Evaluation of Fish Community Structure in *Trapa natans* Beds in the Middle Hudson River Estuary

A Final Report of the Tibor T. Polgar Fellowship Program

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Abstract

We collected original data regarding fish community structure within three different European Water Chestnut (*Trapa natans*) beds in the Middle Hudson River Estuary. The beds sampled were at Norrie Point (River Mile 85, east shore), Vanderburg Cove (River Mile 87, east shore), and Esopus Meadows, (River Mile 87, west shore). Fish were collected using pop nets inside the water chestnut beds, beach seines along the unvegetated shallows near the water chestnut beds, and by trawling along the unseinable margins of the water chestnut at the Norrie Point and Esopus Meadows Bed.

Two patches were also cleared within the water chestnut at Norrie Point, one isolated in the vegetation and one with a corridor cleared between it and the main river. These patches were sampled every other week by pop netting. We found no significant difference in species composition between the cleared patches and the interior patches at Norrie Point, although age stratification was noticed. Both the interior and cleared patches were dominated by tessellated darters (*Etheostoma olmstedi*), while the beach seine data for Norrie Point found centrarchids to be the most common family. This generally agrees with previous work at Norrie Point, although pop net data were slightly less consistent. 1997 data indicated that Tessellated Darters were an important species, as was also found in 2003; however, the most common 1997 species were not caught in abundance in 2003. Trawling revealed a different community to be using the edge of the water chestnut, this community being dominated by striped bass (*Morone saxatilis*) at Norrie Point and alewife (*Alosa pseudoharengus*) at Esopus Meadows. Banded killifish (*Fundulus d. diaphanus*) were most common in beach seines at Esopus Meadows and Vanderburg Cove while spottail shiners (*Notropis hudsonius*) dominated pop nets at these two sites.

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Introduction

Tidal wetlands provide many vital natural functions for the environment. They serve as buffer zones between the forces of the ocean and the topography and use of the land, they provide nurseries for fish fry, hunting grounds for higher predators, areas of high bioactivity and nutrients, habitats for many species of waterfowl and other animals, as well as scenic enjoyment (Mitsch and Gosselink 1993). However, these valuable resources are highly dynamic. Tidal wetlands, those of the Hudson River being no exception, are subject to many changes as a result of both natural forces and human impacts (Pinet 2000). All of the components within tidal wetland ecosystems are intimately related. A decrease in the population of one species may lead to higher numbers of species that were competing with or preyed upon by the first, as well as habitat changes brought on by changing plant communities (Smith and Smith 2001).

European water chestnut (*Trapa natans*), an exotic, invasive species, has become a large factor in Hudson River tidal wetlands communities since the 1860's. Its sweeping effects on habitat structure have undoubtedly created a force to be contended with by fish communities.

The purpose of this study was to more fully understand the dynamics and structure of fish communities in water chestnut beds. This research was designed to add on to the base of knowledge regarding this subject, and was engineered with the intent of making it easy to compare to similar studies. This survey was especially important in light of recent observations on Hudson River tidal wetlands fish community structures. In studies conducted by Gilchrest (1998) and Schmidt et al. (2002), results depicted a dramatic change in fish community structure within Tivoli South Bay, transitioning in relative abundance from fourspine sticklebacks (*Apeltes quadracus*) and common carp (*Cyprinus carpio*) in Gilchrest's 1998 study, as well as other surveys cited in his paper (Pelczarski and Schmidt 1991, Hankin and Schmidt 1992), to the most abundant species being goldfish (*Carassius auratus*) in the 2002 study (Schmidt et. al. 2002), with the fourspine sticklebacks almost entirely gone (Gilchrest 1998, Schmidt 2002, Schmidt personal communication). This information, as well as its implications for environmental change, warranted a serious investigation into the continuing change of fish communities as well as possible causes of this change. This information was particularly alarming because while water chestnut beds represent a dynamic environment, such drastic changes in community structure over such a small amount of time, compared to an otherwise stable previous community, implied something out of the ordinary, and required a re-evaluation of our ideas concerning the stability of these communities.

It is likely that fish community structure in Hudson River tidal wetlands would change as the environment was altered by shifting plant dominance, filling in of the wetlands, and other factors which make the habitat suitable for more adaptable species that may then be able to out-compete less adaptable species. Another interesting factor in the case of Hudson River tidal wetlands is that we have a better idea of the changing fish community structure than we do of what is causing this change. Although we may not currently be directly observing the environmental factors that are causing such dramatic changes, we know that fish community structure changes are not an effect without a cause. The changing fish community structures of Hudson River tidal wetlands are acting as an indicator for some sort of environmental change outside of those we have identified and understand.

Although last years' findings may be attributable to the mild 2001-2002 winter, and persisting springtime drought in the already relatively abnormal environment of Tivoli Bays, we believed that these changes in community structure and decreasing biodiversity would be perceptible in 2003 as well, albeit most likely in a less dramatic nature from 2002. Although the data collected this summer supports the idea that last years results represented some sort of strange dip, after which the populations of certain fish, mentionably fourspine sticklebacks seem to be recovering, other noteworthy phenomena were noticed regarding fish communities in the water chestnut beds studied this summer. Since the water chestnut has become a dominant factor in Hudson River tidal wetlands, we hypothesized that selective removal of these plants would cause a perceptible change in community structure. We also believed that there would be a strong edge effect along the water chestnut beds, as there is a mixing of open water communities and those that exist within the water chestnut. We also hypothesized that different communities would develop in clear areas that are isolated within the water chestnut from those that would develop in cleared areas that are connected to the open water outside of the water chestnut beds.

One of the main goals of this study was to identify if the changes documented last year were to persist this year. This is a particularly important goal in that fish community changes may imply that environmental changes outside of the normal dynamics of the system have already occurred or are still occurring. It also was, and will continue to be, critical to evaluate how human activities fit into this web of environmental factors and changes, so that we can better understand from an ecological perspective, what consequences our actions have on the environment which we so heavily depend upon.

Methods and Materials

We sampled fish community structure at two representative Hudson River tidal wetland sites on a biweekly basis (Norrie Point and Vanderburg Cove), and also at Esopus Meadows three times during the summer, between 16 June and 13 August, 2003. These sites were sampled with quantitative pop netting within the water chestnut beds and with seining along the edges of the beds to investigate gradients in the community due to edge effects. We sampled the exterior interface between the water chestnut and the open water along the entire length of the Norrie Point and Esopus Meadows beds, using a trawl loaned by Dutchess County BOCES with the help of Sea Tow Mid Hudson. These data were excellent in terms of mapping the populations of fish that use the water chestnut beds less directly and go towards further understanding the ecotone that Anderson and Schmidt (1989) described between water chestnut and its surroundings. This project sampled from June 16 through August 13, 2003. We acquired a total of fourteen pop net data sets at Norrie Point (four in the clear isolated patch, four in the clear patch with the corridor, and six sets at interior sites); four sets at Vanderburg Cove; and three at Esopus Meadows.

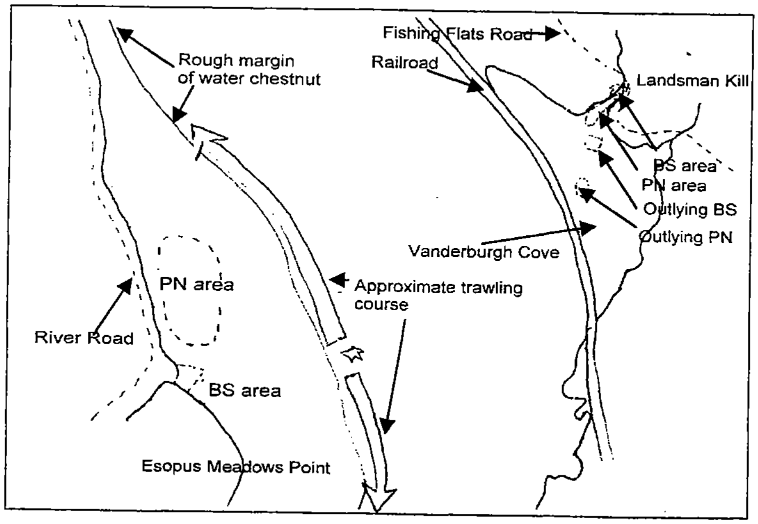
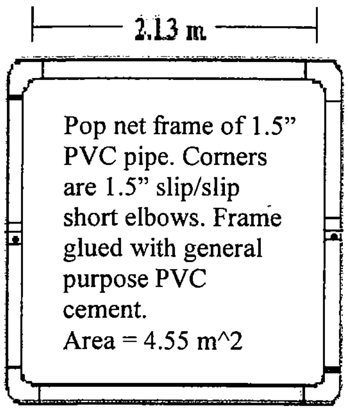
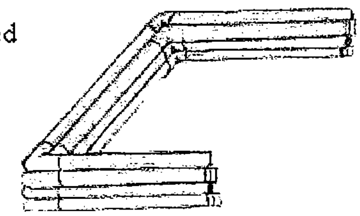


Fig.1: The Sample Sites: Shown above are the Esopus Meadows (EM) and Vanderburg Cove (VBC) sites. The areas within the sites are labeled according to sampling type conducted. Areas shown represent approximately where sampling occurred. Large arrows along the rough margin of the water chestnut bed at EM indicate approximate trawling course. The star indicates Esopus Meadows Lighthouse.

Upon finding two other pop netting projects to cooperate with this summer, Jeremy Frenzel's Polgar Fellowship and Bob Schmidt's continuing studies in Tivoli South Bay, a new pop net was built following the design of Gilchrest (1998) and Schmidt (2002), but modifying it in such a way as to make it collapsible (Fig. 2). This feature allowed it to fit safely and easily into a pick-up truck for transport between storage at Norrie Point and the three sampling sites. The modifications made to the original design left the fully assembled, ready-to-sample net identical to pop nets used in previous studies, thus allowing comparability of these data to those of previous studies. This congruity made it possible to follow trends and to know that discrepancies found in this study were not due to different sampling techniques. Randal Anderson engineered and developed a floating "*Trapa* Sled" made of PVC pipe to facilitate the transportation of the pop net and other gear through the water chestnut (Fig. 3). We used a 25m by 1.5m seine from the Norrie Point Environmental Center to sample around the edges of the water chestnut beds and a 5m trawl from Dutchess County BOCES to sample the unseinable length of the water chestnut beds at NP and EM. Smith (1985) was used to identify species. Species that were still uncertain were confirmed by Wayne Gilchrest and/or Bob Schmidt.



Thin slice taken out of top and bottom frame on both sides and ends capped. One capped side of each part glued into two way union. Hole drilled through union and bolt and wingnut used to hold together when in using position. When being transported, bolts removed, unglued side slipped out of union and entire apparatus folded in half.



Frame during transportation (netting not shown)

Fig. 2: Pop Net Design: The image on the left shows the frame in the ready to sample position. Its interior area and everything else is identical to previous pop net designs. The image on the right shows the frame folded up into its transport position.

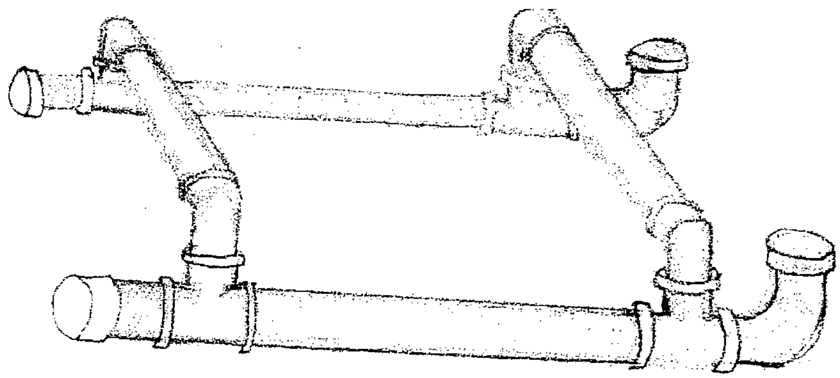


Fig. 3: "*Trapa* Sled" Design: The "*Trapa* sled" was Constructed out of four inch triple wall HDPE PVC pipe and glued with PL-2000 brand glue. The pop net was placed over the rungs on the top of the sled and pulled by a rope attached around the elbows at the first rung.

Sampling was conducted at randomly chosen interior sites at Norrie Point and Vanderburg Cove every other week. The pop net was set at low tide, with care taken to make sure that nothing would snag the net as it popped or otherwise prevent it from rising to the surface fast enough. Initially, weighting the net was a problem, as when it was set, the entire apparatus would float to the surface with the triggers still in place. The use of