A Comparison of Total Mercury Content in Producer and Consumer Species within the Weeks Bay Watershed

Nicole Acree and Kristen Blosser – 9th/10th Grade – Summer 2006

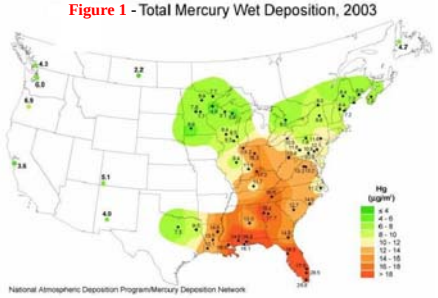
Introduction

Weeks Bay is a small estuary of about 3 square miles located near Mobile Bay's eastern shore in Baldwin County. The estuary receives fresh water from the two rivers and drains an approximately 198 square mile watershed into Mobile Bay. Estuaries such as Weeks Bay are highly productive and provide crucial habitat for many aquatic species that use the bay to breed and raise their young.

Mercury levels in periphyton and fish tissue have been found to be unusually high within the Weeks Bay watershed (Novoveska, 2005; Shelton, 2005). Mercury is a potent neurotoxin which can cause permanent damage to the brain and central nervous system, especially in younger children and pregnant women. Mercury naturally occurs and is stored in rocks, soil, and oceans. Most of the time, it does not enter the food chain, however through the burning of fossil fuels, mercury has been released in large amounts into the atmosphere. It is thought that the source of Mercury within the Weeks Bay watershed is due to atmospheric deposition {Figure 1}. Under conditions conducive to methylation the mercury becomes available for plants and other primary producers to uptake and bioaccumulate within the food web. Eventually this can present a health risk for humans who consume mercury contaminated biota.

Research centered about two streams of similar physical characteristic (substrate, stream bank foliage, canopy cover, abiotic conditions) within the Weeks Bay watershed, Perone Branch and Pensacola Branch. Lucie Novoveska's research revealed that periphyton from Perone Branch contained more than five times the amount of mercury as compared to periphyton from Pensacola Branch. {Figure 2}. Based upon this information we hypothesize that total mercury content in the same species from these two locations will be site and trophic level dependant. Organisms from Perone Branch will have greater total mercury content than those from Pensacola Branch, and higher trophic level organisms will have more than those of lower trophic level. If our hypothesis is correct we predict that the mercury content values will produce a graph similar to graph 1.

Figure 1 - Total Mercury Wet Deposition, 2003



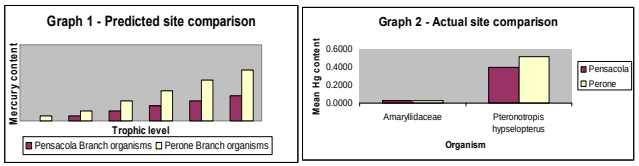
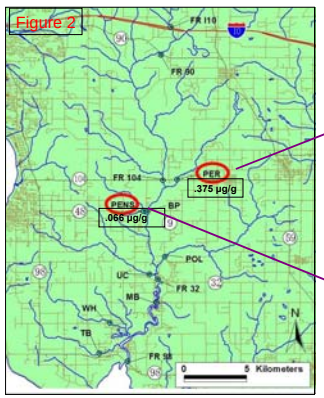


Figure 2



Methodology

To test the hypothesis we collected Amaryllidaceae (aquatic plant) on July 5, 2006, and *Pteronotropis hypselopterus* (sailfin shiner) on July 5 and July 12, 2006, from each site to represent different trophic levels i.e. producer and consumer organisms {Figure 3}. Shiner were collected using dip nets. Plants were collected by carefully removing them from the substrate. Once back at the lab, each fish was weighed and measured. Above and below ground structures of the Amaryllidaceae from were separated. All specimens were placed in a drying oven for 48hrs at 95ºC.

After drying, both *Pteronotropic hypselopterus* and Amaryllidaceae were ground and homogenized by sifting through a 2mm then a 1mm clean wire mesh sieve then mixed. Three twenty milligram samples of randomly chosen individual *Pteronotropic hypselopterus* from each site were placed into Fisherbrand® sterile polypropylene 15ml disposable capped centrifuge tubes which were then sealed with parafilm. Three twenty milligram samples of Amaryllidaceae above and below ground structures from each site were also handled this way. Samples were then shipped overnight to the Trace Element Analysis Core of the Center for Environmental Health Sciences at Dartmouth College. Samples were analyzed for total mercury content via microwave digestion by EPA method 3051.

Results

Mean total mercury levels in Amaryllidaceae from Perone .0245ppm and Pensacola 0.0265. Pensacola Amaryllidaceae mercury levels ranged from 0.0152 to 0.0435, those from Perone ranged from 0.0184 to 0.0370. *Pteronotropis hypselopterus* mercury content at Pensacola ranged from 0.2946 to 0.4669 with a mean of 0.3933. *Pteronotropis hypselopterus* mercury content from Perone ranged from 0.3971 to 0.6044 with a mean of 0.5172. (see Table 1)

Table 1

Site	Organism	Hg in ppm.
Pens.	Amaryllidaceae (BGS)	0.0435
Pens.	Amaryllidaceae (BSG)	0.0236
Pens.	Amaryllidaceae (BSG)	0.0303
Per.	Amaryllidaceae (BSG)	0.0370
Per.	Amaryllidaceae (BSG)	0.0329
Per.	Amaryllidaceae (BGS)	0.0294
Pens.	Amaryllidaceae (AGS)	0.0152
Pens.	Amaryllidaceae (AGS)	0.0177
Pens.	Amaryllidaceae (AGS)	0.0170
Per.	Amaryllidaceae (AGS)	0.0203
Per.	Amaryllidaceae (AGS)	0.0208
Per.	Amaryllidaceae (AGS)	0.0184
Pens.	Pteronotropis	0.4669
Pens.	Pteronotropis	0.4186
Pens.	Pteronotropis	0.2946
Per.	Pteronotropis	0.3971
Per.	Pteronotropis	0.6044
Per.	Pteronotropis	0.5501

Figure 3

BGS = Below ground structure
AGS = Above ground structure

Discussion

Based on the results we could not make a conclusive answer to the hypothesis. The laboratory results show that the mean level of mercury in Amaryllidaceae, (below ground, above ground and collectively) from both sites are nearly equal, suggesting similar amount of mercury uptake and storage by these producers. The mean mercury content in the *Pteronotropis hypselopterus* (sailfin shiner) from Perone is slightly higher than the mercury content from the Pensacola shiners but in order to be more confident that this reflects actual conditions for the entire population we would have to gather more samples from both sites for analysis {Graph 2}. If this were done and demonstrated that there actually is a higher level of mercury in shiners from Perone branch, a possible explanation for this could be that there are more levels in the food chain at Perone, adding to the biomagnification of the mercury content in the shiners. Considering that shiners are omnivorous, another explanation might be that Perone branch shiners have a foraging preference for fauna as compared to the shiners at Pensacola which might prefer flora, or the availability of flora vs fauna for consumption is different between the two sites

Ideas for additional future work would be to

1. study the diet of the shiners more closely, perhaps by looking at stomach contents, to reveal differences in food preference
2. collect and analysis the mercury content in intermediate trophic level organisms such as invertebrates.

Work cited

Novoveska, L. 2005. Benthic algal community structure and bioaccumulation of mercury in a coastal watershed. Graduate thesis, Eastern Illinois University.

Shelton, M. 2005. Mercury Monitoring in Largemouth Bass Tissue in the Weeks Bay Watershed. Grant report to the Mobile Bay National Estuary Program.