

**MACROINVERTEBRATES ASSOCIATED WITH *VALLISNERIA AMERICANA*
AND *TRAPA NATANS* IN TIVOLI SOUTH BAY**

A Final Report of the Tibor T. Polgar Fellowship Program

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ABSTRACT

Aquatic vegetation is an important part of river ecosystems, as a primary producer and as habitat for fish and invertebrates. The invertebrate communities associated with vegetated areas are not well understood. I assessed the benthic and plant dwelling invertebrate communities in the Hudson River outside of Tivoli South Bay, NY. The dominant species of plants at the site were Vallisneria americana and Trapa natans. Samples of Vallisneria americana and Trapa natans were taken to estimate plant biomass in July and August. Sediment cores and a Downing sampler were used to collect benthic invertebrates and phytofauna (plant-dwelling animals). In many cases, the species of plant and/or location of the plant influenced the invertebrate communities. The most common invertebrates were oligochaetes, chironomids, Sida, and Hydra. T. natans had overall higher average densities of invertebrates than V. americana, and both kinds of vegetation supported much denser invertebrate populations than nearby unvegetated sediments.

INTRODUCTION

River ecosystems are productive and diverse, containing different microhabitats, which support diverse aquatic communities. Unfortunately, rivers are understudied and their dynamics are relatively unknown. Aquatic vegetation associated with rivers has been particularly understudied, but may be important in river ecosystems.

Vegetated beds are areas of high nutrient exchanges (Schoeberl 1988), and high rates of primary production. These areas provide refuge for invertebrates and juvenile fish from visual predators, as the vegetation reduces visibility. Both experimental and comparative studies have shown that the abundance and species richness of benthic freshwater macroinvertebrates is higher in habitats containing high densities of submerged macrophytes than in those having low densities (Gerking 1962, Crowder and Cooper 1982, Dvorac and Best 1982, Gilinsky 1984, Rabe and Gibson 1984, Gregg and Rose 1985, Hershey 1985, Diehl 1988, Anderson et al. 1990, Diehl 1992). These results were found in areas that contained fish, which suggests a refuge effect for the submerged vegetation. A combination of these conditions allows secondary consumers such as invertebrates and small fish to prosper.

Aquatic vegetation influences macroinvertebrate community structure by affecting both the physical characteristics of a habitat and the biotic interactions that occur there (Crowder and Cooper 1982, Heck and Crowder 1991, Feldman 1992). It is believed that many biotic and abiotic factors vary among aquatic plants species, with likely consequences on invertebrate community structure.

In the Hudson River, the vegetation beds are dominated by two species of aquatic vegetation: Trapa natans (water chestnut) and Vallisneria americana (water celery) (Findlay et al. 1997). These plants are structurally divergent (Figures 1 and 2) and influence the habitat differently.

Trapa natans (Figure 1) is a floating-leaved plant with large rosettes that float on the water's surface. Native to Eurasia, it was introduced to America in the late 19th century by a botanist. The plant was deliberately introduced to Collins Lake near Schenectady, New York in 1884. It entered the Mohawk River in the 1920s and finally into the Hudson River in the 1930s (Mills et al. 1997). It is a nuisance plant because its thick beds impede boating and other recreational activities. The rosettes release oxygen into the air, and the roots deplete the oxygen from the water column. As a result, the beds of Trapa can become anoxic in late summer (Schoeberl, 1988). The effects of these conditions on the biota are relatively unknown.

Vallisneria americana (Figure 2) is a submerged plant with ribbon-like leaves. The majority of the biomass is located underwater. The leaves introduce oxygen into the water column, and the roots use the oxygen, reducing the chance of the severe oxygen deficit found in the T. natans.

Phytofauna, or plant dwelling invertebrates, are another important part of vegetated aquatic ecosystems. They also serve as food for fish. These invertebrate communities have also been understudied in the Hudson River. Phytofaunal biomass and



Figure 1. Trapa natans

composition may be determined by several factors. Some authors have suggested that the abundance of littoral invertebrates is correlated with the biomass and species composition of their macrophyte substrate (Vincent et al. 1982, Downing 1986, Cyr and Downing 1988a, Lalonde and Downing 1992). Another theory is that a high

macrophyte biomass may lead to less water turbulence, reducing the dislodgment of the invertebrates from the plants (Lalonde and Downing 1992). The phytofaunal biomass may be related to the epiphytic algae growing on the plants, because epiphyton-grazing invertebrates constitute a large proportion of the phytofauna (Lalonde and Downing 1992).

My work is part of a broader multi-year effort to study the functions of vegetation beds in the tidal Hudson River. I am interested in the benthic and phytofaunal (plant dwelling) invertebrates in macrophyte beds in the tidal freshwater region of the river. My goals are to determine the species composition and density of invertebrates in the sediment of the vegetated bed. Secondly, I have determined the species composition of epiphytic invertebrates on the two different species of macrophytes contained within the same bed.

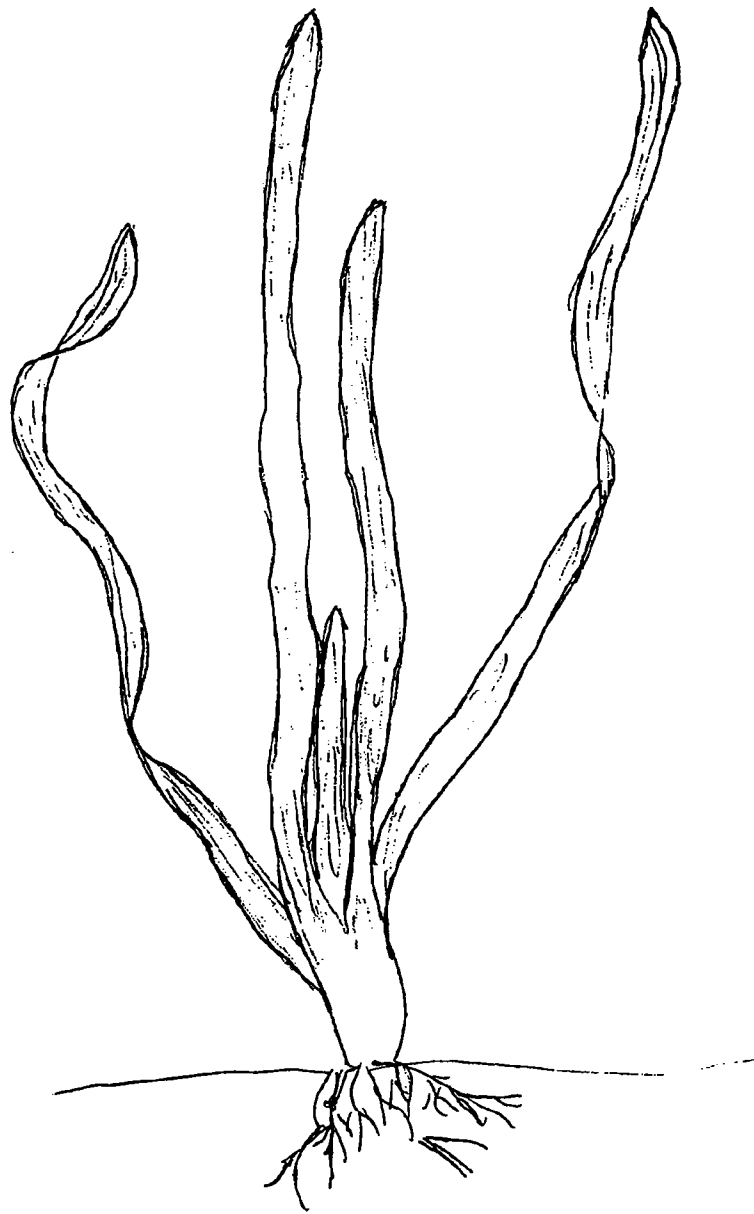


Figure 2. Vallisneria americana

STUDY SITE

The study site was located just outside Tivoli South Bay around Cruger Island (Figure 3). The bed was sampled around low tide, when the depth was approximately 1 m. The sediments were organic also having a large amount of clay particles. The eastern edge of the bed was bordered by the railroad tracks, and the western edge lay along the channel of the Hudson River.

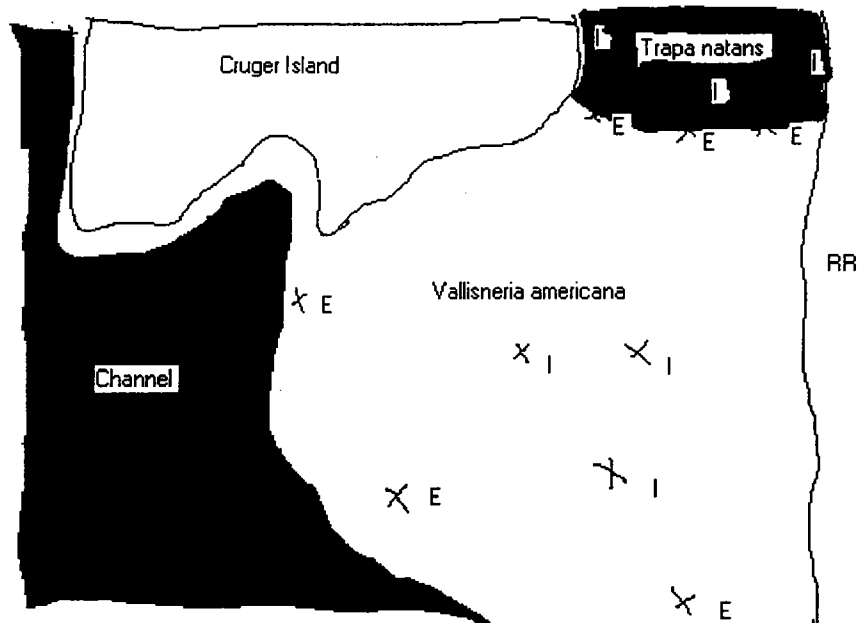


Figure 3. Schematic diagram of the study site, showing the placement of edge (XE) and interior (XI) samples.

METHODS

We divided the area of the bed that was predominately V. americana into three outside edge sites (E) and three interior sites (I) (Figure 3). The area of the bed containing predominantly T. natans was also divided into three outside edge and three interior sites (Figure 3). Each site was haphazardly chosen and sampled at or near low tide. Samples were collected in both July and August, 2000.

Plant biomass

The biomass of T. natans was determined by clipping the rosettes from a known area and weighing the clipped plant matter. Clippings were placed in plastic bags and taken to the lab in a cooler, then rinsed to remove excess silt before drying. The clippings were dried at 60° C for at least 24 hr before weighing. The biomass of T. natans was computed using the following formula:

$$\text{T. natans biomass} = \text{dried weight of plant (g)} / \text{area of plant clipping (m}^2\text{)}$$

V. americana was sampled differently from T. natans. Because of low visibility, V. americana was unclippable in both July and August, therefore a large PONAR grab (0.05 m²) was used to sample the V. americana. Eight collections of the plant were taken at haphazard sites along the edge and interior of V. americana. Roots were removed from the collected plants, which were placed in bags and taken to the lab in a cooler. In the lab, the plants were rinsed of excess silt and dried at 60° C for at least 24 hrs. The biomass of the V. americana was determined using the following equation:

$$\text{V. americana biomass} = \text{dried weight of plant} / 0.05\text{m}^2.$$

Invertebrate communities

We sampled animals living in the sediments and on the plants separately. We collected sediment-dwelling invertebrates by hand-coring with a 20.02 cm² plastic tube. At each sampling site, three replicate cores were sieved through a 500 µm mesh sieve and pooled into a jar containing 5 % buffered formaldehyde. Therefore, at each site an area of 60.06 cm² of river bottom was sampled. Three sites in deep water (3-5 m) just outside the bed were sampled as well. The deeper sediment samples outside the bed were sampled using a petite PONAR grab (0.02 m²). At each site, three grabs were sieved through a 500 µm mesh sieve and preserved in 5% buffered formaldehyde. All sediment samples were resieved through a 500µm mesh screen in the lab. The organisms were sorted into major taxonomic groups using a 6 X objective dissecting microscope.

Phytofaunal samples were collected using a 60 X 20 X 30 cm Downing sampler (Downing 1986, Jackson 1997). At each sampling site, two (*T. natans*) or three (*V. americana*) samples were taken and pooled. The samples were sieved through a 500 µm mesh sieve and preserved in 5% formaldehyde. Before sorting the phytofaunal samples under the dissecting scope, each jar was vigorously shaken to dislodge the organisms from the plants. The sample fluid was re-sieved in a 500µm sieve six times, until most of the invertebrates were dislodged. The invertebrates rinsed off the plants were sorted under the 6 X objective of a dissecting scope. The blades of the plants were examined individually under the 6X objective of the dissecting microscope. The total count of invertebrates per sample was determined by adding the number of rinsed invertebrates to the number of invertebrates left on the leaves.

Following sorting, the leaves of the plant were dried at 60° C for at least 24 hrs and weighed to determine the dry weight of the plant. The number of organisms/g of dried plant was calculated using the following equation:

$$\# \text{ org/g dried plant} = \text{number of organisms counted/weight of plant}$$

After determining the # of organisms/ weight of plant, and average biomass of the plant, the # of phytofauna/ m² of river bottom can be determined:

$$\# \text{ org/m}^2 = \# \text{ org/g plant} \times \text{g plant/m}^2$$

The results of the invertebrate counts were analyzed using two-way ANOVA. The independent factors were generally species of plant and location of the sample, either in the interior or on the outside edge of the bed. The values were determined to be significant at the p = 0.05 level. Invertebrate densities were square-root transformed prior to analysis.

RESULTS

Plant biomass

T. natans had much higher biomass than V. americana in both months (Figure 4). There was also a strong effect of month, month*species combined, and the interaction between month *species*location. The figure also shows an interesting pattern occurring in the T. natans. The July biomass of T. natans shows the highest biomass located inside the bed. Conversely, the August biomass of T. natans is highest on the outside edge.

