EVALUATION OF *GULFWATCH*

Data Report: 2000

TENTH YEAR OF THE GULF OF MAINE ENVIRONMENTAL MONITORING PLAN

Eighth Year of the 9-Year Monitoring Design

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1.0 INTRODUCTION

1.1 Rationale

The Gulf of Maine is the region of the North Atlantic Ocean that extends from Cape Sable, Nova Scotia, through New Brunswick, Maine, and New Hampshire to Cape Cod, Massachusetts, and includes the Bay of Fundy and Georges Bank. The combined productivity of seaweed, salt marsh grasses, and phytoplankton make it one of the world's most productive ecosystems supporting a vast array of animal species, including some of great commercial importance. Commercial fisheries are its principal income-generating enterprises. Tourism is also economically important to coastal communities and marine aquaculture is rapidly expanding. Increases in coastal populations and industrial and residential development have contributed to the deteriorating quality of sections of the Gulf's coastal environment (Jones 2004, Collins and Della Valle 2004, Dow and Braasch 1996, Crawford and Sowles 1992). One important factor resulting from human activities is the steady input of toxic chemicals into the estuarine and coastal environments, despite efforts to improve pollution treatment. Many of these anthropogenic chemicals are bioaccumulated as they transfer through the food chain and have been found to be elevated above natural conditions (Shaw et al in press; Shaw et al. 2003). Furthermore, some of these environmental contaminants may also be present at toxic concentrations, and thus induce adverse biological effects on productivity, reproduction and survival of marine organisms and humans (Jones 2004, Kawaguchi et al. 1999, Wells and Rolston 1991).

To protect water quality and commercial uses in the Gulf of Maine, the *Agreement on the Conservation of the Marine Environment of the Gulf of Maine* was signed in December 1989 by the premiers of Nova Scotia and New Brunswick and the governors of Maine, New Hampshire and Massachusetts establishing the Gulf of Maine Council on the Marine Environment. The overarching mission of this council is to maintain and enhance the Gulf's marine ecosystem, its natural resources and environmental quality. To help meet the council's mission statement, The Gulf of Maine Environmental Monitoring Committee was formed and charged with the development of the Gulf of Maine Environmental Monitoring Plan. The monitoring plan is based on a mission statement provided by the council:

It is the mission of the Gulf of Maine Environmental Quality Monitoring Program to provide environmental resource managers with information to support sustainable use of the Gulf and allow assessment and management risk to public and environmental health from current and potential threats.

Three monitoring goals were established to meet the mission statement:

(1) To provide information on the status, trends, and sources of risk to the marine environment in the Gulf of Maine;
(2) To provide information on the status, trends and sources of marine based human health risks in the Gulf of Maine; and
(3) To provide appropriate and timely information to environmental and resource managers that will allow both efficient and effective management action and evaluation of such action.

In support of the mission and as a first step towards meeting the desired goals, a project named Gulfwatch was established to measure Gulfwide chemical contamination (Barchard and Johnson-Hayden, 1990; Barchard, 1991).

1.2 Gulfwatch Objectives

Gulfwatch is presently a program in which the blue mussel, *Mytilus edulis*, is used as an indicator for habitat exposure to organic and inorganic contaminants. Bivalves such as *M. edulis* have been successfully used as indicator organisms in environmental monitoring programs throughout the world (McIntosh et al. 2004, Glynn et al. 2004, Monirith et al. 2003, O'Connor 2002, Cantillo 1998, Widdows and Donkin, 1992, NOAA, 1991, NAS, 1980) to identify variation in chemical contamination between sites, and contribute to the understanding of trends in chemical contamination (NOAA, 1991; O'Connor, 1998; Widdows et al., 1995). The blue mussel was selected as an indicator organism for the Gulfwatch program for the following reasons:

(1) mussels are abundant within and across each of the 5 jurisdictions bordering the Gulf and they are easy to collect and process;
(2) blue mussels have been comparatively well-studied in the scientific and technical literature;
(3) mussels are a commercially important human food source and may be used to monitor human exposure to chemical contamination; they are also an important link in the marine food chain and thus an indicator of ecosystem exposure;
(4) mussels are sedentary, thereby eliminating the complications in interpretation of results introduced by mobile species;
(5) Mussels are suspension feeders that pump large volumes of water and concentrate many chemicals in their tissues. Therefore, the presence of trace contamination is easier to document in mussels than in water, and the measurement of chemicals in bivalve tissue provides an assessment of biologically available contamination that is not always apparent from measurement of contamination in other environmental compartments (water, sediment, and suspended particles).

Throughout the history of the program, Gulfwatch has refined its approach to using mussels as bioindicators of anthropogenic contamination. During the first two pilot study years of the program (1991 & 1992), both transplanted and native mussels sampled from areas adjacent to the transplant sites were analyzed for organic and inorganic contaminants (GOMC, 1992). Transplanted mussels were initially collected from relatively pristine sites in each jurisdiction, moved to sites selected for monitoring and held there for approximately 60 days. Because of the logistics and the analytical costs, however, only two sites per jurisdiction were monitored each year using this transplant technique. Transplants provided an assessment of the short-term exposure (on the order of weeks to months) to bioavailable contaminants throughout the region whereas sampling of native mussels provided more of an assessment of long-term exposure to bioavailable contaminants (on the order of months to a year). An objective of the first two pilot study years (1991 and 1992) of the Gulfwatch program was to evaluate the feasibility of the project and the level of co-operation required for collecting comparative data from different locations along the Gulf of Maine across both national and state boundaries.

Having met this objective, the program recognized more monitoring sites were needed throughout the Gulf of Maine in order to adequately assess the degree and extent of contamination of the region. As such a sampling scheme involving three successive three-year rotations of sites was implemented in 1993 and continues through 2000.

The pilot study sites included in the GW monitoring program consisted of two categories; caged mussels collected from a "clean" site deployed at test sites that were suspected or known to be contaminated, and at reference sites that were thought to be free of any known contaminant source. For 1993 and 1994, up to 7 additional locations within each jurisdiction (state or province) where deemed feasible. Further, one location in each jurisdiction was chosen as a benchmark station and has been continually re-sampled each year. The broader geographic coverage provided by the added stations increased the chance of locating unforeseen environmental contamination. In the third year of the three-year cycle, transplant experiments were conducted at two sites within each jurisdiction. Thus, the three-year cycle, with transplants being conducted at two sites during the last cycle year and indigenous mussels alone being sampled at 2-7 sites per jurisdiction during the first two years, was to be repeated for the remaining years of the Gulfwatch Program to allow for the assessment of both short-term and long-term contaminant exposure.

In 1996, a five-year review of the program was conducted for the GOM Council by independent regional scientists. The feasibility of continuing transplant studies (Jones et al., 1998) was evaluated and abandoned from the program, citing the cost of performing transplant experiments, the low rate of return, missing data, and the complications with the interpretation of the data. In 1998 additional (previously unsampled) sites were added to the program to increase the spatial coverage within the Gulf of Maine and targeted subregions were Gulfwatch data indicated further investigation. New sample sites were established in New Hampshire and New Brunswick. Sampling of the New Hampshire sites was in conjunction with the New Hampshire Gulfwatch program. The New Brunswick sites were located in the Saint John Harbour, a region of concern for overall environmental contaminants Additional sampling of New Hampshire sites continued for the 1999 and 2000 sampling seasons. Associations with more local programs are advantageous to the Gulfwatch program and illustrate the importance of the regional perspective when evaluating local or subregional contamination (Jones et al. 2001).

In addition to documenting the level of contaminants in mussel tissue, biological variables, including condition index and shell growth (only for transplanted mussels) , were determined as a measure of the organism's stress and its relationship to different concentrations of contaminant burden. Growth is often one of the most sensitive measures of the effect of a contaminant on an organism (Sheehan, 1984; Sheehan et al., 1984; Howells et al., 1990). Specifically, shell growth has often been used as a measure of environmental quality and pollution effects. The rate of growth is a fundamental measure of physiological fitness/performance (Widdows and Donkin, 1992; Salazar and Salazar, 1995) and therefore is a direct, integrative measure of the impairment of organism physiology.
Gulfwatch uses the condition index (CI), traditionally used by shellfishery biologists (Widdows, 1985), as an indicator of the physiological status of the mussels. It relates the tissue wet weight to shell volume. Because gonadal weight is a significant contributor to total body weight just prior to spawning, the CI also reflects differences in the reproductive state of sampled mussels. Since gonadal material tends to have low concentrations of metals (LaTouche and Mix, 1981), tissue metal concentrations may be reduced in mussels having a high CI due to ripened gonads. Organic contaminants, however, would tend to partition into both somatic and gonadal lipids, and may be less impacted by changes in CI that are due to the presence of ripe gametes. Since variable amounts of ripe gametes may be found in some mussel populations even in late fall (Kimball, 1994). Granby and Spliid (1995) found a significant negative correlation between PAHs and CI but no correlation between PCB or DDE concentration and CI. Regardless, the relationship between CI and contaminant concentrations must be carefully considered.

2.0 METHODS

2.1 2000 Sampling Locations

The 2000 Gulf of Maine mussel survey is the eighth year of the nine year sampling design (see Sowles et al., 1997). The 2000 sampling represents the second year of the third 3-year cycle. As such, many of the stations sampled in 2000 were re-visits of stations sampled in 1994 and 1997. Therefore, in addition to spatial analysis, temporal analysis can begin to be performed on the contaminant concentrations at specific sites. In addition to repeating the sites sampled in 1994 and 1997, three extra sites were sampled in New Hampshire: Schiller Station (NHSS), North Mill Pond (NHNM) and Hampton River (NHHR). The New Hampshire sites were sampled as part of the New Hampshire Gulfwatch Program and were included to provide a more comprehensive assessment of toxic contaminant exposure, especially oil (i.e., PAHs), to biota in New Hampshire estuarine waters. The stations sampled in 2000 are presented in Table 1 with reference to site locations in Fig. 1.

TABLE 1.
Gulf of Maine Gulfwatch study site locations sampled in 2000.

Jurisdiction	Site Code	Site Name	Site Type	Longitude	Latitude
Massachusetts					
	MABI	Brewster Island	3-year rotation	-70.87800	42.34250
	MADX	Duxbury	3-year rotation	-70.66717	42.03350
	MAIP	Ipswich	3-year rotation	-70.79067	42.70067
	MASN	Sandwich	Benchmark	-70.40000	41.75000
	MAWN	Marblehead	3-year rotation	-70.96417	42.36483
New Hampshire					
	NHDP	Dover Point	3-year rotation	-70.82670	43.11960
	NHNM	North Mill Pond	GW expansion	-70.76000	43.07500
	NHRH	Rye Harbor	3-year rotation	-70.74000	43.00000
	NHSS	Schiller Station	GW expansion	-70.78833	43.10167
Maine					
	MECC	Cobscook Bay	Benchmark	-70.72440	43.07740
	MECK	Clarks Cove	3-year rotation	-67.05434	44.90450
	MEKN	Kennebec River	Benchmark	-69.78450	43.78500
	MEMR	Machias River	3-year rotation	-67.40350	44.71367
	MEPH	Portland Harbor	3-year rotation	-70.25900	43.63917
	MEPR	Presumpscot River	3-year rotation	-70.24733	43.69217
	MEUR	Union River	3-year rotation	-68.43217	44.50150
New Brunswick					
	NBHI	Hospital Island	Benchmark	-67.00817	45.12050
	NBLB	Limekiln Bay	3-year rotation	-66.81500	45.05583
	NBNR	Niger Reef	3-year rotation	-67.06800	45.06633
Nova Scotia					
	NSAR	Apple River	3-year rotation	-64.83500	45.47000
	NSDI	Digby	Benchmark	-65.75233	44.61700
	NSSC	Spechts Cove	3-year rotation	-65.90783	44.51533

INSERT FIGURE 1 HERE

2.2 Field and Laboratory Procedures

Details regarding the mussel collection, measurement, and sample preparation are published in Sowles et al. (1997) and are briefly summarized here. Gulfwatch attempts to control confounding variables by collecting organisms within a specific size range, at the same location each year, at similar tidal levels and in early fall, after major spawning has occurred. The mussels collected were intended to be *Mytilus edulis*. However, a related species, *Mytilus trossulus*, was identified in some Bay of Fundy samples (Mucklow, 1996). Gulfwatch results could be confounded by inadvertent selection, by field personnel, of the wrong species. To alleviate this problem, a description of *M. edulis* was developed for the Gulfwatch program using shell criteria such as length:height ratio, internal color, weight, and location and size of the adductor scars (Jones et al., 1998).

Field sampling occurred between mid-September and mid-November. Mussels were collected from four discrete areas within a segment of the shoreline that was determined to be representative of local water quality. Using a polycarbonate gauge or a ruler, four (4) replicates of 45-50 mussels of 50-60 mm shell length were collected at each location. The mussels were placed in containers and transported in coolers with ice packs to labs for processing. Mussels were not depurated prior to processing, except for extra mussels collected from Apple River, N.S. (NSAR) as part of special study .

From each replicate, 20 mussels were analysed for trace metals and 20 for organic contaminants. Mussels were washed in the laboratory to remove any external growth, sediment and debris and excess seawater was drained from their mantles. The mussels were then measured for length (anterior umbo to posterior growing lip), height (distance dorsal-ventral) and maximum width to the nearest 0.1mm. Three subsets of mussels (10) used for metal analysis were shucked and weighed individually wet (±0.1g) for reporting contaminant concentrations and for calculation of a condition index. Condition index was calculated using the following formula (after Seed, 1968):

Condition index (CI) = wet tissue weight (mg) / [length (mm) * width (mm) * height (mm)]

All samples for trace metal and organic contaminant analysis were placed in pre-cleaned or quality assured bottles (Sowles et al., 1997). These composite samples (20 mussels/composite; 4 composites/station) were capped, labelled and stored at -15°C for 3-6 months prior to analysis.

2.3 Analytical Procedures

Analytical procedures used followed those reported for the previous years (Jones et al. 1998) and are briefly described in the following sections. Table 2 contains a summary of all trace metal and organic compounds measured.

2.3.1 Metals

Inorganic contaminants were analyzed at the State of Maine Department of Health and Environmental Testing Laboratory (HETL, Orono, ME). The samples were acid digested by EPA Method 3050. Analyses for mercury were conducted on a sub-sample of 1 to 2 g of wet tissue and measured by EPA Method 245.6, cold vapor atomic absorption spectrometry on a Perkin Elmer Model 503 atomic absorption spectrometer. Analyses for all other metals were conducted on 5 to 10 g of wet tissue dried at 100°C. Zinc and iron were measured by EPA Method 200.7, flame atomic absorption using a Perkin Elmer Model 1100 atomic absorption spectrometer. All remaining metals (Ag, Al, Cd, Cr, Cu, Ni and Pb) were analyzed using Zeeman background corrected graphite furnace atomic absorption on a Varian Spectra AA 400. The analyte detection limits for the metals in µg/g dry weight were reported as follows; Ag, 0.1; Al, 3.0; Cd, 0.2; Cr, 0.3; Cu, 0.6; Fe, 6.0; Hg, 0.1; Ni, 1.2; Pb, 0.6; and Zn, 1.5.

2.3.2 Organics

Organic contaminants in mussel samples were analyzed at the Environment Canada Environmental Quality Laboratory in Moncton, New Brunswick. The analyte detection limits ranged from 3.6-12.6 ng/g for aromatic hydrocarbons, from 0.7-2.8 ng/g for PCB congeners, and from 0.9- 2.0 ng/g for chlorinated pesticides (Appendix A). Eighteen of the PCB congeners identified and quantified correspond to congeners analyzed by the National Oceanographic and Atmospheric Administration's (NOAA) National Status and Trends (NS&T) Program in the U.S.A. Other organic compounds selected for analysis are also consistent, for the most part, with NOAA National Status and Trends mussel monitoring (NOAA, 1989).

A description of the full analytical protocol and accompanying performance based QA/QC procedures are found in Sowles et al. (1997), and more comprehensively in Jones et al. (1998). Tissue samples were extracted by homogenization with an organic solvent and a drying agent. Solvent extracts were obtained by vacuum filtration, and biomatrix interference was separated from target analytes in extracts by size exclusion chromatography. Purified extracts were subjected to silica gel liquid chromatography, which provided a non-polar PCB/chlorinated pesticides fraction and a polar chlorinated pesticide fraction. PCBs and pesticides were analyzed by high-resolution dual column gas chromatography/electron capture detection (HRGC/ECD). Following PCB and pesticide analysis, the two fractions were combined and the resulting extract was analyzed for aromatic hydrocarbons by high-resolution gas chromatography/mass spectrometry (HRGC/MS).

Table 2.
Inorganic and organic compounds analyzed in mussel tissue from the Gulf of Maine in 1999.

INORGANIC CONTAMINANTS	
Metals	**Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn**

ORGANIC CONTAMINANTS	
Aromatic Hydrocarbons	**Chlorinated Pesticides**
Naphthalene	Hexachlorobenzene (HCB)
1-Methylnaphthalene	gamma-Benzenehexachloride (BHC)
2-Methylnaphthalene	Heptachlor
Biphenyl	Heptachlor epoxide
2,6-Dimethylnaphthalene	Aldrin
Acenaphthylene	cis-Chlordane
Acenaphthalene	trans-Nonachlor
2,3,5-Trimethylnaphthalene	Dieldrin
Fluorene	alpha-Endosulfan
Phenanthrene	beta-Endosulfan
Anthracene	
1-Methylphenanthrene	
Fluoranthene	
Pyrene	**DDT and Homologues**
Benzo [a] anthracene	
Chrysene	2,4'-DDE 4,4'-DDE
Benzo [b] fluoranthene	2,4'-DDD 4,4'-DDD
Benzo [k] fluoranthene	2,4'-DDT 4,4'-DDT
Benzo [e] pyrene	
Benzo [a] pyrene	
Perylene	**PCB Congeners**
Indo [1,2,3-cd] pyrene	
Dibenze [a,h] anthracene	
Benzo [g,h,I] perylene	PCB 8, PCB 18, PCB 28, PCB 29, PCB 44, PCB 50, PCB 52, PCB 66, PCB 77, PCB 87, PCB 101, PCB 105, PCB 118, PCB 126, PCB 128, PCB 138, PCB 153, PCB 169, PCB 170, PCB 180, PCB 187, PCB 195, PCB 206, PCB 209

2.4 Quality Assurances / Quality Control

Standard operating procedures for the analysis of mussel samples and related laboratory quality control performance criteria are described in *Gulfwatch Project Standard Procedures: Field and Laboratory (GOMCME August 1997)*. Quality assurance provisions described in the manual serve as a guide for the generation of acceptable analytical data for the Gulfwatch program. The quality control results produced also permit users of Gulfwatch data to assess the accuracy and precision of sample results and the comparability of Gulfwatch data with that of other environmental contaminant monitoring programs.

Standard laboratory procedures for metals incorporated method blanks, spike matrix samples, duplicate samples, surrogate addition and Standard reference materials: SRM 1974a – NIST standard mussel tissue; DORM-2 – NRC-CRNC standard dogfish tissue The method blanks were inserted: three at the beginning of the run, one at the end, and six at various intervals during the run. Duplicate samples and matrix spike recoveries were conducted on 15% of the samples. For analysis of organic chemicals, laboratory QC measures which were incorporated with batches of 13 to 15 samples include procedural blanks, duplicate sample analyses, contaminant surrogate sample spikes, sample matrix spikes, and the analysis of certified mussel tissue reference material (SRM 1974a).

Appendixes B and C contain contaminant QC sample results for the 2000 Gulfwatch samples and a brief summary of results for trace metals and organics, respectively. Laboratory QC measures which were incorporated with batches of 13 to 15 samples include procedural blanks, duplicate sample analyses, contaminant surrogate sample spikes, sample matrix spikes, and the analysis of certified mussel tissue reference material.

In addition to intra-laboratory quality control, participation in an external laboratory inter-comparison exercise is an on-going quality assurance requirement of the Gulfwatch program. In 2000, the Environment Canada laboratory that undertakes the analysis of organic contaminants in Gulfwatch samples participated in a National Institute of Standards and Technology (NIST) inter-comparison exercise. Exercise results for all participating laboratories are described in the NIST Inter-comparison Exercise Program for Organic Contaminants in the Marine Environment (NIST 2001).

*2.5 **Statistical Methods and Data Analysis***

Total PAH (□PAH_{24}), total PCB (PCB_{24}) and total pesticides ($TPEST_{17}$) values were calculated from the sum of all individual compounds or congeners with values greater than the detection limit for the compound. Total DDT (□DDT_6) is the sum of 2,4-DDT and 4,4-DDT and homologues (2,4-DDE, 4,4-DDE, 2,4-DDD and 4,4-DDD). Several tissue samples for metals and organics were below the detection level. Variables in which all replicate measurements were below the detection limit were treated as zero and recorded as not-detected (ND). However, if at least one of the replicates was greater than the detection limit, then the other replicates were recorded as 1/2 the detection limit.

From each site, arithmetic means and standard deviations (SD) were calculated for all metal and organic contaminants. Arithmetic means were calculated since, with a few exceptions, metals and organics at each station were normally distributed as demonstrated by applying Kolmogorov-Smorov test using $p=0.05$ (SAS, 1990). Graphs of the mean concentrations (±SD) are presented for all stations sampled. For interpretive purposes, Clark Cove, Maine (MECC) is grouped with the New Hampshire sites because it is located in the Great Bay / Piscataqua River watershed, and therefore more comparable to other nearby sites in New Hampshire Because 2000 was the third and final year of the 9-year program for one group of sites, data from 1994, 1997 and 2000 have been summarized, along with previous year data for the five benchmark sites. Graphs were used to show general temporal trends. However, because of newly discovered questions about the calculation of Hg concentrations based on analytical results for Gulfwatch samples prior to 1999, Hg data from 1994 and 1997 are used in this report only for reference to show differences to 2000 data; hopefully corrected data, if needed, will be provided soon and this report can be corrected.

3.0 RESULTS AND DISCUSSION

3.1 Field Operations and Logistics

Field collections proceeded as planned to revisit the stations sampled in 1994 and 1997, with four additional sites sampled in New Hampshire and one in Maine. Mussels were successfully sampled at a total of 23 sites.

3.2 Trace Metal Concentrations

Table 3 contains the metal concentrations (arithmetic mean ± SD, µg/g dry weight) for mussels from all site composite (n=4) samples in 2000. Metal concentrations for each individual composite sample are provided in Appendix D. Overall metal concentrations for all 2000 mussels are also given as medians (MD) and MD + PC85 to allow for a program-level comparison with NOAA National Status and Trends concentrations (Table 4). Table 4 compares the overall 2000 Gulfwatch values for MD and MD + PC85 with the 1991 to 1996 NS&T Mussel Watch data (O'Connor, 1998; http://ccmaserver.nos.noaa.gov/). Although the NS&T data were summarized for years 1991 to 1996, only 1991 data were used for comparison to Gulfwatch results. Most of the summarized metals concentrations were comparable to the 1991 NS&T MD and MD + PC85 values, except for total PCBs, and especially, Pb and Hg, which were higher in 2000 Gulfwatch samples, and total PAH and total pesticides, which were lower in 2000 Gulfwatch samples.

Site Code	Ag	sd	Al	sd	Cd	sd	Cr	sd	Cu	sd	Fe	sd	Hg	sd	Ni	sd	Pb	sd	Zn	sd	Solids	sd
MASN	0.83	0.33	100	28	1.35	0.24	0.95	0.06	6.50	0.22	250	73	0.20	0.10	1.87	0.09	2.53	0.39	83	7	15.8	1.4
MADX	0.13	0.05	198	43	1.00	0.00	1.60	0.12	8.98	0.86	458	69	0.18	0.12	2.1	0.18	3.95	0.68	93	5	15.6	0.6
MABI	0.09	0.03	101	13	1.78	0.13	1.75	0.06	7.15	0.24	253	17	0.61	0.21	2.63	0.05	4.58	0.49	160	14	12.4	0.7
MAIP	0.15	0.06	54	7	1.53	0.13	1.13	0.15	7.08	0.65	178	26	0.16	0.10	2	0.29	1.58	0.26	110	18	15.7	0.9
MAWN	0.10	0.00	175	40	1.90	0.22	2.28	0.17	6.73	0.26	388	67	0.61	0.07	2.6	0.28	3.60	0.48	123	36	14.2	0.1
NHHR	0.10	0.00	145	44	1.2	0.2	1.1	0.0	9.4	0.5	343	63	0.08	0.06	2.13	0.05	1.8	0.40	107	10	17.3	0.2
NHRH	<0.1	-	123	53	1.80	0.38	1.65	0.51	8.18	2.57	433	121	0.47	0.28	2.93	0.46	3.58	1.26	115	24	15.4	1.0
NHNM	0.09	0.03	275	150	2.08	0.22	2.78	1.08	9.50	1.09	700	337	0.37	0.25	2.48	0.15	7.08	2.75	163	52	12.3	0.8
NHSS	0.16	0.16	138	39	2.08	0.36	1.95	0.24	7.75	0.70	350	72	0.64	0.11	2.58	0.13	3.10	0.43	118	10	12.5	0.7
NHDP	<0.1	-	225	50	2.33	0.15	2.83	0.40	7.88	0.62	515	104	0.51	0.32	2.7	0.14	3.18	0.57	130	24	14.0	0.4
MECC	<0.1	-	325	50	1.98	0.29	3.38	0.56	11.18	1.09	790	149	0.47	0.24	2.83	0.15	6.90	1.04	128	17	11.6	0.9
MEPH	0.09	0.03	370	58	1.78	0.10	2.33	0.13	12.25	1.26	738	84	0.25	0.16	2.45	0.26	11.50	0.58	133	15	9.9	1.0
MEPR	0.14	0.08	533	100	2.05	0.45	3.03	0.42	13.00	2.00	973	108	0.30	0.20	3.05	0.47	7.80	1.00	113	26	9.0	1.4
MEKN	0.10	0.00	195	33	2.28	0.26	1.93	0.24	9.28	1.49	325	53	0.10	0.09	2.1	0.22	2.20	0.22	69	7	11.0	0.1
MEUR	0.10	0.00	200	22	1.75	0.13	1.50	0.08	7.50	1.02	518	49	<0.1	-	2.28	0.1	2.63	0.10	81	12	9.9	0.7
MEMR	0.09	0.03	235	65	1.95	0.21	1.63	0.21	8.50	1.76	595	205	0.34	0.22	2.5	0.22	3.18	0.60	64	14	11.0	0.5
MECK	<0.1	-	298	68	1.70	0.18	1.43	0.17	8.68	0.95	583	117	0.14	0.19	2.43	0.26	2.60	0.29	108	15	11.1	0.6
NBNR	0.10	0.00	85	16	1.10	0.12	0.58	0.13	5.48	0.40	205	37	<0.1	-	1.7	0.12	0.83	0.10	82	20	18.9	1.6
NBHI	0.10	0.00	34	5	0.98	0.10	0.45	0.06	5.33	0.48	100	12	<0.1	-	1.5	0.08	0.38	0.15	61	2	22.2	0.6
NBLB	<0.1	-	158	17	1.50	0.18	0.90	0.08	6.15	0.73	368	22	<0.1	-	1.8	0.22	1.75	0.06	87	16	17.3	1.6
NSAR	<0.1	-	245	42	2.73	0.32	1.65	0.13	5.18	0.60	480	73	0.09	0.08	2.85	0.13	0.60	0.22	62	7	10.7	0.4
NSDI	0.10	0.00	94	3	1.05	0.13	0.88	0.05	6.50	0.53	215	6	0.07	0.03	1.53	0.05	1.05	0.13	49	3	19.3	0.4
NSSC	0.09	0.03	129	34	1.00	0.14	1.10	0.16	4.70	0.27	353	50	<0.1	-	1.95	0.21	1.08	0.25	47	7	14.9	1.0
NSARdep	0.06	0.03	21.5	12	2.9	0.14	1.48	0.21	4.53	0.10	93	18	nd	-	2.53	0.13	0.75	0.21	68	14	9.7	0.3

TABLE 3. Tissue metal concentrations ($\mu g.g^{-1}$ dry weight +/- SD) for Gulfwatch mussels in 2000. The geometric mean of all indigenous mussels is given; n=4 replicates/sample.

TABLE 4

Comparison of contaminant concentrations (median (MD) and MD + 1SD) of Gulfwatch and NOAA, National Status and Trends (NS&T) Mussel Watch data (O'Connor, 1998; http://ccmaserver.nos.noaa.gov/). Concentrations of metal contaminants are $\mu g.g^{-1}$ dry weight, concentrations of organic contaminants are $ng.g^{-1}$ dry weight.

			GULFWATCH						NS&T					
			2000 (n=23)		1991 (n=190)		1992 (n=131)		1993 (n=169)		1994 (n=135)		1995 (n	
taminant	MD	+1SD	MD	+1SD	MD	+1SD	MD	+1SD	MD	+1SD	MD	+1SD	MD	+1
	0.10	0.20	0.08+	0.48+	0.09+	0.55+	0.05+	0.85+	0.12+	0.56+	0.05+	0.76+	NA	N
	180	310	280	653	210	510	120	280	350	1100	480	1577	340	10
	1.70	2.30	2.33	5.43	2.08	4.46	2.47	4.67	1.97	4.29	2.40	4.39	1.88	4.
	1.60	2.40	1.43	2.73	1.41	3.50	1.21	2.71	1.16	2.21	1.80	5.18	11.1	3
	7.25	10.95	8.83+	11.67+	8.64+	10.11+	8.35+	10.5+	8.69+	10.54+	8.41+	12.62+	7.3+	9.
	400	670	400	790	338	690	340	673	350	774	607	1615	424	9
	0.27	0.47	0.11	0.24	0.10	0.23	0.11	0.20	0.10	0.21	0.11	0.23	0.11	0.
	2.35	2.78	2.07	3.60	2.09	3.85	1.64	2.66	1.46	2.78	1.98	3.46	1.6	3
	2.70	6.09	0.77	3.57	0.70	2.30	0.78	2.90	0.99	2.73	0.70	2.36	0.75	2
	94	140	130+	200+	120+	170+	120+	200+	120+	170+	115+	169+	102+	14
H	98	232	227	937	233	959	253	1201	210	1291	190	913	274	8
ST	13.9	34.1	30	116	37	132	37	131	38	127	31	127	40	1
B	49*	143*	26	145	31	186	30	157	39	152	28	207	58	1

*, ΣPCB_{24} calculated as tpcb = tpcbcon x 1.945 + 3.35 (O'Connor, 1998)

+, Median concentrations for Ag, Cu and Zn were calculated for mussels only (O'Connor, 1998)

Trace metals were detected at all Gulfwatch sites except for Ag, which was below the detection limit (0.1 µg/g dry weight) at 6 of the 23 sites and Hg, which was below the detection limit (0.1 µg/g dry weight) at 5 of the 23 sites. Some replicate samples also had Pb concentrations below detection levels. Using the NS&T MD + PC85 value as a measure of elevated concentrations, 1 site exceeded the Ag value, 4 sites exceeded the Cr value, 10 sites exceeded the Hg value, 8 sites exceeded the Pb value, 2 sites exceeded the Cu value and 1 site exceeded the Fe value. Trace metals for which a few sites exceeded the NS&T MD + PC85 value suggests localized sources of these contaminants at those sites. Thus localized sources of Ag, Cr, Al and Fe are indicated in the Gulf of Maine. All 8 sites that had elevated Pb levels and the 10 sites with elevated Hg were located in Massachusetts, New Hampshire and Maine.

3.3 Organic Chemical Concentrations

The total concentration (arithmetic mean ± SD, ng/g dry weight) of detectable polynuclear aromatic hydrocarbons (ΣPAH_{24}), polychlorinated biphenyls (ΣPCB_{24}) and organochlorine pesticides ($\Sigma TPEST_{17}$) measured in mussel tissue samples of indigenous mussels are presented in Table 5. Individual analyte concentrations of each compound class are provided in Appendices E, F and G, respectively. Overall organic contaminant concentrations for indigenous mussels are also given as medians (MD) and MD + PC85 to allow for a program-level comparison with NOAA National Status and Trends concentrations (Table 4). The 2000 Gulfwatch overall average concentration for total PCB was somewhat higher than the 1991 NS&T MD value, and the 2000 Gulfwatch overall average total PAH and total pesticide concentrations were somewhat lower than the 1991 NS&T MD and MD + PC85 values.
No sites had average concentrations that exceeded the 1991 NS&T MD + PC85 value. However, two of four replicate samples from MABI had total PCB concentrations that were >145 ng/g dry weight, and the corrected (O'Connor, 1998) average concentrations of ΣPCB_{24} at Brewster Island, MA (MABI), Duxbury, MA (MADX) and Winthrop, MA (MAWN) exceeded the NS&T MD + 1 SD of 145 ng/g DW (data not presented).

4.0 SUMMARY

4.1 Spatial Patterns

Figures 2 to 6 show the concentration of the metals measured in the tissue of *M. edulis* at the 2000 sampling stations arranged clockwise from south to north. The concentrations of most metals were relatively evenly distributed around the Gulf of Maine, with no apparent spatial trends, except where noted, and an occasional hot spot of elevated concentrations.

4.1.1 Silver (Ag)

Silver concentrations ranged from below the detection limit (0.1 µg/g dry weight) at six sites to 0.83 ± 0.33 µg/g DW at Sandwich, MA (MASN) (Table 3; Figure 2). In addition to geological sources, elevated silver exposure concentrations have been shown to coincide with regions receiving municipal sewage (Sanudo-Wlhelmy and Flegal, 1992; Buchholz ten Brink et al., 1997). Because of silver's use in the photographic and jewellery industries, the coastal waters of Massachusetts are up to 1000 times more concentrated in Ag than in Gulf of Maine waters (Krahforst and Wallace 1996). The high levels observed at Sandwich, MA (MASN), which is not near any significant source of municipal waste, may be a function of transport and deposition of sewage-derived particles (Bothner et al. 1993) that are sequestered in Cape Cod Bay and taken up by mussels.

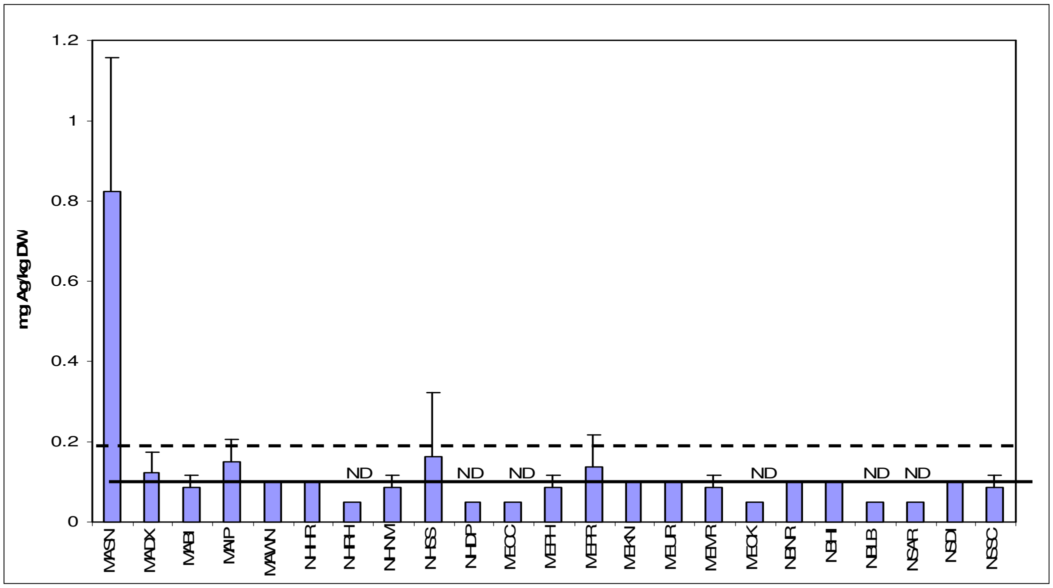

Figure 2. Distribution of silver tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; Dashed line = Gulfwatch median + 1SD.

4.1.2 Cadmium (Cd)

Cadmium is widely used in industry for batteries, plating, stabilizers and as a neutron absorber in nuclear reactors. The concentration of cadmium in mussel tissue ranged from 0.98 µg/g dry weight at Hospital Island, N.B. (NBHI) to 2.73 µg/g dry weight at Annapolis River, NS (NSAR) (Table 3; Figure 3).

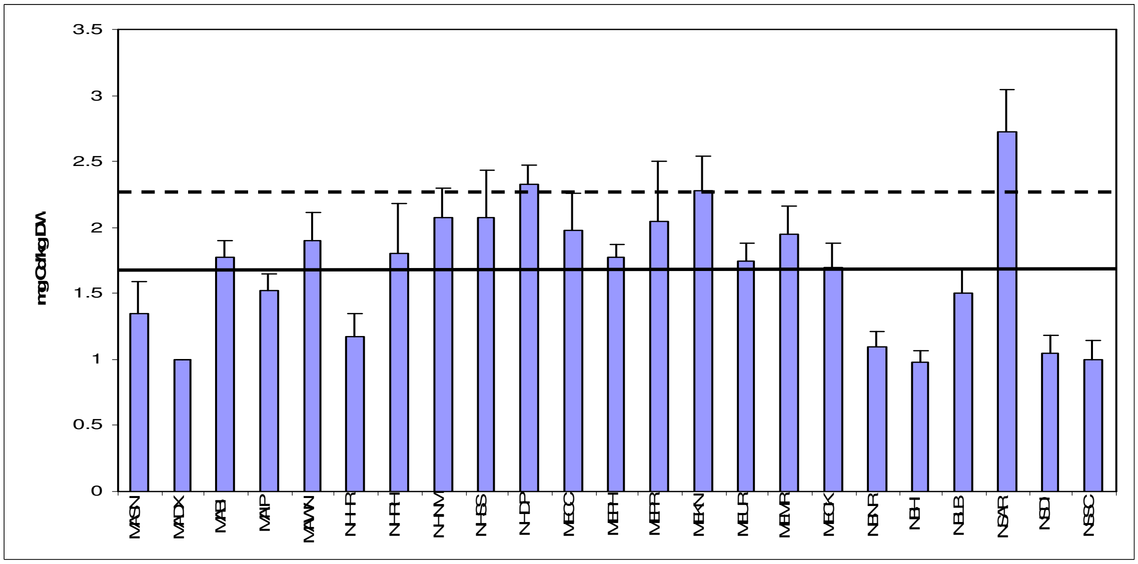

Figure 3. Distribution of cadmium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

4.1.3 Chromium (Cr)

Four sites exceeded both the Gulfwatch MD + PC85 and the NS&T MD + PC85 (North Mill Pond, NH (NHNM), Dover Point, NH (NHDP), Clark Cove, ME (MECC) and Presumpscot R., ME (MEPR) (Table 3; Figure 4). The lowest concentration was at Hospital Island, N.B. (NBHI) (0.45 µg/g dry weight) and the highest at Clark Cove, ME, NH (MECC) (3.4 µg/g dry weight). Chromium is the primary agent used in the tanning process and was discharged with untreated tannery wastes throughout much of this century. Chromium persists in the environment as shown by elevated concentrations in the sediments near such sources (Capuzzo, 1974; NCCOSC, 1997). During the 19^{th} and 20^{th} centuries, coastal New Hampshire was one of the hide tanning centres of the United States. Other tannery centres were located in Salem, MA and on the Saco River, ME (Capuzzo, 1996). Elevated Cr was also observed in the sediments of the Gulf of Maine by other studies (Mayer and Fink, 1990).

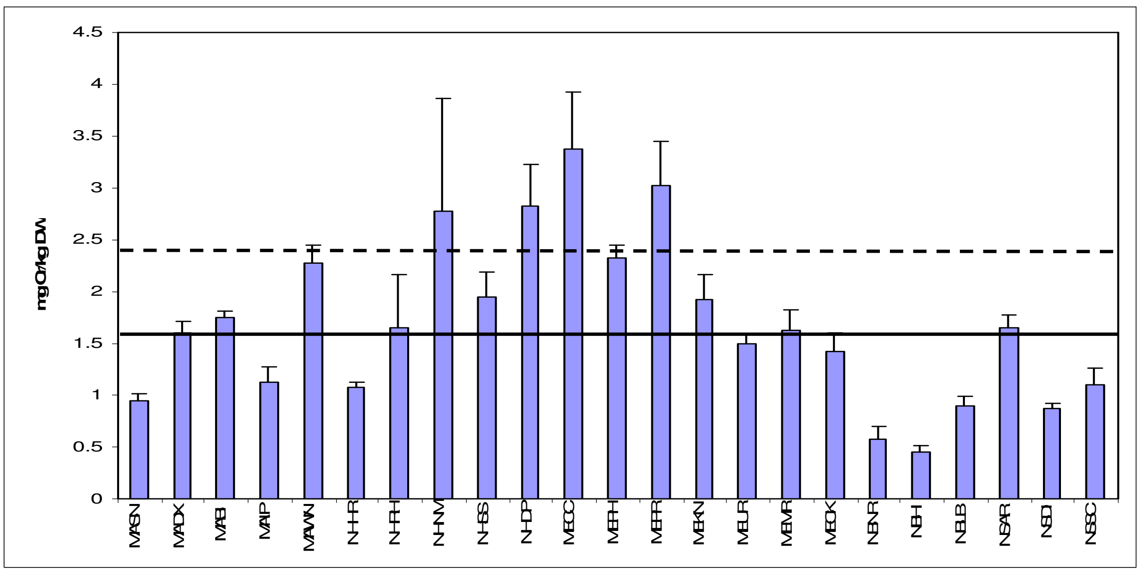

Figure 4. Distribution of chromium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

4.1.4 Copper (Cu)

The concentration of copper in mussel tissue ranged from 4.7 µg/g dry weight at Spechts Cove, NS (NSSC) to 13.0 µg/g dry weight at Presumpscot River, ME (MEPR) (Table 3; Figure 5). Two sites, Portland Harbor, ME (MEPH) and Presumpscot River, ME (MEPR), exceeded the NS&T MD + PC85 and Clark Cove, ME (MECC) exceeded the Gulfwatch median + 85%.

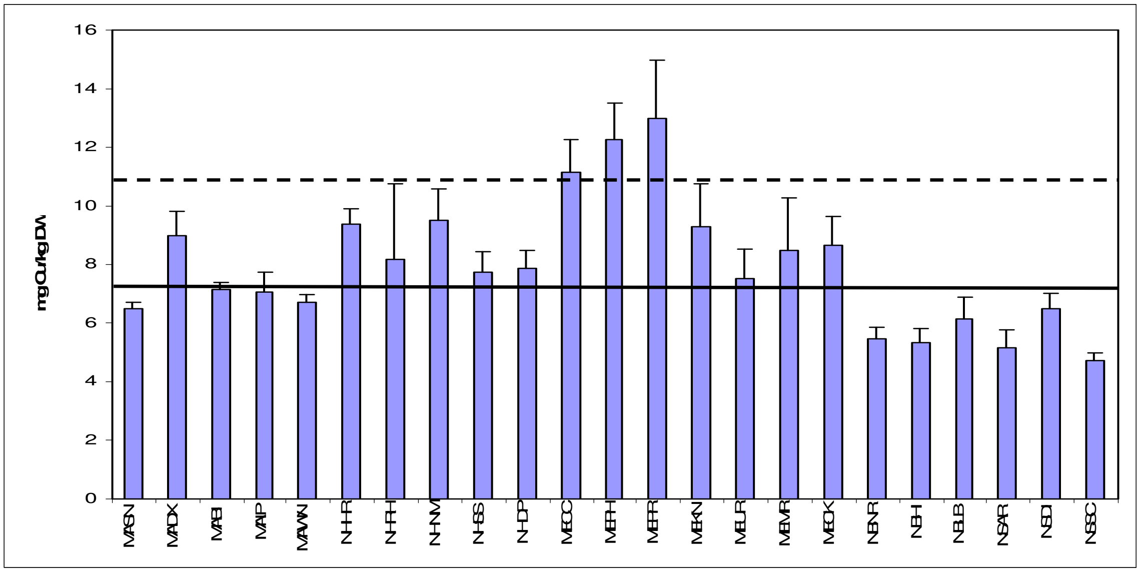

Figure 5. Distribution of copper tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

4.1.5 Mercury (Hg)

The concentration of mercury in mussel tissue ranged from not detected at Union River, ME (MEUR), Niger Reef, N.B. (NBNR), Limekiln Bay (NBLB), Hospital Island, N.B. (NBHI) and Spechts Cove, N.S. (NSSC) to 0.64 ± 0.11 µg/g at Schiller Station, NH (NHSS) (Table 3; Figure 6). None of the sites exceeded the Gulfwatch MD + PC85, however, mercury values exceeded the NS&T MD + PC85 of 0.24 µg/g dry weight at 10 of the 23 sites. In general, the mussel mercury levels at New Hampshire sites, followed by Maine, were higher than sites in other jurisdictions. There are several known historical mercury sources in the Gulf of Maine (Jones 2004, NCCOSC 1997). Mean values of Hg in *Mytilus* spp. from coastal regions world-wide range from 0.1 to 0.4 µg/g dry weight (Kennish, 1997), but can be much higher in areas like the south-west Pacific, where sites average as much as 2.7 µg Hg/g dry weight (Fowler, 1990). In a review of the first five years of the Gulfwatch program tissue concentrations of Hg were discussed as being unusually high in the Gulf of Maine and a possible concern for human consumption (Jones et al. 1998).

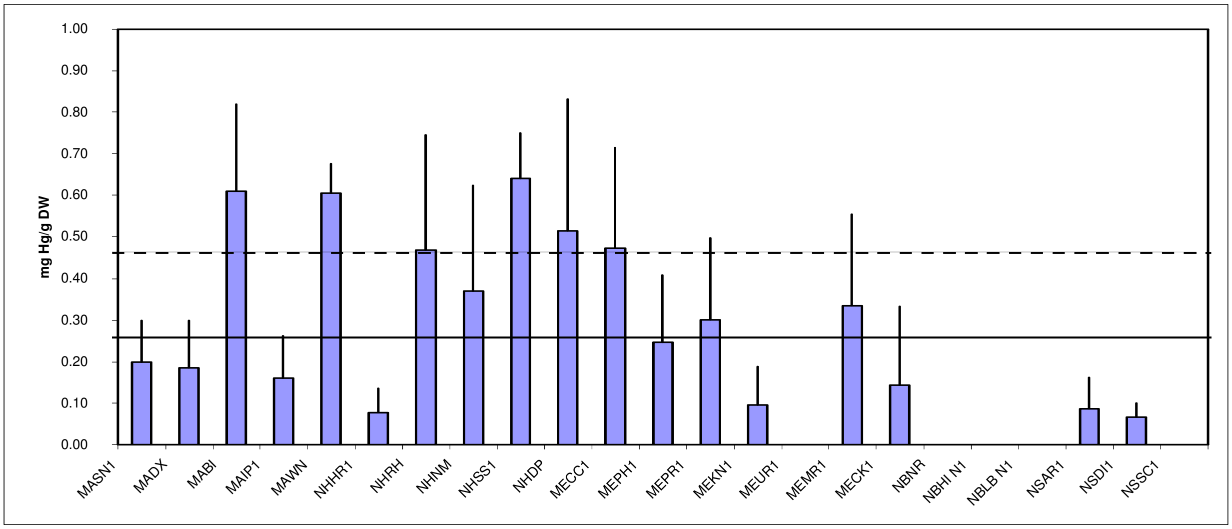

Figure 6. Distribution of mercury tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

4.1.6 Nickel (Ni)

The concentration of nickel ranged from 1.5 µg/g dry weight at Hospital Island, NB (NBHI) to 3.05 µg/g dry weight at Presumpscot River, ME (MEPR) (Table 3; Figure 7). Four sites exceeded the Gulfwatch MD + PC85 of 2.78 µg/g dry weight (Rye Harbor, NH (NHRH), Clark Cove, ME (MECC), Presumpscot R., ME (MEPR) and Annapolis River, NS (NSAR)), however, no site exceeded the NS&T MD + PC85 of 3.6 µg/g dry weight.

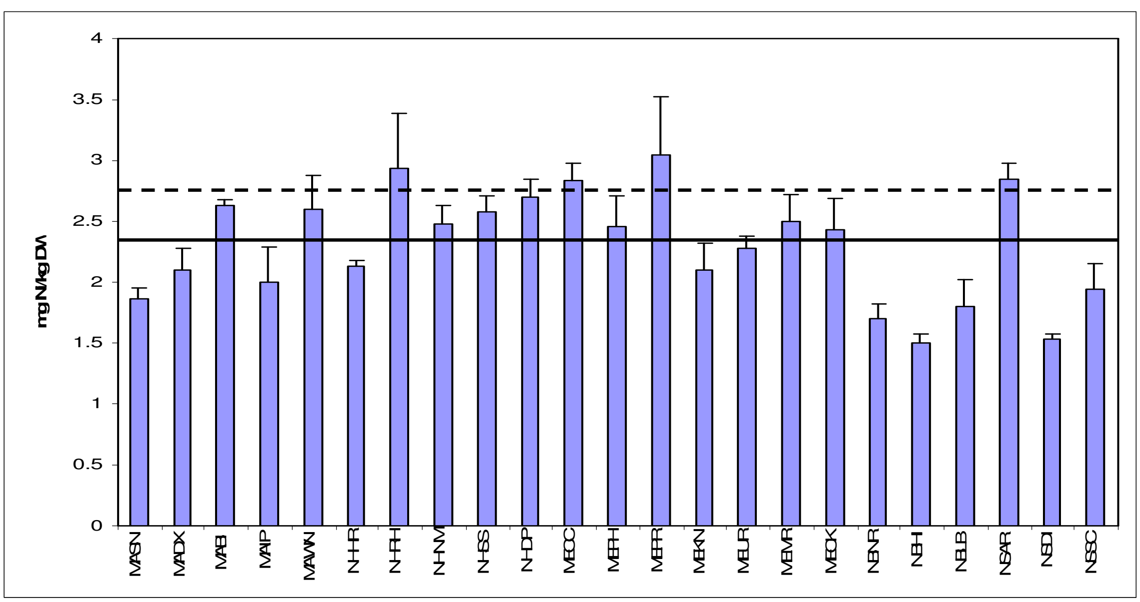

Figure 7. Distribution of nickel tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

4.1.7 Lead (Pb)

The concentration of lead ranged from a value of 0.38 ± 0.15 µg/g dry weight at Hospital Island, N.B., to 11.5 ± 0.58 µg/g dry weight at Portland Harbor, ME (MEPH) (Table 3, Figure 8). Lead levels at Brewster Island, MA (MABI), Duxbury (MADX), Winthrop (MAWN), North Mill Pond, NH (NHNM), Rye Harbor, NH (NHRH), Clark Cove, ME (MECC), Portland Harbor, ME (MEPH) and Presumpscot River, ME (MEPR) exceeded the NS&T MD + PC85 value of 3.57 µg/g dry weight. North Mill Pond, NH (NHNM), Clarks Cove, ME (MECC), Portland Harbor, ME (MEPH) and Presumpscot River, ME (MEPR) also exceeded the Gulfwatch PC85 value of 6.09 µg/g dry weight. Lead concentrations were highest at sites in the Great Bay Estuary and Casco Bay, with generally lower levels in New Brunswick and Nova Scotia (Figure 5). Elevated lead in Great Bay Estuary sites may be related to their close proximity to the Portsmouth Naval Shipyard where waste plating sludge and lead batteries, respectively were disposed of and stored (NCCOSC, 1997). The potential for the Shipyard area to be a source of lead to estuarine biota was demonstrated in July, 1999, when significant amounts of contaminated soil containing as much as 14.2 mg Pb/g soil dry weight was discovered to be eroding into the Piscataqua River (Cohen, 2000).

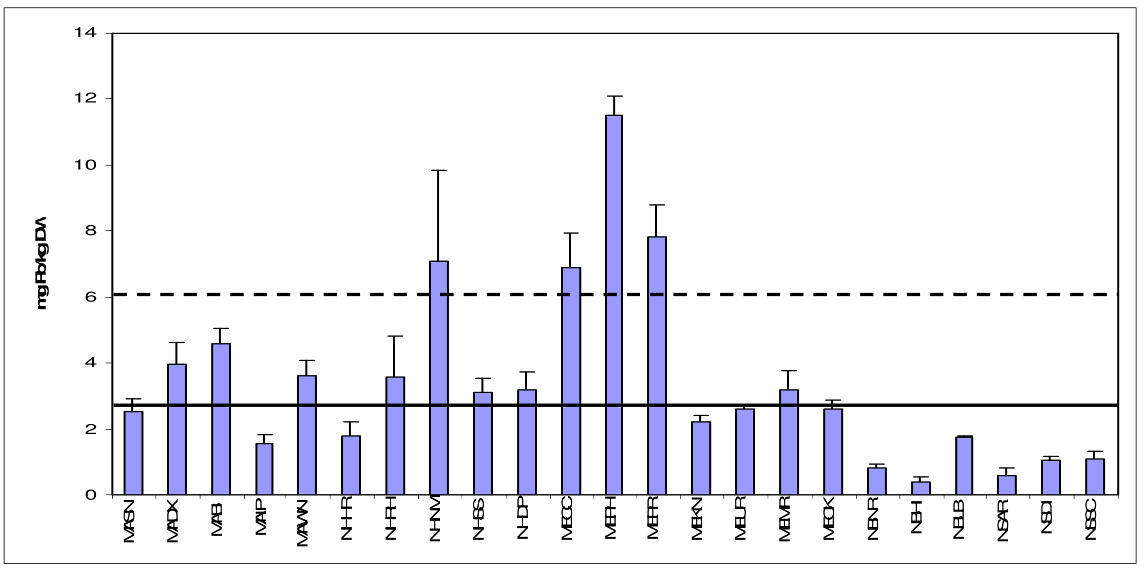

Figure 8. Distribution of lead tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Dashed line = Gulfwatch median + 1SD.

4.1.8 Zinc (Zn)

Zinc concentrations generally reflect human activity associated with tire wear, galvanized materials and industrial discharges. The concentration of zinc ranged from a value of 47 ± 7 µg/g dry weight at Spechts Cove, NS to 163± 52 µg/g dry weight at North Mill Pond, NH (NHNM) (Table 3, Figure 9). Only two sites exceeded the Gulfwatch MD + PC85 (Brewster Island, MA (MABI), North Mill Pond, NH (NHNM). However, no sites exceeded the NS&T MD + PC85 for zinc.

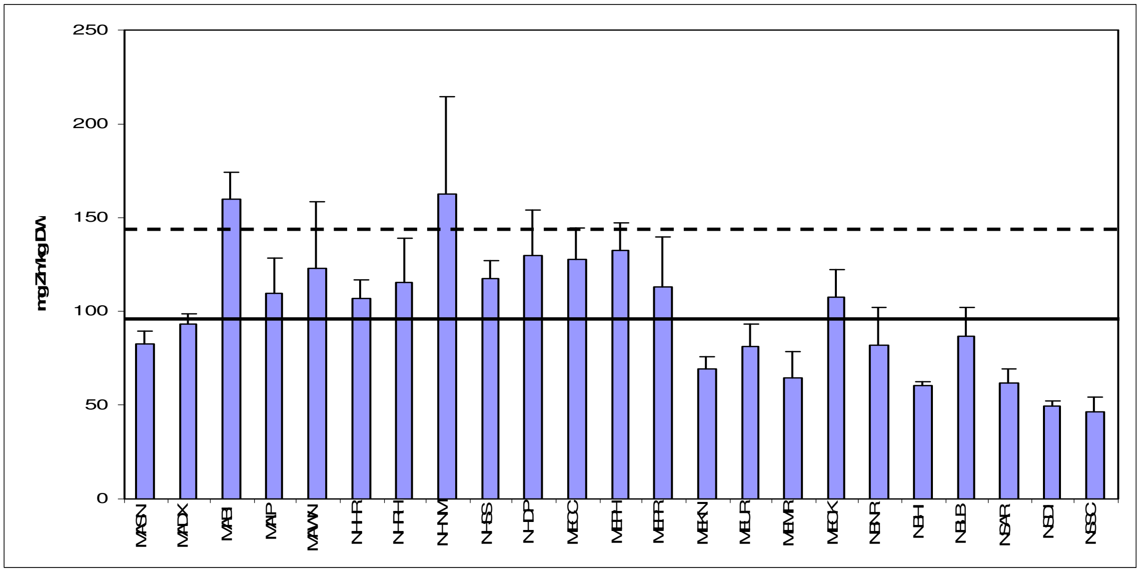

Figure 9. Distribution of zinc tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Dashed line = Gulfwatch median + 1SD.

4.1.9 Iron and Aluminium (Fe & Al)

The highest concentrations for both Al and Fe were generally found at New Hampshire and southern Maine sites (Table 3; Figs. 10 & 11). The concentration of Fe ranged from 100 µg/g dry weight at Hospital Island, N.B. (NBHI) to 973 µg/g dry weight at Presumpscot River, ME (MEPR). The concentration of Al ranged from 34 µg/g dry weight at Hospital Island, N.B. (NBHI) to 533 µg/g dry weight at Presumpscot River, ME (MEPR). Consistent with previous year results, the sites with the lowest and highest Fe concentrations also had the lowest and highest Al concentrations. The tissue analysis for Al and Fe is included to serve as an indication of the degree of sediment contamination in mussel tissue. The concern within the Gulfwatch program is that the observed elevated levels of some trace metals are a function of sediment associated metals or are associated with contaminated sediments (Robinson et al., 1993). Sites in the Bay of Fundy are dominated by extensive intertidal mudflats that can lead to considerable resuspension during windy storm events.

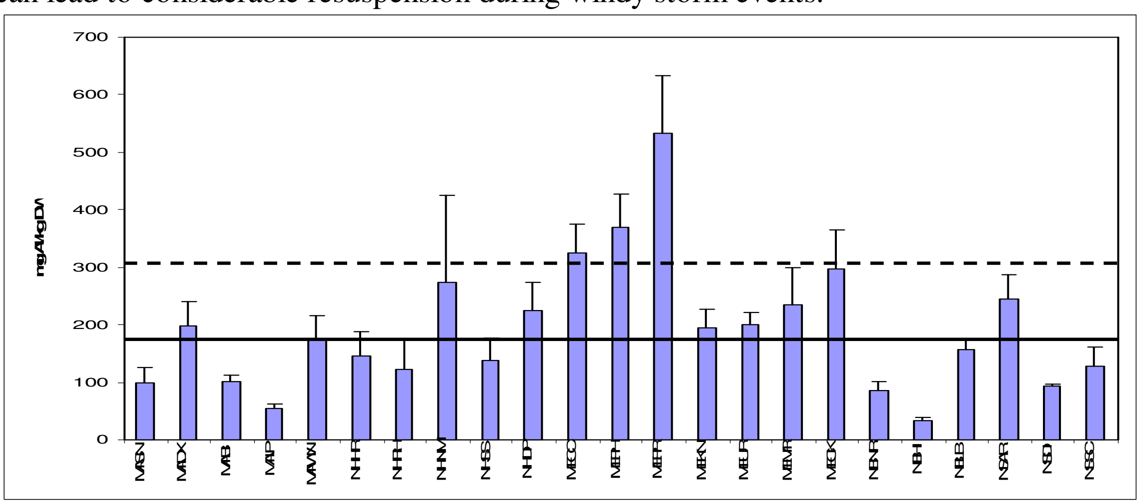

Figure 10. Distribution of aluminum tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

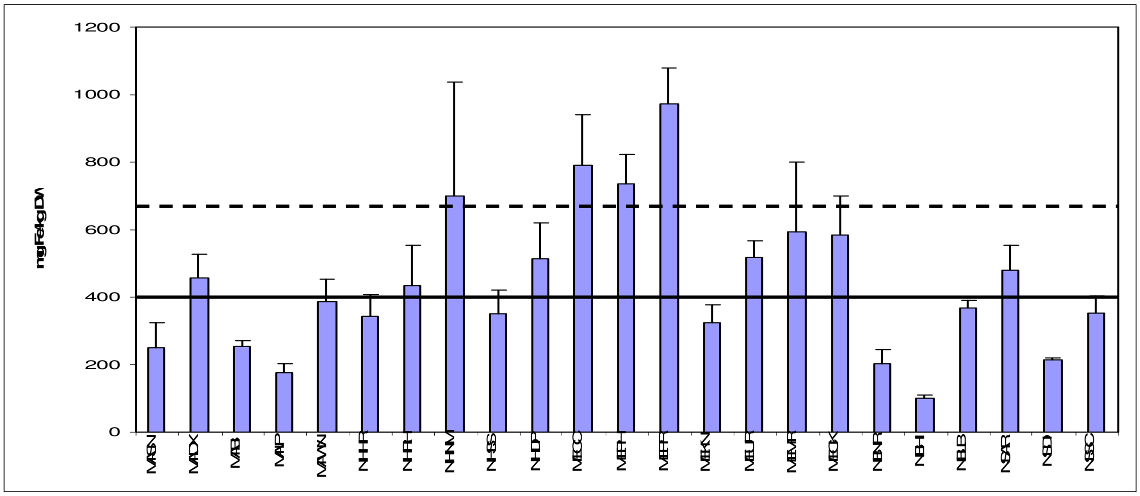

Figure 11. Distribution of iron tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2000. Solid line = Gulfwatch median; dashed line = MD + 1SD.

4.1.10 Organic Chemicals

Analytes within each category of organic contaminant were detected at most sites, except for ΣPCB_{24} at Machais River, ME (MEMR), Union River, ME (MEUR), Annapolis River, N.S. (NSAR), Digby, N.S. (NSDI), and Spechts Cove, N.S. (NSSC) (Table 5). There were much wider ranges in concentrations of organic compared to trace metal contaminants.

	PAH		PCB		Pesticides		DDTs		others	
MASN	70.8	9.2	49.5	7.6	48.0	5.9	37.0	2.9	11.0	3.2
MADX	144.0	49.9	76.0	21.8	46.5	9.0	39.2	7.5	7.3	1.5
MABI	167.8	9.4	136.9	18.6	27.8	2.0	20.4	0.5	7.4	1.8
MAIP	99.6	22.4	62.4	8.9	19.8	1.2	13.0	0.7	6.8	1.4
MAWN	182.3	26.2	94.4	14.8	21.6	1.9	16.4	0.9	5.2	1.7
NHRH	78.3	5.5	9.2	2.7	6.3	2.7	6.0	2.3	0.3	0.6
NHNM	616.5	114.3	65.3	26.5	44.3	26.0	40.8	23.2	3.5	2.9
NHSS	251.3	30.3	39.7	3.4	19.7	2.1	15.8	1.4	3.9	0.8
NHDP	230.3	8.3	39.4	4.9	18.4	3.6	14.7	2.5	3.7	1.1
MECC	177.8	21.0	31.3	6.8	8.4	4.1	6.9	3.2	1.4	3.2
MEPH	788.5	44.7	61.5	9.6	37.5	10.0	24.8	14.6	12.7	4.8
MEPR	230.0	7.2	27.9	3.2	31.6	5.2	21.3	5.2	10.2	4.5
MEKN	105.0	9.6	17.7	6.8	8.8	0.6	8.8	0.6	0.0	0.0
MEUR	45.5	7.3	0.0	0.0	5.6	0.9	2.7	0.2	2.9	0.7
MEMR	68.8	17.5	0.0	0.0	8.2	3.6	7.3	2.9	0.9	1.0
MECK	60.3	8.4	5.0	3.1	10.6	2.3	6.9	1.1	3.7	3.3
NBNR	37.5	4.0	5.1	0.5	8.4	1.1	3.3	0.2	5.2	1.1
NBHI	12.5	0.6	0.3	0.6	8.1	4.9	4.3	3.3	3.7	2.3
NBLB	46.0	12.5	11.7	1.0	15.5	2.1	8.7	1.0	6.8	2.1
NSAR	12.3	3.6	0.0	0.0	10.6	1.7	5.4	1.0	5.2	1.0
NSDI	121.0	18.6	0.0	0.0	8.4	2.5	4.0	2.5	4.4	0.2
NSSC	23.8	5.6	0.0	0.0	1.8	0.0	1.8	0.0	0.0	0.0

TABLE 4. Tissue organic contaminant concentrations ($ng.g^{-1}$ dry weight +/- SD) for Gulfwatch mussels in 2000. The geometric mean of all indigenous mussels is given; n=4 replicates/sample.

There is a pattern of higher ΣPCB_{24}, $\Sigma TPEST_{17}$ and ΣDDT_6 concentrations in the south-western Gulf compared to the north-eastern Gulf (Figs. 12 - 14). The concentrations of ΣPAH_{24} were highest in mussels from Great Bay Estuary and Casco Bay sites, somewhat lower in Massachusetts mussels and the lowest concentrations of ΣPAH_{24} were in the northern Gulf, from eastern Maine through Nova Scotia (Fig. 12). The ΣPAH_{24} concentrations ranged from 12.2 ± 3.6 ng/g dry weight at Annapolis River, NS (NSAR) to 789 ± 45 ng/g dry weight at Portland Harbor, ME (MEPH). The sites with concentrations that exceeded the Gulfwatch MD + PC85 were North Mill Pond, NH (NHNM), Schiller Station, NH (NHSS), and Portland Harbor, ME (MEPH).

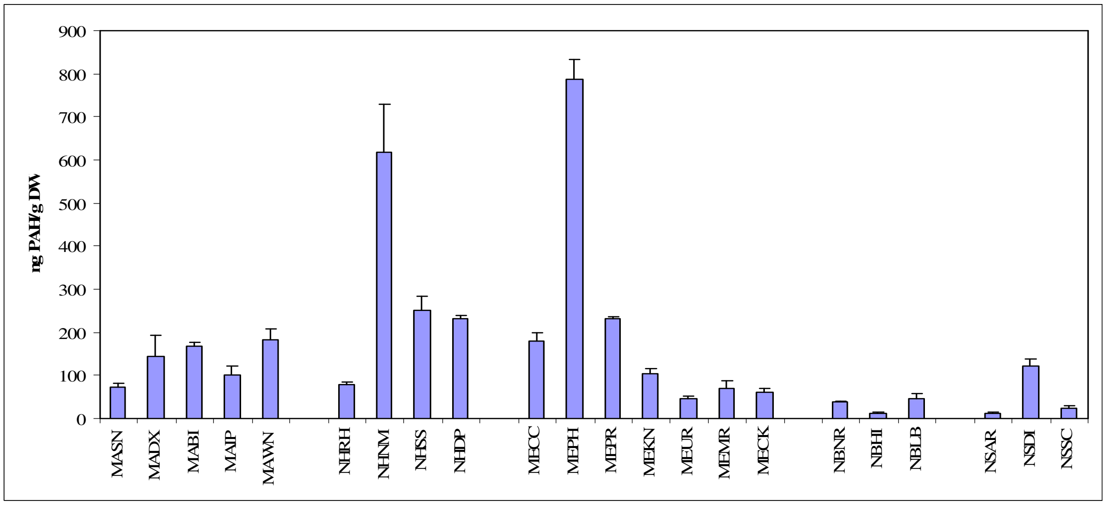

Figure 12. Distribution of ΣPAH_{24} tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 2000.

The concentrations of ΣPCB_{24} ranged from None Detected at Union River, ME (MEUR), Machais River, ME (MEMR), Apple River, N.S. (NSAR), Digby, N.S. (NSDI) and Spechts Cove, N.S. (NSSC) to 137 ± 19 ng/g DW at Brewster Island, MA (MABI) (Table 5; Figure 13). The same pattern of elevated concentrations in the southwest compared to the northeast sites can be seen.

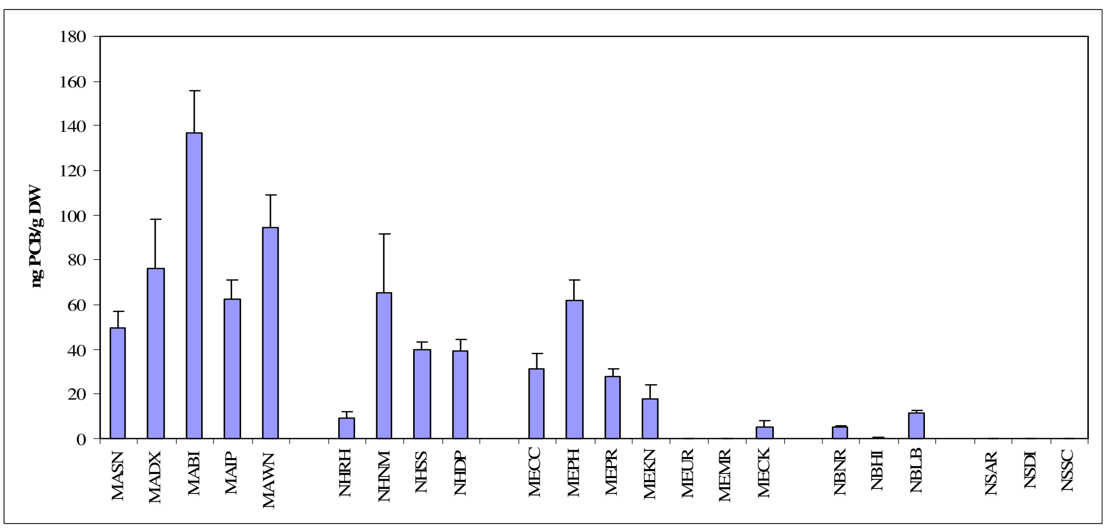

Figure 13. Distribution of ΣPCB_{24} tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 2000.

The concentration of ΣTPEST$_{17}$ ranged from 1.8 ng/g dry weight at Spechts Cove, NS (NSSC) to 48 ± 6 ng/g dry weight at Sandwich, MA (MASN) (Table 5; Figure 14). In 2000 as in previous reports, ΣDDT$_6$ and its degenerative metabolites were the main contributors to total detectable pesticides, and exhibited the same spatial pattern as seen for ΣTPEST$_{17}$ (Figure 15). ΣDDT$_6$ is the only contributor to ΣTPEST$_{17}$ mussels from Kennebec River (MEKN) and Spechts Cove, NS (NSSC) (Figure 16).

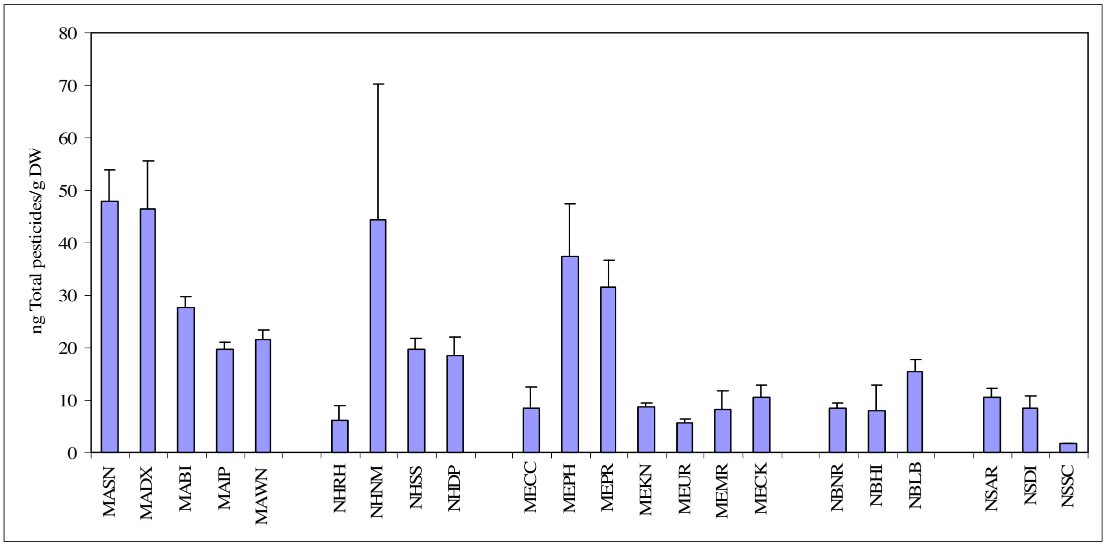

Figure 14. Distribution of ΣTPEST$_{17}$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 2000.

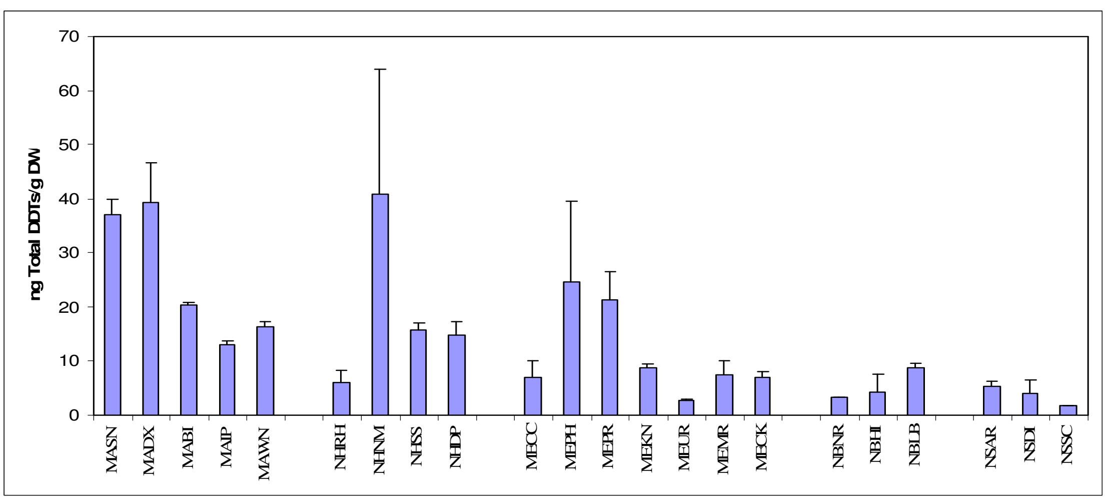

Figure 15. Distribution of ΣDDT$_6$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 2000.

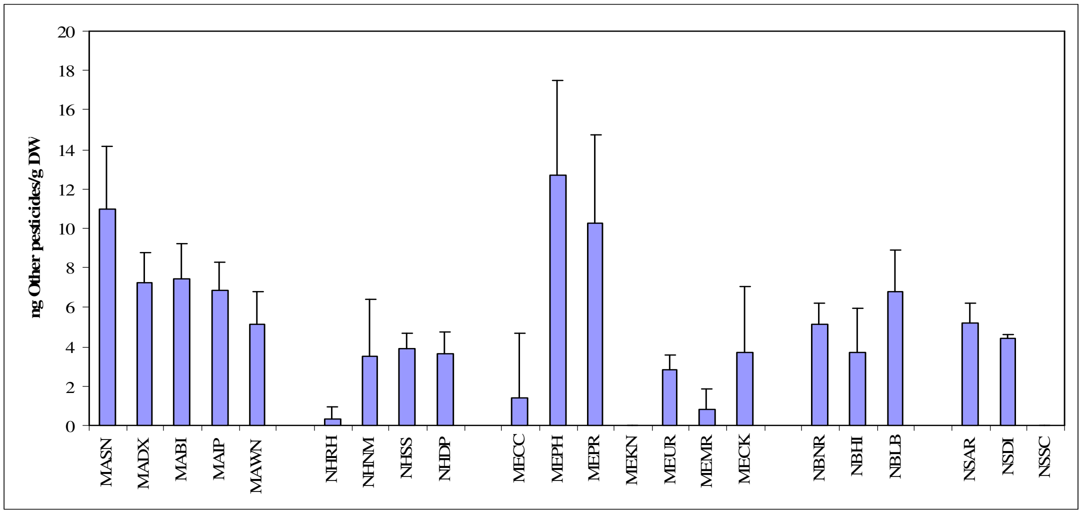

Figure 16. Distribution of other pesticides (no DDT) tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 2000.

4.2 Temporal Patterns

Temporal patterns were determined by comparison of 2000 data to that of previous years. This was successful for 14 of the 3-year rotational sites where data from 1994 and 1997 were also available, and all 5 benchmark sites. For the 3-year rotational sites, there were examples of apparent linear temporal trends either increasing or decreasing for each metal and organic chemical (Figs. 17-29). However, the trends were often heavily influenced by large differences between one year compared to the other two years. The trends for Hg are under scrutiny as there was a mistake discovered in calculations by the analytical lab for the 1999 and 2000 samples. The Hg concentrations at almost every site were much lower in 2000 than in previous years, suggesting the problem may also have occurred in previous years. Until a thorough investigation has been conducted, Hg data for 1994 and 1997 are considered suspect for temporal analyses.

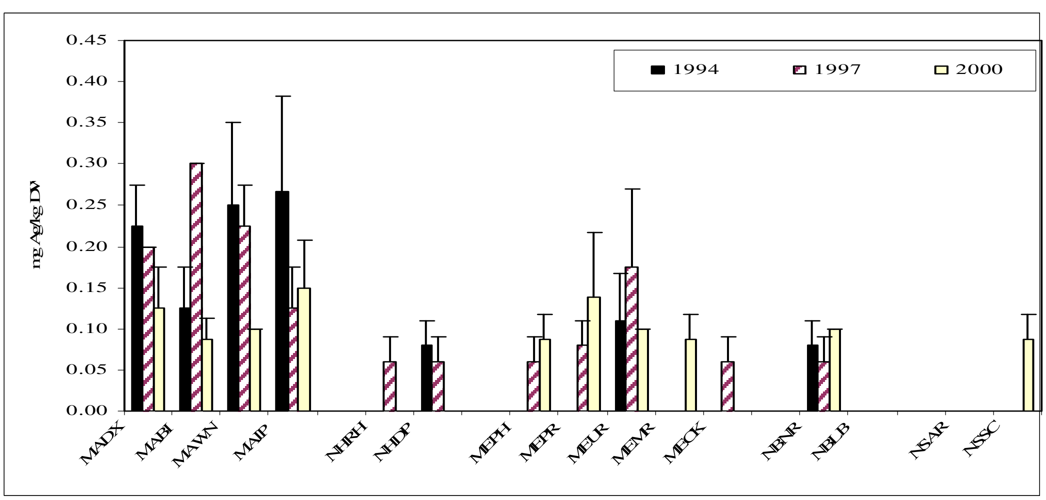

Figure 17. Distribution of silver tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

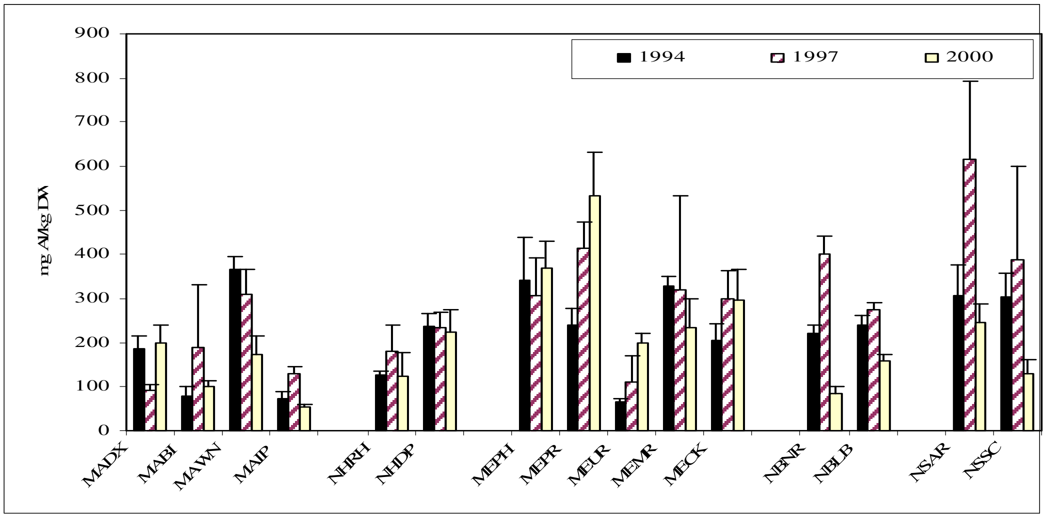

Figure 18. Distribution of aluminum tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

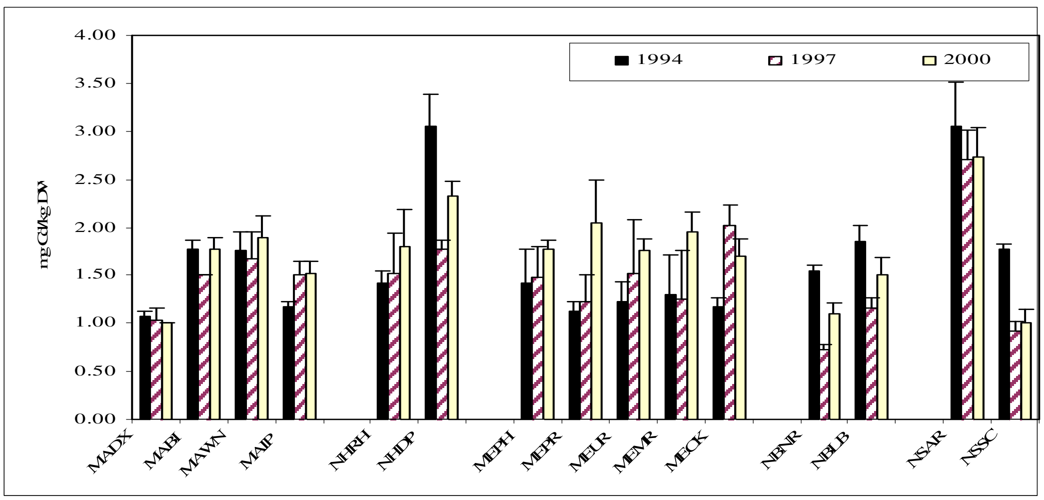

Figure 19. Distribution of cadmium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

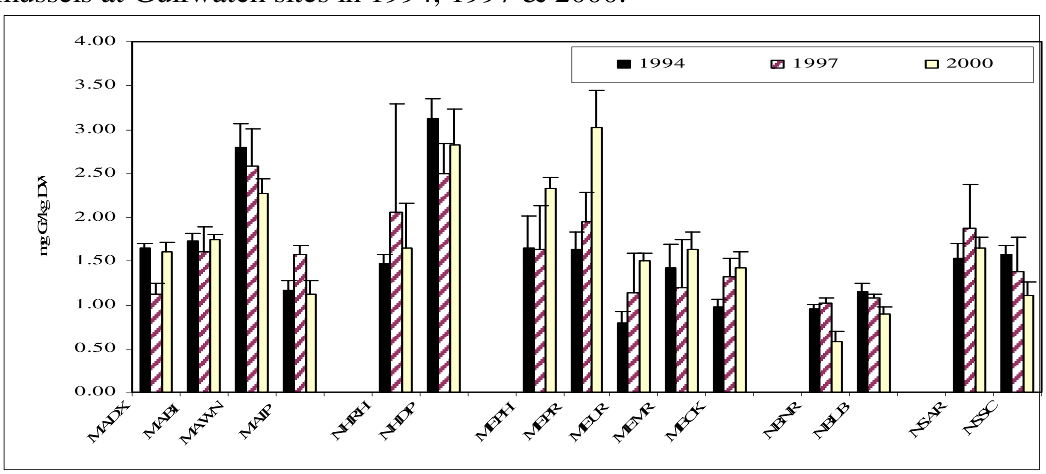

Figure 20. Distribution of chromium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

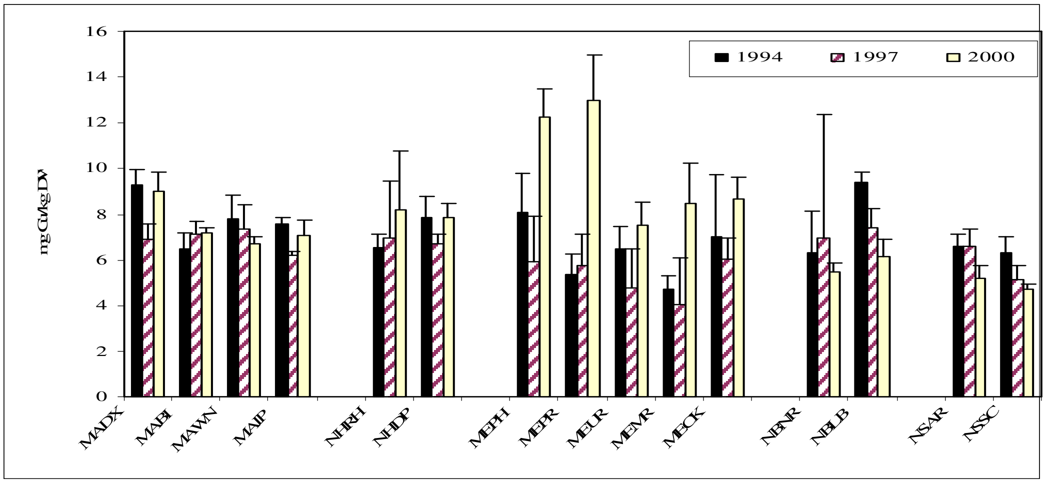

Figure 21. Distribution of copper tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

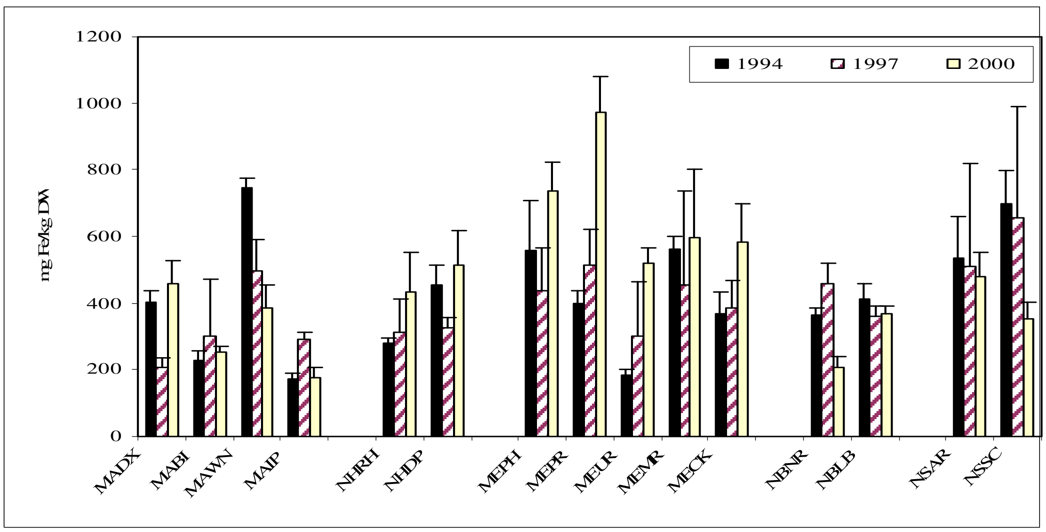

Figure 22. Distribution of iron tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

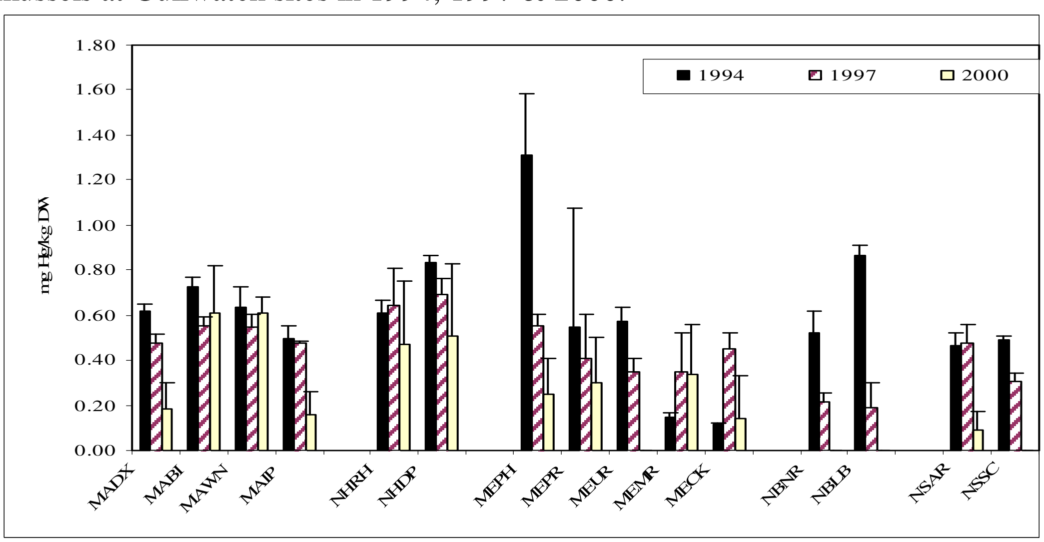

Figure 23. Distribution of mercury tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

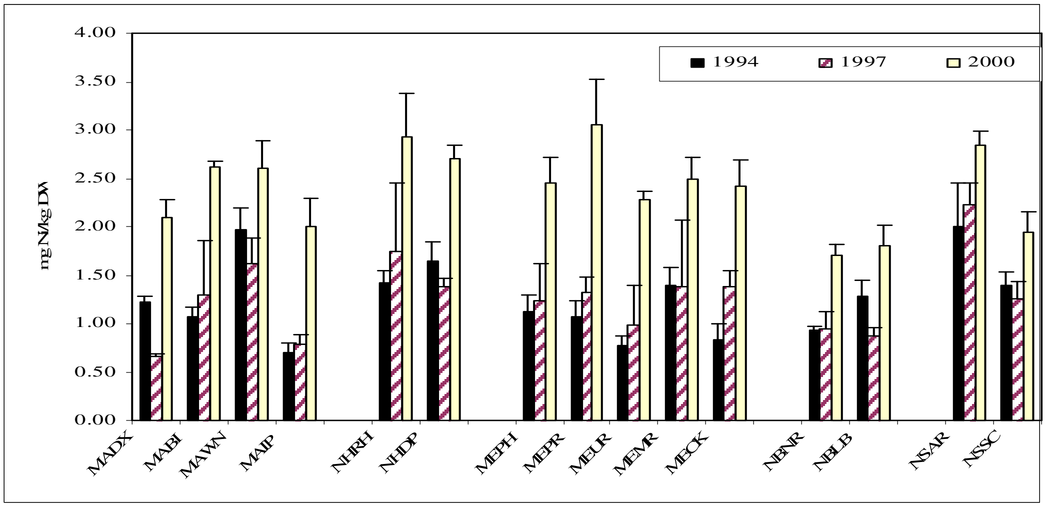

Figure 24. Distribution of nickel tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

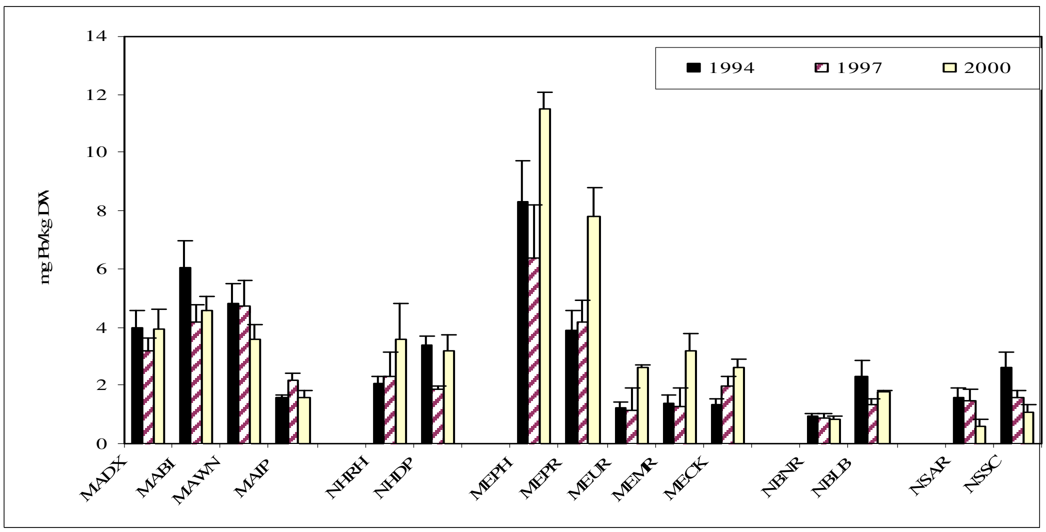

Figure 25. Distribution of lead tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

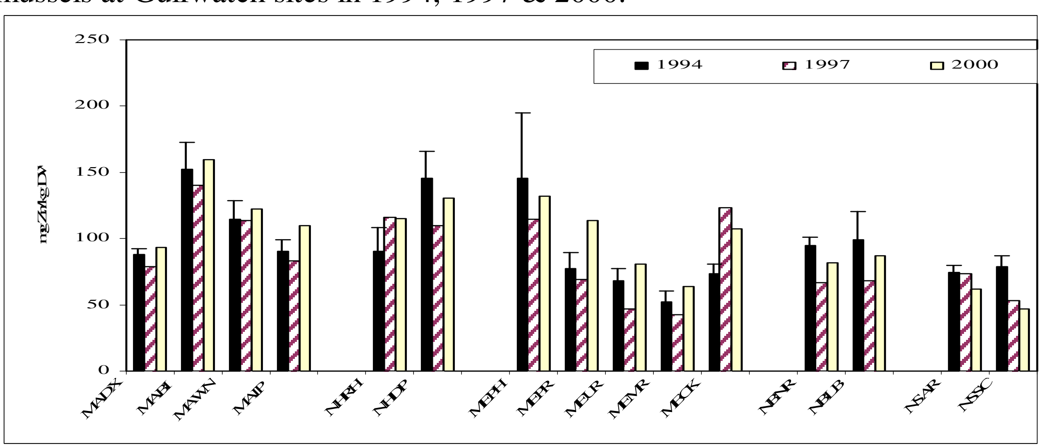

Figure 26. Distribution of zinc tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

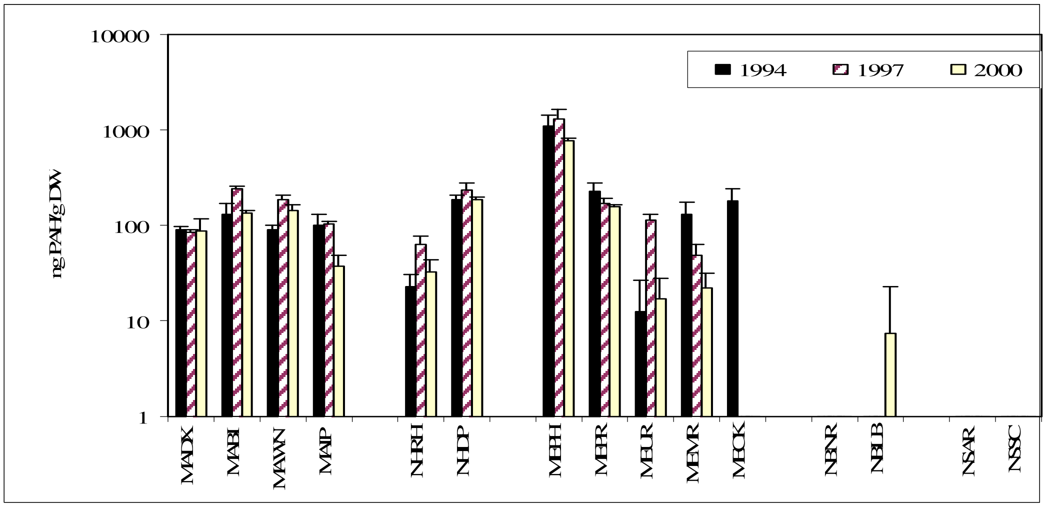

Figure 27. Distribution of ΣPAH24 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

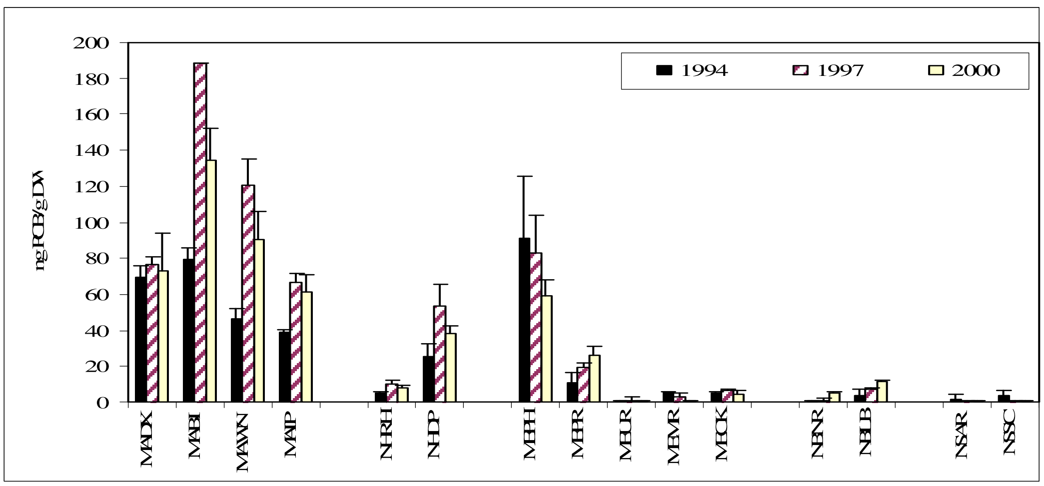

Figure 28. Distribution of ΣPCB24 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

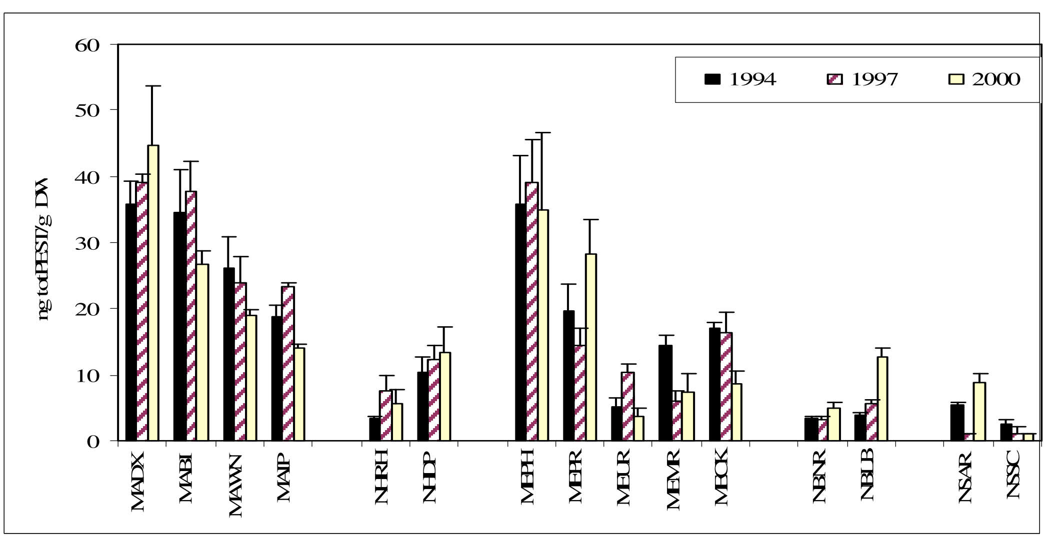

Figure 29. Distribution of $\Sigma PEST_{17}$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites in 1994, 1997 & 2000.

Temporal trends for metals at benchmark sites showed mostly decreasing trends (Figs. 30-42). Statistically significant decreasing trends for several contaminants were reported in Jones et al. (in press) using the full 1993-2001 database for benchmark sites. The sites with significant trends were Sandwich, MA (MASN) for Ag, Pb and Cr, Clark Cove, ME (MECC) for p,p'-DDE, Hospital Island, NB (NBHI) for Pb and Digby, N.S. (NSDI) for Pb and Cr. Again, the Hg trends are questionable, as evidenced by the corrected values being so much lower than previous year results.

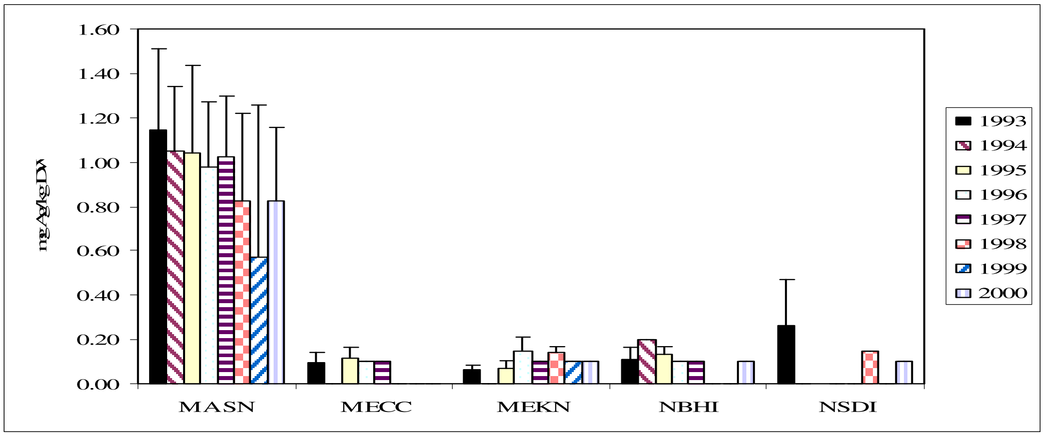

Figure 30. Distribution of silver tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

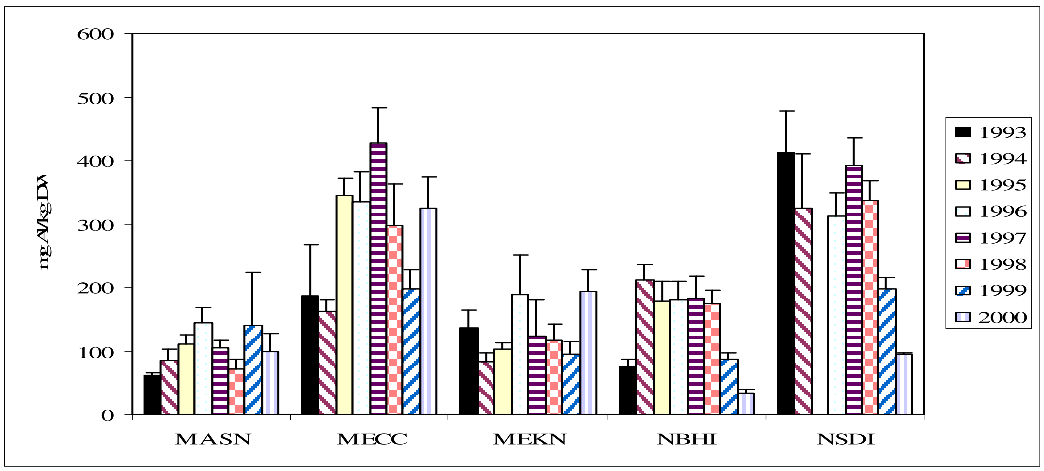

Figure 31. Distribution of aluminum tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

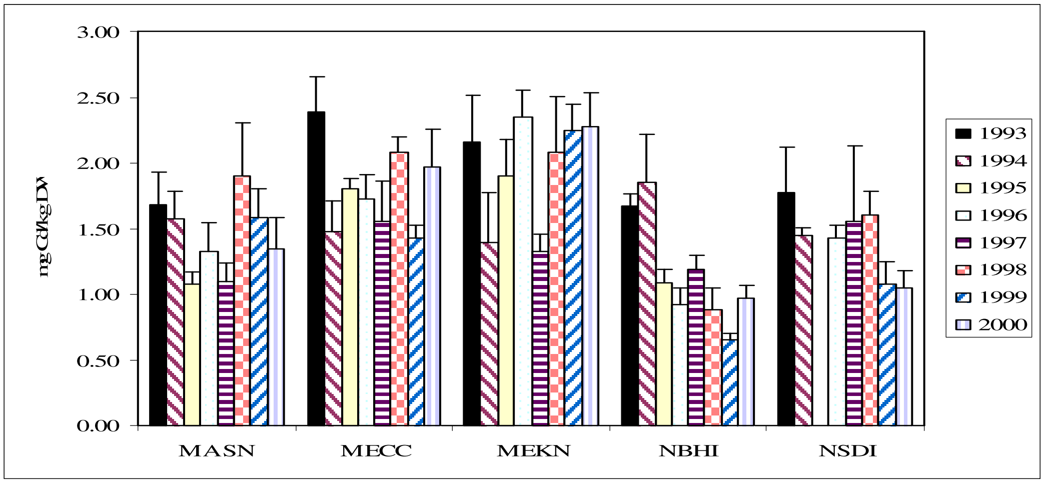

Figure 32. Distribution of cadmium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

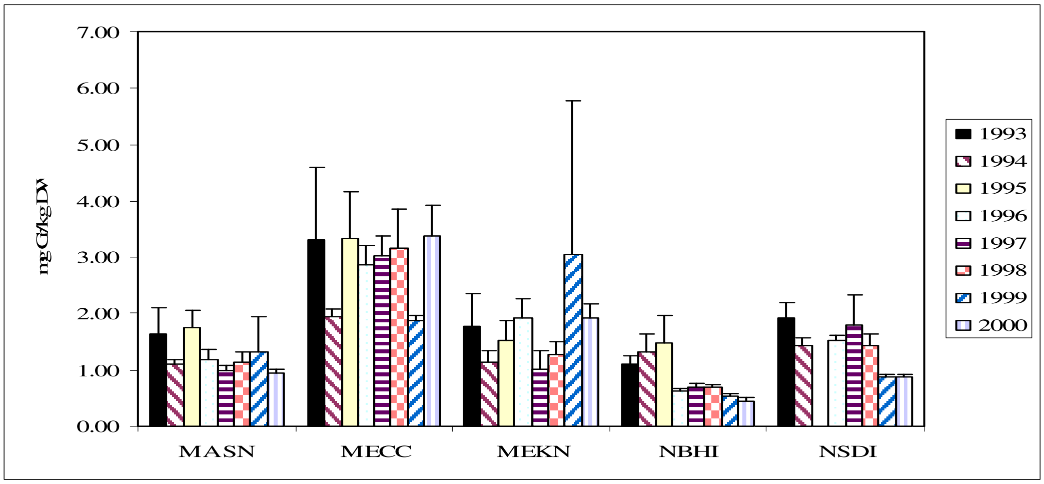

Figure 33. Distribution of chromium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

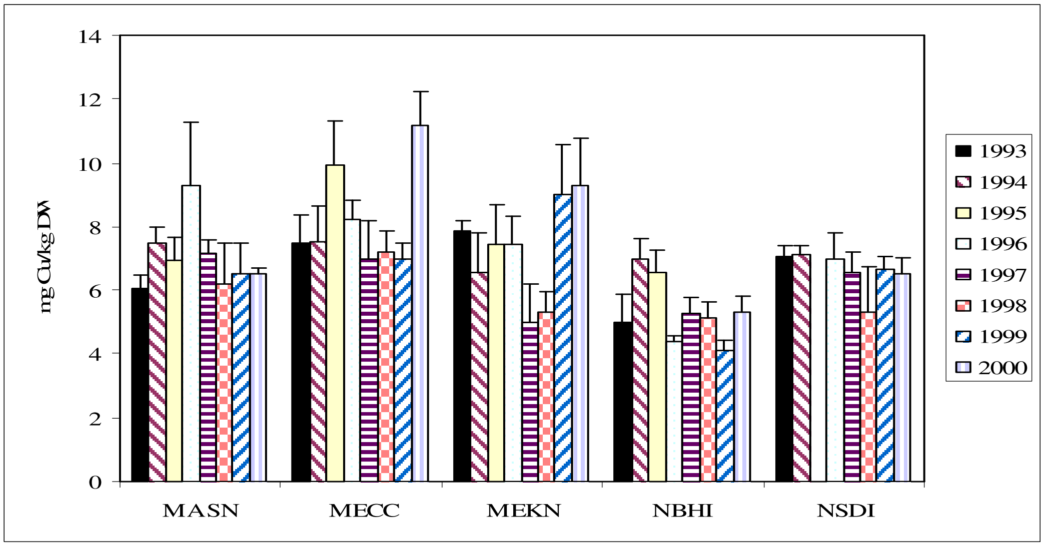

Figure 34. Distribution of copper tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

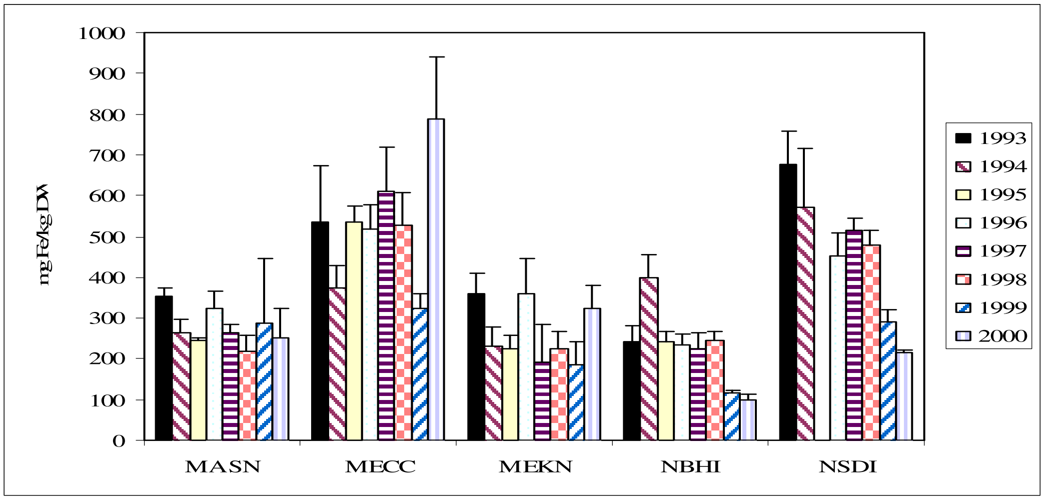

Figure 35. Distribution of iron tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

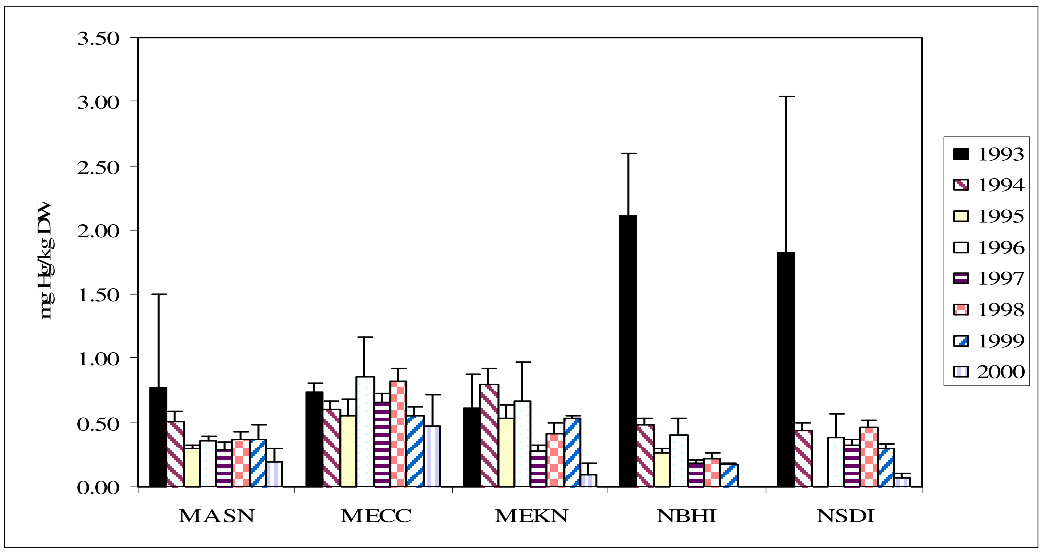

Figure 36. Distribution of mercury tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

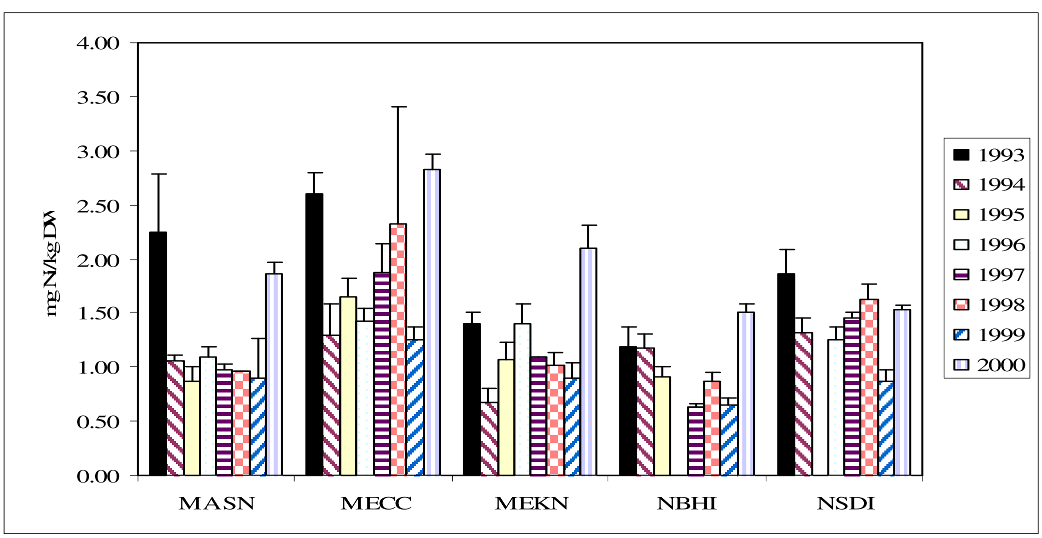

Figure 37. Distribution of nickel tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

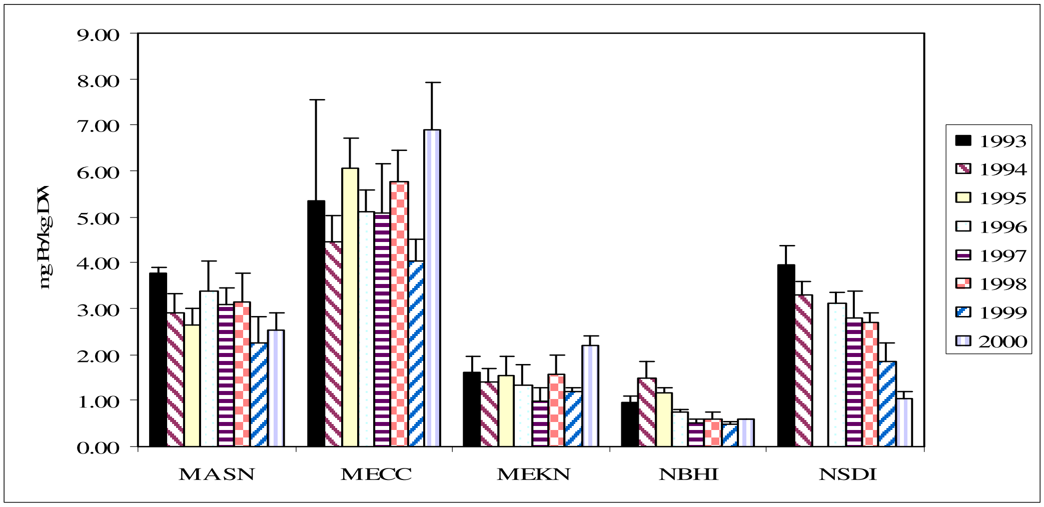

Figure 38. Distribution of lead tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

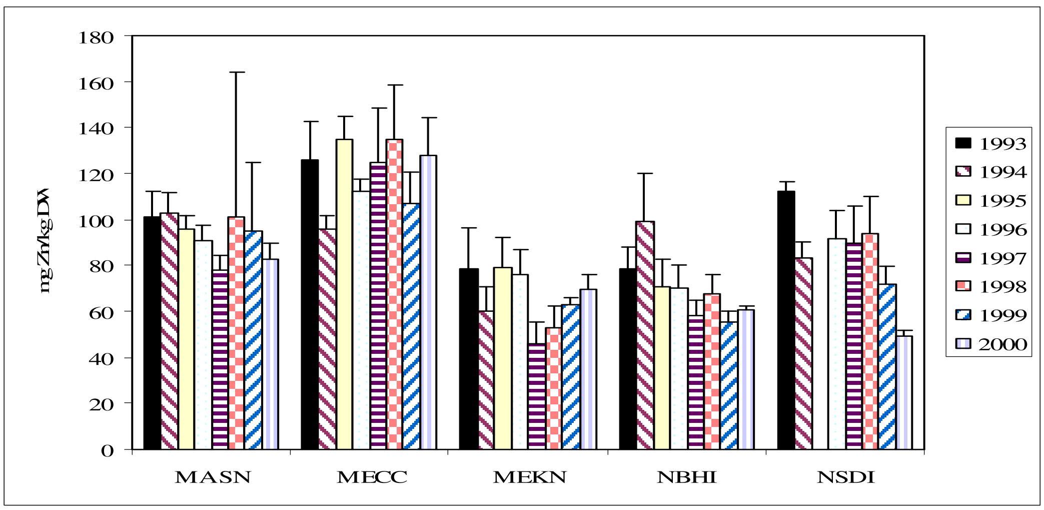

Figure 39. Distribution of zinc tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2000.

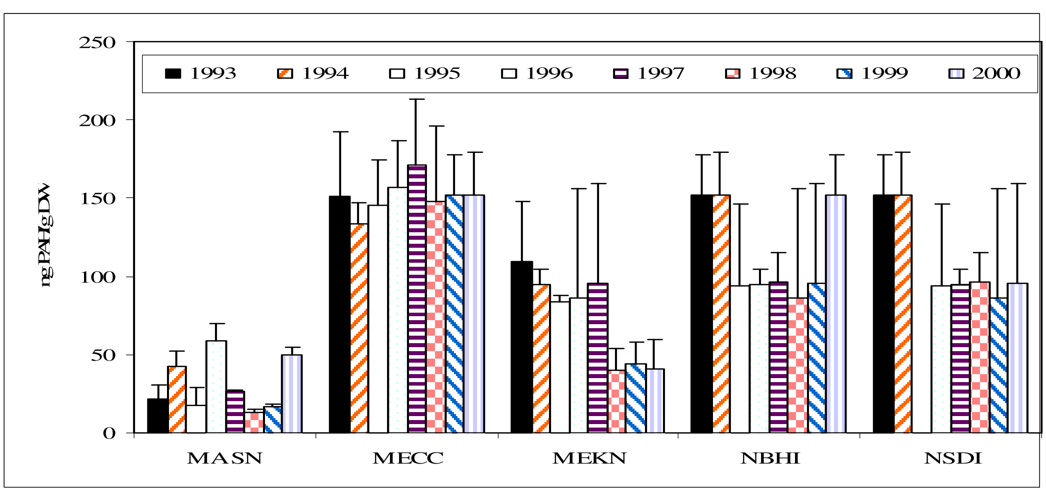

Figure 40. Distribution of ΣPAH24 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993- 2000.

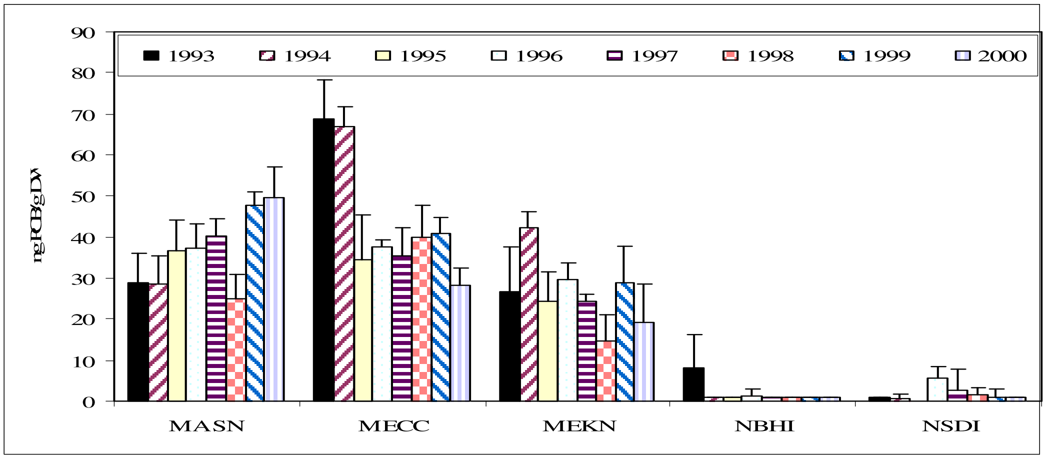

Figure 41. Distribution of ΣPCB24 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993- 2000.

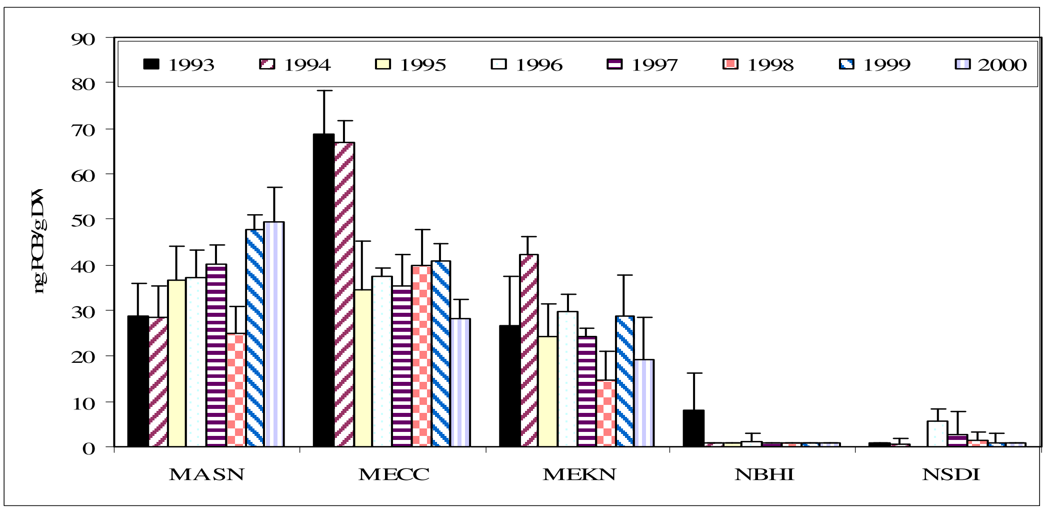

Figure 42. Distribution of ΣPEST17 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993- 2000.

4.3 Depuration Effects

To test the hypothesis regarding an association between high sediment load and higher metal contaminant concentrations a study at Annapolis River, N.S. was carried out. Annapolis River was chosen as an area with large tides and high sediment resuspension during wind events. Results of the depuration study revealed significant differences in contaminant tissue concentrations were observed between depurated and non-depurated mussels for only Al and Fe (Figure 43). No corrected Hg data were available for the depurated oysters. This small study suggests that the lack of significant differences of most metals between depurated and non-depurated mussels lends confidence to other contaminant levels measured at the other Gulfwatch sites. The results may also suggest that the sediment in the Annapolis River mussels was relatively uncontaminated and that removal of the fine sediment particles based on reduced Al and Fe levels may not have much impact on analytical results. Depuration of sediments at sites with higher levels of contamination may have a larger effect on tissue metal levels.

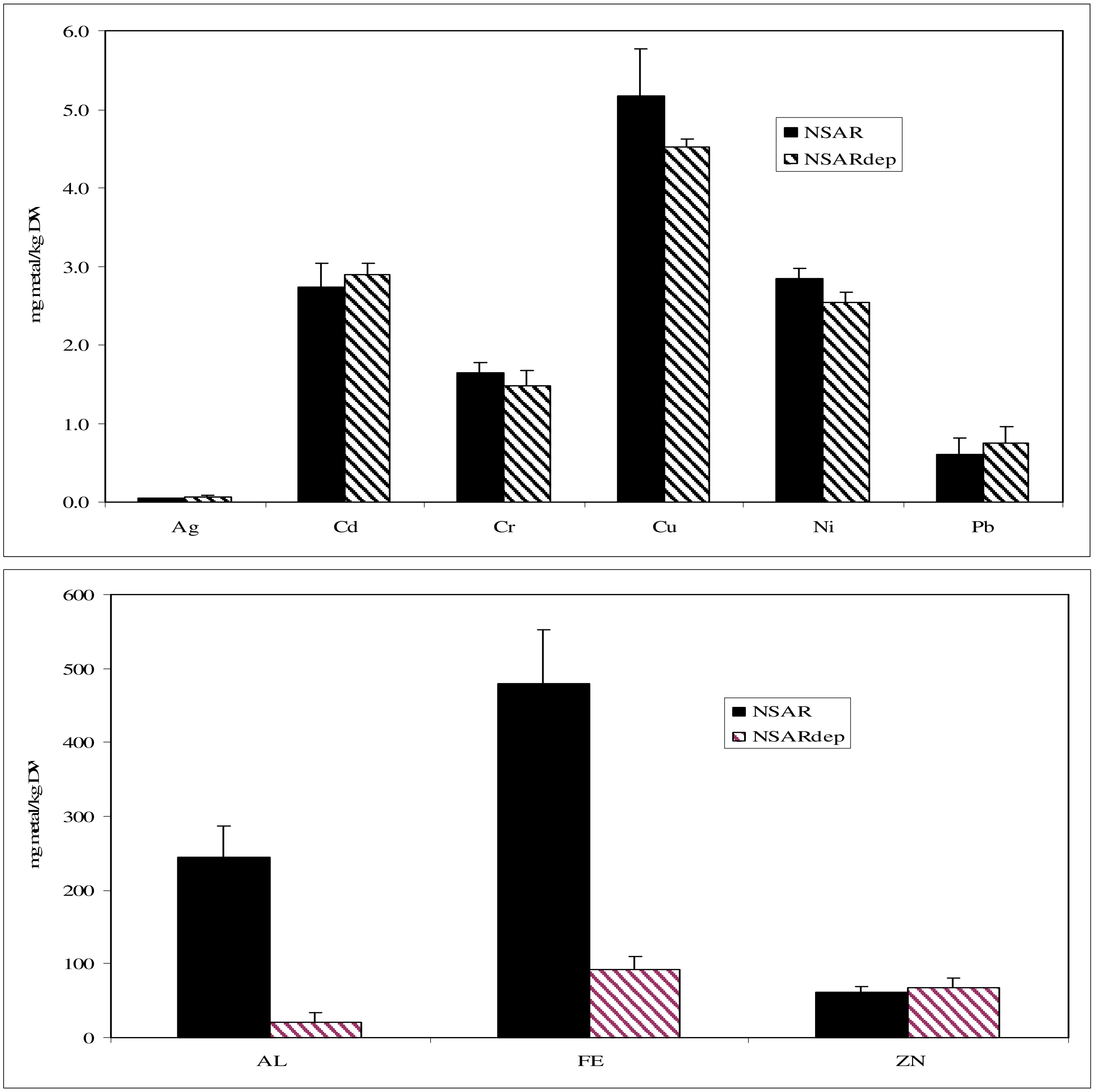

Figure 43. Effect of depuration on tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels from the Apple River (NSAR) Gulfwatch site in 2000.

4.4 Dry Weight and Lipid Fractions

The average % dry weight values ranged from 7.1% at Union River, ME (MEUR) to 19.8% at Hospital Island, N.B. (NBHI) (Table 6; Figure 44). The dry weights of 6 of the 7 samples from Maine (excluding MECC) were lower than for samples from other jurisdictions. The average % lipid values (Table 6) ranged from 4.2% at Apple River, N.S. (NSAR) to 9.6 at Machais River, ME (MEMR). The lipid fractions were somewhat lower in the southwestern Gulf of Maine sites compared to sites in the northeastern portion of the Gulf of Maine.

Sample Code	% DW	SD	Sample Code	% lipids	SD

MASN	17%	0.01061	MASN	7%	0.00948
MADX	16%	0.00739	MADX	6%	0.00463
MABI	14%	0.01511	MAOB	5%	0.00281
MAWN	15%	0.01444	MAWP	5%	0.00697
MAIP	16%	0.00643	MAIP	7%	0.00382
NHHR	17%	0.00732	NHHR	6%	0.00133
NHRH	13%	0.00261	NHRH	4%	0.00684
NHNM	13%	0.00875	NHNM	5%	0.00536
NHSS	14%	0.00481	NHSS	5%	0.0081
NHDP	14%	0.00376	NHDP	5%	0.00466
MECC	15%	0.00436	MECC	4%	0.00448
MEPH	9%	0.00357	MEPH	5%	0.00198
MEPR	8%	0.00572	MEPR	6%	0.0125
MEKN	10%	0.0116	MEKN	8%	0.02286
MEUR	7%	0.00425	MEUR	5%	0.00325
MEMR	9%	0	MEMR	10%	0
MECK	10%	0.01152	MECK	9%	0.00957
NBNR	16%	0.00895	NBNR	6%	0.00456
NBHI	20%	0.00683	NBHI	7%	0.00984
NBLB	15%	0.01202	NBLB	8%	0.00998
NSAR	11%	0.00362	NSAR	4%	0.00367
NSDI	19%	0.00523	NSDI	8%	0.0092
NSSC	15%	0.01113	NSSC	6%	0.0029

Table 6. Mussel tissue % dry weight and % lipids for all Gulfwatch sites in 2000.

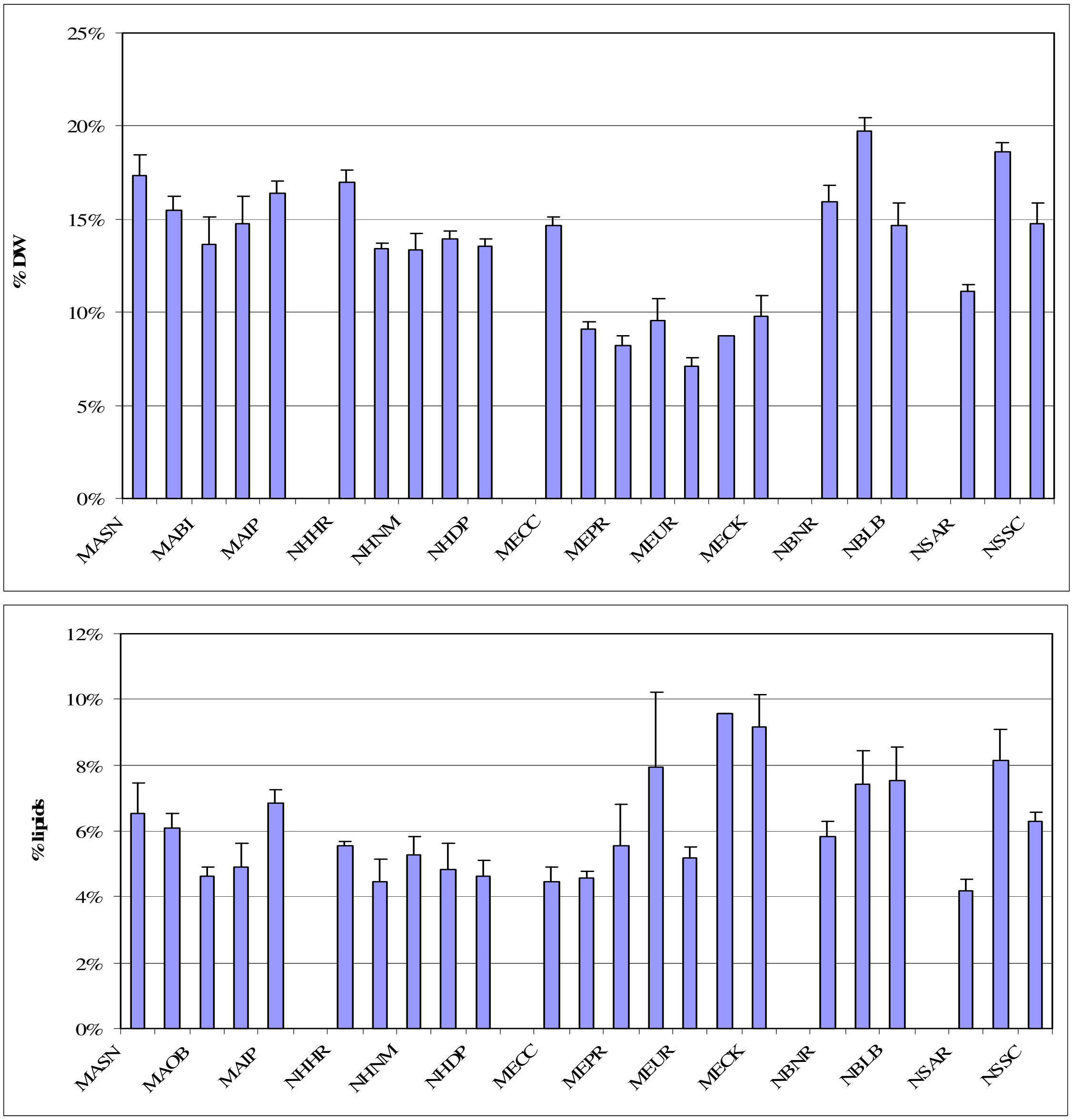

Figure 44. The % dry weight and % lipid contents of mussels at all Gulfwatch site in 2000.

4.5 Shell Length and Condition Index

The average lengths for mussel shells from all sites ranged from 53.0 ± 2.3 mm at Winthrop, MA (MAWN) to 58.0 ± 4.8 mm at Niger Reef, N.B. (NBNR) (Table 7; Figure 45). The targeted range for shell length was ≥50 mm to ≤60 mm. All mussels were within this range at 13 of the 23 sites, and 5 other sites had low (<6%) incidences of mussels outside that range. The other 5 sites, 2 in Massachusetts (Sandwich-MASN, Duxbury-MADX) and all 3 in New Brunswick (Niger Reef-NBNR, Hospital I.-NBHI, Limekiln Bay-NBLB), had 16-35% of all mussels with shell lengths that were outside of the desired range.

The condition index (CI) was calculated on 3 replicate batches of 10 mussels at each site. The CI values ranged from 0.126 ± 0.041 at Dover Point, NH (NHDP) to 0.291 ± 0.039 at Portland Harbor, ME (MEPH) (Table 7; Figure 46). The CI values at all Maine sites (except MECC) were high relative to the rest of the sites while all NH sites had relatively low CI values. The low dry weight and high condition index, which is based on a wet weight of the tissue, may be related to a different method used by the Maine Gulfwatch participants in 2000 for draining seawater from mussels during shucking.

Site	LENGTH Average	LENGTH Std. Dev.	LENGTH % outside length range	CONDITION INDEX Average	CONDITION INDEX Std. Dev.
		Massachusetts			
MASN	54.7	6.1	21%	0.192	0.025
MADX	55.2	5.0	28%	0.174	0.021
MABI	54.0	2.7	0%	0.141	0.013
MAIP	55.9	2.4	0%	0.180	0.020
MAWP	53.0	2.3	4%	0.149	0.022
		New Hampshire			
NHHR	54.4	2.2	0%	0.175	0.036
NHRH	55.7	2.7	4%	0.133	0.018
NHDP	56.1	2.3	0%	0.126	0.041
NHNM	55.3	2.4	0%	0.193	0.038
NHSS	55.6	2.7	6%	0.166	0.024
		Maine			
MECC	56.1	2.3	5%	0.202	0.041
MEPR	54.7	2.7	0%	0.210	0.041
MEPH	55.0	2.7	0%	0.291	0.039
MEKN	55.8	2.9	0%	0.260	0.026
MEUR	55.8	2.7	0%	0.263	0.033
MEMR	53.8	2.5	0%	0.267	0.037
MECK	54.5	3.0	0%	0.223	0.068
		New Brunswick			
NBNR	58.0	4.8	35%	0.215	0.053
NBHI	56.9	3.8	21%	0.230	0.050
NBLB	54.6	3.6	16%	0.160	0.066
		Nova Scotia			
NSAR	53.7	2.5	0%	0.187	0.027
NSAR-dep	53.9	2.6	0%	0.193	0.033
NSDI	55.2	2.8	1%	0.219	0.023
NSSC	55.8	2.5	0%	0.197	0.026

Table 7. Mussel length (mm) and condition index for all Gulfwatch sites in 2000.

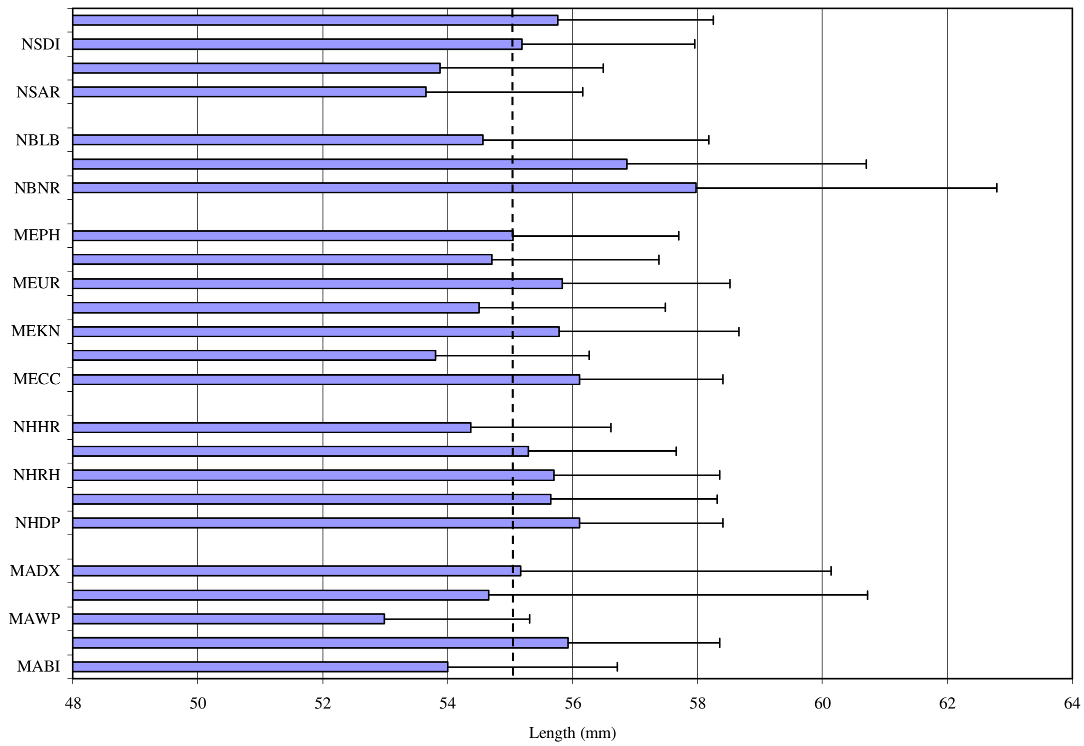

Figure 45. The average mussel shell length at each Gulfwatch site in 2000. The dashed line is the overall average shell length.

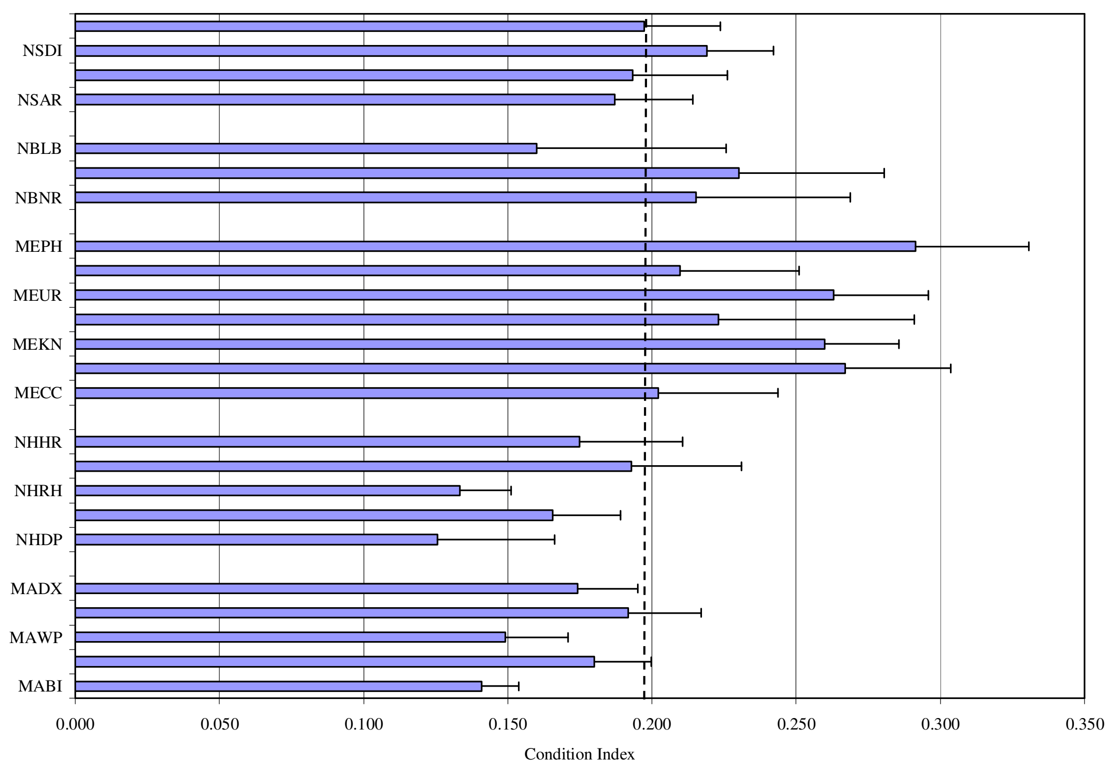

Figure 46. The average mussel condition index at each Gulfwatch site in 2000. The dashed line is the overall average condition index.

5.0 ACKNOWLEDGEMENTS

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Appendix A.

Appendix B
Quality Control Results for 2000 Metal Contaminant Analysis

QC Analysis for the 2000 Gulfwatch Metal Contaminant Analyses

QC criteria for EPA methods 200.7 and 245.6 were used with method limit exceptions noted below. Each analytical run is summarized with the corresponding samples listed. The QC acceptance criteria for the Standard Reference Material (SRM) has been established at a percent recovery of the SRM value +/_ 30%. The same criteria are used for the matrix spikes (MS) and matrix spike duplicates (MSD). The MS and MSD must have a Relative Percent Difference (RPD) of□30%, any value greater than 30% would indicate interference due to the matrix. The mussel tissue is complex and difficult to homogenize leading to the poor agreement of some of the duplicate samples (RPD > 30%). Laboratory Fortified Blanks (LFB) and Calibration Verification (CCV) are the value +/_ 10% and the blanks are below the detection limit of the specific analyte.

Two reference materials were analyzed and are summarized below with each analytical run. The reference materials are: SRM 1974a – NIST standard mussel tissue; DORM-2 – NRC-CRNC standard dogfish tissue.

The mussel preparation blanks are listed in a supplementary table. These blanks were run after every 10 samples.

1. Samples 01E-DIN-06987 – 7000.
   Gulfwatch samples NSAR/NSAR-depurated/NSDI/NSSC 1-4, MADX 1,2

   a. Initial calibration verification for Al, Fe and Ag were 89%, 93% and 94%, respectively. Method limits are 95-105%. The continuing verifications were within the allowed 20% window.
   b. Cr detected above reporting limit in 5 samples, at reporting limit of 0.001 ppm in 3 samples and up to 0.006 ppm in one sample. Fe detected above reporting limit in 4 samples, at reporting limit of 0.02 ppm in 3 samples and up to 0.03 ppm in one sample. Al detected above reporting limit in 18 of 21 samples, at reporting limit of 0.03 ppm in 3 samples and up to 0.13 ppm in one sample. Sample concentrations were significantly above these concentrations.
   c. Metal recoveries in 3rd-source tissues, based on published results were:

SRM 1974a		DORM - 2	
Element	Recovery	Element	Recovery
Ag	58%	Ag *	132%
Al	18%	Al *	283%
Cd	68%	Cd *	167%
Cr	56%	Cr	18%
Cu	78%	Cu	68%
Fe	54%	Fe	31%

Pb	73%	Pb *	N/A%
Ni	131%	Ni	23%
Zn	81%	Zn	100%

- = Below Report Limit

d. All other QC, including lab fortified blanks, matrix spikes and duplicates, were within specification.

2. Samples 01E-DIN-07001 – 7018.
Gulfwatch samples MADX 3,4 MABI/MASN/MAIP/MAWN 1-4

a. lab fortified blank recovery for Pb averaged 125%. Method limit is 85-115%.
b. Cr and Fe were detected in reagent blanks associated with these samples at 0.2 ppm and 6 ppm, respectively. Cr was not detected above 0.2 ppm reporting limit in the clean-out blanks run between each sample.
c. Matrix spike recoveries for Ag were 146% and 156%. Method limits are 70-130%.
d. Pb detected above reporting limit in 2 samples, at reporting limit of 0.003 ppm in 1 sample and at 0.004 ppm in one sample. Fe detected above reporting limit in 6 samples, at reporting limit of 0.02 ppm in 5 samples and up to 0.03 ppm in one sample. Al detected above reporting limit in 7 samples, at reporting limit of 0.03 ppm in 4 samples and up to 0.2 ppm in one sample. Zn detected above reporting level of 0.005 ppm in one sample at 0.008 ppm. Sample concentrations were significantly above these concentrations.
e. Metal recoveries in 3rd-source tissues, based on published results were:

SRM 1974a		DORM - 2	
Element	Recovery	Element	Recovery
Ag	52%	Ag *	0%
Al	22%	Al *	132%
Cd	73%	Cd *	0%
Cr	102%	Cr	33%
Cu	89%	Cu	64%
Fe	69%	Fe	46%
Pb	93%	Pb *	28%
Ni	137%	Ni	36%
Zn	81%	Zn	121%

- = Below Report Limit

f. All other QC were within specification.

3. Samples 01E-DIN-07019 – 7020.
Gulfwatch samples MEMR 1,2

a. Five analytes, Cr, Fe, Zn, Al and Pb were detected in at least one of the two reagent blanks associated with these samples. In all cases except Pb, the samples were >9x the blank level. Pb in the blanks was detected at approximately 50% and 25% of the sample level. Also, Ag, Cr and Ni were detected in 1 of the 3 instrumental blanks at or above their reporting limits. They were not detected above reporting limits in the clean-out blanks between samples. Metals detected in these 2 samples were typical of those found throughout the entire group.
b. Al detected above reporting limit in both samples, at reporting limit of 0.03 ppm in 1 samples and up to 0.06 ppm in one sample. Sample concentrations were significantly above these concentrations.
c. Metal recoveries in 3rd-source tissues, based on published results were:

SRM 1974a		DORM - 2	
Element	Recovery	Element	Recovery
Ag	48%	Ag *	42%
Al	15%	Al *	101%
Cd	71%	Cd *	139%
Cr	50%	Cr	61%
Cu	68%	Cu	68%
Fe	44%	Fe	66%
Pb	113%	Pb *	1570%
Ni	169%	Ni	70%
Zn	77%	Zn	86%

• = Below Report Limit

e. All other QC were within specification.

4. Samples 01E-DIN-07021 – 7040.
Gulfwatch samples MEMR 3,4 MEUR/KN/CK/PH 1-4, MEPR 1,2

a. Continuing calibration verification for Fe 89% vs 90%.
b. Cr was detected in 1 of 3 instrument blanks at its reporting limit. Cr and Pb were detected in the reagent blanks at their respective 0.2 and 0.6 ppm reporting limits.
c. Cr detected above reporting limit in 10 samples, at reporting limit of 0.001 ppm in 8 samples and at 0.002 ppm in 2 samples. Zn detected above reporting level of 0.005 ppm in 3 samples at concentrations from 0.007 to 0.04 ppm. Cu detected above reporting level of 0.005 ppm in 1 sample. Sample concentrations significantly above these concentrations.
d. Metal recoveries in 3rd-source tissues, based on published results were:

SRM 1974a		DORM - 2	
Element	Recovery	Element	Recovery
Ag	84%	Ag *	50%
Al	17%	Al *	17%

Cd	71%	Cd *	250%
Cr	61%	Cr	83%
Cu	93%	Cu	86%
Fe	59%	Fe	92%
Pb	92%	Pb *	950%
Ni	59%	Ni	89%
Zn	89%	Zn	85%

- = Below Report Limit

e. Duplicate values for Fe and Al in one of two duplicate samples were slightly higher than the method limit.
f. All other QC were within specification.

5. Samples 01E-DIN-07041 – 7061.
Gulfwatch samples MECC 1-4 MEPR 3,4 NHDP/NM/RH 1-4 NHHR 1,2

a. The initial calibration verification for Ag was 92% and for Cu was 94%. Continuing calibration verifications were OK.
b. Lab fortified blanks for Pb were higher than the method limit (128% vs 115%).
c. Cr detected above reporting limit in 5 samples, at reporting limit of 0.001 ppm in 2 samples and up to 0.003 ppm. Al detected above reporting limit in 22 of 24 samples, at reporting limit of 0.03 ppm in 4 samples and up to 0.46 ppm in one sample. Zn detected above reporting level of 0.005 ppm in 8 samples at concentrations from 0.005 to 0.025 ppm. Pb detected above reporting level of 0.003 ppm in 3 samples, and up to 0.006 ppm in one sample. Ni detected above reporting level of 0.004 ppm in one sample at 0.005 ppm. Sample concentrations significantly above these concentrations.
d. Metal recoveries in 3rd-source tissues, based on published results were:

SRM 1974a		DORM - 2	
Element	Recovery	Element	Recovery
Ag	50%	Ag *	0%
Al	19%	Al *	0%
Cd	86%	Cd *	0%
Cr	72%	Cr	79%
Cu	96%	Cu	79%
Fe	69%	Fe	NA%
Pb	73%	Pb *	0%
Ni	190%	Ni	87%
Zn	100%	Zn	98%

- = Below Report Limit

e. One matrix spike for Pb was 143%. The other matrix spike failed for most analytes and was re-run using a post-digestion addition to the sample. Ag was recovered at 136% and Pb and 42%. All others were within normal limits.

6. Samples 01E-DIN-07062-7067 & 9756-9767.
Gulfwatch samples NHHR 3,4 NHSS 1-4 NBLR/HI/NR 1-4

a. The initial calibration verification for Cr was 107%.
b. Fe was detected in one of two the reagent blanks at 6 ppm limits. Sample levels were significantly higher. Pb was detected in the same blank at its 0.6 ppm reporting limit.
c. Ag detected above reporting limit in 3 samples, at reporting limit of 0.0005 ppm in 2 samples and at 0.0006 ppm in one sample. Cd detected above reporting limit of 0.0005 ppm in 2 samples. Zn detected above reporting level of 0.005 ppm in 3 samples at concentrations from 0.005 to 0.007 ppm. Pb detected above reporting level of 0.003 ppm in 1 sample, at 0.005 ppm. Fe detected at reporting level of 0.02 ppm in one sample. Al detected above reporting level of 0.03 ppm in 16 samples at concentrations from 0.03 to 0.27 ppm. Sample concentrations were significantly above these concentrations.
d. Metal recoveries in 3rd-source tissues, based on published results were:

SRM 1974a		DORM - 2	
Element	Recovery	Element	Recovery
Ag	92%	Ag *	234%
Al	35%	Al *	13%
Cd	112%	Cd *	100%
Cr	96%	Cr	77%
Cu	137%	Cu	122%
Fe	113%	Fe	87%
Pb	134%	Pb *	592%
Ni	196%	Ni	76%
Zn	134%	Zn	87%

- = Below Report Limit

e. All other QC were within specification.

7. Hg analysis: Samples 01E-DIN-06987-7000.
Gulfwatch samples NSAR/DI/SC 1-4 MADX 1,2

a. All QC were within specification.

8. Hg analysis: Samples 01E-DIN-07001-7020, 23, 26, 32, 47, 51, 54, 56.
Gulfwatch samples MADX 3,4 MABI/MASN/MAIP/MAWN 1-4, MEMR 1,2 MECK 2 MEUR 1,4 MECC 1 NHDP 4 NHNM 4 NHRH 3

a. Reference 1974a recovered at 228%. The 0.22 ppm published value is just above the current reporting limit for mercury in mussel tissue.
b. All QC were within specification.

9. Hg analysis: Samples 01E-DIN-07021, 22, 24, 25, 27, 30, 31, 33, 34, 36-38, 40-42, 44, 48-50, 52, 53, 55, 57-64, 67.
Gulfwatch samples MEMR 3,4 MECK 1,3,4 MEUR 2,3 MECC 2-4 MEKN 1,4 MEPH 2-4 MEPR 2-4 NHDP 1 NHNM 1-3 NHRH 1,2,4 NHHR 2-4 NHSS 1,4

a. Reference 1974a recovered at 151%. The 0.22 ppm published value is just above the current reporting limit for mercury in mussel tissue. Reference DORM-2 recovered at 65.9%.
b. All QC were within specification.

10. Hg analysis: Samples 01E-DIN-09756-9767.
Gulfwatch samples NBNR/LB/HI 1-4

a. Reference 1974a recovered at 191%. The 0.22 ppm published value is just above the current reporting limit for mercury in mussel tissue.
b. All QC were within specification.

11. Hg analysis: Samples 01E-DIN-07028, 29, 35, 39, 45, 46, 60, 65, 66.
Gulfwatch samples MEKN 2,3 MEPH 1 MEPR 1 NHDP 2,3 NHHR 1 NHSS 2,3

a. Reference 1974a recovered at 237%. The 0.22 ppm published value is just above the current reporting limit for mercury in mussel tissue. Reference DORM-2 recovered at 394%.
b. All QC were within specification.

12. Repeat of #11.

a. Reference 1974a recovered at 212%. The 0.22 ppm published value is just above the current reporting limit for mercury in mussel tissue.
b. All QC were within specification.

Appendix C

Quality Control Results for 2000 Organic Contaminant Analysis

QC Analysis for the 2000 Gulfwatch Organic Contaminant Analyses

Matrix Spike Recovery

In general, matrix spike recoveries met expectations (40-120%). Only one PAH , indeno 123 cd pyrene, was twice recovered at 121%, constituting <1% of analyses being outside of the acceptable concentration range (Table C1). One QA run had 12 PCB congeners recovered at up to 128% and there were a few other instances of recoveries being >120%, with 9.7% of analyses falling outside of the accepted concentration range. Only 2% of the pesticide matrix spike recovery analyses were >120%, including aldrin and pp-DDE at 121 and 143%, respectively.

SRM Recovery

The acceptable range for SRM recovery is +/- 30%, or 70-130%. All fluorene and benzo(k)fluoranthene analyses fell outside the acceptable range, and there were 12 other PAH compounds with analyses that fell outside of the range at a frequency of 1-6 times out of a total of 9 analyses (Table C2). Overall, 24.2% of SRM PAH recoveries were outside of the acceptable range, while only 3.5% of PCB recoveries were outside the acceptable range. There were some consistent problems with pesticide SRM recoveries. Recovery of o,p'-DDE and p,p'-DDT either were not recovered because of interferences or were recovered at 218-445%. There were 5 other pesticides with recovereies outside of the acceptable range and 8 pesticides that were not even detected. Overall, 28% of the pesticide SRM recoveries exceeded the acceptable range.

Blank Concentrations

Blank analyses (Table C3) should recover no detectable amounts of target compounds, and instances where the detection exceeds twice the minimum detection level 2x MDL) are of more concern. In Table XX, average concentration was calculated from detectable samples only. No average was calculated for three or fewer detectable samples. In instances where the MDL for an analyte varied by jurisdiction, the higher of the two MDLs is presented (Table C3). For PAHs, all blanks contained phenanthrene and fluoranthene at >2x MDL, all blanks detected chrysene and pyrene, naphthalene was either >2x MDL or detected in 7 of 9 blanks, and 3 other PAHs were detected in some analyses. Only 1 PCB congener was detected at >2x MDL and 2 other congeners were detected in blanks. There were 5 pesticides detected in blanks at >2x MDL, including 7 instances of cis-chlordane and 5 instances of p,p'-DDE, and 8 other pesticides that were detected in blanks, including 9 instances of dieldrin, 5 for o,p'-DDD and 3 each for transnonochlor and p,p'-DDT.

Relative Percent Differences for Duplicate Analyses

The relative percent difference for duplicate analyses on samples is another quality assurance exercise (Table C4). In some cases, a sample would have a detectable value but the duplicate would not. In these cases, the RPD was determined to be 0% since the actual RPD could not be determined. The analysis of duplicates should agree to within 25% of each other. There were 4 instances of PAH duplicate analyses being 26-67% different and 4 instances if duplicate analyses for PCB congeners being 27-44% different. There were 6 instances of pesticide duplicate analyses being different by 26-67%.

Table C1. Matrix spike recovery.

Gulfwatch 2000 PAH Matrix Spike Recoveries (%)

	Massachusetts		New Hampshire		Maine		New Bruns	Nova Scotia			
PAH	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2	Mean	SD
Naphthalene	63%	75%	68%	68%	62%	70%	75%	68%	62%	68%	0.05
1-MethylNaphthalene	59%	70%	68%	56%	57%	62%	70%	56%	57%	62%	0.06
2-MethylNaphthalene	60%	73%	70%	58%	62%	62%	73%	58%	62%	64%	0.06
Biphenyl	62%	75%	68%	55%	58%	66%	75%	55%	58%	64%	0.07
2,6-DiMethylNaphthalene	61%	77%	72%	57%	56%	65%	77%	57%	56%	65%	0.09
Acenaphthylene	61%	76%	71%	56%	59%	65%	76%	56%	59%	65%	0.07
Acenaphthene	61%	79%	74%	59%	61%	68%	79%	59%	61%	67%	0.08
2,3,5-TriMethylNaphthalene	68%	88%	80%	65%	65%	71%	88%	65%	65%	73%	0.09
Fluorene	69%	88%	80%	67%	70%	73%	88%	67%	70%	75%	0.08
Phenanthrene	89%	107%	94%	88%	95%	90%	107%	88%	95%	94%	0.07
Anthracene	77%	89%	84%	75%	80%	75%	89%	75%	80%	80%	0.06
1-MethylPhenanthrene	87%	94%	91%	83%	96%	90%	94%	83%	96%	90%	0.05
Fluoranthene	105%	111%	101%	99%	111%	108%	111%	99%	111%	106%	0.05
Pyrene	96%	101%	95%	93%	106%	101%	101%	93%	106%	99%	0.05
Benzo(a)Anthracene	94%	95%	90%	83%	100%	97%	95%	83%	100%	93%	0.06
Chrysene	97%	94%	93%	91%	103%	97%	94%	91%	103%	96%	0.04
Benzo(b)Fluoranthene	89%	107%	88%	87%	101%	91%	107%	87%	101%	94%	0.08
Benzo(k)Fluoranthene	95%	91%	96%	87%	102%	97%	91%	87%	102%	95%	0.05
Benzo(e)Pyrene	97%	98%	93%	86%	103%	98%	98%	86%	103%	96%	0.06
Benzo(a)Pyrene	89%	88%	84%	80%	92%	90%	88%	80%	92%	87%	0.05
Perylene	87%	89%	90%	86%	100%	92%	89%	86%	100%	90%	0.05
Indeno(1,2,3-cd)Pyrene	91%	121%	90%	86%	99%	98%	121%	86%	99%	98%	0.12
Dibenzo(a,h)Anthracene	93%	115%	90%	83%	94%	100%	115%	83%	94%	96%	0.11
Benzo(g,h,i)Perylene	89%	105%	95%	89%	100%	93%	105%	89%	100%	95%	0.06
Mean	81%	92%	84%	77%	85%	84%	92%	77%	85%		
Surrogate Recovery (%)											
Naphthalene-d8	52%	60%	61%	57%	56%	52%	60%	57%	56%	56%	0.04
Acenaphthene-d10	66%	84%	81%	73%	61%	71%	84%	73%	61%	73%	0.09
Phenanthrene-d10	82%	99%	95%	93%	91%	81%	99%	93%	91%	90%	0.07
Fluoranthene-d10	97%	102%	101%	107%	103%	98%	102%	107%	103%	101%	0.04
Chrysene-d12	97%	92%	99%	102%	106%	98%	92%	102%	106%	99%	0.05
Benzo[a]Pyrene-d12	98%	99%	100%	101%	100%	99%	99%	101%	100%	100%	0.01

Figures shaded green indicate samples outside of target range of 40 - 120%

% Samples outside of 40-120% range 0.69%

Number of Samples N=144

Gulfwatch 2000 PCB Matrix Spike Recoveries (%)

PCB	Massachusettes Group 1	Massachusettes Group 2	New Hampshire Group 1	New Hampshire Group 2	Maine Group 1	Maine Group 2	New Bruns Group 1	Nova Scotia Group 1	Nova Scotia Group 2	Mean	SD
BZ8	66%	84%	52%	71%	72%	61%	84%	71%	72%	67%	0.11
BZ18	74%	113%	70%	86%	83%	70%	113%	86%	83%	83%	0.16
BZ29	77%	112%	74%	87%	98%	71%	112%	87%	98%	86%	0.16
BZ28	96%	112%	107%	102%	87%	89%	112%	102%	87%	99%	0.10
BZ50	79%	99%	70%	65%	87%	72%	99%	65%	87%	79%	0.13
BZ52	INT	97%	69%	63%	118%	INT	97%	63%	118%	87%	0.25
BZ44	90%	103%	73%	90%	118%	79%	103%	90%	118%	92%	0.17
BZ66	99%	126%	91%	88%	113%	96%	126%	88%	113%	102%	0.15
BZ101	92%	127%	83%	85%	109%	90%	127%	85%	109%	98%	0.17
BZ87	109%	107%	99%	89%	123%	108%	107%	89%	123%	106%	0.12
BZ77	101%	96%	89%	82%	122%	98%	96%	82%	122%	98%	0.14
BZ118	95%	128%	82%	99%	110%	93%	128%	99%	110%	101%	0.16
BZ153	97%	127%	86%	85%	116%	95%	127%	85%	116%	101%	0.17
BZ105	89%	119%	76%	88%	109%	87%	119%	88%	109%	95%	0.16
BZ138	94%	127%	83%	89%	117%	93%	127%	89%	117%	100%	0.18
BZ126	98%	121%	86%	83%	114%	97%	121%	83%	114%	100%	0.15
BZ187	90%	120%	80%	80%	114%	89%	120%	80%	114%	96%	0.17
BZ128	90%	120%	94%	92%	115%	89%	120%	92%	115%	100%	0.14
BZ180	92%	126%	81%	94%	115%	91%	126%	94%	115%	100%	0.17
BZ169	92%	126%	78%	91%	111%	89%	126%	91%	111%	98%	0.17
BZ170	93%	125%	81%	95%	111%	91%	125%	95%	111%	99%	0.16
BZ195	89%	124%	79%	93%	107%	88%	124%	93%	107%	97%	0.16
BZ206	88%	123%	83%	91%	103%	81%	123%	91%	103%	95%	0.16
BZ209	98%	127%	82%	90%	103%	82%	127%	90%	103%	97%	0.17
Mean	91%	116%	81%	87%	107%	87%	116%	87%	107%		
Surrogate Recovery (%)											
BZ#103	86%	103%	84%	85%	86%	91%	103%	85%	86%	89%	0.07
BZ#198	91%	122%	99%	93%	104%	94%	122%	93%	104%	100%	0.12
g_Chlordane				118%						118%	

Figures shaded green indicate samples outside of target range of 40 - 120%

% Samples outside of 40-120% range 9.72%

Number of samples N=144

Gulfwatch 2000 OC's Matrix Spike Recoveries (%)

Analyte	Massachusettes Group 1	Massachusettes Group 2	New Hampshire Group 1	New Hampshire Group 2	Maine Group 1	Maine Group 2	New Bruns Group 1	Nova Scotia Group 1	Nova Scotia Group 2	Mean	SD
HexaChloroBenzene	67%	77%	67%	56%	56%	65%	77%	56%	56%	64%	0.08
Lindane	90%	84%	78%	78%	59%	76%	84%	78%	59%	78%	0.10
Heptachlor	83%	92%	67%	68%	66%	69%	92%	68%	66%	74%	0.11
Aldrin	113%	121%	86%	98%	118%	99%	121%	98%	118%	106%	0.14
Heptachlor Epoxide	96%	90%	96%	78%	91%	91%	90%	78%	91%	90%	0.07
O,P'-DDE	85%	98%	81%	61%	84%	79%	98%	61%	84%	81%	0.12
a-Endosulfan	107%	116%	105%	92%	104%	101%	116%	92%	104%	104%	0.08
cis-Chlordane	94%	93%	85%	79%	93%	90%	93%	79%	93%	89%	0.06
Transnonachlor	87%	96%	74%	79%	91%	89%	96%	79%	91%	86%	0.08
P,P'-DDE	111%	143%	87%	85%	103%	92%	143%	85%	103%	104%	0.22
Dieldrin	90%	79%	73%	78%	97%	87%	79%	78%	97%	84%	0.09
O,P'-DDD	106%	94%	103%	87%	44%	79%	94%	87%	44%	85%	0.23
b-Endosulfan	107%	114%	100%	93%	107%	103%	114%	93%	107%	104%	0.07
P,P'-DDD	109%	113%	116%	90%	103%	100%	113%	90%	103%	105%	0.10
O,P'-DDT	74%	107%	94%	70%	96%	84%	107%	70%	96%	88%	0.14
P,P'-DDT	90%	94%	76%	75%	100%	87%	94%	75%	100%	87%	0.10
Mirex	85%	99%	90%	86%	107%	93%	99%	86%	107%	93%	0.08
Mean	94%	101%	87%	80%	89%	87%	101%	80%	89%		
Surrogate Recovery (%)											
BZ#103	84%	112%		84%						93%	0.16
BZ#198	87%	104%		89%						94%	0.09
g_Chlordane	118%	122%	120%	112%	111%	116%	122%	112%	111%	116%	0.05

Figures shaded green indicate samples outside of target range of 40 - 120%

% Samples outside of 40-120% range 1.96%

Number of samples N=102

Table C2. SRM recovery.

Gulfwatch 2000 OC's Standard Reference Material Recoveries (%)

PAH	Massachusettes Group 1	Massachusettes Group 2	New Hampshire Group 1	New Hampshire Group 2	Maine Group 1	Maine Group 2	New Bruns Group 1	Nova Scotia Group 1	Nova Scotia Group 2	Mean	SD
Naphthalene	51%	70%	114%	92%	16%	136%	70%	92%	16%	80%	0.43
1-MethylNaphthalene	65%	74%	80%	89%	29%	95%	74%	89%	29%	72%	0.24
2-MethylNaphthalene	56%	63%	70%	84%	20%	94%	63%	84%	20%	64%	0.26
Biphenyl	52%	65%	48%	73%	29%	112%	65%	73%	29%	63%	0.28
2,6-DiMethylNaphthalene	*	*	*	*	*	*	*	*	*	*	*
Acenaphthylene	97%	104%	86%	115%	79%	85%	104%	115%	79%	94%	0.14
Acenaphthene	68%	91%	76%	72%	74%	97%	91%	72%	74%	80%	0.12
2,3,5-TriMethylNaphthalene	*	*	*	*	*	*	*	*	*	*	*
Fluorene	55%	63%	55%	54%	36%	68%	63%	54%	36%	55%	0.11
Phenanthrene	80%	104%	92%	85%	82%	88%	104%	85%	82%	88%	0.09
Anthracene	120%	106%	88%	74%	90%	133%	106%	74%	90%	102%	0.22
1-MethylPhenanthrene	116%	111%	133%	95%	101%	125%	111%	95%	101%	113%	0.14
Fluoranthene	118%	116%	135%	107%	123%	115%	116%	107%	123%	119%	0.09
Pyrene	119%	113%	130%	104%	123%	119%	113%	104%	123%	118%	0.09
Benzo(a)Anthracene	88%	90%	95%	78%	91%	91%	90%	78%	91%	89%	0.06
Chrysene	100%	94%	101%	90%	103%	99%	94%	90%	103%	98%	0.05
Benzo(b)Fluoranthene	89%	102%	102%	82%	92%	91%	102%	82%	92%	93%	0.08
Benzo(k)Fluoranthene	182%	171%	213%	173%	167%	174%	171%	173%	167%	180%	0.17
Benzo(e)Pyrene	111%	102%	123%	97%	114%	111%	102%	97%	114%	109%	0.09
Benzo(a)Pyrene	104%	110%	124%	106%	116%	102%	110%	106%	116%	110%	0.08
Perylene	105%	100%	122%	95%	108%	102%	100%	95%	108%	105%	0.09
Indeno(1,2,3-cd)Pyrene	84%	122%	104%	78%	102%	115%	122%	78%	102%	101%	0.17
Dibenzo(a,h)Anthracene	105%	145%	126%	96%	166%	118%	145%	96%	166%	126%	0.26
Benzo(g,h,i)Perylene	114%	133%	137%	123%	126%	110%	133%	123%	126%	124%	0.10
Mean	94%	102%	107%	94%	90%	108%	102%	94%	90%		
Surrogate Recovery (%)											
Naphthalene-d8	53%	58%	58%	64%	15%	66%	58%	64%	15%	52%	0.19
Acenaphthene-d10	73%	78%	83%	79%	40%	86%	78%	79%	40%	73%	0.17
Phenanthrene-d10	92%	95%	107%	92%	83%	98%	95%	92%	83%	94%	0.08
Fluoranthene-d10	104%	104%	119%	103%	96%	103%	104%	103%	96%	105%	0.08
Chrysene-d12	103%	99%	107%	96%	96%	102%	99%	96%	96%	101%	0.04
Benzo[a]Pyrene-d12	101%	96%	111%	91%	92%	100%	96%	91%	92%	99%	0.08

*** Not present in NIST SRM 1974a**

Figures shaded green indicate samples outside of target range of +/- 30% SRM; (70-130%)

% Samples outside of 70-130% range 24.24%

Number of samples N=132

Gulfwatch 2000 PCB Standard Reference Material Recoveries (%)

	Massachusettes		New Hampshire		Maine		New Bruns	Nova Scotia			
PCB	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2	Mean	SD
BZ8	*	*	*	*	*	*	*	*	*	*	*
BZ18	96%	108%	110%	191%	70%	97%	108%	191%	70%	112%	0.41
BZ29	*	*	*	*	*	*	*	*	*	*	*
BZ28	78%	98%	89%	105%	70%	78%	98%	105%	70%	86%	0.13
BZ50	96%	92%	*	*	*	*	92%	*	*	94%	0.03
BZ52	*	*	83%	81%	103%	94%	*	81%	103%	90%	0.10
BZ44	93%	92%	90%	110%	84%	94%	92%	110%	84%	94%	0.09
BZ66	IN	114%	116%	132%	83%	IN	114%	132%	83%	111%	0.21
BZ101	117%	122%	117%	93%	100%	121%	122%	93%	100%	111%	0.12
BZ87	119%	124%	102%	106%	88%	121%	124%	106%	88%	110%	0.14
BZ77	*	*	*	*	*	*	*	*	*	*	*
BZ118	111%	113%	109%	102%	82%	113%	113%	102%	82%	105%	0.12
BZ153	103%	104%	102%	96%	70%	103%	104%	96%	70%	96%	0.13
BZ105	100%	95%	101%	96%	116%	104%	95%	96%	116%	102%	0.08
BZ138	109%	111%	107%	99%	81%	111%	111%	99%	81%	103%	0.12
BZ126	*	*	*	*	*	*	*	*	*	*	*
BZ187	112%	115%	110%	110%	84%	111%	115%	110%	84%	107%	0.11
BZ128	136%	126%	93%	95%	103%	122%	126%	95%	103%	112%	0.18
BZ180	79%	95%	89%	107%	114%	84%	95%	107%	114%	95%	0.14
BZ169	*	*	*	*	*	*	*	*	*	*	*
BZ170	108%	113%	IN	IN	97%	96%	113%	IN	97%	103%	0.08
BZ195	*	*	*	*	*	*	*	*	*	*	*
BZ206	*	*	*	*	*	*	*	*	*	*	*
BZ209	*	*	*	*	*	*	*	*	*	*	*
Mean	104%	108%	101%	109%	90%	103%	108%	109%	90%		
Surrogate Recovery (%)											
BZ#103	126%	128%	121%	117%	101%	125%	128%	117%	101%	120%	0.10
BZ#198	100%	108%	91%	100%	101%	102%	108%	100%	101%	100%	0.06
g_Chlordane				74%							

*** Not present in NIST SRM 1974a**
IN = Interferences

Figures shaded green indicate samples outside of target range of +/- 30% SRM; (70-130%)
% Samples outside of 70-130% range 3.49%
Number of samples N=86

Gulfwatch 2000 OC's Standard Reference Material Recoveries (%)

Analyte	Massachusettes Group 1	Massachusettes Group 2	New Hampshire Group 1	New Hampshire Group 2	Maine Group 1	Maine Group 2	New Bruns Group 1	Nova Scotia Group 1	Nova Scotia Group 2	Mean	SD
HexaChloroBenzene	*	*	*	*	*	*	*	*	*	*	*
Lindane	*	*	*	*	*	*	*	*	*	*	*
Heptachlor	*	*	*	*	*	*	*	*	*	*	*
Aldrin	*	*	*	*	*	*	*	*	*	*	*
Heptachlor Epoxide	*	*	*	*	*	*	*	*	*	*	*
O,P'-DDE	218%	229%	440%	354%	IN	IN	229%	354%	IN	310%	1.06
a-Endosulfan	*	*	*	*	*	*	*	*	*	*	*
cis-Chlordane	102%	86%	132%	117%	120%	118%	86%	117%	120%	113%	0.16
Transnonachlor	121%	124%	80%	115%	125%	119%	124%	115%	125%	114%	0.17
P,P'-DDE	120%	122%	92%	97%	115%	102%	122%	97%	115%	108%	0.13
Dieldrin	126%	111%	114%	150%	115%	130%	111%	150%	115%	124%	0.14
O,P'-DDD	117%	126%	*	92%	40%	110%	126%	92%	40%	97%	0.34
b-Endosulfan	*	*	*	*	*	*	*	*	*	*	*
P,P'-DDD	122%	99%	90%	138%	148%	141%	99%	138%	148%	123%	0.24
O,P'-DDT	83%	101%	103%	95%	225%	92%	101%	95%	225%	116%	0.54
P,P'-DDT	IN	372%	IN	445%	IN	IN	372%	445%	IN	408%	0.51
Mirex	*	*	*	*	*	*	*	*	*	*	*
Mean	126%	152%	150%	178%	127%	116%	152%	178%	127%		
Surrogate Recovery (%)											
BZ#103	117%	121%		111%						116%	0.05
BZ#198	95%	100%		94%						97%	0.03
g_Chlordane	IN	IN	349%	65%	363%	342%	IN	65%	363%	280%	1.44

*** Not present in NIST SRM 1974a**
IN = Interferences

Figures shaded green indicate samples outside of target range of +/- 30% SRM; (70-130%)
% Samples outside of 70-130% range 27.66%
Number of samples N=47

Table C3. Blank concentrations results.

PAH	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2	Avg. Conc.	MDL
Naphthalene	6.47	5.32	4.58	8.49	<4	8.89	5	8.49	<4	6.75	<4
1-MethylNaphthalene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
2-MethylNaphthalene	<3	<3	<3	3.01	<3	3.14	<3	3.01	<3	<3	<3
Biphenyl	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
2,6-DiMethylNaphthalene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Acenaphthylene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Acenaphthene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
2,3,5-TriMethylNaphthalene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Fluorene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Phenanthrene	4.77	5.34	4.13	4.71	5.35	5.93	5	4.71	5.35	5.04	<2
Anthracene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
1-MethylPhenanthrene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Fluoranthene	5.95	6.50	5.44	5.93	7.22	6.38	6	5.93	7.22	6.24	<2
Pyrene	2.80	3.12	2.75	2.90	3.64	4.01	3	2.90	3.64	3.20	<2
Benzo(a)Anthracene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Chrysene	2.25	2.45	2.26	2.41	2.87	2.57	2	2.41	2.87	2.47	<2
Benzo(b)Fluoranthene	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
Benzo(k)Fluoranthene	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Benzo(e)Pyrene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzo(a)Pyrene	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Perylene	<3	3.03	<3	<3	<3	<3	3	<3	<3	<3	<3
Indeno(1,2,3-cd)Pyrene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Dibenzo(a,h)Anthracene	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Benzo(g,h,i)Perylene	<2	2.44	2.02	2.14	<2	<2	2	2.14	<2	2.20	<2
Surrogate Recovery (%)											
Naphthalene-d8	60%	47%	52%	52%	42%	55%	47%	52%	42%		
Acenaphthene-d10	80%	79%	75%	75%	65%	74%	79%	75%	65%		
Phenanthrene-d10	90%	99%	93%	91%	111%	97%	99%	91%	111%		
Fluoranthene-d10	96%	106%	101%	108%	133%	110%	106%	108%	133%		
Chrysene-d12	95%	103%	98%	105%	133%	105%	103%	105%	133%		
Benzo[a]Pyrene-d12	95%	99%	93%	98%	125%	103%	99%	98%	125%		

Samples with detectable values highlighted in green

Samples with detectable values >2X MDL highlighted in red

Gulfwatch 2000 PCB Blank Concentration Results (ng/g)

	Massachusettes		New Hampshire		Maine		New Bruns	Nova Scotia			
PCB	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2	Avg. Conc.	MDL
BZ8	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ18	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ29	<1	<2	<1	<1	<2	<1	<2	<1	<2	<2	<2
BZ28	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ50	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ52	24.7	<2	<2	<2	<2	54.4	<2	<2	<2	<2	<2
BZ44	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ66	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ101	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ87	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ77	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
BZ118	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BZ153	<1.5	2.7	<1.5	<1.5	<1.5	<1.5	2.7	<1.5	<1.5	<1.5	<1.5
BZ105	<1.5	<1	<1	<1	<1	<1.5	<1	<1	<1	<1	<1
BZ138	<1.5	1.8	<1.5	<1.5	<1.5	<1.5	1.8	<1.5	<1.5	<1.5	<1.5
BZ126	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ187	<1	<1	<1	<1.5	<1	<1	<1	<1.5	<1	<1	<1
BZ128	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BZ180	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BZ169	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ170	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ195	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ206	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
BZ209	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5

Surrogate Recovery (%)

BZ#103	85%	91%	92%	88%	82%	89%	91%	88%	82%
BZ#198	84%	113%	98%	93%	90%	90%	113%	93%	90%
g_Chlordane				106%					

Samples with detectable values highlighted in green

Samples with detectable values >2X MDL highlighted in red

Gulfwatch 2000 OC's Blank Concentration Results (ng/g)

Analyte	Massachusettes Group 1	Massachusettes Group 2	New Hampshire Group 1	New Hampshire Group 2	Maine Group 1	Maine Group 2	New Bruns Group 1	Nova Scotia Group 1	Nova Scotia Group 2	Avg. Conc.	MDL
HexaChloroBenzene	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Lindane	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Heptachlor	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	1.7	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	2.9	<1.2	<1.2	<1.2	<1.2	1.5	<1.2	<1.2	<1.2	<1.2	<1.2
O,P'-DDE	<1.2	<1	<1.2	<1.2	<1.2	<1.2	<1	<1.2	<1.2	<1.2	<1.2
a-Endosulfan	1.3	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
cis-Chlordane	2.1	2.1	2.3	<1	2.2	2.1	2.1	<1	2.2	2.2	<1
Transnonachlor	0.5	1.2	<1	<1	<1	<1	1.2	<1	<1	<1	<1
P,P'-DDE	3.2	2.5	2	2.40	2.2	2.2	2.5	2.40	2.2	2.4	<1.2
Dieldrin	1.5	1.6	1.2	1.33	1.5	1.9	1.6	1.33	1.5	1.5	<1.2
O,P'-DDD	1.1	2.0	<1	<1	1.0	1.2	2.0	<1	1.0	1.3	<1
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
P,P'-DDD	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
O,P'-DDT	-0.5	<2	<2	<1.2	<2	<2	<2	<1.2	<2	<2	<2
P,P'-DDT	1.4	<1	<1	<1	1.7	2.5	<1	<1	1.7	1.9	<1
Mirex	-1.8	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5

Surrogate Recovery (%)

	Massachusettes Group 1	Massachusettes Group 2	New Hampshire Group 1	New Hampshire Group 2	Maine Group 1	Maine Group 2	New Bruns Group 1	Nova Scotia Group 1	Nova Scotia Group 2
BZ#103	80%	96%		83%					
BZ#198	82%	99%		90%					
g_Chlordane	111%	131%	124%	104%	100%	116%	131%	104%	100%

Samples with detectable values highlighted in green

Samples with detectable values >2X MDL highlighted in red

Table C4. Duplicate analysis results.

Relative Percent Differences (RPD) of Duplicate Analysis Results for PAH, by State

PAH	Massachusetts	New Hampshire	Maine	New Brunswick	Nova Scotia Group 1	Nova Scotia Group 2
Naphthalene	67%	5%	9%	19%	17%	29%
1-MethylNaphthalene	0%	0%	0%	0%	10%	4%
2-MethylNaphthalene	35%	0%	4%	25%	16%	7%
Biphenyl	0%	0%	0%	0%	0%	9%
2,6-DiMethylNaphthalene	0%	0%	0%	0%	8%	2%
Acenaphthylene	0%	0%	0%	0%	0%	0%
Acenaphthene	0%	0%	0%	0%	0%	0%
2,3,5-TriMethylNaphthalene	0%	0%	0%	0%	16%	0%
Fluorene	0%	0%	0%	0%	1%	5%
Phenanthrene	2%	9%	9%	26%	3%	5%
Anthracene	0%	0%	0%	0%	0%	0%
1-MethylPhenanthrene	0%	0%	0%	0%	0%	7%
Fluoranthene	6%	4%	3%	7%	8%	8%
Pyrene	2%	5%	2%	11%	10%	1%
Benzo(a)Anthracene	4%	3%	1%	0%	0%	0%
Chrysene	1%	0%	3%	5%	14%	4%
Benzo(b)Fluoranthene	0%	5%	4%	0%	0%	0%
Benzo(k)Fluoranthene	6%	1%	6%	2%	0%	0%
Benzo(e)Pyrene	11%	5%	2%	0%	22%	6%
Benzo(a)Pyrene	0%	2%	6%	0%	0%	0%
Perylene	0%	5%	2%	0%	0%	0%
Indeno(1,2,3-cd)Pyrene	0%	4%	1%	0%	0%	0%
Dibenzo(a,h)Anthracene	0%	0%	0%	0%	0%	0%
Benzo(g,h,i)Perylene	2%	5%	1%	0%	0%	0%
Mean						
Surrogate Recovery (%)						
Naphthalene-d8	15%	46%	21%	24%	29%	15%
Acenaphthene-d10	6%	34%	1%	26%	11%	11%
Phenanthrene-d10	7%	9%	1%	19%	2%	10%
Fluoranthene-d10	11%	3%	3%	6%	2%	10%
Chrysene-d12	14%	1%	1%	3%	9%	9%
Benzo[a]Pyrene-d12	16%	4%	4%	4%	14%	8%

Samples with a RPD >25% highlighted in green

Relative Percent Differences (RPD) of Duplicate Analysis Results for PCB, by State

PCB	Massachusetts	New Hampshire	Maine	New Brunswick	Nova Scotia Group 1	Nova Scotia Group 2
BZ8	0%	0%	0%	0%	0%	0%
BZ18	0%	0%	0%	0%	0%	0%
BZ29	0%	0%	2%	0%	0%	0%
BZ28	3%	0%	0%	0%	0%	0%
BZ50	0%	0%	0%	0%	0%	0%
BZ52	8%	0%	0%	0%	0%	0%
BZ44	0%	0%	0%	0%	0%	0%
BZ66	2%	0%	0%	0%	0%	0%
BZ101	8%	24%	0%	0%	0%	0%
BZ87	3%	0%	0%	0%	0%	0%
BZ77	9%	0%	0%	0%	0%	0%
BZ118	10%	22%	44%	14%	0%	0%
BZ153	12%	28%	8%	4%	0%	0%
BZ105	8%	20%	13%	0%	0%	0%
BZ138	11%	25%	8%	23%	0%	0%
BZ126	0%	0%	0%	0%	0%	0%
BZ187	22%	20%	25%	0%	0%	0%
BZ128	12%	41%	0%	0%	0%	0%
BZ180	0%	27%	0%	0%	0%	0%
BZ169	0%	0%	0%	0%	0%	0%
BZ170	0%	0%	0%	0%	0%	0%
BZ195	0%	0%	0%	0%	0%	0%
BZ206	0%	0%	0%	0%	0%	0%
BZ209	0%	0%	0%	0%	0%	0%
Mean						
Surrogate Recovery (%)						
BZ#103	4%	2%	1%	10%	5%	9%
BZ#198	7%	4%	2%	2%	3%	11%
g_Chlordane	0%	2%	0%	0%	0%	0%

Samples with a RPD >25% highlighted in green

Relative Percent Differences (RPD) of Duplicate Analysis Results for OC's, by State

Analyte	Massachusetts	New Hampshire	Maine	New Brunswick	Nova Scotia Group 1	Nova Scotia Group 2
HexaChloroBenzene	0%	0%	0%	0%	0%	0%
Lindane	0%	0%	0%	56%	0%	0%
Heptachlor	0%	0%	0%	0%	0%	0%
Aldrin	0%	0%	0%	0%	0%	0%
Heptachlor Epoxide	0%	0%	0%	0%	0%	0%
O,P'-DDE	0%	0%	0%	0%	0%	0%
a-Endosulfan	0%	0%	0%	0%	0%	0%
cis-Chlordane	26%	67%	20%	1%	2%	0%
Transnonachlor	19%	0%	0%	34%	0%	5%
P,P'-DDE	16%	15%	19%	6%	0%	4%
Dieldrin	0%	4%	6%	0%	5%	0%
O,P'-DDD	41%	12%	27%	0%	6%	0%
b-Endosulfan	0%	0%	0%	0%	0%	0%
P,P'-DDD	3%	4%	11%	0%	0%	0%
O,P'-DDT	0%	0%	0%	0%	0%	0%
P,P'-DDT	0%	0%	0%	0%	16%	6%
Mirex	0%	0%	0%	0%	0%	0%
Mean						
Surrogate Recovery (%)						
BZ#103	0%	6%	0%	0%	0%	0%
BZ#198	0%	9%	0%	0%	0%	0%
g_Chlordane	62%	1%	14%	2%	3%	6%

Samples with a RPD >25% highlighted in green

Table C5. Surrogate recovery results.

PCB Surrogate Recovery Values for Matrix Spike, SRM, and Blank Recoveries

	Massachusettes		New Hampshire		Maine		New Bruns	Nova Scotia	
Matrix Spike Surrogate Recovery	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2
BZ#103	86%	103%	84%	85%	86%	91%	103%	85%	86%
BZ#198	91%	122%	99%	93%	104%	94%	122%	93%	104%
g_Chlordane				118%					
SRM Surrogate Recovery									
BZ#103	126%	128%	121%	117%	101%	125%	128%	117%	101%
BZ#198	100%	108%	91%	100%	101%	102%	108%	100%	101%
g_Chlordane				74%					
Blank Surrogate Recovery									
BZ#103	85%	91%	92%	88%	82%	89%	91%	88%	82%
BZ#198	84%	113%	98%	93%	90%	90%	113%	93%	90%
g_Chlordane				106%					

OC's Surrogate Recovery Values for Matrix Spike, SRM, and Blank Recoveries

	Massachusettes		New Hampshire		Maine		New Bruns	Nova Scotia	
Matrix Spike Surrogate Recovery	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 1	Group 2
BZ#103	84%	112%		84%					
BZ#198	87%	104%		89%					
g_Chlordane	118%	122%	120%	112%	111%	116%	122%	112%	111%
SRM Surrogate Recovery									
BZ#103	117%	121%		111%					
BZ#198	95%	100%		94%					
g_Chlordane	IN	IN	349%	65%	363%	342%	IN	65%	363%
Blank Surrogate Recovery									
BZ#103	80%	96%		83%					
BZ#198	82%	99%		90%					
g_Chlordane	111%	131%	124%	104%	100%	116%	131%	104%	100%

IN = Interferences

Appendix D
Tissue Concentrations of Trace Metals

Year	Site Code	Sample No	AG	AL	CD	CR	CU	FE	HG	PB	ZN	% SOLIDS
					Massachusetts							
2000	MABI	1N	0.1	110.0	1.8	1.8	7.3	270.0	0.70	4.2	140.0	12.5
2000	MABI	2N	0.1	100.0	1.9	1.7	6.9	260.0	0.63	5.3	170.0	11.8
2000	MABI	3N	0.1	110.0	1.8	1.8	7.0	250.0	0.80	4.4	160.0	11.9
2000	MABI	4N	ND0.1	82.0	1.6	1.7	7.4	230.0	0.31	4.4	170.0	13.4
2000	MADX	1N	0.1	180.0	1.0	1.5	8.9	400.0	0.21	3.3	99.0	15.7
2000	MADX	2N	0.2	260.0	1.0	1.7	10.0	550.0	0.15	3.7	92.0	15.1
2000	MADX	3N	0.1	190.0	1.0	1.7	9.1	470.0	ND 0.1	4.9	95.0	15.0
2000	MADX	4N	0.1	160.0	1.0	1.5	7.9	410.0	0.33	3.9	87.0	16.4
2000	MAIP	1N	0.1	59.0	1.7	1.3	6.8	200.0	0.20	1.8	130.0	14.6
2000	MAIP	2N	0.1	62.0	1.5	1.2	6.5	200.0	0.28	1.8	90.0	15.6
2000	MAIP	3N	0.2	48.0	1.5	1.0	7.0	160.0	0.12	1.4	120.0	15.9
2000	MAIP	4N	0.2	48.0	1.4	1.0	8.0	150.0	ND 0.1	1.3	100.0	16.8
2000	MASN	1N	1.3	81.0	1.6	1.0	6.6	210.0	0.24	2.8	86.0	15.2
2000	MASN	2N	0.6	82.0	1.1	0.9	6.2	210.0	0.25	2.1	79.0	14.4
2000	MASN	3N	0.6	140.0	1.5	1.0	6.5	360.0	ND 0.1	2.9	91.0	15.7
2000	MASN	4N	0.8	95.0	1.2	0.9	6.7	220.0	0.26	2.3	75.0	17.7
2000	MAWN	1N	0.1	230.0	1.9	2.3	6.7	470.0	0.69	3.5	91.0	14.2
2000	MAWN	2N	0.1	150.0	1.7	2.1	6.5	350.0	0.54	3.3	100.0	14.1
2000	MAWN	3N	0.1	140.0	1.8	2.2	6.6	320.0	0.55	3.3	130.0	14.4
2000	MAWN	4N	0.1	180.0	2.2	2.5	7.1	410.0	0.64	4.3	170.0	14.2
					New Hampshire							
2000	NHDP	1N	ND 0.1	200.0	2.1	2.4	7.9	440.0	0.23	2.9	160.0	14.4
2000	NHDP	2N	ND 0.1	200.0	2.4	3.0	8.4	520.0	0.52	3.1	140.0	13.4
2000	NHDP	3N	ND 0.1	300.0	2.4	3.3	8.2	660.0	0.35	4.0	110.0	14.2
2000	NHDP	4N	ND 0.1	200.0	2.4	2.6	7.0	440.0	0.96	2.7	110.0	13.9
2000	NHNM	1N	ND 0.1	200.0	2.0	2.2	9.2	510.0	ND 0.1	6.1	130.0	12.0
2000	NHNM	2N	ND 0.1	200.0	1.9	2.2	9.4	600.0	0.53	6.6	140.0	13.3
2000	NHNM	3N	0.2	500.0	2.4	4.4	11.0	1200.0	0.29	11.0	240.0	11.4
2000	NHNM	4N	ND 0.1	200.0	2.0	2.3	8.4	490.0	0.61	4.6	140.0	12.3
2000	NHRH	1N	ND 0.1	100.0	1.5	1.4	7.3	360.0	0.11	2.4	110.0	16.4
2000	NHRH	2N	ND 0.1	81.0	1.9	1.3	6.8	330.0	0.46	3.9	100.0	14.5
2000	NHRH	3N	ND 0.1	200.0	2.3	2.4	12.0	600.0	0.78	5.2	150.0	16.2
2000	NHRH	4N	ND 0.1	110.0	1.5	1.5	6.6	440.0	0.52	2.8	100.0	14.6
2000	NHSS	1N	0.1	120.0	1.9	1.8	7.5	330.0	0.68	3.1	110.0	13.3
2000	NHSS	2N	ND 0.1	100.0	1.8	1.8	6.9	280.0	0.76	2.7	110.0	11.7
2000	NHSS	3N	0.1	190.0	2.6	2.3	8.1	450.0	0.62	3.7	130.0	12.3
2000	NHSS	4N	0.4	140.0	2.0	1.9	8.5	340.0	0.51	2.9	120.0	12.7
					Maine							
2000	MECC	1N	ND 0.1	300.0	2.0	3.1	9.7	670.0	0.78	5.8	130.0	12.0
2000	MECC	2N	ND 0.1	400.0	2.3	4.2	12.0	1000.0	0.46	8.3	150.0	11.2
2000	MECC	3N	ND 0.1	300.0	2.0	3.0	12.0	700.0	0.47	6.9	120.0	10.6
2000	MECC	4N	ND 0.1	300.0	1.6	3.2	11.0	790.0	0.18	6.6	110.0	12.6

2000	MECK	1N	ND0.1	360.0	1.6	1.6	8.9	700.0	ND 0.1	3.0	120.0	12.0
2000	MECK	2N	ND0.1	320.0	1.5	1.4	7.4	610.0	0.43	2.5	91.0	10.8
2000	MECK	3N	ND0.1	310.0	1.9	1.5	8.7	600.0	ND 0.1	2.6	120.0	10.9
2000	MECK	4N	ND0.1	200.0	1.8	1.2	9.7	420.0	ND 0.1	2.3	99.0	10.8
2000	MEKN	1N	0.1	230.0	2.5	2.1	9.6	390.0	ND 0.1	2.4	77.0	11.0
2000	MEKN	2N	0.1	150.0	1.9	1.6	7.4	260.0	ND 0.1	1.9	61.0	10.9
2000	MEKN	3N	0.1	200.0	2.3	1.9	9.1	320.0	0.24	2.2	68.0	11.0
2000	MEKN	4N	0.1	200.0	2.4	2.1	11.0	330.0	ND 0.1	2.3	71.0	11.2
2000	MEMR	1N	0.1	190.0	1.7	1.6	7.0	480.0	0.45	3.2	49.0	11.2
2000	MEMR	2N	0.1	320.0	2.2	1.9	11.0	900.0	0.55	4.0	82.0	10.6
2000	MEMR	3N	ND0.1	180.0	2.0	1.4	7.6	470.0	ND 0.1	2.6	57.0	10.6
2000	MEMR	4N	0.1	250.0	1.9	1.6	8.4	530.0	0.29	2.9	69.0	11.7
2000	MEPH	1N	0.1	330.0	1.7	2.3	12.0	700.0	0.31	12.0	120.0	8.5
2000	MEPH	2N	ND0.1	310.0	1.9	2.2	11.0	640.0	0.20	11.0	140.0	10.7
2000	MEPH	3N	0.1	420.0	1.7	2.3	14.0	780.0	ND 0.1	11.0	150.0	10.5
2000	MEPH	4N	0.1	420.0	1.8	2.5	12.0	830.0	0.43	12.0	120.0	9.8
2000	MEPR	1N	0.2	620.0	2.0	3.2	14.0	1000.0	0.24	8.4	83.0	11.1
2000	MEPR	2N	0.2	510.0	2.6	3.3	14.0	950.0	0.43	8.3	130.0	8.2
2000	MEPR	3N	0.1	600.0	2.1	3.2	14.0	1100.0	ND 0.1	8.2	140.0	8.5
2000	MEPR	4N	ND0.1	400.0	1.5	2.4	10.0	840.0	0.48	6.3	100.0	8.2
2000	MEUR	1N	0.1	200.0	1.9	1.6	7.5	500.0	ND 0.1	2.6	80.0	9.2
2000	MEUR	2N	0.1	180.0	1.6	1.4	7.1	490.0	ND 0.1	2.5	91.0	10.4
2000	MEUR	3N	0.1	230.0	1.8	1.5	8.9	590.0	ND 0.1	2.7	89.0	10.6
2000	MEUR	4N	0.1	190.0	1.7	1.5	6.5	490.0	ND 0.1	2.7	64.0	9.3
					New Brunswick							
2000	NBHI	1N	0.1	37.0	1.1	0.5	5.5	110.0	ND 0.1	ND0.6	63.0	22.1
2000	NBHI	2N	0.1	26.0	0.9	0.4	5.1	88.0	ND 0.1	ND0.6	60.0	22.6
2000	NBHI	3N	0.1	38.0	1.0	0.5	5.9	110.0	ND 0.1	ND0.6	60.0	21.4
2000	NBHI	4N	0.1	34.0	0.9	0.4	4.8	90.0	ND 0.1	0.6	60.0	22.8
2000	NBLB	1N	ND0.1	160.0	1.7	0.9	6.9	360.0	ND 0.1	1.8	100.0	16.6
2000	NBLB	2N	ND0.1	140.0	1.6	1.0	6.6	350.0	ND 0.1	1.8	91.0	16.6
2000	NBLB	3N	ND0.1	180.0	1.4	0.9	5.8	400.0	ND 0.1	1.7	91.0	16.4
2000	NBLB	4N	ND0.1	150.0	1.3	0.8	5.3	360.0	ND 0.1	1.7	64.0	19.7
2000	NBNR	1N	0.1	63.0	1.0	0.4	5.0	160.0	ND 0.1	0.7	63.0	16.6
2000	NBNR	2N	0.1	97.0	1.2	0.6	5.7	200.0	ND 0.1	0.8	110.0	19.0
2000	NBNR	3N	0.1	83.0	1.0	0.6	5.3	210.0	ND 0.1	0.9	72.0	19.9
2000	NBNR	4N	0.1	97.0	1.2	0.7	5.9	250.0	ND 0.1	0.9	82.0	20.0
					Nova Scotia							
2000	NSAR	1N	ND .1	200.0	2.4	1.5	4.3	400.0	ND 0.1	0.6	58.0	-
2000	NSAR	2N	ND .1	250.0	3.0	1.6	5.5	500.0	0.20	0.8	54.0	11.2
2000	NSAR	3N	ND .1	230.0	3.0	1.7	5.6	450.0	ND 0.1	ND0.6	71.0	10.6
2000	NSAR	4N	ND .1	300.0	2.5	1.8	5.3	570.0	ND 0.1	0.7	64.0	10.4
2000	NSDI	1N	0.1	93.0	0.9	0.8	6.0	210.0	ND 0.1	1.1	53.0	19.1
2000	NSDI	2N	0.1	99.0	1.2	0.9	7.2	220.0	ND 0.1	1.2	49.0	18.8
2000	NSDI	3N	0.1	93.0	1.1	0.9	6.6	210.0	0.12	1.0	48.0	19.7
2000	NSDI	4N	0.1	92.0	1.0	0.9	6.2	220.0	ND 0.1	0.9	47.0	19.7
2000	NSSC	1N	0.1	110.0	1.2	1.3	4.6	380.0	ND 0.1	1.4	57.0	13.5
2000	NSSC	2N	0.1	94.0	0.9	0.9	4.6	280.0	ND 0.1	1.1	40.0	15.7

2000	NSSC	3N	0.1	140.0	1.0	1.1	5.1	360.0	ND 0.1	1.0	44.0	15.2
2000	NSSC	4N	ND0.1	170.0	0.9	1.1	4.5	390.0	ND 0.1	0.8	46.0	15.2

Appendix E

Organic Contaminant Analysis Information:

Lab ID, Analysis Group #, Analysis Dates

Massachussetts Sampling Locations

Laboratory ID	Sample Code	Group #	Sample date	Site Name	Extraction date	Analysis date PAH's	Analysis date OC's & PCBs
2001000777	MADX1N	1		Duxbury	10/29/2001	11/3/2001	11/13/2001
2001000778	2N	1		Duxbury	10/29/2001	11/3/2001	11/13/2001
2001000779	3N	1		Duxbury	10/29/2001	11/8/2001	11/20/2001
2001000780	4N	1		Duxbury	10/29/2001	11/3/2001	11/13/2001
2001000781	MABI 1N	1		Brewster Island	10/29/2001	11/3/2001	11/13/2001
2001000782	2N	1		Brewster Island	10/29/2001	11/13/2001	11/20/2001
2001000783	3N	1		Brewster Island	10/29/2001	11/13/2001	11/20/2001
2001000784	4N	1		Brewster Island	10/29/2001	11/13/2001	11/20/2001
2001000785	MAWN1N	1		Marblehead	10/29/2001	11/13/2001	11/20/2001
2001000786	2N	1		Marblehead	10/29/2001	11/13/2001	11/20/2001
2001000787	3N	1		Marblehead	10/29/2001	11/13/2001	11/20/2001
2001000788	4N	1		Marblehead	10/29/2001	11/22/2001	11/20/2001
2001000789	MAIP1N	1		Ipswich	10/29/2001	11/22/2001	11/20/2001
2001000790	2N	1		Ipswich	10/29/2001	11/22/2001	11/20/2001
2001000791	3N	1		Ipswich	10/29/2001	11/22/2001	11/20/2001
2001000792	4N	1		Ipswich	10/29/2001	11/8/2001	11/20/2001
2001000793	MASN1N	2		Sandwich	10/23/2001	11/13/2001	12/12/2001
2001000794	2N	2		Sandwich	10/23/2001	11/8/2001	12/12/2001
2001000795	3N	2		Sandwich	10/23/2001	11/22/2001	12/12/2001
2001000796	4N	2		Sandwich	10/23/2001	11/13/2001	12/12/2001
				New Hamshire Sampling Locations			
2000003307	NHHR1N	1	9/29/2000	Hampton River	11/5/2001	11/26/2001	12/6/2001
2000003308	2N	1	9/29/2000	Hampton River	11/5/2001	11/26/2001	12/6/2001
2000003309	3N	1	9/29/2000	Hampton River	11/5/2001	11/26/2001	12/6/2001
2000003310	4N	1	9/29/2000	Hampton River	11/5/2001	11/30/2001	12/6/2001
2000003311	NHRH 1N	1	9/29/2000	Rye Harbor	11/5/2001	11/16/2001	12/6/2001
2000003312	2N	1	9/29/2000	Rye Harbor	11/5/2001	11/30/2001	12/6/2001
2000003313	3N	1	9/29/2000	Rye Harbor	11/5/2001	11/22/2001	12/6/2001
2000003314	4N	1	9/29/2000	Rye Harbor	11/5/2001	11/22/2001	12/6/2001
2000003315	MECC1N	1	9/29/2000	Clark Cove	11/5/2001	11/22/2001	12/6/2001
2000003316	2N	1	9/29/2000	Clark Cove	11/5/2001	11/22/2001	12/6/2001
2000003317	3N	1	9/29/2000	Clark Cove	11/5/2001	11/30/2001	12/6/2001
2000003318	4N	1	9/29/2000	Clark Cove	11/5/2001	11/30/2001	12/6/2001
2000003319	NHNM1N	1	9/28/2000	North Mill Pond	11/5/2001	11/22/2001	12/6/2001
2000003320	2N	1	9/28/2000	North Mill Pond	11/5/2001	11/22/2001	12/6/2001
2000003321	3N	2	9/28/2000	North Mill Pond	10/29/2001	11/16/2001	12/6/2001
2000003322	4N	2	9/28/2000	North Mill Pond	10/29/2001	11/22/2001	12/4/2001
2000003323	NHSS1N	2	9/29/2000	Schiller Station	10/29/2001	11/16/2001	12/4/2001
2000003324	2N	2	9/29/2000	Schiller Station	10/29/2001	11/16/2001	12/4/2001
2000003325	3N	2	9/29/2000	Schiller Station	10/29/2001	11/16/2001	12/4/2001
2000003326	4N	2	9/29/2000	Schiller Station	10/29/2001	11/16/2001	12/4/2001
2000003327	NHDP1N	2	9/28/2000	Dover Point	10/29/2001	11/16/2001	12/4/2001
2000003328	2N	2	9/28/2000	Dover Point	10/29/2001	11/16/2001	12/4/2001
2000003329	3N	2	9/28/2000	Dover Point	10/29/2001	11/16/2001	12/4/2001
2000003330	4N	2	9/28/2000	Dover Point	10/29/2001	11/16/2001	12/4/2001
				Maine Sampling Locations			
2001000753	MEUR1N	1	10/12/2000	Union River	9/27/2001	10/13/2001	10/25/2001
2001000754	2N	1	10/12/2000	Union River	9/27/2001	10/13/2001	10/25/2001
2001000755	3N	1	10/12/2000	Union River	9/27/2001	10/13/2001	10/25/2001
2001000756	4N	1	10/12/2000	Union River	9/27/2001	10/13/2001	10/25/2001
2001000757	MEPH 1N	1	10/18/2000	Portland	9/27/2001	10/13 & 11/3/01	10/25/2001
2001000758	2N	1	10/18/2000	Portland	9/27/2001	10/13 & 11/3/01	11/9/2001
2001000759	3N	1	10/18/2000	Portland	9/27/2001	10/13 & 11/3/01	11/9/2001
2001000760	4N	1	10/18/2000	Portland	9/27/2001	10/13 & 11/3/01	11/9/2001
2001000761	MECK1N	1	10/24/2000	Lubec	9/27/2001	10/13/2001	11/9/2001
2001000762	2N	1	10/24/2000	Lubec	9/27/2001	10/13/2001	11/9/2001
2001000763	3N	2	10/24/2000	Lubec	10/3/2001	11/3/2001	11/5/2001
2001000764	4N	2	10/24/2000	Lubec	10/3/2001	11/3/2001	11/5/2001
2001000765	MEMR1N	2	11/2/2000	Machias	10/3/2001	11/3/2001	11/5/2001
2001000766	2N	2	11/2/2000	Machias	10/3/2001	11/3/2001	11/5/2001
2001000767	3N	2	11/2/2000	Machias	10/3/2001	11/3/2001	11/5/2001
2001000768	4N	2	11/2/2000	Machias	10/3/2001	11/3/2001	11/5/2001
2001000769	MEKN1N	2	10/16/2000	Kennebec R./Phippsburg	10/3/2001	11/8/2001	11/5/2001
2001000770	2N	2	10/16/2000	Kennebec R./Phippsburg	10/3/2001	11/8/2001	11/5/2001
2001000771	3N	2	10/16/2000	Kennebec R./Phippsburg	10/3/2001	11/8/2001	11/5/2001
2001000772	4N	2	10/16/2000	Kennebec R./Phippsburg	10/3/2001	11/8/2001	11/5/2001
2001000773	MEPR1N	2	10/18/2000	Presumpscot River	10/3/2001	11/8/2001	11/13/2001
2001000774	2N	2	10/18/2000	Presumpscot River	10/3/2001	11/8/2001	11/9/2001

2001000775	3N	2	10/18/2000	Presumpscot River	10/3/2001	11/8/2001	11/13/2001
2001000776	4N	2	10/18/2000	Presumpscot River	10/3/2001	11/8/2001	11/13 & 11/20/01
				New Brunswick Sampling Locations			
2001001954	NBNR1N	1		Niger Reef	10/23/2001	11/13/2001	12/12/2001
2001001955	2N	1		Niger Reef	10/23/2001	11/13/2001	12/12/2001
2001001956	3N	1		Niger Reef	10/23/2001	11/13/2001	12/12/2001
2001001957	4N	1		Niger Reef	10/23/2001	11/13/2001	12/12/2001
2001001958	NBHI1N	1		Hospital Island	10/23/2001	11/13/2001	12/12/2001
2001001959	2N	1		Hospital Island	10/23/2001	11/16/2001	12/12/2001
2001001960	3N	1		Hospital Island	10/23/2001	11/16/2001	
2001001961	4N	1		Hospital Island	10/23/2001	11/16/2001	
2001001962	NBLB1N	1		Limekiln Bay	10/23/2001	11/16/2001	
2001001963	2N	1		Limekiln Bay	10/23/2001	11/22/2001	
2001001964	3N	1		Limekiln Bay	10/23/2001	11/22/2001	
2001001965	4N	1		Limekiln Bay	10/23/2001	11/22/2001	
				Nova Scotia Sampling Locations			
2000003331	NSAR 1N	1	10/16/2000	Apple River	10/29/2001	11/22/2001	
2000003332	2N	1	10/16/2000	Apple River	10/29/2001	11/22/2001	
2000003333	3N	1	10/16/2000	Apple River	10/29/2001	11/16/2001	
2000003334	4N	1	10/16/2000	Apple River	10/29/2001	11/22/2001	
2000003335	NSDI 1N	1	10/18/2000	Digby	10/29/2001	11/22/2001	
2000003336	2N	1	10/18/2000	Digby	10/29/2001	11/26/2001	
2000003337	3N	2	10/18/2000	Digby	9/27/2001	10/13/2001	10/23/2001
2000003338	4N	2	10/18/2000	Digby	9/27/2001	10/13/2001	10/23/2001
2000003339	NSSC 1N	2	10/20/2000	Spechts Cove	9/27/2001	10/13/2001	10/23/2001
2000003340	2N	2	10/20/2000	Spechts Cove	9/27/2001	10/13/2001	10/23/2001
2000003341	3N	2	10/20/2000	Spechts Cove	9/27/2001	10/13/2001	10/23/2001
2000003342	4N	2	10/20/2000	Spechts Cove	9/27/2001	10/13/2001	10/25/2001