



## **Casco Bay Gulfwatch Data Years 2000-2008**

### *Initial Analysis*

**Prepared by: Ecosystem Indicator Partnership (ESIP), Gulf of Maine  
Council on the Marine Environment**

**March 2010 - Version 2**

## **Introduction**

The Gulf of Maine Council on the Marine Environment (Council) formed the Ecosystem Indicator Partnership (ESIP) in 2006 as a direct result of the recognized need to provide information on change in the Gulf of Maine. Indicators were selected following a thorough consensus based process for seven focus areas: aquaculture, aquatic habitats, climate change, coastal development, contaminants, eutrophication, and fisheries. After initial data discovery efforts were completed two to four priority indicators were selected for each focus area. Three indicators were selected with respect to contamination: shellfish sanitation data, sediment triad (toxicity, chemical concentrations, and benthic community structure), and Gulfwatch data.

The Gulfwatch program data is a rich dataset representing parameters measured in blue mussel, *Mytilus edulis*, tissue since 1991 in the Gulf of Maine. Initial effort on sampling program was meant to supplement National Status and Trends efforts (<http://ccma.nos.noaa.gov/about/coast/nsandt/musselwatch.html>). Sampling locations for the Gulfwatch program are spread throughout the Gulf of Maine. Three sites sampled from 2000-2009 lie within the Casco Bay watershed: Portland Harbor (MEPH; sampled five times in the study period), Presumpscot River (MEPR; sampled three times in the study period) and Royal River (MERY; sampled twice in the study period).

## **Metals**

All metal methodology is detailed in Gulfwatch reports by year and available at: <http://www.gulfofmaine.org/gulfwatch/data/files.php>. Concentrations for most metals appear to have decreased over time. In addition, concentrations for the most part are observed to decrease with increasing latitude. Table 1 details metal concentrations over time for the three Casco Bay locations. At the Portland Harbor site, most metal concentrations have decreased from 2000 to 2008. Likewise, metals concentrations at the Presumpscot River site have decreased from 2000 to 2007 with lead concentrations in the latter year less than half of the initial concentration. Lead at the Royal River site was quite low initially and remained so.

**Table 1: Metals concentrations by year for the three Casco Bay locations.**

**Portland Harbor Site (Multi-year site - sampled every 3 years)**

<b>Year</b>	<b>Hg</b>	<b>Ag</b>	<b>Cd</b>	<b>Pb</b>	<b>Ni</b>	<b>Zn</b>	<b>Al</b>	<b>Cr</b>	<b>Fe</b>	<b>Cu</b>
2000	NA	0.1	1.78	11.5	2.45	357.5	370	2.3	737.5	12.3
2003	0.30	0.09	1.48	2.33	7.62	107.8	467		668.8	
2005	0.29	0.05	1.89	6.58	1.39	159.5	464	1.8	761.3	8.6
2007	0.2	0.02	1.39	4.34	0.95	146	250	1.7	444	7.6
2008	0.2	0.02	1.48	5.16	1.06	139	483	1.4	606	8.08

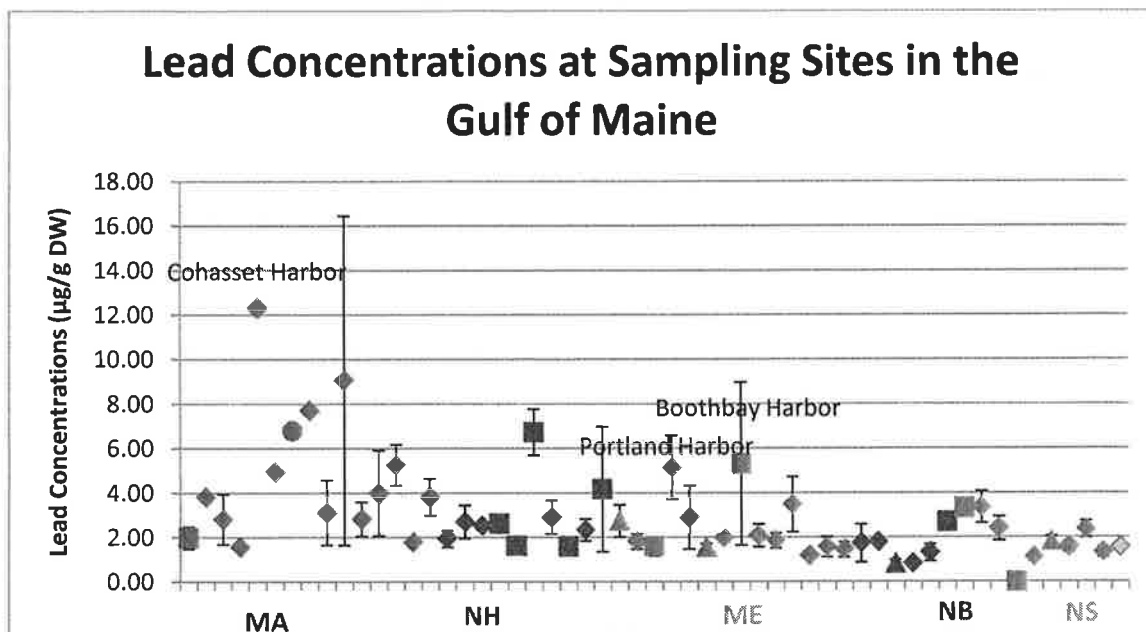
**Presumpscot River (Rotational)**

<b>Year</b>	<b>Hg</b>	<b>Ag</b>	<b>Cd</b>	<b>Pb</b>	<b>Ni</b>	<b>Zn</b>	<b>Al</b>	<b>Cr</b>	<b>Fe</b>	<b>Cu</b>
2000	NA	0.17	2.05	7.8	3.05	113.25	532.5	3.025	972.5	13
2003	0.18	0.14	1.25	1.48	4.52	66.25	499.5	1.82	548.2	
2007	0.21	0.06	1.2	2.92	1.11	93.5	417	1.38	524	8.3

**Royal River (Multi-year site - sampled every 3 years)**

<b>Year</b>	<b>Hg</b>	<b>Ag</b>	<b>Cd</b>	<b>Pb</b>	<b>Ni</b>	<b>Zn</b>	<b>Al</b>	<b>Cr</b>	<b>Fe</b>	<b>Cu</b>
2002	NA	ND	0.9	2.08	1.2	67.5	240	0.8	535	7.75
2005	0.135	0.04	1.335	1.88	1.45	98.8	995	1.78	761	7.58

When trend results for these three locations are placed within the greater Gulf of Maine picture, similar to trends reported in the 1990's, highest lead values were observed in Massachusetts (Boston Harbor = 13.5 µg/g DW; Long Island/Boston Harbor = 7.7 µg/g DW), see **Figure 1**. Casco Bay locations were similar to results observed at other Maine sites. The lowest lead concentrations were observed in New Brunswick.



**Figure 1:** Eight-year (2000-2008) median and median absolute deviations in lead concentrations micrograms per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

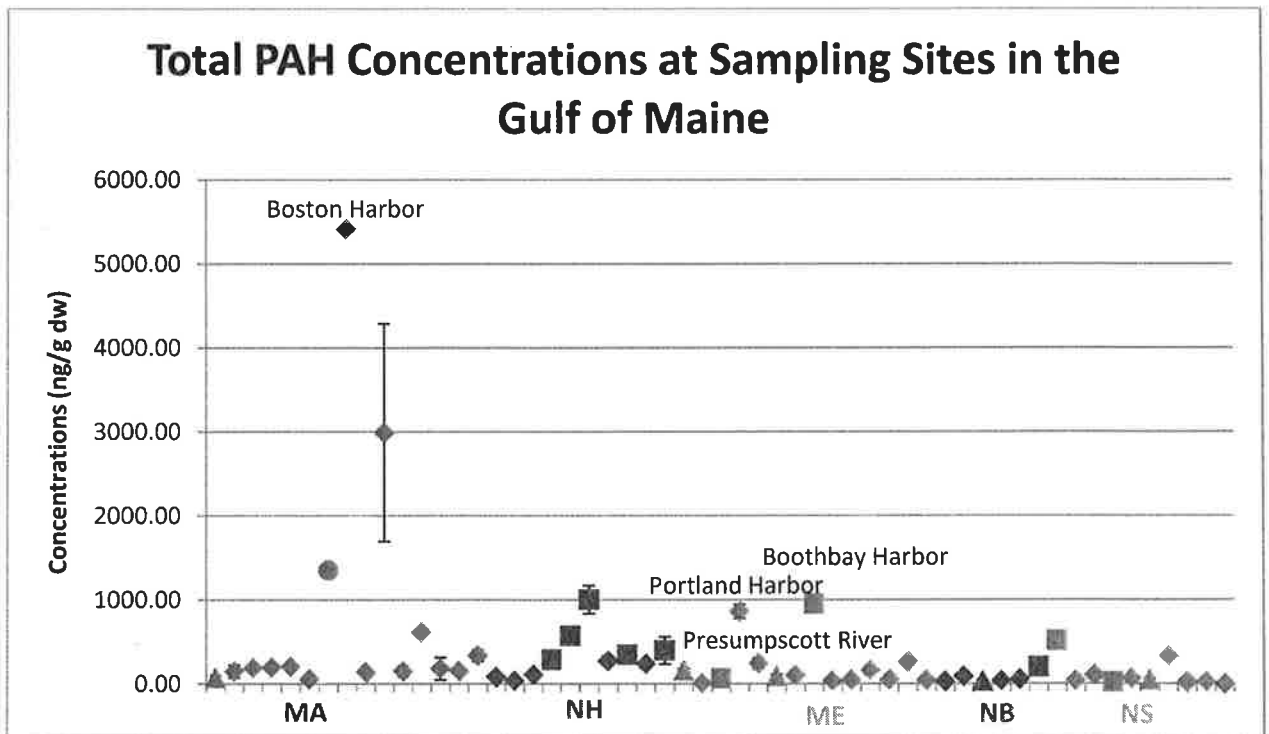
### PAHs

All PAH methodology is detailed in Gulfwatch reports by year and available at: <http://www.gulfofmaine.org/gulfwatch/data/files.php>. In previous reports, Casco Bay Estuary Partnership compared results for the sum of PAHs utilizing sum totals of 24 PAHs (see **Box 1**). These same parameters were measured for the Gulfwatch sites through 2006. In 2007, the sample suite changed and those data are not included in this discussion. However, for 2007 and 2008 calculations, the appropriate PAHs were included for comparison purposes (see e-mail from S. Jones on March 12, 2010).

#### **Box 1: PAHs included in $\Sigma_{24}$ PAH suite.**

PAHs: Naphthalene, C1-Naphthalenes, C2-Naphthalenes, C3-Naphthalenes, Biphenyl, Acenaphthylene, Acenaphthene, Fluorine, Dibenzothiophene, Phenanthrene, Anthracene, C2-Phenanthrene, Fluoranthene, Pyrene, Benzo(a)Anthracene, Chrysene, Benzo(b)Fluoranthene, Benzo(k)Fluoranthene, Benzo(a)Pyrene, Perylene, Indeno(1,2,3-cd)Pyrene, Dibenz(a,h)Anthracene, Benzo(ghi)Perylene (or equivalents in 2007-2008).

PAHs in the region were highest for the two sites located in Boston Harbor (MAIH=3942 ng/g DW) and Long Island- Boston Harbor (5408 ng/g DW). For the most part, sample locations for the remainder of the Gulf of Maine contained relatively low PAHs. However, the fourth highest total PAHs in the Gulf of Maine were observed at Portland Harbor (MEPH = 815 ng/g DW), see **Figure 2**.



**Figure 2:** Eight-year (2000-2008) median and median absolute deviations in PAH concentrations nanograms per gram dry weight (ng/g DW) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

**Pesticides and PCBs**

As part of this initial analysis, average sum pesticides and average sum PCBs were compared throughout the region. All pesticide and PCB methodology is detailed in Gulfwatch reports by year and available at: <http://www.gulfofmaine.org/gulfwatch/data/files.php>). Pesticides and PCBs included in the analysis are listed in **Box 2**.

**Box 2: Pesticides and PCBs included in the analysis.**

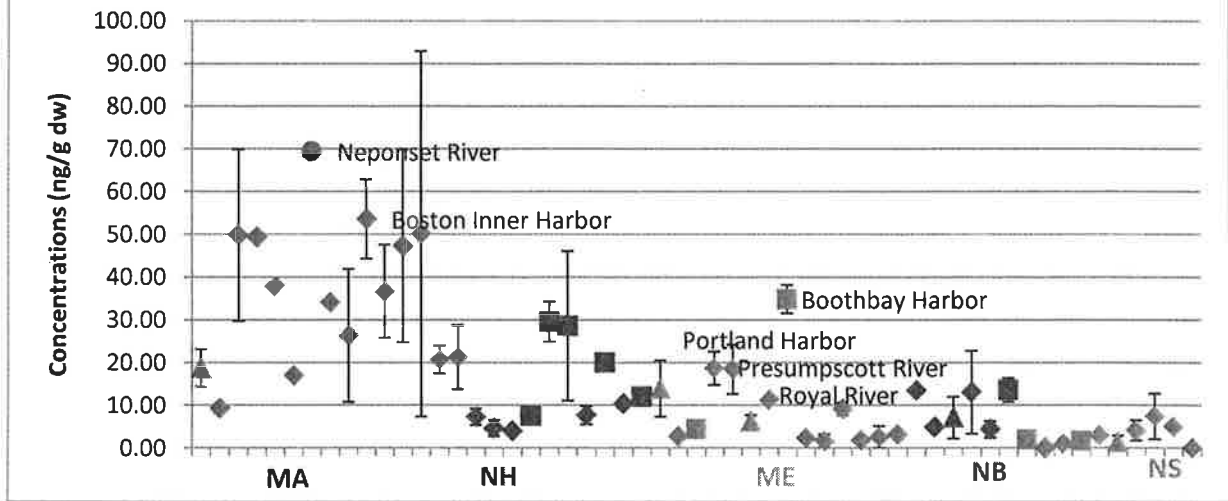
**Chlorinate Pesticides:**  $\alpha$ -BHC, HCB,  $\gamma$ -HCH (Lindane), Heptachlor, Aldrin, Heptachlor Epoxide,  $\gamma$ -Chlordane, o,p'-DDE,  $\alpha$ -Endosulfan, cis-Chlordane, trans-Nonachlor, p,p'-DDE, Dieldrin, o,p'-DDD, Endrin,  $\beta$ -Endosulfan, p,p'-DDD, o,p'-DDT, p,p'-DDT, Metoxychlor, Mirex

**PCB Congeners:** 8;5, 18;15, 29, 50, 28, 52, 44, 66;95, 101;90, 87, 77, 118, 153;132, 105, 138, 126, 187, 128, 180, 169, 170;190, 195;208, 206, 209

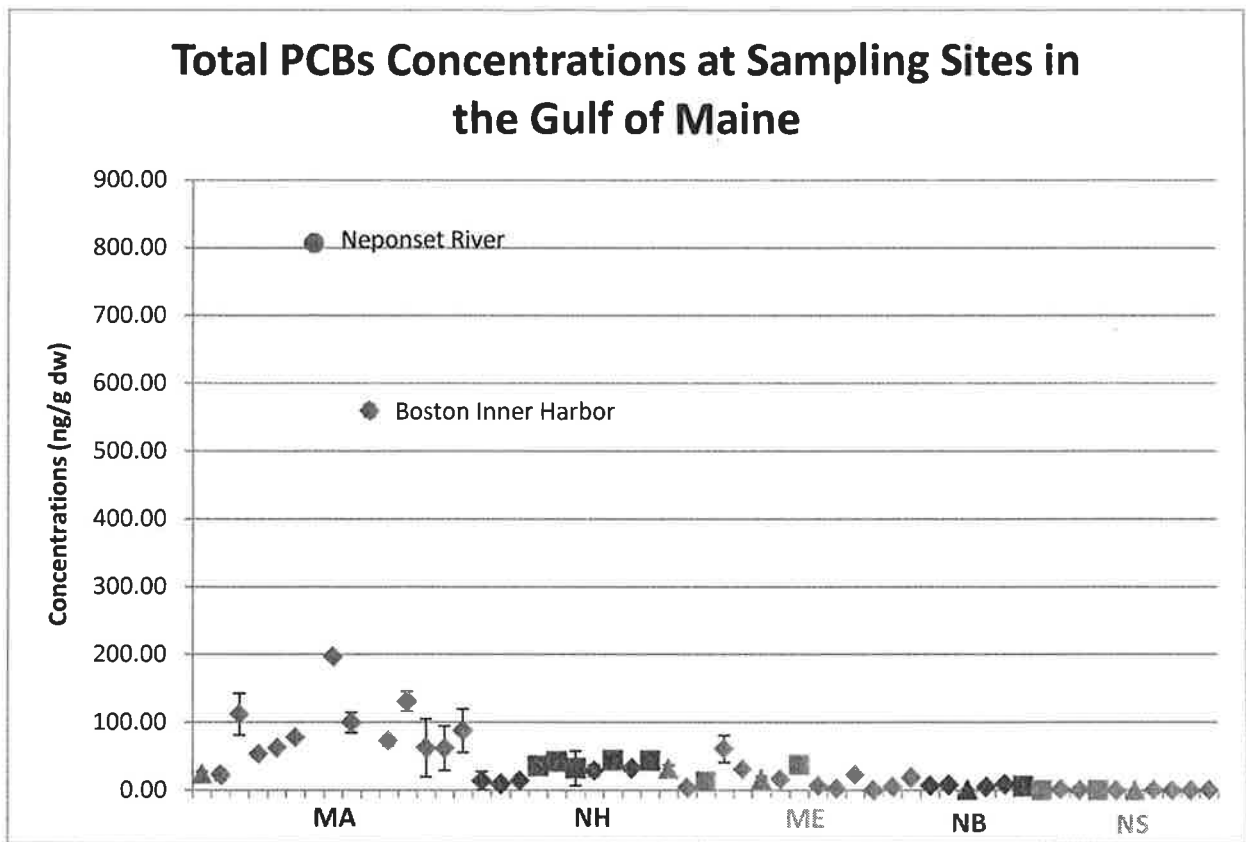
In general, variation within the sample sets was much greater for PCBs and pesticides resulting in higher standard deviations represented in **Figures 3** and **4**. With respect to pesticides, values were quite high in Massachusetts with the largest concentrations observed in Boston's Inner Harbor (MAIH = 85.6 ng/g DW). Casco Bay samples ranged from a low at the Royal River site (MERY = 11.3 ng/g DW) to a high at Portland Harbor (MEPH = 18.6 ng/g DW). In general concentrations of pesticides decreased with increases in latitude with the majority of samples in New Brunswick and Nova Scotia less than or equal to 6 ng/g DW.

Similarly the concentrations of all PCBs summed together decreased with increases in latitude. Highest values were observed in Massachusetts at Neponset River (MANR = 807 ng/g DW) and Boston's Inner Harbor (MAIH = 516 ng/g DW). Casco Bay samples ranged from a low at the Royal River site (MERY = 16 ng/g DW) to a high at Portland Harbor (MEPH = 60 ng/g DW).

## Total Pesticide Concentrations at Sampling Sites in the Gulf of Maine



**Figure 3:** Eight-year (2000-2008) median and median absolute deviations in pesticide concentrations nanograms per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.



**Figure 4:** Eight-year (2000-2008) median and median absolute deviations in PCB concentrations micrograms per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

**Conclusion**

The Gulfwatch Monitoring Program and associated dataset continues to provide one of the longest and most inclusive records of observable contaminants within the Gulf of Maine ecosystem. The three sites within Casco Bay that are included in the Gulfwatch dataset all show observed concentrations of lead, pesticides, PCBs and PAHs less than sites located to the south in New Hampshire and Massachusetts. However, Portland Harbor's samples are often the highest in concentration for Maine (examples include PCBs, pesticides, and lead).





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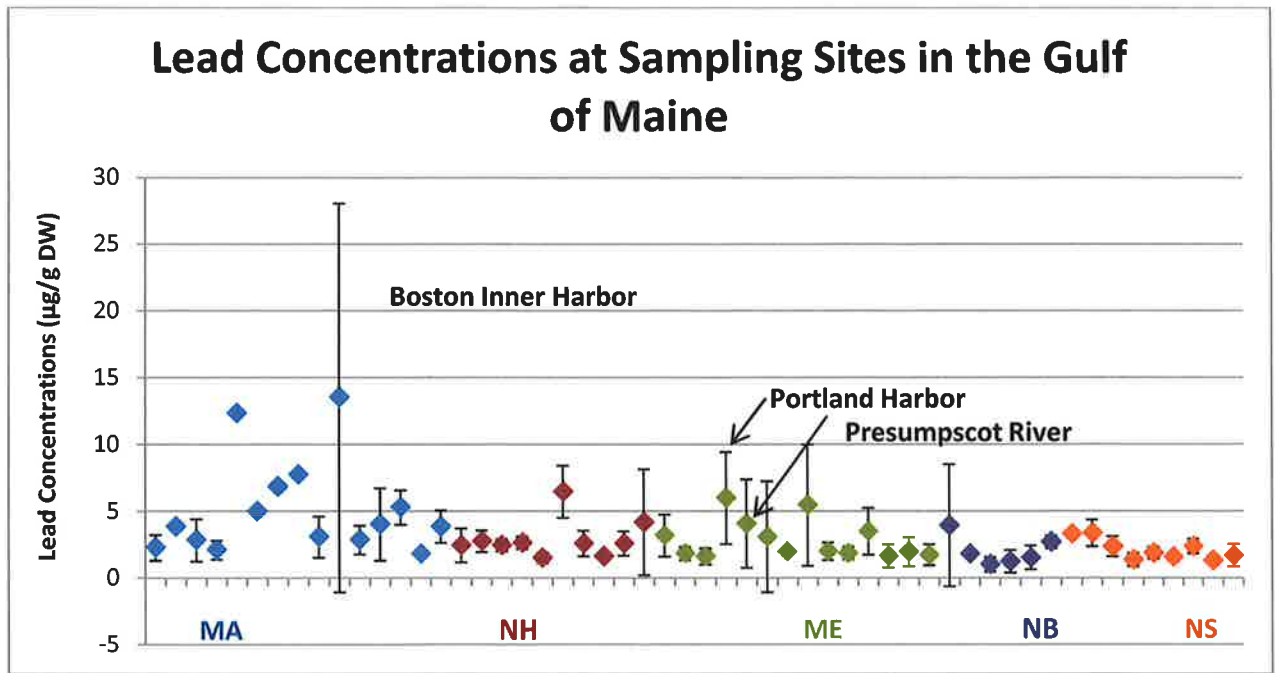
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**Figure 1:** Lead concentrations ( $\mu\text{g/g DW}$ ) with increasing latitude throughout the Gulf of Maine.

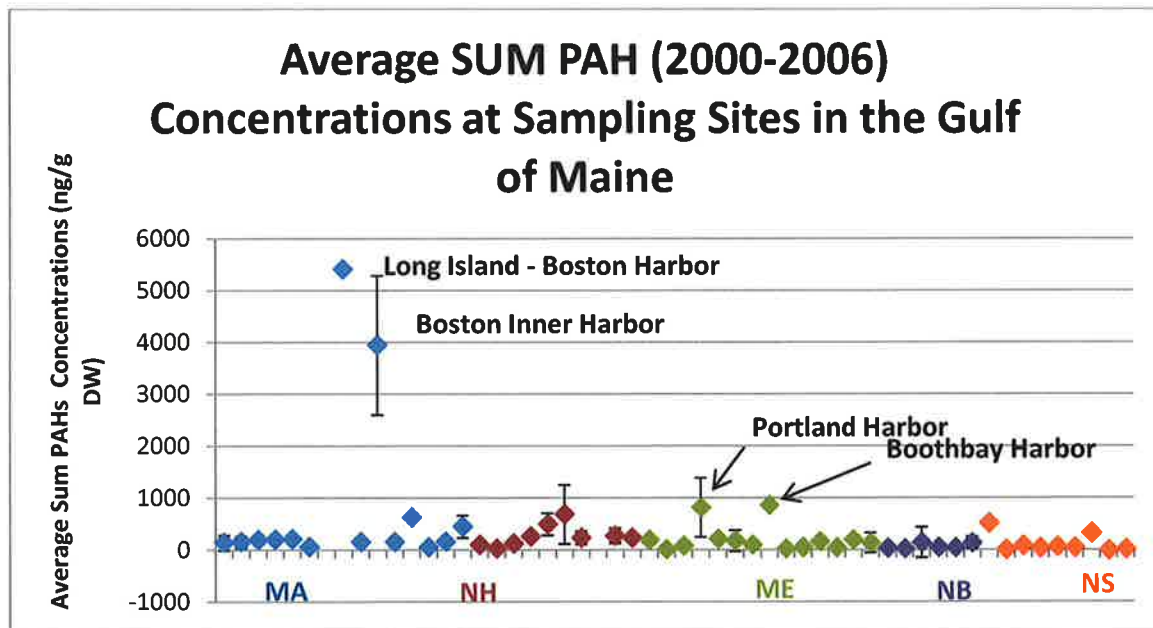
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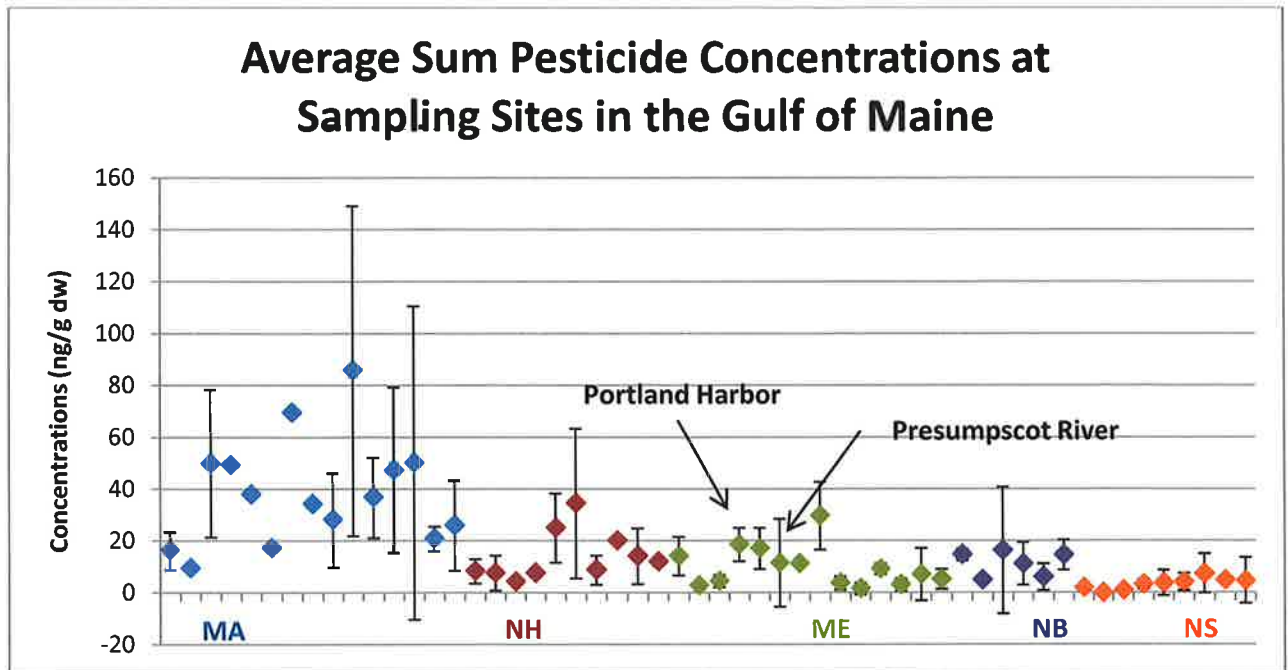
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**Box 3: PCBs included in the analysis.**

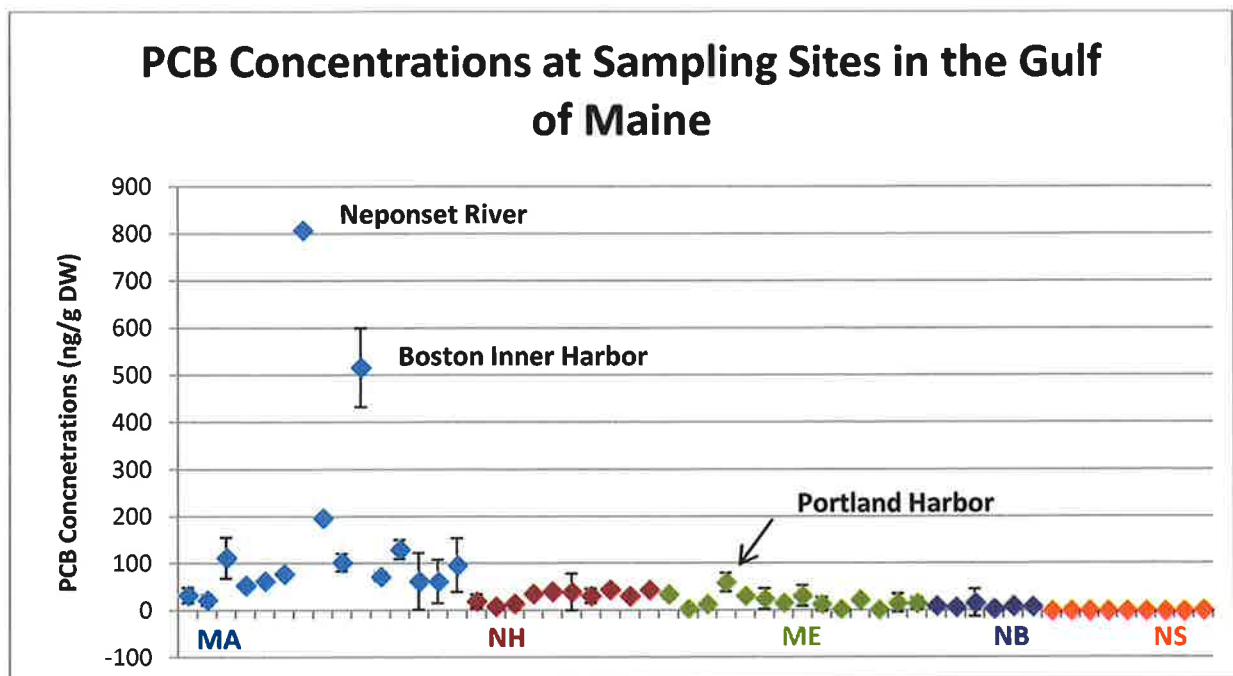
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**Figure 3:** Sum pesticide concentrations (ng/g DW) with increasing latitude throughout the Gulf of Maine.



**Figure 4:** Sum PCB concentrations (ng/g DW) with increasing latitude throughout the Gulf of Maine.

## **Conclusion**

The Gulfwatch Monitoring Program and associated dataset continues to provide one of the longest and most inclusive records of observable contaminants within the Gulf of Maine ecosystem. The three sites within Casco Bay that are included in the Gulfwatch dataset all show observed concentrations of lead, pesticides, PCBs and PAHs less than sites located to the south in New Hampshire and Massachusetts. However, Portland Harbor's samples are often the highest in concentration for Maine (examples include PCBs, pesticides, and lead).





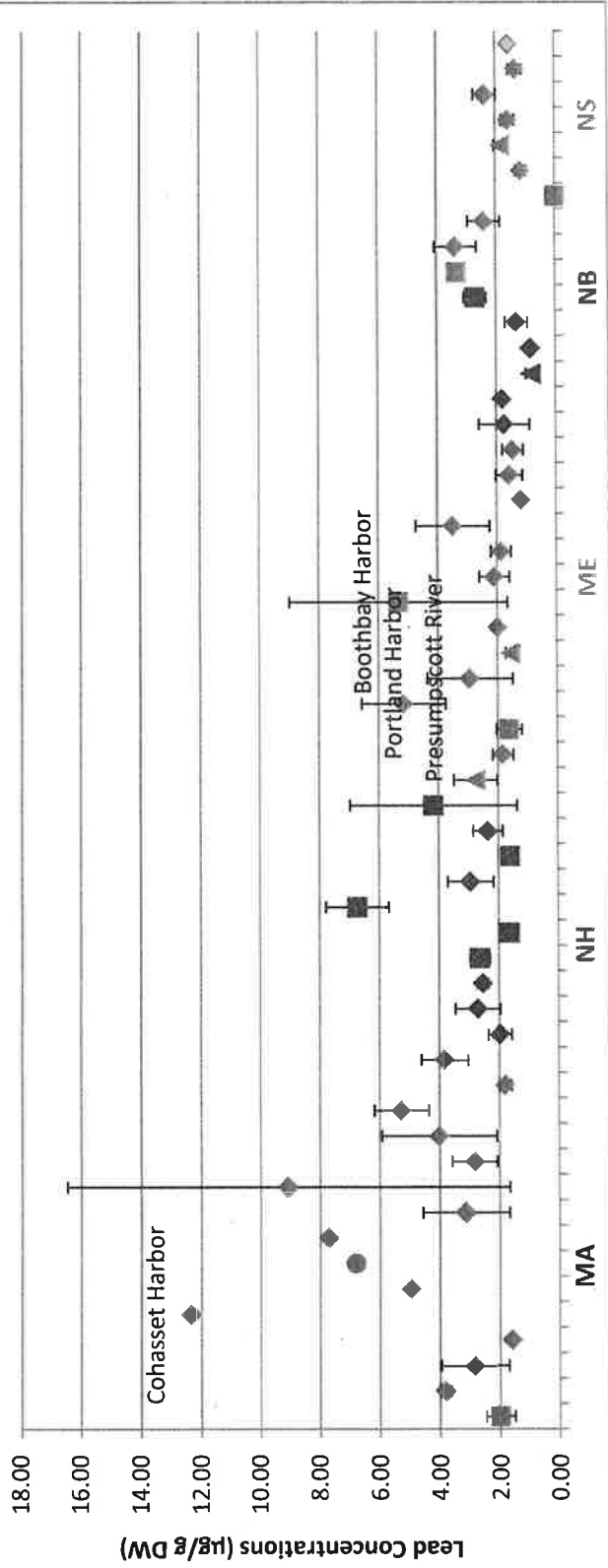
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### *Appendix*

**Prepared by: Ecosystem Indicator Partnership (ESIP), Gulf of Maine Council on the Marine Environment**

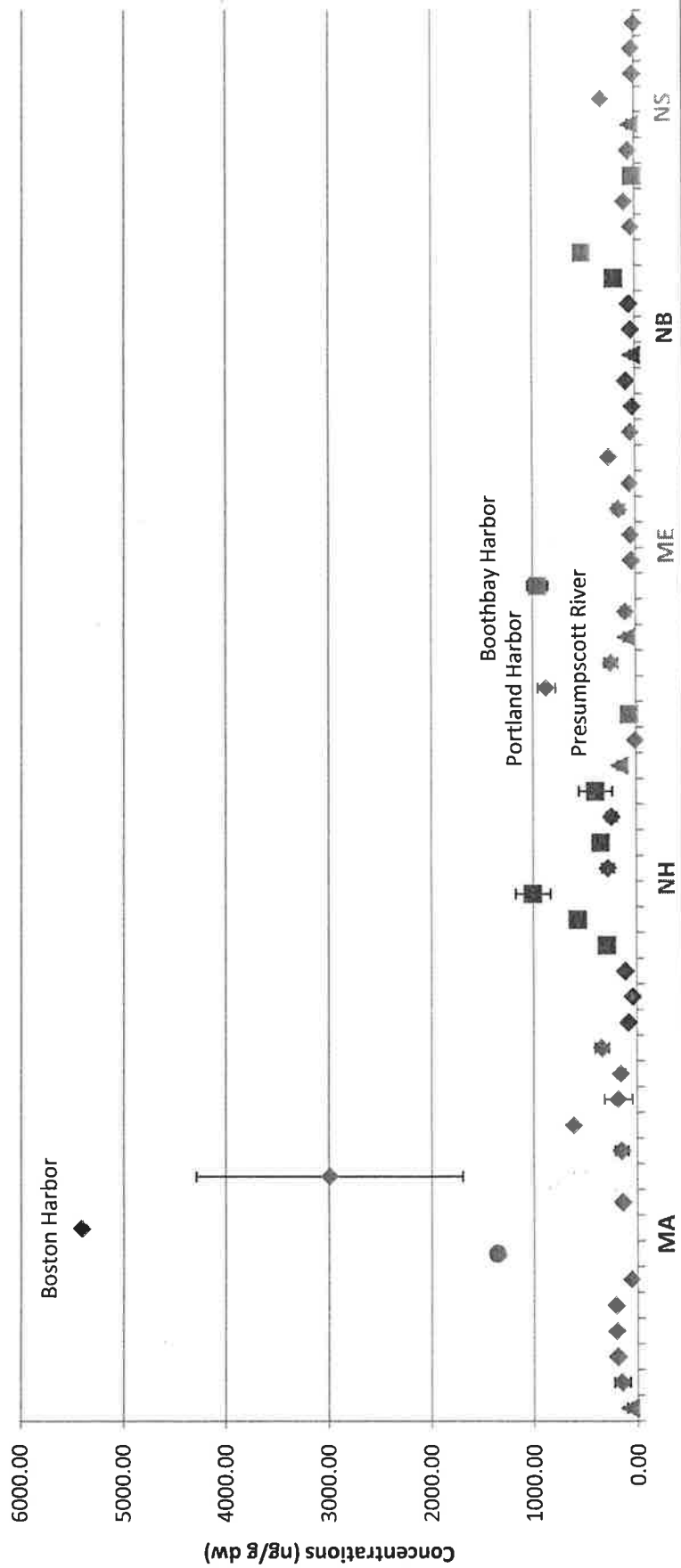
**March 2010**

## Lead Concentrations at Sampling Sites in the Gulf of Maine

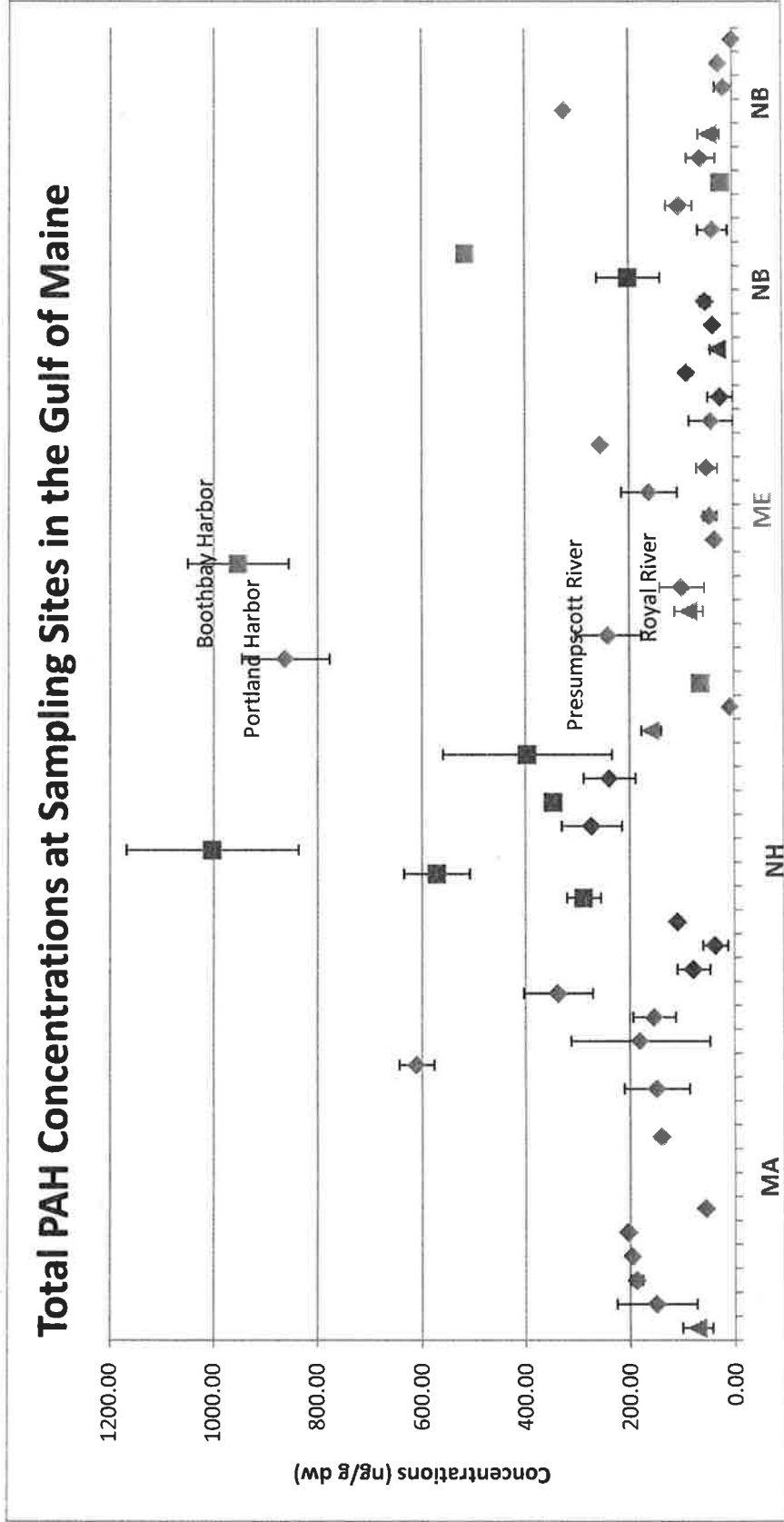


**Figure 1:** Eight-year (2000-2008) median and median absolute deviations in lead concentrations micrograms per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds = multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

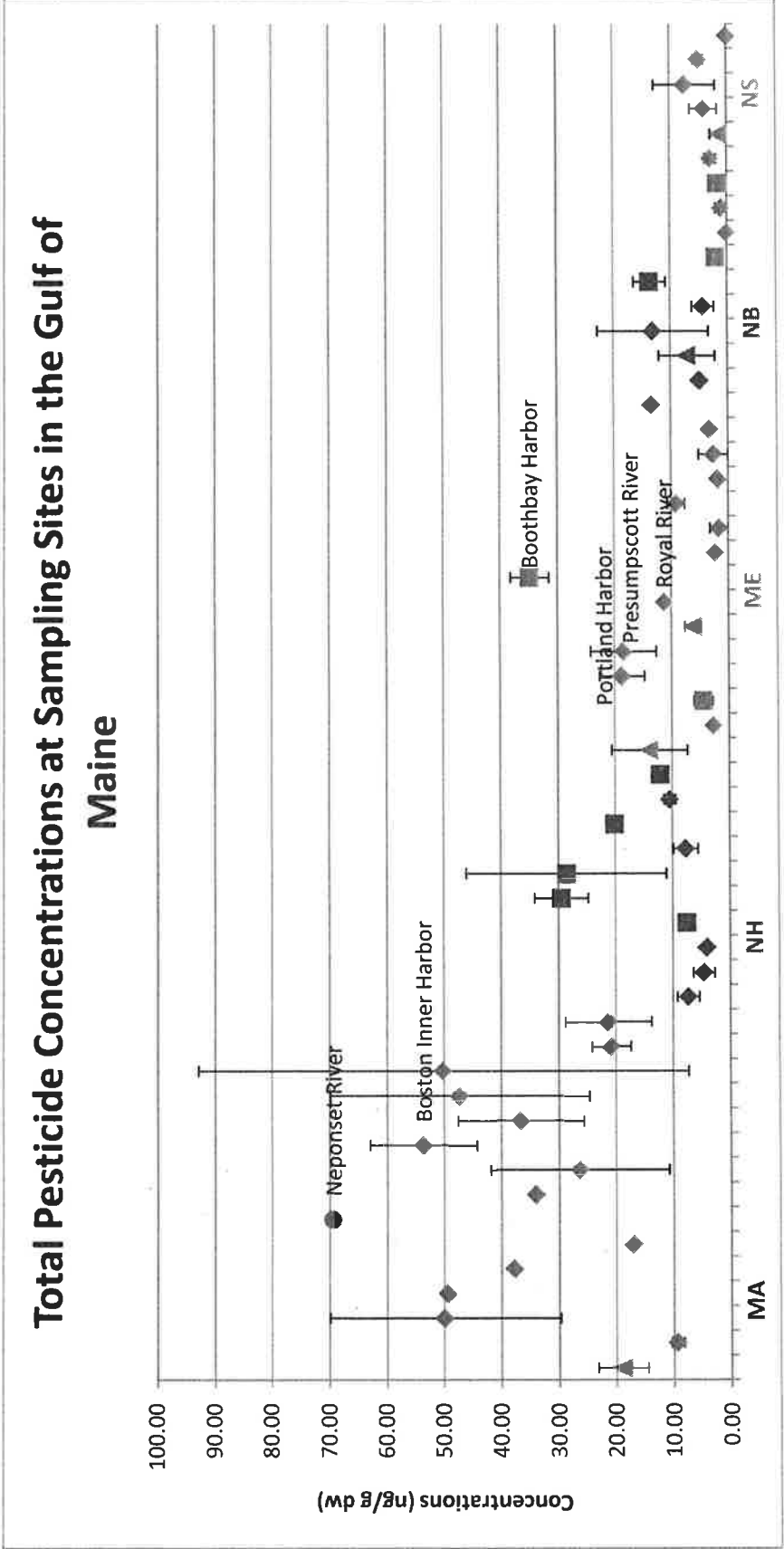
## Total PAH Concentrations at Sampling Sites in the Gulf of Maine



**Figure 2:** Eight-year (2000-2008) median and median absolute deviations in PAH concentrations nanograms per gram dry weight (ng/g DW) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

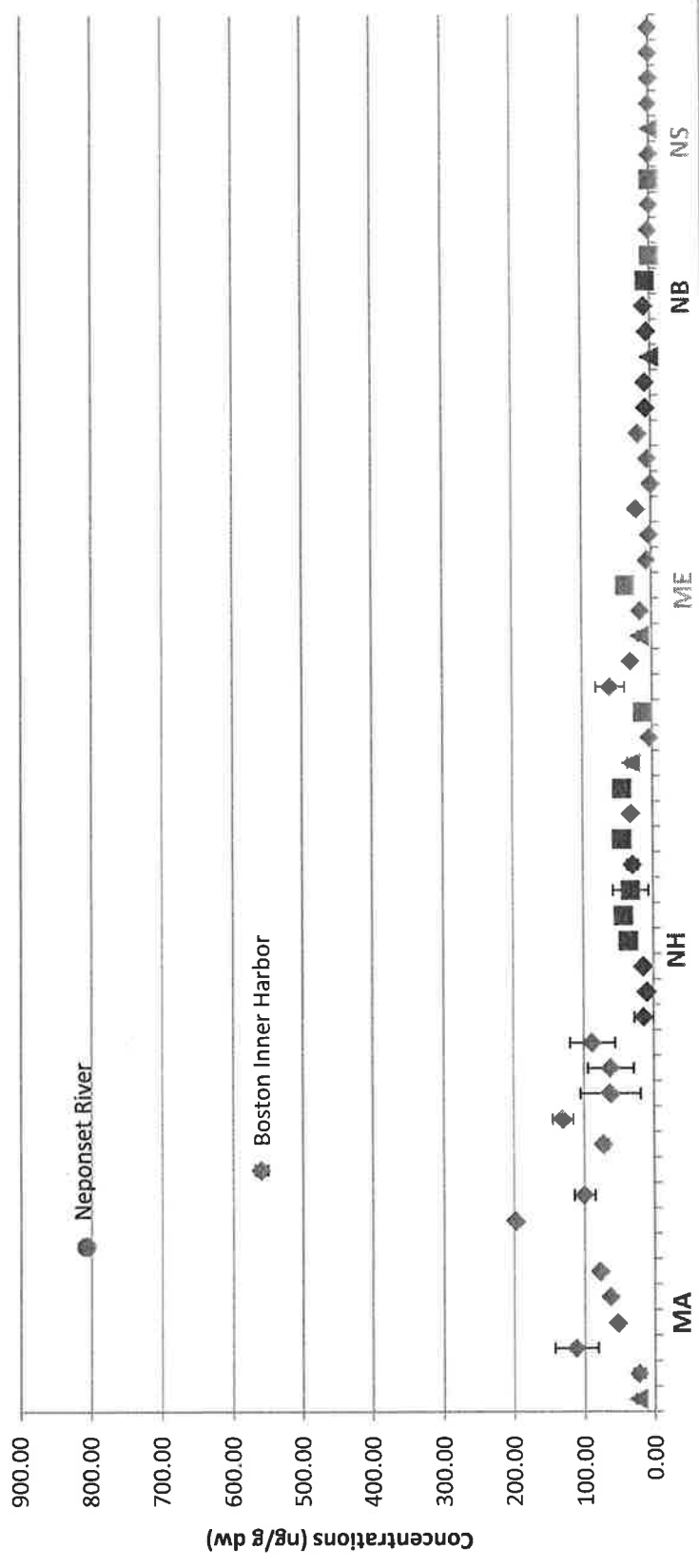


**Figure 3: Low-range only:** Eight-year (2000-2008) median and median absolute deviations in PAH concentrations nanograms per gram dry weight (ng/g DW) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds = multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.



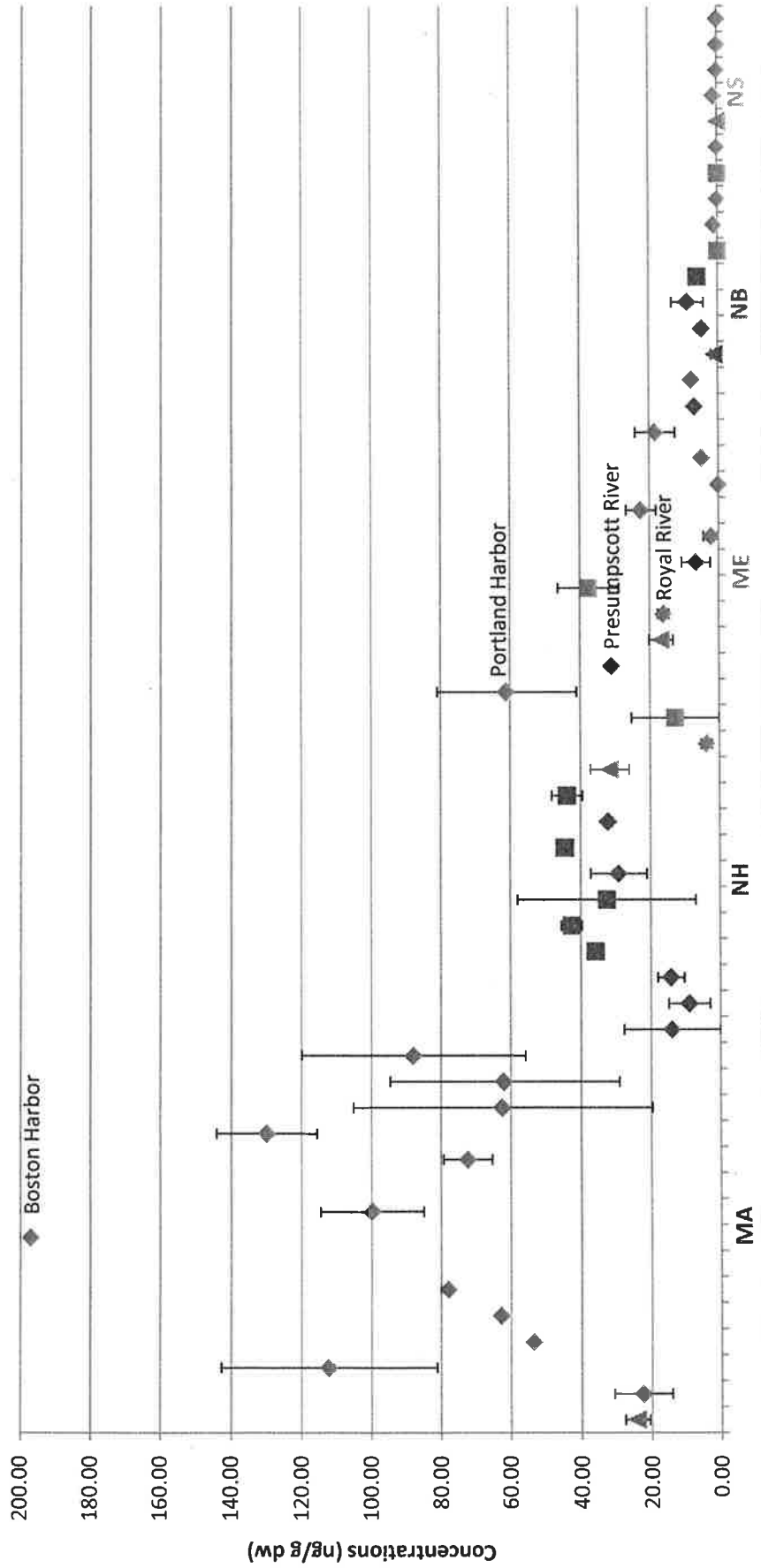
**Figure 4:** Eight-year (2000-2008) median and median absolute deviations in pesticide concentrations in mussel tissues per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds = multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

## Total PCBs Concentrations at Sampling Sites in the Gulf of Maine



**Figure 5:** Eight-year (2000-2008) median and median absolute deviations in PCB concentrations micrograms per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.

# Total PCBs Concentrations at Sampling Sites in the Gulf of Maine



**Figure 6: Low range only:** Eight-year (2000-2008) median and median absolute deviations in PCB concentrations micrograms per gram dry weight ( $\mu\text{g/g DW}$ ) in mussel tissues at all Gulfwatch sites, in geographic order (south to north along the x axis from Massachusetts to Nova Scotia). Triangles = Benchmark site (sampled every year); Diamonds - multi-year sites (sampled every 3 years); Circles = sampled every 6 years; Squares = occasionally sampled sites.