A Herpetological Survey of Tivoli Bays and Stockport Flats

A Final Report of the Tibor T. Polgar Fellowship Program

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ABSTRACT

Populations of amphibians and reptiles in the Hudson Estuary appear to exhibit low densities. The goals of this study were: (1) to provide baseline data on the amphibian and reptile populations at two Hudson River sites and (2) to determine if more detailed studies will be necessary to assess these populations. The populations of amphibians and reptiles at North Bay in Tivoli, and at the mouth of Stockport Creek were studied from late May until late July 1998. Few turtles were captured at either site for the duration of the study. Only one species of frog, the green frog (*Rana clamitans)*, occurred in the estuary. We found no evidence that salamanders actively associated with the estuarine environment. Relatively few snakes were encountered during this study. However, this was probably due to the survey methods employed. Species that are considered common in similar wetlands were either absent or represented by only a few individuals at the study sites. Two of the species of concern are the painted turtle and the water snake. All other species of amphibians and reptiles at these sites also exhibited low population densities. These apparent low population densities may be the result of stress factors such as tidal influence, pollution, predation, or other factors that are inherent to estuarine systems. However, these stress factors cannot be properly identified until quantitative data from other estuarine systems are available so that comparisons of population levels can be made.

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INTRODUCTION

The worldwide decline in the density of amphibian and reptile populations is a topic that has received a substantial amount of research in the last few years (Blaustein 1994; McCoy 1994; Pechmann and Wilbur 1994; Travis 1994). While there is no single causative factor for their decline, research suggests that amphibians and reptiles are sensitive to habitat loss and fragmentation, pollution, over-harvest, highway mortality, and a variety of other physical and chemical stresses (Klemens 1993; Pechmann and Wilbur 1994). The ecology of these animals in inland freshwater wetlands is well documented. However, studies in estuarine habitats are lacking and the interactions between these animals and tidal habitats are poorly understood.

Estuarine habitats are complex and populations of amphibians and reptiles may be limited by factors such as tidal fluctuation, salinity, predation, pollution, ice scouring, water depth, currents, storms, or extreme temperatures (Kiviat 1989). The Hudson River is a highly industrialized estuarine system and has been subjected to extensive pollution (Stone et al. 1980). Snapping turtles (*Chelydra serpentina*) collected from the Hudson River have been found to contain significant concentrations of PCBs, DDE, and the insecticide Dieldrin (Stone et al. 1980). These data imply that this habitat may be extremely stressful to sensitive organisms such as amphibians and reptiles.

Comparative data from other estuaries (Swarth 1998) point to depauperate populations of amphibians and reptiles in the Hudson. Of the roughly 50 species of amphibians and reptiles found in the Hudson Valley, only 14 have been recorded in the wetlands of Tivoli Bays (Kiviat, unpublished data). Only one of these (the snapping turtle) is common, as compared to the 13 that are rare to absent, in freshwater tidal habitats (Kiviat, unpublished data). In comparison, 20 species, of which only 10 are rare, occur in the Jug Bay fresh-tidal wetlands of the Patuxent River in Maryland (Smithberger and Swarth 1993). The wetlands of the Patuxent River are similar to the Hudson except that they are more southerly, smaller, and less contaminated by PCBs (Kiviat, unpublished data). From these data one might hypothesize that the herpetofauna (amphibians and reptiles) of the Hudson are under stress.

Quantitative studies on the herpetofauna of the Hudson will help to describe accurately the current populations of these animals. This study was undertaken to: (1) supply baseline information on the populations of amphibians and reptiles in the Hudson River, and (2) and determine if more detailed studies will be necessary to asses these populations.

METHODS

Study Sites

Amphibian and reptile populations at two Hudson River sites and two non-estuarine sites were surveyed to determine relative estimates of species richness and abundance (Heyer et al. 1994). Surveys took place from late May until late July 1998. The non-estuarine sites were sampled to determine species richness in nearby non-tidal habitats. The Hudson River sites were Hudson River National Estuarine Research Reserve (HRNERR) areas located at North Bay in Tivoli, and at the mouth of Stockport Creek in Stockport (Fig. 1). The non-estuarine sites corresponding to Tivoli North Bay were located in the town of Red Hook at the intersection of Stony Creek and Kidd Lane, and at Mill Pond. The shortest straight-line distance to the estuary for these two sites is 0.4 km for Stony Creek, and 3.7 km for Mill Pond. The non-estuarine sites at Stockport were Fittings Creek and a pond along Falls Road. Both sites were within the town of Stockport. These sites were located at a straight-line distance, from the estuary, of approximately 3.1 km for Fittings Creek, and 5.9 km for the pond on Falls Road.

The surficial geology and soil texture of the sites were determined by consulting soil surveys (Case 1989; Dutchess County Soil and Water Conservation District, unpublished data). This was done to assess the influence of soil type on species distribution. The soil type at North Bay is Hudson-Vergennes (HvE) on the east side of the marsh, and Nassau-Cardigan (NwC) on Cruger Island (Dutchess County Soil and Water Conservation District, unpublished data). HvE soils are silty clays that have slow permeability, and a high available water capacity (Case 1989). NwC soils are loamy till soils that have moderate permeability, and a moderate water capacity (Dutchess County Soil and Water Conservation District, unpublished data). The soil types at the inland sites were HvE at Stony Creek, and a well drained loam (HeB) at Mill Pond. HeB soils have a moderate permeability, and a low to moderate water capacity (Dutchess County Soil and Water Conservation District, unpublished data).

The soil types at Stockport are HvE, dredged Udipsamments (Ud), and Saprists (Sa) (Case 1989). Ud soils are dredged sediments from the Hudson River, they are highly permeable and have a low water potential (Case 1989). Sa soils are very deep, poorly drained soils with the water table at or near the surface for most of the year (Case 1989). Soils at the inland creek were mainly Hudson and Vergennes soil series, of the types HvA and HvD (Case 1989). These soils are moderately well drained soils. The soil types at the inland pond were Knickerbocker (KnA), Walpole (Wa), and Hoosic (Ho) (Case 1989). These series range from excessively drained, to poorly drained (Case 1989).

Habitat Types

At each estuarine site we selected three distinct habitat types for sampling: (1) the open marsh, (2) tidal swamp creeks, and (3) supratidal pools. The open marsh was defined as any predominantly intertidal area surrounded by herbaceous vegetation and capable of maintaining standing water at low tide. Tidal swamp creek habitats were surrounded typically by woody vegetation, and were also capable of maintaining water at low tide. Supratidal pools were defined as any pool flooded irregularly by tides (spring, flood tides) and found in deciduous woodlands approximately 5 meters horizontally from mean high water. Habitat types at the inland sites were inland creeks (i.e., Stony Creek, Fittings Creek), and inland ponds (i.e., Mill Pond, pond along Falls Road).

Sampling at Tivoli was restricted to North Bay. Turtle trapping was conducted in the open marsh at Big Pool and Channel II B, and in the tidal swamp at South Channel along Cruger Island Road (Fig. 1). We conducted call surveys at supratidal pools on Cruger Island, in the tidal swamp along Cruger Island Road, and in the open marsh from the Department of Environmental Conservation (DEC) observation platform (Fig. 1). Cover object surveys were conducted along the mean high water shoreline from the northeast corner of North Bay to the DEC observation platform off of Cruger Island Road. (Fig. 1). Cover object surveys were also conducted around the northwest pool on Cruger Island. Call surveys and cover object surveys were conducted at the inland sites (i.e., Stony Creek and Mill Pond).

Turtle trapping at Stockport took place in the open marsh south of the unnamed island and in a tidal swamp distributary (Fig. 1). Call surveys were conducted at the eastern edge of the open marsh, at the tidal swamp east of the boat launch, and at supratidal pools east of the open marsh and east of the unnamed island (Fig. 1). Cover object surveys took place on the southern shore of the open marsh and on the shoreline east of the unnamed island (Fig. 1). We also conducted cover object surveys and call surveys at the inland sites (i.e., Fittings Creek and the pond along Falls Road).

Turtle Trapping

Turtles were trapped using 8-10 live traps (single-funnel, 2.5 cm square mesh, collapsible, 76 cm diameter hoops [Nylon Net Co., Memphis, TN.]). We set traps for a standardized period of 5 hours; from mid-ebb to mid-flood tides (Rozycki and Kiviat

1995; Swarth 1998). Trap days were chosen based upon the occurrence of low tide so that the 5 hour trapping period would fall between sunrise and sunset. Turtle traps were placed in the water as to never be completely submerged or completely exposed, thus avoiding drowning or desiccation of the turtles. Traps were baited with 3-5 adult size killifish seined from the tidal swamp at Stockport. While the traps were set we actively searched for turtles, and if possible, captured observed individuals by the use of dipnets or by hand. Trapping was repeated 3 times in each habitat at each site.

Call Surveys

Call surveys were conducted during the evenings from approximately sunset until midnight (Scott and Woodward 1994). The surveys took place on randomly chosen evenings, and were conducted between 55-75°F and in appropriate wind conditions (Scott and Woodward 1994). Due to the large distance between sites, only one site (i.e., Tivoli or Stockport) could be completely sampled in one survey. In order to help diminish the effects of periodic weather fluctuations, surveys were replicated 3 times for each habitat at each site. In order to conduct a survey, we would go to a predetermined location in the study area, wait 2-3 minutes and then begin a 10 minute period in which all frog calls would be scored. We scored call surveys on a scale from 0-3: 0 = no frogs calling; 1 = actual number of frogs calling could be counted (usually 1-5 individuals); 2 = individuals could be heard but not counted; and 3 = full chorus with call overlap (Scott and Woodward 1994).

Cover object searches

Cover object surveys were conducted along the mean high water shoreline (+/- 3meters horizontally) in tidal habitats and along the waters edge (+ 3meters horizontally) in non-tidal habitats. All cover object surveys were done along the wetland/upland edge, except the survey along the east edge of the unnamed island which

Figure 1. Map of study area. Tivoli North Bay (Map A) and Stockport (Map B). Labeled areas represent location of surveys. (adapted from U.S. Geological Survey, Saugerties, NY, and Hudson North, NY 7.5 minute topographic map sheet)

↔ = Cover Object Survey

● = Call Survey

■ = Turtle Trapping

N↑

A ← 1 kilometer → B

was along the edge of Stockport Creek and a tidal swamp. All debris in the search zone was turned to reveal hidden amphibians and reptiles which were identified and counted. The approximate ground contact surface area of the object was measured to the nearest cm. We also recorded the distance from the cover object to mean high water, or to the waters edge. In order to sample a site accurately, a minimum total area of 2.0 square meters of cover objects was deemed necessary for analysis (M. Rubbo and S. Nyman, unpublished data). A minimum size of 0.025 square meters was also used to avoid objects too small for animals to be associated with (M. Rubbo and S. Nyman, unpublished data).

The soil moisture under each object was scored on an increasing scale of 1-4. We assigned a value of 1 if they were completely dry. A value of 2 was assigned if the soil was damp, but no moisture was released when squeezed in the palm of the hand. A value of 3 was assigned when the soil was not saturated, but released moisture when squeezed. When soils were fully saturated, values of 4 were assigned. The decay stage of the cover objects, if wood, were also graded on a scale of 1-4. A value of 1 was assigned for no decay, 2 when the object was structurally intact and fairly resistant to breakage by hand, 3 when the object showed obvious signs of decay and would break easily, and 4 when the object no longer retained a solid form. We also recorded whether or not any ants or leaf litter were found beneath the object. Cover object searches were not repeated in an area due to the uncertainty of the effect of the disturbance of overturning the object on the animal beneath.

Data Analysis

Frog call counts were analyzed by habitat with a Kruskal-Wallis one-way ANOVA by ranks (Zar 1984). Only one species of frog, the green frog (*Rana clamitans*), was recorded in numbers sufficient to analyze. Statistics were computed with the aid of Statistica release 5.1 (StatSoft, Inc., Tulsa, Oklahoma).

We calculated estimates of red-backed salamanders per square meter by dividing the number of salamanders found at a site by the total ground contact area of the cover objects overturned at that site. These abundance estimates were then used for comparative purposes between sites.

RESULTS

Turtle Trapping

We set traps for a total of 12 days at the various sites and habitats. On the first day of trapping, June 3, one painted turtle (*Chrysemys picta*) and two snapping turtles (*Chelydra serpentina*) were caught in the tidal swamp at Stockport. For the remainder of the study no turtles were caught in traps. Hand captures of snapping turtles totaled four in the tidal swamp at Tivoli, and 13 in the open marsh at Tivoli. We also hand caught one snapping turtle in the tidal swamp at Stockport, and two in the open marsh at Stockport.

Call Surveys

Three anuran species were encountered during call surveys: green frog (*Rana clamitans*), gray treefrog (*Hyla versicolor*), and bullfrog (*Rana catesbeiana*). Of these species, the gray treefrog was heard mainly in upland sites away from the study area, and the bullfrog was found only in the inland pond at Stockport. No anuran species was heard calling at the inland creeks, and only one to two green frogs were heard at Mill Pond. Full choruses of the green frog and bullfrog were heard in the inland pond at Stockport. Calling activity was irregular at the inland sites. The green frog was the only

species commonly encountered in the estuarine environment. When all 5 habitats were combined, the sites (i.e., Tivoli and Stockport) were not significantly different (Kruskal-Wallis ANOVA, $p=0.73$). When both sites were combined the 5 habitats differed ($p=0.0007$). This was due to the low counts for the inland creek habitats. When only the three estuarine habitats were compared with sites combined or separate, the ANOVAs were not quite significant ($0.1>p>0.05$). Call counts were not correlated with date (Spearman's r_s, $p=0.35$).

Cover Object Surveys

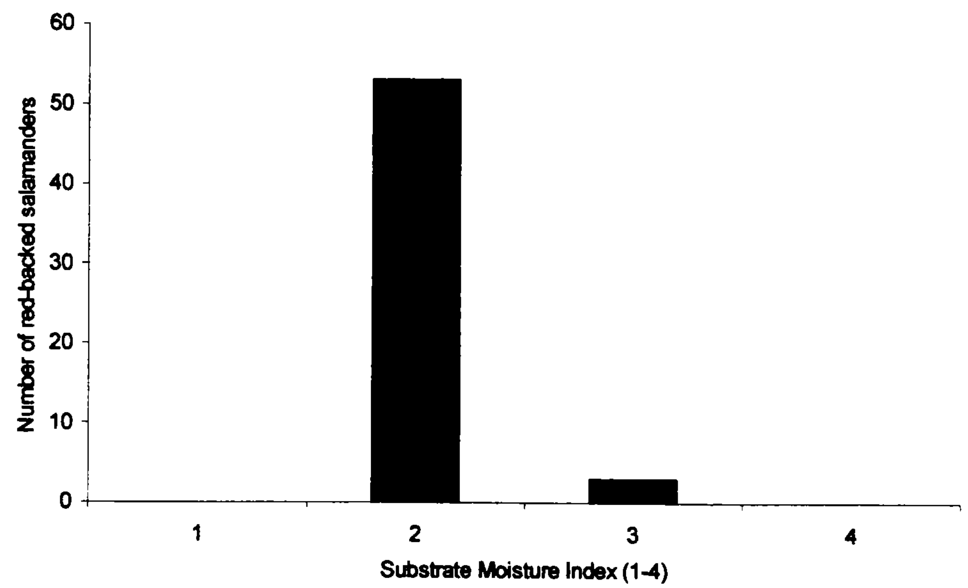
We encountered very few amphibian or reptile species during cover object surveys: spotted salamander (*Ambystoma maculatum*), garter snake (*Thamnophis sirtalis*), eastern newt (eft stage), (*Notophthalmus viridescens*), wood frog (*Rana sylvatica*), and red-backed salamander (*Plethodon cinereus*). These species were typically represented by only one or two individuals. Only one species, the red-backed salamander, was found in sufficient numbers to analyze. Salamander density was variable and seemed related to soil type (Table 1). We did not include data from the cover object surveys at Fittings Creek because the available amount of cover area for survey was too small (see Methods section).

Red-backed salamanders were never found below mean high water (the closest individual was found 0.5 meters above mean high water). We commonly found the salamanders under cover objects associated with intermediate values of substrate moisture (Fig. 2). Red-backed salamanders were never found under objects that had ants or leaf litter underneath.

Table 1. Red-backed salamanders per square meter, soil type, and water capacity

Site	Salamanders/m^2	Soil Type	Water Capacity
North Bay	1.16	HvE	High
Stockport	0.00	Ud, Sa	Low/High
Cruger Island	3.08	NwC	Moderate
Mill Pond	0.37	HeB	Moderate/Low
Stony Creek	2.62	HvE	High
Falls Road Pond	0.33	KnA, Wa, Ho	Low/High

Figure 2. Red-backed salamander (*Plethodon cinereus)* distribution by substrate moisture index



DISCUSSION

The lack of turtles trapped could be due to a variety of factors. It has been found that trapping success is negatively correlated with date, with the most successful trapping period in early April-May (Kiviat 1980; Rozycki and Kiviat 1995). It is also known that the activity of snapping turtles decreases with increasing temperatures (Kiviat 1980). However, it is not uncommon to capture turtles in traps later in the season (Swarth 1998). At the very least, snapping turtles should have been captured at North Bay during the

trapping period. A confounding factor could have been the warm spring accompanied by heavy June rains. We commonly observed snapping turtles at North Bay in the open marsh, while only one painted turtle was observed at North Bay. In contrast, snapping turtles seemed much less common in Stockport, while a number of observations were made of painted turtles in the tidal swamp distributary. Previous studies have found that the painted turtle population at North Bay is at a low density (Rozycki and Kiviat 1995). Our findings also suggest that painted turtles are not abundant at these study sites. Moreover, we suggest that these populations should be monitored to determine if they are stable or declining.

The frogs were also found in low numbers at the study sites. However, many species of spring breeding frogs were most likely missed due to the initiation time of the project. In the estuarine environment, we observed a nonsignificant increase in the abundance of green frogs with decreasing tidal influence. However, this lack of significance may be due to the small sample size and low number of replicates used in this study. The tidal influence of the estuarine environment may be too stressful for anuran egg masses and tadpoles (Kiviat 1989). Green frogs do appear to associate with the estuarine environment, although this may be limited to protected areas where tidal influence is diminished.

We found no salamanders below mean high water, or in any environment affected directly by tides. We found that red-backed salamanders were distributed in narrow habitat ranges. They were most commonly associated with intermediate substrate moisture values (Fig. 2). The red-backed salamander density appeared to vary with soil type (Table 1). Twice as many salamanders were found on Cruger Island than the adjacent North Bay. HvE soils are found at North Bay while NwC soils are found on Cruger Island (Dutchess County Soil and Water Conservation District, unpublished data). No salamanders of any species were found at Stockport where the soils were Sa and Ud. Red-backed salamanders have been found to preferentially associate with moderately moist soils (Jaeger 1971). This variation in red-backed salamanders between sites may result from the ability of the soils at these sites to hold water at a given water potential. Soils with high water capacities will hold relatively more water than soils with lower water capacities (Brady 1990) and appear to support higher salamander densities.

As a result of the methods employed in this study, snakes were not observed in adequate detail. Garter snakes were fairly commonly encountered along the terrestrial and estuarine border, probably feeding on the frogs in this area, yet no species were seen in the estuarine habitat. The lack of water snakes is perplexing, as they have been seen in these habitats (Kiviat, unpublished data). However, we did not observe a single specimen during the course of this study. Their populations should be described quantitatively to determine population status.

This study provides basic data on the current state of amphibian and reptile populations in the Hudson Estuary. These data do not portray accurately the numbers of individuals in these wetlands, yet point to the need for finely tuned studies on specific animals to more accurately determine population levels. Populations in the Hudson Estuary cannot be considered to exhibit decreased population densities relative to other estuarine systems until more quantitative data are gathered on these organisms in tidal habitats.

These types of comparative data are lacking (e.g., in Louisiana's extensive coastal wetlands there has been no detailed survey work on the populations of amphibians and reptiles---Jeff Boundy, LA State Herpetologist, personal communication). Comparative data are necessary in order to describe population dynamics of amphibians and reptiles in estuarine systems. Once the ecology of these animals in these habitats is better understood, population trends and stress factors may be defined. The possible low abundances of amphibians and reptiles in estuaries have been hypothesized to be the result of pollution (Stone et al. 1980), predators (Rozycki and Kiviat 1995), or many other stress factors inherent to estuarine systems (Kiviat 1989). The herpetofauna of the

Hudson Estuary does appear to be under stress and depauperate, but to determine this properly, these amphibian and reptile populations should continue to be monitored.

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