Gulfwatch
2006 Data Report:

SIXTEENTH YEAR OF THE GULF OF MAINE ENVIRONMENTAL MONITORING PROGRAM

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Prepared for
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1.0 INTRODUCTION

This report summarizes the metals and organic contaminant data associated with the collection and analyses of blue mussel (*Mytilus edulis*) tissue from selected sites along the Gulf of Maine coast during the 2006 sampling season. Contaminant monitoring is conducted by the Gulfwatch Program for the Gulf of Maine Council on the Marine Environment (GOMC). These data are also compared with analytical results from earlier Gulfwatch monitoring beginning in 1993. Statistical analyses are generally limited to fundamental descriptive measures of replicates from each sampling site and include: averages, geometric means, and appropriate measures of variance. The primary purpose of this report is to present the current annual results, qualitatively describe trends in the data, identify potential outliers, and lead users towards further investigations.

1.1 PROGRAMMATIC RATIONALE

The Gulf of Maine is the region of the North Atlantic Ocean that extends from Cape Sable, Nova Scotia, through New Brunswick, Maine, and New Hampshire to Cape Cod, Massachusetts; and includes the Bay of Fundy and Georges Bank. The Gulf of Maine ecosystem is one of the world's most productive ecosystems with an extensive and diverse array of plants and animals (Census of Marine Life - Gulf of Maine Area, 2008) that support important economic activities including commercial catch and aquaculture fisheries, recreational fishing, shipping, and tourism. The Gulf of Maine ecosystem includes large watersheds draining from western Nova Scotia, southwestern New Brunswick, the state of Maine, southern and eastern New Hampshire, and eastern Massachusetts. Several urban industrialized areas lie within that watershed, including: Boston, Massachusetts; Portsmouth, New Hampshire; Portland and Bangor, Maine: and Saint John, New Brunswick. Increases in industrial, commercial, and expanding residential development along the Gulf of Maine coast and the subsequent discharge of chemical contaminants have contributed to deterioration of water quality in some near shore areas (Dow and Braasch, 1996). Certain of these anthropogenically introduced chemicals bioaccumulate through transfers up the food chain, and are found at elevated concentrations in higher trophic organisms (Chen et al., 2008; Shaw et al., 2006, 2005 and 2003; Mallory et al., 2005; Aguilar et al., 2002; Weisbrod et al., 2000). When concentrations of some contaminants become too high they can pose a threat to marine life by adversely affecting their growth, reproduction, and survival (Kawaguchi et al. 1999, Wells and Rolston 1991). Thus, bioaccumulation of contaminants in organisms also signals the status of ecosystem health, with implications for the human health, especially among those who derive benefits of food,

recreation, and other uses from the near shore marine environment (Dolan at al., 2005). It is for this purpose that individual jurisdictions around the Gulf of Maine have implemented steps to control the discharge of chemical contaminants to the Gulf of Maine. The Gulfwatch monitoring program provides region-wide tracking of chemical contaminants exposure (spatial status and time trends) for both urban and less populated areas within all five Gulf of Maine jurisdictions.

Gulfwatch informs the GOMC member jurisdictions in the U.S. and Canada on the status and trends of chemical contaminants accumulation in mussels. The Gulfwatch monitoring program is thus responsive to the goals articulated by the Council that seek balances in environmental integrity and human uses in the Gulf of Maine. The GOMC (http://www.gulfofmaine.org/) was established by the *Agreement on the Conservation of the Marine Environment of the Gulf of Maine* which was signed in December 1989 by the premiers of Nova Scotia and New Brunswick and the governors of Maine, New Hampshire and Massachusetts. The GOMC's mission is to maintain and enhance the Gulf's marine ecosystem, its natural resources and environmental quality. To achieve the GOMC's mission statement, the Gulf of Maine Environmental Quality Monitoring Committee was formed and charged with the development of the Gulf of Maine Environmental Quality Monitoring Program. The program is based on the mission statement endorsed by the GOMC:

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

The Gulfwatch program is charged with the assessment component of in the GOMC's 2007-2012 Action Plan Goal 2 (of 3): *Environmental conditions in the Gulf of Maine support ecosystem and human health***.** Three monitoring goals were established to help meet the goals of the current Action Plan and the mission of the Gulfwatch Program:

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

Gulfwatch uses the blue mussel, *Mytilus edulis*, as an indicator for habitat exposure to organic and inorganic contaminants. Bivalves, including blue mussel, have been successfully

used as an indicator organism in environmental monitoring programs throughout the world (McIntosh et al., 2004; Glynn et al., 2004; Airas, 2003; Monirith et al., 2003; NAS, 1980; NOAA, 1991; Widdows et al., 1995, Widdows and Donkin, 1992; O'Connor and Lauenstein, 2006; O'Connor, 2002 and 1998). Blue mussels were selected because they are:

(1) abundant within and across each of the five Gulf of Maine jurisdictions and are relatively easy to collect and process.
(2) comparatively well studied and reported in the scientific and technical literature.
(3) commercially harvested for food and may be used to evaluate human exposure to chemical contamination.
(4) sedentary, thereby reducing sources of data variability associated with mobile species.
(5) suspension feeders that pump large volumes of water and concentrate many chemicals in their tissues both directly and indirectly from the water column. This increases the ability to measure chemical contaminants found at lower concentrations in other environmental matrices. Contaminant accumulation in mussel tissue represents the biologically available proportion that is not always apparent from measurement of contaminants in other environmental matrices such as water, sediment, and suspended particles.

Gulfwatch also reports on shell size and the growth condition using the condition index (CI); the latter has a potential for use in normalizing the contaminant concentration data. CI is traditionally used as an indicator of the physiological status of mussels (Widdows, 1985). CI relates the tissue's wet weight to shell volume. Because CI generally reflects differences in the reproductive state of sampled mussels gonadal weight is a significant contributor to total body weight just prior to spawning,. Since gonadal material tends to have low concentrations of metals (LaTouche and Mix, 1981), tissue metal concentrations may be reduced in mussels having a high CI due to ripened gonads. Organic contaminants, however, would tend to partition into both somatic and gonadal lipids, and may be less impacted by changes in CI if due to the presence of ripe gonads. Variable amounts of ripe gonads have been found in some mussel populations even in late fall (Kimball, 1994) which is the period when Gulfwatch sampling is scheduled. Granby and Spliid (1995) found a significant negative correlation between PAHs and CI but no correlation between PCB or DDE concentration and CI. Regardless, the relationship between CI and contaminant concentrations should be considered during in-depth analyses of Gulfwatch data.

2.0 METHODS

2.1 NEW 12-YEAR SAMPLING DESIGN

In 2005, the Gulfwatch committee developed a new 12-year sampling design (2005-2016) that modified the original 9-year sampling strategy. The new design drew from the previous experience of the program, a review of past Gulfwatch data, and input from committee members from each jurisdiction (Massachusetts, New Hampshire, Maine, New Brunswick, and Nova Scotia). This design addresses the following two broad hypotheses:

1. No changes in mussel tissue contaminant concentrations occur with time at each sampling site.
2. Mussel tissue contaminant concentrations are the same at all sites.

The new sampling design continues the tradition of four (4) replicate mussel tissue samples collected at all the sites with each replicate coming from a distinct area within each designated site. Two tiers of sampling where identified based on sampling intensity: once every two years (temporally intensive) and once every six years (spatial coverage). These sites will be sampled on a rotating basis and repeated in each 6-year cycle resulting in three (3)"temporal" samples and one (1) "spatial" sample at the end of each 6-year cycle for designated sites.

Sample Sites:

The Gulfwatch Committee evaluated all sites included in its program up to 2005. Sites of less interest were then identified and discontinued to enhance flexibility in the design, free resources to address emerging issues, strengthen temporal and spatial evaluations, improve monitoring capacity, and allow for continuity under variable funding and support.

Members from each jurisdiction solicited respective environmental management and science audiences to determine which Gulfwatch sites should be sampled intensively and which should be sampled less frequently for the long-term. Criteria used for site selection included:

-management interest or activity (sewage treatment, new industry, oil spill, dredging, aquaculture siting, etc,)

-a relatively pristine (reference) site in each jurisdiction,

-potential or suspect contamination of site,

-high population/industrial activity, or,

-other reasons articulated by the management and science communities why detecting a temporal trend or intensive scrutiny would be necessary.

The Program considered additional criteria, such as:

- The sampling scheme can accommodate collecting more samples than can be analyzed due to costs. Extra samples would be archived for future analyses.
- Sites selected for metals and organics monitoring may differ, as there are some sites where concern dictates intensive sampling for one category or the other.
- Each reader can examine their own jurisdictional plots of annual means in the PAH, PCB, pesticide and metals chapters on contaminant concentration trends and ranges.

The Program identified the several advantages to the new 12-year design (Table 1). The new sampling scheme:

- continues to support long-term monitoring goals;
- has evolved from the results of the 9-year Review of Gulfwatch;
- maintains continuity with original vision for both temporal and spatial monitoring;
- preserves original sites with ability to add a few new sites; and
- is adaptive such that sites can move between temporal and long-term sampling schemes depending on the significance of the results or local/regional management interest.

TABLE 1. Gulfwatch 12-year Sampling design shown for 2005-2010 (repeat for 2011-2016). "Trend" sites are designated for sampling every two years. The other stations are sampled once every 6 years.

Station	Name	2005	2006	2007	2008	2009	2010	Comment
Massachusetts								
MASN*	Sandwich	GoM-T		GoM-T		GoM-T		trend
MAME	Merrimack Estuary		GoM-T		GoM-T		GoM-T	trend
MAPY	Plymouth	GoM-S						6-year
MABI	Outer Brewster Island		GoM-S					6-year
MAIH	Boston Inner Harbor			GoM-S				6-year
MAMH	Marblehead				GoM-S			6-year
New Hampshire								
MECC*	Clarks Cove	GoM-T	GoM-T	GoM-T	GoM-T	GoM-T	GoM-T	trend
NHDP	Dover Point	NHEP	NHEP	NHEP	NHEP	NHEP	NHEP	trend
NHHS	Hampton/Seabrook	NHEP	NHEP	NHEP	NHEP	NHEP	NHEP	trend
NHNM	North Mill Pond	GoM-S						6-year
NHRH	Rye Harbor			GoM-S				6-year
NHSM	South Mill Pond		GoM-S					6-year
NHLH	Little Harbor				GoM-S			6-year
NHSS	Schiller Station		GoM-S			GoM-S		3-year
NHFP	Fox Point						GoM-S	6-year
NHPI	Pierce Island				GoM-S			6-year
Maine								
MEPH	Portland Harbor	GoM-T		GoM-T		GoM-T		trend
MEKN*	Kennebec River	GoM-T		GoM-T		GoM-T		trend
MEBB	Boothbay Harbor		GoM-T		GoM-T		GoM-T	trend
MEBH	Brave Boat Harbor		GoM-S					6-year
MESA	Saco River				GoM-S			6-year
MEPR	Presumpscot River			GoM-S				6-year
MERY	Royal River		GoM-S					6-year
MEDM	Damarscotta					GoM-S		6-year
MEFP	Penobscot River	GoM-S						6-year
MEPI	Pickering Island	GoM-S						6-year
MEUR	Union River							6-year
MEMR	Machias River						GoM-S	6-year
MECK	Cobscook Bay						GoM-S	6-year

Table 1 (continued)

Station	Name	2005	2006	2007	2008	2009	2010	Comment
New Brunswick								
NBTC	Tin Can Beach	GoM-T		GoM-T		GoM-T		trend
NBSC	St. Croix		GoM-T		GoM-T		GoM-T	trend
NBHI*	Hospital Island	GoM-S						6-year
NBLB	Limekiln Bay		GoM-S					6-year
NBNR	Niger River			GoM-S				6-year
NBMI	Manawagonish				GoM-S			6-year
NBCG	St. John Harbour					GoM-S		6-year
upper SJH	St. John Harbour					GoM-S		6-year
NBSB	Shepody						GoM-S	6-year
NBAL	Alma						GoM-S	6-year
Nova Scotia								
NSDI*	Digby	GoM-T		GoM-T		GoM-T		trend
NSYR	Yarmouth		GoM-T		GoM-T		GoM-T	trend
NSBI	Brier Island	GoM-T		GoM-T		GoM-T		trend
NSAR	Apple River		GoM-T		GoM-T		GoM-T	trend
NSSC	Spechts Cove			GoM-S				6-year
NSBP	Barrington Passage	GoM-S						6-year
NSAG	Argyle Sound				GoM-S			6-year
NSBC	Broad Cove	GoM-S						6-year
NSFI	Five Islands						GoM-S	6-year
Windsor	Windsor Area		GoM-S					6-year

*Original benchmark sites that were scheduled for collection during each sampling cycle prior to 2007. GoM-T = Temporal Trend Station , GoM-S = Spatial Trend Station.

2.2 2006 SAMPLING STATIONS

For the most part, the 2006 Gulf of Maine Gulfwatch mussel survey followed the new 12-year sampling design of the Program. The only "benchmark" stations sampled were MECC (Clarks Cove, actually located in ME, but is part of the Great Bay Estuary in NH and thus serves as the "benchmark" site for NH), and MEKN (Kennebeck River site) in Maine. Benchmark stations were selected by the founding Gulfwatch committee, where one location in each jurisdiction would serve to assess baseline conditions in each jurisdiction where little or no contaminant exposure might be expected, or to assess a site with heightened management concern where contamination exposure may be elevated. These sites continue to be monitored with relatively high temporal frequency (almost every year since the inception of the Program) to provide highly resolved temporal data for trend analyses. These "benchmark" sites are now referred to as "trend" sites. All of the other sites visited in 2006 have now been sampled more than four times and provide an additional source of data for further temporal/trend analyses. A total of 15 stations were sampled in 2006, including two additional sites (MACG and MACJ)

sampled in Massachusetts. The Massachusetts sites were added to evaluate potential contamination from direct discharge of municipal wastewater to the coastal waters of Cohasset Harbor and help address concerns raised by the local board on harbor health. In addition, two sites in New Hampshire (NHDP and NHHS) were sampled as part of the New Hampshire Gulfwatch Program and are included with the Gulfwatch Program annual data sets. The Outer Brewster Island site in Massachusetts (MABI) was not sampled as scheduled due to complications in reaching the remote harbor island but it is expected to be included in the 2007 sampling season. Also scheduled for sampling, but not collected, was the Royal River site in Maine (MERY). The Windsor area in Nova Scotia was to be sampled in 2006 under the new sampling design but sampling was not possible because a suitable mussel bed site remains to be identified. The stations sampled during the 2006 season are presented in Table 2 with reference to site locations shown in Fig. 1.

2.3 FIELD AND LABORATORY PROCEDURES

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

Field sampling occurred between October and mid-December (Appendix A, Table A.1). Mussels were collected from four discrete areas within a short stretch of shoreline to be representative of the mussel bed(s) at each site. Using a polycarbonate gauge or a ruler, four (4) replicates, each consisting of 45-50 mussels having shell lengths within the range of 50-60 mm, were placed in field containers and transported in coolers with ice packs to labs for processing. One half of those mussels predestined for organic analysis were wrapped in pre-combusted aluminum foil prior to placing in field containers. Mussels were not depurated prior to processing.

TABLE 2. Gulfwatch stations visited during the 2006 sampling year.

Jurisdiction	Site Code	**Site Name**	**Site Type**	**West Longitude (decimal degrees)**	**North Latitude (decimal degrees)**
Massachusetts					
	MACJ	Cohasset Harbor	Expanded GW	70.7874	42.2428
	MACG	Cohasset Gulf River	Expanded GW	70.7895	42.2384
	MAME	Merrimack Estuary	MA Trend	70.8208	42.8165
New Hampshire					
	NHHS	Hampton/Seabrook Harbor	NH Trend	70.8163	42.8972
	NHSM	South Mill Pond	6-year rotation	70.7489	43.0729
	NHDP	Dover Point	NH Trend	70.8267	43.1196
	NHSS	Schiller Station	6-year rotation	70.7907	43.1018
	MECC	Clark's Cove	NH Trend	70.7244	43.0774
Maine					
	MEBH	Brave Boat Harbor	6-year rotation	70.6597	43.1007
	MEKN	Kennebec River	ME Trend	69.7850	43.7850
	MEBB	Boothbay Harbor	ME Trend	69.6259	43.8513
New Brunswick					
	NBLB	Limekiln Bay	6-year rotation	66.4880	45.0345
	NBSC	St. Croix	NB Trend	67.0965	45.1002
Nova Scotia					
	NSYR	Yarmouth	NS Trend	66.8440	43.8180
	NSAR	Apple River	NS Trend	64.8350	45.4700

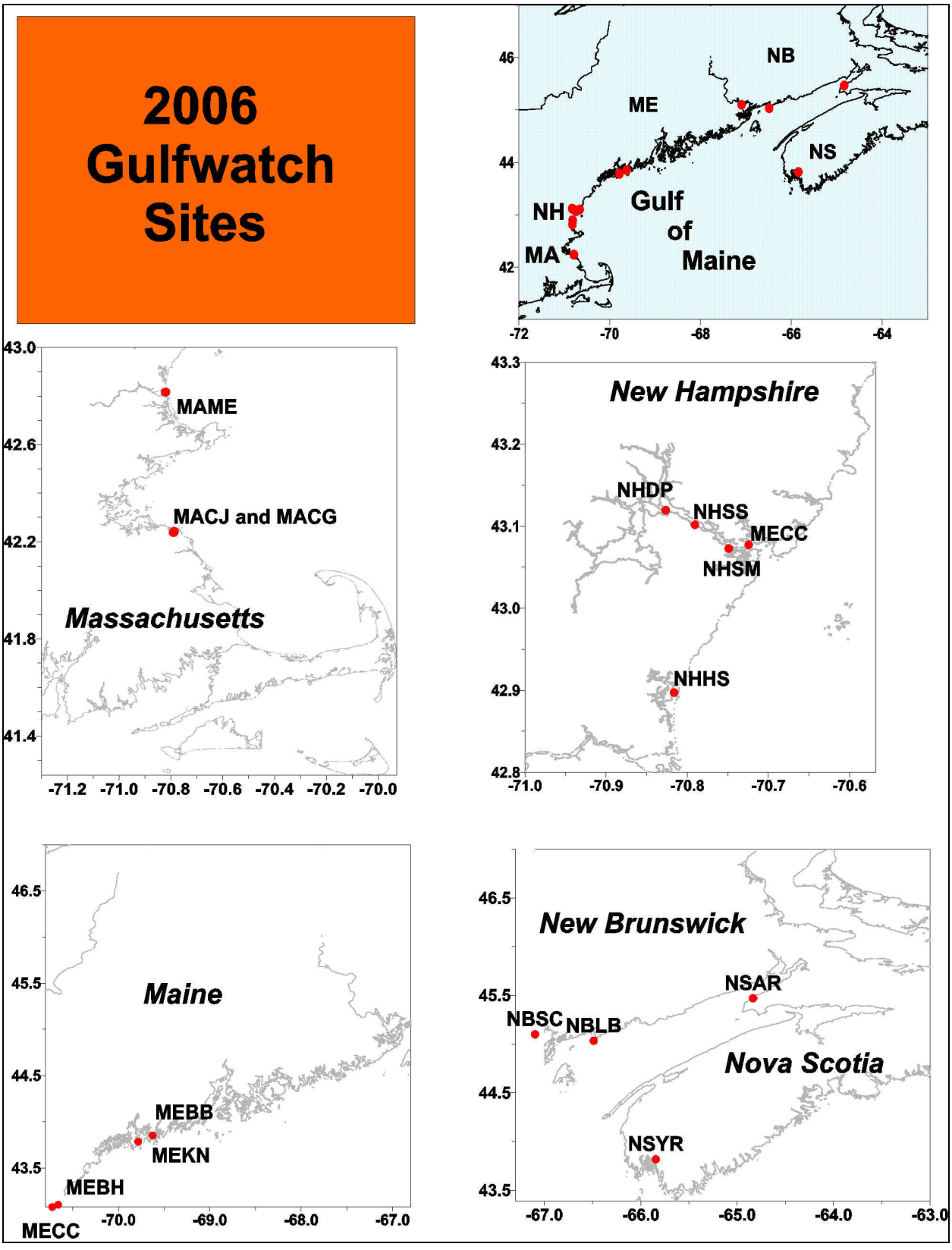

Figure 1. Locations along the Gulf of Maine of Gulfwatch sampling sites, 2006.

From each replicate (typically 4 for each Gulfwatch station), soft tissue from 20 mussels were combined to form a composite for trace metals and an additional 20 for the analyses of organic contaminants. Mussels were washed with deionized water in the laboratory while removing any loose external growth, sediment, and debris. If tissue sample processing was not logistically possible within 24 hours of sampling, excess seawater was drained from their mantles with either plexiglass or stainless steel spatulas and samples were frozen for later processing of metals or organics, respectively. Individual mussels were measured to the nearest 0.1mm for length (anterior umbo to posterior growing lip) and their soft tissue removed and combined in their respective organic or metals composite. In addition to shell length, shell height, width (mm), and soft tissue wet weight (to the nearest 0.01g) measurements were typically performed on three (3) subsets of ten mussels destined for the metal analysis composite for determining Condition index (CI). The CI is calculated using the following formula (after Seed, 1968):

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

All samples for trace metal and organic contaminant analyses were placed in pre-cleaned or quality-assured bottles (see Sowles et al., 1997). These composite samples (20 mussels/composite; 4 composites/station) were capped, labelled and stored at -15°C for 3-6 months prior to analysis. Gulfwatch sample identification numbers, field replicates, species, and dates collected are summarized in Appendix A.

2.4 ANALYTICAL PROCEDURES

Analytical procedures followed those reported for the previous years (Sowles et al., 1997). An overview of the analytical methods used for the 2006 samples for both organic and inorganic analytes is detailed below. Table 3 contains a summary of trace metal and organic compounds determined from tissue samples of collected organisms.

2.4.1 Metals

Samples collected during 2006 for metals were analyzed by Battelle Marine Sciences Laboratory (MSL, Sequim, WA). The samples were analyzed for the requisite ten metals: silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn).

Digested samples were analyzed for Hg by cold-vapor atomic absorption spectroscopy (CVAA) according to Battelle SOP MSL-I-016 *Total Mercury in Tissues and Sediments by Cold Vapor Atomic Absorption*, which is based on EPA Method 245.6 *Determination of Mercury in Tissue by Cold Vapor Atomic Absorption Spectrometry*. (EPA-approved Clean Water Act analytical test methods are summarized at http://www.epa.gov/waterscience/methods/. Digested samples were analyzed for Al, Cr, Cu, Fe, Ni, and Zn using inductively coupled plasma optical emissions spectroscopy (ICP-OES) according to Battelle SOP MSL-I-033 *Determination of Elements in Aqueous and Digestate Samples by ICP-OES*. This procedure is based on two methods (EPA Method 6010B and 200.7) modified and adapted for analysis of low level samples. Digested samples were analyzed for Ag, Cd, and Pb using inductively coupled plasma-mass spectrometry (ICP-MS) according to Battelle SOP MSL-I-022, *Determination of Elements in Aqueous and Digestate Samples by ICP/MS*. This procedure is based on two methods modified and adapted for analysis of low-level solid sample digestates: EPA Method 1638, *Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma-Mass Spectrometry* and EPA Method 200.8, *Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma – Mass Spectrometry*. The MSL reported MDLs (µg/g dry weight) were as follows; Ag, 0.01; Cd, 0.01; Cr, 0.1; Cu, 0.1; Fe, 0.5; Hg, 0.005; Ni, 0.05; Pb, 0.02; and Zn, 0.6; Al, 1.3. A summary of method detection limits and reporting limits are further presented in Appendix B. A copy of the MSL QA/QC report is reprinted in end of Appendix C (§ C5).

2.4.2 Organic Contaminants

Organic contaminants in mussel samples were analyzed at the Environment Canada Atlantic Environmental Science Centre in Moncton, New Brunswick. The analyte detection limits ranged from 4 -15 ng/g for polycyclic aromatic hydrocarbons and from 1-4 ng/g for PCB congeners and chlorinated pesticides (Appendix B). Eighteen of the PCB congeners identified and quantified correspond to congeners monitored by the U.S. National Oceanographic and Atmospheric Administration's (NOAA) National Status and Trends (NS&T) Program. Other organic compounds (i.e., PAH and organochlorine compounds) selected for analysis are also consistent, for the most part, with NOAA National Status and Trends mussel monitoring (NOAA, 1989).

TABLE 3. Inorganic and organic compounds analyzed in mussel tissue from the Gulf of Maine, 2006.

INORGANIC CONTAMINANTS	
Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn	
ORGANIC CONTAMINANTS	
Aromatic Hydrocarbons(ΣPAH_{24})	***Chlorinated Pesticides($\Sigma PEST_{21}$)***
Naphthalene	Hexachlorobenzene (HCB)
1-Methylnaphthalene	γ-Hexachlorocyclohexane (γ-HCH)
2-Methylnaphthalene	α-Hexachlorocyclohexane (α-HCH)
Biphenyl	Heptachlor
2,6-Dimethylnaphthalene	Heptachlor epoxide
Acenaphthylene	Aldrin
Acenaphthalene	cis-Chlordane
2,3,5-Trimethylnaphthalene	γ-Chlordane
Fluorene	trans-Nonachlor
Phenanthrene	Dieldrin
Anthracene	α-Endosulfan
1-Methylphenanthrene	β-Endosulfan
Fluoranthene	Endrin
Pyrene	Metoxychlor
Benz [a] anthracene	Mirex
Chrysene	
Benzo [b] fluoranthene	***DDT and Homologues (incl. in $\Sigma PEST_{21}$)***
Benzo [k] fluoranthene	2,4'-DDE 4,4'-DDE
Benzo [e] pyrene	2,4'-DDD 4,4'-DDD
Benzo [a] pyrene	2,4'-DDT 4,4'-DDT
Perylene	
Indeno [1,2,3-cd] pyrene	***PCB Congeners (ΣPCB_{24})***
Dibenz [a,h] anthracene	PCB 8+5, PCB 18+15, PCB 28, PCB 29,
Benzo [g,h,I] perylene	PCB 44, PCB 50, PCB 52, PCB 66+95, PCB 77, PCB 87, PCB 101+90, PCB 105, PCB 118, PCB 126, PCB 128, PCB 138, PCB 153+132, PCB 169, PCB 170+190, PCB 180, PCB 187, PCB 195+208, PCB 206, PCB 209

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

2.4.3 Ancillary parameters

Ancillary measurements and determinations from each site included as part of the annual Gulfwatch mussel monitoring are:

- individual shell length,;
- a subset (~30) of individual wet tissue mass and respective shell width and height; for calculating condition indices (CI);
- moisture content of tissue composites; and
- percent lipid content of tissue composites.

A discussion of measurements of shell morphology and individual wet tissue mass was previously presented (§ 2.3). Moisture content (reported here as percent solids) was determined gravimetrically at the Battelle lab for each replicate composite either by freeze- or oven-drying. Briefly, a tissue sub-sample (~5-20 g) is placed in a drying oven (at 105^{o}C) and monitored after a minimum of 8 hrs, placed in a dessicator, allowed to reach room temperature, and weighed. This process is continued until a constant weight is observed. For freeze-drying, the sub-sample is frozen to -68 ^{0}C for 2-4 days and periodically weighed until a constant weight is observed. Percent moisture is determined from the ratio of dry to wet weight of tissue.

Lipid content in tissue samples was determined gravimetrically. Briefly, a sub-sample (~15 g) of each tissue sample was extracted with three portions of dichloromethane. The combined solvent extract was then distilled down to a calibrated volume of 6 mL from which 1 mL was quantitatively removed and placed in a tared aluminum dish. The dish was then placed in a clean environment for solvent evaporation. The remaining residue represents one sixth (1/6) of the Total Extractable Organics (TEO) in the original sample. After a constant weight of the

residue was observed, the lipid content was determined from the ratio of dry to wet weight of the initial sample that was used in the organic chemical analyses. Lipid-normalized concentrations of organic compounds minimize variation due to fat storage in the mussels. Here we report these observations as percent lipids (or TEO).

Thus, TEO is calculated as follows: weight in grams of the residue (Wt_R) multiplied by six (for the correction of the 1/6 aliquot taken), divided by the dry weight of the sample extracted (Wt_{Dry}), and then multiplied by one hundred:

$$\%TEO = 6\ Wt_R/Wt_{Dry} * 100$$

2.5 QUALITY ASSURANCES / QUALITY CONTROL

Standard operating procedures for the analysis of mussel samples and related laboratory quality control performance criteria are described in *Gulfwatch Project Standard Procedures: Field and Laboratory* (Sowles et al., 1997). Quality assurance (QA) provisions described in the manual serve as a guide for generating acceptable analytical data by the Gulfwatch program. The quality control (QC) results, when compared to Gulfwatch data quality objectives, also present data users with measures of accuracy and precision when comparing among annual Gulfwatch monitoring results as well as a comparative measure for other environmental contaminant monitoring programs.

Appendix C contains the trace metal contaminant QC sample results and a brief QA/QC summary for the 2006 Gulfwatch samples, and Appendix D contains the organic contaminant QC sample results and summary for the 2006 Gulfwatch samples. Laboratory QC measures reported in Appendices C and D include procedural blanks, duplicate sample analyses, contaminant surrogate sample spikes, sample matrix spikes, and the analysis of certified reference material. The analytical organic laboratory performance of the 2005 National Institute of Standards and Technology organic contaminants inter-calibration exercise (Schantz et al., 2006) was previously summarized in the Gulfwatch 2005 Data Report.

2.6 STATISTICAL METHODS AND DATA ANALYSIS

Total PAH (ΣPAH_{24}), total PCB (ΣPCB_{24}) and total chlorinated pesticides ($\Sigma PEST_{21}$) values were calculated from the sum of all individual compounds or congeners that had values greater than the detection limit for the compound. Beginning in 2002, Gulfwatch included four

additional pesticides (α-HCH, γ-Chlordane, endrin, and metoxychlor) in the analyses of organic contaminants. Total DDT (ΣDDT_6) is the sum of 2,4-DDT and 4,4-DDT and homologues (2,4-DDE, 4,4-DDE, 2,4-DDD and 4,4-DDD). Several tissue samples for metals and organics were below the detection level. Variables in which all replicate measurements were below the detection limit were treated as zero and recorded as not detected (ND). However, if at least two of the replicates were greater than the detection limit, then the other replicates were treated as having a value equal to ½ the method detection limit (MDL) for simple statistical computations.

From each site, arithmetic means, standard deviations (SD), and geometric means were calculated for all metal and organic contaminants. Analytical replicates (e.g., repeat analyses of a field replicate) were not used in the computation of the above statistical parameters. Graphs of the mean concentrations (±SD) are presented for all stations sampled. Gulfwatch data are compared with *M. edulis* data from NOAA's NS&T Mussel Watch Program in the following section. The medians and 85th percentiles for the Gulf of Maine have been calculated to allow comparison of Gulfwatch results with other 'mussel watch' programs. The 85th percentiles are taken to represent "high" concentrations (O'Connor and Beliaeff, 1995; Cantillo,1998; Lauenstein et al., 2002). Gulfwatch considers "elevated" criteria as mean values equal to or greater than the NS&T national 85th percentile. For interpretive purposes, Clark Cove, Maine (MECC) serves as the trend (benchmark) site for the group of New Hampshire sites because of its location in the Great Bay / Piscataqua River watershed and, therefore, is more comparable to the sites in New Hampshire. Gulfwatch mean data for the stations sampled in 2006 are summarized beginning from 1993 in graphic form, along with all annual data for the 5 trend sites, in order to help evaluate potential temporal trends and spatial extent of contaminant exposure along the rim of the Gulf of Maine.

3.0 RESULTS AND DISCUSSION

3.1 2006 FIELD OPERATIONS AND LOGISTICS SUMMARY

Mytilus edulis samples were collected at 15 sites in 2006. As mentioned in the previous section, several "trend" stations along the Gulfwatch region have now been visited annually from 1993-2006 and many of the "Rotational" sites have now been revisited at least four (4) times over the duration of the program (Table 4). Two additional sites were sampled in the Cohasset, Massachusetts (MACJ and MACG) during 2006 for targeted issues of local concern (See http://www.mass.gov/envir/massbays/). Mussels from each station - at four (4) locations within each site - were collected and processed (prepared soft tissue composites of each station replicate; measured for linear dimensions and wet weight for the determination of Condition Index) by volunteers from each jurisdiction. (See § 2.3.). Because of limited number of organisms within the appropriate size class (50-60 mm) at the Merrimack estuary site in MA, only three replicates for metals analysis were collected. All 2006 tissue composites were frozen and delivered to the University of New Hampshire prior to shipping to the analytical laboratories. (Note, the Canadian samples destined for organic analyses were delivered directly to Environmental Canada in Moncton, since the 2006 organic analyses were performed there.) Appropriate field and initial sample preparation information from each jurisdiction were forwarded to the Program Coordinators shortly after sample collection and composite preparations.

3.2 TRACE METAL CONCENTRATIONS

Table 5 contains the metal concentrations summaries (geometric and arithmetic means ± SD, µg/g dry weight) for mussels from all site composites taken in 2006. All summary statistics were generated using the field replicate values. In most cases there were four field replicates taken from each site. Metal analytes were detected in all samples. Metal concentrations in mussel tissue of each individual composite sample (field replicates) are further detailed in Appendix E.

In addition, metal concentrations for all mussels are also reported as medians (MD) and the 85th percentile (85th P) in Table 6 to allow for a program-level comparison with NOAA NS&T concentrations. Table 7 provides the median and the 85th percentile data of the national Mussel Watch data from the years 1991 through 1996 (O'Connor, 1998; http://ccmaserver.nos.noaa.gov/). Most of the summarized Gulfwatch metals concentrations were

comparable to the NS&T MD and 85th P summary data, with the exception of some of the samples for Pb and Hg. Pb and Hg are thought to have a significant atmospheric component to their loading to the Gulf of Maine, and remain typically elevated in Gulfwatch samples, as in previous years, when compared to NOAA NS&T data.

TABLE 4. List of Stations sampled in 2006 along with the years previously visited.

Massachusetts	Site Name	Years Sampled: 1993 - 2005
MACG	Cohasset Gulf River	2006
MACJ	Cohasset Harbor Jetty	2006
MAME	Merrimack Estuary	1993, 1996, 1999, 2002, 2006
New Hampshire		
NHHS	Hampton/Seabrook Harbor	1993, 1995, 1996, 1999-2006
NHSM	South Mill Pond	1999, 2001, 2003, 2006
NHSS	Schiller Station	1998, 2000, 2001, 2002, 2006
NHDP	Dover Point	1994, 1996$^{\perp}$, 1997, 1998, 2000-2006
MECC	Clarks Cove ME	1993 -2006
Maine		
MEBH	Brave Boat Harbor	1993 – 2002, 2006
MEKN	Kennebec River	1993 – 2004, 2006
MEBB	Boothbay Harbor	1998, 2004, 2006
New Brunswick		
NBSC	St. Croix	1993, 1996, 1999, 2002, 2006
NBLB	Limekiln Bay	1994, 1997, 1998, 2000, 2003, 2006
Nova Scotia		
NSAR	Apple River	1994, 1997, 2000, 2002, 2003, 2006
NSYR	Yarmouth	1993, 1996, 1999, 2002, 2004, 2006

TABLE 5. Summary of tissue metal concentrations (µg g^{-1} dry wt) for Gulfwatch mussels in 2006. The arithmetic mean ($M_A \pm SD$) and geometric mean (M_G) of all indigenous mussels is given; (n=4 replicates/sample). All summary statistics were computed from all individual replicate data points.

Site		Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
MACG	$Mean_A$	0.070	1.65	1.67	8.53	454	1.29	4.23	106	383	0.247
	SD	0.006	0.25	0.13	0.78	46	0.10	0.93	9	17	0.005
	$Mean_G$	0.070	1.64	1.67	8.51	452	1.29	4.16	106	383	0.246
MACJ	$Mean_A$	0.074	1.59	1.80	8.28	386	1.36	4.69	113	315	0.238
	SD	0.008	0.11	0.53	0.86	54	0.28	0.68	9	37	0.022
	$Mean_G$	0.073	1.59	1.74	8.24	383	1.34	4.65	113	314	0.237
MAME	$Mean_A$	0.063	1.37	1.77	6.94	362	1.12	2.98	84	238	0.140
	SD	0.004	0.11	0.20	0.15	60	0.22	0.71	5	38	0.005
	$Mean_G$	0.063	1.37	1.76	6.94	359	1.11	2.93	84	236	0.140
NHHS	$Mean_A$	0.042	1.86	1.25	6.79	357	1.05	1.79	97	466	0.118
	SD	0.007	0.30	0.18	0.31	48	0.24	0.52	9	81	0.017
	$Mean_G$	0.041	1.84	1.24	6.79	355	1.03	1.74	97	461	0.117
NHSM	$Mean_A$	0.057	2.21	2.41	8.69	522	1.78	15.9	172	491	0.367
	SD	0.006	0.26	0.13	0.18	31	0.03	1.2	30	48	0.032
	$Mean_G$	0.056	2.20	2.41	8.69	521	1.78	15.8	170	489	0.366
NHSS	MeanA	0.040	2.00	2.10	6.42	529	1.76	2.35	109	450	0.303
	SD	0.004	0.06	0.18	0.19	84	0.01	0.08	7	43	0.016
	MeanG	0.040	2.00	2.10	6.42	524	1.76	2.35	109	448	0.303

Table 5 (continued)

Site		Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
NHDP	$Mean_A$	0.042	2.12	2.46	7.30	384	1.63	2.14	100	383	0.251
	SD	0.003	0.22	0.49	0.62	62	0.22	0.45	7	69	0.031
	$Mean_G$	0.042	2.11	2.42	7.28	380	1.62	2.10	100	379	0.249
MECC	$Mean_A$	0.034	2.52	2.53	7.12	449	1.73	3.14	111	437	0.287
	SD	0.003	0.11	0.30	0.57	93	0.18	0.81	7	133	0.024
	$Mean_G$	0.034	2.52	2.51	7.10	441	1.72	3.06	111	420	0.286
MEBH	$Mean_A$	0.125	1.85	1.82	5.99	477	1.30	1.58	87.6	507	0.128
	SD	0.028	0.21	0.62	0.07	201	0.19	0.32	7.3	220	0.016
	$Mean_G$	0.122	1.84	1.74	5.98	447	1.29	1.56	87.4	464	0.127
MEKN	$Mean_A$	0.054	2.07	1.60	6.15	404	1.03	1.40	60.9	313	0.173
	SD	0.007	0.38	0.27	0.43	81	0.13	0.27	3.1	49	0.032
	$Mean_G$	0.054	2.04	1.58	6.14	398	1.02	1.38	60.8	310	0.171
MEBB	$Mean_A$	0.018	1.07	1.14	10.8	317	0.69	12.8	156	238	0.241
	SD	0.007	0.11	0.04	1.4	24	0.04	3.4	15	24	0.012
	$Mean_G$	0.017	1.06	1.13	10.7	316	0.69	12.5	155	237	0.241
NBSC	$Mean_A$	0.055	1.99	1.44	5.98	457	1.16	1.15	86	392	0.172
	SD	0.018	0.25	0.15	0.99	48	0.13	0.12	7	42	0.025
	$Mean_G$	0.053	1.98	1.44	5.92	455	1.16	1.15	86	390	0.170
NBLB	$Mean_A$	0.018	2.51	1.82	6.24	530	1.15	2.60	113	494	0.162
	SD	0.001	0.40	0.19	0.22	71	0.16	0.49	6	64	0.031
	$Mean_G$	0.018	2.48	1.81	6.23	526	1.14	2.56	113	491	0.160
NSAR	$Mean_A$	0.041	3.01	2.51	6.78	924	2.53	1.67	85.5	1279	0.214
	SD	0.007	0.42	0.17	0.17	124	0.15	0.24	5.0	269	0.018
	$Mean_G$	0.041	2.99	2.51	6.78	918	2.53	1.66	85.4	1259	0.214
NSYR	$Mean_A$	0.138	1.69	1.77	6.62	570	1.43	2.94	96	364	0.217
	SD	0.035	0.16	0.16	0.22	87	0.14	0.37	7	71	0.018
	$Mean_G$	0.135	1.69	1.76	6.62	565	1.43	2.92	96	360	0.216

TABLE 6. Gulf of Maine Median (using the means of field replicates for each site)/85th Percentile values; 2003-2006.

		Ag	Cd	Cr	*Cu	Fe	Ni	Pb	Zn	Al	Hg
2003	**Median**	0.07	1.5	2.1		407	1.7	2.2	71	375	0.14
	85th P	0.13	1.9	3.5		708	2.3	4.7	105	617	0.26
2004	**Median**	0.06	1.7	1.8	7.2	521	1.7	2.6	83	490	0.14
	85th P	0.11	2.0	2.6	8.9	858	1.9	6.2	108	635	0.30
2005	**Median**	0.05	2.0	1.8	6.6	503	1.4	2.2	116	433	0.16
	85th P	0.08	2.5	2.4	7.8	758	1.6	4.0	132	666	0.33
2006	**Median**	0.05	2.0	2.6	1.8	457	6.9	1.3	100	437	0.22
	85th P	0.07	2.5	4.6	2.5	529	8.6	1.8	113	505	0.28

*GULFWATCH Cu values for 2003 were reanalyzed in 2006 and are not reported here. (The 2003 Cu and Cd were suspected contamination due to sample processing and/or storage container artifacts as indicated by analytical laboratory notes and unusually high variances of the analyses of field replicates. The results of the metal reanalysis of the 2003 data will be reported in its entirety at a later date.)

TABLE 7. Median metal concentrations (and 85th percentile) reported by the NOAA National Status & Trends program (1991-1996). Also given are the 2002/2003 national median values for select metals reported in O'Connor and Lauenstien, 2006. NA= not analyzed, NR= not reported.

		Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
NS&T 1991	Median,	0.08	2.3	1.4	8.8	400	2.1	0.8	130	280	0.11
	85th P	0.48	5.4	2.7	11.7	790	3.6	3.6	200	653	0.24
NS&T 1992	Median,	0.09	2.1	1.4	8.6	338	2.1	0.7	120	210	0.10
	85th P	0.55	4.5	3.5	10.1	690	3.9	2.3	170	510	0.23
NS&T 1993	Median,	0.05	2.5	1.2	8.4	340	1.6	0.8	120	120	0.11
	85th P	0.85	4.7	2.7	10.5	673	2.7	2.9	200	280	0.20
NS&T 1994	Median,	0.12	2.0	1.2	8.7	350	1.5	1.0	120	350	0.10
	85th P	0.56	4.3	2.2	10.5	774	2.8	2.7	170	1100	0.21
NS&T 1995	Median,	0.05	2.4	1.8	8.4	607	2.0	0.7	115	480	0.11
	85th P	0.76	4.4	5.2	12.6	1615	3.5	2.4	169	1577	0.23
NS&T 1996	Median,	NA	1.9	1.1	7.3	424	1.6	0.8	102	340	0.11
	85th P	NA	4.2	3.1	9.9	985	3.3	2.4	148	1020	0.20
NS&T 2002/2003	Median,	NR	2.1	NR	8.0	NR	1.8	0.77	110	NR	0.10

Comparison of Gulfwatch annual geometric means of concentrations observed at each station to NOAA NS&T median and 85th P values serves as a measure the region's condition relative to the national level. For comparison, the most recent complete NS&T statistics (from 1996) are used. (For Ag - the 1995 NS&T data are used.) Over half of the sites visited for this reporting period (8 out of 15) had mean lead concentrations that exceeded the Gulfwatch "elevated" criteria (≥ Mussel Watch 85th Percentile) of 2.4 µg Pb g^{-1} dry wt (Table 8). Tissue samples from two of these sites (NHSM and MEBB) were notably more contaminated with Pb (15.8 and 12.5 µg g^{-1} dry wt., respectively). The annual means of mussel lead concentrations from South Mill Pond samples, located in the lower New Hampshire's Great Bay (NHSM) increased since the program began monitoring this site in 1999 (Fig. 18B). In addition, 60% of the stations (9 of 15) visited by Gulfwatch in 2006, resulted in site mean mercury concentrations that exceeded the Gulfwatch elevated criteria of 0.2 µg Hg g^{-1} dry wt. Further, copper was observed at the elevated level of 10.8 µg Cu g^{-1} dry wt in mussels collected from the Boothbay Harbor site in ME (MEBB). This site was also elevated with respect to Zn, Pb, and Hg. The "elevated" levels of aluminum from the upper Bay of Fundy site (NSAR) are associated the gut contents containing re-suspended material due to the large tidal energy of this site.

TABLE 8. Sample means from Gulfwatch sites 2006 that exceeded the NOAA Status & Trends Mussel Watch Program's 1996 national 85th percentile value.

Cu	Pb	Zn	Hg	Al
MEBB	MACG	NHSM	MACG	NSAR
	MACJ	MEBB	MACJ	
	MAME		NHSM	
	NHSM		NHSS	
	MECC		NHDP	
	MEBB		MECC	
	NBLB		MEBB	
	NSYR		NSAR	
			NSYR	

3.3 ORGANIC CONTAMINANTS CONCENTRATIONS

The total concentration (arithmetic mean ± SD and geometric mean, ng/g dry weight) of detectable polynuclear aromatic hydrocarbons (ΣPAH_{22}), polychlorinated biphenyls (ΣPCB_{24}), and organochlorine pesticides ($\Sigma PEST_{21}$) measured in indigenous blue mussel tissue samples collected during 2006 are presented in Table 9. Individual analyte concentrations of each compound class for each field replicate are reported by station and given in Appendix F.

Overall gulf-wide medians (MD) and the 85th percentile of the organic contaminant concentrations for indigenous mussels are also presented to allow for a program-level comparison with NOAA NS&T concentrations (Table 10). However, the Gulfwatch ΣPCB_{24} median is not directly comparable to NOAA's Mussel Watch ΣPCB median values since the NOAA Mussel Watch PCB data are determined from 18 congeners, while Gulfwatch includes an additional 6 congeners in the ΣPCB_{24}. Further, co-eluting congeners (PCB-5, -15, -90, -95, -132, -190, and -208) are not distinguished by the Gulfwatch PCB analyses, and may contribute to some extent to the differences observed in the summary statistics. The Gulfwatch ΣPCB_{18} median and 85th percentile were, however, calculated by summing the 18 common congeners (with those co-eluting congeners) and then multiplying by two (2) to be consistent with the NS&T reporting.

The 2006 Gulfwatch overall average concentrations for summary organic contaminant (PAH, PCB, and chlorinated pesticides) statistics were compared with the 2002/2003 NS&T median values (Table 10). None of the Gulfwatch sites sampled in 2006 exceeded the NS&T 85th percentile summary statistics for PAHs, PCBs, and chlorinated pesticides. Mussel tissue PAH levels at the Boothbay Harbor site in ME (MEBB) were more than twice the NS&T national median and were the highest observed among 2006 samples. PCB levels at the Merrimack estuary site (MAME) exceeded the NS&T national median and were the highest observed among 2006 samples. Massachusetts sites had generally higher organic contaminant exposure relative to the remaining 2006 sites.

TABLE 9. Arithmetic mean (M_A), standard deviation (SD), and geometric mean (M_G) tissue organic contaminant concentrations (ng/g dry weight) from mussels collected by the Gulfwatch Program, 2006. ND = not detected, and NA = not applicable.

Site	Statistic	∑PAH$_{24}$	∑PCB$_{24}$	∑Pest$_{21}$	∑OrgPest$_{15}$	∑DDTs$_6$
MACG	M_A	182	52	46.3	<3	43.4
	SD	38	4	5.2		3.8
	M_G	179	52	46.1		43.3
MACJ	M_A	159	62	37.8	5.5	32.4
	SD	25	5	3.8	2.0	1.9
	M_G	158	62	37.7	5.2	32.3
MAME	M_A	464	172	47.2	19.6	27.6
	SD	145	12	4.7	1.8	3.5
	M_G	445	171	47.0	19.5	27.5
NHHS	M_A	45	13	4.9	<3	4.9
	SD	5	1	0.4		0.4
	M_G	45	13	4.9		4.9
NHSM	M_A	633	42	23.1	<3	21.1
	SD	52	5	1.8		1.1
	M_G	632	42	23.0		21.1
NHSS	M_A	249	29	5.6	<3	3.7
	SD	8	1	0.5		0.2
	M_G	248	29	5.6		3.7
NHDP	M_A	238	32	8.6	<3	6.0
	SD	26	5	1.3		0.7
	M_G	237	32	8.5		5.9
MECC	M_A	141	30	12.8	7.2	5.6
	SD	43	5	5.9	3.6	2.8
	M_G	135	30	11.7	6.1	5.1
MEBH	M_A	<10	<3	3.6	<3	<3
	SD			0.2		
	M_G			3.6		
MEKN	M_A	69	19	5.0	<3	<3
	SD	18	3	0.4		
	M_G	67	19	5.0		

Table 9 (Continued)

Site	Statistic	∑PAH24	∑PCB24	∑Pest21	∑OrgPest15	∑DDTs6
MEBB	M_A	895	42	31.0	4.2	26.8
	SD	81	6	4.5	0.9	4.2
	M_G	893	41	30.8	4.2	26.5
NBSC	M_A	34	19	6.6	3.1	3.5
	SD	5	4	4.1	4.5	0.5
	M_G	33	18	5.9	NA	3.4
NBLB	M_A	24	15	8.8	<3	7.2
	SD	4	5	0.5		0.4
	M_G	24	14	8.7		7.2
NSAR	M_A	15	<3	<3	<3	<3
	SD	10				
	M_G	NA				
NSYR	M_A	116	6	3.4	<3	<3
	SD	44	4	2.0		
	M_G	110	5	3.0		

TABLE 10. Median summary organic contaminant concentrations (and 85th percentile) for the 2002-2006 Gulfwatch samples. NOAA National Status and Trend national summary data (1986-1999 and 2002/2003) provided for comparative purposes. Values are ng g^{-1} dry weight.

	Gulfwatch 2002 Median (85th P)*2*	Gulfwatch 2003 Median (85th P)	Gulfwatch 2004 Median (85th P)	Gulfwatch 2005 Median (85th P)	Gulfwatch 2006 Median (85th P)	NS&T (1986-1999)† National Median (85th P)	NS&T (2002/2003)‡ National Median
ΣPAH_{24}	46 (265)	72 (195)	92 (377)	187 (560)	141 (443)	320 (1100)	220
*ΣPCB_{18}	58 (224)	60 (254)	24 (138)	25 (66)	58 (102)	110 (500)	50
$\Sigma PEST_{21}$	6 (13)	8 (25)	5 (17)	7 (17)	9 (37)	48 (192)	18
ΣDDT_6	6 (12)	5 (15)	4 (14)	7 (13)	6 (27)	31 (140)	13

*$\sum PCB_{18}$ *twice* the sum of concentrations of eighteen congeners (and co-eluting congeners): PCB8, PCB18, PCB28 PCB44, PCB52, PCB66, PCB101, PCB105, PCB118, PCB128, PCB138, PCB153, PCB170, PCB180, PCB187, PCB195, PCB206, and PCB209 computed for comparative purposes with the NOAA Mussel Watch Program (O'Connor, 2002).

† Compiled from O'Connor, 2002

‡Compiled from O'Connor and Lauenstein, 2006

$\sum DDT_6$: The sum of concentrations of DDTs and their metabolites, DDEs and DDDs.

4.0 2006 DISTRIBUTIONS OF CONTAMINANTS IN *MYTILUS EDULIS*

4.1 SPATIAL PATTERNS

Figures 2 through 11 show the concentration of the metals determined in the tissue of *M. edulis* from the 2006 Gulfwatch sampling sites. The data are displayed geographically beginning clockwise around the GOM from Sandwich, Massachusetts, and ending with the southern-most station in Nova Scotia (See Fig. 1 above). Overall, the concentrations of most metals appear relatively evenly distributed around the Gulf of Maine, with no apparent spatial trends and an occasional hot spot of elevated concentrations. Exceptions to this general pattern and further details for individual metals and organic contaminant categories are noted in the following individual sections.

4.1.1 Silver (Ag)

Silver concentrations ranged from 0.018 µg/g dry weight at the Limekiln Bay, NB site (NBLB) to 0.138 µg/g dry weight at the Yarmouth, NS site (NSYR) (Table 5; Figure 2). The 2006 levels were near the NOAA NS&T 1995 median. Higher silver concentrations in sediments and water column samples have been shown to coincide with regions receiving municipal sewage (Sanudo-Wlhelmy and Flegal, 1992; Buchholz ten Brink et al., 1997), and in mussel tissue as measured in this program in previous years at sites influenced by wastewater discharges

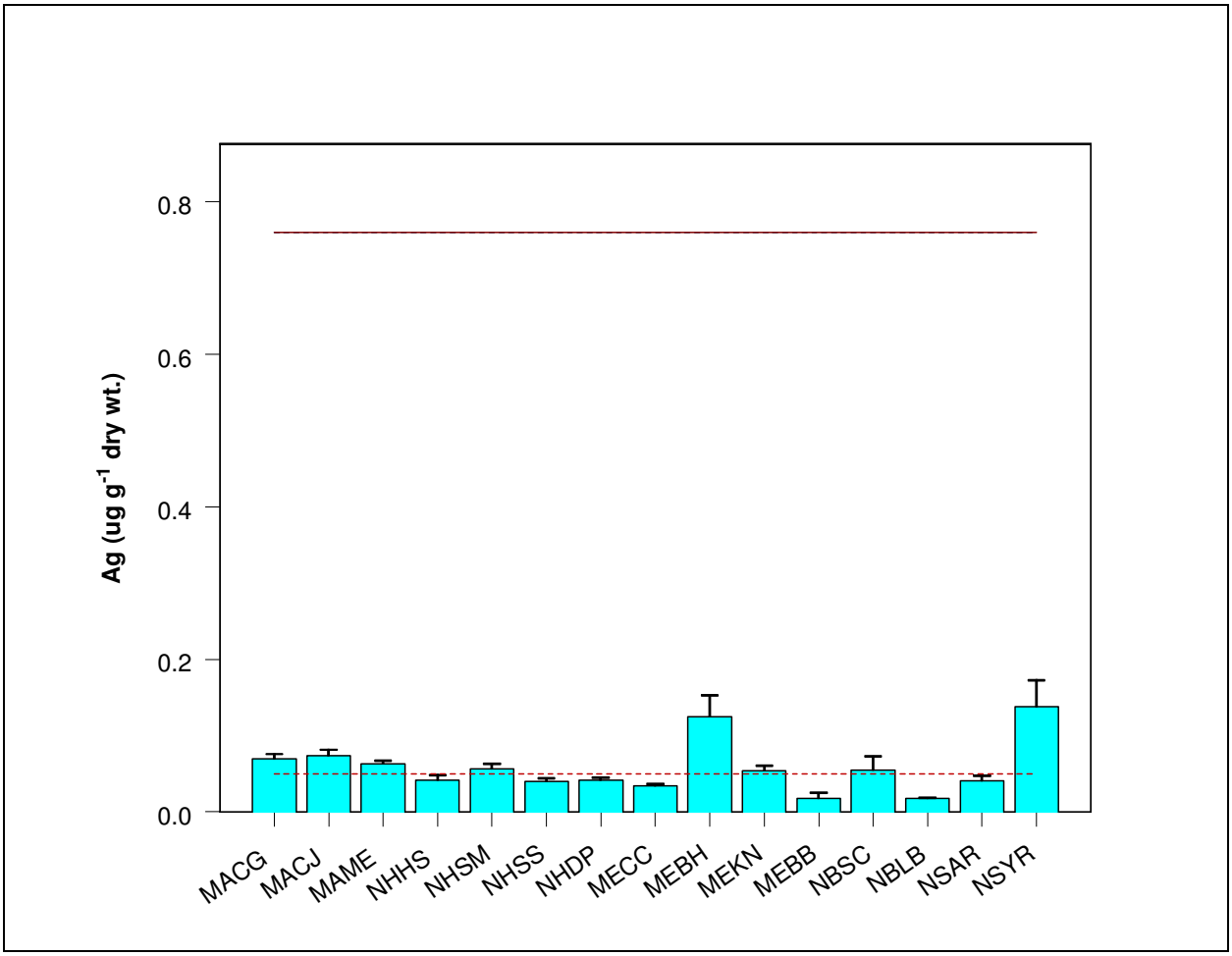

Figure 2. Distribution of silver tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1995 Mussel Watch National median; Solid line = 1995 Mussel Watch 85th Percentile.

4.1.2 Cadmium (Cd)

The concentration of cadmium in mussel tissue ranged from 1.07 µg/g dry weight at Boothbay Harbor, ME (MEBB) to 3.01 µg/g dry weight at the Apple River, NS site (NSAR) (Table 5; Figure 3) and were generally comparable to the 1996 NS&T median. Apple River (NSAR) mussels have the highest concentration that probably resulted from ingestion of re-suspended sediment in a turbid environment. Based on a qualitative examination of the annual means of cadmium concentrations in mussels from NHSM this site seems to show a marked increase since this site was first monitored in 1999 (Fig. 18A). Cadmium was rather uniformly distributed among the Gulfwatch 2006 stations reflecting the influence natural coastal sediments and ubiquitous non-point source pollution may play on Cd bioavailability in marine environments (O'Connor, 2002). Sediments can act as a major pollutant reservoir because metals and other contaminants often bind to the sediments and become bioavailable to the rest of the food chain. Globally, about half of the Cd released to the environment occurs through weathering of rocks and transported by rivers; some Cd is released into air through forest fires and volcanoes. The remaining significant release occurs via human activities, such as manufacturing, fossil fuel combustion (including those from automotive use), and agriculture (Bruland and Lohan, 2004; Bruland and Franks, 1983). Localized sources of Cd from industrial waste associated with the production of batteries, plating, stabilizers, and nuclear energy production may have more importance as sources of exposure for *M. edulis.*

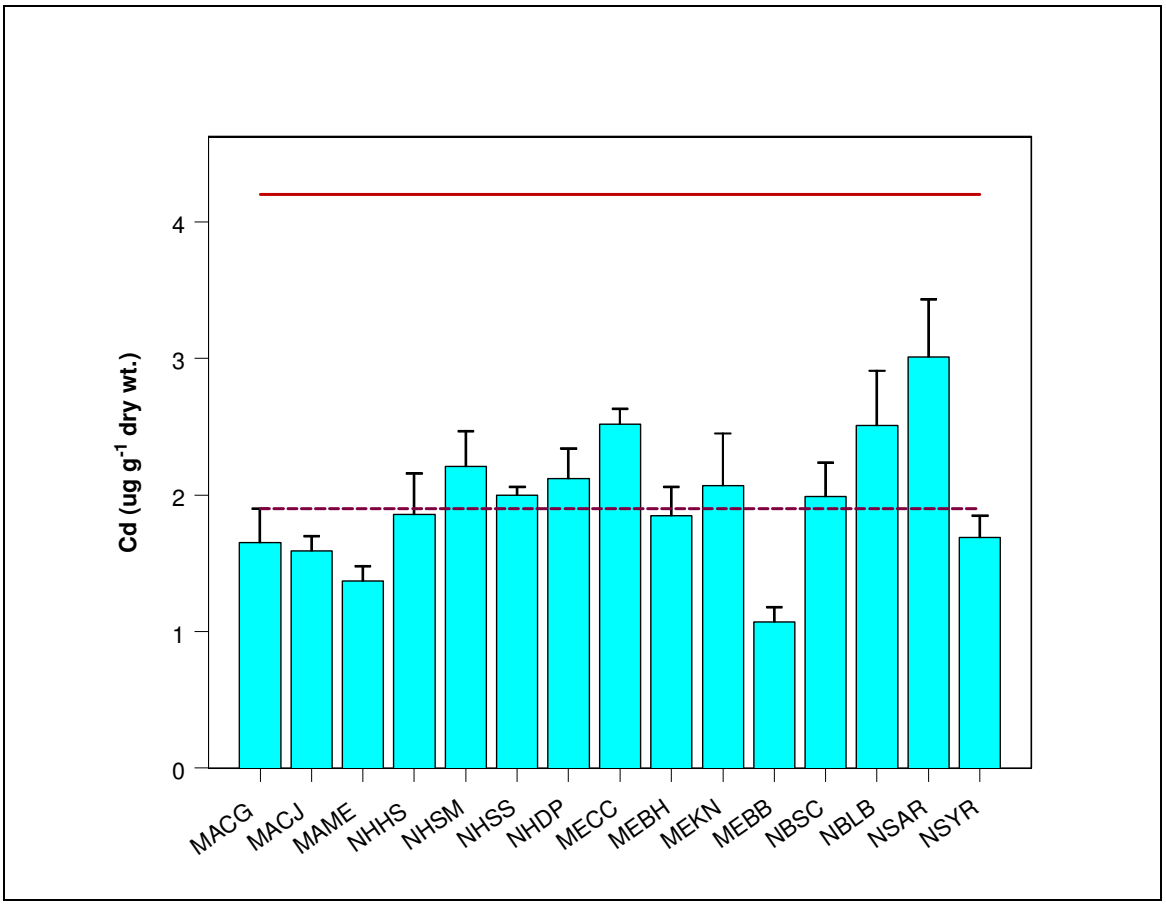

Figure 3. Distribution of cadmium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

4.1.3 Chromium (Cr)

The median chromium concentration in mussel soft tissue for the Gulf of Maine for 2006 was comparable to observations reported for previous Gulfwatch years (~2 µg/g dry weight). No sites visited in 2006 exceeded the national Mussel Watch comparative criteria (NS&T 85th P); however, all sites were above the NS&T national median. The lowest mean concentration observed in 2006 by Gulfwatch (1.14 µg/g dry weight) occurred at the Boothbay Harbor, ME site (MEBB). The highest station mean value (2.53 µg/g dry weight) was observed at Clarks Cove, the NH trend site at the mouth of the Great Bay estuary (MECC). These data are listed in Table 5 and shown below in Figure 4.

Chromium is the primary agent used in tanning processes and discharged with untreated tannery wastes throughout much of the nineteenth and twentieth centuries (Capuzzo, 1974). New Hampshire was one of the leading hide-tanning centers of the United States at that time

(Capuzzo, 1996). Chromium persists in the environment at elevated concentrations in the sediments near such sources (Capuzzo, 1974; NCCOSC, 1997). High Cr concentrations were also observed in coastal sediments along the Gulf of Maine by other investigators (Mayer and Fink, 1990).

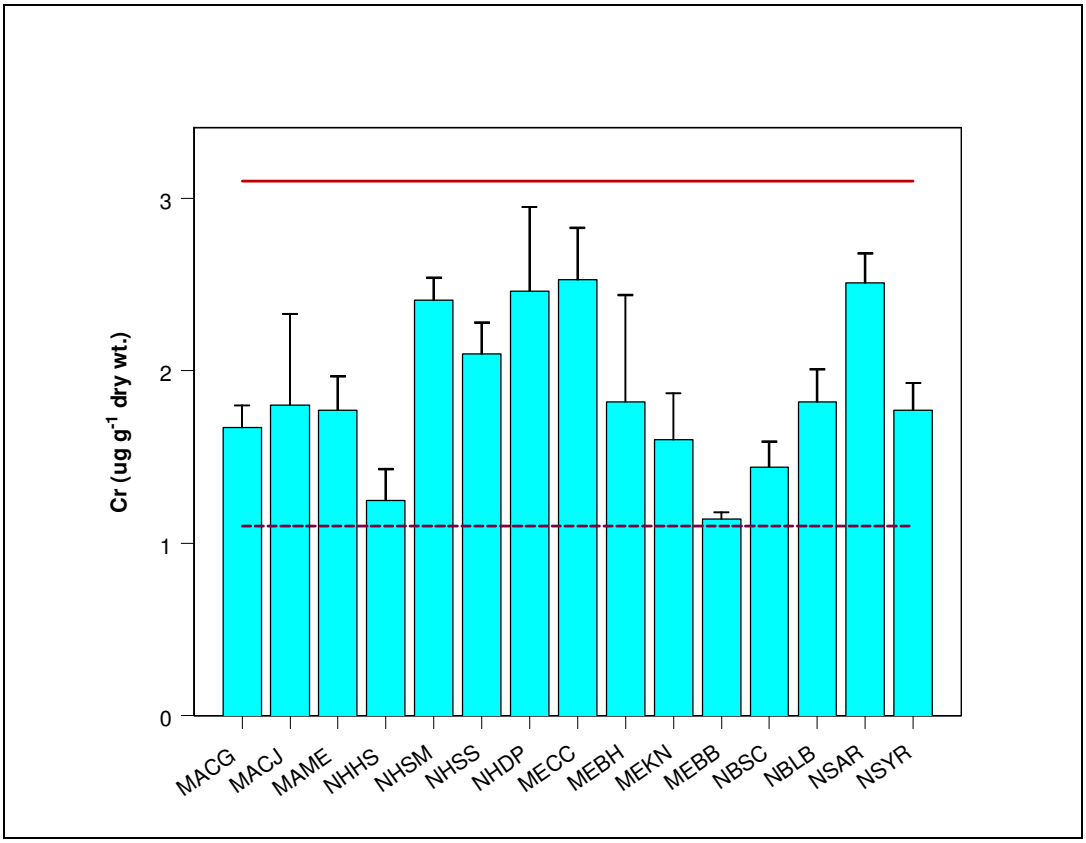

Figure 4. Distribution of chromium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

4.1.4 Copper (Cu)

The 2006 copper concentrations in *M. edulis* ranged from 5.98 µg/g dry wt at the St Croix, NB site (NBSC) to 10.8 µg/g dry wt at the Boothbay Harbor site in ME (MEBB) (Table 5; Figure 5). With the exception of MEBB, Cu levels in 2006 Gulfwatch samples were fairly uniform in distribution throughout the study region. The higher Cu levels observed in blue mussels from Boothbay Harbor (MEBB) exceeded the NS&T 1996 85th percentile, consistent with previous Gulfwatch observations for this site (see Fig. 22A).

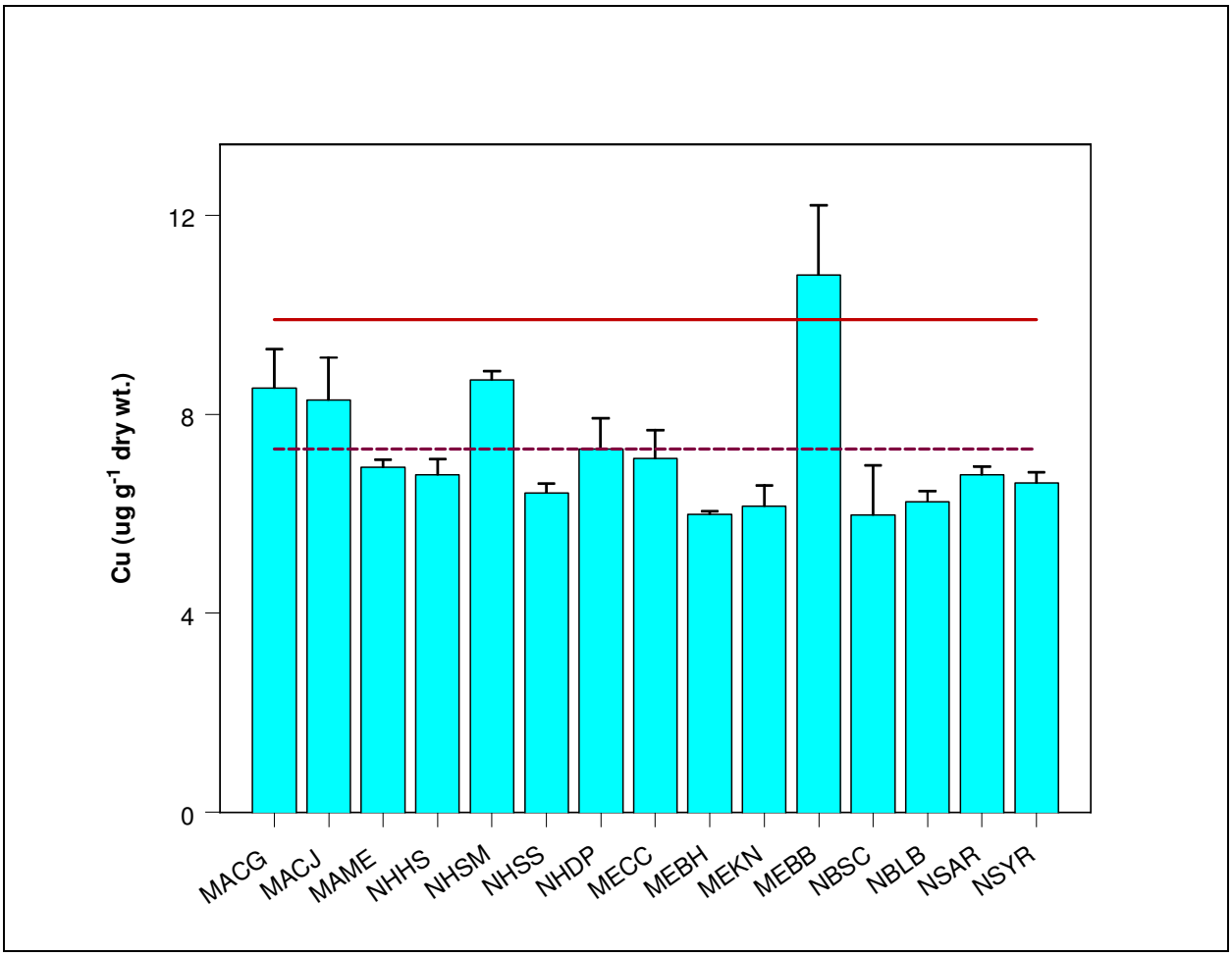

Figure 5. Distribution of copper tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

4.1.5 Iron and Aluminum (Fe & Al)

For 2006, the highest concentrations for both iron and aluminum were generally found at the Apple River, NS site (Table 5; Figures 6 and 7). Mean concentrations of Fe ranged from 317 µg/g dry weight at MEBB to 924 µg/g dry wt at NSAR. The site mean concentrations for Al ranged from 238 µg/g dry wt at both MAME and MEBB to 1279 µg/g dry wt at NSAR. This site was above the NS&T national 85th percentile for aluminum. The 2006 sites with the lowest and highest Fe concentrations generally agreed with samples from previous years at these same sites. High aluminum and iron values are the result of excessive ingestion of re-suspended particulates at the tidally energetic Apple River site as shown previously with gut depuration experiments from both the Apple River (NSAR) and Five Islands (NSFI) sites.

Because of their high abundance in crustal material (Wedepohl, 1995), Al and Fe may or may not represent bioaccumulated anthropogenic levels since the sediment-associated metals could be attached to mussel tissue or contained within mussel's gut and not necessarily

"bioaccumulate" (i.e. become incorporated within the soft tissue). Sites where winds and intensive tidal energy often occur, such as the Bay of Fundy, could yield higher crustal material incorporated with the analyses reflecting greater sediment re-suspension of crustally derived material. Aluminum values may prove valuable for correcting metal concentrations in mussel tissue to better evaluate exposure of *M. edulis* to contamination. Thus, the crustal signal is derived from elemental ratios relative to Al. The element/Al crustal ratios can then be used and compared to the Al-normalized metal data. However, before normalizing the data to Al, the method recoveries from standard reference materials needs to be evaluated. Al is one of the more recalcitrant elements in many analytical digestion methods.

4.1.6 Nickel (Ni)

Nickel levels in 2006 Gulfwatch samples appear uniformly distributed in the Gulf of Maine region, with the exception of NSAR. The concentration of site means for nickel ranged from 0.69 µg/g dry wt at MEBB to 2.53 µg/g dry wt at NSAR (Table 5; Figure 8). Higher levels of Ni observed at Apple River (NSAR) are related, in a similar fashion as Al and Fe, to the gut contents in a tidally energetic region.

4.1.7 Lead (Pb)

All sites visited were also above the NS&T 1996 National median value of 0.8 ug/g dry wt. Site mean Pb concentrations ranged from a low value of 1.15 µg/g dry wt at NBSC to 15.9 µg/g dry wt at NHSM (Table 5, Figure 9). Over half the sites (8/15) visited by Gulfwatch were considered elevated for Pb, i.e., above the NS&T 1996 85^{th} P = 2.4 µg Pb/g dry wt. Lead levels at NHSM and MEBB (12.8 µg/g dry wt) appear well above the Gulfwatch elevated criteria. Samples from the South Mill Pond site in the Portsmouth Harbor (NHSM) have seen a four-fold increase in Pb levels since it was first monitored in 1999 (See Fig. 18B, top left panel), a result that warrants further investigation. In contrast, the elevated Pb levels observed at MEBB are consistent with earlier Gulfwatch monitoring results (Fig. 22B, top left panel).

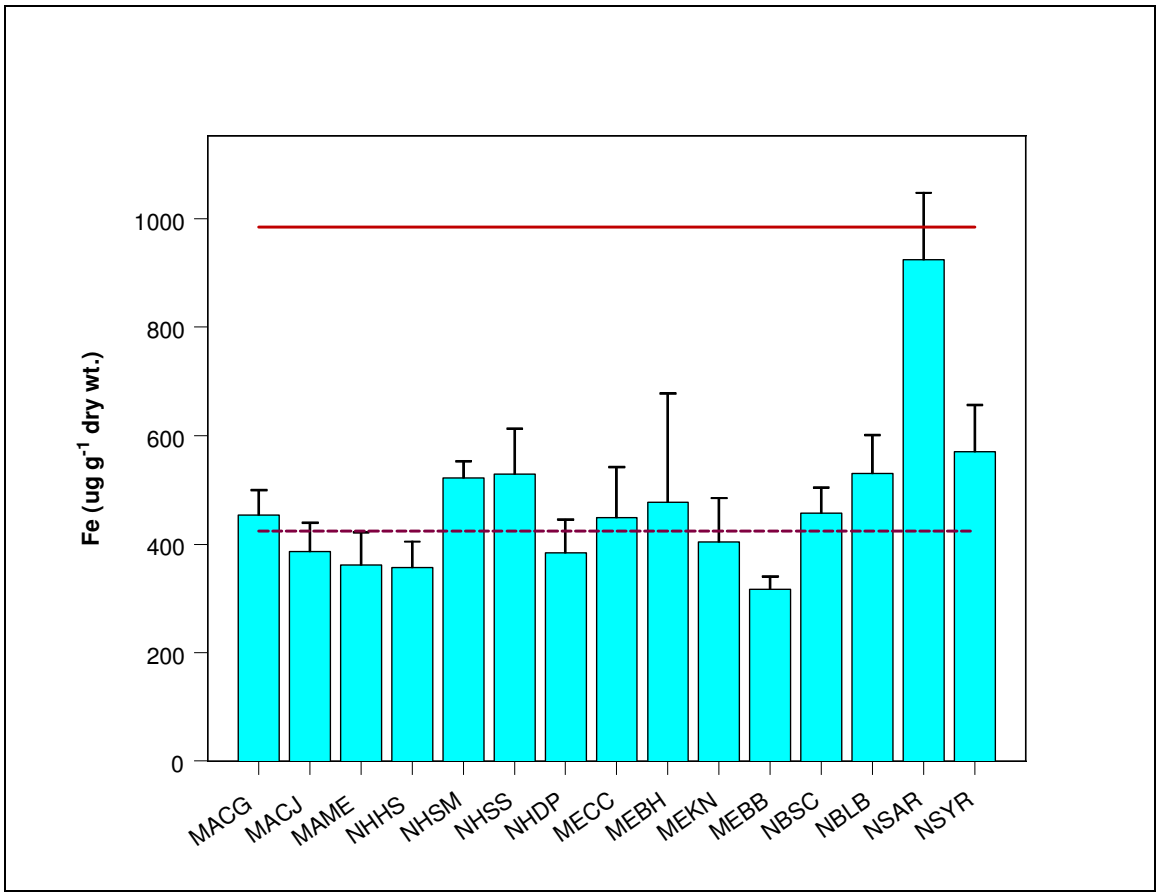

Figure 6. Distribution of iron tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

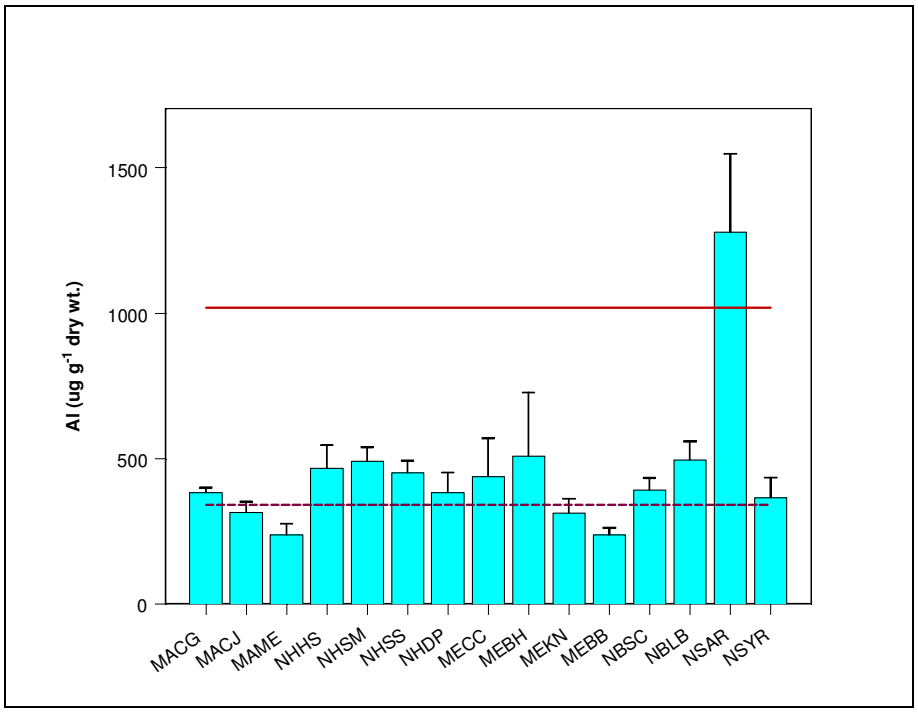

Figure 7. Distribution of aluminum tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median. Solid line = 1996 Mussel Watch National 85th Percentile.

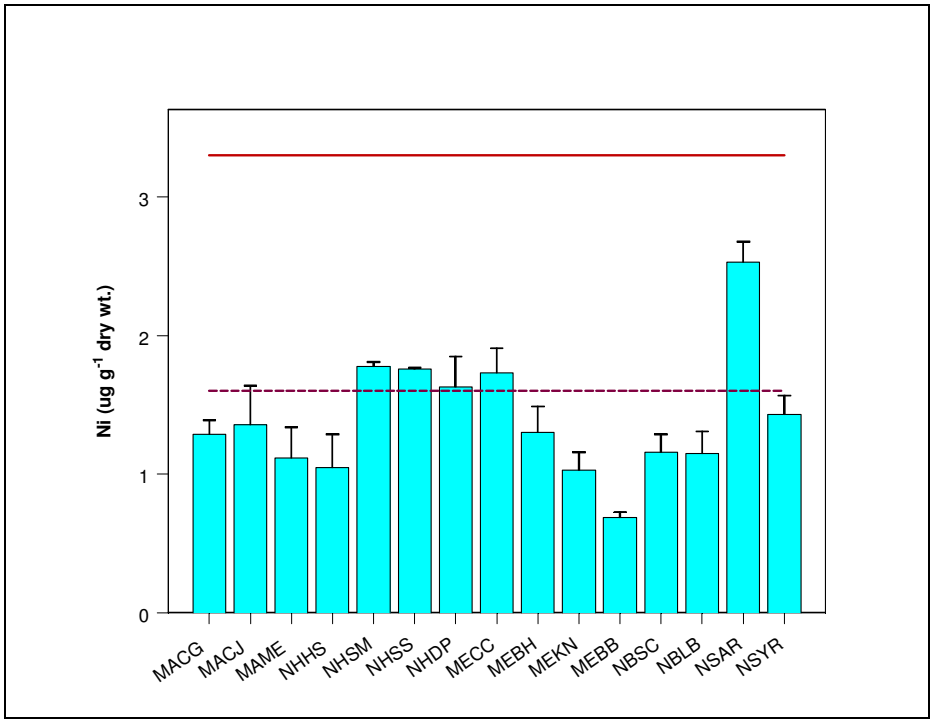

Figure 8. Distribution of nickel tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

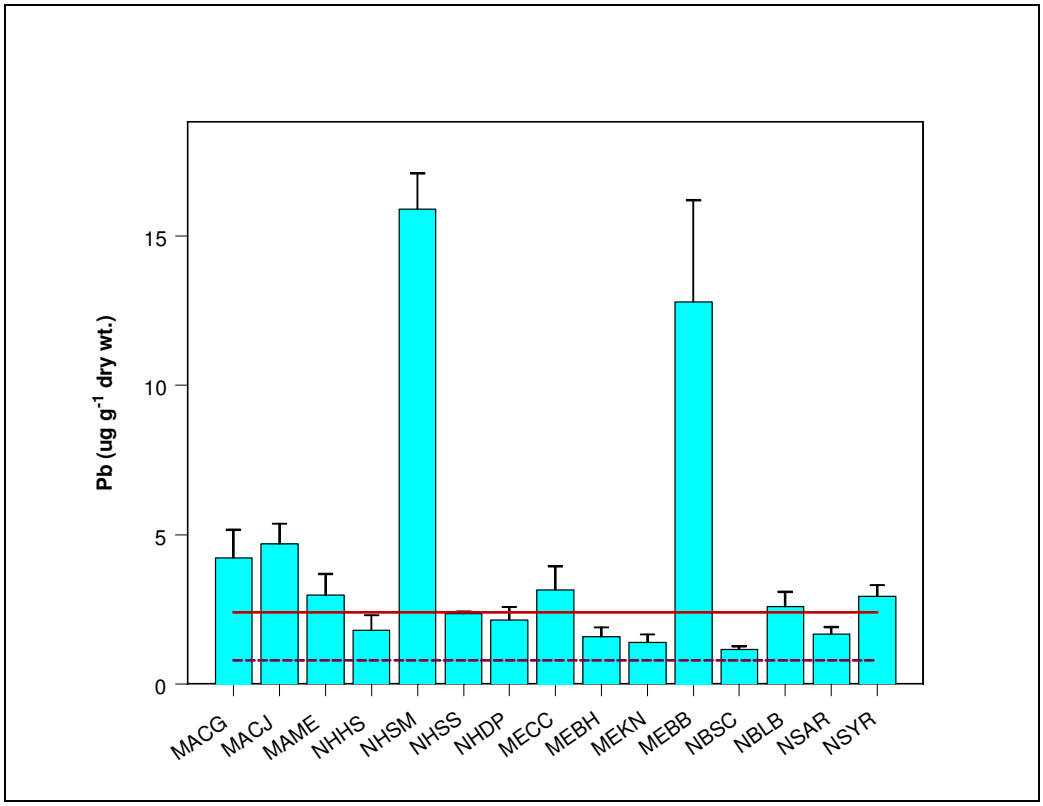

Figure 9. Distribution of lead tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

4.1.8 Zinc (Zn)

The concentration of zinc ranged from a low value of 60.9 µg/g dry wt at the Maine trend site, MEKN, to 172 µg/g dry wt at the South Mill Pond site (NHSM). (Table 5; Figure 10). Zinc concentrations at NHSM exceeded the Gulfwatch elevated criteria (above the NS&T 1996 85th P = 148 µg Zn/g dry wt.). Qualitatively, Zn concentrations in mussels collected from South Mill Pond in NH (NHSM) show an increase similar to that observed for Pb and Cd between 1999 and 2006 (Figs. 18 A and B). Zinc is a ubiquitous environmental contaminant generally reflecting a wide range of land-based activities (tire wear, galvanized materials, industrial waste discharges, etc.).

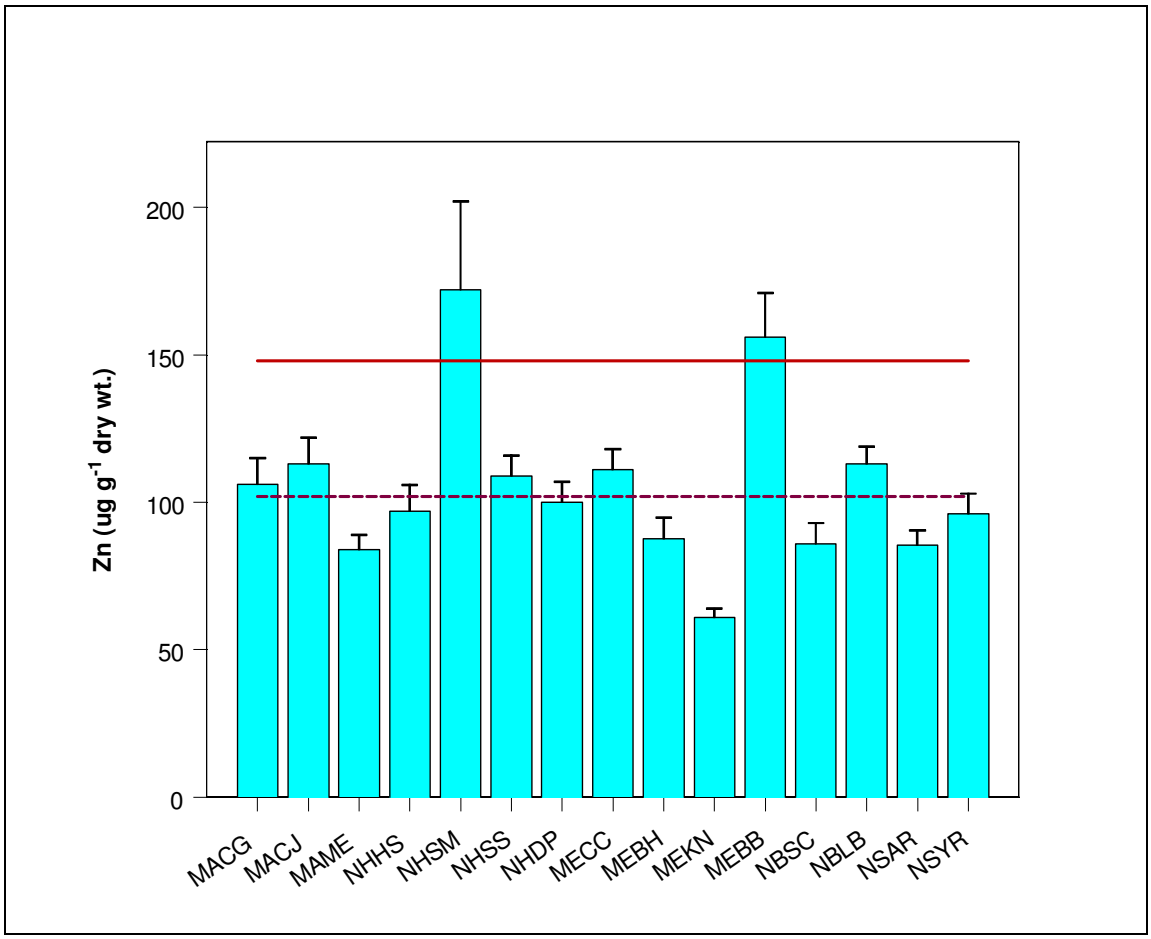

Figure 10. Distribution of zinc tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

4.1.9 Mercury (Hg)

Mercury was detected in mussels collected at all 2006 Gulfwatch stations. The lowest mean Hg concentration (0.12 µg/g dry wt) in mussel tissue was observed at NHHS, and the highest (0.37 µg/g dry w) at NHSM (Table 5; Figure 11). All 2006 mean site concentrations for Hg in mussels were above the NS&T 1996 median value (0.11 µg Hg/g dry wt.). Sixty percent (9 of 15) of the 2006 sites exceeded the NS&T 85th P value of 0.20 µg Hg/g dry wt. There are several significant historical Hg sources in the Gulf of Maine (Jones 2004, NCCOSC, 1997). Mussel tisssue Hg levels from New Hampshire sites in 2006 were generally greater than sites in other jurisdictions, including observations from previous years. Mussels from the benchmark station for NH (MECC) that is located within the Great Bay Estuary but along the Maine coast, had Hg levels comparable to the remaining Great Bay Estuary sites. Relatively higher Hg levels in the Great Bay Estuary system suggest Hg dynamics in this region warrants further investigation.

World-wide, the mean values of Hg in *Mytilus* spp. from coastal regions can range from 0.1 to 0.4 µg/g dry wt (Kennish, 1997) but can be much higher, notably the south-west Pacific where mussel tissue concentrations have been reported as high as 2.7 µg Hg/g dry wt (Fowler, 1990). The 2006 GOM-wide median and 85th Percentile for Hg is 0.22 and 0.28 µg/g dry wt, respectively, and is comparable with recent sampling years. In a review of the first five years of the Gulfwatch program, tissue concentrations of Hg were discussed as being unusually high and a possible concern for human health (Tripp et al., 1997). In contrast, Goodale et al. (2006) present evidence from selected marine bird species (eggs and blood) collected from remote islands off the coast of ME showing Hg contamination to be well below thresholds considered critical for healthy reproduction and survival.

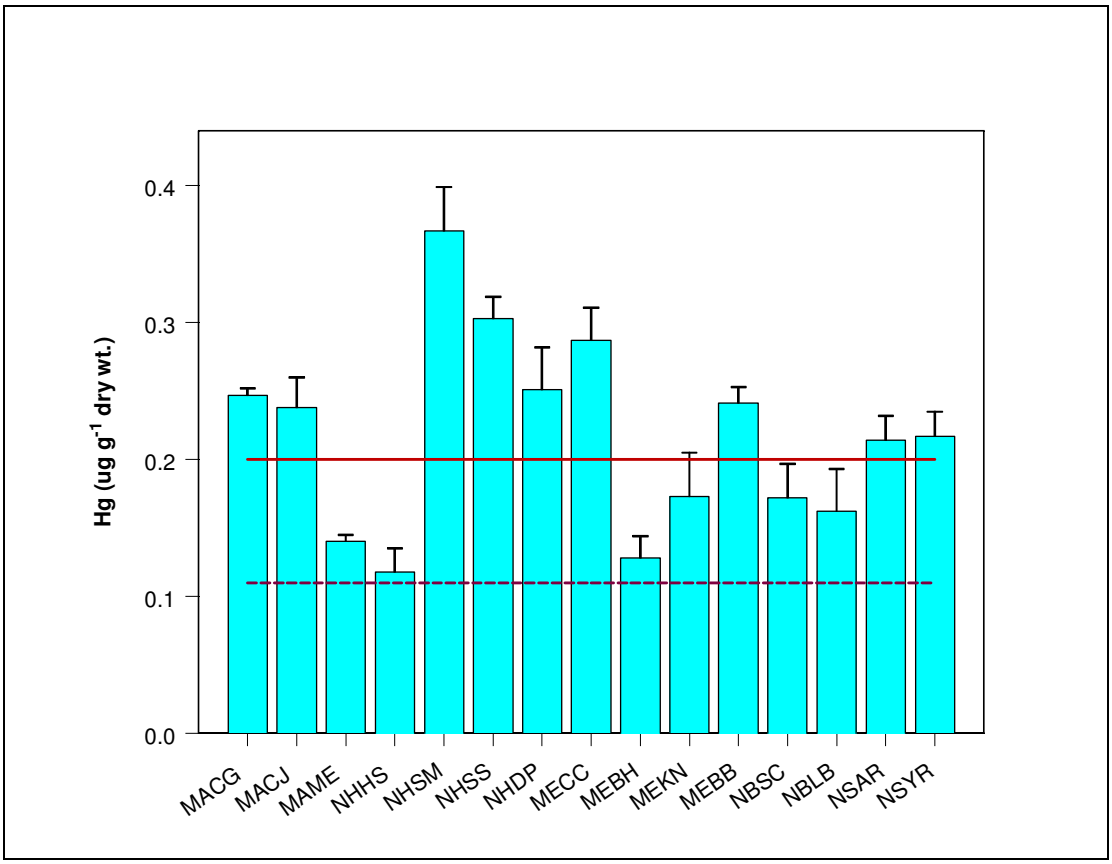

Figure 11. Distribution of mercury tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch sites in 2006. Dashed line = 1996 Mussel Watch National median; Solid line = 1996 Mussel Watch National 85th Percentile.

4.1.10 Organic Contaminants

For 2006, most of analyte categories of organic contaminants were detected at all Gulfwatch sites (Table 9 above) with the exception of MEBH and NSAR. The pattern of higher ΣPAH$_{24}$, ΣPCB$_{24}$, and ΣDDT$_6$ concentrations in the southwestern Gulf compared to the northeastern Gulf (Table 9, Figs. 12-15) continues as observed from the previous annual Gulfwatch results (Jones et al., 2001; Jones et al., 2006). None of the 2006 Gulfwatch sites exceeded the NS&T 85th percentile concentrations (Table 10) for any of the monitored organic contaminant classes.

ΣPAH$_{24}$ site mean concentrations ranged from non-detectable levels (ND) at MEBH to 895 ng/g dry wt at MEBB (Table 9; Figure 12). ΣPCB$_{24}$ concentrations ranged from ND levels at NSAR and MEBH to 172 ng g^{-1} dry wt at MAME (Table 9; Figure 13). Massachusetts sites had generally higher PCB contaminant exposure relative to the remaining 2006 sites. The

highest levels of ΣPCB_{24} concentrations are often observed in mussels from the more urbanized estuaries of the region.

Detectable concentrations of $\Sigma PEST_{21}$ ranged from ND at NSAR to 47.2 ng/g dry wt at MAME (Table 9; Figure 14). As in previous reports, ΣDDT_6 and its environmental degradation products were the main contributors to total detectable organochlorine pesticides, and exhibited the similar spatial pattern with the highest levels observed in the southwest region of the GOM.(Figures 14 - 15). $\Sigma PEST_{21}$ values for 2006 Gulfwatch mussel samples were at or below the NS&T national median (48 ng g^{-1} dry wt) and only MACG and MACJ, both in Cohasset Harbor, MA, exceeded the national NS&T median value for ΣDDT_6 (31 ng g^{-1} dry wt).

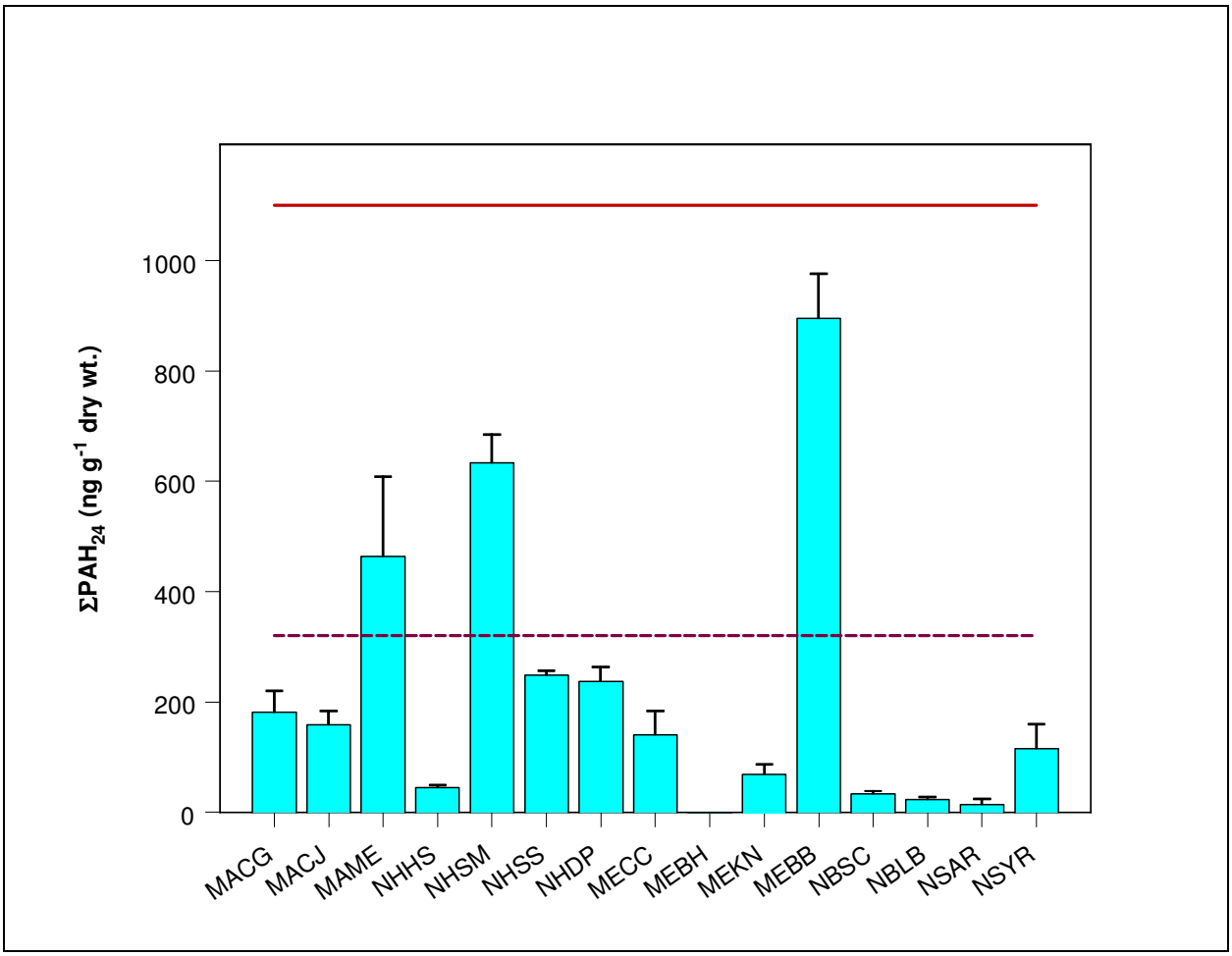

Figure 12. Distribution of $\sum PAH_{24}$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites during 2006. Dashed line = 1986-1999 Mussel Watch National median; Solid line = 1986-1999 Mussel Watch National 85th Percentile.

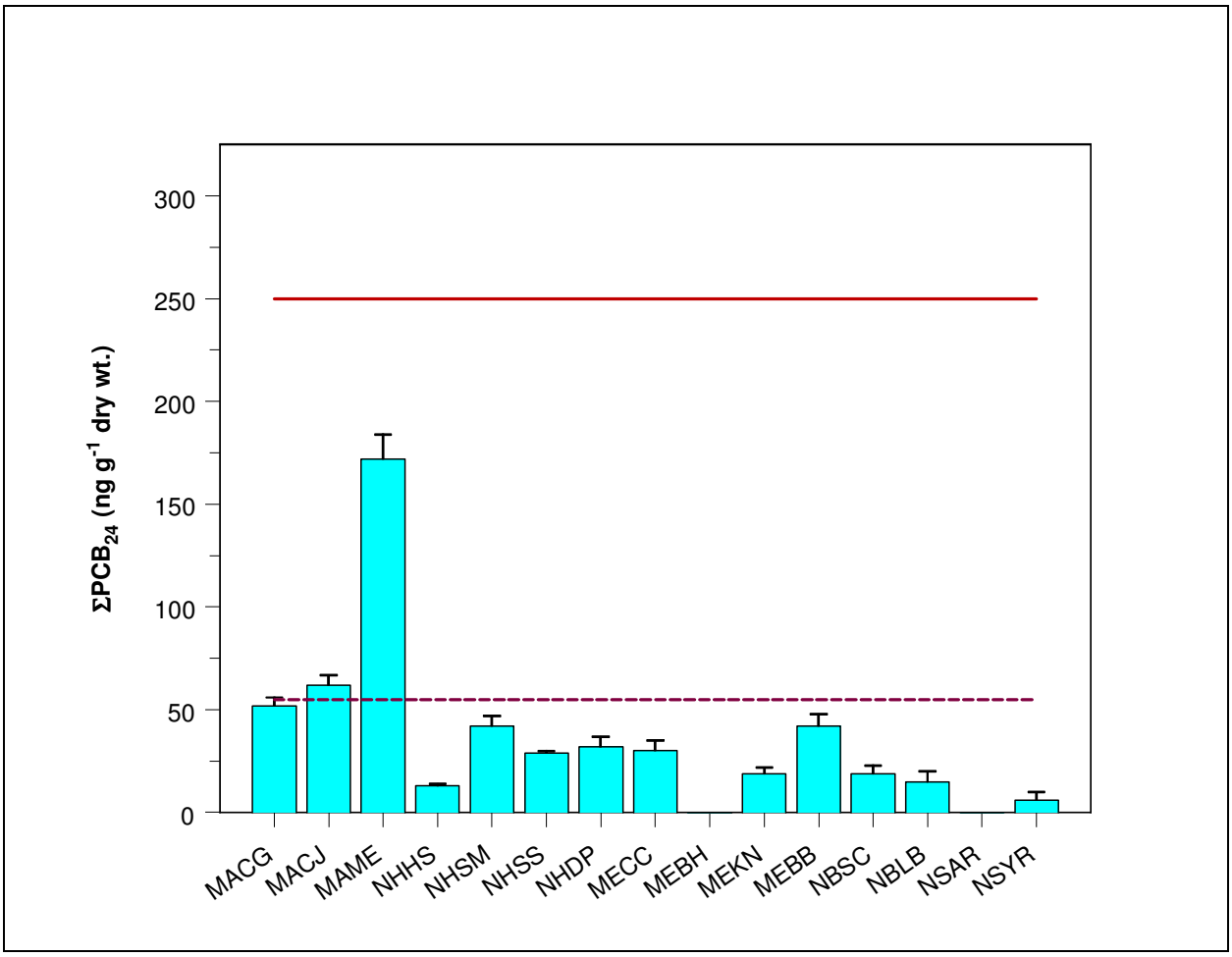

Figure 13. Distribution of $\sum PCB_{24}$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites during 2006. Dashed line = ½ (1986-1999 Mussel Watch National median); Solid line = ½ (1986-1999 Mussel Watch National 85th Percentile).

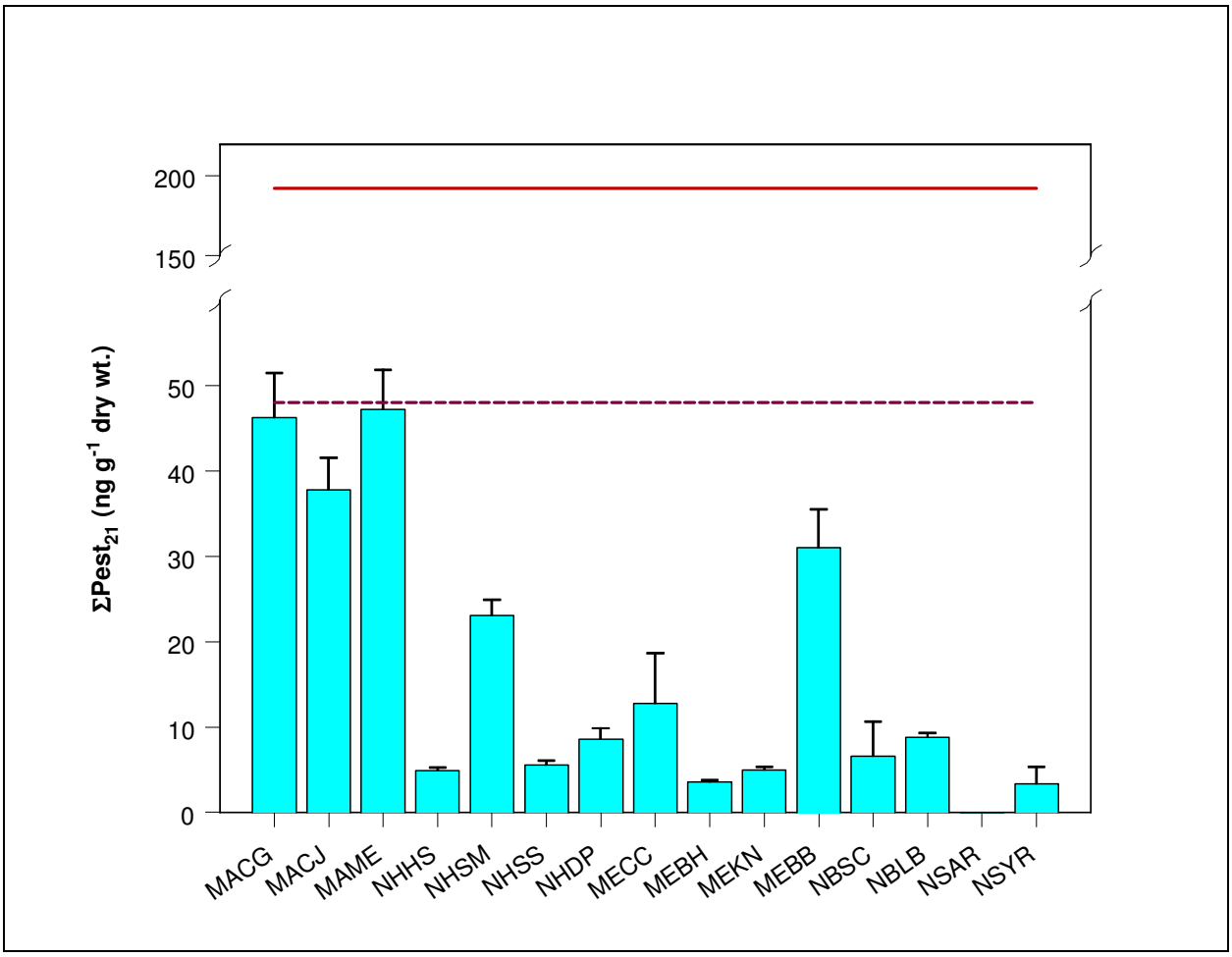

Figure 14. Distribution of $\sum PEST_{21}$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites during 2006. Dashed line = 1986-1999 Mussel Watch National median; Solid line = 1986-1999 Mussel Watch National 85th Percentile.

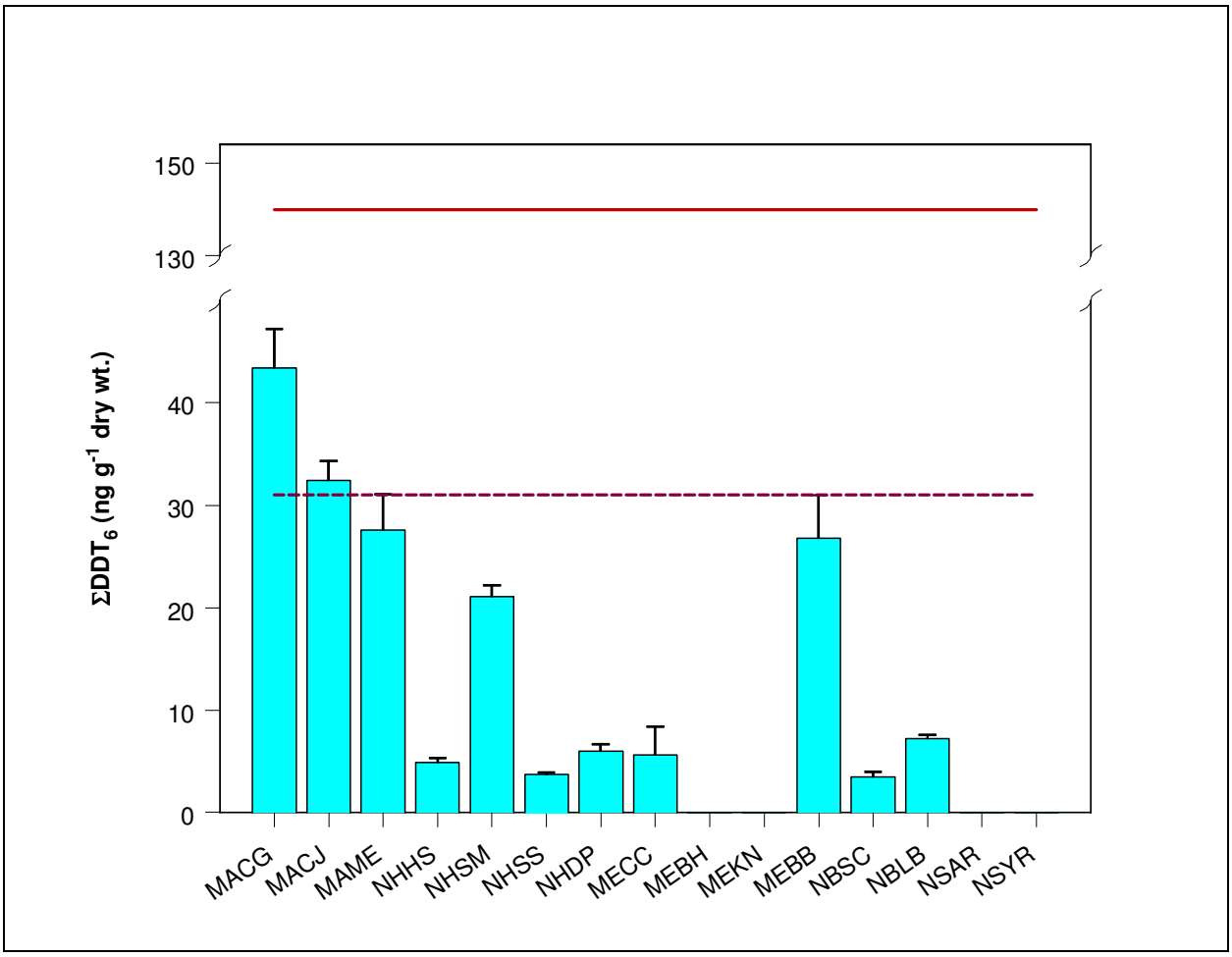

Figure 15. Distribution of $\sum DDT_6$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch sites during 2006. Dashed line = 1986-1999 Mussel Watch National median; Solid line = 1986-1999 Mussel Watch National 85th Percentile.

4.2 TEMPORAL PATTERNS

This section presents the distribution of inorganic and organic contaminants in mussel tissue collected from rotational and trend sites along the Gulf of Maine, from 1993 to 2006. All of the 2006 sites (except for MACG and MACJ) have now been sampled by the Gulfwatch Program at least four times (Table 4). The temporal distribution of rotational station means is plotted for each contaminant or class of contaminants at individual sites in Figures 16-26. All individual replicate results for each 2006 site are provided in Appendices E and F. The distribution of contaminants in mussels from the five (5) traditional benchmark sites (MASN, MECC, MEKN, NBHI, and NSDI) is updated with data from mussels collected in 2006 at MECC and MEKN in Figures 27-40. In general, the figures are arranged in geographical order

beginning with Sandwich, MA, and continuing clockwise around the Gulf of Maine, ending with Yarmouth, NS. For plotting purposes, each non-detectable value was assigned ½ the MDL value for the lower limit of each concentration axis to help visualize any potential temporal trends.

4.2.1 Rotational Sites

No statistical analyses were performed to quantify apparent visual trends. For the rotational sites, there were examples of apparent temporal trends of increasing, decreasing, or unchanging contaminant concentrations. In some cases the trends were nullified by excessive within-site variability among replicate analyses that confounds the assessment for potential temporal differences (e.g., Hg at MAME, Fig. 16B, bottom panel). Visual inspection of the temporal data (Figs. 16 – 26) suggests some apparent trends but requires confirmation through quantitative trend analysis, which is beyond the scope of this report. The quality of the Gulfwatch Hg data prior to 2003 remains suspect due to high analytical detection limits and only data from 2003 through 2006. Apparent temporal changes in the contaminant data to note include; increasing Cd, Zn, and Pb at NHSM (Figs. 18A and 18B), although this may be influenced by increase in crustal material, as previously discussed relative to high Al levels at this site; decreasing DDT at MEBB (Fig. 22C) and PAH at NSYR (Fig. 26C, top left panel). We attribute changes in ∑Pest levels to changes in DDT and DDT homologues, which tend to dominate in terms of frequency and amount of detection amongst the suite of pesticides.

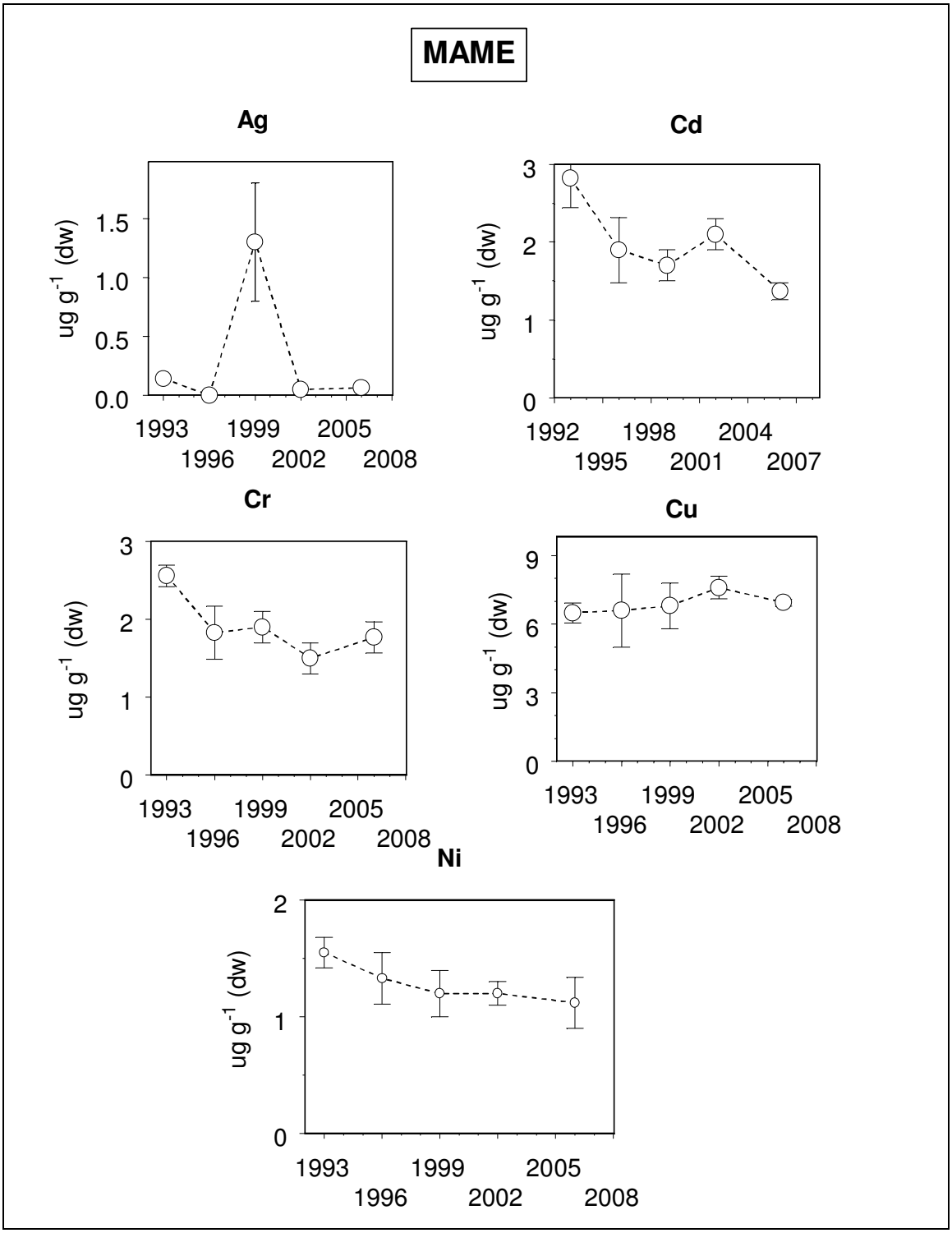

Figure 16A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the MAME Gulfwatch site from selected years during the period from 1993 - 2006.

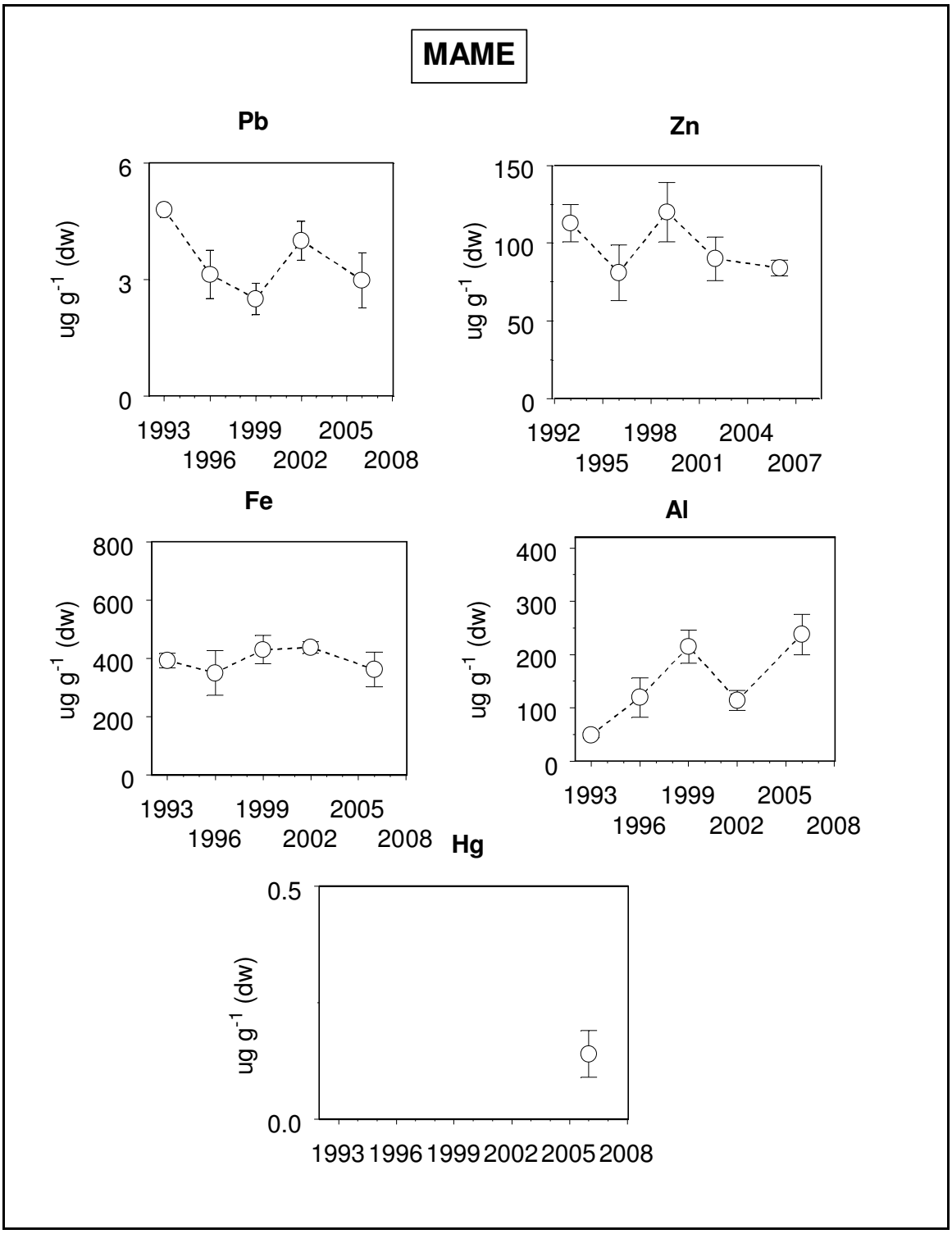

Figure 16B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the MAME Gulfwatch site from selected years during the period from 1993 - 2006. Hg data prior to 2003 remains suspect for analytical reasons.

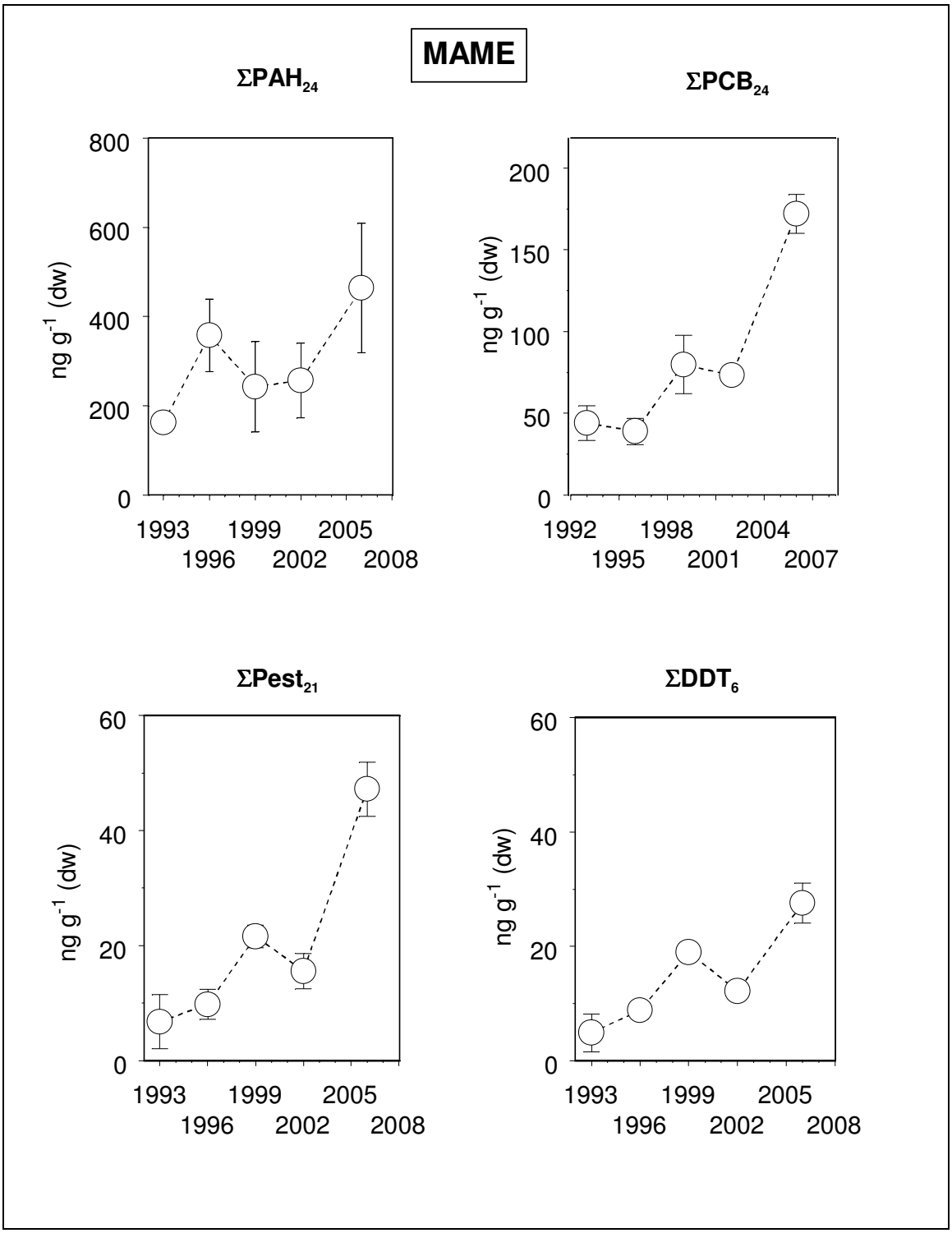

Figure 16C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the MAME Gulfwatch site from selected years during the period from 1993-2006.

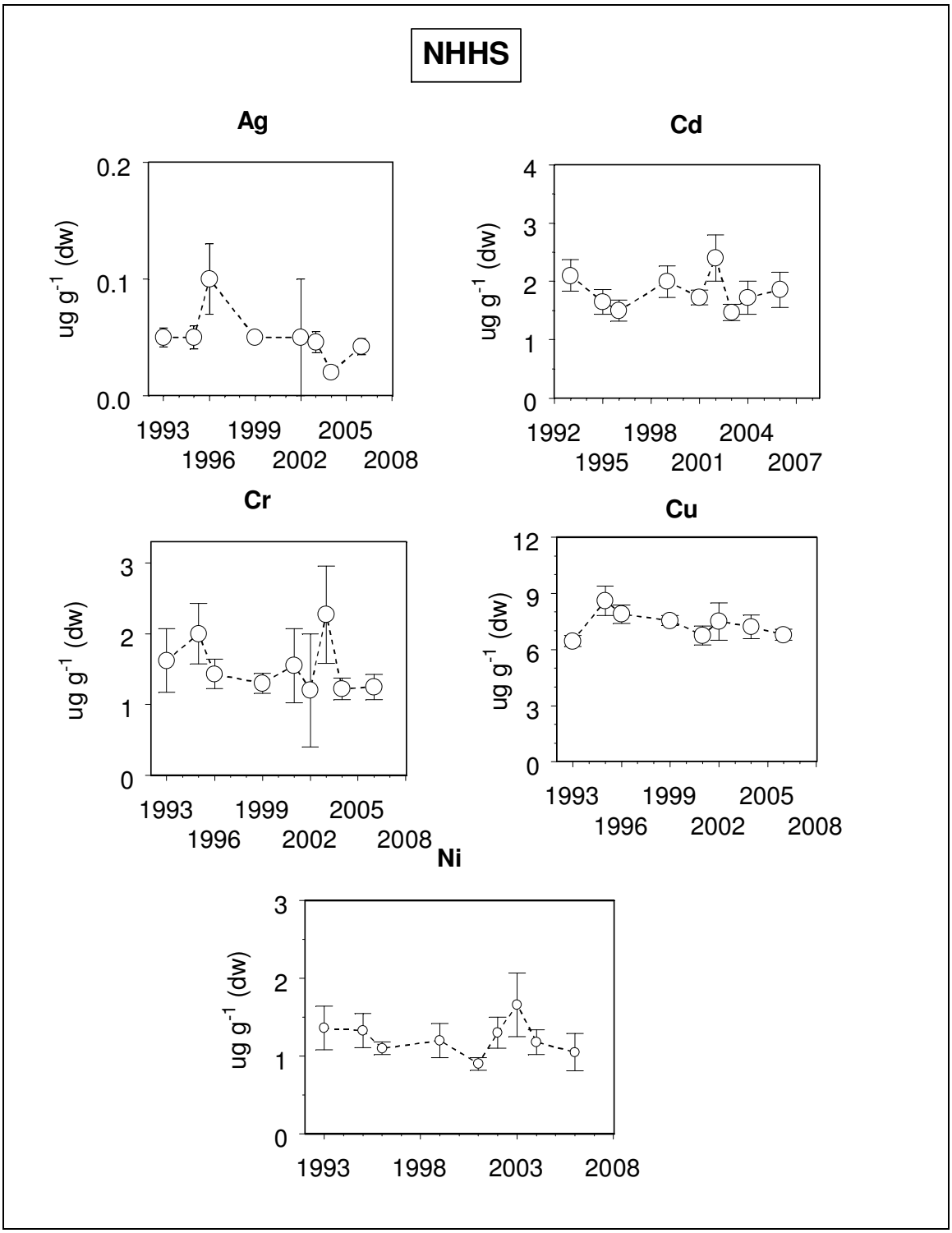

Figure 17A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHHS Gulfwatch site from selected years during the period from 1993-2006.

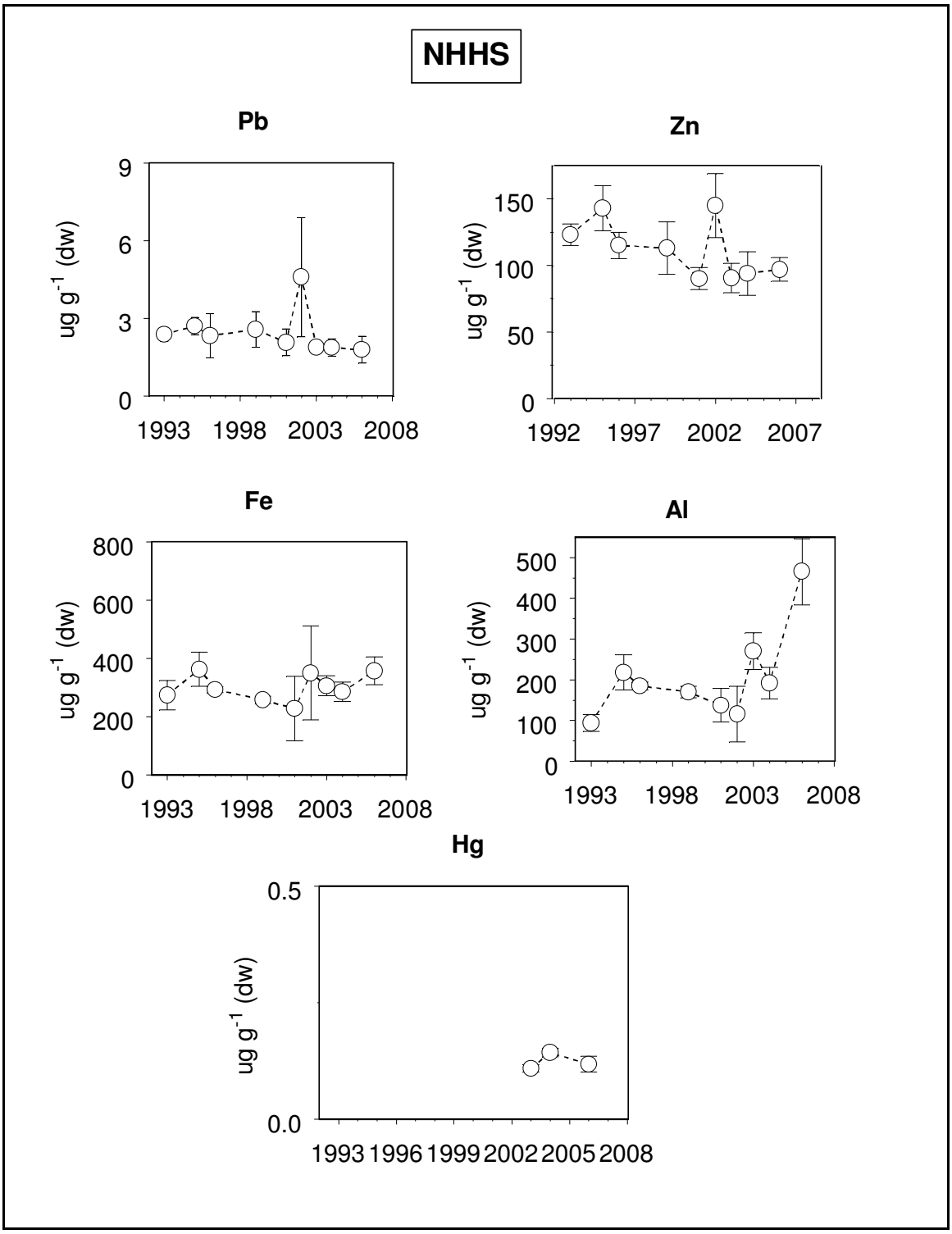

Figure 17B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHHS Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

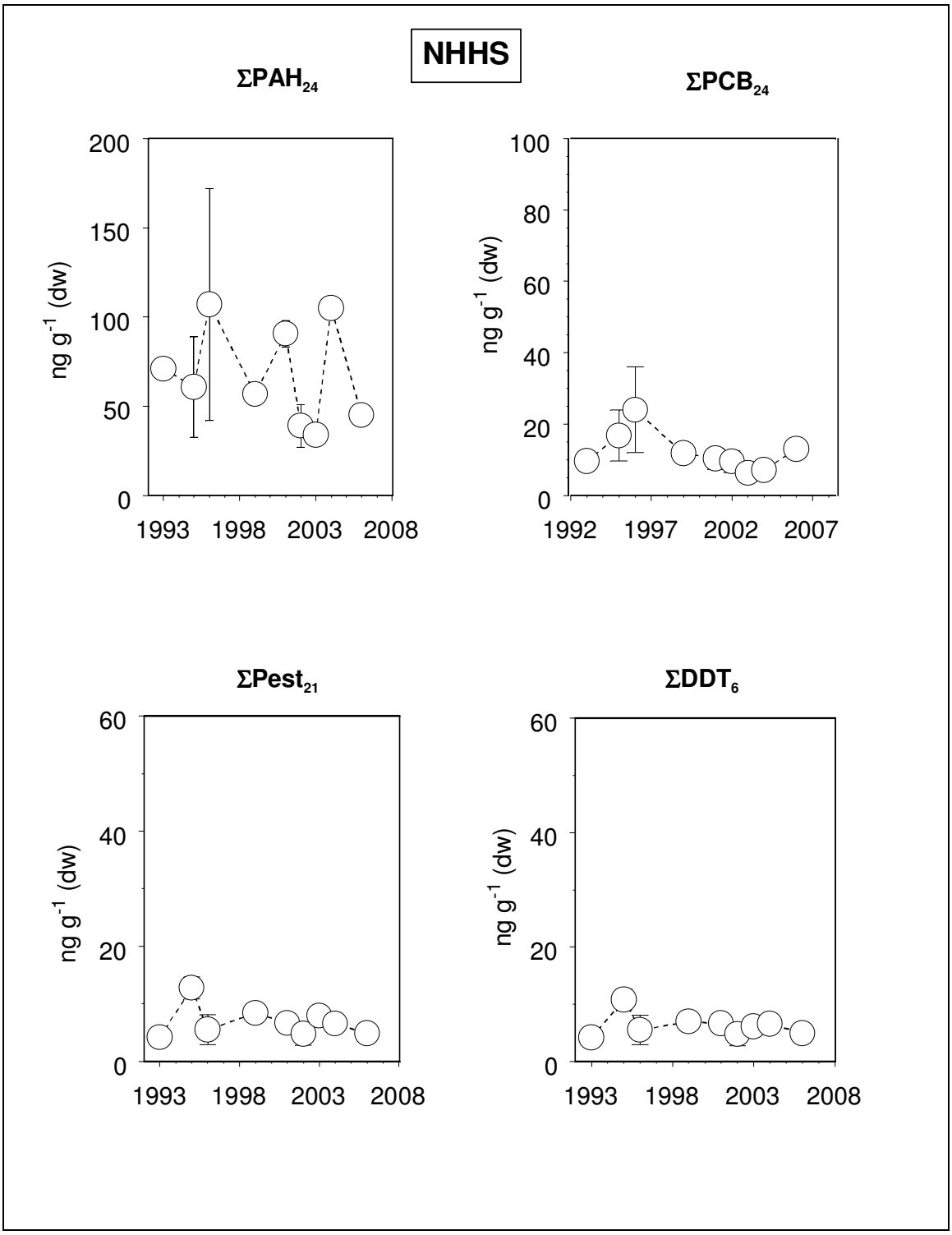

Figure 17C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NHHS Gulfwatch site from selected years during the period from 1993-2006.

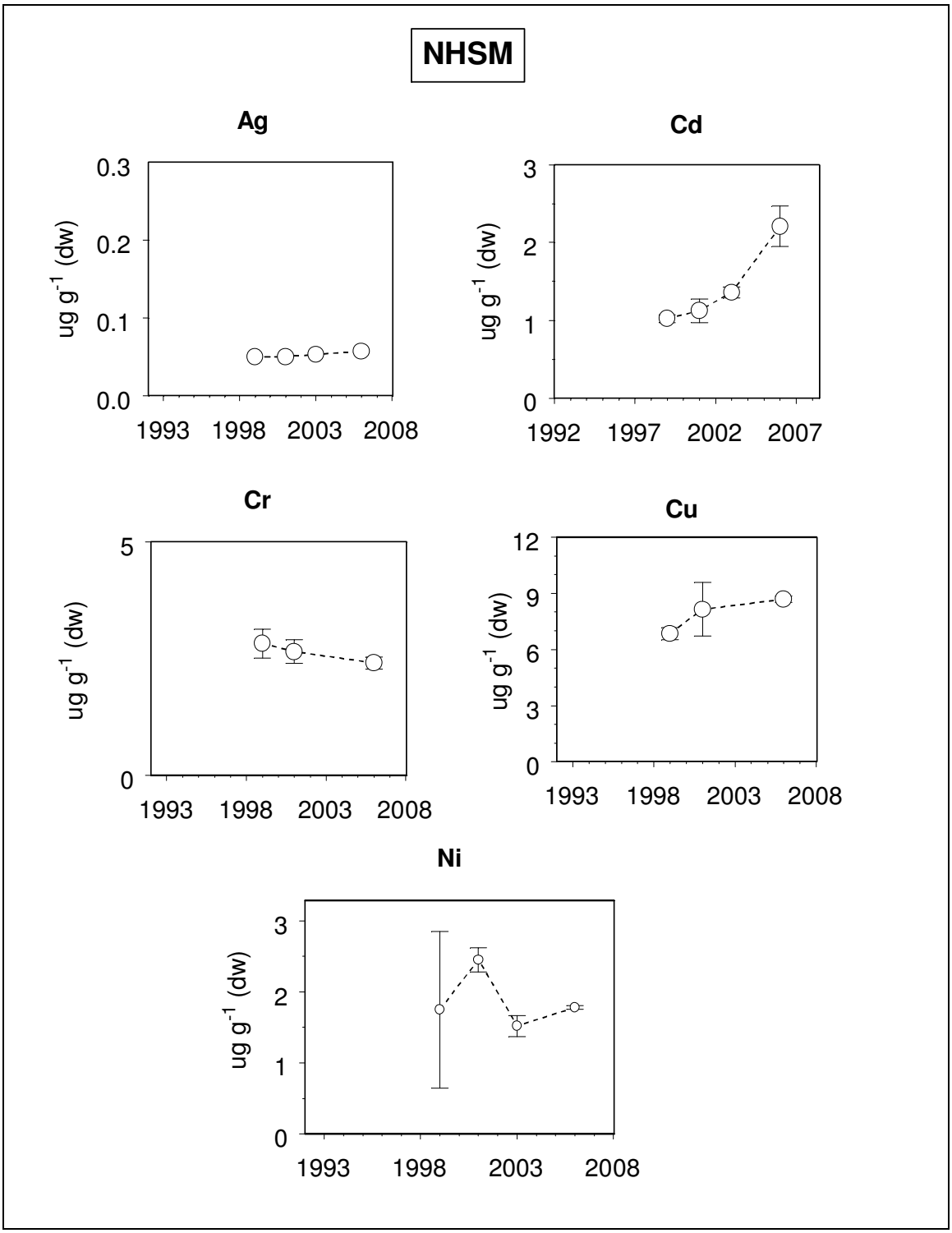

Figure 18A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHSM Gulfwatch site from selected years during the period from 1993-2006. Cu and Cr values determined on the 2003 samples are omitted due to suspected contamination.

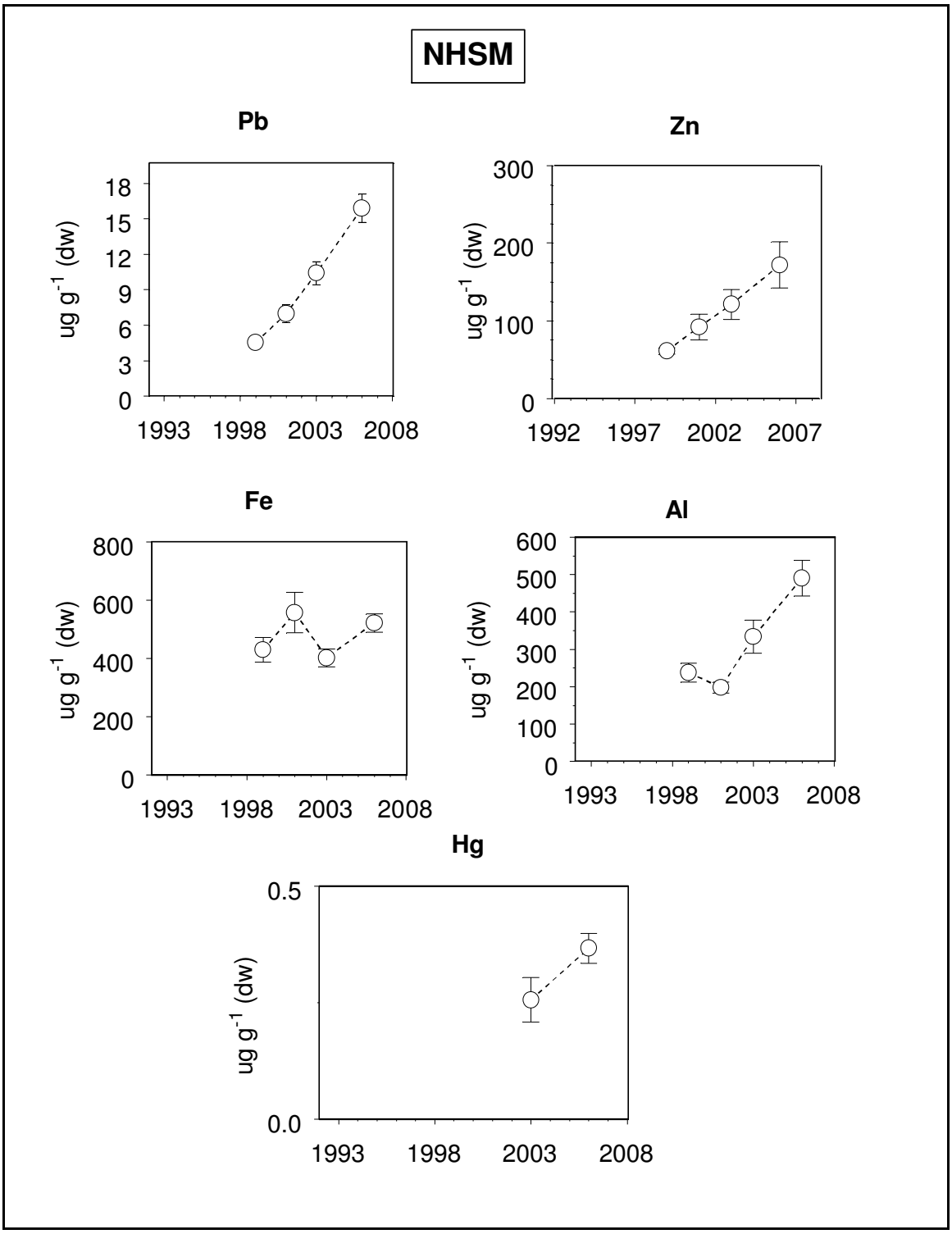

Figure 18B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHSM Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

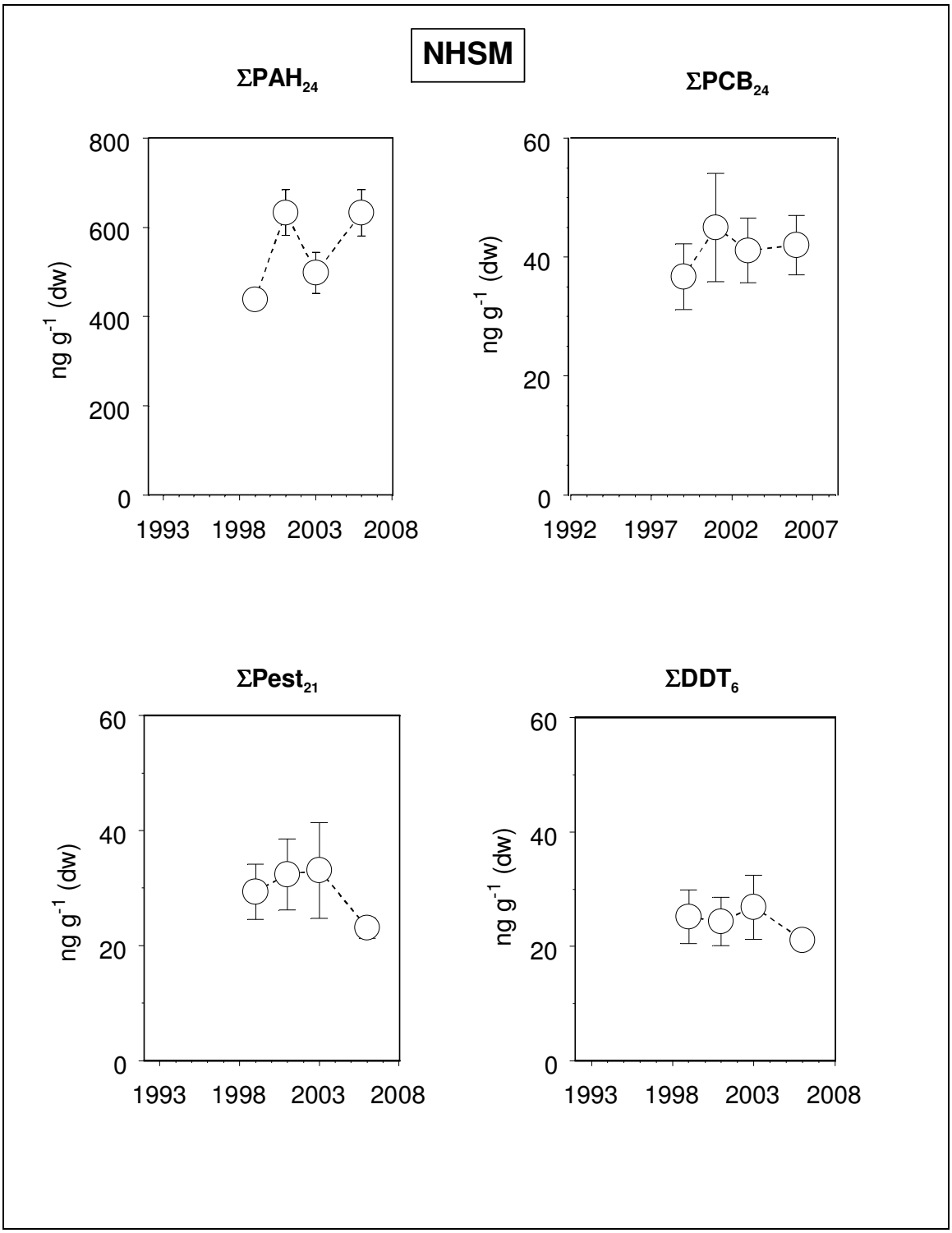

Figure 18C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NHSM Gulfwatch site from selected years during the period from 1993-2006.

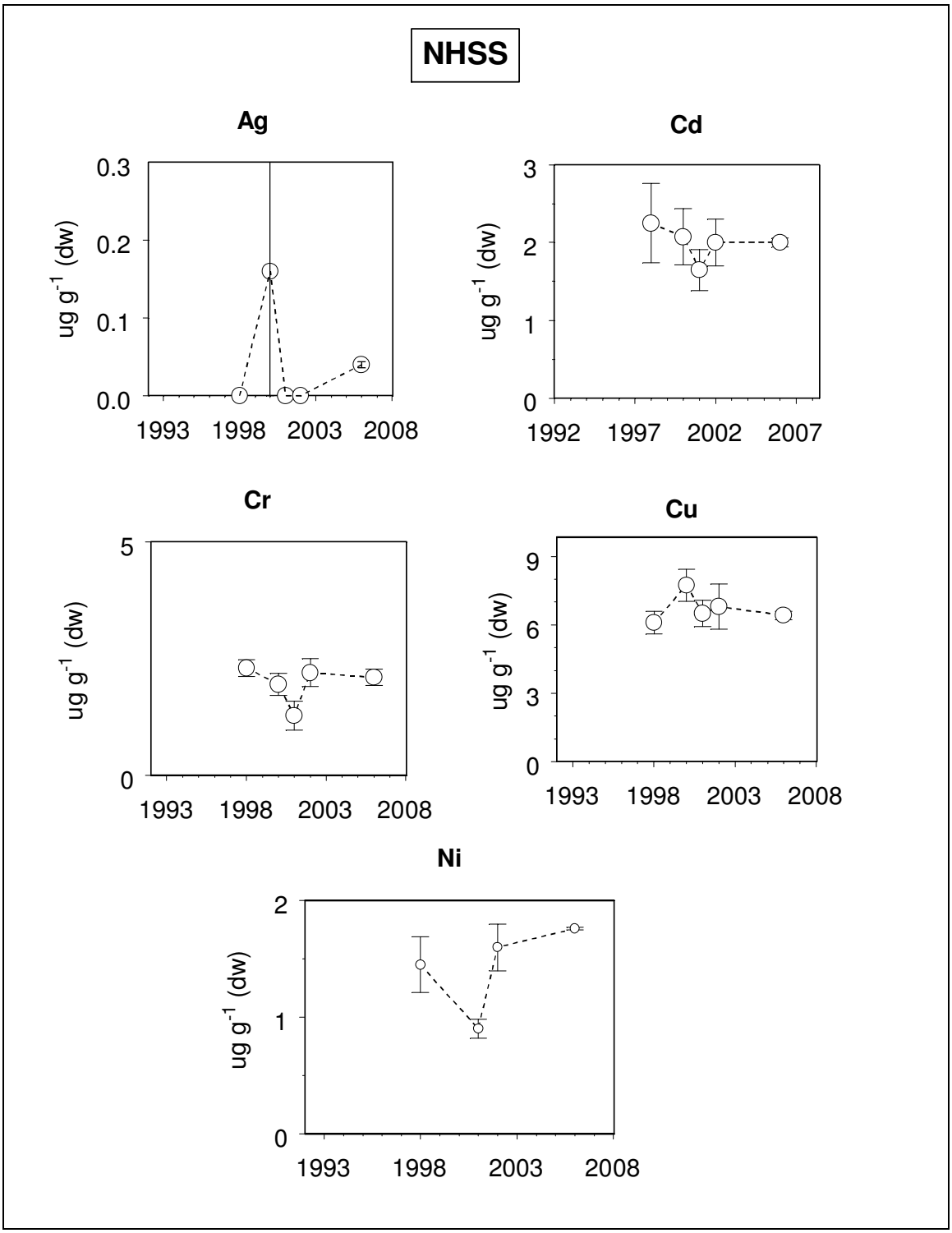

Figure 19A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHSS Gulfwatch site from selected years during the period from 1993-2006. Cu and Cr values determined on the 2003 samples are omitted due to suspected contamination.

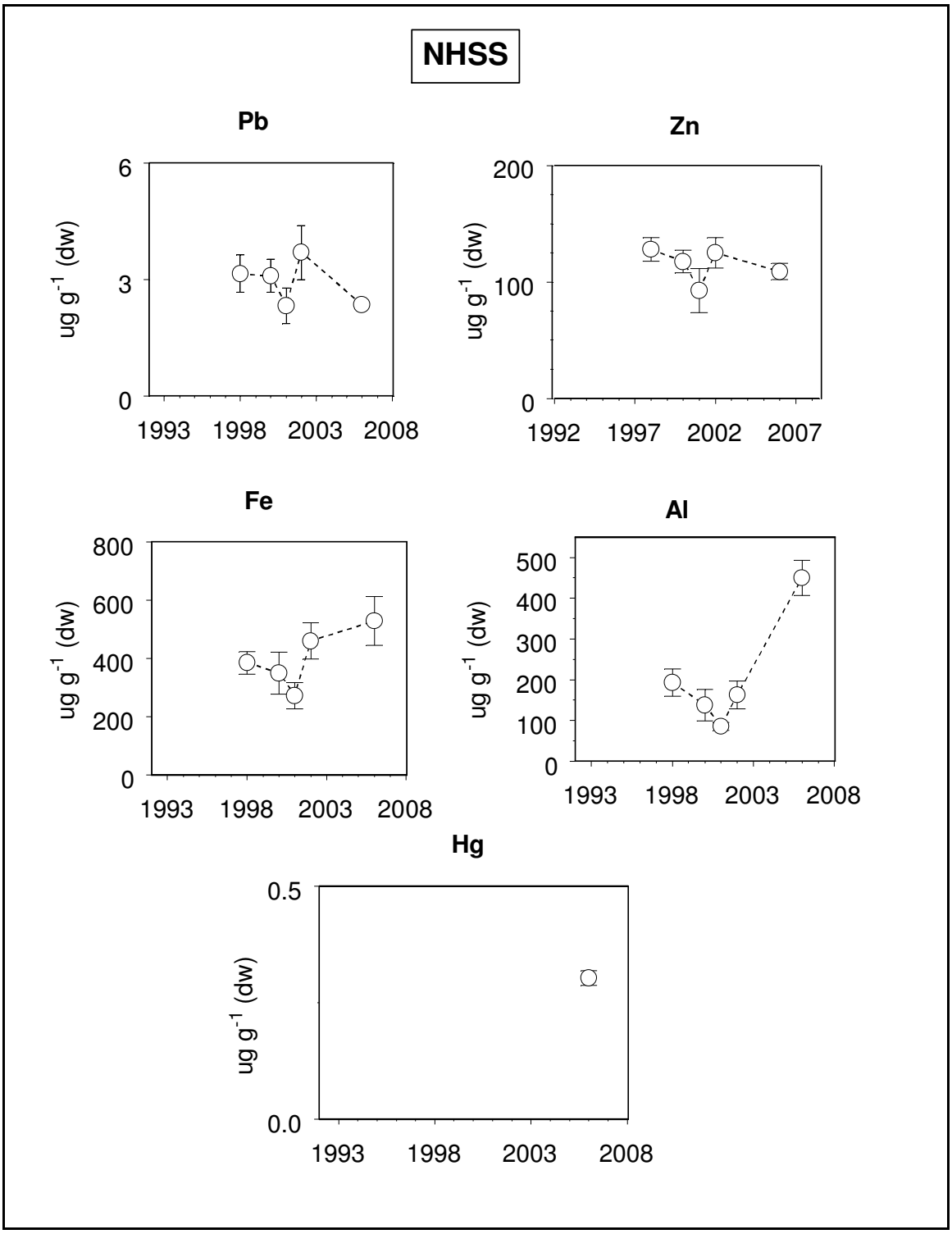

Figure 19B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHSS Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

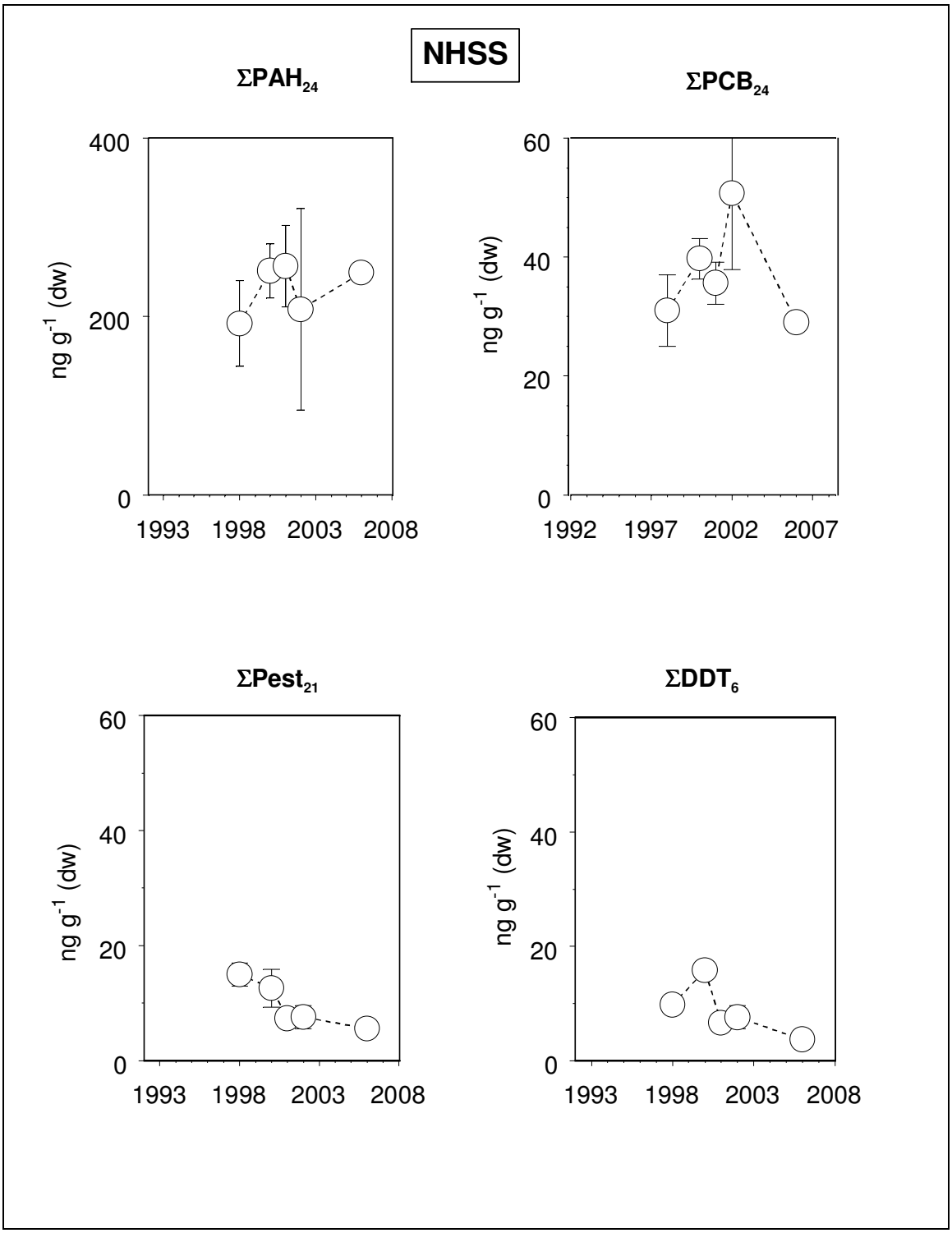

Figure 19C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NHSS Gulfwatch site from selected years during the period from 1993-2006.

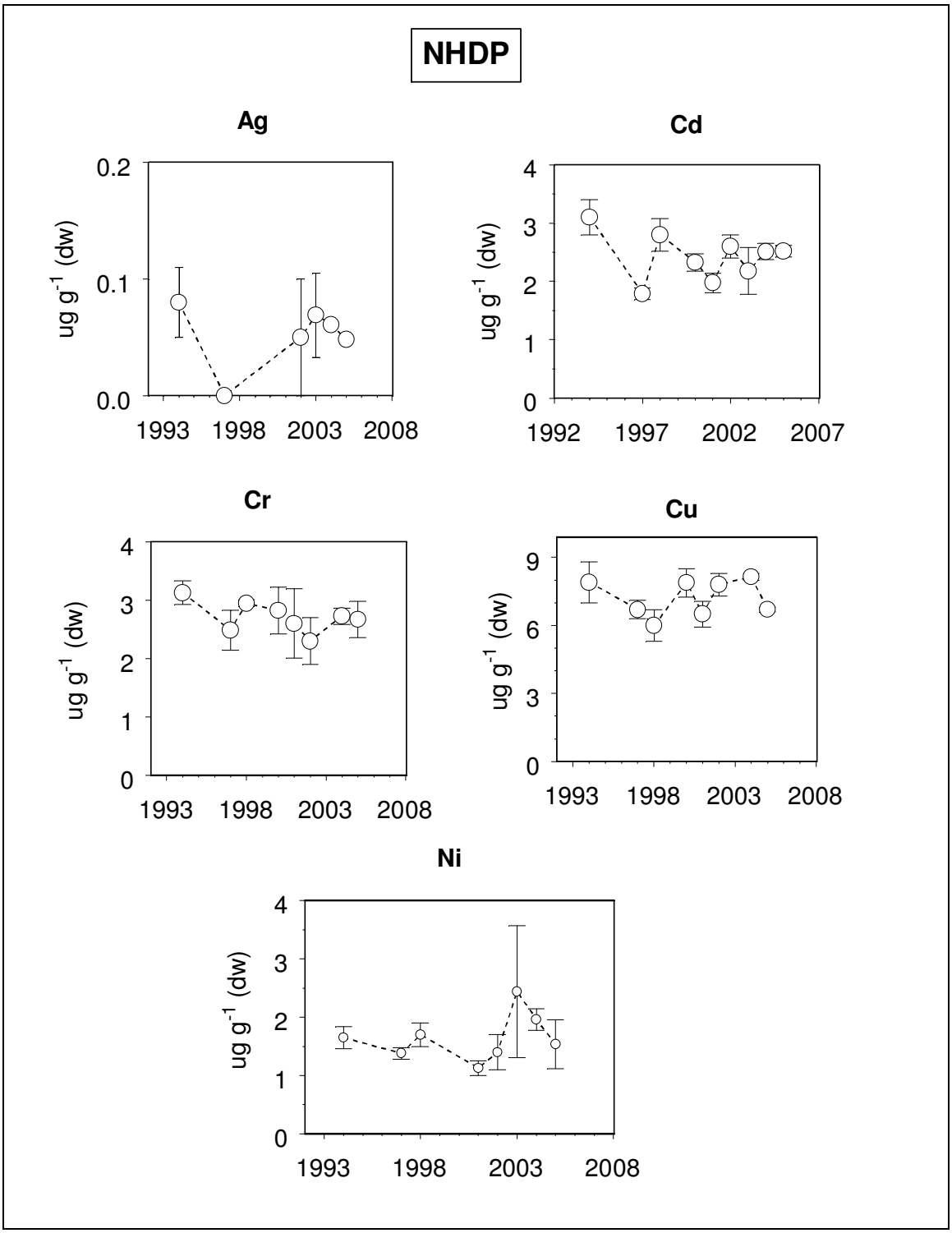

Figure 20A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHDP Gulfwatch site from selected years during the period from 1993-2006. Cu and Cr values determined on the 2003 samples are omitted due to suspected contamination.

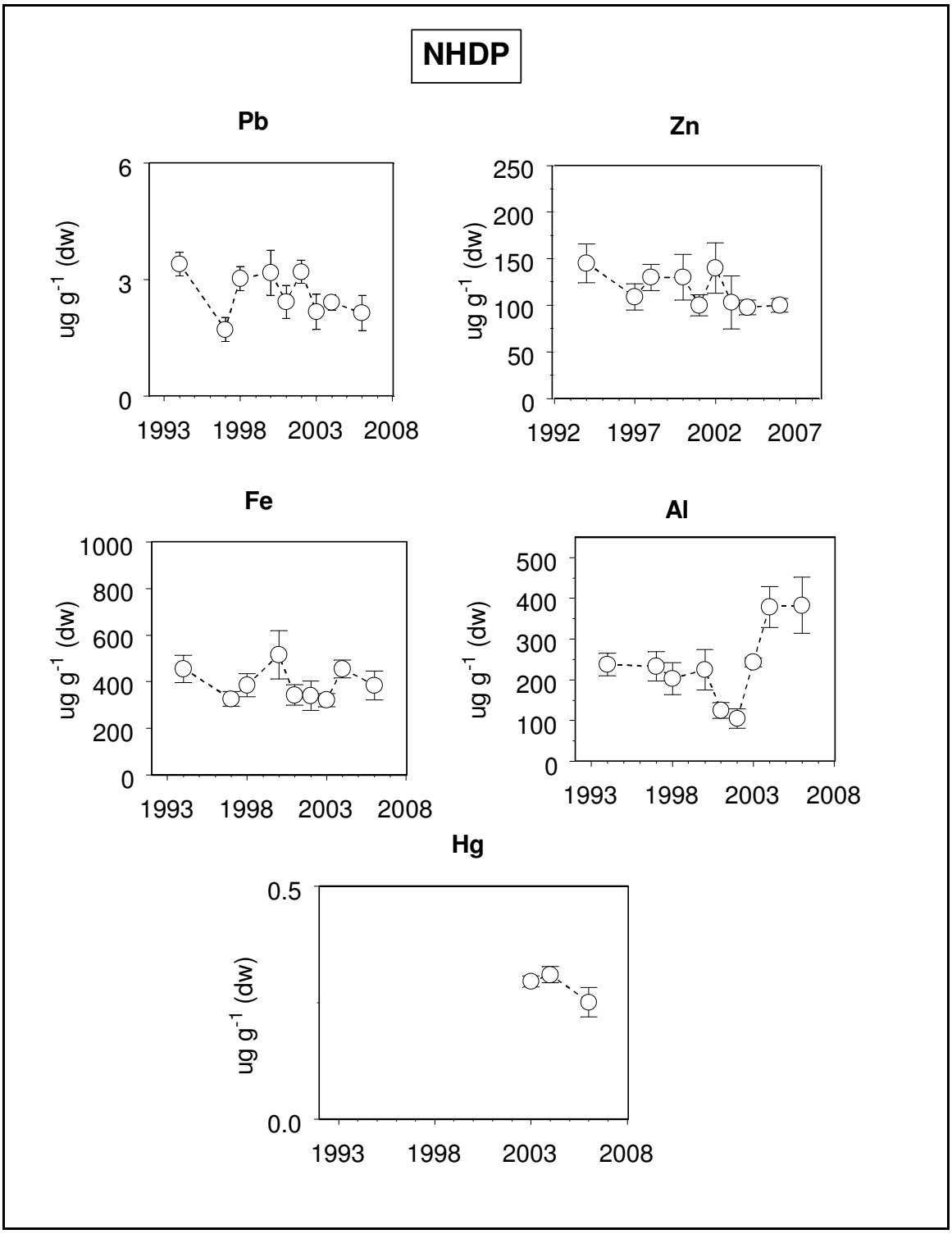

Figure 20B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NHDP Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

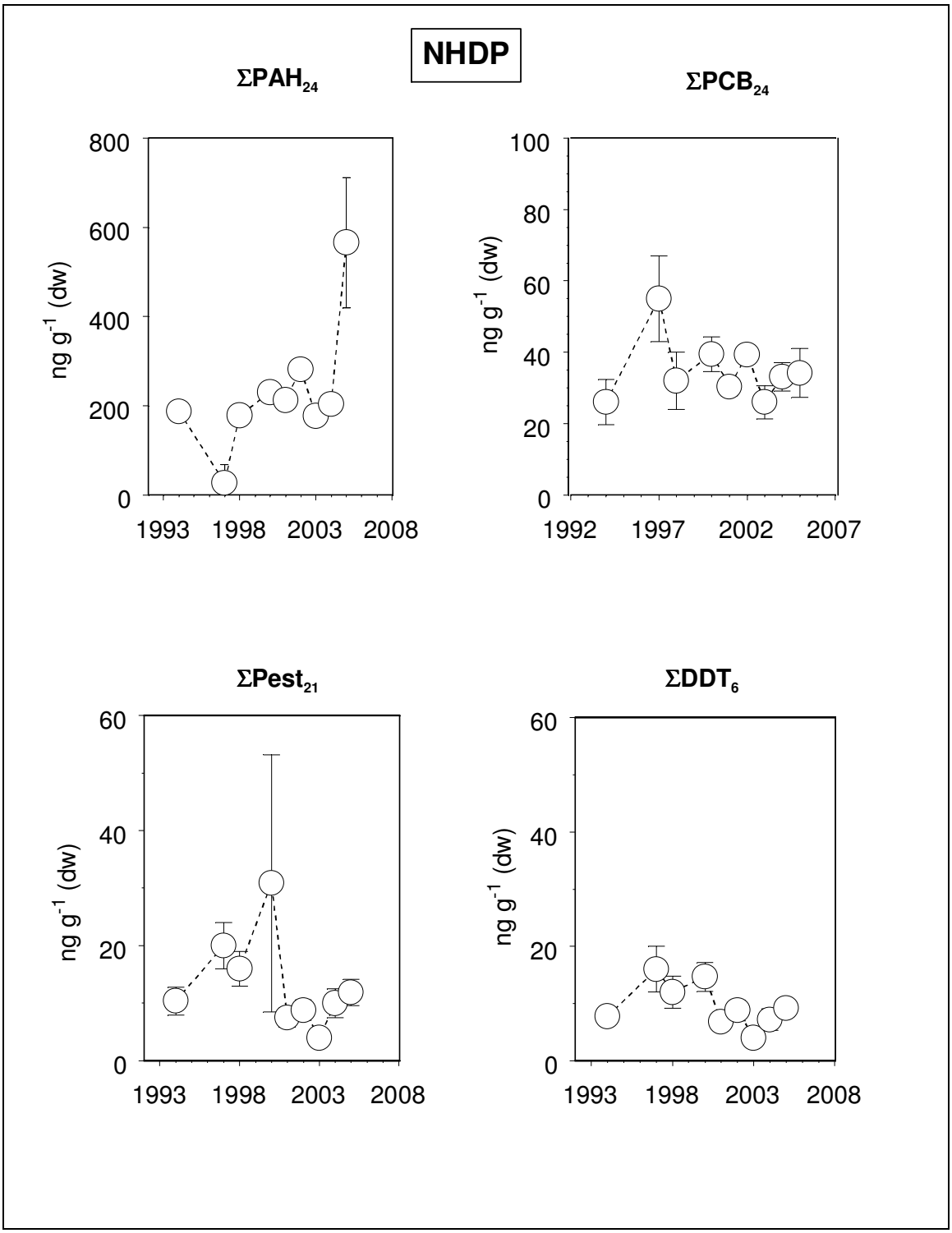

Figure 20C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NHDP Gulfwatch site from selected years during the period from 1993-2006.

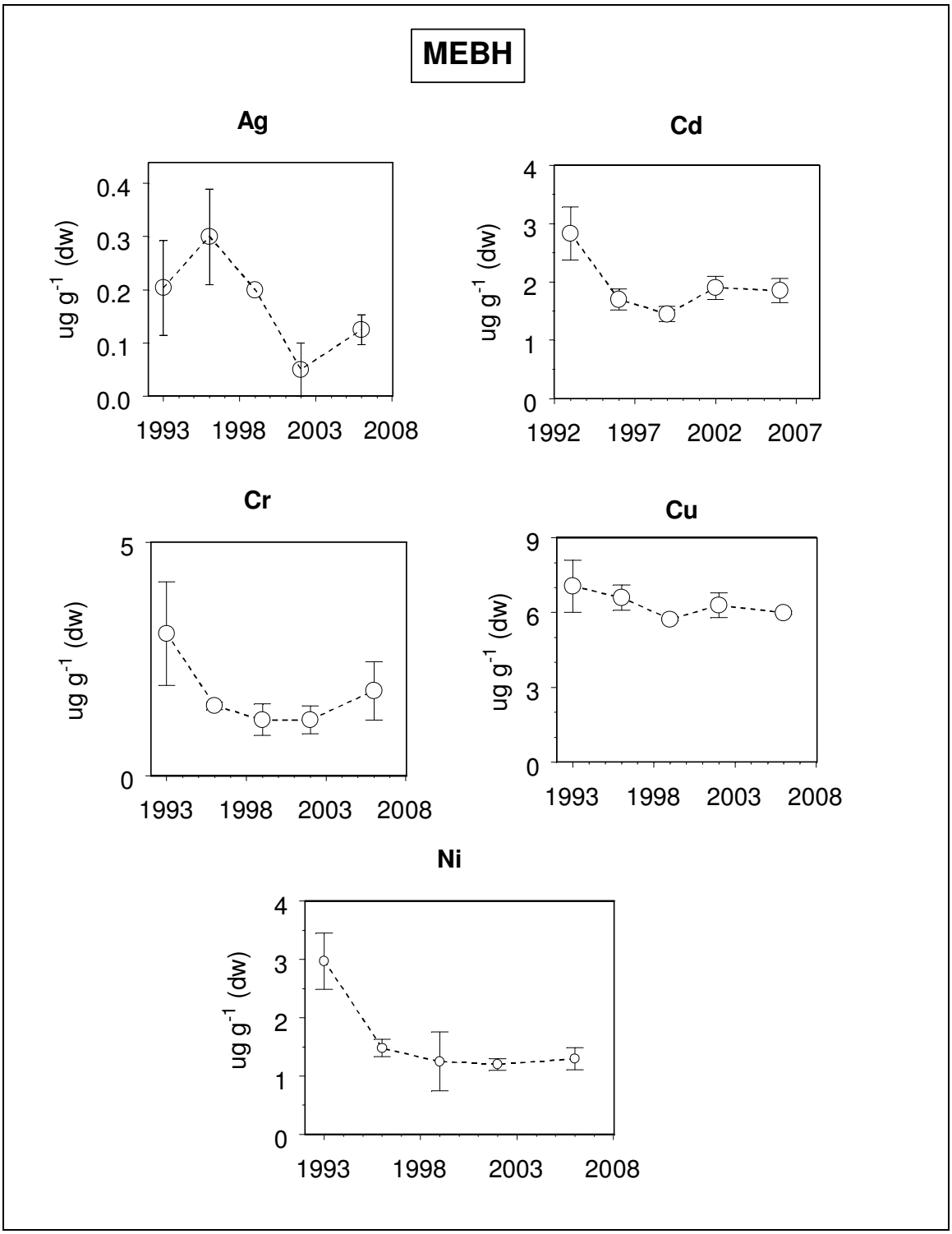

Figure 21A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the MEBH Gulfwatch site from selected years during the period from 1993-2006.

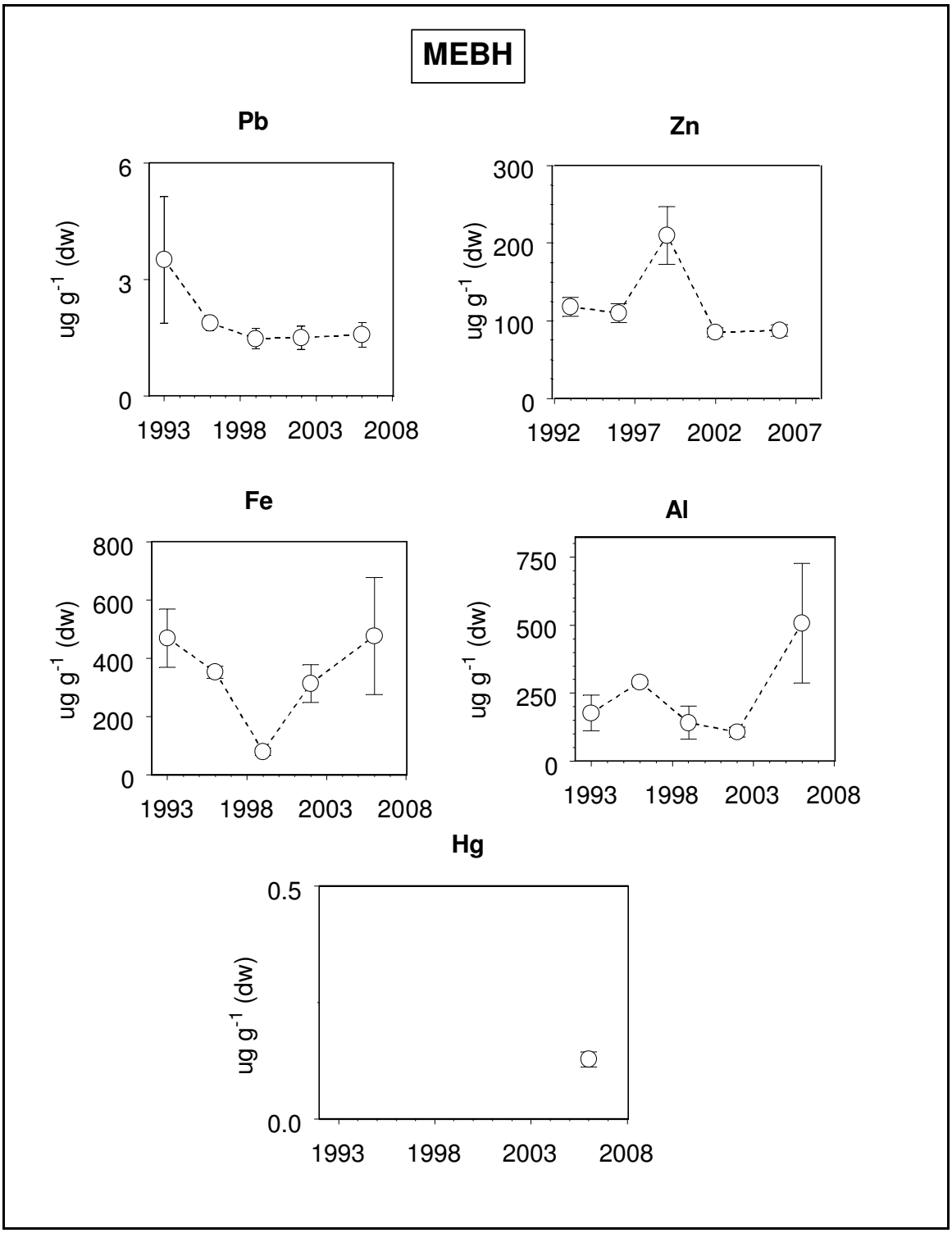

Figure 21B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the MEBH Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

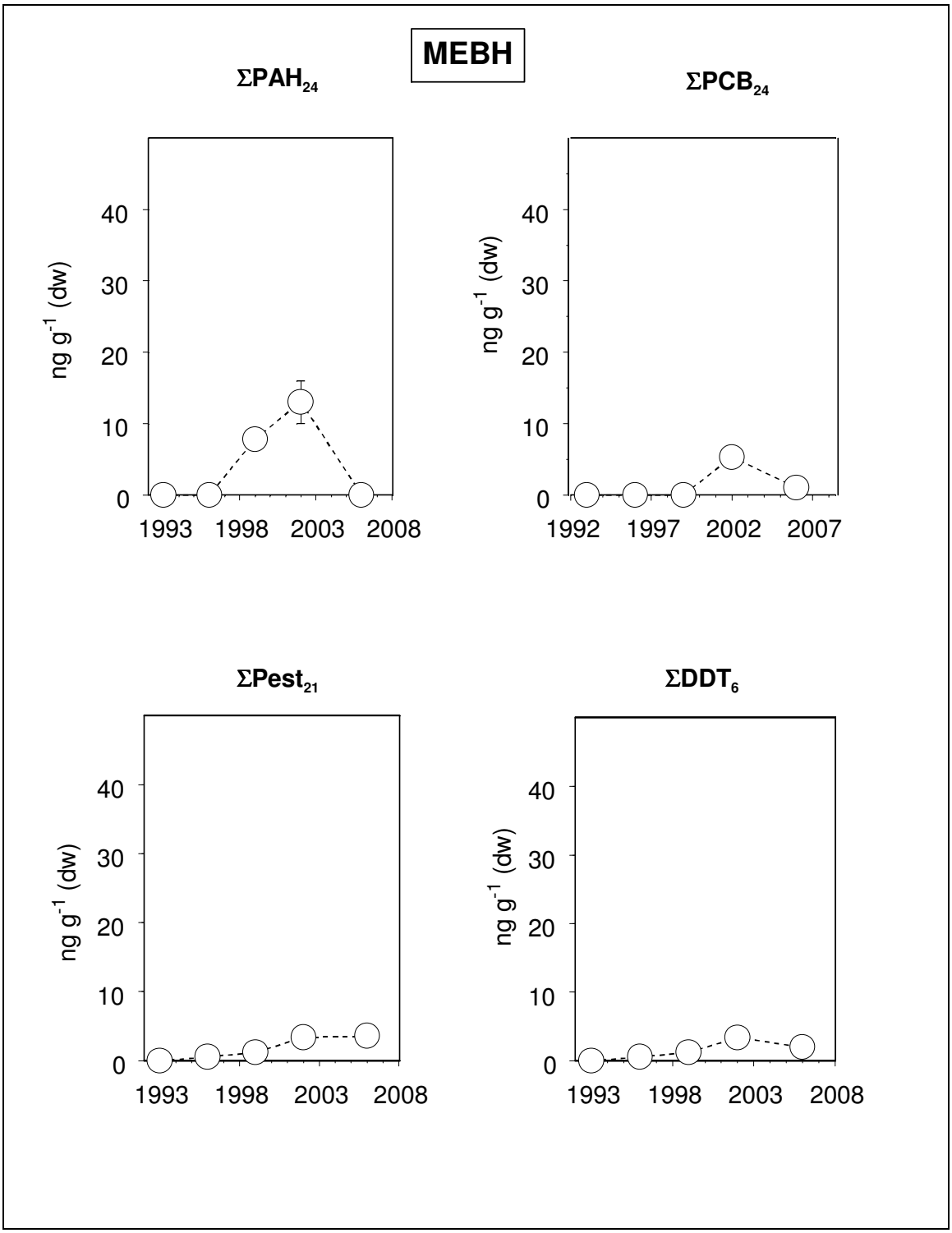

Figure 21C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the MEBH Gulfwatch site from selected years during the period from 1993-2006.

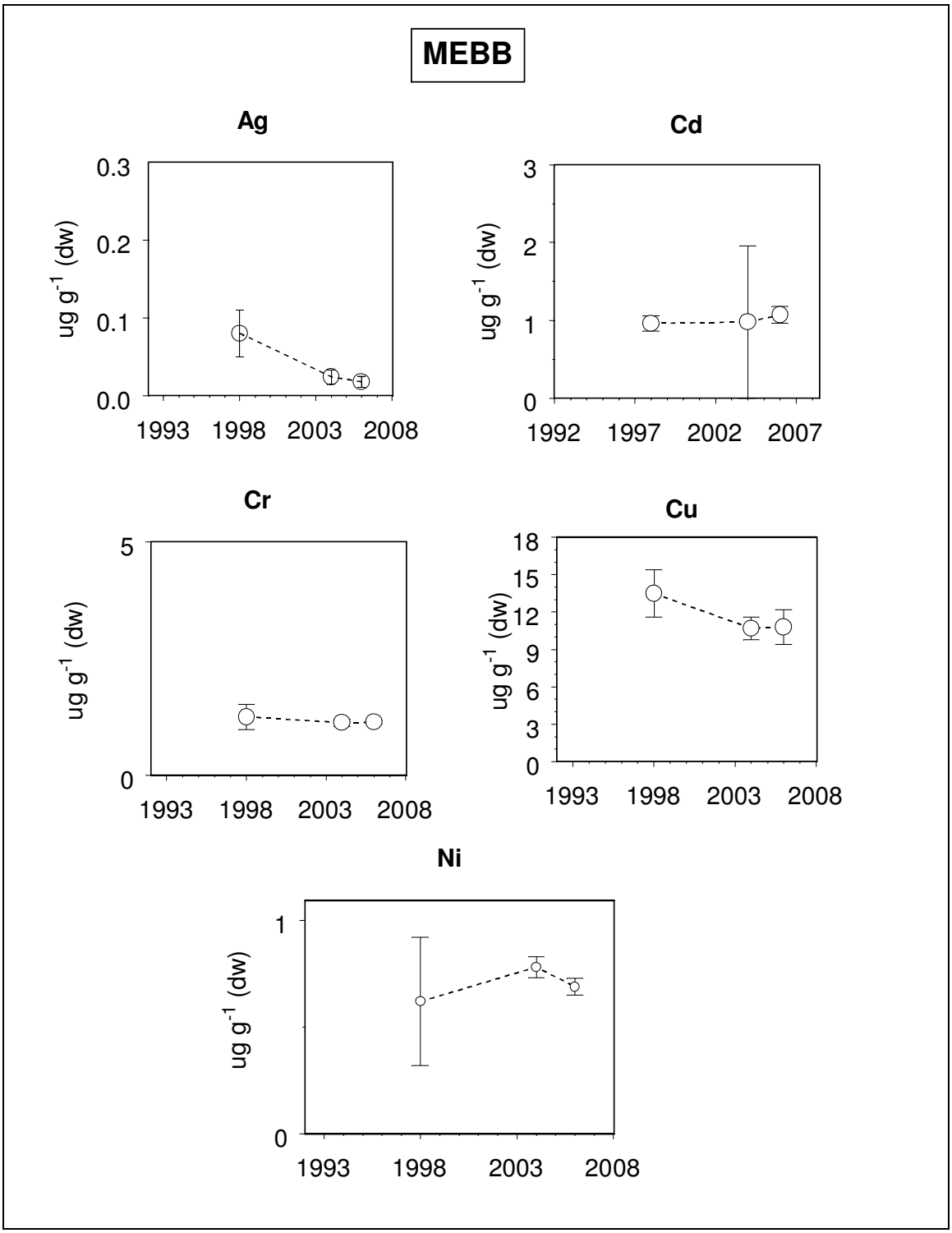

Figure 22A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the MEBB Gulfwatch site from selected years during the period from 1993-2006. Cu and Cr values determined on the 2003 samples are omitted due to suspected contamination.

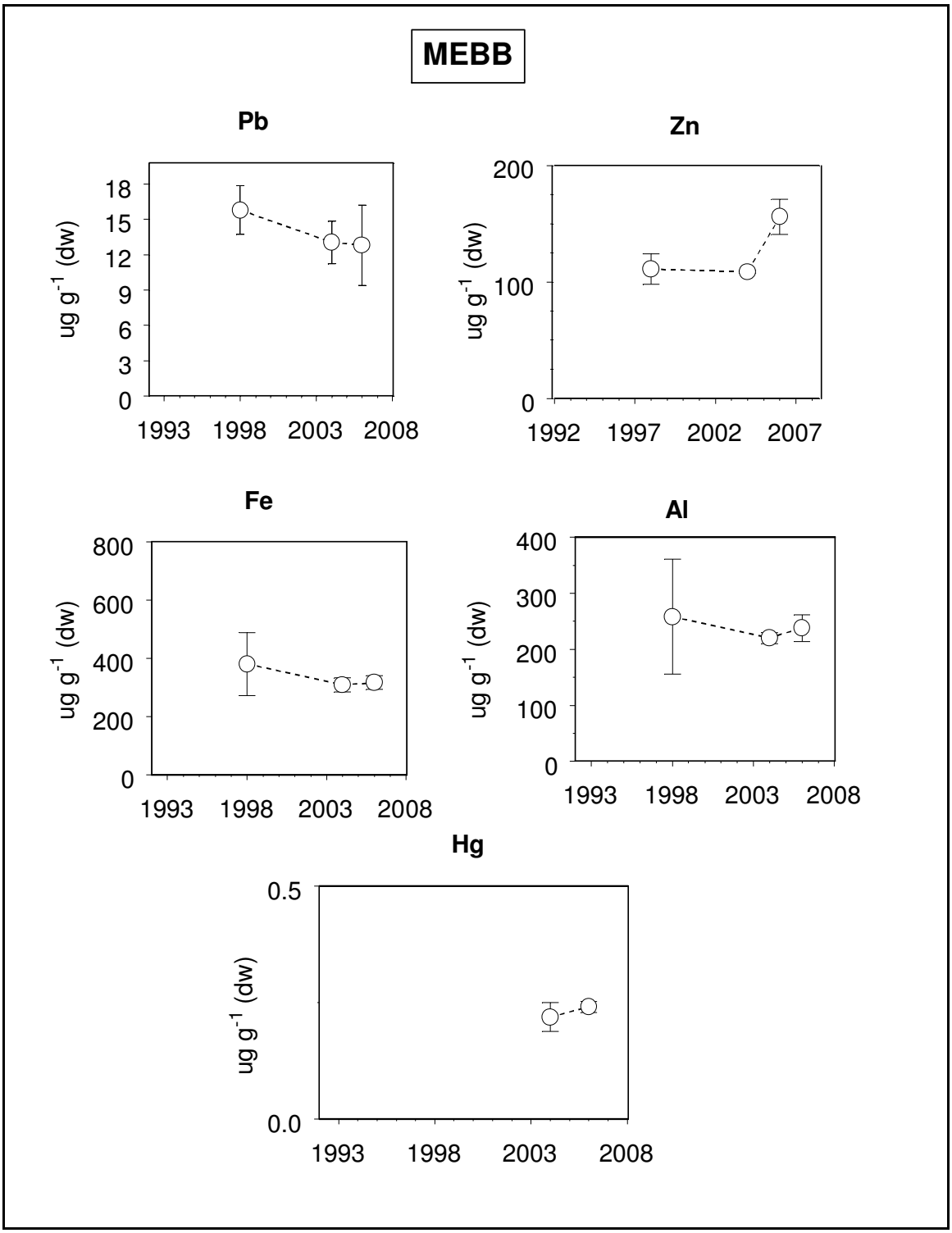

Figure 22B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the MEBB Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

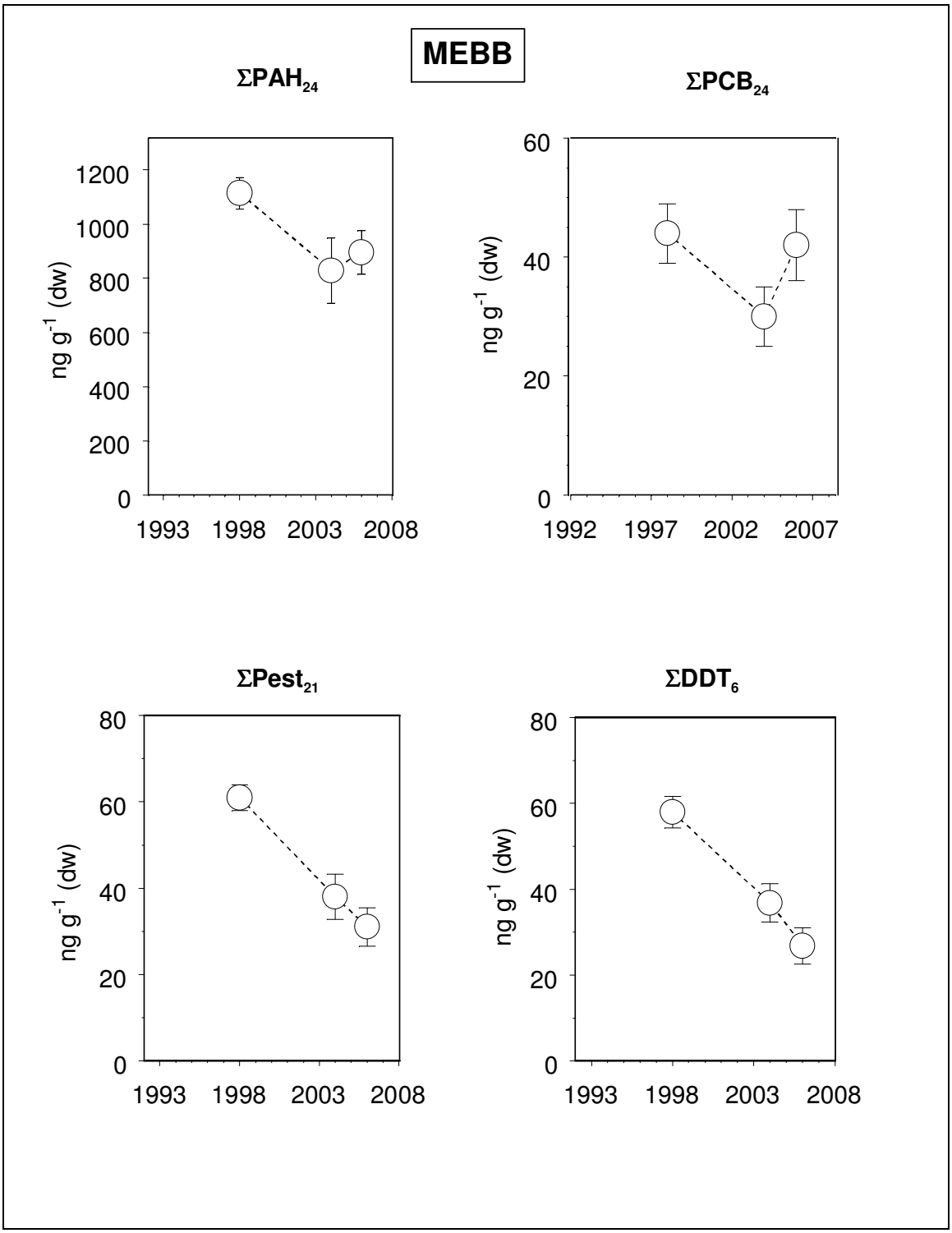

Figure 22C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the MEBB Gulfwatch site from selected years during the period from 1993-2006.

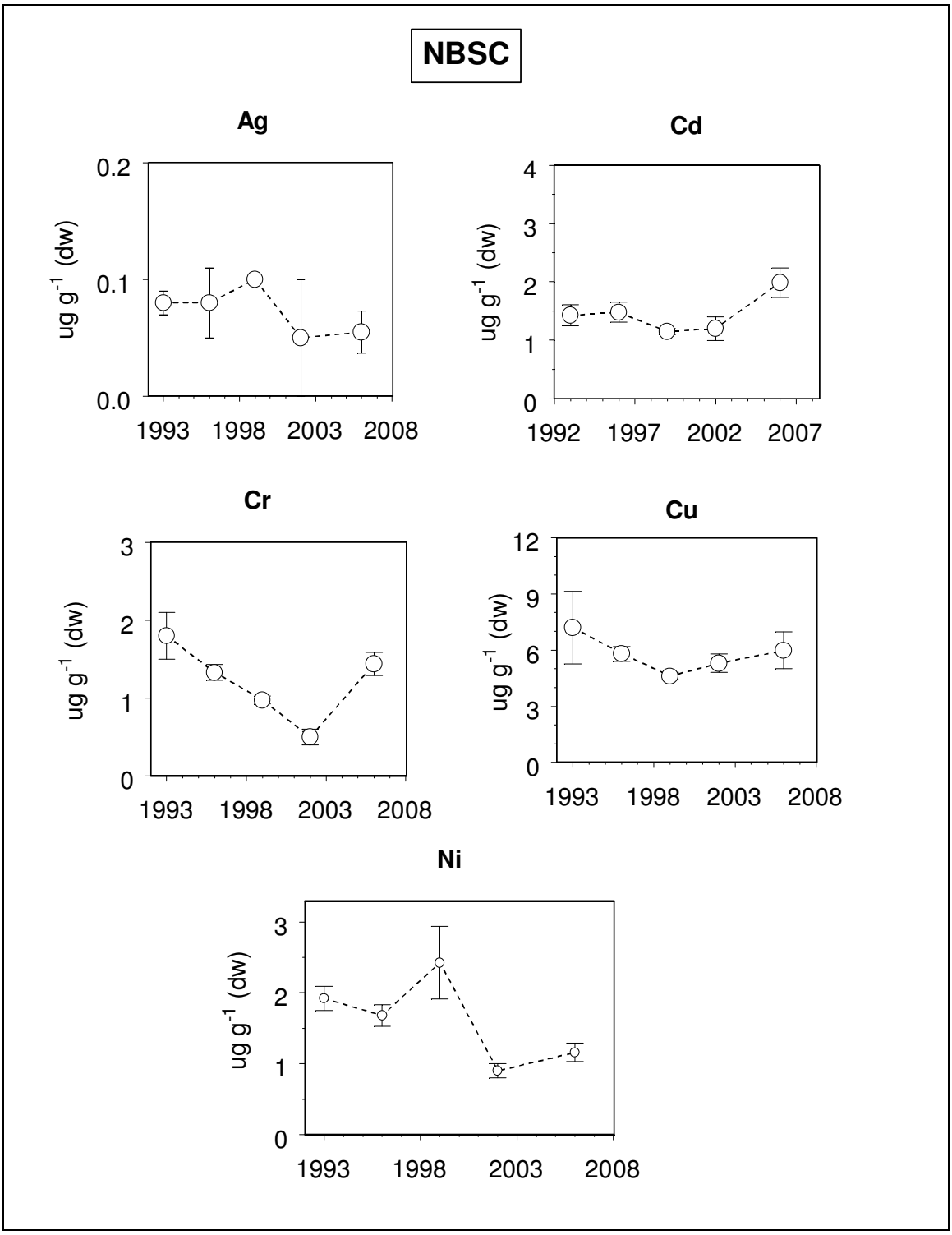

Figure 23A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NBSC Gulfwatch site from selected years during the period from 1993-2006.

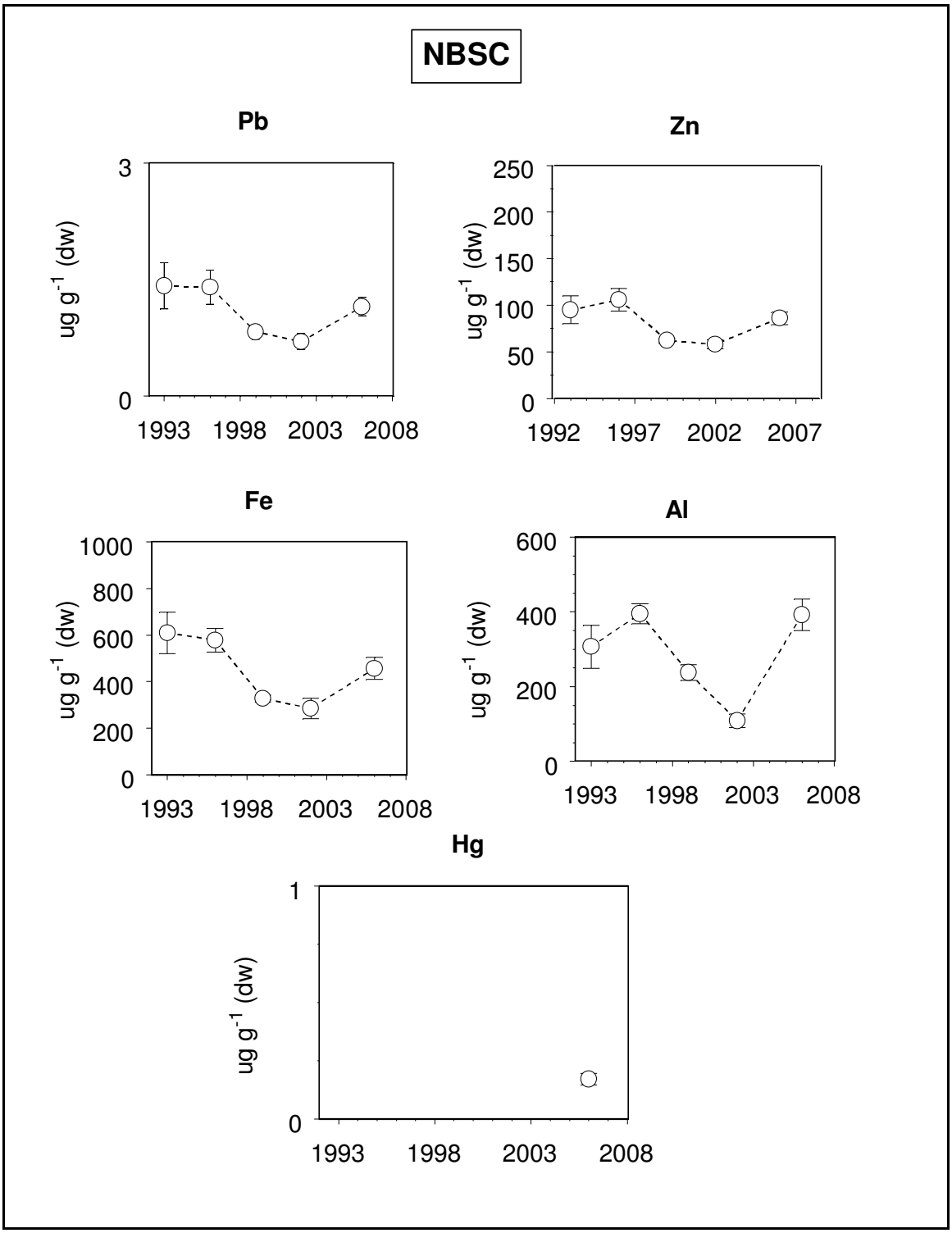

Figure 23B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NBSC Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

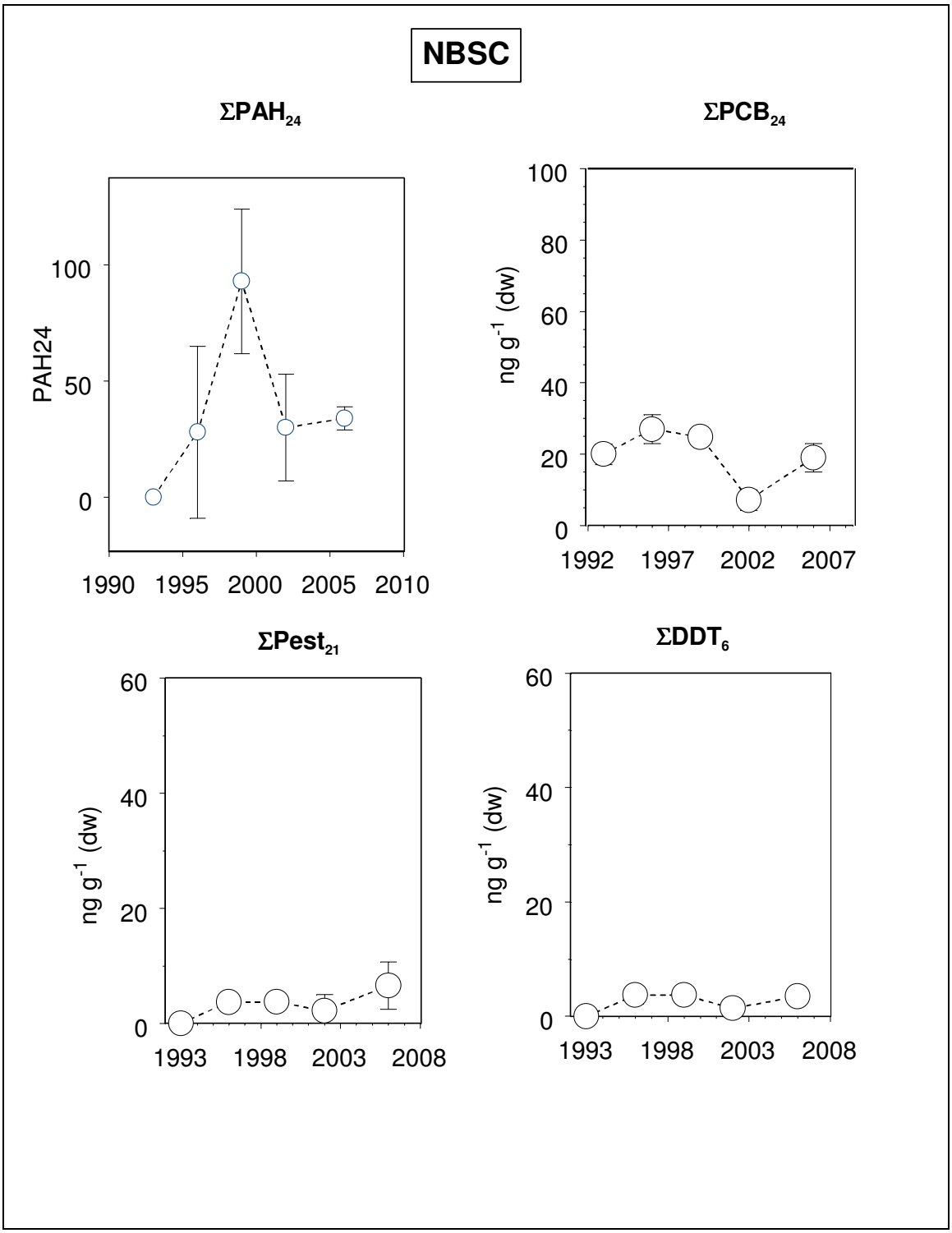

Figure 23C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NBSC Gulfwatch site from selected years during the period from 1993-2006.

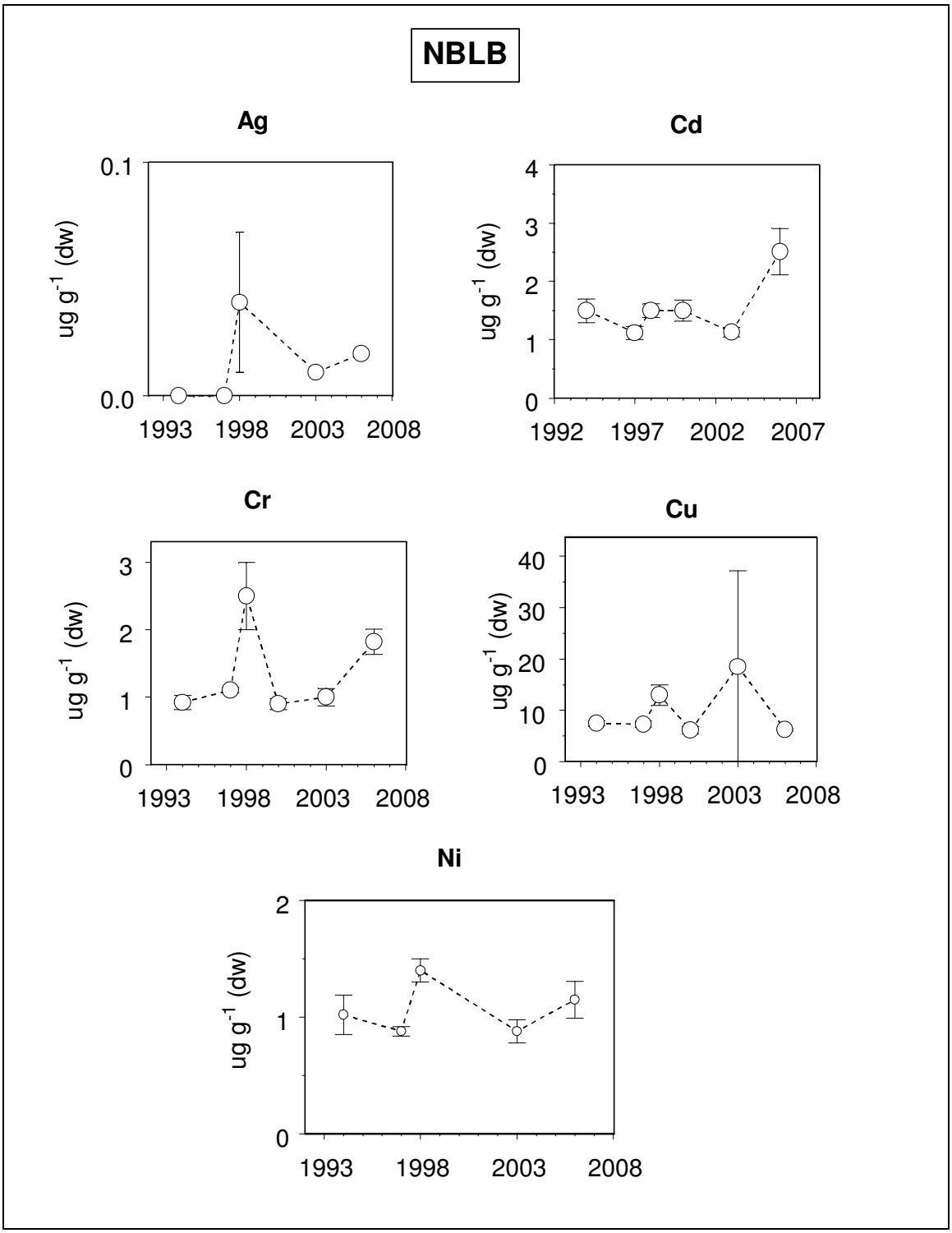

Figure 24A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NBLB Gulfwatch site from selected years during the period from 1993-2006.

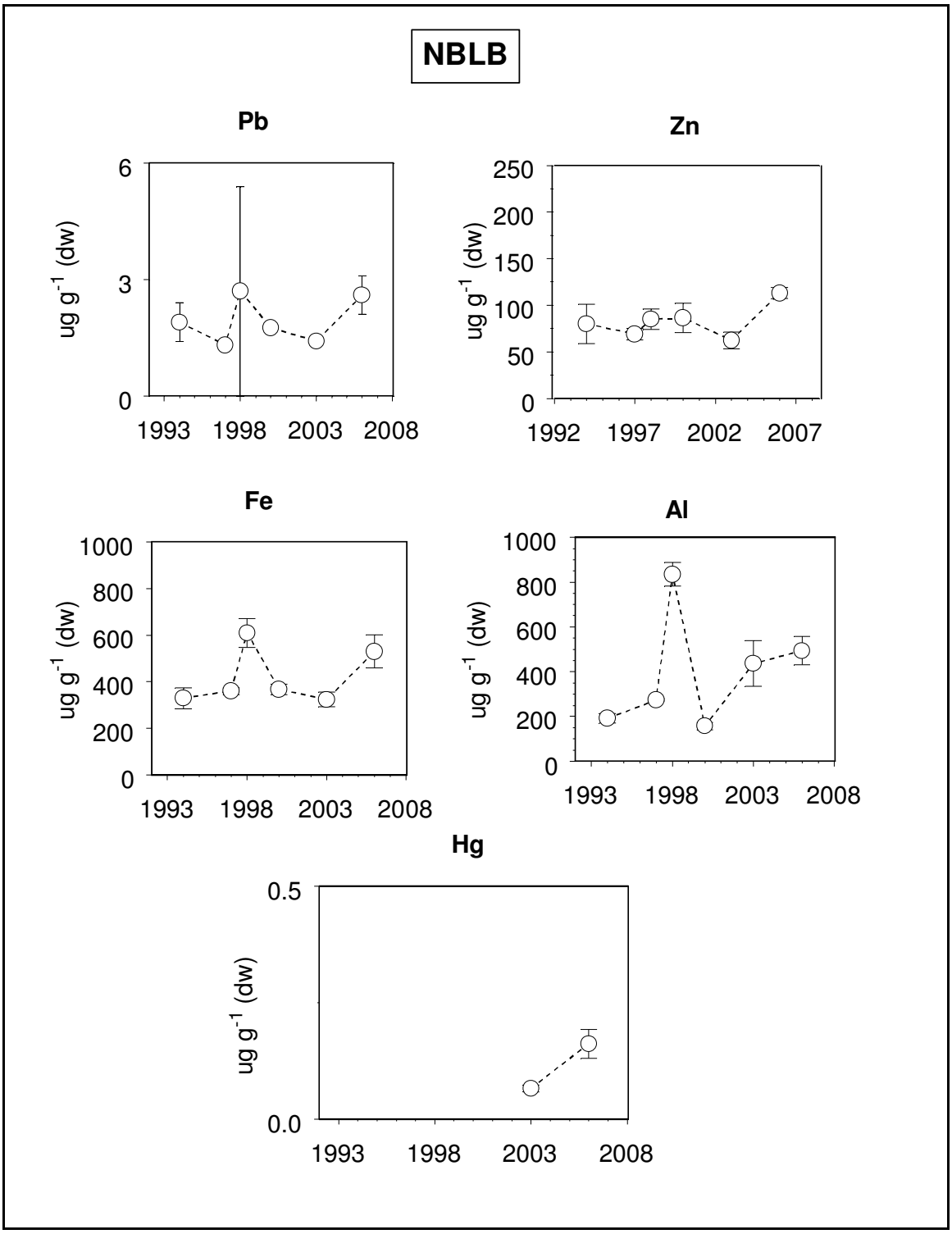

Figure 24B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NBLB Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

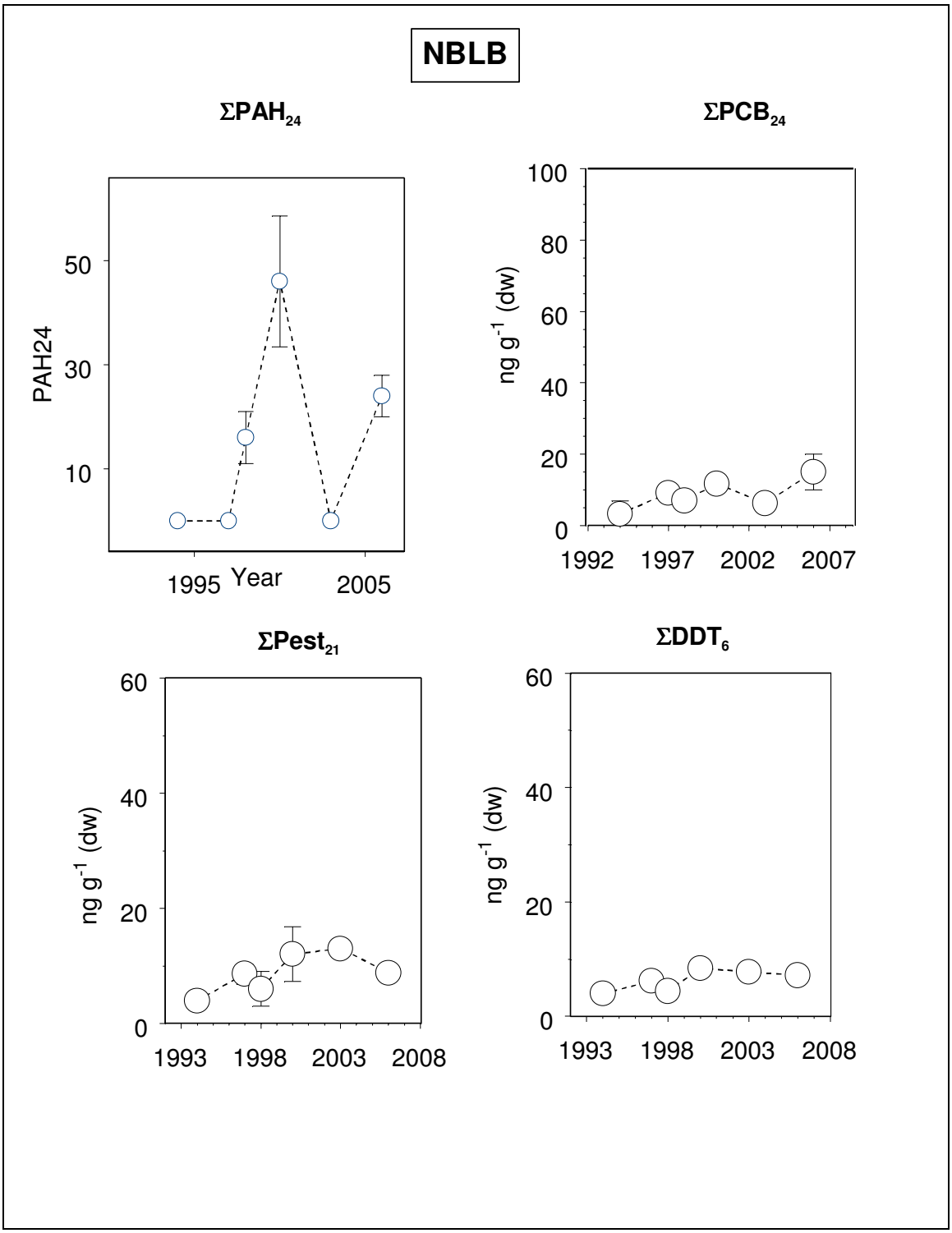

Figure 24C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NBLB Gulfwatch site from selected years during the period from 1993-2006.

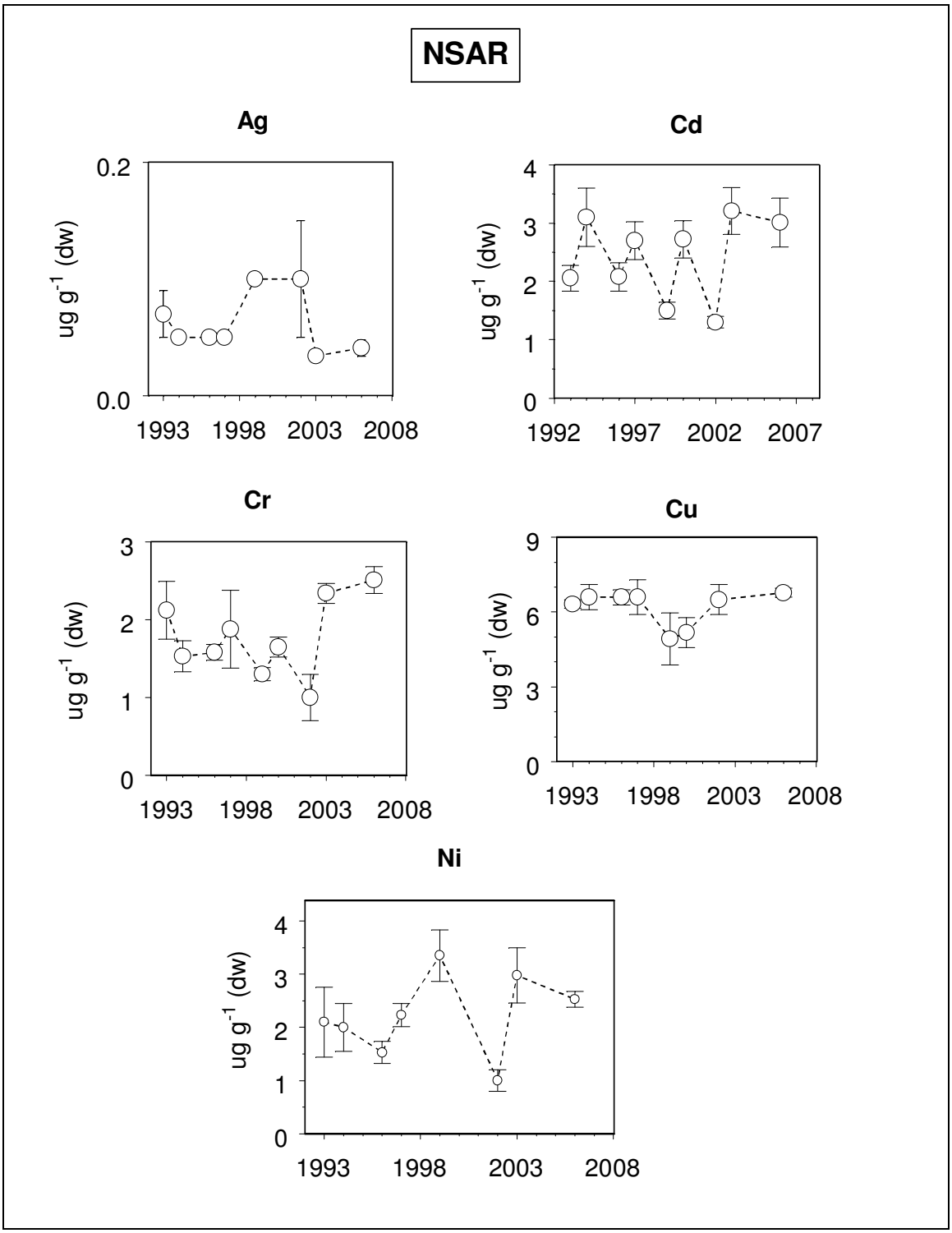

Figure 25A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NSAR Gulfwatch site from selected years during the period from 1993-2006.

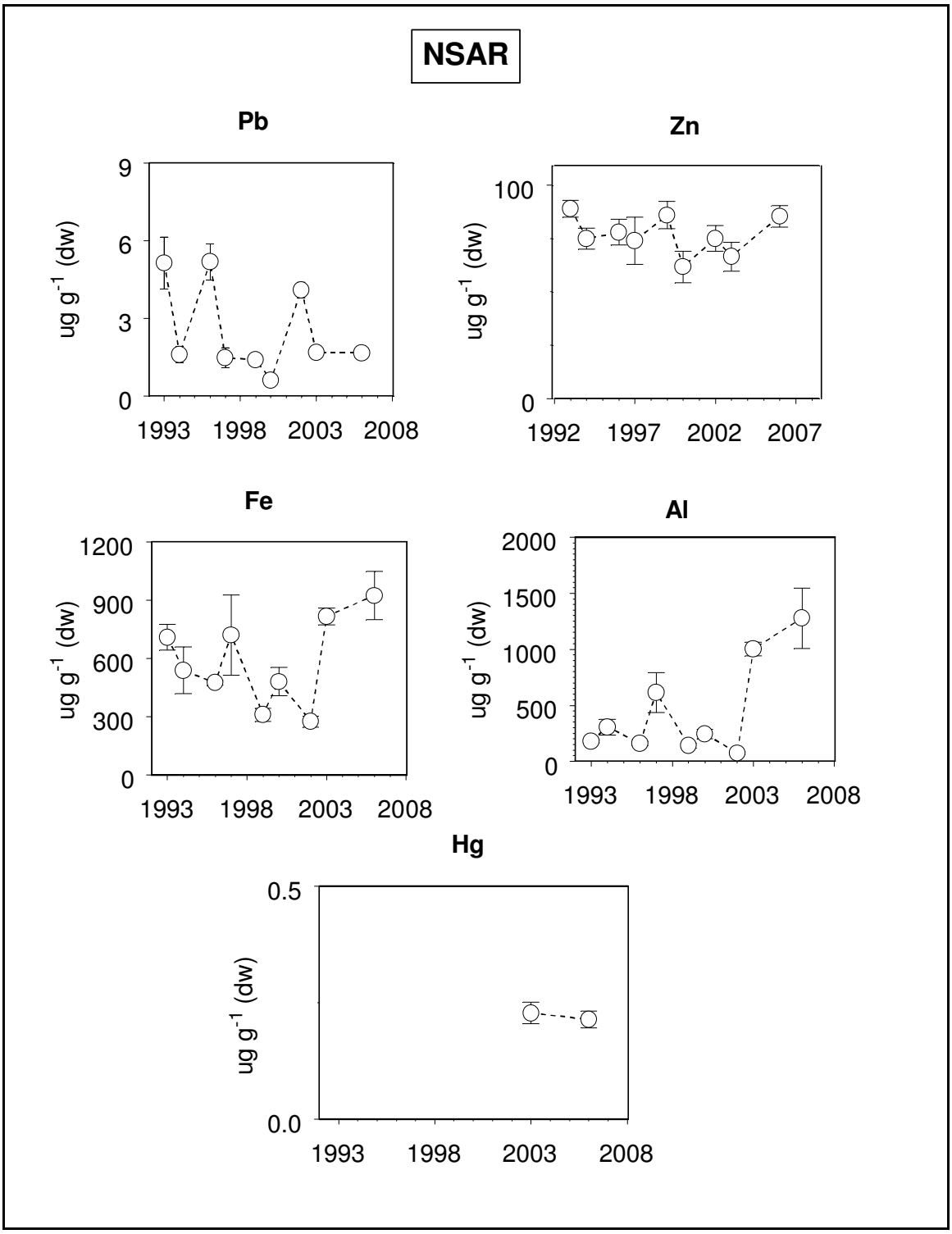

Figure 25B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NSAR Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

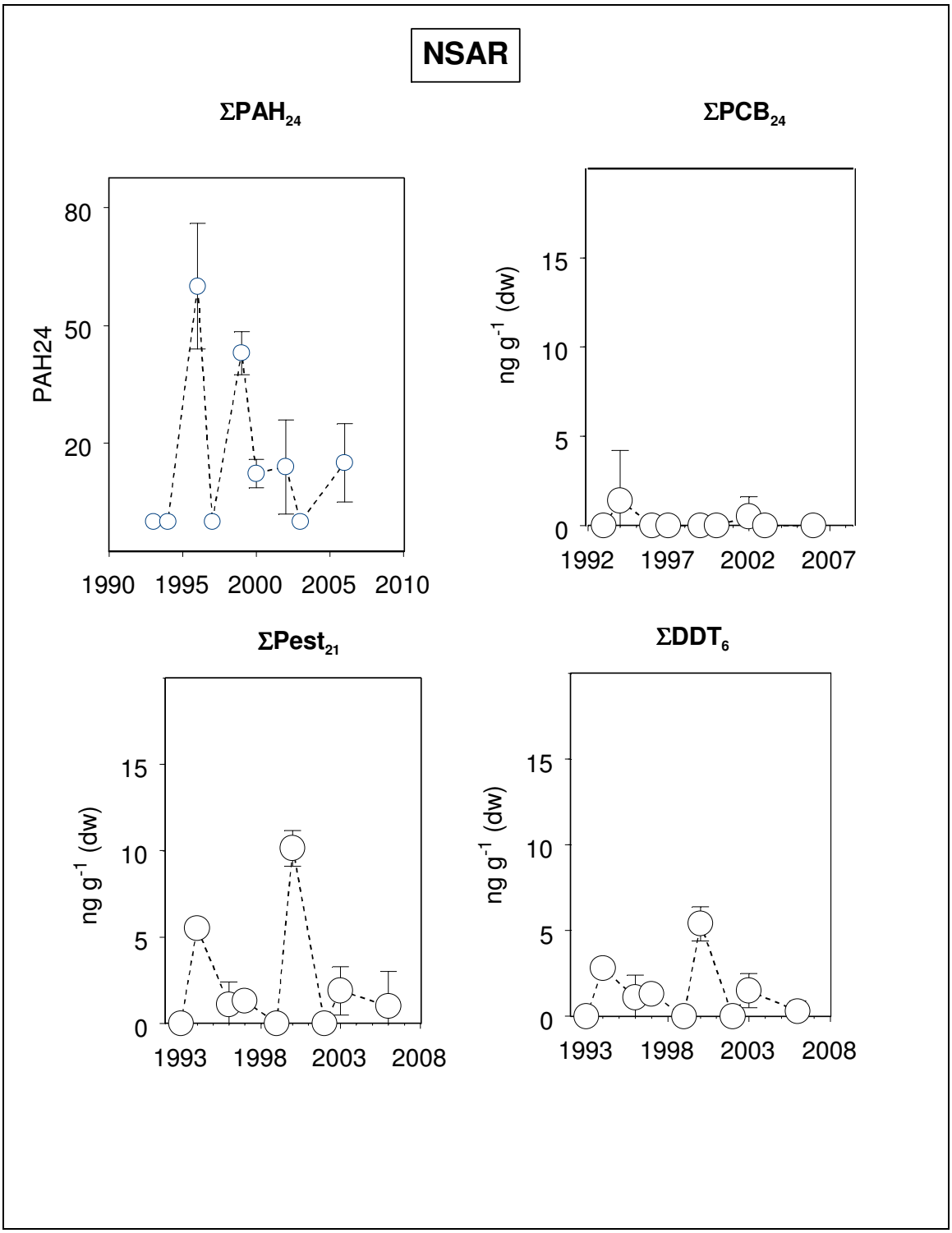

Figure 25C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NSAR Gulfwatch site from selected years during the period from 1993-2006.

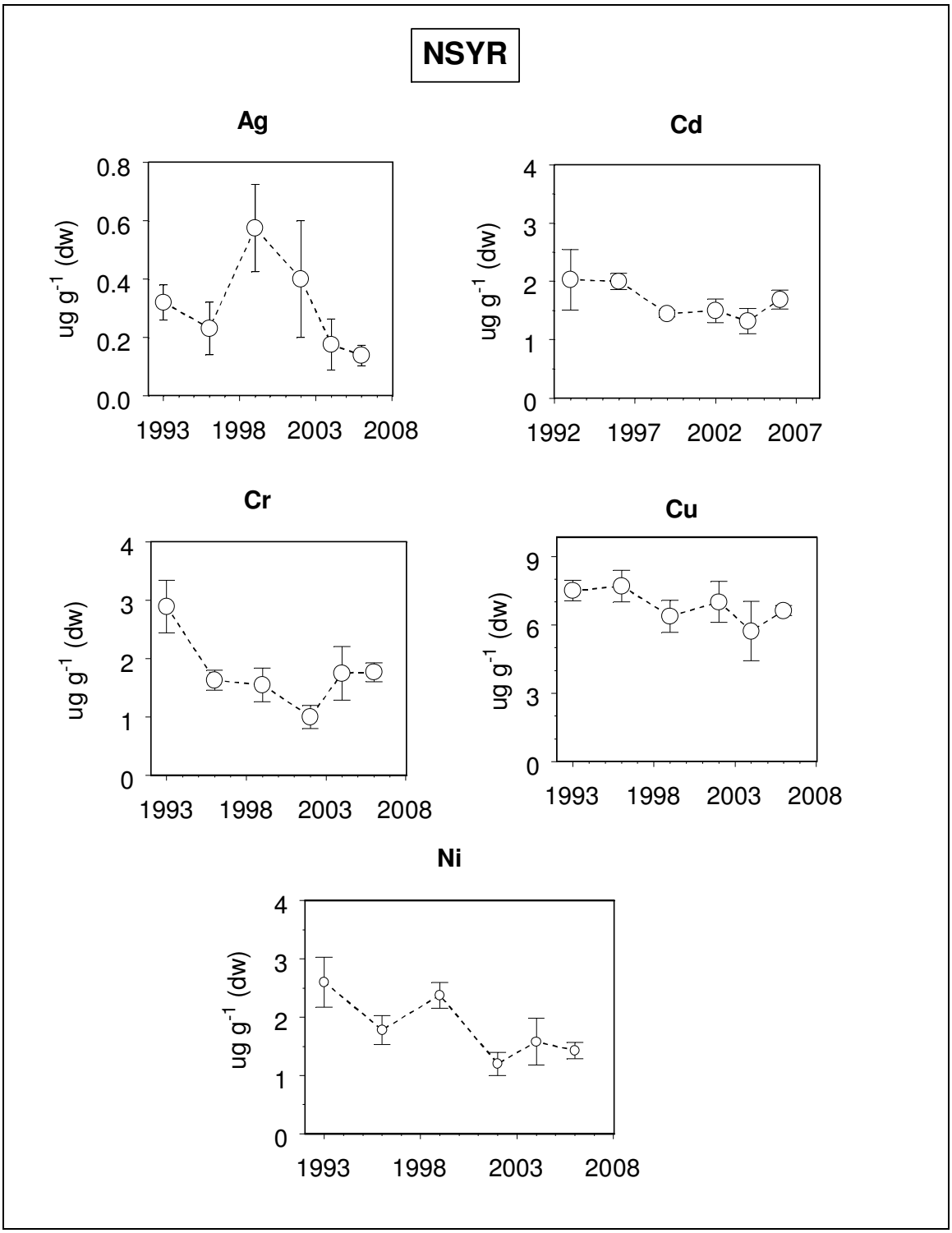

Figure 26A. Distribution of metals (Ag, Cd, Cr, Cu, Ni) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NSYR Gulfwatch site from selected years during the period from 1993-2006.

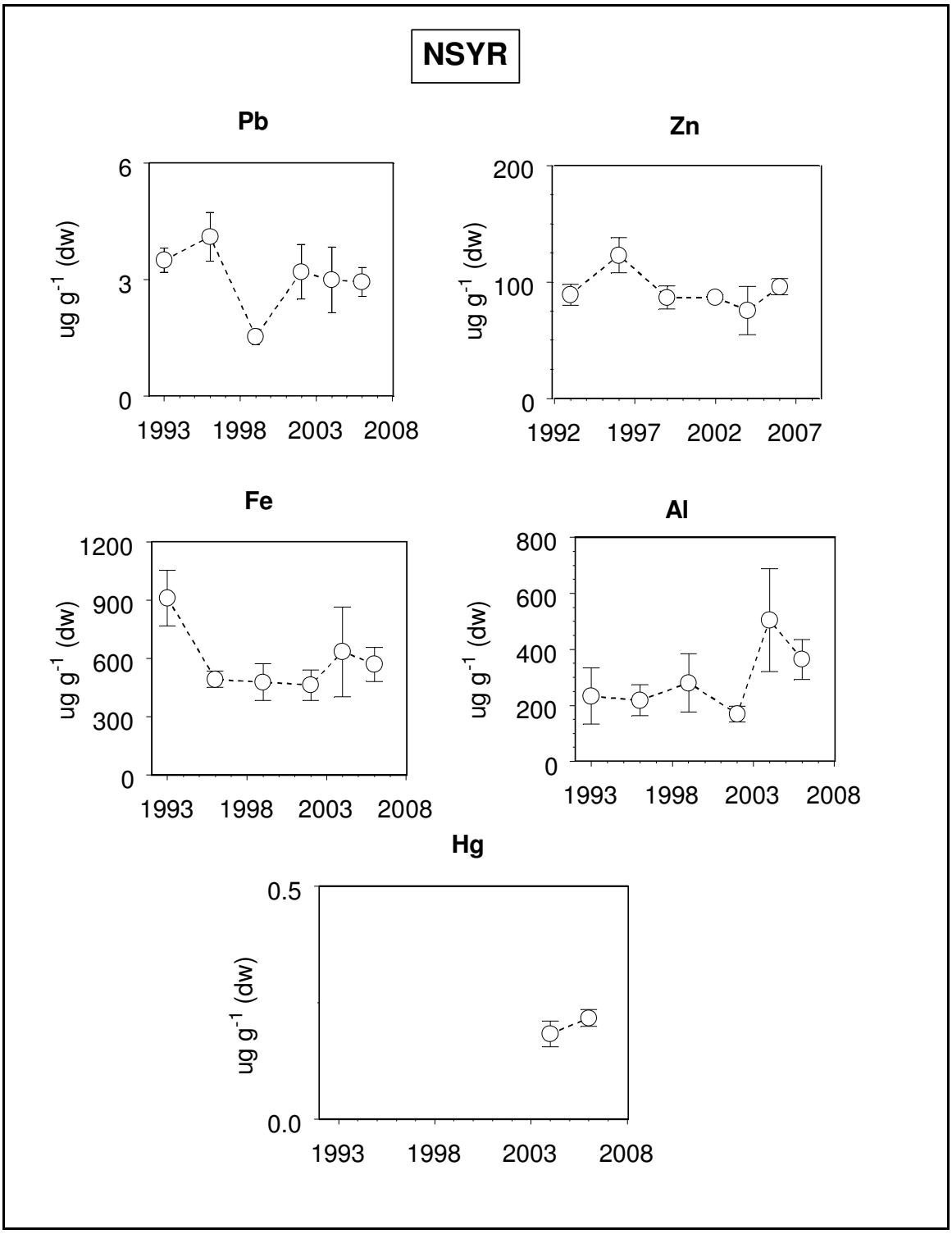

Figure 26B. Distribution of metals (Pb, Zn, Fe, Al, and Hg) concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels collected at the NSYR Gulfwatch site from selected years during the period from 1993-2006. Hg data prior to 2003 remains suspect for analytical reasons.

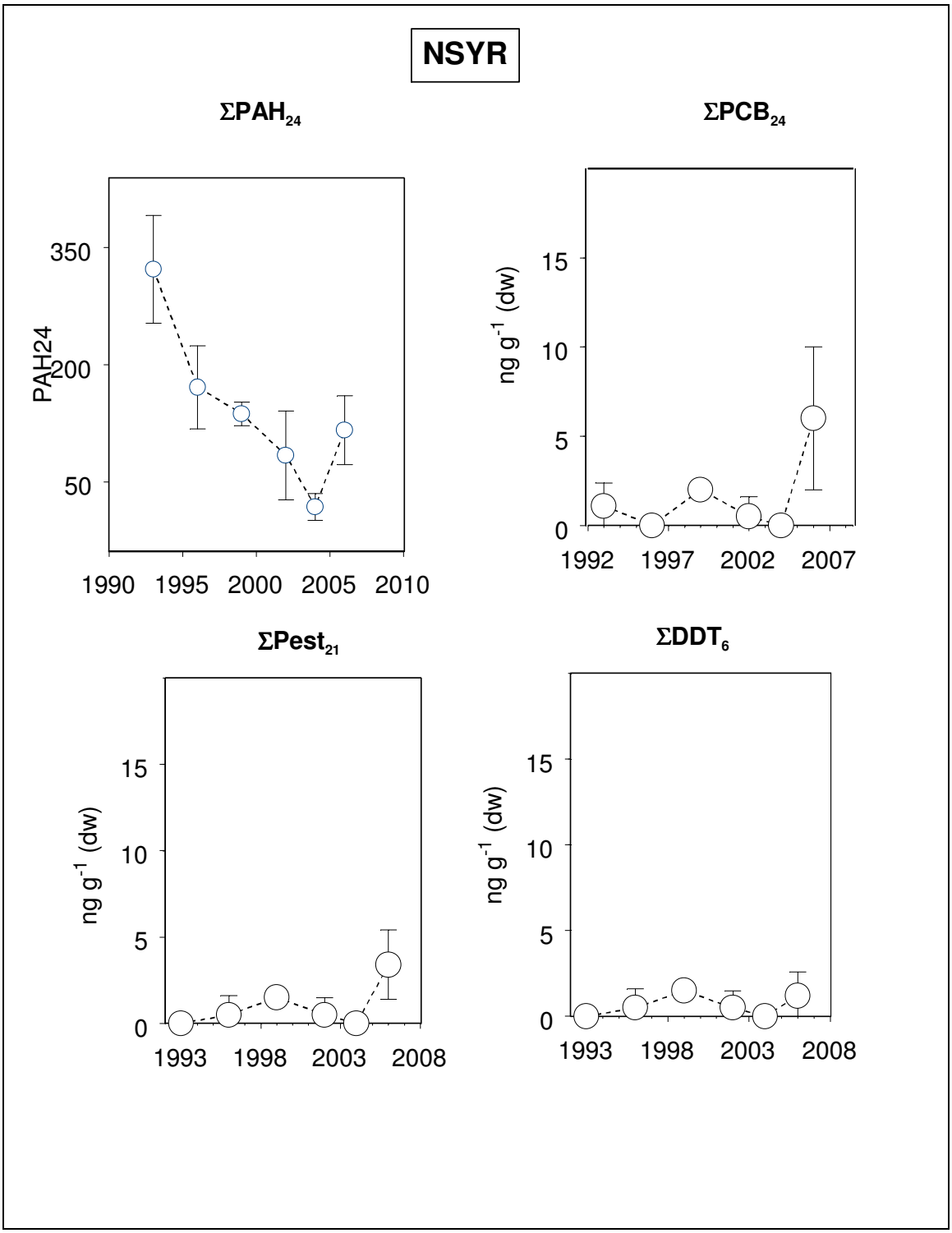

Figure 26C. Distribution of selected organic contaminant concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels collected at the NSYR Gulfwatch site from selected years during the period from 1993-2006.

4.2.2 Trend (Benchmark) Sites

Five trend sites (previously referred to as Benchmark sites) that were scheduled for sampling each year in addition to the rotational sites are plotted for the 1993-2006 Program period below. Only two of the trend sites were sampled in 2006 (MECC and MEKN) and these sites are thus updated. These plots show contaminant-specific changes observed at the individual trend sites beginning with MASN (Sandwich, MA) and continuing north and east in a clockwise manner (Figures 27-40). Statistically significant decreases for several contaminants over time were reported in Jones et al. (in press) using the 1993-2001 database for trend sites and have not included the 2002-2005 data. From a qualitative examination of the mean of contaminants levels in mussel tissue, the Sandwich, MA site (MASN) data may show trends in Ag, $\sum PEST_{21}$, and $\sum DDT_6$. Only Gulfwatch mercury data after to 2002 are shown because of suspected analytical artifacts (variable and high detection limits) existed prior to 2003.

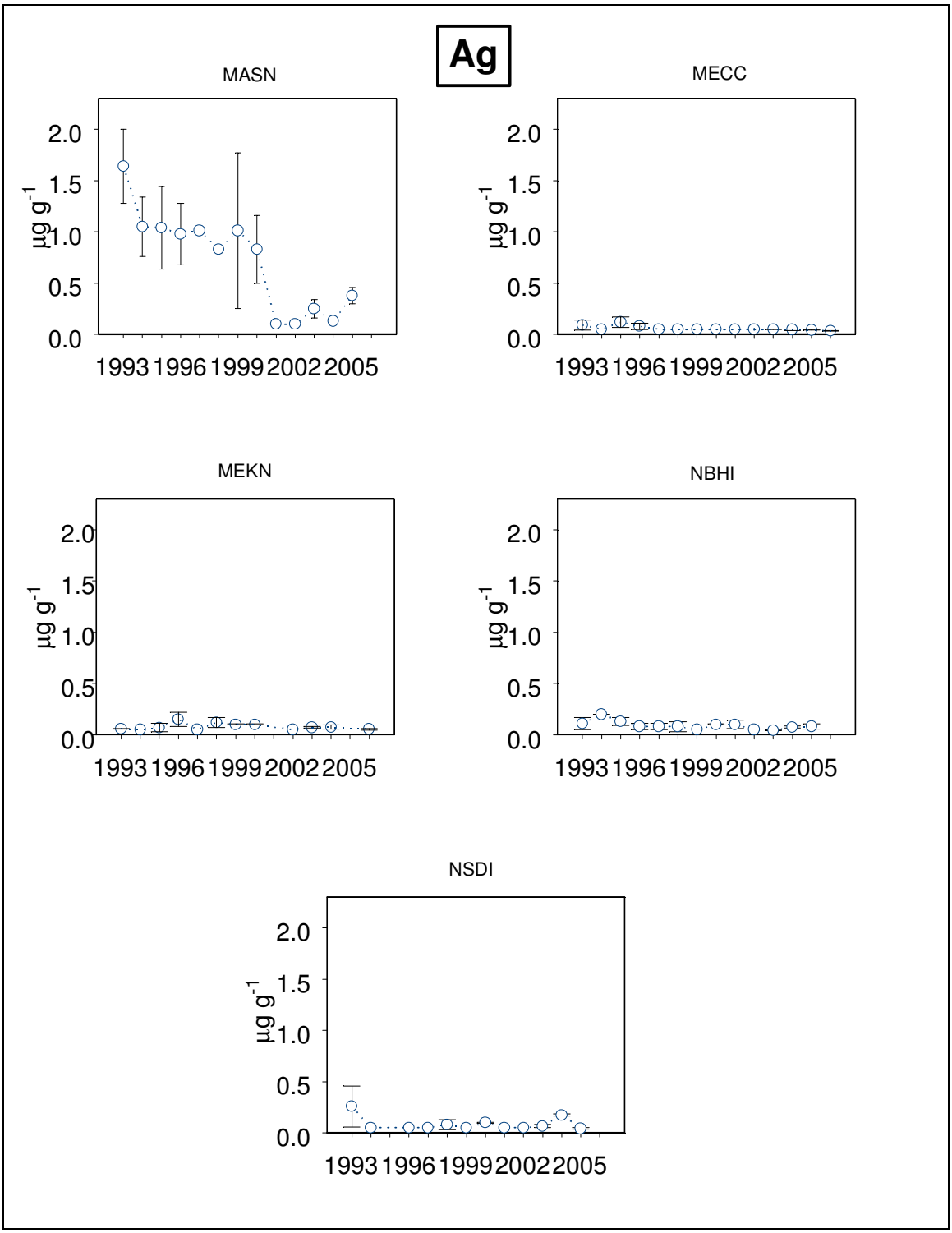

Figure 27. Distribution of silver tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

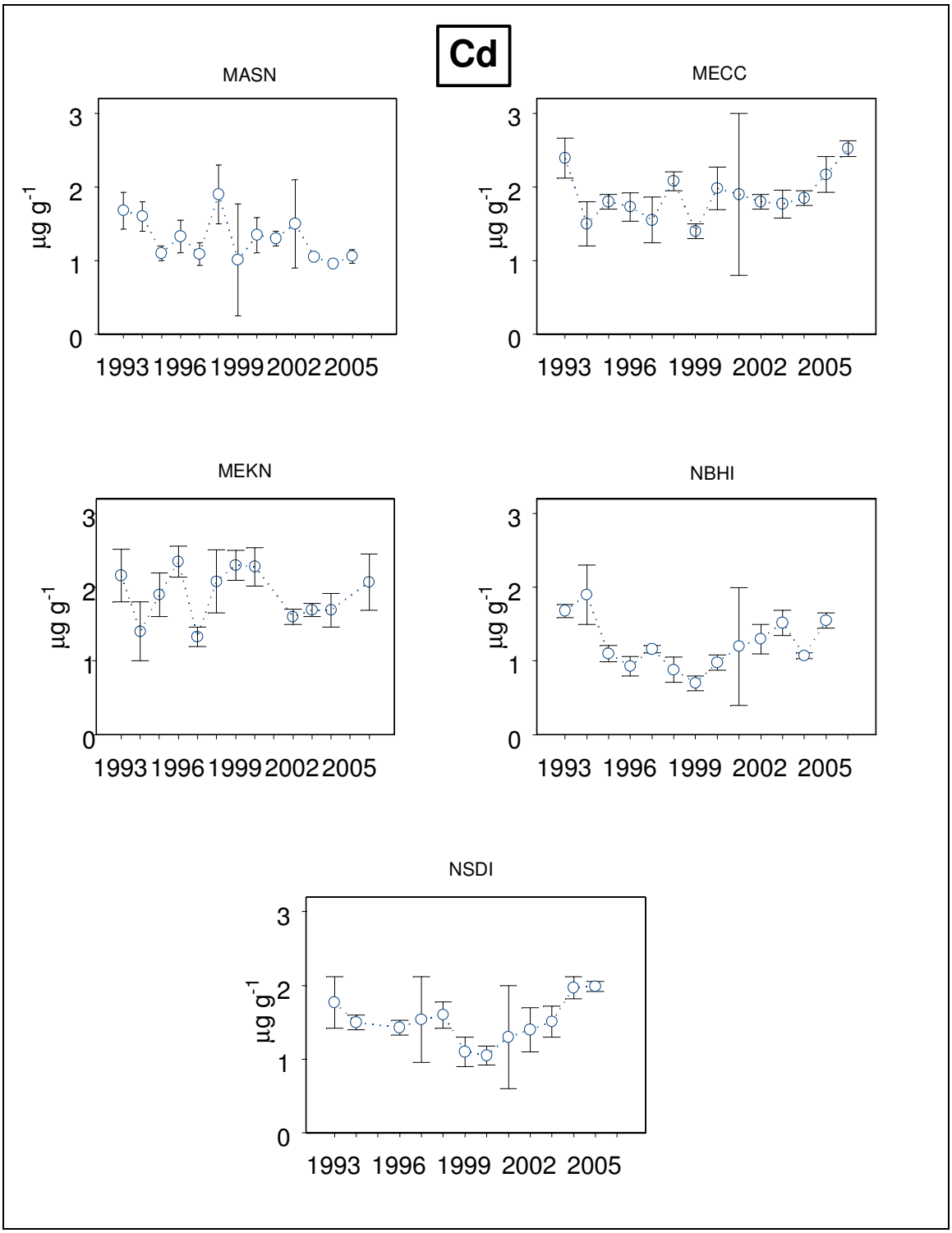

Figure 28. Distribution of cadmium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

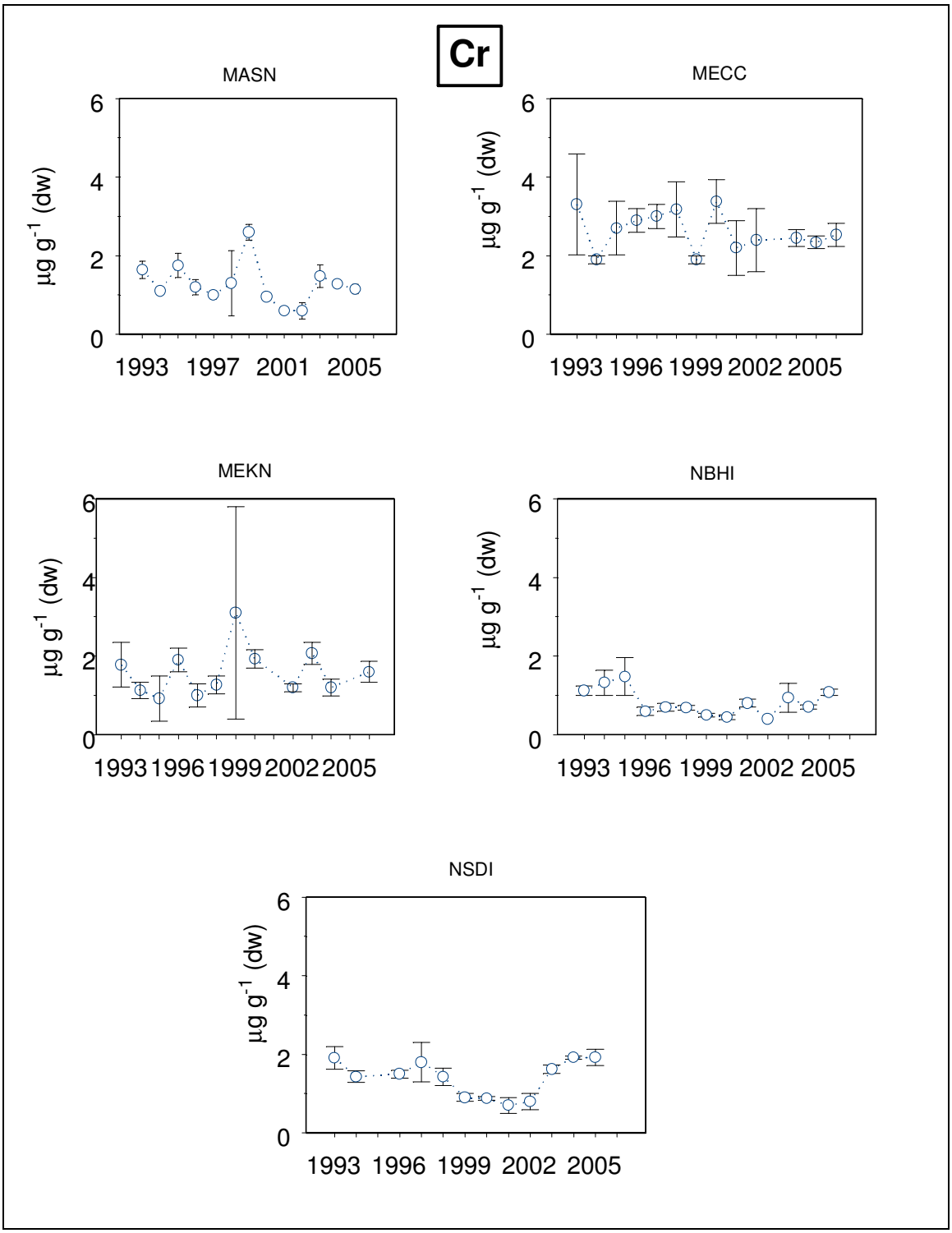

Figure 29. Distribution of chromium tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

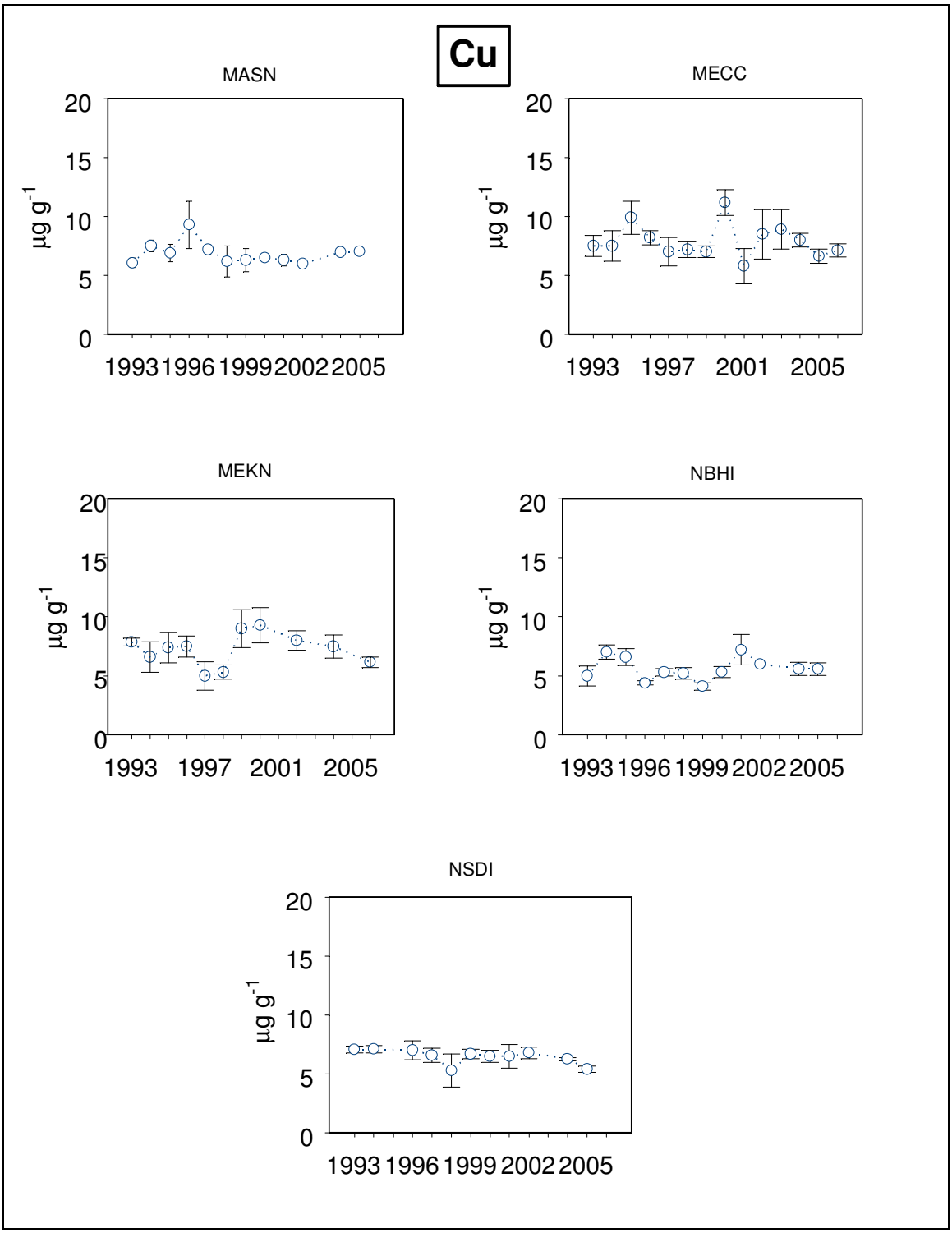

Figure 30. Distribution of copper tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006**.**

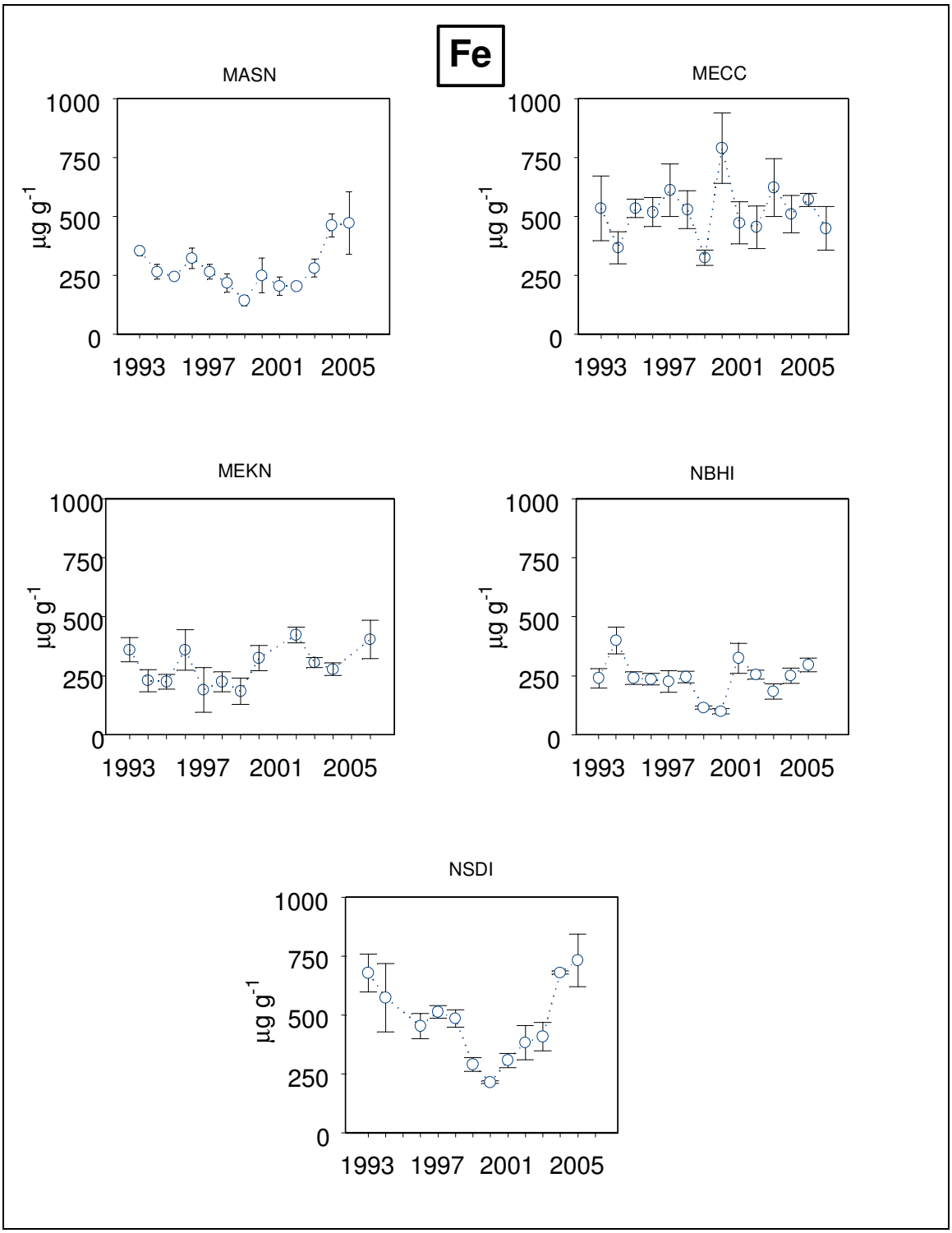

Figure 31. Distribution of iron tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

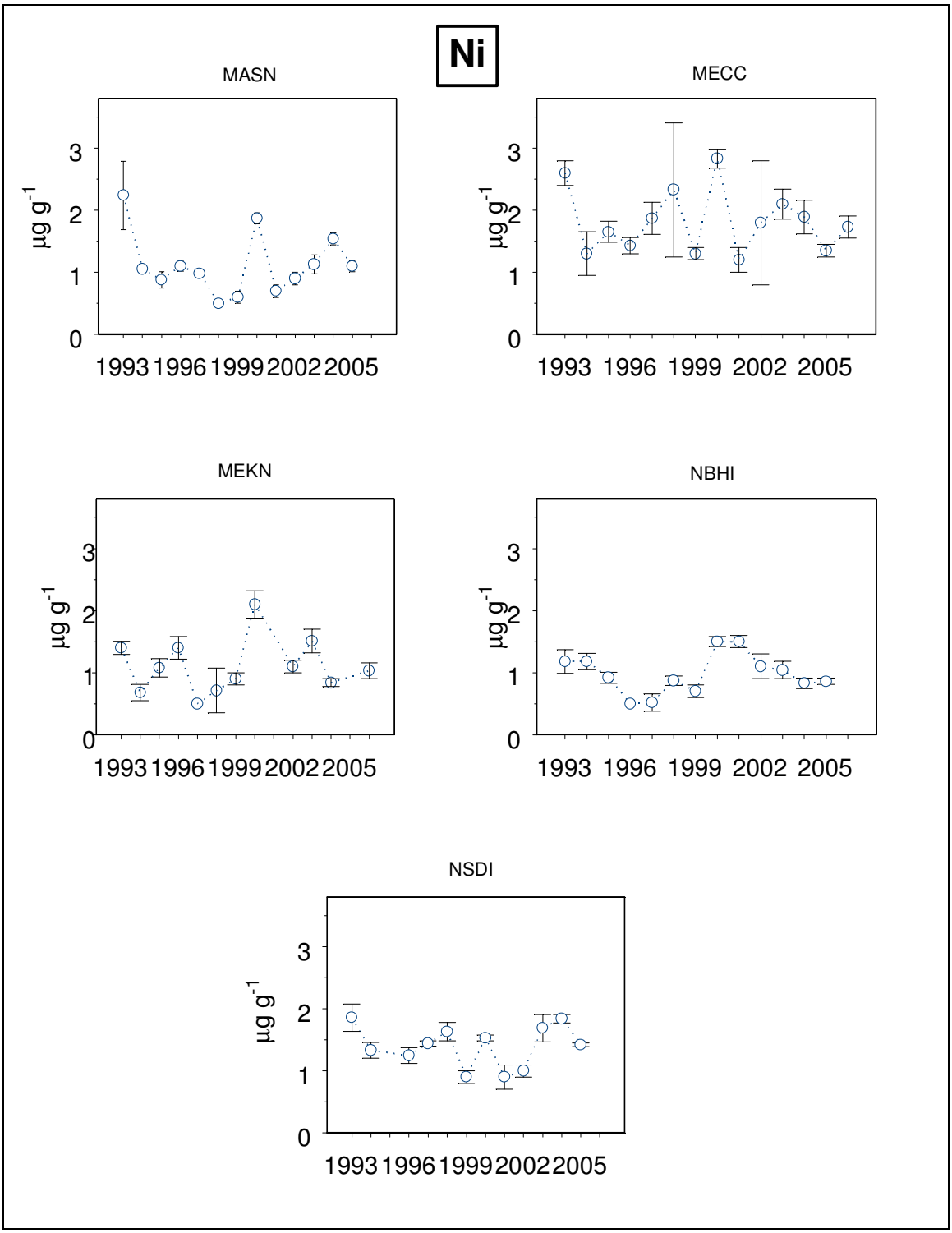

Figure 32. Distribution of nickel tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

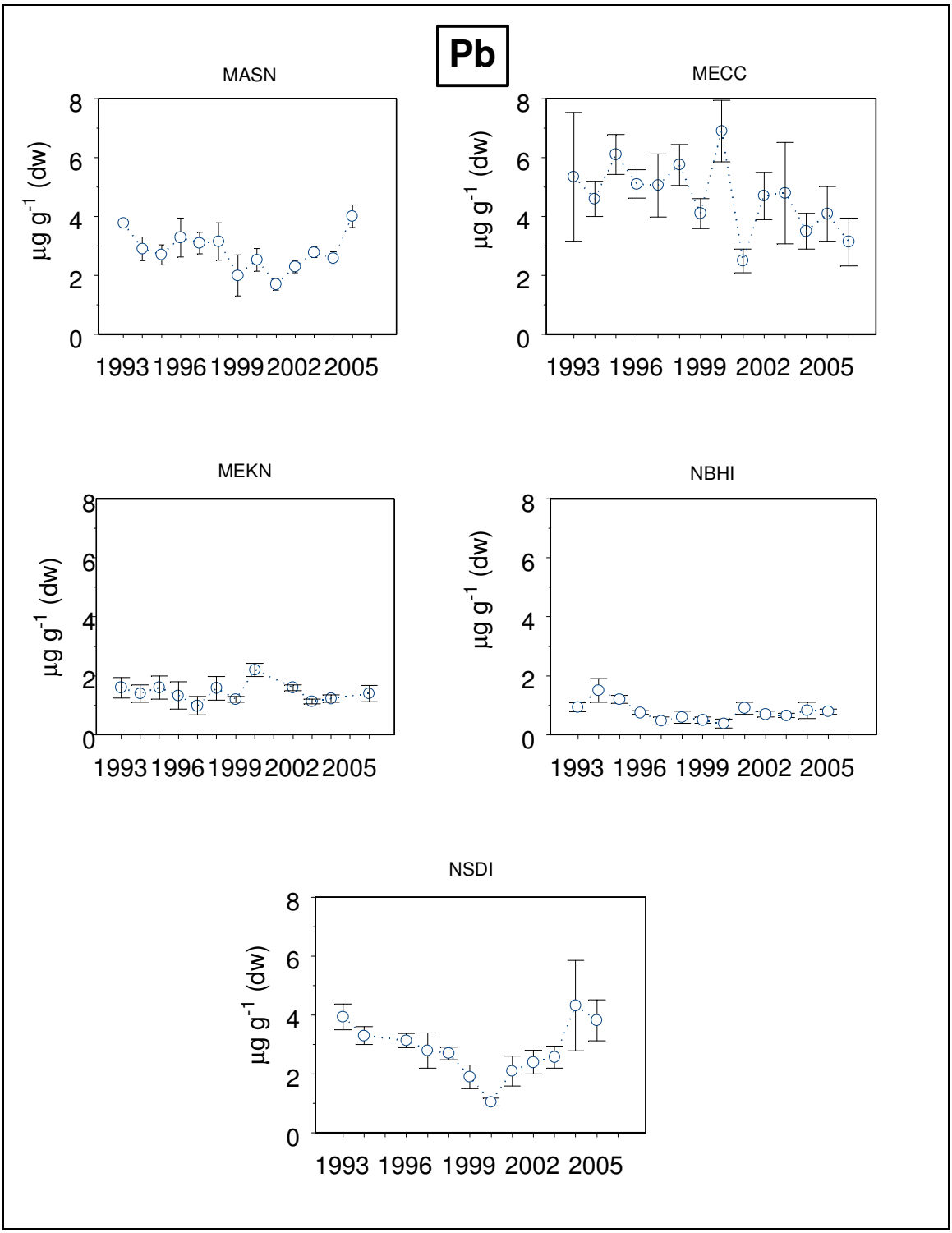

Figure 33. Distribution of lead tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

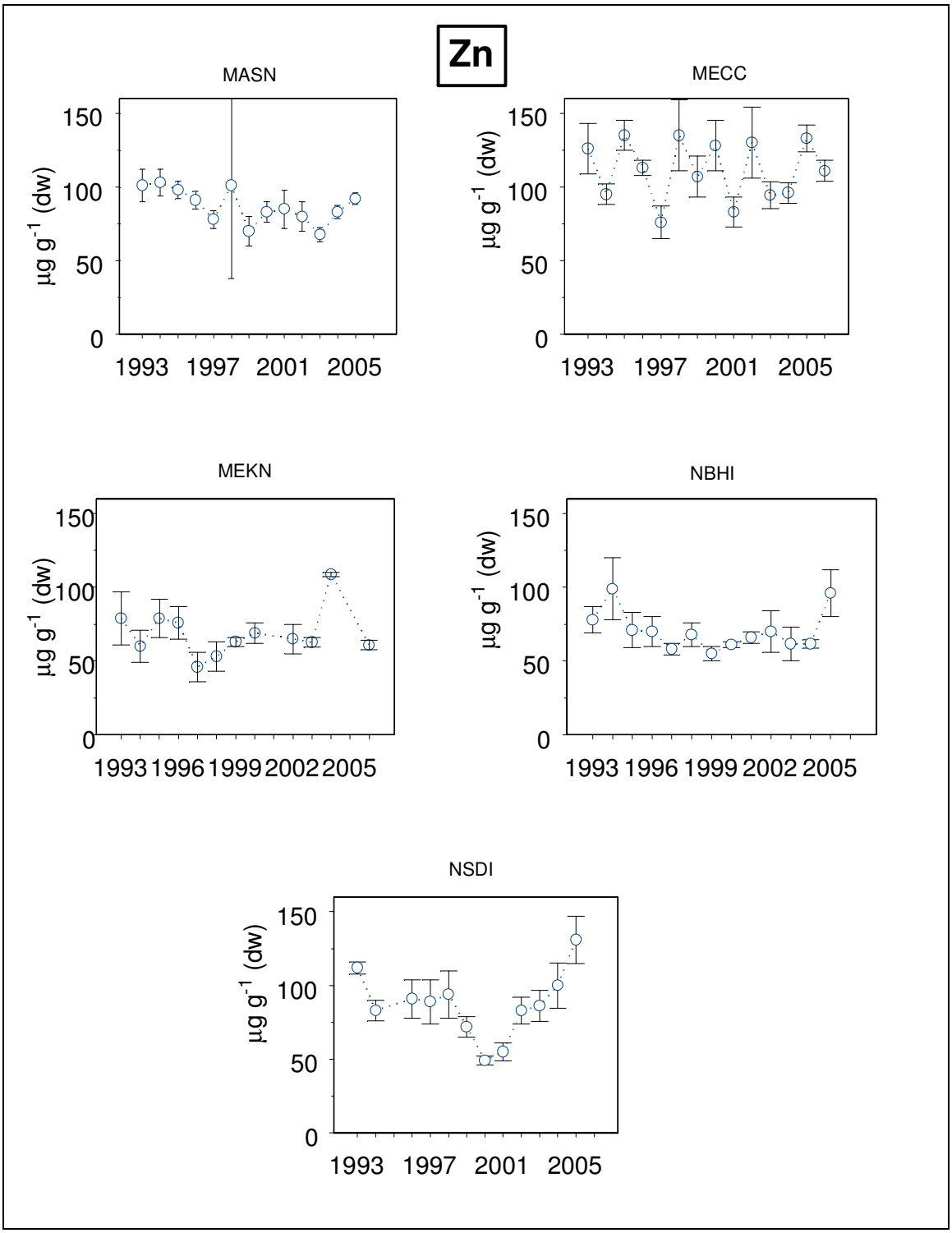

Figure 34. Distribution of zinc tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

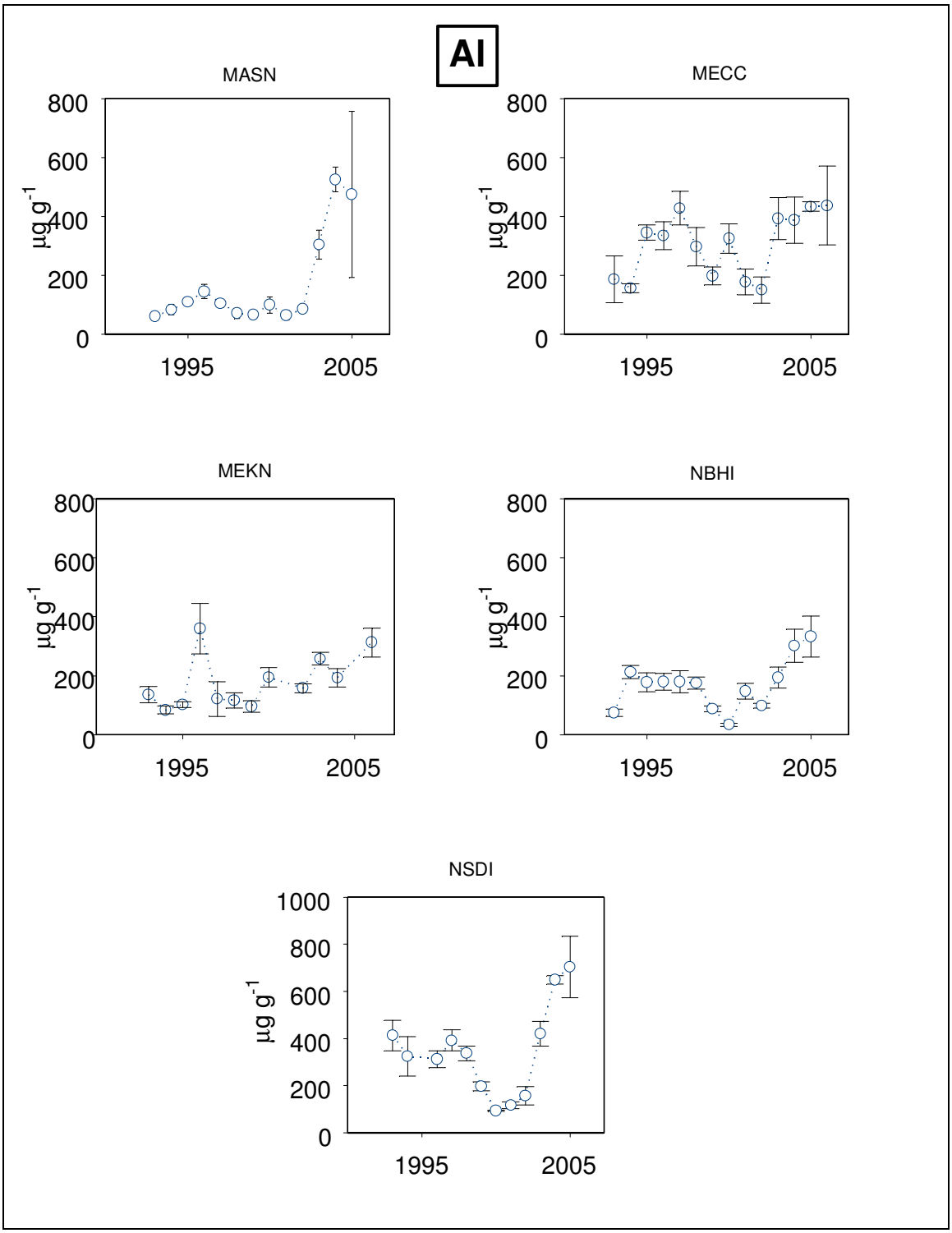

Figure 35. Distribution of aluminum tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 1993-2006.

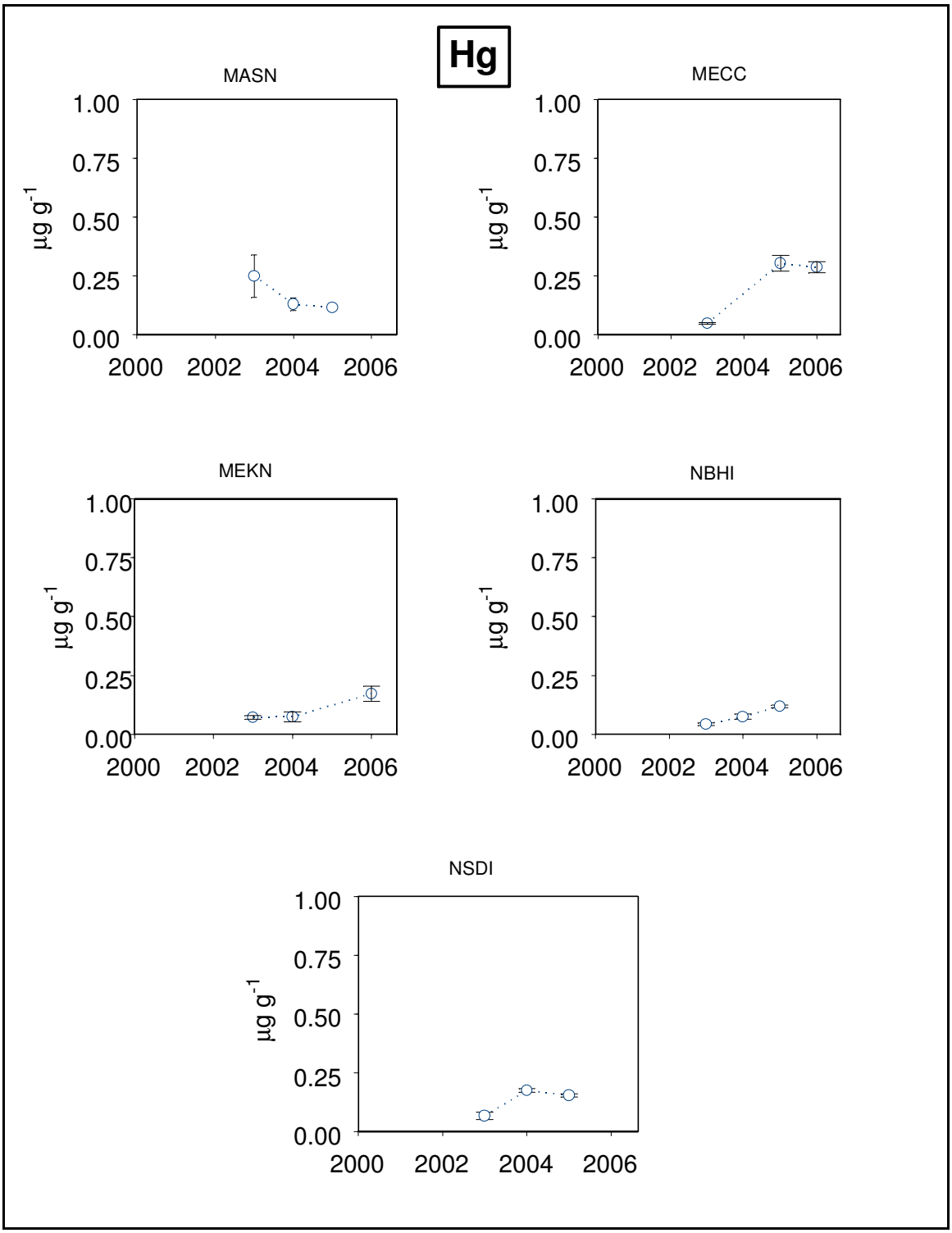

Figure 36. Distribution of mercury tissue concentrations (arithmetic mean +/- SD, µg/g dry weight) in mussels at Gulfwatch benchmark sites in 2003-2006.

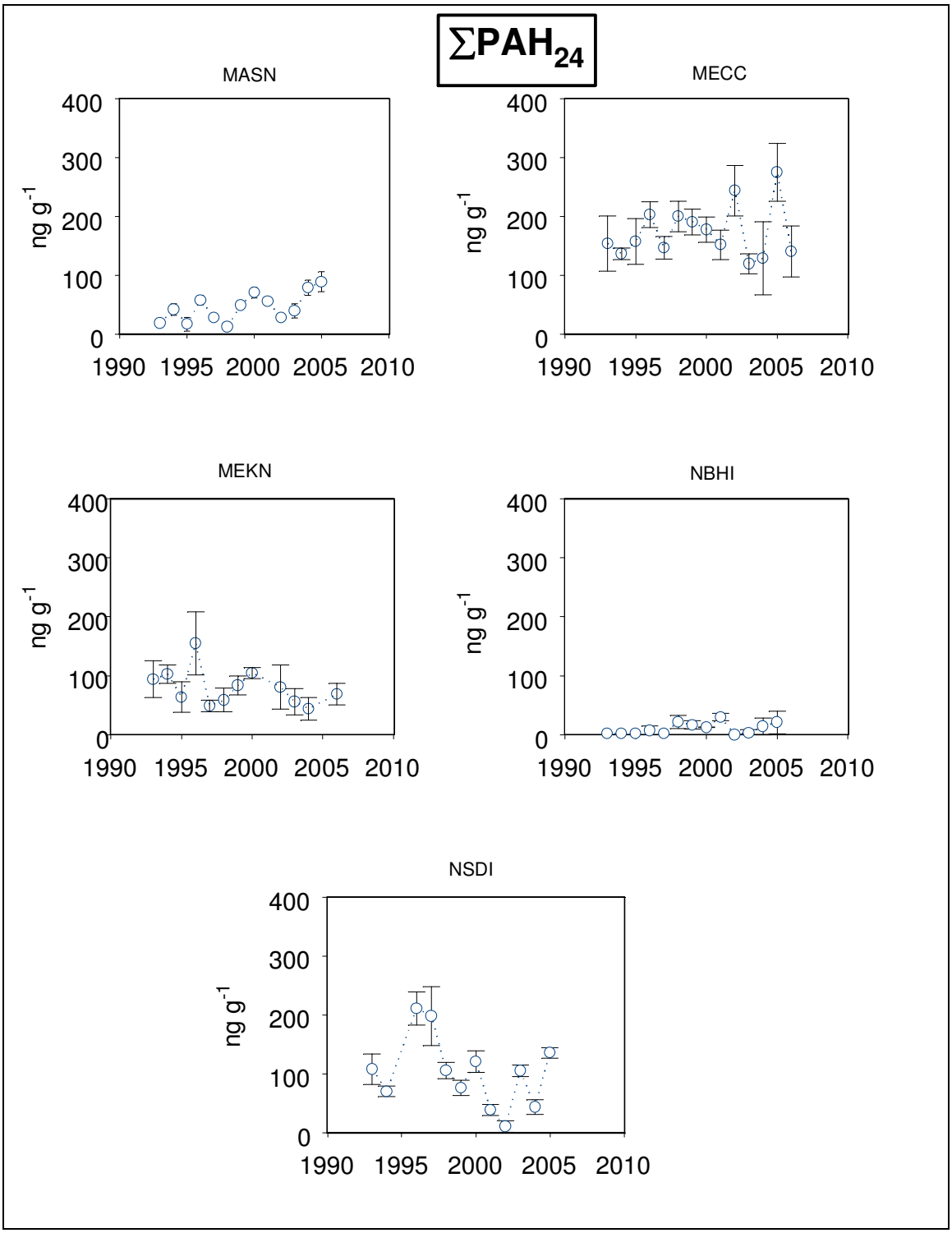

Figure 37. Distribution of ΣPAH24 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993 - 2006.

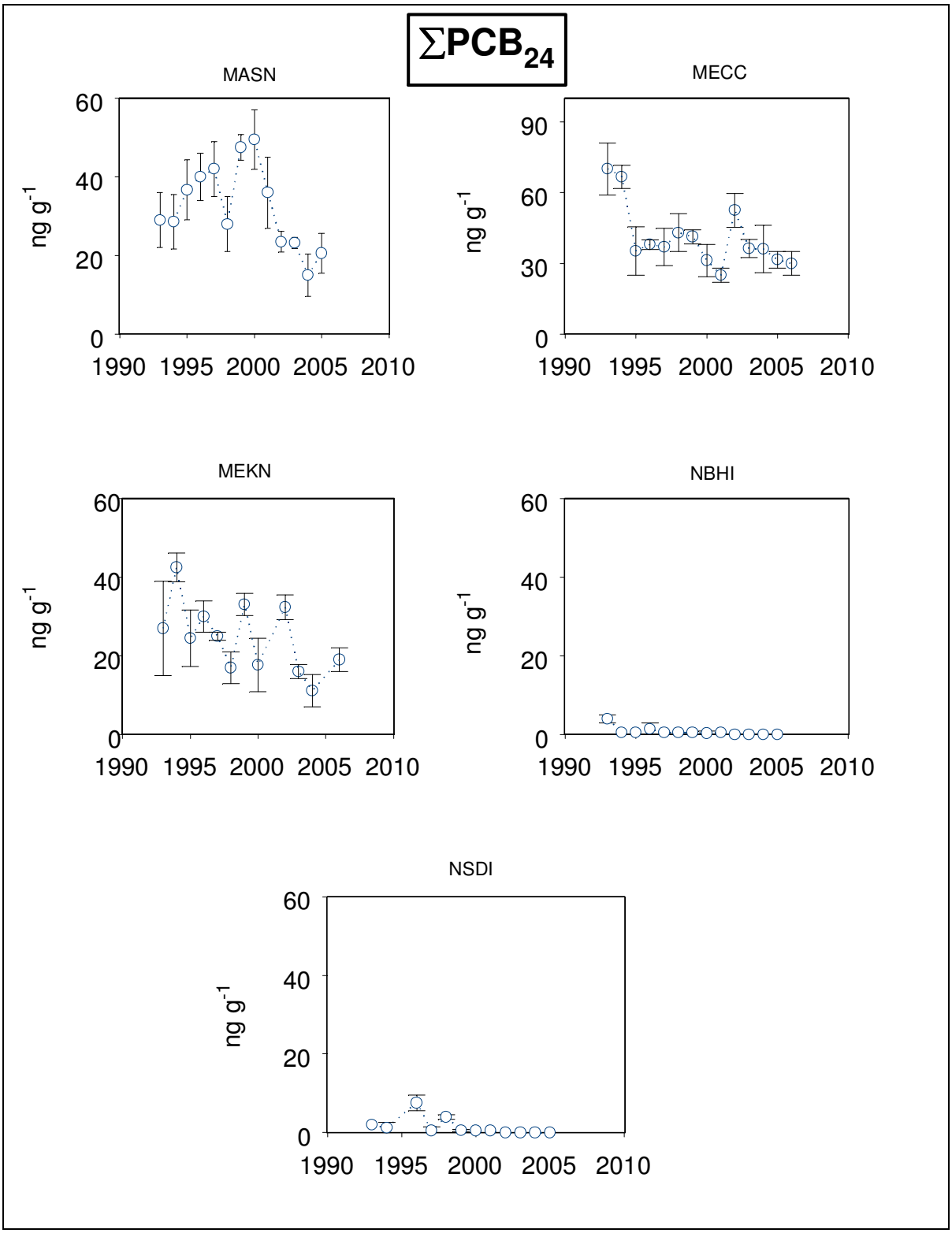

Figure 38. Distribution of ΣPCB24 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993- 2006. Note: 1) different scale for MECC.

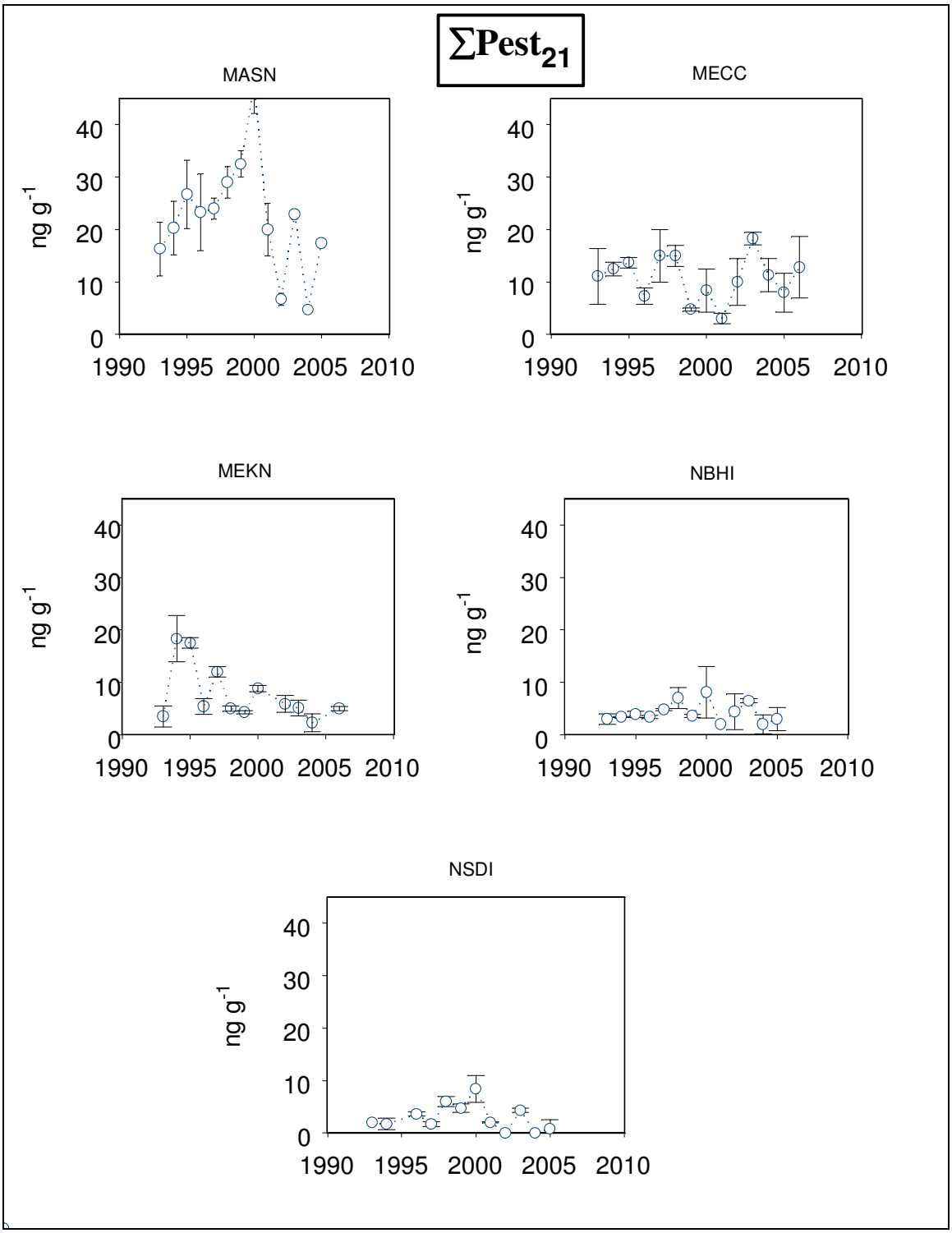

Figure 39. Distribution of $\Sigma PEST_{21}$ tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993 - 2006.

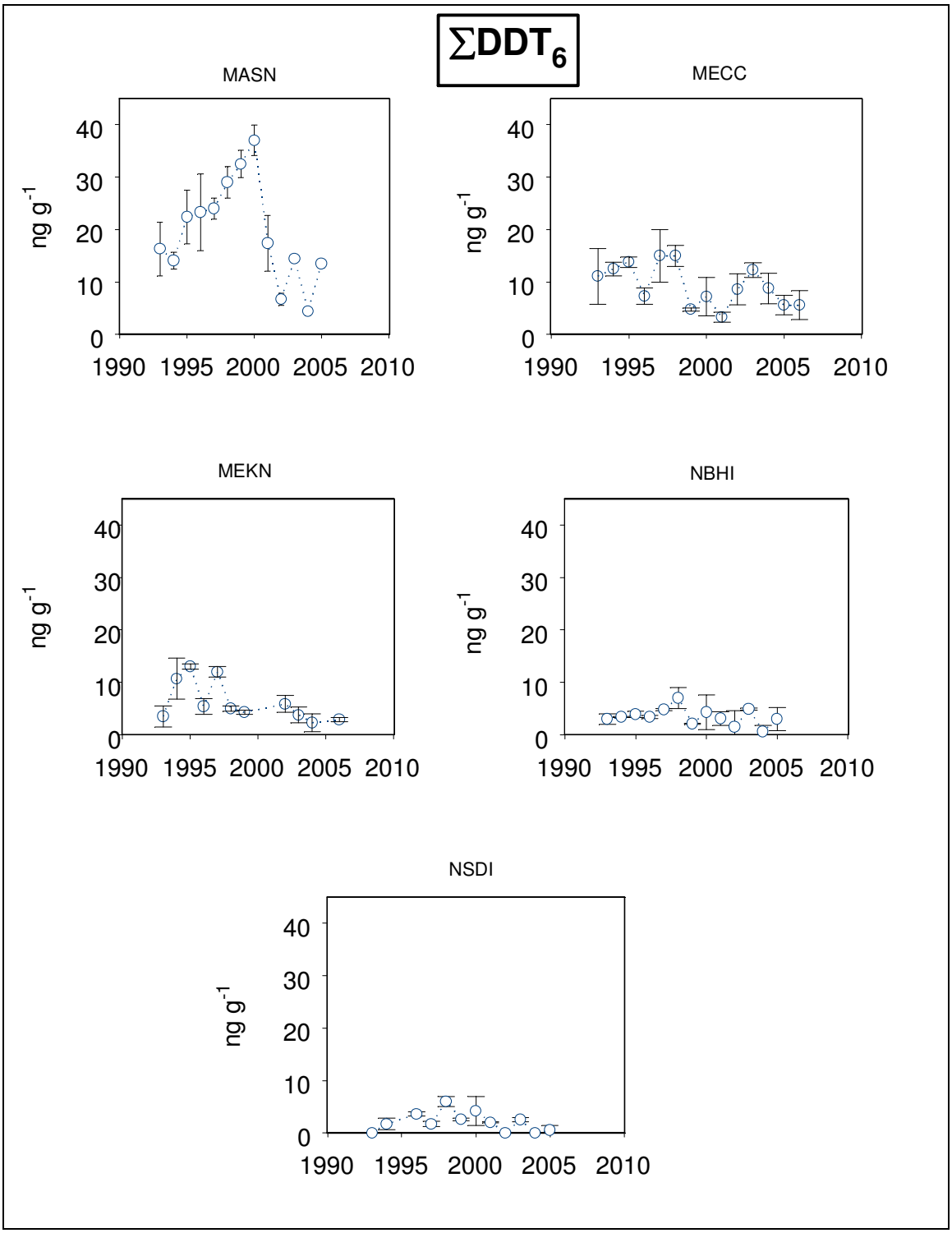

Figure 40. Distribution of ΣDDT_6 tissue concentrations (arithmetic mean +/- SD, ng/g dry weight) in mussels at Gulfwatch benchmark sites in 1993- 2006.

4.3 DRY WEIGHT AND LIPID FRACTIONS

Lipid content and percent dry weights (represented as % solids) were determined on sub-samples of composites, typically between 5-15 g of wet tissue, after drying to a constant weight (See § 2.4.3). The mean (+ 1SD) percent of solids and lipids as a function of tissue mass are plotted in Figs. 41 and 42, respectively. Percent solids were typically between 10-15% of the overall tissue mass. Percent lipid content was typically between 5-10% of the tissue mass. O'Conner and Lauenstein (2006) reported an average of 8% lipid content for the mussels collected by the NOAA Mussel Watch program which is similar to the observed mean of 7.3% for the Gulfwatch Program for 2006.

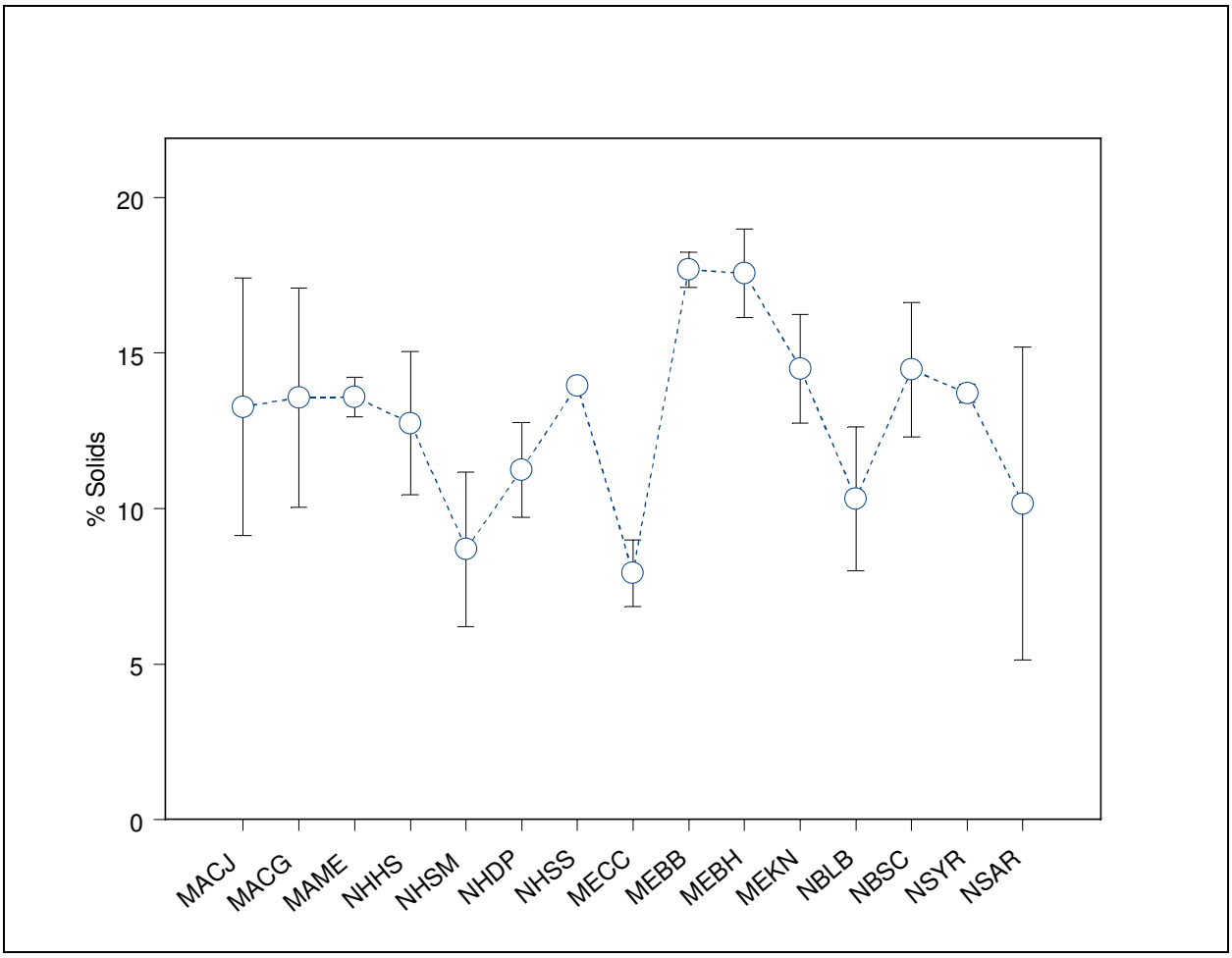

Figure 41. Mean (and standard deviation) of % solids in Gulfwatch mussels collected during 2006.

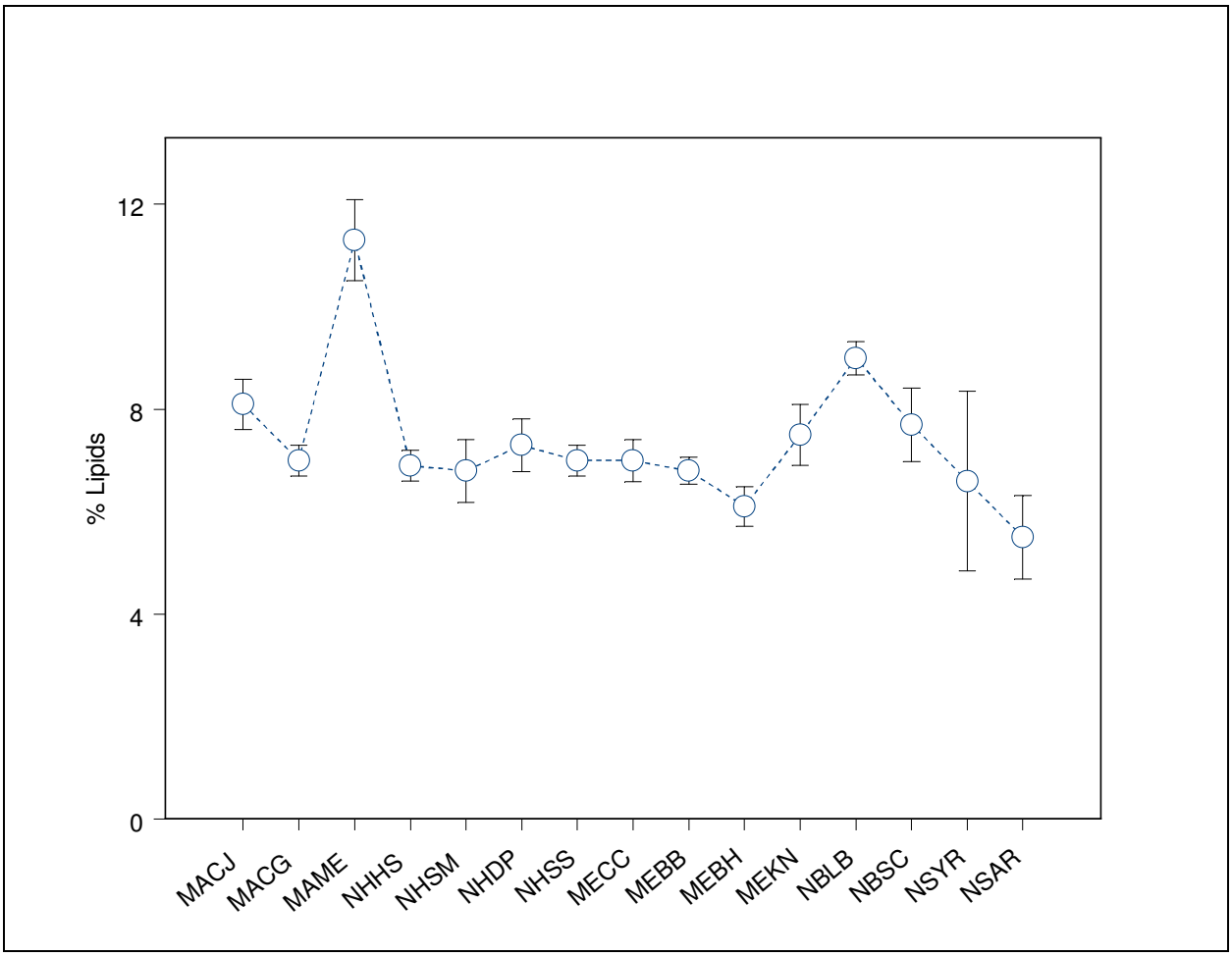

Figure 42. Mean (and standard deviation) of lipid content (%) in Gulfwatch mussels collected during 2006.

4.4 SHELL LENGTH AND CONDITION INDEX

Table 11 contains a summary of the morphological measurements and condition indices for mussels collected at each site in 2006. The morphological measurements for two stations (MEKN and MEBB) are missing and thus not reported.

4.4.1 Shell Morphology

Gulfwatch field collection protocol recommends collecting *M. edulis* within the length range of 50-60 mm. The gulf-wide mean shell length (±SD) from the 2006 sites was 54.5 ± 2.7 mm (Table 11, Fig. 43).

4.4.2 Condition Index

Mean condition indices (CI) calculated from morphological measurements of 2006 Gulfwatch mussels are also listed in Table 11 and shown in Figure 44. The mean CI (±SD) for mussels from all Gulfwatch sites was 0.14 (±0.03).

TABLE 11 Morphometric determinations and statistics (Mean, standard deviation) on mussels collected along the Gulf Maine, 2006 Gulfwatch . L=length, H=height, and W = width (in mm)

Station	CI	SD_{CI}	n	L	SD_L	H	SD_H	W	SD_W
MACG	0.132	0.027	(n=39)	55.3	2.7	28.2	1.8	22.0	1.5
MACJ	0.124	0.022	(n=30)	54.8	2.7	28.2	1.8	22.6	1.9
MAME	0.122	0.026	(n=10)	54.7	2.8	26.9	1.4	22.9	1.3
NHHS	0.144	0.028	(n=28)	52.4	2.1	26.8	1.5	25.5	1.5
NHSM	0.160	0.017	(n=30)	55.5	2.6	29.2	1.6	21.6	1.9
NHSS	0.147	0.019	(n=30)	54.2	2.6	28.2	1.8	21.2	1.6
NHDP	0.160	0.026	(n=30)	53.7	2.5	26.9	2.5	23.0	2.6
MECC	0.111	0.021	(n=30)	55.4	2.3	29.2	1.9	23.0	1.6
MEBH	0.139	0.019	(n=80)	55.4	2.6	28.8	2.3	24.5	2.6
MEKN	*Data*	*Not*	*Available*						
MEBB	*Data*	*Not*	*Available*						
NBSC	0.176	0.061	(n=80)	52.7	4.4	27.6	2.1	22.5	2.3
NBLB	0.149	0.046	(n=80)	55.3	3.4	28.5	2.0	24.1	2.6
NSAR	0.137	0.043	(n=80)	54.9	2.4	28.0	1.9	21.1	1.6
NSYR	0.142	0.030	(n=80)	54.4	2.6	29.1	2.1	21.9	1.9

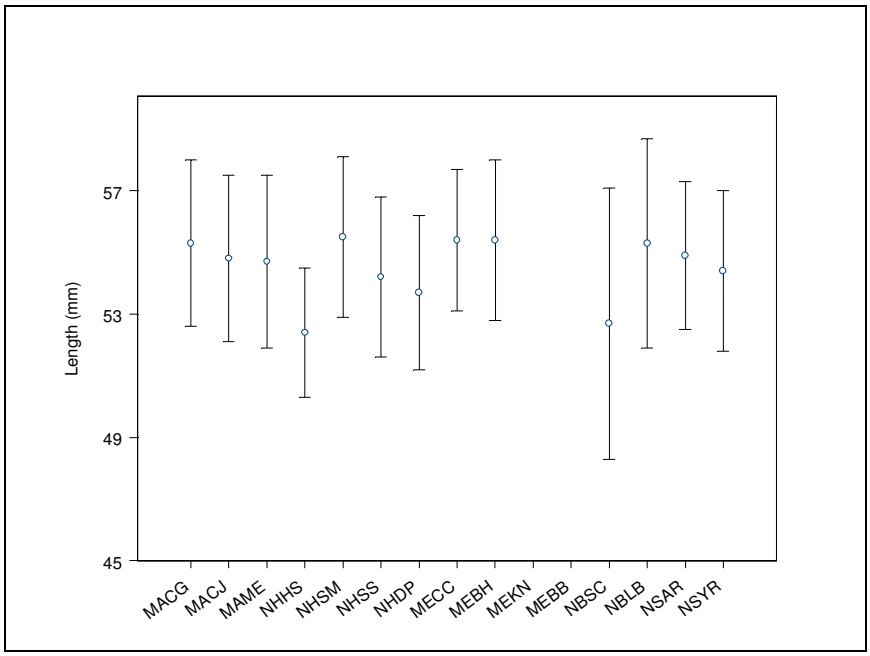

Figure 43. Mean (and standard deviation) of length of Gulfwatch mussels collected during 2006. Data from MEKN and MEBB are not available.

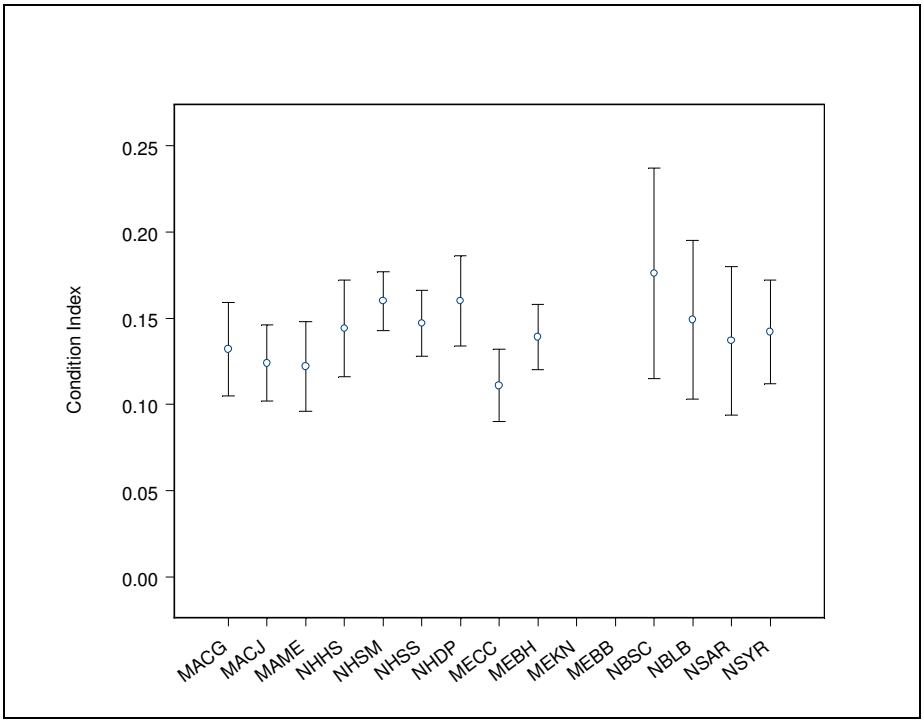

Figure 44. Mean (and standard deviation) condition index of Gulfwatch mussels collected during 2006. Data from MEKN and MEBB are not available.

5.0 2006 GULFWATCH SUMMARY

Monitoring of contaminants in the soft tissue of *M. edulis* from Massachusetts to Nova Scotia in the 16th year of the monitoring program continues to add information for the evaluation of temporal trends of contaminant exposure of aquatic organisms in the Gulf of Maine and, in part, meet the Goals (particularly #2) articulated in the 2007-2012 GOMC Action Plan. The 2006 Gulfwatch field season implemented a modified sampling design that included two benchmark sites now re-classified as trend sites based on their unique sampling frequency (visited once every two years), eleven rotational sites (to be visited once every 6 years), and two sites in Cohasset Harbor, MA, to address local jurisdiction management concern. Samples were collected, processed, and analyzed in accordance with program QC/QA protocols. Most benchmark sites now have as much as 14 years of data while rotational sites have been sampled up to 9 times (e.g., NHHS. All data associated with the 2006 samples are provided in the accompanying appendices.

The Gulfwatch 2006 results were qualitatively reviewed in comparison to the NOAA National Status and Trends national median concentrations. The data were additionally examined relative to the 85th percentile of the NOAA national median for 1996 (1995 for Ag) that Gulfwatch uses to determine if an analyte concentration is excessive. Most trend sites now have as much as 14 years of data while rotational sites have been sampled up to 9 times (e.g., NHHS, Fig.17). Temporal distributions were also reviewed for some analytes across the entire region and individual locations. Beginning in 2003, quality assurance and control improved and were better documented for some metals, i.e. aluminum, chromium, nickel, and mercury when Gulfwatch acquired analytical services from Battelle Marine Science Laboratory, Sequim, WA. Where noted, the change in analyte concentrations should be taken into consideration for any future time trend analysis relative to pre-2003 QC/QA data quality objectives. Quantitative temporal and spatial analysis of the data is beyond the scope of this report.

Given the above caveats, the status of contaminants in near shore areas around the Gulf of Maine suggests the more heavily populated/industrialized coastal areas of the Gulf of Maine have higher contaminant levels compared to locations with smaller communities and less industrial activity. Contaminants at many sites appear to have concentrations at or near the NOAA national median. Lead and mercury exceeded the 85th percentile of the NOAA national

median at several sites, mostly located in MA, NH, and ME. Kimbrough, et al., (2008) reported the status of lead and mercury contamination in blue mussel tissue on a regional and national basis. Overall, contaminants in mussels were consider high among sites in MA, and NH, and low in ME, and reported either no change or decreasing trend for cadmium, copper, mercury, nickel, lead, tin, and zinc in mussels collected from MA, NH, and ME. These results are consistent with the Gulfwatch observations reported here.

Organic contaminants did not exceed the 85th percentile of the NOAA national median at any site. The NOAA Mussel Watch-based status of organic contaminants regionally and nationally was either low or medium in MA, NH, and ME, with one high concentration in the vicinity of Boston Harbor, MA (Kimbrough, et al., 2008). Mussel Watch trends for all organics (butyltins, chlordanes, DDTs, Dieldrins, PAHs, and PCBs) were either decreasing or unchanged in MA, NH, and ME over a twenty year period. Visually, trends of contaminant concentrations in mussels monitored by Gulfwatch suggest most areas in the region are showing no change or a decrease in contaminant levels over time and are consistent with recent Mussel Watch observations (Kimbrough et al., 2008). Apparent (i.e., not statistically validated) Gulfwatch trends in some areas, particularly the rotational sites, suggest increasing levels for some contaminants.

Local hot spots (e.g. MACG, MACJ, MAME, NHSM, and MEBB) point to the need for more focused monitoring and mitigation at the sub-regional scale. For instance, silver concentrations appear to have decreased in recent samples collected at the Sandwich, MA site (MASN) and may be related to source reduction in wastewater effluents and/or relocation of wastewater discharges in Massachusetts Bay. Selected metals (Cd, Zn, and Pb) show increases at the South Mill Pond site, which is located in the lower reaches of the NH Great Bay Estuary within the downtown area of Portsmouth, NH. Increases in PCB and selected pesticides exposure in mussels are indicated when compared to earlier Gulfwatch data for the Merrimack estuary (MAME). Many of the organic contaminants were higher in MA waters relative to other Gulfwatch jurisdictions and are related, in part, to the influence of greater industrialization and densely populated watersheds that drain into MA waters. Readers may wish to examine contaminant results the appendices for further analyses.

When the Gulf of Maine Council was formed, it recognized the need to provide all jurisdictions with contaminant information to enable improved capability to assess, understand,

and, where necessary, respond to issues involving contaminants, ecosystem health, and human health. Thus, the GOMC created the Gulfwatch Program, which is the only marine contaminant monitoring program conducted jointly by the United Sates and Canada. Gulfwatch continues to monitor contaminants in the Gulf of Maine to address the goals established by the Council and articulated in their 2007-2012 Action Plan. The program continues to refine temporal and spatial sampling and analytical protocols to provide information for coastal resource managers who make decisions on issues related to contaminants in near shore waters of the Gulf of Maine. The Gulfwatch 2006 data report provides contaminant information for this purpose and to inform researchers and others living around the Gulf of Maine Environment.

Coastal monitoring programs like Gulfwatch provide valuable measures, which can enable managers to better understand the environmental condition of the Gulf of Maine with respect to contaminants and biological exposure and help reveal the direction that coastal ecosystems may be heading. Gulfwatch results provide a geographically intensive perspective on relative contaminant exposure in the region, ranging from relatively pristine coastal waters to highly polluted urban estuaries. Through continued analyses, the program continues to add to the temporal and spatial perspective necessary for determining trends and impacts of anthropogenic perturbation in the Gulf of Maine. As such, Gulfwatch provides a unique and invaluable source of information for resource managers who make decisions on issues related to toxic contamination in the near coastal waters of the Gulf of Maine. It is anticipated that the Gulfwatch program will be used as guidance for improved monitoring of current contamination and extend monitoring to address new and emerging contaminant concerns of coastal resource managers.

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APPENDIX A: Sample Collection Information

TABLE A.1 2006 Gulfwatch Sample identification numbers, replicates, species, and collection dates.

Gulfwatch Sample ID	Field Rep. #	species	Collection Date
MACJ1N061019	MACJ-1	*Mytilus edulis*	19-Oct-06
MACJ2N061019	MACJ-2		
MACJ3N061019	MACJ-3		
MACJ4N061019	MACJ-4		
MACG1N061019	MACG-1	*Mytilus edulis*	19-Oct-06
MACG2N061019	MACG-2		
MACG3N061019	MACG-3		
MACG4N061019	MACG-4		
MAME1N061019	MAME-1	*Mytilus edulis*	19-Oct-06
MAME2N061019	MAME-2		
MAME3N061019	MAME-3		
MAME4N061019	MAME-4		
NHHS1N061012	NHHS-1	*Mytilus edulis*	12-Oct-06
NHHS2N061012	NHHS-2		
NHHS3N061012	NHHS-3		
NHHS4N061012	NHHS-4		
NHSM1N061012	NHSM-1	*Mytilus edulis*	12-Oct-06
NHSM2N061012	NHSM-2		
NHSM3N061012	NHSM-3		
NHSM4N061012	NHSM-4		
NHDP1N061012	NHDP-1	*Mytilus edulis*	12-Oct-06
NHDP2N061012	NHDP-2		
NHDP3N061012	NHDP-3		
NHDP4N061012	NHDP-4		
NHSS1N061012	NHSS-1	*Mytilus edulis*	12-Oct-06
NHSS2N061012	NHSS-2		
NHSS3N061012	NHSS-3		
NHSS4N061012	NHSS-4		
MECC1N061012	MECC-1	*Mytilus edulis*	12-Oct-06
MECC2N061012	MECC-2		
MECC3N061012	MECC-3		
MECC4N061012	MECC-4		
MEBH1N061011	MEBH-1	*Mytilus edulis*	11-Oct-06
MEBH2N061011	MEBH-2		
MEBH3N061011	MEBH-3		
MEBH4N061011	MEBH-4		

TABLE A.1 (Continued).

Gulfwatch Sample ID	Field Rep. #	species	Collection Date
MEKN1N060913	MEKN-1	*Mytilus edulis*	13-Sep-06
MEKN2N060913	MEKN-2		
MEKN3N060913	MEKN-3		
MEKN4N060913	MEKN-4		
MEBB1N060914	MEBB-1	*Mytilus edulis*	14-Sep-06
MEBB2N060914	MEBB-2		
MEBB3N060914	MEBB-3		
MEBB4N060914	MEBB-4		
NBLB1N061212	NBLB-1	*Mytilus edulis*	12-Dec-06
NBLB2N061212	NBLB-2		
NBLB3N061212	NBLB-3		
NBLB4N061212	NBLB-4		
NBSC1N061129	NBSC-1	*Mytilus edulis*	29-Nov-06
NBSC2N061129	NBSC-2		
NBSC3N061129	NBSC-3		
NBSC4N061129	NBSC-4		
NSYR1N061019	NSYR-1	*Mytilus edulis*	19-Oct-06
NSYR2N061019	NSYR-2		
NSYR3N061019	NSYR-3		
NSYR4N061019	NSYR-4		
NSAR1N061016	NSAR-1	*Mytilus edulis*	16-Oct-06
NSAR2N061016	NSAR-2		
NSAR3N061016	NSAR-3		
NSAR4N061016	NSAR-4		

APPENDIX B: 2006 Reported Methods Detection Limits

For organic analysis, method detection limits (MDL) are estimated following the U.S Environmental Protection Agency's procedure for the determination of method detection limits described in the US Federal Register (40 CFR part 136 appendix B). Briefly, this method uses the standard deviation of replicate analyses of low level spiked mussel tissue. Analyte MDLs are calculated at a 95% confidence level, rather than the 99% confidence level specified in 40 CFR part 136 Appendix B. Tables B-1 and B-2 list the MDLs for the respective contaminants monitored for 2006.

TABLE B-1. 2006 Reported Organic Analytical Methods Detection Limits (ng/g dry wt.)

PAH		PCB congener		Pesticide	
Naphthalene	<10	8 ; 5	<2.8	a_BHC	<2.0
2-Methyl-naphthalene	<8	18 ; 15	<2.7	HCB	<2.4
1-Methyl-naphthalene	<10	28 ;	<2.4	g-HCH(Lindane)	<1.5
Biphenyl	<7	29 ;	<2.2	Heptachlor	<2.0
2,6-Dimethyl naphthalene	<8	44 ;	<2.3	Aldrin	<1.5
Acenaphthylene	<11	50 ;	<2.4	HeptachlorEpoxide	<1.8
Acenaphthene	<8	52 ;	<2.0	g-Chlordane	<1.5
2,3,5-Trimemethyl naphthalene	<7	66 ; 95	<2.2	o,p'-DDE	<1.0
Fluorene	<7	77 ;	<2.2	a-Endosulfan	<1.5
Phenanthrene	<6	87 ;	<1.9	cis-Chlordane	<1.2
Anthracene	<10	101 ; 90	<2.2	t-Nonachlor	<1.4
1-Methyl phenanthrene	<12	105 ;	<1.4	p,p'_DDE	<1.8
Fluoranthene	<14	118 ;	<2.0	Dieldrin	<1.4
Pyrene	<9	128 ;	<1.9	o,p'-DDD	<4.0
Benzo(a)anthracene	<6	138 ;	<2.0	Endrin	<2.2
Chrysene	<6	153 ; 132	<1.8	b-Endosulfan	<3.4
Benzo(b)fluoranthene	<6	170 ; 190	<1.8	p,p'-DDD	<2.0
Benzo(k)fluoranthene	<4	180 ;	<1.7	o,p'-DDT	<2.8
Benzo(e)pyrene	<7	187 ;	<1.9	p,p'-DDT	<2.5
Benzo(a)pyrene	<4	195 ; 208	<1.8	Metoxychlor	<3.1
Perylene	<5	206 ;	<1.7	Mirex	<1.5
Indeno(123cd)pyrene	<7	209 ;	<1.7		
Dibenzo(ah)anthrace	<11				
Benzo(ghi)perylene	<15				

TABLE B-2. 2006 Reported Metal Methods Detection Limits (µg/g dry wt.)

Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Hg	Al
0.01	0.01	0.05	0.1	1.5	0.05	0.02	0.3	0.005	0.5

APPENDIX C: Summary of Trace Metal Analysis Quality Assurance/Quality Control for 2006

C.1 ACCURACY

C.1.1 Standard Reference Materials

Accuracy refers to the agreement between the amount of a component measured by the test method and the amount actually present. The quality assurance protocol for the Gulfwatch project sets the accuracy criteria of ±25% for trace metals of the certified value of a standard reference material (SRM). Certified values are reported by the NRC (National Research Council) or NIST (National Institute of Standards and Technology). Standard reference materials with values >10 times the detection limits were used to verify the accuracy of the analytical methods. The NRC standard, DORM-2 (dogfish muscle and liver tissue), and NIST standard 2976 (blue mussel tissue) were used to certify accuracy in the metals analysis. Overall mean SRM recoveries for the metals analyzed ranged from 70 -133% (Table C.1.1). Only 4 of the 140 SRM recoveries fell outside of the targeted data quality objectives.

TABLE C.1.1 Analyses of standard reference materials for trace metals (ug/g dry mass basis) associated with the 2006 analyses performed by Battelle MSL, Sequim, WA.

Reference	Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
NIST SRM 2976	0.01	0.89	0.58	3.76	170	0.75	1.42	146	138	0.0737
	0.01	0.83	0.59	3.76	171	0.85	1.34	143	141	0.0748
	0.01	0.85	0.57	3.78	174	0.79	1.34	146	137	0.0624
	0.01	0.82	0.64	4.08	184	0.81	1.35	155	143	0.0632
	0.01	0.75	0.64	3.94	175	0.73	1.27	151	134	0.0631
	0.01	0.75	0.67	4.08	176	0.77	1.26	160	134	0.0599
	0.01	0.82	0.58	4.05	176	0.79	1.18	149	137	0.0685
Certified/Reference value	0.011	0.82	0.5	4.02	171	0.93	1.19	137	134	0.0610
Range	±0.005	±0.2	±0.16	±0.33	±4.9	0.12	±0.18	±13	±34	±0.0036
Recovery:	91%	109%	116%	94%	100%	81%	119%	106%	103%	121%
	91%	101%	118%	94%	100%	91%	112%	105%	105%	123%
	94%	103%	114%	94%	102%	85%	112%	107%	103%	102%
	91%	99%	128%	101%	107%	88%	113%	113%	106%	104%
	91%	92%	128%	98%	102%	79%	107%	110%	100%	103%
	91%	91%	133%	101%	103%	83%	106%	117%	100%	98%
	95%	99%	116%	101%	103%	85%	99%	109%	102%	112%
Mean % Recovery	**92%**	**99%**	**122%**	**98%**	**102%**	**84%**	**110%**	**110%**	**103%**	**109%**
RSD	**2%**	**6%**	**8%**	**4%**	**3%**	**4%**	**6%**	**4%**	**2%**	**10%**

TABLE C.1.1 (Continued)

Reference	Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
NRC CRM DORM2	0.031	0.051	34.8	2.01	157	18.9	0.060	24.9	10.9	4.27
	0.031	0.046	33.1	2.01	146	18.4	0.062	27.4	13.2	4.50
	0.037	0.046	34.5	1.95	156	19.5	0.056	26.5	11.4	4.19
	0.034	0.040	36.0	2.15	165	20.1	0.056	26.7	10.2	4.24
	0.029	0.044	34.3	2.12	155	19.3	0.055	26.9	9.48	3.98
	0.035	0.037	34.7	2.13	159	19.0	0.054	28.2	12.3	4.33
	0.039	0.051	34.8	2.13	159	19.4	0.054	26.0	10.8	4.13
Certified/Reference value	0.041	0.043	34.7	2.34	142	0.065	0.065	25.6	10.9	4.64
Range	±0.013	±0.008	±5.5	±0.16	±10	±0.007	±0.007	±2.3	±1.70	±0.26
Recovery:	75%	119%	100%	86%	110%	98%	92%	97%	100%	92%
	75%	106%	95%	86%	102%	95%	95%	107%	121%	97%
	90%	106%	99%	83%	110%	100%	86%	104%	104%	90%
	83%	93%	104%	92%	116%	104%	86%	104%	94%	91%
	70%	101%	99%	91%	109%	100%	84%	105%	87%	86%
	86%	85%	100%	91%	112%	98%	83%	110%	113%	93%
	94%	118%	100%	91%	112%	100%	84%	101%	99%	89%
Mean % Recovery	**82%**	**104%**	**100%**	**89%**	**110%**	**99%**	**87%**	**104%**	**103%**	**91%**
RSD	**9%**	**12%**	**2%**	**3%**	**4%**	**3%**	**4%**	**4%**	**11%**	**4%**

NIST 2976: National Institute of Standards and Technology Trace Organics and Trace elements and methylmercury in Mussel Tissue (*Mytilus edulis*); DORM2: Trace elements in Dogfish (*Squalus acanthias*) mussel from the National Research Council of Canada.

C.1.2 Blank and Matrix Spikes

Blank and matrix spikes are another prescribed measurement of accuracy of the Gulfwatch Program. Matrix spikes recoveries between 75 -125% are considered as meeting the data quality objectives of the Program. Matrix spikes ranged from 85-163% and averaged 102 (+/- 11)% over all the batches. All but one of the matrix spike results were within acceptable criteria (Table C.1.2.2).

TABLE C.1.2.1 Blank spike results reported by Battelle Marine Sciences Laboratory for the 2006 metals analyses

Blank Spike Results	**Ag**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Ni**	**Zn**	**Al**	**Hg**
LCS 071007 R1	2.03	1.98	26.0	24.9	130	2.04	25.8	25.6	130	2.10
Blank R1 071007	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.3	0.706	0.005
Spike concentration	*2.0*	*2.0*	*25*	*25*	*125*	*2.0*	*25*	*25*	*125*	*2.0*
%RECOVERY, LCS	**102%**	**99%**	**104%**	**100%**	**104%**	**102%**	**103%**	**102%**	**103%**	**105%**
LCS 071007 R2	2.05	2.03	25.4	24.1	127	2.13	26.0	24.6	129	2.06
Blank R2 071007	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.344	0.616	0.005
Spike concentration	*2.0*	*2.0*	*25*	*25*	*125*	*2.0*	*25*	*25*	*125*	*2.0*
% RECOVERY, LCS	**103%**	**101%**	**102%**	**96%**	**102%**	**107%**	**104%**	**97%**	**103%**	**103%**
LCS 071107	2.46	2.43	25.3	24.0	127	2.43	25.7	24.2	129	2.16
Blank 071107	0.01	0.01	0.05	0.1	1.5	0.02	0.05	3.01	0.576	0.005
Spike concentration	*2.0*	*2.0*	*25*	*25*	*125*	*2.0*	*25*	*25*	*125*	*2.0*
% RECOVERY, LCS	**123%**	**121%**	**101%**	**96%**	**102%**	**122%**	**103%**	**85%**	**104%**	**108%**
LCS 071607	2.27	2.11	26.1	25.2	131	2.37	25.9	25.8	126	2.20
Blank 071607	0.0143	0.01	0.05	0.1	1.5	0.02	0.05	0.3	0.5	0.00560
Spike concentration	*2.0*	*2.0*	*25*	*25*	*125*	*2.0*	*25*	*25*	*125*	*2.0*
% RECOVERY, LCS	**113%**	**106%**	**104%**	**101%**	**105%**	**119%**	**104%**	**103%**	**101%**	**110%**
LCS 071707	2.19	2.06	25.9	25.3	127	2.32	26.0	25.3	127	2.10
Blank 071707	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.3	0.5	0.005
Spike concentration	*2.0*	*2.0*	*25*	*25*	*125*	*2.0*	*25*	*25*	*125*	*2.0*
% RECOVERY, LCS	**110%**	**103%**	**104%**	**101%**	**102%**	**116%**	**104%**	**101%**	**102%**	**105%**
LCS 071807	2.16	1.83	26.7	26.1	134	2.01	27.0	26.8	132	2.18
Blank 071807	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.3	0.5	0.005
Spike concentration	*2.0*	*2.0*	*25*	*25*	*125*	*2.0*	*25*	*25*	*125*	*2.0*
% RECOVERY, LCS	**108%**	**91%**	**107%**	**105%**	**107%**	**101%**	**108%**	**107%**	**105%**	**109%**
LCS 071907	2.07	1.92	26.0	25.2	230	1.98	25.8	25.2	226	2.18
Blank 071907	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.3	0.5	0.005
Spike concentration	*2.0*	*2.0*	*25*	*25*	*225*	*2.0*	*25*	*25*	*225*	*2.0*
% RECOVERY, LCS	**104%**	**96%**	**104%**	**101%**	**102%**	**99%**	**103%**	**101%**	**100%**	**109%**

TABLE C.1.2.2 Matrix spike results reported by Battelle Marine Sciences Laboratory for the 2006 metals analyses. SL = Insufficient spiking level relative to native metal concentrations; see blank spikes and SRMs for accuracy.

Matrix Spike Results		**Ag**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Ni**	**Zn**	**Al**	**Hg**
2766-14MS		1.98	2.77	28.1	31.8	1123	31.4	25.4	334	1312	2.23
2766-14	MAWN 2N	0.198	0.97	4.65	8.12	993	4.75	2.16	118	1142	0.188
Spike concentration, MS		1.92	1.92	24.9	24.9	124.3	24.9	24.9	224	124	1.92
% RECOVERY, MS		**93%**	**94%**	**94%**	**95%**	**105%**	**107%**	**94%**	**97%**	**SL**	**106%**
2766-40MS		1.84	25.0	26.5	30.5	607	27.7	25.4	334	660	2.27
2766-40	MECC 4N	0.0348	2.43	2.60	6.87	439	2.18	1.88	114	459	0.258
Spike concentration, MS		1.96	24.0	24.0	24.0	120.2	24.0	24.0	216.3	120.2	1.96
% RECOVERY, MS		**92%**	**94%**	**99%**	**98%**	**SL**	**106%**	**98%**	**102%**	**SL**	**103%**
2766-54MS		1.96	3.92	27.0	91.6	1029	4.41	50.5	342	460	2.34
2766-54	NHSS 2N	0.0376	1.95	2.07	30.7	631	2.31	9.33	107	532	0.300
Spike concentration, MS		2.01	2.01	25.3	25.3	127	2.01	25.3	228	127	2.01
% RECOVERY, MS		**96%**	**98%**	**99%**	**SL**	**SL**	**105%**	**163%**	**103%**	**SL**	**101%**
2766-73MS		1.93	3.56	26.7	31.8	818	29.9	25.9	336	584	2.17
2766-73	NSYR 2N	0.116	1.63	1.96	6.67	680	2.87	1.62	97.8	459	0.210
Spike concentration, MS		1.98	1.98	23.8	23.8	119	23.8	23.8	214	119	1.98
% RECOVERY, MS		**92%**	**97%**	**104%**	**105%**	**116%**	**114%**	**102%**	**111%**	**105%**	**99%**
2766-96MS		1.83	3.15	28.0	37.3	797	3.51	27.5	311	654	2.28
2766-96	MEMR 1N	0.0465	1.42	2.29	11.3	682	1.60	1.41	65.0	613	0.218
Spike concentration, MS		2.03	2.03	23.8	23.8	119	2.03	23.8	214	119	2.03
% RECOVERY, MS		**88%**	**85%**	**108%**	**109%**	**97%**	**94%**	**110%**	**115%**	**SL**	**102%**
2766-125MS		1.81	3.03	29.0	34.7	758	3.39	28.1	355	778	2.10
2766-125	MECK 3N	0.0212	1.16	1.91	7.64	662	1.36	1.37	91.7	755	0.0763
Spike concentration, MS		1.96	1.96	24.3	24.3	122	1.96	24.3	219	122	1.96
% RECOVERY, MS		**91%**	**96%**	**112%**	**111%**	**79%**	**103%**	**110%**	**120%**	**SL**	**103%**
2766-144MS		1.87	3.71	28.4	34.4	768	5.22	27.5	349	633	2.44
2766-144	NHLH 2N	0.0476	1.99	2.61	7.73	521	3.28	1.73	103	404	0.332
Spike concentration, MS		1.97	1.97	25.3	25.3	228	1.97	25.3	228	228	1.97
% RECOVERY, MS		**92%**	**88%**	**102%**	**105%**	**109%**	**99%**	**102%**	**108%**	**100%**	**107%**

C.2 PRECISION

Precision refers to the reproducibility of a method when it is repeated under controlled conditions. For this assessment, the Gulfwatch Program uses the relative percent difference (RPD) of duplicate samples as a test of precision. The RPD of laboratory duplicates should be less than 25% for all metals. Results of duplicate comparisons from 3 samples are listed in Tables C.2.1-2. The RPD between laboratory duplicates ranged from near 0-25%, with a mean of 4 (+/- 5)%. The RPDs of all duplicates were well within acceptable limits.

TABLE C.2.1. Replicate metals analysis (µg/g) for 2006 samples performed by Battelle Marine Sciences Laboratory (MSL). RPD = relative % difference.

Duplicates		Ag	Cd	Cr	Cu	Fe	Pb	Ni	Zn	Al	Hg
2766-7	MEBB 3N	0.0128	1.04	1.09	10.4	287	10.7	0.681	163	236	0.236
2766-7DUP	MEBB 3N	0.0125	1.04	1.11	10.3	280	10.7	0.697	163	199	0.226
	MEAN	0.0127	1.04	1.10	10.3	283	10.7	0.689	163	217	0.231
	RPD	**2%**	**0%**	**2%**	**1%**	**3%**	**0%**	**2%**	**0%**	**17%**	**4%**
2766-29	NBLB 1N	0.01	1.20	0.954	6.08	289	1.15	0.676	67.4	388	0.0602
2766-29DUP	NBLB 1N	0.01	1.17	0.993	6.06	296	1.12	0.716	65.0	395	0.0629
	MEAN	0.01	1.19	0.974	6.07	293	1.13	0.696	66.2	392	0.0616
	RPD	**NA**	**3%**	**4%**	**0%**	**2%**	**2%**	**6%**	**4%**	**2%**	**4%**
2766-50	NHSM 2N	0.0579	2.28	2.59	8.92	566	17.1	1.83	211	514	0.368
2766-50DUP	NHSM 2N	0.0605	2.31	2.64	8.68	570	16.9	1.65	207	662	0.363
	MEAN	0.0592	2.29	2.61	8.8	568	17.0	1.74	209	588	0.366
	RPD	**4%**	**1%**	**2%**	**3%**	**1%**	**1%**	**10%**	**2%**	**25%**	**1%**
2766-79	NSAR 4N	0.0495	3.61	2.58	6.84	935	2.00	2.74	90.3	1333	0.227
2766-79DUP	NSAR 4N	0.0478	3.51	2.48	6.88	846	1.92	2.68	90.7	1184	0.226
	MEAN	0.0487	3.56	2.53	6.86	890	1.96	2.71	90.5	1259	0.226
	RPD	**3%**	**3%**	**4%**	**1%**	**10%**	**4%**	**2%**	**0%**	**12%**	**0%**
2766-104	MECC 2N	0.0368	1.61	16.5	9.26	539	3.68	1.85	105	387	0.277
2766-104DUP	MECC 2N	0.0397	1.72	13.3	9.42	528	4.01	1.69	107	421	0.264
	MEAN	0.0383	1.67	14.9	9.34	533	3.85	1.77	106	404	0.271
	RPD	**8%**	**7%**	**22%**	**2%**	**2%**	**9%**	**9%**	**1%**	**8%**	**5%**
2766-131	MESA 1N	0.0639	1.66	1.96	7.22	366	1.70	1.35	76.5	252	0.117
2766-131DUP	MESA 1N	0.0611	1.48	2.13	7.43	363	1.75	1.29	75.9	271	0.119
	MEAN	0.0625	1.57	2.04	7.33	365	1.72	1.32	76.2	262	0.118
	RPD	**5%**	**11%**	**8%**	**3%**	**1%**	**3%**	**5%**	**1%**	**7%**	**2%**
2766-147	NSAR 1N	0.0359	3.16	2.28	7.95	757	1.45	2.33	98.9	836	0.227
2766-147DUP	NSAR 1N	0.0346	3.23	2.29	7.30	772	1.45	2.40	101	842	0.232
	MEAN	0.0352	3.19	2.29	7.62	765	1.45	2.36	100	839	0.229
	RPD	**4%**	**2%**	**0%**	**9%**	**2%**	**0%**	**3%**	**2%**	**1%**	**2%**

C.3 BLANKS

Seven digestion procedure blanks were reported for trace metal analysis and are reported in Table C.3.1.

TABLE C.3.1. MSL reported analysis of mussel preparation blanks for 2006.

Procedural Blanks	Ag	Cd	Cr	Cu	Fe	Pb	Ni	Al	Zn	Hg
Blank R1 071007	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.7	0.3	0.005
Blank R2 071007	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.6	0.3	0.005
Blank 071107	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.6	3.0	0.005
Blank 071607	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.5	0.3	0.006
Blank 071707	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.5	0.3	0.005
Blank 071807	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.5	0.3	0.005
Blank 071907	0.01	0.01	0.05	0.1	1.5	0.02	0.05	0.5	0.3	0.005

C.4 COMPLETENESS

100% of samples collected (15 of 15 samples; 59 individual replicates) were analyzed successfully. In general, the analyses of SRMs met the data quality objectives of the Program. All matrix spikes were within control limits and all the RPDs for laboratory duplicates were within precision limits. The sampling site at MAME had low abundance for mussels in the appropriate size range and yielded only three field replicates for metals analysis.

C.5 BATTELLE QUALITY ASSURANCE/QUALITY CONTROL NARRATIVE FOR 2006 SAMPLES

PROJECT: Gulf of Maine 2006
PARAMETER: Metals (Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, and Zn)
LABORATORY: Battelle Marine Sciences Laboratory (MSL), Sequim, Washington
MATRIX: Tissue

SAMPLE CUSTODY AND PROCESSING: Sixty three tissue samples were received at MSL on 05/05/06. All samples were received in good condition (i.e., containers were intact and cooler temperature was acceptable). The samples were collected in glass jars with metals lids. The optimal container for the analysis of metals in tissue samples is a pre-cleaned glass jar with a plastic lid or pre-cleaned plastic container. The samples are considered minimally impacted as no rust was noticed on the metal lids. A representative split of each sample was transferred to a pre-cleaned, tarred plastic jar to allow determination of percent moisture. The samples were assigned a Battelle Central File (CF) identification number (2565). All project information was entered into Battelle's laboratory information and sample tracking system.

Chemistry Lab IDs:	**2565*1-63**
Description	*Tissue*
Collection dates	2001 (see table for dates)
Laboratory arrival date	05/05/06
Cooler temperatures, on arrival	-15°C
Digestion (aqua regia)	06/07/06
CVAA analysis (Hg)	06/14/06 and 06/16/06
ICP-OES analysis (Al, Cr, Cu, Fe, Ni, and Zn)	06/19/06 and 06/20/06
ICP-MS analysis (Ag, Cd, and Pb)	06/14/06 and 06/15/06

QA/QC DATA QUALITY OBJECTIVES:

Analyte	Analytical Method	Range of Recovery	SRM Accuracy	Relative Precision	Method Detection Limit (µg/g dry weight)[(a)]	Reporting Limit (µg/g dry weight)[(b)]
Silver	ICP-MS	75-125%	≤25%	≤25%	0.01	0.03
Aluminum	ICP-OES	75-125%	≤25%	≤25%	0.5	2
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.01	0.03
Chromium	ICP-OES	75-125%	≤25%	≤25%	0.05	0.2
Copper	ICP-OES	75-125%	≤25%	≤25%	0.1	0.3
Iron	ICP-OES	75-125%	≤25%	≤25%	1.5	5
Mercury	CVAA	75-125%	≤25%	≤25%	0.005	0.02
Nickel	ICP-OES	75-125%	≤25%	≤25%	0.05	0.2
Lead	ICP-MS	75-125%	≤25%	≤25%	0.02	0.06
Zinc	ICP-OES	75-125%	≤25%	≤25%	0.3	1

(a) MDL determined annually using seven replicates of a tissue matrix spiked at an appropriate concentration.
(b) RL determined as 3.18* MDL

METHODS: The samples were analyzed for nine metals including silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn). Tissue samples were digested according to Battelle SOP MSL-I-024, Mixed Acid Tissue Digestion. An approximately 500-mg aliquot of each dried, homogeneous sample was combined with nitric and hydrochloric acids (aqua regia) in a Teflon vessel and heated in an oven at 130ºC (±10ºC) for a minimum of eight hours. After heating and cooling, deionized water was added to the acid-digested tissue to achieve analysis volume and the digestates were submitted for analysis by three methods.

Digested samples were analyzed for Hg by cold-vapor atomic absorption spectroscopy (CVAA) according to Battelle SOP MSL-I-016, Total Mercury in Tissues and Sediments by Cold Vapor Atomic Absorption, which is based on EPA Method 245.6, Determination of Mercury in Tissue by Cold Vapor Atomic Absorption Spectrometry.

Digested samples were analyzed for Al, Cr, Cu, Fe, Ni, and Zn using inductively coupled plasma optical emissions spectroscopy (ICP-OES) according to Battelle SOP MSL-I-033, Determination of Elements in Aqueous and Digestate Samples by ICP-OES. This procedure is based on two methods modified and adapted for analysis of low level samples: EPA Method 6010B and 200.7.

Digested samples were analyzed for Ag, Cd, and Pb using inductively coupled plasma-mass spectrometry (ICP-MS) according to Battelle SOP MSL-I-022, Determination of Elements in Aqueous and Digestate Samples by ICP/MS. This procedure is based on two methods modified and adapted for analysis of low-level solid sample digestates: EPA Method 1638, Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma-Mass Spectrometry and EPA Method 200.8, Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma – Mass Spectrometry.

All results were determined and reported in units of µg/g on a dry-weight basis.

HOLDING TIMES: Samples were archived frozen prior to arrival at MSL. The samples were freeze dried within 30 days of receipt and analyzed within six months.

DATA QUALIFIERS: Sample concentrations were evaluated and flagged to the following criteria:

U Analyte not detected greater than the MDL, MDL reported with qualifier

J Analyte detected greater than the MDL, but less than the RL

* Duplicate analysis not within QC criterion of ≤25% relative percent difference.

N QC sample outside QC criterion of ±25% recovery

SL Insufficient spiking level relative to native sample concentration.

METHOD BLANK: One method blank was analyzed with every 20 field samples. Analytes were not detected above the RL.

LABORATORY CONTROL SAMPLE/BLANK

One blank spike/laboratory control sample (LCS) was analyzed with every 20 field samples. LCS recoveries were within the QC acceptance criterion of 75-125% recovery for all metals.

SPIKE ACCURACY:

MATRIX SPIKE ACCURACY:

One tissue sample was processed with a matrix spike in each batch of 20 field samples. Matrix spike recoveries were within the QC acceptance criterion of 75-125% recovery for all metals except two matrix spikes for Al and Fe. The spiking level for Al and Fe was insufficient relative to native sample concentrations to be used for evaluating accuracy. Acceptable accuracy was demonstrated in the LCS and SRM quality control samples.

REPLICATE PRECISION:

One set of laboratory duplicates was analyzed for every 20 field samples. Precision was expressed as the relative standard difference (RPD) between replicate results. The RPD values were within the QC criterion of ≤25% for all metals.

STANDARD REFERENCE MATERIAL ACCURACY:

Standard reference material (SRM) accuracy was expressed as the percent recovery between the measured and certified concentrations. Reference values are provided for evaluation purposes.

SRM 2976 Mussel Tissue and SRM DORM-2 Dogfish Tissue were digested and analyzed with this set of samples. Multiple SRMs were selected because no single SRM is certified for all metals of interest at appropriate concentration ranges.

SRM 2976 is certified for Cd, Cu, Fe, Hg, Pb, and Zn. The percent recoveries were within QC acceptance criterion of 75-125% recovery for all metals.

The metals in SRM DORM-2 certified greater than the RL are Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, and Zn. The percent recoveries were within the QC acceptance criterion for all metals except one replicate for Al (72%). All other measures of accuracy and precision were within the QC criteria.

APPENDIX D: Summary of 2006 Organic Contaminant Analysis Assurance/Quality Control

D.1 ACCURACY

The quality assurance protocol for the Gulfwatch project sets the accuracy criteria of ±30% for organic contaminants certified value of a standard reference material (SRM). Certified values are reported by the NIST (National Institute of Standards and Technology). Standard reference materials with values >10 times the detection limits were used to verify the accuracy of the analytical methods. 48% of the PAH compounds fell within the Program's data quality objectives (DQO) for assessing accuracy (Table D.1.1.1). 71% of the PCB congeners met the Program's accuracy DQO. 67% of the targeted pesticide met the Program's accuracy DQO for 2006.

Table D.1.1.1 - D.1.1.3 list the analytical results of NIST SRM 2977 analyses for PCB, PAH and chlorinated pesticides, respectively.

D.1.1.1 PAH Standard Reference Materials, Gulfwatch 2006 Analyses

PAH	SRM 2977 Concentration (ng/g)			SRM-1	SRM-2	SRM-3	% Recry	% Recry	% Recry
Naphthalene	**19.0**	±	**5.00**	13.7	18.3	12.3	71.9	96.5	64.7
1-Methylnaphthalene	**16.0**	±	**5.00**	4.7	6.0	4.6	29.2	37.7	29.0
2-Methylnaphthalene	**18.0**	±	**5.00**	7.6	10.6	7.7	42.3	58.7	42.7
Biphenyl	**6.8**	±	**0.60**	4.2	5.2	4.6	62.0	76.1	67.8
2,6-Dimethylnaphthalene	**-**			11.9	14.4	12.6			
Acenaphthylene	**-**			<11	<11	<11			
Acenaphthene	**4.2**	±	**0.40**	3.2	3.2	3.1	76.8	77.1	74.7
2,3,5-Trimethylnaphthalene	**-**			38.7	50.4	39.9			
Fluorene	**10.24**	±	**0.43**	7.6	9.1	7.9	74.0	88.6	77.4
Phenanthrene	**35.1**	±	**3.80**	28.9	39.3	38.1	82.3	112.0	108.5
Anthracene	**8.0**	±	**4.00**	7.0	6.6	6.1	88.1	83.1	75.7
1-Methylphenanthracene	**44**	±	**2.00**	26.0	31.9	26.5	59.0	72.4	60.2
Fluoranthene	**38.7**	±	**1.00**	INT	34.8	36.4	INT	89.8	93.9
Pyrene	**78.9**	±	**3.50**	23.6	41.0	35.7	29.9	52.0	45.2
Benzo(a)Anthracene	**20.34**	±	**0.78**	24.2	20.9	19.9	119.1	102.5	97.7
Chrysene	**49.0**	±	**2.00**	48.5	72.2	69.6	98.9	147.4	142.0
Benzo(b)Fluoranthene	**11.01**	±	**0.28**	8.3	10.3	9.0	75.1	93.2	81.6
Benzo(k)Fluoranthene	**4.0**	±	**1.00**	5.7	5.9	5.9	143.3	148.6	147.7
Benzo(e)Pyrene	**13.1**	±	**1.10**	11.4	12.1	11.0	86.7	92.4	83.6
Benzo(a)Pyrene	**8.35**	±	**0.72**	2.9	3.7	3.5	34.4	44.1	41.7
Perylene	**3.5**	±	**0.76**	2.0	2.1	2.2	57.1	61.4	61.8
Indeno(1,2,3,4-cd)Pyrene	**4.84**	±	**0.81**	3.5	4.0	3.9	73.3	81.8	79.9
Dibenz(a,h)Anthracene	**2.0**	±	**0.20**	0.9	0.9	0.9	43.3	47.0	43.9
Benzo(ghi)Perylene	**9.53**	±	**0.43**	5.7	6.1	5.7	59.6	64.0	59.5

D.1.1.2 PCB Standard Reference Materials, Gulfwatch 2006 Analyses

PCB	SRM 2977 Concentration (ng/g)			SRM-1	SRM-2	SRM-3	% Recry	% Recry	% Recry
#8,5	**2.10**	**±**	**0.15**	<2.8	<2.8	<2.8			
#18,15	**2.65**	**±**	**0.30**	<2.7	<2.7	<2.7			
#29	**-**			<2.2	<2.2	<2.2			
#50	**-**			<2.4	<2.4	<2.4			
#28	**5.37**	**±**	**0.44**	4.3	4.7	4.8	81.0	87.9	89.0
#52	**8.37**	**±**	**0.54**	5.7	6.3	6.5	68.1	75.1	78.1
#44	**3.25**	**±**	**0.63**	<2.3	<2.3	<2.3			
#66,95	**3.64**	**±**	**0.32**	2.5	2.8	2.8	67.7	76.0	75.8
#101,90	**11.20**	**±**	**1.20**	8.4	9.6	9.6	74.9	85.5	85.3
#87	**2.15**	**±**	**0.10**	<1.9	<1.9	<1.9			
#77	**-**			<2.3	<2.3	<2.3			
#118	**10.50**	**±**	**1.00**	7.8	8.6	8.8	74.6	82.2	83.9
#153,132	**14.10**	**±**	**1.00**	11.5	9.7	9.9	81.9	68.8	70.3
#105	**3.76**	**±**	**0.49**	2.9	3.7	3.1	78.2	98.0	82.6
#138	**16.60**	**±**	**1.60**	9.3	10.4	10.0	55.9	62.4	60.3
#126	**-**			<1.9	<1.9	<1.9			
#187	**4.76**	**±**	**0.38**	2.8	3.3	3.2	58.0	70.2	66.3
#128	**2.49**	**±**	**0.28**	<1.9	2.1	2.1		84.9	82.5
#180	**6.79**	**±**	**0.67**	4.2	4.7	4.7	61.3	69.0	69.7
#169	**-**			<1.7	<1.7	<1.7			
#170,190	**2.95**	**±**	**0.23**	2.1	2.4	2.4	70.2	80.5	82.3
#195,208	**-**			<1.8	<1.8	<1.8			
#206	**-**			<1.7	<1.7	<1.7			
#209	**-**			<1.7	<1.7	<1.7			

D.1.1.3 Pesticides Standard Reference Materials, Gulfwatch 2006 Analyses

Pesticides	SRM 2977 Concentration (ng/g)	SRM-1	SRM-2	SRM-3	% Recry	% Recry	% Recry
a_BHC	-	<2.0	<2.0	<2.0			
HCB	-	<2.4	2.5	2.5			
g-HCH(Lindane)	-	<1.5	<1.5	<1.5			
Heptachlor	-	<2	<2	<2			
Aldrin	-	<1.5	<1.5	<1.5			
HeptachlorEpoxide	-	<1.8	<1.8	<1.8			
g-Chlordane	-	4.0	3.4	3.2			
o,p'-DDE	-	<1.0	<1.0	<1.0			
a-Endosulfan	-	<1.5	<1.5	<1.5			
cis-Chlordane	**1.42 ± 0.13**	1.6	1.5	1.5	114.3	107.4	105.9
t-Nonachlor	**1.43 ± 0.10**	<1.4	<1.4	<1.4			
p,p'_DDE	**12.50 ± 1.60**	6.2	7.1	6.8	49.5	56.8	54.4
Dieldrin	**6.04 ± 0.52**	5.4	5.5	5.7	88.6	91.4	94.1
o,p'-DDD	**3.32 ± 0.29**	<4.0	<4.0	<4.0			
Endrin	-	<2.2	<2.2	<2.2			
b-Endosulfan	-	<3.4	<3.4	<3.4			
p,p'-DDD	**4.30 ± 0.38**	3.0	3.1	2.9	70.7	71.9	66.7
o,p'-DDT	-	<2.8	<2.8	<2.8			
p,p'-DDT	**1.28 ± 0.18**	<2.5	<2.5	<2.5			
Metoxychlor	-	<3.1	<3.1	3.9			
Mirex	-	<1.5	<1.5	<1.5			

D.1.2 Matrix Spikes

The acceptable range for matrix spike recovery is 40-120%. The matrix spikes of organic compounds monitored by Gulfwatch are summarized in Table D.1.2.1-3 for PAHs, PCBs, and chlorinate pesticides, respectively.

TABLE D.1.2.1 Percent recovery of 2006 Gulfwatch PAH matrix spikes

PAH Spiked Mussel Tissue (2.0g dry weight)		**SP070502**	**SP070507**	**SP070509**	**SP070522**	**SP070605**	**SP070619**	**SP070720**
	Conc. (ng.g)	%	%	%	%	%	%	%
Naphthalene	41.67	79%	80%	75%	63%	56%	57%	57%
1-Methylnaphthalene	41.67	70%	71%	68%	72%	76%	66%	77%
2-Methylnaphthalene	41.67	80%	83%	80%	78%	86%	74%	93%
Biphenyl	41.67	91%	77%	65%	81%	78%	75%	75%
2,6-Dimethylnaphthalene	41.67	NA	NA	NA	95%	NA	85%	89%
Acenaphthylene	41.67	76%	75%	66%	78%	76%	72%	66%
Acenaphthene	41.67	83%	88%	72%	79%	80%	77%	71%
2,3,5-Trimethylnaphthalene	41.67	114%	82%	114%	118%	118%	116%	123%
Fluorene	41.67	87%	92%	93%	79%	122%	81%	84%
Phenanthrene	41.67	73%	45%	28%	94%	94%	68%	140%
Anthracene	41.67	75%	52%	37%	92%	100%	78%	137%
1-Methylphenanthracene	41.67	85%	118%	INT	INT	INT	INT	INT
Fluoranthene	41.67	INT	59%	INT	INT	INT	INT	INT
Pyrene	41.67	61%	75%	INT	INT	INT	INT	INT
Benzo(a)Anthracene	41.67	75%	96%	84%	106%	73%	INT	INT
Chrysene	41.67	81%	95%	66%	118%	214%	INT	INT
Benzo(b)Fluoranthene	41.67	74%	81%	59%	103%	35%	INT	70%
Benzo(k)Fluoranthene	41.67	83%	101%	88%	105%	152%	INT	93%
Benzo(e)Pyrene	41.67	79%	88%	56%	94%	76%	INT	76%
Benzo(a)Pyrene	41.67	82%	100%	76%	93%	114%	INT	76%
Perylene	41.67	84%	76%	55%	80%	109%	INT	75%
Indeno(1,2,3,4-cd)Pyrene	41.67	80%	87%	INT	81%	80%	100%	90%
Dibenz(a,h)Anthracene	41.67	81%	85%	INT	78%	93%	82%	75%
Benzo(ghi)Perylene	41.67	94%	69%	65%	81%	90%	99%	77%

TABLE D.1.2.2. Gulfwatch 2006 PCB Matrix Spike Recoveries (%)

PCB Spiked Mussel Tissue (2.0g dry weight)		**SP070 502**	**SP070 507**	**SP070 509**	**SP070 522**	**SP070 605**	**SP070 619**
	Concentration (ng.g)	%	%	%	%	%	%
#8,5	20.84	69%	76%	75%	73%	70%	61%
#18,15	20.84	73%	78%	78%	75%	74%	64%
#29	20.84	74%	81%	79%	78%	80%	70%
#50	20.84	72%	83%	78%	76%	72%	66%
#28	20.84	73%	81%	77%	79%	73%	67%
#52	20.84	91%	99%	99%	83%	79%	86%
#44	20.84	75%	82%	83%	80%	80%	71%
#66,95	20.84	75%	81%	85%	83%	78%	73%
#101,90	20.84	77%	90%	88%	87%	83%	78%
#87	20.84	75%	88%	84%	83%	79%	76%
#77	20.84	70%	78%	73%	83%	78%	74%
#118	20.84	79%	88%	92%	87%	93%	77%
#153,132	20.84	78%	89%	92%	89%	86%	81%
#105	20.84	71%	81%	86%	81%	80%	75%
#138	20.84	83%	95%	101%	88%	85%	80%
#126	20.84	77%	78%	81%	84%	81%	76%
#187	20.84	77%	81%	86%	87%	82%	77%
#128	20.84	73%	80%	85%	80%	78%	73%
#180	20.84	68%	79%	83%	84%	83%	76%
#169	20.84	67%	79%	85%	81%	80%	74%
#170,190	20.84	72%	83%	87%	83%	81%	76%
#195,208	20.84	70%	80%	84%	82%	80%	74%
#206	20.84	63%	79%	77%	80%	77%	72%
#209	20.84	64%	79%	80%	75%	77%	72%

TABLE D.1.2.3 Quality Control Results for 2006 Pesticide Analysis

Pesticides Spiked Mussel Tissue (2.0g dry weight)		**SP070 502**	**SP070 507**	**SP070 509**	**SP070 522**	**SP070 605**	**SP070 619**
	Concentration (ng.g)	**%**	**%**	**%**	**%**	**%**	**%**
a_BHC	10.42	103%	96%	88%	83%	85%	83%
HCB	10.42	72%	77%	83%	80%	74%	67%
g-HCH(Lindane)	10.42	74%	80%	72%	67%	78%	77%
Heptachlor	10.42	56%	60%	66%	57%	54%	77%
Aldrin	10.42	75%	80%	81%	80%	76%	71%
HeptachlorEpoxide	10.42	88%	67%	60%	60%	53%	63%
g-Chlordane	10.42	70%	64%	56%	60%	72%	67%
o,p'-DDE	10.42	96%	91%	70%	65%	60%	78%
a-Endosulfan	10.42	78%	97%	75%	74%	79%	78%
cis-Chlordane	10.42	59%	83%	72%	71%	81%	72%
t-Nonachlor	10.42	87%	107%	104%	83%	77%	71%
p,p'_DDE	10.42	89%	93%	110%	102%	96%	88%
Dieldrin	10.42	117%	102%	102%	96%	92%	75%
o,p'-DDD	10.42	132%	131%	152%	159%	INT	91%
Endrin	10.42	83%	73%	61%	62%	93%	71%
b-Endosulfan	10.42	80%	71%	66%	61%	61%	64%
p,p'-DDD	10.42	78%	77%	87%	59%	59%	66%
o,p'-DDT	10.42	83%	86%	86%	77%	63%	77%
p,p'-DDT	10.42	86%	93%	90%	81%	79%	70%
Metoxychlor	10.42	79%	75%	86%	92%	73%	87%
Mirex	10.42	55%	78%	85%	76%	72%	72%

Accuracy Summary for matrix spikes:

PAH: In general, matrix spike recoveries means all met the data quality objectives of the program (40-120%) as shown in Table D.1.2.1. Approximately 5% of individual analyses (highlighted in blue-green) fell outside of the targeted DQO range, the majority of which exceeded 120%.

PCB: Recovery of matrix spikes ranged from 61-101% for all matrix spikes. Matrix spike recoveries means all met targeted performance criteria of 40-120% (Table D.1.2.2).

Chlorinated Pesticides: Recovery of matrix spikes and surrogates ranged from 53 - 159% (Table D.1.2.3). Only 4 individual analyses (~3%, highlighted in blue-green) where outside the targeted performance criteria of 40-120% and these were all above the 120% criteria.

D.2 PRECISION

Relative Percent Differences for Duplicate Analyses

The relative percent difference (RPD) for duplicate analyses on samples is another quality assurance exercise (Table D.2.1-3 for PAH, PCB, and pesticides, respectively). In some cases where samples are near the method detection limit, one analysis would have a detectable value but the other duplicate would not. In these cases, the RPD was determined to be 0% since the actual RPD could not be determined. The analysis of duplicates should agree to within 25% of each other.

TABLE D.2.1 PAH Duplicate analysis 2006 Gulfwatch mussel tissue concentrations (ng/g dry wt.)

	MACJ 4N	MACJ 4N DU	NHSM 4N	NHSM 4N DU	MEKN 4N	MEKN 4N DU	NBLB 3N	NBLB 3N DU	NSAR 4N	NSAR 4N DU
Pesticide	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	2.1	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	1.6	1.7	<1.2	<1.2	1.7	2.0	<1.2	<1.2
t-Nonachlor	2.5	2.3	<1.4	<1.4	<1.4	1.4	<1.4	2.6	<1.4	<1.4
p,p'_DDE	19.1	22.4	14.1	15.3	2.9	2.8	7.2	6.2	<1.8	<1.8
Dieldrin	2.1	2.0	<1.4	<1.4	2.2	2.2	<1.4	4.5	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	13.7	12.8	5.8	5.5	<2	<2	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	3.1	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Total:	**39.5**	**41.0**	**21.6**	**25.5**	**5.1**	**6.5**	**8.9**	**16.8**	**0.0**	**0.0**
$Mean_A$	40.3		23.6		5.8		12.9		0.0	
RPD	2%		8%		12%		31%			

TABLE D.2.2 PCB Duplicate analysis 2006 Gulfwatch mussel tissue concentrations (ng/g dry wt.)

PCB Congener	MACJ 4N	MACJ 4N DU	NHSM 4N	NHSM 4N DU	MEKN 4N	MEKN 4N DU	NBLB 3N	NBLB 3N DU	NSAR 4N	NSAR 4N DU
8;5	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	2.4	2.6	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	7.6	8.1	7.3	7.8	3.3	<2.2	3.6	<2.2	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
118	8.1	8.9	6.2	6.7	<2	<2	<2	<2	<2	<2
153;132	14.8	16.0	11.2	11.8	6.7	<2.1	6.4	5.7	<2.1	<2.1
105	2.2	2.3	1.7	1.9	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
138	13.3	14.3	10.3	10.9	5.4	<2	7.9	4.2	<2	<2
126	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
187	5.5	5.9	4.4	4.7	3.3	<1.9	1.9	<1.9	<1.9	<1.9
128	2.7	2.9	<1.9	2.0	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
180	<1.7	1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
Total	**57**	**63**	**41**	**46**	**19**	**0**	**20**	**10**	**0**	**0**
$Mean_A$	59.7		43.4		9.3		14.8		0.0	
RPD	5%		6%		100%		33%			

TABLE D.2.3 Pesticide duplicate analysis 2006 Gulfwatch mussel tissue concentrations (ng/g dry wt.)

Pesticide	MACJ 4N	MACJ 4N DU	NHSM 4N	NHSM 4N DU	MEKN 4N	MEKN 4N DU	NBLB 3N	NBLB 3N DU	NSAR 4N	NSAR 4N DU
	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}	ng g^{-1}
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	2.1	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	1.6	1.7	<1.2	<1.2	1.7	2.0	<1.2	<1.2
t-Nonachlor	2.5	2.3	<1.4	<1.4	<1.4	1.4	<1.4	2.6	<1.4	<1.4
p,p'_DDE	19.1	22.4	14.1	15.3	2.9	2.8	7.2	6.2	<1.8	<1.8
Dieldrin	2.1	2.0	<1.4	<1.4	2.2	2.2	<1.4	4.5	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	13.7	12.8	5.8	5.5	<2	<2	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	3.1	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Total:	**39.5**	**41.0**	**21.6**	**25.5**	**5.1**	**6.5**	**8.9**	**16.8**	**0.0**	**0.0**
$Mean_A$	40.2		23.5		5.8		12.9		0.0	
RPD	2%		8%		12%		31%			

Precision (analysis of duplicates) Summary:

PAHs: All but one of the duplicate analyses of station replicates met the data quality objectives (relative percent difference ≤ 25%) of the Program (Table D.2.1). The duplicate analysis is sensitive to individual compounds that may be near the level of detection and result in greater RPD for samples with low level contamination.

PCBs: The RPD of duplicate analyses ranged from 5 -100% (Table D.2.2). Three of the 5 duplicate analyses of station replicates met the data quality objectives (relative percent difference ≤ 25%) of the Program. The duplicate analysis is sensitive to individual congeners that may be near the level of detection and result in greater RPD for samples with low level contamination.

Chlorinated Pesticides: The RPD of duplicate analyses ranged from 2 -9931% (Table D.2.3). Four of the 5 duplicate analyses of station replicates met the data quality objectives (relative percent difference ≤ 25%) of the Program.

D.3 BLANKS

Blank analyses should ideally recover no detectable amounts of target compounds. For 2006, no discernible analytical signal was observed for PAHs, PCBs, and PEST.

D.4 COMPLETENESS

100% of the 2006. 100% of the samples collected (15 of 15 sampling sites; 60 individual replicates) were collected, analyzed and are reported here.

APPENDIX E: 2006 Trace Metal (and % solids) Data
Gulfwatch Mussel Samples

TABLES E. Selected metals concentration (ug/g dry wt.) and % solids content observed in blue mussel tissue collected by Gulfwatch, 2006. Stations are ordered by year, essentially clockwise in rotation, south (Massachusetts) to north (to Nova Scotia).

TABLE E.1 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at Cohasset Harbor Jetty, MA (MACJ); 42.2428°N, 70.7874°W. **New Gulfwatch Site**.

MACJ	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.077	0.075	0.063	0.080
Cd	1.74	1.61	1.49	1.53
Cr	2.56	1.41	1.46	1.76
Cu	9.04	7.68	7.40	8.99
Fe	835	352	357	448
Ni	1.73	1.29	1.07	1.34
Pb	5.57	4.87	4.02	4.30
Zn	125	105	109	115
Al	936	282	354	309
Hg	0.246	0.228	0.213	0.264
%Solids	15.8	10.2	9.4	17.8

TABLE E.2 2006 Blue mussel tissue metal concentrations (µg/g dry wt.) in Massachusetts Cohasset Harbor/Gulf River (MACG); 42.2384°N, 70.7895°W

MACG	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.078	0.063	0.070	0.071
Cd	1.97	1.62	1.66	1.36
Cr	1.83	1.66	1.69	1.51
Cu	8.47	8.09	9.66	7.92
Fe	511	471	419	415
Ni	1.44	1.28	1.21	1.24
Pb	5.59	4.05	3.79	3.50
Zn	116	99	110	98
Al	383	391	360	400
Hg	0.248	0.249	0.250	0.238
%Solids	9.7	16.6	16.5	11.4

TABLE E.3 2006 Blue mussel tissue metal concentrations (µg/g dry wt.) at the Merrimack Estuary site, Newburyport, MA(MAME); 42.8165°N, 70.8208°W

MAME	(µg/g dry wt.)		
Replicate	*1N*	*2N*	*3N*
Ag	0.065	0.065	0.059
Cd	1.44	1.44	1.25
Cr	1.71	1.98	1.60
Cu	6.90	6.82	7.11
Fe	372	418	298
Ni	0.96	1.37	1.04
Pb	2.55	3.80	2.59
Zn	79	89	84
Al	227	280	206
Hg	0.136	0.139	0.145
%Solids	12.9	14.1	13.8

TABLE E.4 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at the Hampton/Seabrook estuary, NH site (NHHS); 42.8972°N, 70.8163°W

NHHS	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.031	0.044	0.045	0.047
Cd	2.00	2.16	1.47	1.81
Cr	1.27	1.50	1.12	1.11
Cu	6.64	6.91	7.16	6.46
Fe	378	412	302	335
Ni	0.96	1.29	1.20	0.76
Pb	1.81	2.52	1.42	1.42
Zn	99	107	98	84
Al	462	581	405	416
Hg	0.119	0.141	0.104	0.109
%Solids	11.2	16.1	11.1	12.6

TABLE E.5 2006 blue mussel tissue metal concentrations (µg/g dry wt.), South Mill Pond, NH (NHSM); 43.0729°N, 70.7489°W. #N-Dup represents duplicate analysis of site replicate.

NHSM	(µg/g dry wt.)				
Replicate	*1N*	*2N*	*2N-Dup*	*3N*	*4N*
Ag	0.064	0.058	0.060	0.056	0.049
Cd	1.95	2.28	2.31	2.06	2.54
Cr	2.35	2.59	2.64	2.29	2.43
Cu	8.73	8.92	8.68	8.48	8.64
Fe	518	566	570	505	498
Ni	1.77	1.83	1.65	1.77	1.75
Pb	14.34	17.13	16.92	15.50	16.54
Zn	139	211	207	166	172
Al	498	514	662	531	422
Hg	0.392	0.368	0.363	0.323	0.387
%Solids	7.3	6.9	6.9	12.3	8.3

TABLE E.6 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at Dover Point, NH (NHDP); 43.1196°N, 70.8267°W.

NHDP	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.044	0.037	0.044	0.043
Cd	2.10	1.83	2.33	2.21
Cr	1.84	2.32	2.94	2.74
Cu	6.87	6.74	7.52	8.08
Fe	338	323	441	435
Ni	1.63	1.41	1.55	1.93
Pb	2.46	1.54	2.53	2.04
Zn	95	99	110	98
Al	340	319	472	403
Hg	0.222	0.227	0.285	0.268
%Solids	11.4	12.7	9.1	11.9

TABLE E.7 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at Schiller Station site (NHSS); 43.1018°N, 70.7907°W

NHSS	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.044	0.038	0.044	0.036
Cd	2.08	1.95	1.96	2.03
Cr	2.33	2.11	1.90	2.08
Cu	6.37	15.09	6.63	6.26
Fe	562	633	451	470
Ni	1.75	8.21	1.77	1.74
Pb	2.36	2.31	2.28	2.47
Zn	114	116	102	106
Al	487	390	448	473
Hg	0.296	0.300	0.291	0.326
%Solids	14.0	13.8	14.0	13.9

TABLE E.8 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at Clark's Cove, ME (MECC); 43.0774°N, 70.7244°W. **NH Trend Site**.

MECC	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.037	0.035	0.030	0.035
Cd	2.43	2.62	2.62	2.43
Cr	2.69	2.74	2.08	2.60
Cu	7.34	7.79	6.47	6.87
Fe	561	461	333	439
Ni	1.67	1.86	1.49	1.88
Pb	3.84	3.78	2.75	2.18
Zn	111	118	102	114
Al	586	440	263	459
Hg	0.315	0.292	0.281	0.258
%Solids	6.9	7.4	8.1	9.3

TABLE E.9 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at Brave Boat Harbor, ME (MEBH); 43.1007°N, 70.6597°W

MEBH	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.083	0.144	0.134	0.138
Cd	1.56	2.06	1.91	1.87
Cr	2.02	1.21	2.60	1.45
Cu	5.89	6.00	6.06	6.00
Fe	538	305	735	331
Ni	1.39	1.07	1.50	1.23
Pb	1.22	1.43	1.96	1.72
Zn	78	94	87	91
Al	632	230	726	438
Hg	0.106	0.127	0.136	0.144
%Solids	17.2	15.8	19.3	17.9

TABLE E.10 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at the Kennebec River site, ME (MEKN); 43.7850°N, 69.7850°W. **ME Trend Site.**

MEKN	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.058	0.061	0.047	0.050
Cd	1.97	2.52	2.18	1.60
Cr	1.54	1.97	1.35	1.53
Cu	6.54	6.30	5.53	6.22
Fe	364	484	310	458
Ni	1.04	1.20	0.99	0.88
Pb	1.51	1.71	1.12	1.25
Zn	61	65	57	60
Al	272	333	274	373
Hg	0.165	0.221	0.155	0.152
%Solids	14.5	12.1	15.4	16.1

TABLE E.11 2006 Blue mussel tissue metal concentrations (µg/g dry wt.) at the Booth Bay Harbor site, ME (MEBB); 43.8513°N, 69.6259°W. #N-Dup represents duplicate analysis of site replicate.

MEBB	(µg/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*3N-Dup*	*4N*
Ag	0.028	0.014	0.013	0.013	0.019
Cd	1.19	0.93	1.04	1.04	1.12
Cr	1.13	1.18	1.09	1.11	1.15
Cu	12.73	9.49	10.36	10.30	10.57
Fe	334	308	287	280	338
Ni	0.74	0.65	0.68	0.70	0.67
Pb	17.59	10.13	10.73	10.73	12.77
Zn	171	138	163	163	150
Al	265	244	236	199	207
Hg	0.253	0.226	0.236	0.226	0.249
%Solids	17.0	18.0	18.3	18.3	17.4

TABLE E.12 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at the Limekiln Bay site, NB (NBLB); 45.0345°N, 66.4880°W

NBLB	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.019	0.018	0.017	0.019
Cd	2.59	2.98	2.00	2.46
Cr	1.80	1.99	1.56	1.93
Cu	6.54	6.20	6.16	6.04
Fe	455	557	491	615
Ni	1.28	1.24	0.92	1.17
Pb	2.93	3.10	2.14	2.21
Zn	113	120	113	106
Al	455	458	569	734
Hg	0.156	0.207	0.133	0.154
%Solids	11.3	11.9	11.2	6.9

TABLE E.13 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at the St. Croix site, NB (NBSC); 45.1002°N, 67.0965°W **NB Trend Site**

NBSC	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.039	0.065	0.076	0.042
Cd	1.70	2.16	2.23	1.86
Cr	1.24	1.61	1.50	1.42
Cu	5.37	7.00	6.61	4.93
Fe	385	476	487	482
Ni	1.00	1.18	1.15	1.32
Pb	0.98	1.20	1.22	1.21
Zn	81	81	96	88
Al	338	389	439	401
Hg	0.147	0.207	0.170	0.163
%Solids	12.3	17.3	14.9	13.4

TABLE E.14 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at the Yarthmouth site, NS (NSYR); 43.8180°N, 66.8440°W. **NS Trend Site.**

NSYR	(µg/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Ag	0.118	0.116	0.189	0.127
Cd	1.52	1.63	1.72	1.90
Cr	1.74	1.96	1.80	1.57
Cu	6.77	6.67	6.74	6.30
Fe	597	680	521	483
Ni	1.28	1.62	1.40	1.44
Pb	2.44	2.87	3.21	3.23
Zn	89	98	94	105
Al	375	459	325	298
Hg	0.195	0.210	0.230	0.233
%Solids	13.9	13.9	13.3	13.6

TABLE E.15 2006 blue mussel tissue metal concentrations (µg/g dry wt.) at the Apple River site, NS (NSAR); 43.7390°N, 66.1430°W. #N-Dup represents duplicate analysis of site replicate.

NSAR	(µg/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
Ag	0.044	0.035	0.038	0.050	0.048
Cd	2.93	2.89	2.61	3.61	3.51
Cr	2.30	2.49	2.70	2.58	2.48
Cu	6.99	6.74	6.58	6.84	6.88
Fe	817	850	1094	935	846
Ni	2.37	2.54	2.49	2.74	2.68
Pb	1.46	1.54	1.68	2.00	1.92
Zn	83	79	89	90	91
Al	1099	1046	1637	1333	1184
Hg	0.205	0.231	0.194	0.227	0.226
%Solids	11.9	2.7	12.7	13.4	13.4

APPENDIX F: Organic Contaminants (and % Lipids Content) in 2006 Gulfwatch Mussel Samples

TABLES F.1 PAH concentration (ng/g dry wt.) and % lipid content observed in Mussel tissue collected by Gulfwatch, 2006. "Int." indicates the presence of interferences during analysis. Stations are ordered by year, essentially clockwise in rotation, south (Massachusetts) to north (to Nova Scotia).

Table F.1.1 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Cohasset Harbor Jetty, MA (MACJ); 42.2428°N, 70.7874°W. #N-Dup represents duplicate analysis of site replicate.

MACJ	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
Naphthalene	15.7	11.6	<10	<10	21.4
1-Methylnaphthalene	<8	<8	<8	<8	8.5
2-Methylnaphthalene	15.6	13.0	13.3	14.2	18.2
Biphenyl	<7	<7	<7	<7	<7
2,6-Dimethylnaphthalene	NA	NA	NA	NA	NA
Acenaphthylene	<11	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7	<7
Phenanthrene	17.6	22.2	17.2	22.8	21.3
Anthracene	<10	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	13.6	14.1
Fluoranthene	29.3	28.1	29.1	36.4	35.0
Pyrene	22.0	15.0	21.6	24.6	28.0
Benzo(a)Anthracene	6.6	<6	<6	11.7	10.2
Chrysene	13.7	21.0	13.4	18.4	16.0
Benzo(b)Fluoranthene	10.4	<6	9.4	11.5	13.3
Benzo(k)Fluoranthene	7.7	<4	7.4	11.7	11.4
Benzo(e)Pyrene	13.0	16.2	14.1	21.3	14.9
Benzo(a)Pyrene	5.6	4.2	6.4	<4	6.1
Perylene	6.4	10.2	7.3	6.5	5.4
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15	<15
% Lipid	8.4	8.3	7.4	8.3	8.3

Table F.1.2 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Cohasset Harbor Gulf , MA, (MACG); 42.2384°N, 70.7895°W

MACG	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	<10	10.3	10.8
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	11.8	<10	11.4	12.2
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	NA	NA	NA	NA
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	9.3	<7	7.8	8.8
Phenanthrene	18.5	13.6	17.3	18.7
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	32.9	26.5	34.5	39.6
Pyrene	25.6	21.5	20.5	26.0
Benzo(a)Anthracene	8.9	<6	9.6	11.7
Chrysene	13.5	13.5	16.1	17.7
Benzo(b)Fluoranthene	9.1	12.5	10.2	11.3
Benzo(k)Fluoranthene	10.4	7.3	10.9	12.5
Benzo(e)Pyrene	14.6	13.7	16.4	14.2
Benzo(a)Pyrene	5.4	5.6	5.2	7.0
Perylene	35.0	12.3	25.0	22.1
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	6.7	7.1	7.0	7.4

Table F.1.3 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Merrimack estuary, MA, (MAME); 42.8165°N, 70.8208°W

MAME	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	11.0	19.2	19.9
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	10.6
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	NA	NA	NA	NA
Acenaphthylene	<11	<11	<11	11.3
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	8.6	7.2	<7	12.9
Phenanthrene	14.5	19.4	21.5	44.2
Anthracene	<10	10.5	10.6	34.2
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	71.2	85.0	82.4	84.5
Pyrene	87.6	89.3	94.9	58.8
Benzo(a)Anthracene	22.9	45.8	42.9	INT
Chrysene	49.5	80.1	74.9	INT
Benzo(b)Fluoranthene	32.8	48.3	55.2	INT
Benzo(k)Fluoranthene	37.4	36.6	35.3	INT
Benzo(e)Pyrene	<7	61.0	62.0	INT
Benzo(a)Pyrene	58.6	22.0	23.4	INT
Perylene	17.3	18.2	21.3	INT
Indeno(1,2,3,4-cd)Pyrene	<7	15.0	15.8	INT
Dibenz(a,h)Anthracene	<11	<11	<11	INT
Benzo(ghi)Perylene	22.7	22.4	25.5	INT
% Lipid	10.8	12.2	10.5	11.7

Table F.1.4 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Hampton/Seabrook estuary, NH, (NHHS); 42.8972°N, 70.8163°W.

NHHS	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	<10	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	NA	NA	NA	NA
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	10.4	11.4	10.2	10.6
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	<14	<14	<14	<14
Pyrene	13.0	15.1	12.5	12.6
Benzo(a)Anthracene	<6	<6	<6	<6
Chrysene	9.5	10.5	8.4	8.7
Benzo(b)Fluoranthene	<6	<6	<6	<6
Benzo(k)Fluoranthene	4.6	5.0	<4	4.2
Benzo(e)Pyrene	8.6	9.7	7.9	8.7
Benzo(a)Pyrene	<4	<4	<4	<4
Perylene	<5	<5	<5	<5
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	7.1	7.0	6.4	7.0

Table F.1.5 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at South Mill Pond, NH (NHSM); 43.0729°N, 70.7489°W. #N-Dup represents duplicate analysis of site replicate.

NHSM	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
Naphthalene	<10	<10	<10	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7	<7
2,6-Dimethylnaphthalene	NA	NA	NA	NA	NA
Acenaphthylene	<11	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7	<7
Phenanthrene	23.9	22.0	24.7	20.6	24.0
Anthracene	<10	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12	<12
Fluoranthene	67.7	62.5	66.7	53.8	58.5
Pyrene	111.8	106.9	115.0	97.4	109.5
Benzo(a)Anthracene	35.2	38.1	40.7	32.3	36.2
Chrysene	72.6	69.8	75.3	70.7	74.1
Benzo(b)Fluoranthene	84.5	80.0	103.1	73.0	80.8
Benzo(k)Fluoranthene	55.1	66.9	71.6	61.0	69.4
Benzo(e)Pyrene	80.7	83.6	94.7	80.3	90.9
Benzo(a)Pyrene	26.8	29.9	32.7	28.1	31.2
Perylene	26.8	31.9	36.4	28.0	31.8
Indeno(1,2,3,4-cd)Pyrene	33.0	38.0	44.5	35.4	40.4
Dibenz(a,h)Anthracene	<11	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15	<15
% Lipid	7.1	6.6	6.1	7.4	7.9

Table F.1.6 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Dover Point, NH (NHDP); 43.1196°N, 70.8267°W.

NHDP	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	<10	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	8.7	9.9	12.0	10.2
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	28.3	37.0	40.1	34.5
Pyrene	56.6	67.6	69.0	65.2
Benzo(a)Anthracene	10.7	16.2	16.2	13.9
Chrysene	24.3	28.4	27.3	22.9
Benzo(b)Fluoranthene	11.8	22.2	17.7	18.7
Benzo(k)Fluoranthene	14.1	16.5	19.1	15.9
Benzo(e)Pyrene	24.0	27.3	27.1	25.6
Benzo(a)Pyrene	7.7	9.3	11.4	8.7
Perylene	8.5	10.4	10.5	10.2
Indeno(1,2,3,4-cd)Pyrene	8.0	9.6	10.9	9.4
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	6.6	7.2	7.4	7.9

Table F.1.7 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Schiller Station, NH (NHSS); 43.1196°N, 70.8267°W.

NHSS	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	<10	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	NA	NA	NA	NA
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	7.8	7.4	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	15.2	20.7	20.0	15.9
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	29.5	33.1	29.3	32.8
Pyrene	49.9	54.9	55.2	55.6
Benzo(a)Anthracene	17.0	16.8	15.5	15.9
Chrysene	28.9	28.5	28.7	27.5
Benzo(b)Fluoranthene	20.8	20.1	19.8	21.5
Benzo(k)Fluoranthene	17.4	18.3	17.2	18.2
Benzo(e)Pyrene	27.7	27.3	27.0	27.1
Benzo(a)Pyrene	11.7	8.9	10.4	9.7
Perylene	9.8	10.1	9.7	10.6
Indeno(1,2,3,4-cd)Pyrene	10.7	11.7	11.0	11.1
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	7.0	7.2	7.3	6.6

Table F.1.8 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Clark's Cove, ME (MECC); 43.0774°N, 70.7244°W. **NH Trend Site**

MECC	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	10.6	11.5	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	9.4	7.1	6.6	<6
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	24.7	20.7	18.8	15.5
Pyrene	33.3	31.3	28.1	21.3
Benzo(a)Anthracene	9.5	9.0	8.2	<6
Chrysene	17.1	16.2	15.2	10.2
Benzo(b)Fluoranthene	15.9	12.6	14.6	7.8
Benzo(k)Fluoranthene	13.7	12.8	12.6	7.3
Benzo(e)Pyrene	21.2	19.7	18.2	13.5
Benzo(a)Pyrene	6.4	6.8	4.6	<4
Perylene	8.7	8.3	7.7	5.6
Indeno(1,2,3,4-cd)Pyrene	8.1	7.6	7.0	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	7.2	7.1	7.2	6.3

Table F.1.9 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Brave Boat Harbor, ME (MEBH); 43.1007°N, 70.6597°W.

MEBH	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	<10	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	<6	<6	<6	<6
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	<14	<14	<14	<14
Pyrene	<9	<9	<9	<9
Benzo(a)Anthracene	<6	<6	<6	<6
Chrysene	<6	<6	<6	<6
Benzo(b)Fluoranthene	<6	<6	<6	<6
Benzo(k)Fluoranthene	<4	<4	<4	<4
Benzo(e)Pyrene	<7	<7	INT	<7
Benzo(a)Pyrene	<4	<4	<4	<4
Perylene	<5	<5	<5	<5
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	5.7	6.0	6.6	5.9

Table F.1.10 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Kennebec River, ME, (MEKN); 43.7850°N, 69.7850°W. #N-Dup represents duplicate analysis of site replicate.

MEKN	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
Naphthalene	<10	10.6	<10	<10	<10
1-Methylnaphthalene	<8	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7	<7
Phenanthrene	<6	<6	<6	<6	<6
Anthracene	<10	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12	<12
Fluoranthene	16.6	14.8	14.0	15.2	15.4
Pyrene	22.8	19.0	16.0	15.8	16.7
Benzo(a)Anthracene	6.0	6.8	<6	6.4	<6
Chrysene	8.1	9.4	6.8	7.8	7.6
Benzo(b)Fluoranthene	7.7	8.6	<6	<6	<6
Benzo(k)Fluoranthene	<4	5.1	<4	4.6	4.3
Benzo(e)Pyrene	INT	<7	INT	<7	<7
Benzo(a)Pyrene	4.3	4.3	<4	4.2	4.3
Perylene	10.5	10.4	11.0	9.5	11.4
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15	<15
% Lipid	6.8	7.2	7.6	8.2	8.1

Table F.1.11 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at the Booth Bay, ME (MEBB); 43.8513°N, 69.6259°W.

MEBB	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	<10	<10	11.9	<10
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	32.4	23.5	26.0	28.0
Anthracene	13.4	10.1	11.6	18.2
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	183.0	182.5	186.3	174.9
Pyrene	195.0	187.2	182.4	181.1
Benzo(a)Anthracene	59.2	37.1	34.1	46.0
Chrysene	89.9	83.6	79.2	72.2
Benzo(b)Fluoranthene	109.1	95.7	77.9	63.8
Benzo(k)Fluoranthene	75.4	53.2	48.8	75.5
Benzo(e)Pyrene	126.9	113.3	102.3	85.9
Benzo(a)Pyrene	37.1	22.7	21.4	24.2
Perylene	16.4	11.9	11.5	15.7
Indeno(1,2,3,4-cd)Pyrene	34.8	28.0	24.5	22.5
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	39.2	37.5	32.4	25.0
% Lipid	6.6	6.7	7.2	6.9

Table F.1.12 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Limekiln Bay, NB, (NBLB); 45.0345°N, 66.4880°W. #N-Dup represents duplicate analysis of site replicate.

NBLB	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*3N-Dup*	*4N*
Naphthalene	13.7	14.2	22.2	<10	13.6
1-Methylnaphthalene	<8	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7	<7
Phenanthrene	9.0	8.0	7.8	8.2	8.4
Anthracene	<10	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12	<12
Fluoranthene	<14	<14	<14	<14	<14
Pyrene	<9	<9	<9	<9	<9
Benzo(a)Anthracene	<6	<6	<6	<6	<6
Chrysene	<6	<6	<6	<6	<6
Benzo(b)Fluoranthene	<6	<6	<6	<6	<6
Benzo(k)Fluoranthene	<4	<4	<4	<4	<4
Benzo(e)Pyrene	<7	<7	<7	<7	<7
Benzo(a)Pyrene	<4	<4	<4	<4	<4
Perylene	<5	<5	<5	<5	<5
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15	<15
% Lipid	9.2	8.8	9.4	7.7	8.7

Table F.1.13 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at St. Croix, NB (NBSC); 45.1002°N, 67.0965°W. #N-Dup represents duplicate analysis of site replicate. **NB Trend Site.**

NBSC	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*2N-Dup*	*3N*	*4N*
Naphthalene	13.6	18.5	<10	26.5	20.9
1-Methylnaphthalene	<8	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7	<7
Phenanthrene	8.9	7.8	8.3	8.0	8.1
Anthracene	<10	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12	<12
Fluoranthene	<14	<14	<14	<14	<14
Pyrene	<9	<9	<9	<9	<9
Benzo(a)Anthracene	<6	<6	<6	<6	<6
Chrysene	<6	<6	<6	<6	<6
Benzo(b)Fluoranthene	<6	<6	<6	<6	<6
Benzo(k)Fluoranthene	<4	<4	<4	<4	<4
Benzo(e)Pyrene	<7	<7	<7	<7	<7
Benzo(a)Pyrene	<4	<4	<4	<4	<4
Perylene	5.9	5.1	<5	5.4	5.3
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15	<15
% Lipid	8.2	6.7	5.1	7.6	8.2

Table F.1.14 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Yarmouth, NS, (NSYR); 43.8180°N, 66.8440°W. **NS Trend Site.**

NSYR	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
Naphthalene	12.1	14.5	25.8	12.5
1-Methylnaphthalene	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
Phenanthrene	14.1	11.0	22.0	11.6
Anthracene	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12
Fluoranthene	31.7	25.0	48.2	27.0
Pyrene	19.3	14.1	22.8	16.8
Benzo(a)Anthracene	6.5	<6	6.6	INT
Chrysene	10.1	7.7	18.6	INT
Benzo(b)Fluoranthene	9.0	6.4	10.1	7.8
Benzo(k)Fluoranthene	<4	<4	<4	<4
Benzo(e)Pyrene	7.9	<7	9.4	<7
Benzo(a)Pyrene	<4	<4	INT	INT
Perylene	7.6	5.6	13.1	8.4
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
% Lipid	5.9	6.0	9.2	5.4

Table F.1.15 2006 blue mussel tissue PAH concentrations (ng/g dry wt.) at Apple River, NS (NSAR); 43.7390°N, 66.1430°W. #N-Dup represents duplicate analysis of site replicate.

NSAR			(ng/g dry wt.)			
Replicate	*1N*	*1N-Dup*	*2N*	*3N*	*4N*	*4N-Dup*
Naphthalene	14.7	<10	14.6	15.1	<10	12.7
1-Methylnaphthalene	<8	<8	<8	<8	<8	<8
2-Methylnaphthalene	<10	<10	<10	<10	<10	<10
Biphenyl	<7	<7	<7	<7	<7	<7
2,6-Dimethylnaphthalene	<8	<8	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8	<8	<8
2,3,5-Trimethylnaphthalene	<7	<7	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7	<7	<7
Phenanthrene	8.1	7.6	6.3	<6	<6	6.0
Anthracene	<10	<10	<10	<10	<10	<10
1-Methylphenanthracene	<12	<12	<12	<12	<12	<12
Fluoranthene	<14	<14	<14	<14	<14	<14
Pyrene	<9	<9	<9	<9	<9	<9
Benzo(a)Anthracene	<6	<6	<6	<6	<6	<6
Chrysene	<6	<6	<6	<6	<6	<6
Benzo(b)Fluoranthene	<6	<6	<6	<6	<6	<6
Benzo(k)Fluoranthene	<4	<4	<4	<4	<4	<4
Benzo(e)Pyrene	<7	<7	<7	<7	<7	<7
Benzo(a)Pyrene	<4	<4	<4	<4	<4	<4
Perylene	<5	<5	<5	<5	<5	<5
Indeno(1,2,3,4-cd)Pyrene	<7	<7	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15	<15	<15
% Lipid	4.4	4.7	6.3	5.7	5.8	5.6

TABLES F.2 PCB concentration (ng/g dry wt.) observed in Mussel tissue collected by Gulfwatch, 2006. "Int." indicates the presence of interferences during analysis. Stations are ordered by year, essentially clockwise in rotation, south (Massachusetts) to north (to Nova Scotia).

Table F.2.1 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Cohasset Harbor Jetty, MA (MACJ); 42.2428°N, 70.7874°W. #N-Dup represents duplicate analysis of site replicate.

MACJ	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
8;5	<2.8	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	2.9	2.7	3.6	2.4	2.6
101;90	8.4	8.5	7.6	7.6	8.1
87	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	9.3	8.7	8.1	8.1	8.9
153;132	17.5	16.3	14.8	14.8	16.0
105	2.6	2.4	2.9	2.2	2.3
138	15.6	14.4	13.3	13.3	14.3
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	6.6	6.0	5.5	5.5	5.9
128	3.2	3.0	2.6	2.7	2.9
180	2.0	<1.7	1.8	<1.7	1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7

Table F.2.2 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Cohasset Harbor Gulf , MA, (MACG); 42.2384°N, 70.7895°W.

MACG	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	2.4	<2.2	<2.2	2.4
101;90	7.5	7.0	7.3	7.8
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	7.6	7.4	7.5	8.2
153;132	13.2	12.9	13.6	15.1
105	2.3	2.0	2.2	2.3
138	12.1	11.6	12.3	13.6
126	<1.9	<1.9	<1.9	<1.9
187	5.0	4.8	5.1	5.7
128	2.4	2.3	2.5	2.8
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.3 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Merrimack estuary, MA, (MAME); 42.8165°N, 70.8208°W.

MAME	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	4.1	4.4	<2.3	4.9
52	9.9	10.8	11.9	11.8
44	6.5	7.2	8.0	7.9
66;95	17.7	17.9	21.9	17.8
101;90	22.9	27.6	29.2	25.0
87	6.0	6.6	7.4	7.3
77	2.7	2.6	3.3	3.1
118	16.1	18.6	20.1	18.9
153;132	23.9	26.8	30.0	24.7
105	5.3	5.5	6.1	6.0
138	24.0	26.7	29.3	25.8
126	<1.9	<1.9	<1.9	<1.9
187	9.0	9.0	10.5	9.7
128	4.6	4.6	5.7	5.5
180	3.9	3.6	3.6	3.3
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.4 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Hampton/Seabrook estuary, NH, (NHHS); 42.8972°N, 70.8163°W.

NHHS	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	3.2	3.7	3.2	3.1
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	<2	<2	<2	2.7
153;132	4.5	4.7	4.2	4.5
105	<1.4	<1.4	<1.4	<1.4
138	4.1	4.7	3.9	4.3
126	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.5 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at South Mill Pond, NH (NHSM); 43.0729°N, 70.7489°W. #N-Dup represents duplicate analysis of site replicate.

NHSM	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
8;5	<2.8	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	7.72	6.58	7.9	7.3	7.8
87	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	6.51	5.47	6.7	6.2	6.7
153;132	12.08	9.69	12.1	11.2	11.8
105	1.86	1.52	1.8	1.7	1.9
138	11.07	9.23	11.3	10.3	10.9
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	4.75	4.00	4.7	4.4	4.7
128	1.95	<1.9	1.9	<1.9	2.0
180	<1.7	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7

Table F.2.6 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Dover Point, NH (NHDP); 43.1196°N, 70.8267°W.

NHDP	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	4.8	6.6	6.1	6.4
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	3.8	5.5	5.1	5.0
153;132	7.2	9.9	9.6	9.8
105	<1.4	<1.4	1.4	<1.4
138	6.7	9.1	8.9	9.1
126	<1.9	<1.9	<1.9	<1.9
187	2.8	3.6	3.8	4.0
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.7 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Schiller Station, NH (NHSS); 43.1196°N, 70.8267°W.

NHSS	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	4.5	5.2	5.35	5.34
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	3.7	4.3	4.68	4.44
153;132	8.5	8.5	8.90	8.67
105	<1.4	<1.4	<1.4	<1.4
138	7.6	7.7	8.10	7.87
126	<1.9	<1.9	<1.9	<1.9
187	3.4	3.2	3.35	3.11
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.8 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Clark's Cove, ME (MECC); 43.0774°N, 70.7244°W. **NH Trend Site**

MECC	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	5.0	5.3	5.7	4.0
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	4.1	4.2	4.6	3.2
153;132	9.1	9.5	9.8	7.0
105	<1.4	<1.4	<1.4	<1.4
138	8.4	8.8	9.3	6.7
126	<1.9	<1.9	<1.9	<1.9
187	4.0	4.2	4.2	2.4
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.9 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Brave Boat Harbor, ME (MEBH); 43.1007°N, 70.6597°W.

MEBH	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	<2.2	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	<2	<2	<2	<2
153;132	<2.1	<2.1	2.1	<2.1
105	<1.4	<1.4	<1.4	<1.4
138	<2	<2	<2	<2
126	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.10 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Kennebec River, ME, (MEKN); 43.7850°N, 69.7850°W. #N-Dup represents duplicate analysis of site replicate.

MEKN	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
8;5	<2.8	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	3.3	2.6	3.9	3.3	<2.2
87	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	<2	<2	2.0	<2	<2
153;132	6.6	5.9	7.5	6.7	<2.1
105	<1.4	<1.4	<1.4	<1.4	<1.4
138	5.0	4.5	5.6	5.4	<2
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	3.0	2.7	3.5	3.3	<1.9
128	<1.9	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7

Table F.2.11 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at the Booth Bay, ME (MEBB); 43.8513°N, 69.6259°W.

MEBB	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	6.9	7.0	7.8	8.3
87	<1.9	<1.9	2.0	2.2
77	<2.3	<2.3	<2.3	<2.3
118	5.6	5.8	6.3	6.9
153;132	9.0	9.2	9.8	11.1
105	2.1	2.1	2.3	2.6
138	8.1	8.3	8.7	9.9
126	<1.9	<1.9	<1.9	<1.9
187	4.9	4.9	5.2	5.9
128	<1.9	<1.9	2.0	2.1
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.12 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Limekiln Bay, NB, (NBLB); 45.0345°N, 66.4880°W. #N-Dup represents duplicate analysis of site replicate.

NBLB	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*3N-Dup*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	2.4	3.6	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	<2	2.0	<2	<2	<2
153;132	5.9	6.8	6.4	5.7	6.1
105	<1.4	<1.4	<1.4	<1.4	<1.4
138	4.5	5.1	7.9	4.2	4.5
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	<1.9	2.1	1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7

Table F.2.13 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at St. Croix, NB (NBSC); 45.1002°N, 67.0965°W. **NB Trend Site.**

NBSC	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	<2.2	2.6	2.7
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	<2	<2	<2	<2
153;132	7.8	6.6	8.2	8.8
105	<1.4	<1.4	<1.4	<1.4
138	5.7	4.8	7.0	7.5
126	<1.9	<1.9	<1.9	<1.9
187	3.1	2.5	3.2	4.4
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.14 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Yarmouth, NS, (NSYR); 43.8180°N, 66.8440°W. **NS Trend Site.**

NSYR	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
8;5	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	<2.2	2.7	<2.2
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	<2	<2	2.2	<2
153;132	2.3	2.3	3.9	2.2
105	<1.4	<1.4	<1.4	<1.4
138	2.3	2.0	3.5	<2
126	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7

Table F.2.15 2006 blue mussel tissue PCB concentrations (ng/g dry wt.) at Apple River, NS (NSAR); 43.7390°N, 66.1430°W. #N-Dup represents duplicate analysis of site replicate.

NSAR	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
8;5	<2.8	<2.8	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.3	<2.3	<2.3	<2.3	<2.3
52	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	<2.2	<2.2	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	<2	<2	<2	<2	<2
153;132	<2.1	<2.1	<2.1	<2.1	<2.1
105	<1.4	<1.4	<1.4	<1.4	<1.4
138	<2	<2	<2	<2	<2
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7

TABLES F.3 Pesticide concentration (ng/g dry wt.) observed in Mussel tissue collected by Gulfwatch, 2006. "Int." indicates the presence of interferences during analysis. Stations are ordered by year, essentially clockwise in rotation, south (Massachusetts) to north (to Nova Scotia).

Table F.3.1 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Cohasset Harbor Jetty, MA, (MACJ); 42.2428°N, 70.7874°W. #N-Dup represents duplicate analysis of site replicate.

MACJ	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5	1.5
Heptachlor	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	2.1	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2	<1.2	<1.2
t-Nonachlor	5.6	2.1	1.9	2.5	2.3
p,p'_DDE	22.5	20.1	19.0	19.1	22.4
Dieldrin	2.0	2.0	1.6	2.1	2.0
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	12.1	11.8	11.1	13.7	12.8
o,p'-DDT	<2.8	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5

Table F.3.2 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at at Cohasset Harbor Gulf , MA, (MACG); 42.2384°N, 70.7895°W.

	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	1.8	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2	<1.2
t-Nonachlor	2.1	1.9	<1.4	2.2
p,p'_DDE	25.7	25.5	29.6	30.5
Dieldrin	1.9	<1.4	<1.4	1.6
o,p'-DDD	4.5	<4.0	<4.0	4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	13.3	13.3	13.6	13.6
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.3 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Merrimack estuary, MA, (MAME); 42.8165°N, 70.8208°W.

MAME	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	3.3	3.5	3.2	3.3
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	8.8	8.5	5.8	9.5
t-Nonachlor	4.5	5.4	5.8	5.9
p,p'_DDE	15.9	18.5	19.4	18.4
Dieldrin	2.0	3.2	2.8	2.8
o,p'-DDD	<4.0	<4.0	<4.0	4.1
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	7.6	8.1	9.0	9.5
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3,4 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Hampton/Seabrook estuary, NH, (NHHS); 42.8972°N, 70.8163°W.

NHHS	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2	<1.2
t-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	4.9	5.4	4.5	4.9
Dieldrin	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.5 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at South Mill Pond, NH (NHSM); 43.0729°N, 70.7489°W. #N-Dup represents duplicate analysis of site replicate.

NHSM	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.6	1.8	1.4	1.6	1.7
t-Nonachlor	1.4	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	15.7	13.5	14.2	14.1	15.3
Dieldrin	<1.4	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	7.0	7.5	6.8	5.8	5.5
o,p'-DDT	<2.8	<2.8	<2.8	<2.8	3.1
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5

Table F.3.6 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Dover Point, NH (NHDP); 43.1196°N, 70.8267°W.

NHDP	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.3	<1.2	<1.2	<1.2
t-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	4.1	5.7	5.6	5.5
Dieldrin	2.2	2.5	2.3	2.2
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	2.9	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.7 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Schiller Station, NH (NHSS); 43.1196°N, 70.8267°W.

NHSS	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	2.4	1.8	1.9	1.5
t-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	3.9	3.5	3.6	3.6
Dieldrin	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.8 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Clark's Cove, ME (MECC); 43.0774°N, 70.7244°W. **NH Trend Site**

MECC	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	2.1	2.1
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.4	1.3	<1.2	<1.2
t-Nonachlor	<1.4	4.2	6.1	<1.4
p,p'_DDE	4.1	4.5	4.7	4.0
Dieldrin	6.3	2.8	2.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	5.1	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.9 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Brave Boat Harbor, ME (MEBH); 43.1007°N, 70.6597°W.

MEBH	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.6	1.4	1.7	1.4
t-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	1.9	2.2	2.2	1.9
Dieldrin	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.10 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Kennebec River, ME, (MEKN); 43.7850°N, 69.7850°W. #N-Dup represents duplicate analysis of site replicate.

MEKN	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2	<1.2	<1.2
t-Nonachlor	<1.4	<1.4	<1.4	<1.4	1.4
p,p'_DDE	3.1	2.4	3.1	2.9	2.8
Dieldrin	1.8	2.2	2.3	2.2	2.2
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5

Table F.3.11 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at the Booth Bay, ME (MEBB); 43.8513°N, 69.6259°W.

MEBB	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.4	1.7	2.1	1.6
t-Nonachlor	1.5	1.6	<1.4	<1.4
p,p'_DDE	4.5	4.5	5.2	6.1
Dieldrin	1.7	1.9	1.8	1.7
o,p'-DDD	INT	INT	INT	INT
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	19.8	23.6	26.8	16.5
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.12 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Limekiln Bay, NB, (NBLB); 45.0345°N, 66.4880°W. #N-Dup represents duplicate analysis of site replicate.

NBLB	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*3N-Dup*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	1.5	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.5	1.6	1.7	2.0	1.5
t-Nonachlor	<1.4	<1.4	<1.4	2.6	<1.4
p,p'_DDE	6.8	7.8	7.2	6.2	7.0
Dieldrin	<1.4	<1.4	<1.4	4.5	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5

Table F.3.13 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at St. Croix, NB (NBSC); 45.1002°N, 67.0965°W. **NB Trend Site.**

NBSC	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.4	1.3	1.2	<1.2
t-Nonachlor	<1.4	1.7	<1.4	<1.4
p,p'_DDE	3.3	2.8	3.6	4.1
Dieldrin	<1.4	3.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	3.5	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.14 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Yarmouth, NS, (NSYR); 43.8180°N, 66.8440°W. **NS Trend Site.**

NSYR	(ng/g dry wt.)			
Replicate	*1N*	*2N*	*3N*	*4N*
a_BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	2.1	1.7	3.3	1.7
t-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	<1.8	1.9	2.8	<1.8
Dieldrin	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5

Table F.3.15 2006 blue mussel tissue pesticide concentrations (ng/g dry wt.) at Apple River, NS (NSAR); 43.7390°N, 66.1430°W. #N-Dup represents duplicate analysis of site replicate.

NSAR	(ng/g dry wt.)				
Replicate	*1N*	*2N*	*3N*	*4N*	*4N-Dup*
a_BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
g-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5	<1.5
HeptachlorEpoxide	<1.8	<1.8	<1.8	<1.8	<1.8
g-Chlordane	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	1.1	<1.0	<1.0	<1.0	<1.0
a-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2	<1.2	<1.2
t-Nonachlor	<1.4	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	<1.8	<1.8	<1.8	<1.8	<1.8
Dieldrin	2.9	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2
b-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5