EVALUATION OF *GULFWATCH* 1993

THIRD YEAR OF THE GULF OF MAINE ENVIRONMENTAL MONITORING PLAN

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PREPARED BY: John Sowles,[1] Robert Crawford,[2] John Machell,[3] Peter Hennigar,[3] Steven Jones,[4] Judith Pederson,[5] Karen Coombs,[6] Glenn Atkinson,[3] Darrell Taylor,[7] Gareth Harding,[8] Margo Chase,[4] and Bill Robinson[9]

WRITTEN BY: Peter Hennigar[3], John Sowles,[1] Robert Crawford,[2] and Gareth Harding[8]

EDITED BY: Gareth Harding[8]

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[1]Maine Department of Environmental Protection

[2]Nova Scotia Department of Fisheries

[3]Environment Canada

[4]University of New Hampshire

[5]Massachusetts Coastal Program

[6]New Brunswick Department of Fisheries and Aquaculture

[7]Nova Scotia Department of the Environment

[8]Fisheries and Oceans Canada

[9]University of Massachusetts

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INTRODUCTION

In 1989, the Gulf of Maine Council on the Marine Environment endorsed the concept of a Gulf-wide environmental health monitoring project and funded a pilot project consistent with the goals of the Gulf of Maine Environmental Monitoring Plan. This report presents the findings of the third full year of this project. Results of the first and second year of this project are presented in "Evaluation of Gulfwatch - 1991 Pilot Project of the Gulf of Maine Marine Environmental Monitoring Plan" (GMCME 1992a) and "Evaluation of Gulfwatch 1992. Second year of the Gulf of Maine Environmental Monitoring Plan" (GMCME 1994), respectively. The Monitoring Plan is based on a mission statement provided by the Council:

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

Three monitoring goals were established to meet the mission statement:

- to provide information on the status, trends, and sources of risks to the marine environment in the Gulf of Maine;
- to provide information on the status, trends, and sources of marine-based human health risks in the Gulf of Maine; and
- 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.

GULFWATCH OBJECTIVES

The original objectives of the pilot Gulfwatch study (Gulf of Maine mussel monitoring project for toxic organic compounds and metals) are three-fold:

- to evaluate the feasibility of using a mussel watch approach as one means of assessing the Gulf-wide environmental health;
- to determine the level of logistical cooperation needed between jurisdictions, identify weaknesses, and recommend measures to strengthen cooperation; and

- to initiate testing of simple hypotheses and collect comparative data from different locations in the Gulf of Maine.

The initial 1991 Gulfwatch Project was based on three hypotheses relating to mussel growth and contaminant levels in caged and indigenous mussels at contaminated and reference sites (GMCME 1992a). Shell growth was selected as one of the most important biological indicators of an organism's response to different levels of contaminant burdens. The procedural aspects of studying shell growth utilized marked mussels held in suspended cages for a 2-month period at contaminated and reference sites. Condition index (CI) was also used in the assessment process as an indicator of the physiological status of both caged and indigenous mussels. Sampling protocol has been documented in a previous report (see GMCME 1992b). The 1992 Gulfwatch Project was essentially a continuation of the 1991 study both in terms of hypotheses and methodology. It was, however, recognized that there should be a broader or Gulf-wide orientation of the mussel watch in addition to the assessment of known contaminated and reference sites within each jurisdiction.

In the present account, therefore, we report the results of an expanded sampling scheme undertaken in the fall of 1993 (see GMCME 1995). Levels of the same contaminants as in 1991 and 1992 were determined in up to four new locations within each jurisdiction (state or province), where feasible, to increase our geographic coverage. This approach is intended to both increase our ability to locate unforeseen environmental contamination and enable contouring of contaminant concentrations away from their sources. One location from previous samplings in each jurisdication, except New Hampshire, was retained to provide continuity for future time trend analysis.

1993 SAMPLING LOCATIONS

In our expanded coverage of the Gulf, we sampled six locations in Massachusetts, one in New Hampshire, six in Maine, three in New Brunswick, and five in Nova Scotia (see Table 1 and Fig. 1). Five of these sampling sites were retained from the previous year to enable contaminant trend analysis in the future: Sandwich, MA; Kennebec River, ME; Hospital Island, N.B.; Digby, N.S.; and Broad Cove, N.S. This is the first of the new three-year rotation sampling design explained in detail in our previous report (GMCME 1995).

TABLE 1. Gulf of Maine Gulfwatch study site locations sampled in 1993.

Code	Site location	Latitude	Longitude
MASA*	Sandwich, MA	41°45.0'N	70°24.0'W
MACO	Cohasset, MA	42°15.3'N	70°47.4'W
MALI	Long Island, MA	42°19.7'N	70°57.3'W
MAMH	Marblehead, MA	42°29.9'N	70°50.9'W
MAPY	Manomet Point, Plymouth, MA	41°55.7'N	70°32.3'W
MAME	Merrimac, MA	42°48.5'N	70°49.4'W
NHHS	Hampton, Seabrook Estuary, NH	42°53.5'N	70°49.0'W
MECC	Clarke Cove, ME	43°04.4'N	70°43.4'W
MEBH	Brave Boat Harbor, ME	43°05.6'N	70°39.2'W
MERY	Royal River, ME	43°47.8'N	70°08.8'W
MEKN*	Kennebec River, ME	43°47.5'N	69°47.6'W
MEFP	Fort Point, Penobscot R., ME	44°28.3'N	68°48.9'W
MEPI	Pickering Island, ME	44°15.6'N	68°43.8'W
NBSC	St. Croix River, Todds Pt., N.B.	45°10.0'N	67°09.7'W
NBHI*	Hospital Island, N.B.	45°07.4'N	67°00.2'W
NBLN	Letang Estuary, Haddock Ledge, N.B.	45°04.6'N	66°48.0'W
NSFI	Five Islands, Economy, N.S.	45°39.5'N	64°06.7'W

TABLE 1 (continued)

Code	Site location	Latitude	Longitude
NSDI*	Digby, N.S.	44°38.1'N	65°44.7'W
NSBC*	Broad Cove, N.S.	44°40.1'N	65°49.8'W
NSYR	Yarmouth, N.S.	43°81.8'N	66°14.3'W
NSAG	Argyle, N.S.	43°73.9'N	65°84.4'W

*Locations sampled each year.

The majority of the mussels were collected from subtidal locations at each site because mussel growth is known to be adversely affected by aerial exposure time (Phillips 1976) and to maximize and standardize mussel exposure to water-borne contaminants. In some Nova Scotia sites, mussels were collected in the low intertidal zone because the extreme tidal range in the Bay of Fundy makes subtidal sampling difficult. The reader is referred to our manuals for more detail (GMCME 1992b; 1995).

METHODS

The 1993 Gulf of Maine mussel watch program (Gulfwatch) represents a change in approach from the previous two years efforts where mussels were sampled at two sites in each jurisdiction, tentatively presumed to be "clean" and polluted. The 1993 sampling season extends our survey to 16 new sites. This coverage will be increased further in the following year to better determine background concentrations, contour pollutant gradients, and pinpoint pollution sources.

The mussels collected were intended to be *Mytilus edulis*; however, a similar species *(Mytilus trossulus)* may have been inadvertantly included in some of the Bay of Fundy samples. An attempt to evaluate this concern is made here by examining the height-to-length ratio (Freeman et al. 1992) of a measured subsample for each collection site. The proportion of *M. trossulus* in the composite mussel samples, for metal and organic contaminant analyses, are tabulated in the Results section.

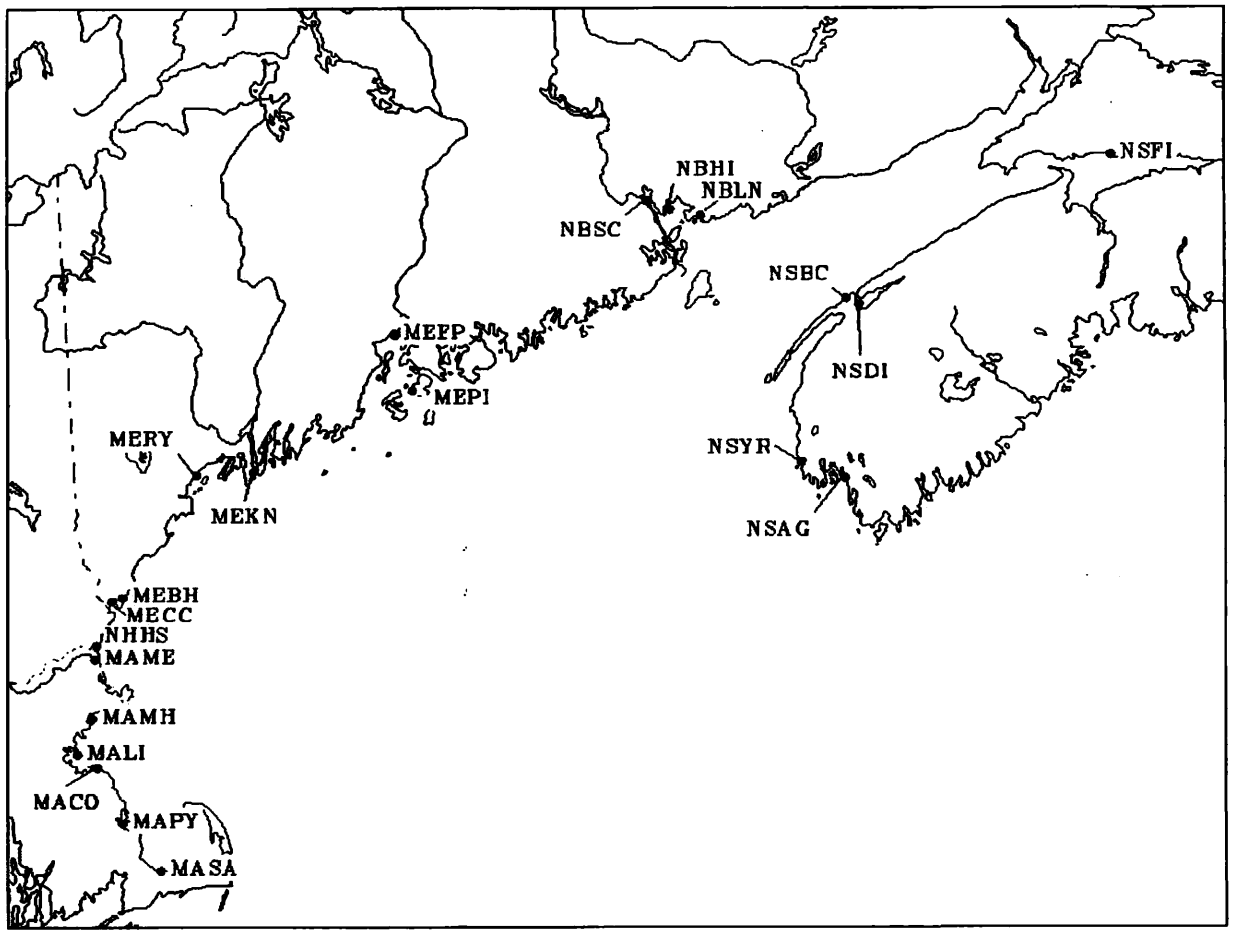


FIGURE 1. Location of Gulfwatch mussel sampling sites occupied in 1993, Gulf of Maine.

The field operations of sampling, mussel measurement, and sample preparation used in 1993 were similar to the previous two years. Mussel collection was synchronized around the Gulf to mid to late September. Details of these procedures have been published in the field manual "Standard Procedures for Field Sampling, Measurement and Sample Preparation," Gulfwatch pilot project period 1991-1992 (GMCME 1992b).

FIELD PROCEDURES

It was intended that mussels for contaminant analysis be collected from one previously sampled site and several new sites in each jurisdiction, depending on the amount of coastline in each state or province. Mussels were selected between 50 and 60 mm in length for study, if existent at the site (GMCME 1992b). These mussels were cleaned of all external growth and accretions and measured to the nearest tenth millimetre in the laboratory. The valves of each mussel were forced slightly open, either in the field or upon return to the laboratory and intravalve fluids were drained for approximately 1 minute before shucking and placement of the tissues in prepared glass jars and frozen for later processing.

LABORATORY PROCEDURES

Individual mussel length, width, and height (as defined by Seed 1968) was determined to the nearest 0.1 mm using vernier callipers in the laboratory. Mussels were then shucked with either plastic or stainless-steel wedges directly into appropriately prepared containers for metal and organic analysis, respectively (GMCME 1992b). Composite samples were capped, labelled, and returned to the freezer and stored at -20°C. The number of individual mussels per composite sample was increased to 20, and a fourth replicate was added per station to obtain a better measure of within-site variance from the previous year. Metals and organics were analysed approximately 2 and 4 months after sampling, respectively.

Condition index (CI) is a potential biological indicator of the effect of pollutants on mussel health in the Gulf of Maine. In this study CI has been defined as [tissue wet weight ÷ length x height x width] after Seed (1968). As the CI is a ratio, the logarithm (base 10) of the variable has been used in statistical analyses.

ANALYTICAL PROCEDURES

Analytical procedures used followed those reported for the previous year (Appendices A and B). A summary of these procedures and an explanation of exceptions follows.

Metals

Inorganic contaminants were analyzed at the State of Maine Health and Environmental Testing Laboratory (Augusta, ME). Methods were identical to those of Gulfwatch 1992 (GMCME 1994). Analyses for mercury were done on a subsample of 1 to 2 g of wet tissue and measured by cold vapour atomic absorption on a Perkin Elmer Model 503. 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 flame atomic absorption using a Perkin Elmer Model 1100. All remaining metals (Ag, Al, Cd, Cu, Cr, Ni and Pb) were run using Zeeman background-corrected graphite furnace atomic absorption on a Varian Spectra AA 400.

Organics

Organic contaminants in mussel samples were analyzed at the Environment Canada Environmental Protection Laboratory in Dartmouth, N.S., with the exception of dioxins and furans which were analysed on contract by Axys Analytical Services Ltd. in Sidney, B.C.

The analytical methods for organic contaminants are described previously in "Evaluation of Gulfwatch 1992. Second year of the Gulf of Maine Monitoring Plan" (GMCME 1994). Twenty-four polyaromatic hydrocarbons, 17 chlorinated pesticides, and 24 polychlorinated biphenyl congeners were systematically searched for in each composite sample (Table 2). The analyte detection limit for aromatic hydrocarbons was 10 ng/g (20-30 ng/g for some lower molecular weight aromatics) and generally <2 ng/g for PCB congeners. Eighteen of the PCB congeners identified and quantified are included in the National Oceanographic and Atmospheric Administration (NOAA) designated congeners. Other organic compounds selected for analysis are consistent with NOAA status and trends mussel monitoring (NOAA 1989).

TABLE 2. Organic compounds analysed in mussel tissues from the Gulf of Maine in 1993.

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

The analysis of mussel tissue was conducted as shown in Figure 2. A description of the full analytical method and accompanying performance based QA/QC method are found in Appendices A and B.

Tissue samples were extracted by homogenization with an organic solvent and a drying agent. Solvent extracts were obtained by vacuum filtration, and biomatrix interferences were separated from target analytes in extracts by size exclusion chromatography. Purified extracts were subjected to silica gel liquid column chromatography which providcd a polar PCB-chlorinated pesticides fraction and

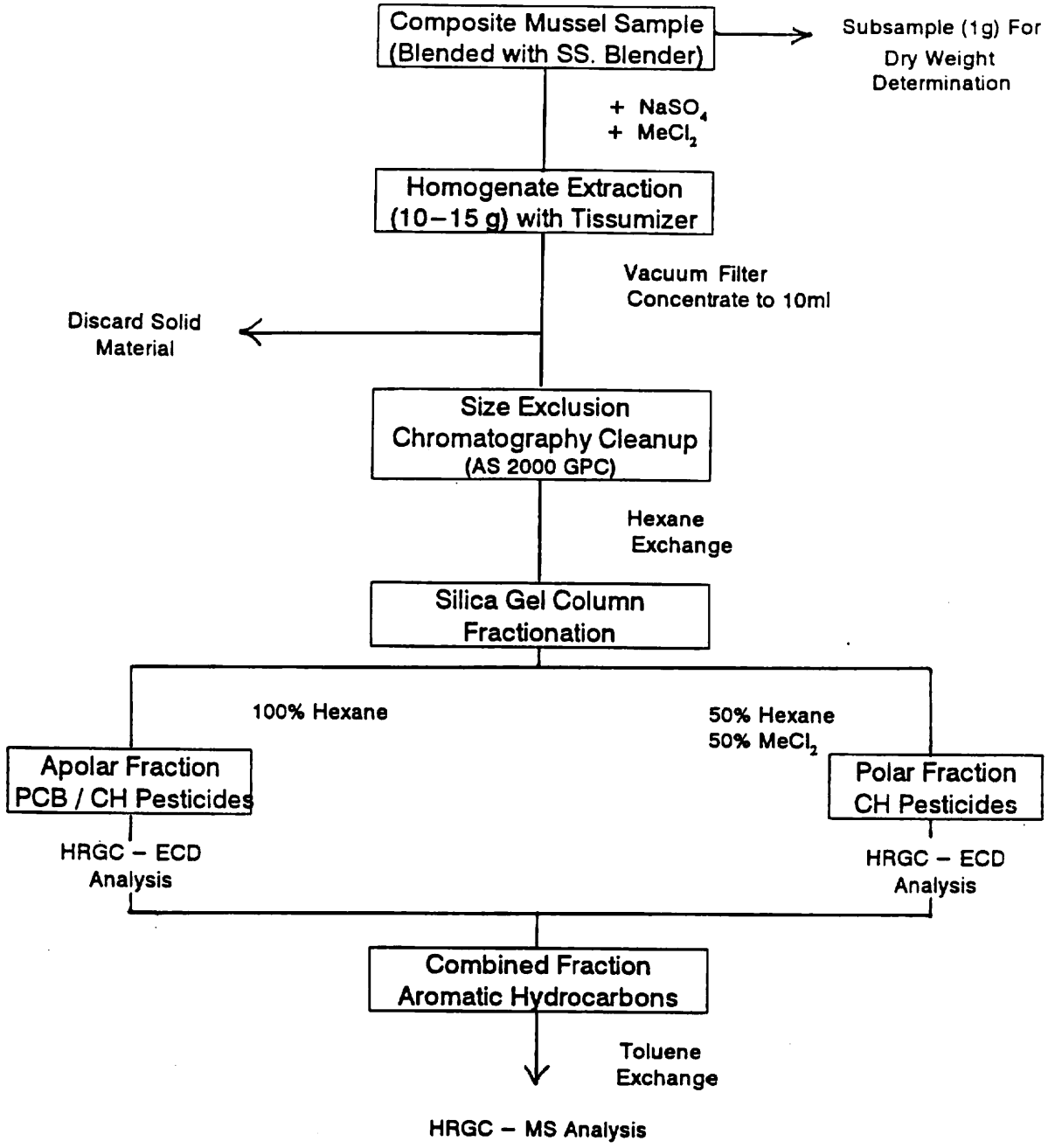


FIGURE 2. Analytical flow chart for organic analyte determination at the Environment Canada laboratory in 1993.

a polar chlorinated pesticides fraction. PCBs and/or pesticides in each fraction were analyzed by high-resolution dual-column gas chromatography/electron capture detection (HRGC/ECD). Following PCB and pesticides analysis, the two fractions were combined and the resulting extract was analyzed for polyaromatic hydrocarbons by high-resolution gas chromatography and mass spectrometry (HRGC/MS).

QUALITY ASSURANCE/QUALITY CONTROL

The laboratory participated in the National Institute of Standards and Technology (NIST) Status and Trends Intercomparison Marine Sediment Exercise IV and Bivalve Homogenate Exercise V which occur annually in the fall.

Internal quality control and method performance specifications for organic contaminants analysis are described in the Environment Canada Shellfish Surveillance Protocol (Appendix B). The Protocol includes mandatory QC measures with every sample batch including method blanks, spike matrix samples, duplicate samples, surrogate addition, and standard reference materials.

Some modifications were made in 1993 to improve toxic organic analytical quality control. These include the addition of two PCB recovery surrogates (CB 103 and CB 198) and a pesticide recovery surrogate (γ-chlordene) to sample homogenates prior to extraction. The PCB and pesticide surrogates replace 3,4,5-trichlorobiphenyl-d5 which was used in the analysis of 1992 samples to assess method performance of both PCBs and pesticides.

Standard laboratory procedures for metals incorporated method blanks, spike matrix samples, duplicate samples, surrogate addition and standard oyster tissue (SRM 1566A). Ten 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.

STATISTICAL METHODS

Arithmetic means were used to express the results of replicate samples. Total PAH and PCB values were created from the sum of all individual compounds or isomers, with non-detected values equal to zero. Geometric means were calculated for regional analyses. Student t-tests were conducted on the log-transformed data (Wilkinson 1990). Organic variables in which all replicate measurements were below the detection limit

were treated as zero. However, if at least one of the four replicates had a value above the detection limit then a value of one-half the detection limit was used for the remaining measurements. TDDT is the sum of o,p'-DDT, p,p'-DDT, p,p-DDE,o,p'-DDD, and p,p'-DDD. TPCB is the sum of all PCB congeners quantified.

RESULTS AND DISCUSSION

FIELD OPERATIONS AND LOGISTICS

Field collection proceeded as planned with no loss in transit to the Bedford Institute of Oceanography Laboratory in Dartmouth, N.S., or to the metal analysis laboratory in Augusta, ME.

SPECIFIC IDENTIFICATION OF *MYTILUS*

In our report for the 1992 Gulfwatch Project, mussel speciation was identified as a potential problem; and *Mytilus* samples were collected at several sites in Massachusetts, New Brunswick, and Nova Scotia. Specimens were identified to species by either allozyme analysis (Herbert and Beaton 1989) and/or morphometric characters (MacDonald et al. 1991). For samples collected from two sites in Massachusetts and Manawagonish Island, N.B., speciation testing showed only *Mytilus edulis* was present. However, at Hospital Island, N.B., both *M. edulis* and *M. trossulus* were present in about equal numbers. Sites at Broad Cove and Digby, N.S., contained a mixture of these two species.

The 1993 project did not include a detailed allozyme and/or morphometric analysis of samples collected from the various jurisdictions. However, length and height measurements were available for mussels used in determination of condition index. The ratio of shell length to height was used by Freeman et al. (1992) as a selection criterion for distinguishing *M. edulis* and *M. trossulus*. The length/height ratios used to select *M. edulis* and *M. trossulus* were <2.0 and >2.2 respectively, and it is assumed that ratios between 2.0 and 2.2 represent a mix of the two species with hybrids as well. It is evident from the results given in Table 3 that *M. edulis* is considerably more abundant than *M. trossulus*. From a total samples size of 917 mussels for all Gulfwatch stations, 75% of the mussels were classified as *M. edulis* and 4% as *M. trossulus*. Of the 21 Gulfwatch stations, 11 sites showed some evidence of *M. trossulus*, with significant numbers at St. Croix River, N.B. Based on the speciation testing done in 1992, it was assumed that

TABLE 3. Specific identifications of *Mytilus* using morphometric characters.

Location	Percentage			Sample Size
	M. edulis	Hybrids(?)	*M. trossulus*	
Sandwich, MA (MASA)	77	23	0	30
Plymouth, MA (MAPY)	57	36	6	30
Cohasset, MA (MACO)	70	24	6	50
Long Island, MA (MALI)	60	40	0	30
Marblehead, MA (MAMH)	92	3	5	40
Merrimac, MA (MAME)	67	33	0	30
Hampton, Seabrook, NH (NHHS)	90	10	0	30
Clarke Cove, ME (MECC)	88	8	3	60
Brave Boat Hr., ME (MEBH)	63	37	0	30
Royal River, ME (MERY)	93	7	0	30
Kennebec R., ME (MEKN)	55	38	7	29
Fort Point, ME (MEFP)	100	0	0	30

TABLE 3 (Continued)

Location	Percentage			Sample Size
	M. edulis	Hybrids(?)	*M. Trossulus*	
Pickering Island, ME (MEPI)	97	3	0	30
St. Croix River, N.B. (NBSC)	10	57	33	30
Hospital Island, N.B. (NBHI)	50	30	20	30
Letang Estuary, N.B. (NBLN)	80	10	10	30
Five Islands, N.S. (NSFI)	67	33	0	58
Digby, N.S. (NSDI)	84	15	1	80
Broad Cove, N.S. (NSBC)	76	18	6	80
Yarmouth, N.S. (NSYR)	60	35	5	80
Argyle, N.S. (NSAG)	95	5	0	80

M. trossulus was only present in the northern portion of the Gulf of Maine (Nova Scotia and New Brunswick); but it would appear from the present results that both species are present further south, though with considerably fewer numbers of *M. trossulus*.

MORPHOMETRIC COMPARISON OF INDIGENOUS MUSSELS

Mussel Shell Size

The field protocol recommended the collection of mussels within the length range of 50-60 mm. The Gulfwide mean length for mussels collected at 21 sites was 55.5 mm. The New Brunswick stations, St. Croix River and Hospital Island, diverged markedly from the intended value, with mussels averaging 41.9 and 66.7 mm in length, respectively (Table 4). For the other locations sampled, the average length of mussels generally fell within the 50-60 mm range, with the samples from Massachusetts, New Hampshire, and Maine having mean lengths at or slightly above, and the Nova Scotia samples slightly below, the Gulf mean (Fig. 3).

TABLE 4. Morphometric characteristics of indigenous mussels collected at the Gulf of Maine stations in September 1993. Station listing arranged from south to north, clockwise around the Gulf of Maine.

Station	N	Length (mm)	Height (mm)	Width (mm)	Wet Weight (g)	Condition Index (Ci)
MASA	20	55.5(2.6)*	28.6(1.5)	23.5(2.0)	7.2(1.7)	0.186(0.032)
MAPY	30	56.3(2.3)	28.2(1.5)	23.1(2.2)	6.5(1.7)	0.188(0.038)
MACO	50	56.0(2.6)	28.6(1.9)	22.9(1.9)	6.9(2.1)	0.182(0.036)
MALI	30	55.3(2.7)	28.0(1.4)	21.7(1.5)	6.4(1.7)	0.190(0.029)
MAMH	40	55.3(2.5)	29.1(2.1)	21.7(2.2)	6.5(1.6)	0.184(0.028)
MAME	30	59.8(3.5)	30.4(2.1)	25.2(2.0)	8.1(1.4)	0.177(0.018)
NHHS	30	56.6(4.0)	29.9(1.9)	24.4(2.6)	7.0(1.6)	0.169(0.026)
MECC	60	57.0(3.5)	30.2(2.3)	23.4(2.6)	6.5(1.6)	0.162(0.032)
MEBH	30	57.4(3.0)	29.0(2.0)	24.4(1.7)	6.0(1.4)	0.146(0.029)
MERY	30	56.1(2.9)	30.2(1.5)	21.7(1.7)	6.3(1.3)	0.169(0.019)
MEKN	29	55.5(2.0)	27.5(1.8)	22.5(1.7)	6.1(0.7)	0.177(0.014)
MEFP	30	56.4(3.7)	31.4(2.0)	21.7(1.7)	7.0(2.0)	0.181(0.032)
MEPI	30	57.0(3.2)	29.8(1.9)	22.1(2.5)	6.3(1.4)	0.169(0.018)
NBSC	30	41.9(2.2)	19.6(1.4)	15.6(1.2)	1.8(0.4)	0.133(0.026)
NBHI	30	66.7(8.1)	32.7(4.5)	28.8(4.8)	10.4(5.2)	0.158(0.028)
NBLN	30	55.1(6.7)	30.1(5.1)	22.8(4.1)	5.1(2.3)	0.130(0.022)
NSFI	58	53.5(2.8)	27.7(1.8)	22.1(2.2)	4.5(1.0)	0.137(0.024)
NSDI	80	55.3(2.6)	28.1(2.4)	23.1(1.8)	5.5(1.0)	0.153(0.020)
NSBC	80	52.8(2.7)	27.7(1.7)	23.2(1.8)	4.9(1.4)	0.145(0.035)
NSYR	80	52.1(5.4)	28.1(3.2)	23.2(2.7)	4.7(1.5)	0.136(0.024)
NSAG	80	53.2(3.0)	29.3(1.7)	20.8(2.0)	5.2(1.3)	0.159(0.025)
Total**	21	55.5	28.8	22.7	6.1	0.163

*Arithmetic mean (standard derivation)
**Mean of means

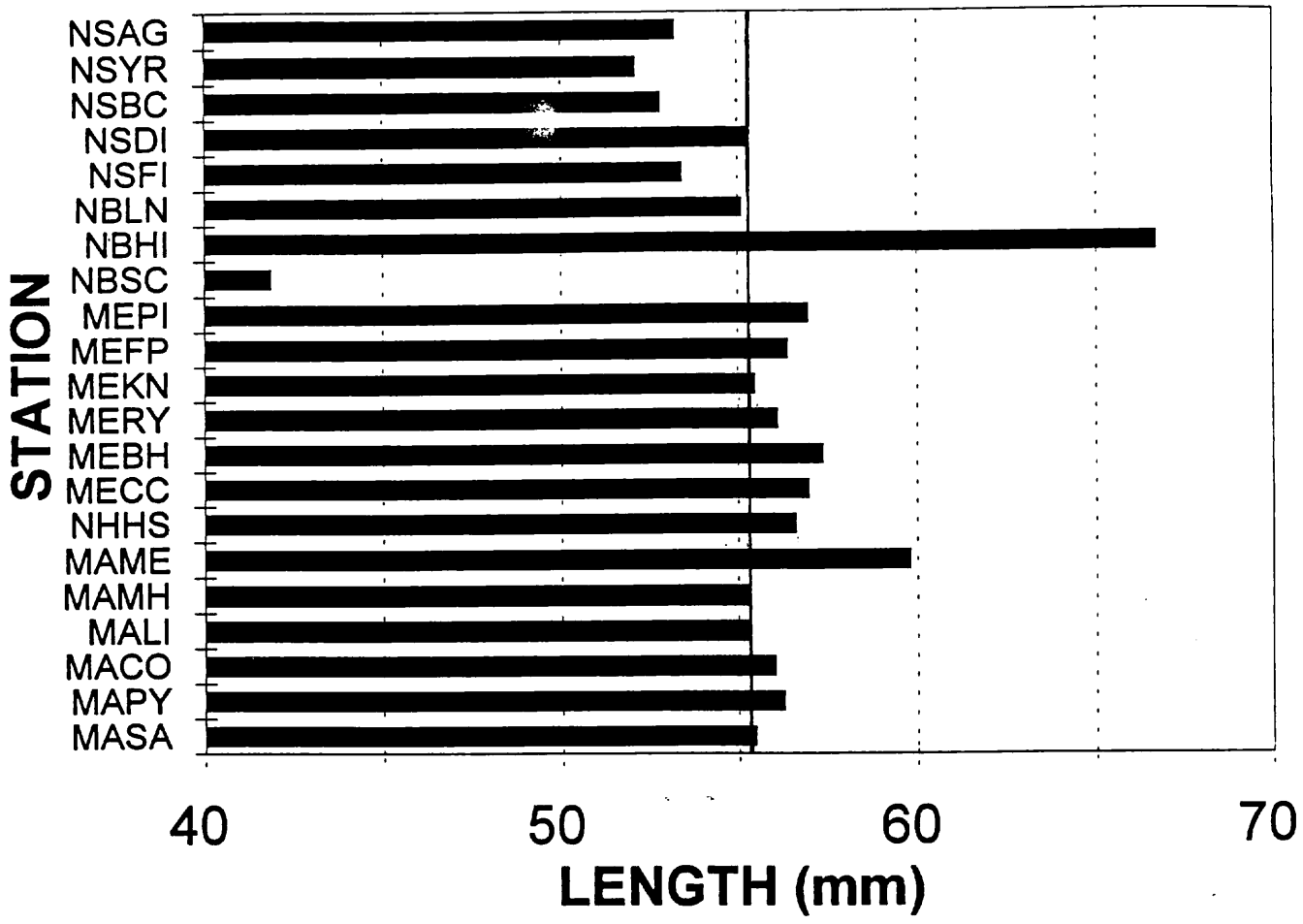


FIGURE 3. Mean length of mussels collected at each station in 1993, organized clockwise from south to north around the Gulf of Maine. Overall average of 55.5 mm is shown.

The average mussel height and width all Gulf of Maine stations combined was 28.8 and 22.7 mm, respectively. However, most stations were close to these values, with the exception of the already-mentioned New Brunswick stations: St. Croix River and Hospital Island (see Table 4).

CONDITION INDEX

The mussel wet tissue weight varied throughout the Gulf of Maine relative to an overall mean of 6.1 g (Table 4). The samples from Massachusetts, New Hampshire, and Maine were generally above this value; and the Nova Scotia station samples were all below. As expected from the smaller shell size, the lowest mean weight was recorded at St. Croix River (1.8 g) and the highest at Hospital Island, N.B. (10.8 g).

Condition index, calculated as tissue weight/(length*height*width), averaged 0.163 throughout the Gulf of Maine. With the exception of Clarke Cove, ME, and Brave Boat Harbor, ME, the American stations exhibited mean condition indices above the Gulfwide mean (Fig. 4). The condition indices for the Canadian samples were all below the Gulf mean, with the lowest value observed at Letang Estuary, N.B. There appears to be a north-south gradient in condition index which probably reflects differing seasonal stages of gonadal maturity and growth around the Gulf of Maine at the time of sampling.

METAL CONTAMINANTS

Mercury

Initial results revealed unexpectedly high variability in the measurement of mercury in mussel tissue (Fig. 5). The average values for each station were well above (0.47-2.46 μg/g dry weight) previous means of 0.10-0.67 μg/g dry weight for 1992 (GMCME 1994). The 1993 results are both high and variable, and thus their accuracy is suspect (Table 5; Fig. 5).

Nickel

Nickel levels in mussels were unchanged at stations reoccupied in Maine, New Brunswick, and Nova Scotia in 1993 compared to the 1991 and 1992 levels but were elevated above the 1992 levels at Sandwich, MA, in caged mussels (Fig. 5). Mussels from most locations sampled in 1993 had levels above the 1990 National Status and

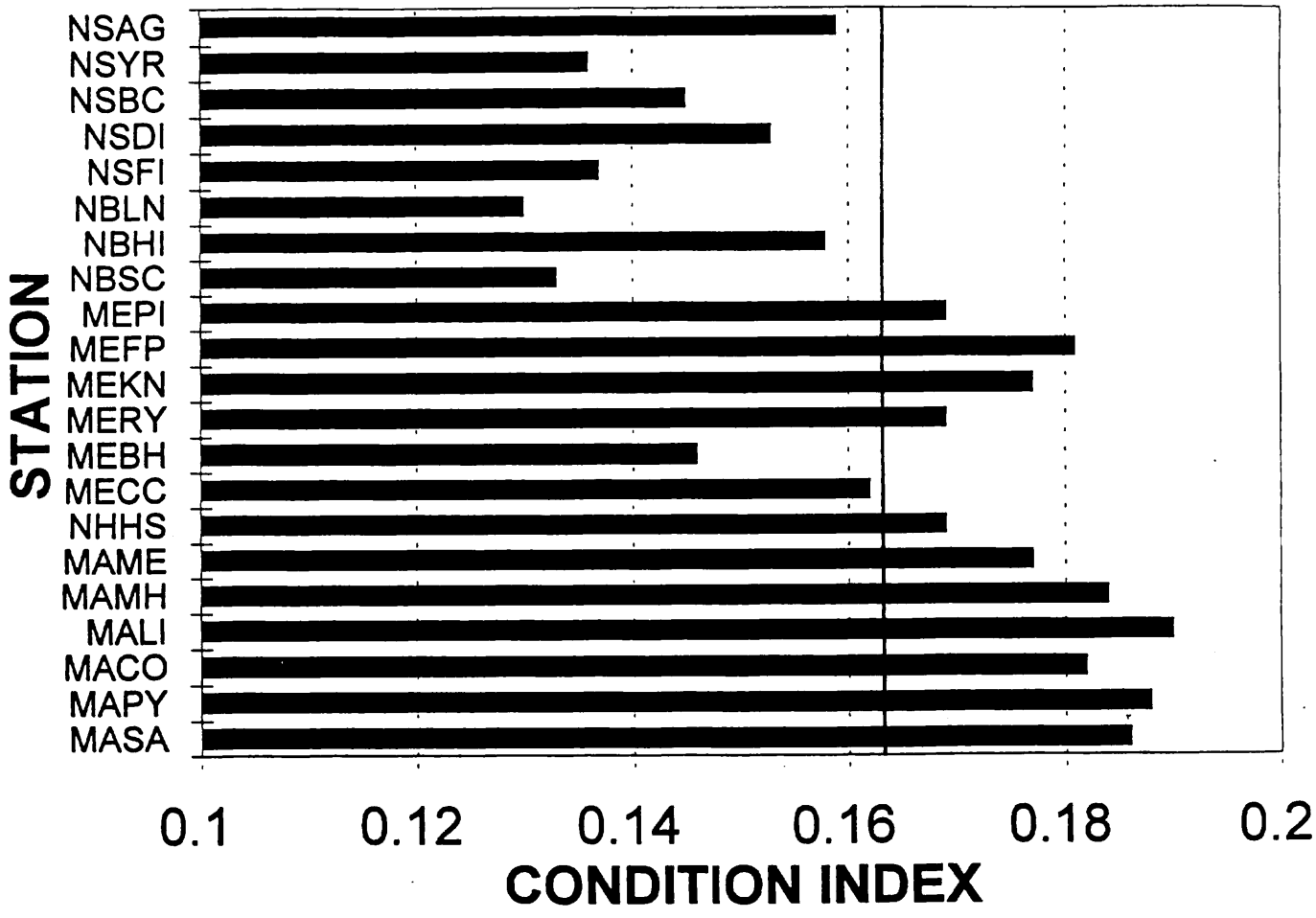
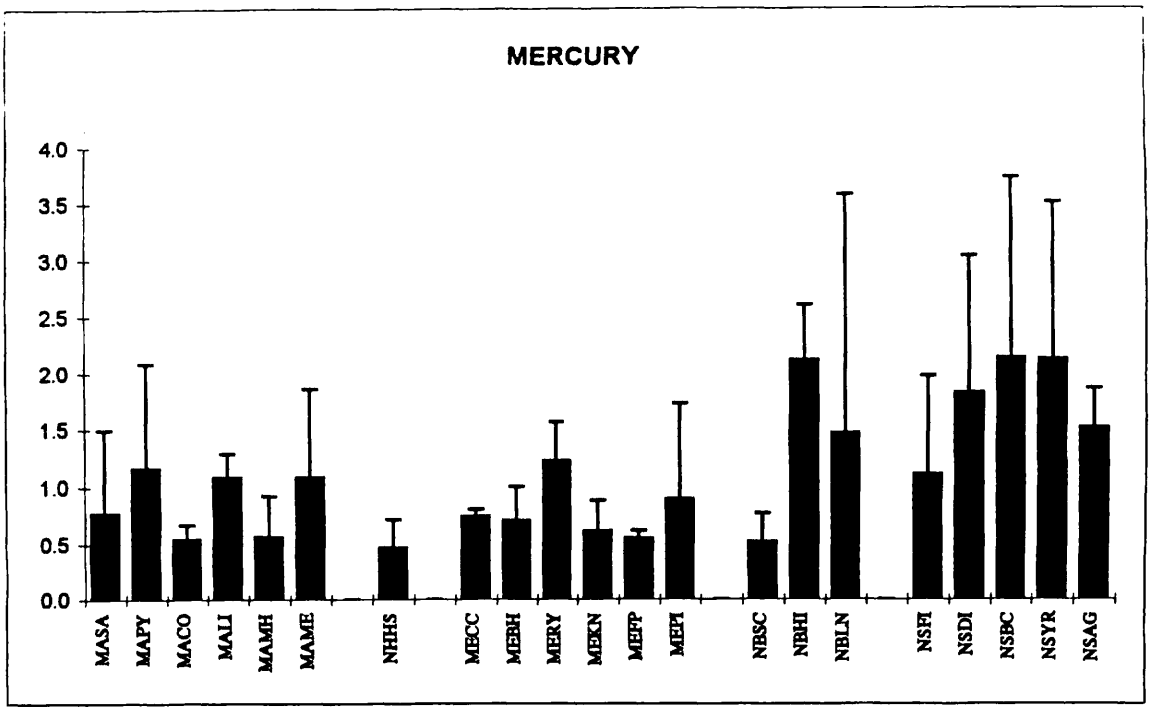


FIGURE 4. Mean condition index of mussels collected at each station in 1993, organized clockwise from south to north around the Gulf of Maine. Overall average of 0.163 is shown.



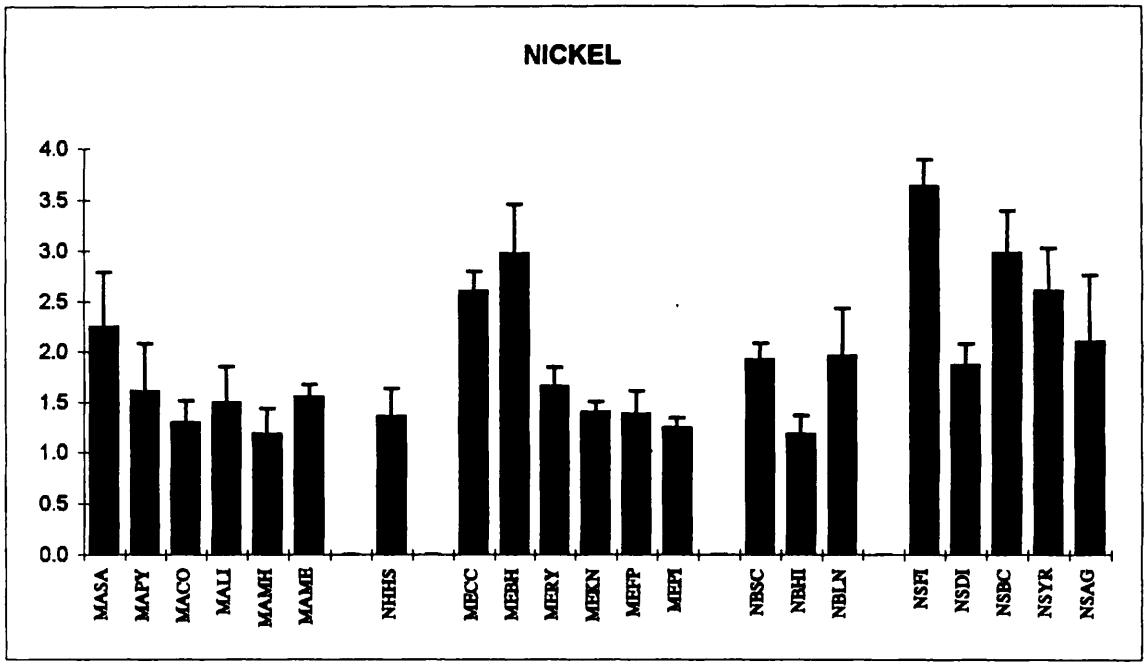


FIGURE 5 Distribution of mercury and nickel tissue concentrations ($\overline{X} \pm SD$, ug/g dry weight) in mussels plotted clockwise around the Gulf of Maine from Massachusetts to Nova Scotia.

TABLE 5. Tissue concentrations ($\bar{X}$ ± SD) for mussels collected at sites around the Gulf of Maine in 1993(μg/g dry weight).

Station	Ag	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Al	Fe	Solids
MASA	1.636±0.364	1.68±0.25	1.64±0.46	6.06±0.40	3.78±0.12	0.77±0.73	2.24±0.55	101±11	60.7±4.3	354±20	11.1±0.39
	0.769-1.636	1.45-2.04	1.25-2.27	5.55-6.48	3.68-3.93	0.27-1.85	1.79-3.04	85-111	55-65	333-380	10.8-11.7
MAPY	0.386±0.157	1.70±0.13	1.54±0.22	6.17±0.33	3.54±0.44	1.16±0.92	1.60±0.48	125±11	39.5±11.1	259±29	12.6±0.15
	0.273-0.614	1.52-1.84	1.36-1.81	5.76-6.56	2.88-3.83	0.40-2.50	1.18-2.03	117-140	24.0-48.0	224-289	12.5-12.8
MACO	1.693±0.729	1.42±0.17	1.63±0.21	6.90 ±0.54	5.24±0.75	0.55±0.12	1.29±0.22	127±13	83.0±16.1	280±37	15.1 ±0.80
	1.083-2.533	1.27-1.66	1.40-1.86	6.11-7.33	4.46-6.18	0.45-0.73	1.08-1.53	113-140	73.0-107.0	248-329	14.0-15.7
MALI	1.194±1.426	1.67±0.11	2.94±0.21	8.73±0.41	9.08±1.09	1.09±0.21	1.49±0.36	170±12	165±24	500±61	13.2±0.9
	0.433-3.333	1.57-1.83	2.63-3.08	8.27-9.17	7.52-9.93	0.85-1.27	1.12-1.92	158-187	135-194	436-583	12.0-14.1
MAMH	0.247±0.098	1.20±0.13	2.12±0.18	5.77±0.42	2.81±0.31	0.57±0.36	1.18±0.26	122±11	94±13	307±25	15.4±0.6
	0.137-0.344	1.01-1.30	1.89-2.34	5.21-6.19	2.44-3.18	0.38-1.10	1.00-1.56	112-137	75-106	277-338	14.6-16.0
MAME	0.137±0.037	2.82±0.38	2.56±0.14	6.49±0.43	4.80±0.19	1.08±0.78	1.55±0.13	113±12	49±5	393±26	12.7±0.44
	0.081-0.160	2.29-3.18	2.42-2.75	6.14-7.12	4.58-5.04	0.57-2.24	1.38-1.68	98-128	45-57	371-427	12.3-13.2
NHHS	0.050±0.008	2.10±0.27	1.62±0.45	6.45±0.30	2.38±0.27	0.47±0.25	1.36±0.28	123±8	94±21	274±50	16.4±0.7
	0.039-0.059	1.71-2.32	1.12-2.13	6.04-6.77	2.00-2.60	0.29-0.83	1.10-1.72	112-129	76-124	212-325	15.5-17.0
MECC	0.095±0.047	2.39±0.27	3.31±1.28	7.51±0.87	5.35±2.18	0.74±0.06	2.60±0.20	126±17	187±80	535±138	12.7±1.0
	0.066-0.165	2.11-2.73	1.74-4.86	6.36-8.44	2.23-6.97	0.66-0.80	2.39-2.87	107-148	124-303	331-634	12.1-14.2
MEBH	0.204±0.086	2.83±0.46	3.05±1.11	7.06±1.05	3.51±1.63	0.71±0.30	2.97±0.48	118±12	177±66	469±100	11.8±1.0
	0.076-0.257	2.14-3.12	2.04-4.43	5.87-8.40	2.61-5.95	0.35-1.07	2.37-3.49	101-126	138-275	404-618	10.9-13.1
MERY	0.038±0.010	2.02±0.31	1.65±0.24	8.40±0.33	2.07±0.26	1.23±0.34	1.65±0.19	103±18	260±65	525±82	9.4±0.2
	0.022-0.044	1.61-2.31	1.29-1.77	7.96-8.75	1.83-2.29	0.91-1.67	1.40-1.87	76-115	172-323	430-604	9.1-9.6

TABLE 5 (Continued)

Station	Ag	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Al	Fe	% Solids
MEKN	0.064±0.002	2.16±0.36	1.78±0.58	7.85±0.33	1.60±0.35	0.61±0.27	1.40±0.11	79±18	136±27	360±51	13.3±0.9
	0.032-0.078	1.79-2.56	1.44-2.64	7.59-8.32	1.24-2.08	0.39-0.96	1.24-1.47	63-104	114-176	317-432	12.5-14.5
MEFP	0.094±0.052	1.93±0.20	1.74±0.53	7.40±0.50	1.82±0.26	0.56±0.07	1.38±0.23	82±9	129±41	369±80	14.1±1.1
	0.032-0.142	1.72-2.20	1.19-2.41	6.83-7.95	1.52-2.13	0.46-0.63	1.13-1.63	76-95	90-184	265-433	12.6-15.1
MEPI	0.130±0.067	1.62±0.18	1.29±0.27	5.56±0.74	1.26±0.16	0.89±0.83	1.24±0.10	105±17	85±46	272±94	13.1±0.8
	0.037-0.197	1.46-1.80	1.05-1.61	4.89-6.62	1.02-1.35	0.25-2.04	1.10-1.34	81-118	59-154	218-412	11.9-13.7
NBSC	0.076±0.006	1.43±0.18	1.80±0.30	7.20±1.95	1.42±0.30	0.52±0.25	1.92±0.17	95±15	307±58	609±90	13.3±0.9
	0.070-0.083	1.26-1.61	1.53-2.07	5.84-10.08	1.12-1.82	0.22-0.83	1.75-2.12	74-107	226-356	524-736	12.1-14.3
NBHI	0.108±0.058	1.68±0.09	1.12±0.12	4.99±0.86	0.94±0.15	2.11±0.49	1.18±0.19	78±9	75±12	240±41	15.7±0.5
	0.065-0.187	1.57±1.75	1.04±1.29	4.39-6.26	0.78-1.10	1.69-2.80	0.98-1.43	67-90	59-84	196-279	15.3-16.4
NBLN	0.030±0.002	1.99±0.80	1.43±0.27	6.17±0.20	1.74±0.55	1.46±2.12	1.96±0.47	96±15	296±25	627±135	13.6±0.9
	0.028-0.033	1.42-3.17	1.13-1.67	5.93-6.39	1.27-2.52	0.22-4.63	1.49-2.60	82-114	269-325	500-813	12.3-14.4
NSFI	0.009±0.009	3.37±0.83	5.43±3.68	6.54±0.83	1.66±0.15	1.10±0.87	3.63±0.27	64±23	890±183	1360±60	10.6±2.3
	<0.002-0.019	2.23-3.98	3.23-10.94	5.61-7.61	1.51-1.87	0.50-2.39	3.33-3.98	32-88	633-1043	1295-1430	8.8-13.9
NSDI	0.264±0.204	1.77 ±0.35	1.91±0.29	7.08±0.29	3.94±0.43	1.82±1.22	1.86±0.22	112±4	413±65	678±80	12.5±0.5
	0.076-0.553	1.52-2.28	1.59-2.28	6.83-7.48	3.48-4.39	1.06-3.64	1.57-2.03	106-116	325-480	626-797	12.1-13.2
NSBC	0.076±0.012	2.96 ±0.25	2.53±0.54	7.33±0.52	3.83±0.48	2.13±1.60	2.98±0.42	123±12	223±29	565±45	11.0±0.7
	0.064-0.092	2.75-3.31	1.95-3.04	6.88-8.07	3.31-3.40	0.93-4.40	2.57-3.49	110-138	202-263	517-624	10.2-11.8
NSYR	0.324±0.059	2.03 ±0.52	2.89±0.45	7.51±0.45	3.50±0.31	2.12±1.39	2.60±0.43	89±9	233±100	911±143	9.8±0.5
	0.279-0.411	1.54-2.76	2.47-3.27	7.20-8.16	3.26-3.94	0.71-4.04	2.04-3.08	81-100	140-375	742-1087	9.3-10.4
NSAG	0.071±0.016	2.06 ±0.22	2.12±0.37	6.32±0.17	5.14±1.00	1.51±0.35	2.10±0.66	89±4	179±16	709±67	11.2±0.7
	0.055-0.091	1.82-2.28	1.74-2.60	6.12-6.49	3.72-6.06	1.07-1.93	1.49-2.98	84-92	165-202	612-760	10.4-12.1

Trends Program geometric mean of 1.18 μg/g dry weight for mussels in the Gulf of Maine (GMCME 1994, Table 6).

Aluminum and Iron

Aluminum and iron were previously thought to be indicators of bottom contamination of mussels, through their feeding on resuspended sedimentary material (GMCME 1994). Aluminum and iron analyzed in the 1993 field season support the findings from the previous year's sampling (Fig. 6). Highest values were obtained at Five Islands, N.S., which is consistent with elevated turbidity in this area (Fig. 6). However, large differences occur in the ratio of aluminum to iron which suggests that local sediment geochemistry and composition of the organic or inorganic fractions of the resuspended material must be considered. Aluminum concentrations at the Digby, N.S., and Kennebec River, ME, stations revisited in 1993 have significantly elevated levels, whereas levels were lower at Hospital Island, N.B., and Broad Cove, N.S. Iron concentrations, similarly, are elevated in mussels from the Massachusetts, Maine, New Brunswick, and Digby, N.S., locations resampled in 1993.

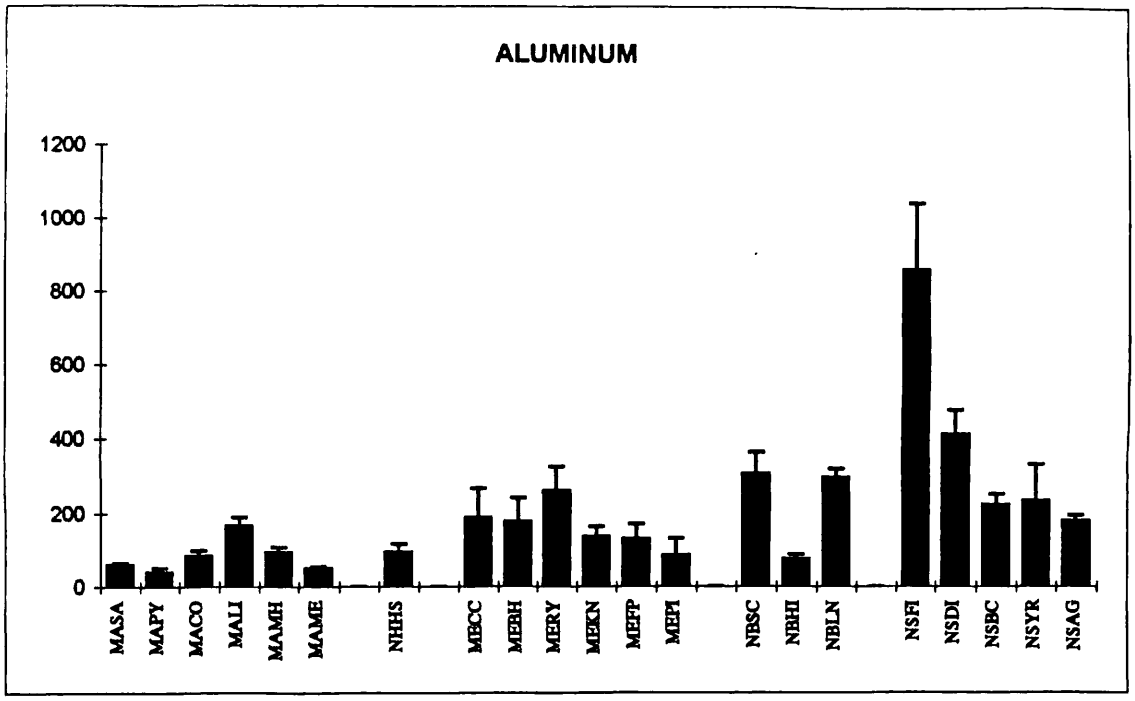
Cadmium

Mussel cadmium levels, as in previous years, did not show a geographic trend or any anomalously high concentrations (Table 5; Fig. 7), although the overall Gulfwatch average values were above the National Status and Trends values for Gulf of Maine mussels for 1990 (Table 6).

TABLE 6. National Status and Trends (NS&T) mussel watch summary statistics for Gulf of Maine mussel samples collected in 1990 (μg/g dry weight) (NOAA 1992 pers. comm.).

	Ag	Cd	Cr	Pb	Hg	Ni	Zn	Fe	Al
Geometric mean	0.22	1.10	1.39	2.97	0.13	1.18	92	312	203
"High value"*	0.51	1.52	2.78	6.75	0.31	1.72	113	482	387

*Logarithmic mean (geometric) plus one standard deviation (O'Connor 1992).



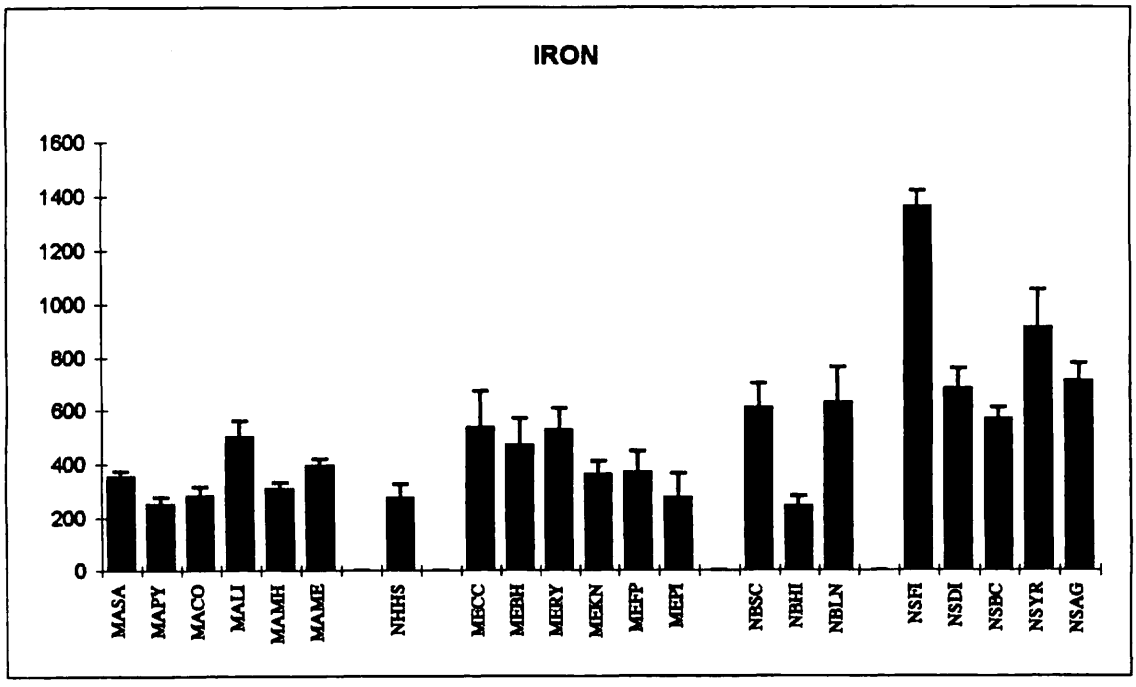
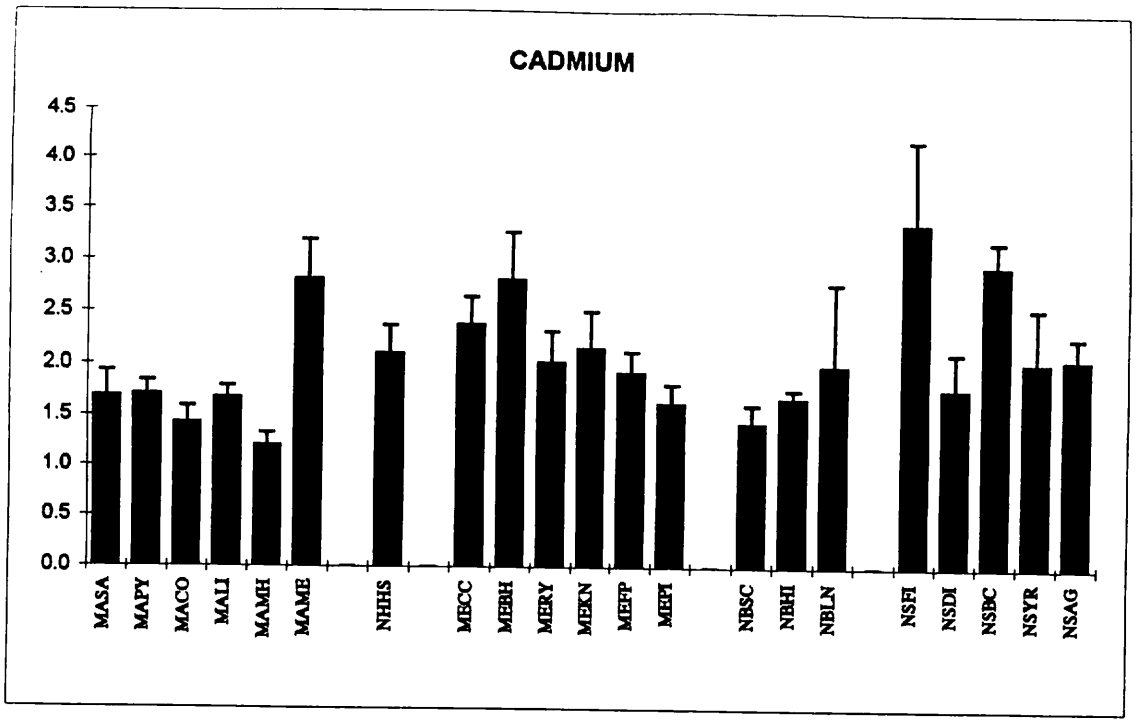


FIGURE 6 Distribution of aluminum and iron tissue concentrations ($\overline{X} \pm SD$, ug/g dry weight) in mussels plotted clockwise around the Gulf of Maine from Massachusetts to Nova Scotia.



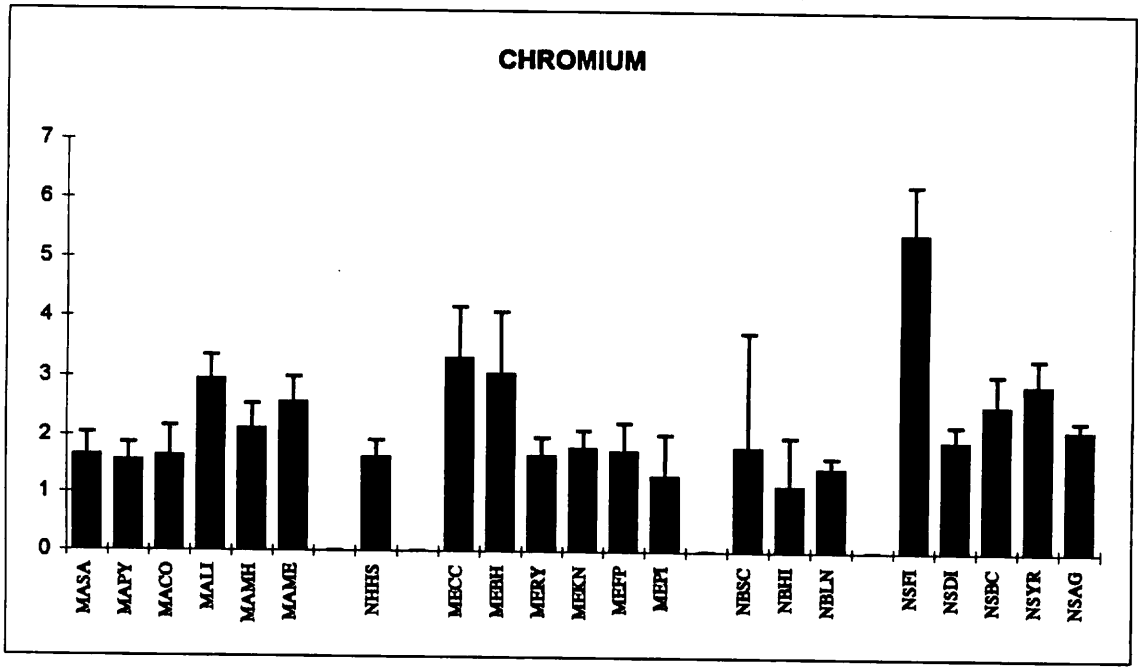


FIGURE 7 Distribution of cadmium and chromium tissue concentrations ($\overline{X} \pm$ SD, ug/g dry weight) in mussels plotted clockwise around the Gulf of Maine from Massachusetts to Nova Scotia.

Chromium

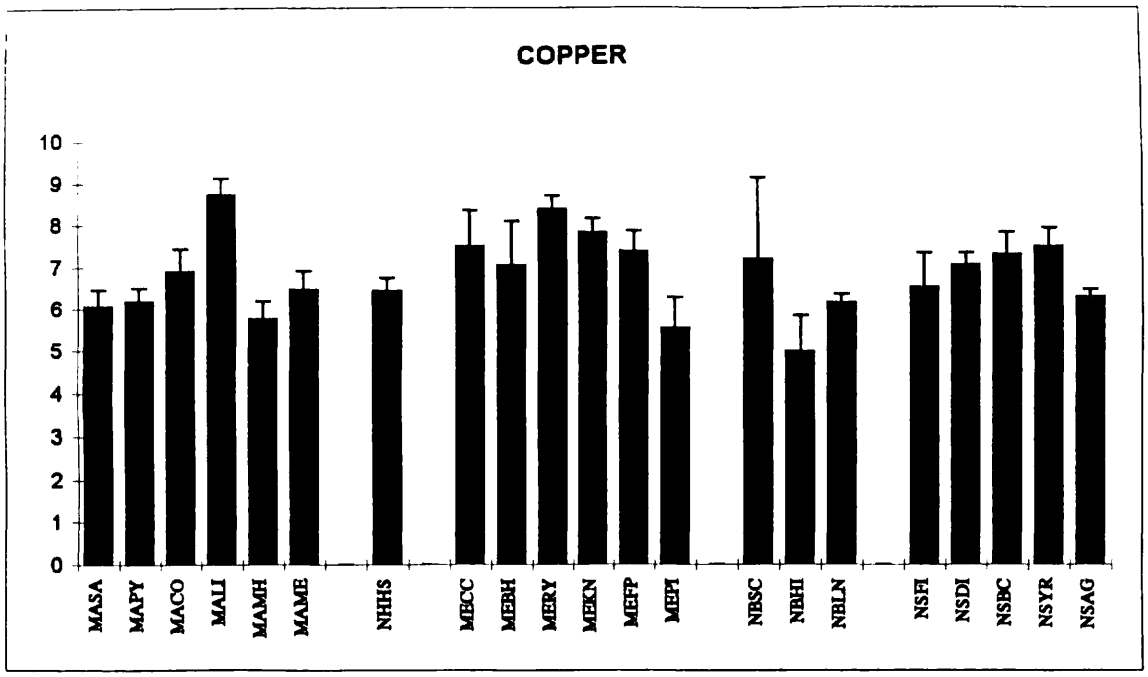
Chromium concentrations showed no geographic trend in 1993, which is consistent with the first (1991) but not the second year of study (GMCME 1992a; 1994) (Fig. 7). Five Islands, N.S., had levels of chromium well above the 2.8 μg/g dry weight NS&T "high" (Table 6). This anonomous level at Five Islands cannot be solely explained by the high sediment load in the water column and therefore in the guts of the mussels because other regions with high aluminum and iron levels did not contain as much chromium proportionately. Digby and Broad Cove, N.S., and Kennebec, ME, had significantly reduced levels in 1993 compared to 1992. In general, chromium levels in mussels were lower (2.19 μg/g dry weight, average of site averages) than measured in the previous year (6.04 μg/g dry weight) (GMCME 1994).

Copper

The levels measured in 1993 are comparable to those measured in 1991, with the exception that elevated concentrations were not found in Massachusetts and New Hampshire (Fig. 8). No values are available from 1992 due to an analytical contamination problem in the laboratory.

Lead

Lead concentrations were highest in mussel tissues from Massachusetts, New Brunswick, and Digby, N.S. (Fig. 8). We had suggested previously that highest levels were due to pollution because of close proximity to population centres (GMCME 1994); however, the elevated levels observed in some Nova Scotian sites, compared to Bay of Fundy sites, suggest that local natural or anthropogenic sources may be possible. The highest value was recorded in mussels from Long Island, MA, which is comparable to the 9.6 μg Pb/g dry weight recorded at Digby, N.S., in 1992. Surprisingly, the measured concentration at Digby in 1993 had declined below 4 μg/g dry weight. Broad Cove, N.S., Hospital Island, N.B., and Sandwich, MA, all had mussel lead concentrations that were greater than in 1992, with the exception of Kennebec, MA, where mussel lead concentrations were similar to the previous year.



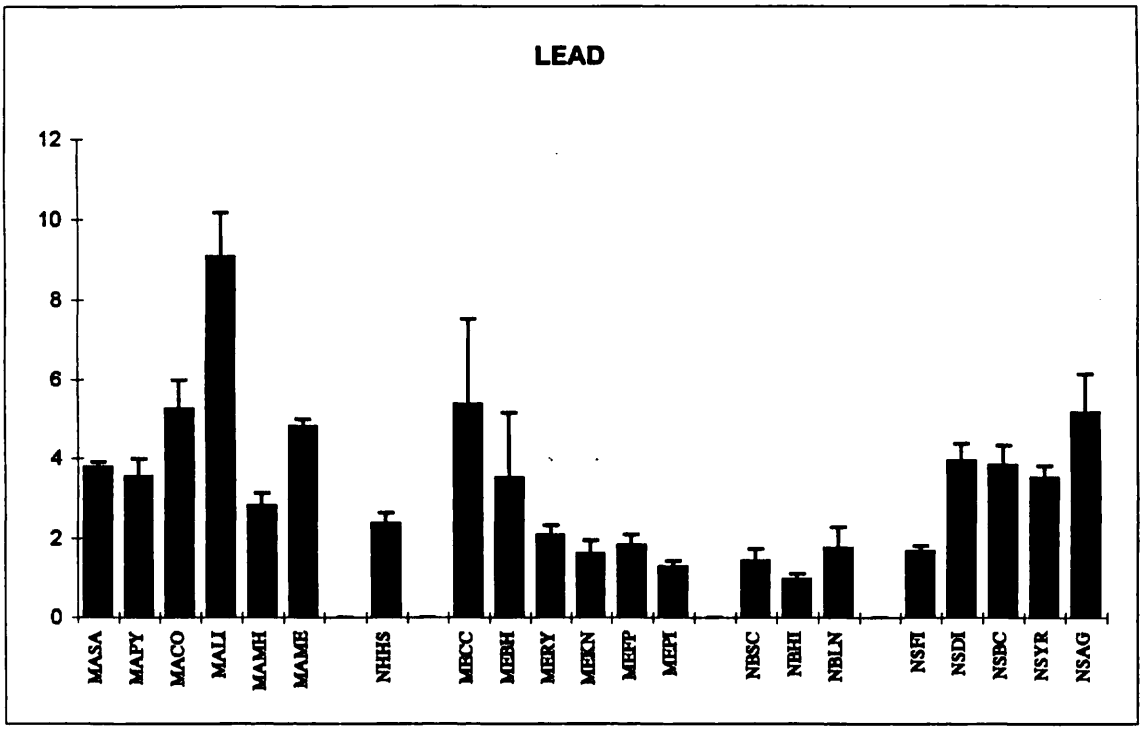


FIGURE 8 Distribution of copper and lead tissue concentrations ($\overline{X} \pm SD$, ug/g dry weight) in mussels plotted clockwise around the Gulf of Maine from Massachusetts to Nova Scotia.

Silver

Silver levels in mussel tissue have been shown to coincide with regions receiving municipal sewage. In all three years of Gulfwatch, Massachusetts mussels had the highest levels of silver in the Gulf of Maine study (Fig. 9) which exceeded the "high" level (0.51 μg/g dry weight) of the NS&T sites (Table 6). This should not be surprising given the fact that the Massachusetts sites are located near one of the municipal outfalls for Boston and hence within the immediate influence of the largest human population in the Gulf of Maine. Even mussels from the Massachusetts reference site at Sandwich, MA (MASA), had higher levels of silver than the rest of the Gulf, presumably a result of being situated downcurrent of the metropolitan Boston area. Silver levels measured in Massachusetts, Maine, New Brunswick, and Nova Scotia this year are comparable to levels measured in previous years.

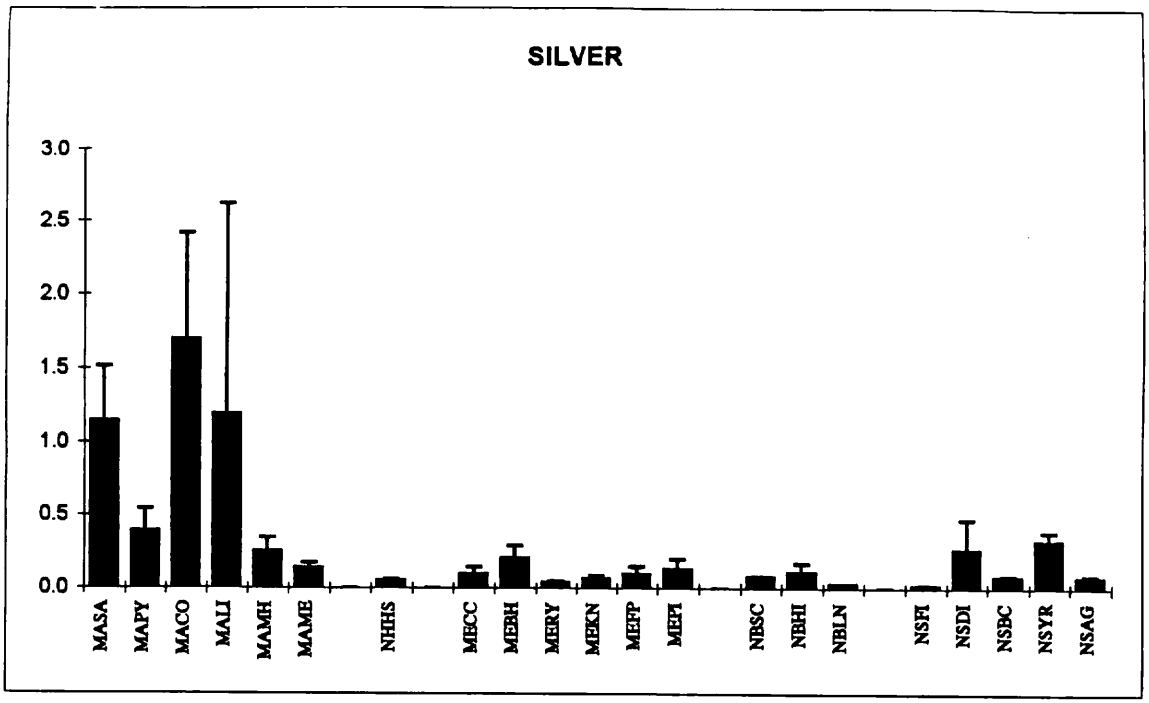
Zinc

Zinc levels generally reflect human activity associated with tire wear, galvanized materials, and industrial discharges, all of which occur within the drainage basins of the Gulf of Maine. Most sites sampled in Massachusetts, New Hampshire, southern Maine, and Broad Cove, N.S., had levels elevated above the National Status and Trends Program geometric mean of 114 μg/g dry weight (Table 6; Fig. 9). Reoccupied benchmark sites reflect similar values to those found in 1991 and 1992, with the exception that the Digby, N.S., site had dropped to the Gulf average (GMCME 1992a; 1994).

ORGANIC CONTAMINANTS

The total concentrations of polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and organochlorine pesticides (OCs) measured in mussel tissue samples from the five Gulf of Maine jurisdictions in 1993 are presented in Table 7. Individual analyte concentrations of each compound class are provided in Appendices D, E, and F.

In 1993, as in the previous year, there is a general southward trend toward higher contaminant concentrations. This north-to-south increase in contaminant levels can be attributed to the increasing population density and industrialization near Boston. This trend is most evident in the PCB and DDT data sets (Fig. 10 and 11) which probably



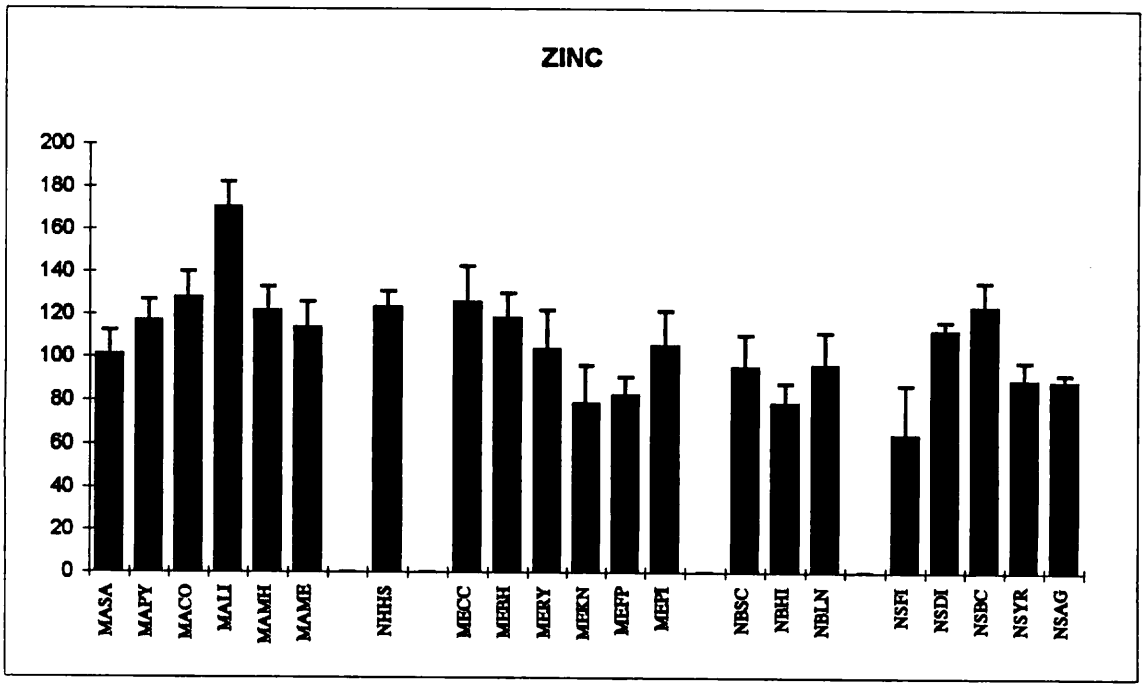


FIGURE 9 Distribution of silver and zinc tissue concentrations ($\overline{X} \pm SD$, ug/g dry weight) in mussels plotted clockwise around the Gulf of Maine from Massachusetts to Nova Scotia.

TABLE 7. Summary of organic contaminants (ng/g dry weight) in the Gulf of Maine, 1993.

Location	Species	TPAH (Mean ± Sd)	TPCB (Mean ± Sd)	TDDT (Mean ± Sd)	Other pesticides (Mean ± Sd)	TPEST (Mean ± Sd)
MASA	Me	19±7	28.8±7.2	15.0±3.7	1.2±1.4	16.3±5.1
MAPY	Me & Mt	13±2	71.5±22.8	7.8±3.2	3.1±2.5	11.4±6.2
MACO	Me & Mt	118±13	101.3±7.8	30.4±2.4	7.7±1.0	38.1±3.1
MALI	Me	336±74	410.0±111.6	50.7±16.1	16.9±5.5	67.8±21.4
MAMH	Me & Mt	37±22	58.0±23.8	15.7±4.3	8.2±1.5	24±6.0
MAME	Me	162±22	44.0±10.6	4.9±3.3	2.1±0.2	6.8±4.7
NHHS	Me	71±5	9.6±1.2	4.2±0.7	ND	4.2±0.7
MECC	Me & Mt	154±47	70.3±10.7	11.1±5.3	ND	11.1±5.3
MEBH	Me	ND	ND	ND	ND	ND
MERY	Me	65±62	13.4±9.0	5.4±7.5	ND	5.4±7.5
MEKN	Me & Mt	94±31	27.3±11.7	3.5±2.0	ND	3.5±2.0
MEFP	Me	112±42	14.3±2.6	9.9±1.1	ND	9.9±1.1
MEPI	Me	ND	3.4±0.7	1.2±1.4	ND	1.2±1.4
NBSC	Mt & Me	ND	20.0±2.9	ND	ND	ND
NBHI	Me & Mt	ND	3.7±1.2	3.0±1.0	ND	3.0±1.0
NBLN	Me & Mt	ND	7.6±0.9	5.0±1.0	ND	5.0±1.0
NSFI	Me	ND	ND	ND	ND	ND
NSDI	Me & Mt	108±26	ND	ND	ND	ND
NSBC	Me & Mt	383±82	ND	ND	ND	ND
NSYR	Me & Mt	322±69	1.1±1.3	ND	ND	ND
NSAG	Me	ND	ND	ND	ND	ND

ND = non detectable
Me = *Mytilus edulis*
Mt = *Mytilus trossulus*

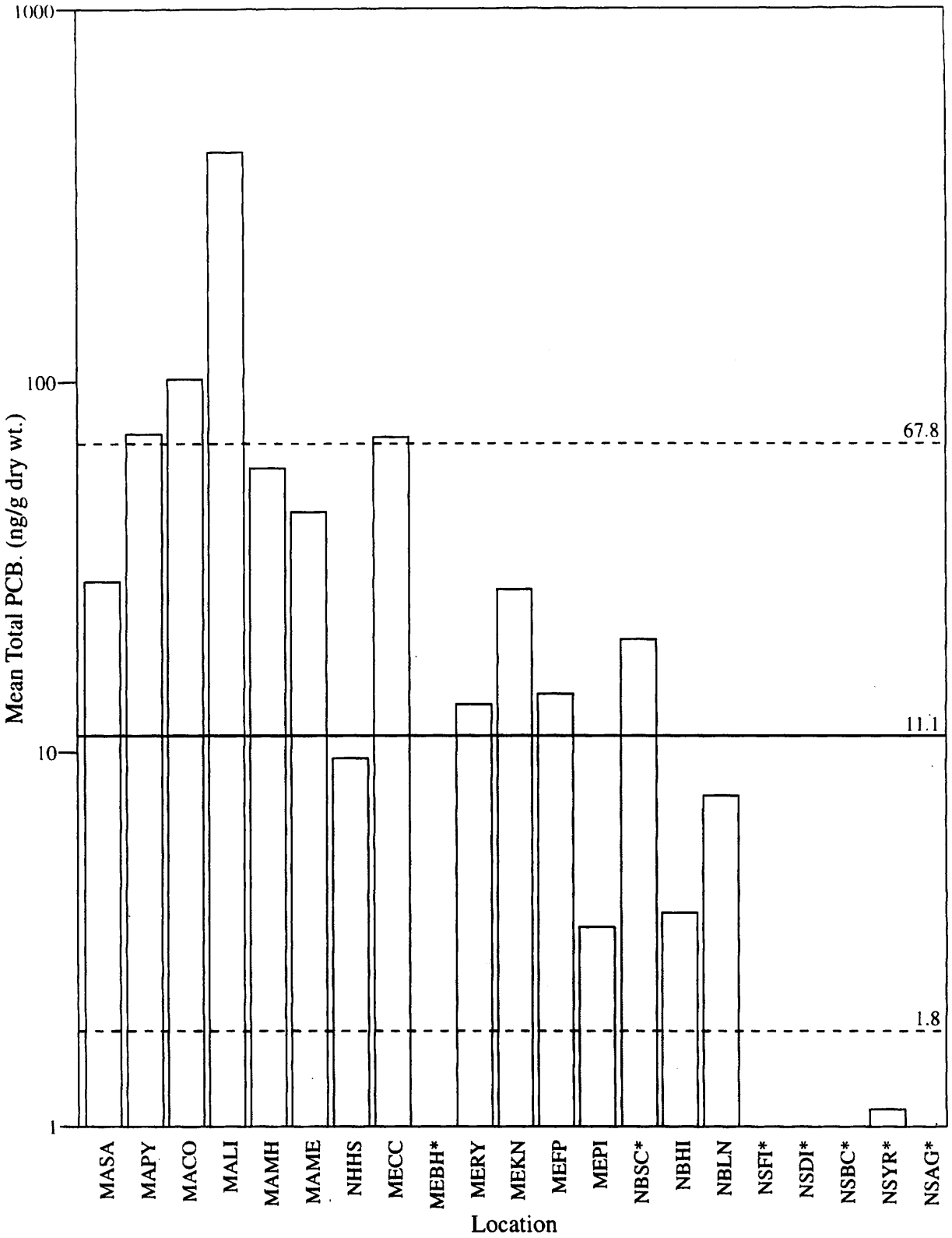


FIGURE 10. Mean total PCB concentrations in *Mytilus* spp. at sites in the Gulf of Maine in 1993. Geometric mean ±1 sd of all sites combined are shown. * = non detectable.

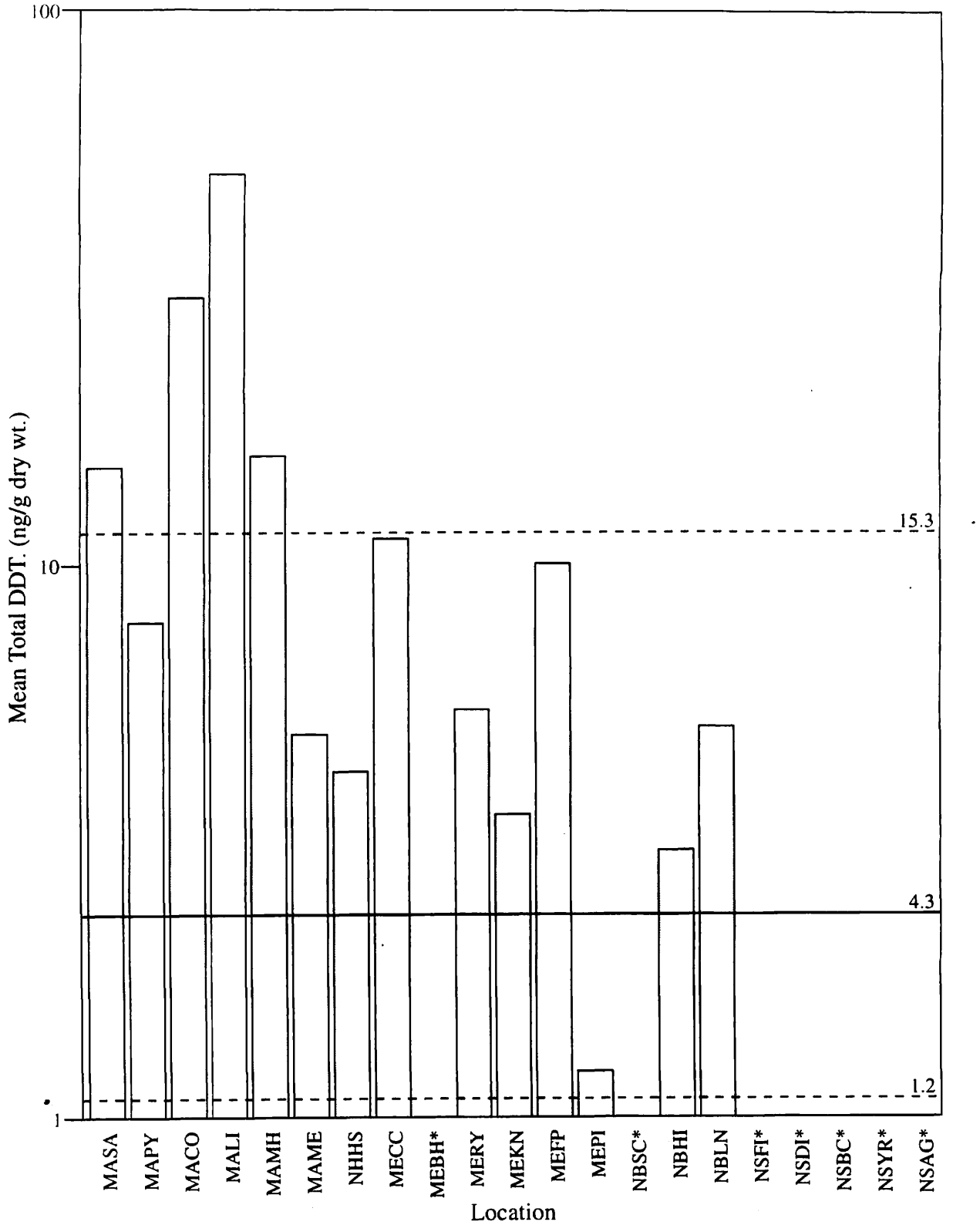


FIGURE 11. Mean total DDT concentrations in *Mytilus* spp. at sites in the Gulf of Maine in 1993. Geometric mean ±1 sd of all sites combined are shown. * = non detectable.

reflects the historical use and deposition of these contaminants in sediments. On the other hand, PAH concentrations more likely reflect recent point source and shipping inputs, judging from the location of most "hot spots" near cities or river mouths (Fig. 12). A comparison of organic contaminant values by jurisdiction is presented in Table 8. Geometric means of total PAH concentrations range from ND to 72 ng/g dry weight with three of five jurisdictions having means greater than the overall Gulf of Maine mean of 22 ng/g (Table 8). Only three Gulf of Maine sites (Long Island, MA, and Broad Cove and Yarmouth, N.S.) individually exceed the geometric mean +1 standard deviation (Fig. 12). The geometric mean +1 standard deviation is considered high relative to most Gulf of Maine sites sampled in 1993. Geometric means of total PCBs range from ND to 79 ng/g dry weight with an overall Gulf of Maine mean of 11 ng/g (Table 8). Four of the 21 sites (Plymouth, Cohasset, and Long Island, MA, and Clarke Cove, ME) exceed the PCB geometric mean +1 standard deviation (Fig. 10). All are located in Massachusetts, except the Clarke Cove site which is located on the Maine-New Hampshire border. Total DDT geometric means range from ND to 17 ng/g dry weight with an overall Gulf of Maine mean of 4.3 ng/g dry weight (Table 8). Four of the six sites along Massachusetts and the Clarke Cove site on the Maine-New Hampshire border exceed the mean +1 standard deviation level. Pesticides other than DDT and its degradation homologues were detected in mussels only from sites in Massachusetts.

Polyaromatic Hydrocarbons

In the Gulf of Maine region, the highest total PAH mussel concentrations were detected in samples from sites at Long Island, MA (336 ng/g dry weight); Yarmouth Harbour, N.S. (322 ng/g dry weight), and Broad Cove, N.S. (383 ng/g dry weight (Fig. 12). Lower but still elevated PAH concentrations were measured in mussels from sites at Cohasset, MA (118 ng/g), Merrimack, MA (162 ng/g), Hampton Seabrook Estuary, NH (71 ng/g), Clarke Cove, ME (154 ng/g), Kennebec, ME (94 ng/g), Fort Point, ME (112 ng/g), and at Digby Harbour, N.S. (108 ng/g). The lowest detectable PAH levels in mussels were from Sandwich, MA (19 ng/g), a Gulf of Maine Gulfwatch reference site, and Plymouth, MA (13 μg/g). No PAHs were detected in mussels from Pickering Island, ME, any site in New Brunswick, or from the Argyle and Five Islands sites in Nova Scotia.

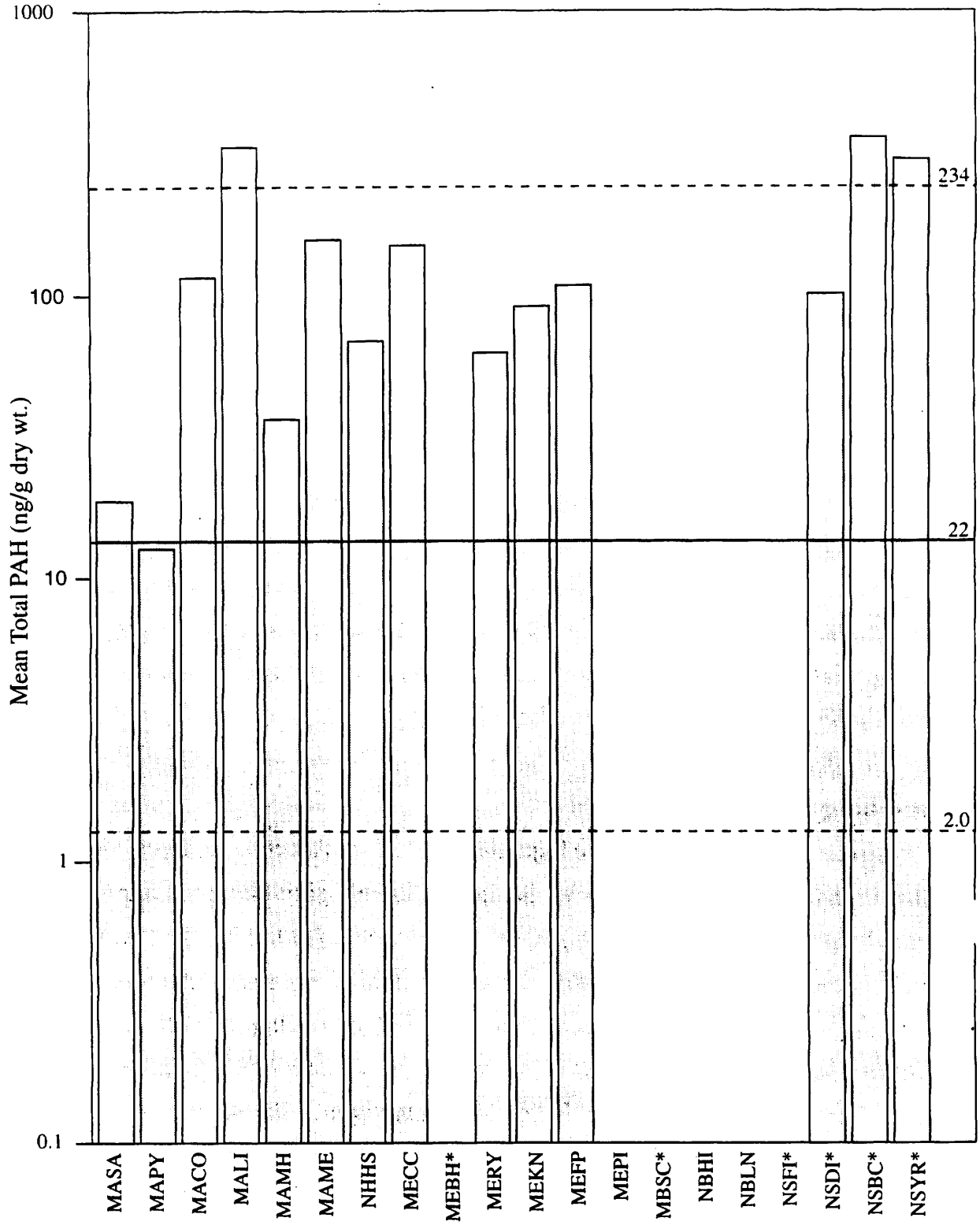


FIGURE 12. Mean total PAH concentrations in *Mytilus* spp. at sites in the Gulf of Maine in 1993. Geometric mean ±1 sd of all sites combined are shown. * = non detectable.

TABLE 8. Comparison of organic contaminant concentrations (ng/g dry weight) in the Gulf of Maine, 1993, by jurisdiction[1].

Jurisdiction	TPAH	TPCB	TDDT	Other Pest	TPest.
Massachusetts	70	79	17	5.8	22
New Hampshire	72	11	5.2	ND	7.9
Maine	22	11	4.5	ND	3.7
New Brunswick	ND	9.4	2.9	ND	2.9
Nova Scotia	27	ND	ND	ND	ND
Gulf of Maine[2]	22	11	4.3	2.4	4.7

[1]Geometric means
[2]All sites
ND = non detectable

Total PAH mussel concentrations in 1993 are similar to concentrations measured at comparable sites in 1992. In four of five jurisdictions (Sandwich, MA; Kennebec, ME; Hospital Island, N.B.; and Broad Cove, N.S.) the 1993 mussel PAH concentrations are within 5% of the previous year's values. In Digby Harbour, N.S., a region of fishing and light industry, the mean total PAH concentration in 1993 was less than one-half the value measured in 1992; however, as in 1992, the mean total PAH concentration at this site remains elevated relative to many other Gulf of Maine sites. No comparable between-year data are available for New Hampshire.

The presence of 2- and 3-ring PAH compounds, especially the alkylated PAHs, in environmental samples are often associated with contamination originating from petroleum sources as these hydrocarbons are more concentrated in petroleum oils than in combustion products. Along with other hydrocarbon indices, these PAHs have been used to identify diagenetic and petrogenic sources of PAHs from pyrogenic sources in sediments (Colombo et al. 1989; Steinhauser and Boehm 1992; Page et al. 1995). A few Gulf of Maine sites have PAH mussel concentrations of the type that are indicative of petrogenic and diagenetic sources. Methyl phenanthrene was detected in 1993 samples from Hampton Seabrook Estuary, NH, and Digby Harbour and Broad Cove, N.S. In 1992, 2- and 3-ring and alkylated PAHs also were reported in mussels from Digby Harbour and Broad Cove, N.S. Interestingly, Broad Cove, a presumed "uncontaminated" reference site which was sampled in 1992 and again in 1993, recorded elevated total PAH concentrations in both years from an as yet unidentified source. No petroleum-associated PAHs were detected in mussels from other sites with relatively high PAH concentrations, such as Long Island, Merrimack, and Cohasset, MA, Clarke Cove and Fort Point, ME, and Yarmouth, N.S.

Polychlorinated Biphenyls

The 1993 PCB levels were highest in mussels from the Massachusetts sites as in the previous year (28.8-410.0 ng/g dry weight) (Figure 10, Table 7). The highest PCB concentration measured was in mussels from Long Island, MA (410±112 ng/g dry weight) and is similar to the PCB concentration reported in indigenous mussels from Nut Island, MA (362±116 ng/g dry weight) in 1992 which is a site near one of Boston Harbor's major municipal sewage outfalls. In other jurisdictions, significantly lower mussel PCB concentrations were measured at sites in New Hampshire (9.6 ng/g), Maine

(ND-70.3 ng/g), and in New Brunswick (3.7 - 20.0 ng/g) and were not detectable at most sites in Nova Scotia.

In 1993, no mussel tissue PCB concentration exceeded any action level or guideline for PCB in edible seafood. It should be noted that the PCB values reported in the present study are the sum of selected congeners and do not represent the total PCB content that may be present in mussels. However, it is likely that the highest PCB mussel tissue concentration measured in 1993; Long Island, MA (410 ng/g dry weight, 82 ng/g wet weight), is well below the United States (USFDA 1989) and the Canadian (CSSP 1992b) action level of 2 μg/g wet weight.

In 1993, total PCB concentrations in mussels from most Gulf of Maine sites were lower than concentrations measured in mussels from comparable sites in 1992. With the exception of Hospital Island, N.B., total PCB concentrations in mussels from Sandwich, MA, Kennebec, ME, and Digby and Broad Cove, N.S., were lower than the 1992 concentrations. The Massachusetts and Maine PCB concentrations of 28.8 ± 7.2 ng/g and 27.3 ± 11.7 ng/g dry weight, respectively, are approximately half the preceeding year's concentrations of 69.4 ± 8.1 and 52.6 ± 8.3 ng/g. Also in 1993, PCBs were not detected in mussels from Broad Cove and Digby Harbour, N.S. (method detection limit -2 ng/g) whereas in 1992, low PCB concentrations had been detected in mussels from Broad Cove (14.1±0.7 ng/g) and from Digby Harbour (17.0±3.6 ng/g). The reason for these between-year differences is not clear but could be due to a number of factors including environmental conditions such as water temperature, salinity, and sediment turbidity and physiological condition, such as lipid reserves, etc. An examination of analytical methods, including: reference standard records, standard calibration curves, response factors, intralaboratory quality control data including matrix spikes, sample surrogate recoveries, and CRM analytical results for both years gives no indication that laboratory QC might account for the between-year differences.

The distribution patterns of chlorobiphenyl congeners in mussels may provide useful information about PCB type and sources of contamination. Although the number of congeners measured in Gulfwatch, like that of most mussel watch monitoring programs, is limited, analysis of the congener data sets from the present study should be considered during the more exhaustive examination of the data in Year 5 of the project.

Pesticides

In 1993, as in 1992, DDT and its degradative metabolites were the sole contributors to total detectable pesticide mussel concentrations in all jurisdictions except Massachusetts (Tables 7 and 8). Pesticides were not detected (MDL=2 ng/g) in mussels from any station site in Nova Scotia or from the Saint Croix River site in New Brunswick (Fig. 11). In Massachusetts, DDTs and cis-chlordane were detected in mussels from Merrimack and, as in 1992, continue to be detected at low concentrations in mussels from the Sandwich site. DDTs, cis-chlordane, and trans-nonachlor were detected in mussels from Cohasset and Plymouth, MA. In Long Island mussels, DDTs, cis-chlordane, trans-nonachlor, and dieldrin were detected.

In 1993 all Gulf of Maine mussel tissue concentrations were below the Canadian and United States action level for DDT (5 μg/g wet weight [CSSP 1992b; USFDA 1993]) and the United States action level for cis-chlordane, trans-nonachlor, and dieldrin (0.1 μg/g wet weight [USFDA 1993]). Interest in environmental levels of these persistent chlorinated pesticides (cis-chlordane, dieldrin, as well as endosulfan and toxaphene) has increased, however, with recent reports of their synergistically oestreomimetic hormone disruptor properties and potential effects on the reproduction, growth, and development of marine organisms.

There are significant between-year differences in mussel pesticide concentrations from Sandwich Island, MA, and Kennebec, ME. In both cases between-year differences were due to decreased DDT concentrations in 1993. No significant concentration difference was noted between 1992 and 1993 in mussels from Hospital Island, N.B.; and pesticides were not detected in mussels from Digby Harbour and Broad Cove, N.S., in 1993; whereas in 1992, low levels were detected at these sites (5.2±1.4 and 4.5±1.3 ng/g, respectively).

Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs)

In 1993, mussels from three Gulf of Maine sites were analyzed for PCDDs and PCDFs (Fig. 13). Appendix E gives individual PCDD and PCDF congener concentrations in mussels from Hospital Island and Back Bay, N.B., and from Yarmouth Harbour, N.S. PCDD and PCDF congener concentrations in mussels from the two New Brunswick sites were either very low or below the level of detection. These results are

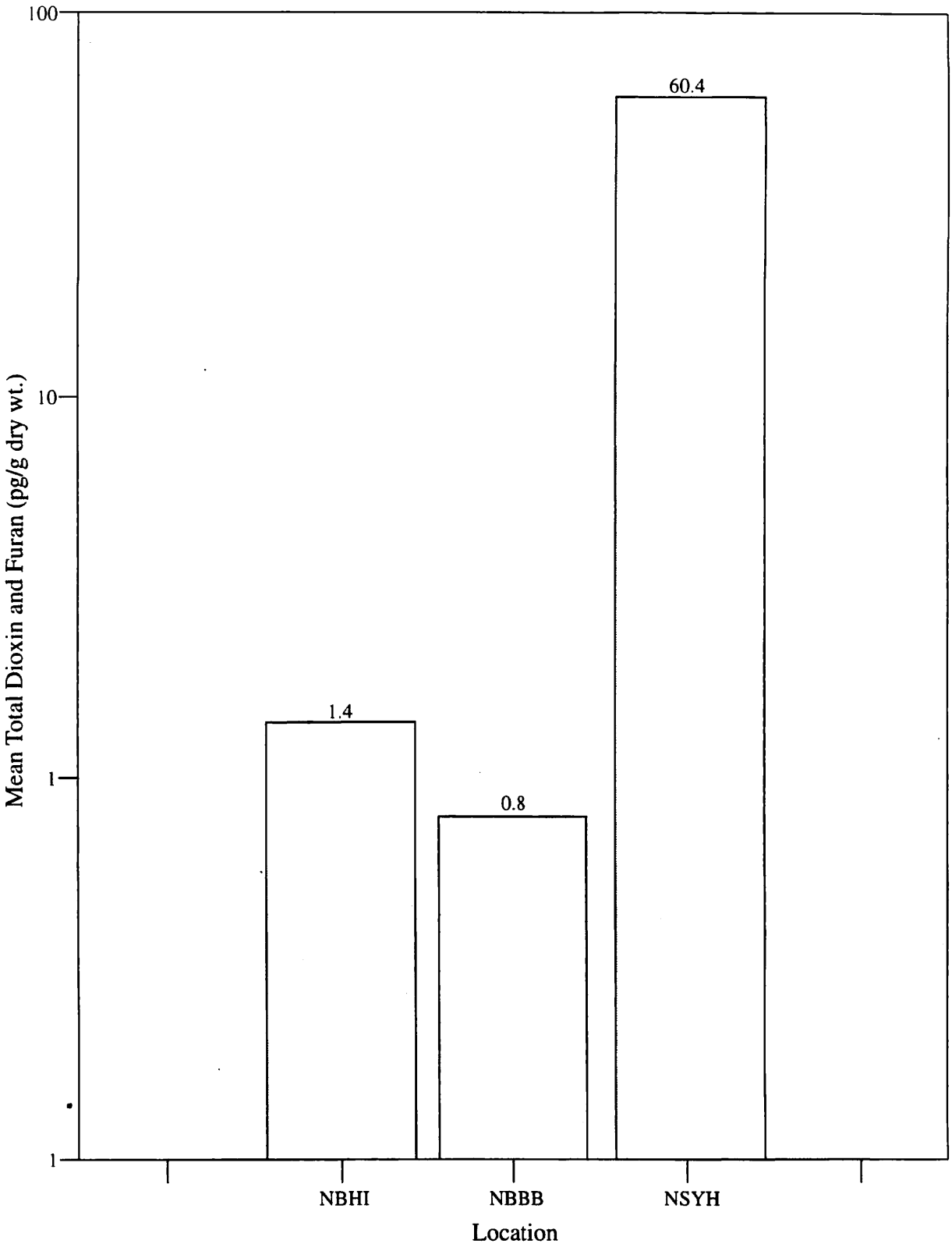


FIGURE 13. Mean total dioxin and furan concentrations in *Mytilus* spp. at sites in the Gulf of Maine in 1993.

likely representative of non-point source background levels in these areas. In mussels from Yarmouth, N.S., mean total PCDD (51±11 pg/g) and PCDF (9.4±3.1 pg/g) concentrations appear to be somewhat elevated and probably reflect point source inputs in an urbanized locale with fish processing and light industrial activity. The distribution of PCDD and PCDF congeners in the Yarmouth mussels also resembles more closely the pattern reported for municipal air particulates and various incineration sources than it does from pulpmill sources (Rappe and Buser 1989) or from PCDF contamination in Aroclors (Roberts et al. 1978). The higher PCDD and PCDF concentrations are consistent with elevated levels of PAHs in mussels found from this site, but do not appear to be related to PCB mussel concentrations as has been reported in other parts of the world (Miyata et al. 1987).

The mean total 2,3,7,8-dioxin toxic equivalent (TEQ) of 0.032 pg/g in Yarmouth Harbour mussels, calculated from individual PCDD/PCDF congener wet weight concentrations, is well below the Canadian guideline for dioxin concentration of 20 pg/g wet weight in edible seafood products (CSSP 1992b).

ACCEPTABLE LEVELS AND STANDARDS OF MUSSEL CONTAMINATION FOR HUMAN CONSUMPTION

Limited information is available for human health effects. In general, most levels reported in the literature are on a wet weight basis, in contrast to Gulfwatch dry weight values. To facilitate general comparisons with Gulfwatch values, an average moisture content of 85% has been applied to wet weight health values to derive dry weight equivalents. The reported organic concentrations are within acceptable levels for those compounds which have established action limits in fish and shellfish. Total PCB values found (Appendix E) are less than the action level of 13 ppm dry weight or 2 ppm wet weight (USFDA 1990; CSSP 1992a). Long Island, MA, had the highest levels of PCBs in mussels during the 1993 survey of 0.4 ± 0.1 ppm dry weight. Action level for the pesticides dieldrin, aldrin, chlordane, heptachlor, and heptachlor epoxide is 2.0 ppm dry weight or 0.3 ppm wet weight (USFDA 1990). Most of these pesticides were below detection levels in the 1993 mussel survey. The total DDT levels found are several orders-of-magnitude below the action level of 33 ppm dry weight or 5 ppm wet weight (USFDA 1990; CSSP 1992a). Long Island, MA, has the highest level in 1993 of 0.05 ± 0.02 ppm dry weight TDDT in mussels. Canadian limits for agricultural chemicals

exclusive of DDT are 0.67 ppm dry weight or 0.1 ppm wet weight, and the dioxin limit is 133 ppt dry weight or 20 ppt wet weight (CSSP 1992a), also well above present values found in Gulfwatch (Appendix F).

Admissible levels of methyl mercury, expressed as mercury, are less than 6.7 ppm dry weight or 1 ppm wet weight in the United States (USFDA 1990) and less than 3.3 ppm dry weight or 0.5 ppm wet weight in Canada (CSSP 1992a). The highest concentration of mercury found in the 1992 Gulfwatch Project was 0.7 μg/g dry weight, well below the lower of the two federal action levels. Unfortunately, the 1993 values are not reliable.

Recently, a series of "Guidance Documents" (USFDA 1993) for cadmium, chromium, lead, and nickel has been released in the United States to complement the mercury action level. These levels, however, are guidelines and by themselves do not warrant the issuance of health advisories. In Table 9, guidance concentrations are reported on both a wet weight basis and dry weight equivalent and compared to the highest observed concentration of any single replicate analysed in the 1993 Gulfwatch Project. With the exception of lead which is represented by several high replicate concentrations from Long Island, MA, no other metals approach the guidelines. All Long Island replicates contained 9.1 ± 1.1 μg lead/g dry weight. It would, therefore, be prudent to resample Long Island, MA, in the near future.

Mussels from Five Islands, N.S., contain consistently high metal levels, albeit at order-of-magnitude levels below the United States Food and Drug Administration guidelines (Table 9). Additional locations from the head of the Bay of Fundy need to be examined to check whether these observed elevated levels are more widespread.

CONCLUSIONS

This year's survey greatly increased our geographical coverage of contaminant levels in the Gulf of Maine mussel populations. Unfortunately, we still have analytical problems with some of the metals, most conspicuously with mercury. Contaminant results for 1993 continue to show a geographic gradient of low to high contamination as one moves from northeast to southwest in the Gulf of Maine. The Boston area contains the greatest number and volume of municipal and industrial discharges and it is downstream from the more pristine regions of the Gulf based on surface currents.

TABLE 9. A comparison of United States Food and Drug Administration guidelines for various metals with Gulfwatch results.

Metal	Guideline (Wet Weight Basis)	Guideline (Dry Weight Basis) (Dry Weight)	Highest Observed 1993 Gulfwatch Value	Location
Cadmium	3.7 μg/g	25 μg/g	3.9 μg/g	Five Islands, N.S.
Chromium	13 μg/g	87 μg/g	10.9 μg/g	Five Islands, N.S.
Lead	1.7 μg/g	11.5 μg/g	9.9 μg/g	Long Island, MA
Nickel	80 μg/g	533 μg/g	3.9 μg/g	Five Islands, N.S.

The opposite trend applies to metals such as aluminum and iron where highest values were attained at stations bordering the Bay of Fundy. It is hypothesized in our preceding report (GMCME 1994) that these values may well reflect resuspended sediment material in the guts of the mussels. Avoiding collection during periods of flood tide and turbidity would help to minimize feeding on sediment particles; however, the Bay of Fundy and some other bays are persistently turbid. Proximity to mudflats is all that is needed for resuspension to occur even during minor wind storms. Future work might consider normalizing metal concentrations to aluminum or iron content, using caged mussels, or allowing mussels to clear their guts overnight in areas of high turbidity.

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APPENDIX A. METHODS FOR MUSSEL EXTRACTION AND ANALYSIS OF ORGANIC CONTAMINANTS

Compounds for organic analysis were selected to be consistent with NOAA status and trends mussel monitoring. All samples were analyzed at the Environment Canada Atlantic Regional Laboratory in Dartmouth, N.S., with the exception of polychlorinated dibenzodioxins/furans which were analyzed on contract by Axys Analytical Services Ltd. in Sidney, B.C.

ANALYTICAL METHODS

Modifications to the methods for organic contaminants have been made since the 1991 Gulf of Maine Mussel Watch Effort (GMCME 1992a and b). The major changes include: 1) lowering target analyte detection limits to 10 ng/g for most aromatic hydrocarbons (20-30 ng/g for some of the lower molecular weight aromatics); 2) the addition of 17 chlorinated pesticides to the variable list including alpha and beta endosulfan; and 3) identification and quantitation of PCB by congener analysis which include 18 NOAA designated congeners and 6 other congeners including some co-planar PCBs. The specific compounds and their detection limits are listed in Tables A1 and A2.

Some modifications were made in the analysis of the 1993 samples in order to improve the analytical quality control. These include the addition of two PCB recovery surrogates (CB-103 and CB-198) and an organochlorine pesticide recovery surrogate (γ-chlordene) to sample homogenates prior to extraction. The PCB and pesticide surrogates replace 3,4,5-trichlorobiphenyl-d5 which was used previously to assess method performance of both PCBs and pesticides.

METHOD DESCRIPTION

Sample Preparation and Extraction

Composite samples of shucked-mussel meats from various coastal locations were provided to the laboratory in solvent-cleaned glass sample jars and stored at -20°C until samples were processed.

Prior to analyzing mussel tissue samples, the laboratory verified that all glassware, chemical reagents, and solvents used in the analysis of tissue samples were free of contamination which could interfere with the identification and quantitation of target analytes.

TABLE A1. Aromatic hydrocarbons.

Compound	Quantitation ion	Confirmatory ion	Spike* concentration (ng/g)
Naphthalene	128	127 [15]	40
2-Methylnaphthalene	142	141 [90]	"
1-methylnaphthalene	142	141 [90]	"
Biphenyl	154	152 [35]	"
2,6-Dimethylnaphthalene	156	155 [30]	"
Acenaphthylene	152	151 [20]	"
Acenaphthene	153	154 [90]	"
2,3,5-trimethylnaphthalene	170	169 [90]	"
Fluorene	166	165 [90]	"
Phenanthrene	178	176 [20]	"
Anthracene	178	176 [20]	"
1-Methylphenanthrene	192	191 [50]	"
Fluoranthene	202	200 [20]	"
Pyrene	202	200 [20]	"
Benzo(a)anthracene	228	226 [20]	"
Chrysene	228	226 [25]	"
Benzo(b)fluoranthene	252	250 [20]	"
Benzo(k)fluoranthene	252	250 [20]	"
Benzo(e)pyrene	252	250 [20]	"
Benzo(a)pyrene	252	250 [20]	"
Perylene	252	250 [25]	"
Indeno(123cd)pyrene	276	277 [25]	"
Dibenzo(ah)anthracene	278	279 [25]	"
Benzo(ghi)perylene	276	277 [25]	"

*Spike Matrix Samples
[ ] % of base peak

SURROGATES:			Amount* (ng)
Naphthalene-d8	136	137	120
Acenaphthene-d10	164	162	120
Chrysene-d12	240	241	60
Benzo(a)pyrene-d12	264	265	60
Benzo(ghi)perylene-d12	288	289	60

*Added to sample homogenates

.../Cont.

TABLE A1. Continued

Compound	Quantitation ion	Confirmatory ion	Concentration* (ng/mL)
INTERNAL STANDARDS:			
Fluorene-d10	176	174	350
Pyrene-d12	212	210	350
Perylene-d12	264	260	350

*In calibration curve

TABLE A2. Polychlorinated biphenyls.

IUPAC	Congener	Spike* concentration (ng/g)
8/5	2,4'-dichloro	20
18/15	2,2',5-trichloro	"
28/31	2,4,4'-trichloro	"
29	2,4,5-trichloro	"
44	2,2',3,5-tetrachloro	"
50	2,2',4,6-tetrachloro	"
52	2,2',5,5'-tetrachloro	"
66/95	2,3',4,4'-tetrachloro	"
77/110	3,3',4,4'-tetrachloro	"
87	2,2',3,4,5-pentachloro	"
101/90	2',2,4,5,5'-pentachloro	"
104	2,2',4,6,6'-pentachloro	"
105	2,3,3',4,4'-pentachloro	"
118	2,3',4,4',5-pentachloro	"
126/178	3,3',4,4',5-pentachloro	"
128	2,2',3,3'4,4'-hexachloro	"
138/163/164	2,2',3,4,4',5'-hexachloro	"

.../Cont.

TABLE A2. Continued

IUPAC	Congener	Spike* concentration (ng/g)
153/132	2,2',4,4',5,5'-hexachloro	"
169	2,2',4,4',5,6'-hexachloro	"
170/190	2,2',3,3',4,4',5-heptachloro	"
180	2,2',3,4,4',5,5'-heptachloro	"
187	2,2',3,4',5,5',6-heptachloro	"
188	2,2',3,4',5,6,6'-heptachloro	"
195/208	2,2',3,3',4,4',5,6-octchloro	"
200	2,2',3,3',4,5',6,6'-octachloro	"
206	2,2',3,3',4,4',5,5',6-nonachloro	"
209	decachloro	"

*Spike matrix samples /coeluting congeners

SURROGATE:	Amount* (ng)
CB-103	25
CB-198	25

*In all samples

INTERNAL STANDARDS:	Concentration* (pg/μL)
4,4'-dibromooctafluorobiphenyl	10
octachloronaphthalene (ref time only)	10

*In calibration curve

A frozen composite sample (5-200 g) was thawed and homogenized in a Waring blender at high speed for 3 minutes (for details on sample homogenization refer to Shrimpton 1988). Ten to 15 g of homogenate were transferred to a 300 mL Berzelius

beaker and 100 mL of methyl chloride added. Two grams of homogenate were put aside for dry weight determination.

One hundred microlitres of surrogate solution containing five deuterated aromatic hydrocarbon recovery standards (Table A1) and 100 mL of surrogate solution containing one pesticide and two PCB congener recovery standards (Table A2) were added to the homogenate. Anhydrous sodium sulphate (7 g/g of homogenate) was added and the contents of the beaker and blended for 2 minutes at high speed with a Polytron tissumizer. The mixture along with methylene chloride rinsings were vacuum filtered through a Whatman GF/C glass microfibre filter. The extract was concentrated to about 3 mL, transferred to a 10 mL glass syringe, and forced through a 0.5 mm Millex SR filter unit into a 15 mL ABC AS2000 System GPC-autovap loading tube. The final volume of extract was made exactly to 8.0 mL with methylene chloride.

EXTRACT CLEAN-UP AND FRACTIONATION

Gel Permeation Chromatography

Lipids, elemental sulphur, and other larger molecular-size compounds derived from the biomatrix were removed by gel permeation chromatography using an Autovap AS2000 GPC Sample Processing System (Analytical Bio-Chemistry Laboratories). The system included a low-pressure GPC column packed with methylene chloride pre-swollen SX-3 envirobeads and was run in dual GPC/auto-evaporation mode with an end-of-run hexane solvent exchange. A sample matrix effect helped reduce analyte losses during the evaporation stage; and a keeper, therefore, was not used.

Silica Column Chromatography

PCB congeners and apolar pesticides were fractionated from more polar pesticides on 1 cm x 10 cm silica gel columns. Columns were prepared by sandwiching a pentane slurry of 7% deactivated silica gel (Davidson 923, mesh 100/200) between two 1 cm layers of anhydrous sodium sulphate.

A column was pre-rinsed with 30 mL of pentane, and 1 mL of concentrated sample extract in pentane was placed on top of the column bed. Twenty millilitres of pentane were passed through the column which eluted most PCB congeners and apolar pesticides.

This was followed by 20 mL of pentane/methylene chloride (1:1) which eluted the more polar pesticides.

Each fraction was collected separately and concentrated to 0.5 mL. Ten microlitres of PCB/pesticide internal standard solution (Tables A2 and A3) were added to each fraction prior to analysis by high-resolution gas chromatography-ECD.

After completion of the PCB/pesticide GC-ECD analysis, the two fractions were combined and concentrated to 0.5 mL in toluene. Ten microlitres of internal standard solution containing five deuterated aromatic compounds (Table A1) were added to the extract and reanalyzed by GC-MS for aromatic hydrocarbons.

INSTRUMENTAL ANALYSIS

Polychlorinated Biphenyls and Pesticides

PCB congeners and pesticides in mussel tissue extracts were analyzed by high-resolution gas chromatography-electron capture detection. A four-point calibration curve was constructed covering the concentration range 2 to 500 pg/mL for these analyses.

Apolar PCB congeners and pesticides contained in fraction one and the more polar compounds contained in fraction two were analyzed on two different fused silica capillary columns. Column 1 contained a 5% phenylmethyl polysiloxane stationary phase while Column 2 contained a 50% phenylmethyl polysiloxane stationary phase. PCB congeners analyzed on Column 1 were identified and quantified individually or as co-eluting pairs (Table A2). Pesticides detected on Column 1 were confirmed on Column 2. PCB congeners and pesticides which co-eluted on Column 1 were resolved on Column 2 for identification and quantitation.

Gas Chromatograph-Electron Capture Detector Operating Conditions

Gas chromatograph:	HP 5890 Series 11
Column 1:	DB-5, 30 m x 0.20 mm fused silica, 0.33 m film
Injection:	Splitless
Temperature program:	90°C for 0 minutes, to 175°C at 10°C/minute, to 280°C at 2.5°C/minute, and hold 5 minutes
Carrier gas:	Helium

TABLE A3. Pesticides.

Compound	Concentration* (ng/g)
Hexachlorobenzene	20
Heptachlor	"
Aldrin	"
4,4'-DDE	"
Mirex	"
Lindane	"
Heptachlor Epoxide	"
cis-Chlordane	"
trans-Nonachlor	"
Dieldrin	"
2,4'-DDE	"
2,4'-DDD	"
4,4'-DDD	"
2,4'-DDT	"
4,4'-DDT	"
alpha-Endosulfan	"
beta-Endosulfan	"

*Spike matrix samples

SURROGATES:	Amount* (ng)
γ-chlordene	40

*Added to sample homogenates

INTERNAL STANDARDS:	Concentration* (pg/mL)
4,4'-dibromooctafluorobiphenyl	10
Octachloronaphthalene (ref time only)	10

*In calibration curve

Secondary Analysis

Gas chromatograph:	HP 5880
Column 2:	HP-17, 25 m x 0.32 fused silica, 0.26 μ film
Injection:	Splitless
Temperature program:	As above
Carrier gas:	Helium

Polyaromatic Hydrocarbons

Analysis of aromatic hydrocarbons was conducted by high-resolution capillary gas chromatography and low-resolution quadruple mass spectrometry in selective ion mode. A five-point calibration curve was constructed for analysis covering the concentration range 10 to 1000 pg/μl.

Gas Chromatograph and Mass Spectrometer Operating Conditions

Gas chromatograph:	HP 5890 Series 11
Column:	DB-5, 30 m x 0.25 mm fused silica, 0.25 μ film or equivalent
Injection:	Cool on column
Temperature program:	70°C for 1 minute, to 250°C at 10°C/minute, to 290°C at 20°C/minute, and hold 12 minutes
Carrier gas:	Helium
Mass spectrometer:	HP 5971A MSD
Ionization mode:	Electron impact 70 ev
Ion dwell time:	150-250 msec (optimized for maximum sensitivity)
Scan speed:	1 cps

REFERENCES

GMCME (Gulf of Maine Council on the Marine Environment). 1992a. Evaluation of Gulfwatch 1991 pilot project of the Gulf of Maine Environmental Monitoring Plan. October. 39 p + Appendices A-D.

GMCME (Gulf of Maine Council on the Marine Environment). 1992b. Gulfwatch Project, standard procedures for field sampling, measurement and sample preparation. Gulfwatch pilot project period 1991-1992. 11 p.

Shrimpton J. 1988. Contaminants Control-Toxic Chemicals Program Technical Resources Manual, 1988. Environ. Can., Conservation and Protection, Pacific and Yukon Region. p. 14-17.

APPENDIX B. QUALITY ASSURANCE/QUALITY CONTROL PROTOCOL

1.0 INTRODUCTION

The quality assurance provisions of this performance-based standard are intended as a guide for the generation of acceptable analytical data for use in Gulf of Maine contaminants monitoring. The standard permits flexibility in the selection of an analytical method for the generation of chemical data, provided the laboratory institutes the quality control measures identified and the method can attain the minimum performance stated.

2.0 SPECIFIED VARIABLES

Essential target analytes required for reporting are listed in the following tables:

- Polyaromatic Hydrocarbons (Table A1 and Appendix D)
- PCB Congeners and Chlorinated Pesticides (Tables A2 and A3 and Appendices E and F)
- Dioxins and Furans (Appendix G)
- Metals (Appendix C)

3.0 EXTERNAL CHECK SAMPLE PROGRAM PARTICIPATION

A laboratory providing analytical data for use in shellfish contaminants monitoring is required to demonstrate proficiency in contaminant analysis through yearly participation in a refereed interlaboratory check sample program if available. Exercise results are provided to the regional project coordinator for review. Deficiencies in check sample performance must be discussed with the project coordinator and corrective action taken where necessary.

The check sample program must be relevant to the analysis of organic and inorganic contaminants at trace concentrations in marine shellfish matrices. The National Institute of Standards and Technology (NIST) (Gaithersburg, MD) conducts a QA intercomparison exercise program for both government and private laboratories engaged in the measurement of organic and inorganic contaminants in marine sediment, fish, and shellfish samples.

4.0 INTRALABORATORY QUALITY CONTROL: INSTRUMENT OPERATING REQUIREMENTS AND PERFORMANCE CRITERIA

4.1 AROMATIC HYDROCARBON ANALYSIS

Gas chromatography-mass spectrometry: Aromatic hydrocarbons in mussel tissue extracts are analyzed on a GC-mass spectrometer in selective ion mode. The gas

chromatograph must be capable of ramp temperature programming up to 290°C and accommodating a 25 m or longer DB-5 capillary column or equivalent. It is recommended that on-column injection is used in order to avoid mass discrimination of higher molecular weight aromatic hydrocarbons which can occur with flash vaporization injection. It also is advisable that deactivated retention gaps are used and routinely replaced in order to maintain column performance.

4.1.1 Initial Set-Up

- MS Tuning: The mass spectrometer is tuned to standard specifications with perfluorotributylamine (PFTBA). Periodic retuning after initial set-up should be performed to ensure MS calibration consistency. Recalibration of the calibration curve is necessary after each retuning.

  Following PFTBA tuning, it may be necessary to manually tune the mass spectrometer, maximizing sensitivity in the low- to mid-mass range (e.g., maximizing the absolute abundance of mass 264) in order to achieve analyte target detection.
- Calibration Curve: A five-point calibration curve is constructed for every target and surrogate analyte. The concentration range covered is 10 to 1000 pg/µl. The curve should not be forced through the origin. Linearity is verified when the relative standard deviation of response factors for each analyte is less than 30%.
- Detection Limits: Laboratories must verify that the method and instruments achieve target method detection limits of 30 ng/g (dry weight) or lower for low molecular weight aromatic hydrocarbons (two-ring aromatic compounds) and 10 ng/g or lower for higher molecular weight aromatic compounds.
- Analyte Identification: Positive identification is assumed when relative to an internal standard, the analyte retention time is within ±0.05 minutes of the corresponding standard retention time; the ratio of quantitation ion and confirmatory ion (Table A1) is within ±20% of the calculated theoretical value except when the abundance of the confirmation ion is too low to permit detection; and the peak maxima for quantitation and qualifier ions coincide within 3 seconds. Identified analytes which fail to meet these criteria should be flagged.

- Quantitation: An internal standard method is recommended for the quantitation of sample data. A minimum of three internal standards should be spiked into sample extracts prior to GC-MS analysis. Suggested internal standards and spiking concentrations are given Table A1.

  Analyses are conducted within the range of the standard calibration curve. Sample extracts with concentrations of analytes greater than the highest calibration standard must be diluted to bring analyte concentrations within the calibration range.

4.1.2 Method Performance Test

Prior to processing any samples, a laboratory must demonstrate that its method and instrument operating conditions will provide acceptable recoveries of surrogate and target analytes. Three replicate uncontaminated tissue homogenate samples are spiked with surrogates and target analytes and analyzed by the full procedure. Recovery of target analytes and surrogates must meet the performance criteria stated in Section 4.1.2 under "Matrix Spike Sample" and "Surrogate Spikes." Method precision (RSD) for each analyte should not be greater than 25%.

4.1.3 Daily Performance Checks

- Calibration Curve Check: At least one calibration standard is run prior to each batch analysis. The calculated amount for each analyte must be within $\pm 15\%$ on average and not exceed $\pm 25\%$ for any one analyte.
- Chromatographic Column Performance: Chromatographic resolution is verified on a daily basis. Adequate resolution is demonstrated if for the highest peak there is no more than a 1% valley between the phenanthrene/anthracene peaks and less than a 25% valley between the Benzo(a)anthracene/chrysene peaks. If these performance criteria are not met, column resolution must be restored before any further sample analyses can proceed.

4.1.4 Batch Analysis

A laboratory is required to analyze tissue samples for organic contaminants in batches of no more than 15 samples including quality control samples. The following quality control measures are required for each batch of sample analyses:

- Method Blank (1): The method blank must be free of contamination at or above the method detection limit. If contamination is greater than the MDL a correction may be made by subtracting the average amount in the blanks from the amount in samples when the blank contamination can be shown to be constant over a number of batch runs. If blank contamination is greater than two times the MDL, corrective action must be taken to eliminate the source of contamination.
- Duplicate Samples (1 set): The relative percent difference between the analytical results for duplicate samples should be no more than 25% for measured values greater than five times the MDL.

  The percent difference is calculated by dividing the absolute difference of the duplicate values by their average value.
- Spiked Matrix Sample (1): A matrix spike is prepared for all the analytes of interest (Table A1). If possible, spike matrix concentrations should be in the same proximity as sample concentrations. Otherwise, the addition of 75 ng of each analyte to matrix homogenates is usually sufficient. Spike recoveries must fall into the range of 40-120% for 80% of analytes. If more than 20% of recoveries are outside the range, instrument response, sample chromatograms and surrogate recoveries for each sample in the batch are checked to ensure that batch analysis is in control. Failing performance criteria will result in individual samples or the entire batch being reanalyzed.
- Standard Reference Material: Ideally, one mussel tissue SRM should be included with each batch of sample analyses. Availability and cost of bivalve reference material, however, may preclude a SRM in every batch. As a minimum at least one SRMs is analyzed with every two or three batches. For projects with higher numbers of samples, a SRM is run at the beginning, mid-point, and end of the analytical project. Marine bivalve certified reference material (SRM 1974) can be obtained from NIST (United States Department of Commerce, Gaithersberg MD).

On average, laboratory results (corrected for surrogate recoveries) should be within ±30% of the certified value's confidence range for all analytes and may not exceed ±35% for more than 30% of individual analytes.

- Surrogate Spikes: Deuterated surrogate analytes (Table A1), representative of each aromatic hydrocarbon group of the same ring number, are spiked into each sample homogenate and method blank prior to extraction. Surrogate recoveries must be in the acceptable range of 30-150%. Samples with surrogate recoveries outside the range are reanalyzed.

4.2 PCB CONGENER AND CHLORINATED PESTICIDES ANALYSIS

The following QC and performance standards are intended for the analysis of PCB congeners and chlorinated pesticides by high-resolution gas chromatography and electron capture detection. Requirements for the gas chromatograph are the same as described in Section 4.2. If flash vaporization injection is used, care should be exercised in selecting the injection port temperature in order to minimize degradation of thermally labile compounds such as 4,4'-DDT.

Gas chromatographic analysis is performed on a 30-m or longer 5% phenylmethyl polysiloxane column (DB-5 or equivalent).

It is highly recommended that a laboratory include in its analytical method provision for the absorptive column fractionation of apolar PCB congeners and chlorinated pesticides from more polar pesticides. The laboratory must verify the PCB and pesticide column elution pattern for every new batch of absorptive material used. Correction of analytical results based on the distribution of some analytes in the two fractions may be required.

4.2.1 Initial Set-Up

- Calibration Curve: For every target analyte a five-point calibration curve is constructed which covers the concentration range 2 to 500 pg/µl. Calibration curve linearity is verified when the relative standard deviation of response factors for each analyte is less than 30%.
- Detection Limit: The laboratory must verify that methods and instrument operating conditions can achieve target method detection limits of 2 ng/g for individual PCB congeners and chlorinated pesticides.

- Chromatographic Column Performance: Chromatograms of standard analytes are checked regularly to ensure that analyte peak shape, resolution, and sensitivity have not degraded with time.
- Analyte Identification: PCBs in mussel tissue are analyzed as selected congeners (Table A2). Co-eluting congeners are identified in data reports.

  Analysis with a second capillary column possessing a stationary phase different from DB-5 type columns such as 50% phenylmethyl polysiloxane (DB-17 or equivalent) is required in order to resolve and accurately identify and quantify PCB congeners and pesticides which co-elute on DB-5 type columns.

  The positive identification of a PCB congener or pesticide is assumed when relative to an internal standard, the analyte retention time is within ± 0.05 minutes of the corresponding standard retention time.
- Quantitation: An internal standard method is recommended for the quantitation of sample data. Suggested internal standards and concentrations for the GC-ECD analysis of PCB congeners and pesticides are given in Tables A2 and A3.

4.2.2 Method Performance Test

The same as per section.

4.2.3 Batch Analysis

Laboratories are required to analyze tissue samples in batches of 15 individuals or less. The following quality control measures are required with each batch:

- Method Blank (1): The same as in Section 4.1.4.
- Duplicate Samples (1 SET): Performance criteria as in Section 4.1.4.
- Spiked Matrix Sample (1): A matrix spike is analyzed for all PCB and pesticide target analytes (Table 3A). Performance criteria are the same as in Section 4.1.4.
- Standard Reference Material: The same as in Section 4.1.4.
- Surrogate Spikes: PCB congener and pesticide surrogates (Table A2) are spiked into each sample homogenate prior to extraction. Performance criteria as in Section 4.1.4.

4.3 DIOXINS AND FURANS ANALYSIS

A laboratory undertaking the analysis of chlorinated dibenzodioxins and chlorinated dibenzofurans (Appendix G) is referred to the quality control measures and performance criteria provided in the Environment Canada report titled "Internal Quality Assurance Requirements for the Analysis of Dioxins in Environmental Samples" (Environment Canada 1992a). Reference also is made to the quality control provisions found in the Environment Canada report titled "Reference Method for the Determination of Polychlorinated Dibenzo-para-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) in Pulp and Paper Mill Effluents" (Environment Canada 1992b).

All samples were spiked with ^{13}C-labelled surrogates (tetrachlorodioxin, tetrachlorofuran, pentachlorodioxin, hexachlorodioxin, heptachlorodioxin, and octachlorodioxin) prior to analysis. Tissue samples were ground with sodium sulphate, packed in a glass chromatographic column and eluted with solvent. The extracts were subject to a series of clean-up steps prior to analysis by gas chromatography with mass spectrometric detection (GC/MS).

4.3.1 Extraction Method

A subsample of tissue was dried to determine moisture content.

A wet tissue sample was spiked with an aliquot of surrogate standard and ground with anhydrous sodium sulphate to a free-flowing powder. The mixture was loaded into a glass chromatographic column containing dichloromethane:hexane and the column eluted with additional solvent. The extract was concentrated and subsampled for gravimetric lipid analysis. The remaining extract was loaded onto a calibrated Biobeads SX-3 column and eluted with dichloromethane/hexane. The 150-300 mL fraction was retained and concentrated prior to chromatographic clean-up.

4.3.2 Column Chromatography

a) Silica Gel Column

The extract was transferred to a 10-g layered silica gel column (layers: activated silica gel, silica gel treated with sodium hydroxide, activated silica gel, silica gel treated with sulfuric acid, activated silica gel) and eluted with hexane.

b) Alumina Column

The extract from the silica gel column was loaded onto a 10-g basic alumina column. The first fraction, eluted with 3% dichloromethane:hexane, was discarded. The next fraction, eluted with 1:1 dichloromethane:hexane, was retained.

c) Carbon/Celite Column

The extract from the alumina column was loaded onto a carbon:celite column. The first fraction (F1), which eluted with cyclohexane:dichloromethane followed by toluene:ethyl acetate, was discarded. The column was inverted and eluted with toluene. This fraction (F2) was evaporated to near dryness and redissolved in hexane.

d) Alumina Column

The extract from the carbon/celite column procedure was loaded onto an alumina column. The first fraction, eluted with 3% dichloromethane:hexane, was discarded. The next fraction, eluted with 1:1 dichloromethane:hexane, was retained and concentrated to 1 mL.

e) Preparation for GC/MS Analysis

The extract was evaporated just to dryness and an aliquot of ^{13}C-labelled recovery standards (^{13}C-labelled 1,2,3,4-tetrachlorodibenzodioxin; 1,2,3,6,7,8-hexachlorodibenzodioxin and 1,2,3,4,6,7,8-heptachlorodibenzofuran) was added.

4.3.3 GC/MS Analysis

Polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF) were analyzed on a Finnigan INCOS 50 mass spectrometer equipped with a Varian 3400 GC, a CTC autosampler, and a DG 10 data system running Incos 50 (Rev 9) software. Data were acquired in the Multiple Ion Detection (MID) mode to enhance sensitivity. At least three ions were monitored for each group of isomers. Two were from the parent cluster while the third was from the loss of COCl (i.e. M-COCl or M-63). Two ions were used to monitor each of the ^{13}C-labelled surrogate standards, and five additional ions were monitored to check for interference from chlorinated diphenyl ethers.

High-Resolution GC/MS Analysis

High-resolution analysis of polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF) was required for some samples to improve detection limits. The analysis was carried out using a VG 70SE mass spectrometer equipped with a Hewlett Packard 5890 GC, a 60 m DB-5 chromatography column (0.25 mm i.d. x 0.1 μm film thickness) and a CTC autosampler. Data were acquired in the Multiple Ion Detection (MID) mode to enhance sensitivity.

4.3.4 Quality Control/Quality Assurance

QA/QC Samples

- Batch Size: Analyses were carried out in batches. Each batch consisted of up to nine samples, one blank, one duplicate, and one spiked sample or reference material.
- Blanks: One procedural blank was analyzed for each batch of samples.
- Duplicates: Results for duplicates (10%) are presented along with the analysis results.
- Reference Materials: Standard reference materials for most matrix types are not yet available for dioxin/furan analysis; consequently, spiked samples are relied on to demonstrate the accuracy of the data. Spiked samples were analyzed at regular intervals (one per batch samples).
- External Standards: NBS SRM #1614 (2,3,7,8-T_4CDD in iso-octane) was analyzed to verify the accuracy of our 2,3,7,8-T_4CDD quantification.

Instrumental Analysis

- Instrument Linearity: Quantification linearity of the GC/MS was periodically verified by a five-point calibration covering a concentration range of 5 to 1000 pg/μL.
- Instrument Sensitivity: Regular verification that 5 pg of 2,3,7,8-T_4CDD was observed at greater than three times the noise.
- Isomer Specificity: Mixture of four T_4CDD isomers (1,2,3,4; 1,2,3,7; 1,2,3,8; and 2,3,7,8) was analyzed to verify isomer specificity for 2,3,7,8-T_4CDD.
- Calibration: Instrument mass range was calibrated daily, every 8 h at the beginning of the day and every 8 h thereafter and at the end of run. RRFs at the beginning and end of the sample suite must agree to within 15% (RSD).

- Column Carryover: Periodic assessment of column carryover by running solvent blanks.
- Interferences: The M+ ion of the chlorodiphenyl ethers were monitored to demonstrate the lack of interference from them.

Data Reporting

- Windows: A chromatogram of a "window-defining" mixture was run periodically to define the "window" during which each dioxin or furan group elutes.
- Surrogate Recoveries: Internal standard recoveries (reported with each sample result) were required to be in the range of 40% to 120%. If recoveries were outside the range, the analysis was repeated.
- Ions Monitored: Response of at least three ions, including the COCl loss ion, was monitored for each dioxin/furan of interest. Peak maxima for ions monitored coincided within one scan for peak to be included in total congener summation. Peak area ratios for the two monitored molecular ions for each congener group were within $\pm 20\%$ of the ratio obtained for the corresponding ions in the day's calibration runs for the peak to be included.
- Detection Limits: Detection limits were monitored and reported for all congener groups on a sample-specific basis. The detection limit was calculated as the concentration corresponding to the area reject. The area reject, determined from the ion chromatogram of each congener group, was the area of a peak with height three times the maximum height of the noise. Only peaks with responses greater than three times the background noise level were quantified.

4.4 REPORTING

- Analytical results are reported individually on a dry weight basis. All surrogate recoveries and results of duplicate analysis must be reported with the relevant sample data. Data corrected for surrogate recoveries (done in agreement with the project coordinator) must be identified as such.
- The results of check sample exercises are reported and discussed with project coordinators.
- The results of all performance tests, matrix spike samples, and surrogate spiked method blanks are tabulated and provided at the request of the project coordinator.
- A laboratory should be prepared to provide a copy of the analytical method including handling, storage, and any modifications required to accommodate problems encountered

(example matrix interferences). A laboratory also should maintain on file all relevant sample, standard, and blank chromatographic and related QC data as well as tables of all calibration standard and surrogate solution concentrations for possible future examination.

4.5 REFERENCES

Environment Canada. 1992a. Internal quality assurance requirements for the analysis of dioxins in environmental samples. October 1992, Rep. EPS 1/RM/23.

Environment Canada. 1992b. Reference method for the determination of polychlorinated dibenzo-*para*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in pulp and paper mill effluents. February 1992, Rep. EPS 1/RM/19.

APPENDIX C. TISSUE CONCENTRATIONS OF HEAVY METALS IN *MYTILUS EDULIS* IN THE GULF OF MAINE, 1993 (NG/G WEIGHT).

Station	Ag	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Al	Fe	% Solids
					MASSACHUSETTS						
MASA 1N	1.161	1.61	1.25	6.25	3.93	0.45	3.04	107.1	63	357	11.2
MASA 2N	1.026	1.62	1.37	5.98	3.68	0.51	1.79	85.5	60	333	11.7
MASA 3N	0.769	2.04	1.67	6.48	3.70	1.85	2.13	111.1	65	380	10.8
MASA 4N	1.636	1.45	2.27	5.55	3.82	0.27	2.00	100.0	55	345	11
MAPY 1N	0.614	1.73	1.81	6.14	3.70	0.94	1.18	118.1	47	252	12.7
MAPY 2N	0.360	1.52	1.36	5.76	2.88	0.40	1.20	104.0	48	224	12.5
MAPY 3N	0.296	1.84	1.36	6.56	3.76	0.80	2.00	128.0	24	232	12.5
MAPY 4N	0.273	1.72	1.64	6.25	3.83	2.50	2.03	117.2	39	289	12.8
MACO 1N	1.083	1.66	1.53	7.01	6.18	0.45	1.53	140.1	76	255	15.7
MACO 2N	2.533	1.33	1.73	7.33	4.87	0.73	1.13	113.3	73	287	15
MACO 3N	2.071	1.43	1.86	7.14	5.43	0.50	1.43	135.7	107	329	14
MACO 4N	1.083	1.27	1.40	6.11	4.46	0.51	1.08	121.0	76	248	15.7
MALI 1N	0.433	1.63	3.05	8.51	9.93	0.85	1.28	170.2	163	496	14.1
MALI 2N	0.522	1.57	2.99	8.96	9.70	1.27	1.12	186.6	194	485	13.4
MALI 3N	0.489	1.65	2.63	8.27	7.52	0.98	1.65	157.9	135	436	13.3
MALI 4N	3.333	1.83	3.08	9.17	9.17	1.25	1.92	166.7	167	583	12
MAMH 1N	0.344	1.30	2.34	5.97	3.18	1.10	1.56	123.4	97	338	15.4
MAMH 2N	0.313	1.25	2.13	6.19	2.44	0.38	1.00	112.5	106	313	16
MAMH 3N	0.195	1.01	1.89	5.72	2.89	0.38	1.07	113.2	75	277	15.9
MAMH 4N	0.137	1.23	2.12	5.21	2.74	0.41	1.10	137.0	96	301	14.6
MAME 1N	0.152	3.18	2.42	6.14	4.77	0.76	1.59	113.6	45	371	13.2
MAME 2N	0.160	2.88	2.56	7.12	5.04	2.24	1.68	128.0	48	400	12.5
MAME 3N	0.153	2.29	2.75	6.34	4.58	0.76	1.53	114.5	46	427	13.1
MAME 4N	0.081	2.93	2.52	6.34	4.80	0.57	1.38	97.6	57	374	12.3

APPENDIX C (CONTINUED)											
Station	Ag	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Al	Fe	% Solids
					NEW HAMPSHIRE						
NHHS 1N	0.039	2.19	1.81	6.77	2.52	0.32	1.42	129.0	90	303	15.5
NHHS 2N	0.059	2.19	2.13	6.51	2.60	0.83	1.72	112.4	124	325	16.9
NHHS 3N	0.049	2.32	1.40	6.04	2.38	0.43	1.10	128.0	85	256	16.4
NHHS 4N	0.053	1.71	1.12	6.47	2.00	0.29	1.18	123.5	76	212	17
					MAINE						
MECC 1N	0.165	2.73	1.74	6.36	2.23	0.74	2.56	107.4	124	331	12.1
MECC 2N	0.066	2.46	3.44	8.44	6.97	0.66	2.87	147.5	303	590	12.2
MECC 3N	0.070	2.11	4.86	7.46	5.49	0.77	2.39	119.7	176	634	14.2
MECC 4N	0.080	2.24	3.20	7.76	6.72	0.80	2.56	128.0	144	584	12.5
MEBH 1N	0.252	2.94	3.45	7.14	2.61	0.76	3.19	126.1	151	429	11.9
MEBH 2N	0.257	3.12	2.29	5.87	2.84	0.64	3.49	100.9	138	404	10.9
MEBH 3N	0.230	3.10	2.04	6.81	2.65	0.35	2.83	123.9	142	425	11.3
MEBH 4N	0.076	2.14	4.43	8.40	5.95	1.07	2.37	122.1	275	618	13.1
MERY 1N	0.044	2.31	1.76	8.46	1.87	1.32	1.87	108.8	253	484	9.1
MERY 2N	0.042	2.19	1.77	8.44	2.29	0.94	1.67	114.6	323	604	9.6
MERY 3N	0.042	1.98	1.77	8.75	2.29	1.67	1.67	114.6	292	583	9.6
MERY 4N	0.022	1.61	1.29	7.96	1.83	0.97	1.40	76.3	172	430	9.3
MEKN 1N	0.078	2.56	2.64	7.83	1.55	0.39	1.47	72.1	132	357	12.9
MEKN 2N	0.076	2.35	1.52	7.65	1.52	0.68	1.44	75.0	114	333	13.2
MEKN 3N	0.069	1.79	1.52	7.59	1.24	0.41	1.24	63.4	124	317	14.5
MEKN 4N	0.032	1.92	1.44	8.32	2.08	0.96	1.44	104.0	176	432	12.5
MEFP 1N	0.132	1.72	1.46	7.95	1.52	0.46	1.13	79.5	106	265	15.1
MEFP 2N	0.142	2.20	2.41	7.16	2.13	0.57	1.63	78.0	184	433	14.1
MEFP 3N	0.069	1.88	1.88	7.64	1.74	0.63	1.25	76.4	90	347	14.4
MEFP 4N	0.032	1.90	1.19	6.83	1.90	0.56	1.51	95.2	135	429	12.6

APPENDIX C (CONTINUED)											
Station	Ag	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Al	Fe	% Solids
MEPI 1N	0.151	1.76	1.09	5.38	1.34	0.25	1.34	117.6	59	218	11.9
MEPI 2N	0.135	1.80	1.05	5.34	1.35	0.30	1.28	112.8	60	218	13.3
MEPI 3N	0.197	1.46	1.61	4.89	1.02	2.04	1.24	109.5	66	241	13.7
MEPI 4N	0.037	1.47	1.40	6.62	1.32	0.96	1.10	80.9	154	412	13.6
					NEW BRUNSWICK						
NBSC 1N	0.076	1.29	2.05	6.74	1.29	0.53	2.12	73.5	356	598	13.2
NBSC 2N	0.070	1.26	1.54	6.15	1.12	0.49	1.75	97.9	308	524	14.3
NBSC 3N	0.073	1.61	1.53	5.84	1.46	0.22	1.82	102.2	226	577	13.7
NBSC 4N	0.083	1.57	2.07	10.08	1.82	0.83	1.98	107.4	339	736	12.1
NBHI 1N	0.116	1.65	1.04	4.39	0.85	2.80	1.16	67.1	73	213	16.4
NBHI 2N	0.065	1.57	1.11	4.51	0.78	2.09	0.98	78.4	59	196	15.3
NBHI 3N	0.187	1.74	1.29	6.26	1.10	1.87	1.16	90.3	84	271	15.5
NBHI 4N	0.065	1.75	1.04	4.81	1.04	1.69	1.43	77.9	84	279	15.4
NBLN 1N	0.030	1.64	1.27	6.27	1.27	0.22	1.94	82.1	269	500	13.4
NBLN 2N	0.028	1.74	1.67	6.39	1.67	0.35	1.81	104.2	306	813	14.4
NBLN 3N	0.033	3.17	1.63	5.93	2.52	4.63	2.60	113.8	325	626	12.3
NBLN 4N	0.028	1.42	1.13	6.10	1.49	0.64	1.49	85.1	284	567	14.1
					NOVA SCOTIA						
NSFI N1	0.014	2.23	10.94	5.61	1.87	0.50	3.60	32.4	633	1295	13.9
NSFI N2	ND.002	3.98	3.23	6.34	1.51	0.65	3.33	65.6	1043	1430	9.3
NSFI N3	0.019	3.30	3.79	6.60	1.65	0.87	3.59	70.9	796	1330	10.3
NSFI N4	ND.002	3.98	3.75	7.61	1.59	2.39	3.98	87.5	966	1386	8.8
NSDI 1N	0.228	1.54	1.79	6.83	4.39	1.06	2.03	113.8	480	797	12.3
NSDI 2N	0.076	1.52	1.59	6.89	3.48	1.21	1.82	106.1	432	644	13.2
NSDI 3N	0.553	2.28	2.28	7.48	3.66	1.38	2.03	113.8	325	626	12.3
NSDI 4N	0.198	1.74	1.98	7.11	4.21	3.64	1.57	115.7	413	645	12.1

APPENDIX C (CONTINUED)

Station	Ag	Cd	Cr	Cu	Pb	Hg	Ni	Zn	Al	Fe	% Solids
NSBC 1N	0.092	2.75	2.94	8.07	4.40	4.40	3.49	110.1	202	624	10.9
NSBC 2N	0.064	2.94	2.20	6.88	3.58	2.11	2.57	137.6	202	550	10.9
NSBC 3N	0.078	2.84	3.04	7.06	4.02	1.08	3.14	127.5	225	569	10.2
NSBC 4N	0.068	3.31	1.95	7.29	3.31	0.93	2.71	118.6	263	517	11.8
NSYR 1N	0.279	1.54	3.27	7.40	3.94	4.04	3.08	80.8	375	1087	10.4
NSYR 2N	0.306	2.76	3.27	8.16	3.47	0.71	2.65	100.0	204	939	9.8
NSYR 3N	0.411	2.00	2.53	7.26	3.26	1.79	2.63	92.6	211	874	9.5
NSYR 4N	0.301	1.83	2.47	7.20	3.33	1.94	2.04	82.8	140	742	9.3
NSAG 1N	0.091	1.82	1.74	6.12	3.72	1.07	1.49	90.9	174	612	12.1
NSAG 2N	0.061	2.28	1.93	6.49	5.26	1.49	2.98	87.7	202	746	11.4
NSAG 3N	0.055	2.20	2.20	6.42	5.50	1.93	2.20	91.7	165	716	10.9
NSAG 4N	0.077	1.92	2.60	6.25	6.06	1.54	1.73	83.7	173	760	10.4

APPENDIX D. TISSUE CONCENTRATIONS OF POLYAROMATIC HYDROCARBONS IN *MYTILUS EDULIS* (NG/G DRY WEIGHT) IN 1993 FROM THE GULF OF MAINE.

PAHs	NSFI1N	NSFI2N	NSFI3N	NSFI4N	NSYR1N	NSYR2N	NSYR3N
	93JM094	93JM095	93JM096	93JM097	93JM152	93JMI53	93JM154
Naphthalene	<30	<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<10	<10
Fluorene	<10	<10	<10	<10	<10	10	<10
Phenanthrene	<10	<10	<10	<10	76	70	46
Anthracene	<10	<10	<10	<10	<10	<10	<10
1-Me phenanthrene	<10	<10	<10	<10	10	<10	<10
Fluoranthene	<10	<10	<10	<10	159	151	111
Pyrene	<10	<10	<10	<10	70	62	47
Benzo(a)anthracene	<10	<10	<10	<10	16	14	12
Chrysene	<10	<10	<10	<10	31	29	24
Benzo(b)fluoranthen	<10	<10	<10	<10	26	23	20
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	<10	<10	<10	<10	13	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10
Perylene	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10	<10
TOTAL	ND	ND	ND	ND	401	359	260
Surrogate Recovery (%)							
Naph-d8	32	53	38	40	30	30	38
Anap-d10	62	45	68	69	68	63	58
Chry-d12	93	82	94	93	101	89	91
BaP-d12	94	76	94	88	103	83	86
BghiP-d12	94	83	101	93	103	37	76

APPENDIX D (CONTINUED)

PAHs	NSYR4N	NSDI1N	NSDI2N	NSDI3N	NSDI4N	NSBC1N	NSBC2N
	93JM155	93JM156	93JM157	93JM158	93JM159	93JM160	93JM161
Naphthalene	<30	<30/<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30/<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30/<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20/<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20/<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10/<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10/<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<10/<10	<20	<20	<20	<20	<20
Fluorene	<10	<10/<10	<10	<10	<10	28	17
Phenanthrene	49	23/22	18	27	19	133	103
Anthracene	<10	<10/<10	<10	<10	<10	14	12
1-Me phenanthrene	<10	12/10.	<10	15	<10	15	10
Fluoranthene	113	38/34	31	45	27	127	100
Pyrene	48	22/19	16	25	14	91	72
Benzo(a)anthracene	12	<10/<10	<10	<10	<10	27	20
Chrysene	25	15/14	11	16	11	27	21
Benzo(b)fluoranthen	21	16/15	14	13	13	32	24
Benzo(k)fluoranthen	<10	<10/<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	<10	<10/<10	<10	<10	<10	<10	<10
Benzo(a)pyrene	<10	<10/<10	<10	<10	<10	<10	<10
Perylene	<10	<10/<10	<10	<10	<10	<10	<10
Indeno(123cd)pyren	<10	<10/<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10/<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	<10	<10/<10	<10	<10	<10	<10	<10
TOTAL	268	126/104	90	141	84	494	379
Surrogate Recovery (%)							
Naph-d8	38	41/36	30	42	36	37	38
Anap-d10	58	67/54	56	69	58	43	66
Chry-d12	91	90/91	80	79	81	63	87
BaP-d12	93	84/86	77	90	82	58	83
BghiP-d12	97	84/94	81	99	87	51	74

APPENDIX D (CONTINUED)

PAHs	NSBC3N	NSBC3N	NSAG1n	NSAG2N	NSAG3N	NSAG4N	MACO1N
	93JM162	93JM163	93JM164	93JM165	93JM166	93JM167	93JM098
Naphthalene	<30	<30/<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30/<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30/<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20/<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20/<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10/<10	<10	<10	<10	<10	<10
Acenaphthene	<10	21/22	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20/<20	<10	<10	<10	<10	<20
Fluorene	16	21/22	<10	<10	<10	<10	<10
Phenanthrene	98	88/86	<10	<10	<10	<10	28
Anthracene	10	<10/<10	<10	<10	<10	<10	<10
1-Me phenanthrene	10	<10/<10	<10	<10	<10	<10	<10
Fluoranthene	95	69/69	<10	<10	<10	<10	36
Pyrene	67	48/48	<10	<10	<10	<10	25
Benzo(a)anthracene	19	17/16	<10	<10	<10	<10	<10
Chrysene	20	18/18	<10	<10	<10	<10	<10
Benzo(b)fluoranthen	23	14/21	<10	<10	<10	<10	14
Benzo(k)fluoranthen	<10	<10/<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	<10	<10/<10	<10	<10	<10	<10	15
Benzo(a)pyrene	<10	<10/<10	<10	<10	<10	<10	<10
Perylene	<10	<10/<10	INF	INF	INF	INF	<10
Indeno(123cd)pyren	<10	<10/<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10/<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	<10	<10/<10	<10	<10	<10	<10	<10
TOTAL	358	296/302	ND	ND	ND	ND	118
Surrogate Recovery (%)							
Naph-d8	36	33/35	34	30	44	34	41
Anap-d10	63	68/66	59	54	66	60	75
Chry-d12	88	86/84	85	81	87	91	85
BaP-d12	88	84/79	83	79	85	86	73
BghiP-d12	83	78/76	76	81	80	91	117

APPENDIX D (CONTINUED)

PAHs	MACO2N	MACO3N	MAMH1N	MAMH2N	MAMH3N	MAMH4N	MALI1N
	93JM099	93JM100	93JM101	93JM102	93JM103	93JM104	93JM105
Naphthalene	<30	<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20	<20
Fluorene	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	23	30	15	10	13	<10	23/23
Anthracene	<10	<10	<10	<10	<10	<10	<10/<10
1-Me phenanthrene	<10	<10	<10	<10	<10	<10	<10/<10
Fluoranthene	32	40	29	15	26	13	120/119
Pyrene	23	28	15	<10	13	<10	90/91
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10	14/15
Chrysene	<10	<10	<10	<10	<10	<10	43/43
Benzo(b)fluoranthen	14	16	<10	<10	<10	<10	40/40
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10	<10/<10
Benzo(e)pyrene	14	17	<10	<10	<10	<10	40/42
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10/<10
Perylene	<10	<10	<10	<10	<10	<10	<10/<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10	<10/<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10	<10/<10
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10	11/14.
TOTAL	106	131	59	25	52	13	381/387
Surrogate Recovery (%)							
Naph-d8	32	37	34	37	30	44	40/45
Anap-d10	58	69	73	73	87	73	80/82
Chry-d12	75	77	81	79	79	74	87/90
BaP-d12	66	64	71	72	76	66	75/79
BghiP-d12	103	94	117	108	107	103	135/106

APPENDIX D (CONTINUED)

PAHs	MALI2N	MALI3N	MALI4N	MAPY1N	MAPY2N	MAPY3N	MAPY4N
	93JM106	93JM107	93JM108	93JM109	93JM110	93JM111	93JM112
Naphthalene	<30	<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20	<20
Fluorene	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	23	21	16	<10	<10	<10	<10
Anthracene	<10	<10	<10	<10	<10	<10	<10
1-Me phenanthrene	<10	<10	<10	<10	<10	<10	<10
Fluoranthene	130	112	72	13	16	13	11
Pyrene	100	88	56	<10	<10	<10	<10
Benzo(a)anthracene	15	14	<10	<10	<10	<10	<10
Chrysene	18	41	26	<10	<10	<10	<10
Benzo(b)fluoranthen	41	36	27	<10	<10	<10	<10
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	37	34	29	<10	<10	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10
Perylene	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	12	11	<10	<10	<10	<10	<10
TOTAL	376	357	226	13	16	13	11
Surrogate Recovery (%)							
Naph-d8	45	40	49	44	41	48	35
Anap-d10	74	73	74	68	63	78	61
Chry-d12	83	88	92	80	92	106	80
BaP-d12	82	84	80	76	91	103	74
BghiP-d12	111	129	133	95	117	141	94

APPENDIX D (CONTINUED)

PAHs	MASA1N	MASA2N	MASA3N	MASA4N	MAME1N	MAME2N	MAME3N
	93JM113	93JM114	93JM115	93JM116	93JM117	93JM118	93JM119
Naphthalene	<30	<30	<30	<30	<30	<30/<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30/<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30/<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20/<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20/<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10/<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10/<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20/<20	<20
Fluorene	<10	<10	<10	<10	<10	<10/<10	<10
Phenanthrene	<10	<10	<10	11	23	11/10.	21
Anthracene	<10	<10	<10	<10	<10	<10/<10	<10
1-Me phenanthrene	<10	<10	<10	<10	<10	<10/<10	<10
Fluoranthene	16	20	12	17	52	37/39	51
Pyrene	<10	11	<10	<10	40	30/31	39
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10/<10	<10
Chrysene	<10	<10	<10	<10	28	21/22	27
Benzo(b)fluoranthen	<10	<10	<10	<10	23	23/24	21
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10/<10	<10
Benzo(e)pyrene	<10	<10	<10	<10	18	17/17	18
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10/<10	<10
Perylene	<10	<10	<10	<10	<10	<10/<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10/<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10/<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10/<10	<10
TOTAL	16	20	12	28	184	139/143	177
Surrogate Recovery (%)							
Naph-d8	50	44	36	40	34	48/41	35
Anap-d10	78	76	62	72	70	74/67	66
Chry-d12	89	88	82	93	85	88/89	86
BaP-d12	84	81	80	94	83	87/87	83
BghiP-d12	118	113	108	111	123	111/109	122

APPENDIX D (CONTINUED)

PAHs	MAME4N	MECC1N	MECC2N	MECC3N	MECC4N	NHHS1N	NHHS2N
	93JM120	93JM121	93JM122	93JM123	93JM124	93JM125	93JM126
Naphthalene	<30	<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20	<20
Fluorene	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	12	18	11	10	10	18	17
Anthracene	<10	<10	<10	<10	<10	<10	<10
1-Me phenanthrene	<10	<10	<10	<10	<10	13	13
Fluoranthene	38	61	39	36	33	22	21
Pyrene	31	50	31	28	26	17	16
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10	<10
Chrysene	23	28	18	16	14	<10	<10
Benzo(b)fluoranthen	24	30	26	24	22	<10	<10
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	18	25	18	16	15	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10
Perylene	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	<10	10	<10	<10	<10	<10	<10
TOTAL	146	222	143	130	120	70	67
Surrogate Recovery (%)							
Naph-d8	48	35	45	41	41	54	53
Anap-d10	68	83	70	70	70	81	82
Chry-d12	94	81	89	87	85	89	90
BaP-d12	91	82	86	87	84	87	88
BghiP-d12	75	101	95	91	93	96	101

APPENDIX D (CONTINUED)

PAHs	NHHS3N	NHHS4N	MEBH1N	MEBH2N	MEBH3N	MEBH4N	MEKN1N
	93JM127	93JM128	93JM129	93JM130	93JM131	93JM132	93JM133
Naphthalene	<30	<30	<30	<30	<30	<30/<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30/<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30/<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20/<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20/<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10/<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10/<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20/<20	<20
Fluorene	<10	<10	<10	<10	<10	<10/<10	<10
Phenanthrene	17	20	<10	<10	<10	<10/<10	<10
Anthracene	<10	<10	<10	<10	<10	<10/<10	<10
1-Me phenanthrene	12	16	<10	<10	<10	<10/<10	<10
Fluoranthene	22	24	<10	<10	<10	<10/<10	27
Pyrene	17	18	<10	<10	<10	<10/<10	34
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10/<10	12
Chrysene	<10	<10	<10	<10	<10	<10/<10	18
Benzo(b)fluoranthen	<10	<10	<10	<10	<10	<10/<10	24
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10/<10	<10
Benzo(e)pyrene	<10	<10	<10	<10	<10	<10/<10	16
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10/<10	<10
Perylene	<10	<10	<10	<10	<10	<10/<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10/<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10/<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10/<10	<10
TOTAL	68	78	ND	ND	ND	ND	131
Surrogate Recovery (%)							
Naph-d8	53	65	48	41	55	46/46	29
Anap-d10	81	83	78	50	72	70/75	52
Chry-d12	90	91	77	82	83	90/92	93
BaP-d12	86	87	81	79	90	85/82	87
BghiP-d12	89	89	108	89	84	78/79	77

APPENDIX D (CONTINUED)

PAHs	MEKN2N	MEKN3N	MEKN4N	MERY1N	MERY2N	MERY3N	MEPI1N
	93JM134	93JM135	93JM136	93JM137	93JM138	93JM139	93JM140
Naphthalene	<30	<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20	<20
Fluorene	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	<10	<10	<10	<10	<10	<10	<10
Anthracene	<10	<10	<10	<10	<10	<10	<10
1-Me phenanthrene	<10	<10	<10	<10	<10	<10	<10
Fluoranthene	15	20	21	38	<10	15	<10
Pyrene	20	26	28	38	<10	22	<10
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10	<10
Chrysene	10	13	18	14	<10	10	<10
Benzo(b)fluoranthen	12	15	21	20	<10	14	<10
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	<10	13	14	14	<10	10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10
Perylene	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10	<10
TOTAL	57	87	102	124	ND	71	ND
Surrogate Recovery (%)							
Naph-d8	48	50	52	30	46	46	41
Anap-d10	71	57	76	41	69	66	66
Chry-d12	95	91	83	92	90	94	92
BaP-d12	86	85	93	87	84	85	84
BghiP-d12	78	86	93	94	79	79	83

APPENDIX D (CONTINUED)

PAHs	MEPI2N	MEPI3N	MEPI4N	MEFP1N	MEFP2N	MEFP3N	MEFP4N
	93JM141	93JM142	93JM143	93JM144	93JM145	93JM146	93JM147
Naphthalene	<30	<30	<30	<30/<30	<30/<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30/<30	<30/<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30/<30	<30/<30	<30	<30
Biphenyl	<20	<20	<20	<20/<20	<20/<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20/<20	<20/<20	<20	<20
Acenaphthylene	<10	<10	<10	<10/<10	<10/<10	<10	<10
Acenaphthene	<10	<10	<10	<10/<10	<10/<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20/<20	<20/<20	<20	<20
Fluorene	<10	<10	<10	<10/<10	<10/<10	<10	<10
Phenanthrene	<10	<10	<10	<10/<10	15/13	15	11
Anthracene	<10	<10	<10	<10/<10	<10/<10	<10	<10
1-Me phenanthrene	<10	<10	<10	<10/<10	<10/<10	<10	<10
Fluoranthene	<10	<10	<10	22/22	34/33	44	33
Pyrene	<10	<10	<10	22/22	32/31	42	32
Benzo(a)anthracene	<10	<10	<10	<10/<10	<10/<10	<10	<10
Chrysene	<10	<10	<10	<10/<10	12/12.	16	11
Benzo(b)fluoranthen	<10	<10	<10	11/11.	22/17	22	15
Benzo(k)fluoranthen	<10	<10	<10	<10/<10	<10/<10	<10	<10
Benzo(e)pyrene	<10	<10	<10	<10/<10	14/12	16	11
Benzo(a)pyrene	<10	<10	<10	<10/<10	<10/<10	<10	<10
Perylene	<10	<10	<10	<10/<10	<10/<10	<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10/<10	<10/<10	<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10/<10	<10/<10	<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10/<10	<10/<10	<10	<10
TOTAL	ND	ND	ND	55/55	129/118	155	113
Surrogate Recovery (%)							
Naph-d8	47	49	30	38/28	43/33	35	37
Anap-d10	65	71	54	63/40	77/62	70	71
Chry-d12	97	97	84	91/87	95/75	80	89
BaP-d12	89	92	72	86/80	79/69	74	86
BghiP-d12	94	97	74	91/95	101/97	82	85

APPENDIX D (CONTINUED)

PAHs	NBSC1N	NBSC2N	NBSC3N	NBSC4N	NBLN1N	NBLN2N	NBLN3N
	93JM168	93JM169	93JM170	93JM177	93JM172	93JM173	93JM174
Naphthalene	<30	<30	<30	<30	<30	<30	<30
2-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
1-Me naphthalene	<30	<30	<30	<30	<30	<30	<30
Biphenyl	<20	<20	<20	<20	<20	<20	<20
2,6-Dime naphthalen	<20	<20	<20	<20	<20	<20	<20
Acenaphthylene	<10	<10	<10	<10	<10	<10	<10
Acenaphthene	<10	<10	<10	<10	<10	<10	<10
2,3,5-Trime naphthal	<20	<20	<20	<20	<20	<20	<20
Fluorene	<10	<10	<10	<10	<10	<10	<10
Phenanthrene	<10	<10	<10	<10	<10	<10	<10
Anthracene	<10	<10	<10	<10	<10	<10	<10
1-Me phenanthrene	<10	<10	<10	<10	<10	<10	<10
Fluoranthene	<10	<10	<10	<10	<10	<10	<10
Pyrene	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene	<10	<10	<10	<10	<10	<10	<10
Chrysene	<10	<10	<10	<10	<10	<10	<10
Benzo(b)fluoranthen	<10	<10	<10	<10	<10	<10	<10
Benzo(k)fluoranthen	<10	<10	<10	<10	<10	<10	<10
Benzo(e)pyrene	<10	<10	<10	<10	<10	<10	<10
Benzo(a)pyrene	<10	<10	<10	<10	<10	<10	<10
Perylene	<10	<10	<10	<10	<10	<10	<10
Indeno(123cd)pyren	<10	<10	<10	<10	<10	<10	<10
Dibenzo(ah)anthrace	<10	<10	<10	<10	<10	<10	<10
Benzo(ghi)perylene	<10	<10	<10	<10	<10	<10	<10
TOTAL	ND	ND	ND	ND	ND	ND	ND
Surrogate Recovery (%)							
Naph-d8	46	47	42	42	30	42	36
Anap-d10	70	70	67	69	38	69	61
Chry-d12	92	92	88	86	78	85	82
BaP-d12	90	90	82	84	87	82	80
BghiP-d12	96	93	87	80	90	129	129

APPENDIX D (CONTINUED)

PAHs	NBLN4N	NBHI1N	NBHI2N	NBHI3N	NBHI4N		
	93JM175	93JM176	93JM177	93JM178	93JM179		
Naphthalene	<30	<30/<30	<30	<30	<30		
2-Me naphthalene	<30	<30/<30	<30	<30	<30		
1-Me naphthalene	<30	<30/<30	<30	<30	<30		
Biphenyl	<20	<20/<20	<20	<20	<20		
2,6-Dime naphthalen	<20	<20/<20	<20	<20	<20		
Acenaphthylene	<10	<10/<10	<10	<10	<10		
Acenaphthene	<10	<10/<10	<10	<10	<10		
2,3,5-Trime naphthal	<20	<20/<20	<20	<20	<20		
Fluorene	<10	<10/<10	<10	<10	<10		
Phenanthrene	<10	<10/<10	<10	<10	<10		
Anthracene	<10	<10/<10	<10	<10	<10		
1-Me phenanthrene	<10	<10/<10	<10	<10	<10		
Fluoranthene	<10	<10/<10	<10	<10	<10		
Pyrene	<10	<10/<10	<10	<10	<10		
Benzo(a)anthracene	<10	<10/<10	<10	<10	<10		
Chrysene	<10	<10/<10	<10	<10	<10		
Benzo(b)fluoranthen	<10	<10/<10	<10	<10	<10		
Benzo(k)fluoranthen	<10	<10/<10	<10	<10	<10		
Benzo(e)pyrene	<10	<10/<10	<10	<10	<10		
Benzo(a)pyrene	<10	<10/<10	<10	<10	<10		
Perylene	<10	<10/<10	<10	<10	<10		
Indeno(123cd)pyren	<10	<10/<10	<10	<10	<10		
Dibenzo(ah)anthrace	<10	<10/<10	<10	<10	<10		
Benzo(ghi)perylene	<10	<10/<10	<10	<10	<10		
TOTAL	ND	ND	ND	ND	ND		
Surrogate Recovery (%)							
Naph-d8	38	29/45	45	42	34		
Anap-d10	67	52/70	68	66	54		
Chry-d12	76	77/78	79	79	78		
BaP-d12	75	76/79	80	76	80		
BghiP-d12	112	116/104	114	106	105		

APPENDIX E. TISSUE CONCENTRATIONS OF POLYCHLORINATED BIPHENYLS IN *MYTILUS EDULIS* (NG/G DRY WEIGHT) FROM THE GULF OF MAINE.

Congener	NSFI1N	NSFI1N	NSFI3N	NSFI4N	NSYR1N	NSYR2N	NSYR3N
No.	93JM094	93JM095	93JM096	93JM097	93JM152	93JM153	93JM154
8	<2	<2	<2	<2	<2	<2	<2
18	<2	<2	<2	<2	<2	<2	<2
28	<2	<2	<2	<2	<2	<2	<2
29	<2	<2	<2	<2	<2	<2	<2
44	<2	<2	<2	<2	<2	<2	<2
50	<2	<2	<2	<2	<2	<2	<2
52	<2	<2	<2	<2	<2	<2	<2
66	<2	<2	<2	<2	<2	<2	<2
77	<2	<2	<2	<2	<2	<2	<2
87	<2	<2	<2	<2	<2	<2	<2
101	<2	<2	<2	<2	<2	<2	<2
105	<2	<2	<2	<2	<2	<2	<2
118	<2	<2	<2	<2	<2	<2	<2
126	<2	<2	<2	<2	<2	<2	<2
128	<2	<2	<2	<2	<2	<2	<2
138	<2	<2	<2	<2	<2	<2	<2
153	<2	<2	<2	<2	<2	2.2	2.2
169	<2	<2	<2	<2	<2	<2	<2
170	<2	<2	<2	<2	<2	<2	<2
180	<2	<2	<2	<2	<2	<2	<2
187	<2	<2	<2	<2	<2	<2	<2
195	<2	<2	<2	<2	<2	<2	<2
206	<2	<2	<2	<2	<2	<2	<2
209	<2	<2	<2	<2	<2	<2	<2
TOTAL	ND	ND	ND	ND	ND	2.2	2.2
Surrogate Recovery (%)							
#-103	96	96	97	112	104	104	99
# 198	102	109	107	110	114	115	116

APPENDIX E (CONTINUED)

Congener No.	NSYR4N 93JM155	NSDI1N 93JM156	NSDI2N 93JM157	NSDI3N 93JM158	NSDI4N 93JM159	NSBC1N 93JM160	NSBC2N 93JM161
8	<2	<2	<2/<2	<2	<2	<2	<2
18	<2	<2	<2/<2	<2	<2	<2	<2
28	<2	<2	<2/<2	<2	<2	<2	<2
29	<2	<2	<2/<2	<2	<2	<2	<2
44	<2	<2	<2/<2	<2	<2	<2	<2
50	<2	<2	<2/<2	<2	<2	<2	<2
52	<2	<2	<2/<2	<2	<2	<2	<2
66	<2	<2	<2/<2	<2	<2	<2	<2
77	<2	<2	<2/<2	<2	<2	<2	<2
87	<2	<2	<2/<2	<2	<2	<2	<2
101	<2	<2	<2/<2	<2	<2	<2	<2
105	<2	<2	<2/<2	<2	<2	<2	<2
118	<2	<2	<2/<2	<2	<2	<2	<2
126	<2	<2	<2/<2	<2	<2	<2	<2
128	<2	<2	<2/<2	<2	<2	<2	<2
138	<2	<2	<2/<2	<2	<2	<2	<2
153	<2	<2	<2/<2	<2	<2	<2	<2
169	<2	<2	<2/<2	<2	<2	<2	<2
170	<2	<2	<2/<2	<2	<2	<2	<2
180	<2	<2	<2/<2	<2	<2	<2	<2
187	<2	<2	<2/<2	<2	<2	<2	<2
195	<2	<2	<2/<2	<2	<2	<2	<2
206	<2	<2	<2/<2	<2	<2	<2	<2
209	<2	<2	<2/<2	<2	<2	<2	<2
TOTAL	ND	ND	ND	ND	ND	ND	ND
Surrogate Recovery (%)							
#-103	100	105	107/97	91	98	96	96
# 198	111	106	110/111	108	113	97	105

APPENDIX E (CONTINUED)

Congener No.	NSBC3N 93JM162	NSBC4N 93JM163	NSAG1N 93JM164	NSAG2N 93JM165	NSAG3N 93JM166	NSAG4N 93JM167	MACO1N 93JM098
8	<2	<2	<2	<2	<2	<2/<2	2.9
18	<2	<2	<2	<2	<2	<2/<2	<2
28	<2	<2	<2	<2	<2	<2/<2	<2
29	<2	<2	<2	<2	<2	<2/<2	<2
44	<2	<2	<2	<2	<2	<2/<2	<2
50	<2	<2	<2	<2	<2	<2/<2	<2
52	<2	<2	<2	<2	<2	<2/<2	<2
66	<2	<2	<2	<2	<2	<2/<2	8.4
77	<2	<2	<2	<2	<2	<2/<2	4.3
87	<2	<2	<2	<2	<2	<2/<2	<2
101	<2	<2	<2	<2	<2	<2/<2	12
105	<2	<2	<2	<2	<2	<2/<2	6
118	<2	<2	<2	<2	<2	<2/<2	15
126	<2	<2	<2	<2	<2	<2/<2	2.8
128	<2	<2	<2	<2	<2	<2/<2	3.8
138	<2	<2	<2	<2	<2	<2/<2	22
153	<2	<2	<2	<2	<2	<2/<2	26
169	<2	<2	<2	<2	<2	<2/<2	<2
170	<2	<2	<2	<2	<2	<2/<2	<2
180	<2	<2	<2	<2	<2	<2/<2	<2
187	<2	<2	<2	<2	<2	<2/<2	7
195	<2	<2	<2	<2	<2	<2/<2	<2
206	<2	<2	<2	<2	<2	<2/<2	<2
209	<2	<2	<2	<2	<2	<2/<2	<2
TOTAL	ND	ND	ND	ND	ND	ND	110
Surrogate Recovery (%)							
#-103	89	95	84	86	83	87/91	86
# 198	110	109	99	104	108	101/109	84

APPENDIX E (CONTINUED)

Congener	MACO2N	MACO3N	MAMH1N	MAMH2N	MAMH3N	MAMH4N	MALI1N
No.	93JM099	93JM100	93JM101	93JM102	93JM103	93JM104	93JM105
8	<2	<2	4	<2	4	2	<2
18	<2	<2	<2	<2	<2	<2	<2
28	<2	<2	<2	<2	<2	<2	<2
29	<2	<2	<2	<2	<2	<2	<2
44	<2	<2	<2	<2	<2	<2	5.9/5.3
50	<2	<2	<2	<2	<2	<2	<2
52	<2	<2	<2	<2	<2	<2	13/12
66	7.2	6.7	5.2	2.5	6.3	2.8	43/39
77	<2	3	3.4	<2	4.3	<2	30/27
87	<2	<2	<2	<2	<2	<2	16/14
101	11	10	8.7	4.9	9.4	5.2	50/45
105	5.2	5	2.9	<2	3.6	<2	29/28
118	14	14	9.4	5.3	9.1	5.3	57/54
126	2.9	2.1	<2	<2	<2	<2	11/9.4
128	<2	<2	<2	<2	<2	<2	8.5/8.3
138	23	22	15	10	20	10	75/70
153	28	26	18	12	23	12	78/72
169	<2	<2	<2	<2	<2	<2	<2
170	<2	<2	<2	<2	<2	<2	<2
180	<2	<2	<2	<2	<2	<2	9.4/7.4
187	7.5	6.3	4.1	2.2	5	2	20/17
195	<2	<2	<2	<2	<2	<2	<2
206	<2	<2	<2	<2	<2	<2	<2
209	<2	<2	<2	<2	<2	<2	<2
TOTAL	99	95	71	37	85	39	446/408
Surrogate Recovery (%)							
#-103	84	74	99	99	103	99	109/93
# 198	85	80	103	99	103	100	109/97

APPENDIX E (CONTINUED)

Congener	MALI2N	MALI3N	MALI4N	MAPY1N	MAPY2N	MAPY3N	MAPY4N
No.	93JM106	93JM107	93JM108	93JM109	93JM110	93JM111	93JM112
8	<2	<2	<2	<2	<2	<2	<2
18	<2	<2	<2	<2	<2	<2	<2
28	3.7	<2	<2	<2	<2	<2	<2
29	<2	<2	<2	<2	<2	<2	<2
44	9.7	7.6	3.2	<2	<2	<2	<2
50	<2	<2	<2	<2	<2	<2	<2
52	17	14	8.1	<2	<2	<2	<2
66	53	42	27	4.3	6.2	4	2
77	40	24	21	3.7	5.6	3.5	<2
87	20	15	9.9	<2	<2	<2	<2
101	58	46	30	7.3	10	7	4
105	35	27	16	4.1	5.8	3.6	<2
118	68	52	33	11	14	9.9	5.6
126	13	9.4	5.6	<2	<2	<2	<2
128	11	8.3	5	<2	<2	<2	<2
138	89	70	44	19	23	17	13
153	89	70	47	22	26	20	14
169	<2	<2	<2	<2	<2	<2	<2
170	<2	<2	<2	<2	<2	<2	<2
180	10	7.4	4.1	<2	<2	<2	<2
187	22	17	12	5.2	6.2	4.5	3
195	<2	<2	<2	<2	<2	<2	<2
206	<2	<2	<2	<2	<2	<2	<2
209	<2	<2	<2	<2	<2	<2	<2
TOTAL	538	410	266	77	97	70	42
Surrogate Recovery (%)							
#-103	120	90	109	95	105	106	83
# 198	111	117	106	95	102	103	88

APPENDIX E (CONTINUED)

Congener	MASA1N	MASA2N	MASA3N	MASA4N	MAME1N	MAME2N	MAME3N
No.	93JM113	93JM114	93JM115	93JM116	93JM117	93JM118	93JM119
8	<2	<2	<2	<2	<2	<2/<2	<2
18	<2	<2	<2	<2	<2	<2/<2	<2
28	<2	<2	<2	<2	<2	<2/<2	<2
29	<2	<2	<2	<2	<2	<2/<2	<2
44	<2	<2	<2	<2	<2	<2/<2	<2
50	<2	<2	<2	<2	<2	<2/<2	<2
52	<2	<2	<2	<2	<2	<2/<2	<2
66	<2	<2	<2	<2	6.1	8.9/6.8	6.5
77	<2	<2	<2	<2	2.3	4.2/3.1	3.3
87	<2	<2	<2	<2	<2	<2/<2	<2
101	<2	2.6	2	3.2	4.7	7.6/5.2	4.9
105	<2	<2	<2	<2	<2	<2/<2	<2
118	2.2	4.9	3.1	5	5.7	8.1/6.3	6.2
126	<2	<2	<2	<2	<2	<2/<2	<2
128	<2	<2	<2	<2	<2	<2/<2	<2
138	8.6	11	8.1	11	9.7	17/11	11
153	11	14	10	14	11	18/12	11
169	<2	<2	<2	<2	<2	<2/<2	<2
170	<2	<2	<2	<2	<2	<2/<2	<2
180	<2	<2	<2	<2	<2	<2/<2	<2
187	<2	2.2	<2	2.2	<2	5.4/2.7	2.3
195	<2	<2	<2	<2	<2	<2/<2	<2
206	<2	<2	<2	<2	<2	<2/<2	<2
209	<2	<2	<2	<2	<2	<2/<2	<2
TOTAL	22	35	23	35	40	69/47	45
Surrogate Recovery (%)							
#-103	84	103	101	105	77	108/103	85
# 198	80	110	104	107	84	110/106	95

APPENDIX E (CONTINUED)

Congener	MAME4N	MECC1N	MECC2N	MECC3N	MECC4N	NHHS1N	NHHS2N
No.	93JM120	93JM121	93JM122	93JM123	93JM124	93JM125	92JM126
8	<2	<2	<2	<2	<2	<2	<2
18	<2	<2	<2	<2	<2	<2	<2
28	<2	<2	<2	<2	<2	<2	<2
29	<2	<2	<2	<2	<2	<2	<2
44	<2	<2	<2	<2	<2	<2	<2
50	<2	<2	<2	<2	<2	<2	<2
52	<2	<2	<2	<2	<2	<2	<2
66	4.6	4.8	3.6	3.5	5	<2	<2
77	<2	3.3	2.3	2.2	3.5	<2	<2
87	<2	<2	<2	<2	<2	<2	<2
101	3.9	8.6	6.5	5.9	8.2	<2	<2
105	<2	3.2	2.7	3.1	3.8	<2	<2
118	3.9	10	6.9	6.3	8.3	<2	<2
126	<2	2.8	<2	<2	2.6	<2	<2
128	<2	<2	<2	<2	<2	<2	<2
138	8.7	19	16	15	17	3.4	4.2
153	10	24	19	18	20	4.8	5.8
169	<2	<2	<2	<2	<2	<2	<2
170	<2	<2	<2	<2	<2	<2	<2
180	<2	<2	<2	<2	<2	<2	<2
187	2.2	7.6	5.8	5.6	6.7	<2	<2
195	<2	<2	<2	<2	<2	<2	<2
206	<2	<2	<2	<2	<2	<2	<2
209	<2	<2	<2	<2	<2	<2	<2
TOTAL	33	83	63	60	75	8.2	10
Surrogate Recovery (%)							
#-103	97	95	100	99	104	92	106
# 198	101	93	102	101	97	88	112

APPENDIX E (CONTINUED)

Congener	NHHS3N	NHHS4N	MEBH1N	MEBH2N	MEBH3N	MEBH4N	MEKN1N
No.	93JM127	93JM128	93JM129	93JM130	93JM131	93JM132	93JM133
8	<2	<2	<2	<2	<2	<2/<2	<2
18	<2	<2	<2	<2	<2	<2/<2	<2
28	<2	<2	<2	<2	<2	<2/<2	<2
29	<2	<2	<2	<2	<2	<2/<2	<2
44	<2	<2	<2	<2	<2	<2/<2	<2
50	<2	<2	<2	<2	<2	<2/<2	<2
52	<2	<2	<2	<2	<2	<2/<2	<2
66	<2	<2	<2	<2	<2	<2/<2	<2
77	<2	<2	<2	<2	<2	<2/<2	<2
87	<2	<2	<2	<2	<2	<2/<2	<2
101	<2	<2	<2	<2	<2	<2/<2	<2
105	<2	<2	<2	<2	<2	<2/<2	<2
118	<2	<2	<2	<2	<2	<2/<2	<2
126	<2	<2	<2	<2	<2	<2/<2	<2
128	<2	<2	<2	<2	<2	<2/<2	<2
138	4	4.7	<2	<2	<2	<2/<2	5.5
153	5.3	6.4	<2	<2	<2	<2/<2	8.9
169	<2	<2	<2	<2	<2	<2/<2	<2
170	<2	<2	<2	<2	<2	<2/<2	<2
180	<2	<2	<2	<2	<2	<2/<2	<2
187	<2	<2	<2	<2	<2	<2/<2	2.1
195	<2	<2	<2	<2	<2	<2/<2	<2
206	<2	<2	<2	<2	<2	<2/<2	<2
209	<2	<2	<2	<2	<2	<2/<2	<2
TOTAL	9.3	11	ND	ND	ND	ND	17
Surrogate Recovery (%)							
#-103	92	114	108	89		105/113	84
# 198	96	109	110	92		105/119	84

APPENDIX E (CONTINUED)

Congener No.	MEKN2N 93JM134	MEKN3N 93JM135	MEKN4N 93JM136	MERY1N 93JM137	MERY2N 93JM138	MERY3N 93JM139	MEPI1N 93JM140
8	<2	<2	<2	<2	<2	<2	<2
18	<2	<2	<2	<2	<2	<2	<2
28	<2	<2	<2	<2	<2	<2	<2
29	<2	<2	<2	<2	<2	<2	<2
44	<2	<2	<2	<2	<2	<2	<2
50	<2	<2	<2	<2	<2	<2	<2
52	<2	<2	<2	<2	<2	<2	<2
66	3	<2	<2	2.2	<2	<2	<2
77	<2	<2	<2	<2	<2	<2	<2
87	<2	<2	<2	<2	<2	<2	<2
101	4.6	<2	3.2	2.9	<2	<2	<2
105	<2	<2	<2	<2	<2	<2	<2
118	<2	<2	<2	<2	<2	<2	<2
126	2	<2	<2	<2	<2	<2	<2
128	<2	<2	<2	<2	<2	<2	<2
138	11	6.1	9.8	5.9	<2	5.5	<2
153	15	9.6	15	8.6	3.2	9.6	3.3
169	<2	<2	<2	<2	<2	<2	<2
170	<2	<2	<2	<2	<2	<2	<2
180	<2	<2	<2	<2	<2	<2	<2
187	5.4	2.6	4.5	<2	<2	2.1	<2
195	<2	<2	<2	<2	<2	<2	<2
206	<2	<2	<2	<2	<2	<2	<2
209	<2	<2	<2	<2	<2	<2	<2
TOTAL	41	18	33	20	3.2	17	3.3
Surrogate Recovery (%)							
#-103	96	87	100	101	102	86	92
# 198	102	87	95	96	102	86	92

APPENDIX E (CONTINUED)

Congener	MEPI2N	MEPI3N	MEPI4N	MEFP1N	MEFP2N	MEFP3N	MEFP4N
No.	93JM141	93JM142	93JM143	93JM144	93JM145	93JM146	93JM147
8	<2	<2	<2	<2/<2	<2/<2	<2	<2
18	<2	<2	<2	<2/<2	<2/<2	<2	<2
28	<2	<2	<2	<2/<2	<2/<2	<2	<2
29	<2	<2	<2	<2/<2	<2/<2	<2	<2
44	<2	<2	<2	<2/<2	<2/<2	<2	<2
50	<2	<2	<2	<2/<2	<2/<2	<2	<2
52	<2	<2	<2	<2/<2	<2/<2	<2	<2
66	<2	<2	<2	<2/<2	<2/<2	<2	<2
77	<2	<2	<2	<2/<2	<2/<2	<2	<2
87	<2	<2	<2	<2/<2	<2/<2	<2	<2
101	<2	<2	<2	<2/<2	<2/<2	<2	<2
105	<2	<2	<2	<2/<2	<2/<2	<2	<2
118	<2	<2	<2	<2/2.6	3.0/4.3	3.9	2.6
126	<2	<2	<2	<2/<2	<2/<2	<2	<2
128	<2	<2	<2	<2/<2	<2/<2	<2	<2
138	<2	<2	<2	4.7/4.9	4.2/5.8	5.4	4.3
153	4.3	3.2	2.7	6.7/6.2	5.7/8.4	7.6	6.1
169	<2	<2	<2	<2/<2	<2/<2	<2	<2
170	<2	<2	<2	<2/<2	<2/<2	<2	<2
180	<2	<2	<2	<2/<2	<2/<2	<2	<2
187	<2	<2	<2	<2/<2	<2/<2	<2	<2
195	<2	<2	<2	<2/<2	<2/<2	<2	<2
206	<2	<2	<2	<2/<2	<2/<2	<2	<2
209	<2	<2	<2	<2/<2	<2/<2	<2	<2
TOTAL	4.3	3.2	2.7	11.4/11.1	13/19	17	13
Surrogate Recovery (%)							
#-103	95	95	103	107/102	90/112	91	91
# 198	93	94	102	104/110	82/110	91	97

APPENDIX E (CONTINUED)

Congener	NBSC1N	NBSC2N	NBSC3N	NBSC4N	NBLN1N	NBLN2N	NBLN3N
No.	93JM168	93JM169	93JM170	93JM171	93JM172	93JM173	93JM174
8	<2	<2	<2	<2	<2	<2	<2
18	<2	<2	<2	<2	<2	<2	<2
28	<2	<2	<2	<2	<2	<2	<2
29	<2	<2	<2	<2	<2	<2	<2
44	<2	<2	<2	<2	<2	<2	<2
50	<2	<2	<2	<2	<2	<2	<2
52	<2	<2	<2	<2	<2	<2	<2
66	<2	<2	<2	<2	<2	<2	<2
77	<2	<2	<2	<2	<2	<2	<2
87	<2	<2	<2	<2	<2	<2	<2
101	<2	<2	<2	<2	<2	<2	<2
105	<2	<2	<2	<2	<2	<2	<2
118	4.6	3.7	4.5	3.1	<2	<2	<2
126	<2	<2	<2	<2	<2	<2	<2
128	<2	<2	<2	<2	<2	<2	<2
138	5.7	5.2	6.1	4.7	3.2	2.4	3.6
153	9.3	8.6	10	9.1	5.4	4.1	4.2
169	<2	<2	<2	<2	<2	<2	<2
170	<2	<2	<2	<2	<2	<2	<2
180	<2	<2	<2	<2	<2	<2	<2
187	2.1	<2	2.3	2.1	<2	2.3	<2
195	<2	<2	<2	<2	<2	<2	<2
206	<2	<2	<2	<2	<2	<2	<2
209	<2	<2	<2	<2	<2	<2	<2
TOTAL	22	18	23	17	8.6	6.5	7.8
Surrogate Recovery (%)							
#-103	91	89	93	93	82	88	93
# 198	96	96	97	98	90	95	99

APPENDIX E (CONTINUED)

Congener	NBLN4N	NBHI1N	NBHI2N	NBHI3N	NBHI4N
No.	93JM175	93JM176	93JM177	93JM178	93JM179
8	<2	3.9/3.2	4.7	4.5	2
18	<2	<2/<2	<2	<2	<2
28	<2	<2/<2	<2	<2	<2
29	<2	<2/<2	<2	<2	<2
44	<2	<2/<2	<2	<2	<2
50	<2	<2/<2	<2	<2	<2
52	<2	<2/<2	<2	<2	<2
66	<2	<2/<2	<2	<2	<2
77	<2	<2/<2	<2	<2	<2
87	<2	<2/<2	<2	<2	<2
101	<2	<2/<2	<2	<2	<2
105	<2	<2/<2	<2	<2	<2
118	<2	<2/<2	<2	<2	<2
126	<2	<2/<2	<2	<2	<2
128	<2	<2/<2	<2	<2	<2
138	2.8	<2/<2	<2	<2	<2
153	4.8	<2/<2	<2	<2	<2
169	<2	<2/<2	<2	<2	<2
170	<2	<2/<2	<2	<2	<2
180	<2	<2/<2	<2	<2	<2
187	<2	<2/<2	<2	<2	<2
195	<2	<2/<2	<2	<2	<2
206	<2	<2/<2	<2	<2	<2
209	<2	<2/<2	<2	<2	<2
TOTAL	7.6	3.9/3.2	4.7	4.5	2
Surrogate Recovery (%)					
#-103	85	88/96	95	89	90
# 198	89	93/102	97	97	97

APPENDIX F. TISSUE CONCENTRATIONS OF CHLORINATED PESTICIDES IN *MYTILUS EDULIS* (NG/G DRY WEIGHT) FROM THE GULF OF MAINE.

Chlorinated	NSFI1N	NSFI2N	NSFI3N	NSFI4N	NSYR1N	NSYR2N	NSYR3N
Pesticide	93JM094	93JM095	93JM096	93JM097	93JM152	93JM153	93JM154
HCB	<2	<2	<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2	<2
Aldrin	<2	<2	<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2	<2
cis-Chlordane	<2	<2	<2	<2	<2	<2	<2
trans-Nonachlor	<2	<2	<2	<2	<2	<2	<2
p,p'-DDE	<2	<2	<2	<2	<2	<2	<2
Dieldrin	<2	<2	<2	<2	<2	<2	<2
o,p'-DDD	<2	<2	<2	<2	<2	<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2
p,p'-DDD	<2	<2	<2	<2	<2	<2	<2
o,p'-DDT	<2	<2	<2	<2	<2	<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2	<2
Mirex	<2	<2	<2	<2	<2	<2	<2
TOTAL	ND	ND	ND	ND	ND	ND	ND
Surrogate Recovery (%)							
γ–Chlordene	84	82	86	81	94	93	95

APPENDIX F (CONTINUED)

Chlorinated	NSYR4N	NSDI1N	NSDI2N	NSDI3N	NSDI4N	NSBC1N	NSBC2N
Pesticide	93JM155	93JM156	93JM157	93JM158	93JM159	93JM160	93JM161
HCB	<2	<2	<2/<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2/<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2/<2	<2	<2	<2	<2
Aldrin	<2	<2	<2/<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2/<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2/<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2/<2	<2	<2	<2	<2
cis-Chlordane	<2	<2	<2/<2	<2	<2	<2	<2
trans-Nonachlor	<2	<2	<2/<2	<2	<2	<2	<2
p,p'-DDE	<2	<2	<2/<2	<2	<2	<2	<2
Dieldrin	<2	<2	<2/<2	<2	<2	<2	<2
o,p'-DDD	<2	<2	<2/<2	<2	<2	<2	<2
b-Endosulfan	<2	<2	<2/<2	<2	<2	<2	<2
p,p'-DDD	<2	<2	<2/<2	<2	<2	<2	<2
o,p'-DDT	<2	<2	<2/<2	<2	<2	<2	<2
p,p'-DDT	<2	<2	<2/<2	<2	<2	<2	<2
Mirex	<2	<2	<2/<2	<2	<2	<2	<2
TOTAL	ND	ND	ND	ND	ND	ND	ND
Surrogate Recovery (%)							
γ-Chlordene	84	89	87/83	86	82	84	94

APPENDIX F (CONTINUED)

Chlorinated	NSBC3N	NSBC4N	NSAG1N	NSAG2N	NSAG3N	NSAG4N	MACO1N
Pesticide	93JM162	93JM163	93JM164	93JM165	93JM166	93JM167	93JM98
HCB	<2	<2	<2	<2	<2	<2/<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2/<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2/<2	<2
Aldrin	<2	<2	<2	<2	<2	<2/<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2/<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2/<2	<2
cis-Chlordane	<2	<2	<2	<2	<2	<2/<2	4.9
trans-Nonachlor	<2	<2	<2	<2	<2	<2/<2	4
p,p'-DDE	<2	<2	<2	<2	<2	<2/<2	14
Dieldrin	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDD	<2	<2	<2	<2	<2	<2/<2	7
b-Endosulfan	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDD	<2	<2	<2	<2	<2	<2/<2	11
o,p'-DDT	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2/<2	<2
Mirex	<2	<2	<2	<2	<2	<2/<2	<2
TOTAL	ND	ND	ND	ND	ND	ND	41
Surrogate Recovery (%)							
γ-Chlordene	92	96	76	86	82	77/83	75

APPENDIX F (CONTINUED)

Chlorinated	MACO2N	MACO3N	MAMH1N	MAMH2N	MAMH3N	MAMH4N	MALI1N
Pesticide	93JM99	93JM100	93JM101	93JM102	93JM103	93JM104	93JM105
HCB	<2	<2	<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2	<2
Aldrin	<2	<2	<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2	<2
cis-Chlordane	3.9	3.9	5.1	3.6	5.1	3.9	7.7/7.4
trans-Nonachlor	3.3	3.3	4.4	3	4.4	3.2	7.9/7.5
p,p'-DDE	13	12	8	4.5	7.8	4.5	21/20
Dieldrin	<2	<2	<2	<2	<2	<2	3.1/3.0
o,p'-DDD	9.5	6.7	4	2.3	3.3	2.7	16/17
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2/<2
p,p'-DDD	9	8.9	8	4.9	7.7	5.2	15/14
o,p'-DDT	<2	<2	<2	<2	<2	<2	<2/<2
p,p'-DDT	<2	<2	<2	<2	<2	<2	<2
Mirex	<2	<2	<2	<2	<2	<2	<2/<2
TOTAL	39	35	30	18	28	20	71/69
Surrogate Recovery (%)							
γ–Chlordene	85	72	86	88	93	87	87/92

APPENDIX F (CONTINUED)

Chlorinated Pesticide	MALI2N 93JM106	MALI3N 93JM107	MALI4N 93JM108	MAPY1N 93JM109	MAPY2N 93JM110	MAPY3N 93JM111	MAPY4N 93JM112
HCB	<2	<2	<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2	<2
Aldrin	<2	<2	<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2	<2
cis-Chlordane	9	7.7	4.5	2.9	3.1	2.2	<2
trans-Nonachlor	9	7.5	4.4	2	2.1	<2	<2
p,p'-DDE	28	20	12	6.9	7.4	5.3	3.5
Dieldrin	3.4	3.8	<2	<2	<2	<2	<2
o,p'-DDD	15	23	3.8	<2	<2	<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2
p,p'-DDD	18	15	9.1	2.6	3.3	2	<2
o,p'-DDT	<2	<2	2.9	<2	<2	<2	<2
p,p'-DDT	2.4	2	<2	<2	<2/<2	<2	<2
Mirex	<2	<2	<2	<2	<2	<2	<2
TOTAL	85	79	37	14	18	10	3.5
Surrogate Recovery (%)							
γ-Chlordene	86	94	90	88	96	96	77

Chlorinated	MASA1N	MASA2N	MASA3N	MASA4N	MAME1N	MAME2N	MAME3N
Pesticide	93JM113	93JM114	93JM115	93JM116	93JM117	93JM118	93JM119
HCB	<2	<2	<2	<2	<2	<2/<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2/<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2/<2	<2
Aldrin	<2	<2	<2	<2	<2	<2/<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2/<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2/<2	<2
cis-Chlordane	<2	2.4	<2	2.5	<2	2/2.7	2
trans-Nonachlor	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDE	7.8	12	8	11	<2	4.2/3.8	4
Dieldrin	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDD	<2	<2	<2	<2	<2	<2/<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDD	4.2	7.4	3.7	5.7	<2	2/4.	2.3
o,p'-DDT	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2/<2	<2
Mirex	<2	<2	<2	<2	<2	<2/<2	<2
TOTAL	12	22	12	19	ND	8.2/13	8.3
Surrogate Recovery (%)							
γ-Chlordene	81	100	92	101	90	116/184	114

APPENDIX F (CONTINUED)

Chlorinated	MAME4N	MECC1N	MECC2N	MECC3N	MECC4N	NHHS1N	NHNS2N
Pesticide	93JM120	93JM121	93JM122	93JM123	93JM124	93JM125	93JM126
HCB	<2	<2	<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2	<2
Aldrin	<2	<2	<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2	<2
cis-Chlordane	2	<2	<2	<2	<2	<2	<2
trans-Nonachlor	<2	<2	<2	<2	<2	<2	<2
p,p'-DDE	3.9	9.7	5.8	5.2	7.7	3.5	4.3
Dieldrin	<2	<2	<2	<2	<2	<2	<2
o,p'-DDD	<2	3.5	2	<2	2.5	<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2
p,p'-DDD	2.5	4.6	3.2	<2	<2	<2	<2
o,p'-DDT	<2	<2	<2	<2	<2	<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2	<2
Mirex	<2	<2	<2	<2	<2	<2	<2
TOTAL	8.4	18	11	5.2	10	3.5	4.3
Surrogate Recovery (%)							
γ–Chlordene	104	92	94	100	102	97	103

APPENDIX F (CONTINUED)

Chlorinated	NHNS3N	NHHS4N	MEBH1N	MEBH2N	MEBH3N	MEBH4N	MEKN1N
Pesticide	93JM127	93JM128	93JM129	93JM130	93JM131	93JM132	93JM133
HCB	<2	<2	<2	<2	<2	<2/<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2/<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2/<2	<2
Aldrin	<2	<2	<2	<2	<2	<2/<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2/<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2/<2	<2
cis-Chlordane	<2	<2	<2	<2	<2	<2/<2	<2
trans-Nonachlor	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDE	3.8	5	<2	<2	<2	<2/<2	2.3
Dieldrin	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDD	<2	<2	<2	<2	<2	<2/<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDD	<2	<2	<2	<2	<2	<2/<2	<2
o,p'-DDT	<2	<2	<2	<2	<2	<2/<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2/<2	<2
Mirex	<2	<2	<2	<2	<2	<2/<2	<2
TOTAL	3.8	5	ND	ND	ND	ND	2.3
Surrogate Recovery (%)							
γ–Chlordene	120	138	105	83	85	94/108	107

APPENDIX F (CONTINUED)

Chlorinated	MEKN2N	MEKN3N	MEKN4N	MERY1N	MERY2N	MERY3N	MEPI1N
Pesticide	93JM134	93JM135	93JM136	93JM137	93JM138	93JM139	93JM140
HCB	<2	<2	<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2	<2
Aldrin	<2	<2	<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2	<2
cis-Chlordane	<2	<2	<2	<2	<2	<2	<2
trans-Nonachlor	<2	<2	<2	<2	<2	<2	<2
p,p'-DDE	4	2	3.1	7	2.2	<2	<2
Dieldrin	<2	<2	<2	<2	<2	<2	<2
o,p'-DDD	<2	<2	<2	<2	<2	<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2
p,p'-DDD	2.4	<2	<2	7.3	<2	<2	<2
o,p'-DDT	<2	<2	<2	<2	<2	<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2	<2
Mirex	<2	<2	<2	<2	<2	<2	<2
TOTAL	6.4	2	3.1	14	2.2	ND	ND
Surrogate Recovery (%)							
γ–Chlordene	133	114	112	90	90	93	86

Chlorinated Pesticide	MEPI2N 93JM141	MEPI3N 93JM142	MEPI4N 93JM143	MEFP1N 93JM144	MEFP2N 93JM145	MEFP3N 93JM146	MEFP4N 93JM147
HCB	<2	<2	<2	<2/<2	<2/<2	<2	<2
γ-BHC	<2	<2	<2	<2/<2	<2/<2	<2	<2
Heptachlor	<2	<2	<2	<2/<2	<2/<2	<2	<2
Aldrin	<2	<2	<2	<2/<2	<2/<2	<2	<2
Hepta epoxide	<2	<2	<2	<2/<2	<2/<2	<2	<2
o,p'-DDE	<2	<2	<2	<2/<2	<2/<2	<2	<2
a-Endosulfan	<2	<2	<2	<2/<2	<2/<2	<2	<2
cis-Chlordane	<2	<2	<2	<2/<2	<2/<2	<2	<2
trans-Nonachlor	<2	<2	<2	<2/<2	<2/<2	<2	<2
p,p'-DDE	2.6	2.2	<2	5.1/4.5	3.0/4.2	4.7	3.8
Dieldrin	<2	<2	<2	<2/<2	<2/<2	<2	<2
o,p'-DDD	<2	<2	<2	<2/<2	<2/<2	<2	<2
b-Endosulfan	<2	<2	<2	<2/<2	<2/<2	<2	<2
p,p'-DDD	<2	<2	<2	5.5/5.3	4.3/5.5	6.6	5.8
o,p'-DDT	<2	<2	<2	<2/<2	<2/<2	<2	<2
p,p'-DDT	<2	<2	<2	<2/<2	<2/<2	<2	<2
Mirex	<2	<2	<2	<2/<2	<2/<2	<2	<2
TOTAL	2.6	2.2	ND	11/10.	7.3/9.7	11	9.6
Surrogate Recovery (%)							
γ-Chlordene	98	87	89	89/95	70/90	84	90

APPENDIX F (CONTINUED)

Chlorinated	NBSC1N	NBSC2N	NBSC3N	NBSC4N	NBLN1N	NBLN2N	NBLN3N
Pesticide	93JM168	93JM169	93JM170	93JM171	93JM172	93JM173	93JM174
HCB	<2	<2	<2	<2	<2	<2	<2
γ-BHC	<2	<2	<2	<2	<2	<2	<2
Heptachlor	<2	<2	<2	<2	<2	<2	<2
Aldrin	<2	<2	<2	<2	<2	<2	<2
Hepta epoxide	<2	<2	<2	<2	<2	<2	<2
o,p'-DDE	<2	<2	<2	<2	<2	<2	<2
a-Endosulfan	<2	<2	<2	<2	<2	<2	<2
cis-Chlordane	<2	<2	<2	<2	<2	<2	<2
trans-Nonachlor	<2	<2	<2	<2	<2	<2	<2
p,p'-DDE	<2	<2	<2	<2	4.6	6.2	3.8
Dieldrin	<2	<2	<2	<2	<2	<2	<2
o,p'-DDD	<2	<2	<2	<2	<2	<2	<2
b-Endosulfan	<2	<2	<2	<2	<2	<2	<2
p,p'-DDD	<2	<2	<2	<2	<2	<2	<2
o,p'-DDT	<2	<2	<2	<2	<2	<2	<2
p,p'-DDT	<2	<2	<2	<2	<2	<2	<2
Mirex	<2	<2	<2	<2	<2	<2	<2
TOTAL	ND	ND	ND	ND	4.6	6.2	3.8
Surrogate Recovery (%)							
γ-Chlordene	83	86	87	83	81	82	92

APPENDIX F (CONTINUED)

Chlorinated	NBLN4N	NBHI1N	NBHI2N	NBHI3N	NBHI4N
Pesticide	93JM175	93JM176	93JM177	93JM178	93JM179
HCB	<2	<2/<2	<2	<2	<2
γ-BHC	<2	<2/<2	<2	<2	<2
Heptachlor	<2	<2/<2	<2	<2	<2
Aldrin	<2	<2/<2	<2	<2	<2
Hepta epoxide	<2	<2/<2	<2	<2	<2
o,p'-DDE	<2	<2/<2	<2	<2	<2
a-Endosulfan	<2	<2/<2	<2	<2	<2
cis-Chlordane	<2	<2/<2	<2	<2	<2
trans-Nonachlor	<2	<2/<2	<2	<2	<2
p,p'-DDE	5.7	2.4/2.4	4.4	2.6	2.5
Dieldrin	<2	<2/<2	<2	<2	<2/<2
o,p'-DDD	<2	<2/<2	<2	<2	<2/<2
b-Endosulfan	<2	<2/<2	<2	<2	<2/<2
p,p'-DDD	<2	<2/<2	<2	<2	<2/<2
o,p'-DDT	<2	<2/<2	<2	<2	<2/<2
p,p'-DDT	<2	<2/<2	<2	<2	<2/<2
Mirex	<2	<2/<2	<2	<2	<2/<2
TOTAL	5.7	2.4/2.4	4.4	2.6	2.5
Surrogate Recovery (%)					
γ–Chlordene	91	96/93	83	94	86

APPENDIX G. POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS IN *MYTILUS EDULIS* TISSUE FROM THE GULF OF MAINE (HOSPITAL ISLAND, N.B., NOVEMBER 1992; BACK BAY, N.B., JUNE 1993; YARMOUTH, N.S., JUNE 1993).

Analytes (Isomers)	Hospital Island, N.B.					
	10099		10100		10101	
	Concentration (pg/g dry wt.)*	SDL	Concentration (pg/g dry wt.)	SDL	Concentration (pg/g dry wt.)	SDL
DIOXINS:						
Total T4CDD	ND	0.1	ND	0.1	0.3	0.1
2378	ND		ND		ND	
Total P5CDD	ND	0.1	ND	0.1	ND	0.1
12378	ND		ND		ND	
Total H6CDD	ND	0.2	ND	0.2	ND	0.2
123478	ND		ND		ND	
123678	ND		ND		ND	
123789	ND		ND		ND	
Total H7CDD	ND	0.4	ND	0.4	0.5	0.4
1234678	ND		ND		ND	
8CDD	ND	0.8	ND	0.8	1.6	0.8
TOTAL DIOXINS	ND		ND		2.4	
FURANS:						
Total P4CDF	0.1	0.1	0.2	0.1	1.5	0.1
2378	0.1		0.1		0.4	
Total P5CDF	ND	0.1	ND	0.1	ND	0.1
12378	ND		ND		ND	
23478	ND		ND		ND	
Total H6CDF	ND	0.2	ND	0.2	ND	0.2
123478	ND		ND		ND	
123678	ND		ND		ND	
123789	ND		ND		ND	
Total H7CDF	ND	0.4	ND	0.4	ND	0.4
1234678	ND		ND		ND	
1234789	ND		ND		ND	
8CDF	ND	0.6	ND	0.6	ND	0.6
TOTAL FURANS	0.1		0.2		1.5	
TOTAL CDD AND CDF	0.1		0.2		3.9	
% Moist.	90		89	89	84	
% Lipid	0.37		0.49	0.64	1.6	

* = High Resolution; SDL = Sample Detection Limit; ND = Not Detected

APPENDIX G (CONTINUED)

Analytes (Isomers)	Back Bay, N.B.					
	9306N1		9306N2		9306N3	
	Concentration (pg/g dry wt.)*	SDL	Concentration (pg/g dry wt.)	SDL	Concentration (pg/g dry wt.)	SDL
DIOXINS						
Total T4CDD	ND	0.1	ND	0.1	ND	0.1
2378	ND		ND		ND	
Total P5CDD	ND	0.1	ND	0.1	ND	0.1
2378	ND		ND		ND	
Total H6CDD	ND	0.2	ND	0.2	ND	0.2
123478	ND		ND		ND	
123678	ND		ND		ND	
123789	ND		ND		ND	
Total H7CDD	ND	0.4	ND	0.4	ND	0.4
1234678	ND		ND		ND	
8CDD	ND	0.8	ND	0.8	0.7	0.6
TOTAL DIOXINS	ND		ND		0.7	
FURANS:						
Total P4CDF	1.3	0.1	0.2	0.1	0.3	0.1
2378	0.3		0.2		0.2	
Total P5CDF	ND	0.1	ND	0.1	ND	0.1
12378	ND		ND		ND	
23478	ND		ND		ND	
Total H6CDF	ND	0.2	ND	0.2	ND	0.2
123478	ND		ND		ND	
123678	ND		ND		ND	
123789	ND		ND		ND	
Total H7CDF	ND	0.4	ND	0.4	ND	0.4
1234678	ND		ND		ND	
1234789	ND		ND		ND	
8CDF	ND	0.6	ND	0.6	ND	0.6
TOTAL FURANS	1.3		0.2		0.3	
TOTAL CDD AND CDF	1.3		0.2		1.0	
% Moist.	85		90	89	88	
% Lipid	0.14		0.61	0.64	0.92	

* = High Resolution; SDL = Sample Detection Limit; ND = Not Detected

APPENDIX G (CONTINUED)

Analytes (Isomers)	Yarmouth Harbour, N.S.					
	NSYH9306N1		NSYH9306N2		NSYH9306N3	
	Concentration (pg/g dry wt.)*	SDL	Concentration (pg/g dry wt.)	SDL	Concentration (pg/g dry wt.)	SDL
DIOXINS:						
Total T4CDD	3.7	0.2	3.5	0.1	3.6	0.1
2378	ND		ND		ND	
Total P5CDD	0.6	0.2	ND	0.2	0.3	0.2
12378	ND		ND		ND	
Total H6CDD	6.5	0.3	4.6	0.4	3.2	0.3
123478	ND		ND		ND	
123678	0.5		ND		ND	
123789	0.4		ND		ND	
Total H7CDD	27	0.3	23	0.4	17	0.4
1234678	4.1		3		2.6	
8CDD	24	0.5	20	0.5	16	0.5
TOTAL DIOXINS	61.8		51.1		40.1	
FURANS:						
Total P4CDF	4.5	0.1	3.4	0.1	3.9	0.1
2378	0.6		0.5		0.5	
Total P5CDF	2	0.3	1.1	0.3	1.0	0.2
12378	ND		ND		ND	
23478	ND		ND		ND	
Total H6CDF	2.2	0.4	1.1	0.4	0.6	0.3
123478	ND		ND		ND	
123678	ND		ND		ND	
123789	ND		ND		ND	
Total H7CDF	2.1	0.4	2.1	0.4	ND	0.4
1234678	1.0		1.0		NDR(0.7)	
1234789	ND		ND		ND	
8CDF	1.7	0.5	1.8	0.4	0.8	0.4
TOTAL FURANS	12.5		9.5		6.3	
TOTAL CDD AND CDF	74.3		60.6		46.4	
% Moist.	84.8		83.4		84.2	
% Lipid	1.3		1.1		1.1	

* = High Resolution; SDL = Sample Detection Limit; ND = Not Detected

APPENDIX H. MONITORING STATION DATA-ENTRY FORMS FOR 1993.

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MASA 1 Name: SANDWICH MA 2

Latitude: 41.4500 3 *(DD.MMMM)*

Longitude: 70.2400 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
OFFSHORE MUSSEL TRANSPLANT
STATION 6

Geographic Location

Access Road: NA 7 Distance from shore: 0.4 8 km

Township: SANDWICH 9 County: BARNSTABLE 10 Province/State: MA 11

Nearest Centre: SANDWICH 12 Population: 15489 13 Proximity: 0.5 14 km

Pollution Source: NPO 15 Distance from source: 0.8 16 km

Basin Name: MILL CREEK 17 Basin Area: 4.0 18 km2 Dist. from river mouth: 1.5 19 km

Physical Characteristics

Substrate: CAGE TRANSPLANT SITE 20

Station Exposure: 000 °21 Tidal Range: 2.7 22 m Depth below mean water: . 23 m

Audit Information

Established By: J PEDERSON 24 Agency: MACZM 25 Date: 92.08.24 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MACO 1 **Name:** COHASSET MA LITTLE HARBOR 2

Latitude: 42.1526 3 *(DD.MMMM)*

Longitude: 70.4736 4 *(DDD.MMMM)* **Pos. Method:** C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
QUARRY POINT AT MOUTH TO LITTLE HARBOR LARGE
MUSSEL BED TO WEST OF BRIDGE 6

Geographic Location

Access Road: JERUSALEM ROAD 7 **Distance from shore:** 0.0 8 km

Township: COHASSET 9 **County:** NORFOLK 10 **Province/State:** MA 11

Nearest Centre: COHASSET 12 **Population:** 7995 13 **Proximity:** 0.5 14 km

Pollution Source: NPO 15 **Distance from source:** 0.0 16 km

Basin Name: NO FRESHWATER INPUT 17 **Basin Area:** NA . 18 km2 **Dist. from river mouth:** NA. 19 km

Physical Characteristics

Substrate: ROCK OR MATS ON SAND 20

Station Exposure: 000 *21 **Tidal Range:** 3.0 22 m **Depth below mean water:** 1.5 23 m

Audit Information

Established By: WM ROBINSON 24 **Agency:** UMASS 25 **Date:** 93.09.21 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MALI [1] Name: LONG ISLAND BOSTON MA [2]

Latitude: 42.1973 [3] *(DD.MMMM)*

Longitude: 70.5727 [4] *(DDD.MMMM)* Pos. Method: C [5] *(C,G,T,O)*

Station Description: *(132 Characters Max)*
TIP OF LONG ISLAND EXPOSED TO PRESIDENTS ROAD
BOSTON HARBOR ACCESS THROUGH STATE HOSPITAL
GROUNDS [6]

Geographic Location

Access Road: EAST SQUANTUM STREET [7] Distance from shore: 0.0 [8] km

Township: BOSTON [9] County: SUFFOLK [10] Province/State: MA [11]

Nearest Centre: QUINCY [12] Population: 84985 [13] Proximity: 5.0 [14] km

Pollution Source: MUN [15] Distance from source: 0.5 [16] km

Basin Name: NEPONSET CHARLES MYS [17] Basin Area: 13.00 [18] km2 Dist. from river mouth: 4.0 [19] km

Physical Characteristics

Substrate: ROCK AND BOULDER WITH MATS [20]

Station Exposure: 045 [21] Tidal Range: 3.0 [22] m Depth below mean water: 1.5 [23] m

Audit Information

Established By: WM ROBINSON [24] Agency: UMASS [25] Date: 93.09.27 [26] *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MAMH 1 Name: DEVEREUX BEACH MARBLEHEAD MA 2

Latitude: 42.2994 3 *(DD.MMMM)*

Longitude: 70.5092 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
ROCKEY COBBLE OUTCROP MIDWAY ALONG CAUSEWAY
EAST OF DEVEREUX BEACH 6

Geographic Location

Access Road: OCEAN AVE 7 Distance from shore: 0.0 8 km

Township: MARBLEHEAD 9 County: ESSEX 10 Province/State: MA 11

Nearest Centre: MARBLEHEAD 12 Population: 19971 13 Proximity: 0.8 14 km

Pollution Source: MUN 15 Distance from source: 4.0 16 km

Basin Name: NO FRESHWATER INPUT 17 Basin Area: NA . 18 km2 Dist. from river mouth: NA. 19 km

Physical Characteristics

Substrate: BOULDERS AND COBBLE 20

Station Exposure: 180 °21 Tidal Range: 2.7 22 m Depth below mean water: 1.5 23 m

Audit Information

Established By: WM ROBINSON 24 Agency: UMASS 25 Date: 93.09.18 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MAPY 1 Name: MANOMET POINT PLYMOUTH MA 2
Latitude: 41.5565 3 *(DD.MMMM)*
Longitude: 70.3231 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*
Station Description: *(132 Characters Max)*
ROCKY SHORELINE WITH TIDAL POOLS DIRECT
EXPOSURE TO OPEN WATER DESCENDCLIFF VIA
STAIRS BEHIND FISHING SHACK 6

Geographic Location

Access Road: POINT ROAD 7 Distance from shore: 0.0 8 km
Township: PLYMOUTH 9 County: PLYMOUTH 10 Province/State: MA 11
Nearest Centre: PLYMOUTH 12 Population: 45608 13 Proximity: 1.0 14 km
Pollution Source: NPO 15 Distance from source: 0.0 16 km
Basin Name: NO FRESHWATER INPUT 17 Basin Area: NA. 18 km2 Dist. from river mouth: NA. 19 km

Physical Characteristics

Substrate: ROCK AND TIDE POOLS 20
Station Exposure: 040 °21 Tidal Range: 3.0 22 m Depth below mean water: 1.5 23 m

Audit Information

Established By: WM ROBINSON 24 Agency: UMASS 25 Date: 93.09.22 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MAME 1 Name: MERRIMACK RIVER 2

Latitude: 42.4854 3 *(DD.MMMM)*

Longitude: 70.4936 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description *(132 Characters Max)*: BED WITHIN MOUTH OF HARBOR OFF SHORE BY STATE DEPURATION PLANT ON PLUM ISLAND AT END OF PLUM ISLAND TURNPIKE 6

Geographic Location

Access Road: PLUM ISLAND TURNPIKE END 7 Distance from shore: 0.1 8 km

Township: NEWBURYPORT 9 County: ESSEX 10 Province/State: MA 11

Nearest Centre: NEWBURYPORT 12 Population: 18000 13 Proximity: 3.0 14 km

Pollution Source: MUN 15 Distance from source: 3.0 16 km

Basin Name: MERRIMACK RIVER 17 Basin Area: 5960. 18 km2 Dist. from river mouth: 1.1 19 km

Physical Characteristics

Substrate: SAND MIXED WITH FINES 20

Station Exposure: 180 °21 Tidal Range: 2.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: BILL ROBINSON 24 Agency: UMASS 25 Date: . . 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NHHS 1 Name: HAMPTON SEABROOK ESTUARY 2

Latitude: 42.5350 3 *(DD.MMMM)*

Longitude: 70.4903 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
BED ALONG CHANNEL AT NORTH SIDE OF HARBOR
MOUTH UNDER RT1 BRIDGE PARK IN LOT ON NORTH
WEST SIDE OF BRIDGE 6

Geographic Location

Access Road: US RT1 BRIDGE NORTH SIDE 7 Distance from shore: 0.1 8 km

Township: HAMPTON BEACH 9 County: ROCKINGHAM 10 Province/State: NH 11

Nearest Centre: HAMPTON BEACH 12 Population: 12000 13 Proximity: . 14 km

Pollution Source: MUN 15 Distance from source: 3.0 16 km

Basin Name: HAMPTONSEABROOKESTUAR Y Basin Area: 120. 18 km2 Dist. from river mouth: 0.5 19 km

Physical Characteristics

Substrate: SAND 20

Station Exposure: 90 °21 Tidal Range: 2.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: STEVE JONES 24 Agency: UNH 25 Date: . . 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MECC 1 Name: CLARK COVE 2
Latitude: 43.0438 3 *(DD.MMMM)*
Longitude: 70.4335 4 *(DDD.MMMM)* Pos. Method: G 5 *(C,G,T,O)*
Station Description: *(132 Characters Max)*
BED WITHIN CLARK COVE ON SEAVEY ISLAND AT EDGE OF SHORE OF NORTHWEST EDGE OF CLARK ISLAND NORTH OF CAUSEWAY 6

Geographic Location

Access Road: ON NAVAL SHIPYARD LAND 7 Distance from shore: 0.1 8 km
Township: KITTERY 9 County: YORK 10 Province/State: ME 11
Nearest Centre: KITTERY 12 Population: 10000 13 Proximity: . 14 km
Pollution Source: MUN 15 Distance from source: 1.0 16 km
Basin Name: PISCATAQUA SALMONFALL S Basin Area: 1400. 18 km2 Dist. from river mouth: 3.0 19 km

Physical Characteristics

Substrate: MUD 20
Station Exposure: 160 °21 Tidal Range: 2.5 22 m Depth below mean water: . 23 m

Audit Information

Established By: STEVE JONES 24 Agency: UNH 25 Date: . . 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MEBH 1 Name: BRAVE BOAT HARBOR 2

Latitude: 43.0556 3 *(DD.MMMM)*

Longitude: 70.3922 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
BED ON SHORE AT TIP OF SOUTH ENTRANCE TO HARBOR JUST INSIDE AND SLIGHTLY WEST OF TIP OF LAND 6

Geographic Location

Access Road: RT103 N FROM KITTERY LAUNCHBOAT Distance from shore: 0.1 8 km

Township: KITTERY 9 County: YORK 10 Province/State: ME 11

Nearest Centre: KITTERY 12 Population: 10000 13 Proximity: . 14 km

Pollution Source: 15 Distance from source: . 16 km

Basin Name: BRAVE BOAT HARBOR 17 Basin Area: 2.0 18 km2 Dist. from river mouth: 0.1 19 km

Physical Characteristics

Substrate: MUDDY SAND 20

Station Exposure: 100 °21 Tidal Range: 2.5 22 m Depth below mean water: . 23 m

Audit Information

Established By: JOHN SOWLES 24 Agency: MEDEP 25 Date: .. 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MERY [1] Name: ROYAL RIVER [2]

Latitude: 43.4775 [3] *(DD.MMMM)*

Longitude: 70.0876 [4] *(DDD.MMMM)* Pos. Method: T [5] *(C,G,T,O)*

Station Description: *(132 Characters Max)*
CONFUENCE OF ROYAL AND COUSINS RIVERS MID CHANNEL MUDFLAT JUST OFF PENNISULA [6]

Geographic Location

Access Road: PUBLIC RAMP OFF BAYVIEW ST YAR [7] Distance from shore: 0.0 [8] km

Township: YARMOUTH [9] County: CUMBERLAND [10] Province/State: ME [11]

Nearest Centre: YARMOUTH [12] Population: 8200 [13] Proximity: 1.0 [14] km

Pollution Source: MUN [15] Distance from source: 1.0 [16] km

Basin Name: ROYAL RIVER [17] Basin Area: 430.00 [18] km2 Dist. from river mouth: 00 [19] km

Physical Characteristics

Substrate: MUD SAND [20]

Station Exposure: 90 °[21] Tidal Range: 3.0 [22] m Depth below mean water: . [23] m

Audit Information

Established By: JOHN SOWLES [24] Agency: MEDEP [25] Date: 93.09.03 [26] *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MEKN 1 Name: KENNEBEC RIVER 2
Latitude: 43.4750 3 *(DD.MMMM)*
Longitude: 69.4760 4 *(DDD.MMMM)* Pos. Method: T 5 *(C,G,T,O)*
Station Description: SOUTH TIP PERKINS ISLAND 6
(132 Characters Max)

Geographic Location

Access Road: ACCESS FROM BOAT 7 Distance from shore: 0.5 8 km
Township: GEORGETOWN 9 County: SAGADAHOC 10 Province/State: ME 11
Nearest Centre: BATN 12 Population: 12000 13 Proximity: . 14 km
Pollution Source: 15 Distance from source: 16.5 16 km
Basin Name: KENNEBEC 17 Basin Area: 24171 18 km2 Dist. from river mouth: . 19 km

Physical Characteristics

Substrate: LEDGE MIXED WITH SAND 20
Station Exposure: 030 °21 Tidal Range: 3.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: JSOWLES 24 Agency: MEDEP 25 Date: 92.08.20 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MEFP 1 Name: FORT POINT ON PENOBSCOT RIVER 2

Latitude: 44.2826 3 *(DD.MMMM)*

Longitude: 68.4891 4 *(DDD.MMMM)* Pos. Method: T 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
FORT POINT STATE PARK NO SHORE PENINSULA
SAND BEACH BETWEEN TIP AND OLD WHARF 6

Geographic Location

Access Road: FORT POINT RD WALK 7 Distance from shore: 0.0 8 km

Township: STOCKTON SPRING 9 County: WALDO 10 Province/State: ME 11

Nearest Centre: BUCKSPORT 12 Population: 5000 13 Proximity: . 14 km

Pollution Source: IND 15 Distance from source: 11.5 16 km

Basin Name: PENOBSCOT 17 Basin Area: 23867 18 km2 Dist. from river mouth: 0.0 19 km

Physical Characteristics

Substrate: SANDY GRAVEL 20

Station Exposure: 180 °21 Tidal Range: 3.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: J SOWLES 24 Agency: MEDEP 25 Date: 93.09.21 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: MEPI [1] Name: PICKERING ISLAND [2]
Latitude: 44.1555 [3] *(DD.MMMM)*
Longitude: 68.4380 [4] *(DDD.MMMM)* Pos. Method: T [5] *(C,G,T,O)*
Station Description: *(132 Characters Max)* SMALL LEDGE 350 METRE SOUTHEAST PICKERING [6]

Geographic Location

Access Road: SWAINS COVE LITTLE DEER IS [7] Distance from shore: 1.5 [8] km
Township: DEER ISLE [9] County: HANCOCK [10] Province/State: ME [11]
Nearest Centre: DEER ISLE [12] Population: 1850 [13] Proximity: 6.5 [14] km
Pollution Source: NPO [15] Distance from source: 20.0 [16] km
Basin Name: PENOBSCOT [17] Basin Area: 23867 [18] km2 Dist. from river mouth: 10.0 [19] km

Physical Characteristics

Substrate: LEDGE BOULDER [20]
Station Exposure: [21] Tidal Range: 3.0 [22] m Depth below mean water: . [23] m

Audit Information

Established By: J SOWLES [24] Agency: MEDEP [25] Date: 93.09.22 [26] *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NBSC 1 Name: SAINT CROIX RIVER 2
Latitude: 45.1002 3 *(DD.MMMM)*
Longitude: 67.0965 4 *(DDD.MMMM)* Pos. Method: 5 *(C,G,T,O)*
Station Description: *(132 Characters Max)*
TODDS POINT AT MOUTH OF SAINT CROIX OPPOSITE BAYSIDE TERMINAL 6

Geographic Location

Access Road: GLEBE RD 7 Distance from shore: 8 km
Township: 9 County: CHARLOTTE 10 Province/State: NB 11
Nearest Centre: ST STEPHEN 12 Population: 8000 13 Proximity: 14 km
Pollution Source: 15 Distance from source: 16 km
Basin Name: ST CROIX ESTUARY 17 Basin Area: 18 km2 Dist. from river mouth: 19 km

Physical Characteristics

Substrate: ROCKY 20
Station Exposure: °21 Tidal Range: 22 m Depth below mean water: 23 m

Audit Information

Established By: KAREN COOMBS 24 Agency: NBDFA 25 Date: 94.03 14 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NBHI 1 Name: HOSPITAL ISLAND 2
Latitude: 45.0738 3 *(DD.MMMM)*
Longitude: 67.0024 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*
Station Description: *(132 Characters Max)* BACK OF HOSPITAL ISLAND 6

Geographic Location

Access Road: GLEBE ROAD 7 Distance from shore: 1.5 8 km
Township: 9 County: CHARLOTTE 10 Province/State: NB 11
Nearest Centre: ST ANDREWS 12 Population: 1500 13 Proximity: . 14 km
Pollution Source: MUN 15 Distance from source: . 16 km
Basin Name: PASSAMAQUODDY BAY 17 Basin Area: . 18 km2 Dist. from river mouth: . 19 km

Physical Characteristics

Substrate: SANDY 20
Station Exposure: 21 Tidal Range: . 22 m Depth below mean water: . 23 m

Audit Information

Established By: KAREN COOMBS 24 Agency: NBDFA 25 Date: 94.03.14 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NBLN 1 Name: LETANG ESTUARY 2
Latitude: 45.0459 3 *(DD.MMMM)*
Longitude: 66.4800 4 *(DDD.MMMM)* Pos. Method: T 5 *(C,G,T,O)*
Station Description: LEDGE IN CENTRE OF ESTUARY HADDOCK LEDGE 6
(132 Characters Max)

Geographic Location

Access Road: LIMEKILN RD 7 Distance from shore: 1.0 8 km
Township: 9 County: CHARLOTTE 10 Province/State: NB 11
Nearest Centre: ST GEORGE 12 Population: 1500 13 Proximity: 10.0 14 km
Pollution Source: IND 15 Distance from source: 5.0 16 km
Basin Name: LETANG 17 Basin Area: . 18 km2 Dist. from river mouth: . 19 km

Physical Characteristics

Substrate: ROCKY 20
Station Exposure: °21 Tidal Range: . 22 m Depth below mean water: . 23 m

Audit Information

Established By: KAREN COOMBS 24 Agency: NBDFA 25 Date: 94.03.14 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NSFI [1] Name: FIVE ISLANDS ECONOMY [2]

Latitude: 45.3953 [3] *(DD.MMMM)*

Longitude: 64.0674 [4] *(DDD.MMMM)* Pos. Method: T [5] *(C,G,T,O)*

Station Description: *(132 Characters Max)*
NEAR PROVINCIAL PARK BETWEEN SAND POINT AND CAMPGROUND [6]

Geographic Location

Access Road: HWY 2 [7] Distance from shore: 0.4 [8] km

Township: [9] County: COLCHESTER [10] Province/State: NS [11]

Nearest Centre: FIVE ISLANDS [12] Population: 231 [13] Proximity: [14] km

Pollution Source: NPA [15] Distance from source: 1.0 [16] km

Basin Name: MINAS BASIN [17] Basin Area: [18] km2 Dist. from river mouth: 0.5 [19] km

Physical Characteristics

Substrate: ROCK SAND SILT [20]

Station Exposure: 40 °[21] Tidal Range: 8.0 [22] m Depth below mean water: [23] m

Audit Information

Established By: D WALTER [24] Agency: ECEPB [25] Date: 93.09.16 [26] *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NSDI 1 Name: DIGBY ANNAPOLIS BASIN 2

Latitude: 44.3810 3 *(DD.MMMM)*

Longitude: 65.4465 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
CAGE SITE OFF OLD WEIR 6 METER FROM SOUTH END
POST BEARING S 340 FIGBUOY 270 FI 12 BUOY 120
BEAR ISLAND 315 GRAPPLE LINE 6

Geographic Location

Access Road: 7 Distance from shore: 1.1 8 km

Township: 9 County: DIGBY 10 Province/State: NS 11

Nearest Centre: DIGBY 12 Population: 5000 13 Proximity: 1.4 14 km

Pollution Source: MUN 15 Distance from source: 0.0 16 km

Basin Name: ANNAPOLIS 17 Basin Area: 1600.00 18 km2 Dist. from river mouth: 24.0 19 km

Physical Characteristics

Substrate: MUD BOTTOM 20

Station Exposure: 360 °21 Tidal Range: 8.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: B CRAWFORD 24 Agency: NSDOF 25 Date: 92.08.19 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NSBC 1 Name: BROAD COVE BAY OF FUNDY 2

Latitude: 44.4005 3 *(DD.MMMM)*

Longitude: 65.4975 4 *(DDD.MMMM)* Pos. Method: C 5 *(C,G,T,O)*

Station Description: *(132 Characters Max)*
CAGE SITE EAST OF WHARF SIXTY METERS EAST OF
LAST BUOY GRAPPLING LINE RUNS FROM LAST BUOY
TO CAGES 6

Geographic Location

Access Road: CULLODEN BROAD COVE ROAD 7 Distance from shore: 0.1 8 km

Township: 9 County: DIGBY 10 Province/State: NS 11

Nearest Centre: DIGBY 12 Population: 5000 13 Proximity: 15.0 14 km

Pollution Source: 15 Distance from source: . 16 km

Basin Name: BAY OF FUNDY 17 Basin Area: . 18 km2 Dist. from river mouth: . 19 km

Physical Characteristics

Substrate: LEDGE AND ROCK 20

Station Exposure: 135 °21 Tidal Range: 8.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: R CRAWFORD 24 Agency: NSDOF 25 Date: 92.08.19 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NSYR 1 Name: YARMOUTH HARBOUR 2
Latitude: 43.8179 3 *(DD.MMMM)*
Longitude: 66.1426 4 *(DDD.MMMM)* Pos. Method: T 5 *(C,G,T,O)*
Station Description: ALONG ROAD TO CAPE FORCHU NEAR FISHERMANS
(132 Characters Max) MONUMENT AT JOHNSONS POINT 6

Geographic Location

Access Road: RT 304 OVERTON 7 Distance from shore: . 8 km
Township: 9 County: YARMOUTH 10 Province/State: NS 11
Nearest Centre: YARMOUTH 12 Population: 8500 13 Proximity: 2.0 14 km
Pollution Source: MUN 15 Distance from source: . 16 km
Basin Name: YARMOUTH HARBOUR 17 Basin Area: . 18 km2 Dist. from river mouth: . 19 km

Physical Characteristics

Substrate: SAND SILT FEW BOULDERS 20
Station Exposure: 180 °21 Tidal Range: 5.0 22 m Depth below mean water: . 23 m

Audit Information

Established By: R CRAWFORD 24 Agency: NSDOF 25 Date: 93.09.16 26 *(YY.MM.DD)*

Gulf of Maine
Monitoring Committee
GulfWatch Project

MONITORING STATION
Data Entry Form

Station Designation

Station Number: NSAG 1 Name: ARGYLE 2

Latitude: 43.7390 3 *(DD.MMMM)*

Longitude: 65.8435 4 *(DDD.MMMM)* Pos. Method: 5 *(C,G,T,O)*

Station Description: PUBLIC PARK WHARF 6
(132 Characters Max)

Geographic Location

Access Road: OFF RT 335 7 Distance from shore: . 8 km

Township: ARGYLE 9 County: YARMOUTH 10 Province/State: NS 11

Nearest Centre: LOWER ARGYLE 12 Population: 13 Proximity: . 14 km

Pollution Source: 15 Distance from source: . 16 km

Basin Name: 17 Basin Area: . 18 km2 Dist. from river mouth: 12.0 19 km

Physical Characteristics

Substrate: BOULDER MUD 20

Station Exposure: 180 °21 Tidal Range: . 22 m Depth below mean water: . 23 m

Audit Information

Established By: A BAGNALL 24 Agency: NSDOF 25 Date: 93.09.24 26 *(YY.MM.DD)*