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Metals and PCB Concentrations in Mussels from Long Island Sound

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Metals and polychlorinated biphenyls (PCBs) are contaminants of concern in Long Island Sound. To gain an understanding of contaminant inputs from the major rivers of Connecticut into the Sound, a continuous measurement over time should be made of the concentrations of contaminants in the river water. Analyses of water for contaminants are quite complex and often ambiguous because of the dynamic nature of river water. To alleviate this problem, the mussel, Mytilus edulis, has been proposed by various researchers to be a good subject for monitoring contaminants present in the water column (Farrington et al. 1983; National Academy of Sciences 1981; Goldberg et al. 1978). Farrington et al. (1983) listed nine reasons for using bivalves, such as the mussel and the oyster, for measurement of contaminants in seawater. The more important reasons to this study are:

1. "They are sedentary and are thus better than mobile species as integrators of chemical pollution status for a given area."
2. "They concentrate many chemicals by factors of 10^2-10^5 compared to seawater in their habitat. This makes trace constituent measurements often easier to accomplish in their tissues than in seawater."
3. "They survive under conditions of pollution that often severely reduce or eliminate other species."
4. "They are commercially valuable seafood species on a worldwide basis. Therefore, measurement of chemical contamination is of interest for public health considerations."

For this study, we collected mussels from the mouths of various rivers and inshore areas along the Connecticut shoreline and analyzed them for cadmium, copper, and PCBs.

MATERIALS AND METHODS

Mussels were collected by hand over a two-week period in September 1983 from ten locations indicated in Tables 1-3. Mussel meats were removed from the shell and placed in hexane (pesticide grade)-cleaned glass jars with hexane-cleaned aluminum foil under the lid. These samples were held frozen until analysis.

Metal analyses were conducted using a graphite furnace-atomic absorption method (Greig et al. 1982). PCB analyses were conducted by the saponification procedure described by Stout and Beezhold (1979), followed by G.L.C., using a packed column of 3% OV17 on gas chrom WHP (100/120 mesh). A standard of Arochlor 1254 was used for comparison since the chromatograms from these mussels closely matched it.

RESULTS AND DISCUSSION

Levels of PCBs in mussels from all ten stations sampled were low, ranging from a mean of 0.049 to 0.115 ppm wet weight (Table 1). Mussel samples from six stations ranged in PCB levels from 0.049 to 0.068 ppm, whereas mussels from the remaining four stations ranged from 0.084 to 0.115 ppm. Such differences as 0.049 ± 0.030 compared to 0.115 ± 0.025 ppm are statistically different, but it is not known whether the higher concentration could cause more physiological damage to mussels than the lower concentration. From a public health standpoint, both concentrations are quite low compared to the 5 ppm limit set by the United States Food and Drug Administration (USFDA) for PCBs in fish and shellfish. Farrington et al. (1983) examined mussels from the east and west coasts of the United States for PCBs and metals, as well as several other pollutants. They found PCBs to range from about 100 to 400 ppb dry weight. We determined the dry weight to wet weight ratio in our study to be 4.5, thus our samples ranged from 220 to 518 ppb dry weight, which is on the same order of magnitude as that of the Farrington et al. (1983) data. Farrington et al. (1983) sampled one station at New Haven, Connecticut, and reported PCB levels in mussels of 100 and 300 ppb dry weight. PCB levels in mussels from New Haven in this study would be 441 ppb on a dry weight basis, which is similar to the higher level reported by Farrington et al. (1983).

Table 1. Polychlorinated biphenyls (PCBs) in Mytilus edulis collected from various locations along the Connecticut shoreline

Sampling Location	PCBs (ppm, wet wt)	
	Mean[a]	Standard Deviation
Thames River	0.049	0.030
Connecticut River	0.068	0.018
Hammonasset	0.084	0.042
New Haven Harbor	0.098	0.051
Milford Harbor	0.067	0.025
Housatonic River	0.087	0.042
Stratford Point	0.067	0.020
Bridgeport	0.115	0.025
Norwalk Harbor	0.053	0.027
Cos Cob Harbor	0.057	0.015

[a] 10 individuals analyzed from each location

Copper levels were also low in all mussel samples, with means ranging from 1.0 to 2.3 ppm (Table 2). Mussels from only two stations had the lower levels of 1.0 and 1.1 Cu, whereas mussels from the other stations had levels in the range of 1.7 to 2.3 ppm. The lower values are statistically different from the higher values, but no evidence can be presented to indicate that the higher levels could cause more physiological damage to the mussels than the lower ones. The USFDA does not have an action limit for Cu in fish and shellfish, but Mackay et al. (1975) reported maximal concentrations of Cu in seafood set by the National Health and Medical Research Council of Australia to be 30 ppm. The amounts of copper found in mussels in this study are well below this 30 ppm level.

Table 2. Copper content of Mytilus edulis collected from various locations along the Connecticut shoreline

Sampling Location	Copper (ppm, wet wt)	
	Mean[a]	Standard Deviation
Connecticut River	1.1	0.10
Hammonasset	1.0	0.37
New Haven Harbor	2.3	0.52
Milford Harbor	2.2	0.48
Housatonic River	1.7	0.38
Stratford Point	1.8	0.36
Bridgeport	1.9	0.54
Norwalk Harbor	2.2	0.55
Cos Cob Harbor	1.8	0.56

[a] 10 individuals analyzed from each location

The levels of cadmium in mussels were low, with the exception of those taken from Bridgeport where the mussels had a mean level of 5.1 ppm (Table 3). Mussels from the other stations had mean levels of cadmium ranging from 0.41 to 1.3 ppm. Again, the USFDA had no action level for cadmium in seafood but Mackay et al. (1975) reported a recommended maximal level of 2 ppm cadmium for human consumption of seafood in Australia. Thus, the mussels collected from Bridgeport had levels of cadmium higher than those recommended in Australia to be safe for human consumption. We now plan to take further samples over a wider area in and around Bridgeport to determine whether this is a local incident of cadmium pollution. Farrington et al. (1983) measured cadmium levels in mussels from the east coast of the United States, but their presentation of the data prevents one from determining wet weight values. However, mussel samples from New Haven, Connecticut, had levels of cadmium that appeared to be among the highest found; about 2-5 ppm on a dry weight basis. Cadmium levels for mussels taken from New Haven in this study would be about 3.2 ppm on a dry weight basis, which is in the same range of values as determined by Farrington et al. None of the east coast samples analyzed by Farrington et al. (1983) exceeded 10 ppm. Thus, the cadmium level of 5.1 ppm wet weight or 23 ppm dry weight

found in mussels from Bridgeport in the present study is an outstandingly high value.

Table 3. Cadmium content of Mytilus edulis collected from various locations along the Connecticut shoreline

Sampling Location	Cadmium (ppm, wet wt)	
	Mean[a]	Standard Deviation
Connecticut River	0.41	0.08
Hammonasset	0.57	0.17
New Haven Harbor	0.7	0.23
Milford Harbor	1.2	0.30
Housatonic River	0.93	0.24
Stratford Point	1.3	0.31
Bridgeport	5.1	2.15
Norwalk Harbor	0.75	0.21
Cos Cob Harbor	0.46	0.14

[a] 10 individuals analyzed from each location

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