Trophic Transfer of Metals in Estuarine Food Webs

Celia Y. Chen & Brandon M. Mayes

Department of Biological Sciences
Dartmouth College, Hanover, NH 03755

Human exposure to metals such as Hg is largely from consumption of fish which bioaccumulate this neurotoxin from the water and from their food. To date, research on the transfer of Hg in aquatic food webs to fish has focused on freshwater systems where metal concentrations in fish are related to a variety of biotic and abiotic factors. However, consumption of fish by humans is largely from marine systems. Although, Hg in estuaries has been investigated, many hypotheses involving the relationship between metal trophic transfer, community structure, and biomass have not been tested in estuarine food webs. The objective of this research was to examine the bioaccumulation and trophic transfer of Hg in estuarine food webs, particularly in the resident and transient benthic, epibenthic, and nektonic species inhabiting the intertidal and subtidal portions of estuaries. The food webs of three Gulf of Maine estuaries which differ in hydrology, physical transport, and contaminant and nutrient inputs were compared. The three sites chosen for this study were Great Bay, NH, Wells Estuary, ME, and Salisbury Cove, ME.

Within each estuarine system, we measured metal bioaccumulation in water and multiple trophic levels. Within each estuarine system, metal bioaccumulation will be related to trophic position of resident intertidal and transient subtidal nekton species. The role of common intertidal and subtidal nekton species such as *Fundulus heteroclitus* (Common mummichog), *Menidia menidia* (Atlantic Silverside), *Pungitius pungitius* (9-spine stickleback), *Pseudopleuronectes americanus* (Winter flounder), and Paeaemonid shrimp species in transferring metals to higher trophic levels in the food web will be determined. During summer of 2003, species were collected in each estuary at various sites in the intertidal and subtidal portions of the estuary during high tide. Samples from each site were collected using minnow traps, Ponar dredge, pitfall traps, and fyke nets. Zooplankton and particulate samples were taken in deeper water near the intertidal sites. Biotic samples included benthic invertebrates, zooplankton, forage fish, and predatory fish. Samples were processed using trace metal clean technique at each site. All biotic samples are currently being analyzed for Hg, ^{15}N, ^{13}C, and biomass. To date, analyses have been completed for a portion of the sampling sites. Across site Hg concentrations in *Menidia menidia* varied as did trophic position.

Table 1: Comparison of total Hg (µg/g WW) concentrations and $\delta^{15}N$ for *Menidia menidia* between different sites.

Site	Location	Mean Size (g)	Hg(µg/g WW) mean +/- SE	mean $\delta^{15}N$ +/- SE	Trophic Position
Drakes Island	Wells, ME	0.29	0.0076 +/- 0.0025	11.16 +/- 0.37	5.5
Drakes Island	Wells, ME	1.00	0.0125 +/- 0.0007	11.49 +/- 0.29	5.6
Northeast Creek	Salisbury Cove, ME	0.28	0.0180 +/- 0.0037	7.68 +/- 0.58	n.a.
Portsmouth Naval Shipyard	Portsmouth, NH	0.47	0.1003 +/- 0.0073	9.71 +/- 0.55	4.2
Portsmouth Naval Shipyard	Portsmouth, NH	2.70	0.0282 +/- 0.0030	10.33 +/- 0.17	4.3
Portsmouth Naval Shipyard	Portsmouth, NH	4.40	0.0277 +/- 0.0011	11.81 +/- 0.07	4.8

This work was supported by the MDIBL new investigator award (NIEHS-P30ES03828-18) and the Salisbury Cove Research Fund, New Hampshire Sea Grant development funds, and the Dartmouth Center for Environmental Health Sciences.