Gulfwatch 2010 Data Report:

TWENTIETH YEAR OF THE

GULF OF MAINE ENVIRONMENTAL MONITORING PROGRAM

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 2010 sampling season. Contaminant monitoring is conducted by the Gulfwatch Program for the Gulf of Maine Council on the Marine Environment (GOMC). A subset of these data is compared with analytical results from earlier Gulfwatch monitoring (2001-2009). Statistical analyses are limited to descriptive measures of replicates from selected sampling sites and include: arithmetic means, and appropriate measures of variance. The primary purpose of this report is to present the current annual results, present graphical representation of spatial and temporal trends and identify potential outliers in order to provide investigators and other interested persons with contemporary information concerning water quality in the Gulf of Maine, as reflected by uptake into resident shellfish (i.e., mussels).

1.1 PROGRAM 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, and the states of Maine, southern and eastern New Hampshire, and eastern Massachusetts. Several urban industrialized areas lie within those watersheds, 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 and sediment quality in some near shore areas (Larsen et al., 2010; Dow and Braasch, 1996). Many of these contaminants have been shown to bioaccumulate and biomagnify throughout the food web, resulting in elevated concentrations in organisms, especially those at higher trophic levels (Elfes et al., 2010; Shaw et al., 2009 a, b, 2008, 2005 and 2003; Park et al., 2009; Chen et al., 2008; Mallory et al., 2005; Aguilar et al., 2002; Weisbrod et al., 2000). When critical body burdens are reached (exact concentrations differ with contaminant and organism) contaminants have been shown to adversely affect the growth, reproduction, and survival of marine organisms (Kawaguchi et al. 1999, Wells and Rolston 1991). Contaminant bioaccumulation serves therefore as an indicator of the status of ecosystem health with implications for human health, especially for those who derive the 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 contaminant 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 contaminant accumulation in mussels. The Gulfwatch monitoring program is thus responsive to the goals articulated by the Council that seek to balance 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:

"Using mussel tissue monitoring of toxic chemical contaminants, the Gulfwatch Program will contribute to the provision of high quality and relevant data to allow for characterization of the condition of ecosystems in the GOM for enhancing marine resource management and protecting public health."

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

1) Conduct regional contaminant monitoring using the blue mussel (*Mytilus edulis)* as an indicator of exposure to organic and inorganic contaminants
2) Assess the status and trends of chemical contaminants in coastal habitats of the Gulf of Maine and Bay of Fundy.

The Gulfwatch Program tests the following hypotheses:

1) Concentrations of chemical contaminants in mussel tissues are the same at all sites in the Gulf of Maine;
2) No changes in mussel tissue contaminant concentrations occur with time at each sampling site.

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. The effect of gonadal weight on total body weight and CI values (i.e., high CI values can be due to ripe gonads present just prior to spawning), and implications to the interpretation of metal and organic contaminant tissue concentrations has been covered in other Gulfwatch reports (e.g., Gulfwatch, 2006 report, GOMC, 2009).

2.0 METHODS

2.1 SAMPLING DESIGN

The year 2010 is year five of the 12-year sampling design (2005-2016) developed by the Gulfwatch committee, which modified the original 9-year sampling strategy.

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 sampling design was modified from the tradition of four (4) replicate mussel tissue samples collected at all the sites, with the majority of sites having one sample, made from a composite from the four mussel site replicates. Two tiers of sampling were identified based on sampling intensity: once every two years (temporally intensive) and once every six years (spatial coverage). The sites are 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. New Hampshire continued with sampling four site replicates for the temporally intensive sites sampled.

Sample Sites:

Sample sites were chosen after a review of all the sites sampled up to 2005. Opinions of environmental management and general scientific audiences from each jurisdiction were solicited, and new sites chosen, older sites retained or discarded based upon the following criteria:

- management interest or activity (sewage treatment, new industry, oil spill, dredging, locating aquaculture sites, 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.

2.2 2010 SAMPLING STATIONS

The 2010 Gulf of Maine Gulfwatch mussel survey somewhat followed the above mentioned survey plan. Most of the sites planned for 2010 were sampled, with the exception of sites in New Brunswick. Several other sites were sampled throughout all regions, resulting in continuation of sampling at yearly trend sites including Sandwich, MA (MASN), the Merrimack River (MAME), Dover Point, NH (NHDP), Hampton/Seabrook Harbor, NH (NHHS), Clarks Cove, ME (MECC), Portland Harbor, ME (MEPH), the Kennebec River, ME (MEKN), Boothbay Harbor, ME (MEBB), Yarmouth, NS (NSYR), Digby, NS (NSDI), and the Apple River, NS (NSAR) as well as planned sampling sites at Boston Inner Harbor, MA (MAIH), Marblehead, MA (MAMH), Rye Harbor, NH (NHRH), Little Harbor, NH (NHLH), Peirce Island, NH (NHPI), Saco River, ME (MESA), Presumpscott River, ME (MEPR), and Argyl Sound, NS (NSAG). A total of 20 sites were sampled during 2010 (Table 1). Locations of all sampling sites are presented, by state and province, in Figure 1

Table 1. Gulfwatch stations visited during the 2010 sampling year.

Site Code	Site Name	Site type	Lat	Lon	Years sampled
Massachusetts					
MASN	Sandwich	Trend (**Benchmark**)	41.7500	70.4000	93-2001, 2002-2004, 2007-20010
MAIH	Boston Inner Harbor	Rotational (6 yr)	42.3590	71.0490	95, 98, 2001, 2004, 2007, 2010
MAMH	Marblehead	Rotational (6 yr)	42.49833	70.84833	93, 96, 99, 2002, 2007, 2010
MAME	Merrimack River	trend (multi-year)	42.80833	70.8233	93, 96, 99, 2002, 2006-20010
New Hampshire					
NHHS	Hampton/Seabrook Harbor	Trend (multi-yr)	42.89717	70.8163	93, 95, 96, 99-2010
NHRH	Rye Harbor	Rotational (6 yr)	43.00000	70.74000	94, 97, 2000, 2002, 2007, 2010
NHLH	Little Harbor	Rotational (6 yr)	43.05810	70.7154	95, 96 -98, 2001, 2003, 2007, 2010
NHPI	Peirce Island	Rotational (6 yr)	43.07167	70.74333	99, 2001, 2004, 2007, 2010
NHDP	Dover Point	Trend (multi-yr)	43.11960	70.8267	94, 96-98, 2000-2004, 2006-2010
Maine					
MECC	Clarks Cove	Trend (**Benchmark**)	43.07740	70.7244	93-2001, 2002-2004, 2006-2010
MESA	Saco River	Rotational (6 yr)	43.45983	70.3743	94, 97, 2003, 2007, 2010
MEPH	Portland Harbor	Trend (multi-yr)	43.63917	70.2590	94, 97, 2000, 2003, 2005, 2007-2010
MEPR	Presumpscott River	Rotational (6 yr)	43.69217	70.24733	94, 97, 2000, 2003, 2007, 2010
MEKN	Kennebec River	Trend (**Benchmark**)	43.78500	69.7845	93-2004, 2006-20010
MEBB	Boothbay Harbor	Trend (multi-yr)	43.85067	69.6727	91, 98, 2004, 2006-20010
MEUR	Union River	Rotational (6 yr)	44.5015	68.4322	94, 97, 2000, 2003, 2007, 20010
New Brunswick					
NBSC	St. Croix River	Trend (multi-yr)	45.16750	67.1638	93, 96, 99, 2002, 2003, 2006-2009
NBNR					
NBMI					
NBTC	Tin Can Beach	Trend (multi-yr)	45.26250	66.0570	98, 2004, 2005, 2007-2009
Nova Scotia					
NSAG	Argyle Sound	Rotational (6 yr)	43.69371	65.81644	93, 96, 99, 2007, 2010
NSYR	Yarmouth	Trend (multi-yr)	43.81767	66.1448	93, 96, 99, 2002, 2004, 2006-2010
NSDI	Digby	Trend (**Benchmark**)	44.61700	65.7523	92,93,94, 96-2005,2007-2010
NSAR	Apple River	Trend (multi-yr)	45.47000	64.8350	94, 97, 2000, 2003, 2006-2010

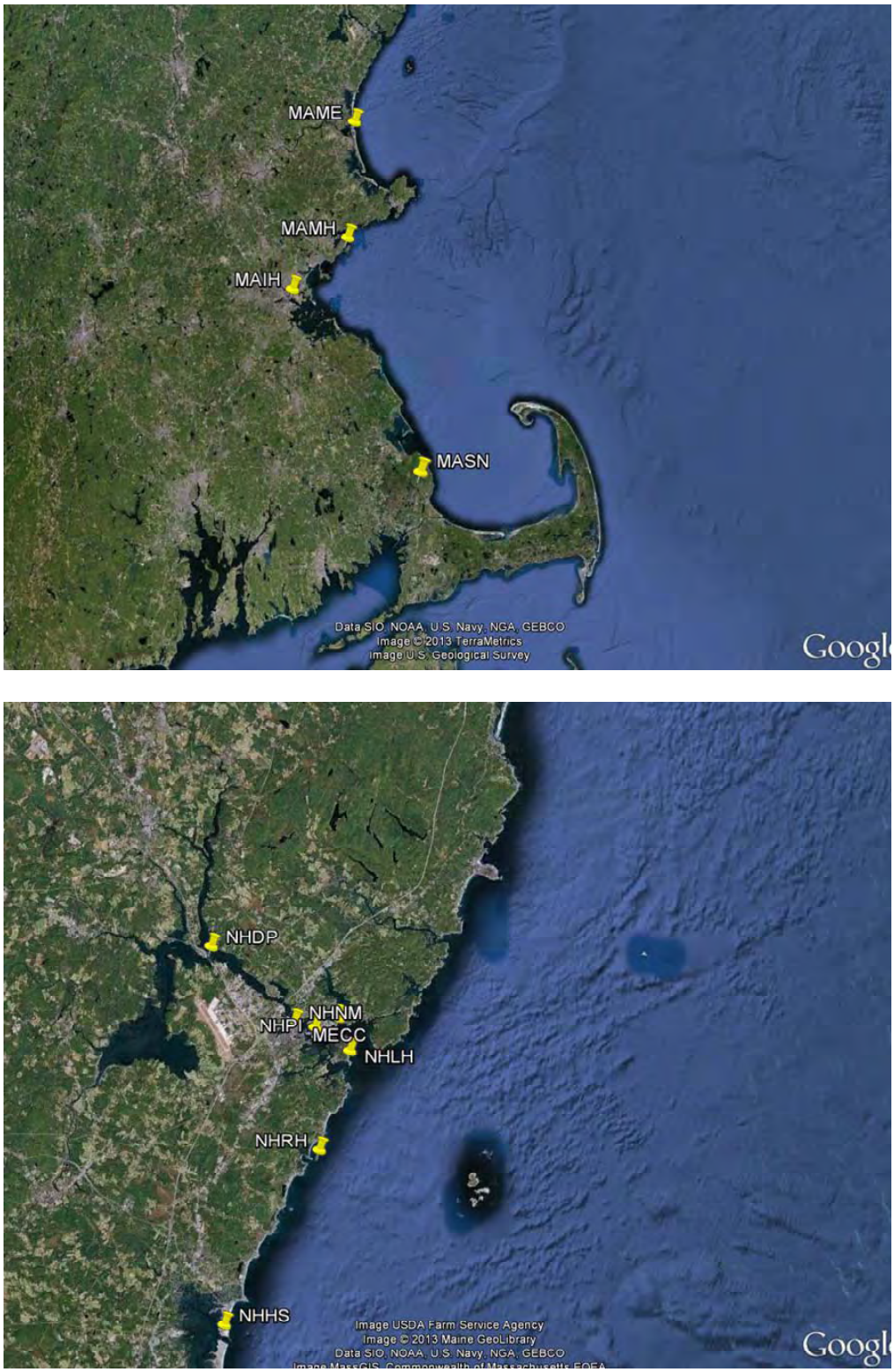

Figure 1. Locations of 2010 Gulfwatch sampling sites from Massachusetts and New Hampshire. Tables 1 and A.2 in the appendix provide latitudinal and longitudinal coordinates for more precise site location.

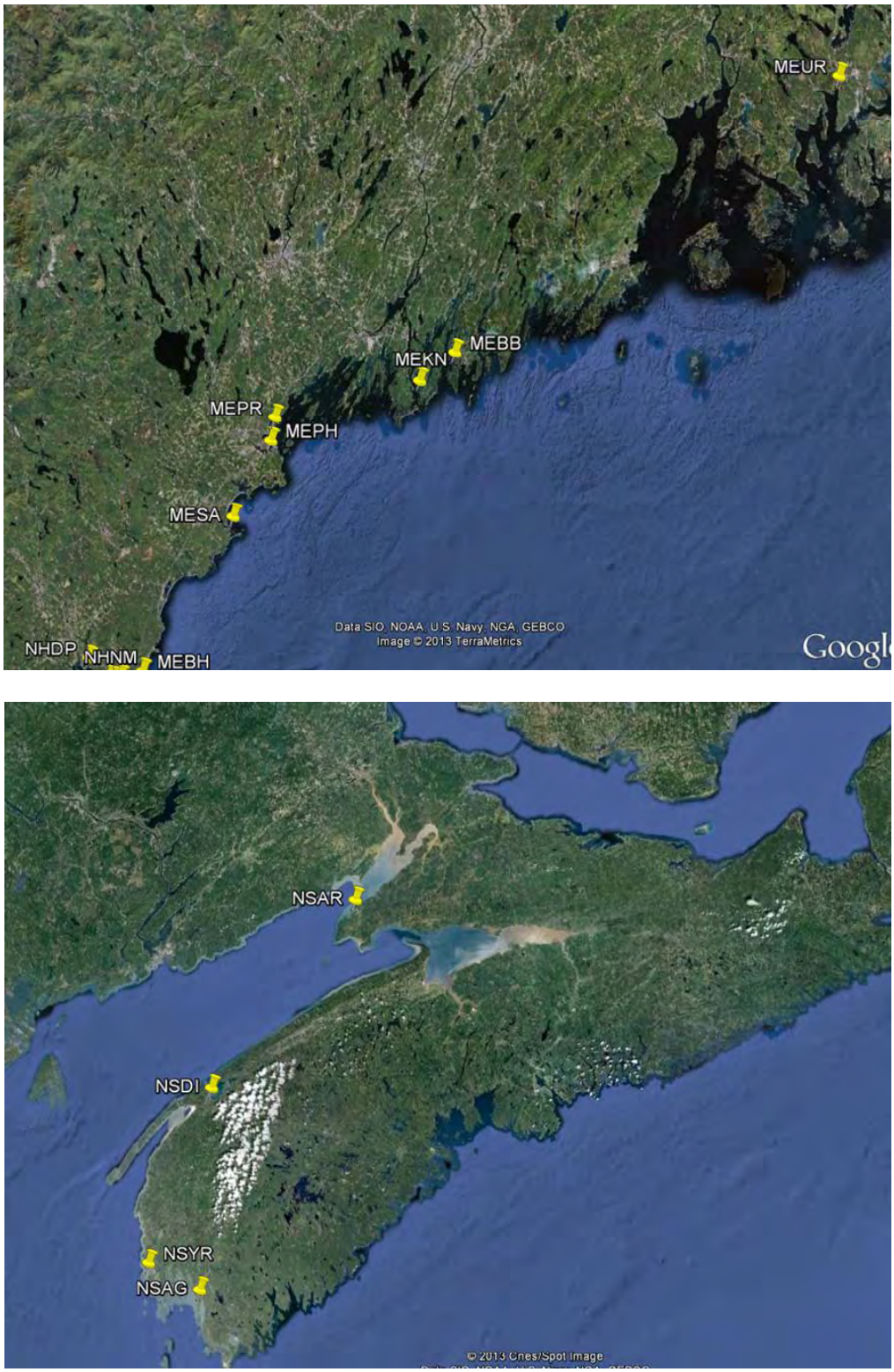

Figure 1 (cont'd). Locations of 2010 Gulfwatch sampling sites from Maine and Nova Scotia. Tables 1 and A.2 in the appendix provide latitudinal and longitudinal coordinates for more precise site location.

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. Field sampling occurred between mid-September through October, 2010 (Appendix A, Table A.1). In past years sampling was conducted as follows: 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 the mussels allocated for organic analysis were wrapped in pre-combusted aluminum foil prior to placing in field containers. Mussels were not depurated prior to processing.

A somewhat different collection and processing procedure was used starting in 2007. For each site three batches of 60 mussels were collected, each from a distinct area within the sampling site mussel bed. Each of these 60 mussels was separated into 3 batches of 20, one for metals analysis, one for organics and one that was used to make up a composite sample for each site. Twenty mussels from each of the three distinct areas at each site were shucked for metal analysis. 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. Another 20 mussels from each of the three distinct samples were shucked for organics analysis. A composite sample composed of mussels from all three areas (20 total, 6 or 7 animals from each replicate) was processed for trace metal and another for organic chemical analyses. Mussel shell length was recorded for all mussels. 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). Also (wet weight-based) condition index (CI) measurements were conducted on each of 10 (out of the 20 total) individual mussels from two areas. This provided twenty total CI measurements per site.

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, labeled and stored at -15°C for 3-6 months prior to analysis. Gulfwatch sample identification numbers, field replicates and dates collected are summarized in Appendix A.

2.4 ANALYTICAL PROCEDURES

Analytical procedures were the same as those reported in previous years (LeBlanc et al., 2009 a, b; 2010; Sowles et al., 1997). An overview of the analytical methods used for the 2010 samples for both organic and inorganic analytes is described below. Table 2 contains a summary of trace metal and organic compounds determined from tissue samples of collected organisms.

2.4.1 Metals

Samples collected during 2010 for metals were analyzed by Battelle Marine Sciences Laboratory (MSL, Sequim, WA). The samples were analyzed for the ten metals chosen by the program: silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), 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 ICPOES*. 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.

The MSL reported method detection limits (MDLs, µg/g dry weight) are as follows; Ag, 0.002; Cd, 0.003; Cr, 0.02; Cu, 0.1; Fe, 0.3; Hg, 0.004; Ni, 0.04; Pb, 0.0035; Zn, 0.03; and Al, 0.3. A summary of method detection limits and reporting limits are further described in Appendix B. A copy of the MSL QA/QC report is reprinted in Appendix C.

2.4.2 Organic Contaminants

Organic contaminants in mussel samples were analyzed at the Environment Canada Atlantic Laboratory for Environmental Testing - Environmental Science Centre in Moncton, New Brunswick. The analyte detection limits ranged from 4 -15 ng/g for polycyclic aromatic hydrocarbons (PAHs) and from 1-5 ng/g for polychlorinated biphenyl (PCB) congeners and chlorinated pesticides (Appendix B).

Twenty one of the twenty four 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 (Kimbrough et al., 2008). The summed quantities ΣPAH_{24} and ΣPAH_{40} (= total PAHs), the sum of 24 PAH compounds and 40 PAH compounds respectively, are consistent with what is reported by the National Status and Trends program, as is the sum of 21 chlorinated pesticide analytes ($\Sigma PEST_{21}$). For 2010, four pyrethroid insecticides have been added to the analyte list (Table 2).

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 polytron ultrasonic probes using dichloromethane (DCM) solvent and filter-dried over sodium sulfate salt to remove residual water. Biomatrix interference was removed through automated size exclusion gel permeation chromatography using S-X3 Bio-Beads (200-400 mesh) resin. Purified extracts were then subjected to silica gel liquid chromatography for a better clean-up of macro molecular biomatrix effects prior to the initial analysis.

After clean-up, samples were calibrated to final volume with internal standards added for polyaromatic hydrocarbon (PAH) analysis. A 100uL aliquot was extracted from this calibrated final volume and analyzed for PAHs by high-resolution gas chromatography/mass spectrometry (HR GC-MS) in Single Ion Monitoring mode (SIM) for best sensitivity. Quantifying and Qualifier ions for each compound of interest can be found in Table 3.0.

The remaining volume of the extract was then further fractionated using a larger silica gel bed for the liquid chromatographic separation of non-polar and polar compounds. This final step provided a relatively non-polar PCB/chlorinated pesticides fraction using a hexane mobile phase, and a more polar chlorinated pesticide fraction using a 1:1 hexane:DCM mobile phase. PCBs and pesticides analysis were then performed on two calibrated fractions using high-resolution dual column gas chromatography/electron capture detection (HRGC/ECD). Simultaneous analysis of each fraction on a different polarity thin liquid phase chromatographic columns allowed for quantification and confirmation of target compounds via external calibration.

Table 2. Inorganic and organic compounds analyzed in mussel tissues from the Gulf of Maine, 2010.

INORGANIC CONTAMINANTS			
Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn			
ORGANIC CONTAMINANTS			
Aromatic Hydrocarbons		***Chlorinated***	***PCB***
		Pesticides	***Congeners***
Naphthalene[1,2]	Fluoranthene[1,2]	**HCHs**	8;5[3,4]
C1-Naphthalenes[2]	Pyrene[1,2]	α–HCH	18;15[3,4]
C2-Naphthalene[2]	C1-FP	HCB	29[3,4]
C-3 Naphthalene[2]	C2-FP	γ–HCH(Lindane)	50[3,4]
C4-Naphthalene	Benzo(a)Anthracene[1,2]	**Chlordanes**	28[3,4]
Biphenyl[1,2]	Chrysene[1,2]	γ-Chlordane	52[3,4]
Acenaphthylene[1,2]	C1-Chrysene	Cis-Chlordane	44[3,4]
Acenaphthene[1,2]	C2-Chrysene	Heptachlor	66;95[4]
Fluorene[1,2]	C3-Chrysene	Heptachlor Epoxide	101;90[3,4]
C1- Fluorene	C4-Chrysene	Trans-Nonachlor	87[3,4]
C2-Fluorene	Benzo(b)Fluoranthene[1,2]	**Endosulfans**	77[3,4]
C3- Fluorene	Benzo(k)Fluoranthene[1,2]	α-Endosulfan	118[3,4]
C4- Fluorene	Benzo(e)Pyrene[1]	β-Endosulfan	153;132[3,4]
Dibenzothiophene[1,2]	Benzo(a)Pyrene[1,2]		105[3,4]
C1-Dibenzothiophene	Perylene[1,2]	Aldrin	138[3,4]
C2- Dibenzothiophene	Indeno(1,2,3-cd)Pyrene[1,2]	Dieldrin	126[4]
C3-Dibenzothiophene	Dibenz(a,h)Anthracene[1,2]	Endrin	187[3,4]
Phenanthrene[1,2]	Benzo(ghi)Perylene[1,2]		128[3,4]
Anthracene[1,2]		Metoxychlor	180[3,4]
C1-Phenanthrene[2]		Mirex	169[4]
C2-Phenanthrene			170;190[3,4]
C3-Phenanthrene		**DDTs**	195;208[3,4]
C4-Phenanthrene		2,4'-DDT, 4, 4'-DDT	206[3,4]
		2,4' DDE; 4,4'-DDE	209[3,4]
		2,4'-DDD; 4, 4'-DDD	
		Pyrethoid insecticides	
		permethrin	
		cypermethrin	
		deltamethrin	

Table 2 (cont'd)
Summed parameters and diagnostic ratios
[1]**ΣPAH$_{19}$** (= the sum of the unsubstituted, i.e., non-alkylated PAH compounds)
[2]**ΣPAH$_{24}$** (= the sum of the 19 unsubstituted PAHs, and a few alkyl-substituted PAHs, as indicated. This quantity is the total PAH number of previous Gulfwatch reports).
Total PAH (= the sum of all 40 PAH compounds listed in Table 2, = ΣPAH_{40})
Flu+Pyr/Σ(FP C2-C4-P) = The sum of fluoranthene + pyrene/fluoranthene+pyrene+C2-C4 alkylphenanthrene.
ΣPEST21 = sum of all chlorinated pesticide and DDTs
[3]**ΣPCB$_{21}$** = the sum of 21 congeners, calculated to be consistent with the sum of PCBs calculated by NOAA National Status and Trends. [4]**ΣPCB$_{24}$ =** sum of 24 congeners**.** Numbers represent IUPAC designation of individual PCB congeners. Double numbers represent co-elution or congeners that are quantified together as one peak on the GC.

Table 3.0. List of target ions and quantification ions for GC-MS analysis of mussel tissue extracts for unsubstituted and alkyl-substituted polyaromatic hydrocarbons.

Compound [1]	*Target Ions* [2]	*Qions* [3]
Naphthalene	128	127
C1-Naph	142	141
C2-Naph	156	141
C3-Naph	170	155
C4-Naph	184	169
Biphenyl	154	153
Acenaphthalene	152	151
Acenaphthene	153	154
Dibenzothiophene	184	185
C1-Dibenz	198	197
C2-Dibenz	212	197
C3-Dibenz	226	197
Fluorene	166	165
C1-Fluor	180	165
C2-Fluor	194	165
C3-Fluor	208	165
C4-Fluor	222	165
Anthracene	178	176
Phenanthrene	178	176
C1-Phen	192	191
C2-Phen	206	191
C3-Phen	220	205
C4-Phen	234	219
Fluoranthene/Pyrene	202	200
C1-FP	216	217
C2-FP	230	215
Pyrene	202	200
Benzo(a) Anthracene	228	226
Chrysene	228	226
C1-Chry	242	241
C2-Chry	256	241
C3-Chry	270	241
C4-Chry	284	241
benzo(b) Fluoranthene	252	250
benzo(k) Fluoranthene	252	250
benzo(e)Pyrene	252	250
benzo(a)Pyrene	252	250
Perylene	252	250
Indeno(1,2,3-cd)Pyrene	276	277
Dibenzo(a,h) Anthracene	278	276

[1]Analytes in bold are summed to yield the quantity ΣPAH_{24}, [2]Target ions are used in GC-MS analysis for compound identification and quantification, [3]Q ions = qualifier ions are used for compound identification and confirmation in GC-MS analyses.

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,;
- tissue wet weight and shell width and height on a subset (~30) of individual mussels for condition index calculations;
- moisture content of tissue composites; and
- percent lipid content of tissue composites.

Moisture content was determined gravimetrically at the Battelle lab for each replicate composite either by freeze- or oven-drying. A tissue sub-sample (~5-20 g) was placed in a drying oven (at 105^{o}C) for a minimum of 8 hrs, then placed in a dessicator, allowed to reach room temperature, and weighed until constant weight is achieved. For freeze-drying, the sub-sample is frozen to -68°C for two - four days and periodically weighed until a constant weight is observed. Percent moisture is determined from the ratio of tissue dry weight to tissue wet weight.

Lipid content of tissue samples was also determined gravimetrically. A sub-sample (~15 g) of each tissue sample was extracted with three portions of dichloromethane. The combined solvent extract was then reduced to a measured 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 and dried to a constant weight. This residue represents one sixth (1/6) of the total extractable organics (TEO) in the original sample.

TEO was calculated as follows:

$$\%TEO = \frac{6 * WtR}{WtDry} * 100$$

Where WtR = the weight in grams of the residue and
Wt Dry = the dry weight of the original sample, calculated using the percent moisture.
The lipid residue number is multiplied by 6 to correct for the 1/6th aliquot taken for the measurement.

Lipid-normalized concentrations of organic compounds can be used to interpret tissue concentration comparisons between sites or over time, since organic contaminants tend to partition into organism lipids. Normalizing to lipid weight can help minimize variability in chemical concentrations caused by differences in lipid content due to reproductive stage and other factors. Here we report these observations as percent lipids (or TEO).

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 2010 Gulfwatch samples, and Appendix D contains the organic contaminant QC sample results and summary for the 2010 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 2010 National Institute of Standards and Technology organic contaminants inter-calibration exercise is available upon request.

2.6 DATA PRESENTATION

Summed parameters were calculated from the sum of all individual analytes that had values greater than compound detection limits. Summed parameters included ΣPAH_{19}, which is the sum of the unsubstituted (non-alkylated) aromatic ring compounds, ΣPAH_{24}, which is the total PAH quantity that has traditionally been used for the Gulfwatch program prior to 2007 (includes a few alkyl-substituted PAHs such as methyl and ethyl-naphthalenes and methyl phenanthrenes, in addition to the unsubstituted PAH analytes). Starting in 2007, more alkyl-substituted PAH compounds were included in the analysis, and so a new total PAH number (ΣPAH_{40}) has also been calculated. The major difference in the quantitation of PAHs in data reports from 2007 onward (including this 2010 report) versus earlier years, concerns the quantitation of alkylnaphthalene and alkylphenanthrene compounds. Prior to 2007, only two C1-naphthalene compounds (1-methylnaphthalene and 2 methylnaphthalene), one C2-naphthalene compound (2, 6-dimethylnaphthalene) and one C3 naphthalene compound were quantified. Beginning in 2007, the sum of all C1-naphthalenes, C2-naphthalenes and C3-naphthalenes were quantified. Likewise, formerly only one C1 phenanthrene analyte was quantified, while beginning in 2007, the sum of all detected methylphenanthrenes was quantified. This may result in slight differences in the summed parameter ΣPAH_{24} for 2010 compared to earlier datasets.

Other summed parameters include ΣDDT_6, the sum of DDT and metabolites, $\Sigma PEST_{21}$, the sum of all the chlorinated pesticide analytes (pyrethroid insecticides not included in this sum), and ΣPCB_{24}, the sum of the PCB congeners (congeners which co-elute on the GC column are summed together as one peak) quantified in the analysis. Differences exist between the ΣPCB_{24} parameter calculated in Gulfwatch and the ΣPCB_{21} quantity provided by NS&T (PCB congeners 66, 126 and 169 are not quantified in the NS&T Program). To make a better comparison, three congeners are eliminated from the Gulfwatch summed PCB values, and the quantity is called ΣPCB_{21}. Other differences which may exist between the two programs, due to differing co-elutions of congeners on different analytical columns, are expected to be very small. All of the target analytes and summed quantities are listed in Table 2.

Inorganic and organic analytes 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. Replicate sampling was performed at three sites: MECC, NHHS and NHDP. For these sites, arithmetic means and standard deviations (stdev) were calculated for all metal and organic contaminants. Analytical duplicates were not used in the computation of the above statistical parameters. Results of duplicate analyses are presented in the QA/QC section of the appendix.

Graphs of arithmetic mean concentrations from site replicates, as well as single values from composite samples, are presented for all stations and are compared with medians and 85th percentiles of data from the 2008 National Status and Trends Mussel Watch Program (Figs. 2-15). These data are presented in tabular format as well in the next section. The medians and 85th percentiles for the Gulf of Maine have been calculated to allow comparison of Gulfwatch results with the National Musselwatch National Status and Trends (NS&T) program. The 85th percentiles are taken to represent "high" concentrations (O'Connor and Beliaeff, 1995; Cantillo, 1998; Lauenstein et al., 2002). In the Gulfwatch program, a target analyte is considered "elevated" and of concern if the concentration is 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 sites in New Hampshire. MECC is also the one site where the GOMC have supported multiple replicate analyses as a benchmark of variability from year to year. Gulfwatch mean data for the stations sampled in 2010 are summarized beginning from 2001 in graphic form, along with all annual data for the 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 2010 Field Operations and Logistics Summary

Mussel samples were collected at 20 sites in 2010. Eleven trend sites were sampled: Sandwich (MASN) and Merrimack River (MAME) in Massachusetts, Hampton/Seabrook Harbor (NHHS) and Dover Point (NHDP) from New Hampshire, Clark's Cove (MECC), Kennebec River (MEKN), Portland Harbor (MEPH) and Boothbay Harbor (MEBB) in Maine, and Apple River (NSAR), Yarmouth (NSYR) and Digby (NSDI) in Nova Scotia. The remaining nine mussel sites were for spatial analysis, usually sampled on a regular (3 yr) or more occasional basis (Table 1).

All 2010 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 2010 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 4 contains the metal concentrations for site replicates (arithmetic means ± SD, μg/g dry weight) and site composite samples (single value) for mussels sampled in 2010. Summary statistics were generated using the field replicate values. In only three cases (MECC, NHHS and NHDP) were field replicates taken. The mean and standard deviation of the three site replicates from these sites are compared with a fourth value which is a site composite in Table 4. At all other sites, replicates were composited as previously described to form one site composite (labeled in Table 4 as "site name-comp"). Metals 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 and the 85th percentile (85th P) in Table 5 to allow for a program-level comparison with NOAA NS&T concentrations. Tables 4 and 5 also provide the median and the 85th percentile data of the national Mussel Watch data for 2008. Slightly less than half (118 out of 240 values) of the summarized Gulfwatch metals concentrations were higher than the NS&T median. Thirty five values were above the NS&T 85th percentile, with the majority being either mercury (19) or lead (12), with a few aluminum concentrations (4), silver (2) iron (2) and chromium (2). Numbers above the NS&T 85th percentile are considered by the Gulfwatch program to be elevated, and are highlighted in red in Table 4. Comparison of metal concentrations with NS&T median values shows that several sites had concentrations at or higher than median values for Ag , Al, Cd, Cr, Fe, Hg, Ni, Pb and Zn (indicated in bold, Table 4). No sites had values higher than the NS&T median or 85th percentile for Cu. The range of concentrations over all sites are also presented in Table 5, and show that concentrations of most elements vary less than a factor of 10 across sites in 2010, with the exception of Ag and Pb which have slightly higher ranges (concentrations vary by a factor of 12 and 16, respectively). Elevated concentrations of iron and aluminum, known to be crustally-derived (Burdige, 2006) can result from the ingestion of sediment. Since these elements are not retained by the mussels, their appearance may be due to the mussels not being depurated prior to extraction.

Table 4. Summary data of tissue metal concentrations (µg g^{-1} dry wt) in mussels from Gulfwatch 2010 stations. Those with site replicates have calculated means and standard deviations, while site composites have only a single value. Values in red are higher than the 85th percentile values for National Status and Trends, those in bold are higher than NS&T median values. Stations in red have at least one analyte higher than NOAA NS&T 85th percentile values.

Station Abbreviation		Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
Station Code		(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
NS&T median[1]		0.152	2.01	1.06	20.1	366	2.02	0.894	160	185	0.065
NS&T 85th P		2.01	5.28	2.98	147	870	7.66	2.61	2190	473	0.134
MAME-Comp[2]		0.0410	1.92	**1.58**	7.56	325	1.12	**2.6**	106	172	**0.163**
MAIH-Comp		0.0343	1.61	**1.48**	9.75	**460**	0.98	**11.2**	**198**	**273**	**0.159**
MAMH-Comp		0.0199	0.96	**4.39**	9.44	303	0.73	**9.9**	128	**197**	**0.197**
MASN-Comp		0.1000	0.94	0.78	5.76	239	0.75	**1.8**	109	**217**	**0.112**
MECC[3]	**mean**	0.049	**2.07**	**1.94**	7.55	**486**	1.27	**2.96**	116	274	**0.277**
	stdev	0.015	0.24	0.33	0.56	78	0.09	0.91	12	31	0.047
MECC-Comp		0.0372	**2.20**	**2.06**	7.08	**580**	1.63	**3.04**	123	**302**	**0.268**
NHDP	**mean**	0.032	**2.32**	**1.95**	6.6	365	1.24	**1.47**	109	**200**	**0.264**
	stdev	0.004	0.08	0.22	0.24	197	0.17	0.22	9.0	91	0.008
NHDP-Comp		0.0427	**2.62**	**2.23**	7.13	329	1.35	**1.85**	101	**228**	**0.278**
NHHS	**mean**	0.038	**2.36**	**1.47**	6.60	400	1.26	**2.01**	98	**295**	**0.126**
	stdev	0.007	0.35	0.62	0.37	227	0.46	0.12	10	175	0.013
NHHS-Comp		0.0461	**2.38**	**1.26**	6.75	**439**	1.13	**2.22**	112	**305**	**0.131**
NHLH-Comp		0.0517	**2.22**	**1.79**	6.54	**373**	1.24	**3.07**	117	**220**	**0.305**
NHPI-Comp		0.0350	**2.23**	**2.13**	6.94	**513**	1.33	**3.18**	112	**319**	**0.364**
NHRH-Comp		0.0297	**2.03**	**1.59**	10.8	**372**	**2.07**	**2.68**	140	170	**0.336**
MEBB-Comp		0.0220	1.82	**1.55**	9.69	**423**	0.947	**16.2**	**168**	**225**	**0.308**
MEKN-Comp		0.0543	**2.30**	**1.24**	7.10	310	0.880	**1.26**	64.7	134	**0.167**
MEPH-Comp		0.0347	1.79	**1.89**	9.83	**641**	1.34	**6.22**	**168**	**427**	**0.242**
MEPR-Comp		0.0511	1.77	**1.75**	8.50	**616**	1.53	**4.12**	87.7	**364**	**0.254**
MESA-Comp		0.0604	**2.80**	**1.53**	6.88	**392**	1.67	**2.11**	133	**244**	**0.140**
MEUR-Comp		0.0349	1.16	0.969	4.18	**391**	0.912	**1.03**	48.9	149	**0.079**
NSAR-Comp		0.0490	**2.68**	**2.14**	6.18	**952**	1.97	**1.36**	86.6	**899**	**0.187**
NSAG-Comp		0.0432	1.28	**1.55**	6.18	**542**	1.40	**4.20**	80.4	**256**	**0.174**
NSDI-Comp		0.0335	1.36	**1.88**	6.32	**725**	1.36	**2.87**	91.7	**556**	**0.112**
NSYR-Comp		**0.2590**	1.36	**1.83**	7.21	**668**	1.41	**2.47**	93.0	**307**	**0.205**

[1]Percentile and median data from received from NOAA National Status and Trends Program in 2008, upon written request.
[2]comp refers to a site composite. Three areas within a site were sampled for mussels and composited, as described in section 2.3. [3]Means and standard deviations calculated for replicated samples.

Table 5. Gulf of Maine median and 85th percentile values, compared with 2008 National Status and Trends data.

	Ag (μg/g)	Cd (μg/g)	Cr (μg/g)	Cu (μg/g)	Fe (μg/g)	Ni (μg/g)	Pb (μg/g)	Zn (μg/g)	Al (μg/g)	Hg (μg/g)
2010 Gulfwatch										
range	0.020-0.259	0.940-2.80	0.783-4.39	4.18-10.8	239-952	0.729-2.07	1.03-16.2	48.9-198	134-899	0.079-0.364
median	0.041	2.03	1.75	7.08	423	1.27	2.68	109	256	0.197
85th P	0.054	2.38	2.11	9.62	634	1.60	5.61	138	350	0.297
	2008 NOAA NS&T									
median	0.152	2.01	1.06	20.1	366	2.02	0.894	160	185	0.0647
85th P	2.01	5.28	2.98	147	870	7.66	2.61	2190	473	0.134

3.3 ORGANIC CONTAMINANT CONCENTRATIONS

The total concentration of detectable polynuclear aromatic hydrocarbons (ΣPAH_{40}), along with other summations of PAH analytes (ΣPAH_{19} and ΣPAH_{24}) described in section 2.6, polychlorinated biphenyls (ΣPCB_{24}), and organochlorine pesticides ($\Sigma PEST_{21}$) measured in mussel tissue samples collected during 2010 are presented in Table 6. Individual analyte concentrations of each compound class for field replicates and composite samples are reported by station and given in Appendix F.

Pyrogenic (combustion-derived) PAH have high relative concentrations of unsubstituted PAH species relative to alkyl-substituted PAH species, while petrogenic (petroleum-derived) PAH are dominated by alkyl-substituted PAH (NRC, 1985). These characteristics can be used to differentiate between petrogenic and pyrogenic PAH sources in environmental samples. The concentration ratio: (fluoranthene + pyrene)/[(fluoranthene + pyrene) + (C2+C3+C4 phenanthrenes)], expressed as FP:(FP+C24P), is a useful pyrogenic indicator for sediments and tissues (Burns et al., 1997; Neff et al., 2005) whose value varies from 0.00 (petrogenic) to 1.00 (pyrogenic). Samples with FP:(FP+C24P) ratios greater than ~0.2 are interpreted to have a pyrogenic PAH component. Petroleum-sourced PAHs generally have values <0.1 (Neff et al., 2005). Table 6 contains mean values of this ratio for site replicate samples, and individual values for site composites. Values of zero (0) reflect that all fluoranthene or pyrene analytes were below detection limits.

Overall gulf-wide medians and the 85th percentile of the organic contaminant concentrations for indigenous mussels are also presented to allow for program-level comparisons with NOAA NS&T concentrations (Table 7). The 2010 Gulfwatch concentrations (single composite values or arithmetic means) for summed organic contaminants (PAH, PCB, and chlorinated pesticides) were compared with 2008 NS&T median values and 85th percentile (Table 6). One site, Boston Inner Harbor (MAIH) exceeded 85th percentile NS&T values for PAHs and PCBs. The highest PAH concentrations were seen at the aforementioned site, followed by Boothbay Harbor and Portland Harbor in Maine (MEBB and MEPH, respectively). The fluoranthene-pyrene indicator ratio overwhelmingly suggests a pyrogenically-derived source of PAHs. The highest PCB concentrations were from Boston Inner Harbor, Massachusetts (MAIH) , followed by Marblehead Harbor (MAMH) and the Merrimack River, also in Massachusetts. Pesticide concentrations which exceeded NS&T median values were found at Marblehead Harbor and Boston Inner Harbor in Massachusetts, as well as in Boothbay Harbor (MEBB), Maine. The

summed pesticide concentration was dominated by concentrations of DDT metabolites (p,p'-DDE, o,p and p,p'-DDD).

Median values for summed PAHs in tissues from the Gulf of Maine were consistently lower than National Status and Trends median values. Median PCB values were lower by half than the 2008 Status and Trend national median and pesticide median values were 1/3 of NS&T median concentration. Gulfwatch 85th percentile values were lower than the corresponding Status and Trends 85th percentile values for all summed organic parameters.

Table 6. Summary data of tissue summed organic contaminant concentrations for Gulfwatch 2010 stations. Those sites with site replicates have calculated means and standard deviations, while site composites only have a single value. Values in red are higher than the NS&T 85th percentile, those in bold are higher than the NS&T median. Stations in red have at least one value higher than the NS&T 85th percentile value.

		ΣPAH19	ΣPAH24	ΣPAH40	ΣFP/ΣFPC24P	ΣPCB21	ΣPEST21
		(ng/g)	(ng/g)	(ng/g)		(ng/g)	(ng/g)
NS&T median[1]		**180**	**247**	**353**		**29.2**	**22.9**
NS&T 85th P[1]		**1104**	**1216**	**1674**		**141**	**128**
MAME-comp		**220**	229	263	1.0	**54.6**	21.3
MASN-comp		0	0.0	0.0	0	25.6	8.77
MAIH-comp		**1729**	**1814**	**1862**	1.0	**573**	**83.1**
MAMH-comp		**345**	**385**	**388**	1.0	**77.5**	**84.7**
MECC-comp		144	168	192	1.0	12.1	11.9
MECC 1-3N	mean	117	127	128	1.0	11.8	5.72
	stdev	7.8	6.3	6.7	0.0	5.34	1.42
NHDP-comp		**186**	197	234	1.0	17.4	12.6
NHDP 1-3N	mean	174	184	195	1.0	15.5	6.92
	stdev	5.4	5.2	8.0	0.0	3.48	0.92
NHHS - comp		23.6	34.4	27.8	1.0	4.85	7.29
NHHS 1-3N	mean	0.0	12.0	12.0	0	3.66	5.19
	stdev	0.0	3.2	3.2	NA[2]	0.94	1.80
NHRH-comp		21.2	42.3	47.9	1.0	6.51	4.78
NHPI-comp		**208**	252	285	1.0	11.9	3.14
NHLH-comp		65.6	73.6	80.9	1.0	6.53	4.41
MEPH-comp		**610**	674	693	1.0	**45.4**	17.1
MEKN-comp		24.8	24.8	34.2	1.0	3.70	2.15
MEPR-comp		**240**	282	301	1.0	17.7	15.0
MEBB-comp		**1065**	**1193**	**1316**	1.0	16.0	**23.2**
MESA-comp		5.3	5.3	5.3	0	2.21	0.00
MEUR-comp		10.5	10.5	10.5	1.0	0.00	0.00
NSAR-comp		0.0	0.0	0.0	0	0.00	5.62
NSAG-comp		0	0	31	0	0.00	9.54
NSDI-comp		31.6	31.6	31.6	1.0	0.00	5.18
NSYR-comp		43.2	94.0	100	1.0	0.00	3.56

[1]Data received from NOAA NS&T office upon written request. [2]NA = not applicable

Table 7. Comparison of median and 85 percentile values of tissue concentrations of summed organic analytes from Gulfwatch 2010 sites and National Status and Trends 2008 sites.

	ΣPAH19 (ng/g)	ΣPAH24 (ng/g)	ΣPAH40 (ng/g)	ΣPCB21 (ng/g)	ΣPEST21 (ng/g)
Gulfwatch 2010					
Median	54	84	90	9.15	6.32
85th P[1]	298	339	349	36.5	19.41
National Status and Trends 2008					
Median	180	247	353	29.2	22.9
85th P	1100	1220	1670	141	128

[1]85th P = 85th percentile, data obtained from NOAA NS&T office upon written request

4.0 2010 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 2010 Gulfwatch sampling sites. The data are displayed geographically beginning clockwise around the GOM from Sandwich, Massachusetts, and ending with the southern-most station sampled 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 0.020 µg/g dry weight at the Boothbay Harbor, ME site (MEBB) to 0.259 µg/g dry weight at the Yarmouth, NS site (NSYR) (Table 4; Figure 2). Mussels from the NSYR site had concentrations higher than the NS&T national median, but still below the 85th percentile. All 2010 tissue concentrations were thus below the NOAA NS&T 85th percentile values, which are used in Gulfwatch as criteria for an "elevated" concentration (Figure 2, solid lines). High silver concentrations in sediments and water column samples have been shown to coincide with regions receiving municipal sewage (Sanudo-Wilhelmy and Flegal, 1992; Buchholz ten Brink et al., 1997).

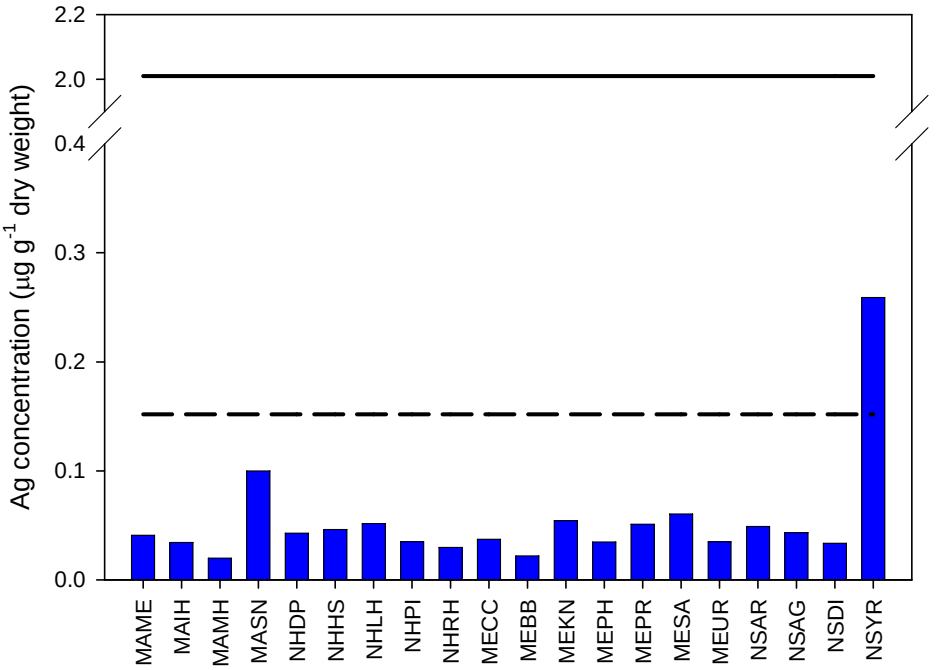

Figure 2. Distribution of silver tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.2 Cadmium (Cd)

The concentration of cadmium in mussel tissue ranged from 0.94 µg/g dry weight at Sandwich, MA (MASN) to 2.8 µg/g dry weight at the Saco River, ME site (MESA) (Table 4; Figure 3). Nine sites had concentrations above the NS&T national median: NHDP, NHHS, NHLH, NHPI and NHRH in New Hampshire, MECC, MEKN and MESA in Maine, and NSAR in Nova Scotia. Differences seen between stations may reflect localized sources. Globally, about half of the Cd released to the environment occurs through weathering of rocks and subsequent transport by rivers; some Cd is released into air through forest fires and volcanoes. This would be expected to provide an even distribution across stations if these were the only sources. 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). All sites had values below the NS&T 85th percentile value.

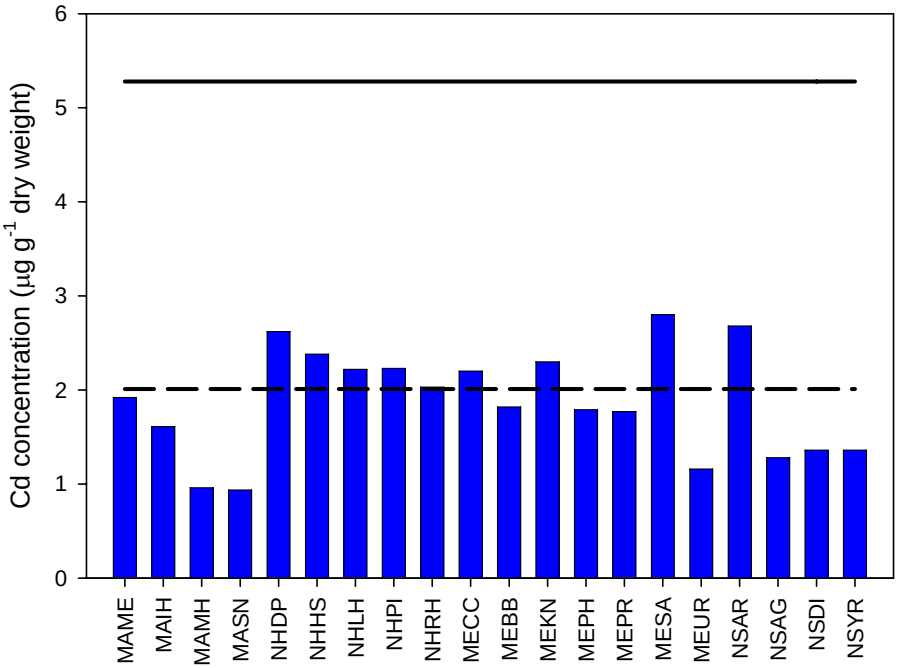

Figure 3. Distribution of cadmium tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.3 Chromium (Cr)

Chromium concentrations in mussel tissue for the Gulf of Maine for 2010 ranged from 0.78 µg/g dry weight at the Sandwich, MA site (MASN) to 4.39 µg/g at the Marblehead, MA site (MABB). Mussels from all sites except for MASN and MEUR exceeded the Musselwatch NS&T median tissue concentrations. One site (MAMH) had mussel tissue concentrations that exceeded the NS&T 85th percentile (Table 4, 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). Chromium persists in the environment at elevated concentrations in the sediments near such sources (Capuzzo, 1974; NCCOSC, 1997).

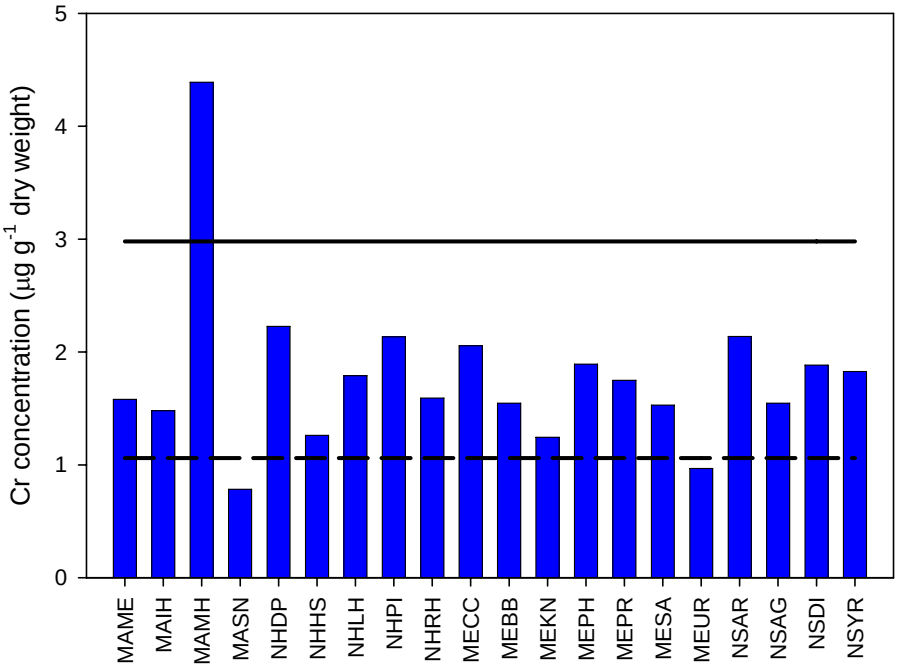

Figure 4. Distribution of chromium tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.4 Copper (Cu)

The 2010 copper concentrations in *M. edulis* ranged from 4.2 µg/g dry wt at the Union River, ME site (MEUR) to 10.8 µg/g dry wt at the Rye Harbor, NH site (NHRH, Table 4, Figure 5). Gulfwatch Cu levels were fairly uniform in distribution throughout the study region (site to site differences varied by no more than a factor of 2.5). No tissue concentrations exceeded NS&T median or 85th percentile concentrations.

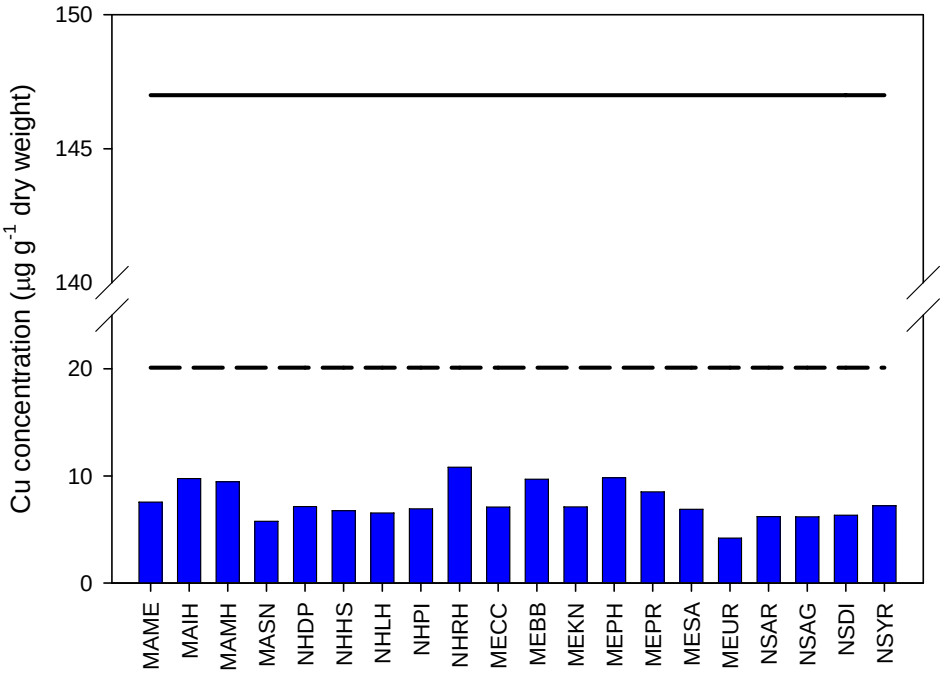

Figure 5. Distribution of copper tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.5 Iron and Aluminum (Fe & Al)

For 2010, the highest concentrations for both iron and aluminum were found at sites in Nova Scotia. Apple River, NS had the highest tissue concentrations of Fe and Al. One site exceeded the NS&T 85th percentile criteria for Fe (NSAR) and two sites exceeded the national NS&T 85th percentile value for Al: NSAR and NSDI in Nova Scotia. Concentrations of Fe ranged from 239 µg/g dry weight at Sandwich, MA (MASN) to 952 µg/g dry wt at NSAR in Nova Scotia. Tissue concentrations of Al ranged from 134 µg/g dry wt at MEKN (Kennebec River ME) to 899 µg/g dry wt at NSAR. Because of the high abundance of these elements in crustal material (Wedepohl, 1995), Al and Fe tissue concentrations may or may not be derived from anthropogenic inputs. The Gulfwatch sites had tissue concentrations that were near to or exceeded NS&T median values, which may reflect the aluminosilicate composition sediments in northeastern North America. Aluminum concentrations can be valuable as a way to normalize to background concentrations derived from continental crustal material and enhance differences in concentration due to uptake of localized (non-crustal derived) sources. Previous reports (Krahforst et al., 2006) have mentioned the greater exposure of mussels near the top of the Gulf

of Maine to higher frequencies and intensities of tidally-induced sediment resuspension. Also mentioned in prior reports was that such sediment may not truly be incorporated into tissues, since mussels are known to be particle-selective and will void undesirable ingested particulates as pseudofeces (Barnes, 1974) bypassing digestion in the gut. It is possible that non-depurated mussels may contain a sediment signal not reflective of true metal incorporation, and such a normalizing parameter may aid in the gulf-wide comparisons of tissue concentrations. Caution has been urged in prior reports to evaluate Al recoveries, which in 2010 were adequate (see Appendix C).

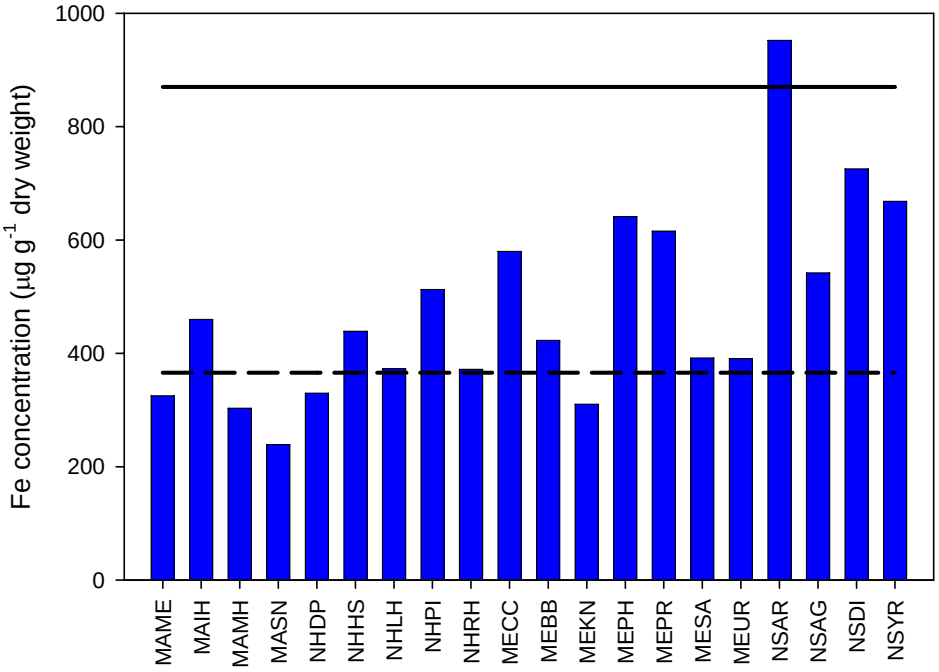

Figure 6. Distribution of iron tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

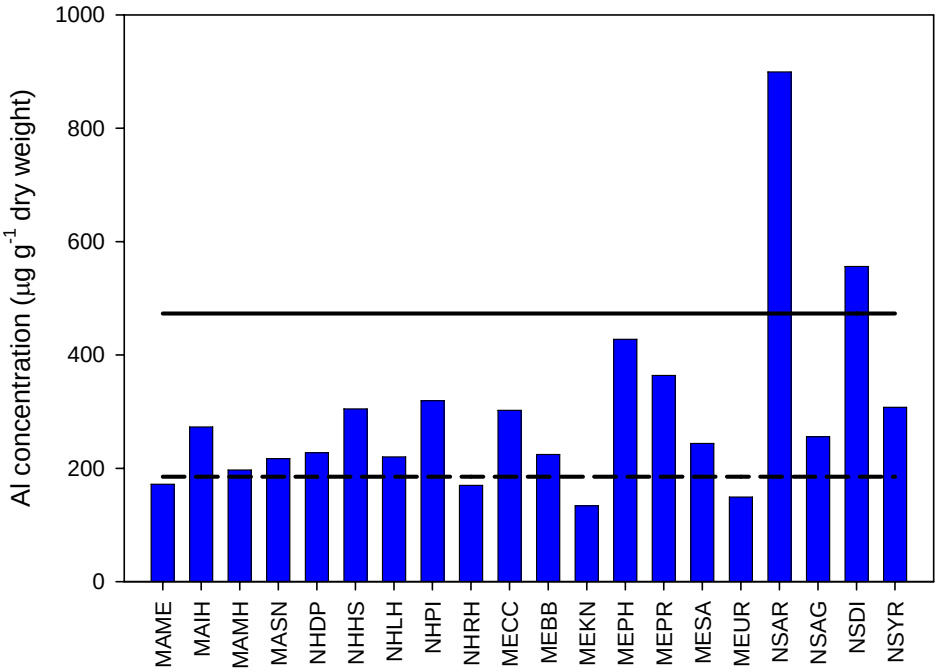

Figure 7. Distribution of aluminum tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.6 Nickel (Ni)

The concentration of nickel ranged from 0.729 µg/g dry wt at Marblehead, MA (MAMN) to 2.07 µg/g dry wt at Rye Harbor, NH (NHRH, Table 4; Figure 8). No concentrations exceed the NS&T 85th percentile values, although concentrations at NHRH were at the median value.

4.1.7 Lead (Pb)

As in past years, many sites visited in 2010 had tissue concentrations that exceeded the NS&T median value of 0.89 µg/g dry wt. Lead concentrations ranged from 1.03 µg/g dry wt at the Union River, ME site (MEUR) to 16.2 µg/g dry wt at Boothbay Harbor, ME site (MEBB, Table 4, Figure 9). Several of the sites (11 out of 20) visited by Gulfwatch were elevated for Pb, (i.e., above the NS&T 85th percentile value of 2.61 µg/g dry wt). As in past years, Boston Inner Harbor (MAIH) and Marblehead (MAMH) which are close to the urban center of Boston, along with Boothbay Harbor, ME (MEBB), a tourist center and relatively small fishing harbor had the highest tissue concentrations (LeBlanc et al., 2010). Tissue Pb concentrations from MAIH and MAMH exceeded 85th percentile values by a factor of four, while concentrations at MEBB were six times higher. High tissue concentrations in the Boothbay Harbor site are likely related to high concentrations in the sediment concentrations of metals in this area, which has been hypothesized to be the result of transport from the urbanized Kennebec/Adroscoggin River watershed (Larsen and Gaudette, 1995; 2010).

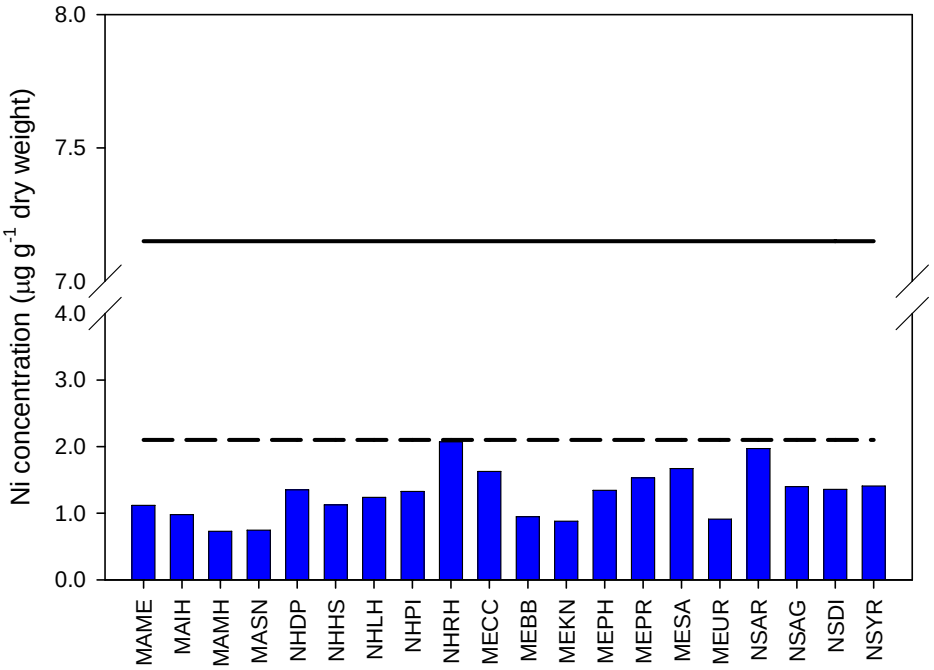

Figure 8. Distribution of nickel tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

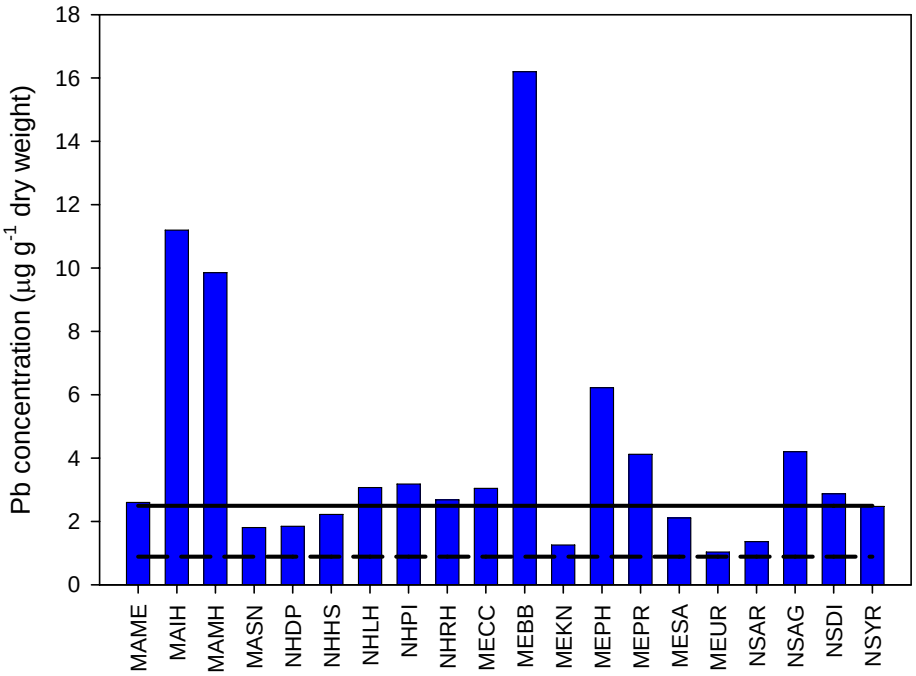

Figure 9. Distribution of lead tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.8 Zinc (Zn)

Concentrations of zinc ranged from a low value of 48.9 µg/g dry wt in mussels from the Union River, ME site (MEUR) to a high of 198 µg/g dry wt in mussels from the Boston Inner Harbor, (MAIH) site (Table 4, Figure 10). No sites had zinc concentrations exceeding the 85th percentile although a few sites were higher than median values from the 2008 NS&T sampling program (MAIH, MEBB, and MEPH). Zinc is a ubiquitous environmental contaminant generally reflecting a wide range of land-based activities (tire wear, galvanized materials, industrial waste discharges, etc.).

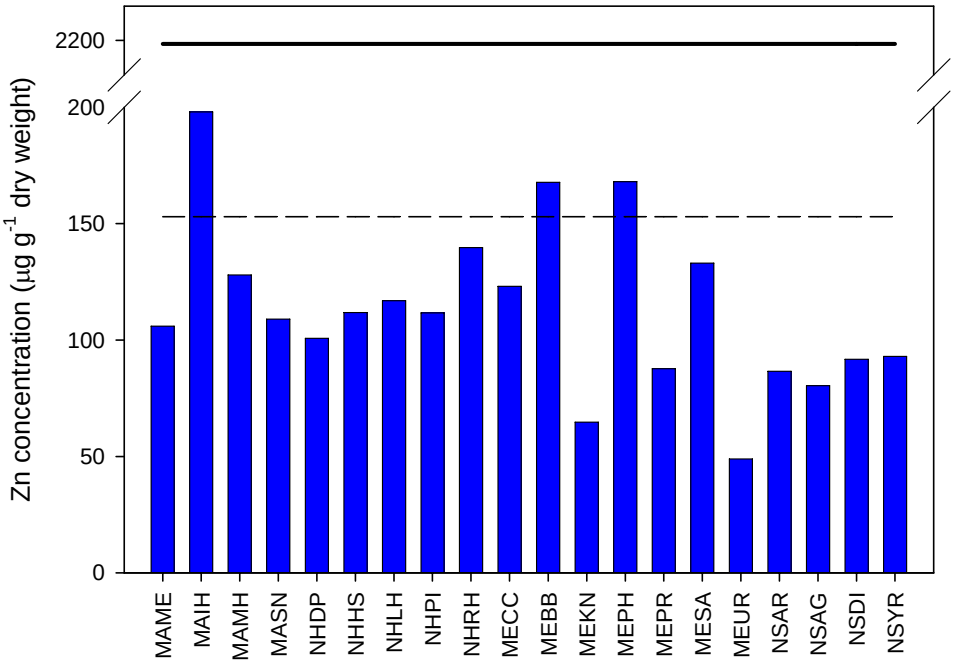

Figure 10. Distribution of zinc tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile value.

4.1.9 Mercury (Hg)

Mercury was detected in mussels collected at all 2010 Gulfwatch stations. Concentrations ranged from a low of 0.08 µg/g dry wt at the Union River, ME site (MEUR) to a high of 0.36 µg/g dry wt at the Peirce Island, NH (NHPI) site. All 2010 site concentrations except for MASN, MEUR and NSDI were above the NS&T 2008 85th percentile value of 0.134 µg Hg/g dry weight (Table 4, Figure 11). Elevated mercury concentrations relative to NS&T median values reflect the elevated concentrations found in the northeast (Evers, 2005; Evers et al., 2007). Highest tissue concentrations are seen at the New Hampshire sites (within the Great South Bay Estuary), Casco Bay (MEPH) and Boothbay Harbor. Sources of mercury to the Gulf of Maine are described in Jones (2004) and Evers (2005).

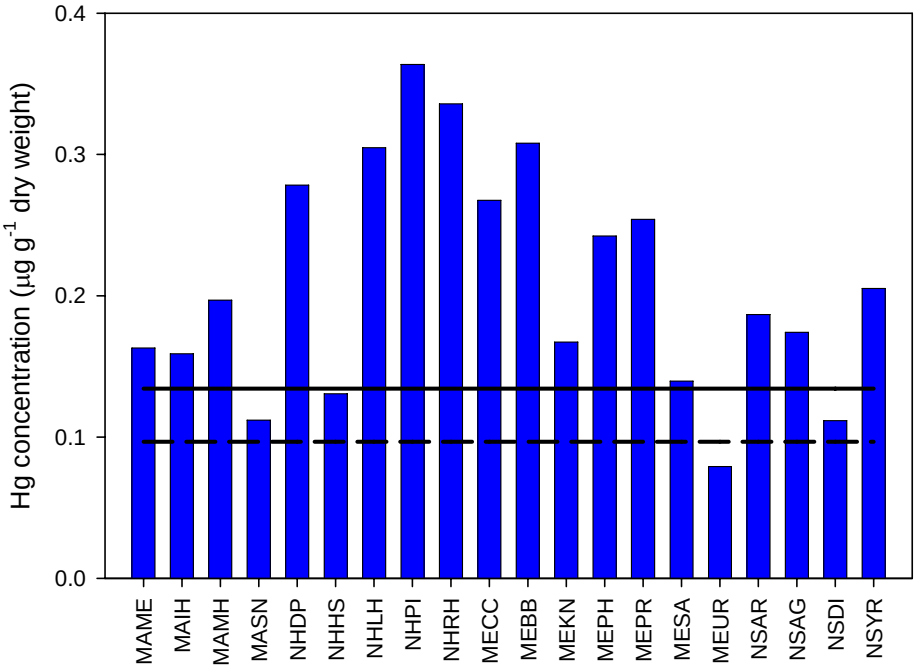

Figure 11. Distribution of mercury tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.10 Organic Contaminants

In 2010 concentrations, as expressed as summed quantities, were present at most sites (Table 6 and Figures 12-14). As in previous years, higher concentrations of summed PAHs were found in the New England states compared to the Canadian provinces, and the highest concentration was found at the Boston Inner Harbor site (MAIH), which exceeded the NS&T 85th percentile concentrations for the three summed PAH quantities (ΣPAH_{19}, ΣPAH_{24} and ΣPAH_{40}.) The highest PAH concentrations were seen at the MAIH site (1814 ng/g for ΣPAH_{24}), Boothby Harbor, ME (MEBB, 1065 ng/g for ΣPAH_{24}), and Portland Harbor, ME (MEPH, 610 ng/g for ΣPAH_{24}). The pattern seen for the sum of 40 PAH analytes (which includes a greater quantity of alkyl-substituted PAHs) is nearly identical to the graph of ΣPAH_{24}. Seven Gulfwatch sites out of

the 20 sampled had PAH concentrations that were close to or higher than the national median concentration.

The Composite sample from Boston Inner Harbor had a summed a ΣPCB21 PCB concentration of 573 ng/g, which exceeds the NS&T 85th percentile value of 141 ng/g. The Marblehead Harbor site (MAMH), the Merrimack River site (MAME) and the Portland Harbor site (MEPH) had concentrations higher than the NS&T national median concentration of 29.2 ng/g dry weight. PCBs ranged from not detected at the four sites sampled in Nova Scotia up to the high value found at MAIH.

Tissue concentrations of $\Sigma PEST_{21}$ ranged from not detected at stations MESA and MEUR (Maine) to 85 ng/g dry wt at MAMH (Massachusetts, Table 6, and Figure 14). The greatest contributors to the quantity $\Sigma PEST_{21}$ were p, p'-DDE, p, p'-DDD and o, p-DDD, degradation products of DDT. No tissue concentrations exceeded the NS&T 85th percentile criteria for summed chlorinated pesticides. New to the analysis of pesticides in 2010 was the inclusion of three pyrethroid insecticides (Table 2). All tissue concentrations were found to be below the detection limit of 5 ng/g.

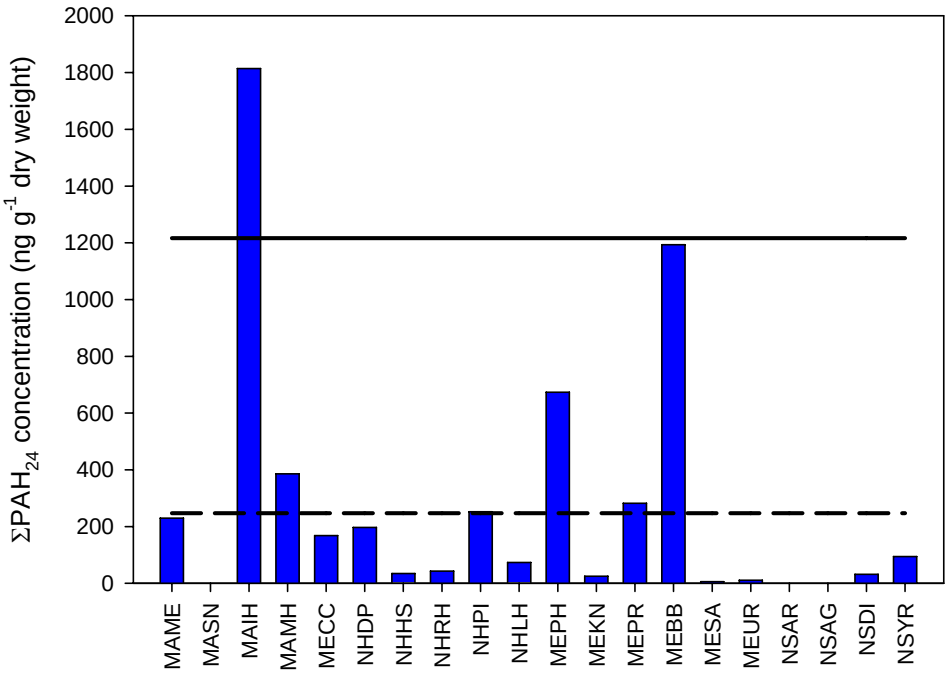

Figure 12. Distribution the sum of 24 PAHs in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

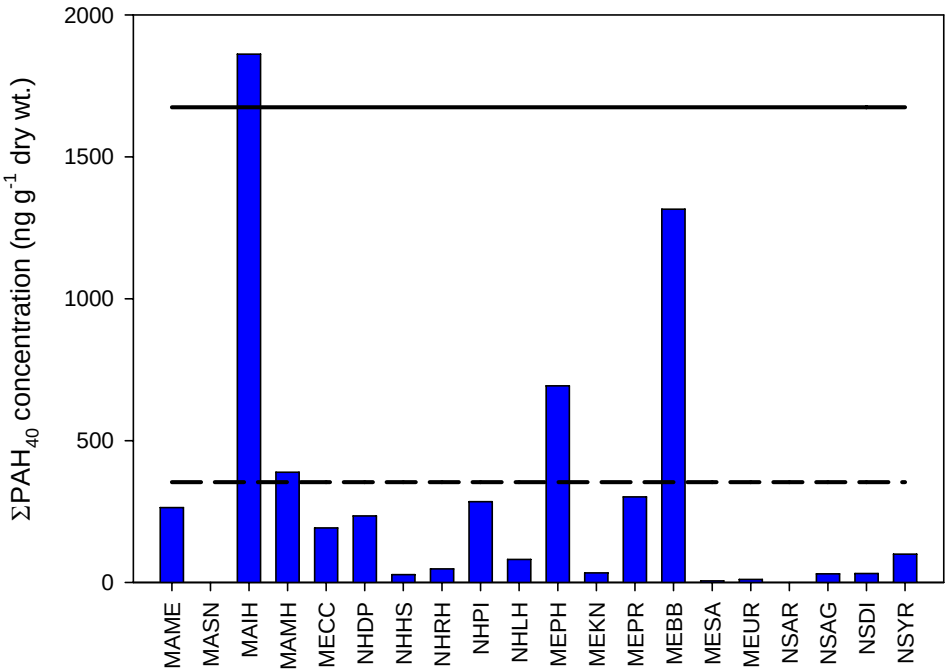

Figure 13. Distribution the sum of 40 PAHs in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

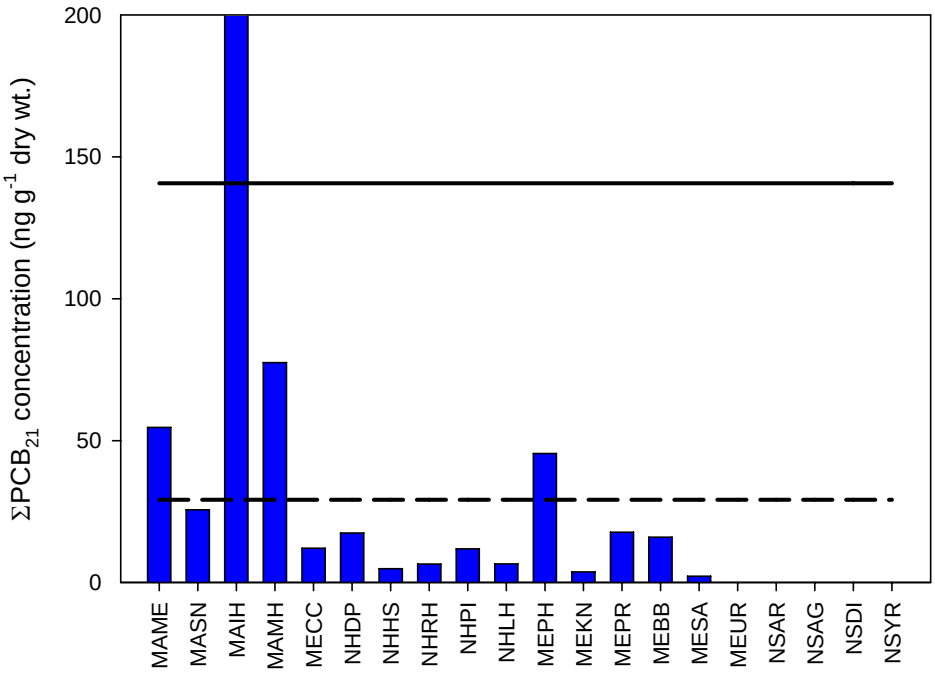

Figure 14. Distribution the sum of 21 PCB congeners in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile (for the sum of 21 PCB congeners).

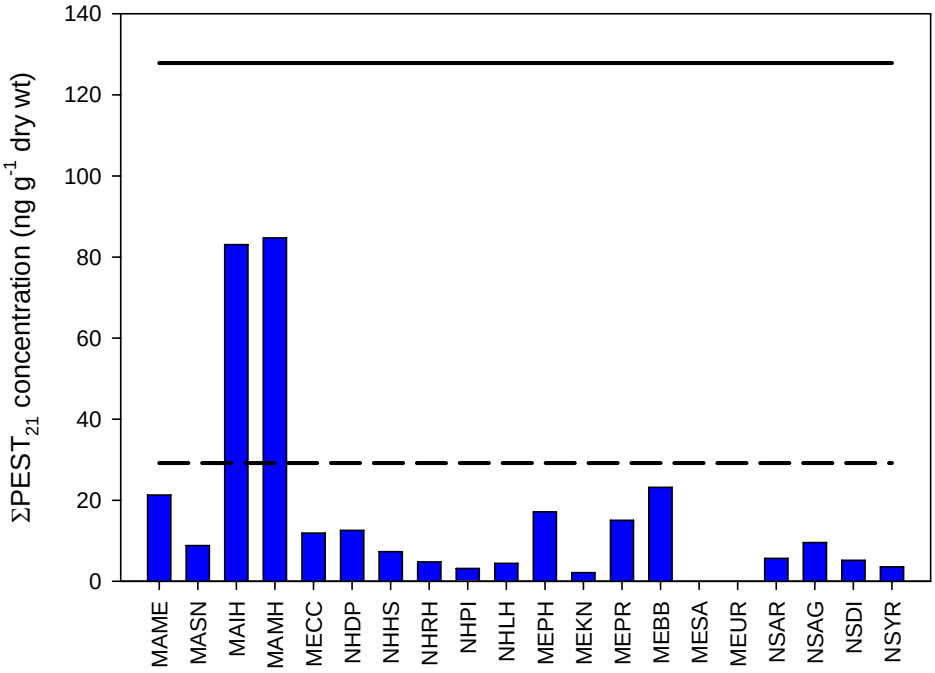

Figure 15. Distribution the sum of 21 chlorinated pesticides in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2010. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.2 TEMPORAL PATTERNS

This section presents the distribution of inorganic and organic contaminants in mussel tissue collected at trend sites along the Gulf of Maine, from 2001 to 20010. The temporal distribution of station means is plotted for each contaminant or class of contaminants, and compared to individual tissue concentrations from year 2010 site composite samples in Figures 16-26. All individual replicate results for each 2010 site are provided in Appendices E and F. The distribution of contaminants in mussels from the four of the five traditional benchmark sites (MASN, MECC, MEKN, and NSDI) and 7 trend sites (MAME, NHHS, NHDP, MEPH, MEBB, NSAR and NSYR) is updated with data from mussels collected in 2010.

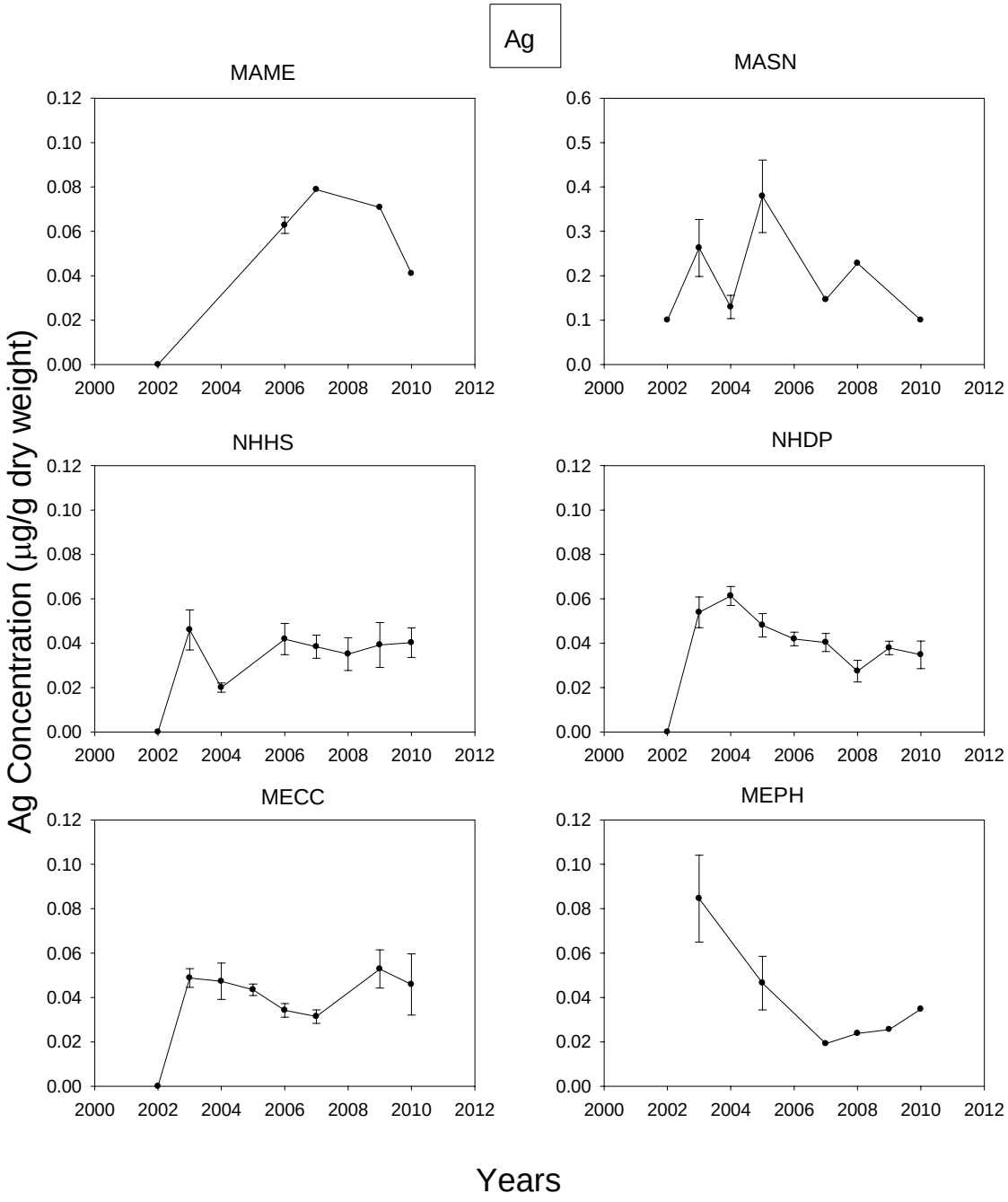

Figure 16. Distribution of silver tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

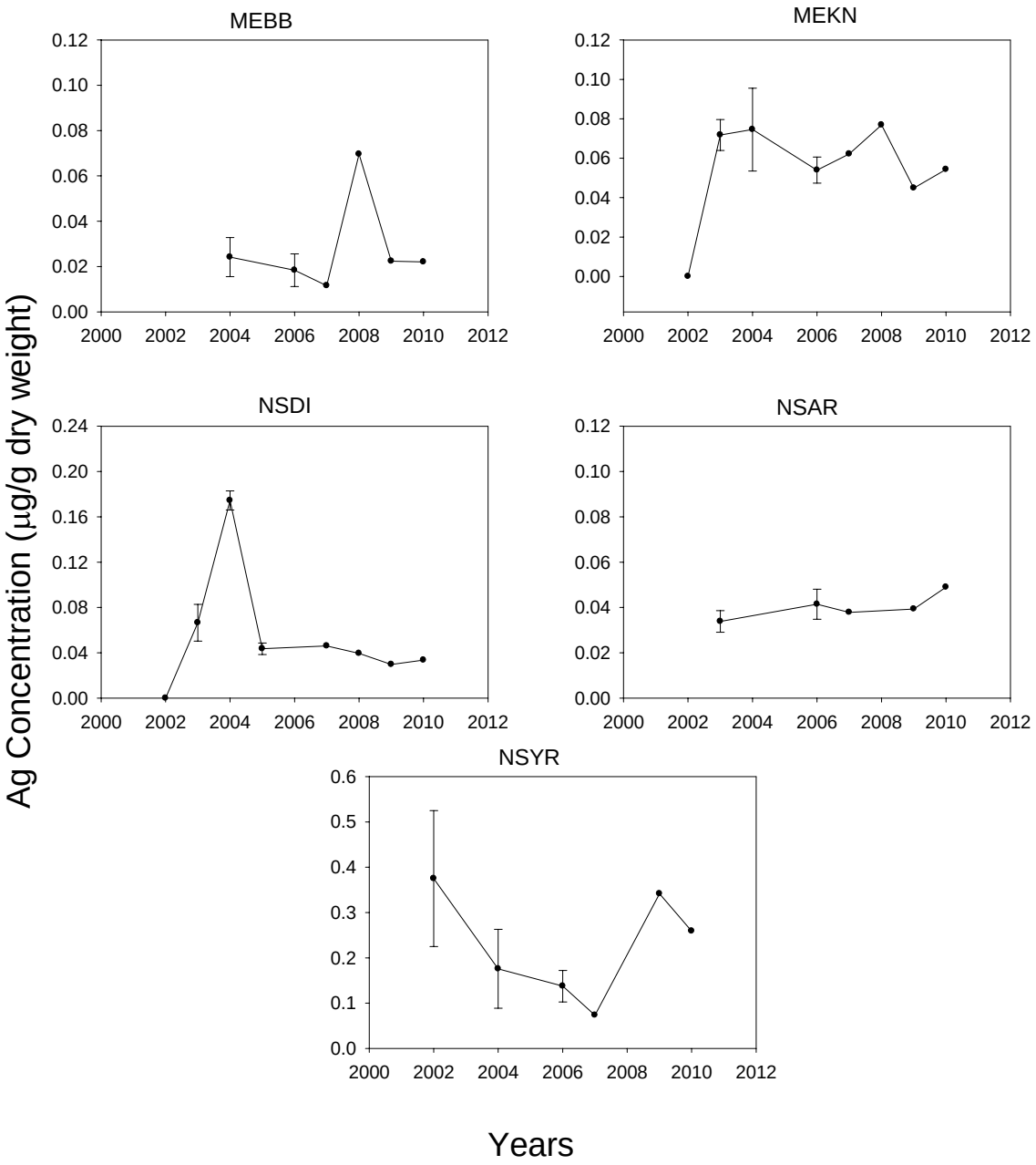

Figure 16 (cont'd). Distribution of silver tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

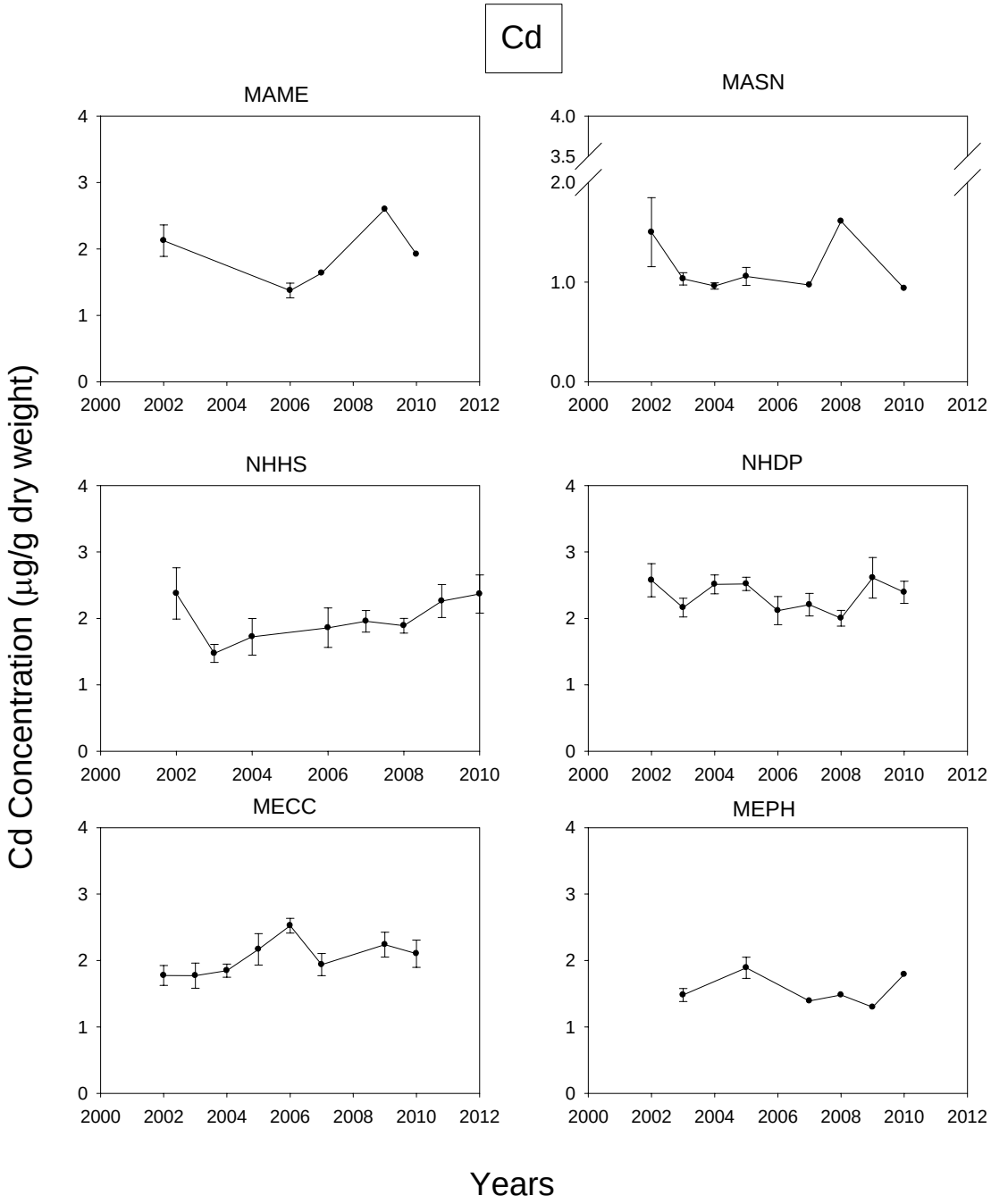

Figure 17. Distribution of cadmium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

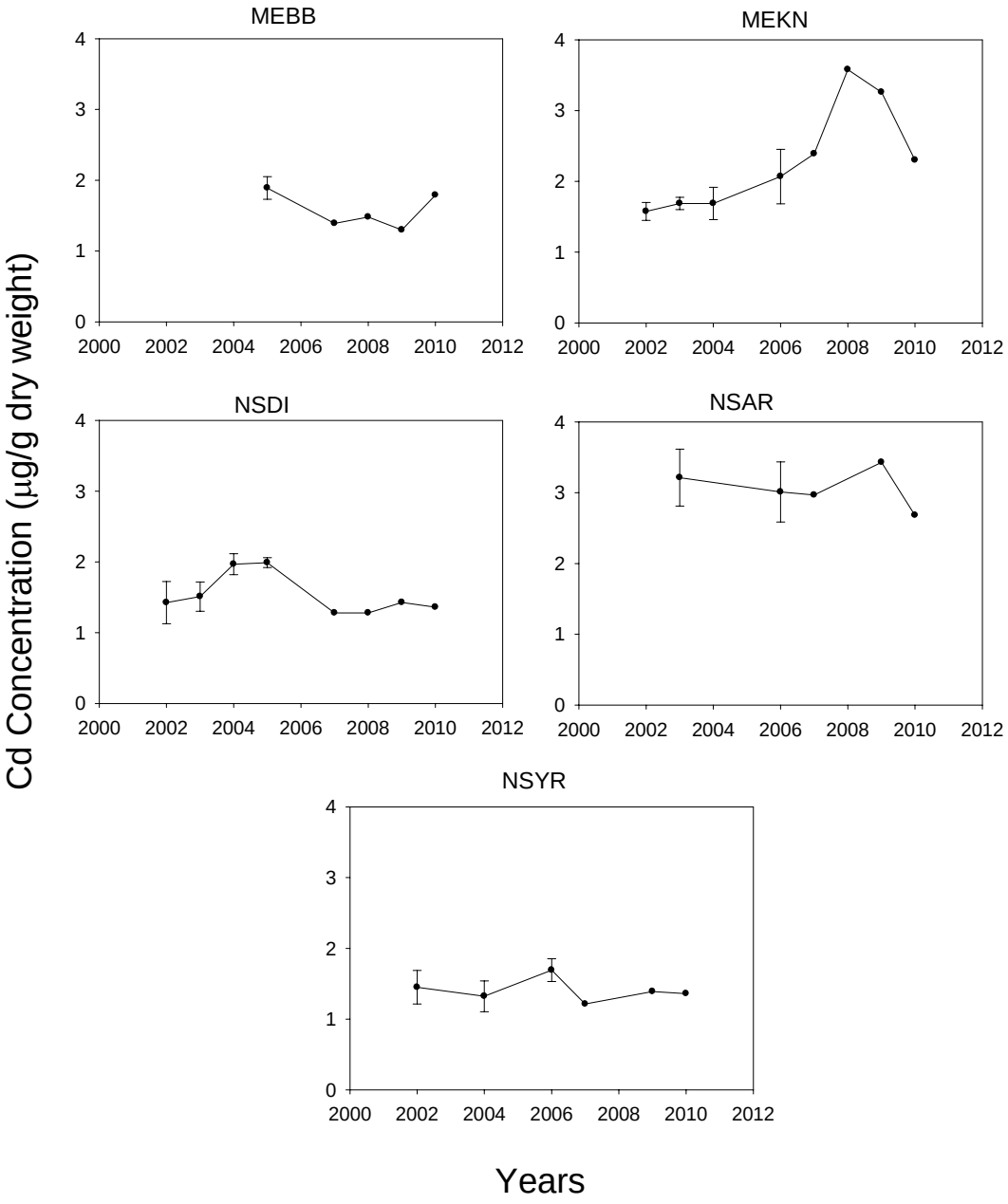

Figure 17 (cont'd). Distribution of cadmium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

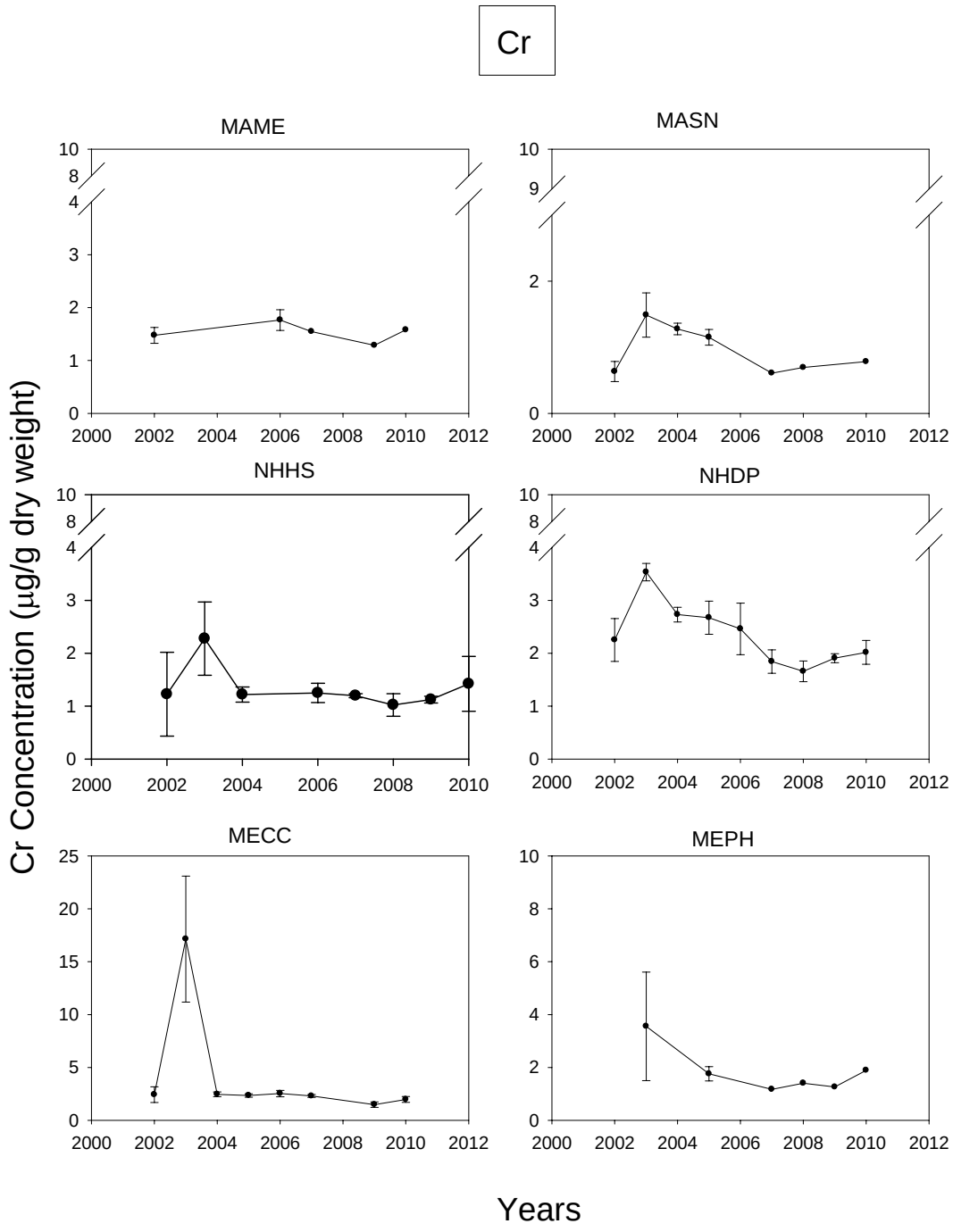

Figure 18. Distribution of chromium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

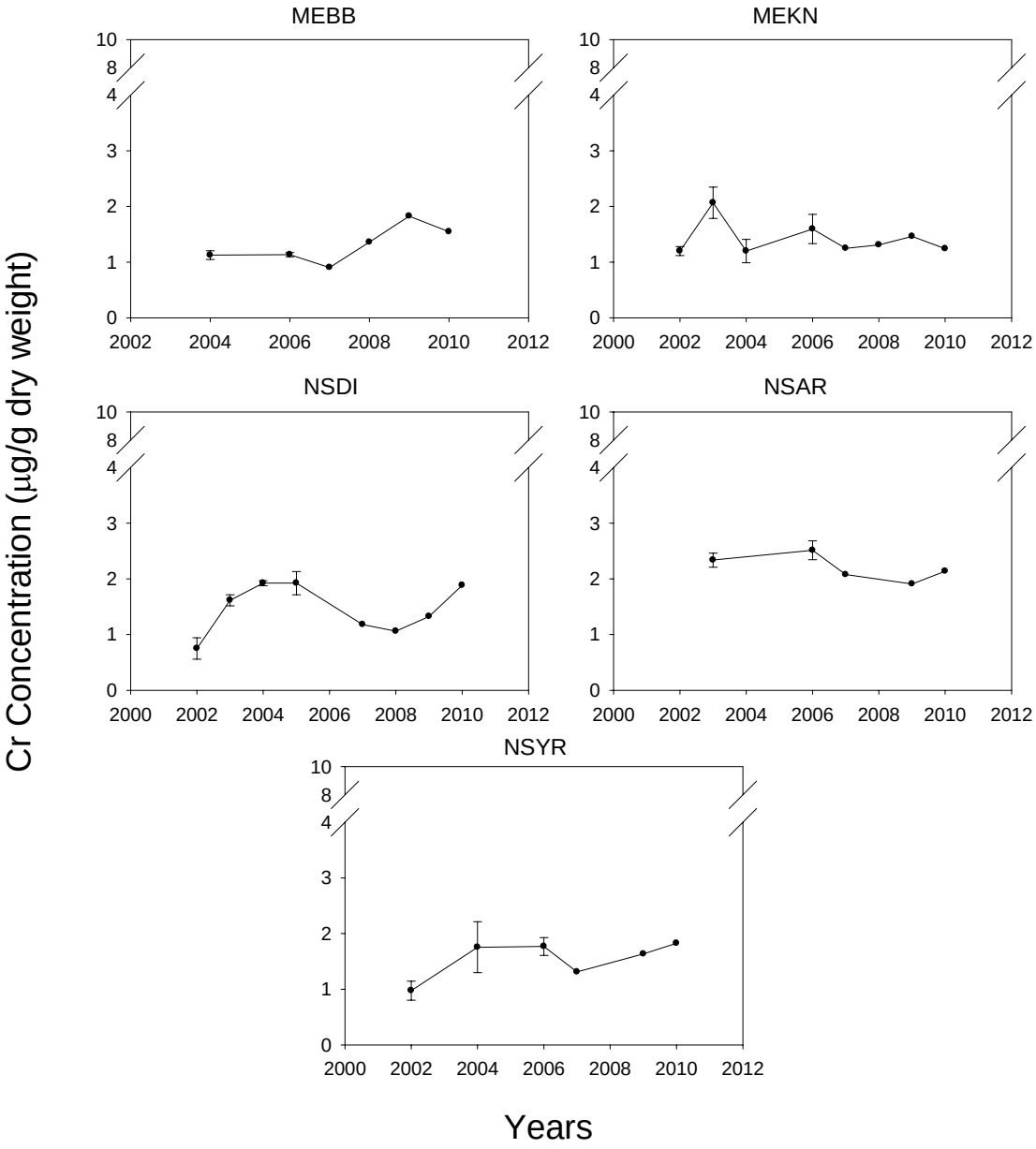

Figure 18 (cont'd). Distribution of chromium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

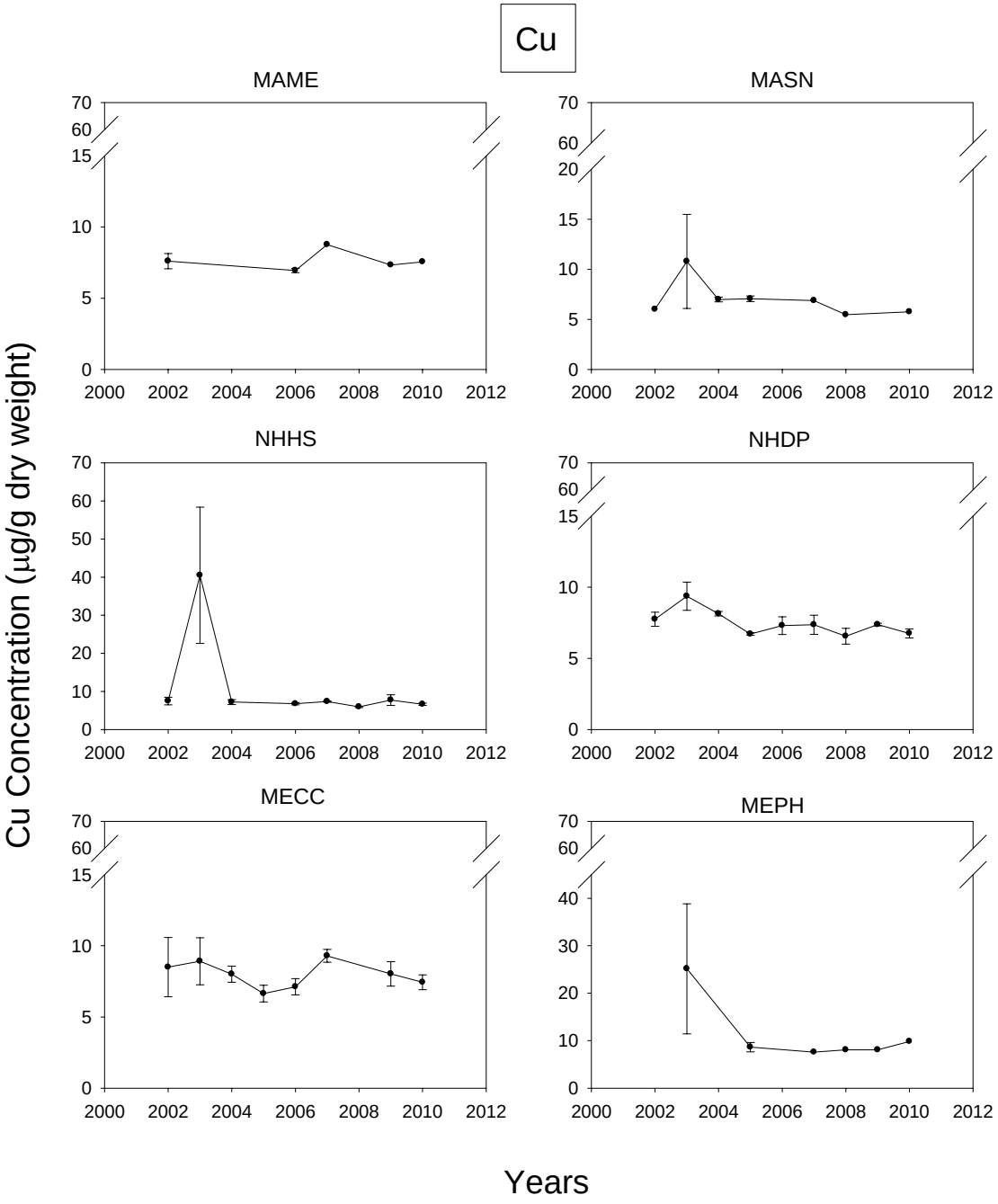

Figure 19. Distribution of copper tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

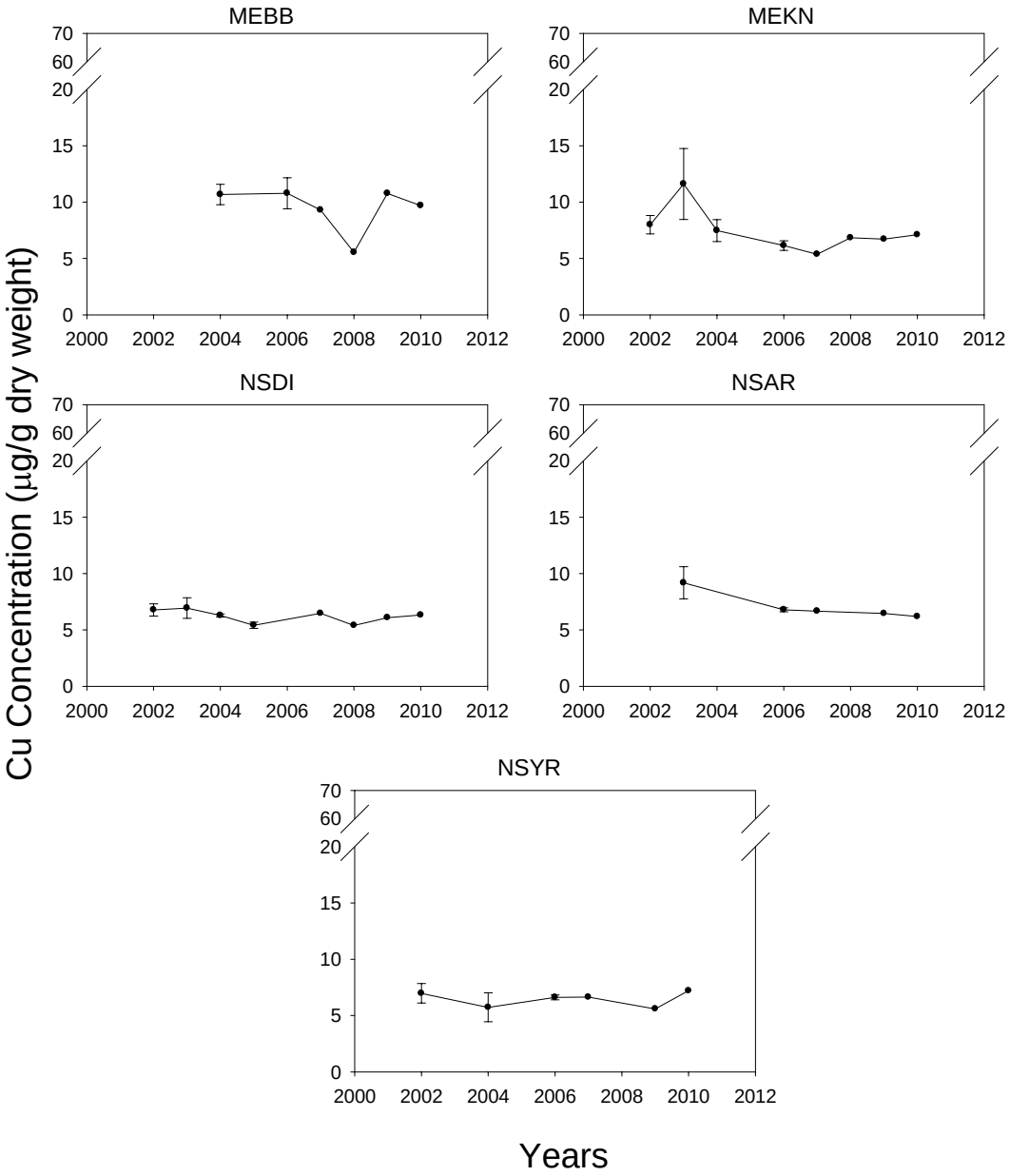

Figure 19 (cont'd). Distribution of copper tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

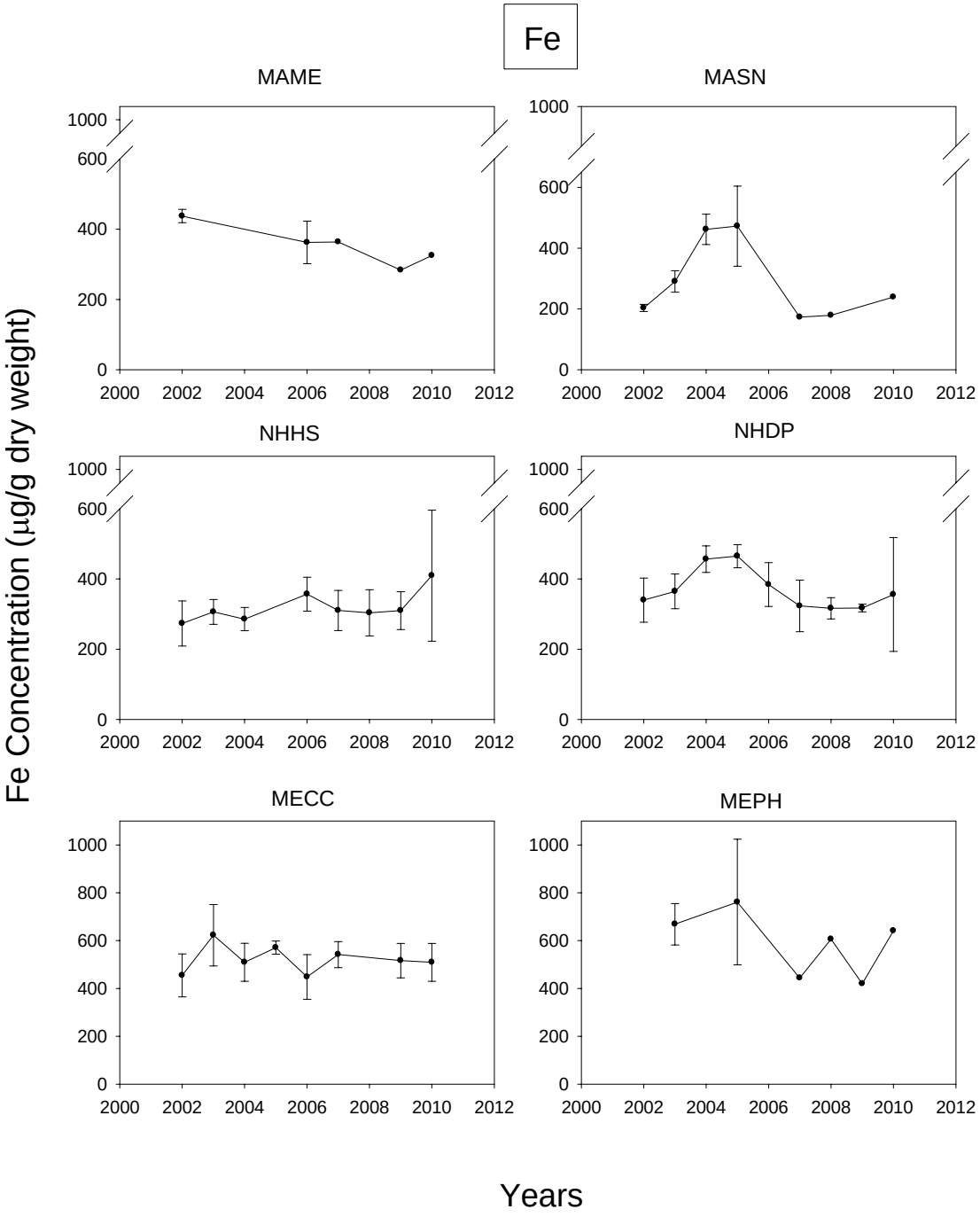

Figure 20. Distribution of iron tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

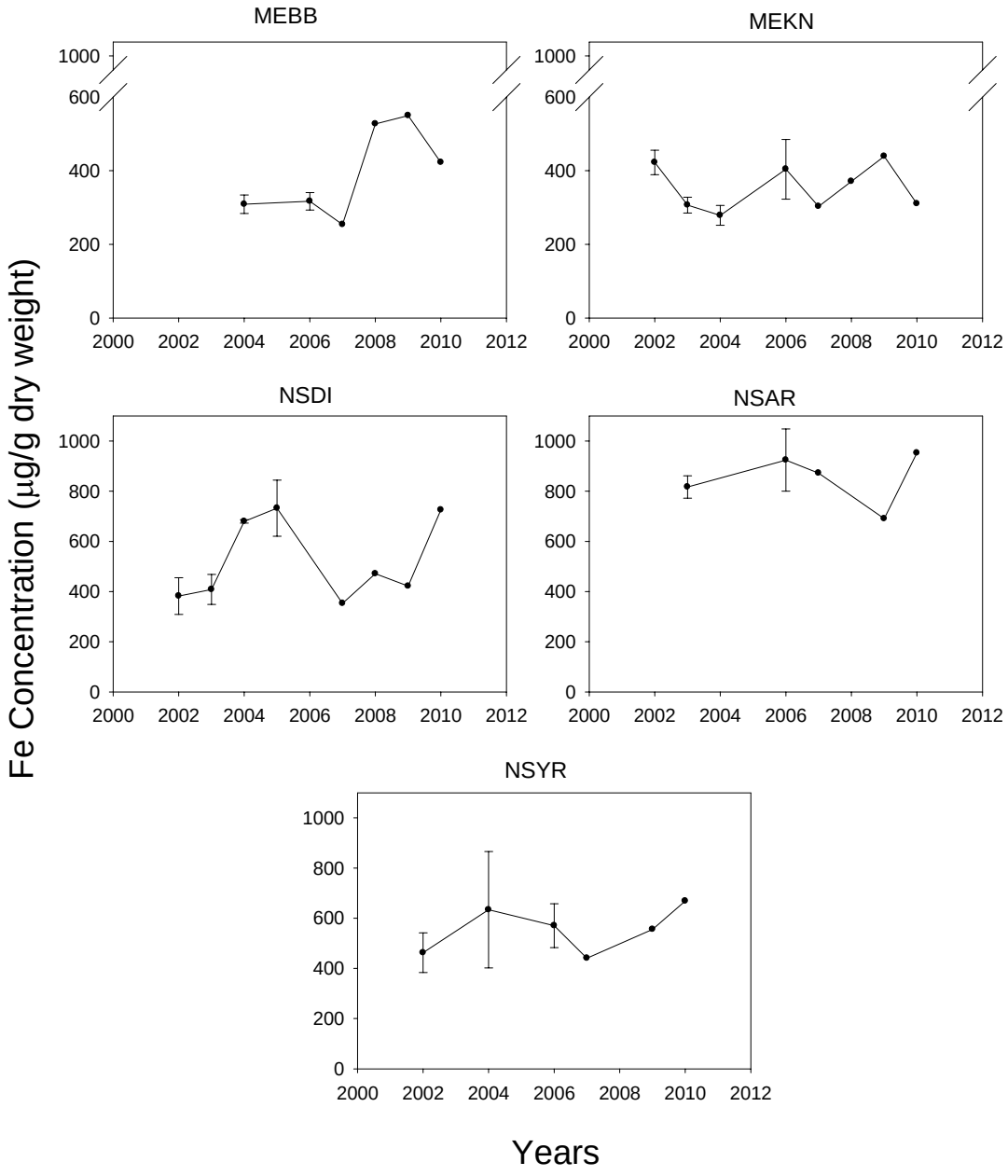

Figure 20 (cont'd). Distribution of iron tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

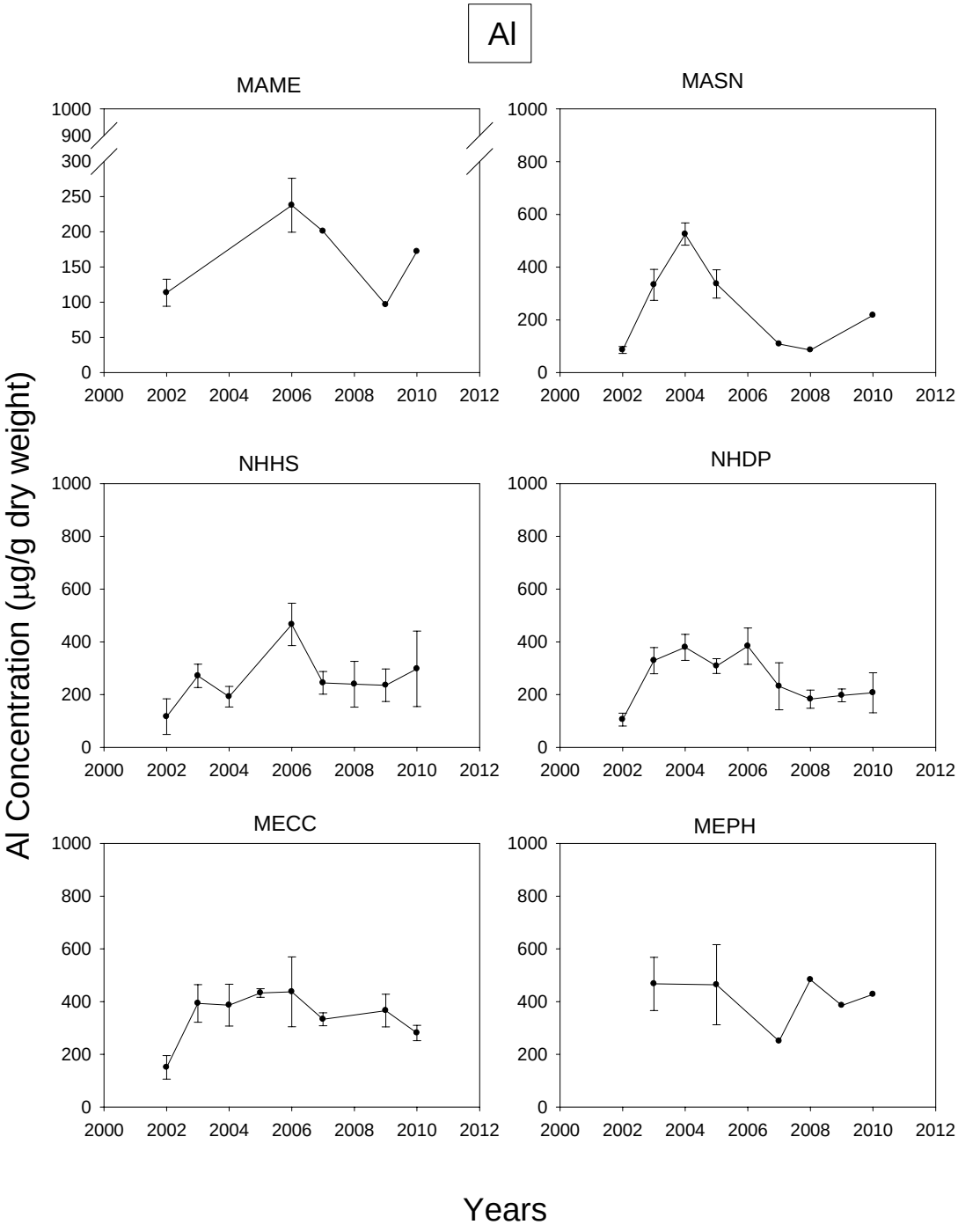

Figure 21. Distribution of aluminum tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

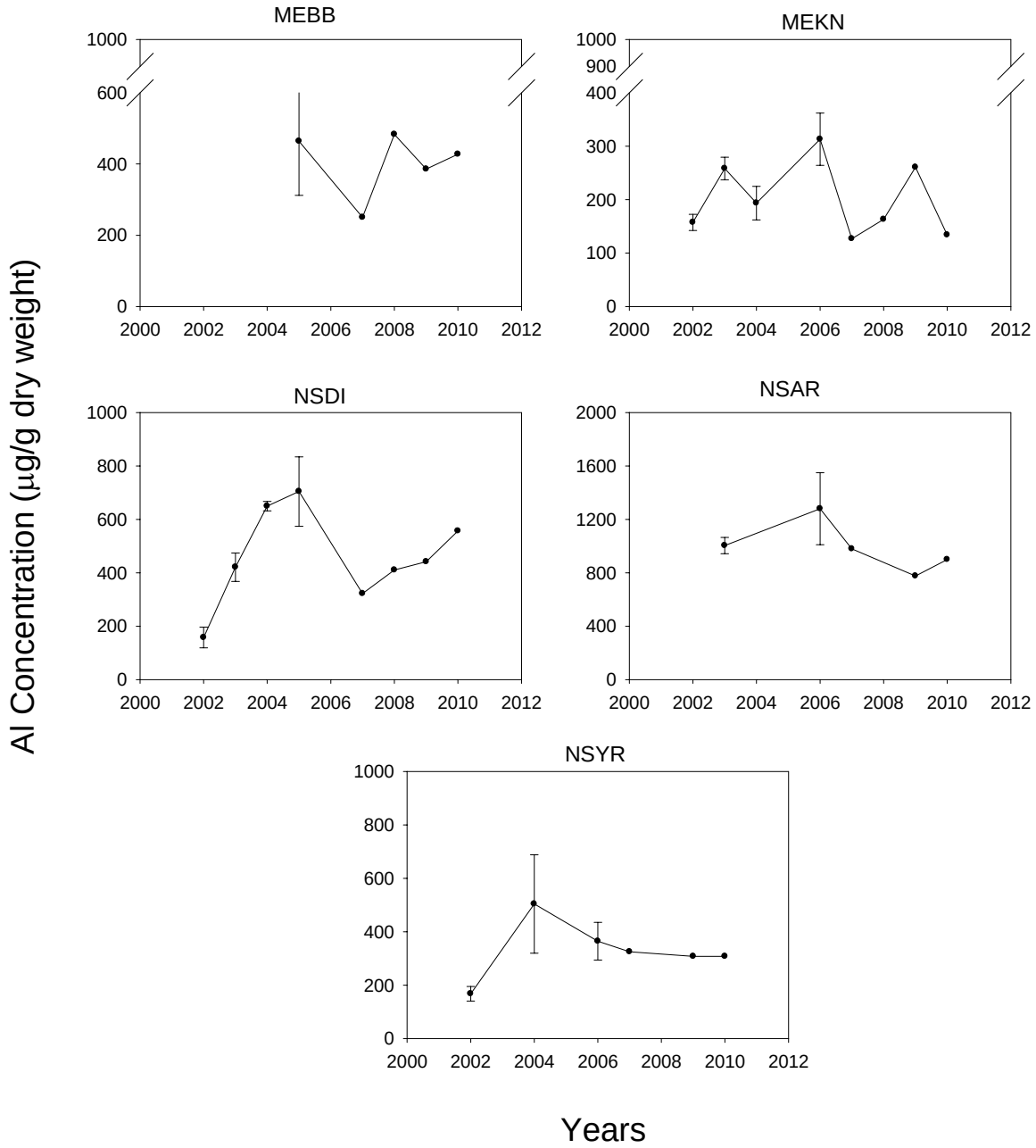

Figure 21 (cont'd). Distribution of aluminum tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

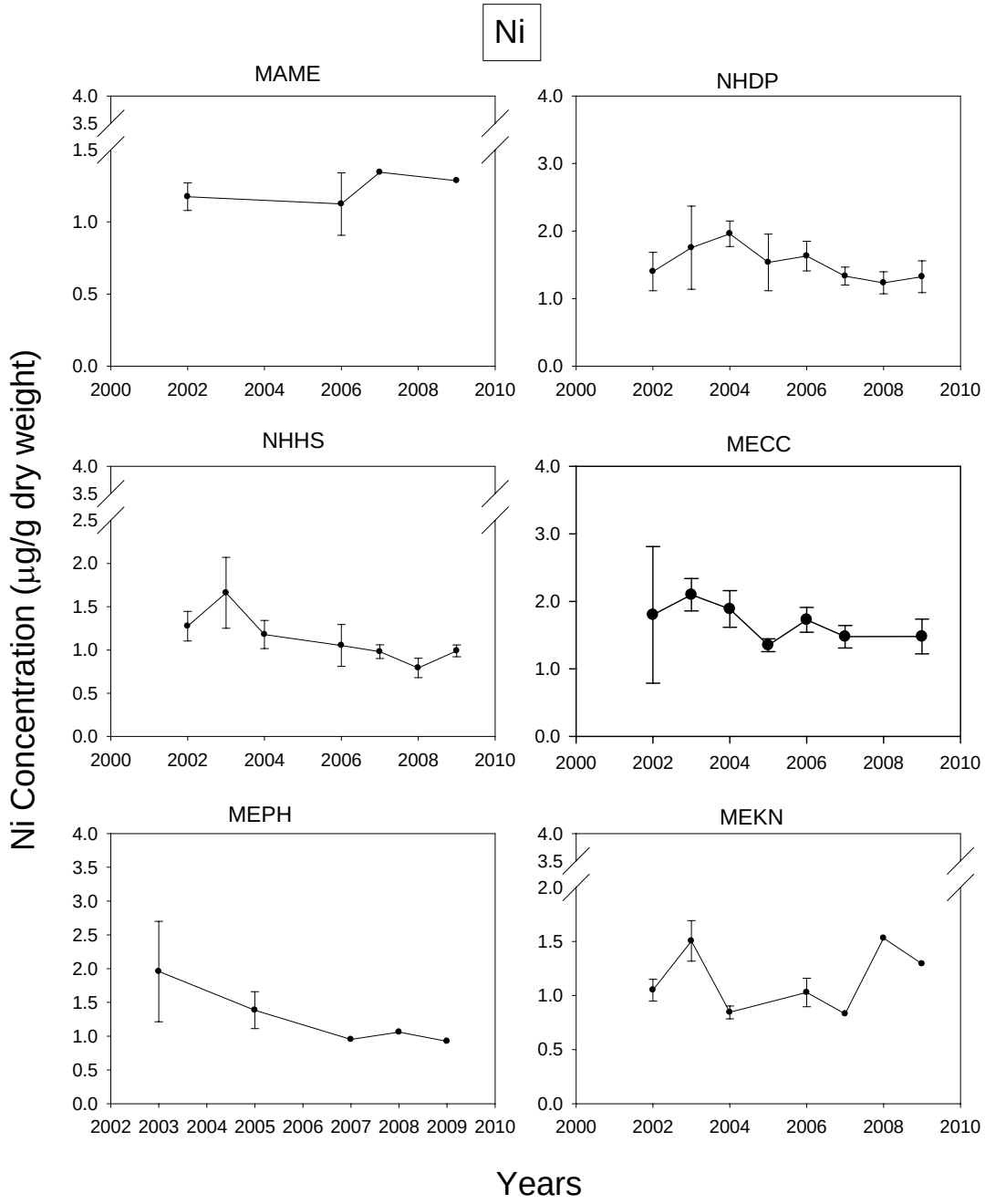

Figure 22. Distribution of nickel tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

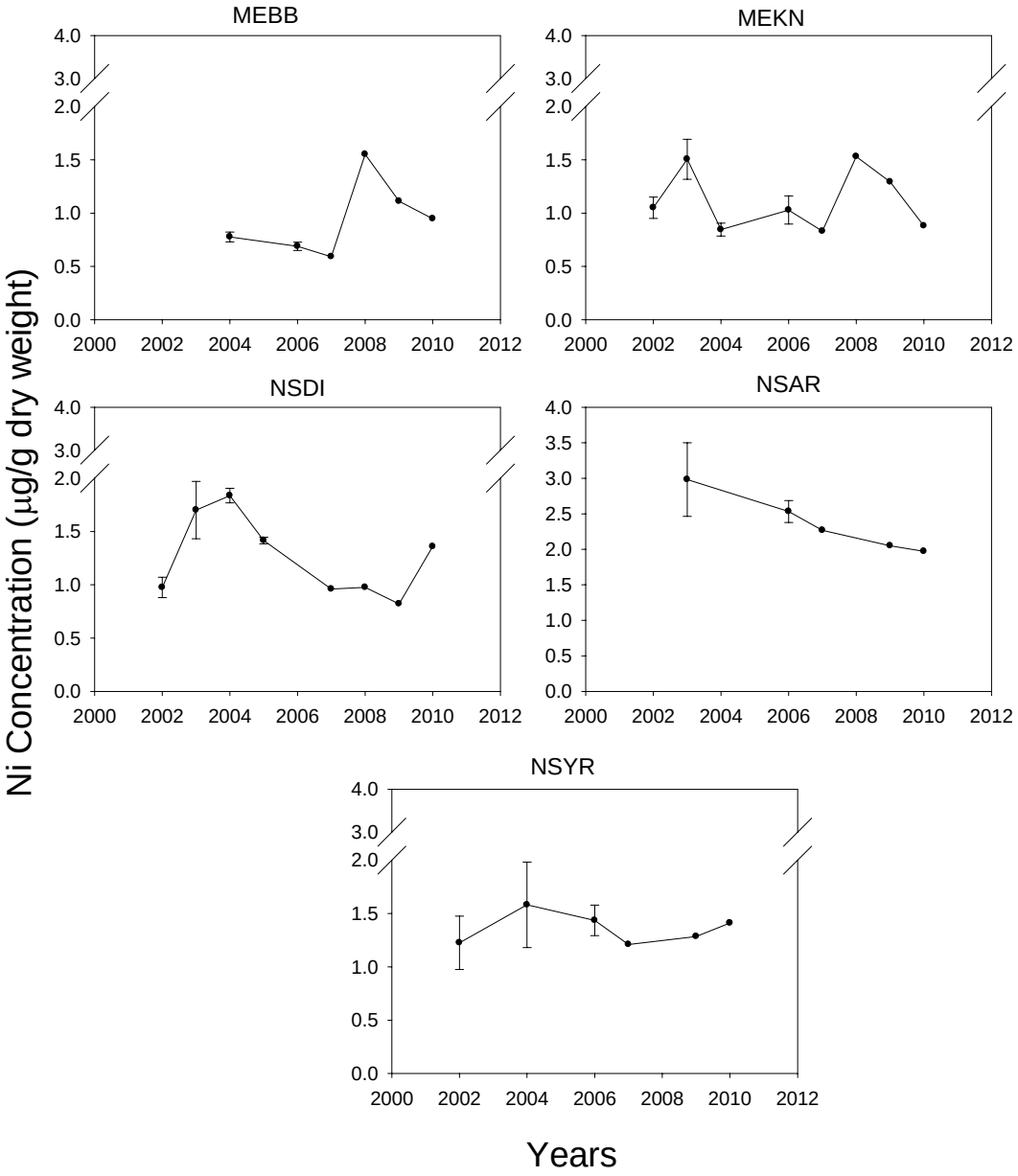

Figure 22 (cont'd). Distribution of nickel tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

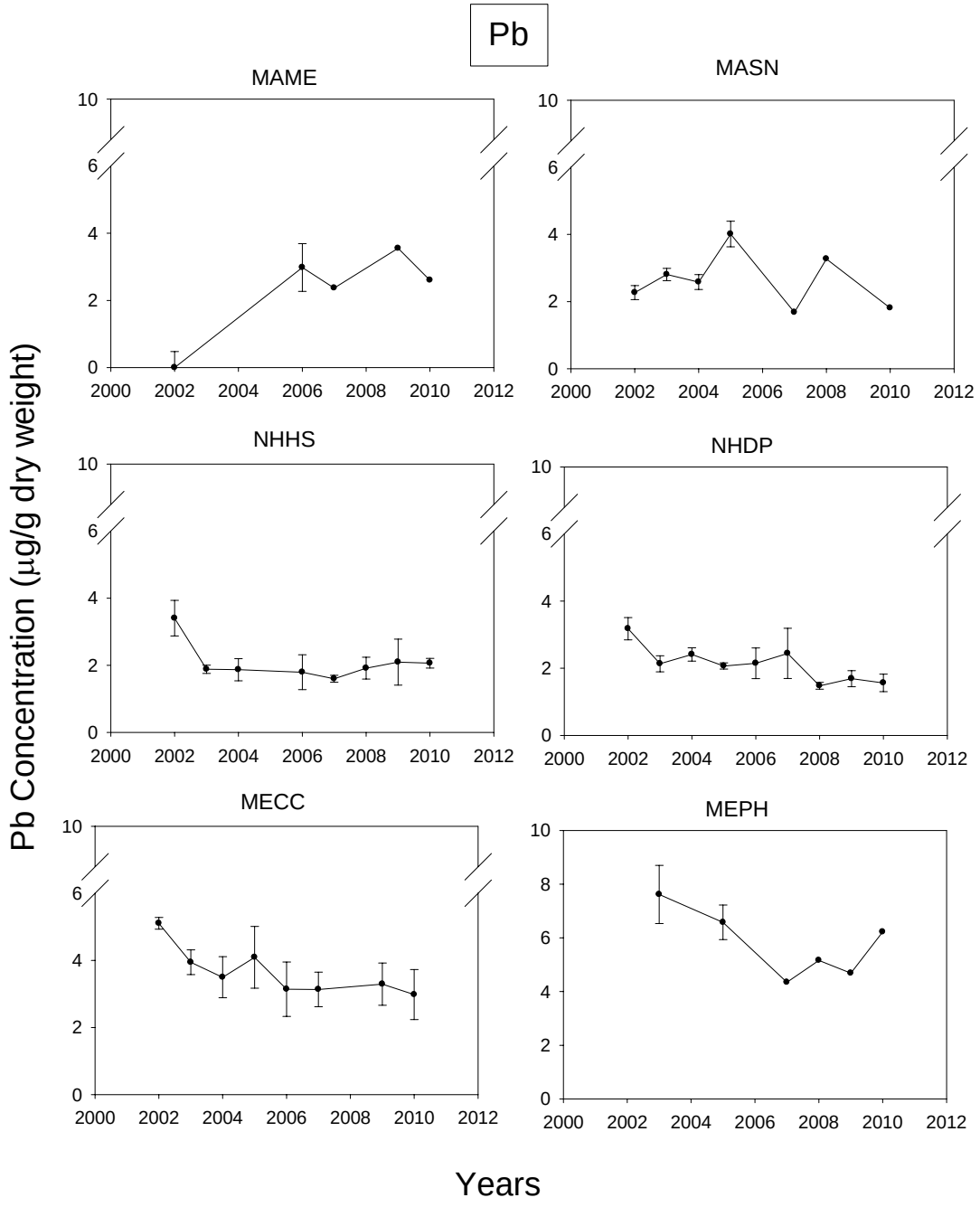

Figure 23. Distribution of lead tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

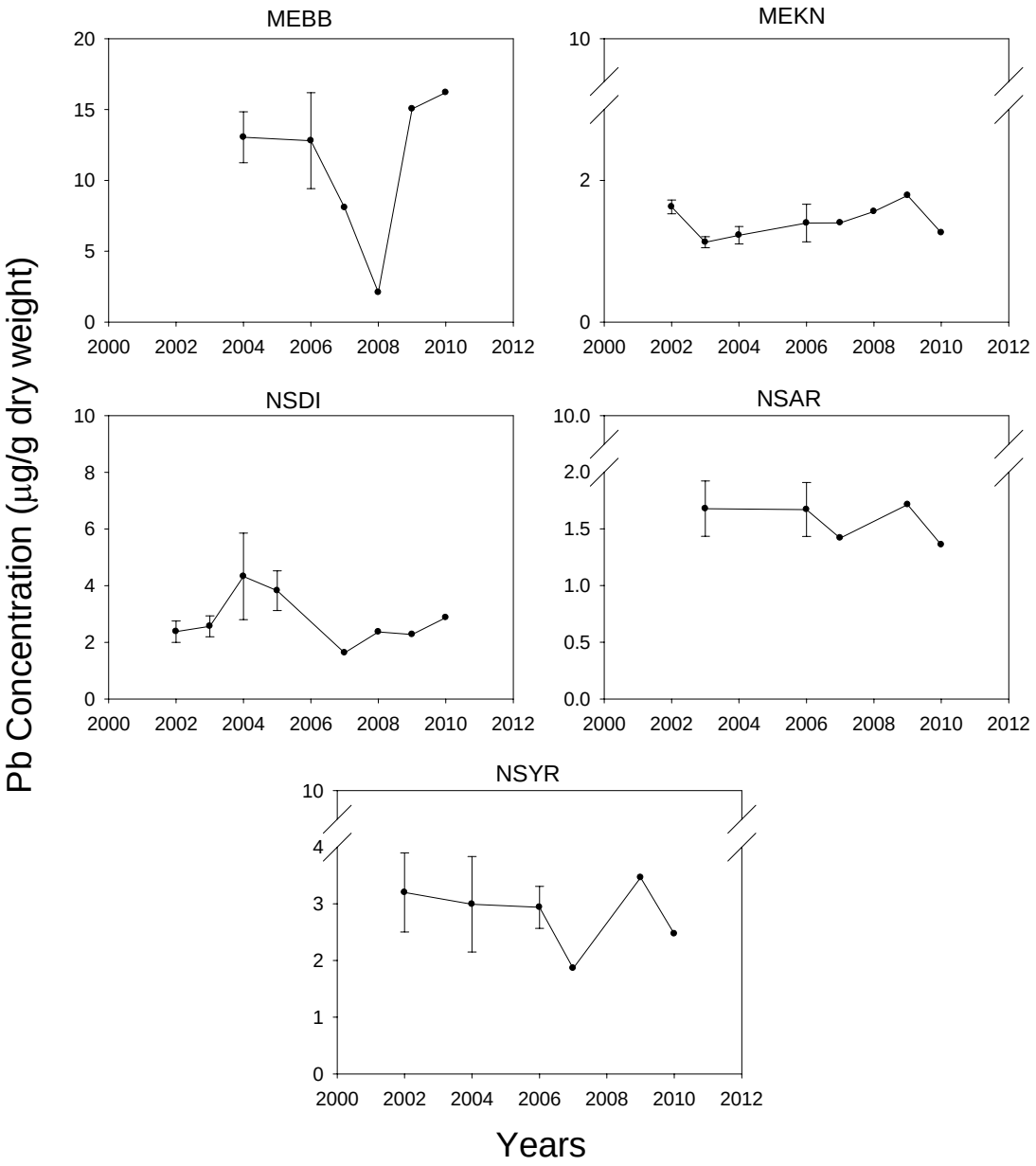

Figure 23 (cont'd). Distribution of lead tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

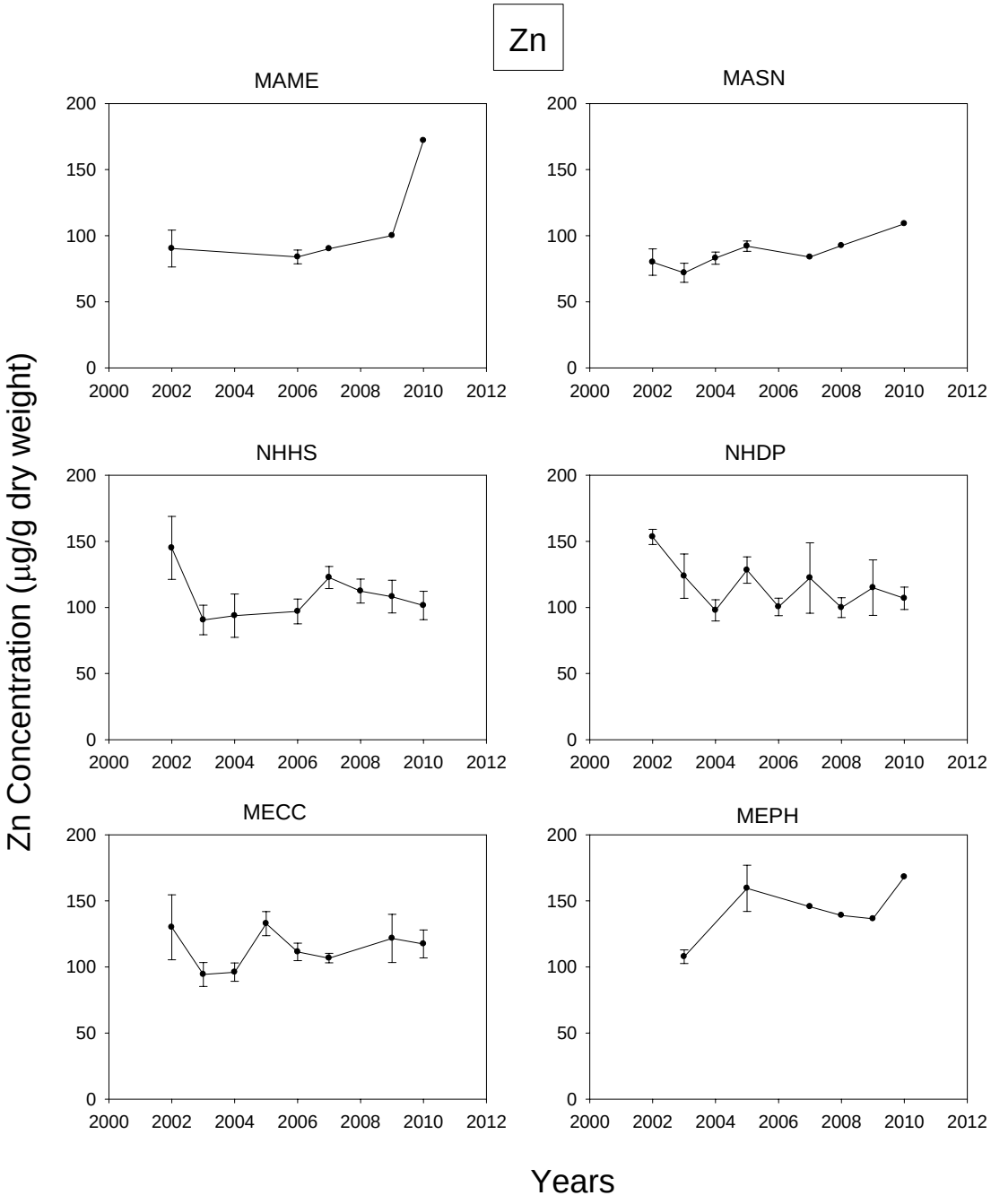

Figure 24. Distribution of zinc tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

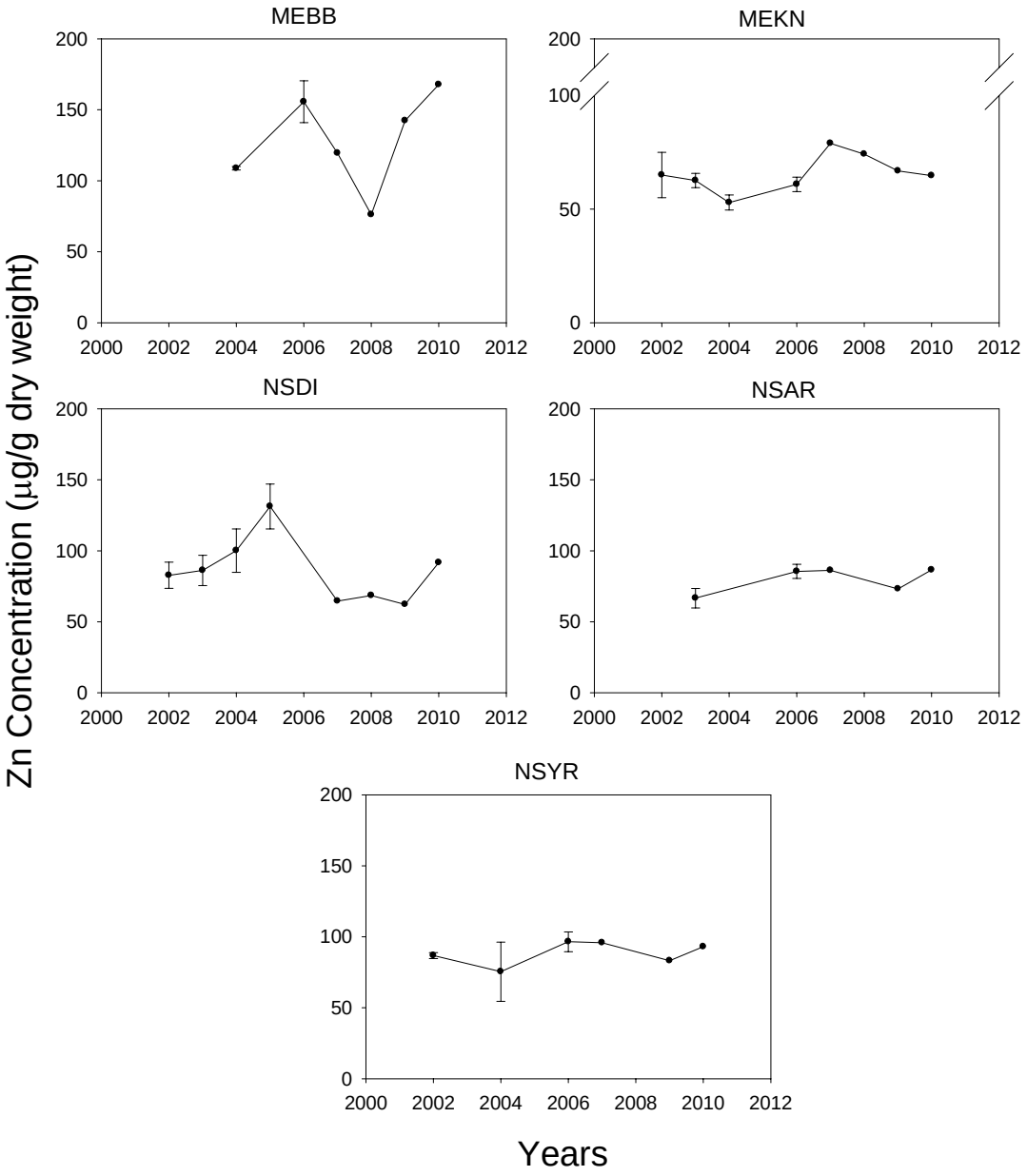

Figure 24 (cont'd). Distribution of zinc tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

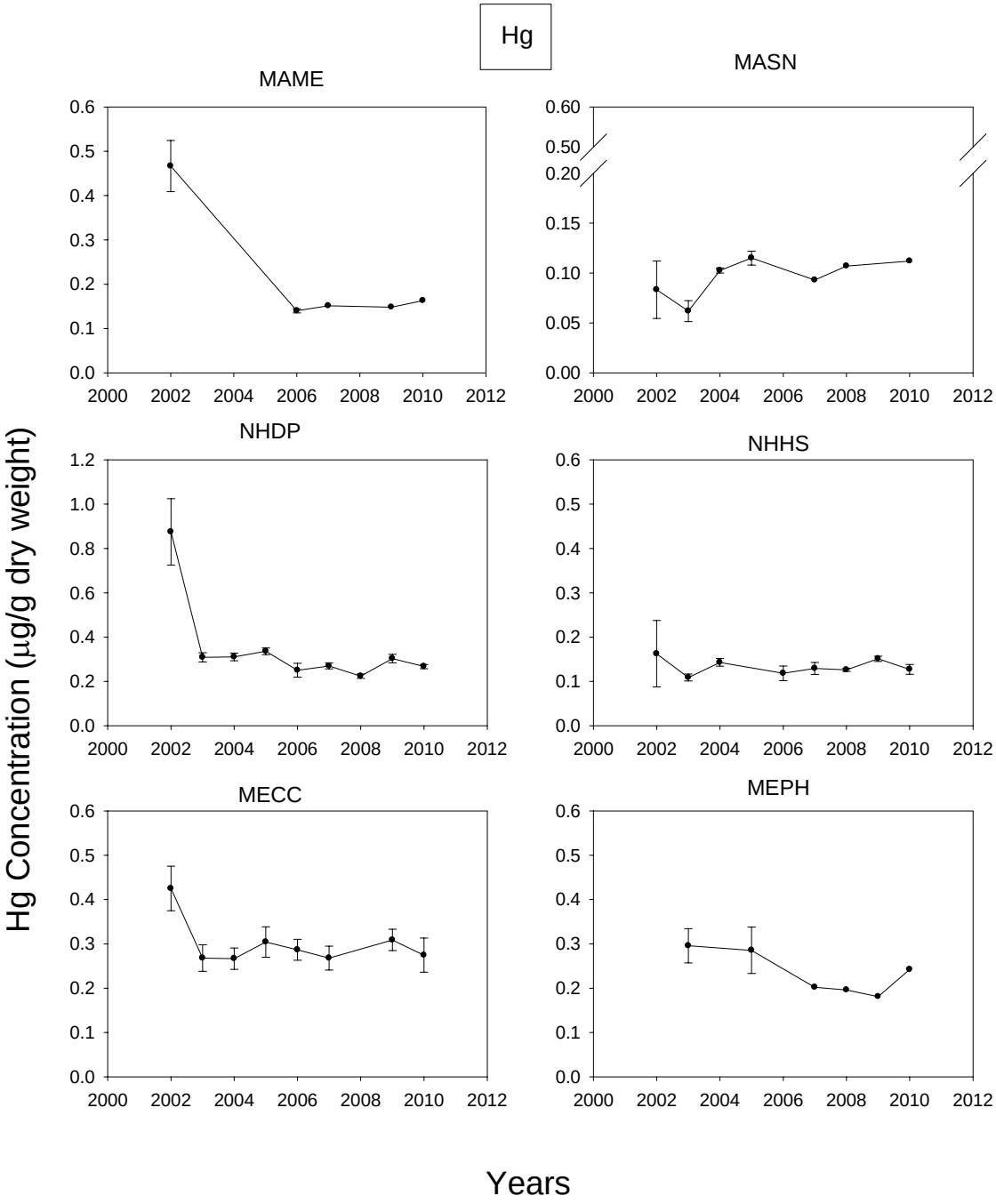

Figure 25. Distribution of mercury tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

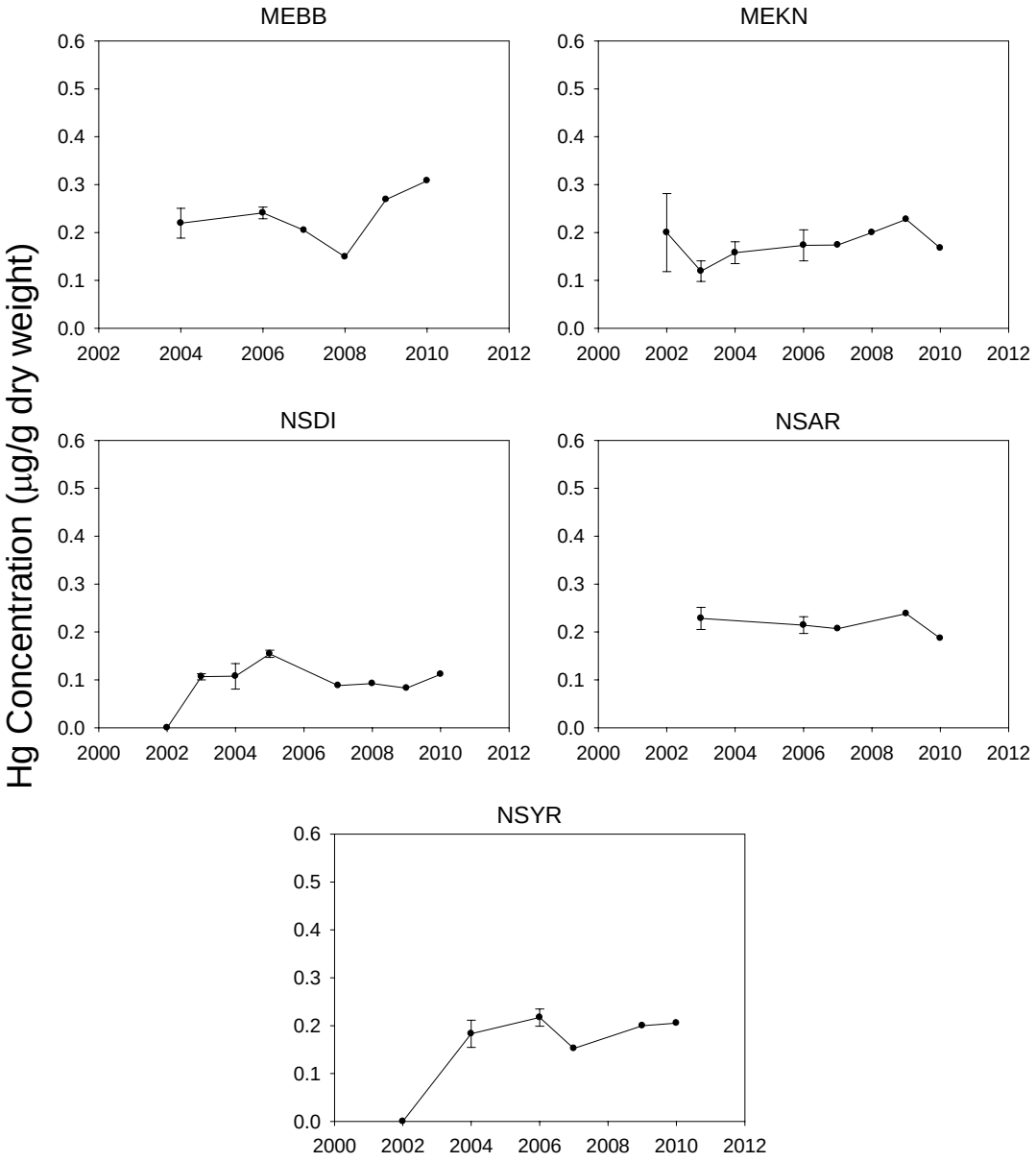

Figure 25 (cont'd). Distribution of mercury tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

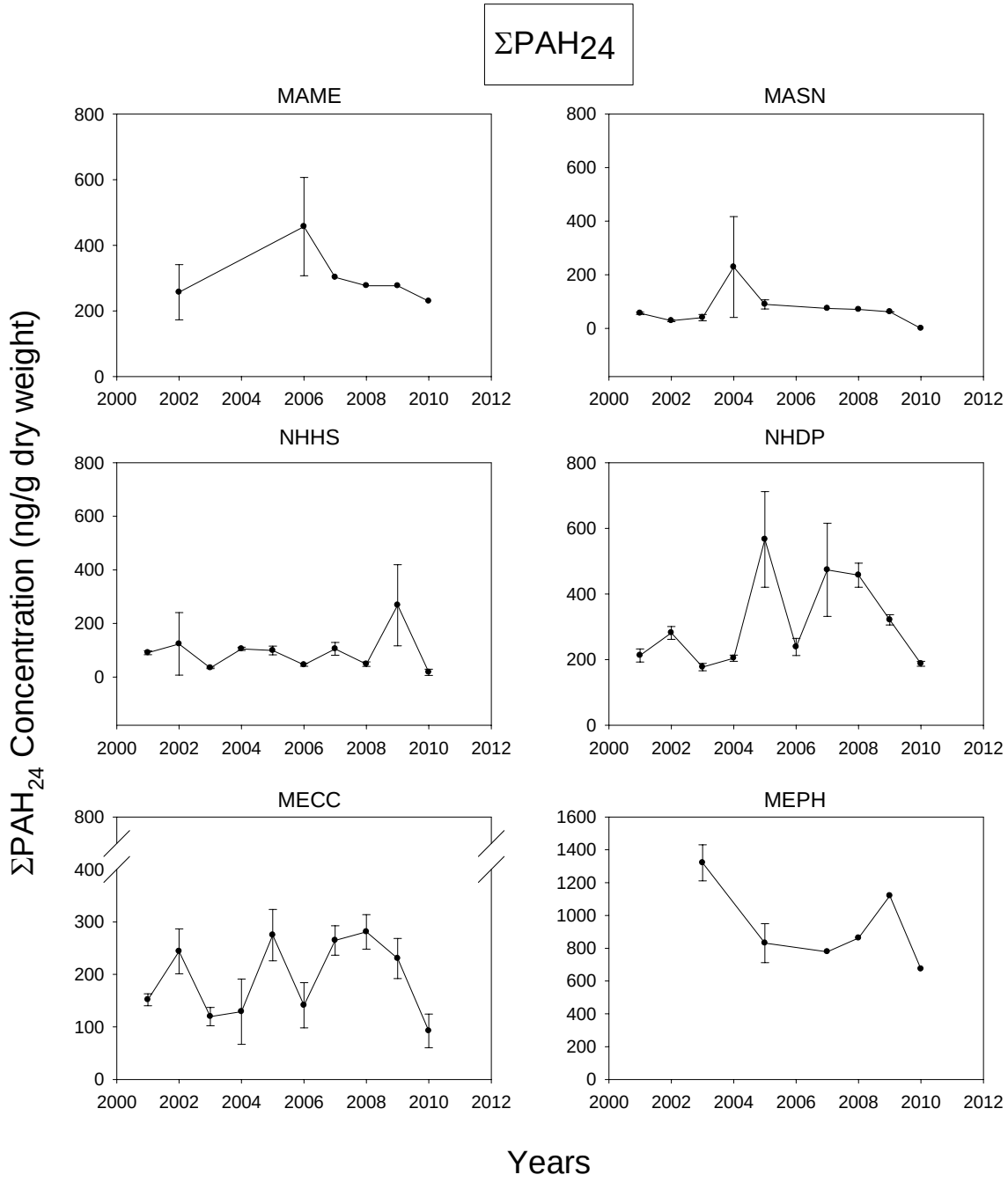

Figure 26. Distribution of the sum of 24 PAH compounds in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

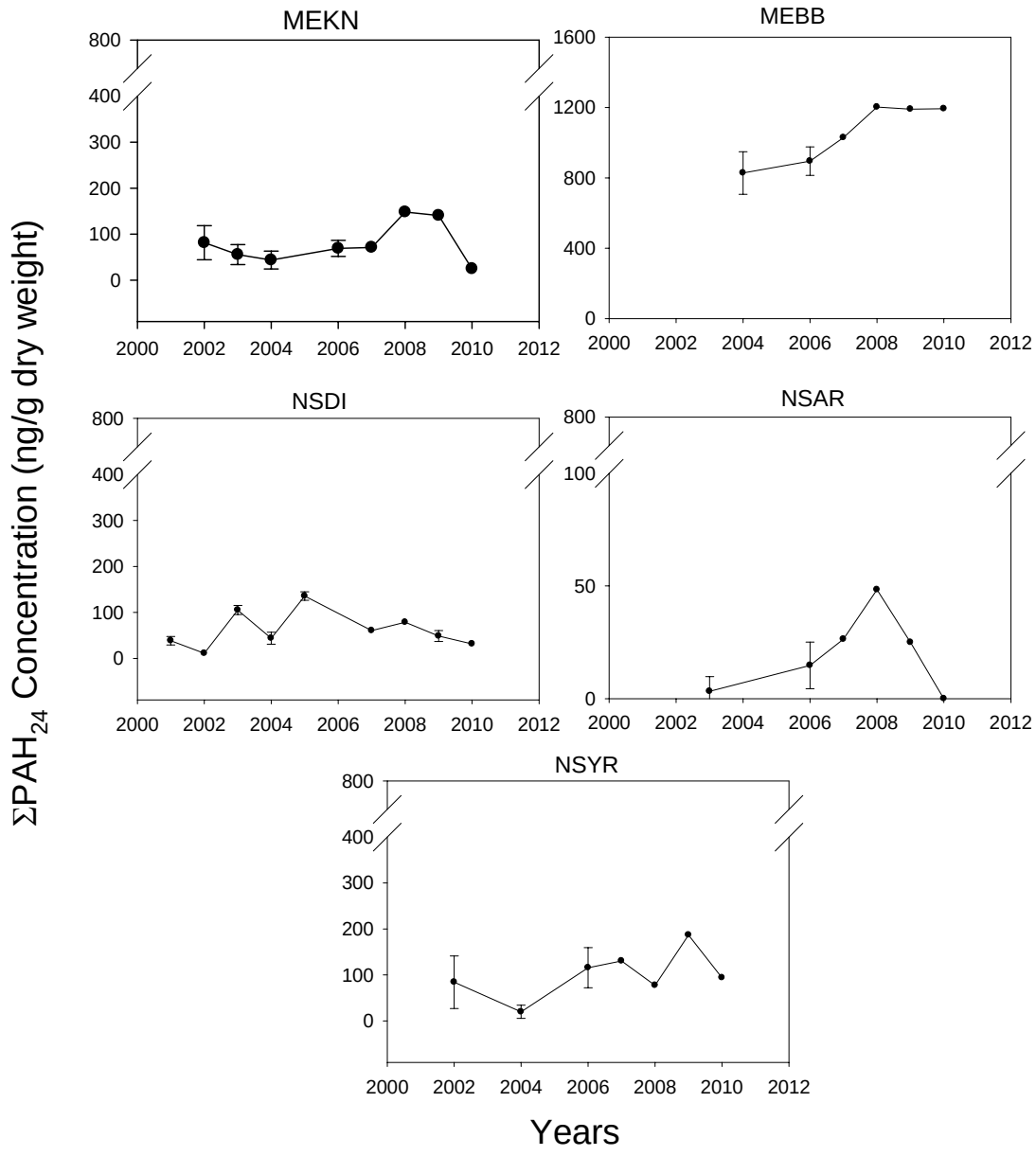

Figure 26 (cont'd). Distribution of the sum of 24 PAH compounds in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

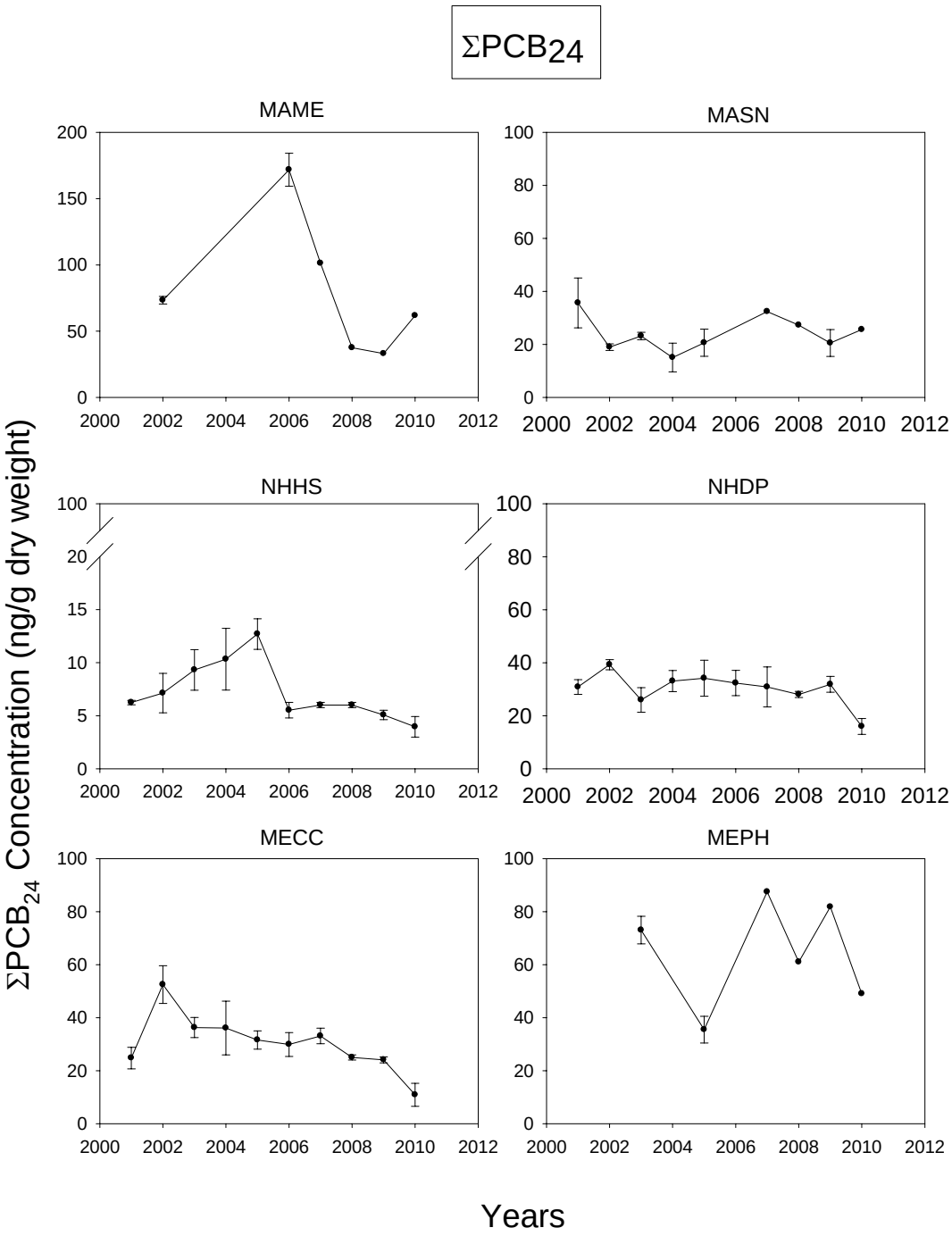

Figure 27. Distribution of the sum of 24 PCB congeners in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

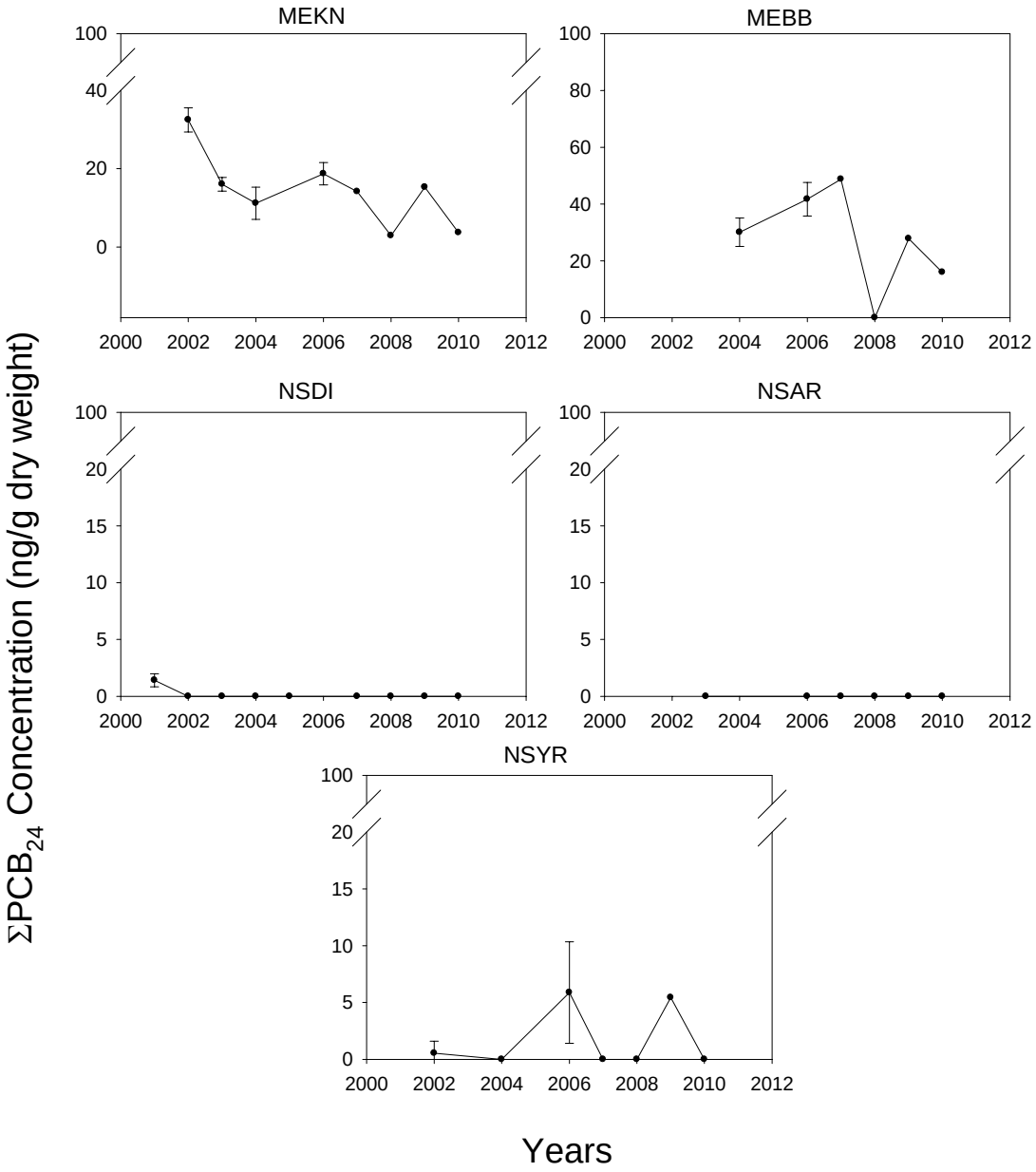

Figure 27 (cont'd). Distribution of the sum of 24 PCB congeners in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC. One can observe that PCBs have been not-detected (represented as a zero value) since 2003 at the NSAR site.

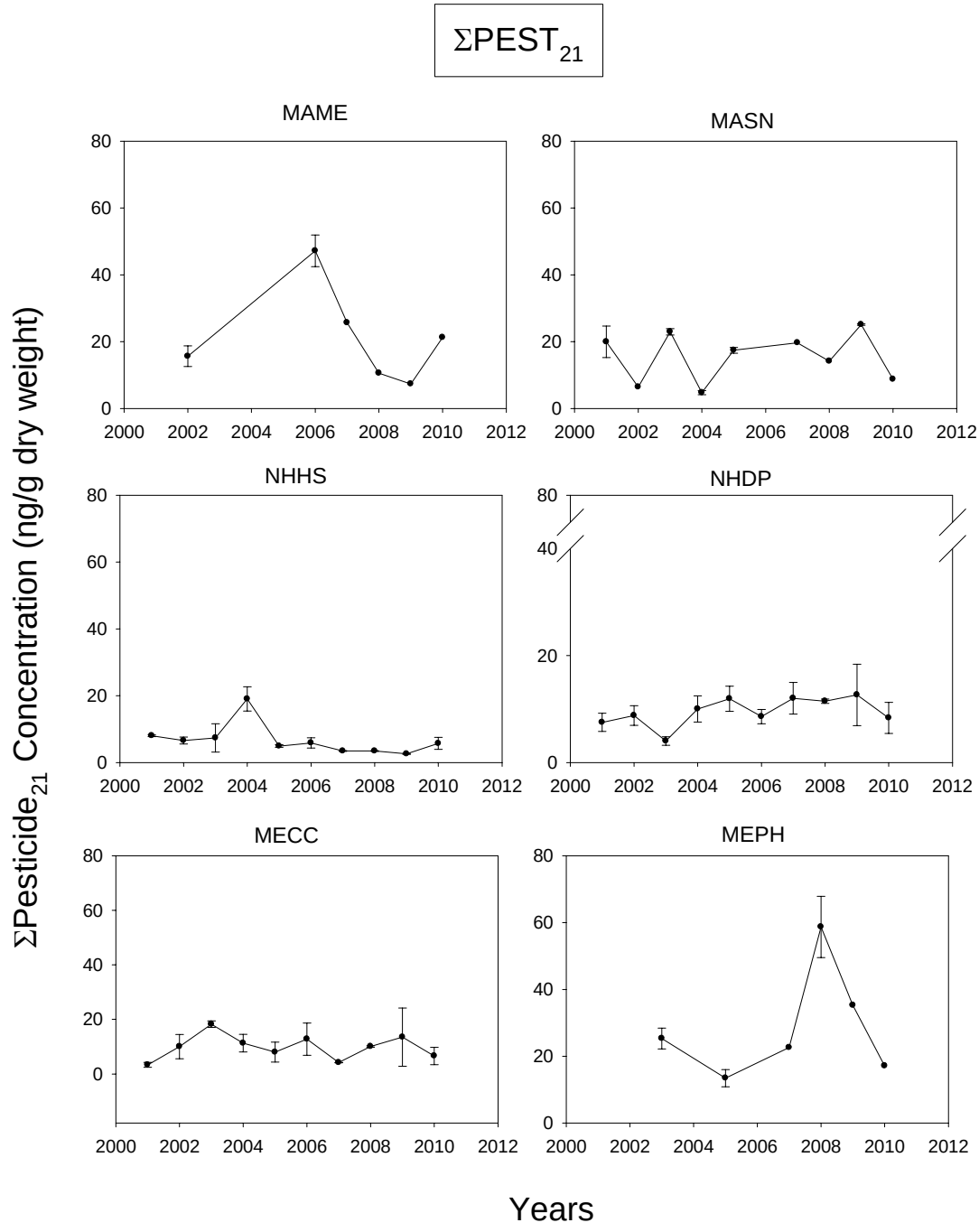

Figure 28. Distribution of the sum of 21 chlorinated pesticide compounds in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

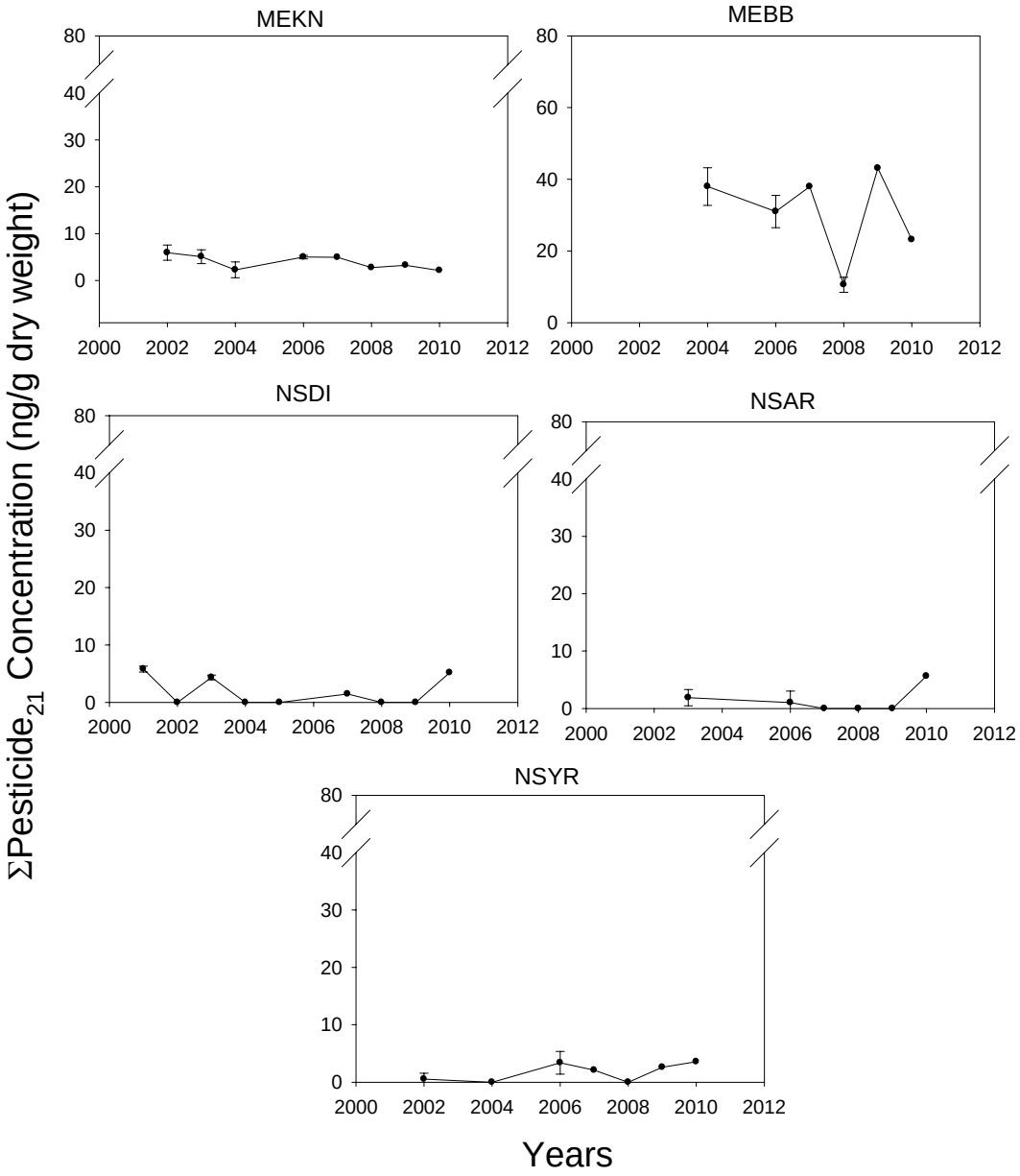

Figure 28 (cont'd). Distribution of the sum of 21 chlorinated pesticide compounds in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2010. For 2007-2010 there are only single site composite values except for stations NHDP, NHHS and MECC.

4.3 DRY WEIGHT AND LIPID FRACTIONS

Lipid content and percent wet weight (represented as % moisture) 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 (± one standard deviation) % moisture and % lipids as a function of tissue mass are plotted in Figs. 29 and 30, respectively. These data can be found in table form in Appendices E and F. Percent moisture was between 81.0% - 88.2% of the overall tissue mass. Percent lipid content was between 3.7 and 8.0 % of the tissue mass (Appendix F). O'Conner and Lauenstein (2006) reported an average of 8% lipid content for the mussels collected by the NOAA Mussel Watch program. In 2010 the mean lipid weight was 5.5 ± 1.3 % for the Gulfwatch Program samples.

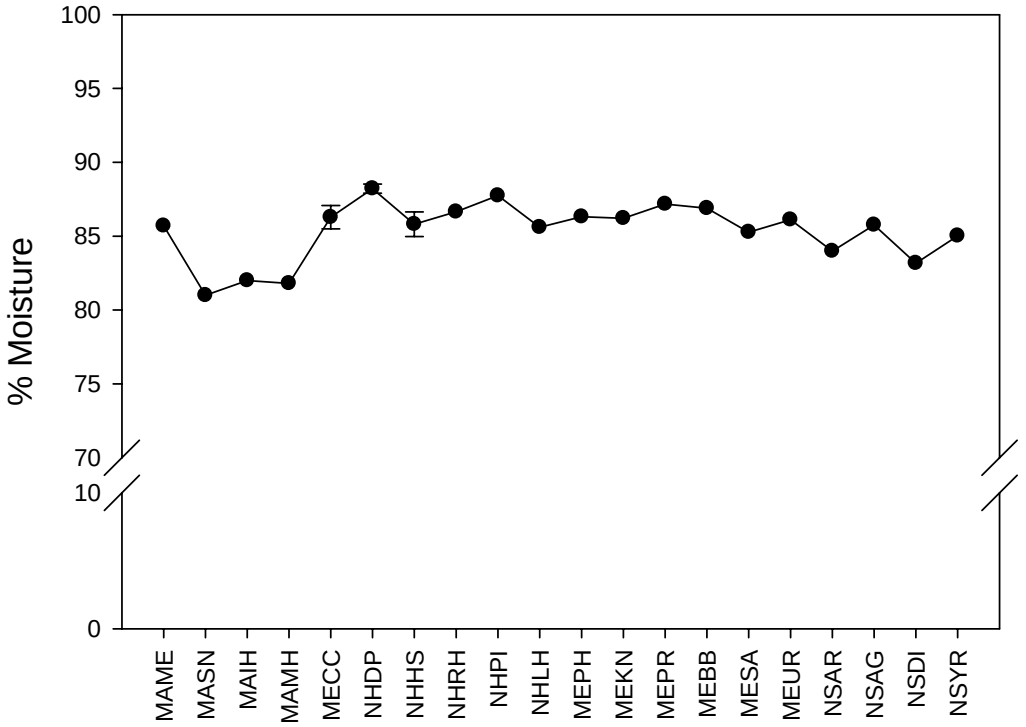

Figure 29. Mean and standard deviation of % moisture in Gulfwatch mussels collected during 2010.

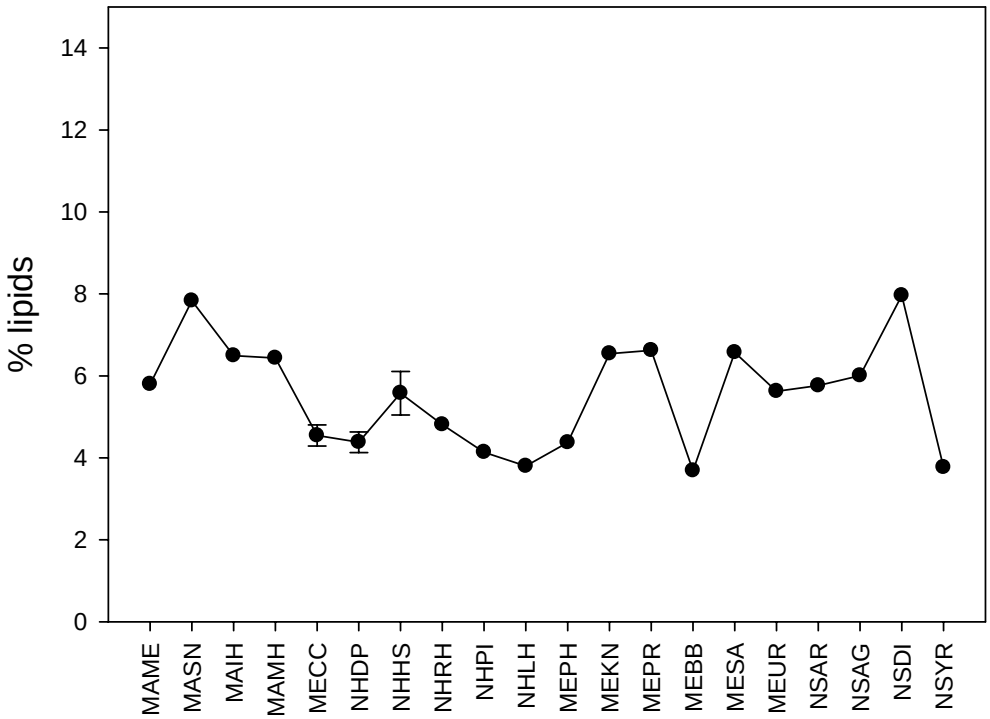

Figure 30. Mean and standard deviation of lipid content (% of tissue dry weight) in Gulfwatch mussels collected during 2010.

4.4 SHELL LENGTH AND CONDITION INDEX

Table 10 contains a summary of the morphological measurements and condition indices for mussels collected at each site in 2010. Mean condition index is plotted for all of the 2010 stations in Figure 32.

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 2010 sites was 55.3± 3.03 mm.

Table 8. Morphometric determinations and statistics (arithmetic mean, standard deviation) for mussels collected along the Gulf of Maine, 2010 Gulfwatch.

	CI[1]		Length (mm)		Height[3] (mm)		Width (mm)		
Station	Mean	Stdev[2]	Mean	Stdev	Mean	Stdev	Mean	Stdev	n[4]
MAME	0.12	0.02	55.77	2.61	23.76	2.19	23.61	1.52	20
MAMH	0.14	0.03	54.74	3.63	24.80	1.93	23.90	7.82	20
MAIH	0.13	0.02	55.53	2.90	25.14	1.96	24.88	2.25	20
MECC	0.14	0.02	55.7	2.14	28.5	1.95	22.6	1.41	20
NHDP	0.14	0.01	55.0	2.32	26.9	1.79	21.9	2.09	20
NHHS	0.17	0.03	50.5	2.59	26.4	2.37	25.7	1.77	20
NHRH	0.13	0.03	55.4	1.83	30.4	2.76	23.1	2.47	20
NHLH	0.14	0.03	54.1	2.52	23.6	1.39	27.9	2.17	20
NHPI	0.14	0.02	55.1	2.40	23.0	1.59	29.1	1.49	20
MEPH	0.142	0.023	55.4	2.4	28.44	4.00	21.70	2.01	60
MEKN	0.156	0.021	55.2	2.7	28.04	1.80	22.44	1.51	60
MEBB	0.145	0.025	55.4	2.7	29.64	2.18	22.41	2.21	60
MEDM	0.127	0.024	55.7	2.9	29.24	4.21	21.87	2.28	60
MEMR	0.160	0.048	56.4	2.8	28.85	4.10	19.96	1.53	60
MECK	0.148	0.040	54.9	2.8	29.55	1.99	21.87	1.81	60
NSYR	0.141	0.025	56.03	2.63	28.41	1.84	25.82	1.74	20
NSDI	0.140	0.026	59.7	3.11	31.3	1.55	25.4	1.98	20
NSAR	0.106	0.016	53.7	3.21	26.5	1.78	20.7	1.98	20
NSAG	0.114	0.019	54.8	2.75	30.7	2.20	21.9	1.98	20

[1]CI = condition index = individual tissue weight (mg)/length (mm) * height (mm) * width (mm)
[2]Stdev = standard deviation, [3]Ht. = height (mm), [4]n = number of mussels measured for CI determinations

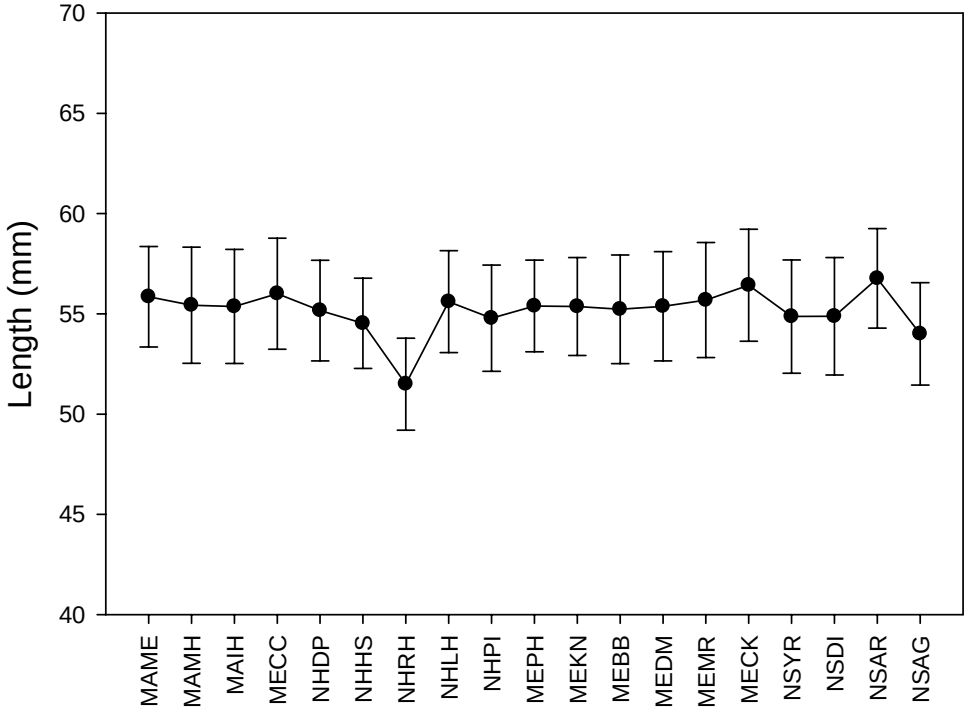

Figure 31. Mean and standard deviation of length (mm) in all Gulfwatch mussels collected for trace metal and organic analysis and archival during 2010.

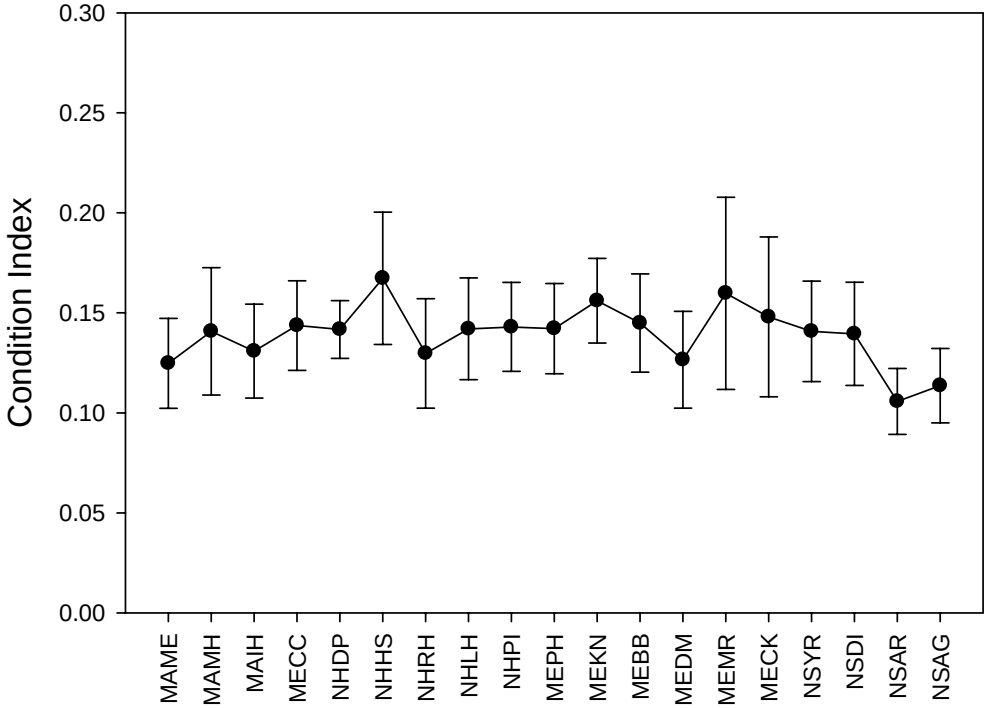

Figure 32. Mean and standard deviation condition index of Gulfwatch mussels collected during 2010.

5.0 2010 GULFWATCH SUMMARY

Monitoring of contaminants in the soft tissues of *M. edulis* from Massachusetts to Nova Scotia in the 19th year of the monitoring program continues to add information for the evaluation of temporal and spatial trends of contaminant exposure of aquatic organisms in the Gulf of Maine and, in part, meets the Goals (particularly #2) articulated in the 2007-2012 GOMC Action Plan. The 2010 Gulfwatch field season continues the modified sampling design begun in 2006, and includes four benchmark sites now re-classified as trend sites based on their unique sampling frequency (visited once every two years), seven other trend sites and nine rotational sites (to be visited once every 6 years). Four sites originally planned for sampling – NBSC, NBNR, NBMI and NBTC were not sampled, due to a combination of logistics and insufficient mussels present. Samples were collected, processed, and analyzed in accordance with program QC/QA protocols. All data associated with the 2010 samples are provided in the accompanying appendices.

The Gulfwatch 2010 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 2008, which is used by Gulfwatch as the criteria for a tissue concentration to be considered elevated and of concern, and is the most recent year where all concentration parameters are available.

Temporal distributions were reviewed for some analytes across the entire region for the designated trend sites. 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. High concentrations are not confined solely to the south and western regions of the Gulf, as elevated concentrations were also observed at sites throughout the region. Lead and mercury exceeded the 85th percentile of the NOAA National Status and Trends dataset at several sites in all jurisdictions. Lead was elevated at MAIH and MAMH in Massachusetts, NHLH NHPI and NHRH in New Hampshire, MECC, MEBB, MEPH and MEPR in Maine, and NSAG and NSDI in Nova Scotia. Mercury was found to be elevated at 16 of the 20 Gulfwatch sites sampled, with maxima seen in all jurisdictions. The highest Hg concentrations were found in mussels from Peirce Island (NHPI) in New Hampshire, although concentrations differed by only slightly more than a factor of three throughout most of the stations and varied by no more than a factor of 4.6 between the highest and lowest concentrations. 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 considered high among sites in MA and NH, and low in ME. However elevated concentration of lead was detected at sites in Maine, New Hampshire, New Brunswick and Nova Scotia with MEBB having the highest concentration of any sites sampled. Mercury was elevated at all sites in Maine and New Hampshire, except for MEUR in Maine. Mercury concentrations were found to be higher than the NS&T median concentrations, although no sites exceeded the NS&T 85th percentile value. In Nova Scotia,

elevated silver was found at NSYR, elevated lead at NSAG and NSDI sites, elevated aluminum at the NSAR site and elevated iron at all four sites.

Organic contaminants were highest overall in Massachusetts and Maine sites. The Boston Inner Harbor site (MAIH) had PAH and PCB concentrations that exceeded the NS&T 85th percentile as well as relatively high chlorinated pesticide concentrations. Marblehead also had PAH, PCB and chlorinated pesticide concentrations which exceeded NS&T median values. Two sites in Maine, Portland Harbor (MEPH) and Boothbay Harbor (MEBB) had PAH concentrations that exceeded NS&T median values for summed PAH quantities, and MEPH also had summed PCB concentrations higher than the NS&T median

The highest tissue concentrations total of total PAHs (ΣPAH 40 = 1862 ng/g) and total PCBs (ΣPCB 21 576 ng/g) were found at the Boston inner harbor site (MAIH), along with the 2nd highest concentration of chlorinated pesticides (83 ng/g). The summed chlorinated pesticide values were primarily made up of the sum of the DDT metabolites DDE and DDD. No sites had chlorinated pesticide concentrations exceeding the NS&T 85th percentile although both the Boston Inner harbor and Marblehead sites had values higher than the NS&T median value.

Overall, the Boston Inner Harbor site remains an area of elevated concentrations of organic contaminants and a few metals (notably Pb). Marblehead has elevated concentrations of Pb and Cr, and Boothbay Harbor contains elevated tissue concentrations of Pb and among the highest PAH concentrations of all sites monitored (although not exceeding NS&T's 85th percentile value. High concentrations of mercury, relative to NS&T metrics are seen at most sites in the Gulf of Maine.

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 chemical 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 and the most recent 2012-2017 sampling plan. The program continues to refine temporal and spatial sampling and analytical protocols to provide information for coastal resource managers (state and region-wide) who make decisions on issues related to contaminants in near shore waters of the Gulf of Maine. It provides an important resource for both scientists and non-scientists concerned with water and shellfish quality in the region. Data generated by this program has been used by the Gulfwatch Ecosystem Indicator Partnership (ESIP) program scientists in formulating their biological indicators of environmental stress, and data have been linked to their website. The Gulfwatch 2010 data report provides contaminant information for this purpose and to inform researchers and others living around the Gulf of Maine Environment.

6.0 REFERENCES

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7.0 ACKNOWLEDGEMENTS

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APPENDIX A: Sample Collection Information

Table A1. 2010 Gulfwatch sample identification numbers, replicates, sampling dates, species collected and site comments.

		Date	**Organism**	2010	Comments
Sample ID	**Sample Type**	**Sampled**	**Collected**	Sampling status	
MAIH	Site composite	10/07/2010	Mytilus edulis	YES	Sparse mussels
MAME	Site composite	10/06/2010	Mytilus edulis	YES	
MASN	Site composite	10/19/2010	Mytilus edulis	YES	Re-located sample site
MASN DUP	Analytical duplicate	10/19/2010	Mytilus edulis	YES	
MAMH	Site composite	10/07/2010	Mytilus edulis	YES	
NHHS-COMP	Site composite	9/14/2010	Mytilus edulis	YES	NHDES
NHHS-Dup	Analytical duplicate	9/14/2010	Mytilus edulis	YES	NHDES
NHHS-1N	Site replicate	9/14/2010	Mytilus edulis	YES	NHDES
NHHS-2N	Site replicate	9/14/2010	Mytilus edulis	YES	NHDES
NHHS-3N	Site replicate	9/14/2010	Mytilus edulis	YES	NHDES
NHRH	Site composite	9/14/2010	Mytilus edulis	YES	
NHLH	Site composite	9/14/2010	Mytilus edulis	YES	
NHPI	Site composite	9/14/2010	Mytilus edulis	YES	NHDES
NHDP	Site composite	9/14/2010	Mytilus edulis	YES	
NHDP-1N	Site replicate	9/14/2010	Mytilus edulis	YES	NHDES
NHDP-2N	Site replicate	9/14/2010	Mytilus edulis	YES	NHDES
NHDP-3N	Site replicate	9/14/2010	Mytilus edulis	YES	NHDES
MECC-COMP	Site composite	9/14/2010	Mytilus edulis	YES	
MECC-1N	Site replicate	9/14/2010	Mytilus edulis	YES	
MECC-2N	Site replicate	9/14/2010	Mytilus edulis	YES	
MECC-3N	Site replicate	9/14/2010	Mytilus edulis	YES	
MESA	Site composite	9/28/2010	*Mya arenaria*	YES	
MEPH	Site composite	10/05/2010	Mytilus edulis	YES	

Table A.1 (continued)					
		Date	**Organism**	2009	Comments
Sample ID	**Sample Type**	**Sampled**	**Collected**	Sampling status	
MEPR	Site composite	10/05/2010	Mytilus edulis	YES	
MEKN	Site composite	10/04/2010	Mytilus edulis	YES	
MEBB	Site composite	10/10/2010	Mytilus edulis	YES	
MEUR	Site composite	9/30/2010	Mytilus edulis	YES	
MEUR-DUP	Analytical Duplicate	9/30/2010	Mytilus edulis	YES	
NBNR	NA	NA	Mytilus edulis	NO	Could not sample
NBSC	NA	NA	Mytilus edulis	NO	Could not sample
NBMI	NA	NA	Mytilus edulis	NO	Could not sample
NBTC	NA	NA	NA	NO	Too few mussels
NSAG	Site composite	10/19/2010	Mytilus edulis	YES	no mussels present
NSAG	Analytical Duplicate	10/19/2010	Mytilus edulis	YES	mussels now depleted
NSSC	NA	NA	NA	NO	Mussels now depleted
NSYR	Site composite	10/18/2010	Mytilus edulis	YES	
NSDI	Site composite	10/07/2010	Mytilus edulis	YES	
NSAR	Site composite	10/14/2010		YES	

Table A.2. Latitude and longitude for Gulfwatch 2010 stations, expressed in decimal degrees and in degrees, minutes, seconds

SITE	LOCATION	Site type	Lat	Long	Latitude	Longitude
Massachusetts			**decimal degrees**		**Degrees minutes seconds**	
MASN	Sandwich	Trend (**Benchmark**)	41.75000	70.4000	41° 45' 0"	70° 24' 0"
MAME	Merrimack River	Trend	42.80833	70.8233	42° 48' 29.987"	70° 49' 23.987"
MAIH	Boston Inner Harbor	Rotational-Occasional	42.359	71.049	42°21'32.4"	71° 2'56.4"
MAMH	Marblehead	Rotational-Occasional	42.49833	70.84833	42° 29' 53.988"	70° 50' 53.988"
New Hampshire						
MECC	Clark Cove	Trend (**Benchmark**)	43.07740	70.7244	43° 4' 38.6394"	70° 43' 27.84"
NHHS	Hampton/Seabrook Harbor	Trend (multi-yr)	42.89717	70.8163	42° 53' 49.812"	70° 48' 58.787"
NHRH	Rye Harbor	Rotational-Occasional	43.0	70.74	43° 0' 0"	70° 44' 23.9994"
NHLH	Little Harbor	Rotational-Occasional	43.0581	70.7154	43° 3' 29.16"	70.7154
NHNM	North Mill Pond	Rotational-Occasional	43.07500	70.7600	43° 4' 30"	70° 45' 36"
NHPI	Peirce Island	Rotational-Occasional	43.07167	70.74333	43° 4' 18.0114"	70° 44' 35.988"
NHDP	Dover Point	Trend (multi-yr)	43.11960	70.8267	43° 7' 10.5594"	70° 49' 36.12"
Maine						
MESA	Saco River	Rotational-Occasional	43.45983	70.3743	43° 27' 35.387"	70° 22' 27.588"
MEBH	Brave Boat Harbor	Rotational-Occasional	43.09333	70.65333	43° 5' 35.988"	70° 39' 11.99"
MEPH	Portland Harbor	Trend (multi-yr)	43.63917	70.2590	43° 38' 21.012"	70° 15' 32.4"
MEPR	Presumpscott River	Rotational-Occasional	43.69217	70.24733	43° 41' 31.811"	70° 14' 50.388"
MEKN	Kennebec River	Trend (**Benchmark**)	43.78500	69.7845	43° 47' 5.9994"	69° 47' 4.1994"
MEBB	Boothbay Harbor	Trend (multi-yr)	43.85067	69.6727	43° 51' 2.412"	69° 40' 21.72"
MEUR	Union River	Rotational-Occasional	44.5015	68.4322	44° 30' 5.4"	68° 25' 55.811"
New Brunswick						
NBNR	Niger River	Rotational-Occasional	45.06633	67.068	45° 3' 58.788"	67° 4' 4.7994"
NBSC	St. Croix River	Trend (multi-yr)	45.16750	67.1638	45° 10' 2.999"	67° 9' 49.679"
NBMI	Manawagonish	Rotational-Occasional	45.21667	66.1	45'13.0'	66'6.0'
NBTC	Tin Can Beach	Trend (multi-yr)	45.26250	66.0570	45° 15' 45"	66° 3' 25.2"
Nova Scotia						
NSAG	Argyle Sound	Trend (multi-yr)	43.69371	65.81644	43° 41' 56.3994"	65° 49' 5.4114"
NSYR	Yarmouth	Trend (multi-yr)	43.81767	66.1448	43° 49' 3.611"	66° 8' 41.387"
NSDI	Digby	Trend (**Benchmark**)	44.61700	65.7523	44° 37' 1.199"	65° 45' 8.28"
NSAR	Apple River	Trend (multi-yr)	45.47000	64.8350	45° 28' 11.999"	64° 50' 5.999"

Table A.3. 2010 Gulfwatch Program sample list

	Organics analysis	Metals analysis	Organics archive	Metals archive	SAMPLED?	NOTES
Massachusetts						
MAME	1	1	4	3	YES	
MASN	1	1	4	3	YES	
MAIH	1	1	4	3	YES	
MAMH	1	1	4	3	YES	
New Hampshire						
MECC	3	4	0	0	YES	
NHDP	3	4	0	0	YES	
NHHS	3	4	0	0	YES	
NHRH	1	1	4	3	YES	
NHPI	1	1	4	3	YES	
NHLH	1	1	4	0	YES	
Maine						
MEPH	1	1	3	3	YES	
MEKN	1	1	3	3	YES	
MEPR	1	1	3	3	YES	
MEBB	1	1	3	3	YES	
MESA	1	1	3	3	YES	
MEUR	1	1	3	3	YES	
New Brunswick						
NBTC	0	0	0	0	NO	
NBSC	0	0	0	0	NO	
NBNR	0	0	0	0	NO	
NBMI	0	0	0	0	NO	
Nova Scotia						
NSDI	1	1	3	3	YES	
NSYR	1	1	3	3	YES	
NSAR	1	1	3	3	YES	
NSAG	1	1	3	3	YES	
Totals	28	30	54	51		

Photo Documentation of Sampling Sites
(NH Stations)

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

Gulfwatch Station Information

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

NH Gulfwatch SOPs
Standard Operating Procedures for Gulfwatch
Revised: 9/25/2009
Mussel Field Collection SOP
1. Navigate to station
2. In the general location of the station, identify 3 replicate mussel bed sites within a 50 m section of shoreline (low intertidal zone).
3. Complete field data sheet including measuring the latitude and longitude of each replicate site with a GPS unit.
4. Measure water temperature and salinity with YSI-30 meter and record values on field data sheet
5. Select the plastic baskets which are labeled with the site name and replicate number (e.g., "NHDP-1" = station NHDP, replicate #1).
6. Collect at least 60 mussels from each replicate site (must be 50-60 mm in length). Use the ruler to measure the mussels. Place the mussels from each replicate site in the correct plastic basket. When a basket is full, it will contain ~60 mussels.
7. Count out exactly 60 mussels from the basket onto a clean surface (spread out a plastic garbage bag), verifying that each mussel is not full of mud by trying to separate the two shells.
8. Return any extra mussels to the intertidal zone at the site
9. Collect wash water in a large basin.
10. Use a brush and the wash water to clean the outside shell of the 60 mussels collected, placing each mussel back into the correct basket after it is cleaned. Do not pour all of the mussels into the cleaning basin. Dunk and clean each mussel separately.
11. Place the baskets of clean mussels upright in the cooler on ice.
12. Verify that field sheet is complete and that the baskets are correctly labeled.
13. Transport cooler to laboratory.

Mussel Measurement SOP

1. Bring the coolers into the laboratory.
2. Set up 3 measuring stations, each with a caliper, the lab data sheets for one station, the mussels from one station.
3. Assign two people to each measuring station.
4. Each team will place 40 mussels from each basket into a tray in rows of 10. The two rows on the left side of the tray will be for metals analysis. The two rows on the right side of the tray will be for organics analysis. Do this for each of the three replicates (The mussels from basket #1 go into tray #1, etc.). Then take 12 mussels from replicate #1, 14 mussels from replicate #2, and 14 mussels from replicate #3 and put them in the "COMP" tray. Randomize the mussels so that some mussels from each replicate are in the metals and organics rows. There should be ~5 left over mussels in the baskets. Leave the extra mussels in the baskets and return the baskets to the cooler.
5. Each team will measure the length, height and width of the mussels in the tray and record the information on the lab data sheet. Be sure to record the measurements of the mussels for metals and organics analysis on the correct sheets (there are separate sheets for metals and organics analysis). The mussels are in the same order in the tray as on the sheet. The top left mussel is number 1. The bottom left is 10. The top right is number 11. The bottom right is 20. The height and width (and later weight) measurements are done for mussels number 11 through 20. Record the length, height and width to the nearest tenth of a millimeter. Do not report values for cells that are filled in with gray.
6. Store trays of mussels in the walk-in refrigerator.

Mussel Shucking SOP - Organics

1. Set up 3 shucking stations for organics analysis. Each station will have two metal knives, a beaker of DI water, a tray of mussels and the corresponding jar (from the jars for organics analysis). One of the scales should be placed on a separate table so that the full jars can be weighed easily.
2. Assign two people to each shucking station and two other people to act as floaters and to help with weighing jars, sealing jars and storing jars.
3. Clean all of the metal knives in solvents. Put out 300 ml of methanol, toluene, and hexane in 500 ml beakers under the fume hood. Swish each metal knife in the 3 solutions (in order) three times. Clean the knives in this way before each new tray of mussels.
4. Open and scrape the meat from the mussels into the jar using the following procedure.
a. Swish the knife tip in DI water.
b. Select one of the mussels marked for organics analysis.
c. Turn the mussel upside down so that the byssus is facing up.
d. Tear off the byssus.
e. Insert the tip of knife between the shells where the byssus was formerly and twist the knife to open the shell slightly.
f. Shake the mussel over the waste bin for 10-20 seconds to remove water from the shell.
g. Run the knife blade around the mussel between the two shells to cut the adductor muscle and then separate the two shells.
h. Place the two shells on the table, meat side up.
i. Scrape the meat out of one of the shells into the jar.
j. Discard the empty shell into the waste bin.
k. Scrape the meat from the second shell into the jar.
l. Discard the empty shell.
m. Swish the knife in DI water to clean it.
n. If there are more mussels left on the tray for organics analysis, repeat steps b-m.
5. When all 20 mussels have been shucked, weigh the jar and record the value on the lab data sheet, cover the top with a piece of aluminum foil, screw on the lid, and place the jar in the freezer. Then, clean the knives in the solvents under the hood using the same procedure from Step 3. Get a new tray of mussels and repeat.

Mussel Shucking SOP - Metals

1. Set up 2 shucking stations for metals analysis. Each station will have a scale, a waste bucket, DI water, one acid-washed ceramic knife (or one metal knife) and three acid-washed plastic knives.
2. Assign four people to each station.
3. Clean all of the knives in nitric acid solution. Put out 300 ml of 4 N nitric acid in a 500 ml beaker under the fume hood. Swish each knife in the solution. Clean the knives in this way before each new tray of mussels.
4. Open and scrape the meat from the mussels #11 through #20 into the jar using the following procedure. Mussel #11 will be the mussel at the top of the right hand row for metals analysis. Mussel #20 will be the mussel at the bottom of the right hand row for metals analysis. Each person in the group does a different task. The person with the ceramic knife does steps c-i. Two people with plastic knives do steps j-m. The person with the scale and lab sheets does steps a and o.

a. Tare the scale, then place the correct jar on the scale.
b. Swish the knives in DI water.
c. Select mussel #11 marked for metals analysis.
d. Turn the mussel upside down so that the byssus is facing up.
e. Tear off the byssus.
f. Insert the tip of knife between the shells where the byssus was formerly and twist the knife to open the shell slightly.
g. Shake the mussel over the waste bin for 10-20 seconds to remove some water from the shell.
h. Run the knife blade around the mussel between the two shells to cut the adductor muscle and then separate the two shells. If using a metal knife for step f, use a plastic knife for this step.
i. Place the two shells on the table, meat side up.
j. Scrape the meat out of one of the shells into the jar.
k. Discard the empty shell into the waste bin.
l. Scrape the meat from the second shell into the jar.
m. Discard the empty shell.
n. Swish the knives in DI water to clean them.
o. Record the total weight of the jar and the mussel meat on the lab data sheet in the location for mussel #11.
p. Repeat steps for mussels #12 through #20. When complete, leave the jar on the scale and go to Step 5.

5. Open and scrape the meat from mussels #1 through #10 into the jar using the same procedure as for Step 4 except: (1) Weight does not need to be recorded after each mussel (step o), only at the end; (2) the person who recorded the weights should use a plastic knife to help with steps j-m.
6. When all 20 mussels from the tray have been shucked, weigh the jar (without the cap) and record the value on the lab data sheet, screw on the lid, and place the jar in the freezer. Then, clean the knives in the nitric acid solution under the hood using the same procedure from Step 3. Get a new tray of mussels and repeat.

APPENDIX B: 2010 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 2010, which included additional alkyl-substituted polycyclic aromatic hydrocarbon (PAH) analytes as well as three pyrethroid insecticides

Table B.1. Reported method detection limits for the organic target analytes.

PAHs		PCBs		Pesticides	
Analyte	**Detection Limit (ng/g)**	**Analyte (congener #)**	**Detection Limit (ng/g)**	**Analyte**	**Detection Limit (ng/g)**
Naphthalene	<10	8;5	<2.8	α–BHC	<2.0
C1-Naphthalenes	<8	18;15	<2.8	HCB	<2.4
Biphenyl	<10	29	<2.7	γ-HCH(Lindane)	<1.5
C2-Naphthalene (5-Pks)	<8	50	<2.2	Heptachlor	<2
Acenaphthylene	<11	28	<2.4	Aldrin	<1.5
Acenaphthene	<8	52	<2.3	Heptachlor Epoxide	<1.8
C-3 Naphthalene	<7	44	<2	γ-Chlordane	<1.5
Fluorene	<7	66;95	<2.3	o,p'-DDE	<1.0
C1- Fluorene	<7	101;90	<2.2	a-Endosulfan	<1.5
C2-Fluorene	<7	87	<2.2	cis-Chlordane	<1.2
C3- Fluorene	<7	77	<1.9	t-Nonachlor	<1.4
C4-Naphthalene	<7	118	<2.3	p,p'_DDE	<1.8
Dibenzothiophene	<10	153;132	<2	Dieldrin	<1.4
C4- Fluorene	<10	105	<2.1	o,p'-DDD	<4.0
C1-Dibenzothiophene	<10	138	<1.4	Endrin	<2.2
C2- Dibenzothiophene	<10	126	<2	b-Endosulfan	<3.4
C3-Dibenzothiophene	<10	187	<1.9	p,p'-DDD	<2
Phenanthrene	<6	128	<1.9	o,p'-DDT	<2.8
Anthracene	<10	180	<1.9	p,p'-DDT	<2.5
C1-Phenanthrene	<12	169	<1.7	Metoxychlor	<3.1
C2-Phenanthrene	<6	170;190	<1.7	Mirex	<1.5
Fluoranthene	<14	195;208	<1.8	Permethrin	<5
Pyrene	<9	206	<1.8	Cypermethrin	<5
C1-FP	<9	209	<1.7	Deltamethrin	<5
C3-Phenanthrene	<6				
C2-FP	<9				
C4-Phenanthrene	<6				
Benzo(a)Anthracene	<6				
Chrysene	<6				
C1-Chrysene	<6				
C2-Chrysene	<6				
C3-Chrysene	<6				
C4-Chrysene	<6				
Benzo(b)Fluoranthene	<6				
Benzo(k)Fluoranthene	<4				
Benzo(e)Pyrene	<7				
Benzo(a)Pyrene	<4				
Perylene	<5				
Indeno(1,2,3-cd)Pyrene	<7				
Dibenz(a,h)Anthracene	<11				
Benzo(ghi)Perylene	<15				

Table B.2. Reported laboratory method detection limits and reporting limits[1] for elemental target analytes.

Element	MDL[2] (µg/g)	RL[3] (µg/g)
Ag	**0.0021**	**0.01**
Al	**0.3**	**1**
Cd	**0.0034**	**0.01**
Cr	**0.02**	**0.1**
Cu	**0.1**	**0.3**
Fe	**0.3**	**1**
Hg	**0.0044**	**0.01**
Ni	**0.04**	**0.1**
Pb	**0.0035**	**0.01**
Zn	**0.03**	**0.1**

[1]Reporting limit = 3.18*MDL (Federal Register, 40 CFR Part 136, Appendix B)

[2]MDL = method detection limit, [3]RL = reporting limit

APPENDIX C: Summary of Trace Metal Analysis Quality Assurance/Quality Control for 2010

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 NIST standard 2976 (blue mussel tissue) was used to certify accuracy in the metals analysis. Overall SRM recoveries for the metals analyzed ranged from 95-127% (Table C.1.1). All sample recoveries met the targeted data quality objectives.

Table C.1.1 Analyses of standard reference materials for trace elements associated with analyses performed by Battelle, MSL Sequim, WA for the 2010 Gulfwatch Program.

	Hg	Ag	Cd	Pb	Al	Cr	Cu	Fe	Ni	Zn
	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
SRM										
CRM 2976 R1 032111	0.0687	0.00786	0.849	1.34	132	0.537	3.86	172	0.889	146
CRM 2976 R2 032111	0.0517	0.00788	0.829	1.28	136	0.598	3.95	178	0.751	156
certified or reference value	0.061	NA	0.82	1.19	134	0.5	4.02	171	0.93	137
range	±0.0036	NA	±0.2	±0.18			±0.33	±4.9	REF	±13
percent recovery, R1	**101%**	NA	**106%**	**112%**	**102%**	**95%**	NA	**102%**	**101%**	**119%**
percent recovery, R2	**100%**	NA	**107%**	**114%**	**103%**	**101%**	NA	**102%**	**99%**	**111%**
SRM										
CRM2976 042711	0.0772	0.011	0.817	1.21	140	0.528	4.03	174	0.881	147
certified or reference value	0.061	NA	0.82	1.19	134	0.5	4.02	171	0.93	137
range	±0.0036	NA	±0.2	±0.18	REF	REF	±0.33	±4.9	REF	±13
percent recovery, R1	**127%**	NA	**100%**	**102%**	**104%**	**106%**	**100%**	**102%**	**95%**	**107%**

C.1.2 Blank and Matrix Spikes

Blank and matrix spikes are another prescribed measurement of accuracy of the Gulfwatch Program. Blank spikes recoveries between 95% -105% are considered as meeting the data quality objectives of the Program. Matrix spikes ranged from 84%-124% and averaged 102 (± 6.7 %) over all the batches. Matrix spike results were within acceptable criteria with the (Table C.1.2.2) with the exception of iron (> 105%) for the NHHS matrix spike.

Table C.1.2.1 Blank spike results reported by Battelle Marine Sciences Laboratory for the Gulfwatch 2010 elemental analyses.

	Hg	Ag	Cd	Pb	Al	Cr	Cu	Fe	Ni	Zn
	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
Blank Spike Results										
LCS R1 032111	2.08	2.02	2.02	2.09	26.2	2.02	1.96	25.9	2.10	2.03
Blank R1 032111	0.0044	0.0021	0.0034	0.0035	0.3	0.02	0.1	0.3	0.0410	0.03
Spike conc.	*2.0*	*2.0*	*2.0*	*2.0*	*25*	*2.0*	*2.0*	*25*	*2.0*	*2.0*
PERCENT RECOVERY, LCS	**104%**	**101%**	**101%**	**104%**	**104%**	**100%**	**93%**	**103%**	**103%**	**100%**
LCS R2 032111	2.03	2.00	2.02	2.03	29.0	2.12	2.00	27.1	2.10	2.17
Blank R2 032111	0.00590	0.0021	0.0034	0.0035	2.47	0.0263	0.1	0.3	0.04	0.0472
Spike conc.	*2.0*	*2.0*	*2.0*	*2.0*	*25*	*2.0*	*2.0*	*25*	*2.0*	*2.0*
PERCENT RECOVERY, LCS	**101%**	**100%**	**101%**	**101%**	**106%**	**105%**	**95%**	**107%**	**103%**	**106%**
LCSR1 42711	1.91	1.9	2.06	2.06	25.9	2.05	2.03	26.1	2.1	2.05
Blank R1 42711	0.0044	0.00485	0.0034	0.0035	0.3	0.02	0.1	0.3	0.04	0.03
Spike conc.	*2.0*	*2.0*	*2.0*	*2.0*	*25*	*25.0*	*2.0*	*25*	*25.0*	*2.0*
PERCENT RECOVERY	**95%**	**103%**	**103%**	**102%**	**8%**	**97%**	**103%**	**103%**	**101%**	**95%**
LCS R2 42711	1.94	1.86	1.98	1.94	25.1	2.02	2.06	26	2.1	2.13
Blank R2 42711	0.0044	0.00363	0.0034	0.0035	0.3	0.02	0.1	0.3	0.0479	0.03
Spike conc.	*2*	*2*	*2*	*2*	*25*	*25*	*2*	*2*	*25*	*2.0*
PERCENT RECOVERY	**93%**	**99%**	**97%**	**99%**	**8%**	**98%**	**103%**	**103%**	**105%**	**93%**

Table C.1.2.2. Matrix spike results reported by Battelle Marine Sciences Laboratory for the Gulfwatch 2010 elemental analyses.

	Hg	**Ag**	**Cd**	**Pb**	**Al**	**Cr**	**Cu**	**Fe**	**Ni**	**Zn**
	(µg/g)	**(µg/g)**	**(µg/g)**	**(µg/g)**	**(µg/g)**	**(µg/g)**	**(µg/g)**	**(µg/g)**	**(µg/g)**	**(µg/g)**
NSDI COMP										
Measured Conc.	2.16	1.98	11.7	13.2	798	12.1	16.9	1202	11.5	314
Background Conc.	0.112	0.0335	1.36	2.87	556	1.88	6.32	725	1.36	91.7
Spike concentration	1.99	1.99	10.1	10.1	222	10.1	10.1	222	10.1	222
% Recovery	**103%**	**98%**	**102%**	**102%**	**109%**	**101%**	**104%**	**--**	**100%**	**100%**
MECC COMP										
Measured Conc.	2.32	1.92	12.4	13.6	541	12.5	17.8	767	11.7	359
Background Conc.	0.268	0.0372	2.20	3.04	302	2.06	7.08	580	1.63	123
Spike concentration	*2.02*	*2.02*	*10.0*	*10.0*	*222*	*10.0*	*10.0*	*222*	*10.0*	*222*
% Recovery	**102%**	**93%**	**102%**	**106%**	**108%**	**104%**	**107%**	**84%**	**101%**	**106%**
MAME COMP										
Measured Conc.	2.13	1.83	27.5	27	418	26.2	32.5	530	25.3	308
Background Conc.	0.163	0.041	1.92	2.6	172	1.58	7.56	325	1.12	106
Spike concentration	*2.01*	*2.01*	*24.8*	*24.8*	*198*	*24.8*	*24.8*	*198*	*24.8*	*198*
% Recovery	**98%**	**89%**	**103%**	**98%**	**124%**	**99%**	**101%**	**104%**	**98%**	**102%**

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. RPD is the absolute value (ABS) of the difference between the two replicates, divided by the mean value and multiplied by 100. Results of duplicate comparisons from 3 samples are listed in Tables C.2.1. The RPD between laboratory duplicates ranged from 0.2%-48%, with a mean of 8 (±0.1)%. The RPDs of all duplicates were all within acceptable limits, with the exception of aluminum and iron for NHHS .

Table C.2.1. Duplicate metals analysis for Gulfwatch 2010 samples performed by Battelle Marine Sciences Laboratory (MSL)

	Hg	Ag	Cd	Pb	Al	Cr	Cu	Fe	Ni	Zn
	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
NSAG	0.174	0.0432	1.28	4.20	256	1.55	6.18	542	1.40	80.4
NSAG-dup	0.165	0.0411	1.30	4.28	269	1.51	6.04	543	1.49	78.9
MEAN	0.170	0.0422	1.29	4.24	262	1.53	6.11	542	1.44	79.6
RPD[1]	**5%**	**5%**	**2%**	**2%**	**5%**	**3%**	**2%**	**0.2%**	**6%**	**2%**
NHHS	0.131	0.0461	2.38	2.22	305	1.26	6.75	439	1.13	112
NHHS-dup	0.124	0.0428	2.21	2.15	188	1.06	6.26	279	0.878	102
MEAN	0.127	0.0445	2.30	2.19	246	1.16	6.51	359	1.00	107
RPD	**5%**	**7%**	**7%**	**3%**	**48%**	**18%**	**8%**	**45%**	**25%**	**9%**
MASN	0.112	0.1	0.937	1.81	5.76	0.746	217	0.783	239	109
MASN Comp Dup	0.106	0.097	0.946	1.79	5.68	0.743	218	0.808	246	107
MEAN	0.109	0.0985	0.942	1.8	5.72	0.745	218	0.796	243	108
RPD	**6%**	**3%**	**1%**	**1%**	**1%**	**0.4%**	**0.5%**	**3%**	**3%**	**2%**

[1]RPD = relative percent difference = [ABS(rep1-rep2)]/mean *100

C.3 BLANKS

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

Table C.3.1. Laboratory blanks reported by Battelle Marine Sciences Laboratory (MSL) for Gulfwatch 2010 metals analysis.

	Hg	Ag	Cd	Pb	Al	Cr	Cu	Fe	Ni	Zn
	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
Procedural Blanks										
Blank R1 032111	0.0044	0.0021	0.0034	0.0035	0.3	0.02	0.1	0.3	0.0410	0.03
Blank R2 032111	0.00590	0.0021	0.0034	0.0035	2.47	0.0263	0.1	0.3	0.04	0.0472
Blank R1 42711	0.0044	0.00485	0.0034	0.0035	0.3	0.02	0.1	0.3	0.04	0.03
Blank R2 42711	0.0044	0.00363	0.0034	0.0035	0.3	0.02	0.1	0.3	0.0479	0.03

C.4 COMPLETENESS

100% of samples collected (25 of 25 samples) were analyzed successfully. 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 with a few exceptions.

C.5 Battelle QA/QC Narrative for 2010 Samples

PROJECT: Gulf of Maine Fall 2010
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: Nineteen tissue samples were received at MSL on 03/17/11 and an additional six tissue samples were received at MSL on 03/18/11. All samples were received in good condition (i.e., containers were intact and cooler temperature was acceptable). Select 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. 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 (3211). All project information was entered into Battelle's laboratory information and sample tracking system.

Chemistry Lab IDs:	**3211*1-25**
Description	*Tissue*
Collection dates	2010
Laboratory arrival date	03/17/11, 03/18/11
Cooler temperatures, on arrival	2.0, 4.1, and 2.0°C
Digestion (aqua regia)	03/21/11
CVAA analysis (Hg)	03/24/11
ICP-OES analysis (Al, Cr, Cu, Fe, Ni, and Zn)	03/25/11
ICP-MS analysis (Ag, Cd, and Pb)	03/23/11

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%	0.0021	0.01
Aluminum	ICP-OES	75-125%	≤25%	≤25%	0.3	1
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.0034	0.01
Chromium	ICP-OES	75-125%	≤25%	≤25%	0.02	0.1
Copper	ICP-OES	75-125%	≤25%	≤25%	0.1	0.3
Iron	ICP-OES	75-125%	≤25%	≤25%	0.3	1
Mercury	CVAA	75-125%	≤25%	≤25%	0.0044	0.01
Nickel	ICP-OES	75-125%	≤25%	≤25%	0.04	0.1
Lead	ICP-MS	75-125%	≤25%	≤25%	0.0035	0.01
Zinc	ICP-OES	75-125%	≤25%	≤25%	0.03	0.1

(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 ten metals including silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), 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, with the exception of one replicate of Al (2.47). Field sample concentrations for Al were more than 10 times the detected blank concentration. The result was flagged; no additional action taken.

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

MATRIX SPIKE ACCURACY: One tissue sample was selected for a matrix spike in each batch of 20 field samples. The matrix spike recoveries were within the QC acceptance criterion of 75-125% recovery for all metals with the exception of one Fe matrix spike, which was spiked inappropriately for the field sample concentration and flagged SL. Demonstration of acceptable accuracy for Fe can be found in both the SRM recoveries and LCS recoveries.

REPLICATE PRECISION: One set of laboratory duplicates was analyzed for every 20 field samples. Precision was expressed as the relative percent difference (RPD) between replicate results. The RPD values were within the QC criterion of ≤25% for all metals with the exception of one replicate of Al and once replicate of Fe. Both results were flagged.

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 only. Acceptable accuracy for non-certified elements was evaluated using high purity standards from two separate lots.

SRM 2976 Mussel Tissue was digested and analyzed with this set of samples. The SRM 2976 is certified at appropriate levels for Hg, Cd, Pb, Cu, Fe, and Zn and reference values are provided for Al, Cr, and Ni. The percent recoveries were within the QC acceptance criterion of 75-125% recovery for all certified metals.

PROJECT: Gulf of Maine Fall 2010, New Hampshire Samples

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:
Four tissue samples were received at MSL on 4/21/11. All samples were received in good condition (i.e., containers were intact and cooler temperature was acceptable). The samples were assigned a Battelle Central File (CF) identification number (3215). All project information was entered into Battelle's laboratory information and sample tracking system.

SAMPLE CUSTODY AND PROCESSING:
Thirty-four tissue samples were received at MSL on 01/07/09. All samples were received in good condition (i.e., containers were intact and cooler temperature was acceptable). Select 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 (2986). All project information was entered into Battelle's laboratory information and sample tracking system.

Chemistry Lab IDs:	3215*1-4
Description	Tissue
Collection dates	2010
Laboratory arrival date	4/21/2011
Cooler temperatures, on arrival	2.3°C
Digestion (aqua regia)	4/27/2011
CVAA analysis (Hg)	5/6/2011
ICP-OES analysis (Al, Cr, Cu, Fe, Ni, and Zn)	5/2/2011
ICP-MS analysis (Ag, Cd, and Pb)	5/7/2011

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)
Silver	ICP-MS	75-125%	≤0.25%	≤0.25%	0.021	0.01
Aluminum	ICP-OES	75-125%	≤0.25%	≤0.25%	0.3	1
Cadmium	ICP-MS	75-125%	≤0.25%	≤0.25%	0.0034	0.01
Chromium	ICP-OES	75-125%	≤0.25%	≤0.25%	0.02	0.1
Copper	ICP-OES	75-125%	≤0.25%	≤0.25%	0.1	0.3
Iron	ICP-OES	75-125%	≤0.25%	≤0.25%	0.3	1
Mercury	CVAA	75-125%	≤0.25%	≤0.25%	0.0044	0.01
Nickel	ICP-OES	75-125%	≤0.25%	≤0.25%	0.04	0.1
Lead	ICP-MS	75-125%	≤0.25%	≤0.25%	0.035	0.01
Zinc	ICP-OES	75-125%	≤0.25%	≤0.25%	0.03	0.1
(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 ten metals including silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), 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 SPIKE ACCURACY: One blank spike/laboratory control sample (LCS) was analyzed with every 20 field samples. The LCS recoveries were within the QC acceptance criterion of 75-125% recovery for all metals.

MATRIX SPIKE ACCURACY: One tissue sample was selected for a matrix spike in each batch of 20 field samples. The matrix spike recoveries were within the QC acceptance criterion of 75-125% recovery for all metals.

REPLICATE PRECISION: One set of laboratory duplicates was analyzed for every 20 field samples. Precision was expressed as the relative percent 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 only. Acceptable accuracy for non-certified elements was evaluated using high purity standards from two separate lots.

SRM 2976 Mussel Tissue was digested and analyzed with this set of samples. The SRM 2976 is certified at appropriate levels for Hg, Cd, Pb, Cu, Fe, and Zn and reference values are provided for Al, Cr, and Ni. The percent recoveries were within the QC acceptance criterion of 75-125% recovery for all certified metals with the exception of Hg (127%). The result was flagged and the data set reviewed for potential contamination. No evidence of laboratory contamination was identified as all other forms of quality control passed. No additional corrective action was taken.

APPENDIX D: Summary of 2010 Organic Contaminant Analysis Quality 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.

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. Recoveries for PAHs ranged from 55% - 202% with an overall mean recovery of 93 ± 16.9%. Those values that fell outside the range are highlighted in Table 1.2.1 and are due to matrix interference in the instrumental analysis. Recoveries for PCBs ranged from 52%-118% with a mean recovery over all congeners of 77 ± 11.1%. For chlorinated pesticides, there were interferences that led to recoveries of certain analytes that were outside of the limits established by the Gulfwatch project (indicated in color). Recoveries ranged from 35%-202%, with a mean recovery of 81 ± 21%.

TABLE D.1.2.1. Percent recoveries of PAHs from matrix spikes for the 2010 Gulfwatch Monitoring Program.

Spiked Mussel Tissue			ALKYL		ALKYL		ALKYL
(2.0g dry weight)		SP120222	SP120222	SP120508	SP120508	SP120514	SP120514
PAH	Conc.	Recoveries (%)					
	(ng.g)						
Naphthalene	25.00	73%	54%	37%	61%	62%	61%
C1-Naphthalenes	50.00	74%	62%	50%	57%	71%	60%
Biphenyl	25.00	82%	76%	89%	89%	91%	71%
C2-Naphthalene (5-Pks)	25.00	61%	86%	80%	95%	75%	86%
Acenaphthylene	25.00	70%	64%	82%	76%	83%	72%
Acenaphthene	25.00	72%	65%	87%	79%	89%	78%
C-3 Naphthalene	25.00	85%	82%	90%	90%	88%	83%
Fluorene	25.00	75%	77%	98%	93%	79%	85%
C1- Fluorene	125.00	-	79%	-	101%	-	98%
C2-Fluorene	62.50	-	98%	-	101%	-	96%
C3- Fluorene	31.25	-	93%	-	93%	-	91%
C4-Naphthalene	62.50	-	97%	-	103%	-	95%
Dibenzothiophene	93.75	-	88%	-	91%	-	85%
C4- Fluorene	31.25	-	86%	-	82%	-	87%

TABLE D.1.2.1. (cont'd)							
	Conc		ALKYL		ALKYL		ALKYL
	(ng/g)	SP120222	SP120222	SP120508	SP120508	SP120514	SP120514
C1-Dibenzothiophene	81.25	-	91%	-	92%	-	88%
C2- Dibenzothiophene	62.50	-	95%	-	107%	-	105%
C3-Dibenzothiophene	62.50	-	93%	-	100%	-	96%
Phenanthrene	25.00	78%	82%	109%	87%	104%	82%
Anthracene	25.00	86%	84%	86%	85%	99%	89%
C1-Phenanthrene	25.00	75%	82%	89%	93%	96%	87%
C2-Phenanthrene	62.50	-	99%	-	92%	-	86%
Fluoranthene	25.00	79%	81%	95%	89%	92%	96%
Pyrene	25.00	73%	77%	101%	90%	101%	90%
C1-FP	93.75	-	91%	-	92%	-	96%
C3-Phenanthrene	62.50	-	95%	-	95%	-	100%
C2-FP	31.25	-	93%	-	95%	-	95%
C4-Phenanthrene	31.25	-	94%	-	96%	-	96%
Benzo(a)Anthracene	25.00	76%	76%	100%	95%	100%	91%
Chrysene	25.00	85%	85%	101%	96%	105%	92%
C1-Chrysene	187.50	-	88%	-	94%	-	92%
C2-Chrysene	31.25	-	95%	-	95%	-	92%
C3-Chrysene	31.25	-	92%	-	110%	-	95%
C4-Chrysene	31.25	-	85%	-	105%	-	108%
Benzo(b)Fluoranthene	25.00	85%	81%	108%	96%	102%	90%
Benzo(k)Fluoranthene	25.00	89%	85%	101%	95%	105%	93%
Benzo(e)Pyrene	25.00	96%	-	101%	-	103%	0%
Benzo(a)Pyrene	25.00	92%	87%	102%	98%	100%	86%
Perylene	25.00	70%	-	107%	-	70%	0%
Indeno(1,2,3-cd)Pyrene	25.00	104%	104%	101%	81%	106%	105%
Dibenz(a,h)Anthracene	25.00	97%	99%	110%	96%	113%	100%
Benzo(ghi)Perylene	25.00	84%	84%	101%	84%	107%	93%
Surrogate Recovery							
Napthalene-d8	24.00	69%	70%	62%	69%	67%	68%
Acenaphthene-d10	24.00	83%	82%	83%	85%	81%	79%
Phenanthrene-d10	24.00	81%	87%	91%	88%	91%	87%
Fluoranthene-d10	24.00	90%	93%	101%	100%	93%	94%
Chrysene-d12	24.00	92%	95%	101%	96%	94%	94%
Benzo(a)pyrene-d12	24.00	94%	98%	100%	110%	99%	97%
Benzo(g,h,i)perylene-d12	24.00	102%	108%	100%	94%	102%	100%

indicates interference

TABLE D.1.2.2. Percent recoveries of PCBs from matrix spikes for the 2010 Gulfwatch Monitoring Program.

Spiked Mussel Tissue				
(2.0g dry weight)		**SP120222**	**SP120508a**	**SP120514**
PCB	**Concentration**	**Recovery (%)**		
	(ng/g)			
#8,5	8.80	62%	72%	64%
#18,15	8.80	75%	91%	93%
#29	8.80	73%	79%	75%
#50	8.80	79%	83%	77%
#28	8.80	67%	79%	67%
#52	8.70	85%	100%	87%
#44	8.70	84%	89%	87%
#66,95	8.80	76%	78%	70%
#101,90	8.70	97%	73%	82%
#87	8.70	89%	83%	87%
#77	8.75	84%	81%	76%
#118	8.70	101%	97%	95%
#153,132	8.70	107%	94%	93%
#105	8.75	78%	80%	82%
#138	8.75	113%	99%	100%
#126	8.80	94%	88%	88%
#187	8.75	82%	93%	93%
#128	8.70	69%	91%	89%
#180	8.75	83%	89%	88%
#169	8.80	88%	95%	95%
#170,190	8.80	99%	92%	91%
#195,208	8.80	88%	92%	90%
#206	8.80	81%	86%	88%
#209	8.75	92%	89%	89%
Surrogate Recovery				
103	10.05	83%	71%	68%
198	9.95	81%	78%	76%

TABLE D.1.2.3. Percent recoveries of pesticides from matrix spikes for the 2010 Gulfwatch Monitoring Program.

Spiked Mussel Tissue				
(2.0g dry weight)				
Pesticide	**Conc.**	**SP081118**	**SP081203**	**SP081209**
	(ng/g)	**%**	**%**	**%**
a_BHC	5.05	120%	100%	106%
HCB	5.00	76%	71%	77%
g-HCH(Lindane)	4.99	104%	96%	105%
Heptachlor	5.05	45%	54%	54%
Aldrin	5.05	73%	77%	77%
HeptachlorEpoxide	4.98	75%	55%	72%
g-Chlordane	5.00	90%	69%	107%
o,p'-DDE	4.97	86%	62%	69%
a-Endosulfan	5.05	92%	120%	116%
cis-Chlordane	5.10	104%	101%	114%
t-Nonachlor	5.00	108%	59%	87%
p,p'_DDE	5.00	117%	98%	105%
Dieldrin	4.99	82%	94%	94%
o,p'-DDD	5.00	85%	67%	103%
Endrin	5.05	96%	62%	67%
b-Endosulfan	5.00	82%	51%	59%
p,p'-DDD	5.00	48%	53%	81%
o,p'-DDT	5.00	98%	103%	99%
p,p'-DDT	5.00	96%	81%	85%
Metoxychlor	4.98	393%	249%	1093%
Mirex	5.05	90%	66%	68%
Permethrin*	10.00	116%	101%	105%
Cypermethrin*	10.00	84%	80%	73%
Deltamethrin*	12.00	85%	98%	69%
Surrogate Recovery				
g-Chlordene	9.92	76%	57%	76%
b-BHC	10	111%	82%	58%
g-Chlordene**		83%	88%	79%
b-BHC**		98%	54%	56%
Interference found on both signals				
***analyzed separately. **surrogates added to pyrethroid samples.**				

D.1.3 Surrogate Recoveries

Recoveries of added surrogate compounds are presented in Tables D.1.3.1 – D.1.3.2. Surrogate compounds are added to each sample at a known level, and provide an internal quality control check to the structurally similar (or identical) target analytes. Recoveries outside of QA/QC criteria are highlighted in yellow.

Table D.1.3.1 Percent recoveries of spiked surrogates[1] added to 2010 Gulfwatch samples as part of the PAH analysis.

Samples	NAP-d_8	ACE-d_{10}	PHEN-d_{10}	FLU-d_{10}	CHRY-d_{12}	BAP-d_{12}	BGHIP-d_{12}
MAME-comp	60%	80%	89%	97%	101%	107%	97%
MASN-comp	64%	82%	94%	100%	91%	100%	96%
MAIH-comp	64%	88%	94%	95%	100%	106%	100%
MAMH-comp	63%	84%	97%	102%	96%	99%	99%
MECC-1N	64%	79%	87%	92%	97%	98%	90%
MECC-2N	59%	76%	85%	86%	93%	94%	88%
MECC-3N	54%	74%	88%	96%	98%	96%	89%
MECC-3N	58%	76%	87%	95%	98%	98%	89%
MECC-comp	73%	74%	84%	89%	91%	91%	88%
NHDP-1N	62%	77%	90%	95%	99%	100%	92%
NHDP-2N	56%	79%	95%	95%	94%	93%	99%
NHDP-3N	62%	78%	90%	96%	99%	98%	93%
NHDP-comp	76%	87%	87%	94%	96%	96%	96%
NHHS-1N	58%	77%	90%	99%	99%	99%	93%
NHHS-2N	65%	79%	97%	98%	95%	97%	99%
NHHS-3N	67%	74%	88%	97%	96%	91%	97%
NHHS-comp	73%	79%	85%	91%	94%	92%	94%
NHRH-comp	78%	87%	86%	92%	96%	93%	96%
NHPI-comp	74%	76%	87%	93%	93%	94%	94%
NHLH-comp	68%	72%	84%	89%	91%	91%	93%
MEPH-comp	55%	67%	75%	80%	83%	83%	82%
MEKN-comp	71%	78%	87%	96%	97%	94%	95%
MEPR-comp	70%	79%	86%	91%	94%	96%	92%
MEBB-comp	62%	74%	85%	91%	96%	96%	91%
MESA-comp	64%	76%	84%	92%	97%	99%	94%
MEUR-comp	56%	76%	85%	93%	96%	100%	91%
MEUR-comp	66%	76%	83%	90%	92%	95%	89%
NSAR-comp	65%	71%	86%	96%	95%	103%	93%
NSAG-comp	60%	69%	76%	82%	81%	85%	83%
NSDI-comp	60%	71%	79%	83%	80%	79%	81%

[1]Deuterated surrogate abbreviations: NAP = naphthalene, ACE = acenaphthene, FLU = fluorine, CHRY = chrysene and BGJHIP = benzo[g,h,i]perylene.

TABLE D.1.3.2. Percent recoveries of spiked surrogates added to 2010 Gulfwatch samples as part of the analyses for PCBs and chlorinated pesticides

GOM Stations	PCBs		Pesticides	
	103	198	γ-Chlordene	β-BHC
MAME-comp	93%	82%	92%	85%
MASN-comp	98%	77%	86%	83%
MAIH-comp	156%	83%	95%	82%
MAMH-comp	78%	76%	87%	87%
MECC-1N	72%	84%	84%	87%
MECC-2N	68%	79%	84%	71%
MECC-3N	78%	88%	88%	59%
MECC-3N	87%	81%	86%	88%
MECC-comp	69%	71%	85%	92%
NHDP-1N	81%	84%	89%	91%
NHDP-2N	92%	84%	90%	88%
NHDP-3N	78%	82%	87%	83%
NHDP-comp	85%	79%	87%	94%
NHHS-1N	72%	81%	79%	73%
NHHS-2N	72%	84%	82%	84%
NHHS-3N	73%	77%	84%	78%
NHHS-comp	70%	74%	76%	84%
NHRH-comp	80%	75%	88%	93%
NHPI-comp	72%	75%	89%	96%
NHLH-comp	78%	74%	84%	111%
MEPH-comp	72%	69%	74%	66%
MEKN-comp	71%	88%	69%	72%
MEPR-comp	70%	72%	76%	68%
MEBB-comp	75%	72%	72%	64%
MESA-comp	73%	72%	71%	59%
MEUR-comp	86%	83%	85%	70%
MEUR-comp	78%	75%	73%	81%
NSAR-comp	70%	79%	76%	65%
NSAG-comp	72%	77%	61%	66%
NSDI-comp	69%	70%	68%	79%
NSYR-comp	71%	73%	81%	81%

[1]INT = interference

Accuracy Summary for Surrogate spikes:

PAH: In general, surrogates recoveries means all met the data quality objectives of the program (52-202%) with the exception of 5 samples which had low recoveries of benzo(g,h,i)perylene-d_{12} (indicated in color in Table D.1.3.1), although adequate recoveries of the other surrogates.

PCB: Recovery of surrogate spikes ranged from 59-97% for all surrogate spikes with an average recovery of 82 $\pm$ 8.8% (Table D.1.3.2).

Chlorinated Pesticides: Recovery of surrogates ranged from 50 - 100% with an average recovery (+ standard deviation) of 74 $\pm$ 9.9 % (Table D.1.2.3).

D.1.4 Precision

The relative percent differences (RPD) of duplicate samples for organic analytes are presented in Tables D.2.1 – D.2.3. As mentioned above, the RPD of laboratory duplicates should be less than 25% for all analytes. RPD is the absolute value (ABS) of the difference between the two replicates, divided by the average value and multiplied by 100. The RPD between laboratory duplicates ranged from near 0-61%, with a mean of 15 ($\pm$19)%. RPDs that fell outside of the criteria are highlighted in yellow.

PAHs: The two duplicate analyses of station replicates met the data quality objectives (relative percent difference $\leq$ 25%) of the Program (Table D.2.2). 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 (for individual congeners) ranged from 22.4 -35.4%. While the data quality objectives were met, the many non-detects (the second duplicate had all non-detects) hampered the effectiveness of this measure. 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 individual analytes from duplicate analyses ranged from 7.6% -62% (data not shown). The summed quantities met the data quality objectives for both duplicates.

D.2 BLANKS

Blank analyses should ideally recover no detectable amounts of target compounds. For 2010 no discernible analytical signal was observed for PAHs, PCBs, and PEST.

D.3 COMPLETENESS

100% of the samples collected in (22 of 22 sampling sites; 33 individual replicates) were collected, analyzed and are reported here.

Table D.1.4.1 Duplicate PAH analysis for Gulfwatch 2010 samples.

PAH analytes	MECC 3N (ng/g)	MECC 3N DU (ng/g)	MEUR (ng/g)	MEUR DU (ng/g)
Naphthalene	<10	<10	<10	<10
C1-Naphthalenes	10.1	10.4	<8	<8
Biphenyl	<10	<10	<10	<10
C2-Naphthalene	<8	<8	<8	<8
Acenaphthylene	<11	<11	<11	<11
Acenaphthene	<8	<8	<8	<8
C-3 Naphthalene	<7	<7	<7	<7
Fluorene	<7	<7	<7	<7
C1- Fluorene	<7	<7	<7	<7
C2-Fluorene	<7	<7	<7	<7
C3- Fluorene	<7	<7	<7	<7
C4-Naphthalene	<7	<7	<7	<7
Dibenzothiophene	<10	<10	<10	<10
C4- Fluorene	<10	<10	<10	<10
C1-Dibenzothiophene	<10	<10	<10	<10
C2- Dibenzothiophene	<10	<10	<10	<10
C3-Dibenzothiophene	<10	<10	<10	<10
Phenanthrene	6.13	<6	<6	<6
Anthracene	<10	<10	<10	<10
C1-Phenanthrene	<12	<12	<12	<12
C2-Phenanthrene	<6	<6	<6	<6
Fluoranthene	22.2	15.8	<14	<14
Pyrene	21.1	16.1	10.5	9.2
C1-FP	<9	<9	<9	<9
C3-Phenanthrene	<6	<6	<6	<6
C2-FP	<9	<9	<9	<9
C4-Phenanthrene	<6	<6	<6	<6
Benzo(a)Anthracene	6.95	<6	<6	<6
Chrysene	11.93	8.37	<6	<6
C1-Chrysene	<6	<6	<6	<6
C2-Chrysene	<6	<6	<6	<6
C3-Chrysene	<6	<6	<6	<6
C4-Chrysene	<6	<6	<6	<6
Benzo(b)Fluoranthene	12.5	9.65	<6	<6
Benzo(k)Fluoranthene	10.8	7.82	<4	<4
Benzo(e)Pyrene	12.8	9.82	<7	<7
Benzo(a)Pyrene	7.28	4.24	<4	<4
Perylene	5.70	5.15	<5	<5

Table D.1.4.1 (cont'd)				
Indeno(1,2,3-cd)Pyrene	8.06	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
ΣPAH40	**136**	**87**	**10.5**	**9.2**
Average	**111**		**9.8**	
% RPD[1]	**43.4**		**13.8**	

Table D.1.4.2 Duplicate PCB analysis for Gulfwatch 2010 samples

Congeners	MASN (ng/g)	MASN DU (ng/g)	NSDI (ng/g)	NSDI DU (ng/g)
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	4.33	3.67	<2.1	<2.1
105	<1.4	<1.4	<1.4	<1.4
138	4.08	3.43	<2	<2
126	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9
128	<2	<2	<2	<2
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
ΣPCB24	**8.41**	**7.10**	**0.00**	**0.00**
Average	**7.75**		**0.00**	
% RPD[1]	**8.47**		**NA**	

[1]RPD = the relative % difference = absolute value of [(rep1-rep2) / average(rep1:rep2)]*100

Table D.1.4.3 Duplicate chlorinated pesticide analysis for Gulfwatch 2010 samples.

	MASN	MASN DU	NHHS-1N	NHHS-1N DU
Pesticides	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
α-BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
γ-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8
γ-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	1.31	1.40	<1.2	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	2.79	2.59	<1.8	<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
β-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
Permethrin	<5	<5	<5	<5
Cypermethrin	<5	<5	<5	<5
Deltamethrin	<5	<5	<5	<5
Σ Pest 24	**4.10**	**3.99**	**0.00**	**0.00**
Average	**4.04**		**0.00**	
% RPD[1]	**2.72**		**NA**	

[1]RPD = the relative % difference = absolute value of [(rep1-rep2) / average(rep1:rep2)]*100

APPENDIX E: 2010 Trace Metal (and % water) Data for Gulfwatch Mussel Samples

TABLES E. Metals concentration (μg/g dry wt.) and % water content observed in blue mussel tissue collected by Gulfwatch, 2010. Tables E.2 and E.3 contain individual site replicates (3 stations). Replicates are compared with the composite samples also taken at the same time.

Table E.1 Metals concentrations for site composite samples, Gulfwatch 2010.

GOM Stations	Moisture %	Ag (ng/g)	Cd (ng/g)	Cr (ng/g)	Cu (ng/g)	Fe (ng/g)	Ni (ng/g)	Pb (ng/g)	Zn (ng/g)	Al (ng/g)	Hg (ng/g)
MAME	85.7	0.0410	1.92	1.58	7.56	325	1.12	2.6	106	172	0.163
MAIH	82.0	0.0343	1.61	1.48	9.75	460	0.98	11.2	198	273	0.159
MAMH	81.8	0.0199	0.96	4.39	9.44	303	0.73	9.9	128	197	0.197
MASN	81.0	0.1000	0.94	0.78	5.76	239	0.75	1.8	109	217	0.112
MECC	85.6	0.0372	2.20	2.06	7.08	580	1.63	3.04	123	302	0.268
NHDP	88.0	0.0427	2.62	2.23	7.13	329	1.35	1.85	101	228	0.278
NHHS	86.6	0.0461	2.38	1.26	6.75	439	1.13	2.22	112	305	0.131
NHLH	85.6	0.0517	2.22	1.79	6.54	373	1.24	3.07	117	220	0.305
NHPI	87.7	0.0350	2.23	2.13	6.94	513	1.33	3.18	112	319	0.364
NHRH	86.7	0.0297	2.03	1.59	10.8	372	2.07	2.68	140	170	0.336
MEBB	86.9	0.0220	1.82	1.55	9.69	423	0.947	16.2	168	225	0.308
MEKN	86.2	0.0543	2.30	1.24	7.10	310	0.880	1.26	64.7	134	0.167
MEPH	86.3	0.0347	1.79	1.89	9.83	641	1.34	6.22	168	427	0.242
MEPR	87.2	0.0511	1.77	1.75	8.50	616	1.53	4.12	87.7	364	0.254
MESA	85.3	0.0604	2.80	1.53	6.88	392	1.67	2.11	133	244	0.140
MEUR	86.1	0.0349	1.16	0.969	4.18	391	0.912	1.03	48.9	149	0.079
NSAR	84.0	0.0490	2.68	2.14	6.18	952	1.97	1.36	86.6	899	0.187
NSAG	85.8	0.0432	1.28	1.55	6.18	542	1.40	4.20	80.4	256	0.174
NSDI	83.2	0.0335	1.36	1.88	6.32	725	1.36	2.87	91.7	556	0.112
NSYR	85.0	0.2590	1.36	1.83	7.21	668	1.41	2.47	93.0	307	0.205

Table E.2. Tissue concentrations of metals in mussels collected in 2010 from Dover Pt., NH (NHDP).

	MECC	MECC	MECC	MECC
Metals	**1N**	**2N**	**3N**	**COMP**
	(μg/g)	**(μg/g)**	**(μg/g)**	**(μg/g)**
Ag	0.0317	0.0364	0.0283	0.0427
Cd	2.38	2.35	2.22	2.62
Cr	1.86	2.19	1.79	2.23
Cu	6.67	6.85	6.37	7.13
Fe	292	588	214	329
Ni	1.30	1.37	1.05	1.35
Pb	1.39	1.71	1.30	1.85
Zn	115	113	98.5	101
Al	189	296	114	228
Hg	0.262	0.272	0.257	0.278
% Moisture	88.6	87.9	88.3	88.0

Table E.3. Tissue concentrations of metals in mussels collected in 2010 from Hampton/Seabrook Harbor, NH (NHHS).

	NHHS	NHHS	NHHS	NHHS
Metals	**1N**	**2N**	**3N**	**COMP**
	(μg/g)	**(μg/g)**	**(μg/g)**	**(μg/g)**
Ag	0.031	0.045	0.039	0.046
Cd	1.96	2.53	2.60	2.38
Cr	2.19	1.17	1.07	1.26
Cu	6.48	7.02	6.31	6.75
Fe	662	264	273	439
Ni	1.80	1.05	0.943	1.13
Pb	2.08	2.07	1.87	2.22
Zn	91.9	110	92.5	112
Al	497	192	196	305
Hg	0.129	0.138	0.112	0.131
% Moisture	84.8	85.5	86.4	86.6

Table E.4. Tissue concentrations of metals in mussels collected in 2010 from Clark's Cove (ME).

	MECC 1N (µg/g)	MECC 2N (µg/g)	MECC 3N (µg/g)	MECC COMP (µg/g)
Ag	0.066	0.039	0.041	0.037
Cd	2.34	1.89	1.98	2.20
Cr	2.30	1.88	1.64	2.06
Cu	8.20	7.20	7.26	7.08
Fe	568	475	415	580
Ni	1.37	1.24	1.21	1.63
Pb	3.94	2.80	2.14	3.04
Zn	119	126	102	123
Al	309	264	249	302
Hg	0.316	0.289	0.225	0.268
% Moisture	87.2	85.6	86.7	85.6

APPENDIX F: Organic Contaminants (and % Lipids Content) Data for 2010 Gulfwatch Mussel Samples

Table F.1. Tissue concentrations of PAHs in composite samples collected from sites in Massachusetts in 2010.

PAH Abbrev	MAME (ng/g)	MASN (ng/g)	MAIH (ng/g)	MAMH (ng/g)
NAP	<10	<10	<10	14.44
C1-NAP	9.17	<8	10.58	12.33
C2-NAP	<8	<8	10.23	<8
C3-NAP	<7	<7	<7	<7
C4-NAP	<7	<7	<7	<7
BIP	<10	<10	11.66	<10
ACE	<11	<11	<11	<11
ACEY	<8	<8	11.45	<8
FLU	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7
C3-FLU	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10
DBT	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10
PHEN	6.93	<6	44.33	12.41
ANTH	<10	<10	13.0	<10
C1-PHEN	<12	<12	63.99	27.64
C2-PHEN	<6	<6	<6	<6
C3-PHEN	<6	<6	<6	<6
C4-PHEN	<6	<6	<6	<6
FLUO	39.91	<14	355.7	67.83
PYR	37.39	<9	346.1	68.99
C1-FP	21.11	<9	<9	<9
C2-FP	<9	<9	<9	<9
BAA	13.06	<6	82.24	13.42
CHRY	24.80	<6	202.5	32.73
C1-CHRY	14.06	<6	114.67	16.73
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	22.98	<6	154.8	28.31
BKF	17.49	<4	99.2	21.13
BEP	27.20	<7	200.8	35.13

Table F.1 (cont'd)				
PAH	**MAME**	**MASN**	**MAIH**	**MAMH**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
BAP	9.00	<4	44.87	9.65
PER	11.87	<5	15.90	<5
IND	8.49	<7	30.50	11.95
DBAHA	<11	<11	<11	<11
BGHIP	<15	<15	49.67	15.80
Surrogate Recovery				
NAPH-d8	60%	64%	64%	63%
ACE-d10	80%	82%	88%	84%
PHEN-d10	89%	94%	94%	97%
FLUO-d10	97%	100%	95%	102%
CHRY-d12	101%	91%	100%	96%
BAP-d12	107%	100%	106%	99%
BGHIP-d12	97%	96%	100%	99%
% Lipids	5.80%	7.83%	6.50%	6.43%

NAP = naphthalene, BIP = biphenyl, ACE = acenaphthene ACEY = acenaphthylene, FLU = fluorene, DBT = dibenzothiophene, PHEN = phenanthrene, ANTH = anthracene, FLUO = fluoranthene, PYR = pyrene, FP = fluoranthenes/pyrenes, BAA = benzo[a]anthracene, CHRY = chrysene, BBF = benzo[b] fluoranthene, BKF = benzo[k]fluoranthene, BEP = benzo[e]pyrene, BAP = Benzo[a]pyrene, PER = perylene, IND = indeno(1,2,3,c,d)pyrene, DBAHA = Dibenz[a,h]anthracene, BGHIP = Benzo[g,h,i]perylene.

Table F.2. Tissue concentrations of PAHs in composite samples collected from sites in New Hampshire in 2010.

PAH	**NHDP**	**NHHS**	**NHRH**	**NHPI**	**NHLH**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	<10	<10	<10	<10	<10
C1-NAPH	<8	10.83	10.21	11.09	<8
C2-NAPH	<8	<8	<8	<8	<8
C3-NAPH	<7	<7	<7	<7	<7
C4-NAPH	<7	<7	<7	<7	<7
BIP	<10	<10	<10	<10	<10
ACE	<11	<11	<11	<11	<11
ACEY	<8	<8	<8	<8	<8
FLU	<7	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7	<7
C3-FLU	<7	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10	<10
DBT	<10	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10	<10

Table F.2 (cont'd)					
PAH	**NHDP**	**NHHS**	**NHRH**	**NHPI**	**NHLH**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
PHEN	<6	<6	<6	8.46	<6
ANTH	<10	<10	<10	<10	<10
C1-PHEN	<12	<12	<12	13.14	<12
C2-PHEN	10.79	<6	10.87	19.07	7.98
C3-PHEN	<6	<6	<6	<6	<6
C4-PHEN	<6	<6	<6	<6	<6
FLUO	30.65	<14	<14	35.23	15.67
PYR	36.00	10.42	9.76	35.71	13.22
C1-FP	19.58	<9	<9	19.02	<9
C2-FP	<9	<9	<9	<9	<9
BAA	11.54	6.57	<6	12.66	<6
CHRY	18.26	<6	6.74	21.85	8.56
C1-CHRY	17.74	<6	<6	17.69	7.31
C2-CHRY	<6	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6	<6
BBF	20.15	<6	<6	21.41	7.59
BKF	17.77	<4	4.75	17.21	7.26
BEP	21.73	<7	<7	23.96	8.68
BAP	7.98	<4	<4	8.63	4.66
PER	11.54	<5	5.62	9.33	<5
IND	10.65	<7	<7	10.48	<7
DBAHA	<11	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15	<15
Surrogate Recovery					
NAPH-d8	76%	73%	78%	74%	68%
ACE-d10	87%	79%	87%	76%	72%
PHEN-d10	87%	85%	86%	87%	84%
FLUO-d10	94%	91%	92%	93%	89%
CHRY-d12	96%	94%	96%	93%	91%
BAP-d12	96%	92%	93%	94%	91%
BGHIP-d12	96%	94%	96%	94%	93%
% Lipids	4.13%	5.87%	4.81%	4.14%	3.80%

PAH abbreviations are listed in Table F.1.

Table F.3. Tissue concentrations of PAHs in composite samples collected from sites in Maine in 2010.

PAH	MECC	MEPH	MEKN	MEPR	MEBB	MESA	MEUR	MEUR DUP
Abbrev	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
NAPH	12.64	<10	<10	<10	<10	<10	<10	<10
C1-NAPH	12.24	<8	<8	<8	11.83	<8	<8	<8
C2-NAPH	<8	<8	<8	<8	<8	<8	<8	<8
C3-NAPH	<7	<7	<7	<7	<7	<7	<7	<7
C4-NAPH	<7	<7	<7	<7	<7	<7	<7	<7
BIP	<10	<10	<10	<10	<10	<10	<10	<10
ACE	<11	<11	<11	<11	<11	<11	<11	<11
ACEY	<8	<8	<8	<8	<8	<8	<8	<8
FLU	<7	<7	<7	<7	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7	<7	<7	<7	<7
C3-FLU	<7	<7	<7	<7	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10	<10	<10	<10	<10
DBT	<10	<10	<10	<10	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10	<10	<10	<10	<10
PHEN	<6	23.08	<6	15.20	33.00	<6	<6	<6
ANTH	<10	<10	<10	<10	10.22	<10	<10	<10
C1-PHEN	<12	29.24	<12	17.95	50.28	<12	<12	<12
C2-PHEN	11.49	34.78	<6	23.65	65.38	<6	<6	<6
C3-PHEN	<6	<6	<6	<6	<6	<6	<6	<6
C4-PHEN	<6	<6	<6	<6	<6	<6	<6	<6
FLUO	22.49	124.91	<14	60.36	193.18	<14	<14	<14
PYR	22.22	111.25	14.71	49.28	197.52	<9	10.51	9.2
C1-FP	11.67	<9	<9	<9	98.12	<9	<9	<9
C2-FP	<9	<9	<9	<9	<9	<9	<9	<9
BAA	8.46	31.08	<6	13.49	57.46	<6	<6	<6
CHRY	14.07	63.31	6.02	23.08	95.39	<6	<6	<6
C1-CHRY	11.76	37.89	<6	16.80	67.56	<6	<6	<6
C2-CHRY	<6	<6	<6	<6	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6	<6	<6	<6	<6
BBF	13.59	56.21	<6	15.85	101.26	<6	<6	<6
BKF	11.85	45.89	4.10	15.54	77.25	5.31	<4	<4
BEP	15.26	61.36	<7	17.47	116.18	<7	<7	<7
BAP	7.03	18.10	<4	8.41	44.05	<4	<4	<4
PER	9.25	12.29	9.38	16.34	14.64	<5	<5	<5

Table F.3 (cont'd)								
PAH	**MECC**	**MEPH**	**MEKN**	**MEPR**	**MEBB**	**MESA**	**MEUR**	**MEUR DUP**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
IND	8.06	20.02	<7	7.96	38.37	<7	<7	<7
DBAHA	<11	<11	<11	<11	<11	<11	<11	<11
BGHIP	<15	23.37	<15	<15	43.83	<15	<15	<15
Surrogate recovery								
NAPH-d8	73%	55%	71%	70%	62%	64%	56%	66%
ACE-d10	74%	67%	78%	79%	74%	76%	76%	76%
PHEN-d10	84%	75%	87%	86%	85%	84%	85%	83%
FLUO-d10	89%	80%	96%	91%	91%	92%	93%	90%
CHRY-d12	91%	83%	97%	94%	96%	97%	96%	92%
BAP-d12	91%	83%	94%	96%	96%	99%	100%	95%
BGHIP-d12	88%	82%	95%	92%	91%	94%	91%	89%
% Lipids	4.38%	4.37%	6.54%	6.62%	3.69%	6.57%	5.63%	4.27%

PAH abbreviations are listed in Table F.1.

Table F.4. Tissue concentrations of PAHs in composite samples collected from sites in Nova Scotia in 2010.

PAH	**NSAR**	**NSAG**	**NSDI**	**NSYR**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	<10	<10	<10	<10
C1-NAPH	<8	<8	<8	<8
C2-NAPH	<8	<8	<8	<8
C3-NAPH	<7	<7	<7	<7
C4-NAPH	<7	<7	<7	<7
BIP	<10	<10	<10	<10
ACE	<11	<11	<11	<11
ACEY	<8	<8	<8	<8
FLU	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7
C3-FLU	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10
DBT	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10
PHEN	<6	<6	7.21	8.89
ANTH	<10	<10	<10	<10
C1-PHEN	<12	<12	<12	19.11
C2-PHEN	<6	<6	<6	31.66
C3-PHEN	<6	<6	<6	<6
C4-PHEN	<6	<6	<6	<6

Table F.4 (cont'd)				
PAH	**NSAR**	**NSAG**	**NSDI**	**NSYR**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
FLUO	<14	<14	14.49	23.01
PYR	<9	<9	9.88	11.34
C1-FP	<9	<9	<9	<9
C2-FP	<9	<9	<9	<9
BAA	<6	<6	<6	<6
CHRY	<6	<6	<6	<6
C1-CHRY	<6	<6	<6	<6
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	<6	<6	<6	<6
BKF	<4	<4	<4	<4
BEP	<7	<7	<7	<7
BAP	<4	<4	<4	<4
PER	<5	30.52	<5	5.70
IND	<7	<7	<7	<7
DBAHA	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15
Surrogate Recovery				
NAPH-d8	65%	60%	60%	55%
ACE-d10	71%	69%	71%	71%
PHEN-d10	86%	76%	79%	84%
FLUO-d10	96%	82%	83%	91%
CHRY-d12	95%	81%	80%	91%
BAP-d12	103%	85%	79%	92%
BGHIP-d12	93%	83%	81%	93%
% Lipids	5.76%	6.01%	7.96%	3.77%

PAH abbreviations are listed in Table F.1.

Table F.5. Tissue concentrations of PAHs in mussels collected from Dover Point, NH (NHDP) in 2010.

	NHDP	NHDP	NHDP	NHDP
PAH	**1N**	**2N**	**3N**	**Comp**
Abbrev.	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	10.17	<10	<10	<10
C1-NAPH	11.05	9.15	9.08	<8
C2-NAPH	<8	<8	<8	<8
C3-NAPH	<7	<7	<7	<7
C4-NAPH	<7	<7	<7	<7
BIP	<10	<10	<10	<10
ACE	<11	<11	<11	<11
ACEY	<8	<8	<8	<8
FLU	<7	<7	<7	<7
C1-FLU	9.88	<7	<7	<7
C2-FLU	<7	<7	<7	<7
C3-FLU	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10
DBT	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10
PHEN	<6	<6	<6	<6
ANTH	<10	<10	<10	<10
C1-PHEN	<12	<12	<12	<12
C2-PHEN	<6	<6	<6	10.79
C3-PHEN	<6	<6	<6	<6
C4-PHEN	<6	<6	<6	<6
FLUO	26.29	31.12	28.92	30.65
PYR	32.90	39.63	35.21	36.00
C1-FP	<9	<9	<9	19.58
C2-FP	<9	<9	<9	<9
BAA	10.57	11.42	10.90	11.54
CHRY	14.80	17.29	17.23	18.26
C1-CHRY	8.37	9.99	7.69	17.74
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	18.17	18.97	17.89	20.15
BKF	14.92	14.90	14.67	17.77
BEP	19.28	20.66	19.75	21.73
BAP	6.82	6.86	7.00	7.98
PER	9.77	10.20	9.48	11.54
IND	7.56	8.25	7.91	10.65
DBAHA	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15

Table F.5 (cont'd)				
PAH Abbrev.	NHDP 1N (ng/g)	NHDP 2N (ng/g)	NHDP 3N (ng/g)	NHDP Comp (ng/g)
Surrogate Recovery				
NAPH-d8	62%	56%	62%	76%
ACE-d10	77%	79%	78%	87%
PHEN-d10	90%	95%	90%	87%
FLUO-d10	95%	95%	96%	94%
CHRY-d12	99%	94%	99%	96%
BAP-d12	100%	93%	98%	96%
BGHIP-d12	92%	99%	93%	96%
% Lipids	4.27%	4.72%	4.41%	4.13%

PAH abbreviations are listed in Table F.1.

Table F.6. Tissue concentrations of PAHs in mussels collected from Hampton/Seabrook Harbor, NH (NHHS) in 2010.

PAH Abbrev.	NHHS 1N (ng/g)	NHHS 2N (ng/g)	NHHS 3N (ng/g)	NHHS Comp (ng/g)
NAPH	<10	11.43	<10	<10
C1-NAPH	12.12	15.10	8.74	10.83
C2-NAPH	<8	<8	<8	<8
C3-NAPH	<7	<7	<7	<7
C4-NAPH	<7	<7	<7	<7
BIP	<10	<10	<10	<10
ACE	<11	<11	<11	<11
ACEY	<8	<8	<8	<8
FLU	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7
C3-FLU	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10
DBT	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10
PHEN	<6	<6	<6	<6
ANTH	<10	<10	<10	<10
C1-PHEN	<12	<12	<12	<12
C2-PHEN	<6	<6	<6	<6
C3-PHEN	<6	<6	<6	<6
C4-PHEN	<6	<6	<6	<6
FLUO	<14	<14	<14	<14
PYR	<9	<9	<9	10.42
C1-FP	<9	<9	<9	<9

Table F.6. (cont'd)				
	NHHS	**NHHS**	**NHHS**	**NHHS**
PAH	**1N**	**2N**	**3N**	**Comp**
Abbrev.	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
C2-FP	<9	<9	<9	<9
BAA	<6	<6	<6	6.57
CHRY	<6	<6	<6	<6
C1-CHRY	<6	<6	<6	<6
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	<6	<6	<6	<6
BKF	<4	<4	<4	<4
BEP	<7	<7	<7	<7
BAP	<4	<4	<4	<4
PER	<5	<5	<5	<5
IND	<7	<7	<7	<7
DBAHA	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15
Surrogate Recovery				
NAPH-d8	58%	65%	67%	73%
ACE-d10	77%	79%	74%	79%
PHEN-d10	90%	97%	88%	85%
FLUO-d10	99%	98%	97%	91%
CHRY-d12	99%	95%	96%	94%
BAP-d12	99%	97%	91%	92%
BGHIP-d12	93%	99%	97%	94%
% Lipids	**5.43%**	**4.90%**	**6.11%**	**5.87%**

PAH abbreviations are listed in Table F.1.

Table F.7. Tissue concentrations of PAHs in mussels collected from Clark's Cover, ME (MECC) in 2010.

	MECC	**MECC**	**MECC**	**MECC**	**MECC**
PAH	**1N**	**2N**	**3N**	**3NDup**	**Comp**
Abbrev.	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	11.35	<10	<10	<10	12.64
C1-NAPH	12.37	8.35	10.11	10.35	12.24
C2-NAPH	<8	<8	<8	<8	<8
C3-NAPH	<7	<7	<7	<7	<7
C4-NAPH	<7	<7	<7	<7	<7
BIP	<10	<10	<10	<10	<10
ACE	<11	<11	<11	<11	<11
ACEY	<8	<8	<8	<8	<8
FLU	<7	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7	<7

Table F7 (cont'd)					
	MECC	MECC	MECC	MECC	MECC
PAH	1N	2N	3N	3NDup	Comp
Abbrev.	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
C3-FLU	<7	<7	<7	<7	<7
C4-FLU	<7	<7	<7	<7	<7
DBT	<10	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10	<10
PHEN	<10	<10	<10	<10	<10
ANTH	<6	6.56	6.13	<6	<6
C1-PHEN	<10	<10	<10	<10	<10
C2-PHEN	<12	<12	<12	<12	<12
C3-PHEN	<6	<6	<6	<6	11.49
C4-PHEN	<6	<6	<6	<6	<6
FLUO	<6	<6	<6	<6	<6
PYR	19.10	24.67	22.21	15.81	22.49
C1-FP	20.53	24.82	21.12	16.06	22.22
C2-FP	<9	<9	<9	<9	11.67
BAA	<9	<9	<9	<9	<9
CHRY	7.41	8.03	6.95	<6	8.46
C1-CHRY	10.50	13.08	11.93	8.37	14.07
C2-CHRY	<6	<6	<6	<6	11.76
C3-CHRY	<6	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6	<6
BBF	<6	<6	<6	<6	<6
BKF	13.90	13.90	12.51	9.65	13.59
BEP	11.10	11.35	10.82	7.82	11.85
BAP	13.59	15.52	12.76	9.82	15.26
PER	5.74	6.80	7.28	4.24	7.03
IND	7.91	7.78	5.70	5.15	9.25
DBAHA	7.22	8.00	8.06	<7	8.06
BGHIP	<11	<11	<11	<11	<11
Surrogate Recovery					
NAPH-d8	<15	<15	<15	<15	<15
ACE-d10	64%	59%	54%	58%	73%
PHEN-d10	79%	76%	74%	76%	74%
FLUO-d10	87%	85%	88%	87%	84%
CHRY-d12	92%	86%	96%	95%	89%
BAP-d12	97%	93%	98%	98%	91%
BGHIP-d12	98%	94%	96%	98%	91%
% Lipids	90%	88%	89%	89%	88%

Table F.8. Tissue concentrations of PCBs in composite samples collected from sites in Massachusetts in 2010.

Congener	MAME	MASN	MAIH	MAMH
	(ng/g)	(ng/g)	(ng/g)	ng/g)
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	3.00	<2.3
52	3.99	<2	17.20	2.22
44	2.63	<2.3	8.66	<2.3
66;95	7.08	<2.2	58.6	5.59
101;90	7.47	3.47	100.2	11.38
87	2.10	<1.9	17.23	2.01
77	<2.3	<2.3	5.81	<2.3
118	7.66	4.13	74.9	11.50
153;132	11.88	8.77	137.8	17.63
105	2.74	<1.4	14.35	3.67
138	11.26	6.45	124.3	18.43
126	<1.9	<1.9	5.15	<1.9
187	4.92	2.76	44.2	5.27
128	<2	<2	9.76	3.54
180	<1.7	<1.7	13.19	1.81
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	2.56	<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
Surrogate Recovery				
103	93%	98%	156%	78%
198	82%	77%	83%	76%

[1]INT = interference (with the instrumental analysis)

Table F.9. Tissue concentrations of PCBs in composite samples collected from sites in New Hampshire in 2010.

Congener	NHDP	NHHS	NHRH	NHPI	NHLH
	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
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	2.5	<2.2	<2.2	2.3	<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	<2	2.2	<2
153;132	5.5	2.5	3.2	5.1	3.2
105	<1.4	<1.4	<1.4	<1.4	<1.4
138	5.1	2.3	3.3	4.4	3.3
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	2.1	<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
Surrogate Recovery					
103	85%	70%	80%	72%	78%
198	79%	74%	75%	75%	74%

Table F.10. Tissue Concentrations of PCBs in composite samples collected from sites in Maine analyzed for Gulfwatch in 2010.

Congener	MECC	MEPH	MEKN	MEPR	MEBB	MESA	MEUR	MEUR DUP
	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
8;5	<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
29	<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
28	<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
44	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	3.57	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	5.72	<2.2	3.92	3.63	<2.2	<2.2	<2.2
87	<1.9	8.71	<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
118	<2	4.56	<2	2.04	3.37	<2	<2	<2
153;132	5.3	10.16	3.70	8.58	6.09	<2.1	<2.1	<2.1
105	<1.4	1.81	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
138	4.7	9.22	<2	<2	<2	2.21	<2	<2
126	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
187	2.1	5.27	<1.9	3.16	2.90	<1.9	<1.9	<1.9
128	<1.9	<2	<2	<2	<2	<2	<2	<2
180	<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
170;190	<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
206	<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
Surrogate Recovery								
103	69%	72%	71%	70%	75%	73%	86%	78%
198	71%	69%	88%	72%	72%	72%	83%	75%

Table F.11. Tissue concentrations of PCBs in composite samples collected from sites in Nova Scotia in 2010.

Congener	NSAR	NSAG	NSDI	NSYR
	(ng/g)	(ng/g)	(ng/g)	(ng/g)
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	<2	<2	<2	<2
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
Surrogate Recovery				
103	70%	72%	69%	71%
198	79%	77%	70%	73%

Table F.12. Tissue concentrations of PCBs in mussels collected from Dover Point, NH (NHDP) in 2010.

Congener Number	NHDP 1N (ng/g)	NHDP 2N (ng/g)	NHDP 3N (ng/g)	NHDP Comp (ng/g)
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	2.39	2.62	2.44	2.5
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	2.52	2.66	2.34	2.2
153;132	5.21	5.68	5.00	5.5
105	<1.4	<1.4	<1.4	<1.4
138	4.83	6.35	4.83	5.1
126	<1.9	<1.9	<1.9	<1.9
187	<1.9	2.04	<1.9	2.1
128	<2	<2	<2	<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
Surrogate Recovery				
103	81%	92%	78%	85%
198	84%	84%	82%	79%

Table F.13. Tissue concentrations of PCBs in mussels collected from Hampton/Seabrook Harbor, NH (NHHS) in 2010.

	NHHS	NHHS	NHHS	NHHS
Congener	1N	2N	3N	Comp
Number	(ng/g)	(ng/g)	(ng/g)	(ng/g)
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	2.20	2.15	2.58	2.5
105	<1.4	<1.4	<1.4	<1.4
138	2.02	2.03	<2	2.3
126	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9
128	<2	<2	<2	<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
103	<2.8	<2.8	<2.8	<2.8
198	<2.7	<2.7	<2.7	<2.7
Surrogate Recovery				
103	72%	72%	73%	70%
198	81%	84%	77%	74%

Table F.14. Tissue concentrations of PCBs in mussels collected from Clark's Cover, ME (MECC) in 2010.

	MECC	MECC	MECC	MECC	MECC
Congener	1N	2N	3N	3N DUP	Comp
Number	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
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	2.46	<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	2.30	<2	<2	<2
153;132	4.65	5.45	4.33	3.67	5.3
105	<1.4	<1.4	<1.4	<1.4	<1.4
138	4.32	5.29	4.08	3.43	4.7
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	<1.9	2.42	<1.9	<1.9	2.1
128	<2	<2	<2	<2	<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
Surrogate Recovery					
103	72%	68%	78%	87%	69%
198	84%	79%	88%	81%	71%

Table F.15. Tissue concentrations of pesticides in composite samples collected from sites in Massachusetts in 2010.

Pesticide	MAME	MASN	MAIH	MAMH
	(ng/g)	(ng/g)	(ng/g)	ng/g)
α–BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
γ-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8
γ-Chlordane	2.84	<1.5	4.40	4.32
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	2.31	2.55	7.09	6.92
τ-Nonachlor	<1.4	<1.4	5.68	3.89
p,p'_DDE	6.83	3.66	25.7	19.4
Dieldrin	<1.4	<1.4	2.99	1.42
o,p'-DDD	<4.0	<4.0	9.04	12.52
Endrin	<2.2	<2.2	<2.2	<2.2
β-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	4.19	<2	21.38	33.08
o,p'-DDT	<2.8	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	2.56	6.82	3.21
Metoxychlor	5.11	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5
Permethrin	<5	<5	<5	<5
Cypermethrin	<5	<5	<5	<5
Deltamethrin	<5	<5	<5	<5
Surrogate Recovery				
γ-Chlordene	92%	86%	95%	87%
β-BHC	85%	83%	82%	87%

Table F.16. Tissue concentrations of pesticides in composite samples collected from sites in New Hampshire in 2010.

Pesticide	NHDP	NHHS	NHRH	NHPI	NHLH
	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
α–BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
γ-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
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8	<1.8
γ-Chlordane	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	1.6	<1.2	2.0
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	3.7	2.7	3.2	3.1	2.4
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
β-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	2.2	<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	6.7	4.6	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5
Permethrin	<5	<5	<5	<5	<5
Cypermethrin	<5	<5	<5	<5	<5
Deltamethrin	<5	<5	<5	<5	<5
Surrogate Recovery					
γ-Chlordene	87%	76%	88%	89%	84%
β-BHC	94%	84%	93%	96%	111%

Table F.17. Tissue concentrations of pesticides in composite samples collected from Sites in Maine in 2010.

Pesticide	MECC	MEPH	MEKN	MEPR	MEBB	MESA	MEUR	MEUR DUP
	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
α–BHC	<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
γ-HCH(Lindane)	<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
Aldrin	<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
γ-Chlordane	<1.5	1.88	<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	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2	<1.2	2.77	<1.2	<1.2	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	2.8	5.32	2.15	5.47	3.18	<1.8	<1.8	<1.8
Dieldrin	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	4.17	<4.0	4.03	6.10	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
β-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	<2	5.75	<2	5.54	11.11	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<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
Metoxychlor	9.0	<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
Surrogate Recovery								
γ-Chlordene	85%	74%	69%	76%	72%	71%	85%	73%
β-BHC	92%	66%	72%	68%	64%	59%	70%	81%

F.18. Tissue concentrations of pesticides in composite samples collected from sites in Nova Scotia in 2010.

Pesticide	NSAR	NSAG	NSDI	NSYR
	(ng/g)	(ng/g)	(ng/g)	(ng/g)
α–BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
γ-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8
γ-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	1.86	2.00	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	<1.8	<1.8	<1.8	<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
β-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	5.62	7.68	3.18	3.56
Mirex	<1.5	<1.5	<1.5	<1.5
Surrogate Recovery				
γ-Chlordene	<5	<5	<5	<5
β-BHC	<5	<5	<5	<5

Table F.19. Tissue concentrations of pesticides in mussels collected from Dover Point, NH (NHDP) in 2010.

Pesticide	NHDP 1N (ng/g)	NHDP 2N (ng/g)	NHDP 3N (ng/g)	NHDP Comp (ng/g)
α–BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
γ-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8
γ-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.55	<1.2	1.39	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	3.58	3.77	3.43	3.7
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
β-Endosulfan	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	2.44	2.11	2.50	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	6.7
Mirex	<1.5	<1.5	<1.5	<1.5
Permethrin	<5	<5	<5	<5
Cypermethrin	<5	<5	<5	<5
Deltamethrin	<5	<5	<5	<5
Surrogate Recovery				
γ-Chlordene	89%	90%	87%	87%
β-BHC	91%	88%	83%	94%

Table F.20. Tissue concentrations of pesticides in mussels collected from Hampton/Seabrook Harbor, NH (NHHS) in 2010.

	NHHS	NHHS	NHHS	NHHS
Congener	**1N**	**2N**	**3N**	**Comp**
Number	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
α–BHC	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4
γ-HCH(Lindane)	<1.5	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8
γ-Chlordane	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.85	1.42	<1.2	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	2.59	2.46	3.15	2.7
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
β-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	4.08	4.6
Mirex	<1.5	<1.5	<1.5	<1.5
Surrogate Recovery				
γ-Chlordene	79%	82%	84%	76%
β-BHC	73%	84%	78%	84%

Table F.21. Tissue concentrations of pesticides in mussels collected from Clark's Cover, ME (MECC) in 2010.

Congener Number	MECC 1N (ng/g)	MECC 2N (ng/g)	MECC 3N (ng/g)	MECC 3N DUP (ng/g)	MECC Comp (ng/g)
α–BHC	<2.0	<2.0	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4	<2.4	<2.4
γ-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
Heptachlor Epoxide	<1.8	<1.8	<1.8	<1.8	<1.8
γ-Chlordane	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5	<1.5	<1.5
cis-Chlordane	1.41	1.36	1.31	1.40	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	2.82	3.02	2.79	2.59	2.8
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
β-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	2.14	2.33	<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	9.0
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5
Surrogate Recovery					
γ-Chlordene	84%	84%	88%	86%	85%
β-BHC	87%	71%	59%	88%	92%