TOXIC SUBSTANCES MONITORING PROGRAM

1991 DATA REPORT

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1993

Prepared by
Del Rasmussen
Division of Water Quality

Field and Laboratory Operations Conducted by the
Water Pollution Control Laboratory
California Department of Fish and Game

STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

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LIST OF ABBREVIATIONS

DBP	Dichlorobenzophenone
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DDMS	Dichlorodiphenylmonochlorosaturatedethane
DDMU	Dichlorodiphenylmonochlorounsaturatedethane
DFG	California Department of Fish and Game
d/s	Downstream
EDL	Elevated Data Level(s)
FDA or (USFDA)	United States Food and Drug Administration
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
MIS	Median International Standard(s)
MTRL	Maximum Tissue Residue Level(s)
NAS	National Academy of Sciences
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
ppb	Parts Per Billion (ng/g)
ppm	Parts Per Million (ug/g)
Regional Water Boards	California Regional Water Quality Control Boards
State Water Board or SWRCB	California State Water Resources Control Board
TSMP	Toxic Substances Monitoring Program
USEPA	United States Environmental Protection Agency
u/s	Upstream

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Introduction

The Toxic Substances Monitoring Program (TSMP) was initiated in 1976 by the California State Water Resources Control Board (State Water Board). The TSMP was organized to provide a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in fresh, estuarine, and marine waters of the State through the analysis of fish and other aquatic life. The TSMP primarily targets water bodies with known or suspected impaired water quality and is not intended to give an overall water quality assessment. The California Department of Fish and Game (DFG) carries out the statewide TSMP for the State Water Board by collecting and analyzing samples. The State Water Board provides funding for the program under an ongoing interagency agreement with the DFG. Sampling stations are selected primarily by the nine Regional Water Quality Control Boards (Regional Water Boards) which are identified on the inside back cover.

The DFG reports annual sampling results to the State Water Board. The information is transmitted to the Regional Water Boards and to other federal, State, and local agencies in the form of an annual TSMP report. The report provides information on the statewide occurrence and levels of toxic substances and the data can be used by the Regional Water Boards and other agencies to identify waters impacted by toxic pollutants and to eventually abate such problems. This report presents the results of the 1991 sampling and analysis program. The raw data from the 1991 sampling program has already been released to the Regional Water Boards, other State agencies, and to the interested public. This report is the formal report on the 1991 program. The TSMP reports are routinely transmitted to the Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency, which has responsibility for evaluating pollutant levels based on human health concerns and issuing fish consumption health advisories if indicated.

TSMP results are used by the State and Regional Water Boards in the statewide Water Quality Assessment/Clean Water Strategy. Water bodies are classified from good to impaired water quality relative to each other and ranked according to this classification and resource value. TSMP results are used to assist in the ranking process. For example, water bodies that exceed human health criteria are considered more impaired than water bodies that only exceed environmental protection criteria. TSMP results are also used in the regulatory activities of the Regional Water Boards and the Department of Pesticide Regulation.

Summary

Table 1 at the end of this section lists the 108 stations (94 water bodies) sampled in 1991 including 15 stations sampled as part of a special urban lake survey in Region 4. Fifty-six of the stations were sampled for the first time. A total of 159 samples were analyzed for trace elements (metals), pesticides, and PCBs (Appendix A). Fish were collected at all but five of the stations. Crayfish were collected at five stations in Regions 4, 5, and 8. A spiny soft shelled turtle was collected at the Westmorland station on the New River in Region 7. Along with aquatic organisms, sediment was analyzed from five stations in

Regions 1 and 3 (Appendices B and C). Arroyo chub, speckled dace, prickly sculpin, and Santa Ana sucker were collected and analyzed for the first time in the TSMP. Species collected in 1991 are listed in Table 2 (freshwater fish), Table 3 (marine fish), and Table 4 (non-fish species) at the end of this section.

Sampling results were compared to criteria such as Maximum Tissue Residue Levels (MTRLs), U.S. Food and Drug Administration (FDA) action levels, Median International Standards (MIS), and the National Academy of Sciences (NAS) recommended guidelines for predator protection (see Administrative and Comparative Criteria section). MTRLs are a new criterion developed from water quality objectives in the November 1992 *California Inland Surface Waters Plan* (SWRCB 1992). MTRLs were exceeded at 13 water bodies from Regions 3, 4, 6, 7, and 9 (Appendix D). The FDA action level for mercury was exceeded in white bass from two stations on Lake Nacimiento in Region 3 (Appendix E). The FDA action level for chlordane was exceeded in a carp sample from Harbor Park Lake in Region 4 (Appendix F). Mercury exceeded the MIS at seven water bodies in Regions 1, 4, and 5 (Appendix E). Selenium exceeded the MIS at 2 stations; Suisun Bay in Region 2 and Lindero Lake in Region 4 (Appendix E). The NAS guidelines for organic chemicals were exceeded at 17 stations (15 water bodies) in Regions 3, 4, 7, and 8 (Appendix F). In addition to the regular chemical scan, four samples from Region 1 were analyzed for PCP and TCP and one sample of arroyo chub from the Valencia station on the Santa Clara River (Region 4) were analyzed for polynuclear aromatic hydrocarbons (PAHs). PCP and TCP results can be found in Appendix G. PAHs were not detected at the Valencia station.

The pesticide diazinon was found at the three highest concentrations found to date statewide. Diazinon was detected at 260 and 180 ppb in whole samples of red shiner from San Diego Creek near Michelson Drive in Region 8. Diazinon was also found at 180 ppb in another whole sample of red shiner from Peters Canyon Channel, a tributary to San Diego Creek. The previous high diazinon value was 140 ppb in a 1990 whole sample of red shiner from Peters Canyon Channel. The second highest levels of arsenic, lead, and dieldrin were also found in 1991. A liver sample of grey smoothhound shark from Mugu Lagoon (Region 4) contained 20.9 ppm arsenic. Grey smoothhound shark collected from this station in 1988 contained the highest level of arsenic at 29 ppm. Lead was found at 1.2 ppm in a whole sample of fathead minnow from Belvedere Park Lake, an urban lake in Region 4. This concentration is second only to a whole sample of California killifish collected in 1990 from Famosa Slough in Region 9. Dieldrin was found at the second and third highest levels (1,100 and 1,000 ppb) in whole samples of threespine stickleback from Blanco Drain near the Salinas River in Region 3. The highest concentration of dieldrin (1,700 ppb) occurred in a whole sample of threespine stickleback from Watsonville Slough (Region 3) in 1984. DDT continues to be found in high concentrations with the third and fourth highest concentrations yet detected in the TSMP. The two stickleback samples from Blanco Drain contained 13,019 and 12,299 ppb DDT. The highest DDT concentration found statewide is 19,270 ppb in a 1989 goldfish filet sample from Rio de Santa Clara in Region 4.

Additional tabular summaries of chemistry data are provided in Appendices H through N. Marine fish samples exceeding criteria are summarized in Appendix H (trace elements) and Appendix I (organic chemicals). Lipid weight data ascendances are summarized in Appendix J (freshwater) and Appendix K (marine). Summaries of all chemistry data are provided in Appendix L (trace elements), Appendix M (organic chemicals), and Appendix N (lipid weight data). A complete TSMP sampling history is provided in Appendix O. Station location descriptions and latitude and longitude information can be found in Appendices P and Q, respectively. Regional maps showing 1991 station locations are in Appendix R.

TABLE 1

1991 Toxic Substances Monitoring Program

Station Name	Sample		Collection Date	Analyses
	Region 1			
Beaughton Creek/d/s Highway 97 Bridge	Brown Trout	(BN)	09/19/91	Metals, Organics, PCP, TCP
Carrville Pond*	Sediment	(SED)	09/18/91	Metals, Organics
Estero Americano*	Pacific Staghorn Sculpin	(STG)	07/16/91	Cu, Hg
Estero de San Antonio*	Prickly Sculpin	(PCP)	07/16/91	Metals
Klamath River/d/s Iron Gate Reservoir*	Speckled Dace	(DC)	09/19/91	Metals, Organics, PCP, TCP
Lake Mendocino	Largemouth Bass	(LMB)	09/09/91	Hg
Lake Pillsbury	Largemouth Bass	(LMB)	09/10/91	Metals
Lake Sonoma	Largemouth Bass	(LMB)	09/09/91	Hg
Lost River/Tule Lake	Tui Chub	(TC)	09/20/91	Metals, Organics
McDaniel Slough	Threespine Stickleback	(STB)	09/16/91	Metals
Russian River/Duncans Mills*	Prickly Sculpin	(PCP)	07/17/91	Metals, Organics
Shasta River	Speckled Dace	(DC)	09/19/91	Metals, PCP, TCP
Trinity River/d/s Burnt Ranch	Rainbow Trout	(RBT)	09/17/91	Organics
Trinity River/East Fork	Rainbow Trout	(RBT)	09/18/91	Metals, Organics, PCP, TCP
Trinity River/Willow Creek	Sculpin	(SCP)	09/16/91	Metals, Organics
	Region 2			
Alameda Creek/Niles Canyon Road*	Sculpin	(SCP)	07/09/91	Metals, Organics
Napa River/Napa	Hitch	(HCH)	07/11/91	Hg, Se, Organics
Stevens Creek	Rainbow Trout	(RBT)	07/09/91	Metals, Organics
Suisun Bay	White Sturgeon	(WST)	01/12/92	Metals, Organics
Walker Creek*	Pacific Staghorn Sculpin	(STG)	07/16/91	Metals, Organics
Walnut Creek*	Green Sunfish	(GSF)	07/10/91	Metals, Organics
	Region 3			
Aptos Creek*	Prickly Sculpin	(PCP)	08/07/91	Metals, Organics
Blanco Drain/Salinas River	Threespine Stickleback	(STB)	09/04/91	Organics
Carmel Lagoon	Threespine Stickleback	(STB)	08/01/91	Metals, Organics
	Sediment	(SED)	08/01/91	Metals, Organics
Corcoran Lagoon*	Pacific Staghorn Sculpin	(STG)	08/07/91	Metals, Organics
El Estero*	Bluegill	(BG)	08/02/91	Metals, Organics
Lake Nacimiento/Dip Creek	White Bass	(WHB)	07/31/91	Metals
	Sediment	(SED)	07/31/91	Metals
Lake Nacimiento/Las Tablas	White Bass	(WHB)	07/31/91	Metals
	Sediment	(SED)	07/31/91	Metals
Moran Lake*	Threespine Stickleback	(STB)	08/06/91	Metals, Organics
Neary's Lake*	Sacramento Sucker	(SSKR)	08/06/91	Hg, Se, Organics
Roberts Lake*	Sacramento Perch	(SP)	08/01/91	Metals, Organics
Santa Maria River/Mouth*	Sediment	(SED)	07/31/91	Organics
Schwann Lake*	Largemouth Bass	(LMB)	08/07/91	Metals, Organics

* Stations sampled for the first time.

TABLE 1 (continued)

1991 Toxic Substances Monitoring Program

Station Name	Sample		Collection Date	Analyses
	Region 4			
Alamitos Bay*	California Corbina	(CCB)	06/12/91	Metals, Organics
Arroyo Conejo	Green Sunfish	(GSF)	06/19/91	Metals, Organics
Arroyo Simi*	Fathead Minnow	(FHM)	06/19/91	Metals, Organics
Belvedere Park Lake*#	Fathead Minnow	(FHM)	04/18/91	Metals, Organics
Calabasas Lake*#	Largemouth Bass	(LMB)	04/20/91	Metals, Organics
Calleguas Creek	Goldfish	(GF)	06/18/91	Organics
Conejo Creek*	Mosquitofish	(GAM)	06/19/91	Metals, Organics
Echo Park Lake #	Largemouth Bass	(LMB)	04/19/91	Metals, Organics
Eleanor Lake*#	Black Bullhead	(BLB)	04/22/91	As
	Goldfish	(GF)	04/22/91	As, Hg, Se, Organics
El Dorado Park Lake*#	Largemouth Bass	(LMB)	04/21/91	Metals, Organics
Harbor Park Lake #	Carp	(CP)	06/15/91	Organics
Hollenbeck Park Lake*#	Red Swamp Crayfish	(PROI)	04/18/91	Metals, Organics
Legg Lake #	Largemouth Bass	(LMB)	04/17/91	Metals, Organics
Lincoln Park Lake #	Largemouth Bass	(LMB)	04/18/91	Metals, Organics
Lindero Lake*#	Largemouth Bass	(LMB)	04/22/91	Metals, Organics
Los Angeles River/Sepulveda Basin*	Goldfish	(GF)	05/15/91	Hg, Se, Organics
Malibu Creek	Bluegill	(BG)	06/18/91	Metals, Organics
Malibou Lake*#	Largemouth Bass	(LMB)	04/23/91	Metals, Organics
Mugu Lagoon	Gray Smoothhound Shark	(GSS)	06/17/91	Metals
Peck Road Lake #	Largemouth Bass	(LMB)	04/17/91	Metals, Organics
Puddingstone Reservoir #	Largemouth Bass	(LMB)	06/11/91	Metals, Organics
Rio de Santa Clara/Oxnard Drain	Mosquitofish	(GAM)	06/17/91	Organics
San Gabriel River	Mozambique Tilapia	(TLM)	06/16/91	Metals
Santa Clara River/Santa Paula	Santa Ana Sucker	(SAKR)	06/20/91	Hg, Se
Santa Clara River/Valencia*	Arroyo Chub	(AC)	06/11/91	Organics, PAHs
Sherwood Lake*#	Largemouth Bass	(LMB)	04/22/91	Metals, Organics
Ventura River	Carp	(CP)	06/20/91	Metals, Organics
Westlake Lake*#	Largemouth Bass	(LMB)	04/23/91	Metals, Organics
	Region 5			
American River/d/s Folsom Reservoir*	Largemouth Bass	(LMB)	10/03/91	Hg
American River/d/s Watt Avenue Bridge	Sacramento Sucker	(SSKR)	10/16/91	Hg
Feather River/d/s Highway 99 Bridge	Channel Catfish	(CCF)	10/09/91	Hg
Feather River/d/s Oroville Reservoir*	Sucker	(SKR)	11/05/91	Hg
Franks Tract*	Crayfish	(PACI)	10/21/91	Metals
Sacramento River/Hood	White Catfish	(WCF)	10/11/91	Hg
	White Catfish	(WCF)	11/21/91	Hg
	Crayfish	(PACI)	10/21/91	Metals
Sacramento River/u/s I-5 Overcrossing*	Crayfish	(PACI)	10/11/91	Metals
San Joaquin River/Vernalis	Channel Catfish	(CCF)	10/30/91	Hg
Yuba River/N.F./d/s Bullards Bar Res*	Smallmouth Bass	(SMB)	10/15/91	Hg

* Stations sampled for the first time.

Urban Lake Survey

TABLE 1 (continued)

1991 Toxic Substances Monitoring Program

Station Name	Sample		Collection Date	Analyses
	Region 6			
Bishop Creek Canal/d/s Bishop*	Brown Trout	(BN)	07/23/91	Metals, Organics
Carson River/W.F./d/s Paynesville*	Brown Trout	(BN)	09/27/91	Metals, Organics
Donner Lake*	Kokanee	(KOK)	10/23/91	Metals, Organics
Gull Lake*	Sacramento Perch	(SP)	07/24/91	Metals
Haiwee Reservoir*	Smallmouth Bass	(SMB)	07/24/91	Metals
Little Rock Creek Reservoir*	Black Bullhead	(BLB)	08/14/91	Metals
Sabrina Lake*	Brown Trout	(BN)	07/23/91	Metals
Silver Creek*	Sucker	(SKR)	09/27/91	Metals
Silverwood Lake*	Largemouth Bass	(LMB)	08/14/91	Metals
Squaw Creek	Brown Trout	(BN)	10/22/91	Metals, Organics
	Region 7			
Colorado River/Needles	Carp	(CP)	08/20/91	Hg, Se, Organics
Colorado River/u/s Imperial Dam	Largemouth Bass	(LMB)	08/18/91	Metals, Organics
Fig Drain	Sailfin Molly	(MOL)	08/17/91	Se, Organics
Mayflower Drain*	Mosquitofish	(GAM)	08/16/91	Se, Organics
New River/International Boundary	Carp	(CP)	12/18/91	Se, Hg, Organics
New River/Westmorland	Channel Catfish	(CCF)	08/15/91	Se, Organics
	Spiny Soft Shelled Turtle	(SST)	08/15/91	Se, Organics
Orange Drain*	Mosquitofish	(GAM)	08/17/91	Se, Organics
Palo Verde Outfall Drain	Carp	(CP)	08/19/91	Se, Organics
Peach Drain*	Mosquitofish	(GAM)	08/17/91	Se
Reservation Main Drain	Redbelly Tilapia	(TLZ)	08/18/91	Se, Organics
Rose Drain	Mosquitofish	(GAM)	08/17/91	Se, Organics
Salton Sea/North	Orangemouth Corvina	(ORC)	05/30/91	Metals, Organics
	Orangemouth Corvina	(ORC)	06/18/91	Se, Organics
	Sargo	(SAR)	05/30/91	Metals, Organics
Salton Sea/South	Orangemouth Corvina	(ORC)	05/15/91	Metals, Organics
	Region 8			
El Modena Channel/u/s Walnut Avenue Brg*	Red Shiner	(PRS)	05/16/91	Metals, Organics
Huntington Harbour/Anaheim Bay	White Croaker	(WCK)	11/21/91	Metals, Organics
Newport Bay	Spotted Sand Bass	(SSB)	06/20/91	Metals, Organics
Peters Canyon Channel	Red Shiner	(PRS)	05/16/91	Metals, Organics
San Diego Creek/Barranca Parkway	Red Shiner	(PRS)	05/16/91	Metals, Organics
San Diego Creek/Michelson Drive	Red Shiner	(PRS)	05/16/91	Metals, Organics
Santa Ana River/Prado Dam	Largemouth Bass	(LMB)	05/14/91	Metals, Organics
	Red Swamp Crayfish	(PROI)	05/14/91	Metals, Organics
Santa Ana River/USGS Gage	Santa Ana Sucker	(SAKR)	05/14/91	Hg, Se

* Stations sampled for the first time.

TABLE 1 (continued)

1991 Toxic Substances Monitoring Program

Station Name	Sample		Collection Date	Analyses
	Region 9			
Chollas Creek/Main Street*	Longjaw Mudsucker	(LJM)	06/14/91	Metals, Organics
Keys Creek*	Green Sunfish	(GSF)	06/13/91	Metals, Organics
Rainbow Creek*	Black Bullhead	(BLB)	06/14/91	Metals, Organics
San Luis Rey River/Foussat Road*	Largemouth Bass	(LMB)	06/13/91	Metals, Organics
San Luis Rey River/Highway 15*	Largemouth Bass	(LMB)	06/13/91	Metals, Organics
San Luis Rey River/Highway 76*	Largemouth Bass	(LMB)	06/13/91	Metals, Organics
Santa Margarita River/Willow Glen Road*	Green Sunfish	(GSF)	06/14/91	Metals, Organics

* Stations sampled for the first time.

TABLE 2

Toxic Substances Monitoring Program

1991 Freshwater Fish Code List*

Species Code	Common Name	Species Name	Family Name
AC	Arroyo Chub**	*Gila orcutti*	Cyprinidae
BG	Bluegill	*Lepomis macrochirus*	Centrarchidae
BLB	Black Bullhead	*Ameiurus melas*	Ictaluridae
BN	Brown Trout	*Salmo trutta*	Salmonidae
CCF	Channel Catfish	*Ictalurus punctatus*	Ictaluridae
CP	Carp	*Cyprinus carpio*	Cyprinidae
DC	Speckled Dace**	*Rhinichthys osculus*	Cyprinidae
FHM	Fathead Minnow	*Pimephales promelas*	Cyprinidae
GAM	Mosquitofish	*Gambusia affinis*	Poeciliidae
GF	Goldfish	*Carassius auratus*	Cyprinidae
GSF	Green Sunfish	*Lepomis cyanellus*	Centrarchidae
HCH	Hitch	*Lavinia exilicauda*	Cyprinidae
KOK	Kokanee	*Oncorhynchus nerka*	Salmonidae
LJM	Longjaw Mudsucker	*Gillichthys mirabilis*	Gobiidae
LMB	Largemouth Bass	*Micropterus salmoides*	Centrarchidae
MOL	Sailfin Molly	*Poecilia latipinna*	Poeciliidae
PCP	Prickly Sculpin**	*Cottus asper*	Cottidae
PRS	Red Shiner	*Cyprinella lutrensis*	Cyprinidae
RBT	Rainbow Trout	*Oncorhynchus mykiss*	Salmonidae
SAKR	Santa Ana Sucker**	*Catostomus santaanae*	Catostomidae
SCP	Sculpin	*Cottus sp.*	Cottidae
SKR	Sucker	*Catostomus sp.*	Catostomidae
SMB	Smallmouth Bass	*Micropterus dolomieu*	Centrarchidae
SP	Sacramento Perch	*Archoplites interruptus*	Centrarchidae
SSKR	Sacramento Sucker	*Catostomus occidentalis*	Catostomidae
STB	Threespine Stickleback	*Gasterosteus aculeatus*	Gasterosteidae
STG	Pacific Staghorn Sculpin	*Leptocottus armatus*	Cottidae
TC	Tui Chub	*Gila bicolor*	Cyprinidae
TLM	Mozambique Tilapia	*Tilapia mossambica*	Cichlidae
TLZ	Redbelly Tilapia	*Tilapia zillii*	Cichlidae
WCF	White Catfish	*Ameiurus catus*	Ictaluridae
WHB	White Bass	*Morone chrysops*	Percichthyidae
WST	White Sturgeon	*Acipenser transmontanus*	Acipenseridae

* Common and scientific names were obtained from Robins et al. (1991). List includes fish that inhabit both fresh and estuarine waters.

** Collected for the first time.

TABLE 3

Toxic Substances Monitoring Program

1991 Marine Fish Code List*

Species Code	Common Name	Species Name	Family Name
CCB	California Corbina	*Menticirrhus undulatus*	Sciaenidae
GSS	Gray Smoothhound Shark	*Mustelus californicus*	Carcharhinidae
ORC	Orangemouth Corvina	*Cynoscion xanthulus*	Sciaenidae
SAR	Sargo	*Anisotremus davidsoni*	Haemulidae
SSB	Spotted Sand Bass	*Paralabrax maculatofasciatus*	Serranidae
WCK	White Croaker	*Genyonemus lineatus*	Sciaenidae

*Common and scientific names were obtained from Robins et al. (1991).

TABLE 4

Toxic Substances Monitoring Program

1991 Non-Fish Species Code List

Species Code	Common Name	Species Name	Family Name
PACI	Crayfish	*Pacifastacus leniusculus*	Astacidae
PROI	Red Swamp Crayfish	*Procambarus clarki*	Astacidae
SST	Spiny Soft Shelled Turtle	*Trionyx spiniferus*	Trionychidae

FIELD AND LABORATORY OPERATIONS

The presence of many toxic substances in fresh waters is determined by analyzing tissues from fish and other aquatic organisms. Concentrations of these substances in water are often too low or transitory to be reliably detected through the more traditional methods of analysis of water samples. Also, many toxic substances are not water soluble, but can be found associated with sediment or organic matter. Fish and other aquatic organisms are sampled because they bioaccumulate and bioconcentrate toxic substances to levels which may be many hundreds of times the levels actually in the water. This concentration factor facilitates detection of toxic pollutants. The following is a general overall discussion of field and laboratory procedures. A detailed discussion is provided in Appendix S.

Substances Measured

A total of 10 trace elements (metals) and 45 pesticides and PCBs (organic chemicals) are analyzed in the TSMP on a regular basis. Additional substances, such as polynuclear aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), and tetrachlorophenol (TCP), are looked for on a request basis only. Not every sample is analyzed for all metals or organic chemicals. Each sample at each station is handled individually. The requesting agency, usually the Regional Water Boards, will specify the type of analysis for each sample. All metals, except mercury and selenium, are routinely analyzed in liver tissue. Mercury, selenium, and all organic chemicals are analyzed in muscle tissue (filet). When only very small fish are available, metal or organic chemical analysis is performed on a whole-body composite of larger than usual numbers of individual fish.

Sample Size

Composite samples, using six fish of each species, are collected whenever possible. The number and size uniformity of the fish in each composite depends upon their availability. Replicate composites are collected and analyzed to measure the variability of toxicant concentrations in single species composites collected at the same time and place. Collection of the same species from all stations is desirable to minimize possible variation in the data due to differences in pollutant uptake between species. However, this is not possible over the entire State due to the variety of habitat sampled and limited collection time available in the program. All reasonable efforts are made to maintain both station-to-station and year-to-year uniformity in collections. In general, predator fish are desired from all stations. Forage fish are desired as supplemental samples at stations where pollution problems are known to exist, or as substitute samples where predatory fish are not available.

Wet and Lipid Weight Measurements

Tissue concentrations of metals and organic chemicals are measured on a wet weight basis. Metal data are presented in parts per million (ppm), while organic chemical data are presented in parts per billion (ppb). In addition to wet weight measures, organic chemicals are also expressed on a lipid weight basis. Lipid

weight measurements offer several advantages. Because chlorinated hydrocarbons are much more soluble in lipids (fat tissues) than in water, they partition into lipid-rich tissues of aquatic organisms (Stout and Beezhold 1981). Animals with higher proportions of lipid in their tissue usually have had higher concentrations of chlorinated hydrocarbon pollutants (Phillips 1980). Factors such as season, water temperature, health of the organism, stress on the organism, and type of species can affect the lipid levels of samples collected for analysis and can, therefore, cause variability in results. Use of lipid weight measurements may reduce this source of variability, although disadvantages have also been noted (Phillips 1980). As a result, lipid weight values may represent a more realistic measure of environmental availability of chlorinated hydrocarbons than wet weight values. Wet weight measures, however, remain the preferred measure for most readers because all standards for human health and for predator protection are based on wet weight measures. Also, wet weight measures better reflect the exposure of predators or humans to the actual concentration in freshly caught fish.

Station Numbers

Each TSMP station is identified by a unique seven digit number derived from the State Water Board's hydrologic basin planning maps. The first digit of a station number signifies one of the nine Regional Water Boards. The second and third digits represent a hydrologic area, while the fourth and fifth digits identify a hydrologic subarea. The sixth and seventh digits represent the distance in miles above the downstream hydrologic boundary. For example, station 519.21.01 is in Region 5, hydrologic area 19, subarea 21, and is one mile upstream from the hydrologic unit boundary. Not all mileage indicators are accurate, however. In certain instances, it was necessary to assign an arbitrary mileage indicator. For example, the arbitrary designation is used when two or more stations within the same hydrologic subarea are located within the same number of miles of the hydrologic boundary, resulting in the same station number. In this case, one or more of the stations is arbitrarily assigned a mileage designator from 90 to 99.

ADMINISTRATIVE AND COMPARATIVE CRITERIA

In this report, as in previous TSMP reports, the term "criteria" is used to refer to the criteria against which a particular metal or organic chemical is being compared. As more than one criterion may apply to any one metal or organic compound, a hierarchy was established. The intent of the hierarchy is to compare data against the more important criterion. In general, FDA action levels and the "Median International Standards" (MIS), human health-related criteria, are considered more important or critical. Following human health criteria are NAS guidelines, predator protection criteria. Last in the hierarchy are "elevated data levels" (EDL). New to this report are Maximum Tissue Residue Levels (MTRLs), also human health related criteria. All appropriate 1991 data will be compared separately to MTRLs in addition to following the usual hierarchy. The criteria mentioned above are discussed below.

In interpreting the TSMP data by any of the criteria provided, the reader is cautioned that there is no simple relationship between concentrations of toxic substances observed in tissue samples and actual concentrations in water. Different aquatic organisms tend to bioaccumulate a given toxic substance in water to different levels; however, the differences usually do not prevent a general interpretation of the data. The reader is cautioned that the limited number of samples obtained and analyzed at each station in a single year is generally too small to provide a statistically sound basis for making absolute statements on toxic substance concentrations. The values reported herein should be accepted as indicators of relative levels of toxic pollution in water, not as absolute values. In this sense, trends over time and ranking values of a toxic substance in a particular species provide only an indication of areas where fish are evidently accumulating concentrations which are above "normal".

Maximum Tissue Residue Levels (MTRLs)

MTRLs were developed from human health water quality objectives in Table 2 of the State Water Board's November 1992 *California Inland Surface Waters Plan* (SWRCB 1992). The objectives represent concentrations in water that protect against drinking water and consuming fish or shellfish that contain substances at levels which could result in significant human health problems. MTRLs are used as alert levels or guidelines indicating water bodies with potential human health concerns and are an assessment tool and not compliance or enforcement criteria. MTRLs are compared only to filet or edible tissue samples and should not be compared to whole body or liver samples. Table 5 at the end of this section lists MTRLs for those substances monitored in the TSMP. The MTRLs for 10 of the 15 carcinogens listed in Table 5 are below the current tissue detection limit for those substances. Only MTRLs for arsenic, DDT, HCB, gamma-HCH, and PCP are above the detection limits.

The MTRLs were calculated by multiplying the human health water quality objectives by the bioconcentration factor (BCF) for each substance as recommended in the USEPA *Draft Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (USEPA 1991). BCFs were taken from the USEPA 1980 Ambient Water Quality Criteria Documents for each substance. MTRLs were not calculated for objectives that are based on maximum contaminant levels (MCLs) or taste and odor criteria.

FDA Action Levels and NAS Guidelines

The U.S. Food and Drug Administration (FDA) has established maximum concentration levels for some toxic substances in human foods (USFDA 1985). The levels are based on specific assumptions of the quantities of food consumed by humans and upon the frequency of their consumption. The FDA limits are intended to protect humans from the chronic effects of toxic substances consumed in foodstuffs. The National Academy of Sciences (NAS) has established recommended maximum concentrations of toxic substance concentrations in freshwater fish tissue (NAS 1973). They were established not only to protect the organisms containing the toxic compounds, but also to protect the species that consume these contaminated organisms. The specific action levels and guidelines used in this report are shown in Table 6 at the end of this section.

Median International Standards (MIS) for Trace Elements

The Food and Agriculture Organization of the United Nations has published a survey of health protection criteria used by member nations (Nauen 1983). These criteria vary somewhat in the tissues to be analyzed or the level of protection desired, but may be compared qualitatively. Table 7 at the end of this section summarizes these standards as an indication of what other countries have determined to be unsafe levels of trace elements. Though the standards do not apply within the United States, they provide an indication of what other nations consider to be an elevated concentration of trace elements in fish tissues. Even so, the reader is reminded that most TSMP metal analyses are done in liver, rather than in edible portions. To date, only mercury and selenium are routinely measured in edible portions in the TSMP. Measurements in liver should not be compared to Median International Standards. A description of how the Median International Standards were compiled is provided in Appendix T.

Elevated Data Levels

The "elevated data level" (EDL) was introduced in 1983 as an internal comparative measure which ranks a given concentration of a particular substance with previous data from the TSMP. The EDL is calculated by ranking all of the results for a given chemical from the highest concentration measured down to and including those records where the chemical was not detected. From this, a cumulative distribution is constructed and percentile rankings are calculated. For example, the 50^{th} percentile corresponds to the median or "middle" value rather than to the mean. With a large number of records, the median can be approximately compared to the mean.

Starting in 1990, EDL calculations were modified to reflect the growing number of marine species analyzed in the TSMP. In the past, EDL calculations for wet weight measures were grouped by similar tissue types, such as filet or whole-body samples. In 1990, the EDL calculations were further split into freshwater and marine fish types. Now when any sample is compared to an EDL, it is compared to the EDL calculated from the same fish and tissue types (i.e. freshwater fish filets are compared only to other freshwater fish filets, etc.). The substance most affected by the change in the EDL calculations was arsenic. The EDL criteria for arsenic in freshwater fish livers and whole samples were lowered by approximately half from 1978-1989 calculations. A separate copper EDL is calculated for salmonid liver tissue because trout are known to accumulate copper to higher levels than other species. White bass also seem to accumulate copper and other trace elements to higher levels. Starting in 1988, white bass are not included in the EDL

calculations. White bass are found only in a few locations in California and further sampling of this species will be avoided whenever possible. In calculating the EDLs for lipid weight measures of organic chemicals, all tissue types are combined because lipid weight measures in different tissue types tend to be far more similar than wet weight measures (Phillips 1980). However, like wet weight measures, EDL lipid weight calculations were also split into freshwater and marine fish types. The 1978-1991 EDLs and the number of data points used to calculate each EDL are provided in Tables 8 through 16 at the end of this section.

The 85th percentile (EDL 85) was chosen as an indication that a chemical is elevated from the median. The 85th percentile corresponds to measures used by the U.S. Fish and Wildlife Service in their National Contaminant Biomonitoring Program and would represent approximately one and one-half standard deviations from the mean, if the data were normally distributed. The 95th percentile (EDL 95) was chosen to indicate values that are highly elevated above the median. The 95th percentile would represent two standard deviations from the mean, if the data were normally distributed. When used along with other information, these measures provide a useful guideline to determine if a chemical has been found in unusually high concentrations. A more detailed description of EDL rankings is provided in Appendix U. The reader is again cautioned that EDLs are not directly related to potentially adverse human or animal health effects; they are only a way to compare findings in a particular area with the larger data base of findings from all over the state.

TABLE 5

Toxic Substances Monitoring Program

Maximum Tissue Residue Levels (MTRLs) for Carcinogens in Inland Surface Waters

Substance	Water Quality Objective [a] (µg/l)	BCF [b] (l/kg)	MTRL [c] (µg/kg, ppb)
aldrin	0.00013	**d**	0.05
arsenic	5.0 [e]	44	200.0 (0.2 ppm)
chlordane (total)	0.00008	14100	1.1
DDT (total)	0.00059	53600	32.0
dieldrin	0.00014	4670	0.65
heptachlor	0.00016	11200	1.8
heptachlor epoxide	0.00007	11200	0.8
hexachlorobenzene (HCB)	0.00066	8690	6.0
hexachlorocyclohexane (HCH), alpha	0.0039	130	0.5
hexachlorocyclohexane (HCH), beta	0.014	130	1.8
hexachlorocyclohexane (HCH), gamma	0.019	130	2.5
PAHs (total)	0.0028	30	0.08
PCBs (total)	0.00007	31200	2.2
pentachlorophenol (PCP)	0.28	11	3.1
toxaphene	0.00067	13100	8.8

Maximum Tissue Residue Levels (MTRLs) for Non-carcinogens in Inland Surface Waters

Substance	Water Quality Objective [a] (µg/l)	BCF [b] (l/kg)	MTRL [c] (µg/kg, ppb)
cadmium	0.01	64	0.64
endosulfan (total)	0.0009	270	0.25 (250 ppb)
endrin	0.0008	3970	3.0 (3,000 ppb)
mercury	0.000012	**f**	1.0
nickel	0.6	47	28.0

a. From Table 2, Human Health Water Quality Objectives, "California Inland Surface Waters Plan" (SWRCB 1992). MTRLs were not developed for objectives based on maximum contaminant levels (MCLs) or taste and odor criteria.

b. Bioconcentration Factors taken from the USEPA 1980 Ambient Water Quality Criteria Documents for each substance.

c. MTRLs were calculated by multiplying the Water Quality Objective by the BCF, except for aldrin, arsenic, and mercury.

d. Aldrin MTRL is derived from a combination of aldrin and dieldrin risk factors and BCFs as recommended in the USEPA 1980 "Ambient Water Quality Criteria for Aldrin/Dieldrin" (USEPA 1980).

e. Arsenic MTRL was calculated from the formula NSRL ÷ (WI/BCF) + FC = MTRL. [NSRL (California's No Significant Risk Level for arsenic) = 10 µg/d, WI (Water Intake) = 2 l/d, FC (daily fish consumption) = 0.0065 kg/d].

f. The MTRL for mercury is the FDA action level. The water quality objective for mercury in the Inland Surface Waters Plan is based on the FDA action level as recommended in the USEPA 1985 "Ambient Water Quality Criteria for Mercury" (USEPA 1985).

TABLE 6

NAS Guidelines and FDA Action Levels for Toxic Chemicals in Fish
(wet weight)

Chemical	NAS[a] Recommended Guideline for Freshwater Fish (Whole Fish) ug/g (ppm)	NAS[a] Recommended Guideline for Freshwater Fish (Whole Fish) ng/g (ppb)	FDA[b] Action Level for Freshwater and Marine Fish (Edible Portion) ug/g (ppm)	FDA[b] Action Level for Freshwater and Marine Fish (Edible Portion) ng/g (ppb)
Mercury	0.5	500	1.0[d]	1,000
DDT (total)	1.0	1,000	5.0	5,000
PCB (total)	0.5	500	2.0[e]	2,000
aldrin	0.1[c]	100	0.3	300
dieldrin	0.1[c]	100	0.3	300
endrin	0.1[c]	100	0.3	300
heptachlor	0.1[c]	100	0.3	300
heptachlor epoxide	0.1[c]	100	0.3	300
chlordane (total)	0.1[c]	100	0.3	300
lindane	0.1	100	-	-
hexachlorocyclo-hexane (total)	0.1[c]	100	-	-
endosulfan (total)	0.1[c]	100	-	-
toxaphene	0.1[c]	100	5.0	5,000

a National Academy of Sciences-National Academy of Engineering. 1973. Water Quality Criteria, 1972 (Blue Book). U.S. Environmental Protection Agency, Ecological Research Series.

b U. S. Food and Drug Administration. 1984. Shellfish Sanitation Interpretation: Action Levels for Chemical and Poisonous Substances, June 21, 1984. U.S.F.D.A., Shellfish Sanitation Branch, Washington, D.C.

c Individually or in combination. Chemicals in this group under NAS Guidelines are referred to as Chemical Group A in this report.

d As methyl mercury.

e A tolerance, rather than an action level, has been established for PCBs (21CFR 109, published May 29, 1984). An action level is revoked when a regulation establishes a tolerance for the same substance and use.

TABLE 7

Median International Standards for Trace Elements
in Freshwater Fish and Marine Shellfish [a]
(edible portion, ppm, wet weight)

Element	Fish	Shellfish	Range	Number of Countries with Standards
Antimony	1.0	1.0	1.0 to 1.5	3
Arsenic	1.5	1.4	0.1 to 5.0	11
Cadmium	0.3	1.0	0.05 to 2.0	10
Chromium	1.0	1.0	1.0	1
Copper	20.0	20.0	10 to 100	8
Fluoride	150.0	-	150.0	1
Fluorine	17.5	-	10 to 25	2
Lead	2.0	2.0	0.5 to 10.0	19
Mercury	0.5	0.5	0.1 to 1.0	28
Selenium	2.0	0.3	0.3 to 2.0	3
Tin	150.0	190.0	50 to 250	8
Zinc	45.0	70.0	40 to 100	6

a Based on: Nauen, C. C., Compilation of Legal Limits for Hazardous Substances in Fish and Fishery Products, Food and Agriculture Organization of the United Nations, 1983.

TABLE 8. TSMP EDL 85 AND EDL 95 for Trace Elements in Fish Livers
Calculated Using 1978 - 1991 Data.
(ppm, wet weight)

Freshwater Fish

Element	Fish Type*	EDL 85	EDL 95	Number of Samples
Arsenic	ALL	0.22	0.74	498
Cadmium	ALL	0.36	1.00	512
Chromium	ALL	0.03	0.08	495
Copper	SALMO	170.00	230.00	113
Copper	NON	13.00	32.00	400
Lead	ALL	0.10	0.20	493
Nickel	ALL	<0.10	0.31	496
Selenium**	ALL	3.44	4.98	104
Silver	ALL	0.25	0.68	496
Zinc	ALL	28.00	38.00	494

Marine Fish

Element	EDL 85	EDL 95	Number of Samples
Arsenic	7.10	18.94	28
Cadmium	1.15	3.38	28
Chromium	<0.02	0.03	26
Copper	17.20	25.00	28
Lead	<0.10	0.16	28
Nickel	<0.10	0.16	28
Selenium**	ID	ID	3
Silver	0.18	0.69	28
Zinc	40.00	44.60	28

* Non = Includes all non-salmonid species. Salmo = Salmonids.
All=All fish species.

** Selenium analysis in liver was discontinued starting in 1985.

< = EDL lies below the indicated detection limit.

ID = Insufficient number of data points to calculate the EDL.

TABLE 9. TSMP EDL 85 AND EDL 95 for Trace Elements in Whole Fish
Calculated Using 1978 - 1991 Data.
(ppm, wet weight)

Freshwater Fish

Element	EDL 85	EDL 95	Number of Samples
Arsenic	0.48	0.85	93
Cadmium	0.08	0.15	93
Chromium	0.19	0.34	93
Copper	3.41	4.14	93
Lead	0.20	0.77	93
Mercury	0.08	0.15	94
Nickel	0.20	0.46	94
Selenium	1.50	2.06	114
Silver	0.03	0.04	93
Zinc	40.00	44.35	93

Marine Fish

Element	EDL 85	EDL 95	Number of Samples
Arsenic	ID	ID	2
Cadmium	ID	ID	2
Chromium	ID	ID	2
Copper	ID	ID	4
Lead	ID	ID	2
Mercury	ID	ID	4
Nickel	ID	ID	2
Selenium	ID	ID	2
Silver	ID	ID	2
Zinc	ID	ID	2

ID = Insufficient number of data points to calculate the EDL.

TABLE 10. TSMP EDL 85 AND EDL 95 for Trace Elements in Fish Filets
Calculated Using 1978 - 1991 Data.
(ppm, wet weight)

Freshwater Fish

Element	EDL 85	EDL 95	Number of Samples
Arsenic	0.10	0.20	30
Cadmium	<0.01	0.01	16
Chromium	<0.02	<0.02	16
Copper	0.70	0.81	16
Lead	<0.10	<0.10	16
Mercury	0.83	1.80	1070
Nickel	<0.10	<0.10	16
Selenium	1.10	2.00	384
Silver	<0.02	<0.02	16
Zinc	23.40	32.80	16

Marine Fish

Element	EDL 85	EDL 95	Number of Samples
Arsenic	ID	ID	2
Cadmium	ID	ID	1
Chromium	ID	ID	1
Copper	ID	ID	1
Lead	ID	ID	1
Mercury	0.17	0.68	28
Nickel	ID	ID	1
Selenium	3.64	3.96	44
Silver	ID	ID	1
Zinc	ID	ID	1

< = EDL lies below the indicated detection limit.
ID = Insufficient number of data points to calculate the EDL.

TABLE 11

TSMP EDL 85 AND EDL 95 For Organic Chemicals in Freshwater Fish Filets
Calculated Using 1978 - 1991 Data.
(ppb, wet weight)

Chemical	EDL 85	EDL 95	Number of Samples
Aldrin	<5.0	<5.0	682
Chemical Group A	439.0	1263.6	702
Chlordene, Alpha	<5.0	<5.0	578
Chlordene, Gamma	<5.0	<5.0	578
Cis-chlordane	14.0	38.0	687
Cis-nonachlor	6.1	18.2	578
Oxychlordane	<5.0	<5.0	686
Trans-chlordane	8.5	21.0	687
Trans-nonachlor	19.0	45.0	658
Total Chlordane	43.0	121.6	687
Chlorpyrifos	<10.0	19.0	682
Dacthal	12.0	316.0	688
DDD, o,p'	12.0	36.0	687
DDD, p,p'	95.8	260.0	687
DDE, o,p'	<5.0	25.7	687
DDE, p,p'	636.0	2000.0	688
DDMS, p,p'	<30.0	<30.0	687
DDMU, p,p'	<15.0	43.3	687
DDT, o,p'	<10.0	18.0	685
DDT, p,p'	31.0	120.0	687
Total DDT	823.6	2534.2	688
Diazinon	<50.0	<50.0	663
Dichlorobenzophenone, p,p'	ID	ID	6
Dicofol (Kelthane)	<100.0	<100.0	682
Dieldrin	11.0	37.5	669
Endosulfan I	<5.0	25.0	688
Endosulfan II	<70.0	94.2	228
Endosulfan sulfate	<85.0	126.0	228
Total Endosulfan	5.5	63.2	688
Endrin	<15.0	<15.0	685
HCH, Alpha	<2.0	<2.0	685
HCH, Beta	<10.0	<10.0	685
HCH, Delta	<5.0	<5.0	685
HCH, Gamma (Lindane)	<2.0	3.6	685
Total HCH	*	5.1	685
Heptachlor	<5.0	<5.0	682
Heptachlor Epoxide	<5.0	<5.0	682
Hexachlorobenzene	<2.0	6.3	685
Methoxychlor	<15.0	<15.0	680
Oxadiazon	<5.0	11.8	148
Parathion, Ethyl	<10.0	<10.0	663
Parathion, Methyl	<10.0	<10.0	663
PCB-1248	<50.0	<50.0	717
PCB-1254	<50.0	161.5	717
PCB-1260	66.0	191.5	717
Total PCB	137.8	372.6	717
Pentachlorophenol	2.8	5.0	20
2,3,5,6-tetrachlorophenol	<2.0	1.7	20
Toxaphene	270.0	1100.0	700

< = EDL lies below the indicated detection limit.
ID = Insufficient number of data points to calculate the EDL.
* = EDL lies below the detection limit.

TABLE 12

TSMP EDL 85 AND EDL 95 For Organic Chemicals in Marine Fish Filets
Calculated Using 1978 - 1991 Data.
(ppb, wet weight)

Chemical	EDL 85	EDL 95	Number of Samples
Aldrin	<5.0	<5.0	33
Chemical Group A	7.6	36.8	33
Chlordene, Alpha	<5.0	<5.0	32
Chlordene, Gamma	<5.0	<5.0	32
Cis-chlordane	<5.0	<5.0	33
Cis-nonachlor	<5.0	8.5	32
Oxychlordane	<5.0	<5.0	33
Trans-chlordane	<5.0	<5.0	33
Trans-nonachlor	<5.0	13.1	33
Total Chlordane	*	23.4	33
Chlorpyrifos	<10.0	<10.0	33
Dacthal	21.4	30.7	33
DDD, o,p'	<10.0	<10.0	33
DDD, p,p'	16.0	20.1	33
DDE, o,p'	<10.0	<10.0	33
DDE, p,p'	222.0	288.0	33
DDMS, p,p'	<30.0	<30.0	33
DDMU, p,p'	<15.0	<15.0	33
DDT, o,p'	<10.0	<10.0	33
DDT, p,p'	<10.0	<10.0	33
Total DDT	236.8	308.9	33
Diazinon	<50.0	<50.0	33
Dichlorobenzophenone, p,p'	ID	ID	0
Dicofol (Kelthane)	<100.0	<100.0	33
Dieldrin	<5.0	<5.0	33
Endosulfan I	<5.0	<5.0	33
Endosulfan II	<70.0	<70.0	20
Endosulfan sulfate	<85.0	<85.0	20
Total Endosulfan	*	*	33
Endrin	<15.0	<15.0	33
HCH, Alpha	<2.0	<2.0	33
HCH, Beta	<10.0	<10.0	33
HCH, Delta	<5.0	<5.0	33
HCH, Gamma (Lindane)	<2.0	<2.0	33
Total HCH	*	*	33
Heptachlor	<5.0	<5.0	33
Heptachlor Epoxide	<5.0	<5.0	33
Hexachlorobenzene	<2.0	<2.0	33
Methoxychlor	<15.0	<15.0	33
Oxadiazon	<5.0	<5.0	16
Parathion, Ethyl	<10.0	<10.0	33
Parathion, Methyl	<10.0	<10.0	33
PCB-1248	<50.0	<50.0	33
PCB-1254	<50.0	141.0	33
PCB-1260	59.8	127.0	33
Total PCB	96.2	266.6	33
Pentachlorophenol	ID	ID	0
2,3,5,6-tetrachlorophenol	ID	ID	0
Toxaphene	<100.0	<100.0	33

< = EDL lies below the indicated detection limit.
ID = Insufficient number of data points to calculate the EDL.
* = EDL lies below the detection limit.

TABLE 13

TSMP EDL 85 AND EDL 95 For Organic Chemicals in Whole Freshwater Fish
Calculated Using 1978 - 1991 Data.
(ppb, wet weight)

Chemical	EDL 85	EDL 95	Number of Samples
Aldrin	<5.0	<5.0	119
Chemical Group A	1716.1	3751.0	119
Chlordene, Alpha	<5.0	5.5	119
Chlordene, Gamma	6.5	10.1	119
Cis-chlordane	48.0	70.2	119
Cis-nonachlor	20.1	30.2	119
Oxychlordane	14.0	20.0	119
Trans-chlordane	28.1	40.0	119
Trans-nonachlor	52.3	82.2	119
Total Chlordane	162.6	246.6	119
Chlorpyrifos	34.3	82.9	119
Dacthal	120.0	483.5	119
DDD, o,p'	59.8	240.5	119
DDD, p,p'	360.0	1200.0	119
DDE, o,p'	28.1	61.2	119
DDE, p,p'	2145.0	5365.0	119
DDMS, p,p'	<30.0	<30.0	119
DDMU, p,p'	80.2	182.5	119
DDT, o,p'	56.2	190.5	119
DDT, p,p'	201.5	729.0	119
Total DDT	3568.6	7348.7	119
Diazinon	<50.0	84.8	118
Dichlorobenzophenone, p,p'	ID	ID	0
Dicofol (Kelthane)	<100.0	<100.0	119
Dieldrin	126.0	584.0	118
Endosulfan I	13.0	56.1	119
Endosulfan II	<10.0	84.0	80
Endosulfan sulfate	180.0	240.0	80
Total Endosulfan	127.4	328.7	119
Endrin	<15.0	58.0	119
HCH, Alpha	<2.0	2.0	119
HCH, Beta	<10.0	<10.0	119
HCH, Delta	<5.0	<5.0	119
HCH, Gamma (Lindane)	3.1	8.0	119
Total HCH	4.1	9.6	119
Heptachlor	<5.0	<5.0	119
Heptachlor Epoxide	5.4	13.1	119
Hexachlorobenzene	4.8	10.1	119
Methoxychlor	<15.0	<15.0	119
Oxadiazon	331.0	1800.0	53
Parathion, Ethyl	<10.0	<10.0	118
Parathion, Methyl	<10.0	<10.0	118
PCB-1248	<50.0	<50.0	120
PCB-1254	180.0	520.0	120
PCB-1260	100.0	210.0	120
Total PCB	283.0	840.0	120
Pentachlorophenol	ID	ID	5
2,3,5,6-tetrachlorophenol	ID	ID	5
Toxaphene	1200.0	2465.0	119

< = EDL lies below the indicated detection limit.
ID = Insufficient number of data points to calculate the EDL.

TABLE 14

TSMP EDL 85 AND EDL 95 For Organic Chemicals in Whole Marine Fish
Calculated Using 1978 - 1991 Data.
(ppb, wet weight)

Chemical	EDL 85	EDL 95	Number of Samples
Aldrin	ID	ID	1
Chemical Group A	ID	ID	1
Chlordene, Alpha	ID	ID	1
Chlordene, Gamma	ID	ID	1
Cis-chlordane	ID	ID	1
Cis-nonachlor	ID	ID	1
Oxychlordane	ID	ID	1
Trans-chlordane	ID	ID	1
Trans-nonachlor	ID	ID	1
Total Chlordane	ID	ID	1
Chlorpyrifos	ID	ID	1
Dacthal	ID	ID	1
DDD, o,p'	ID	ID	1
DDD, p,p'	ID	ID	1
DDE, o,p'	ID	ID	1
DDE, p,p'	ID	ID	1
DDMS, p,p'	ID	ID	1
DDMU, p,p'	ID	ID	1
DDT, o,p'	ID	ID	1
DDT, p,p'	ID	ID	1
Total DDT	ID	ID	1
Diazinon	ID	ID	1
Dichlorobenzophenone, p,p'	ID	ID	0
Dicofol (Kelthane)	ID	ID	1
Dieldrin	ID	ID	1
Endosulfan I	ID	ID	1
Endosulfan II	ID	ID	1
Endosulfan sulfate	ID	ID	1
Total Endosulfan	ID	ID	1
Endrin	ID	ID	1
HCH, Alpha	ID	ID	1
HCH, Beta	ID	ID	1
HCH, Delta	ID	ID	1
HCH, Gamma (Lindane)	ID	ID	1
Total HCH	ID	ID	1
Heptachlor	ID	ID	1
Heptachlor Epoxide	ID	ID	1
Hexachlorobenzene	ID	ID	1
Methoxychlor	ID	ID	1
Oxadiazon	ID	ID	0
Parathion, Ethyl	ID	ID	1
Parathion, Methyl	ID	ID	1
PCB-1248	ID	ID	1
PCB-1254	ID	ID	1
PCB-1260	ID	ID	1
Total PCB	ID	ID	1
Pentachlorophenol	ID	ID	0
2,3,5,6-tetrachlorophenol	ID	ID	0
Toxaphene	ID	ID	1

ID = Insufficient number of data points to calculate the EDL.

TABLE 15

TSMP EDL 85 AND EDL 95 for Organic Chemicals in
Filet and Whole Freshwater Fish
Calculated Using 1980 - 1991 Lipid Data
(ppb, lipid weight)

Chemical	EDL 85	EDL 95	Number of Samples
Aldrin	*	*	721
Chemical Group A	26256.8	101486.2	742
Chlordene, Alpha	*	*	694
Chlordene, Gamma	*	106.1	694
Cis-chlordane	928.7	2456.6	727
Cis-nonachlor	326.8	1105.1	694
Oxychlordane	*	237.8	727
Trans-chlordane	452.0	1214.5	727
Trans-nonachlor	1453.3	4041.0	727
Total Chlordane	3481.4	8295.0	727
Chlorpyrifos	*	1855.7	721
Dacthal	1530.2	19636.9	728
DDD, o,p'	748.5	3015.3	727
DDD, p,p'	6620.7	22038.7	727
DDE, o,p'	182.3	1082.5	727
DDE, p,p'	51040.1	140072.5	728
DDMS, p,p'	*	*	727
DDMU, p,p'	490.8	2623.9	727
DDT, o,p'	*	1895.5	726
DDT, p,p'	785.6	5313.2	726
Total DDT	63165.6	185564.2	728
Diazinon	*	*	701
Dichlorobenzophenone, p,p'	ID	ID	6
Dicofol (Kelthane)	*	*	721
Dieldrin	823.2	3675.1	708
Endosulfan I	189.0	1830.5	728
Endosulfan II	*	2680.9	307
Endosulfan sulfate	*	10571.4	307
Total Endosulfan	350.4	6496.8	728
Endrin	*	*	725
HCH, Alpha	*	*	725
HCH, Beta	*	*	725
HCH, Delta	*	*	725
HCH, Gamma (Lindane)	*	289.4	725
Total HCH	41.7	601.8	725
Heptachlor	*	*	721
Heptachlor Epoxide	*	*	721
Hexachlorobenzene	51.5	442.4	725
Methoxychlor	*	*	720
Oxadiazon	*	3984.0	202
Parathion, Ethyl	*	*	702
Parathion, Methyl	*	*	702
PCB-1248	*	*	756
PCB-1254	2258.9	10877.2	756
PCB-1260	2143.9	13999.5	756
Total PCB	7949.5	37288.3	756
Pentachlorophenol	253.6	376.4	19
2,3,5,6-tetrachlorophenol	*	234.3	19
Toxaphene	14557.0	76808.6	740

ID = Insufficient number of data points to calculate the EDL.
* = EDL lies below the detection limit.

TABLE 16

TSMP EDL 85 AND EDL 95 for Organic Chemicals in
Filet and Whole Marine Fish
Calculated Using 1980 - 1991 Lipid Data
(ppb, lipid weight)

Chemical	EDL 85	EDL 95	Number of Samples
Aldrin	*	*	34
Chemical Group A	537.4	1611.9	34
Chlordene, Alpha	*	*	33
Chlordene, Gamma	*	*	33
Cis-chlordane	*	284.4	34
Cis-nonachlor	*	317.3	33
Oxychlordane	*	*	34
Trans-chlordane	*	182.8	34
Trans-nonachlor	*	390.4	34
Total Chlordane	*	1155.2	34
Chlorpyrifos	*	*	34
Dacthal	1761.7	2433.5	34
DDD, o,p'	*	*	34
DDD, p,p'	936.1	1841.7	34
DDE, o,p'	*	*	34
DDE, p,p'	28582.9	36517.9	34
DDMS, p,p'	*	*	34
DDMU, p,p'	*	499.3	34
DDT, o,p'	*	*	34
DDT, p,p'	*	*	34
Total DDT	30431.6	36517.9	34
Diazinon	*	*	34
Dichlorobenzophenone, p,p'	ID	ID	0
Dicofol (Kelthane)	*	*	34
Dieldrin	*	*	34
Endosulfan I	*	*	34
Endosulfan II	*	*	21
Endosulfan sulfate	*	*	21
Total Endosulfan	*	*	34
Endrin	*	*	34
HCH, Alpha	*	*	34
HCH, Beta	*	*	34
HCH, Delta	*	*	34
HCH, Gamma (Lindane)	*	*	34
Total HCH	*	*	34
Heptachlor	*	*	34
Heptachlor Epoxide	*	*	34
Hexachlorobenzene	*	*	34
Methoxychlor	*	*	34
Oxadiazon	*	*	16
Parathion, Ethyl	*	*	34
Parathion, Methyl	*	*	34
PCB-1248	*	*	34
PCB-1254	*	5274.3	34
PCB-1260	3753.0	20741.1	34
Total PCB	8519.5	26018.3	34
Pentachlorophenol	ID	ID	0
2,3,5,6-tetrachlorophenol	ID	ID	0
Toxaphene	*	*	34

ID = Insufficient number of data points to calculate the EDL.
* = EDL lies below the detection limit.

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