0.00	0.00	0.00	0.48	3.78
Total Chlordane									
Chlordane, alpha-	ppb	52	0.0	4.3	0.00	0.00	0.00	0.43	1.90
Chlordane, gamma-	ppb	52	0.0	5.1	0.00	0.00	0.00	0.00	0.11
Nonachlor, cis-	ppb	52	0.0	39.3	0.00	0.00	0.00	0.09	5.94
Nonachlor, trans-	ppb	52	0.0	10.6	0.00	0.00	0.00	0.63	1.52
Oxychlordane	ppb	52	0.0	3.7	0.00	0.00	0.00	0.00	0.26
Other Organochlorine Pesticides									
Aldrin	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Dicofol	ppb	52	0.0	586.8	0.00	0.00	0.00	0.00	0.00
Dieldrin	ppb	52	0.0	15.4	0.00	0.00	0.00	0.09	1.41
Endosulfan I	ppb	52	0.0	5.4	0.00	0.00	0.00	0.00	0.00
Endosulfan II	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Endosulfan Sulfate	ppb	52	0.0	2.1	0.00	0.00	0.00	0.00	0.00
Endrin	ppb	52	0.0	7.3	0.00	0.00	0.00	0.00	0.00
Ethalfluralin	ppb	52	0.0	11.7	0.00	0.00	0.00	0.61	2.45
Heptachlor	ppb	52	0.0	16.3	0.00	0.00	0.00	0.00	0.67
Heptachlor epoxide	ppb	52	0.0	3.8	0.00	0.00	0.00	0.00	0.02
Hexachlorocyclohexane (BHC), alpha-	ppb	52	0.0	0.7	0.00	0.00	0.00	0.00	0.00
Hexachlorocyclohexane (BHC), beta-	ppb	52	0.0	10.6	0.00	0.00	0.00	0.00	2.81
Hexachlorocyclohexane (BHC), delta-	ppb	52	0.0	2.6	0.00	0.00	0.00	0.00	0.00

TABLE I-4. ORGANOCHLORINE PESTICIDES *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole bodies) *(continued)*									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
Isodrin	ppb	52	0.0	2.4	0.00	0.00	0.00	0.00	0.00
Kepone (Chlordecone)	ppb	52	0.0	174.0	0.00	0.00	0.00	2.20	21.97
Methoxychlor	ppb	52	0.0	48.9	0.00	0.00	0.00	0.00	0.00
Mirex	ppb	52	0.0	1.2	0.00	0.00	0.00	0.00	0.00
Octachlorostyrene	ppb	52	0.0	1.1	0.00	0.00	0.00	0.00	0.00
Pendimethalin	ppb	52	0.0	17.3	0.00	0.00	0.00	0.00	1.30
Pentachloroanisole	ppb	52	0.0	2.7	0.00	0.00	0.00	0.07	0.46
Pentachloronitrobenzene	ppb	52	0.0	2.9	0.00	0.00	0.00	0.00	0.34
Permethrin, cis-	ppb	52	0.0	124.0	0.00	0.00	0.00	0.00	0.00
Permethrin, trans-	ppb	52	0.0	32.4	0.00	0.00	0.00	0.00	0.00
Toxaphene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Trifluralin	ppb	52	0.0	66.9	0.00	0.00	0.00	1.07	7.46

TABLE I-5. SEMIVOLATILE ORGANIC COMPOUNDS

Tissue Concentration Differences for Predators (Fillets)									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Semivolatile Organic Compounds: PAHs									
Acenaphthene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Anthracene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Benzo[a]Anthracene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Benzo[a]Pyrene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Benzo(b)Fluoranthene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Benzo(ghi)Perylene	ppb	70	0.0	1776.0	0.00	0.00	0.00	0.00	0.00
Benzo(j)Fluoranthene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Benzo(k)Fluoranthene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Chrysene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Dibenz[a,h]Anthrancene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Fluoranthene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Fluorene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)Pyrene	ppb	70	0.0	1776.0	0.00	0.00	0.00	0.00	0.00
Naphthalene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Perylene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Phenanthrene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Pyrene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Other Semivolatile Organic Compounds									
1,2,4,5-Tetrachlorobenzene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
1,2,4-Trichlorobenzene (TCB)	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00

TABLE I-5. SEMIVOLATILE ORGANIC COMPOUNDS *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
2,4,5-Trichlorophenol	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
2,4,6-Tris(1,1-Dimethylethyl) Phenol	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
4,4'-Methylenebis(2-Chloroaniline)	ppb	70	0.0	1776.0	0.00	0.00	0.00	0.00	0.00
4-Bromophenyl Phenyl Ether	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
4-Nonylphenol	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Acenaphthylene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Bis(2-ethylhexyl)phthalate	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Butyl benzyl phthalate	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Chlorpyriphos	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Diazinon	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Diethylstilbestrol	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Disulfoton	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Disulfoton Sulfone	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Ethion	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Hexachlorocyclohexane, gamma-BHC (Lindane)	ppb	70	0.0	1.1	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Hexachlorobutadiene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Nitrobenzene	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Paraoxon	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Parathion-Ethyl	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Pentachlorobenzene	ppb	70	0.0	1776.0	0.00	0.00	0.00	0.00	0.00
Pentachlorophenol	ppb	70	0.0	4440.0	0.00	0.00	0.00	0.00	0.00

TABLE I-5. SEMIVOLATILE ORGANIC COMPOUNDS *(continued)*

Tissue Concentration Differences for Predators (Fillets) *(continued)*									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
Phenol	ppb	70	0.0	888.0	0.00	0.00	0.00	0.00	0.00
Terbufos	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Terbufos Sulfone	ppb	70	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Tetrabromobisphenol A	ppb	70	0.0	44400.0	0.00	0.00	0.00	0.00	0.00

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies)									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
Semivolatile Organic Compounds: PAHs									
Acenaphthene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Anthracene	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Benzo[a]Anthracene	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Benzo[a]Pyrene	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Benzo(b)Fluoranthene	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Benzo(ghi)Perylene	ppb	52	0.0	1998.0	0.00	0.00	0.00	0.00	0.00
Benzo(j)Fluoranthene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Benzo(k)Fluoranthene	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Chrysene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Dibenz[a,h]Anthrancene	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Fluoranthene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Fluorene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)Pyrene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Naphthalene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Perylene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Phenanthrene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Pyrene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00

TABLE I-5. SEMIVOLATILE ORGANIC COMPOUNDS *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	Units	Number of Samples	Minimum Difference	Maximum Difference	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Other Semivolatile Organic Compounds									
1,2,4,5-Tetrachlorobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
1,2,4-Trichlorobenzene (TCB)	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
1,3-Dichlorobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
1,4-Dichlorobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
2,4,5-Trichlorophenol	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
2,4,6-Tris(1,1-Dimethylethyl) Phenol	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
4,4'-Methylenebis(2-Chloroaniline)	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
4-Bromophenyl Phenyl Ether	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
4-Nonylphenol	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Acenaphthylene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Bis(2-ethylhexyl)phthalate	ppb	52	0.0	19780.1	0.00	0.00	0.00	0.00	0.00
Butyl benzyl phthalate	ppb	52	0.0	999.0	0.00	0.00	0.00	0.00	0.00
Chlorpyriphos	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Diazinon	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Diethylstilbestrol	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Disulfoton	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Disulfoton Sulfone	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Ethion	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Hexachlorocyclohexane, gamma-BHC (Lindane)	ppb	52	0.0	1.5	0.00	0.00	0.00	0.00	0.34

TABLE I-5. SEMIVOLATILE ORGANIC COMPOUNDS *(continued)*

Tissue Concentration Differences for Bottom Dwellers (Whole Bodies) *(continued)*									
Chemical	**Units**	**Number of Samples**	**Minimum Difference**	**Maximum Difference**	**10th Percentile**	**25th Percentile**	**Median**	**75th Percentile**	**90th Percentile**
Hexachlorobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Hexachlorobutadiene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Nitrobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Paraoxon	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Parathion-Ethyl	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Pentachlorobenzene	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Pentachlorophenol	ppb	52	0.0	4995.0	0.00	0.00	0.00	0.00	0.00
Phenol	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Terbufos	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Terbufos Sulfone	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00
Tetrabromobisphenol A	ppb	52	0.0	0.0	0.00	0.00	0.00	0.00	0.00