THE DIAMONDBACK TERRAPINS OF PIERMONT MARSH, HUDSON RIVER, NEW YORK

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ABSTRACT - We investigated the size and structure of a population of diamondback terrapins (*Malaclemys terrapin*) inhabiting Piermont Marsh on the lower Hudson River, New York. From 6 June through 24 August 1997, 39 trapping periods were completed using trammel nets set in and around the marsh complex. Only eight terrapins were captured – six males and two females – indicative of a small or broadly-dispersed population. Terrapins were trapped near a sandbar area outside of the marsh but never seen or trapped in two marsh creeks, suggesting the creeks were not used by terrapins during the time of the study. Instead, terrapins were observed basking and swimming around the rocky piers and breakwaters in the Hudson River. Recent development, soil subsidence, and *Phragmites australis* growth may have deteriorated traditional terrapin nesting sites in the region.

INTRODUCTION

Malaclemys terrapin is a euryhaline species of turtle that inhabits coastal environments situated along the eastern coast of North America from Cape Cod south to the Gulf of Mexico. Diamondback terrapins are a species of conservation concern (Garber 1989, Roosenburg 1990, Seigel and Gibbons 1995), yet little published data on the population status of terrapins in New England coastal environments is available (for a review see Klemens 1993). A terrapin population study in New York has not been performed since 1991 (Seigel and Gibbons 1995).

The Piermont Marsh complex in Rockland County, NY is located on the Hudson River approximately 37 km from the southern tip of Manhattan. Terrapins historically have been documented from the 400 ha marsh (Boyle 1969, Klemens 1993). In recent years, however, most observations have been made of terrapins outside the marsh, either swimming in the river, crawling onto a small sand spit adjacent to the marsh, or sunning on rocks along breakwaters. The size and structure of this population and its current use of the marsh habitat is unknown.

The main objective of this project was to complete a population study of diamondback terrapins of Piermont Marsh during summer 1997. We anticipated that a survey of the terrapins in this marsh complex would yield estimates of total population size, structure, sex ratios, and terrapin nesting success. Ultimately, the results of this work were expected to assist the development of species management plans for the Piermont Marsh complex.

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FIELD-SITE DESCRIPTION

Piermont Marsh, part of the Hudson River National Estuarine Research Reserve, is located just south of the Tappan Zee Bridge in Rockland County, New York (Fig. 1). The pier, which actually is a large, constructed peninsula with associated rocky breakwaters, forms the northern boundary of the marsh complex; a subtidal sandbar occurs south of the pier. The marsh is mesohaline with an average salinity of 8 ppt during summer and is bisected by two major tidal creeks, the Crumkill and Sparkill (Fig. 1). Crumkill Creek has slightly lower levels of dissolved oxygen than Sparkill Creek, with more silts than sand (Ramnarace et al. 1988). Salinity tends to be lower in Sparkill Creek due to freshwater runoff (Perrone and Knizeski 1988). The dominant form of vegetation in the marsh is common reed, *Phragmites australis*, a species that has increased in coverage from 33% to more than 73% of the total marsh area in the past 30 years (Winogrond and Kiviat 1997).

The upland areas adjacent to the marsh complex are part of Tallman Mountain State Park, managed by the New York State Department of Environmental Conservation and the Palisades Interstate Park Commission. However, the area just north of the marsh lies within the jurisdic-

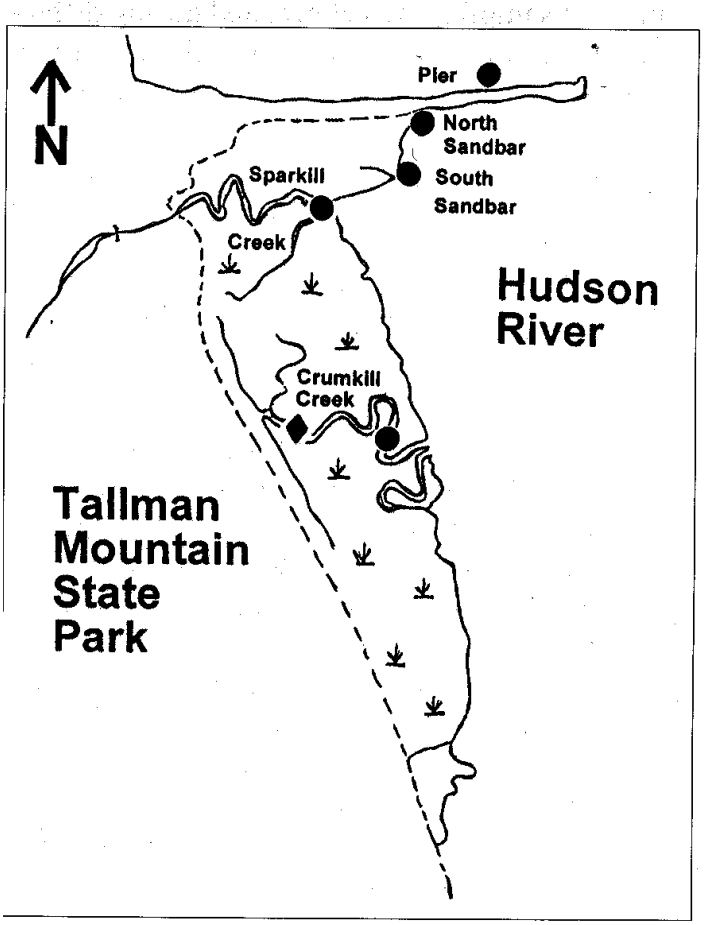

Figure 1. The 400 ha Piermont Marsh complex, showing the five major sampling locations for the study (●). A single sampling period was also completed at a sixth location approximately 400 m upstream of the Crumkill Creek site (◆).

tion of the Town of Piermont and is undergoing intense development. Several condominiums are being constructed along and adjacent to the pier (Fig. 1). The marsh creeks are used by jet skiers and fishermen during the summer; the subtidal areas surrounding the marsh are used by several crabbers.

We established five terrapin trapping stations in the marsh complex based on habitat type, including two marsh stations (Crumkill and Sparkill Creeks), two intertidal sandbar stations (North and South Sandbar) and a single rocky pier station (Fig. 1). In addition, the upland areas adjacent to the marsh in Tallman Mountain State Park and the sand spit areas just south of the pier were surveyed for the presence of open, sandy, unvegetated environments in which terrapins prefer to nest (Burger and Montevecchi 1975, Roosenburg 1994).

METHODS

Adult terrapins were captured using 15.25m and 22.75m trammel nets with a 10cm outer mesh and 5cm inner mesh (Memphis Net and Twine Co.). These nets were deployed during selected tidal periods between 6 June and 24 August. This sampling strategy was chosen to yield adequate seasonal coverage both before, during, and after the nesting season and to ensure that sampling was completed during different tidal stages. A trapping period consisted of running a single net at a station over a complete flooding or ebbing tidal cycle, approximately six and a half hours. Nets were stretched across a location, then checked by canoe every 45 minutes for the duration of the tidal cycle. Terrapins and other by-catch that became entangled in these nets were removed before they experienced hypoxic stress. Collected terrapins were held in the canoe and released at the end of the sampling interval. Juvenile terrapins were too small for capture by trammel nets. Occasional attempts to capture terrapins using baited hoop nets and crab pots were unsuccessful.

At the end of each trapping period, a field form was filled out for each captured terrapin, noting time, station, method of capture, weather conditions, and air temperature. Adult terrapins were sexed and weighed to within $\pm$ 20 g using a Chantillon hanging tube scale. Forestry calipers were used to measure the maximum length and width of the carapace and plastron of all turtles to the nearest millimeter. Females were palpated to determine the presence of shelled eggs. Age was estimated based on the number of growth rings on the plastron, a feature that sometimes is obscured on terrapins whose plastrons are excessively worn (Roosenburg 1990). Physical damage and unusual markings on the shell or skin were noted. Terrapins were marked before release using a file to notch the marginal scutes in unique codes.

RESULTS

Eight diamondback terrapins (two females and six males) were captured with the trammel nets (Table 1). None were recaptured. The average weight of males was 382 ± 68g s.d. (standard deviation) and females 1,175 ± 248g s.d. The mean straight carapace length (SLC) was 133 ± 9 mm s.d. for males; 184 ± 13 mm for females. Carapace width averaged 104 ± 6 mm s.d. for males and 144 ± 9 mm s.d. for females. Because of obscured, worn, growth rings, only one male terrapin was aged and was determined to be five years old. The two females were ages 6 and 7 years. Both females were palpated for eggs but none were detected.

Most of the terrapins caught had extremely worn shells. Six of the eight terrapins had chipped shells and circular blemishes. One female had supernumerary laminae on both her carapace and plastron. Three terrapins were caught with deep jagged scars on their marginal scutes. Two captured terrapins had flesh wounds inflicted prior to capture. The seven-year-old female had a cleft in her chin, and one male had a circular gash on his right hind leg. The six-year-old female terrapin was almost entirely black, with no gray markings on her skin; a completely white terrapin was observed basking on rocks near the North Sandbar station. Such color variation within terrapin populations, however, is not unusual (Klemens 1993).

Terrapins were caught during both inclement and fair weather over a broad range of air temperatures. The first terrapin was captured June 8, a partly cloudy day (21° C); two weeks later two terrapins were caught during a thunderstorm (35° C). Half the terrapins were caught within an hour of high tide. Relative to temperature and tidal patterns, the seasonal pattern of terrapin captures was most pronounced, with five turtles caught in June, two in July and one terrapin caught the last trapping day in August. The number of trapping periods each month was similar, with 15, 12, and 12 for June, July, and August, respectively.

Table 1. Descriptions of Terrapins Captured in Piermont Marsh from June to August 1997

Date	Location	Carapace (mm)	Plastron (mm)	Weight (g)	Sex	Age (yrs)
6/8	S. Sandbar	124 x 97	102 x 63	275	M	CND
6/9	N. Sandbar	131 x 101	109 x 67	400	M	CND
6/20	N. Sandbar	136 x 101	420 x 67	420	M	CND
6/22	N. Sandbar	131 x 102	112 x 66	350	M	CND
6/22	N. Sandbar	175 x 137	161 x 92	1000	F	6
7/12	N. Sandbar	149 x 113	124 x 71	475	M	CND
7/27	S. Sandbar	193 x 150	172 x 95	1350	F	7
8/24	S. Sandbar	128 x 109	113 x 65	375	M	5

CND = Could Not be Determined

All eight terrapins were trapped during 21 total trapping periods completed at the sandbar stations south of the pier (Fig. 2). Also, most visual sightings of terrapins basking on rocks and swimming in the river were made near the North Sandbar station. In contrast, no terrapins were captured at the two marsh stations or at the rocky pier station despite nine trapping periods in each habitat (Fig. 2).

The survey of potential nesting sites identified no high-quality habitats for terrapins around Piermont Marsh. The upland areas at the base of Tallman Mountain were rocky, highly vegetated, and steep. Shrubs, vines, and trees covered the land and *Zizania* (wild rice) and *Phragmites* covered the marsh leading up to the banks. Although the North and South Sandbar beaches were less vegetated, they were mostly submerged during high tide. Further, dense *Phragmites* stands fringed the beaches, possibly restricting terrapin access to uplands more suitable for nesting (pers. comm., C. Nieder).

DISCUSSION

The low numbers of turtles caught in this study (8) and the absence of recaptures indicates the terrapins are broadly dispersed throughout the 400 ha complex and/or the overall population size is small. Terrapins may swim around nets in the open waters of the Hudson (near the Pier and Sandbar stations), thereby reducing trapping efficiency relative to nets strung across entire tidal creeks. For example, two trammel nets

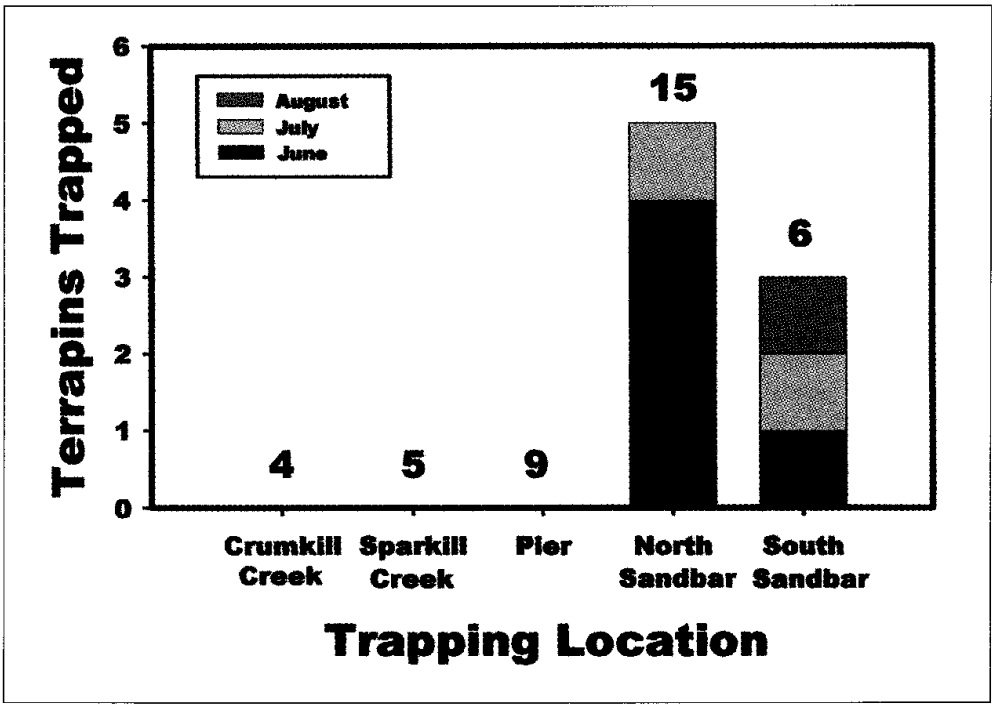

Figure 2. Summary of the number, timing, and location of terrapins trapped in the Piermont Marsh complex, summer 1997. The total number of trapping periods also is presented for each sampling location.

were set up one day in Crumkill Creek during a rising tide, one near the creek mouth and one roughly 400 m upstream (Fig. 1). Of six catfish initially caught in the net near the mouth, all were recaptured an hour later in the net upstream. We are confident the nets would trap terrapins if they were present in the marsh creeks, as the same sampling strategy yielded over 100 terrapins in a similar-sized tidal marsh in CT (Gallowitsch and Chambers 1998).

Terrapins typically forage in tidal marsh creeks for crustaceans, mollusks, and other invertebrates (Carr 1952, Ernst and Barbour 1972, Spagnoli and Margonoff 1975); terrapins are more active during high tides (Muehlbauer 1987) when these prey items are more accessible (Teal 1958, Tucker et al. 1995). In our study, however, all terrapin sightings and captures were not in the marsh. Instead the terrapins are basking and foraging in the Hudson River around the rocky pier and sandbar areas during the summer months.

Terrapin nesting activity also occurs during the summer months but is known to lag behind other turtle species by two to four weeks (Klemens 1993). In New Jersey marshes, oviposition in terrapins has been reported from 9 June to 23 July (Burger and Montevecchi 1975, Burger 1977), in Massachusetts, from 10 June to 20 July (Lazell and Auger 1981), and in Connecticut, from 10 June to 28 July (Gallowitsch and Chambers 1998). Seven terrapins in the current study were caught between 8 June and 27 July. Neither captured female, however, was gravid, indicating they either had not bred or had already nested for the season.

Terrapin nesting sites typically are flat sand substrates above the levels of normal high tides, with shrub canopy ranging between 25% and 75% (Palmer and Cordes 1988). The quality of available nesting habitats influences both maternal nest site choice (Roosenburg 1996) and the sex ratio of hatchlings (Jeyasuria et al. 1994, Roosenburg and Place 1994). Although uplands near the North and South Sandbar locations now are low-quality nesting habitats due to their low elevation, in recent decades they were at higher elevation because of dredge spoil deposition and used by nesting female terrapins (pers. comm., A. Ciganek). Since dredging was discontinued, the South Sandbar uplands have subsided and become overgrown with *Phragmites*. Despite this ongoing deterioration of nesting habitat, a terrapin hatchling was discovered adjacent to the sandbar area during fall 1998, so nesting is still occurring at some frequency in the region.

Several environmental pressures in Piermont Marsh may threaten the stability of this terrapin population. For example, crab pots, fishing nets, and fishing lines all are known to contribute to terrapin mortality at Piermont Marsh and elsewhere (pers. comm., A. Ciganek.; Roosenburg et al. 1997). Further, the quality of the nesting sites around the marsh has decreased over the past 30 years owing primarily to increased human disturbance in the form of construction and car and foot traffic

adjacent to the sandbar area. Finally, the rapid expansion by *Phragmites* in Piermont Marsh (Winogrond and Kiviat 1997) may block access by terrapins to potential upland nesting areas. As nesting sites deteriorate, nesting densities in remaining areas could increase, allowing raccoons to increase predation rates on these concentrated food sources (Roosenburg 1990). This may decrease recruitment of juveniles to the population. Given these limitations, a comprehensive environmental management plan for terrapins in the Piermont Marsh complex must consider the quality of open water, intertidal, and upland habitats for maintaining populations of this unique estuarine species of turtle.

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