Mercury Content in the Exotic Invasive *Hydrilla verticillata:* A Comparison with Native Flora and Evaluation as a Phytoremediator

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Introduction

Weeks Bay Reserve is located southeast of Mobile Bay. The Reserve covers 6,016 acres of swamp, marsh, and upland areas; including Weeks Bay, Fish River, Magnolia River, and a small section of Mobile Bay. Fish River is listed as an impaired water body according to Clean Water Act Section 303(d) standards and has a no consumption advisory for largemouth bass due to mercury (Hg) levels (Alabama DEM, 2006). Barner Branch is a tributary of Fish River. Recent studies have demonstrated that there are significant levels of Hg in Barner Branch biota (Novoveska 2004, Shelton 2005). The main source of Hg is thought to be atmospheric deposition {figure 1}.

Barner Branch has an abundance of *Hydrilla verticillata*, an exotic invasive sub-aquatic species which has dominated native species such as *Vallisinaria americana* and *Utricularia vulgaris* within the Barner Branch basin {Figure 2}.Hydrilla verticillata can dramatically alter habitat conditions in many ways such as restricting water flow, reducing light penetration and oxygen levels in water columns and lowering biodiversity (Florida DEP, 2006).

There is evidence that aquatic plants absorb and store heavy metals, with *Hydrilla verticillata* acting as a hyperaccumulator of Hg (Chandra P. and Gupta M., 1996; Hinman C. 2005). Comparison of total mercury content in native and exotic invasive vegetation will be performed with an evaluation of *Hydrilla verticillata* utilization as a phytoremediator of mercury.

Methodology

On 06/13/06 eight sampling sites at Barner Branch were marked with painted pvc pipes. Sites were labeled as follows: V1, V2, VH1, H1, H2, H3, H4, H5. All sites labeled "V" had *Vallisneria americana* (tape grass) as the dominant sub-aquatic vegetation (SAV). Sites labeled "VH" had a mix of both tape grass and *Hydrilla verticillata*. Sites labeled "H" had *Hydrilla verticillata* as the dominant SAV {Figure 3}. *Utricularia vulgaris* was collected from site H2.

On 06/27/06 SAV samples from each site were collected and stored in labeled opaque plastic containers for transport back to the Weeks Bay NERR laboratory. Once at the lab samples were washed of sediment and periphyton using low pressure tap water followed by a rinse of distilled water. *Vallisneria americana* samples were divided into above ground and below ground structure, no distinguishing of above and below ground structures for *Hydrilla verticillata* or *Utricularia vulgaris* was made. Samples were wrapped in aluminum foil and dried at 98ºC for 24 hours in a Quincy Lab AF Model 40 lab oven. Upon completion of drying, 200mg and 400mg of sample for each SAV sample was passed thru a 1mm wire mesh strainer and homongenized. Samples were transferred into Fisherbrand sterile polyprophylene 15ml disposable centrifuge tubes and sent to the Trace Element Analysis Core of the Center for Environmental Health Sciences at Dartmouth College. Samples were analyzed for total mercury content via EPA method 3051.

To estimate *Hydrilla verticillata* biomass five samples covering 0.05 square meter each were collected from the Barner Branch basin. Samples were taken to the lab and dried via above described method and weighed. The mean weight of these samples was calculated and multiplied by the area of *Hydrilla verticillata* coverage.

Figure 1 -Total Mercury Wet Deposition, 2003

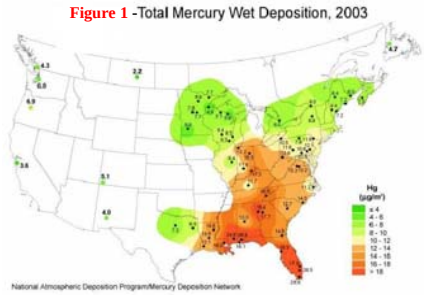


Figure 2

Figure 4 Mean Hg concentration

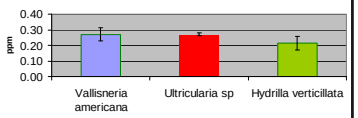


Figure 5 Vallesneria americana

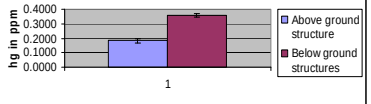
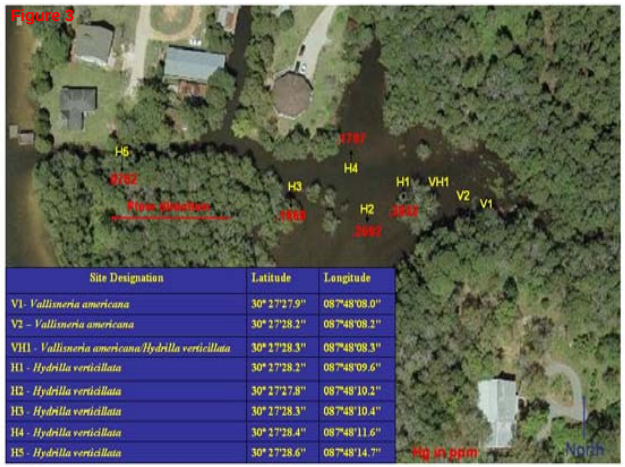


Figure 3



Site Designation	Latitude	Longitude
V1- *Vallisneria americana*	30° 27'27.9"	087°48'08.0"
V2 – *Vallisneria americana*	30° 27'28.2"	087°48'08.2"
VH1 - *Vallisneria americana/Hydrilla verticillata*	30° 27'28.3"	087°48'08.3"
H1 - *Hydrilla verticillata*	30° 27'28.2"	087°48'09.6"
H2 - *Hydrilla verticillata*	30° 27'27.8"	087°48'10.2"
H3 - *Hydrilla verticillata*	30° 27'28.3"	087°48'10.4"
H4 - *Hydrilla verticillata*	30° 27'28.4"	087°48'11.6"
H5 - *Hydrilla verticillata*	30° 27'28.6"	087°48'14.7"

Results

Results of total mercury testing are given in tables one and two. Mean Hg levels for *Hydrilla verticillata* are lower than in either *Vallisneria americana* or *Utricularia vulgaris* although standard errors overlap {Figure 4}. Mean total mercury content significantly (~2x) higher in *Vallisneria americana* below ground tissues {Figure 5} as compared to above ground tissues which is consistent with previous research that demonstrates wetland and aquatic plants, including *Vallisneria spiralis*, concentrating more heavy metals in roots than in stems and leaves (Gupta, M and Chandra P. 1994; Weis J.S. and Weis P. 2004).

Table 1

Flora	Mean Hg in ppm	n
Hydrilla verticillata	.2155	6.0
Vallisneria americana above ground	.1821	3.0
Vallisneria americana below ground	.3596	3.0
Vallisneria american combined	.2708	6.0
Ultricularia vulgaris	.2708	3.0

Table 2

Sample #	Site	Flora	Mercury Concentration (ppm)
1	H1	*Hydrilla verticillata*	0.3932
2	H2	*Hydrilla verticillata*	0.2692
3	H2	*Utricularia vulgaris*	0.2748
4	H2	*Utricularia vulgaris*	0.2560
5	H2	*Utricularia vulgaris*	0.2862
6	H3	*Hydrilla verticillata*	0.1660
7	H4	*Hydrilla verticillata*	0.1787
8	H5	*Hydrilla verticillata*	0.0761
9	V1	*Vallisneria american* above ground structures	0.1499
10	V1	*Vallisneria american* below ground structures	0.3434
11	V2	*Vallisneria american* above ground structures	0.1849
12	V2	*Vallisneria american* below ground structures	0.3509
13	VH1	*Hydrilla verticillata*	0.2095
14	VH1	*Vallisneria american* above ground structures	0.2112
15	VH1	*Vallisneria american* below ground structures	0.3842

Discussion

Baker (1999) defines a hyperaccumulator plant as having a concentration of a metal ion to >0.1 % of the dry weight of the plant i.e. > 1part per thousand. None of the flora tested was found to be a hyperaccumulator of Hg at Barner Branch. This may be due to seasonal growth patterns that limit temporal uptake and accumulation of Hg or insufficient Hg availability to maximize plant tissue storage potential. Although not a hyperaccumulator of Hg, all flora tested contained appreciable amounts of Hg. An interesting trend of reducing Hg content in *Hydrilla verticillata* from east to west {Figure 3} was noted. This suggests that aqueous transported Hg brought into the Barner Branch basin is filtered and sequestered within *Hydrilla verticillata* as water flows through the basin.

Physical removal of *Hydrilla verticillata* would eliminate an estimated 2,372 mg of Hg from the Barner Branch basin. If left, this Hg would most likely be introduced into the detrital food web during the winter months when *Hydrilla verticillata* naturally dies back at this location (Brunden, personal communication). It is also possible that any elemental Hg within the dead *Hydrilla verticillata* would be methylated, increasing toxicity and bioavailability.

Suggestions for future research and/or action is to:

1. Separate above and below ground Hydrilla verticillata structures and test for Hg content.
2. Acquire background Hg levels in water column and sediments of Barner Branch proper and from within the watershed.
3. Test representative trophic level organisms for Hg content to track and estimate biomagnification.
4. Physically remove *Hydrilla verticillata* then monitor return rate and spread while tracking temporal Hg changes in sediment and aquatic plants.

Work Cited

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