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FALL 2001 FINFISH CHARACTERIZATION REPORT

RHODE ISLAND REGION LONG-TERM DREDGED
MATERIAL DISPOSAL SITE EVALUATION PROJECT

FINAL

Fall 2001 Finfish Characterization Report

**Rhode Island Region
Long-Term Dredged Material Disposal Site Evaluation Project**

**Contract Number DACW33-01-D-004
Project Number Delivery Order 0002**

to

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INTRODUCTION

The Rhode Island Region Long-Term Dredged Material Disposal Site Evaluation Project includes the collection of environmental baseline data at Rhode Island Sound Sites 16, 18, 69A, and 69B (Figure 1). Site 16 is the only site that had been used previously for disposal of dredge material. Site characterization efforts are designed to fulfill the baseline monitoring requirements defined in the Marine Protection Research and Sanctuaries Act (MPRSA) regulations at Part 228.13. This includes obtaining information on a contiguous area around each site, which will be used to evaluate secondary impacts from disposal, and also to assist in the identification of suitable reference areas for long-term monitoring.

Site characterization goals include documentation of existing physical, chemical, and biological conditions at the sites to (a) provide a basis for comparison of the biological value of the sites (habitat characterizations); (b) assess the suitability of each site for dredged material disposal (bathymetry, sediment type, hydrodynamics); and (c) assess potential short- and long-term impacts from dredged material disposal at each site.

The Army Corps of Engineers New England Division (the Corps), with consultation from U.S. Environmental Protection Agency (EPA Region 1), contracted Battelle to conduct sampling and analysis of finfish from Rhode Island Sound in Fall 2001. The purpose of the finfish survey was to collect finfish samples from trawls in September within the boundaries and/or in the vicinity of each study site to characterize fish abundance and diversity in the vicinity of the proposed disposal locations and to collect tissue for contaminant body burden analyses (Table 1).

METHODS

This section provides an overview of the methods and protocols used in the survey conducted to collect finfish samples. More detailed descriptions of the methods are contained in the Quality Assurance Project Plan (QAPP) (Battelle 2001).

Stations and Sampling

The Fall 2001 finfish survey was conducted on September 27, 2001 to collect scup, butterfish, and winter flounder for chemical analysis. Otter trawl tows were conducted at three locations in the vicinity of the potential disposal sites in Rhode Island Sound:

- West of Site 18
- Southeast of Site 69A
- Southwest of Site 69B.

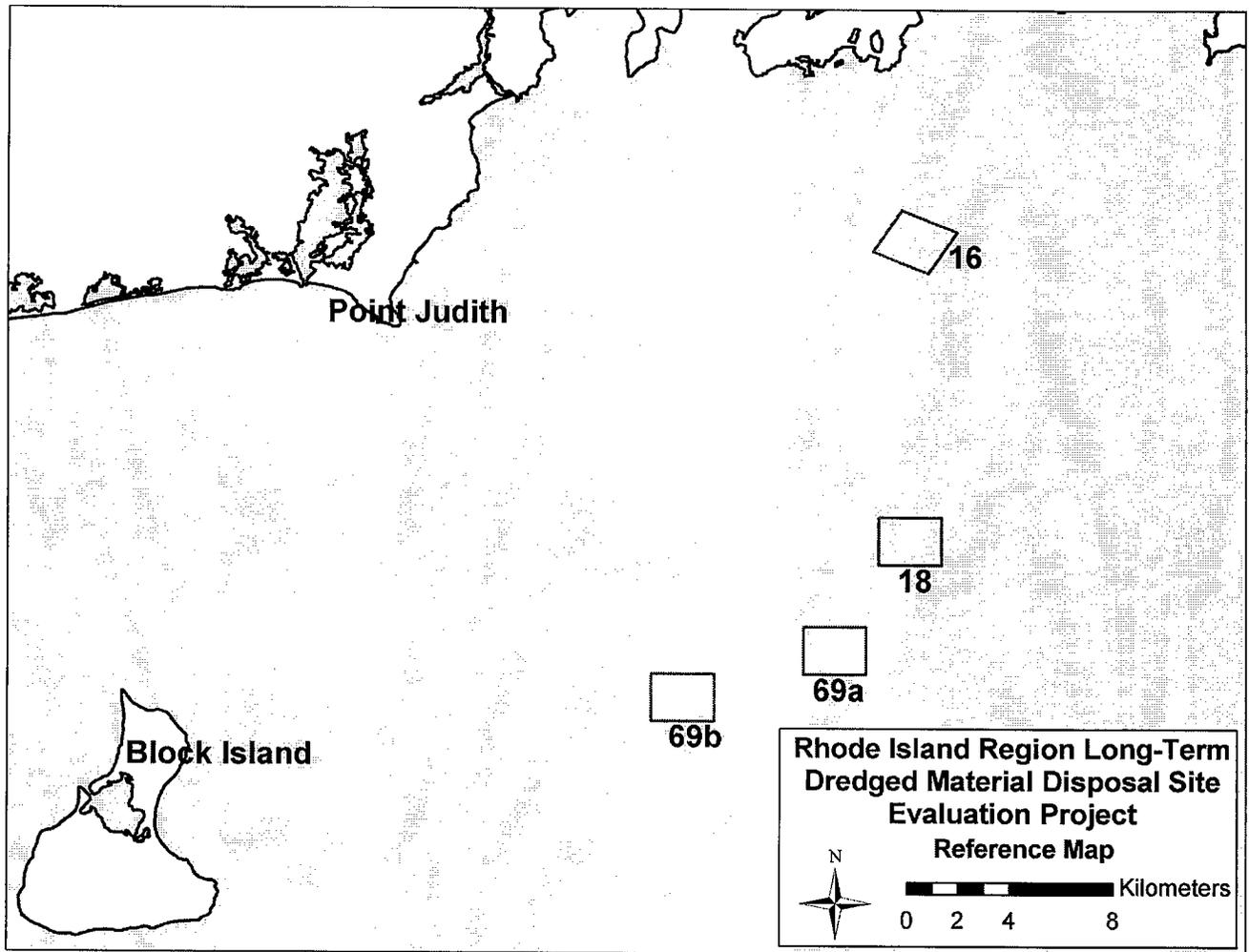


Figure 1. Map of the Four Study Sites in Rhode Island Sound.

Table 1. Specific Chemical Analytes Included in Tissue Chemistry Analyses.

Chemical Analytes	
<p>Trace Metals Arsenic Beryllium Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Zinc</p> <p>Organotins Monobutyltin Dibutyltin Tributyltin Tetrabutyltin</p> <p>Polychlorinated Biphenyls (PCBs) 2,4'-Cl₂(8) 2,2',5'-Cl₃(18) 2,4,4'-Cl₃(28) 2,2',3,5'-Cl₄(44) 2,2',5,5'-Cl₄(52) 2,3',4,4'-Cl₄(66) 2,2',4,5,5'-Cl₅(101) 2,3,3',4,4'-Cl₅(105) 2,3',4,4',5'-Cl₅(118) 2,2',3,3',4,4'-Cl₆(128) 2,2',3,4,4',5'-Cl₆(138) 2,2',4,4',5,5'-Cl₆(153) 2,2',3,3',4,4',5'-Cl₇(170) 2,2',3,4,4',5,5'-Cl₇(180) 2,2',3,4',5,5',6'-Cl₇(187) 2,2',3,3',4,4',5,6'-Cl₈(195) 2,2',3,3',4,4',5,5',6'-Cl₉(206) Decachlorobiphenyl-Cl₁₀(209)</p> <p>Polynuclear Aromatic Hydrocarbons (PAHs) Acenaphthene Acenaphthylene Anthracene Benzo[<i>a</i>]anthracene Benzo[<i>a</i>]pyrene Benzo[<i>b</i>]fluoranthene Benzo[<i>g,h,i</i>]perylene Benzo[<i>k</i>]fluoranthene Chrysene Dibenzo[<i>a,h</i>]anthracene Fluoranthene Fluorene Indeno[1,2,3-<i>c,d</i>]pyrene Naphthalene Phenanthrene Pyrene Bis(2-ethylhexyl)phthalate</p>	<p>Pesticides 2,4'-DDD 2,4'-DDE 2,4'-DDT 4,4'-DDD 4,4'-DDE 4,4'-DDT Aldrin cis-Chlordane Dieldrin Endosulfan I Endosulfan II Endosulfan sulfate Endrin g-BHC Heptachlor Heptachlorepoxyde Hexachlorobenzene Mirex Toxaphene trans-Nonachlor</p> <p>Dioxin/Furans 2,3,7,8-Tetrachlorodibenzo-p-dioxin 2,3,7,8-Tetrachlorodibenzofuran 1,2,3,7,8-Pentachlorodibenzo-p-dioxin 1,2,3,7,8-Pentachlorodibenzofuran 2,3,4,7,8-Pentachlorodibenzofuran 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin 1,2,3,4,7,8-Hexachlorodibenzofuran 1,2,3,6,7,8-Hexachlorodibenzofuran 1,2,3,7,8,9-Hexachlorodibenzofuran 2,3,4,6,7,8-Hexachlorodibenzofuran 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin 1,2,3,4,6,7,8-Heptachlorodibenzofuran 1,2,3,4,7,8,9-Heptachlorodibenzofuran Octachlorodibenzo-p-dioxin Octachlorodibenzofuran</p> <p>Dioxin-Like PCBs PCB77 PCB81 PCB105 PCB114 PCB118 PCB123 PCB126 PCB156 PCB157 PCB167 PCB169 PCB189</p> <p>Lipids Percent Moisture</p>

Table 2 presents the sampling dates and locations of the 2001 finfish sampling. Figure 2 shows the trawls conducted at each of the monitoring locations.

Table 2. Summary Information for Otter Trawl Tows on September 27, 2001.

Tow Location	Date	Start Position (°)	End Position (°)	Start Time	End Time	Water Depth (m)	Tow Speed
Southwest of Site 69b Tow 1	09/27/01	41.1984217 N -71.4196761 W	41.1682258N -71.4035708W	9:20	9:50	40	3 knots
Southeast of Site 69a Tow 2	09/27/01	41.1563567 N -71.2811014W	41.1757031 N -71.2748525 W	12:00	12:30	47	3 knots
West of Site 18 (North 69a & 69b) Tow 3	09/27/01	41.2755658 N -71.4008850 W	41.3044872 N -71.3957128 W	2:45	3:15	34	3 knots

The F/V *Lucky Linda*, owned and operated by Captain Ken Ketcham, served as the sampling platform during the survey. The vessel's crew included Captain Ketcham and deckhand Mr. Dan Ketcham. The scientific crew included Mr. Chris Doyle from Aqua Survey, Inc., and Ms. Jennifer Field from Battelle. Mobilization was conducted while the vessel was docked in Point Judith, Rhode Island, on September 27, 2001. Loran C coordinates were recorded at the beginning and end of each trawl tow, and water depth during the tow was also recorded. All tows were conducted for 30 minutes at a tow speed of 3 knots. The cod end of the trawl contained a 2.5-in. mesh screen enabling juvenile fish to be caught in addition to larger individuals.

The location southwest of Site 69b was sampled first. The second tow was conducted southeast of Site 69a, and the third tow was conducted west of Site 18. One 30-minute tow was required at each location to obtain sufficient numbers of fish for tissue analysis.

Several lobster traps were entangled with the trawl during the sampling tows. Due to the high density of lobster traps in the area, it was not possible to sample any closer to the potential disposal sites than the locations that were sampled with the otter trawl. Therefore, those were the only locations sampled. Following consultation with Mr. Mike Keegan (the Corps Project Manager), Mr. Dave Tomey (EPA Region 1), and Ms. Heather Trulli (Battelle Project Manager), it was decided that no additional tows would be conducted during this survey, and future fish collection efforts also would employ gill nets within the boundaries of each proposed disposal site. The crew demobilized on September 28, 2001.

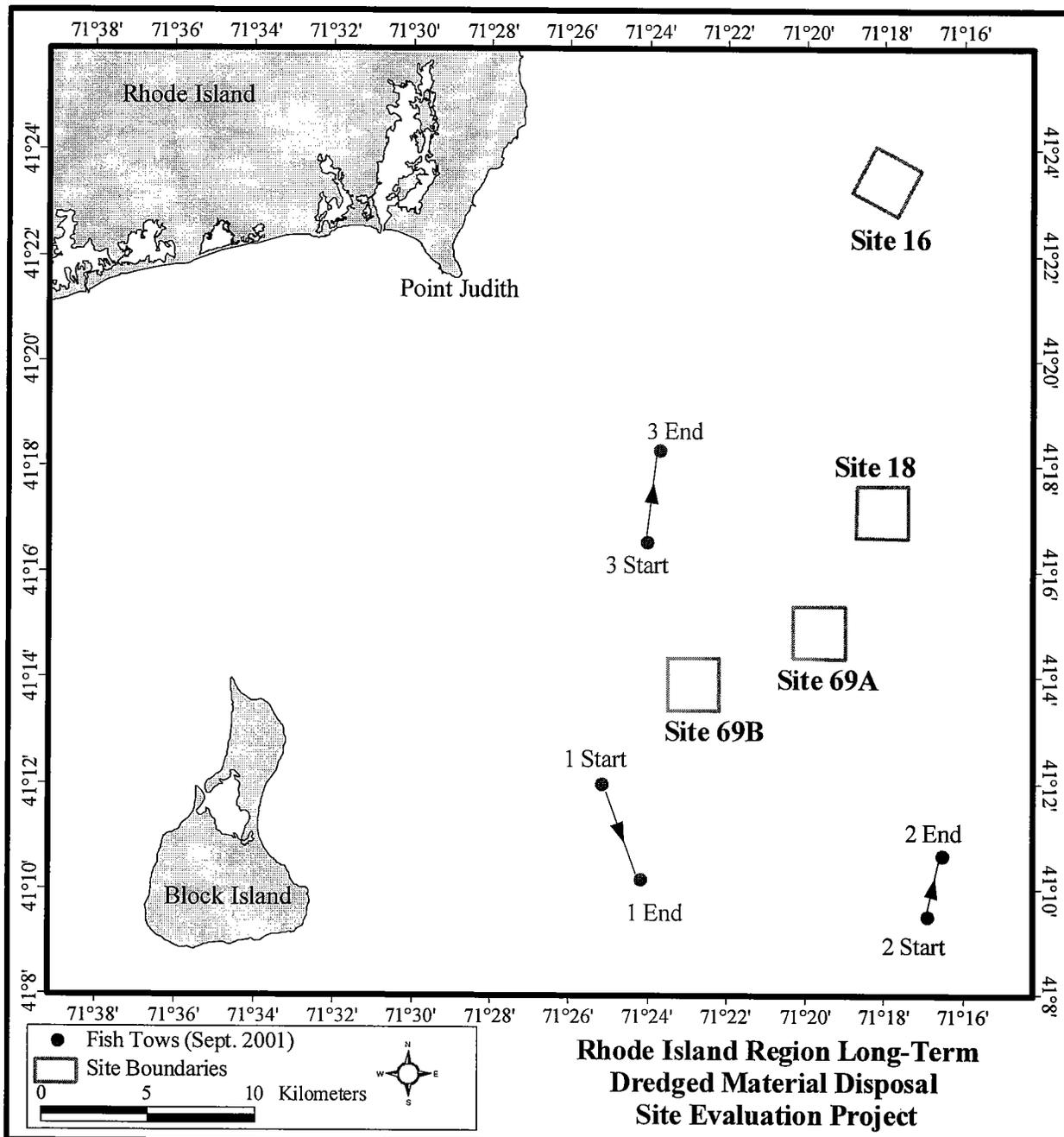


Figure 2. Finfish Otter Trawl Tow Locations Rhode Island Sound, September 2001.

Following each tow, the contents of the trawls were emptied onto the deck, and all fish were sorted by species. All individuals of each species were counted, and five randomly selected¹ individuals from each species were measured for total length. If the total number of individuals for a specific species caught was less than five, then all individuals of that species were measured. For the target species (scup, butterfish, and winter flounder), 20 individuals were randomly selected and measured for total length. Lobster, dogfish, squid, skate, and electric torpedo ray were counted, but not measured.

Compositing Scheme

Several butterfish, scup, and winter flounder individuals were taken from each tow to form at least three field composite samples of each species per tow (Table 3). To obtain sufficient tissue mass for chemical analysis, each field composite was composed of several fish. Most samples consisted of 5-12 fish per sample, depending on the size of the fish. Whole-fish samples were wrapped in Teflon bags, placed on ice in coolers, and transported to Battelle Duxbury for subsequent dissection, compositing, and analysis.

Table 3. Species Collection Matrix from Otter Trawling Activities.

Tow Location	Scup Fillet Tissue	Butterfish Fillet Tissue	Winter Flounder Fillet and Liver Tissue
Southwest of 69b Tow 1	3 composites with ~12 fish/composite	3 composites with ~12 fish/composite	3 composites with ~5 fish/composite
Southeast of 69a Tow 2	3 composites with ~7 fish/composite	3 composites with ~7 fish/composite	3 composites with ~7 fish/composite
West of 18 (North 69a & 69b) Tow 3	3 composites with ~12 fish/composite	3 composites with ~7 fish/composite	3 composites with ~7 fish/composite

Upon arrival at Battelle Duxbury, individual finfish from each field composite were measured for total weight and total length (Appendix A). Scup and butterfish were also measured for fork length. Length measurements were made in inches and then converted to centimeters.

Fish to be dissected and composited for chemical analysis were then selected from all the fish collected based on the size and age class of the measured individuals. The final selection of the fish for compositing and chemical analysis was made by EPA Region 1, with consent by the Corps. The largest individuals of each species per station were selected for analysis (Appendix A). The selected fish were also required to be of approximately the same age class. Table 4 presents the mean lengths and weights for the fish selected for chemical analysis.

¹ "Random" in the context of this document means not consciously choosing or excluding specific animals. It is not meant to imply that animals were selected using a random numbers program.

Table 4. Mean Lengths and Weights of Fish Used for Chemistry Analysis Composites.

Site	Species	Mean Total Length	Mean Fork Length	Mean Total Weight	# of composites	Fish/composite
		(cm)	(cm)	(g wet wt)		
18	Butterfish	21.17	18.20	115.46	1	3
18	Winter Flounder	29.63	NA	313.45	1	3
69A	Butterfish	21.59	18.63	139.26	1	3
69A	Scup	21.59	19.47	170.95	1	3
69A	Scup	22.86	20.32	194.59	1	3
69A	Winter Flounder	29.21	NA	314.58	1	3
69B	Butterfish	21.59	18.42	123.68	1	3
69B	Scup	22.86	20.32	203.33	1	1
69B	Winter Flounder	30.48	NA	357.41	1	3

No scup from Site 18 were analyzed because there was not sufficient size or quantity of fish recovered from this site. All but 2 scup were below 15 cm in total length, and the target size was 20 to 30 cm in total length. Also, only one fish was used for the composite of scup analyzed at Site 69B due to a lack of fish meeting the minimum size requirements. An additional composite of scup was analyzed at Site 69A because there were fish of sufficient size and quantity to be analyzed as two composites.

Dissection and Processing of Fish

Fish selected for chemical analysis were first rinsed thoroughly with tap water, followed by a distilled water rinse. Winter flounder visceral masses, including the spleen, were removed and placed in containers with 10% neutral buffered formalin solution for potential macrophage biomarker analysis by the US EPA Narragansett Laboratory. The liver was also removed from winter flounder collected at each location, and one liver composite sample was created for each of the three locations (Table 5). Liver composites were frozen until chemical analysis was initiated. All fish were then processed as fillets (skin-on, scales removed if present) at Battelle Duxbury. Fish were filleted with a titanium knife on glass or teflon cutting boards, and the cutting boards were rinsed with deionized (DI) water between samples.

Prior to homogenization, all tools and utensils used were cleaned thoroughly with a detergent solution, rinsed with tap water, soaked in 50% HNO₃ (reagent grade or better), for 12 to 24 hours at room temperature, and then rinsed with organics- and metal-free water. Liver and fillet composites were homogenized using a titanium tissuemizer probe. After homogenization, samples were split for metals and organic analyses (Table 5). The samples were shipped frozen by overnight freight to Battelle Sequim and Columbus for chemical analysis.

Table 5. Compositing Matrix for Finfish Samples (Liver and Fillet).

Type of Tissue	Station	Species	Composite ID	Parameters Analyzed		n
				Dioxins/ furans/ WHO PCBs	PAH/Phthalate/ Pesticide/ PCB/ Tins/Metals/Lipid	
Liver	69B	Winter Flounder	ZL09	Yes	Yes	1 composite with 3 fish
	69A	Winter Flounder	ZL10	Yes	Yes	1 composite with 3 fish
	18	Winter Flounder	ZL11	Yes	Yes	1 composite with 3 fish
Fillet	69B	Butterfish	ZS23	No	Yes	1 composite with 3 fish
		Scup	ZS24	No	Yes (except no butyltins)	1 composite with 1 fish
		Winter Flounder	ZS25	Yes	Yes	1 composite with 3 fish
	69A	Butterfish	ZS19	No	Yes	1 composite with 3 fish
		Scup	ZS20	No	Yes	1 composite with 3 fish
		Scup	ZS21	No	Yes	1 composite with 3 fish
		Winter Flounder	ZS22	Yes	Yes	1 composite with 3 fish
	18	Butterfish	ZS26	No	Yes	1 composite with 3 fish
		Winter Flounder	ZS27	Yes	Yes	1 composite with 3 fish

Chemical Analysis

Fish fillet and liver samples were analyzed for moisture content, methylene-chloride-extractable lipid content, polychlorinated biphenyls (PCB) congeners, chlorinated pesticides, polyaromatic hydrocarbons (PAHs), Bis(2-ethylhexyl)phthalate, organotins, dioxins/furans, dioxin-like PCB congeners (also referred to as the 12 World Health Organization [WHO] PCBs), and metals. General descriptions of analytical methods are provided below, and are detailed in the project QAPP (Battelle 2001).

Moisture Content

Moisture content was determined following Battelle Duxbury Standard Operating Procedures (SOP) SOP 5-190. Briefly, 1 to 5-g of well-mixed tissue homogenate was weighed into a pre-weighed, pre-baked, aluminum weighing pan. The pan was placed in a drying oven and dried

overnight at approximately 105 °C. After approximately 24 hours, the pan was removed from the drying oven and allowed to cool at room temperature for at least 30 minutes. The pan was reweighed, and percent moisture was determined.

Lipid Content

Methylene-chloride-extractable lipid content was determined following procedures described in Battelle Duxbury SOP 5-190. Briefly, after extraction and concentration, the tissue extract was transferred to a graduated cylinder, the volume adjusted to exactly 10 mL, and a 0.5 mL aliquot (measured using a calibrated syringe) removed and placed into a pre-weighed aluminum weighing pan. Pans were covered with foil and the extract allowed to air dry overnight or until methylene chloride was no longer visible. After drying, the pan was reweighed and the lipid content calculated. Sample results were reported on a wet weight basis.

Chlorinated Pesticides, PCB Congeners, PAHs, and Phthalate

Tissues were extracted and cleaned following procedures in Battelle SOP 5-190, which are methods developed by Battelle in support of National Oceanic and Atmospheric Administration (NOAA) National Status and Trends (NS&T) Mussel Watch Project (Peven and Uhler, 1998). Approximately 10 to 30 g of wet tissue homogenate was weighed into a Teflon extraction jar, spiked with the appropriate surrogate internal standard (SIS) compounds, combined with 75 mL dichloromethane (DCM) and sodium sulfate, macerated with a tissuemizer, and centrifuged. The extract was decanted into an Erlenmeyer flask. This process was repeated a second time using an additional 75 mL DCM. A third extraction was performed on the sample using 50 mL DCM and shaking on a shaker table for approximately 30 minutes. The sample was then centrifuged a third time and the solvent decanted into the Erlenmeyer with the rest of the sample extract. The combined extract was dried over sodium sulfate, filtered (if necessary), and concentrated by Kuderna-Danish (KD) technique to approximately 10 mL. A measured aliquot of extract was removed for lipid determination (above). The remaining extract was concentrated to approximately 2 to 3 mLs and processed through an alumina cleanup column:

- Packing: 40 g F20 (2% deactivated) alumina, in DCM
- Elution: 150 mL DCM

After alumina column cleanup, all sample extracts were concentrated by KD and nitrogen blow-down techniques to approximately 900- μ L for additional high pressure liquid chromatography (HPLC) cleanup (Battelle SOP 5-191). The post-HPLC extract was concentrated under nitrogen to approximately 1 mL, and spiked with recovery internal standard (RIS) compounds. The extract was split qualitatively, with one half analyzed by gas chromatography/mass spectrometer (GC/MS) for PAHs and phthalate, and the other half solvent exchanged with hexane and analyzed by gas chromatography/electron-capture detector (GC/ECD) for chlorinated pesticides/PCB congeners.

A routine set of quality control samples was prepared and analyzed with each batch of 20 or fewer samples to monitor data quality in terms of accuracy and precision.

GC/ECD Analysis

Chlorinated Pesticides/PCB congeners were analyzed by GC/ECD following Battelle SOP 5-128. The instrument was equipped with two ECD detectors and two 60-m capillary columns of different polarities (DB-5 and DB-1701). The instrument was also equipped with electronic pressure controlled inlet and used hydrogen carrier gas. Concentrations of target analytes were quantified using the method of internal standards based on the RIS added just prior to analysis. Data were reported on a wet weight basis.

GC/MS Analysis

PAHs and phthalate were analyzed by GC/MS in the selective ion monitoring (SIM) mode using a 60-m DB5 column and a Hewlett Packard 5972 (or 5973) detector (Battelle SOP 5-157). Concentrations for all target analytes were determined by the method of internal standards, using RISs for quantification. Sample results were reported on a wet weight basis.

Organotins

Tissue samples requiring organotin analysis were extracted, cleaned, and analyzed following procedures in Battelle SOP 5-196, *Measurement of Butyltin Species in Tissue and Sediment/Soil*, which are methods developed by Battelle in support of NOAA's NS&T Project (Peven and Uhler, 1998). Sample extracts were analyzed by gas chromatography/flame photometric detection (GC/FPD) using a tin-specific photometer. Concentrations of target analytes were quantified by the method of internal standards, using SISs, thereby correcting for sample loss during extraction and clean-up. Sample results were reported on a wet weight basis.

Dioxin/Furan and Dioxin-like PCBs

Winter flounder tissue samples (fillet and liver) were extracted and analyzed for the seventeen 2,3,7,8-substituted polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF) following the general procedures in EPA Method 1613, Revision B, as described in Battelle Columbus SOPs ASAT.II-001-02 and ASAT.II-002-02 with modifications noted below. Tissue samples were also extracted and analyzed for dioxin-like PCBs (also referred to as the 12 World Health Organization, or WHO, PCBs) following the general procedures in EPA Method 1668, Revision A, as described in Battelle Columbus Operations SOP ASAT.II-009-00 and as noted below.

Aliquots of each homogenized tissue sample were weighed into individual jars and mixed with Hydromatrix drying agent. Approximately 5-10 g wet weight of each tissue sample was used. The tissue/Hydromatrix mixtures were placed into Soxhlet apparatus and spiked with ¹³C₁₂-labeled PCDD/PCDF and labeled PCB internal standard solutions. Matrix spike, matrix spike duplicate, and laboratory control samples (LCS) were spiked with native PCDD/PCDF and PCB at this time. Note that the samples received internal standard and matrix spike standards at twice the usual level to accommodate the sample being split in half for separate WHO PCB and PCDD/PCDF cleanup.

The Soxhlets were charged with dichloromethane: hexane (1:1) and allowed to extract for a minimum of 16 hours. The extracts were allowed to cool and drain. Each extract was then spiked with 2,3,7,8-TCDD-³⁷Cl₄ cleanup standard for monitoring recovery of analytes through the cleanup procedures. Each extract was acid washed. After the acid wash step, the samples were split in half, with one aliquot for PCB processing and the other aliquot for dioxin/furan processing.

The PCB aliquots were cleaned by acid/base silica, alumina, followed by additional acid/base silica cleanup columns. The tissue extracts were spiked with ¹³C₁₂-labeled PCB recovery standards and concentrated to a final sample volume of 50 µL.

The dioxin/furan aliquots were then processed through acid/base silica, alumina, and carbon cleanup columns. The tissue extracts were spiked with 1,2,3,4-TCDD-¹³C₁₂ and 1,2,3,7,8,9-HxCDD-¹³C₁₂ recovery standard and concentrated to a final sample volume of 20 µL.

PCDD/PCDF Analysis

Each extract was analyzed by gas chromatography/high resolution mass spectrometry (GC/HRMS) in the selected-ion-monitoring mode at a resolution of 10,000 or greater. A DB5 column was used for initial analysis of the seventeen 2,3,7,8-PCDD/PCDF; and a DB225 column was used for second column confirmation of 2,3,7,8-TCDF. All analytes were quantified by isotope dilution or by method of internal standards using surrogate compounds. Data were reported on a wet weight basis.

PCB Analysis

Each extract was analyzed by gas chromatography/high resolution mass spectrometry (GC/HRMS) in the selected ion-monitoring mode at a resolution of 10,000 or greater. A SuPelco Bonded (SPB)-Octyl column was used for analysis of the PCB congeners. All analytes were quantified by isotope dilution or by method of internal standards using surrogate compounds. Data were reported on a wet weight basis.

Metals

Eleven metals were analyzed: silver (Ag), arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se), and zinc (Zn). To prepare for analysis, the tissues were freeze-dried, then blended in a Spex mixer-mill. Sample percent moisture/dry weight was determined according to Battelle SOP MSL-C-003. Tissue samples were digested using aqua regia according to Battelle SOP MSL-I-024, *Mixed Acid Tissue Digestion*. An approximately 500-mg (dry weight) aliquot of each sample was combined with nitric and hydrochloric acids (aqua regia) in a Teflon bomb and heated in an oven at 130°C (±10°C) overnight. After heating and cooling, deionized water was added to the tissue digestate to achieve analysis volume and the digestates were submitted for analysis.

Sample digestates were analyzed for all metals excluding Hg using inductively coupled plasma-mass spectrometry (ICP-MS) according to Battelle SOP MSL-I-022, *Determination of Elements in Aqueous and Digestate Samples by ICP/MS*. This procedure is based on two methods

modified and adapted for analysis of solid sample digestates: EPA Method 1638, *Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma-Mass Spectrometry* and EPA Method 1640, *Determination of Trace Elements in Water by Preconcentration and Inductively Coupled Plasma-Mass Spectrometry*. Sample digestates were analyzed for Hg using cold-vapor atomic absorption spectroscopy (CVAA) according to Battelle SOP MSL-I-016, *Total Mercury in Tissues and Sediments by Cold Vapor Atomic Absorption*.

All results were reported in units of $\mu\text{g/g}$ on a dry-weight basis and converted to $\mu\text{g/g}$ on a wet-weight basis using the percent dry weight of each sample. The results for analysis of Pb were reported as blank corrected; results for analysis for all other metals were not blank corrected.

Deviations from the QAPP

During the course of the field survey, circumstances arose that lead to deviations from the sample collection protocols described in the QAPP (Battelle 2001). Each of these deviations had the potential to affect the quality of the data collected during the survey.

The initial sampling plan specified that a gill net be used to collect fish for chemical analysis from within the boundaries of each of the proposed disposal sites (Sites 16, 18, 69A and 69B), and the otter-trawl tows be used to characterize fish abundance and diversity in the vicinity of the proposed disposal locations. Fish from the otter trawls would, however, supplement the samples from gill net catches taken within the site boundaries if sufficient fish could not be collected with gill nets. The commercial gill-net fisherman was unable to participate in the survey as planned due to last-minute schedule conflicts with his trade meetings, and no gill netting activities were conducted.

The otter trawling could not be conducted within or near the site boundaries due to the presence of numerous lobster pots and the resulting risk of gear entanglement. Therefore, the fish collected for chemical analysis had to be collected from locations in the vicinity of the sites rather than from within the site boundaries. Tows were conducted in the vicinity of Sites 18, 69A, and 69B, but not near Site 16 due to the presence of numerous lobster pots. Fish collected near Sites 18, 69A, and 69B were considered representative for those sites. There were no representative fish from Site 16.

Due to the small size of the scup collected at Site 18 and Site 69B, no scup composite samples were chemically analyzed for Site 18 as originally planned and only one fish, instead of three, was used to prepare the scup composite from Site 69B. Instead, two scup composites were prepared and analyzed from Site 69A. No tin analysis was performed on the scup 69B composite, due to limited sample size. The QAPP specified that project QC samples (i.e., MS, MSD and laboratory duplicate) would be prepared by tissue type, fillet and liver. Yet a liver tissue MS/MSD was inadvertently not prepared for PCB/pesticides, PAH, or metals analyses. In addition, a fillet tissue MS/MSD was not prepared for phthalate analysis.

General Data Treatment and Reduction

This section describes the data reduction performed on the September 2001 finfish data.

Specifics of data handling are as follows:

- All chemical data were generated by Battelle and qualified when necessary (Table 6). Data were loaded directly into the project database.
- All data were extracted directly from the database and exported into Excel files, where graphical presentations were performed.
- Contaminant data were reported by sample and averaged by species.
- Total PCB was calculated as the sum of the 18 NOAA's NS&T PCB congeners (Table 1).
- Total DDT was calculated as the sum of six DDT-related compounds: 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT (Table 1).
- Total chlordane was calculated as the sum of four compounds: cis-Chlordane, Heptachlor, Heptachlor epoxide, and trans-Nonachlor (Table 1).
- Total PAH was calculated as the sum of the 16 priority pollutant PAHs (Table 1).
- When calculating totals or means using individual analytes, ½ the MDL was used for compounds that were not detected and qualified with a "U" qualifier.

Data qualifiers used for the Rhode Island Sound tissue analysis are defined in Table 6.

Table 6. Data Qualifiers.

Qualifier	Definition
B	compound present in study sample at level <10 times blank value
C and C156	PCB 156 and PCB 157 coelute when analyzed by high-resolution mass spectrometry (HRMS). Data for both compounds are reported as PCB156.
f	compounds quantified but were below the MDL
F	result obtained from second column confirmation analysis
J	compound quantified above the MDL but were below the Project QL Goal
K	contaminant data blank corrected
U	compound not detected; MDL reported as the value, and ½ the MDL used when calculating totals (i.e. Total PCB and Total DDT)

RESULTS

Fish Collected

A total of 23 species was collected during the three otter-trawl tows conducted on September 27, 2001, in Rhode Island Sound (Table 7). The Site 69B trawl collected 20 species, the Site 69A trawl 16 species and the Site 18 trawl 18 species. For each tow, the species composition, abundance, and mean total length for each species are presented in Table 7. Butterfish and scup were larger and more abundant in the trawls near Site 69A than in the other two trawls. Winter flounder were more abundant in the trawls near Site 18 but were larger in the trawls near Site 69B.

Table 7. Species Composition, Abundance (Number), and Mean Total Length (cm) of Fish Caught in Each Otter-Trawl Tow. Target species are bolded.

Species	Tow 1		Tow 2		Tow 3	
	South of 69B		Southeast of 69A		West of 18 (North 69A & 69B)	
	Number	Mean Total Length ¹	Number	Mean Total Length ¹	Number	Mean Total Length ¹
Blueback herring (<i>Alosa aestivalis</i>)	7	16.8	2	17.5	1	17
Bluefish (<i>Pomatomus saltatrix</i>)	1	69	1	63	3	66
Butterfish (<i>Peprilus triacanthus</i>)	1500+	13.55	8000+	18.4	2000+	17.6
Electric torpedo ray (<i>Torpedo nobiliana</i>)	0	NA	2	NA	0	NA
Fourspot flounder (<i>Paralichthys oblongus</i>)	68	28.8	8	29	31	32.6
Little skate (<i>Raja erinacea</i>)	60	NA	151	NA	97	NA
Lobster (<i>Homarus americanus</i>)	4	NA	54	NA	18	NA
Loligo squid (<i>Loligo pealeii</i>)	1200+	NA	600+	NA	250+	NA
Misc. juvenile flounder	0	0	46	14.4	0	0
Goosefish (<i>Lophius americanus</i>)	3	48	0	0	0	0
Red hake (<i>Urophycis chuss</i>)	4	27	800+	29	2	25
Sardine (<i>Harengula sp.</i>)	0	0	12	14.8	2	14.5
Scup (<i>Stenotomus chrysops</i>)	172	11.3	5000+	20.85	150	10.05
Sea raven (<i>Hemitripterus americanus</i>)	3	25.3	0	0	0	0
Silver hake (<i>Merluccius bilinearis</i>)	304	20.2	2000+	24.2	39	22
Smooth dogfish (<i>Mustelus canis</i>)	3	NA	0	NA	3	NA
Spiny dogfish (<i>Squalus acanthias</i>)	90	NA	173	NA	12	NA
Spotted hake (<i>Urophycis regia</i>)	2	26.5	0	0	0	0
Striped searobin (<i>Prionotus evolans</i>)	7	13	0	0	7	14.4
Summer flounder (<i>Paralichthys dentatus</i>)	25	49	9	59.2	8	41.8
Windowpane flounder (<i>Scophthalmus aquosus</i>)	1	30	0	0	6	27
Winter flounder (<i>Pleuronectes americanus</i>)	28	31.6	33	29.7	700+	21.8
Yellow jack (<i>Caranx bartholomaei</i>)	7	13.4	0	0	2	13.5

NA – Not Applicable; dogfish, skates, squid, and lobsters were not measured.

¹Mean total length is based on measurements of five randomly selected individuals for all species except scup, butterfish, and winter flounder. Mean total length for scup, butterfish, and winter flounder is based on measurements of 20 randomly selected individuals.

+ In situations where large numbers of fish of a particular species were collected, the fish were sorted by species, placed in bins, and the total number of individuals estimated.

Spatial Comparison of Tissue Contaminants

The body burdens of contaminants were determined for edible tissue (fillets) for three species of finfish (butterfish, scup, winter flounder) collected during the Fall 2001 survey. Body burdens of contaminants in liver were also determined for winter flounder. Results of these analyses are reported in Table 8 and Appendix B. Quality control sample results, including the data quality objectives for this project, are summarized in the Quality Assurance/Quality Control Summaries (Appendix B).

Edible Tissue (Fillet)

Moisture Content

Moisture content in fillet samples was very similar among the three study areas and among species. Percent moisture values ranged from 77.4% (at Site 69A) to 79.7% (at Site 18). Winter flounder had an average moisture content of 79.4%, slightly higher than for butterfish (78.5%) and scup (78.1%).

Lipid Content

Lipid content was more variable than moisture content, both within sites and species. Lipid content ranged from 1.04% to 2.97% across the three sites. The average lipid content was highest in scup ($2.20 \pm 0.36\%$) and lowest in winter flounder ($1.70 \pm 0.51\%$). Lipid content was most variable in butterfish ($1.95 \pm 0.97\%$).

Pesticides/PCB

Most of the pesticides were undetected in fillet samples from the three study sites. Cis-chlordane, trans-nonachlor, 2,4-DDD, 4,4-DDD, and 4,4-DDE were detected in all of the fillet samples at concentrations above the Project Quantitation Limit (QL) Goal. Total DDT concentrations ranged from 1.68 to 5.56 ng/g across the three sites and were highest in the scup samples (4.23 ± 1.39 ng/g). Concentrations of total chlordane ranged from 0.5 to 1.37 ng/g and were very similar among fish species. Concentrations of total chlordane were most variable in the butterfish fillet composites. 4,4-DDT, mirex and hexachlorobenzene were detected at concentrations below the MDL in a few of the scup and winter flounder composite samples.

PCB 8 and PCB 18 were not detected in any of samples from the three sites. Total PCB concentrations ranged from 9.66 to 32.61 ng/g at Site 69A, which also were the minimum and maximum values, respectively, measured across the three sites. Total PCB concentrations ranged from 11.84 to 15.86 ng/g concentrations in samples from Site 18, and ranged from 13.66 to 25.99 ng/g in samples from Site 69B. Average concentrations of total PCBs were higher in scup samples ($27.07 \pm 5.09\%$) than in butterfish samples ($15.45 \pm 3.98\%$) and winter flounder ($13.06 \pm 3.14\%$).

Table 8. Summary of Contaminant Concentrations (wet wt.) in Fall 2001 Finfish. *n* = 1.

Parameter	Species	Butterfish Fillet						Scup Fillet					
	Site	18		69A		69B		69A		69A		69B	
	Units	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Percent Moisture	%	79.71		77.4		78.53		77.5		78.16		78.62	
Lipids	% wet	1.04		2.97		1.83		1.8		2.48		2.33	
Aldrin	ng/g	0.05	U	0.05	U	0.05	U	0.04	U	0.04	U	0.06	U
cis Chlordane	ng/g	0.24		0.72		0.40		0.20		0.16		0.29	
Dieldrin	ng/g	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.06	U
Endosulfan I	ng/g	0.07	U	0.07	U	0.07	U	0.06	U	0.06	U	0.08	U
Endosulfan II	ng/g	0.10	U	0.10	U	0.10	U	0.09	U	0.09	U	0.12	U
Endosulfan sulfate	ng/g	0.11	U	0.10	U	0.10	U	0.10	U	0.10	U	0.13	U
Endrin	ng/g	0.03	U	0.03	U	0.03	U	0.03	U	0.03	U	0.04	U
g-BHC	ng/g	0.06	U	0.06	U	0.06	U	0.06	U	0.06	U	0.07	U
Heptachlor	ng/g	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.07	U
Heptachlor epoxide	ng/g	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.05	U
Hexachlorobenzene	ng/g	0.08	U	0.08	U	0.08	U	0.08	U	0.08	J	0.10	U
Mirex	ng/g	0.05	U	0.08	U	0.08	U	0.07	U	0.08	J	0.12	J
Toxaphene	ng/g	0.02	U	0.02	U	0.02	U	0.01	U	0.02	U	0.02	U
Trans-Nonachlor	ng/g	0.21		0.60		0.33		0.54		0.44		0.76	
Total Chlordane	ng/g	0.50		1.37		0.77		0.79		0.65		1.11	
2,4 DDD	ng/g	0.18		0.34		0.38		0.31		0.23		0.55	
2,4 DDE	ng/g	0.18	U	0.18	U	0.18	U	0.17	U	0.17	U	0.22	U
2,4 DDT	ng/g	0.07	U	0.07	U	0.07	U	0.06	U	0.06	U	0.08	U
4,4 DDD	ng/g	0.16		0.69		0.40		0.53		0.24		0.53	
4,4 DDE	ng/g	1.19		2.60		1.61		3.36		2.18		3.80	
4,4 DDT	ng/g	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.52	
Total DDD ^a	ng/g	0.34		1.03		0.78		0.84		0.46		1.08	
Total DDE ^a	ng/g	1.19		2.60		1.61		3.36		2.18		3.80	
Total DDT ^b	ng/g	1.68		3.78		2.55		4.33		2.79		5.56	
PCB 8	ng/g	0.64	U	0.64	U	0.63	U	0.60	U	0.61	U	0.78	U
PCB 18	ng/g	0.07	U	0.07	U	0.07	U	0.06	U	0.07	U	0.08	U
PCB 28	ng/g	0.09	U	0.34		0.22		0.24		0.09	U	0.31	
PCB 44	ng/g	0.13		0.35		0.22		0.06	U	0.06	U	0.07	U
PCB 52	ng/g	0.05	U	1.03		0.55		0.69		0.34		0.06	U
PCB 66	ng/g	0.33		1.16		0.52		0.96		0.51		0.76	
PCB 101	ng/g	1.29		1.69		1.46		3.02		1.71		1.85	
PCB 105	ng/g	0.27		0.48		0.38		1.02		0.71		0.72	
PCB 118	ng/g	1.26		2.35		1.60		5.22		3.27		3.04	
PCB 128	ng/g	0.33		0.18	U	0.39		1.29		0.83		0.91	
PCB 138	ng/g	2.14		3.47		2.51		6.33		4.59		4.78	
PCB 153	ng/g	3.33		5.12		3.85		9.57		6.59		6.45	
PCB 170	ng/g	0.37		0.45		0.36		0.58		0.48		0.80	
PCB 180	ng/g	0.97		1.46		1.18		1.31		1.28		2.14	
PCB 187	ng/g	0.82		1.19		0.96		1.62		1.56		2.71	
PCB 195	ng/g	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.09	U
PCB 206	ng/g	0.08	J	0.08	J	0.13		0.23		0.19		0.47	
PCB 209	ng/g	0.07	f	0.05	f	0.09	J	0.15		0.10	J	0.50	
Total PCB	ng/g	11.8		19.7		14.8		32.6		22.6		26.0	

^a Sum of 2, 4' and 4, 4' congeners.

^b Sum of all six DDT-related compounds

Table 8 (cont). Summary of Contaminant Concentrations (wet wt.) in Fall 2001 Finfish. *n* = 1.

Parameter	Species	Butterfish Fillet						Scup Fillet					
	Site	18		69A		69B		69A		69A		69B	
	Units	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Acenaphthene	ng/g	0.28		0.28		0.31		0.02	U	0.14		0.28	
Acenaphthylene	ng/g	0.09	J	0.34		0.20		0.07	J	0.09	J	0.08	J
Anthracene	ng/g	0.14	J	0.43		0.22		0.07	J	0.10		0.10	J
Benz[a]anthracene	ng/g	0.09	J	0.15	B	0.11	B	0.14	B	0.06	J	0.02	U
Benzo[a]pyrene	ng/g	0.03	U	0.02	U	0.02	U	0.02	U	0.02	U	0.03	U
Benzo[b]fluoranthene	ng/g	0.02	U	0.02	U	0.02	U	0.07	J	0.02	U	0.02	U
Benzo[g,h,i]perylene	ng/g	0.02	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Benzo[k]fluoranthene	ng/g	0.03	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
Chrysene	ng/g	0.12	J	0.11	J	0.18	B	0.02	U	0.12	J	0.10	J
Dibenz[a,h]anthracene	ng/g	0.02	U	0.02	U	0.02	U	0.01	U	0.02	U	0.02	U
Fluoranthene	ng/g	0.21	Bf	0.21	Bf	0.23	Bf	0.18	Bf	0.20	Bf	0.19	Bf
Fluorene	ng/g	0.68		0.73		0.68		0.24	B	0.29	B	0.31	B
Indeno[1,2,3-c,d]pyrene	ng/g	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
Naphthalene	ng/g	6.42	B	3.49	B	4.78	B	5.28	B	6.10	B	3.84	B
Phenanthrene	ng/g	1.62	B	1.06	B	1.16	B	1.22	B	1.44	B	1.17	J
Pyrene	ng/g	0.20	Bf	0.17	Bf	0.18	Bf	0.16	Bf	0.18	Bf	0.17	Bf
Total PAH	ng/g	9.91		7.01		8.10		7.46		8.76		6.30	
Bis(2-ethylhexyl)phthalate	ng/g	8.89	Bf	6.55	J	4.28	Bf	3.07	Bf	4.07	Bf	3.60	Bf
Monobutyltin	ng/g	0.65	U	0.68	U	0.86	U	0.64	U	1.52	U	NA	
Dibutyltin	ng/g	1.07	U	1.11	U	1.41	U	1.05	U	2.50	U	NA	
Tributyltin	ng/g	5.23	B	5.13	B	16.39	B	2.29	B	4.86	B	NA	
Tetrabutyltin	ng/g	0.71	U	0.73	U	0.94	U	0.70	U	1.66	U	NA	
Arsenic	µg/g	0.90		0.63		0.86		2.69		1.66		2.19	
Beryllium	µg/g	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U
Cadmium	µg/g	0.01	J	0.02	J	0.01	J	0.00	J	0.00	J	0.00	J
Chromium	µg/g	0.45		0.41		0.43		0.40		0.43		0.46	
Copper	µg/g	0.27		0.23		0.28		0.44		0.46		0.48	
Lead	µg/g	0.00	UK	0.00	UK	0.01	JK	0.01	JK	0.01	JK	0.02	K
Mercury	µg/g	0.05		0.03		0.04		0.05		0.07		0.05	
Nickel	µg/g	0.04	J	0.03	J	0.02	J	0.14	J	0.10	J	0.10	J
Selenium	µg/g	0.38		0.38		0.37		0.57		0.52		0.57	
Silver	µg/g	0.01	J	0.00	J	0.00	U	0.00	U	0.01	J	0.00	J
Zinc	µg/g	5.74		5.75		5.45		4.86		5.08		3.83	

Table 8 (cont). Summary of Contaminant Concentrations (wet wt.) in Fall 2001 Finfish. *n* = 1.

Parameter	Species	Winter Flounder Fillet						Winter Flounder Liver					
	Site	18		69A		69B		18		69A		69B	
	Units	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Percent Moisture	%	79.00		79.56		79.55		66.93		62.30		62.12	
Lipids	%	1.57		1.27		2.27		18.92		22.82		24.18	
Aldrin	ng/g	0.04	U	0.04	U	0.05	U	0.11	U	0.08	U	0.05	U
cis Chlordane	ng/g	0.28		0.22		0.29		4.55		4.54		4.71	
Dieldrin	ng/g	0.05	U	0.05	U	0.05	U	0.12	U	3.91		0.06	U
Endosulfan I	ng/g	0.06	U	0.06	U	0.07	U	0.15	U	0.11	U	0.08	U
Endosulfan II	ng/g	0.09	U	0.09	U	0.10	U	0.23	U	0.16	U	0.11	U
Endosulfan sulfate	ng/g	0.10	U	0.10	U	0.10	U	6.16		0.18	U	0.12	U
Endrin	ng/g	0.03	U	0.03	U	0.03	U	0.08	U	0.06	U	0.04	U
g-BHC	ng/g	0.06	U	0.06	U	0.06	U	0.14	U	0.10	U	0.57	
Heptachlor	ng/g	0.05	U	0.05	U	0.05	U	0.13	U	0.09	U	0.06	U
Heptachlor epoxide	ng/g	0.04	U	0.04	U	0.04	U	0.69		0.06	U	0.04	U
Hexachlorobenzene	ng/g	0.08	U	0.07	f	0.08	U	0.19	U	1.71		0.09	U
Mirex	ng/g	0.03	f	0.07	f	0.08	U	0.60		0.13	U	0.09	U
Toxaphene	ng/g	0.01	U	0.02	U	0.02	U	0.04	U	0.03	U	0.02	U
Trans-Nonachlor	ng/g	0.35		0.29		0.42		6.29		6.37		7.43	
Total Chlordane	ng/g	0.67		0.55		0.75		11.59		10.99		12.20	
2,4 DDD	ng/g	0.22		0.16		0.29		3.81		3.94		5.27	
2,4 DDE	ng/g	0.17	U	0.17	U	0.18	U	0.43	U	0.30	U	0.21	U
2,4 DDT	ng/g	0.06	U	0.06	U	0.07	U	0.16	U	0.11	U	1.67	
4,4 DDD	ng/g	0.17		0.08	J	0.14		2.45		2.01		2.16	
4,4 DDE	ng/g	1.79		1.48		1.80		29.30		28.84		41.32	
4,4 DDT	ng/g	0.05	U	0.05	U	0.05	U	2.48		2.01		4.18	
Total DDD ^a	ng/g	0.39		0.25		0.43		6.26		5.95		7.44	
Total DDE ^a	ng/g	1.79		1.48		1.80		29.30		28.84		41.32	
Total DDT ^b	ng/g	2.32		1.86		2.38		38.34		37.01		54.71	
PCB 8	ng/g	0.60	U	0.61	U	0.63	U	1.50	U	1.06	U	0.75	U
PCB 18	ng/g	0.06	U	0.07	U	0.07	U	0.16	U	0.11	U	0.08	U
PCB 28	ng/g	0.08	U	0.09	U	0.09	U	2.89		2.81		4.15	
PCB 44	ng/g	0.06	U	0.06	U	0.06	U	0.14	U	0.10	U	2.62	
PCB 52	ng/g	0.04	U	0.04	U	0.20		2.79		1.63		3.14	
PCB 66	ng/g	0.52		0.30		0.36		4.09		7.22		10.98	
PCB 101	ng/g	0.79		0.44		0.61		7.28		3.17		10.53	
PCB 105	ng/g	0.33		0.28		0.31		6.41		4.90		7.28	
PCB 118	ng/g	1.69		1.10		1.49		31.25		25.79		35.90	
PCB 128	ng/g	0.45		0.33		0.42		7.10		5.01		7.15	
PCB 138	ng/g	2.92		1.89		2.62		51.43		42.23		58.95	
PCB 153	ng/g	4.23		2.58		3.56		77.44		67.51		88.35	
PCB 170	ng/g	0.45		0.31		0.55		6.03		4.31		7.55	
PCB 180	ng/g	2.09		0.83		1.27		27.71		19.64		29.86	
PCB 187	ng/g	1.46		0.81		1.39		21.95		17.78		25.49	
PCB 195	ng/g	0.07	U	0.14		0.07	U	1.24		3.16		4.30	
PCB 206	ng/g	0.30		0.16		0.24		5.74		3.32		4.57	
PCB 209	ng/g	0.16		0.09	J	0.18		4.58		2.45		3.76	
Total PCB	ng/g	15.9		9.66		13.7		259		212		305	
Acenaphthene	ng/g	0.02	U	0.02	U	0.15		3.63		2.18		0.03	U
Acenaphthylene	ng/g	0.07	J	0.07	J	0.08	J	1.47		1.54		0.61	

^a Sum of 2, 4' and 4, 4' congeners.

^b Sum of all six DDT -related compounds

Table 8 (cont). Summary of Contaminant Concentrations (wet wt.) in Fall 2001 Finfish. *n* = 1.

Parameter	Species	Winter Flounder Fillet						Winter Flounder Liver					
	Site	18		69A		69B		18		69A		69B	
	Units	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Anthracene	ng/g	0.07	J	0.02	U	0.06	J	1.28		0.90		0.66	
Benz[a]anthracene	ng/g	0.02	U	0.02	U	0.02	U	0.04	U	0.03	U	0.02	U
Benzo[a]pyrene	ng/g	0.02	U	0.02	U	0.02	U	0.06	U	0.04	U	0.03	U
Benzo[b]fluoranthene	ng/g	0.02	U	0.02	U	0.02	U	0.04	U	0.03	U	0.02	U
Benzo[g,h,i]perylene	ng/g	0.01	U	0.01	U	0.01	U	0.03	U	0.02	U	0.01	U
Benzo[k]fluoranthene	ng/g	0.02	U	0.02	U	0.02	U	0.05	U	0.03	U	0.02	U
Chrysene	ng/g	0.10	J	0.10	J	0.08	J	0.06	U	0.04	U	0.03	U
Dibenz[a,h]anthracene	ng/g	0.01	U	0.02	U	0.02	U	0.04	U	0.03	U	0.02	U
Fluoranthene	ng/g	0.17	Bf	0.22	Bf	0.18	Bf	0.96	Bf	0.34	U	0.64	J
Fluorene	ng/g	0.11	J	0.03	U	0.17	J	101.00		38.50		6.95	
Indeno[1,2,3-c,d]-pyrene	ng/g	0.01	U	0.01	U	0.01	U	0.02	U	0.01	U	0.01	U
Naphthalene	ng/g	5.04	B	5.80	B	3.29	B	13.20	B	8.99	B	7.62	B
Phenanthrene	ng/g	1.23	B	1.44	B	1.09	B	3.95	B	2.91	B	2.17	B
Pyrene	ng/g	0.18	Bf	0.27	J	0.13	Bf	0.32	U	0.22	U	0.36	J
Total PAH	ng/g	7.04		7.98		5.28		125.81		55.42		19.11	
Bis(2-ethylhexyl)phthalate	ng/g	4.30	Bf	4.22	Bf	2.91	Bf	15.7	J	21.2	J	5.97	Bf
Monobutyltin	ng/g	0.68	U	1.47	U	0.82	U	3.14	U	1.60	U	1.70	U
Dibutyltin	ng/g	1.12	U	2.41	U	1.35	U	5.15	U	2.63	U	2.79	U
Tributyltin	ng/g	1.86	B	4.64	B	2.69	B	74.97		40.01		52.96	
Tetrabutyltin	ng/g	0.74	U	1.59	U	0.89	U	3.41	U	1.74	U	1.85	U
1,2,3,4,6,7,8-HpCDD	pg/g	0.26	J	0.32	U	0.17	f	1.43	J	1.17	J	1.97	J
1,2,3,4,6,7,8-HpCDF	pg/g	0.22	J	0.15	f	0.21	J	0.36	f	0.50	f	0.74	J
1,2,3,4,7,8,9-HpCDF	pg/g	0.25	U	0.25	U	0.22	U	0.52	U	0.08	f	0.27	U
1,2,3,4,7,8-HxCDD	pg/g	0.18	U	0.30	U	0.21	U	0.02	U	0.15	f	0.83	f
1,2,3,4,7,8-HxCDF	pg/g	0.29	J	0.11	f	0.21	U	0.46	J	0.56	J	0.42	J
1,2,3,6,7,8-HxCDD	pg/g	0.19	U	0.31	U	0.22	U	1.51	J	1.60	J	2.23	J
1,2,3,6,7,8-HxCDF	pg/g	0.16	J	0.13	U	0.21	U	0.41	J	0.48	J	0.48	J
1,2,3,7,8,9-HxCDD	pg/g	0.17	U	0.29	U	0.20	U	0.25	J	0.36	f	0.49	J
1,2,3,7,8,9-HxCDF	pg/g	0.07	f	0.16	U	0.24	U	0.02	U	0.29	U	0.10	U
1,2,3,7,8-PeCDD	pg/g	0.31	J	0.32	U	0.28	U	1.09	J	0.80	J	1.18	J
1,2,3,7,8-PeCDF	pg/g	0.53	J	0.37	U	0.25	U	3.71	J	2.42	J	3.61	J
2,3,4,6,7,8-HxCDF	pg/g	0.08	f	0.15	U	0.22	U	0.42	J	0.45	f	0.49	J
2,3,4,7,8-PeCDF	pg/g	0.35	J	0.34	U	0.26	U	2.07	J	1.89	J	2.62	J
2,3,7,8-TCDD	pg/g	0.26	J	0.07	f	0.23	U	1.03	J	0.67	J	1.14	J
2,3,7,8-TCDF	pg/g	1.26	JF	1.16	JF	1.35	F	38.06	F	32.61	F	44.78	F
OCDD	pg/g	0.89	J	0.78	J	0.72	f	2.77	J	2.36	J	4.24	J
OCDF	pg/g	0.19	f	0.14	f	0.12	f	0.32	f	0.14	f	0.62	J
PCB 77	pg/g	31.46	f	27.18	f	33.47	f	963.55	J	677.71		1036.39	
PCB 81	pg/g	1.06	f	0.91	f	0.84	f	16.30	f	198.85	U	196.78	U
PCB 105	pg/g	388.61	J	340.35	J	366.21	J	10766		8639		10112	
PCB 114	pg/g	17.47	f	15.15	f	15.48	f	503.15	J	448.16		505.99	
PCB 118	pg/g	1660.38	J	1313.20	J	1463.52	J	49053		42567		48761	
PCB 123	pg/g	20.92	f	16.97	f	20.08	f	638.80	J	567.63	J	772.78	J
PCB 126	pg/g	7.85	f	5.96	f	8.27	f	265.95	f	200.22	J	291.82	f
PCB 156	pg/g	193.08	JC	136.36	JC	162.50	JC	5852.88	C	5116.22	C	5787.80	C
PCB 157	pg/g	0.00	C156	0.00	C156	0.00	C156	0.00	C156	0.00	C156	0.00	C156
PCB 167	pg/g	125.77	J	86.24	f	110.72	J	4034.53		3910.30		4182.57	
PCB 169	pg/g	2.79	f	1.47	f	2.36	f	56.33	f	59.34	f	65.85	f
PCB 189	pg/g	24.43	f	12.24	f	16.18	f	704.06		679.27		754.94	

Table 8 (cont). Summary of Contaminant Concentrations (wet wt.) in Fall 2001 Finfish. *n* = 1.

Parameter	Species	Winter Flounder Fillet						Winter Flounder Liver					
	Site	18		69A		69B		18		69A		69B	
	Units	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
Arsenic	ug/g	4.41		7.20		4.24		3.33		4.81		5.17	
Beryllium	ug/g	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U	0.00	U
Cadmium	ug/g	0.00	U	0.00	U	0.00	U	0.11	J	0.14	J	0.12	J
Chromium	ug/g	0.36		0.45		0.35		0.42		0.42		0.53	
Copper	ug/g	0.19		0.15		0.24		17.82		11.67		13.61	
Lead	ug/g	0.02	K	0.01	JK	0.01	JK	0.11	K	0.17	K	0.15	K
Mercury	ug/g	0.02		0.03		0.03		0.03		0.02		0.03	
Nickel	ug/g	0.07	J	0.06	J	0.06	J	0.07	J	0.06	J	0.12	J
Selenium	ug/g	0.46		0.46		0.42		1.71		1.41		1.54	
Silver	ug/g	0.01	J	0.00	J	0.01	J	0.30		0.18		0.20	
Zinc	ug/g	8.86		7.43		6.41		46.5		40.0		42.0	

PAH/Phthalate

Six of the 16 priority pollutant PAHs (benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene) were not detected in any of the fillet samples from the three sites. Most of the PAHs that were detected in finfish fillet samples were low molecular weight (LMW) PAHs, which indicate a petrogenic source of PAHs. Concentrations of total PAH ranged from 5.28 to 9.91 ng/g. The average total PAH concentration was slightly higher in butterfish (8.34 ± 1.46 ng/g) than in scup (7.51 ± 1.23 ng/g) and winter flounder (6.77 ± 1.37 ng/g).

Organotins

Monobutyltin, dibutyltin and tetrabutyltin were undetected in all samples from the three study sites. Concentrations of tributyltin (TBT) ranged from 1.86 ng/g at Site 18 to 16.39 ng/g at Site 69B. The mean concentration of butterfish (8.92 ± 6.84 ng/g) was higher and more variable than in scup (3.58 ± 1.82 ng/g) and winter flounder (3.06 ± 1.43 ng/g). This variability is due to one butterfish composite from Site 69B, which had a much higher concentration of TBT (16.39 ng/g) than any of the other fish fillet composite samples. These concentrations, however, were fairly low and were less than 10 times the concentrations present in the procedural blank samples.

Dioxin/Furans and 12 Dioxin-like PCB Congeners

Thirteen of the dioxin/furan compounds were detected in winter flounder fillet samples from Site 18, whereas only seven dioxin/furan compounds were detected at Sites 69A and 69B. Concentrations of all detected compounds were below the Project QL Goal. 1,2,3,4,7,8,9-HpCDF, 1,2,3,4,7,8-HxCDD, 1,2,3,6,7,8-HxCDD, and 1,2,3,7,8,9-HxCDD were not detected at any of the sites. Concentrations of the detected dioxins/furans were generally higher at Site 18 than at Sites 69A or 69B. Concentrations of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD (the two most toxic dioxin compounds) were above the Estimated Detection Limit (EDL) at Site 18 but were either not detected or below the EDL at Sites 69A and 69B.

All of the 12 dioxin-like PCB congeners were detected in fillet samples from the three sites but at concentrations below the Project QL Goal. Concentrations of PCB 77, 81, 114, 123, 126, 169, and 189 were below the EDL. Concentrations were fairly similar at the three sites but were generally highest at Site 18 and lowest at Site 69A.

Metals

Beryllium was not detected in any of the fillet samples from the three study sites. The most abundant metals detected were Zn and As. Concentrations of As ranged from 0.63 µg/g at Site 69A to 7.20 µg/g, also at Site 69A. Concentrations of Zn ranged from 3.83 µg/g at Site 69B to 8.86 µg/g at Site 18. In general, mean metal concentrations, including Cu, Pb, Hg, Ni, and Se, were highest in the scup fillet samples. Winter flounder fillets contained the highest mean concentrations of As (5.29 ug/g), Ag (0.007 ug/g), and Zn (7.57 ug/g). Butterfish fillet samples contained the highest mean concentrations of Cd (0.01 ug/g).

Winter Flounder Liver

Moisture Content

The percent moisture content was lowest in winter flounder livers from Site 69B (62.12%) and highest in livers from Site 18 (66.93%).

Lipid Content

Percent lipids, however, were lowest at Site 18 (18.92%) and highest at Site 69B (24.18%).

Pesticides/PCB

Total DDT concentrations were highest at Site 69B (55 ng/g) and lowest at Site 69A (37 ng/g). Concentrations of total chlordane ranged from 10.99 ng/g at Site 69A to 12.2 at Site 69B. Aldrin, endosulfan I, endosulfan II, endrin, heptachlor, and toxaphene were undetected in all of the three liver composite samples. Liver samples from Site 18 contained detectable levels of endosulfan sulfate, heptachlor epoxide, and mirex. Dieldrin and hexachlorobenzene were detected only in liver sample composites from Site 69A. Gamma-BHC was detected only in the liver composite sample from Site 69B. Concentrations of PCBs and pesticides were generally highest at Site 69B and lowest at Site 69A. Total PCB concentrations ranged from 212 ng/g at Site 69A to 305 ng/g at Site 69B. The most abundant PCBs detected were PCB 138 and PCB 153. PCB 8 and 18 were not detected in any of the three liver composite samples.

PAHs/Phthalate

Eight of the 16 priority pollutant PAHs [benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene] were not detected in any of the three winter flounder liver samples. Most of the PAHs that were detected in the liver samples were LMW PAHs. Total PAH concentrations, calculated as the total of the 16 priority pollutant PAHs, ranged from 19.11 ng/g at Site 69B to 125.8 ng/g at Site 18. The most abundant PAHs detected were fluoranthene and fluorene. Naphthalene and phenanthrene were detected at concentrations

less than 10 times the procedural blank concentrations for these compounds. Bis(2-ethylhexyl)phthalate concentrations were lowest in fish livers from Site 69B (5.97 ng/g) and highest in livers from Site 69A (21.20 ng/g).

Organotins

Monobutyltin, dibutyltin, and tetrabutyltin were not detected in any of the liver samples from the three sites. Tributyltin concentrations ranged from 40 ng/g at Site 69A to 75 ng/g at Site 18.

Dioxin/Furans and 12 Dioxin-like PCB Congeners

Fourteen of the dioxin/furan compounds were detected in the fish liver samples from all three sites. 1,2,3,7,8,9-HxCDF was the only dioxin/furan compound not detected in any of the liver samples. Concentrations of all detected compounds were below the Project QL Goal, with concentrations generally highest at Site 69B. Concentrations of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD (the two most toxic dioxin compounds) were above the MDL at all three sites, with the lowest concentrations measured at Site 69A.

All of the 12 dioxin-like PCB congeners were detected in fillet samples from the three sites, with PCB 105, 118, 167, and 189 present at concentrations greater than the Project QL Goal. Concentrations were generally highest at Site 69B and lowest at Site 69A.

Metals

The trace metals did not demonstrate a clear spatial pattern among the three study sites, though metals concentrations were generally lower at Site 69A. Cu, Hg, Se, Ag, and Zn concentrations were highest in the liver samples from Site 18. Liver composite samples at Site 69A contained the highest concentrations of cadmium and lead, though lead levels at all three sites were detected at concentrations less than 10 times the method blank levels. The highest concentrations of arsenic, chromium, and nickel were in the liver samples from Site 69B. Consistent with the fillet samples, beryllium was undetected in all of the samples from the three sites.

CONCLUSIONS AND DISCUSSION

The September 2001 finfish survey was completed successfully, with the collection and analysis of fillet and liver samples for the three target species from Sites 18, 69A, and 69B. Circumstances in the field, however, resulted in a reduction in sampling and a change in the sampling locations. Results in this report document the baseline fish abundance and diversity and contaminant body burden of finfish from Rhode Island Sound during September 2001 in the vicinity of Sites 18, 69A, and 69B.

Sampling

Due to the presence of large numbers of lobster pots at the sites, otter trawls could not be conducted within, adjacent to, or in close proximity to the four proposed sites. Therefore, the

fish collected for tissue analysis cannot be considered specifically representative of any one site. Additionally, no tows were conducted near Site 16 due to very heavy commercial lobster fishing in and around the site. The recommended action is to re-survey using gill nets placed within the boundaries of each of the proposed sites. This collection method, however, is not suitable for winter flounder and may not be suitable for butterfish. Gill nets can be deployed on one day of a survey, and collected the following day to identify and collect fish caught directly on the site. The deployments may be coordinated with commercial fisherman to avoid the risks of entanglement. Additionally, commercial fishermen, familiar with the site areas, recommended November as a preferred time of year to collect the target species at the proposed disposal locations.

Contaminant Body Burdens

In general, the concentrations of contaminants in edible tissue from finfish collected in the vicinity of Sites 18, 69A, and 69B were low, varying among sites and species. There was no clear spatial trend for fillet contaminant concentrations among the three study sites, with concentrations being fairly similar (i.e., within one order of magnitude) across sites. Without replicate field samples, it was not possible to determine the spatial variability in contaminant concentrations within sites.

The concentration of total PCB was higher in scup than in the other two species. Metals were also generally higher in scup fillet samples than in winter flounder or butterfish. Butterfish fillet samples contained the highest concentrations of tributyltin, though concentrations did not appear to be substantially higher.

As expected, the concentrations of contaminants in winter flounder livers were greater than in edible tissue. The concentrations of total PAH and tributyltin in winter flounder livers were highest near Site 18. Total PCB, total chlordane, total DDT, dioxin, furan, and dioxin-like PCB concentrations were generally highest at Site 69B and lowest at Site 69A. Trace metal concentrations did not demonstrate a clear spatial pattern among the three study sites, though they were generally lowest at Site 69A.

Relationship of Contaminant Levels to FDA and US EPA Legal Limits

The U.S. Food and Drug Administration (FDA) has set action limits for the maximum tissue concentrations of specific contaminants in the edible portions of fish and fishery products (FDA 1989). The Fall 2001 individual concentrations of target analytes in finfish edible meat composite were compared to the FDA's Action Limits (Table 9). All fillet chemical concentrations were well below FDA Action Levels by one or more orders of magnitude.

Table 9. Comparison of Individual Fall 2001 Finfish Concentrations (on a Wet Weight Basis) to FDA Action Levels for Selected Parameters.

Station	Species	Total PCB (ng/g)	Total DDT (ng/g)	Total Chlordane ¹ (ng/g)	Aldrin (ng/g)	Dieldrin (ng/g)	Heptachlor (ng/g)	Heptachlor Epoxide (ng/g)	Mirex (ng/g)	Mercury (µg/g)
18	Butterfish	11.84	1.68	0.45	0.05 U	0.05 U	0.05 U	0.04 U	0.05 U	0.05
18	Winter Flounder	15.86	2.32	0.63	0.04 U	0.05 U	0.05 U	0.04 U	0.03 f	0.02
69A	Butterfish	19.71	3.78	1.32	0.05 U	0.05 U	0.05 U	0.04 U	0.08 U	0.03
69A	Scup	32.61	4.33	0.75	0.04 U	0.05 U	0.05 U	0.04 U	0.07 U	0.05
69A	Scup	22.62	2.79	0.60	0.04 U	0.05 U	0.05 U	0.04 U	0.08	0.07
69A	Winter Flounder	9.66	1.86	0.51	0.04 U	0.05 U	0.05 U	0.04 U	0.07 f	0.03
69B	Butterfish	14.79	2.55	0.73	0.05 U	0.05 U	0.05 U	0.04 U	0.08 U	0.04
69B	Scup	25.99	5.56	1.05	0.06 U	0.06 U	0.07 U	0.05 U	0.12	0.05
69B	Winter Flounder	13.66	2.38	0.70	0.05 U	0.05 U	0.05 U	0.04 U	0.08 U	0.03
FDA Limit		2000	5000	300	300	300	300	300	100	1

¹Total chlordane is the sum of cis Chlordane and trans-Nonachlor, as described in FDA (1989).

U = Not detected

f = Detected, but at concentrations less than the Method Detection Limit (MDL)

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APPENDIX A

Length and Weight Data for Finfish Collected at Each of the Three Study Sites

Table A-1. Length and Weight Data for Finfish Collected at Each of the Three Study Sites.

Site	Species	Sample ID	Total Length (cm)	Fork Length (cm)	Total Wet Weight (g)
69B	Winter Flounder	W7354-1	24.1	NA	212.2
69B	Winter Flounder	W7354-2	30.5	NA	405.4
69B	Winter Flounder	W7354-3	30.5	NA	446.4
69B	Winter Flounder	W7354-4	27.9	NA	279.2
69B	Winter Flounder	W7354-5	36.8	NA	743.3
69B	Winter Flounder	W7354-6	21.6	NA	124.9
69B	Winter Flounder	W7354-7	30.5	NA	400.8
69B	Winter Flounder	W7355-1	21.6	NA	122.8
69B	Winter Flounder	W7355-2	25.4	NA	248.3
69B	Winter Flounder	W7355-3	38.1	NA	684.1
69B	Winter Flounder	W7355-4	27.9	NA	304.1
69B	Winter Flounder	W7355-5	24.1	NA	178.2
69B	Winter Flounder	W7355-6	24.1	NA	181.9
69B¹	Winter Flounder	W7355-7	30.5	NA	347.7
69B	Winter Flounder	W7355-8	20.3	NA	193.6
69B	Winter Flounder	W7356-1	26.7	NA	264.1
69B	Winter Flounder	W7356-2	33.0	NA	527.8
69B	Winter Flounder	W7356-3	27.9	NA	291.0
69B	Winter Flounder	W7356-4	30.5	NA	391.0
69B	Winter Flounder	W7356-5	33.0	NA	439.2
69B	Winter Flounder	W7356-6	30.5	NA	333.5
69B	Winter Flounder	W7356-7	38.1	NA	665.3
69B	Scup	W7357	22.9	20.3	203.3
69B	Scup	W7358	17.8	15.9	98.1
69B	Scup	W7359-1	17.8	16.5	95.1
69B	Scup	W7359-2	15.9	14.0	61.7
69B	Butter Fish	W7361-1	17.1	14.6	62.8
69B	Butter Fish	W7361-10	16.5	14.0	63.0
69B	Butter Fish	W7361-2	17.8	15.2	62.9
69B	Butter Fish	W7361-3	15.2	12.7	41.6
69B	Butter Fish	W7361-4	19.1	16.5	82.5
69B	Butter Fish	W7361-5	17.8	15.9	82.5
69B	Butter Fish	W7361-6	21.6	18.4	123.2
69B	Butter Fish	W7361-7	17.8	15.2	69.7
69B	Butter Fish	W7361-8	18.4	15.9	77.2
69B	Butter Fish	W7361-9	15.9	14.0	54.1
69B	Butter Fish	W7362-1	19.1	16.5	92.7
69B	Butter Fish	W7362-10	19.1	16.5	82.8
69B	Butter Fish	W7362-2	22.9	19.7	141.5
69B	Butter Fish	W7362-3	17.1	14.6	49.3
69B	Butter Fish	W7362-4	15.9	14.6	56.1
69B	Butter Fish	W7362-5	17.8	15.2	81.5
69B	Butter Fish	W7362-6	20.3	17.1	106.4
69B	Butter Fish	W7362-7	14.6	12.7	38.3
69B	Butter Fish	W7362-8	14.0	12.1	34.2

¹Bolded fish are those that were selected to be composited and analyzed as described in the Methods section.

Table A-1 (cont'd). Length and Weight Data for Finfish Collected at Each of the Three Study Sites.

Site	Species	Sample ID	Total Length (cm)	Fork Length (cm)	Total Wet Weight (g)
69B	Butter Fish	W7362-9	16.5	14.0	49.4
69A	Winter Flounder	W7363-1	25.4	NA	284.9
69A	Winter Flounder	W7363-2	21.6	NA	127.2
69A	Winter Flounder	W7363-3	30.5	NA	371.7
69A	Winter Flounder	W7363-4	30.5	NA	375.8
69A	Winter Flounder	W7363-5	43.2	NA	1087.4
69A	Winter Flounder	W7364-1	40.6	NA	1000.8
69A	Winter Flounder	W7364-2	25.4	NA	196.0
69A	Winter Flounder	W7364-3	29.2	NA	318.1
69A	Winter Flounder	W7364-4	29.2	NA	295.2
69A	Winter Flounder	W7364-5	25.4	NA	234.2
69A	Winter Flounder	W7365-1	35.6	NA	702.8
69A	Winter Flounder	W7365-2	29.2	NA	330.5
69A	Winter Flounder	W7365-3	20.3	NA	135.9
69A	Winter Flounder	W7365-4	22.9	NA	134.8
69A	Winter Flounder	W7365-5	19.1	NA	100.5
69A	Scup	W7366-1	22.9	20.3	207.3
69A	Scup	W7366-2	21.6	19.1	150.3
69A	Scup	W7366-3	20.3	19.1	142.4
69A	Scup	W7366-4	22.9	20.3	166.9
69A	Scup	W7366-5	21.6	19.1	165.2
69A	Scup	W7366-6	19.1	17.8	103.6
69A	Scup	W7366-7	22.9	20.3	193.8
69A	Scup	W7367-1	24.1	21.6	222.4
69A	Scup	W7367-2	20.3	19.1	163.4
69A	Scup	W7367-3	19.7	17.8	137.6
69A	Scup	W7367-4	21.6	19.1	179.5
69A	Scup	W7367-5	20.3	17.8	140.3
69A	Scup	W7367-6	22.9	20.3	182.7
69A	Scup	W7367-7	25.4	22.9	250.4
69A	Scup	W7368-1	19.1	17.8	127.6
69A	Scup	W7368-2	20.3	17.8	126.1
69A	Scup	W7368-3	21.6	20.3	168.2
69A	Scup	W7368-4	21.6	19.1	144.7
69A	Scup	W7368-5	19.1	17.8	128.5
69A	Scup	W7368-6	19.1	16.5	106.2
69A	Scup	W7368-7	19.1	17.1	120.3
69A	Butter Fish	W7369-1	21.6	19.1	126.7
69A	Butter Fish	W7369-2	19.1	16.5	89.9
69A	Butter Fish	W7369-3	20.3	17.8	128.6
69A	Butter Fish	W7369-4	17.8	15.2	92.1
69A	Butter Fish	W7369-5	17.1	15.2	72.0
69A	Butter Fish	W7369-6	20.3	17.8	110.5
69A	Butter Fish	W7369-7	19.1	16.5	102.2
69A	Butter Fish	W7369-8	20.3	17.8	120.1

¹Bolded fish are those that were selected to be composited and analyzed as described in the Methods section.

Table A-1 (cont'd). Length and Weight Data for Finfish Collected at Each of the Three Study Sites.

Site	Species	Sample ID	Total Length (cm)	Fork Length (cm)	Total Wet Weight (g)
69A	Butter Fish	W7370-1	18.4	15.9	92.0
69A	Butter Fish	W7370-2	17.8	15.2	70.4
69A	Butter Fish	W7370-3	21.6	19.1	154.9
69A	Butter Fish	W7370-4	16.5	14.6	67.5
69A	Butter Fish	W7370-5	21.6	17.8	136.2
69A	Butter Fish	W7370-6	20.3	17.1	97.1
69A	Butter Fish	W7370-7	15.2	13.3	54.4
69A	Butter Fish	W7370-8	19.7	16.5	83.8
69A	Butter Fish	W7371-1	17.8	15.2	75.8
69A	Butter Fish	W7371-2	18.4	15.9	97.5
69A	Butter Fish	W7371-3	19.1	16.5	99.6
69A	Butter Fish	W7371-4	17.8	15.2	81.1
69A	Butter Fish	W7371-5	18.4	15.9	85.3
69A	Butter Fish	W7371-6	19.1	15.9	82.1
69A	Butter Fish	W7371-7	17.8	15.2	81.8
69A	Butter Fish	W7371-8	18.4	15.2	86.7
18	Winter Flounder	W7372-1	21.6	NA	137.8
18	Winter Flounder	W7372-2	19.1	NA	105.2
18	Winter Flounder	W7372-3	28.6	NA	236.2
18	Winter Flounder	W7372-4	20.3	NA	118.7
18	Winter Flounder	W7372-5	36.2	NA	660.3
18	Winter Flounder	W7372-6	27.9	NA	292.2
18	Winter Flounder	W7372-7	22.9	NA	159.0
18	Winter Flounder	W7373-1	32.4	NA	401.3
18	Winter Flounder	W7373-2	26.7	NA	291.5
18	Winter Flounder	W7373-3	29.2	NA	277.8
18	Winter Flounder	W7373-4	29.2	NA	299.1
18	Winter Flounder	W7373-5	22.9	NA	140.5
18	Winter Flounder	W7373-6	21.6	NA	116.2
18	Winter Flounder	W7373-7	21.6	NA	123.1
18	Winter Flounder	W7374-1	31.8	NA	383.8
18	Winter Flounder	W7374-2	27.9	NA	340.0
18	Winter Flounder	W7374-3	27.9	NA	304.8
18	Winter Flounder	W7374-4	27.9	NA	256.7
18	Winter Flounder	W7374-5	30.5	NA	363.5
18	Winter Flounder	W7374-6	21.6	NA	129.9
18	Scup	W7375	--	--	--
18	Scup	W7376	15.9	14.6	60.8
18	Scup	W7377	15.2	12.7	52.8
18	Butter Fish	W7378-1	19.7	17.1	92.1
18	Butter Fish	W7378-2	18.4	15.9	70.0
18	Butter Fish	W7378-3	19.1	16.5	85.8
18	Butter Fish	W7378-4	21.0	18.4	103.8
18	Butter Fish	W7378-5	21.0	18.4	116.2
18	Butter Fish	W7379-1	20.3	17.8	89.6

¹Bolded fish are those that were selected to be composited and analyzed as described in the Methods section.

Table A-1 (cont'd). Length and Weight Data for Finfish Collected at Each of the Three Study Sites.

Site	Species	Sample ID	Total Length (cm)	Fork Length (cm)	Total Wet Weight (g)
18	Butter Fish	W7379-2	22.9	19.1	145.8
18	Butter Fish	W7379-3	21.6	19.1	148.8
18	Butter Fish	W7379-4	20.3	16.5	95.6
18	Butter Fish	W7379-5	19.7	16.5	102.6
18	Butter Fish	W7380-1	21.6	17.8	126.4
18	Butter Fish	W7380-2	20.3	17.8	100.8
18	Butter Fish	W7380-3	19.7	17.1	86.5
18	Butter Fish	W7380-4	20.3	17.8	103.2
18	Butter Fish	W7380-5	22.2	19.7	123.6
69B	Butter Fish	W7960-1	17.1	15.2	65.9
69B	Butter Fish	W7960-10	17.8	15.9	78.5
69B	Butter Fish	W7960-2	17.8	14.6	68.3
69B	Butter Fish	W7960-3	17.1	14.6	67.2
69B	Butter Fish	W7960-4	14.6	12.7	56.9
69B	Butter Fish	W7960-5	15.9	13.3	49.7
69B	Butter Fish	W7960-6	17.8	15.2	67.0
69B	Butter Fish	W7960-7	17.8	15.2	77.3
69B	Butter Fish	W7960-8	17.1	14.0	64.8
69B	Butter Fish	W7960-9	17.8	15.2	72.5

¹Bolded fish are those that were selected to be composited and analyzed as described in the Methods section.