APPENDIX AA

Field and Laboratory Operations

FIELD AND LABORATORY OPERATIONS

Sample Collection

The State Mussel Watch Program (SMWP) collects about 100 mussels at each station, which are randomly divided into two groups for trace element and synthetic organic chemical analysis. Based on recommendations by Goldberg (1980) and Risebrough *et al.* (1980), the SMWP samples 45 mussels, three replicates of 15 individuals each, for trace elements at each site. Trace element results in the SMWP represent a mean value for the three replicates. A single replicate of 45 composited individuals is analyzed for synthetic organic compounds.

Mussels of 55 to 65 mm in length are collected wherever possible in order to reduce size related effects. Similarly, freshwater clams of 20 to 30 mm in length are collected. Mussels are collected from the highest tidal height where they occur in adequate numbers to reduce variability induced by habitat height. Stainless steel pry bars are used to collect mussels off rocks. The pry bars are cleaned and rinsed in the laboratory and rinsed again with seawater prior to use. Freshwater clams are collected by towing a dredge

At locations where mussels are unavailable and sampling can be accomplished using scuba equipment, transplanted samples are used. The mussel transplant system, consisting of a bottom anchored float buoy used in water up to 40 m depth, is shown in Figure AA-1. Transplanted mussels are placed in polypropylene mesh bags and kept cool in ice chests for no more than 24 hours prior to deployment. To minimize the risk of contamination of the mussel from boat exhaust or surface film during deployment or retrieval, mussel samples are placed in polyethylene bags, where they remain until submerged and deployed. Upon retrieval from the subsurface buoy system, samples are again placed in polyethylene bags before being brought through the air-water interface. Once collected, the transplants are triple bagged. To minimize contamination caused by handling the mussel samples, polyethylene gloves are worn during collection, as well as processing, of mussel samples.Similar bags of freshwater clams are usually tied to plastic stakes placed off the bottom or are attached to submerged structures. A two month transplant period is adequate in most cases where pollutant uptake rates are expected to be high, but for trace elements in less contaminated environments, six month interval may be necessary for an adequate sample (Stephenson *et al.* 1980). A four to six month transplant interval is used for organic chemicals to be consistent with transplant periods for trace elements.

Mussels and clams to be analyzed for trace elements are placed in a ZIPLOCK® polyethylene bag of 4 mm thickness. The samples are placed inside two additional polyethylene ZIPLOCK® bags. Mussels to be analyzed for synthetic organic compounds are placed in a bag constructed of two layers of “heavy duty” aluminum foil. Prior to use, the foil is cleaned by heating to 500° C or by rinsing in hexane. Samples in the foil bags are placed in two polyethylene ZIPLOCK® bags. After bagging, all samples are placed in non-metallic ice chests and frozen using dry ice and stored at or below -20° C until processed.

Laboratory Analysis

A detailed description of procedures and techniques discussed below can be found in the Department of Fish and Game's (DFG) *Laboratory Quality Assurance Program Plan* (DFG 1990). The following is a summary of the 1987-93 Quality Assurance/Quality Control (QA\QC) results provided by the DFG's Moss Landing Laboratory. Copies of the Laboratory Quality Assurance Program Plan and QA\QC results are available upon request. Additional QA/QC information is also provided in *Quality Assurance Report for the Analysis of Marine Bivalve Tissue and Sediment for Organic Contaminants in the California State Mussel Watch Program 1987-1993* (Newman *et al.* 1994)

Trace Elements Analytical Techniques in Tissue and Sediment

The following procedures were employed for mussel dissection and homogenization for trace element analysis: Frozen mussels were removed individually from the bags, cleaned of epiphytic organisms and debris under running deionized water by personnel wearing polyethylene gloves, and allowed to thaw in clean polyethylene trays. Adductor muscles were severed and gonads removed with a MICRO®-cleaned stainless steel scalpel. Gonads were removed from mussels to reduce variability in trace element concentrations due to the sex of the organism (Stephenson *et al.* 1987). The remainder of the soft part was placed in a pre-weighted, acid-cleaned polypropylene 4 oz. jar and re-weighed. The shell lengths were also taken at this time. Samples were then homogenized to a paste-like consistency in the jars using a Brinkmann Polytron (Model PT10-35) equipped with a titanium generator (Model PTA 20). The homogenized samples were then refrozen at -20° C until analyzed. The same procedures were used on freshwater clams except that the entire soft body of the clam (including gonads) was used.

A Perkin-Elmer Model 2280 spectrophotometer with deuterium arc background corrector and digital display was used for techniques employing conventional (flame) atomic absorption spectrophotometry (Al, Cd, Cu, Mn, Zn) and cold vapor technique for mercury. A Perkin-Elmer Model 3030 Zeeman atomic absorption spectrophotometer equipped with an HGA-600 graphite furnace and an AS-60 autosampler was used for techniques requiring a graphite furnace (Ag, As, Cr, Ni, Pb, Se). All analytical values were corrected using procedural blanks. Trace element detection limits are presented in Table AA-1. From July 1, 1987 through June 30, 1990 the technique used for digesting samples was known as "beaker digestion". From July 1, 1990 through June 30, 1993 the technique used for digesting samples was known as "teflon vessel digestion". Separate techniques were performed on sediments and tissues in the "teflon vessel digestion" technique.

The "beaker digestion" technique was performed as followed: Samples were weighed into pre-cleaned 30 ml Pyrex glass beakers. Digestion of each sample was accomplished by adding concentrated 5 ml double distilled HNO_3 and heating the beaker on a hotplate. After the initial reaction, the sample was refluxed for 2-3 hours. Each sample was then evaporated almost to dryness. The volume was brought back up by adding 2 ml of 1% concentrated double distilled HNO_3. The sample was then again evaporated almost to dryness. The digestate was diluted to 20 ml with 1% concentrated double distilled HNO_3 and transferred to a clean polyethylene bottle.

The "teflon vessel digestion" technique for tissue was performed as follows: Samples were weighed into pre-cleaned 125 ml teflon digestion vessels. Digestion of each tissue sample was accomplished by adding a 4:1 concentrated HNO_3: concentrated $HClO_4$ mixture and heating the sample on a

warm (≈75°) hotplate. After the initial reaction, the teflon vessel was capped and heated in a 130° C oven for four hours. Once the digestate had cooled it was transferred to a clean polyethylene bottle and diluted with 20 ml Type ll water. Sediment samples were digested using the same mixture as tissue samples except, instead of warming on a hotplate, sediment samples were heated in a 130° C oven for four hours. After the initial reaction, hydrofluoric acid was added to the sediment sample and the teflon vessel returned to a 130° C oven for 12 hours. Twenty ml of boric acid (2.5%) was added to each sediment sample before again returning to a 130° C oven for another 8 hours. Once the digestate was cool it was transferred to a clean polyethylene bottle.

To protect sample integrity, all materials contacting samples during laboratory operations were analyzed for trace element content. To ensure accuracy, reference materials from the National Bureau of Standards (NBS) were analyzed (Table AA-2).

Synthetic Organic Compounds Analytical Techniques in Tissues and Sediments

Samples were dissected in the same manner as trace element samples except gonads were not removed. Gonads were included because a high percentage of the whole body concentrations for most organic chemicals occur in this tissue. The dissection was conducted on a sheet of oven fired or hexane rinsed aluminum foil. The homogenization procedure was the same as for trace elements except a stainless steel shaft and blade was substituted for the titanium blade and shaft. All samples were stored at -20° C until extraction and analysis.

Summaries of the methods in use over the past six years are outlined below. Synthetic organic compound and polynuclear aromatic hydrocarbons (PAHs) detection limits are listed in Tables AA-3 and AA-4, respectively. Fractionated distribution of synthetic organic compounds are presented in Table AA-5. Results of standard reference materials starting in 1990-91 are presented in Table AA-6. Duplicate analyses results for synthetic organic compounds and PAHs are presented in Tables AA-7 and AA-8.

Analytical Methods for FY 87-88 through FY 89-90

Tissue samples (50g) were extracted using the methods described in the FDA's 1990 edition of the Pesticide Analytical Manual: *Methods Which Detect Multiple Residues* (PAM) by McMahon *et al.* (1990) using the "General Methods for Fatty Foods". Sediment samples (30g) were extracted with acetone and petroleum ether mixture. All samples were fractionated on Florisil using petroleum ether (F1 Fraction), 6% ethyl ether (F2 Fraction), 15% ethyl ether (F3 Fraction), 50% ethyl ether (F4 Fraction) and concentrated as described in PAM. Synthetic standards were fractionated to determine the column fractionation characteristics.

All organic chemicals were analyzed by capillary gas chromatography (GC) using Hewlett-Packard 5890A gas chromatographs. Synthetic organics (SOs) were analyzed on an instrument equipped with dual 30m x 0.25mm i.d. columns of different polarities (J&W Scientific, DB-5 and DB-17) and Ni^{63} electron capture detectors (ECDs). A Hewlett-Packard Pascal ChemStation system was used to acquire and analyze all data.

In FY 87-88 through FY 89-90, PAHs were analyzed from the recombination of the F2 Fraction and the F3 Fraction collected for synthetic organics analysis. Polyaromatic hydrocarbon (PAH) analysis was accomplished with an HP 5890A attached to a Finnigan Model ITD 800 ion trap detector. Sample aliquots were delivered to the detector via on-column injection onto a 30m x 0.25mm i.d. DB-5 column. Spectral data were acquired in a multiple ion mode (MID) such that the base peak and two qualifier ions were monitored for each analyte of interest. Three point calibration curves ranging from 0.025 to 4.0 ng/µl were generated and fitted with linear curve fits ($r > 0.998$). All PAH data were acquired and quantitated using an IBM compatible micro computer and Finnigan ITDS v.4 Software Package.

In FY 88-89 and FY 89-90 polychlorinated biphenyls (PCBs) were quantitated as both unique congeners and technical mixtures. In FY 88-89, PCB congeners were quantitated in the F1 Fraction using a three point calibration curve. Dilutions of the National Institute of Standards Technology (NIST) Concentrated PCB Standard ranging from 2 pg/µl to 200 ng/µl were used to calibrate the instrumentation during the standard synthetic organic analysis. In FY 89-90, PCB congener data were quantitated with a six point calibration curve of a 1:1:1 mixture of Aroclors 1242, 1254, and 1260. The EPA Lot#s of Aroclors used to make these standards were fully characterization by Schulz *et al.* (1989) making the mixture quantitative for congeners. The response factors of coeluting domains were generated in house. The quantitation standard ranged from 0.15 to 15 ng/µl total Aroclor.

Quality assurance data for these years consisted of precision measurements through method duplicate analyses for synthetic organics in tissues. Method performance was further evaluated through the use of matrix spike recoveries and the analysis of split homogenates. Each year, multiple homogenates were split and analyzed at both the DFG Water Pollution Control Laboratory in Rancho Cordova and at the Trace Organics Facility, University of California, Santa Cruz. Analytical comparability was deemed acceptable for each year and verified by the project QA Officer.

All data results were hand transcribed and submitted to the Department of Fish and Game, Moss Landing Laboratory for entry into the SMWP database.

Analytical Methods for FY 90-91

Samples for synthetic organic analysis were processed as in FY 89-90. Tissue samples for PAH analysis were extracted and prepared for GC/ITD analysis using internal standard methodologies as described by Krahn et al. (1988). Samples (5g) were extracted with methylene chloride and coextracted biologicals were removed by silica/alumina gravity flow columns followed by size exclusion chromatography on a high performance liquid chromatograph (SEC/HPLC).

Acquisition and analytical systems were the same as in previous years.

Quality assurance associated with the analysis for this year consisted of precision measurements through method duplicate analyses in tissues and sediments, accuracy measurements for tissue through the analysis of standard reference materials (SRMs), and interference checks through the analysis of method blanks.

During FY 90-91 an organics laboratory database to be used for report generation was developed. All raw data were initially entered into this database and hard copies of final report values were submitted for entry into the main SMWP database.

Analytical Methods for FY 91-92

Tissue (5g) and sediment (10g) samples were extracted and prepared for organic contaminant analyses using the methods described for PAH analyses in FY 90-91. Internal standards were used for both synthetic organic and PAH analyses. Tissue extracts were subdivided such that one quarter was used for synthetic organic analysis, one half was used for PAH analysis, and one quarter was used for gravimetric lipid weight determinations. The synthetic organic sub-sample was fractionated on silica and alumina columns to isolate the PCBs from the polar chlorinated pesticides using one percent methylene chloride in pentane (F1 Fraction) followed by straight methylene chloride (F2 Fraction). Sediment extracts were treated similarly except lipid weight determinations were not performed and one half of the extract was used for synthetic organic analysis. All data analysis was performed as in FY 90-91.

During this year's analysis, PCB congener data were but not reported. Instruments were calibrated with standards prepared in house from neat materials. Data was recorded for 12 of the 18 NIST congeners as well as 12 additional environmentally significant congeners.

Quality assurance associated with the analysis for this year consisted of precision measurements through method duplicate analyses in tissues and sediments, accuracy measurements for tissue through the analysis of SRMs and sediments through the analysis of matrix spikes, and interference checks through the analysis of method blanks.

As in FY 90-91, all raw data were initially entered into the organics laboratory database and hard copies of final reported values were submitted for entry into the main SMWP database.

Analytical Methods for FY 92-93

In FY 92-93, all sample preparation and analysis was performed as in FY 91-92 except new data acquisition systems were used. All synthetic organic data were acquired and analyzed using a Hewlett-Packard DOS based ChemStation systems. Also, a Hewlett-Packard 5971A Mass Selective Detector was substituted for the Finnigan ion trap, the chromatographic column length was increased to 60m, and samples were introduced using splitless injections. Spectral data were acquired in a selective ion mode (SIM) such that the base peak and two qualifier ions were monitored for each analyte of interest. Three point calibration curves ranging from 0.025 to 4.0 ng/µl were generated and fitted with linear curve fits ($r > 0.998$).

During this year, PCB congener data were acquired, but not reported. Instruments were calibrated with standards prepared in house from neat materials. Data were recorded for all of the 18 NIST congeners as well as 33 additional environmentally significant congeners. In addition, Aroclor concentrations were calculated during this year from congener data. Briefly, a compositional analysis was performed on all in house Aroclor mixtures providing conversion factors for PCB congener concentrations to Aroclor concentrations. Aroclor 1260 values were generated from congeners 194, 195, 201, and 203. Aroclor 1248 values were generated from congeners 18, 31, and 28. Aroclor 1254 values were generated from congeners 99, 118, 128, and 138. The bias induced in Aroclor 1254 quantitation congeners by the presence of other Aroclors was removed by subtraction prior to calculation. The values generated by this approach compared well with values calculated using classical approaches as shown by in house tests and round robin exercises with the DFG Water Pollution Control Laboratory in Rancho Cordova.

Quality assurance associated with the analysis for this year consisted of precision measurements through method duplicate analyses in tissues and sediments, accuracy measurements through the analysis of SRMs, and interference checks through the analysis of method blanks.

All data results were electronically imported into the organic laboratory database structure and electronic data copies were submitted to the Department of Fish and Game, Moss Landing Laboratory for incorporation into the SMWP database.

Analytical Techniques for Tributyltin (TBT)

Tributyltin was extracted from tissues by centrifugation 10 g of tissue, 10 ml of 50% HCL, and 25 ml of methylene chloride for 15 hours. The methylene chloride was removed and evaporated under a stream of air and the residue is dissolved in hexane. The hexane was washed in a 3% NaOH solution to remove all monobutyl- and dibutyl-tins and re-evaporated to dryness. The residue was digested with 1 ml of concentrated nitric acid and diluted to 5 ml with deionized water. The solution was analyzed on a Perkin Elmer Model 3030 Zeeman Atomic Absorption Spectrophotometer equipped with a Model 500 Graphite Furnace and an AS60 Autosampler. Ten µl sample was co-injected with 10 µl of matrix modifier consisting of 100 µg phosphate and 10 µg magnesium nitrate per injection. Tributyltin detection limits are provided in Table AA-3. Results of duplicate sample and reference material analysis for tributyltin are provided in Table AA-9.

Procedure for Lipid Determination

FY 1987-88 through FY 1990-91

A thoroughly homogenized sample weighing approximately 5 g (wet weight) was dried and macerated with anhydrous granular Na_2SO_4. The dried sample was transferred to a blender with 150 ml of petroleum ether and blended for two minutes at high speed. The liquid was suction-filtered into a 500 ml filter flask through a 10 cm Buchner funnel containing Whatman #42 filter paper. The sample was blended once more with an additional 100 ml of petroleum ether and filtered. The filtrate was concentrated to approximately 25 ml with heat (steam bath) and air. The remaining filtrate was then quantitatively transferred into a 50 ml preweighed planchet. The petroleum ether was evaporated off, the planchet containing the residue is reweighed and the percent lipid is calculated.

FY 1991-92

In FY 1991-92, the following changes were made in the lipid determination method: a 25 ml portion from the 100 ml extraction was used, methylene chloride replaced petroleum ether as the solvent, and the sample was air dried only, steam baths were not used.

FY 1992-93

In FY 1992-93, the 25 ml sample was transferred to a preweighed 50 ml pear shaped flask. The methylene chloride solvent was removed using a Bucchi Roto-vap. The sample was then dried to 110°C for two hours. The residue was reweighed and the percent lipid was calculated.

Figure AA-1 DIAGRAM OF THE TRANSPLANT SYSTEM DEPLOYED IN CALIFORNIA BAYS AND ESTUARIES

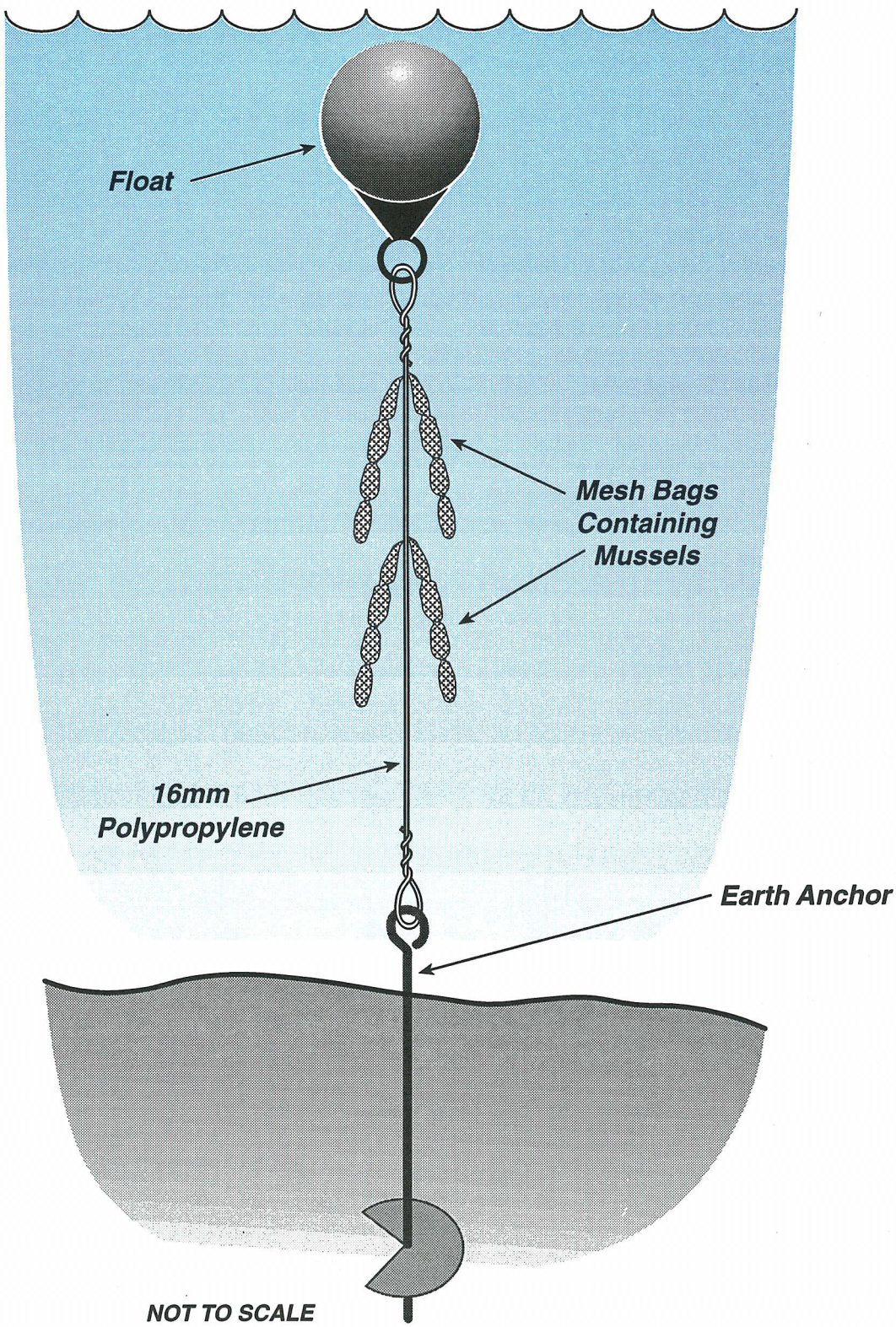

TABLE AA-1

State Mussel Watch Program
Trace Element Detection Limits

Tissue

Element	Detection Limit (µg/g, ppm dry weight)	Detection Limit (µg/g, ppm wet weight)
Aluminum	20.0	3.0
Arsenic	0.25	0.04
Cadmium	0.01	0.002
Chromium	0.1	0.02
Copper	1.0	0.2
Mercury	0.03	0.005
Manganese	1.0	0.2
Nickel	0.1	0.02
Lead	0.1	0.02
Selenium	0.1	0.02
Silver	0.01	0.002
Titanium	0.5	0.08
Zinc	5.0	0.8

Sediment

Element	Detection Limit (µg/g, ppm dry weight)	Detection Limit (µg/g, ppm wet weight)
Aluminum	20.0	3.0
Arsenic	0.25	0.04
Antimony	0.1	0.02
Cadmium	0.01	0.002
Chromium	0.1	0.02
Copper	1.0	0.2
Mercury	0.03	0.005
Manganese	1.0	0.2
Nickel	0.1	0.02
Lead	0.1	0.02
Selenium	0.1	0.02
Silver	0.01	0.002
Tin	0.1	0.02
Zinc	5.0	0.8

TABLE AA-2

State Mussel Watch Program
Trace Element Analysis of Reference Materials (µg/g, dry weight)*

	1987-88**		1988-89**		1989-90**	
	NBS-NIES	NBS-DOLT	NBS-NIES	NBS-DOLT	NBS-Oyster	NBS-DOLT
Ag	NA	NA	0.024±0.006 (0.027±0.003)	NA	1.7±0.11 (1.68±0.15)	NA
Al	206±21 (220)	NA	209±18 (220)	NA	85±14.1 (202.5±14.1)	NA
As	8.6±0.1 (9.2±0.5)	NA	9.2±0.2 (9.2±0.5)	9.7±0.1 (10.1±1.4)	13.5±0.6 (14.0±1.2)	NA
Cd	0.91±0.15 (0.82±0.03)	4.36±0.37 (4.18±0.28)	0.83±0.14 (0.82±0.03)	4.26±0.39 (4.18±0.28)	4.35±0.27 (4.15±0.38)	4.53±0.35 (4.18±0.28)
Cr	0.65±0.13 (0.063±0.07)	0.36±0.07 (0.40±0.07)	0.44±0.09 (0.63±0.07)	0.39±0.05 (0.40±0.07)	0.57±0.08 (1.43±0.46)	0.25±0.06 (0.40±0.07)
Cu	5.2±0.6 (4.9±0.03)	20.0±1.0 (20.8±1.2)	5.1±0.6 (4.9±0.3)	20.9±1.5 (20.8±1.2)	64.7±2.5 (66.3±4.3)	20.1±0.9 (20.8±1.2)
Hg	NA	0.208±0.023 (0.225±0.037)	NA	0.293±0.039 (0.225±0.037)	0.061±0.013 (0.064±0.007)	0.341±0.041 (0.225±0.037)
Mn	16.0±0.5 (16.3±1.2)	8.57±0.29 (8.72±0.53)	16.1±1.2 (16.3±1.2)	8.65±0.50 (8.72±0.53)	11.7±0.8 (12.3±1.5)	8.56±0.53 (8.72±0.53)
Ni	NA	NA	0.73±0.14 (0.93±0.06)	0.28±0.03 (0.26±0.06)	1.84±0.4 (2.25±0.44)	0.21±0.06 (0.26±0.06)
Pb	0.60±0.13 (0.91±0.04)	1.06±0.21 (1.36±0.29)	0.87±0.16 (0.91±0.040	1.45±0.43 (1.36±0.29)	0.311±0.08 (0.371±0.014)	1.26±0.25 (1.36±0.29)
Se	1.4 (1.5)	NA	1.4 (1.5)	NA	2.0±0.0 (2.21±0.24)	NA
Zn	101±5 (106±6)	88.9±4.6 (92.5±2.3)	112±9 (106±6)	94.4±7.9 (92.5±2.3)	816±48 (830±57)	93.5±4.2 (92.5±2.3)

* Sample values are given first, followed by reference values in parentheses, both values include 95% confidence interval where appropriate.
NBS refers to the National Bureau of Standards.
NIES refers to the National Institute of Environmental Studies, Japan Environmental Agency – Certified Reference Material #6, mussel tissue.
DOLT refers to dogfish liver from the National Research Council of Canada.

** Sample Year = State Fiscal Year (July 1 - June 30).

NA = Not Analyzed.

TABLE AA-2 (continued)

State Mussel Watch Program

Trace Element Analysis of Reference Materials (µg/g, dry weight)*

	1990-91**		1991-92**		1992-93**	
	NBS-Oyster	NBS-Mussel	NBS-Oyster	NBS-DOLT	NBS-Oyster	NBS-DOLT
Ag	1.59±0.13 (1.68±0.15)	0.097±0.007 (0.105±0.003	1.58±0.08 (1.68±0.15)	NA	1.61±0.06 (1.68±0.15)	NA
Al	173±9 (202.5±14.1)	41.1±5.4 (62.1±5.7)	172±13 (202.5±14.1)	NA	174±7.2 (202.5±14.1)	NA
As	12.4±0.8 (14.0±1.2)	1.09±0.06 (1.20±0.04)	13.2±0.7 (14.0±1.2)	9.1±0.6 (10.1±1.4)	13.0±0.3 (14.0±1.2)	NA
Cd	4.16±0.22 (4.15±0.38)	0.25±0.02 (0.17±0.05)	4.00±0.12 (4.15±0.38)	4.08±0.15 (4.18±0.28)	4.00±0.12 (4.15±0.38)	4.26±0.42 (4.18±0.28)
Cr	1.08±0.09 (1.43±0.46)	0.324±0.043 (0.322±0.026)	1.12±0.11 (1.43±0.46)	0.29±0.04 (0.40±0.07)	1.17±0.25 (1.43±0.46)	0.31±0.08 (0.40±0.07)
Cu	66.4±2.8 (66.3±4.3)	1.38±0.07 (1.14±0.24)	69.0±1.8 (66.3±4.3)	20.8±0.7 (20.8±1.2)	64.0±1.3 (66.3±4.3)	19.5±0.55 (20.8±1.2)
Hg	0.067±0.009 (0.064±0.007)	NA	0.071±0.004 (0.064±0.007)	0.242±0.055 (0.225±0.037)	0.060±0.004 (0.064±0.007)	0.280±0.044 (0.225±0.037)
Mn	12.02±0.52 (12.3±1.5)	1.41±0.11 (1.26±0.15)	12.1±0.4 (12.3±1.5)	8.68±0.37 (8.72±0.53)	11.5±0.4 (12.3±1.5)	8.7±0.54 (8.72±0.53)
Ni	2.00±0.3 (2.25±0.44)	ND (0.124±0.010)	1.87±0.10 (2.25±0.44)	NA	NA	0.32±0.04 (0.26±0.06)
Pb	0.33±0.02 (0.371±0.014)	1.22±0.06 (1.20±0.07)	0.31±0.03 (0.371±0.014)	1.2±0.18 (1.36±0.29)	0.32±0.06 (0.371±0.014)	1.18±0.16 (1.36±0.29)
Se	1.61±0.14 (2.21±0.24)	0.211±0.049 (0.247±0.007)	2.4±0.3 (2.21±0.24)	7.4±0.6 (7.34±0.42)	2.2±0.03 (2.21±0.24)	7.5±0.0 (7.34±0.42)
Zn	840±34 (830±57)	12.7±0.7 (11.3±0.5)	802±26 (830±57)	86.0±2.8 (92.5±2.3)	821±9.2 (830±57)	84.9±2.2 (92.5±2.3)

* Sample values are given first, followed by reference values in parentheses, both values include 95% confidence interval where appropriate.
NBS refers to the National Bureau of Standards.
NIES refers to the National Institute of Environmental Studies, Japan Environmental Agency - Certified Reference Material #6, mussel tissue.
DOLT refers to dogfish liver from the National Research Council of Canada.

** Sample Year = State Fiscal Year (July 1 - June 30).

NA = Not Analyzed.

ND = Not detected.

TABLE AA-3

State Mussel Watch Program
Synthetic Organic Compounds Analyzed
and Their Detection Limits (ng/g)

Compound	Tissue		Sediment	
	(dry weight)	(wet weight)	(dry weight)	(wet weight)
aldrin	1	0.2	0.5	0.25
chlorbenside	10	2.0	10.0	5.00
cis-chlordane	1	0.2	0.5	0.25
trans-chlordane	1	0.2	0.5	0.25
chlordene, alpha	1	0.2	0.5	0.25
chlordene, gamma	1	0.2	0.5	0.25
chlorpyrifos	4	0.8	1.0	0.50
dacthal	2	0.4	(0.5) 0.2	(0.25) 0.10
DDD, o,p'	5	1.0	1.0	0.50
DDD, p,p'	3	0.6	(1.0) 0.4	(0.5) 0.20
DDE, o,p'	3	0.6	1.0	0.50
DDE, p,p'	(3) 1	(0.6) 0.2	(5.0) 1.0	(2.5) 0.50
DDMS, p,p'	20	4.0	3.0	1.50
DDMU,p,p'	5	1.0	(1.5) 2.0	(0.75) 1.00
DDT, o,p'	4	0.8	1.0	0.50
DDT, p,p'	4	0.8	1.0	0.50
diazinon	23	4.6	5.0	2.50
dichlorobenzophenone-p,p'	25	5.0	3.0	1.50
dicofol (Kelthane)	75	15.0	10.0	5.00
dieldrin	1	0.2	(5.0) 0.5	(2.5) 0.25
endosulfan I	1	0.2	(5.0) 0.5	(2.5) 0.25
endosulfan II	(30) 3	(6.0) 0.6	(7.0) 1.0	(3.5) 0.50
endosulfan sulfate	(50) 5	(10.0) 1.0	(8.5) 2.0	(4.25) 1.00
endrin	6	1.2	(1.5) 2.0	(0.75) 1.00
ethion	(15) 9	(3.0) 1.8	2.0	1.00
HCH, alpha	1	0.2	0.2	0.10
HCH, beta	3	0.6	1.0	0.50
HCH, gamma	0.8	0.2	0.2	0.10
HCH, delta	2	0.4	0.5	0.25
heptachlor	1	0.2	0.5	0.25
heptachlor epoxide	1	0.2	0.5	0.25
HCB	1	0.2	0.2	0.10
methoxychlor	15	3.0	1.5	0.75
mirex	(2) 1	(0.4) 0.2	(1.0) 0.5	(0.5) 0.25
cis-nonachlor	1	0.2	0.5	0.25
trans-nonachlor	1	0.2	0.5	0.25
oxadiazon	6	1.2	(2.0) 0.3	(1.0) 0.15
oxychlordane	1	0.2	0.5	0.25
parathion, ethyl	10	2.0	1.0	0.50
parathion, methyl	4	0.8	1.0	0.50
PCB 1248	50	10.0	5.0	2.5
PCB 1254	10	2.0	5.0	2.5
PCB 1260	10	2.0	5.0	2.5
PCB congeners	2.0	0.4	1.0	0.50
PCT 5460	100	20.0	25.0	12.00
pentachlorophenol	4	0.8	4.0	0.80
phenol	0.5	0.1	0.5	0.10
2,3,5,6-tetrachlorophenol	5	1.0	5.0	1.00
tetradifon (Tedion)	10	2.0	10.0	5.00
toxaphene	100	20.0	10	5.00
tributyltin	20	3.0	20	3.00

()Detection limits from 1987-88 through 1990-91.

TABLE AA-4

State Mussel Watch Program
Polynuclear Aromatic Hydrocarbons (PAHs) Analyzed
and Their Detection Limits (ng/g)

Compound	Tissue		Sediment	
	(dry weight)	(wet weight)	(dry weight)*	(wet weight)
naphthalene	10	2	5	0.2
1-methylnaphthalene	10	2	5	0.2
2-methylnaphthalene	10	2	5	0.2
biphenyl	10	2	5	0.2
2,6-dimethylnaphthalene	10	2	5	0.2
acenaphthylene	10	2	5	0.2
acenaphthene	10	2	5	0.2
2,3,5-trimethylnaphthalene	10	2	5	0.2
fluorene	10	2	5	0.2
phenanthrene	10	2	5	0.2
anthracene	10	2	5	0.2
1-methylphenanthrene	10	2	5	0.2
fluoranthrene	10	2	5	0.2
pyrene	10	2	5	0.2
benz[a]anthracene	10	2	5	0.2
chrysene	10	2	5	0.2
benzo[b]fluoranthrene	10	2	5	0.2
benzo[k]fluoranthrene	10	2	5	0.2
benzo[e]pyrene	10	2	5	0.2
benzo[a]pyrene	10	2	5	0.2
perylene	10	2	5	0.2
indeno[1,2,3-cd]pyrene	10	2	5	0.2
dibenz[a,h]anthracene	10	2	5	0.2
benzo[ghi]perylene	10	2	5	0.2

*Detection limit for dry weight sediment was 50 ng/g (25 ng/g wet weight) from 1987-88 to 1990-91.

TABLE AA-5

State Mussel Watch Program
Distribution of Synthetic Organic Compounds Among
Four Fractions of a Standard Florisil® Column

FY 1987-88 through FY 1990-91

(0%) Fraction 1	(6%) Fraction 2	(15%) Fraction 3
aldrin	HCH, alpha*	dacthal
chlordene, alpha	HCH, beta	diazinon
chlordene, gamma*	HCH, gamma	dichlorobenzophenone, p,p'
cis-chlordane*	HCH, delta	dieldrin
DDE, o,p'	chlorbenside	endosulfan I**
DDE, p,p'*	chlordene, gamma*	endosulfan II***
DDMU, p,p'*	chlorpyrifos	endrin
DDT, o,p'*	cis-chlordane*	parathion, ethyl
DDT, p,p'*	cis-nonachlor	parathion, methyl
heptachlor	DDE, p,p'*	tetradifon (tedion)
hexachlorobenzene	DDD, o,p'	
PCB 1248	DDD, p,p'	
PCB 1254	DDMS, p,p'	
PCB 1260	DDMU, p,p'*	
PCB congeners	DDT, o,p'*	
PCT 5460	DDT, p,p'*	
trans-nonachlor*	dicofol (kelthane)	(50%) Fraction 4
	endosulfan I**	endosulfan II***
	ethion	endosulfan sulfate
	heptachlor epoxide	
	methoxychlor	
	oxadiazon	
	oxychlordane	
	toxaphene	
	trans-chlordane	
	trans-nonachlor*	

* Found in both 0% and 6% fractions. ** Found in both 6% and 15% fractions.
*** Found in both 15% and 50% fractions.

TABLE AA-5 (continued)

State Mussel Watch Program
Distribution of Synthetic Organic Compounds Among
Two Fractions of a Standard Florisil® Column

FY 1991-92 and FY 1992-93

Fraction 1 (1% methylene chloride in pentane)	Fraction 2 (100% methylene chloride)
aldrin	HCH, alpha
chlordene, alpha	HCH, beta
chlordene, gamma*	HCH, gamma
DDE, o,p'	HCH, delta
DDE, p,p'*	chlordene, gamma*
DDMU, p,p'*	chlorpyrifos
DDT, o,p'	cis-chlordane
DDT, p,p'*	cis-nonachlor
heptachlor	dacthal
hexachlorobenzene	DDE, p,p'*
PCB 1248	DDD, o,p'
PCB 1254	DDD, p,p'
PCB 1260	DDMS, p,p'
PCT 5460	DDMU, p,p'*
trans-nonachlor*	DDT, p,p'*
	dichlorobenzophenone, p,p'
	dieldrin
	endosulfan I
	endosulfan II
	endosulfan sulfate
	ethion
	endrin
	heptachlor epoxide
	methoxychlor
	oxadiazon
	oxychlordane
	toxaphene
	trans-chlordane
	trans-nonachlor*

* Found in both Fraction 1 and fraction 2.

TABLE AA-6

State Mussel Watch Program
Organic Compound Analysis of Reference Materials (ng/g, wet weight)

1990-91 PAHs with NIST Certified Values

Polynuclear Aromatic Hydrocarbons (PAHs)	**NIST-Mussel***	**SMWP-Mussel**
Phenanthrene	5.6 ± 1.4	4.65 ± 1.0
Anthracene	0.75 ± 0.21	2.15
Fluoranthrene	33.6 ± 5.8	31.79 ± 7.8
Pyrene	34.1 ± 3.7	33.21 ± 8.5
Perylene	1.05 ± 0.29	0
Benzo[b]fluoranthrene	6.5 ± 1.2	6.63 ± 3.8
Benzo[a]pyrene	2.29 ± 0.47	7.47 ± 4.4
Benzo[ghi]perylene	2.47 ± 0.28	0
Indeno[1,2,3-cd]pyrene	1.8 ± 0.33	0

1990-91 PAHs with Non-Certified Values

Polynuclear Aromatic Hydrocarbons (PAHs)	**NIST-Mussel***	**SMWP-Mussel**
2-methylnaphthalene	2.1 ± 0.5	1.79
1-methylnaphthalene	1.1 ± 0.2	0
Fluorene	1.5 ± 0.2	0
1-methylphenanthrene	2.3 ± 0.6	3.94 ± 1.5
Benz[a]anthracene	4.6 ± 0.4	4.99 ± 2.5
Chrysene	15.3 ± 1.4	13.56 ± 3.6
Benzo[k]fluoranthrene	3.0 ± 0.1	4.13 ± 2.6
Benzo[e]pyrene	10.0 ± 1	7.59 ± 3.9
Dibenz[a,h]anthracene	0.35 ± 0.01	0

* National Institute of Standards and Technology (NIST) Standard Reference Material 1974 - Organics in Mussel Tissue (*Mytilus edulis*).

TABLE AA-6 (continued)

State Mussel Watch Program
Organic Compound Analysis of Reference Materials (ng/g, wet weight)*

1991-92 PAHs with NIST Cetified Values

Polynuclear Aromatic Hydrocarbons (PAHs)	**NIST-Mussel***	**SMWP-Mussel**
Phenanthrene	5.6 ± 1.4	7.49 ± 0.8
Anthracene	0.75 ± 0.21	0
Fluoranthrene	33.6 ± 5.8	34.31 ± 11
Pyrene	34.1 ± 3.7	36.5 ± 3.0
Perylene	1.05 ± 0.29	0
Benzo[b]fluoranthrene	6.5 ± 1.2	8.32 ± 0.5
Benzo[a]pyrene	2.29 ± 0.47	2.93 ± 0.7
Benzo[ghi]perylene	2.47 ± 0.28	3.0 ± 0.5
Indeno[1,2,3-cd]pyrene	1.8 ± 0.33	2.6

1991-92 PAHs with Non-Certified Values

Polynuclear Aromatic Hydrocarbons (PAHs)	**NIST-Mussel***	**SMWP-Mussel**
2-methylnaphthalene	2.1 ± 0.5	2.75 ± 0.4
1-methylnaphthalene	1.1 ± 0.2	2.15 ± 0.1
Fluorene	1.5 ± 0.2	3.2
1-methylphenanthrene	2.3 ± 0.6	2.93 ± 0.6
Benz[a]anthracene	4.6 ± 0.4	5.79 ± 1.3
Chrysene	15.3 ± 1.4	15.2 ± 1.6
Benzo[k]fluoranthrene	3.0 ± 0.1	3.22 ± 0.6
Benzo[e]pyrene	10.0 ± 1.0	11.34 ± 1.4
Dibenz[a,h]anthracene	0.35 ± 0.01	4.0

* National Institute of Standards and Technology (NIST) Standard Reference Material 1974 - Organics in Mussel Tissue (*Mytilus edulis*).

TABLE AA-6 (continued)

State Mussel Watch Program
Organic Compound Analysis of Reference Materials (ng/g, wet weight)*

1991-92 Synthetic Organics with Non-Certified Values

Synthetic Organic Compounds	**NIST-Mussel***	**SMWP-Mussel**
cis-chlordane	3.2 ± 0.2	2.55 ± 0.8
trans-nonachlor	2.6 ± 0.6	2.43 ± 0.4
Dieldrin	1 ± 0.5	0.78 ± 0.2
DDD, o,p'	2.5 ± 0.9	1.84 ± 0.5
DDD, p,p'	8.4 ± 0.4	6.01 ± 1.2
DDE, o,p'	0.72 ± 0.07	2.93 ± 0.5
DDE, p,p'	5.9 ± 0.2	6.37 ± 1.7
DDT, o,p'	0.4 ± 0.2	0.9
DDT, p,p'	0.3 ± 0.3	0.92 ± 0.3

1992-93 Synthetic Organics with Non-Certified Values

Synthetic Organic Compounds	**NIST-Mussel***	**SMWP-Mussel**
cis-chlordane	3.2 ± 0.2	2.39 ± 0.3
trans-nonachlor	2.6 ± 0.6	2.05 ± 0.2
Dieldrin	1 ± 0.5	0.87 ± 0.2
DDD, o,p'	2.5 ± 0.9	1.7 ± 0.2
DDD, p,p'	8.4 ± 0.4	4.81 ± 0.7
DDE, o,p'	0.72 ± 0.07	0.2
DDE, p,p'	5.9 ± 0.2	5.06 ± 0.9
DDT, o,p'	0.4 ± 0.2	0.41 ± 0.1
DDT, p,p'	0.3 ± 0.3	1.1 ± 0.7

* National Institute of Standards and Technology (NIST) Standard Reference Material 1974 - Organics in Mussel Tissue (*Mytilus edulis*).

TABLE AA-6 (continued)

State Mussel Watch Program
Organic Compound Analysis of Reference Materials (ng/g, wet weight)*

1992-93 PAHs with NIST Certified Values

Polynuclear Aromatic Hydrocarbons (PAHs)	**NIST-Mussel***	**SMWP-Mussel**
Phenanthrene	5.6 ± 1.4	5.41 ± 0.6
Anthracene	0.75 ± 0.21	0.92 ± 0.7
Fluoranthrene	33.6 ± 5.8	37.89 ± 5.5
Pyrene	34.1 ± 3.7	37.58 ± 5.3
Perylene	1.05 ± 0.29	0.94 ± 0.4
Benzo[b]fluoranthrene	6.5 ± 1.2	7.8 ± 1.6
Benzo[a]pyrene	2.29 ± 0.47	1.85 ± 0.9
Benzo[ghi]perylene	2.47 ± 0.28	2.87 ± 0.7
Indeno[1,2,3-cd]pyrene	1.8 ± 0.33	2.04 ± 0.6

1992-93 PAHs with Non-Certified Values

Polynuclear Aromatic Hydrocarbons (PAHs)	**NIST-Mussel***	**SMWP-Mussel**
2-methylnaphthalene	2.1 ± 0.5	3.55 ± 1.4
1-methylnaphthalene	1.1 ± 0.2	2.85 ± 1.0
Fluorene	1.5 ± 0.2	1.47 ± 0.7
1-methylphenanthrene	2.3 ± 0.6	2.38 ± 0.4
Benz[a]anthracene	4.6 ± 0.4	4.1 ± 1.1
Chrysene	15.3 ± 1.4	6.49 ± 1.1
Benzo[k]fluoranthrene	3.0 ± 0.1	2.58 ± 0.8
Benzo[e]pyrene	10.0 ± 1.0	10.65 ± 2.3
Dibenz[a,h]anthracene	0.35 ± 0.01	1.02 ± 0.5

* National Institute of Standards and Technology (NIST) Standard Reference Material 1974 - Organics in Mussel Tissue (*Mytilus edulis*).

TABLE AA-7

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1987-88 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	San Andreas Road		Sandholdt Bridge		Carpinteria Marsh		Marina Del Rey/Basin G		Huntington Harbour/ Edinger Street	
Station No.	401.8		404.0		475.0		555.0		713.0	
Species	TFC		RBM		TCM		TCM		TCM	
REPLICATE	1	2	1	2	1	2	1	2	1	2
COMPOUNDS										
aldrin	7.8	8.6								
alpha-chlordene	4.3	4.8					7.1	4.4	3.9	2.9
cis-chlordane	78.0	93.0	7.0	12.0	9.0	6.0	64.9	89.0	65.0	49.0
cis-nonachlor							19.0	26.0	26.0	17.0
gamma-chlordene	8.9	8.2							2.3	1.7
oxychlordane	14.0	18.0					3.4	5.3	4.4	3.4
trans-chlordane	60.0	73.0	9.9	11.0	6.2	4.2	56.0	69.0	57.0	50.0
trans-nonachlor	72.0	79.0	8.3	8.2	5.5	2.9	38.0	41.0	54.4	39.0
chlorpyrifos									7.2	5.1
dacthal	80.0	72.0							3.3	2.8
DDD, o,p'	239.8	320.0	16.0	36.0					18.0	12.0
DDD, p,p'	569.7	799.8	46.0	120.0			12.0	28.0	46.0	31.0
DDE, o,p'	120.0	83.5	10.3	11.2			11.7	15.2	22.2	13.0
DDE, p,p'	2199.4	2399.4	473.0	390.0	62.0	74.0	133.0	120.0	220.0	250.0
DDT, o,p'	475.9	429.7							13.0	11.0
DDT, p,p'	1061.8	1190.4	16.0	25.0	6.6	3.8			41.1	35.9
DDMS,p,p'	55.0	74.0								
DDMU,p,p'	91.0	100.4	24.0	30.0			17.0	14.0	9.3	8.6
diazinon	650.3	650.7								
dichlorobenzophenone,p,p'	14.0	13.0								
dicofol	450.3	749.6								
dieldrin	1403.0	1199.7	13.0	23.0			29.0	48.0	27.0	18.0
endosulfan I	81.0	72.0	43.0	27.0	36.0	38.0			96.0	78.0
endosulfan II	94.8	100.4							68.0	300.0
endosulfan sulfate	230.4	240.0							160.0	270.0
endrin	49.0	50.0								
hexachlorobenzene	3.8	4.3								
alpha-HCH									2.3	2.0
gamma-HCH									4.6	5.1
heptachlor epoxide	22.0	26.0							2.0	1.5
oxadiazon										
PCB 1248										
PCB 1254	180.1	189.7	250.0	140.0			440.0	290.0	530.0	430.0
PCB 1260										
toxaphene	3100.0	3701.4								

RCM = Resident California Mussel
RBM = Resident Bay Mussel
TCM = Transplanted California Mussel
TFC = Transplanted Fresh Water Clam
RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1987-88 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	San Diego Bay/ Sampson Street Pier	
Station No.	882.7	
Species	TCM	
REPLICATE	1	2
COMPOUNDS		
aldrin		
alpha-chlordene		
cis-chlordane	11.4	10.0
cis-nonachlor	3.2	2.0
gamma-chlordene		
oxychlordane		
trans-chlordane	12.0	11.0
trans-nonachlor	8.1	7.3
chlorpyrifos		
dacthal		
DDD, o,p'		
DDD, p,p'	6.5	9.1
DDE, o,p'	16.5	11.0
DDE, p,p'	19.0	22.5
DDT, o,p'		
DDT, p,p'	22.9	23.9
DDMS,p,p'		
DDMU,p,p'		
diazinon		
dichlorobenzophenone, p,p'		
dicofol		
dieldrin	5.2	2.6
endosulfan I		
endosulfan II		
endosulfan sulfate		
endrin		
hexachlorobenzene		
alpha-HCH		
gamma-HCH		
heptachlor epoxide		
oxadiazon		
PCB 1248		
PCB 1254	740.0	850.0
PCB 1260		
toxaphene		

RCM = Resident California Mussel
RBM = Resident Bay Mussel
TCM = Transplanted California Mussel
TFC = Transplanted Fresh Water Clam
RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1988-89 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	Mad River Slough		Eureka Channel		Gaviota		Carpinteria Marsh		Huntington Harbour/ Harbor Lane	
Station No.	100.0		103.0		455.0		475.0		717.0	
Species	TCM		TCM		TCM		TCM		TCM	
REPLICATE	1	2	1	2	1	2	1	2	1	2
COMPOUNDS										
aldrin										
alpha-chlordene									9.0	9.8
cis-chlordane					3.5	3.6	15.0	1.3	9.7	12.0
cis-nonachlor							1.6	1.4	23.0	38.0
gamma-chlordene									5.7	6.8
oxychlordane									7.1	9.3
trans-chlordane							11.0	2.8	58.0	69.0
trans-nonachlor					1.2	1.3	7.5	8.1	69.0	88.0
chlorpyrifos							11.0	6.4	35.0	36.0
dacthal										
DDD, o,p'									5.8	21.0
DDD, p,p'							46.0	69.0	160.0	196.0
DDE, o,p'							3.7	4.9	26.0	33.0
DDE, p,p'					31.0	30.0	130.0	130.0	370.0	450.0
DDT, o,p'										
DDT, p,p'							12.0	14.0	7.7	3.6
DDMS,p,p'									34.0	42.0
DDMU,p,p'							6.7	5.9	26.0	28.0
diazinon										
dichlorobenzophenone, p,p'										
dicofol										
dieldrin	2.5	1.5	2.2	2.4	2.9	3.5	11.0	15.0	40.0	53.0
endosulfan I							22.0	29.0	1.6	4.2
endosulfan II										
endosulfan sulfate										
endrin										
hexachlorobenzene									1.4	2.0
alpha-HCH	2.6	2.0	3.2	2.4	2.4	2.2	2.2	1.6		
gamma-HCH									6.6	8.0
heptachlor epoxide										
oxadiazon										
PCB 1248										
PCB 1254							30.0	32.0	410.0	490.0
PCB 1260										
toxaphene										

RCM = Resident California Mussel
RBM = Resident Bay Mussel
TCM = Transplanted California Mussel
TFC = Transplanted Fresh Water Clam
RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1989-90 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	Trinidad Head		Revolon Slough		LA Harbor/ Consolidated Slip		San Onofre 2		Oceanside	
Station No.	10.0		507.8		616.0		744.2		750.0	
Species	RCM		SED		TCM		TCM		RCM	
REPLICATE	1	2	1	2	1	2	1	2	1	2
COMPOUNDS										
aldrin										
alpha-chlordene					3.3	3.3				
cis-chlordane			7.4	5.5	24.4	26.1	3.5	2.5		
cis-nonachlor			5.4	3.5	12.2	9.8			1.7	0.8
gamma-chlordene										
oxychlordane										
trans-chlordane			6.4	4.7	26.7	23.9	2.5	2.5	7.0	3.3
trans-nonachlor			6.2	4.7	20.0	19.6			2.6	0.8
chlorpyrifos			8.5	4.9						
dacthal										
DDD, o,p'			35.8	28.7	31.1	20.7				
DDD, p,p'			119.3	90.1	122.2	100.0	3.0	8.6	7.8	11.7
DDE, o,p'			9.5	5.3	34.4	22.8	4.5	8.1		
DDE, p,p'			457.3	348.0	177.8	130.4	55.6	44.4	33.0	28.3
DDT, o,p'			35.8	26.6						
DDT, p,p'			91.5	75.4	30.0	9.8	4.0	4.5	9.6	5.0
DDMS,p,p'					25.6	35.0				
DDMU,p,p'			15.5	10.4	6.7	16.3				
diazinon										
dichlorobenzophenone, p,p'										
dicofol										
dieldrin	1.3	1.3	2.2	1.8	6.7	9.8	5.6	2.5	4.3	4.2
endosulfan I			5.4	5.5					1.7	1.7
endosulfan II			9.1	7.8						
endosulfan sulfate			18.1	15.6						
endrin										
hexachlorobenzene			0.6	0.4						
alpha-HCH	7.1	6.1					4.0	3.0	3.5	1.7
beta-HCH	5.8	4.8								
gamma-HCH	1.3	1.3								
heptachlor epoxide										
oxadiazon										
PCB 1248					155.6	217.4				
PCB 1254			4.0	4.3	544.4	510.9	39.4	22.2	64.3	61.7
PCB 1260										
toxaphene			258.4	225.2						

RCM = Resident California Mussel
RBM = Resident Bay Mussel
TCM = Transplanted California Mussel
TFC = Transplanted Fresh Water Clam
RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1989-90 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	Mission Bay/Landfill 1	
Station No.	868.5	
Species	TCM	
REPLICATE	1	2
COMPOUNDS		
aldrin		
alpha-chlordene		
cis-chlordane	6.5	7.1
cis-nonachlor	3.6	2.8
gamma-chlordene		
oxychlordane		
trans-chlordane	5.0	3.5
trans-nonachlor	1.4	3.5
chlorpyrifos		
dacthal		
DDD, o,p'		
DDD, p,p'	4.3	4.3
DDE, o,p'		
DDE, p,p'	18.0	31.9
DDT, o,p'		
DDT, p,p'		
DDMS,p,p'		
DDMU,p,p'		
diazinon		
dichlorobenzophenone, p,p'		
dicofol		
dieldrin		
endosulfan I		
endosulfan II		
endosulfan sulfate		
endrin		
hexachlorobenzene		
alpha-HCH	0.7	0.7
gamma-HCH		
heptachlor epoxide		
oxadiazon		
PCB 1248		
PCB 1254	93.5	170.2
PCB 1260		
toxaphene		

RCM = Resident California Mussel
RBM = Resident Bay Mussel
TCM = Transplanted California Mussel
TFC = Transplanted Fresh Water Clam
RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1990-91 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	Sante Fe Channel/End		Dumbarton Bridge Channel Marker 14		San Luis Obispo Creek 1		Goleta Slough 4		Anaheim Bay Navy Marsh 2	
Station No.	303.4		321.0		446.0		460.3		708.5	
Species	TCM		TCM		TFC		SED		TCM	
REPLICATE	1	2	1	2	1	2	1	2	1	2
COMPOUNDS										
aldrin	5.4	4.7								
alpha-chlordene					6.9	5.7				
cis-chlordane	22.0	19.0	15.0	19.0	73.0	66.0	1.7	1.9	15.0	19.0
cis-nonachlor	5.5	5.0	9.0	11.0	35.0	31.0			10.0	13.0
gamma-chlordene										
oxychlordane					6.4	5.7				
trans-chlordane	20.0	18.0	11.0	11.0	56.0	49.0	1.9	1.9	9.0	11.0
trans-nonachlor	15.0	13.0	6.7	1.3	89.0	82.0	1.5	2.7	13.0	16.0
chlorpyrifos										
dacthal										
DDD, o,p'	260.0	220.0	12.0	15.0					17.0	20.0
DDD, p,p'	930.0	830.0	12.0	14.0	35.0	42.0			23.0	28.0
DDE, o,p'	37.0	43.0							20.0	20.0
DDE, p,p'	400.0	360.0	51.0	46.0	63.0	56.0	5.1	5.8	210.0	264.0
DDT, o,p'	311.0	260.0								
DDT, p,p'	680.0	570.0			20.0	18.0			5.8	7.9
DDMS,p,p'	112.0	92.0								
DDMU,p,p'	110.0	95.0							31.0	38.0
diazinon										
dichlorobenzophenone, p,p'										
dicofol										
dieldrin	250.0	260.0	25.0	31.0					14.0	10.0
endosulfan I										
endosulfan II										
endosulfan sulfate										
endrin										
hexachlorobenzene										
alpha-HCH										
gamma-HCH										
heptachlor epoxide										
oxadiazon	8.9	9.1								
PCB 1248	180.0	180.0								
PCB 1254	880.0	820.0	88.0	110.0	220.0	200.0	140.0	660.0	110.0	140.0
PCB 1260					22.0	76.0				
PCB 5460					1000.0	2400.0				
toxaphene										

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RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1990-91 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	San Onofre 6	
Station No.	744.6	
Species	TCM	
REPLICATE	1	2
COMPOUNDS		
aldrin		
alpha-chlordene		
cis-chlordane	4.0	4.5
cis-nonachlor	1.2	1.1
gamma-chlordene		
oxychlordane		
trans-chlordane	2.3	2.1
trans-nonachlor	2.4	2.3
chlorpyrifos		
dacthal		
DDD, o,p'		
DDD, p,p'		
DDE, o,p'		
DDE, p,p'	89.0	87.0
DDT, o,p'		
DDT, p,p'		
DDMS,p,p'		
DDMU,p,p'	7.0	7.2
diazinon		
dichlorobenzophenone, p,p'		
dicofol		
dieldrin	1.7	2.5
endosulfan I		
endosulfan II		
endosulfan sulfate		
endrin		
hexachlorobenzene		
alpha-HCH	1.7	1.9
gamma-HCH		
heptachlor epoxide		
oxadiazon		
PCB 1248		
PCB 1254	22.0	21.0
PCB 1260		
toxaphene		

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TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1991-92 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	Bodega Harbor/ Spud Point Marina		Santa Clara River Estuary 2		Anaheim Bay/ Navy Harbor		Newport Bay/ Turning Basin		Newport Bay/ Highway 1 Bridge	
Station No.	205.0		487.3		707.0		723.4		724.0	
Species	TCM		SED		TCM		TCM		TCM	
REPLICATE	1	2	1	2	1	2	1	2	1	2
COMPOUNDS										
aldrin										
alpha-chlordene										
cis-chlordane			1.0	0.9	13.8	14.9	26.0	27.9	22.1	40.1
cis-nonachlor					7.1	7.2	17.0	12.5	19.1	21.5
gamma-chlordene										
oxychlordane										
trans-chlordane	1.9	1.3	0.7	0.6	8.9	10.0	24.0	19.2	30.5	32.0
trans-nonachlor	1.9	2.6			16.0	12.7	33.0	19.2	44.2	34.2
chlorpyrifos			1.5	1.4						
dacthal			2.3	2.4						
DDD, o,p'					7.1	7.2	15.0	9.6	24.4	26.0
DDD, p,p'			2.6	2.4	18.0	21.0	67.0	58.7	140.0	178.3
DDE, o,p'					45.0	47.6	18.0	8.7	29.0	20.8
DDE, p,p'	18.1	17.5	6.3	6.6	440.0	420.8	450.0	259.9	990.0	742.9
DDT, o,p'										
DDT, p,p'			11.6	10.1						
DDMS,p,p'										
DDMU,p,p'					38.0	36.5	22.0	14.4	49.6	47.5
diazinon										
dichlorobenzophenone, p,p'										
dicofol										
dieldrin					9.6	10.5	18.0	14.4	18.3	19.3
endosulfan I										
endosulfan II										
endosulfan sulfate										
endrin										
hexachlorobenzene										
alpha-HCH										
gamma-HCH					0.9	1.1				
heptachlor epoxide										
oxadiazon							11.0	5.8	17.5	14.9
PCB 1248										
PCB 1254	130.0	162.0			280.0	276.8	500.0	259.9	480.5	319.5
PCB 1260										
toxaphene										

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RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1991-92 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	La Jolla	
Station No.	832.0	
Species	RCM	
REPLICATE	1	2
COMPOUNDS		
aldrin		
alpha-chlordene		
cis-chlordane		
cis-nonachlor		
gamma-chlordene		
oxychlordane		
trans-chlordane	1.4	2.0
trans-nonachlor		
chlorpyrifos		
dacthal		
DDD, o,p'		
DDD, p,p'		
DDE, o,p'		
DDE, p,p'	11.9	11.2
DDT, o,p'		
DDT, p,p'		
DDMS,p,p'		
DDMU,p,p'		
diazinon		
dichlorobenzophenone, p,p'		
dicofol		
dieldrin		
endosulfan I		
endosulfan II		
endosulfan sulfate		
endrin		
hexachlorobenzene		
alpha-HCH	1.4	2.4
gamma-HCH		
heptachlor epoxide		
oxadiazon		
PCB 1248		
PCB 1254		
PCB 1260		
toxaphene		

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TABLE AA-7 (continued)

State Mussel Watch Program

Results of Duplicate Sample Analysis: 1992-93 Synthetic Organic Compounds Quality Control

(ng/g dry weight)

Station Name	Watsonville Slough/ Bridge		Mugu Lagoon/ Calleguas Creek		Huntington Harbour/ Warner Ave Bridge		San Diego Bay/ Evans Street	
Station No.	401.5		507.3		715.0		887.0	
Species	TFC		SED		TCM		TCM	
REPLICATE	1	2	1	2	1	2	1	2
COMPOUNDS								
aldrin	13.0	9.8						
alpha-chlordene	6.8	6.8						
cis-chlordane	100.0	120.0	4.2	4.2	45.0	40.0	10.0	14.0
cis-nonachlor	92.0	140.0			22.0	23.0	9.2	12.0
gamma-chlordene	7.5	9.1						
oxychlordane								
trans-chlordane	110.0	110.0	3.5	3.8	51.0	40.0	9.9	15.0
trans-nonachlor	110.0	110.0	3.9	3.7	34.0	39.0	8.5	13.0
chlorpyrifos	120.0	120.0			23.0	23.0		
dacthal	220.0	210.0	14.0	12.0				
DDD, o,p'	500.0	450.0	11.0	11.0	10.0	7.7		
DDD, p,p'	670.0	650.0	42.0	44.0	26.0	27.0	5.0	7.1
DDE, o,p'	130.0	130.0			10.0	10.0		
DDE, p,p'	5000.0	5100.0	200.0	200.0	330.0	350.0	21.0	27.0
DDT, o,p'	1100.0	1200.0	6.3	5.2	8.9	11.0		
DDT, p,p'	3000.0	3000.0	21.0	24.0	45.0	47.0	5.4	6.1
DDMS,p,p'								
DDMU,p,p'	210.0	200.0			41.0	36.0	7.4	9.8
diazinon								
dichlorobenzophenone, p,p'								
dicofol								
dieldrin	1500.0	1700.0			22.0	22.0	6.5	7.4
endosulfan I	26.0	31.0						
endosulfan II	110.0	150.0						
endosulfan sulfate	270.0	230.0						
endrin	140.0	180.0						
hexachlorobenzene	7.3	7.1						
alpha-HCH								
gamma-HCH								
heptachlor epoxide	26.0	26.0						
oxadiazon	68.0	280.0						
PCB 1248	98.0	80.0			59.0	65.0		
PCB 1254	250.0	190.0			280.0	300.0	1100.0	1300.0
PCB 1260			28.0	30.0				
toxaphene	12000.0	15000.0	160.0	180.0	200.0	230.0		

RCM = Resident California Mussel
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TCM = Transplanted California Mussel
TFC = Transplanted Fresh Water Clam
RFC = Resident Fresh Water Clam
SED = Sediment

TABLE AA-8

State Mussel Watch Program
Results of Duplicate Sample Analysis: PAH Quality Control
(ng/g dry weight)

Station Name	Samoa Bridge/East		Dumbarton Bridge/ Channel Marker 14		Montana De Oro 2		San Onofre 6		Bodega Harbor/ Spud Point Marina	
Station No.	102.0		321.0		430.4		744.6		205.0	
Year	1990-91		1990-91		1990-91		1990-91		1991-92	
Species	TCM		TCM		TCM		TCM		TCM	
REPLICATE	1	2	1	2	1	2	1	2	1	2
COMPOUNDS										
Naphthalene	26.0	33.0	55.0	55.0	21.0	21.0	34.0	33.0	23.0	23.0
2-Methylnaphthalene									66.0	87.0
1-Methylnaphthalene									15.0	19.0
Biphenyl										
2,6-Dimethylnaphthalene										
Acenaphthylene										
Acenaphthene										
2,3,5-Trimethylnaphthalene										
Fluorene										
Phenanthrene	39.0	28.0	20.0	35.0					230.0	230.0
Anthracene										
1-Methylphenanthrene										
Fluoranthrene	17.0	14.0	51.0	74.0					260.0	250.0
Pyrene	21.0	26.0	74.0	110.0					250.0	200.0
Benz[a]anthracene			15.0	21.0					34.0	37.0
Chrysene			30.0	32.0					59.0	71.0
Benzo[b]fluoranthrene			34.0	41.0					31.0	24.0
Benzo[k]fluoranthrene			23.0	34.0						
Benzo[e]pyrene			37.0	37.0					27.0	29.0
Benzo[a]pyrene			43.0	65.0						
Perylene										
Indeno[1,2,3-cd]pyrene										
Dibenz[a,h]anthracene										
Benzo[ghi]perylene			13.0	38.0						

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SED = Sediment

TABLE AA-8 (continued)

State Mussel Watch Program
Results of Duplicate Sample Analysis: PAH Quality Control
(ng/g dry weight)

Station Name	Huntington Harbour/ Warner Ave Bridge		San Diego Bay/ Evans Street	
Station No.	715.0		887.0	
Year	1992-93		1992-93	
Species	TCM		TCM	
REPLICATE	1	2	1	2
COMPOUNDS				
Naphthalene	30.0	22.0	20.0	37.0
2-Methylnaphthalene	28.0	21.0	47.0	68.0
1-Methylnaphthalene	16.0	11.0	12.0	25.0
Biphenyl			11.0	12.0
2,6-Dimethylnaphthalene				
Acenaphthylene			11.0	20.0
Acenaphthene			140.0	130.0
2,3,5-Trimethylnaphthalene				
Fluorene			170.0	270.0
Phenanthrene	30.0	25.0	1200.0	1100.0
Anthracene			380.0	340.0
1-Methylphenanthrene			110.0	110.0
Fluoranthrene	130.0	120.0	5900.0	5100.0
Pyrene	170.0	160.0	3500.0	3100.0
Benz[a]anthracene	18.0	16.0	780.0	740.0
Chrysene	48.0	40.0	590.0	820.0
Benzo[b]fluoranthrene	22.0	23.0	700.0	760.0
Benzo[k]fluoranthrene			180.0	200.0
Benzo[e]pyrene	30.0	27.0	690.0	740.0
Benzo[a]pyrene			200.0	200.0
Perylene			98.0	98.0
Indeno[1,2,3-cd]pyrene			97.0	100.0
Dibenz[a,h]anthracene				
Benzo[ghi]perylene			160.0	180.0

RCM = Resident California Mussel
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TABLE AA-9

State Mussel Watch Program

Results of Duplicate Sample and Reference Material Analysis: 1987-93 Tributyltin (TBT) Quality Control

(ng/g dry weight)

Year	Station Number	Station Name	Sample Type	Sample Cconcentration	Duplicate Cconcentration
1987-88	No duplicates were analyzed.				
1988-89	10.0	Trinidad Head	RCM	ND	ND
	307.4	Oakland Inner Hbr/Embarcadero Cove	TCM	4,000	5,500
	556.0	Marina Del Rey/Basin E	TCM	7,800	8,400
	899.0	San Diego Bay/Shelter Is/Fshg Pier	TCM	1,100	1,300
1989-90	414.0	Pacific Grove	RCM	ND	ND
	429.2	Morro Bay/Boat Works	TCM	280	420
	726.4	Newport Bay/Rhine Channel/End	TCM	6,500	7,100
1990-91	205.0	Bodega Harbor/Spud Point Marina	TCM	830	680
	302.0	Point Pinole	TCM	300	210
	619.0	LA Harbor/San Pedro Boatworks	RBM	1,400	1,300
	707.0	Anaheim Bay/Navy Harbor	TCM	470	210
	708.0	Anaheim Bay/Navy Marsh	TCM	430	200
	723.4	Newport Bay/Turning Basin	TCM	5,300	4,000
	724.0	Newport Bay/Highway 1 Bridge	TCM	3,300	2,500
	726.4	Newport Bay/Rhine Channel/End	SED	ND	ND
1991-92	616.0	LA Harbor/Consolidated Slip	SED	280	290
	717.0	Huntington Harbor/Harbor Lane	TCM	990	1,200
	901.0	San Diego Bay/Degausing Station	TCM	260	270
1992-93	10.0	Trinidad Head	RCM	ND	ND
	899.2	San Diego Bay/Shelter Island	TCM	5,700	5,900

ND = Not Detected.
RCM = Resident California Mussel
RBM = Resident Bay Mussel
TCM = Transplanted California Mussel
SED = Sediment

1992-93 TBT ANALYSIS OF REFERENCE MATERIAL*

Sample	Concent-tration	Certified Value	Upper Warning Limit	Lower Warning Limit	Upper Control Limit	Lower Control Limit
PACS-1 Replicate 1	1,047	1,270	1,710	893	1,790	840
PACS-1 Replicate 2	1,020					

* Standard reference material (SRM) for TBT was not available for use until 1992-93.
PACS-1 refers to marine sediment reference material from the National Research Council of Canada.
Warning and control limits were calculated according to U.S.EPA/EMAP guidelines.
Warning limits are within 15% of the certified SRM 95% confidence limits, control limits are within 20%.