Gulfwatch 2009 Data Report:

EIGHTEENTH 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 2009 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 (2001-2007). 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 (mussels and clams).

1.1 PROGRAMMATIC RATIONALE

The Gulf of Maine is the region of the North Atlantic Ocean that extends from Cape Sable, Nova Scotia, through New Brunswick, Maine, and New Hampshire to Cape Cod, Massachusetts; and includes the Bay of Fundy and Georges Bank. The Gulf of Maine ecosystem is one of the world's most productive ecosystems with an extensive and diverse array of plants and animals (Census of Marine Life - Gulf of Maine Area, 2008) that support important economic activities including commercial catch and aquaculture fisheries, recreational fishing, shipping, and tourism. The Gulf of Maine ecosystem includes large watersheds draining from western Nova Scotia, southwestern New Brunswick, 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:

- Concentrations of chemical contaminants in mussel tissues are the same at all sites in the Gulf of Maine;
- 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 2009 is year four 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 2009 SAMPLING STATIONS

The 2009 Gulf of Maine Gulfwatch mussel survey somewhat followed the above mentioned survey plan. Most of the sites planned for 2009 were sampled, however no mussels were found at Brewster Island, MA (MABI), Plymouth, MA (MAPY), Limekiln Bay, NB (NBLB) and Hospital Island, NB (NBHI). At the Sandwich, MA site enough mussels were available to perform organic analysis on one composite sample and three replicate samples for archival (organic analysis). At the Yarmouth, NS site, sampling in 2009 depleted the remaining mussels. However, 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 (NHDP), Clarks Cove, Me (MECC), Portland Harbor, ME (MEPH), the Kennebec River, ME (MEKN), Boothbay Harbor (MEBB), the St. Croix River, NB (NBSC), Tin Can Beach, NB (NBTC), Yarmouth, NS (NSYR), Digby, NS (NSDI) and the Apple River, NS (NSAR) as well as planned sampling sites at South Mill Pond, NH (NHSM), North Mill Pond, NH (NHNM), Fox Point, NH (NHFP), Brave Boat Harbor, ME (MEBH), Royal River, ME (MERY), Pickering Island, ME (MEPI), Penobscot River, ME (MEFP), Barrington Passage, NS (NSBP) and Broad Cove, NS (NSBC). A total of 23 sites were sampled during 2009 (Table 1); 22 sites for mussels and one site for softshell clams. Softshell clams (*Mya arenaria)* were sampled at the Fox Point, NH site (NHFP). Locations of all sampling sites are presented, by state and province, in Figure 1

Table 1. Gulfwatch stations visited during the 2009 sampling year.

Site Code	Site Name	Site type	Lat	Lon	Years sampled
Massachusetts					
MASN	Sandwich	Trend (**Benchmark**)	41.75000	70.4000	92-95, 2002-2004, 2007-2009
MAME	Merrimack River	trend (multi-year)	42.80833	70.8233	93, 2002, 2006-2009
New Hampshire					
NHHS	Hampton/Seabrook Harbor	Trend (multi-yr)	42.89717	70.8163	
NHSM	South Mill Pond	Rotational-Occasional	43.07270	70.74890	1999, 2001, 2003, 2006, 2009
NHNM	North Mill Pond	Rotational (6 yr)	43.07500	70.76000	2002, 2005, 2008, 2009
NHDP	Dover Point	Trend (multi-yr)	43.11960	70.8267	94, 96-98, 2002-2004, 2006-2009
NHFP	Fox Point	Rotational-Occasional	43.12015	70.8589	99, 2001, 2008, 2009
Maine					
MECC	Clarks Cove	Trend (**Benchmark**)	43.07740	70.7244	93-95, 2002-2004, 2006-2009
MEBH	Brave Boat Harbor	Rotational-Occasional	43.09333	70.65333	93, 96, 99, 02, 06, 09
MEPH	Portland Harbor	Trend (multi-yr)	43.63917	70.2590	94, 97, 2000, 2003, 2005, 2007-2009
MEKN	Kennebec River	Trend (**Benchmark**)	43.78500	69.7845	92-2004, 2006-2009
MERY	Royal River	Rotational-Occasional	43.79700	70.14550	1993, 1996, 1999, 2005, 2009
MEBB	Boothbay Harbor	Trend (multi-yr)	43.85067	69.6727	91, 98, 2004, 2006-2009
MEPI	Pickering Island	Rotational-Occasional	44.26050	68.73317	93, 96, 99, 2002, 2005. 2009
MEFP	Penobscot River	Rotational-Occasional	44.46950	68.81017	98, 2004, 2005, 2007, 2009
New Brunswick					
NBSC	St. Croix River	Trend (multi-yr)	45.16750	67.1638	93, 96, 99, 2002, 2003, 2006-2009
NBTC	Tin Can Beach	Trend (multi-yr)	45.26250	66.0570	98, 2004, 2005, 2007-2009
Nova Scotia					
NSYR	Yarmouth	Trend (multi-yr)	43.81767	66.1448	93, 96, 99, 2002, 2004, 2006-2009
NSDI	Digby	Trend (**Benchmark**)	44.61700	65.7523	92,93,94, 96-2005,2007-2009
NSAR	Apple River	Trend (multi-yr)	45.47000	64.8350	94, 97, 2000, 2003, 2006-2009
NSBP	Barrington Passage	Rotational	43.51917	-65.62267	1994, 2005, 2009
NSBC	Broad Cove	Rotational	44.66533	-65.83083	1993, 1996, 1999, 2005-2007, 2009

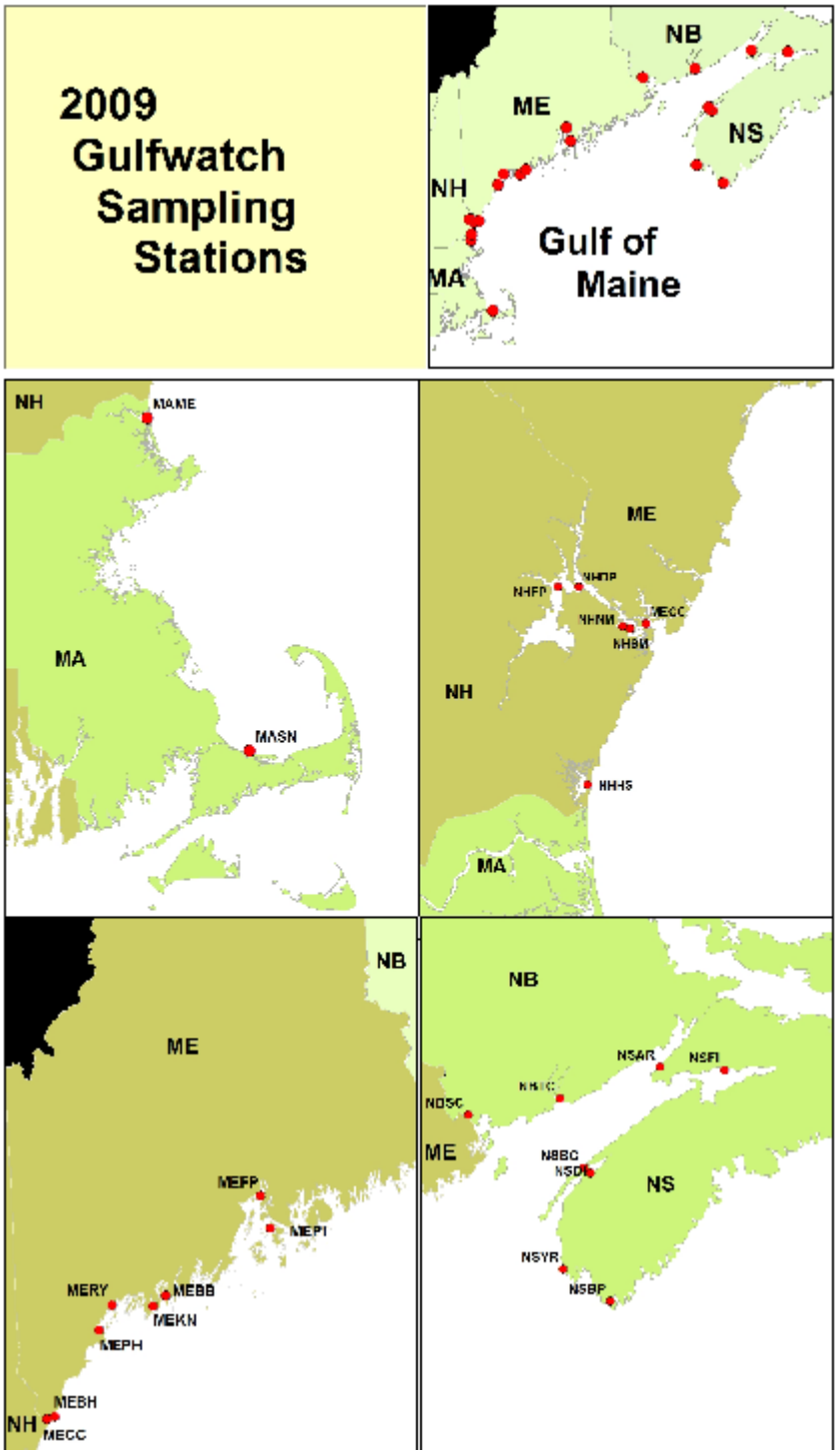

Figure 1. Locations of 2009 Gulfwatch sampling sites. Tables 1 and A.2 in the appendix provide latitudinal and longitudinal coordinates for more precise site location.

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 and late October (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 those mussels predestined for organic analysis were wrapped in pre-combusted aluminum foil prior to placing in field containers. Mussels were not depurated prior to processing.

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, species, and dates collected are summarized in Appendix A.

2.4 ANALYTICAL PROCEDURES

Analytical procedures were the same as those reported in previous years (Sowles et al., 1997). An overview of the analytical methods used for the 2009 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 2009 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, 0.003; Cd, 0.003; Cr, 0.04; Cu, 0.1; Fe, 0.2; Hg, 0.005; Ni, 0.04; Pb, 0.004; Zn, 0.02; 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 1-4 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 (NOAA, 1989). 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 ($\Sigma PEST_{21}$).

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 (HRGC/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, 2009.

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]	α–BHC	8;5[3,4]
C1-Naphthalenes[2]	Pyrene[1,2]	HCB	18;15[3,4]
C2-Naphthalene[2]	C1-FP	γ–HCH(Lindane)	29[3,4]
C-3 Naphthalene[2]	C2-FP	Heptachlor	50[3,4]
C4-Naphthalene	Benzo(a)Anthracene[1,2]	Aldrin	28[3,4]
Biphenyl[1,2]	Chrysene[1,2]	Heptachlor Epoxide	52[3,4]
Acenaphthylene[1,2]	C1-Chrysene	γ-Chlordane	44[3,4]
Acenaphthene[1,2]	C2-Chrysene	o,p'-DDE	66;95[4]
Fluorene[1,2]	C3-Chrysene	α-Endosulfan	101;90[3,4]
C1- Fluorene	C4-Chrysene	cis-Chlordane	87[3,4]
C2-Fluorene	Benzo(b)Fluoranthene[1,2]	trans-Nonachlor	77[3,4]
C3- Fluorene	Benzo(k)Fluoranthene[1,2]	p,p'_ DDE	118[3,4]
C4- Fluorene	Benzo(e)Pyrene[1]	Dieldrin	153;132[3,4]
Dibenzothiophene[1,2]	Benzo(a)Pyrene[1,2]	o,p'-DDD	105[3,4]
C1-Dibenzothiophene	Perylene[1,2]	Endrin	138[3,4]
C2- Dibenzothiophene	Indeno(1,2,3-cd)Pyrene[1,2]	β-Endosulfan	126[4]
C3-Dibenzothiophene	Dibenz(a,h)Anthracene[1,2]	p,p'-DDD	187[3,4]
Phenanthrene[1,2]	Benzo(ghi)Perylene[1,2]	o,p'-DDT	128[3,4]
Anthracene[1,2]		p,p'-DDT	180[3,4]
C1-Phenanthrene[2]		Metoxychlor	169[4]
C2-Phenanthrene		Mirex	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	
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 GCMS analysis for compound identification, [3]Q ions = quant ions are used for quantification 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 2009 Gulfwatch samples, and Appendix D contains the organic contaminant QC sample results and summary for the 2009 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 2007 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, and includes a few alkyl-substituted PAHs (such as methyl and ethyl-naphthalenes and methyl phenanthrenes) in addition to the unsubstituted (aromatic ring) 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. One important difference in the quantitation of PAHs in 2009 versus prior years, is that formerly, only two C1-naphthalene compounds (1-methylnaphthalene and 2 methylnaphthalene), one C2-naphthalene compound (2,6-dimethylnaphthalene) and one C3 naphthalene compound was quantified, whereas starting 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 2009 compared to data from 2006 and before.

Other summed parameters include ΣDDT_6, the sum of DDT and metabolites, $\Sigma PEST_{21}$, the sum of all the chlorinated pesticide analytes, 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. Gulfwatch mean data for the stations sampled in 2009 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 2009 FIELD OPERATIONS AND LOGISTICS SUMMARY

Mussel samples were collected at 23 sites in 2009. Twelve 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, Saint Croix River (NBSC) and Tin Can Beach (NBTC) in New Brunswick, and Digby (NSDI), Apple River (NSAR) and Yarmouth (NSYR) in Nova Scotia. The remaining eight mussel sites were for spatial analysis, usually sampled on a regular (3 yr) or more occasional basis (Table 1).

One 20-organism composite of softshell clams (*Mya arenaria)* was collected at Fox Point (NHFP) in New Hampshire.

All 2009 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 2009 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 2009. 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 more than half (128 out of 240 values) of the summarized Gulfwatch metals concentrations were higher than the NS&T median. Thirty seven values were above the NS&T 85th percentile, with the majority being either mercury (20) or lead (10), 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, and Pb (indicated in bold, Table 4). No sites had values higher than the NS&T median or 85th percentile for Cu, Ni and Zn. The range of concentrations over all sites are also presented in Table 5, and show concentrations of certain elements, such as Al, Cu, Fe, Ni and Pb can vary by a factor of 10 across sites sampled in 2009. Elevated concentrations of iron and aluminum, known to be crustally-derived (Burdige, 2006) can result from the ingestion of sediment, especially in the vicinity of the Bay of Fundy where there is a high degree of sediment resuspension. 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 2009 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 the NOAA S&T 85th percentile values.

Station Abbreviation / Station Code		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)
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		0.071	**2.60**	**1.29**	7.34	284	1.09	**3.55**	100	96.4	**0.148**
MECC	**mean**	0.050	**2.16**	**2.01**	8.03	**512**	1.48	**3.28**	124	358	**0.303**
	stdev	0.008	0.12	0.16	1.05	87.3	0.32	0.77	21.4	73.2	0.026
MECC_-Comp		0.061	**2.48**	**2.19**	8.00	**530**	1.48	**3.31**	114	**389**	**0.326**
NHDP	mean	0.039	**2.64**	**1.92**	7.40	322	1.43	**1.65**	120	**197**	**0.302**
	stdev	0.002	0.36	0.10	0.08	6.4	0.11	0.27	23	29	0.024
NHDP-Comp		0.034	**2.51**	**1.86**	7.28	303	0.997	**1.81**	101	**197**	**0.305**
NHHS	mean	0.035	**2.18**	**1.13**	7.02	320	0.970	**2.03**	103	**249**	**0.148**
	stdev	0.008	0.23	0.07	0.02	61	0.070	0.83	6	68	0.004
NHHS-Comp		0.051	**2.50**	**1.09**	9.84	280	1.05	**2.28**	125	195	**0.159**
NHSM-Comp		0.046	2.01	**2.05**	7.96	**570**	1.63	**11.8**	120	**370**	**0.380**
NHNM-Comp		0.045	**3.28**	**2.14**	7.34	**571**	1.32	**4.29**	136	421	**0.316**
MEPH-Comp		0.026	1.30	**1.26**	8.08	**420**	0.923	**4.68**	136	386	**0.181**
MEKN-Comp		0.045	**3.26**	**1.46**	6.72	**439**	1.29	**1.79**	66.8	**261**	**0.227**
MERY-Comp		0.035	1.31	**1.16**	6.86	**509**	1.10	**1.52**	74.3	**428**	**0.112**
MEBB-Comp		0.022	1.34	**1.83**	10.8	**549**	1.11	**15.1**	142	**427**	**0.269**
MEBH-Comp		**0.256**	**2.80**	**1.26**	6.86	**369**	1.16	**1.47**	109	**353**	**0.169**
MEFP-Comp		0.0539	1.91	**1.64**	7.16	**583**	1.24	**1.65**	62.0	**354**	**0.320**
MEPI-Comp		0.0587	**2.19**	**1.39**	5.13	**385**	1.45	**1.49**	78.7	**290**	**0.120**
NBTC-Comp		0.033	**3.35**	**3.46**	7.28	**1560**	**2.81**	**3.35**	86.6	**1510**	**0.493**
NBSC-Comp		0.054	**2.31**	**1.83**	6.29	**660**	1.49	**1.98**	88.6	**593**	**0.216**
NSDI-Comp		0.030	1.43	**1.33**	6.09	**422**	0.820	**2.27**	62.2	**441**	**0.083**
NSYR-Comp		**0.341**	1.39	**1.63**	5.60	**556**	1.28	**3.46**	83.1	**308**	**0.200**

Table 4 (cont'd)

Station Code	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)
NSAR-Comp	0.039	**3.43**	**1.91**	6.45	**691**	**2.05**	**1.71**	73.1	**776**	**0.238**
NSBC-Comp	0.057	**2.38**	**1.92**	6.00	**601**	1.65	**1.99**	72.0	445	**0.181**
NSBP-Comp	0.010	1.18	**1.17**	6.36	219	0.709	**2.06**	82.5	148	**0.116**

[1]Percentile and median data from received from NOAA National Status and Trends Program 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.

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

	Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
2009 Gulfwatch										
range	0.010-2.51	0.902-3.43	1.07-3.54	5.13-26.6	219-2450	0.709-2.81	1.37-15.1	62.0-146	96.4-1510	0.083-0.493
median	0.045	2.24	1.82	7.22	430	1.29	2.16	102	354	0.233
85th P	0.060	2.86	2.10	8.05	595	1.64	3.92	132	443	0.324
	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 2009 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 2009 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). No sites exceeded 85th percentile NS&T values for PAHs and PCBs. The highest PAH concentrations were seen at North Mill Pond in New Hampshire (NHNM), and Portland Harbor and Boothbay Harbor in Maine (MEPH and MEBB, respectively) The fluoranthene-pyrene indicator ratio suggests predominately a pyrogenically-derived source of PAHs. The highest PCB concentrations were from North and South Mill Pond in New Hampshire (NHNM and NHSM) and Portland Harbor in Maine (MEPH). Pesticide concentrations which exceeded NS&T median values were found at the Sandwich, Massachusetts site (MASN), North Mill and South Mill Pond in New Hampshire (NHNM and NHSM), and in Portland and Boothbay Harbors in Maine (MEPH and MEBB). The summed pesticide value 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 2009 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		**276**	**276**	343	0.74	**33.0**	7.35
MASN comp+dup	mean	20.3	61.6	72.6	0	20.5	**25.1**
	stdev	0.6	0.3	2.7	0	5.1	0.2
MECC-comp		**215**	235	296	0.73	22.9	8.62
MECC 1-3N	mean	**207**	222	287	0.74	24.5	15.1
	stdev	41	52	63	0.01	1.0	12.4
NHNM-comp		**846**	**881**	**1090**	0.77	**69.2**	**80.0**
NHDP-comp		**297**	**320**	**418**	0.73	**30.3**	8.36
NHDP 1-3N	mean	**293**	**320**	**417**	0.73	**32.4**	14.1
	stdev	19.3	22.0	26.5	0.004	3.42	6.13
NHHS comp+dup	mean	70.6	216	**483**	1.00	5.32	2.62
	stdev	0.5	0.3	7	0	0.10	0.04
NHHS 1-3N	mean	86	**286**	**602**	1.00	4.92	2.58
	stdev	34	180	463	0	0.54	0.21
NHSM-comp		**715**	**741**	**905**	0.76	**31.6**	**34.3**
MEPH-comp		**1040**	**1120**	**1390**	0.91	**81.8**	**35.2**
MEKN-comp		148	141	226	0.72	15.3	3.25
MERY-comp		21	11	40	1.00	6.62	9.88
MEBB-comp		**1090**	**1190**	**1500**	0.80	27.8	**43.1**
MEFP-comp		142	167	261	0.61	14.1	11.8
MEPI-comp		0	9	37	0.00	0	0
MEBH-comp		6	6	24	0.00	0	1.39
NBTC-comp		125	169	292	0.55	5.40	7.50
NBSC-comp		27	46	117	0.00	10.4	2.31
NSDI+dup	mean	29.7	48.8	98.8	1.00	0	0
	stdev	9.13	11.8	16.0	0	0	0
NSAR-comp		12.6	24.9	42.5	0	5.43	0
NSBP-comp		80.3	78.0	120	0.85	0	1.73
NSYR-comp		148	187	255	1.00	5.43	2.60
NSBC-comp		**193**	246	313	0.89	0	0

[1]Data received from NOAA NS&T office upon written request.

Table 7. Comparison of median and 85 percentile values of tissue concentrations of summed organic analytes from Gulfwatch 2009 sites and National Status and Trends 2008 sites.

	ΣPAH19	ΣPAH24	ΣPAH40	ΣPCB21	ΣPEST21
	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
Gulfwatch 2009					
Median	142	196	292	14.1	7.17
85th P[1]	300	363	598	31.9	1.24
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

3.4 CONTAMINANT CONCENTRATIONS IN OTHER SHELLFISH

As part of the New Hampshire Gulfwatch 2009 program, and in cooperation with the regional Gulfwatch 2009 Program, softshell clams (*Mya arenaria*) were sampled Fox Point, NH (NHFP). Single values from a composite sample are presented in Table 8 for metals.

Table 8. Metals concentrations in softshell clam samples taken at the Fox Point, New Hampshire site (NHFP) and analyzed for the Gulfwatch 2009 program.

	Ag	Cd	Cr	Cu	Fe	Ni	Pb	Zn	Al	Hg
GOM Site	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
NHFP	2.51	0.902	3.54	26.6	2450	2.72	3.79	121	1120	0.411

4.0 2009 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 2009 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 0.010 µg/g dry weight at the Broad Cove, NS site (NSBP) to 0.341 µg/g dry weight at the Yarmouth, NS site (NSYR) (Table 4; Figure 2). Mussels from the Brave Boat Harbor site, ME (MEBH) site and the NSYR site mentioned above had concentrations higher than the NS&T national median. All 2009 levels were all below the NOAA NS&T 85th percentile values, which are used in Gulfwatch as criteria for an "elevated"

concentration (Figure 2, dashed and solid lines, respectively). 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). The still relatively low concentrations found at MEBH and NSYR most likely reflect naturally-occurring silver.

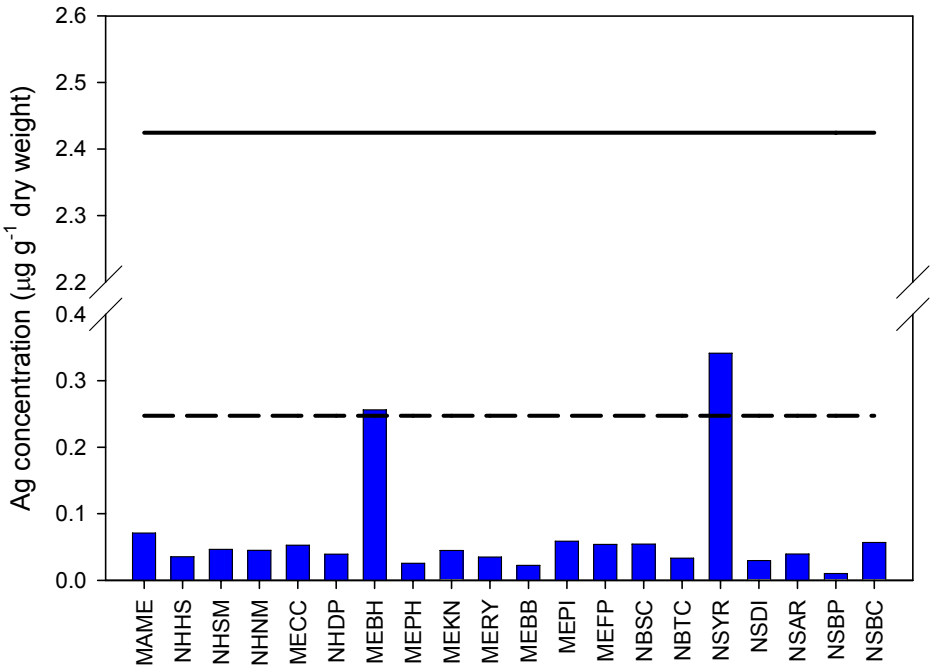

Figure 2. Distribution of silver tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.2 Cadmium (Cd)

The concentration of cadmium in mussel tissue ranged from 1.18 µg/g dry weight at Barrington Passage, NS (NSBP) to 3.43 µg/g dry weight at the Apple River, NS site (NSAR) (Table 4; Figure 3). Twelve sites had concentrations above the NS&T national median: MAME in Massachusetts, NHDP, NHHS, and NHNM in New Hampshire, MECC, MEKN, MEBH, MEPI, in Maine, and NBSC and NBTC in New Brunswick, and NSAR and NSBC 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 well below the NS&T 85th percentile value.

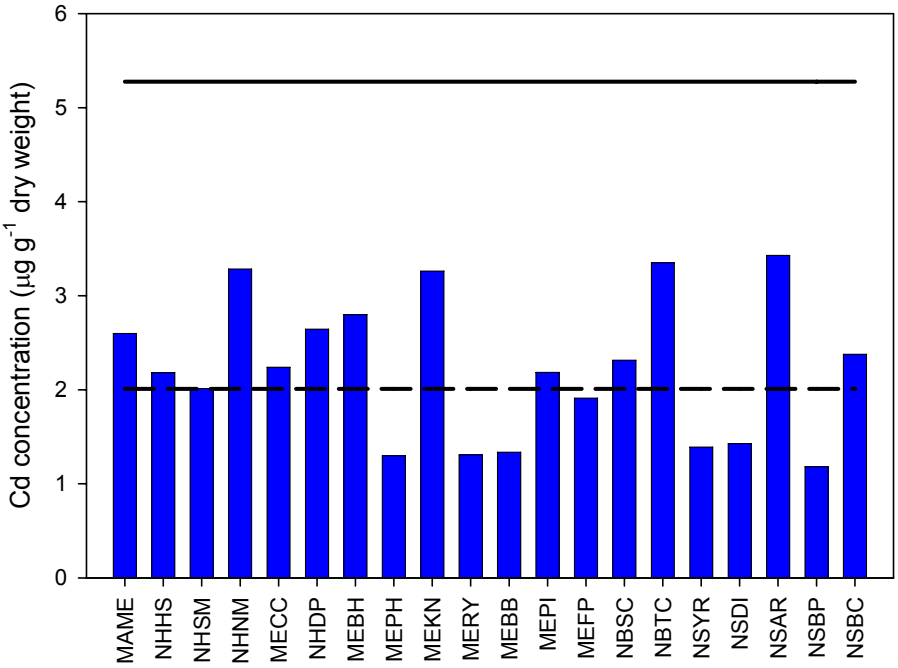

Figure 3. Distribution of cadmium tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.3 Chromium (Cr)

Chromium concentrations in mussel tissue for the Gulf of Maine for 2009 ranged from 1.08µg/g dry weight at the Hampton/Seabrook Harbor, NH site (NHHS) to 3.46 µg/g at the Tin Can Beach, NB site (NBTC). All sites exceeded the Musselwatch NS&T median tissue concentrations. One site, Tin Can Beach in New Brunswick (NBTC) 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).

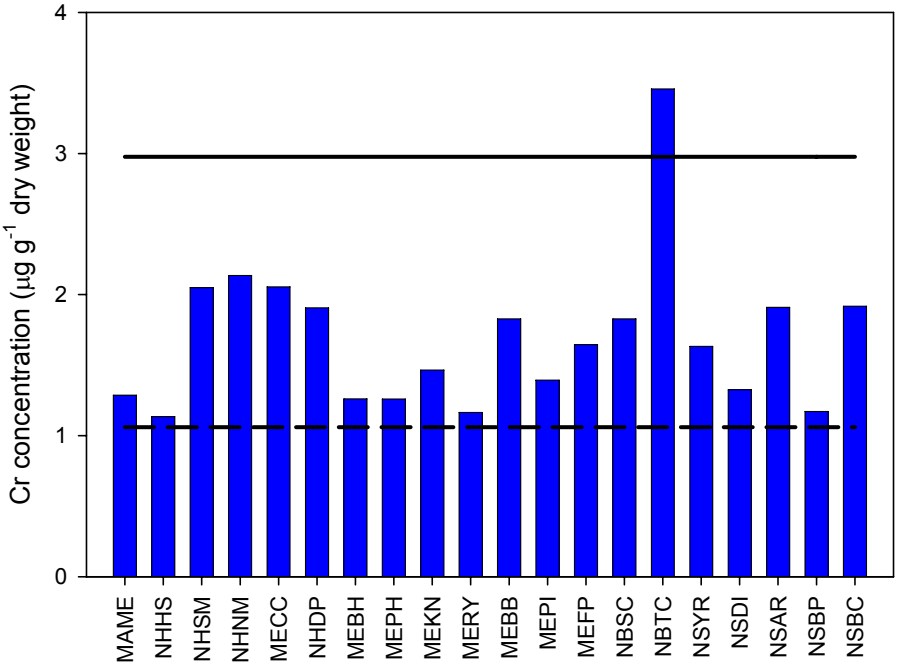

Figure 4. Distribution of chromium tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.4 Copper (Cu)

The 2009 copper concentrations in *M. edulis* ranged from 5.13 µg/g dry wt at the Pickering Island, ME site (MEPI) to 10.8 µg/g dry wt at the Boothbay Harbor, ME site (MEBB, 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 two). No tissue concentrations exceeded NS&T median or 85th percentile concentrations.

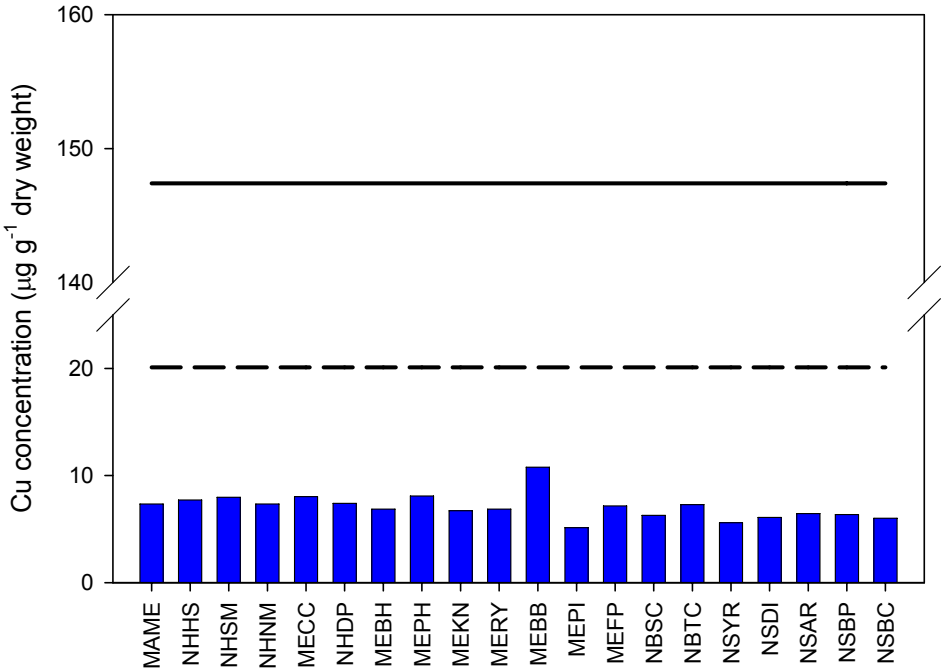

Figure 5. Distribution of copper tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.5 Iron and Aluminum (Fe & Al)

For 2009, the highest concentrations for both iron and aluminum were found at sites in New Brunswick and Nova Scotia. Tin Can Beach, NB had the highest tissue concentrations of Fe and Al. One site exceeded the NS&T 85th percentile criteria for Fe (NBTC) and three sites exceeded the national NS&T 85th percentile value for Al: NBSC, NBTC and NSAR sites from Nova Scotia. Concentrations of Fe ranged from 219 µg/g dry weight at Barrington Passage, NS (NSBP) to 1557 µg/g dry wt at NBTC in New Brunswick. Tissue concentrations of Al ranged from 96.3 µg/g dry wt at MAME (Merrimack River MA) to 1508 µg/g dry wt at NBTC. 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 uptake of localized (non-crustal derived) sources. Previous reports 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. The elevated levels seen at the NBTC site for Fe and Al, as well as other metals (including Cr and Ni) may be the result of this phenomenon. 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 2009 were adequate (see Appendix C).

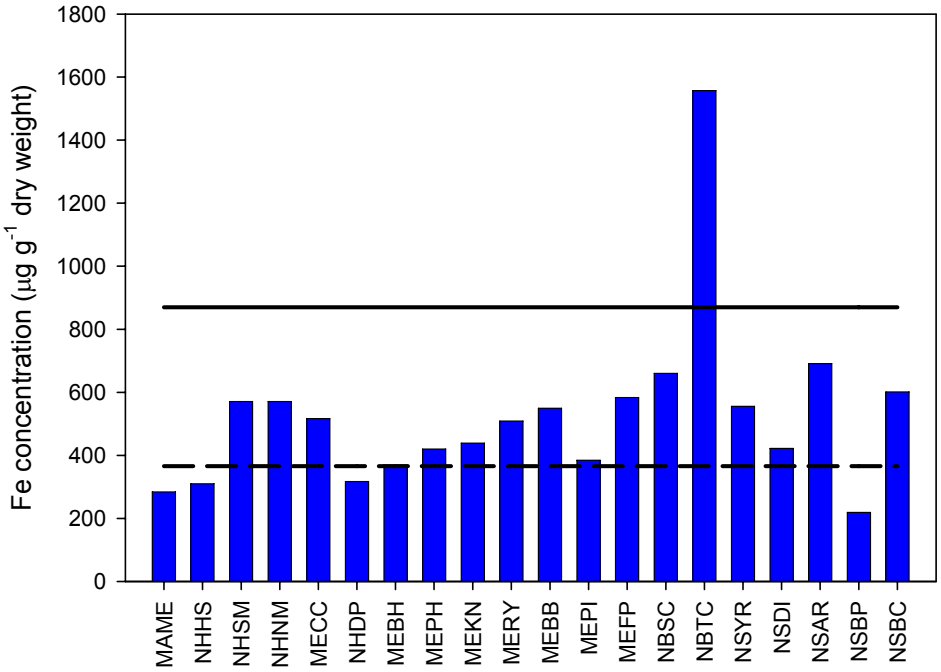

Figure 6. Distribution of iron tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

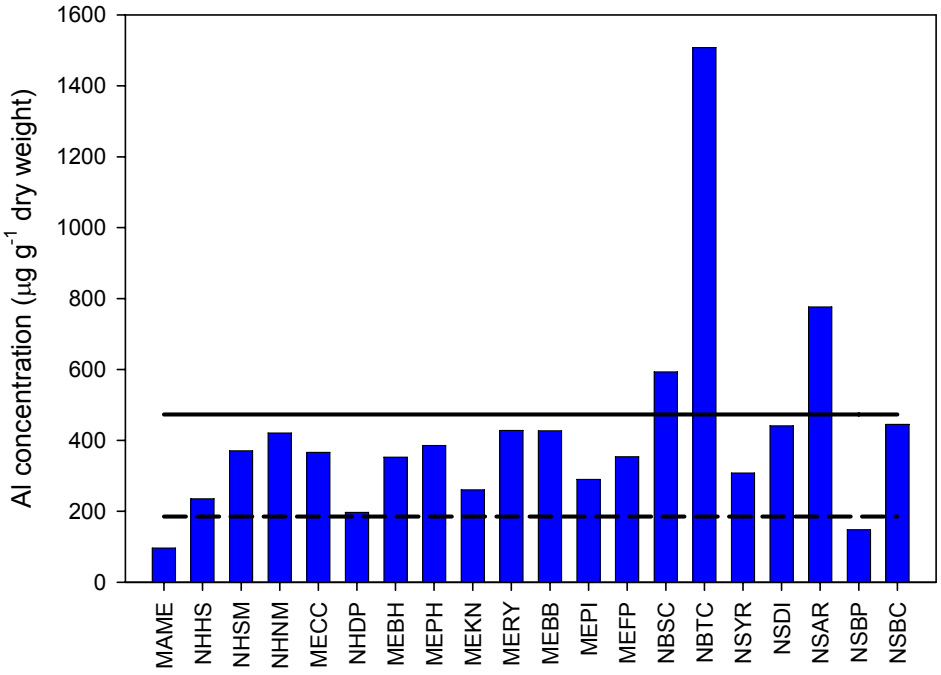

Figure 7. Distribution of aluminum tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.6 Nickel (Ni)

The concentration of nickel ranged from 0.709 µg/g dry wt at NSBP to 2.81 µg/g dry wt at NBTC (Table 4; Figure 8). No concentrations exceed the NS&T 85th percentile values, although NBTC tissue concentrations exceeded the national median value. Concentrations at NSAR were at the median value.

4.1.7 Lead (Pb)

As in past years, all sites visited in 2009 had tissue concentrations that exceeded the 2008 NS&T median value of 0.89 µg/g dry wt. Lead concentrations ranged from 1.77 µg/g dry wt at the Brave Boat Harbor, ME site (MEBH) to 15.05 µg/g dry wt at Boothbay Harbor, ME site (MEBB, Table 4, Figure 9). Several of the sites (8 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). Tissue Pb concentrations from NHSM and MEBB exceeded 85th percentile values by a factor of four or greater.

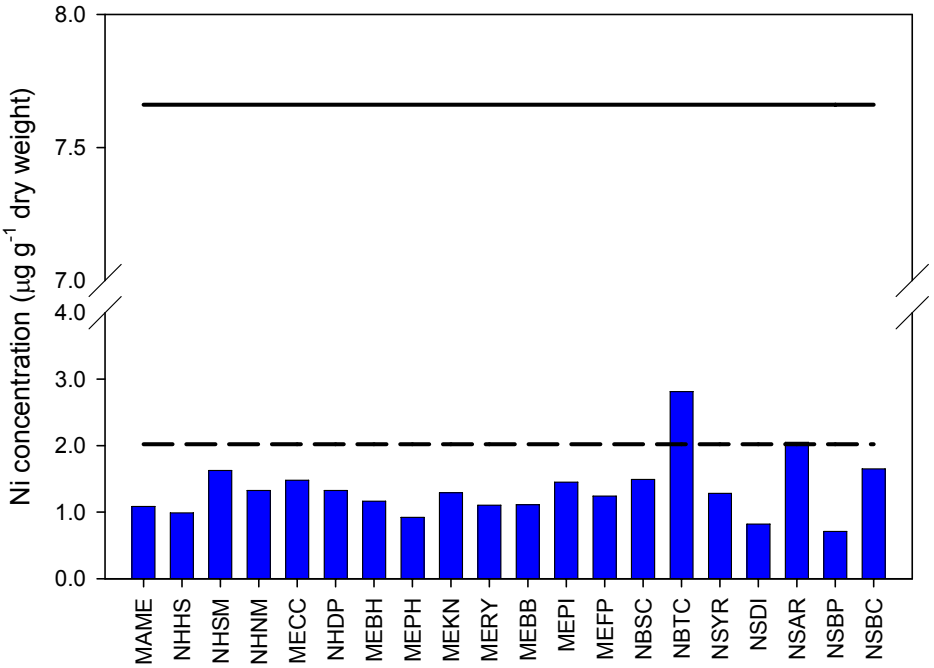

Figure 8. Distribution of nickel tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

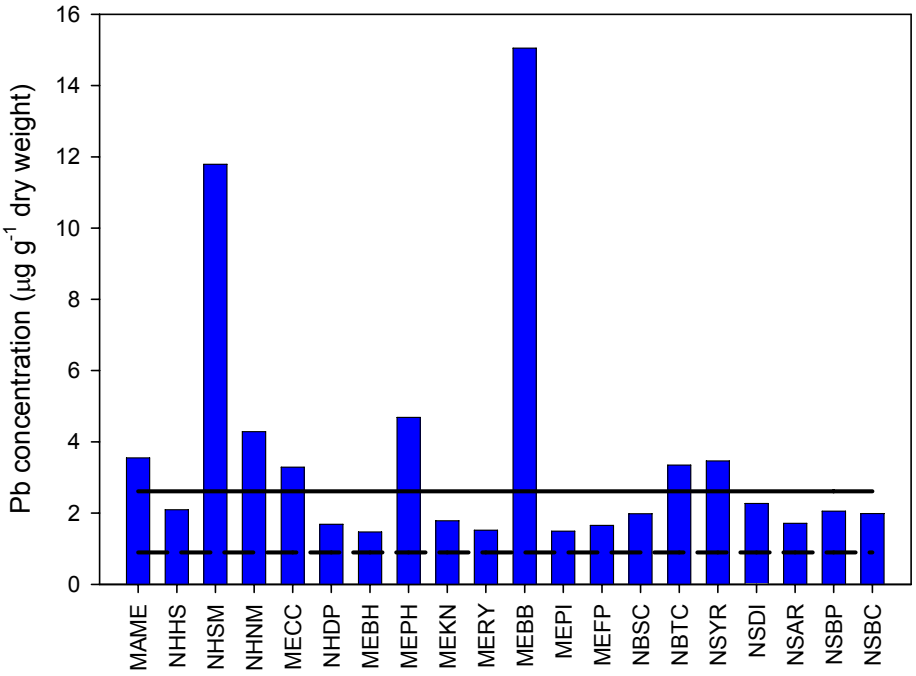

Figure 9. Distribution of lead tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.8 Zinc (Zn)

Concentrations of zinc ranged from a low value of 62 µg/g dry wt in mussels from the Penobscot River site, ME (MEFP) to a high of 142 µg/g dry wt in mussels from the Boothbay Harbor, ME (MEBB) site (Table 4, Figure 10). No sites had zinc concentrations exceeding the 85th percentile or median values from the 2008 NS&T sampling program. Zinc is a ubiquitous environmental contaminant generally reflecting a wide range of land-based activities (tire wear, galvanized materials, industrial waste discharges, etc.).

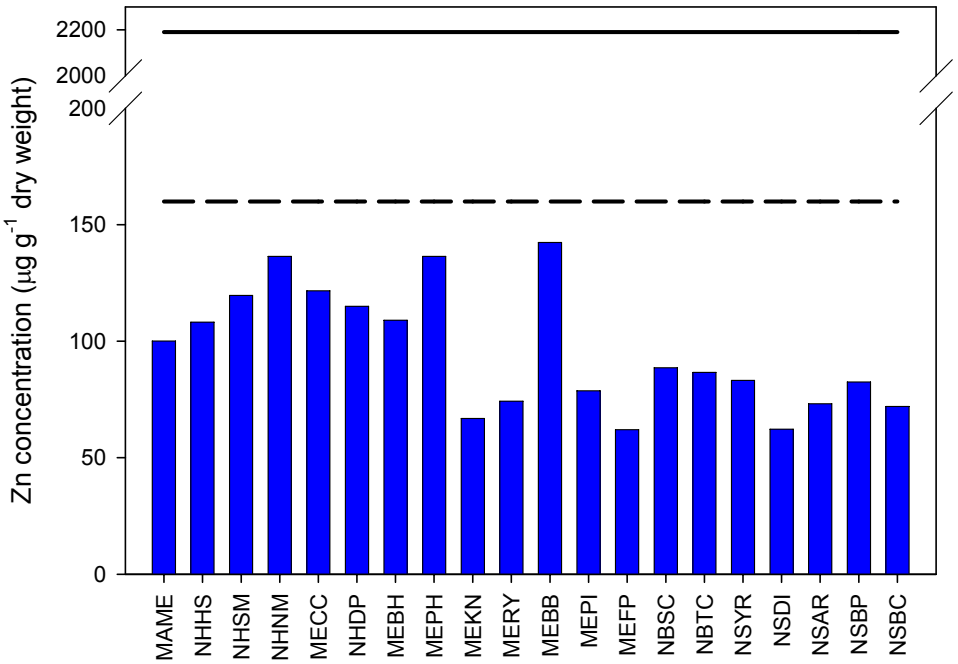

Figure 10. Distribution of zinc tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile value.

4.1.9 Mercury (Hg)

Mercury was detected in mussels collected at all 2009 Gulfwatch stations. Concentrations ranged from a low of 0.083 µg/g dry wt at the Digby Island, NS site (NSDI) to a high of 0.493 µg/g dry wt at the Tin Can Beach, NB (NBTC) site. All 2009 site concentrations except for four (MERY, MEPI, NSDI and NSBP) were above the NS&T 2008 85th percentile value of 0.134 µg Hg/g dry weight (Table 4, Figure 11).

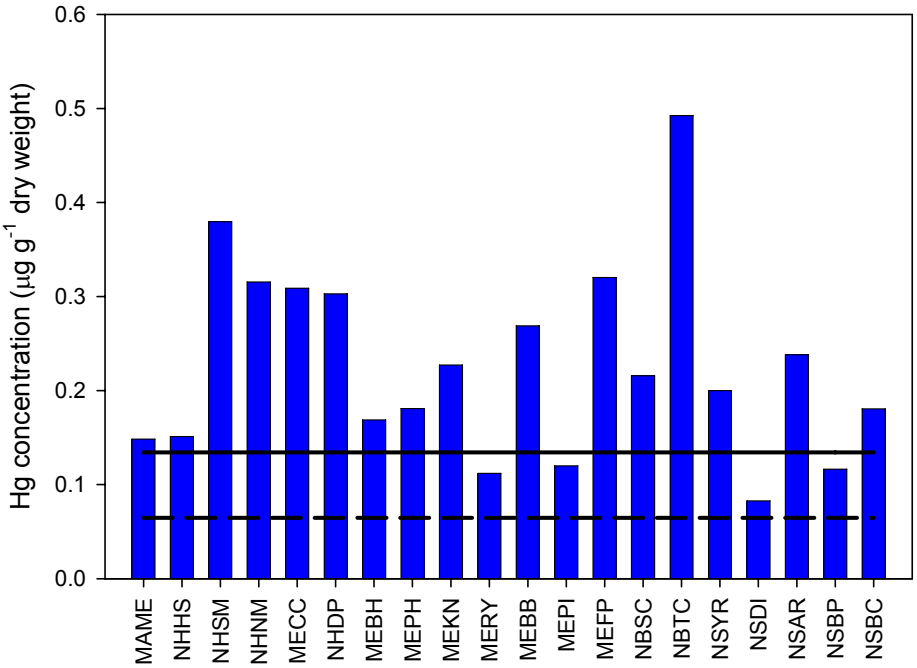

Figure 11. Distribution of mercury tissue concentrations in mussel sample site composites (one per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.1.10 Organic Contaminants

In 2009 samples, enough PAH analytes were present in sufficient quantity such that every site had a value for the summed quantities (Table 6 and Figures 12-14). The pattern of higher concentrations of ΣPAHs in the New England States compared to the Canadian Provinces continued, although in 2009 the highest concentrations were observed in New Hampshire and Maine sites. No sites exceeded the NS&T 85th percentile concentrations for the three summed PAH quantities. The highest PAH concentrations were seen at the North Mill Pond site, NH (NHNM, 881 ng/g for ΣPAH_{24}), Portland Harbor, ME (MEPH, 1120 ng/g for ΣPAH_{24}) and Boothbay Harbor, ME (MEBB, 1191 ng/g for ΣPAH_{24}), all of which were close to, but not did not exceeding the 85th percentile concentration criteria of 1216 ng/g for ΣPAH_{24} (Figure 12, Table 6). 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}. Eight Gulfwatch sites out of the 21 sampled had PAH concentrations that were close to or higher than the national median concentration.

Composite samples from the Merrimack River Massachusetts (MAME), North Mill Pond, Dover Point, and South Mill Pond, New Hampshire (NHNM, NHSM, and NHDP) and Portland Harbor, Maine (MEPH) had PCB concentrations higher than the NS&T national median concentration of 29.2 ng/g dry weight. PCBs ranged from not detected to 5.43 ng/g from the four sites sampled in Nova Scotia and from 5.4ng/g to 10.4 ng/g from the two New Brunswick

sites. ΣPCB_{21} tissue concentrations ranged from not detected at sites in Nova Scotia to 81.8 ng/g in Portland Harbor, Maine (MEPH).

Tissue concentrations of $\Sigma PEST_{21}$ ranged from not detected at stations MEPI, (Maine) NBSC, (New Brunswick), NSDI, and NSBC (Nova Scotia) to 80 ng/g dry wt at the North Mill Pond, NH site (NHNM, 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..

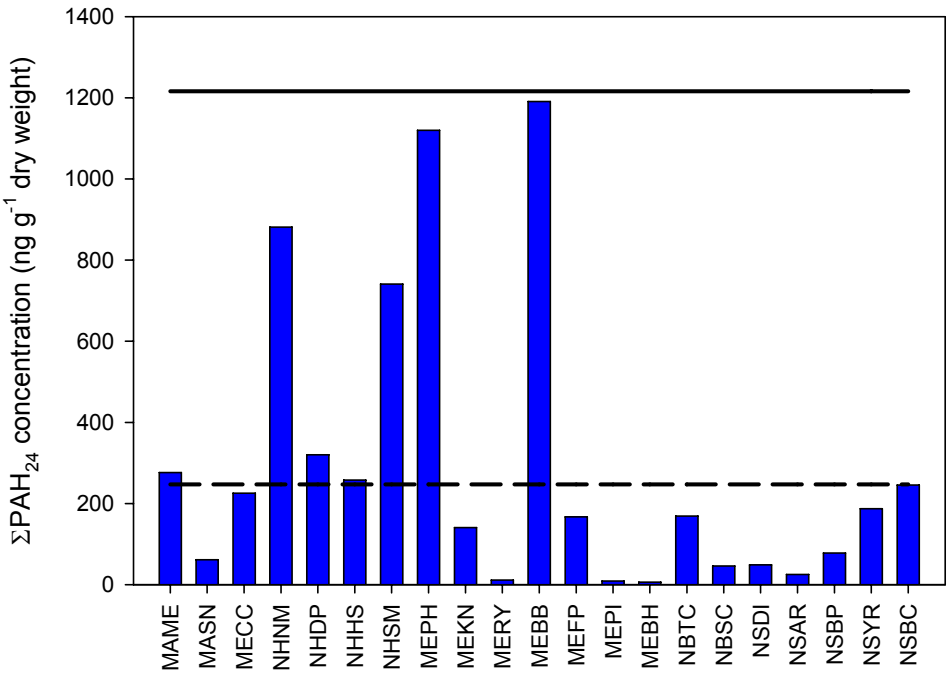

Figure 12. Distribution the sum of 24 PAHs in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

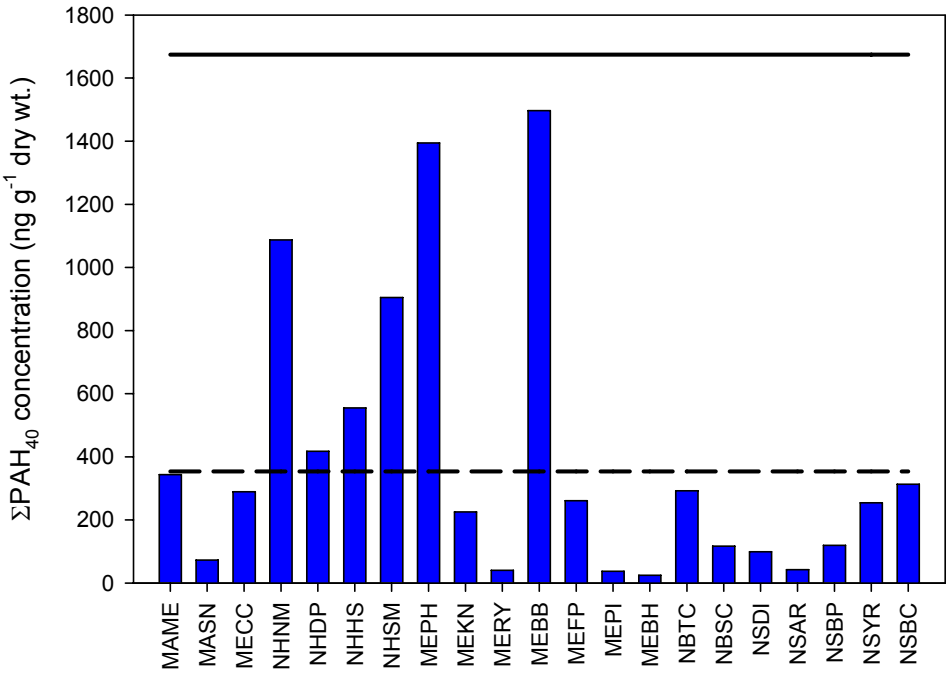

Figure 13. Distribution the sum of 40 PAHs in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

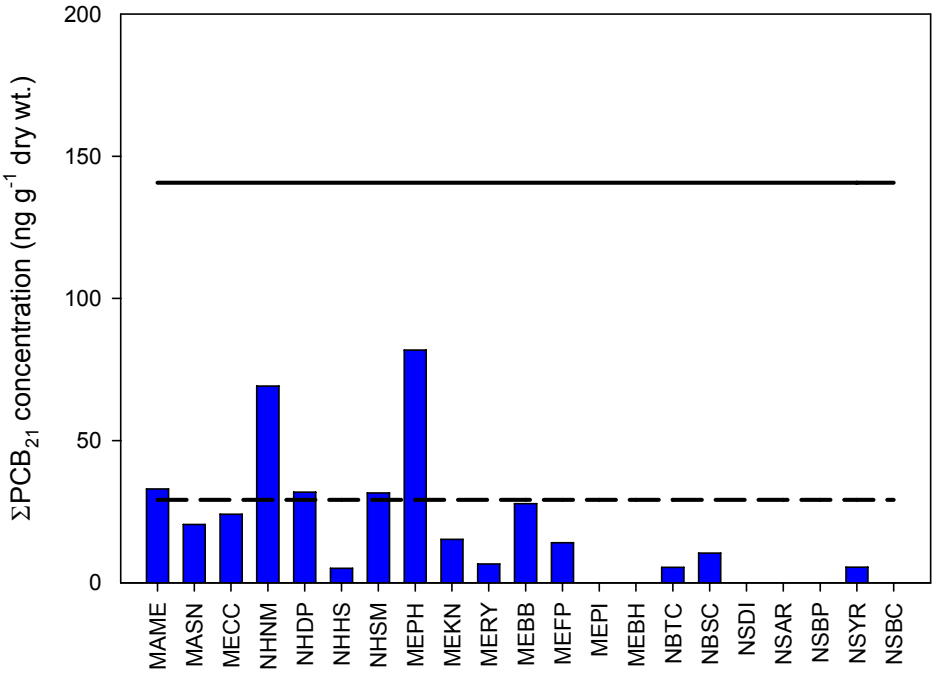

Figure 14. Distribution the sum of 24 PCB congeners in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile (for the sum of 21 PCB congeners).

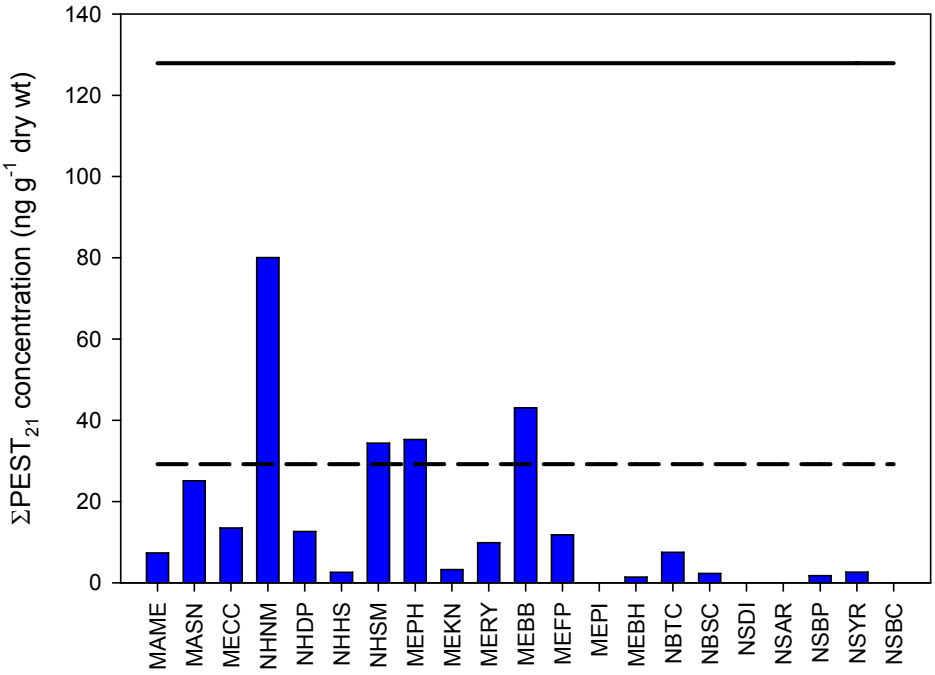

Figure 15. Distribution the sum of 21 chlorinated pesticides in tissues from mussel sample site composites (one composite sample per site) at Gulfwatch sites in 2009. Dashed line = 2008 Mussel Watch National median; Solid line = 2008 Mussel Watch 85th percentile.

4.2 TEMPORAL PATTERNS

This section presents the distribution of inorganic and organic contaminants in mussel tissue collected trend sites along the Gulf of Maine, from 2001 to 2009. The temporal distribution of station means is plotted for each contaminant or class of contaminants, and compared to individual tissue concentrations from year 2009 site composite samples in Figures 16-26. All individual replicate results for each 2009 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 9 trend sites (MAME, NHHS, NHDP, MEPH, MEBB, NBSC, NBTC, NSAR and NSYR) is updated with data from mussels collected in 2009.

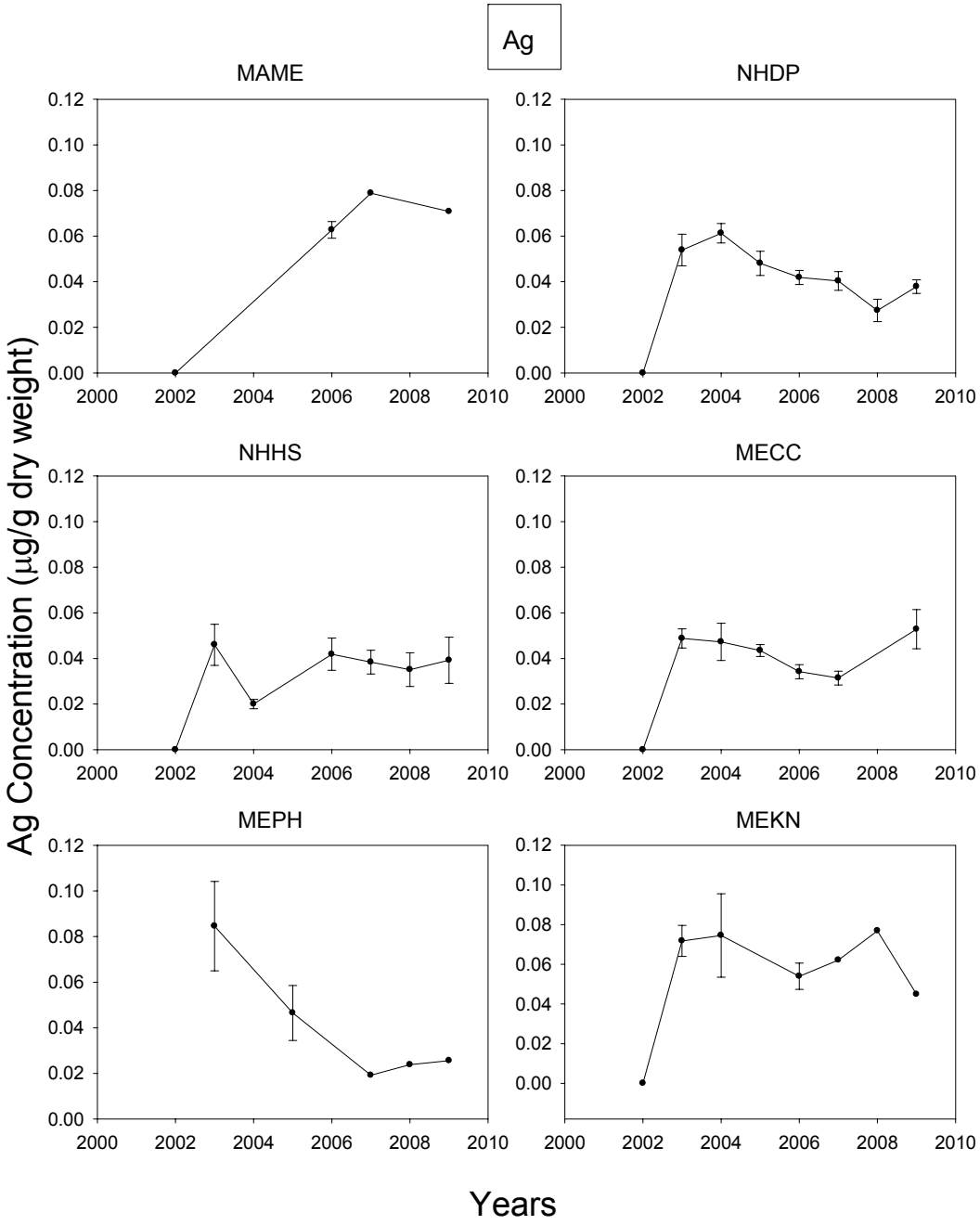

Figure 16. Distribution of silver tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

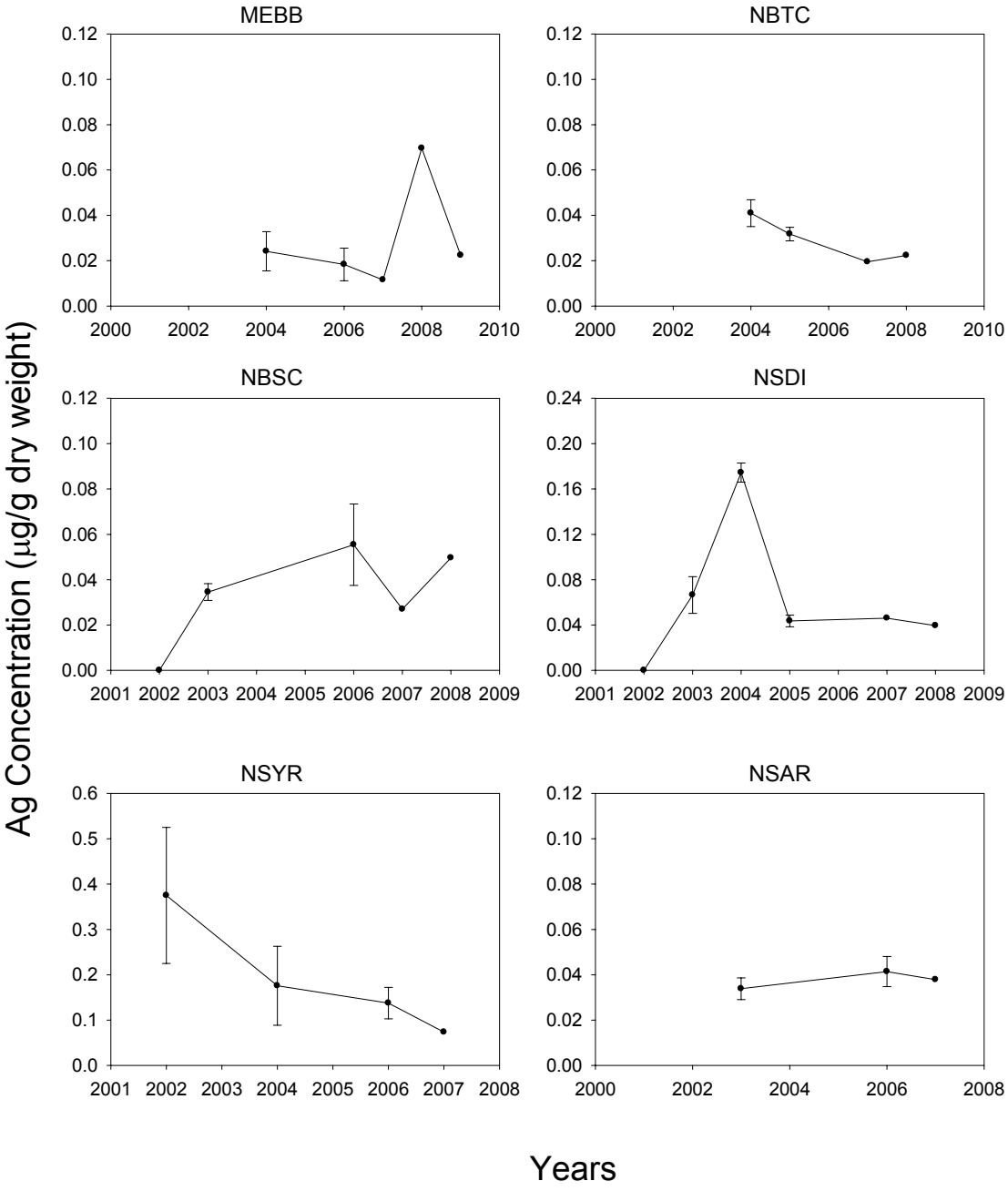

Figure 16 (cont'd). Distribution of silver tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

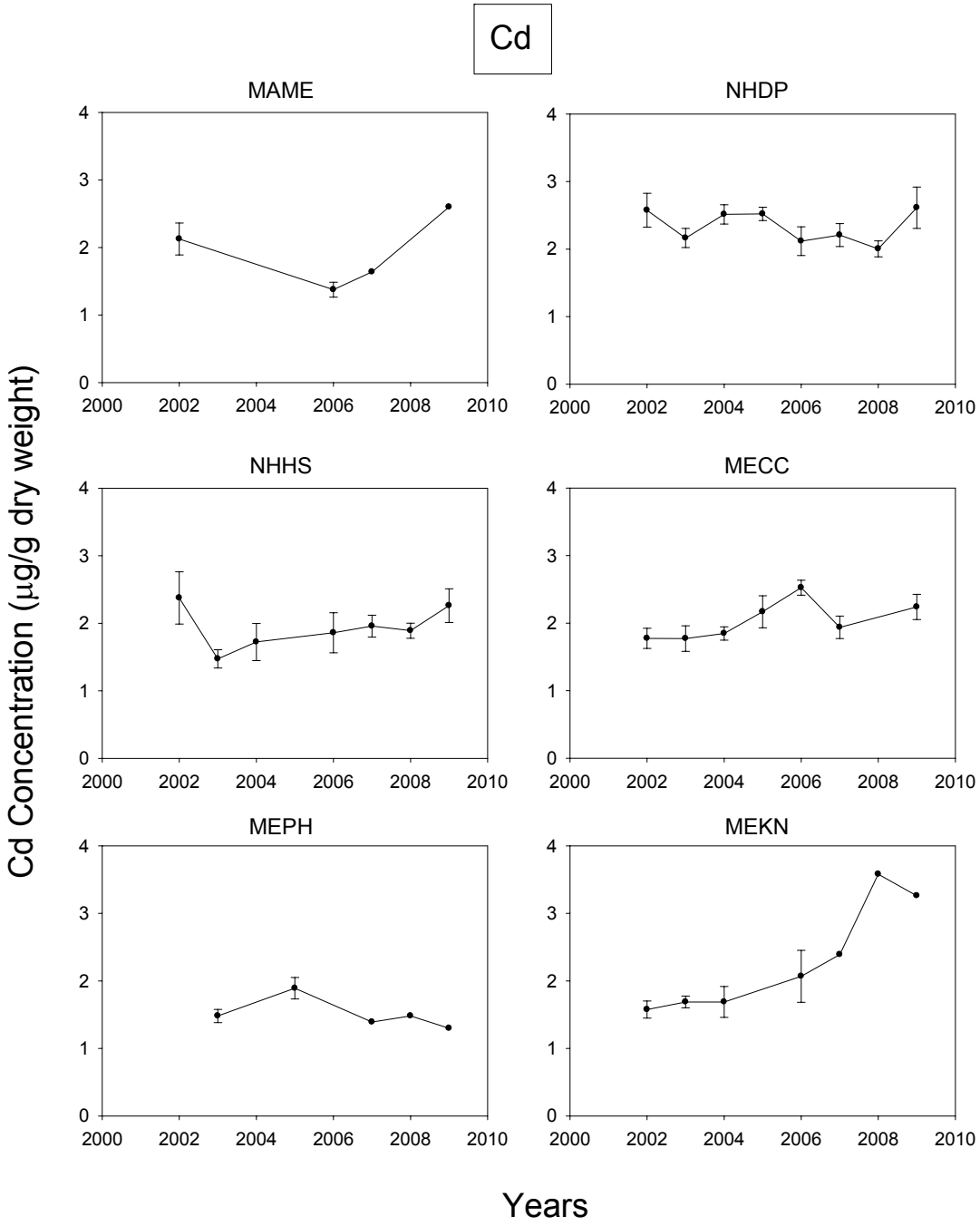

Figure 17. Distribution of cadmium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

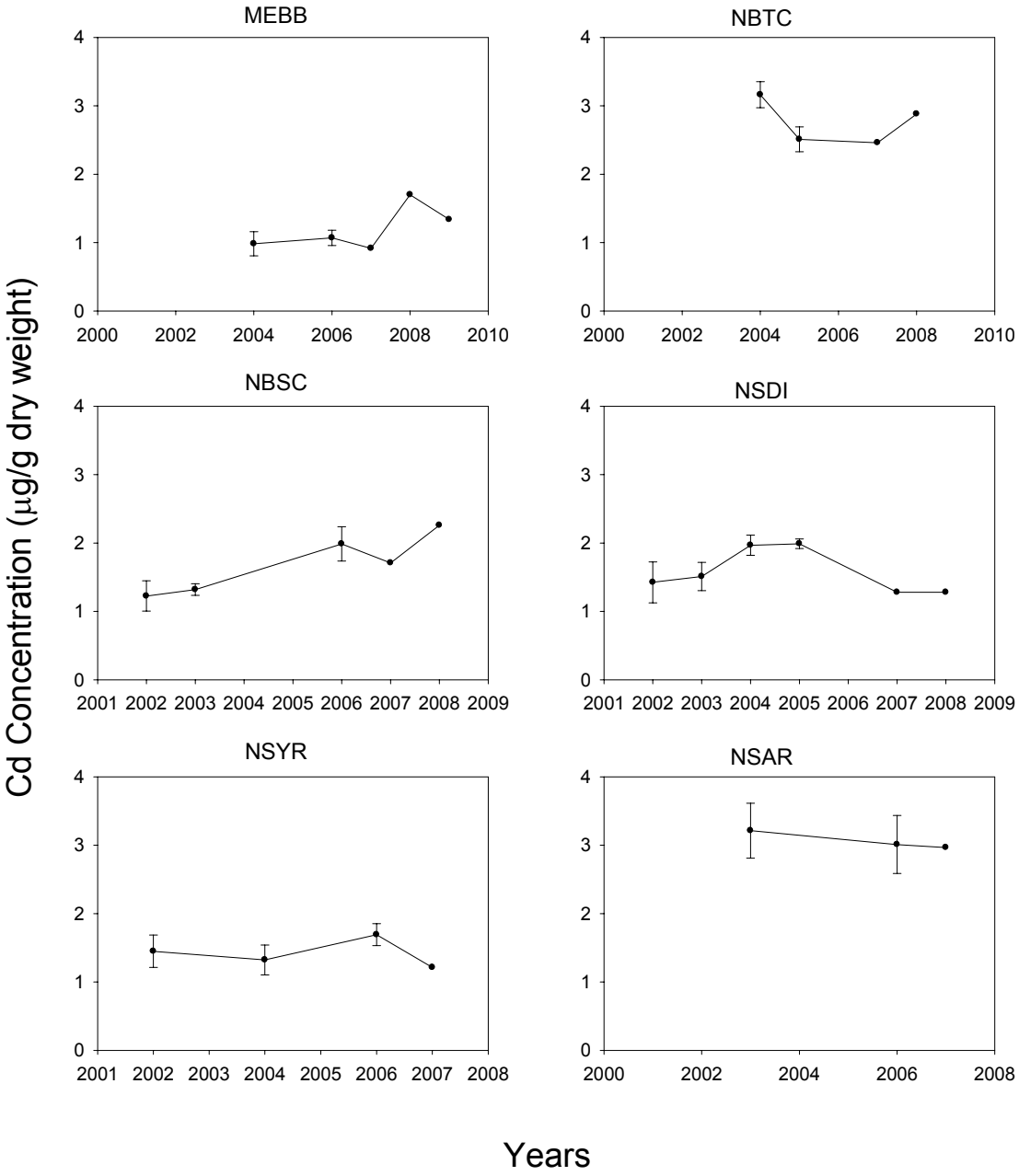

Figure 17 (cont'd). Distribution of cadmium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

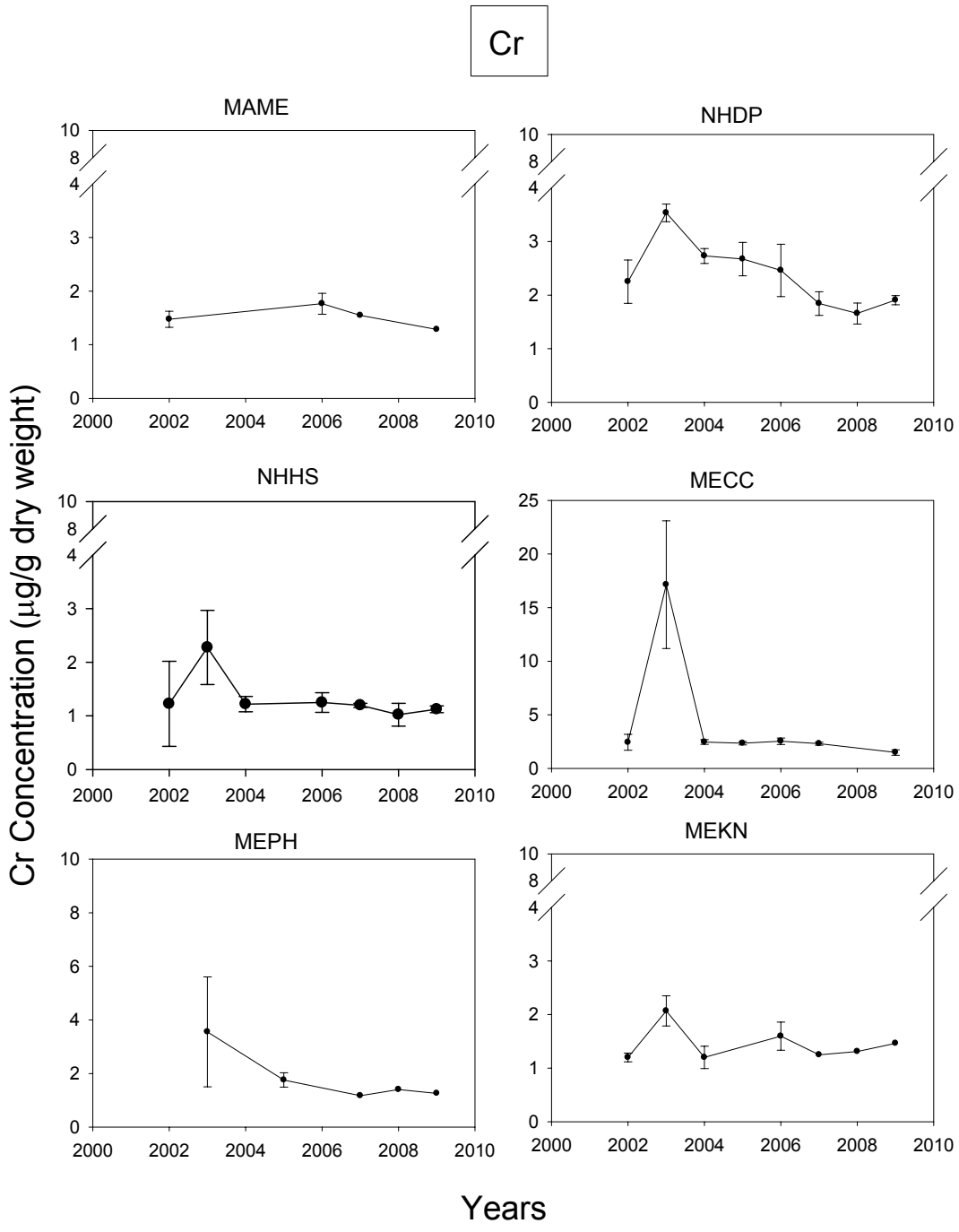

Figure 18. Distribution of chromium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

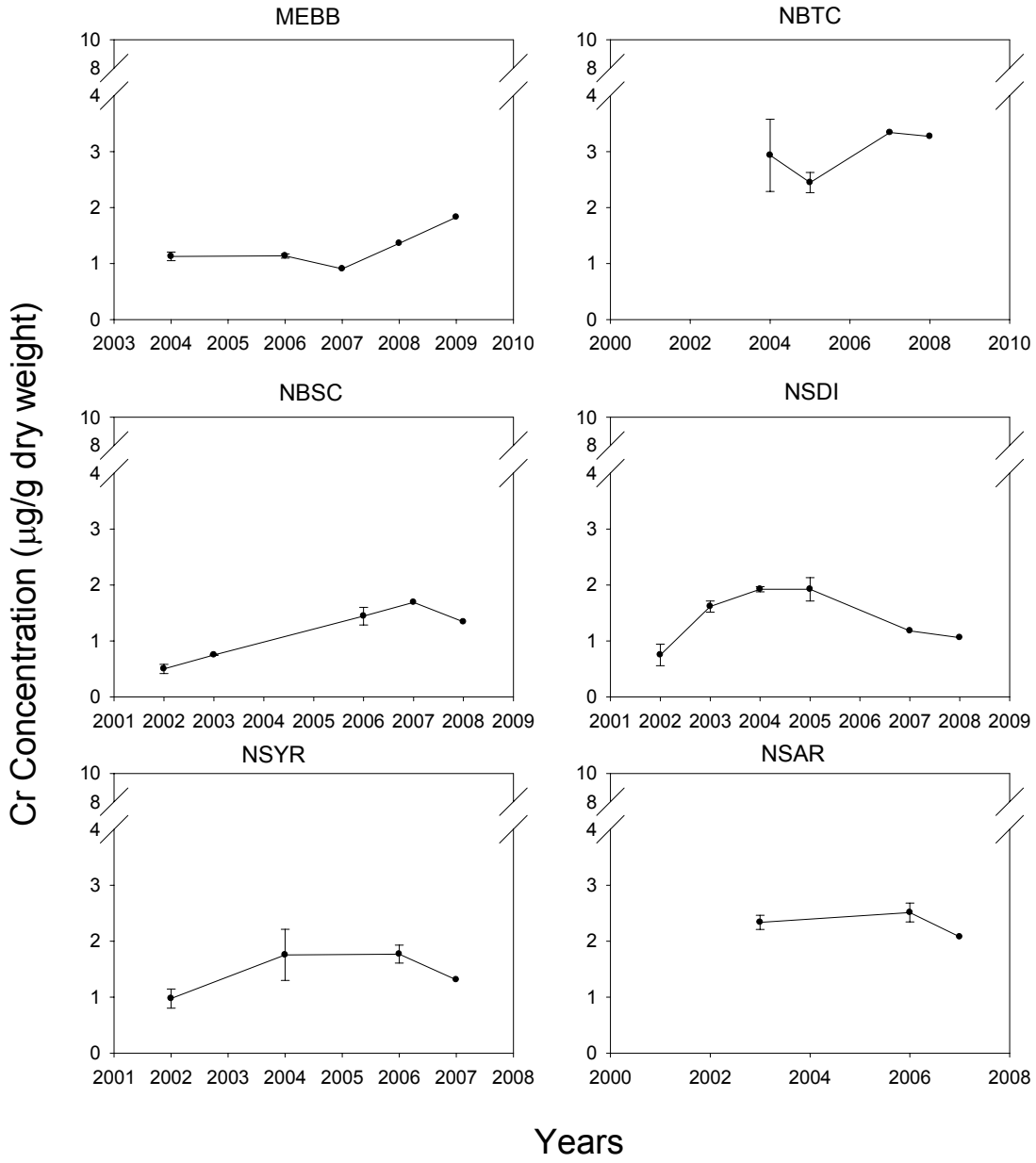

Figure 18 (cont'd). Distribution of chromium tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

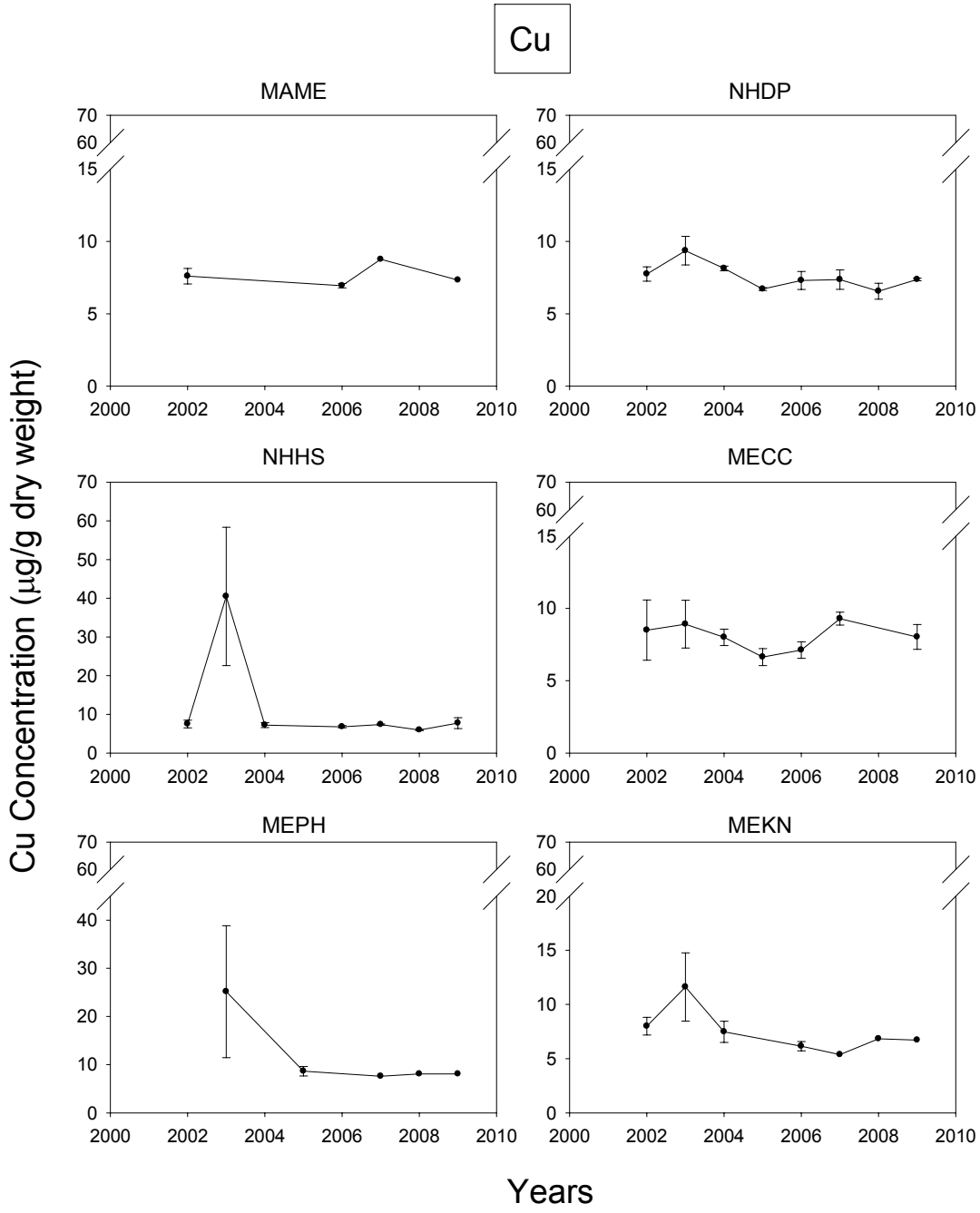

Figure 19. Distribution of copper tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

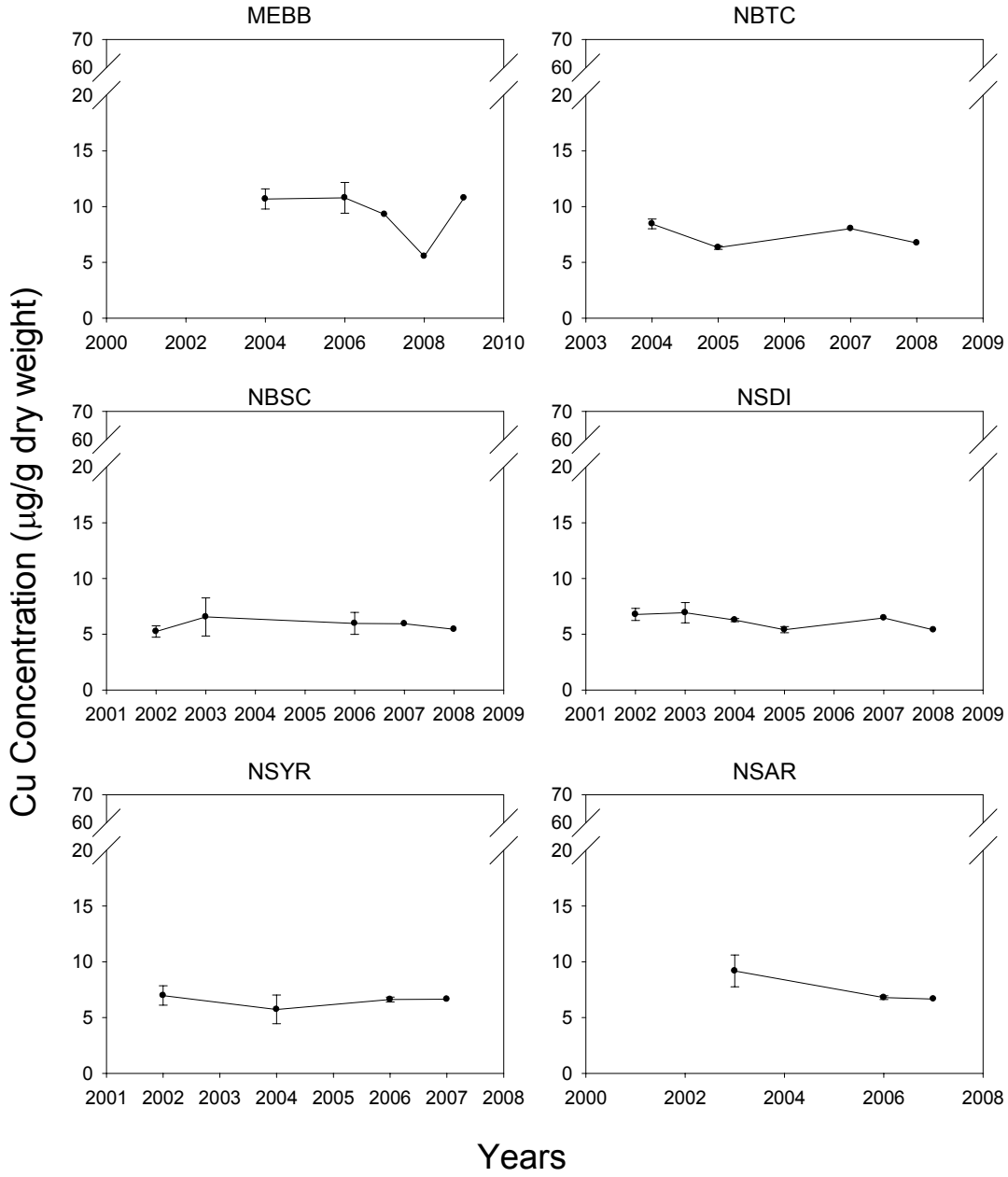

Figure 19 (cont'd). Distribution of copper tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

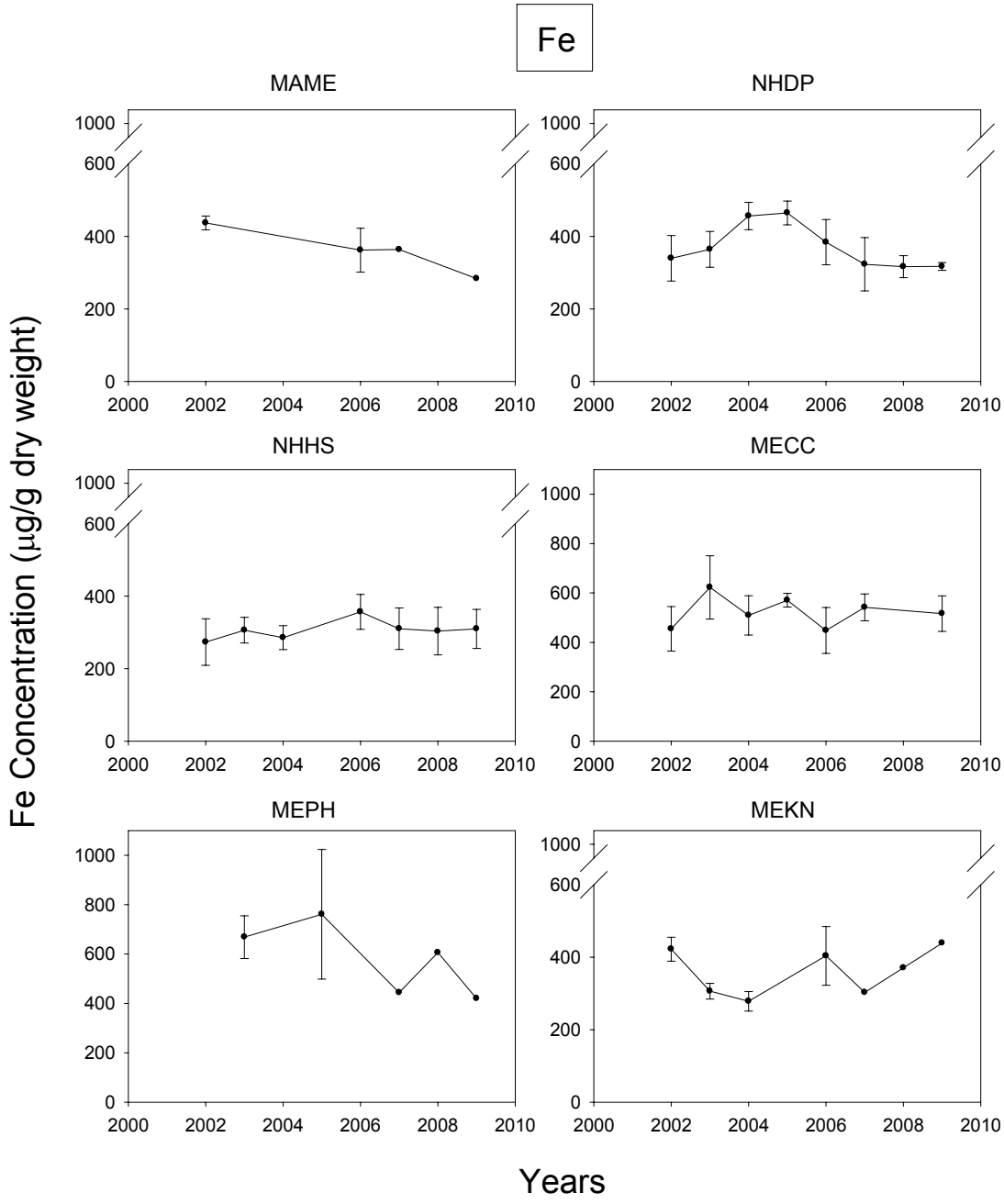

Figure 20. Distribution of iron tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

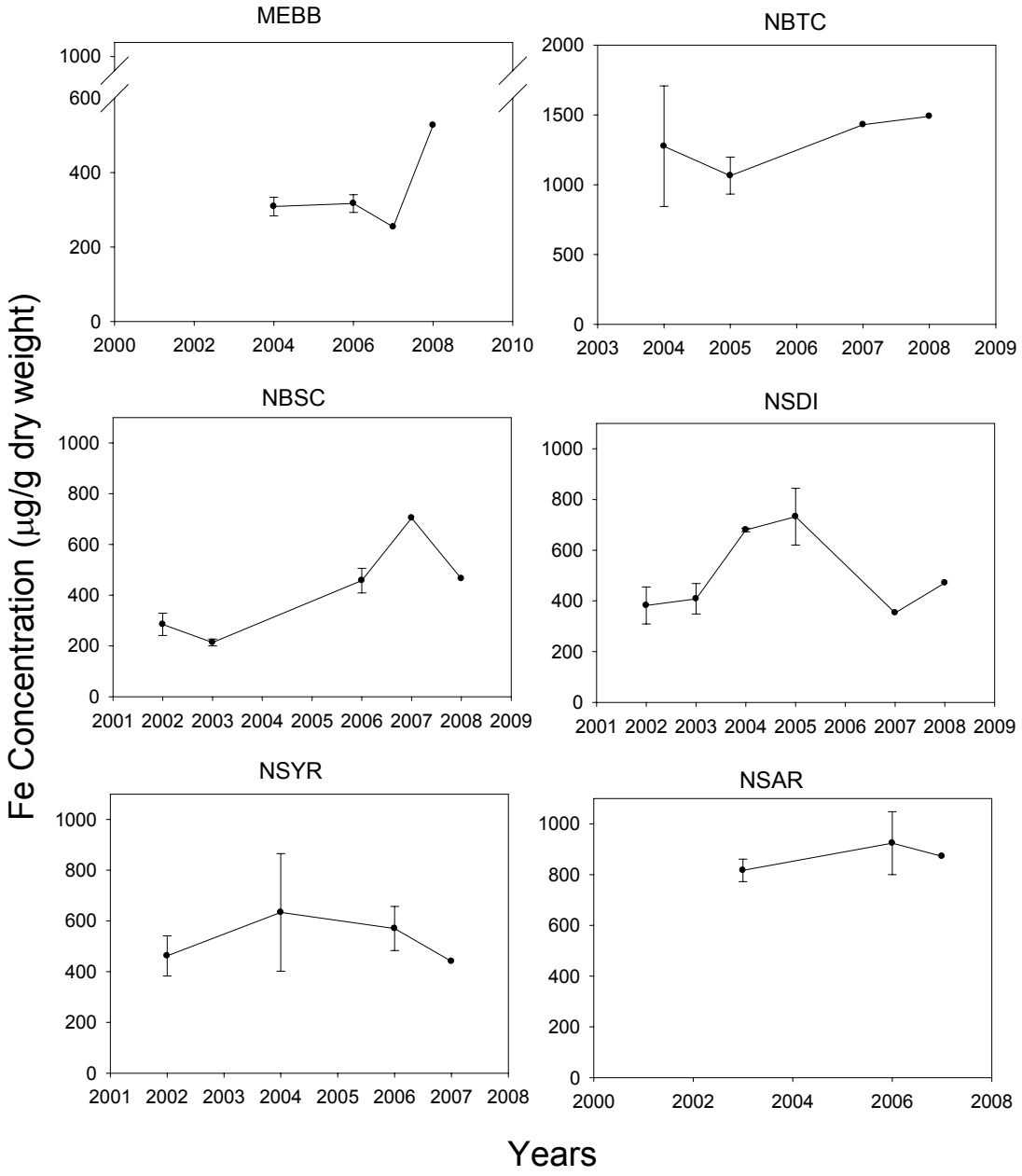

Figure 20 (cont'd). Distribution of iron tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

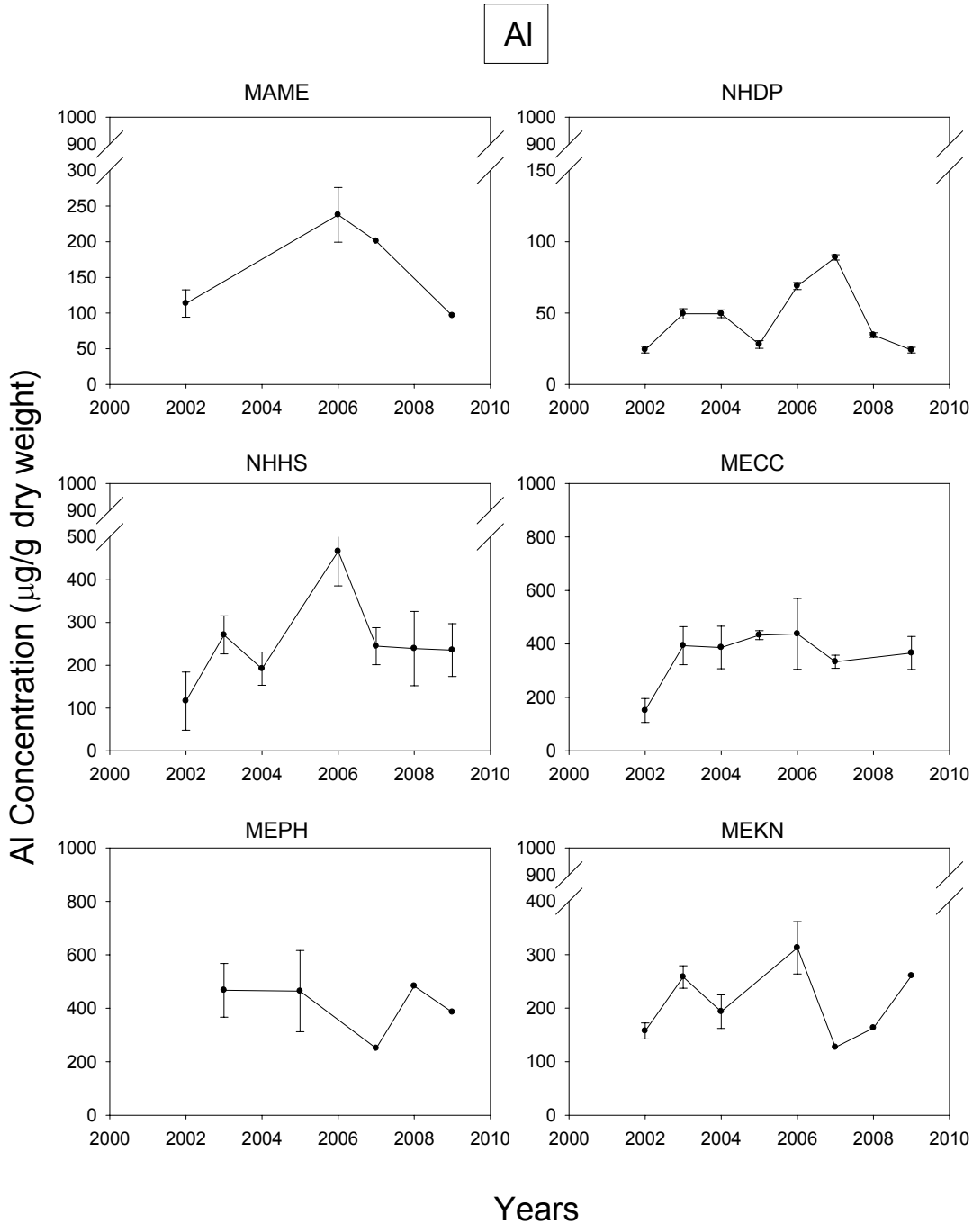

Figure 21. Distribution of aluminum tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

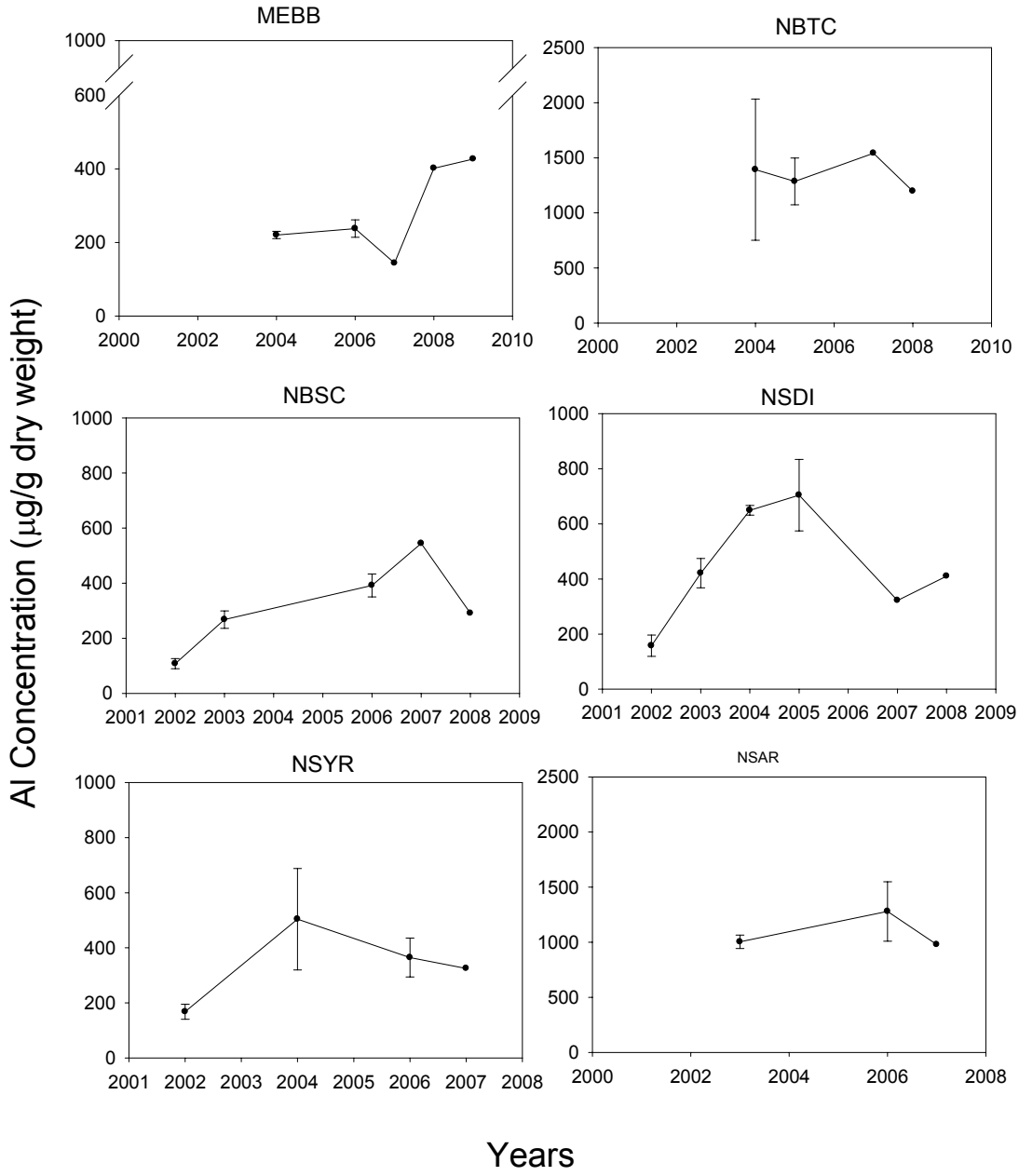

Figure 21 (cont'd). Distribution of aluminum tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

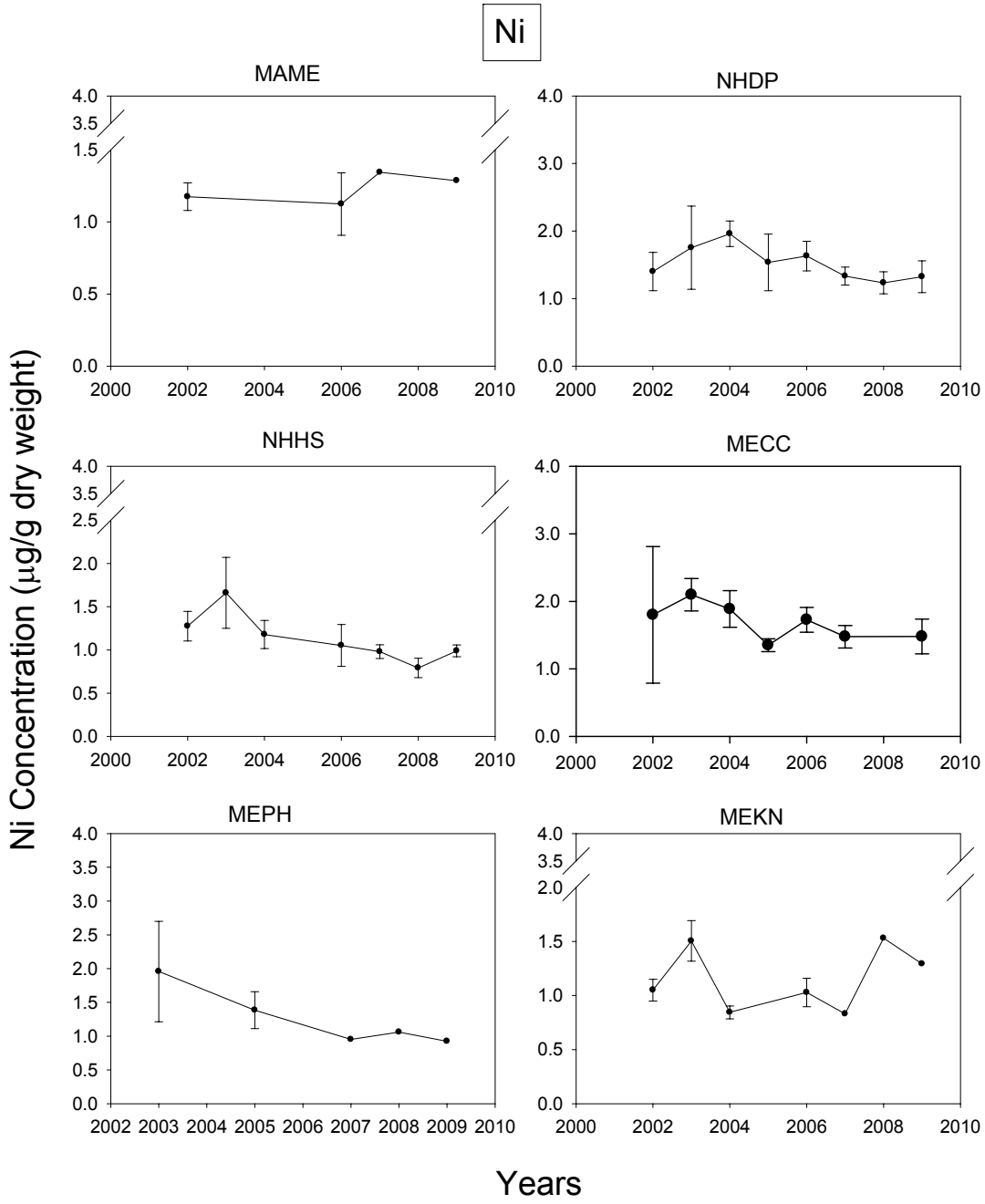

Figure 22. Distribution of nickel tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

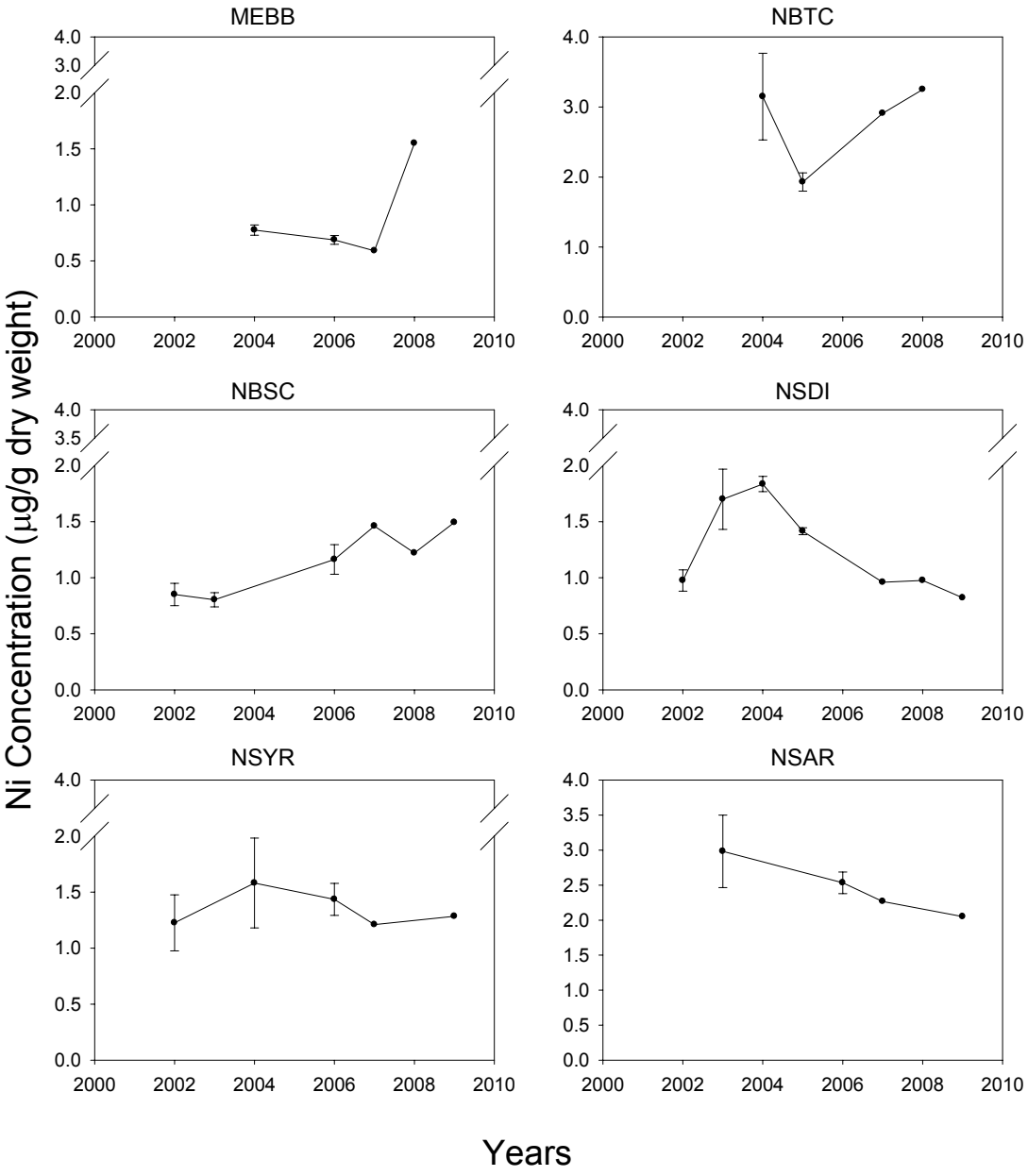

Figure 22 (cont'd). Distribution of nickel tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

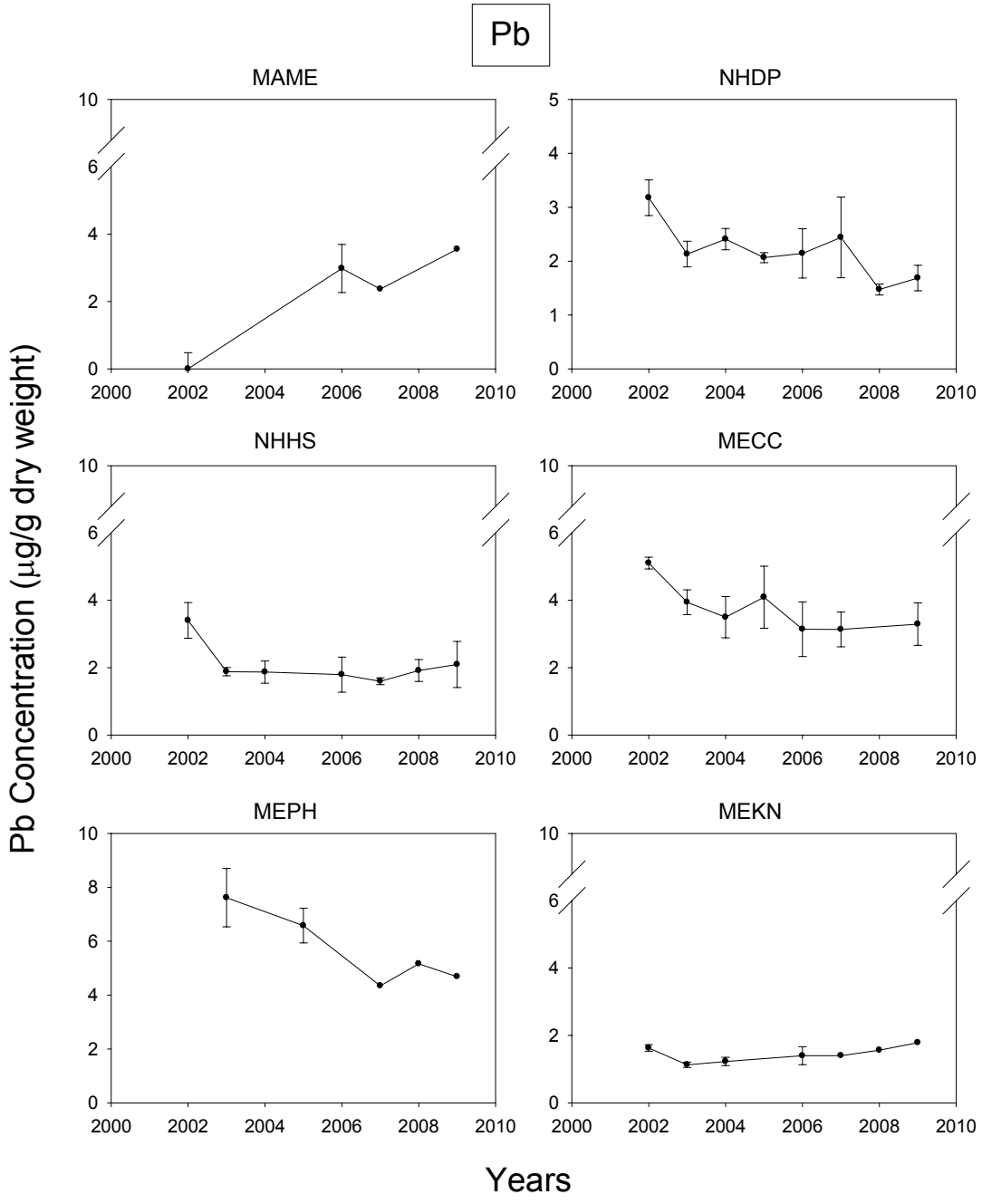

Figure 23. Distribution of lead tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

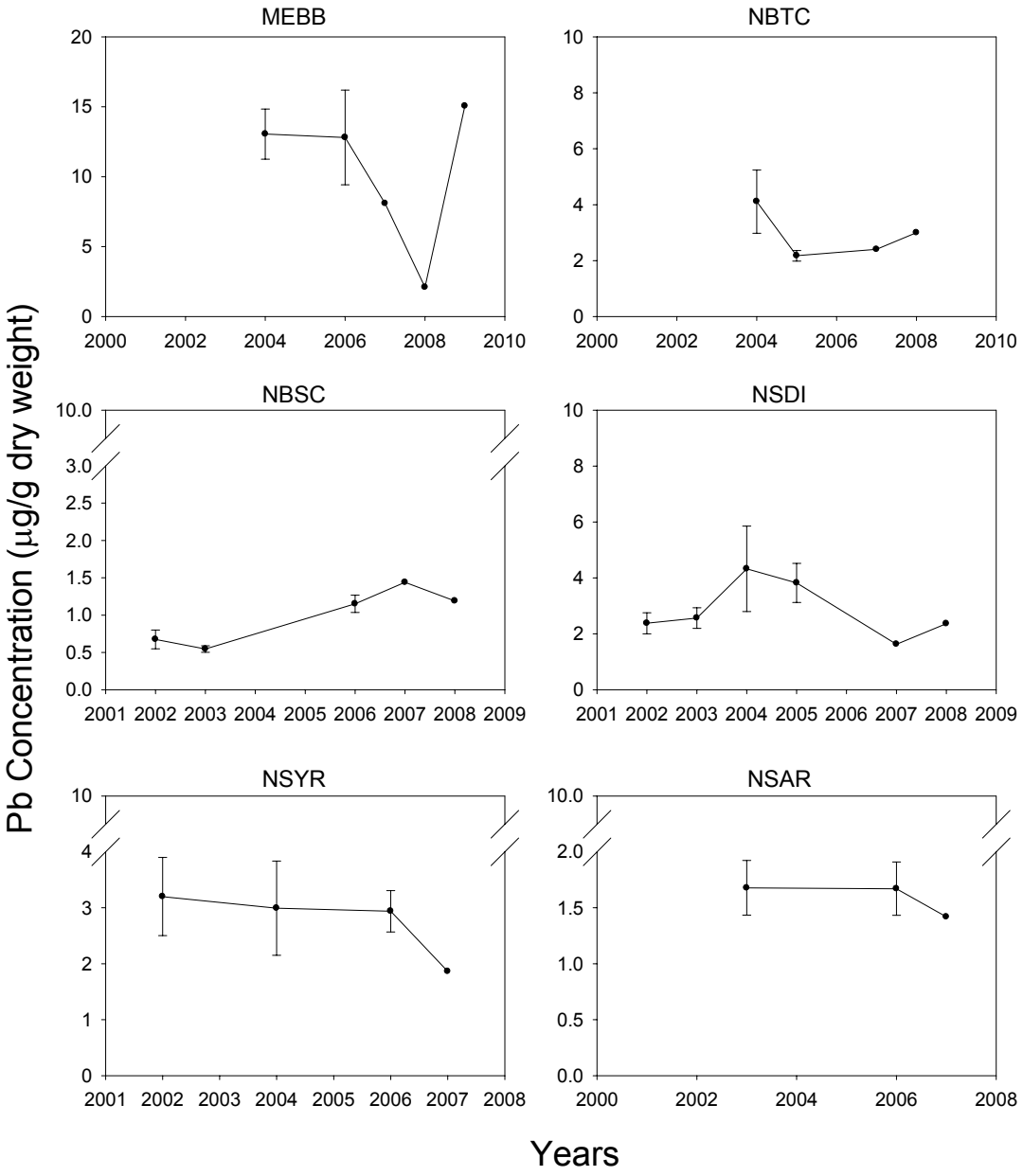

Figure 23 (cont'd). Distribution of lead tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

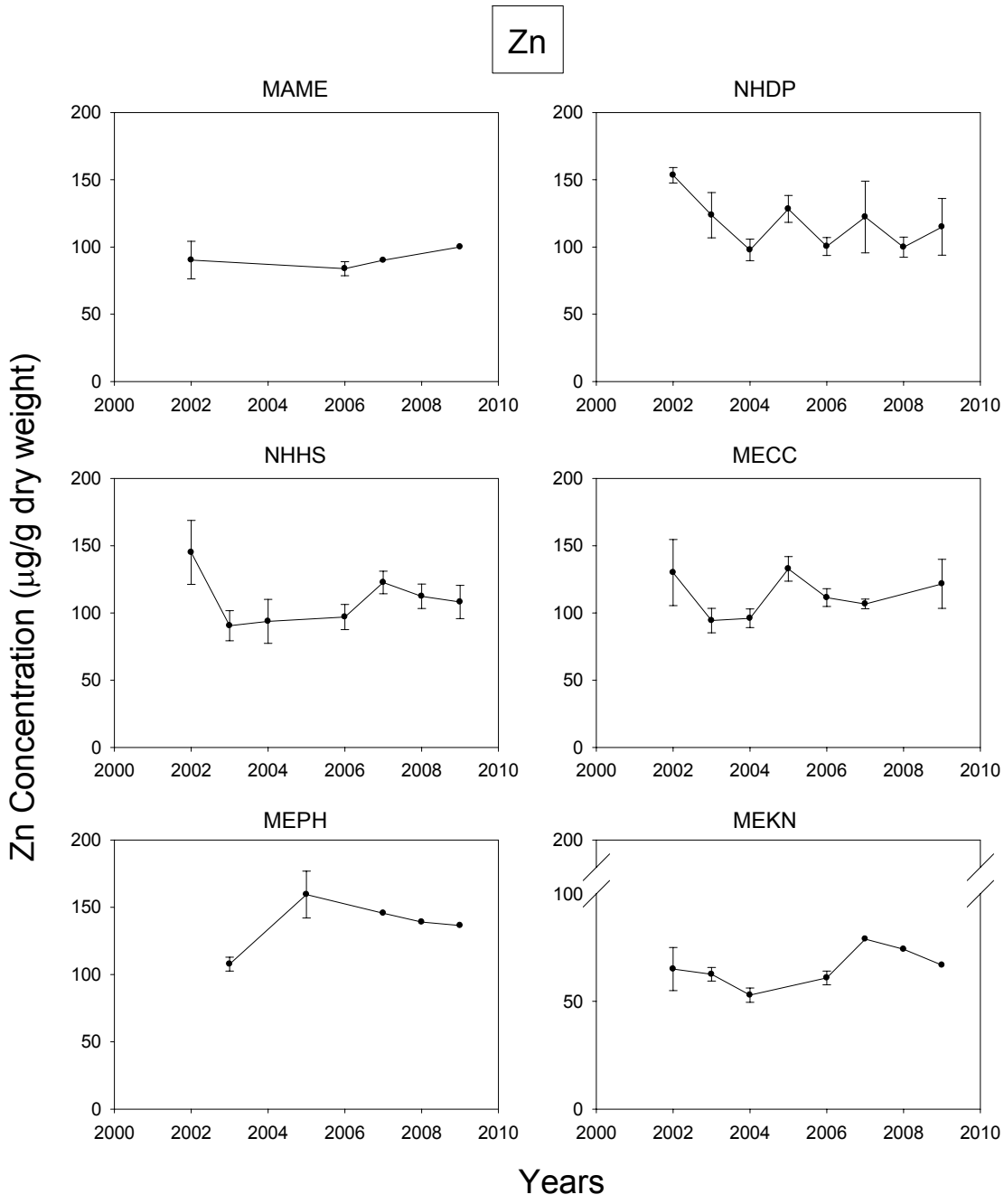

Figure 24. Distribution of zinc tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

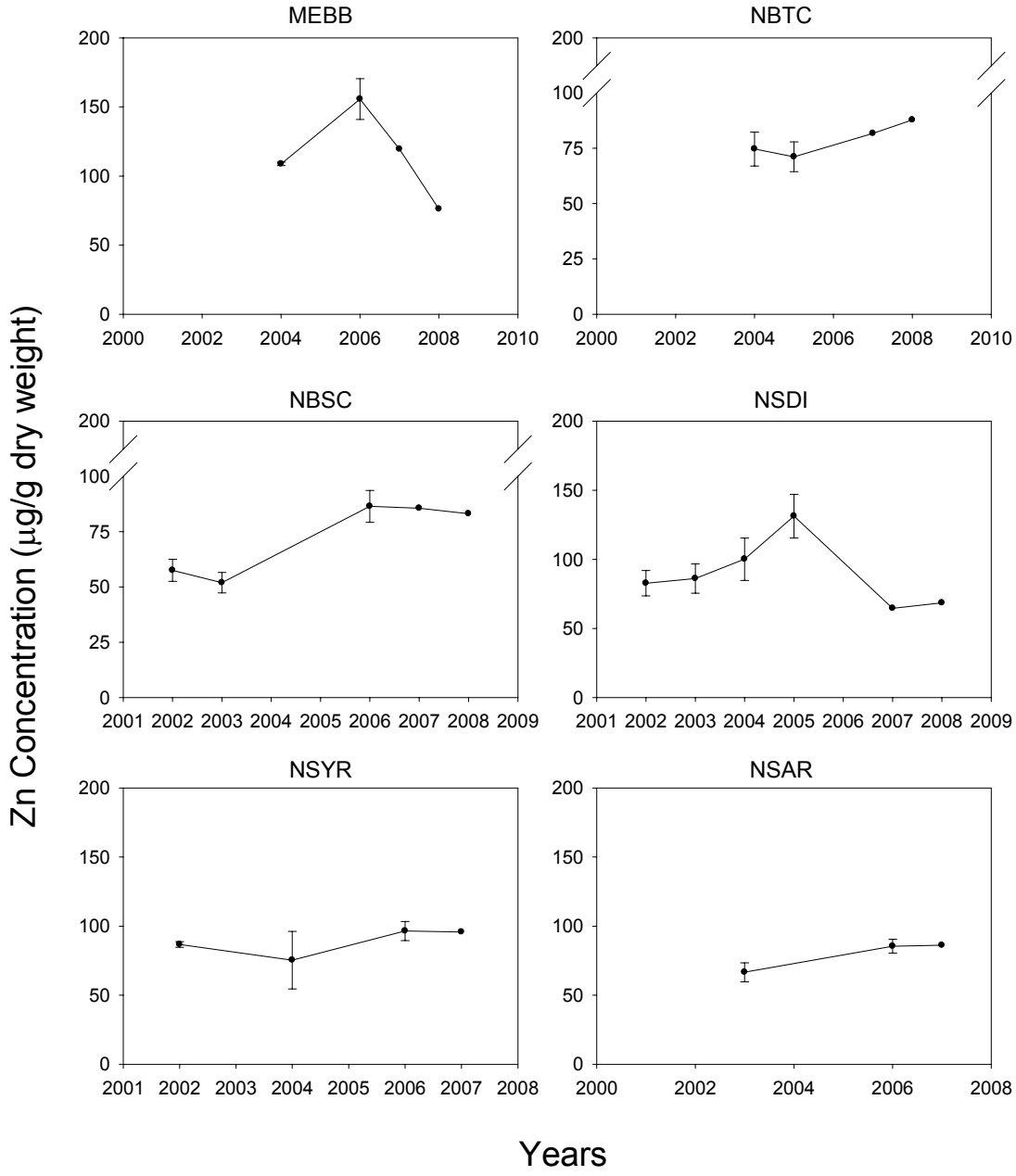

Figure 24 (cont'd). Distribution of zinc tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

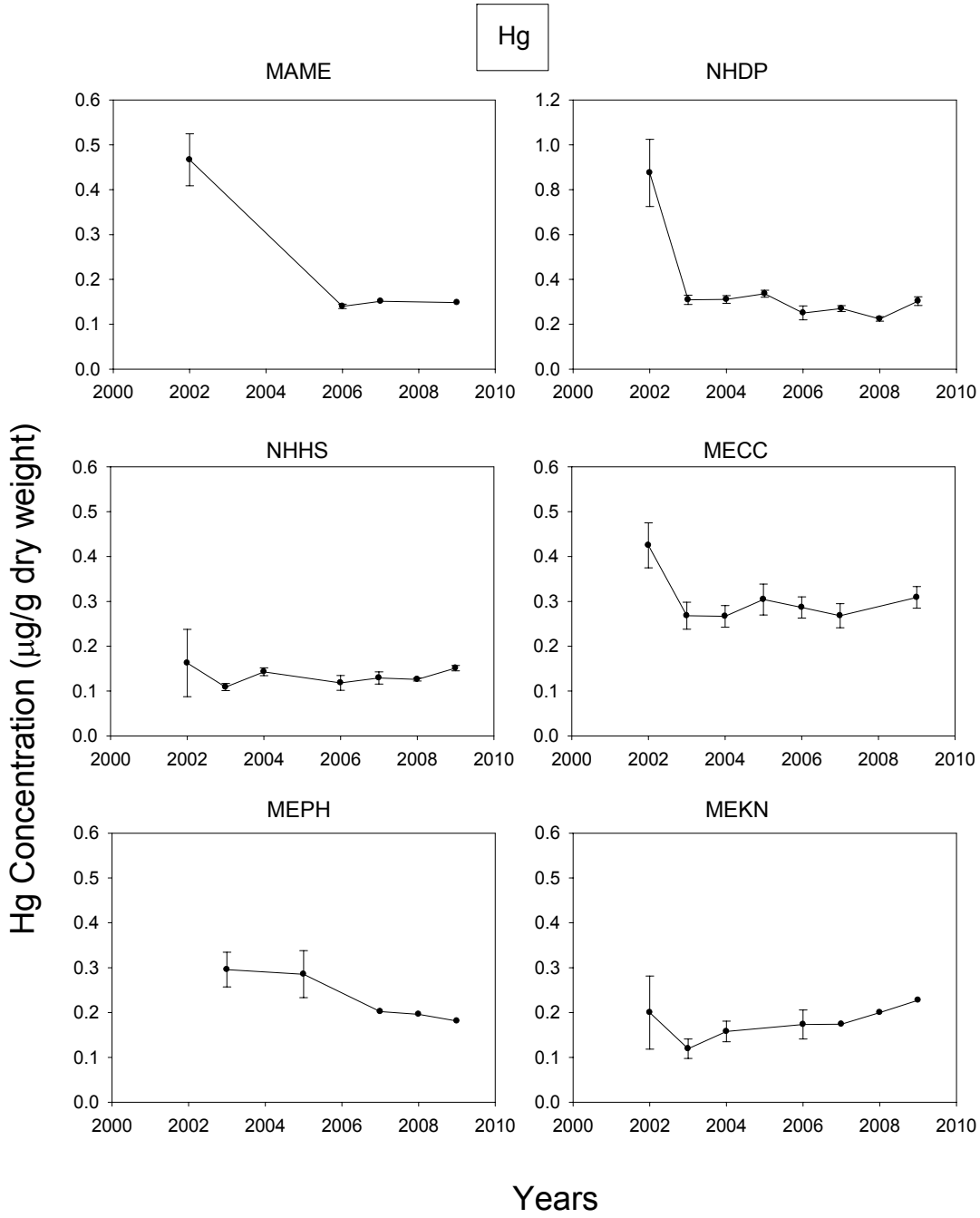

Figure 25. Distribution of mercury tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

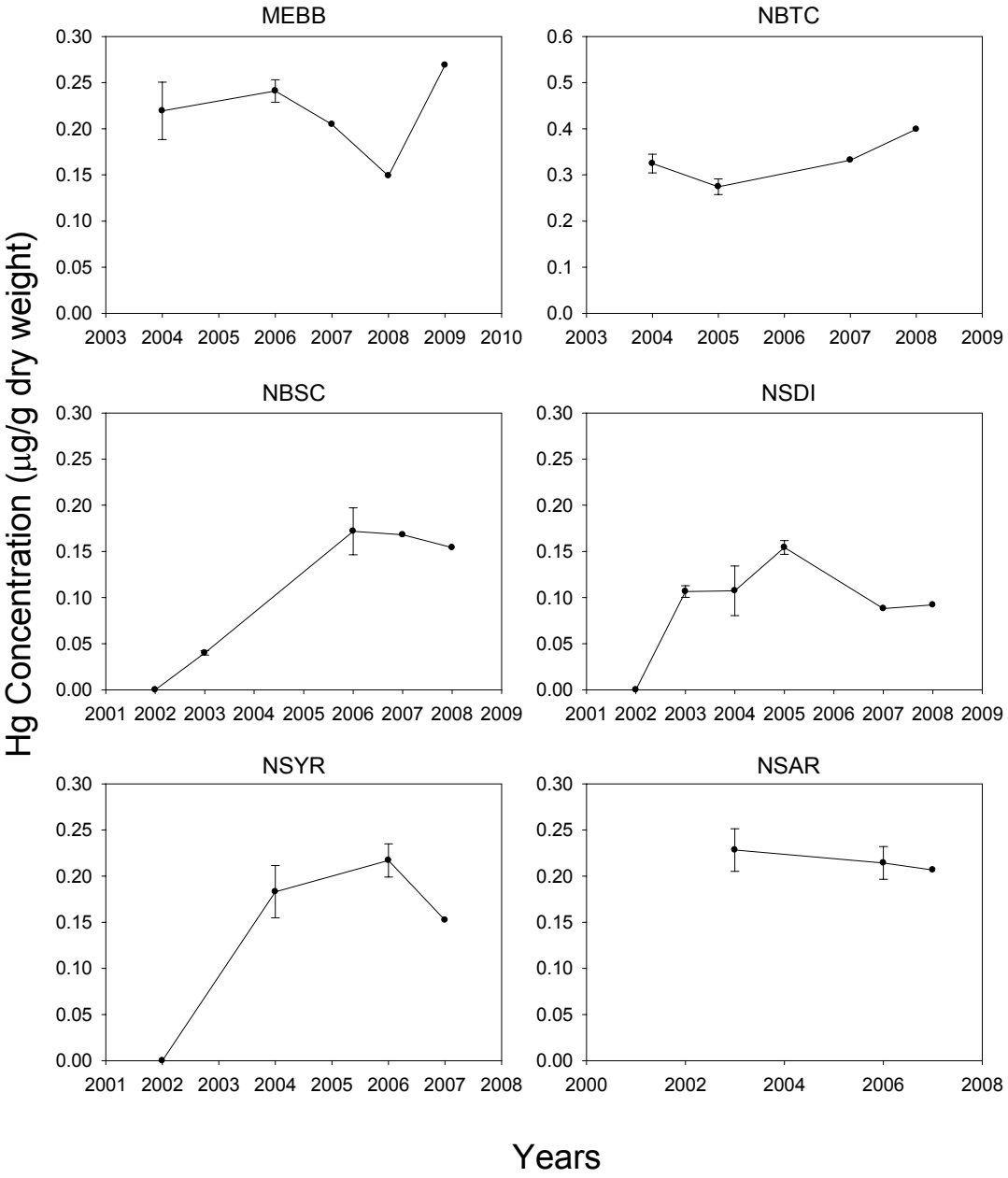

Figure 25 (cont'd). Distribution of mercury tissue concentrations in µg/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

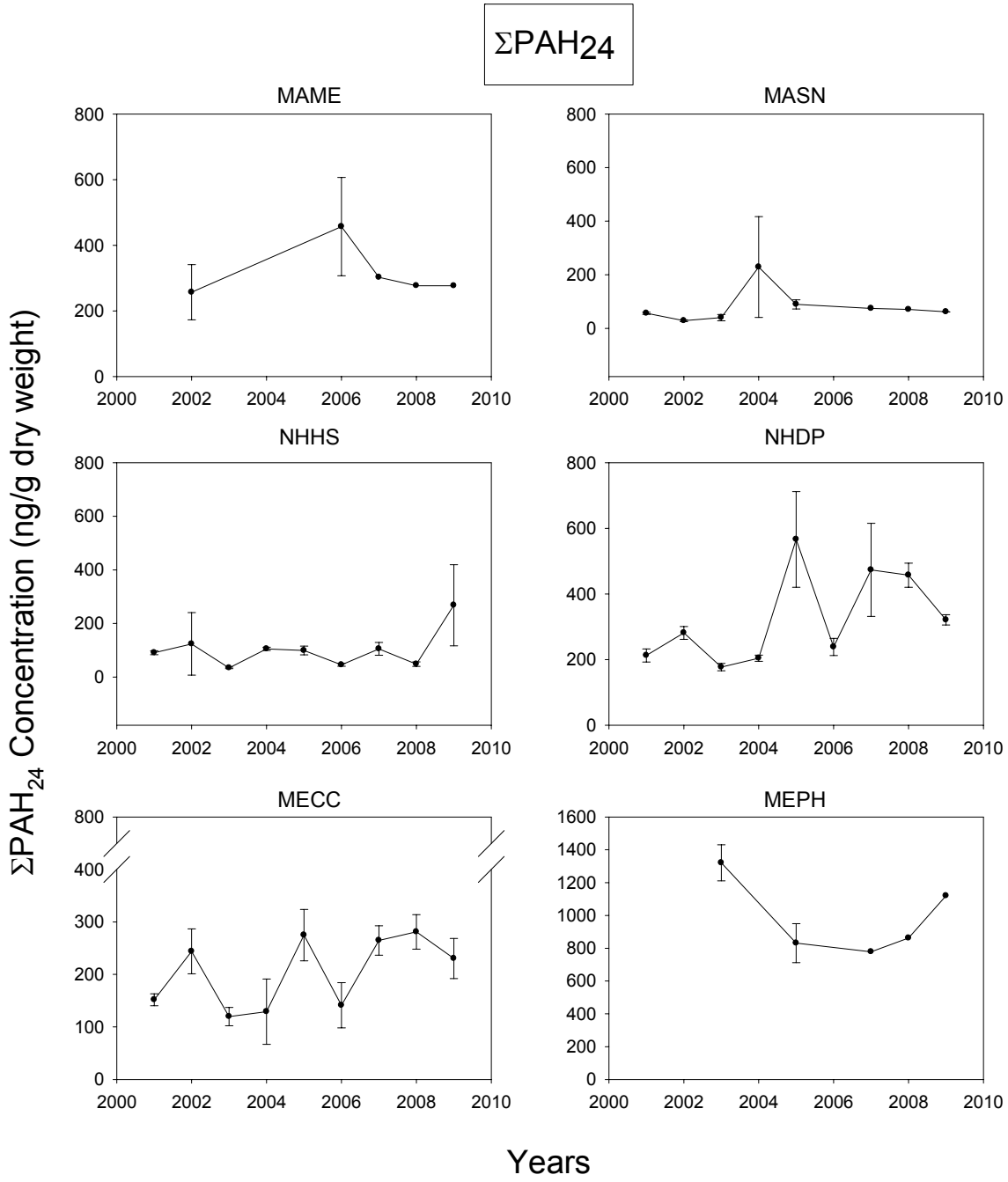

Figure 26. Distribution of the sum of 24 PAH compounds in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

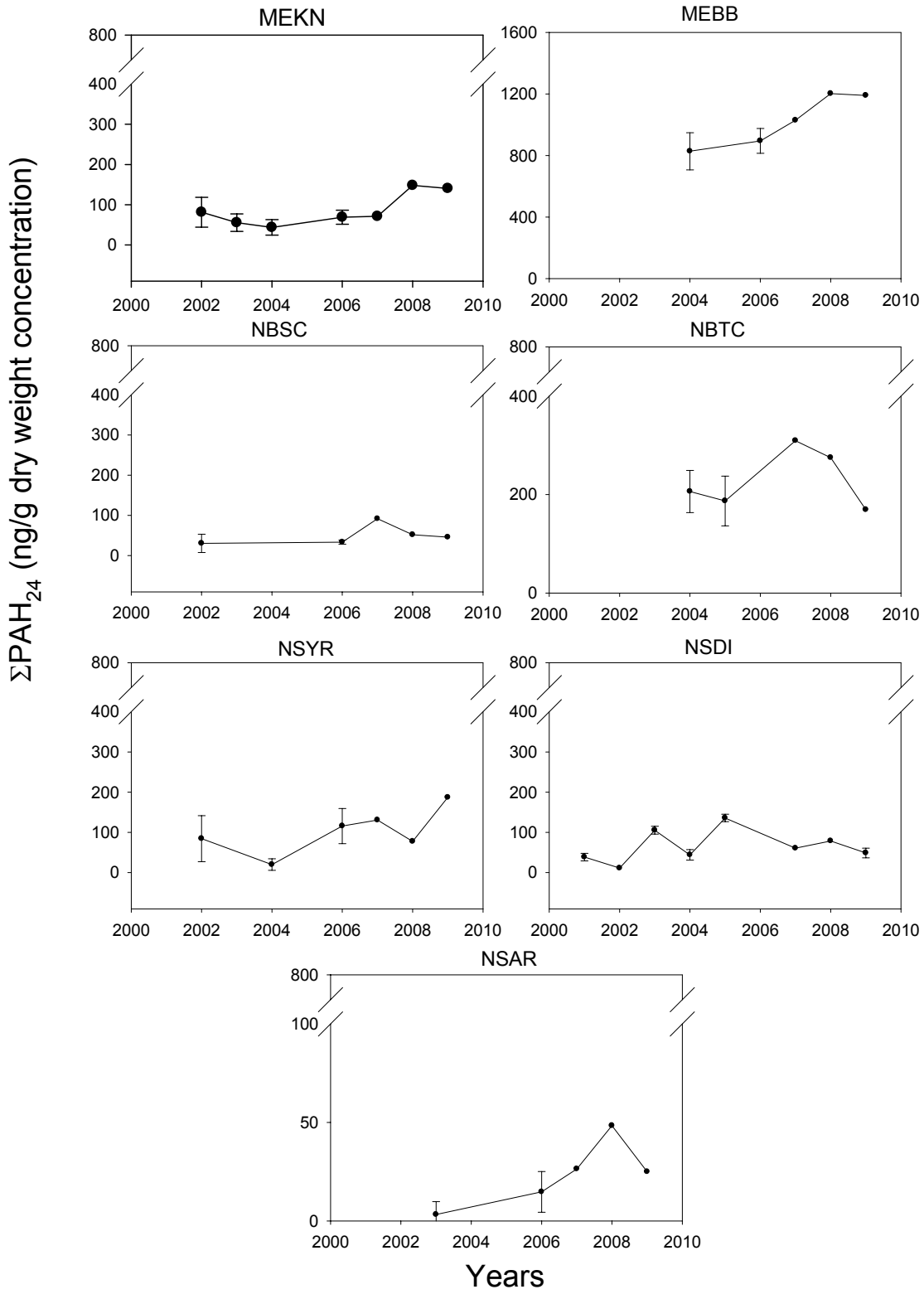

Figure 26 (cont'd). Distribution of the sum of 24 PAH compounds in ng/g dry weight (arithmetic mean ± standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

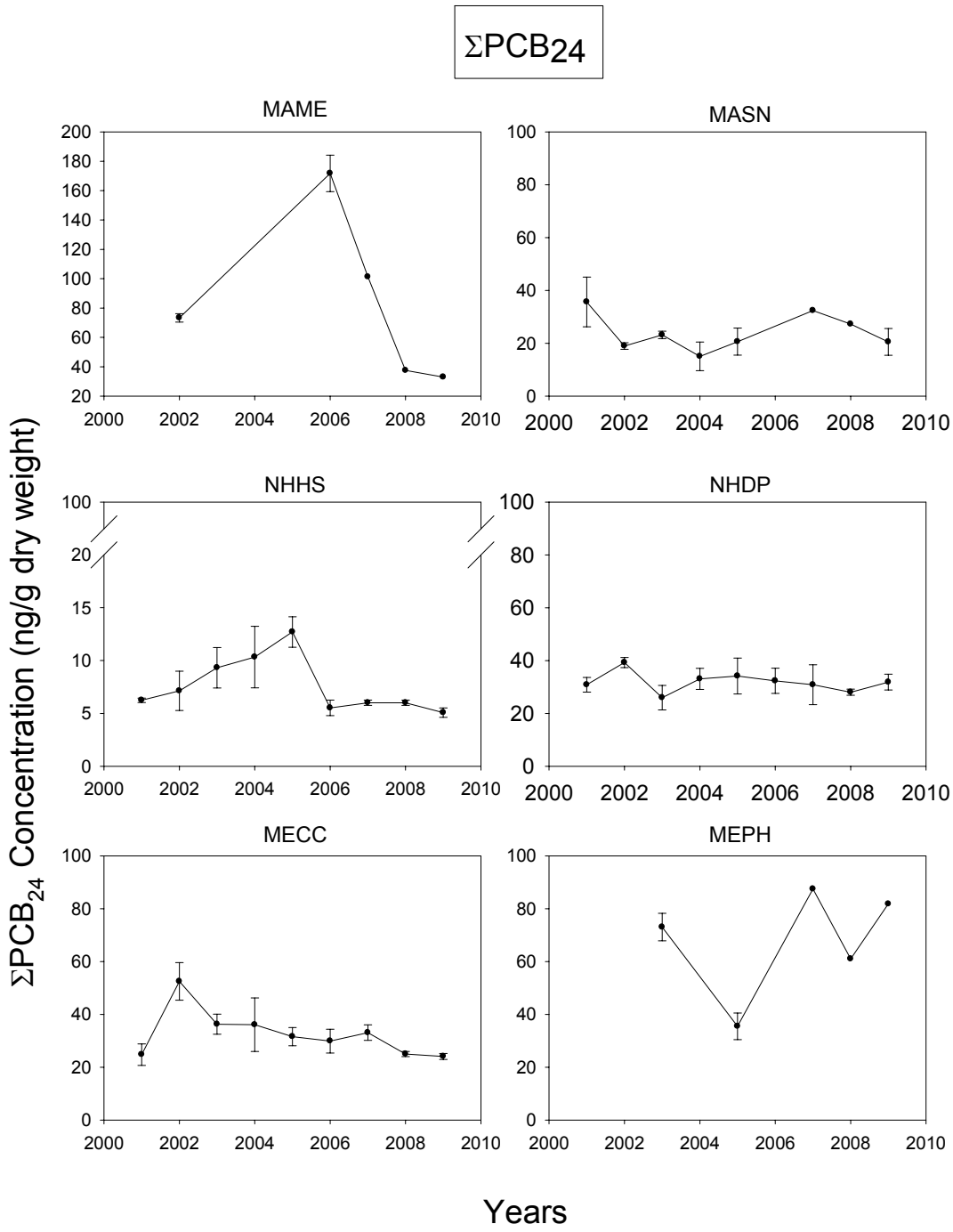

Figure 27. Distribution of the sum of 24 PCB congeners in ng/g dry weight (arithmetic mean $\pm$ standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

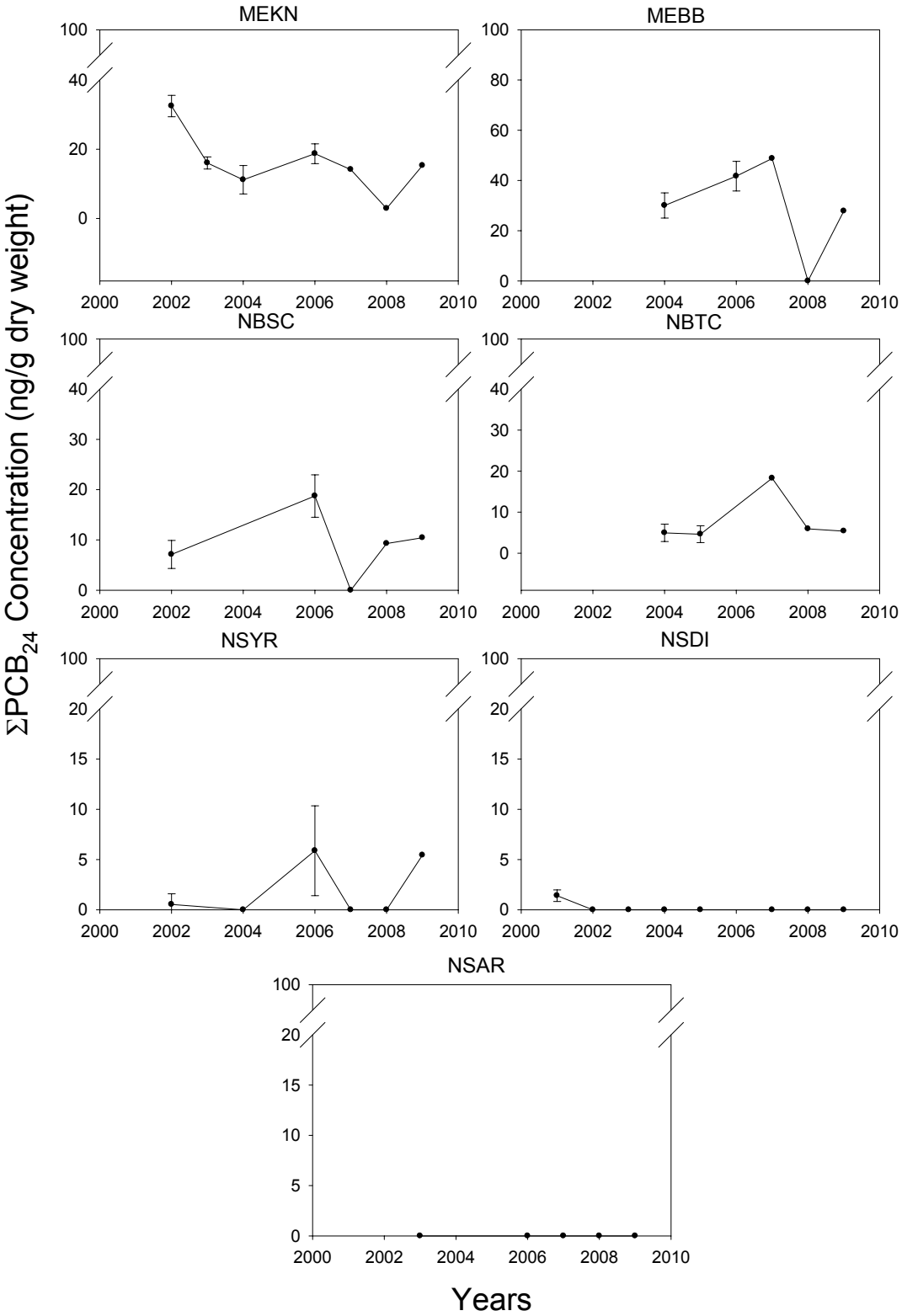

Figure 27 (cont'd). Distribution of the sum of 24 PCB congeners in ng/g dry weight (arithmetic mean $\pm$ standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC. One can observe that PCBs have been not-detected (represented as a zero value) since 2003 at the NSAR site.

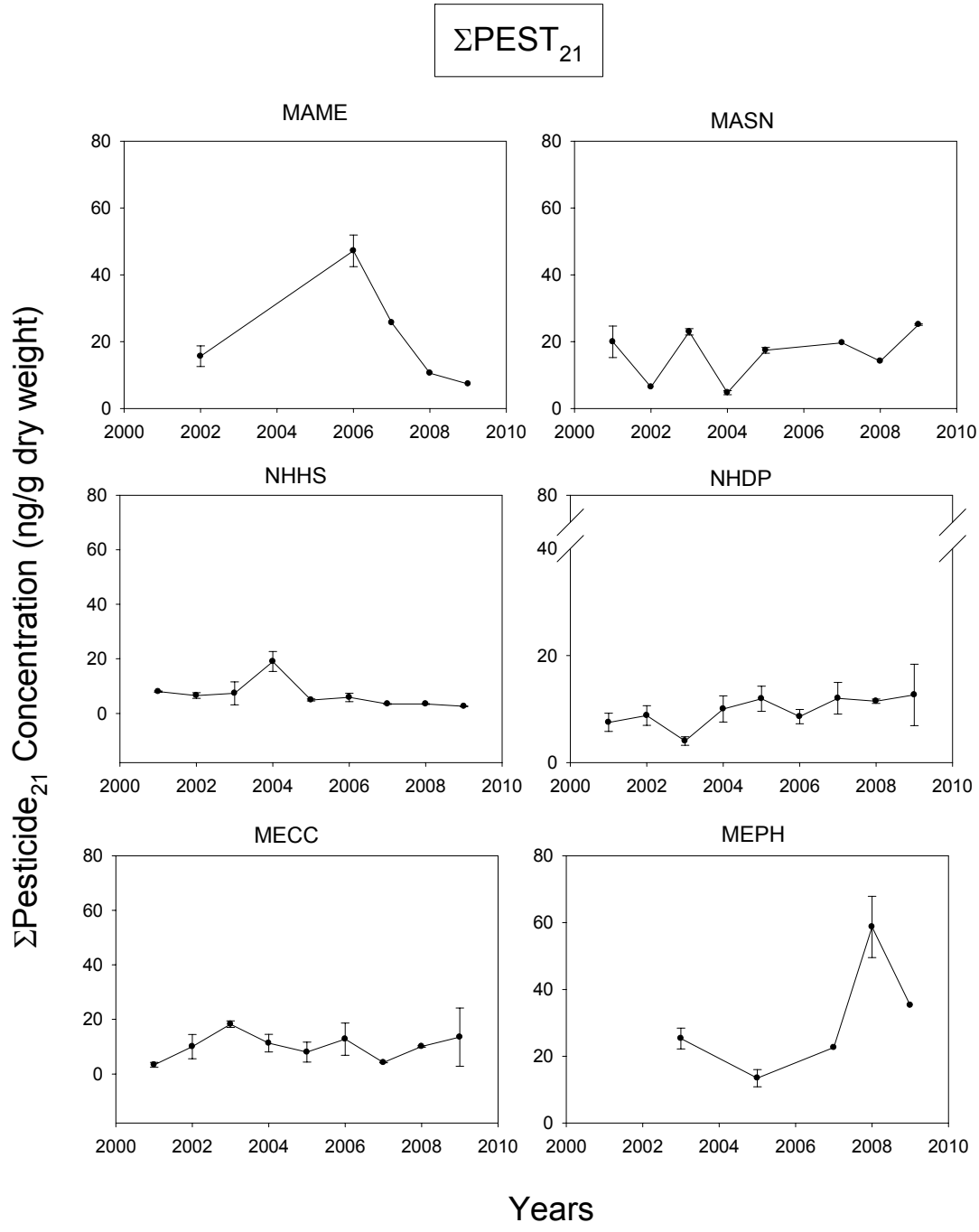

Figure 28. Distribution of the sum of 21 chlorinated pesticide compounds in ng/g dry weight (arithmetic mean $\pm$ standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

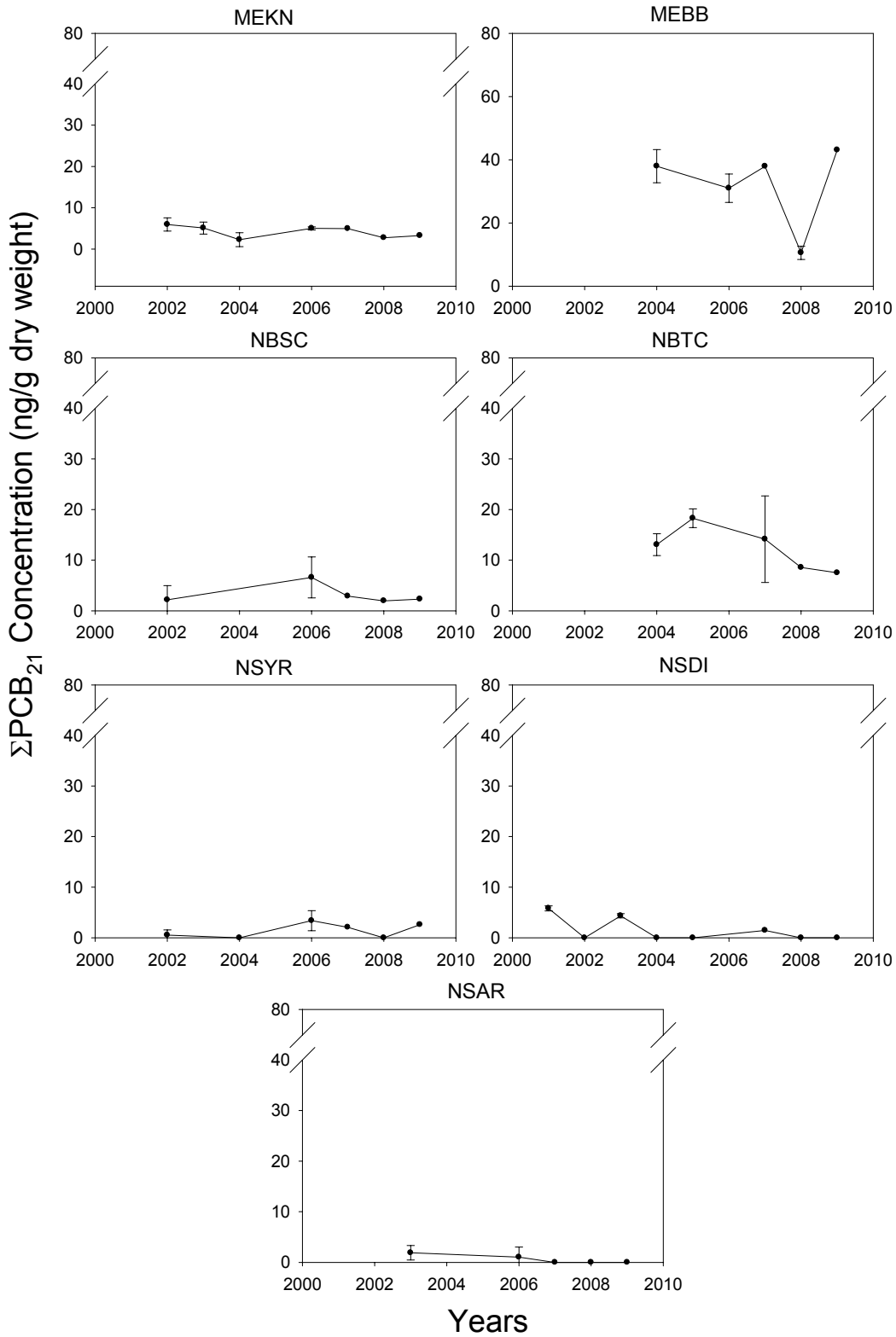

Figure 28 (cont'd). Distribution of the sum of 21 chlorinated pesticide compounds in ng/g dry weight (arithmetic mean $\pm$ standard deviation) in mussels at Gulfwatch trend sites in 2001-2009. For 2007-2009 there are only single site composite values except for stations NHDP, NHHS and MECC.

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, where there are site replicate samples and/or analytical duplicates. These data can be found in table form in Appendices E and F. Percent moisture was between 81.6% - 89.4% of the overall tissue mass. Percent lipid content was between 4.96 and 12.4 % 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 which is similar to the observed mean of 7.16 ± 1.58 % for the Gulfwatch Program for 2009.

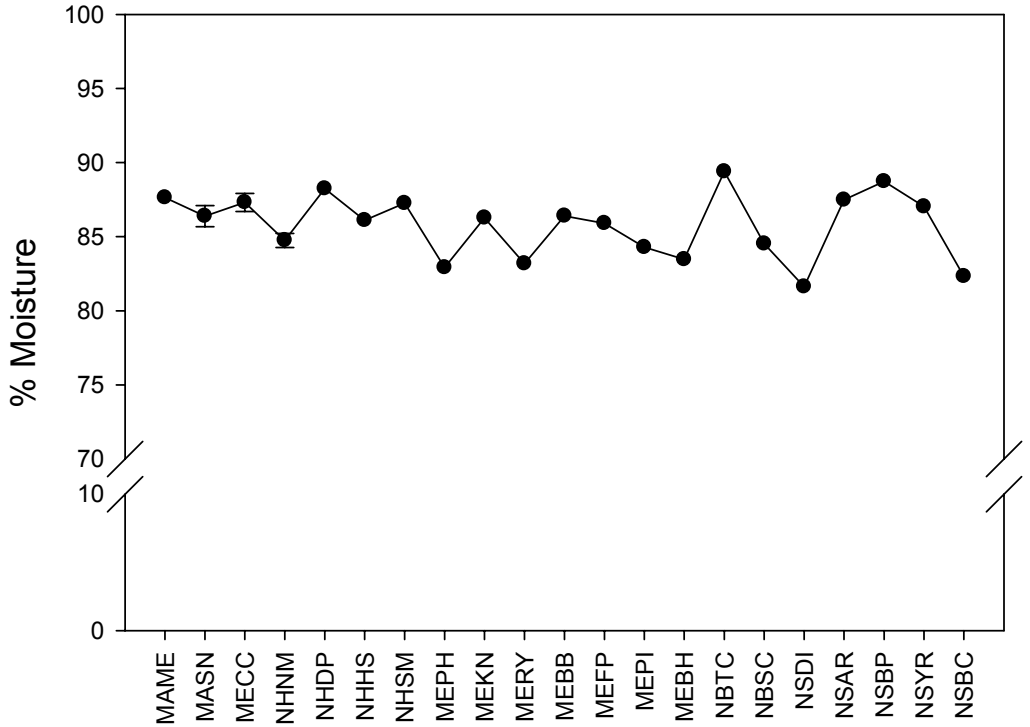

Figure 29. Mean and standard deviation of % moisture in Gulfwatch mussels collected during 2009.

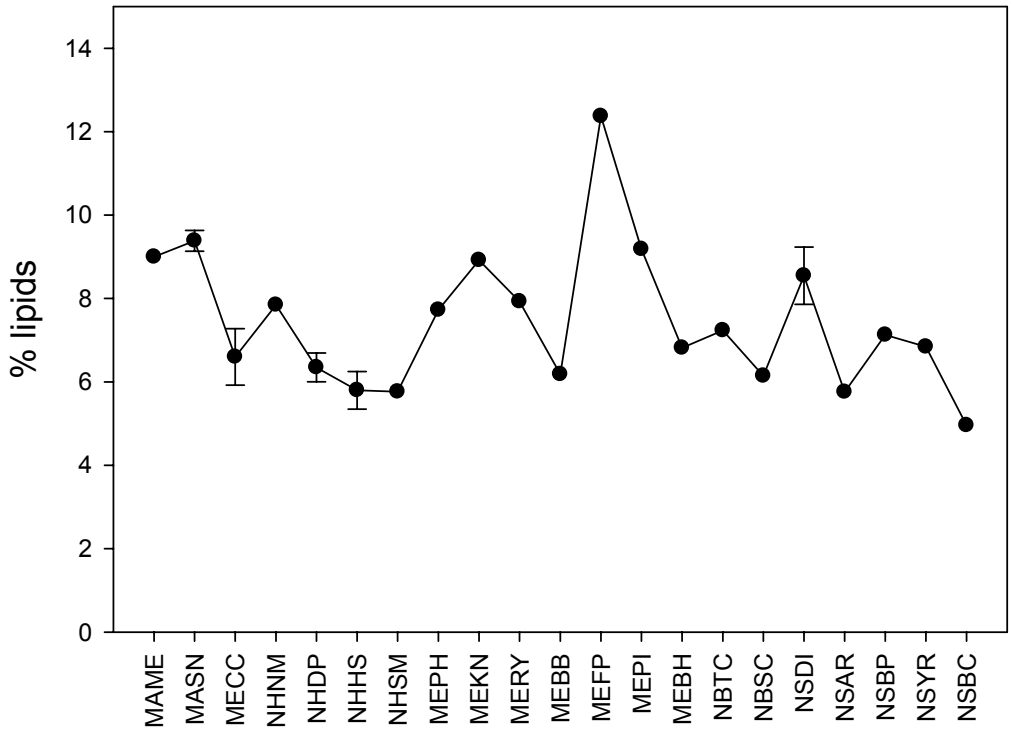

Figure 30. Mean and standard deviation of lipid content (% of tissue dry weight) in Gulfwatch mussels collected during 2009.

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 2009. Mean condition index is plotted for all of the 2009 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 2009 sites was 54.9± 3.45 mm.

Table 9. Morphometric determinations and statistics (arithmetic mean, standard deviation) for mussels collected along the Gulf of Maine, 2009 Gulfwatch.

	CI[1]		Length (mm)		Height[3] (mm)		Width (mm)		
Station	Mean	Stdev[2]	Mean	Stdev	Mean	Stdev	Mean	Stdev	n[4]
MASN	0.176	0.022	49.12	3.33	28.07	1.94	24.59	3.20	20
MAME	0.167	0.023	56.18	3.68	28.32	1.94	24.03	1.83	20
MECC	0.13	0.027	54.72	2.76	28.92	1.48	21.70	1.70	20
NHHS	0.1	0.048	54.7	3.08	29.3	2.33	24.7	2.54	20
NHDP	0.1	0.016	54.4	2.52	27.1	1.83	21.9	1.71	20
NHNM	0.1	0.022	55.8	2.52	28.7	2.27	23.1	2.01	20
NHSM	0.14	0.042	55.6	3.19	29.8	1.43	22.9	1.60	20
MEBB	0.14	0.022	55.99	2.89	30.59	2.54	21.7	1.96	60
MEBH	0.13	0.021	54.32	3.02	27.70	2.17	26.9	2.15	60
MEFP	0.15	0.019	54.65	3.03	28.51	2.21	21.5	1.96	60
MEKN	0.14	0.018	55.43	2.93	28.23	1.97	22.8	1.87	60
MEPH	0.16	0.024	55.88	2.56	28.67	1.85	22.20	1.67	59
MEPI	0.14	0.016	54.66	2.63	27.69	2.13	22.2	1.80	60
MERY	0.18	0.036	55.79	3.1	30.09	1.80	22.2	2.15	60
NBSC	0.11	0.017	54.74	5.14	23.93	2.23	29.4	3.06	20
NBTC	0.10	0.019	51.74	4.82	19.14	2.32	25.6	2.44	20
NSYR	0.15	0.019	54.71	3.02	23.59	2.03	28.86	2.20	20
NSDI	0.17	0.024	56.00	2.88	24.35	2.02	30.65	1.72	20
NSAR	0.14	0.031	54.51	1.60	21.05	1.60	27.10	1.59	20
NSBC	0.13	0.016	56.94	2.30	26.73	2.72	30.61	1.77	20
NSBP	0.14	0.013	55.49	3.13	21.88	1.82	28.91	1.99	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

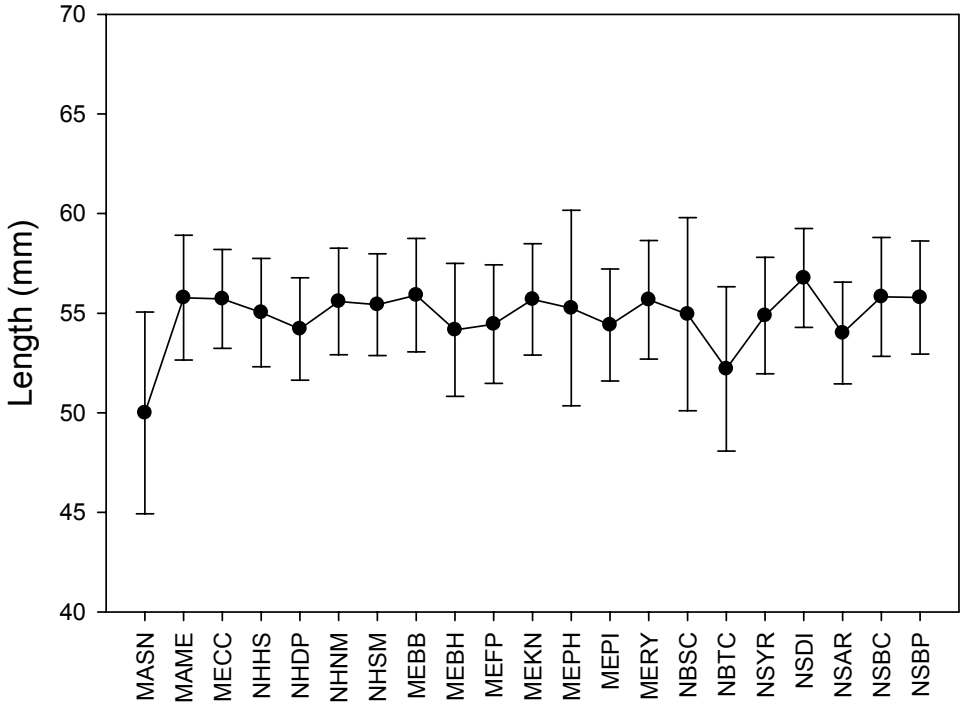

Figure 31. Mean and standard deviation of length (mm) in all Gulfwatch mussels collected for trace metal and organic analysis and archival during 2009.

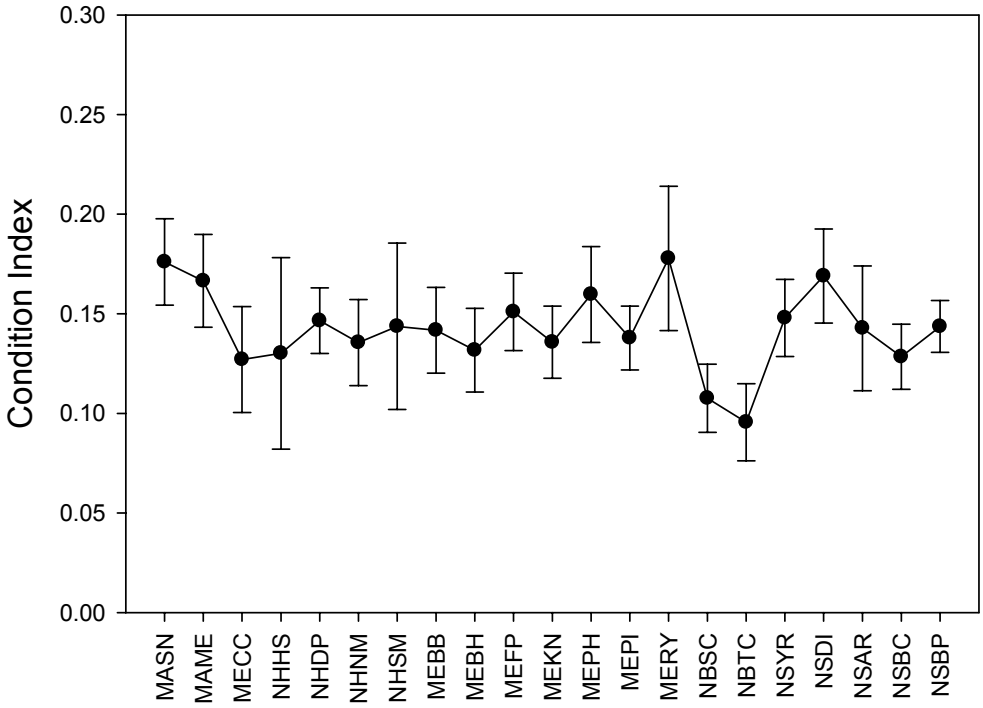

Figure 32. Mean and standard deviation condition index of Gulfwatch mussels collected during 2009.

5.0 2009 GULFWATCH SUMMARY

Monitoring of contaminants in the soft tissues of *M. edulis* from Massachusetts to Nova Scotia in the 18th 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 2009 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), nine other trend sites and ten rotational sites (to be visited once every 6 years). Four sites originally planned for sampling – MAPY and MABY in Massachusetts and NBLB and NBHI in New Brunswick were found to have insufficient quantities of mussels. MASN in Massachusetts only had enough mussels for archiving and for organic analysis. Softshell clams were sampled at one site in New Hampshire (NHFP). Samples were collected, processed, and analyzed in accordance with program QC/QA protocols. All data associated with the 2009 samples are provided in the accompanying appendices.

The Gulfwatch 2009 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.

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 MAME in Massachusetts, NHSM and NHNM in New Hampshire, MECC, MEBB, and MEPH in Maine, NBTC in New Brunswick and NSYR and NSAR in Nova Scotia. Mercury was found to be elevated at 16 of the 25 Gulfwatch sites sampled, with maxima seen in all jurisdictions. The highest Hg concentrations were found in mussels from Tin Can Beach (NBTC) in New Brunswick, 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 six 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 Gulfwatch monitoring detected elevated concentrations of lead 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 MEPI in Maine, which was elevated above the national median

concentrations. Elevated mercury concentrations were also found in New Brunswick and Nova Scotia, with only Digby and Barrington Passage in Nova Scotia not exceeding the NS&T 85th percentile value, and NBTC in New Brunswick having the highest tissue Hg concentrations of all Gulfwatch sites. In Canada, elevated levels of aluminum were found at Tin Can Beach and the St. Croix in New Brunswick (NBTC and NBSC) and at the Apple River site in Nova Scotia (NSAR). Elevated chromium was found at NBTC in New Brunswick, and 19 of 25 sites throughout the entire region had concentrations higher than the NS&T national median value.

Organic contaminants were highest overall in New Hampshire and Maine sites. No sites exceeded the NS&T 85th percentile value for the three summed PAH quantities, although 7 of the 12 sites in New Hampshire and Maine had concentrations that were higher than the NS&T median concentration. The Merrimack River site in Massachusetts also had PAH concentrations that exceeded the NS&T median values. The highest summed PAH concentrations were found at the North Mill Pond site in New Hampshire, at Portland Harbor and Boothbay Harbor sites in Maine (MEPH and n MEBB). PCB concentrations were higher in Massachusetts, New Hampshire and Maine relative to New Brunswick and Nova Scotia, with MAME, NHNM, NHDP, NHSM and MEPH sites having concentrations higher than the NS&T median value. No sites had PCB concentrations considered to be of concern (i.e., higher than the NS&T 85th percentile). The highest tissue concentration (81.8 ng/g) was found at the Portland Harbor, ME site (MEPH). The summed chlorinated pesticide values were primarily made up of the sum of the DDT metabolites DDE and DDD. No sites had values exceeding the NS&T 85th percentile although the Sandwich, MA site (MASN), the North Mill Pond and South Mill Pond, NH sites and the Portland and Boothbay Harbor, ME sites had values higher than the NS&T median value.

While there were no sites that could be considered a hot spot, Tin Can Beach, NB stands out as in past years for having among the highest concentrations of a number of metals (Cr, Ni, Al, Hg). For organic contaminant concentrations, North Mill Pond, NH, and Portland Harbor and Boothbay Harbor, ME have among the highest concentrations of PAHs, PCBs, pesticides, and mercury relative to the other sites.

When the Gulf of Maine Council was formed, it recognized the need to provide all jurisdictions with contaminant information to enable improved capability to assess, understand, and, where necessary, respond to issues involving contaminants, ecosystem health, and human health. Thus, the GOMC created the Gulfwatch Program which is the only marine contaminant monitoring program conducted jointly by the United Sates and Canada. Gulfwatch continues to monitor contaminants in the Gulf of Maine to address the goals established by the Council and articulated in their 2007-2012 Action Plan. The program continues to refine temporal and spatial sampling and analytical protocols to provide information for coastal resource managers who make decisions on issues related to contaminants in near shore waters of the Gulf of Maine. The Gulfwatch 2009 data report provides contaminant information for this purpose and to inform researchers and others living around the Gulf of Maine Environment.

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7.0 ACKNOWLEDGEMENTS

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APPENDIX A: Sample Collection Information

Table A1. 2009 Gulfwatch sample identification numbers, replicates, sampling dates, species collected and site comments.

		Date	Organism	2009	Comments
Sample ID	**Sample Type**	**Sampled**	**Collected**	Sampling status	
MABI	NA	NA	Mytilus edulis	NO	no mussels present
MAME	Site composite	10/13/2009	Mytilus edulis	YES	
MASN	Site composite	10/12/2009	Mytilus edulis	NO	not enough mussels
MASN DUP	Analytical duplicate	10/12/2009	Mytilus edulis	YES	
NHHS-COMP	Site composite	9/24/2009	Mytilus edulis	YES	NHDES
NHHS-1N	Site replicate	9/24/2009	Mytilus edulis	YES	NHDES
NHHS-1N DUP	Analytical duplicate	9/24/2009	Mytilus edulis	YES	NHDES
NHHS-2N	Site replicate	9/24/2009	Mytilus edulis	YES	NHDES
NHHS-3N	Site replicate	9/24/2009	Mytilus edulis	YES	NHDES
NHSM	Site composite	9/24/2009	Mytilus edulis	YES	
NHNM	Site composite	9/24/2009	Mytilus edulis	YES	
NHDP-COMP	Site composite	9/24/2009	Mytilus edulis	YES	NHDES
NHDP-1N	Site replicate	9/24/2009	Mytilus edulis	YES	NHDES
NHDP-2N	Site replicate	9/24/2009	Mytilus edulis	YES	NHDES
NHDP-3N	Site replicate	9/24/2009	Mytilus edulis	YES	NHDES
MECC-COMP	Site composite	9/24/2009	Mytilus edulis	YES	
MECC-1N	Site replicate	9/24/2009	Mytilus edulis	YES	
MECC-2N	Site replicate	9/24/2009	Mytilus edulis	YES	
MECC-3N	Site replicate	9/24/2009	Mytilus edulis	YES	
NHFP	Site composite	6/3/2009	*Mya arenaria*	YES	NHDES
MEBH-COMP	Site composite	9/23/2009	Mytilus edulis	YES	
MEPH	Site composite	9/22/2009	Mytilus edulis	YES	
MEKN	Site composite	9/15/2009	Mytilus edulis	YES	

Table A.1 (continued)

		Date	Organism	2009	Comments
Sample ID	**Sample Type**	**Sampled**	**Collected**	Sampling status	
MERY	Site composite	9/16/2009	Mytilus edulis	YES	
MEBB	Site composite	9/14/2009	Mytilus edulis	YES	
MEPI	Site composite	9/28/2009	Mytilus edulis	YES	
MEFP	Site composite	9/30/2009	Mytilus edulis	YES	
NBSC-comp	Site composite	10/21/2009	Mytilus edulis	YES	
NBTC-comp	Site composite	10/23/2009	Mytilus edulis	YES	
NBLB	NA	NA	NA	NO	no mussels present
NBHI	NA	NA	NA	NO	no mussels present
NSYR - comp	Site composite	10/15/2009	Mytilus edulis	YES	mussels now depleted
NSDI-comp	Site composite	10/16/2009	Mytilus edulis	YES	
NSDI-Dup	Analytical duplicate	10/16/2009		YES	
NSAR	Site composite	10/13/2009	Mytilus edulis	YES	
NSBP-comp	Site composite	10/15/2009	Mytilus edulis	YES	
NSBC-comp	Site composite	10/16/2009	Mytilus edulis	YES	

Table A.2. Latitude and longitude for Gulfwatch 2009 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"
New Hampshire						
NHHS	Hampton/Seabrook Harbor	Trend (multi-yr)	42.89717	70.8163	42° 53' 49.812"	70° 48' 58.787"
NHSM	South Mill Pond	Rotational-Occasional	43.07270	70.74890	43° 4' 21.794"	70° 44' 56.04"
NHNM	North Mill Pond	Rotational-Occasional	43.07500	70.7600	43° 4' 30"	70° 45' 36"
MECC	Clark Cove	Trend (**Benchmark**)	43.07740	70.7244	43° 4' 38.6394"	70° 43' 27.84"
NHDP	Dover Point	Trend (multi-yr)	43.11960	70.8267	43° 7' 10.5594"	70° 49' 36.12"
NHFP	Fox Point	Rotational-Occasional	43.12015	70.8589	43° 7' 12.54"	70° 51' 32.04"
Maine						
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"
MEKN	Kennebec River	Trend (**Benchmark**)	43.78500	69.7845	43° 47' 5.9994"	69° 47' 4.1994"
MERY	Royal River	Rotational-Occasional	43.79700	70.14550	43° 47' 49.199"	70° 8' 43.799"
MEBB	Boothbay Harbor	Trend (multi-yr)	43.85067	69.6727	43° 51' 2.412"	69° 40' 21.72"
MEPI	Pickering Island	Rotational-Occasional	44.26050	68.73317	44° 15' 37.8"	68° 43' 59.41"
MEFP	Penobscot River	Rotational-Occasional	44.46950	68.81017	44° 28' 10.199"	68° 48' 36.611"
New Brunswick						
NBSC	St. Croix River	Trend (multi-yr)	45.16750	67.1638	45° 10' 2.999"	67° 9' 49.679"
NBTC	Tin Can Beach	Trend (multi-yr)	45.26250	66.0570	45° 15' 45"	66° 3' 25.2"
Nova Scotia						
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"
NSFI	Five Islands	Spatial	45.39750	64.0660	45° 23' 51"	64° 3' 57.6"
NSAR	Apple River	Trend (multi-yr)	45.47000	64.8350	45° 28' 11.999"	64° 50' 5.999"
NSBP	Barrington Passage	Occasional	43.51917	65.62267	43° 31' 9.012"	63° 37' 21.611"
NSBC	Broad Cove	Rotational	44.66533	65.83083	44° 39' 55.187"	65° 49' 50.988"

Table A.3. 2009 Gulfwatch Program sample list

	Organics analysis	Metals analysis	Organics archive	Metals archive	SAMPLED?	NOTES
Massachusetts						
MAME	1	1	3	3	YES	
MASN	1	0	3	0	YES	
MABI	0	0	0	0	NO	
MAPY	0	0	0	0	NO	
New Hampshire						
MECC	3	4	0	0	YES	
NHDP	3	4	0	0	YES	
NHHS	3	4	0	0	YES	
NHSM	1	1	3	3	YES	
NHNM	1	1	3	3	YES	
NHFP	1	1	0	0	YES	No GW clams
Maine						
MEPH	1	1	3	3	YES	
MEKN	1	1	3	3	YES	
MERY	1	1	3	3	YES	
MEBB	1	1	3	3	YES	
MEBH	1	1	3	3	YES	
MEFP	1	1	3	3	YES	
MEPI	1	1	3	3	YES	
New Brunswick						
NBTC	1	1	3	3	YES	
NBSC	1	1	3	3	YES	
NBLB	0	0	0	0	NO	
NBHI	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	
NSBC	1	1	3	3	YES	
NSBP	1	1	3	3	YES	
Totals	28	30	54	51		

MEMORANDUM

TO: Dr. Stephen Jones, UNH

FROM: Philip Trowbridge, NHDES 2009

RE: Gulfwatch Samples

DATE: December 31, 2009

The purpose of this memorandum is to document the sample collection activities for Gulfwatch 2009.

On September 24, 2009, NHDES managed the collection of mussel samples from 5 sites. These sites are summarized in the following table. In the table, the coordinates for the replicates are listed in the order of replicate number, where applicable. Maps showing the location of each site are provided in Appendix A.

Date / Time	Station	Latitude (Decimal degrees)	Longitude (Decimal degrees)	Water Temperature (deg C)	Water Salinity (ppt)	Personnel
9/24/09 0925	MECC – Clarks Cove, Kittery, ME	43.07746 43.07749 43.07749	-70.72409 -70.72385 -70.72345	16.2	29.4	P. Trowbridge P. Lisichenko
9/24/09 1000	NHHS - Hampton/ Seabrook Harbor, Hampton, NH	42.89740 42.89734 42.89726	-70.81643 -70.81641 -70.81644	18.2	28.2	T. Walsh C. Dolan J. Brochi S. Kliman
9/24/09 1115	NHDP – Dover Point, Dover, NH	43.11967 43.11960 43.11953	-70.82710 -70.82693 -70.82706	18.7	26.5	T. Walsh C. Dolan J. Brochi S. Kliman
9/24/09 0845	NHNM – North Mill Pond, Portsmouth, NH	43.07962 43.07968 43.07964	-70.76527 -70.76535 -70.76535	17.5	30.1	M. Wood D. Sowers C. Shuman
9/24/09 1000	NHSM – South Mill Pond, Portsmouth, NH	43.07302 43.07296 43.07289	-70.74977 -70.75000 -70.75013	19.5	30.8	M. Wood D. Sowers C. Shuman

Sample collection and processing was conducted following NH Gulfwatch SOPs (Appendix B). Samples were processed and frozen at the UNH Jackson Estuarine Laboratory within 36 hours of collection.

Physical data on the mussels were transferred from hard copy datasheets to Excel spreadsheets. Data entry was checked twice for transcription errors following NHDES protocols. The physical data for the samples is provided in Appendix C. The original datasheets will be kept on file at NHDES.

If you have any questions about this report, please contact me at (603) 271-8872 or Philip.Trowbridge@des.nh.gov.

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

GULFWATCH STATION INFORMATION

The following are memos concerning the 2009 Gulfwatch sampling in New Brunswick and Nova Scotia

NEW BRUNSWICK

-----Original Message----- From: Thorpe, Bruce (DAA/MAA) [
Sent: October 27, 2009 9:32 AM

I have collected mussels from Tin Can Beach in Saint John, as well as the St. Croix samples. They have yet to be couriered to Shawn Roach at BIO. I have been unable to find any adequate population of mussels for sampling at the other 2 sites (NBHI, NBLB). I am not sure why? It sounds like time is a factor this year if we wish to swap samples at the meeting next week. I can send the 2 sites I have now to Shawn and he could process those this week. I am not sure how you would like to proceed with the other 2 sites (NBHI & NBLB). In the past years we have had to dive to find mussels at these sites, we may possibly find mussels without diving during an extreme low tide, but that is not going to happen in the next week or so.

From: Steve Jones
Sent: Tuesday, October 27, 2009 2:22 PM

NBLN is in close proximity to NBLB and is further up near the head of the Letang Estuary, as opposed to NBLB that is located near the mouth of the estuary"

Does it make sense to replace NBLN with NBLB? for some reason we went the other way in this case.

Oct 27, 2009, at 1:47 PM, Thorpe, Bruce (DAA/MAA) wrote:

Steve

Sorry for any inconvenience. I think the biggest reason we cannot find mussels at NBHI is the large eider duck population that is in the area. As far as replacing NBLN with NBLB I do not think it really matters one way or the other.

-----Original Message----- From: Gunnar Lauenstein [mailto:Gunnar.Lauenstein@noaa.gov] Sent: Tue 9/29/2009 8:47 AM To: Krahforst, Christian (EEA) Cc: Kimani.Kimbrough@noaa.gov Subject: Re: Mussel beds disappearing? Christian, We also had a Mussel Watch site on Brewster Island and our contractor was not able to find enough mussels there for a sample in 2009. So, for at least this case we have apparently lost a long term monitoring site. Gunnar Krahforst, Christian (EEA) wrote: >

Hey Gunnar, > > Are you seeing a "disappearance" of Mytilus beds at any of your sites? We've noticed that all of our mussels in Outer Brewster (Boston Harbor), Plymouth (Manomet Point), Sandwich (Town Beach) and Marblehead are altogether all but gone! We've been noticing a decline at the more "clean" areas for a few years now. Anything like that on your end? > > Christian Krahforst | Staff Scientist | Massachusetts Bays National Estuary Program | 251 Causeway Street | Suite 800 | Boston, MA 02045 | 617.626.1216 | Fax: 617.616.1240 > ??Please consider the environment before printing this e-mail >

From: TAYLORDL@gov.ns.ca
Subject: Gulfwatch 2008 - Depleted mussel stocks at Yarmouth site
Date: October 20, 2008 4:13:56 PM EDT

Fellow NS Gulfwatch participants and US colleagues,

This is to advise and document for future sampling efforts that although we collected enough mussels for this year (3 X 60 + mussels), mussel stocks have been depleted at this Yarmouth site. Only a handful of mussels remain, but with green crabs abounding.

Mussels were very localized and found only on a couple of rocks in the area - otherwise mud flats dominated the site. Between our harvesting and the crab predation we will have to look for another site in subsequent years. Andy Bagnall suggests that the local NSDFA Fisheries Rep may be able to scout out another site in future.

Hope others have found a more sustainable site and stock of mussels.

Steve, the mussels were delivered to Shawn at BIO on October 16th for processing. Alan T has provided Shawn with a field sheet with particulars of our sampling for this year for his collective files for the NS Gulfwatch program.

Thanks Shawn, Alan, and Andy for your help getting the Yarmouth site sampled this year.

All the best,

Darrell

On Sep 24, 2008, at 1:49 PM, Darrell L Taylor wrote:

Gareth will be doing Five Islands and Apple River. The two Peters
will
be doing Digby - and maybe alternate / additional reference site
to
replace Briar Island *(which was void of mussels last year). **********
Darrell Taylor

APPENDIX B: 2009 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 2009, which included additional alkyl-substituted polycyclic aromatic hydrocarbon (PAH) analytes.

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

PAHs		PCBs		Pesticides	
	Detection		**Detection**		**Detection**
Analyte	**Limit**	**Analyte**	**Limit**		**Limit**
	(ng/g)	**(congener #)**	**(ng/g)**	**Analyte**	**(ng/g)**
Naphthalene	<10	8;5	<2.8	α–BHC	<2.0
C1-Naphthalenes	<8	18;15	<2.7	HCB	<2.4
Biphenyl	<10	29	<2.2	γ-HCH(Lindane)	<1.5
C2-Naphthalene	<8	50	<2.4	Heptachlor	<2
Acenaphthylene	<11	28	<2.4	Aldrin	<1.5
Acenaphthene	<8	52	<2	Heptachlor Epoxide	<1.8
C-3 Naphthalene	<7	44	<2.3	γ-Chlordane	<1.5
Fluorene	<7	66;95	<2.2	o,p'-DDE	<1.0
C1- Fluorene	<7	101;90	<2.2	a-Endosulfan	<1.5
C2-Fluorene	<7	87	<1.9	cis-Chlordane	<1.2
C3- Fluorene	<7	77	<2.3	t-Nonachlor	<1.4
C4-Naphthalene	<7	118	<2	p,p'_DDE	<1.8
Dibenzothiophene	<10	153;132	<2.1	Dieldrin	<1.4
C4- Fluorene	<10	105	<1.4	o,p'-DDD	<4.0
C1-Dibenzothiophene	<10	138	<2	Endrin	<2.2
C2- Dibenzothiophene	<10	126	<1.9	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	<1.7	p,p'-DDT	<2.5
C1-Phenanthrene	<12	169	<1.7	Metoxychlor	<3.1
C2-Phenanthrene	<6	170;190	<1.8	Mirex	<1.5
Fluoranthene	<14	195;208	<1.8		
Pyrene	<9	206	<1.7		
C1-FP	<9	209	<1.7		
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)
Hg	**0.0054**	**0.02**
Ag	**0.003**	**0.01**
Cd	**0.003**	**0.006**
Pb	**0.004**	**0.01**
Al	**0.30**	**1**
Cr	**0.04**	**0.1**
Cu	**0.1**	**0.3**
Fe	**0.2**	**1**
Ni	**0.04**	**0.1**
Zn	**0.02**	**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 2009

C.1 ACCURACY

C.1.1 Standard Reference Materials

Accuracy refers to the agreement between the amount of a component measured by the test method and the amount actually present. The quality assurance protocol for the Gulfwatch project sets the accuracy criteria of ±25% for trace metals of the certified value of a standard reference material (SRM). Certified values are reported by the NRC (National Research Council) or NIST (National Institute of Standards and Technology). Standard reference materials with values >10 times the detection limits were used to verify the accuracy of the analytical methods. The NRC standard, DORM-2 (dogfish muscle and liver tissue), and NIST standard 2976 (blue mussel tissue) were used to certify accuracy in the metals analysis. Overall mean SRM recoveries for the metals analyzed ranged from 95-119% (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 2009 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 030910	0.0695	0.00717	0.823	1.25	142	0.607	4.08	179	0.771	157
CRM 2976 R2 030910	0.0651	0.00822	0.881	1.28	141	0.556	4.09	177	0.744	159
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										
DORM-2 012309 R1	0.388	0.0279	0.306	0.442	1420	1.93	15.8	351	1.22	61.2
DORM-2 012309 R2	0.381	0.0265	0.310	0.451	1458	1.93	16.0	342	1.30	56.8
certified or reference value	0.382	0.04	0.29	0.395	1700	1.89	15.5	347	1.28	51.3
range	±0.060	REF	±0.020	±0.050	REF	±0.17	±0.63	±20	±0.24	±3.1
percent recovery, R1	**101%**	NA	**106%**	**112%**	NA	**102%**	**102%**	**101%**	**95%**	**119%**
percent recovery, R2	**100%**	NA	**107%**	**114%**	NA	**102%**	**103%**	**99%**	**101%**	**111%**

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 100% -105% are considered as meeting the data quality objectives of the Program. Matrix spikes ranged from 95%-112% and averaged 103 (± 5.64%) over all the batches. All of the matrix spike results were within acceptable criteria (Table C.1.2.2).

Table C.1.2.1 Blank spike results reported by Battelle Marine Sciences Laboratory for the Gulfwatch 2009 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 030910	2.05	2.01	2.07	2.04	25.8	2.00	2.04	26.3	2.09	2.05
Blank R1 030910	0.0108	0.003	0.003	0.004	0.3	0.04	0.1	0.2	0.04	0.02
Spike conc.	*2.0*	*2.0*	*2.0*	*2.0*	*25*	*2.0*	*2.0*	*25*	*2.0*	*2.0*
PERCENT RECOVERY, LCS	**102%**	**101%**	**103%**	**102%**	**103%**	**100%**	**102%**	**105%**	**104%**	**102%**
LCS R2 030910	2.07	2.05	2.09	2.04	25.6	2.04	2.00	25.4	2.03	2.07
Blank R2 030910	0.0054	0.003	0.003	0.004	0.3	0.04	0.1	0.2	0.04	0.02
Spike conc.	*2.0*	*2.0*	*2.0*	*2.0*	*25*	*2.0*	*2.0*	*25*	*2.0*	*2.0*
PERCENT RECOVERY, LCS	**104%**	**102%**	**104%**	**102%**	**102%**	**102%**	**100%**	**102%**	**102%**	**104%**

Table C.1.2.2. Matrix spike results reported by Battelle Marine Sciences Laboratory for the Gulfwatch 2009 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)
MECC-1N										
Measured Conc.	2.25	1.94	12.3	14.0	664	12.3	18.3	776	11.6	334
Background Conc.	0.295	0.0513	2.03	3.39	428	2.11	7.87	575	1.57	104
Spike concentration	1.97	1.97	10.0	10.0	211	10.0	10.0	211	10.0	211
% Recovery	**99%**	**96%**	**102%**	**105%**	**112%**	**102%**	**104%**	**95%**	**100%**	**109%**
NBSC-Comp										
Measured Conc.	2.17	3.96	2.47	15.7	2095	15.3	27.2	4930	12.5	343
Background Conc.	0.216	0.0544	2.31	1.98	593	1.83	6.29	660	1.49	88.6
Spike concentration	2.01	2.01	2.01	10.3	216	10.3	10.3	216	10.3	216
% Recovery	**96%**	**95%**	**98%**	**64%**	**110%**	**81%**	**99%**	**SL[1]**	**91%**	**103%**

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 2 samples are listed in Tables C.2.1. The RPD between laboratory duplicates ranged from 0.3%-15%, with a mean of 3.8 (±3.8)%. The RPDs of all duplicates were all within acceptable limits.

Table C.2.1. Duplicate metals analysis for Gulfwatch 2009 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)
MECC	0.283	0.0415	2.22	2.46	282	1.83	7.07	412	1.13	123
MECC-dup	0.288	0.0421	2.21	2.49	249	1.77	7.12	394	1.12	124
MEAN	0.285	0.0418	2.22	2.47	265	1.80	7.09	403	1.12	123
RPD[1]	**2%**	**1%**	**0.3%**	**1%**	**13%**	**3%**	**1%**	**5%**	**1%**	**1%**
NSYR	0.200	0.341	1.39	3.46	308	1.63	5.60	556	1.28	83.1
NSYR-dup	0.204	0.350	1.44	3.56	330	1.65	5.92	581	1.49	88.0
MEAN	0.202	0.346	1.41	3.51	319	1.64	5.76	569	1.38	85.6
RPD	**2%**	**3%**	**3%**	**3%**	**7%**	**1%**	**6%**	**5%**	**15%**	**6%**

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

C.3 BLANKS

Two 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 2009 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 030910	0.0108	0.003	0.003	0.004	0.3	0.04	0.1	0.2	0.04	0.02
Blank R2 030910	0.0054	0.003	0.003	0.004	0.3	0.04	0.1	0.2	0.04	0.02

C.4 COMPLETENESS

100% of samples collected (29 of 29 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.

QA/QC NARRATIVE

PROJECT: Gulf of Maine 2009

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:
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:	2986*1-34
Description	Tissue
Collection dates	2009
Laboratory arrival date	1/7/2009
Cooler temperatures, on arrival	2.0°C
Digestion (aqua regia)	1/23/2009
CVAA analysis (Hg)	2/5/2009
ICP-OES analysis (Al, Cr, Cu, Fe, Ni, and Zn)	2/10/2009
ICP-MS analysis (Ag, Cd, and Pb)	1/28/2009

QA/QC DATA QUALITY OBJECTIVES:						
	Analytical	Range of	SRM	Relative	Method Detection	Reporting Limit
Analyte	Method	Recovery	Accuracy	Precision	Limit (μ/g dry weight)(a)	(μg/g dry weight)
Silver	ICP-MS	75-125%	0.25%	0.25%	0.004	0.01
Aluminum	ICP-OES	75-125%	0.25%	0.25%	0.4	1
Cadmium	ICP-MS	75-125%	0.25%	0.25%	0.002	0.006
Chromium	ICP-OES	75-125%	0.25%	0.25%	0.04	0.1
Copper	ICP-OES	75-125%	0.25%	0.25%	0.04	0.1
Iron	ICP-OES	75-125%	0.25%	0.25%	0.3	1
Mercury	CVAA	75-125%	0.25%	0.25%	0.0065	0.02
Nickel	ICP-OES	75-125%	0.25%	0.25%	0.07	0.2
Lead	ICP-MS	75-125%	0.25%	0.25%	0.004	0.01
Zinc	ICP-OES	75-125%	0.25%	0.25%	0.07	0.2
(a) MDL determined annually using seven replicates of a tissue matrix spiked at an appropriate concentration.						
(b) RL determined as 3.18* MDL						

QA/QC NARRATIVE

PROJECT: Gulf of Maine 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: Thirty tissue samples were received at MSL on 02/24/10. 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 (3116). All project information was entered into Battelle's laboratory information and sample tracking system.

Chemistry Lab IDs:	**3116*1-30**
Description	*Tissue*
Collection dates	2009
Laboratory arrival date	02/24/10
Cooler temperatures, on arrival	2.1°C
Digestion (aqua regia)	03/09/10
CVAA analysis (Hg)	3/24/10
ICP-OES analysis (Al, Cr, Cu, Fe, Ni, and Zn)	03/15/10
ICP-MS analysis (Ag, Cd, and Pb)	03/15/10

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%	0.003	0.01
Aluminum	ICP-OES	75-125%	≤25%	≤25%	0.3	1
Cadmium	ICP-MS	75-125%	≤25%	≤25%	0.003	0.01
Chromium	ICP-OES	75-125%	≤25%	≤25%	0.04	0.1
Copper	ICP-OES	75-125%	≤25%	≤25%	0.1	0.3
Iron	ICP-OES	75-125%	≤25%	≤25%	0.2	1
Mercury	CVAA	75-125%	≤25%	≤25%	0.0054	0.02
Nickel	ICP-OES	75-125%	≤25%	≤25%	0.04	0.1
Lead	ICP-MS	75-125%	≤25%	≤25%	0.004	0.01
Zinc	ICP-OES	75-125%	≤25%	≤25%	0.02	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

QA/QC NARRATIVE

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.

QA/QC NARRATIVE

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.

QA/QC NARRATIVE

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 and SRM DORM-3 Dogfish Tissue were digested and analyzed with this set of samples. Multiple SRMs were selected because no single SRM is certified for all metals of interest at appropriate concentration ranges.

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.

The percent recoveries for SRM DORM-3 were within the QC acceptance criterion for all certified metals.

APPENDIX D: Summary of 2009 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 2009 Gulfwatch Monitoring Program.

Spiked Mussel Tissue			ALKYL		ALKYL		ALKYL
(2.0g dry weight)		SP100115	SP100115	SP100121	SP100121	SP100215	SP100215
PAH	Conc.	Recoveries (%)					
	(ng.g)						
Naphthalene	25.00	106%	65%	79%	71%	67%	67%
C1-Naphthalenes	50.00	91%	71%	85%	72%	82%	74%
Biphenyl	25.00	105%	92%	97%	91%	127%	105%
C2-Naphthalene (5-Pks)	25.00	83%	84%	86%	87%	81%	86%
Acenaphthylene	25.00	86%	84%	85%	80%	70%	71%
Acenaphthene	25.00	85%	65%	87%	63%	73%	55%
C-3 Naphthalene	25.00	81%	88%	81%	93%	87%	86%
Fluorene	25.00	90%	91%	91%	95%	93%	96%
C1- Fluorene	125.00	-	103%	-	107%	-	99%
C2-Fluorene	62.50	-	198%	-	197%	-	202%
C3- Fluorene	31.25	-	99%	-	100%	-	110%
C4-Naphthalene	62.50	-	101%	-	118%	-	110%
Dibenzothiophene	93.75	-	99%	-	101%	-	94%
C4- Fluorene	31.25	-	98%	-	95%	-	102%

TABLE D.1.2.1. (cont'd)

	Conc		ALKYL		ALKYL		ALKYL
	(ng/g)	SP100115	SP100115	SP100121	SP100121	SP100215	SP100215
C1-Dibenzothiophene	81.25	-	103%	-	105%	-	103%
C2- Dibenzothiophene	62.50	-	114%	-	109%	-	116%
C3-Dibenzothiophene	62.50	-	106%	-	108%	-	122%
Phenanthrene	25.00	95%	93%	91%	95%	79%	81%
Anthracene	25.00	87%	89%	78%	85%	67%	72%
C1-Phenanthrene	25.00	105%	98%	99%	100%	87%	88%
C2-Phenanthrene	62.50	-	117%	-	104%	-	104%
Fluoranthene	25.00	96%	93%	92%	96%	86%	85%
Pyrene	25.00	91%	81%	83%	89%	82%	80%
C1-FP	93.75	-	100%	-	100%	-	94%
C3-Phenanthrene	62.50	-	105%	-	106%	-	103%
C2-FP	31.25	-	102%	-	105%	-	95%
C4-Phenanthrene	31.25	-	107%	-	110%	-	112%
Benzo(a)Anthracene	25.00	99%	97%	93%	99%	71%	77%
Chrysene	25.00	101%	96%	92%	95%	80%	84%
C1-Chrysene	187.50	-	95%	-	100%	-	86%
C2-Chrysene	31.25	-	101%	-	102%	-	88%
C3-Chrysene	31.25	-	98%	-	103%	-	87%
C4-Chrysene	31.25	-	97%	-	99%	-	85%
Benzo(b)Fluoranthene	25.00	95%	104%	81%	95%	68%	80%
Benzo(k)Fluoranthene	25.00	87%	87%	87%	90%	66%	74%
Benzo(e)Pyrene	25.00	105%	-	94%	-	80%	-
Benzo(a)Pyrene	25.00	95%	91%	87%	91%	74%	77%
Perylene	25.00	84%	-	81%	-	78%	-
Indeno(1,2,3-cd)Pyrene	25.00	103%	98%	97%	101%	93%	89%
Dibenz(a,h)Anthracene	25.00	103%	99%	98%	100%	97%	91%
Benzo(ghi)Perylene	25.00	96%	90%	92%	94%	95%	83%
Surrogate Recovery							
Napthalene-d8	24.00	80%	75%	80%	74%	81%	72%
Acenaphthene-d10	24.00	88%	85%	91%	82%	87%	82%
Phenanthrene-d10	24.00	95%	91%	89%	94%	82%	88%
Fluoranthene-d10	24.00	101%	98%	94%	99%	91%	91%
Chrysene-d12	24.00	100%	96%	92%	98%	80%	87%
Benzo(a)pyrene-d12	24.00	97%	92%	92%	96%	79%	82%
Benzo(g,h,i)perylene-d12	24.00	104%	96%	95%	99%	103%	95%

indicates interference

TABLE D.1.2.2. Percent recoveries of PCBs from matrix spikes for the 2009 Gulfwatch Monitoring Program.

Spiked Mussel Tissue				
(2.0g dry weight)		**SP100115**	**SP100121**	**SP100215**
PCB	**Concentration**	**Recovery (%)**		
	(ng/g)			
#8,5	20.84	54%	52%	68%
#18,15	20.84	64%	57%	82%
#29	20.84	68%	62%	83%
#50	20.84	64%	62%	77%
#28	20.84	58%	57%	68%
#52	20.84	73%	70%	89%
#44	20.84	70%	66%	86%
#66,95	20.84	65%	66%	79%
#101,90	20.84	71%	71%	86%
#87	20.84	73%	77%	87%
#77	20.84	67%	78%	81%
#118	20.84	76%	77%	91%
#153,132	20.84	80%	83%	96%
#105	20.84	66%	72%	78%
#138	20.84	81%	98%	118%
#126	20.84	78%	77%	91%
#187	20.84	81%	78%	90%
#128	20.84	76%	73%	85%
#180	20.84	75%	75%	85%
#169	20.84	78%	79%	93%
#170,190	20.84	77%	77%	89%
#195,208	20.84	76%	78%	87%
#206	20.84	82%	80%	89%
#209	20.84	81%	80%	86%
Surrogate Recovery				
103	10.06	86%	79%	100%
198	9.91	81%	82%	92%

TABLE D.1.2.3. Percent recoveries of pesticides from matrix spikes for the 2009 Gulfwatch Monitoring Program.

Spiked Mussel Tissue				
(2.0g dry weight)				
Pesticide	**Conc.**	**SP081118**	**SP081203**	**SP081209**
	(ng/g)	**%**	**%**	**%**
α-BHC	10.42	78%	94%	90%
HCB	10.42	65%	55%	75%
γ-HCH(Lindane)	10.42	78%	92%	57%
Heptachlor	10.42	49%	46%	56%
Aldrin	10.42	71%	64%	79%
Heptachlor Epoxide	10.42	64%	86%	77%
γ-Chlordane	10.42	74%	90%	98%
o,p'-DDE	10.42	67%	72%	75%
α-Endosulfan	10.42	78%	102%	97%
cis-Chlordane	10.42	78%	98%	95%
t-Nonachlor	10.42	78%	88%	103%
p,p'_DDE	10.42	80%	81%	95%
Dieldrin	10.42	77%	77%	90%
o,p'-DDD	10.42	87%	96%	93%
Endrin	10.42	71%	98%	71%
β-Endosulfan	10.42	71%	35%	85%
p,p'-DDD	10.42	74%	81%	78%
o,p'-DDT	10.42	82%	78%	91%
p,p'-DDT	10.42	92%	91%	76%
Metoxychlor	10.42	202%	74%	87%
Mirex	10.42	77%	64%	69%
Surrogate Recovery				
g-Chlordene	9.92	66%	57%	76%
b-BHC	10	58%	82%	58%
Interference found on both signals				

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 2009 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}
MABI	52%	65%	79%	80%	79%	78%	65%
MAME	55%	63%	77%	77%	77%	77%	66%
MASN	55%	69%	81%	82%	81%	79%	68%
MASN DU	50%	61%	76%	78%	76%	77%	68%
MANR	58%	74%	80%	82%	80%	79%	75%
NHHS-COMP	55%	65%	77%	77%	76%	76%	84%
NHHS-1N	53%	63%	72%	75%	74%	74%	74%
NHHS-1N DU	48%	64%	71%	74%	72%	71%	71%
NHHS-2N	53%	65%	73%	77%	74%	73%	70%
NHHS-3N	46%	61%	69%	71%	70%	69%	60%
NHDP-COMP	49%	64%	74%	75%	74%	74%	61%
NHDP-1N	54%	63%	75%	78%	76%	75%	54%
NHDP-2N	52%	66%	75%	78%	76%	75%	48%
NHDP-3N	48%	58%	73%	75%	74%	73%	39%
MECC-COMP	53%	61%	74%	77%	78%	74%	35%
MECC-1N	51%	59%	75%	77%	76%	75%	32%
MECC-2N	54%	60%	78%	79%	80%	77%	27%
MECC-3N	51%	60%	74%	74%	76%	66%	19%
NHFP	56%	72%	80%	81%	81%	79%	68%
NHSS	55%	67%	81%	83%	82%	78%	68%
NHNM	51%	56%	69%	79%	81%	80%	77%
NHWC	57%	60%	74%	83%	83%	84%	77%
NHWC DU	55%	58%	72%	81%	81%	85%	78%
MEPH	59%	69%	79%	81%	83%	78%	66%
MEKN	57%	69%	81%	83%	82%	78%	72%
MEDM	64%	78%	90%	94%	94%	94%	82%
MEBB	62%	75%	81%	70%	82%	79%	77%
MEMR	56%	61%	77%	79%	79%	74%	66%
MECK	65%	71%	81%	80%	81%	77%	69%
METS	54%	59%	72%	82%	81%	83%	78%
METS DU	51%	59%	72%	82%	83%	83%	82%
MEHR	46%	55%	69%	82%	80%	81%	79%
NBTC	62%	64%	76%	82%	82%	85%	79%
NBSC	65%	63%	75%	83%	85%	84%	80%
NSDI	66%	65%	74%	80%	83%	82%	78%
NSAR	66%	65%	72%	81%	76%	81%	80%
NSFI	64%	62%	69%	80%	79%	81%	79%
NSYR	65%	64%	74%	82%	83%	82%	78%

[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 2009 Gulfwatch samples as part of the analyses for PCBs and chlorinated pesticides

GOM Stations	PCBs		Pesticides	
	103	198	γ-Chlordene	β-BHC
MAME	59%	62%	72%	73%
MASN	68%	67%	62%	71%
MASN DU	68%	66%	81%	80%
MECC - 1N	73%	70%	58%	83%
MECC -2N	67%	76%	60%	84%
MECC -3N	69%	77%	61%	77%
MECC - COMP	87%	97%	68%	84%
NHNM	78%	74%	77%	75%
NHDP -1N	87%	86%	75%	71%
NHDP -2N	92%	94%	85%	69%
NHDP -3N	85%	84%	67%	51%
NHDP -COMP	84%	85%	77%	83%
NHHS -1N	77%	81%	69%	83%
NHHS -2N	71%	80%	100%	83%
NHHS -3N	74%	79%	69%	78%
NHHS -COMP	84%	93%	74%	50%
NHHS -COMP	81%	92%	74%	62%
NHSM	84%	79%	67%	82%
MEPH	85%	90%	77%	82%
MEKN	87%	91%	68%	84%
MERY	78%	88%	74%	87%
MEBB	80%	92%	70%	70%
MEFP	80%	93%	75%	84%
MEPI	93%	84%	73%	100%
MEBH	88%	87%	77%	90%
NBTC	88%	97%	68%	69%
NBSC	71%	77%	68%	79%
NSDI	80%	90%	69%	63%
NSDI DU	90%	91%	74%	94%
NSAR	81%	88%	66%	75%
NSBP	86%	79%	74%	56%
NSYR	81%	88%	72%	58%
NSBC	88%	88%	73%	71%

[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.2 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.3 BLANKS

Blank analyses should ideally recover no detectable amounts of target compounds. For 2009 no discernible analytical signal was observed for PAHs, PCBs, and PEST.

D.4 COMPLETENESS

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

Table D.2.1. Duplicate PAH analysis for Gulfwatch 2009 samples.

	MASN	MASN DU	NSDI	NSDI DU
PAH analytes	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
Naphthalene	13.3	12.3	10.8	0
C1-Naphthalenes	25.1	25.6	11.5	9.1
Biphenyl	<10	<10	<10	<10
C2-Naphthalene	16.0	15.9	9.5	8.1
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	24.9	19.5
C2-Fluorene	<7	<7	<7	<7
C3- Fluorene	<7	<7	<7	<7
C4-Naphthalene	<7	<7	11.5	11.8
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	7.4	7.6	10.0	8.6
Anthracene	<10	<10	<10	<10
C1-Phenanthrene	<12	<12	<12	<12
C2-Phenanthrene	12.7	9.3	9.0	9.3
Fluoranthene	<14	<14	15.4	14.7
Pyrene	<9	<9	<9	<9
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	<6	<6	<6
Chrysene	<6	<6	<6	<6
C1-Chrysene	<6	<6	7.5	6.4
C2-Chrysene	<6	<6	<6	<6
C3-Chrysene	<6	<6	<6	<6
C4-Chrysene	<6	<6	<6	<6
Benzo(b)Fluoranthene	<6	<6	<6	<6
Benzo(k)Fluoranthene	<4	<4	<4	<4
Benzo(e)Pyrene	<7	<7	<7	<7
Benzo(a)Pyrene	<4	<4	<4	<4
Perylene	<5	<5	<5	<5
Indeno(1,2,3-cd)Pyrene	<7	<7	<7	<7
Dibenz(a,h)Anthracene	<11	<11	<11	<11
Benzo(ghi)Perylene	<15	<15	<15	<15
SPAH40	**74.5**	**70.7**	**110.1**	**87.5**
Average	**72.6**		**98.8**	
% RPD[1]	**5.23**		**22.9**	

Table D.2.2. Duplicate PCB analysis for Gulfwatch 2009 samples

Congeners	MASN	MASN DU	NSDI	NSDI DU
	(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	<2.4	<2.4	<2.4	<2.4
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	2.3	3.3	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	3.0	3.8	<2	<2
153;132	6.7	8.4	<2.1	<2.1
105	<1.4	<1.4	<1.4	<1.4
138	4.9	6.2	<2	<2
126	<1.9	0	<1.9	<1.9
187	<1.9	2.4	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7
ΣPCB24	16.92	24.10	5.98	5.61
Average	**20.51**		**NA**	
% RPD[1]	**35.03**		**NA**	

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

Table D.2.3. Duplicate chlorinated pesticide analysis for Gulfwatch 2009 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	<1.2	<1.2	<1.2	<1.2
τ-Nonachlor	5.9	7.7	<1.4	<1.4
p,p'_DDE	6.1	7.6	<1.8	<1.8
Dieldrin	1.8	2.0	<1.4	<1.4
o,p'-DDD	5.1	4.7	<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	6.0	3.2	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5
$\Sigma PEST_{21}$	25.0	25.3	3.57	3.24
Average	**25.1**		**3.41**	
% RPD[1]	**1.22**		**9.4**	

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

APPENDIX E: 2009 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, 2009. 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 2009.

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	87.6	0.0708	2.60	1.29	7.34	284	1.09	3.55	100	96.4	0.148
MECC	87.3	0.0610	2.48	2.19	8.00	530	1.48	3.31	114	389	0.326
NHDP	86.8	0.0343	2.51	1.86	7.28	303	0.997	1.81	101	197	0.305
NHHS	85.2	0.0509	2.50	1.09	9.84	280	1.05	2.28	125	195	0.159
NHSM	88.2	0.0463	2.01	2.05	7.96	570	1.63	11.8	120	370	0.380
NHNM	86.1	0.0449	3.28	2.14	7.34	571	1.32	4.29	136	421	0.316
MEPH	82.9	0.0256	1.30	1.26	8.08	420	0.923	4.68	136	386	0.181
MEKN	86.3	0.0448	3.26	1.46	6.72	439	1.29	1.79	66.8	261	0.227
MERY	83.2	0.0347	1.31	1.16	6.86	509	1.10	1.52	74.3	428	0.112
MEBB	86.4	0.0224	1.34	1.83	10.8	549	1.11	15.1	142	427	0.269
MEBH	85.9	0.256	2.80	1.26	6.86	369	1.16	1.47	109	353	0.169
MEFP	84.3	0.0539	1.91	1.64	7.16	583	1.24	1.65	62.0	354	0.320
MEPI	83.5	0.0587	2.19	1.39	5.13	385	1.45	1.49	78.7	290	0.120
NBTC	89.4	0.0332	3.35	3.46	7.28	1557	2.81	3.35	86.6	1508	0.493
NBSC	84.5	0.0544	2.31	1.83	6.29	660	1.49	1.98	88.6	593	0.216
NSDI	81.6	0.0297	1.43	1.33	6.09	422	0.820	2.27	62.2	441	0.083
NSYR	87.5	0.341	1.39	1.63	5.60	556	1.28	3.46	83.1	308	0.200
NSAR	88.7	0.0393	3.43	1.91	6.45	691	2.05	1.71	73.1	776	0.238
NSBC	87.0	0.0570	2.38	1.92	6.00	601	1.65	1.99	72.0	445	0.181
NSBP	82.3	0.00998	1.18	1.17	6.36	219	0.709	2.06	82.5	148	0.116

Table E.2. Tissue concentrations of metals in mussels collected in 2009 from Dover Point, (NH).

	NHDP 1N (µg/g)	NHDP 2N (µg/g)	NHDP 3N (µg/g)	NHDP COMP (µg/g)
Ag	0.275	0.313	0.319	0.305
Cd	0.0366	0.0394	0.0412	0.0343
Cr	2.22	2.88	2.83	2.51
Cu	1.40	1.94	1.59	1.81
Fe	7.32	7.48	7.41	7.28
Ni	1.55	1.41	1.33	0.997
Pb	209	163	218	197
Zn	1.81	2.00	1.95	1.86
Al	329	321	317	303
Hg	101	145	112	101
% Moisture	87.7	87.9	86.7	86.8

Table E.3. Tissue concentrations of metals in mussels collected in 2009 from Hampton/Seabrook Harbor, NH (NHHS).

Metals	NHHS 1N (µg/g)	NHHS 2N (µg/g)	NHHS 3N (µg/g)	NHHS COMP (µg/g)
Ag	0.152	0.149	0.145	0.159
Cd	0.0297	0.0318	0.0444	0.0509
Cr	2.25	2.37	1.92	2.50
Cu	1.76	2.96	1.37	2.28
Fe	7.03	7.00	7.03	9.84
Ni	0.953	1.05	0.909	1.05
Pb	179	315	252	195
Zn	1.12	1.21	1.07	1.09
Al	269	388	304	280
Hg	109	96.6	102	125
% Moisture	84.1	85.0	84.6	85.2

Table E.4. Tissue concentrations of metals in mussels collected in 2009 from Clark's Cove, ME (MECC).

Metals	MECC 1N (μg/g)	MECC 2N (μg/g)	MECC 3N (μg/g)	MECC COMP (μg/g)
Ag	0.295	0.332	0.283	0.326
Cd	0.0513	0.0577	0.0415	0.0610
Cr	2.03	2.23	2.22	2.48
Cu	3.39	3.99	2.46	3.31
Fe	7.87	9.16	7.07	8.00
Ni	1.57	1.74	1.13	1.48
Pb	428	365	282	389
Zn	2.11	2.09	1.83	2.19
Al	575	549	412	530
Hg	104	146	123	114
% Moisture	85.6	86.5	86.2	87.3

APPENDIX F: Organic Contaminants (and % Lipids Content) Data for 2009 Gulfwatch Mussel Samples

Table F.1. Tissue concentrations of PAHs in composite samples collected from sites in Massachusetts in 2009.

PAH Abbrev	MAME (ng/g)	MASN (ng/g)	MASN DU (ng/g)
NAP	10.9	13.3	12.3
C1-NAP	12.6	25.1	25.6
C2-NAP	<10	<10	<10
C3-NAP	11.8	16.0	15.9
C4-NAP	<11	<11	<11
BIP	<8	<8	<8
ACE	<7	<7	<7
ACEY	<7	<7	<7
FLU	<7	<7	<7
C1-FLU	<7	<7	<7
C2-FLU	<7	<7	<7
C3-FLU	<7	<7	<7
C4-FLU	<10	<10	<10
DBT	<10	<10	<10
C1-DBT	<10	<10	<10
C2-DBT	<10	<10	<10
C3-DBT	<10	<10	<10
PHEN	8.9	7.4	7.6
ANTH	<10	<10	<10
C1-PHEN	<12	<12	<12
C2-PHEN	21.9	12.7	9.3
C3-PHEN	34.0	<14	<14
C4-PHEN	32.0	<9	<9
FLUO	23.1	<9	<9
PYR	<6	<6	<6
C1-FP	<9	<9	<9
C2-FP	<6	<6	<6
BAA	15.2	<6	<6
CHRY	26.1	<6	<6
C1-CHRY	22.2	<6	<6
C2-CHRY	<6	<6	<6
C3-CHRY	<6	<6	<6
C4-CHRY	<6	<6	<6
BBF	29.3	<6	<6
BKF	21.2	<4	<4
BEP	32.2	<7	<7

Table F.1. (cont'd)

PAH	MABI	MAME	MASN
Abbrev	(ng/g)	(ng/g)	(ng/g)
BAP	10.2	<4	<4
PER	24.1	<5	<5
IND	14.3	<7	<7
DBAHA	<11	<11	<11
BGHIP	17.6	<15	<15
Surrogate Recovery			
NAPH-d8	74%	73%	79%
ACE-d10	84%	82%	89%
PHEN-d10	90%	90%	97%
FLUO-d10	95%	94%	101%
CHRY-d12	98%	96%	104%
BAP-d12	97%	96%	103%
BGHIP-d12	98%	97%	102%

NAP = naphthalene, BIP = biphenyl, ACE = acenaphthene ACEY = acenaphthylene, FLU = fluorine, 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 2009.

PAH	NHNM	NHDP	NHHS	NHSM
Abbrev	(ng/g)	(ng/g)	(ng/g)	(ng/g)
NAPH	<10	11.7	<10	12.9
C1-NAPH	14.4	12.4	16.0	14.9
C2-NAPH	<10	<10	<10	<10
C3-NAPH	19.4	11.2	34.4	15.2
C4-NAPH	<11	<11	<11	<11
BIP	<8	<8	<8	<8
ACE	<7	<7	<7	<7
ACEY	<7	<7	<7	<7
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

Table F.2 (cont'd)				
PAH	**NHHS**	**NHDP**	**NHFP**	**NHSS**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
PHEN	18.4	7.4	14.9	15.4
ANTH	<10	<10	<10	<10
C1-PHEN	30.0	16.1	94.1	24.9
C2-PHEN	56.5	29.2	253.3	40.0
C3-PHEN	135.1	48.9	19.1	100.7
C4-PHEN	138.9	49.9	24.1	101.8
FLUO	80.1	36.5	<9	62.9
PYR	<6	<6	<6	<6
C1-FP	<9	<9	<9	<9
C2-FP	<6	<6	<6	<6
BAA	49.8	20.3	<6	38.0
CHRY	99.1	30.2	8.1	70.5
C1-CHRY	69.8	33.0	9.4	61.5
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	112.6	32.2	<6	86.9
BKF	74.2	24.2	4.8	71.5
BEP	100.6	34.1	<7	88.7
BAP	27.5	10.5	<4	27.9
PER	28.9	17.0	<5	29.3
IND	30.7	10.7	<7	34.6
DBAHA	<11	<11	<11	<11
BGHIP	30.4	<15	<15	36.5
Surrogate Recovery				
NAPH-d8	72%	76%	79%	73%
ACE-d10	86%	87%	93%	85%
PHEN-d10	91%	93%	97%	89%
FLUO-d10	98%	98%	97%	94%
CHRY-d12	98%	101%	99%	97%
BAP-d12	98%	100%	96%	94%
BGHIP-d12	94%	99%	97%	93%
% Lipids	7.84%	6.80%	5.37%	5.76%

PAH abbreviations are listed in Table F.1.

Table F.3. Tissue concentrations of PAHs in composite samples collected from sites in Maine in 2009.

PAH	MEPH	MEKN	MERY	MEBB	MEFP	MEPI	MEBH
Abbrev	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
NAPH	<10	<10	<10	12.9	11.6	<10	<10
C1-NAPH	14.7	10.8	<8	24.1	15.3	9.2	<8
C2-NAPH	<10	<10	<10	<10	<10	<10	<10
C3-NAPH	17.4	<8	<8	30.1	<8	<8	<8
C4-NAPH	<11	<11	<11	<11	<11	<11	<11
BIP	10.1	<8	<8	<8	<8	<8	<8
ACE	10.9	<7	<7	12.6	<7	<7	<7
ACEY	11.1	<7	<7	7.0	<7	<7	<7
FLU	34.5	22.6	8.2	28.9	9.5	11.5	11.1
C1-FLU	<7	<7	<7	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7	<7	<7	<7
C3-FLU	18.6	<7	<7	25.4	<7	9.4	<7
C4-FLU	<10	<10	<10	<10	<10	<10	<10
DBT	<10	<10	<10	<10	<10	<10	<10
C1-DBT	13.8	<10	<10	14.0	10.1	<10	<10
C2-DBT	<10	<10	<10	31.1	<10	<10	<10
C3-DBT	<10	<10	<10	<10	<10	<10	<10
PHEN	58.2	7.7	<6	24.7	17.8	<6	6.1
ANTH	10.8	<10	<10	<10	<10	<10	<10
C1-PHEN	60.0	<12	<12	56.4	22.0	<12	<12
C2-PHEN	87.0	23.6	11.7	96.9	24.2	<6	<6
C3-PHEN	249.8	19.0	<14	163.2	33.0	<14	<14
C4-PHEN	212.7	24.5	11.2	222.1	23.9	<9	<9
FLUO	48.2	17.1	<9	97.9	10.7	<9	<9
PYR	<6	<6	<6	<6	25.5	<6	<6
C1-FP	<9	<9	<9	<9	<9	<9	<9
C2-FP	<6	<6	<6	<6	<6	<6	<6
BAA	48.0	8.3	<6	44.3	<6	<6	<6
CHRY	99.9	14.6	<6	94.5	13.3	<6	<6
C1-CHRY	72.3	21.8	9.1	12.1	14.1	7.1	7.1
C2-CHRY	<6	<6	<6	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6	<6	<6	<6
BBF	84.8	13.1	<6	112.5	7.3	<6	<6
BKF	59.6	9.7	<4	92.3	6.7	<4	<4
BEP	98.2	16.5	<7	129.1	12.2	<7	<7
BAP	23.5	6.6	<4	48.3	4.1	<4	<4
PER	18.3	18.3	10.2	20.6	11.7	<5	<5

Table F.3 (cont'd)							
PAH	**MECC**	**MEPH**	**MEKN**	**MEDM**	**MEBB**	**MEMR**	**MECK**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
IND	25.5	9.9	<7	56.1	<7	<7	<7
DBAHA	<11	<11	<11	<11	<11	<11	<11
BGHIP	24.6	<15	<15	60.3	<15	<15	<15
Surrogate Recovery							
NAPH-d8	68%	65%	63%	108%	67%	68%	65%
ACE-d10	86%	84%	81%	97%	86%	80%	81%
PHEN-d10	90%	92%	88%	65%	90%	95%	94%
FLUO-d10	98%	97%	95%	96%	99%	99%	98%
CHRY-d12	102%	100%	100%	89%	100%	99%	98%
BAP-d12	106%	107%	107%	81%	89%	94%	99%
BGHIP-d12	87%	106%	111%	96%	89%	90%	92%
% Lipids	7.72%	8.92%	7.93%	6.18%	12.37%	9.18%	6.82%

PAH abbreviations are listed in Table F.1.

Table F.4. Tissue concentrations of PAHs in composite samples collected from sites in New Brunswick and Nova Scotia in 2009.

PAH	**NBTC**	**NBSC**	**NSDI**	**NSAR**	**NSBP**	**NSYR**	**NSBC**
Abbrev	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	12.8	<10	10.8	12.6	<10	16.1	<10
C1-NAPH	16.9	10.1	11.5	12.4	9.5	16.0	10.7
C2-NAPH	<10	<10	<10	<10	<10	<10	<10
C3-NAPH	12.3	8.4	9.5	<8	<8	9.2	11.2
C4-NAPH	<11	<11	<11	<11	<11	<11	<11
BIP	<8	<8	<8	<8	<8	<8	<8
ACE	<7	<7	<7	<7	<7	7.0	<7
ACEY	<7	<7	<7	<7	<7	<7	10.2
FLU	<7	<7	24.9	17.5	18.2	27.9	24.6
C1-FLU	<7	<7	<7	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7	<7	<7	<7
C3-FLU	<7	<7	11.5	<7	<7	<7	<7
C4-FLU	<10	<10	<10	<10	<10	<10	<10
DBT	<10	<10	<10	<10	<10	<10	<10
C1-DBT	<10	<10	<10	<10	<10	<10	<10
C2-DBT	<10	<10	<10	<10	<10	<10	<10
C3-DBT	<10	<10	<10	<10	<10	<10	<10
PHEN	8.3	<6	10.0	<6	10.0	14.9	48.5
ANTH	<10	<10	<10	<10	<10	<10	<10
C1-PHEN	14.7	<12	<12	<12	<12	16.7	30.9
C2-PHEN	57.0	28.4	9.0	<6	6.8	26.2	19.9
C3-PHEN	18.0	<14	15.4	<14	36.6	37.1	49.1
C4-PHEN	11.7	<9	<9	<9	15.8	23.2	31.4

Table F.4 (cont'd)							
PAH Abbrev	**NBTC (ng/g)**	**PAH Abbrev**	**NBTC (ng/g)**	**PAH Abbrev**	**NBTC (ng/g)**	**PAH Abbrev**	**NBTC (ng/g)**
FLUO	23.8	9.8	<9	<9	9.2	<9	10.4
PYR	<6	<6	<6	<6	<6	<6	<6
C1-FP	<9	<9	<9	<9	<9	<9	<9
C2-FP	<6	<6	<6	<6	<6	<6	<6
BAA	12.0	<6	<6	<6	<6	6.4	12.1
CHRY	16.3	11.1	<6	<6	6.0	10.7	12.3
C1-CHRY	42.3	33.1	7.5	<6	7.3	13.2	12.7
C2-CHRY	<6	<6	<6	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6	<6	<6	<6
BBF	15.8	6.7	<6	<6	<6	6.9	8.7
BKF	10.2	5.4	<4	<4	<4	5.9	7.4
BEP	13.1	<7	<7	<7	<7	7.8	7.5
BAP	7.1	4.0	<4	<4	<4	9.1	5.5
PER	13.5	6.2	<5	<5	11.9	9.7	<5
IND	<7	<7	<7	<7	<7	<7	<7
DBAHA	<11	<11	<11	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15	<15	<15	<15
Surrogate Recovery							
NAPH-d8	74%	75%	65%	62%	62%	63%	62%
ACE-d10	91%	85%	80%	78%	78%	80%	77%
PHEN-d10	91%	93%	91%	92%	92%	92%	94%
FLUO-d10	101%	99%	91%	94%	97%	95%	97%
CHRY-d12	99%	100%	91%	92%	96%	97%	98%
BAP-d12	96%	100%	85%	93%	97%	99%	103%
BGHIP-d12	94%	98%	89%	91%	87%	89%	90%
% Lipids	7.23%	6.14%	9.03%	5.76%	7.12%	6.84%	4.96%

PAH abbreviations are listed in Table F.1.

Table F.5. Tissue concentrations of PAHs in mussels collected from Dover Point, NH (NHDP) in 2009.

	NHDP	NHDP	NHDP	NHDP
PAH	**1N**	**2N**	**3N**	**Comp**
Abbrev.	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	<10	12.6	16.9	11.7
C1-NAPH	11.5	13.6	17.2	12.4
C2-NAPH	<10	<10	<10	<10
C3-NAPH	13.2	13.9	13.5	11.2
C4-NAPH	<11	<11	<11	<11
BIP	<8	<8	<8	<8
ACE	<7	<7	<7	<7
ACEY	<7	<7	<7	<7
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	7.3	7.3	8.5	7.4
ANTH	<10	<10	<10	<10
C1-PHEN	14.7	15.6	18.2	16.1
C2-PHEN	28.7	31.9	31.6	29.2
C3-PHEN	47.7	48.3	47.1	48.9
C4-PHEN	50.1	50.2	49.9	49.9
FLUO	35.0	36.8	35.5	36.5
PYR	<6	<6	<6	<6
C1-FP	<9	<9	<9	<9
C2-FP	<6	<6	<6	<6
BAA	18.5	22.0	21.0	20.3
CHRY	28.6	31.4	29.0	30.2
C1-CHRY	28.6	32.8	30.3	33.0
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	30.0	35.3	32.8	32.2
BKF	22.0	26.0	23.9	24.2
BEP	32.6	34.6	30.9	34.1
BAP	9.1	12.5	10.4	10.5
PER	17.0	18.0	16.5	17.0
IND	9.4	12.2	10.3	10.7
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	76%	75%	77%	76%
ACE-d10	86%	86%	88%	87%
PHEN-d10	91%	92%	94%	93%
FLUO-d10	97%	98%	99%	98%
CHRY-d12	98%	100%	101%	101%
BAP-d12	95%	99%	101%	100%
BGHIP-d12	97%	97%	99%	99%
% Lipids	**6.38%**	**6.21%**	**5.99%**	**6.80%**

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 2009.

PAH Abbrev.	NHHS 1N (ng/g)	NHHS 1N DUP (ng/g)	NHHS 2N (ng/g)	NHHS 3N (ng/g)	NHHS Comp (ng/g)
NAPH	<10	<10	<10	<10	<10
C1-NAPH	20.2	18.6	12.6	16.0	14.6
C2-NAPH	<10	<10	<10	<10	<10
C3-NAPH	83.2	59.2	19.8	34.4	32.5
C4-NAPH	<11	<11	<11	<11	<11
BIP	<8	<8	<8	<8	<8
ACE	<7	<7	<7	<7	<7
ACEY	<7	<7	<7	<7	<7
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
PHEN	27.9	17.7	11.8	14.9	14.4
ANTH	<10	<10	<10	<10	<10
C1-PHEN	250.6	104.1	30.1	94.1	98.6
C2-PHEN	614.7	241.2	62.0	253.3	263.2
C3-PHEN	23.5	21.2	15.7	19.1	18.8
C4-PHEN	45.9	25.9	11.9	24.1	24.5
FLUO	<9	<9	<9	<9	<9
PYR	<6	<6	<6	<6	<6
C1-FP	<9	<9	<9	<9	<9

Table F.6 (cont'd)					
	NHHS	**NHHS**	**NHHS**	**NHHS**	**NHHS**
PAH	**1N**	**1N DUP**	**2N**	**3N**	**Comp**
Abbrev.	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
C2-FP	<6	<6	<6	<6	<6
BAA	<6	<6	<6	<6	<6
CHRY	9.9	9.8	7.3	8.1	7.8
C1-CHRY	12.2	10.3	9.4	9.4	9.3
C2-CHRY	<6	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6	<6
BBF	<6	<6	<6	<6	<6
BKF	5.3	5.5	4.7	4.8	4.7
BEP	7.0	7.6	<7	<7	<7
BAP	<4	<4	<4	<4	<4
PER	<5	<5	<5	<5	<5
IND	<7	<7	<7	<7	<7
DBAHA	<11	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15	<15
Surrogate Recovery					
NAPH-d8	75%	72%	76%	79%	80%
ACE-d10	93%	87%	86%	93%	86%
PHEN-d10	96%	96%	92%	97%	96%
FLUO-d10	95%	97%	97%	97%	96%
CHRY-d12	96%	99%	98%	99%	98%
BAP-d12	92%	96%	98%	96%	97%
BGHIP-d12	95%	97%	99%	97%	96%
% Lipids	**5.63%**	**6.55%**	**5.80%**	**5.37%**	**5.62%**

PAH abbreviations are listed in Table F.1.

Table F.7. Tissue concentrations of PAHs in mussels collected from Clark's Cover, ME (MECC).				
	MECC	**MECC**	**MECC**	**MECC**
PAH	**1N**	**2N**	**3N**	**Comp**
Abbrev.	**(ng/g)**	**(ng/g)**	**(ng/g)**	**(ng/g)**
NAPH	<10	12.6	<10	12.0
C1-NAPH	10.2	13.3	8.7	12.4
C2-NAPH	<10	<10	<10	<10
C3-NAPH	8.5	12.8	<8	8.8
C4-NAPH	<11	<11	<11	<11
BIP	<8	<8	<8	<8
ACE	<7	<7	<7	<7
ACEY	<7	<7	<7	<7
FLU	<7	<7	<7	<7
C1-FLU	<7	<7	<7	<7
C2-FLU	<7	<7	<7	<7

Table F7 (cont'd)				
	MECC	MECC	MECC	MECC
PAH	1N	2N	3N	Comp
Abbrev.	(ng/g)	(ng/g)	(ng/g)	(ng/g)
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	7.1	14.5	7.5	7.2
ANTH	<10	<10	<10	<10
C1-PHEN	<12	17.2	12.6	12.1
C2-PHEN	19.7	24.1	21.5	18.8
C3-PHEN	29.1	37.9	32.7	31.5
C4-PHEN	28.8	36.3	32.6	30.7
FLUO	20.4	27.4	21.8	23.1
PYR	<6	<6	<6	<6
C1-FP	<9	<9	<9	<9
C2-FP	<6	<6	<6	<6
BAA	12.9	16.4	11.1	14.3
CHRY	18.0	24.0	16.8	24.3
C1-CHRY	18.7	26.4	14.7	19.1
C2-CHRY	<6	<6	<6	<6
C3-CHRY	<6	<6	<6	<6
C4-CHRY	<6	<6	<6	<6
BBF	23.4	24.8	18.5	20.4
BKF	18.9	22.4	14.4	18.4
BEP	21.3	27.7	19.0	21.9
BAP	8.5	10.4	6.4	9.7
PER	12.9	15.1	9.9	12.8
IND	9.5	11.8	7.6	11.6
DBAHA	<11	<11	<11	<11
BGHIP	<15	<15	<15	<15
Surrogate Recovery				
NAPH-d8	72%	75%	74%	71%
ACE-d10	81%	84%	86%	82%
PHEN-d10	89%	92%	93%	91%
FLUO-d10	94%	96%	98%	95%
CHRY-d12	94%	100%	100%	98%
BAP-d12	93%	98%	100%	99%
BGHIP-d12	93%	95%	96%	96%
% Lipids	**5.80%**	**6.61%**	**7.45%**	**6.55%**

Table F.8. Tissue concentrations of PCBs In composite samples collected from sites in Massachusetts in 2009.

Congener	MAME	MASN	MASN DU
	(ng/g)	(ng/g)	(ng/g)
8;5	<2.8	<2.8	<2.8
18;15	<2.7	<2.7	<2.7
29	<2.2	<2.2	<2.2
50	<2.4	<2.4	<2.4
28	<2.4	<2.4	<2.4
52	2.3	<2	<2
44	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2
101;90	5.9	2.3	3.3
87	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3
118	4.9	3.0	3.8
153;132	7.5	6.7	8.4
105	2.0	<1.4	<1.4
138	7.6	4.9	6.2
126	<1.9	<1.9	<1.9
187	2.7	<1.9	2.4
128	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7
Surrogate Recovery			
103	59%	68%	68%
198	62%	67%	66%

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

Table F.9. Tissue concentrations of PCBs in composite samples collected from sites in New Hampshire in 2009.

Congener	NHNM	NHDP	NHHS	NHHS	NHSM
	(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	<2.4	<2.4	<2.4	<2.4	<2.4
52	3.2	<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	9.9	4.7	<2.2	<2.2	5.0
87	2.3	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	8.6	4.6	<2	<2	4.6
153;132	16.2	9.2	2.8	2.8	8.7
105	2.9	<1.4	<1.4	<1.4	1.8
138	15.0	8.1	2.5	2.6	8.0
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	6.1	3.8	<1.9	<1.9	3.4
128	2.7	<1.9	<1.9	<1.9	<1.9
180	2.1	<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	78%	84%	84%	81%	84%
198	74%	85%	93%	92%	79%

Table F.10. Tissue Concentrations of PCBs in composite samples collected from sites in Maine in 2009.

Congener	MECC	MEPH	MEKN	MEDM	MEBB	MEMR	MECK
	(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
18;15	<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
50	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
28	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
52	3.0	<2	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	12.2	2.4	<2.2	4.5	2.4	<2.2	<2.2
87	3.3	<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
118	9.6	<2	<2	3.9	<2	<2	<2
153;132	18.4	5.8	3.8	7.5	5.0	<2.1	<2.1
105	3.6	<1.4	<1.4	1.6	<1.4	<1.4	<1.4
138	16.4	4.5	2.8	6.2	4.5	<2	<2
126	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
187	9.1	2.6	<1.9	4.0	2.2	<1.9	<1.9
128	3.1	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
180	3.0	<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
170;190	<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
206	<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
Surrogate Recovery							
103	85%	87%	78%	80%	80%	93%	88%
198	90%	91%	88%	92%	93%	84%	87%

Table F.11. Tissue concentrations of PCBs in composite samples collected from sites in New Brunswick and Nova Scotia in 2009.

Congener	NBTC	NBSC	NSDI	NSDI DU	NSAR	NSBP	NSYR	NSBC
	(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	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
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	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3	<2.3
118	<2	<2	<2	<2	<2	<2	<2	<2
153;132	2.8	4.9	<2.1	<2.1	<2.1	<2.1	2.9	<2.1
105	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
138	2.6	3.5	<2	<2	<2	<2	2.6	<2
126	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
187	<1.9	2.0	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7	<1.7
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	88%	71%	80%	90%	81%	86%	81%	88%
198	97%	77%	90%	91%	88%	79%	88%	88%

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

	NHDP	NHDP	NHDP	NHDP
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	<2.4	<2.4	<2.4	<2.4
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	5.2	5.2	4.4	4.7
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	5.1	5.0	4.3	4.6
153;132	9.8	10.5	8.7	9.2
105	1.5	<1.4	<1.4	<1.4
138	8.8	9.2	7.6	8.1
126	<1.9	<1.9	<1.9	<1.9
187	4.0	4.3	3.4	3.8
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7
Surrogate Recovery				
103	87%	92%	85%	84%
198	86%	94%	84%	85%

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

	NHHS	NHHS	NHHS	NHHS	NHHS
Congener	**1N**	**1N DUP**	**2N**	**3N**	**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	<2.4	<2.4	<2.4	<2.4	<2.4
52	<2	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2	<2.2
101;90	<2.2	<2.2	<2.2	<2.2	<2.2
87	<1.9	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3	<2.3
118	<2	<2	<2	<2	<2
153;132	2.8	2.7	2.2	2.8	2.8
105	<1.4	<1.4	<1.4	<1.4	<1.4
138	2.5	2.4	2.1	2.5	2.6
126	<1.9	<1.9	<1.9	<1.9	<1.9
187	<1.9	<1.9	<1.9	<1.9	<1.9
128	<1.9	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7	<1.7
Surrogate Recovery					
103	77%	71%	74%	84%	81%
198	81%	80%	79%	93%	92%

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

	MECC	MECC	MECC	MECC
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	<2.4	<2.4	<2.4	<2.4
52	<2	<2	<2	<2
44	<2.3	<2.3	<2.3	<2.3
66;95	<2.2	<2.2	<2.2	<2.2
101;90	3.5	3.7	3.5	3.1
87	<1.9	<1.9	<1.9	<1.9
77	<2.3	<2.3	<2.3	<2.3
118	3.3	3.3	3.2	2.9
153;132	8.0	7.9	7.3	7.5
105	<1.4	<1.4	<1.4	<1.4
138	7.1	7.1	6.5	6.5
126	<1.9	<1.9	<1.9	<1.9
187	3.1	3.0	2.8	3.0
128	<1.9	<1.9	<1.9	<1.9
180	<1.7	<1.7	<1.7	<1.7
169	<1.7	<1.7	<1.7	<1.7
170;190	<1.8	<1.8	<1.8	<1.8
195;208	<1.8	<1.8	<1.8	<1.8
206	<1.7	<1.7	<1.7	<1.7
209	<1.7	<1.7	<1.7	<1.7
Surrogate Recovery				
103	73%	67%	69%	87%
198	70%	76%	77%	97%

Table F.15. Tissue concentrations of pesticides in composite samples collected from sites in Massachusetts in 2009.

Pesticide	MABI	MAME	MASN
	(ng/g)	(ng/g)	(ng/g)
α–BHC	<2.0	<2.0	<2.0
HCB	<2.4	<2.4	<2.4
γ-HCH(Lindane)	<1.5	<1.5	<1.5
Heptachlor	<2	<2	<2
Aldrin	<1.5	<1.5	<1.5
Heptachlor Epoxide	<1.8	<1.8	<1.8
γ-Chlordane	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0
α-Endosulfan	<1.5	<1.5	<1.5
cis-Chlordane	<1.2	<1.2	<1.2
τ-Nonachlor	2.0	5.9	7.7
p,p'_DDE	5.4	6.1	7.6
Dieldrin	<1.4	1.8	2.0
o,p'-DDD	<4.0	5.1	4.7
Endrin	<2.2	<2.2	<2.2
β-Endosulfan	<3.4	<3.4	<3.4
p,p'-DDD	<2	<2	<2
o,p'-DDT	<2.8	<2.8	<2.8
p,p'-DDT	<2.5	<2.5	<2.5
Metoxychlor	<3.1	6.0	3.2
Mirex	<1.5	<1.5	<1.5
Surrogate Recovery %			
γ-Chlordene	72%	62%	81%
β-BHC	73%	71%	80%

Table F.16. Tissue concentrations of pesticides in composite samples Collected from sites in New Hampshire in 2009.

Pesticide	NHNM	NHDP	NHHS	NHHS Dup	NHSM
	(ng/g)	(ng/g)	(ng/g)	(ng/g)	(ng/g)
α–BHC	6.8	<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	2.4	<1.5	<1.5	<1.5	2.0
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	3.5	<1.2	<1.2	<1.2	2.6
τ-Nonachlor	2.7	<1.4	<1.4	<1.4	2.5
p,p'_DDE	19.5	5.3	2.6	2.65	14.2
Dieldrin	<1.4	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	18.3	<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	21.9	3.0	<2	<2	9.7
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	4.7	<3.1	<3.1	<3.1	3.4
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5
Surrogate Recovery %					
γ-Chlordene	77%	77%	74%	74%	67%
β-BHC	75%	83%	50%	62%	82%

Table F.17. Tissue concentrations of pesticides in composite samples collected from Sites in Maine in 2009.

Pesticide	MECC	MEPH	MEKN	MERY	MEBB	MEFP	MEPI	MEBH
	(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	2.4	<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	1.4	2.3	<1.2	<1.2	<1.2	2.1	<1.2	1.4
τ-Nonachlor	1.7	1.7	<1.4	<1.4	<1.4	2.0	<1.4	<1.4
p,p'_DDE	3.5	11.8	3.2	4.8	3.2	4.5	<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	4.6	<4.0	<4.0	13.3	<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	2.1	12.3	<2	2.5	12.1	3.2	<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	2.6	<2.5	<2.5	<2.5	<2.5
Metoxychlor	<3.1	<3.1	<3.1	<3.1	14.5	<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	68%	77%	68%	74%	70%	75%	73%	77%
β-BHC	84%	82%	84%	87%	70%	84%	100%	90%

F.18. Tissue concentrations of pesticides in composite samples collected from sites In New Brunswick and Nova Scotia in 2009.

Pesticide	NBTC	NBSC	NSDI	NSDI Dup	NSAR	NSBP	NSYR	NSBC
	(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	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
o,p'-DDE	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
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	<1.2	1.7	<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	5.4	2.3	<1.8	<1.8	<1.8	<1.8	2.6	<1.8
Dieldrin	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Endrin	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
β-Endosulfan	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
p,p'-DDD	2.1	<2	<2	<2	<2	<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	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1
Mirex	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Surrogate Recovery								
γ-Chlordene	68%	68%	69%	74%	66%	74%	72%	73%
β-BHC	69%	79%	63%	94%	75%	56%	58%	71%

Table F.19. Tissue concentrations of pesticides in mussels collected from Dover Point, NH (NHDP) in 2009.

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	3.0	<1.2	<1.2	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	6.2	5.7	4.8	5.3
Dieldrin	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	9.0	9.1	<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	2.1	2.2	3.0
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
Surrogate Recovery %				
γ-Chlordene	75%	85%	67%	77%
β-BHC	71%	69%	51%	83%

Table F.20. Tissue concentrations of pesticides in mussels collected from Hampton/Seabrook Harbor, NH (NHHS) in 2009.

	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	<1.2	<1.2	<1.2	<1.2
τ-Nonachlor	<1.4	<1.4	<1.4	<1.4
p,p'_DDE	2.7	2.3	2.6	2.65
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
Surrogate Recovery (%)				
γ-Chlordene	100%	69%	74%	74%
β-BHC	83%	78%	50%	62%

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

Congener Number	MECC 1N (ng/g)	MECC 2N (ng/g)	MECC 3N (ng/g)	MECC 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	2.9	1.3	2.2	1.4
τ-Nonachlor	<1.4	<1.4	2.3	1.7
p,p'_DDE	3.7	3.7	4.2	3.5
Dieldrin	<1.4	<1.4	<1.4	<1.4
o,p'-DDD	20.5	<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	2.4	2.2	<2	2.1
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
Surrogate Recovery				
γ-Chlordene	58%	60%	61%	68%
β-BHC	83%	84%	77%	84%