A Low Density, Tidal Marsh, Painted Turtle Population

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ABSTRACT

We studied a population of the painted turtle (Chrysemys picta) in Tivoli North Bay, a 150 ha freshwater tidal marsh on the Hudson River, from late April to mid-June 1995. We compare our results with data collected in North Bay in the early 1970s. Forty-nine turtles were marked and 4 recaptured in Tivoli North Bay during the 1970s study; 20 turtles were marked and 2 recaptured in 1995. Catch per effort for hand captures was 0.50 turtles/day and 1.11/day in 1995 and the 1970s, respectively; this is very low compared with many published studies of the species in non-tidal habitats. Hand captures per day, adult sex ratio, adult:juvenile ratio, carapace length, and weight did not differ significantly between periods, but turtles were lighter for their length in 1995 than in the 1970s. Between one-third and one-half of the turtles caught in 1995 had scars on their shells from mammal teeth. In 1995, we found no turtles in one area where 15 had been caught in the 1970s. The painted turtle population in North Bay may be limited by tidal fluctuation, predation, pollution, harvest, or other factors affecting reptiles in northeastern estuaries.

TABLE OF CONTENTS

ABSTRACT VII-3

LIST OF FIGURES AND TABLES VII-6

INTRODUCTION VII-7

METHODS VII-7

RESULTS VII-11

DISCUSSION VII-18

RECOMMENDATIONS VII-23

ACKNOWLEDGMENTS VII-23

REFERENCES VII-24

LIST OF FIGURES AND TABLES

Figure 1. Map of Tivoli North Bay, Hudson River National Estuarine Research Reserve VII-9

Figure 2. Tivoli North Bay painted turtle population length - weight relationships in the 1970s and 1995 ..... VII-16

Table 1. Tivoli North Bay painted turtle captures by method in the 1970s and 1995 ..... VII-13

Table 2. Numbers of anomalous scutes, scars, teethmarks, damaged claws and leeches for males and females in 1995 ..... VII-14

Table 3. Minimum, maximum, mean and median carapace lengths, plastron lengths and weights of painted turtles from the 1970s VII-15

Table 4. The Tivoli North Bay painted turtle population by size classes VII-16

Table 5. Tivoli North Bay painted turtle captures by area in 1970s and 1995 ..... VII-17

Table 6. Density of aquatic plants, channel widths, substrate softness, and average water depths for areas VII-17

INTRODUCTION

Reptiles and amphibians are sensitive to habitat loss and fragmentation, pollution, overharvest, highway mortality, and other stresses (Klemens 1993), and many species are considered to be good environmental indicators. The ecology of reptiles and amphibians in estuarine habitats is poorly understood and may be regulated by tidal fluctuation, salinity, predation, and pollution (Kiviat 1989). The painted turtle, Chrysemys picta, is possibly the best studied freshwater turtle in the world (Zweifel 1989), but we know of no published study of a painted turtle population in a tidal habitat, although this species occurs widely in tidal habitats of the eastern United States (e.g. Neill 1958, McCormick 1970, McCormick and Somes 1982, Smithberger and Swarth 1993).

From 1972 to 1975 Kiviat and others collected data on the painted turtle in Tivoli North Bay (Hudson River) while studying snapping turtles (Chelydra serpentina) (Kiviat 1980). Limited data indicated a painted turtle population with a low density and an unusual population structure. Painted turtles in nontidal environments often occur at high densities (Zweifel 1989), and there is a high density population in an old millpond on the Saw Kill 1.7 km from North Bay (Kiviat, personal observations). We therefore wondered what is limiting the density of the North Bay population. In this paper we present data from a 1995 survey of the Tivoli North Bay painted turtle population and a comparison with data from the 1970s, in the context of the natural and anthropogenic features of freshwater tidal marshes as painted turtle habitats.

METHODS

Study Site

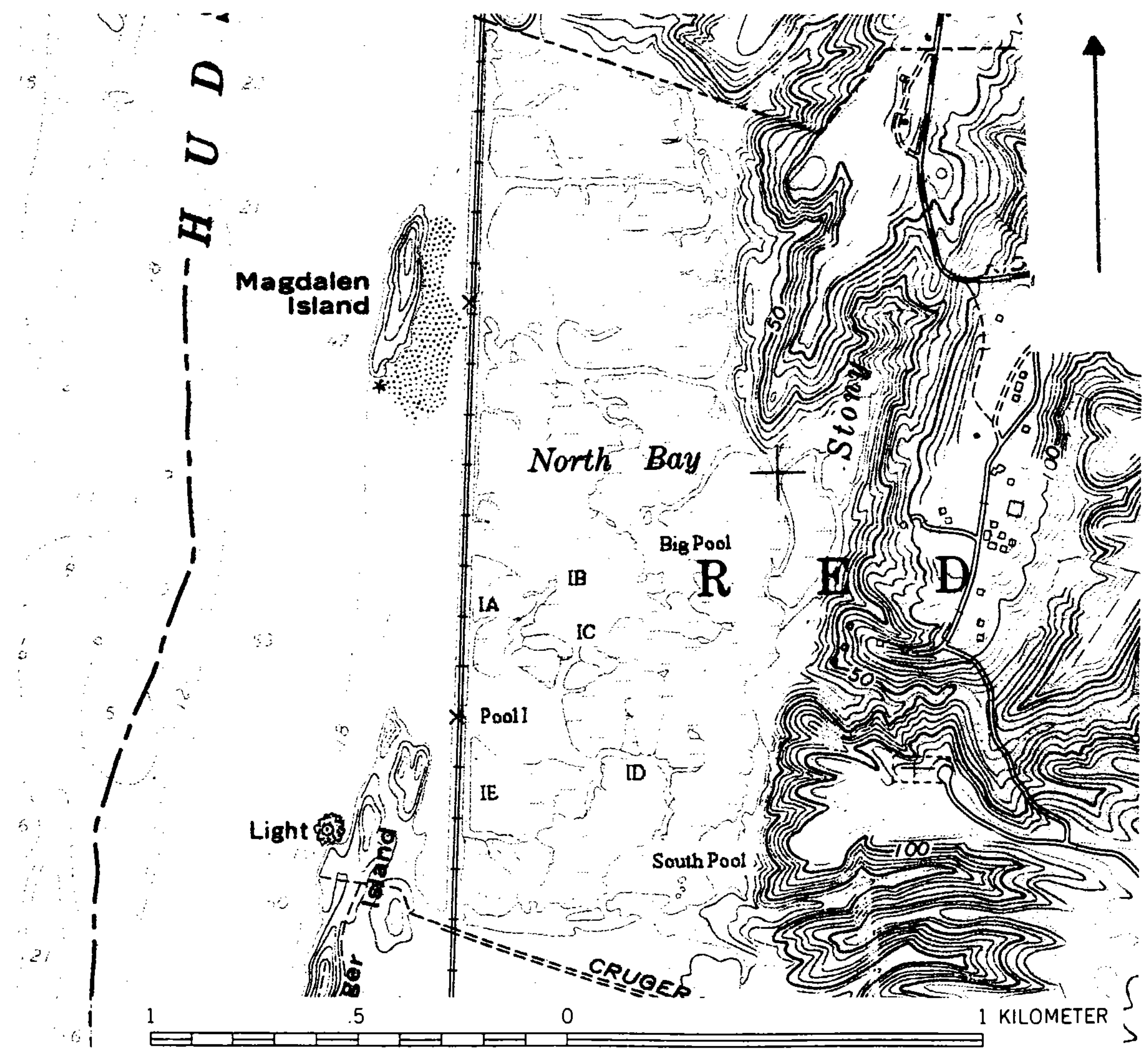
Tivoli North Bay is a 154 hectare freshwater tidal marsh located on the east side of the Hudson River in Dutchess County, New York (Fig. 1) (Kiviat 1978, 1980). North Bay is partially separated from the main river channel by a railroad causeway on fill. Tides are bimodal with a mean range of 1.2 meters. The vegetation of the marsh is dominated by narrow-leaved cattail (Typha angustifolia). Other important plants include purple loosestrife (Lythrum salicaria), spatterdock (Nuphar luteum), pickerelweed (Pontederia cordata), wildcelery (Vallisneria americana), Eurasian watermilfoil (Myriophyllum spicatum), and coontail (Ceratophyllum demersum) (Kiviat 1980). Well defined tidal creeks and pools, where most painted turtle activity occurs in spring and summer, occupy ca 24% of the marsh. Our studies were conducted principally in ca 71 ha of the southern portion of North Bay (Fig. 1) but only ca 17 ha of creeks and pools were actually sampled.

Capture

Field work took place from late April until June 1995. A day of field work comprised 5.0-8.3 hours of searching for turtles by canoe. We set 0-8 live traps (single-funnel, 2.5 cm square mesh, collapsible, 76 cm diameter hoops [Nylon Net Co., Memphis, TN]) from mid-ebb to mid-flood tide, for periods of ca 4-7 hours. We pulled the traps before the rising tide flooded the traps, or checked periodically in order to protect the turtles from prolonged submergence. We also searched visually (with naked eye and binoculars) on the water surface, banks, and mudflats of creeks and pools, and we probed soft sediments with a dipnet handle or canoe paddle. Captures are referred to hereafter as "trap captures" or "hand captures"; the latter category includes turtles caught by hand and by dipnet.

The 1995 data were collected April through June and the 1970s data were collected April through November. We have compared length, weight, population structure, and catch rates, however, only from the spring.

Figure 1. Map of study area, Tivoli North Bay. Labeled creeks and pools represent the areas where most sampling occurred (adapted from U.S. Geological Survey, Saugerties, NY 7.5 minute topographic map sheet)



Marking

We marked individuals by filing or drilling coded notches in the marginal scutes (Cagle 1939). Turtles were released at the capture sites, usually within 30 min.

The 1995 field work was conducted by Rozycki and Denise Edelson; the 1972-75 work was conducted by Kiviat assisted by Devi Ukrain Sharp (1973) or Jeffrey A. Clock (1972). Data collection for the 1970s was similar to that in 1995, except the habitat measurements were not made in the earlier study, nor were leeches, anomalous scutes, or scars recorded consistently.

Data Collection and Analysis

We recorded location, time of capture, tidal zone, tide level, and behavior of turtle before capture for each turtle captured. We also made the following body measurements and observations: 1) greatest carapace length (CL) and greatest plastron length (PL) to the nearest millimeter with Haglof Mantax tree calipers held in the plane of the shell and the caliper arms perpendicular to the carapacial midline (spine); 2) weight to the nearest 5 g with a Pesola precision spring scale; 3) sex determined by the fore claws substantially longer than the hind claws in adult males (Bayless 1975) and the larger maximum body size of adult females; 4) number of visible growth annuli on plastral scutes (an approximate minimum age) (Sexton 1959); 5) number of leeches (probably Placobdella parasitica); 6) anomalous (supernumerary or grossly irregular) carapacial or plastral scutes; and 7) scars, missing claws, and other injuries. In the 1970s, turtles were weighed with a Chatillon precision spring scale calibrated in 25 g intervals but weights were interpolated to the nearest 5 g. An individual between 79 and 115 mm plastron length was considered an adult male if the foreclaws were markedly longer than the hind claws or a juvenile female if the claws were subequal (Gibbons 1968b). Individuals < 79 mm were juveniles; individuals >115 mm were adults and were sexed according to claw length.

Sample size varies for different analyses. Effort data for spring 1995 and 1975 permitted catch-per-unit-effort (CPUE) comparison of these years. We were able to use pre-1975 data for certain other anaylses (e.g. of lengths and weights). For

consistency between time periods, we used data through 8 June for the length and weight anaylses, and data through 20 June for the sex ratio analyses.

Log-transformed CL and weight met assumptions of normality and linearity. We performed ANOVA and ANCOVA on log-transformed CL and weight, excluding nesting or gravid females. Chi-squared tests were computed with Systat 5.02 (Systat, Inc., Evanston, Illinois). Other statistics were computed with Statistica release 3.1 or 5 (StatSoft, Inc., Tulsa, Oklahoma). We present z-approximations for probability levels for the Mann-Whitney tests.

We surveyed submergent vegetation, substrate, and bottom elevation in two areas where painted turtles were captured frequently (IB, IC), and two areas where turtles were captured in the 1970s but not in 1995 (ID, South Pool). Rozycki ranked the abundance of plant species present in each creek or pool, and collected specimens which were identified by Kiviat and Gretchen Stevens. For an index to substrate softness, Rozycki measured the depth her boot soles sank in the mud in each habitat. She also recorded water depths and times of measurement, and derived relative bottom elevations using data from a Stevens Model 420 water level recorder maintained at Tivoli Bays by Paul Barten (Yale University).

RESULTS

Catch per Unit Effort

In 1995, 24 days of field work for 5.0-8.3 hour periods (mean = 6.20 h) included trapping on 17 days (0-8 traps set per day for 78 trap-days). In 1975, 9 days of field work for 3.0-6.5 hour periods (mean = 4.77 h) equalled 9 days of trapping (2 traps per day for 18 trap-days). Hand catches of painted turtles were 12 and 10, trap catches were 8 and 0, and total catches were 20 and 10, respectively, in 1995 and 1975. Catch-per-unit-effort (CPUE) was 0.50 and 1.11 turtles per day for hand captures and 0.10 and 0 turtles per trap-day for trap captures in 1995 and 1975. The number of hunting hours per day was significantly greater in 1995 than in 1975 (Mann-Whitney U = 34.0, p = 0.0036). Between-period differences were not significant for: Julian dates of field work (U = 74.5, p = 0.224), number of traps set per day (U = 90.0, p = 0.572), hunting catch (U = 67.0, p = 0.126), turtles seen but not caught (U = 76.5, p = 0.258), and trap catch (U = 85.5, p = 0.451).

For both years combined, hunting catch is negatively correlated with date (rho = -0.48, p = 0.0049) and number of traps is positively correlated with date (rho = 0.659, p = 0.00004) (the latter due to a trend in 1995 data). Trapping catch is positively correlated with number of hunting hours (rho = 0.40, p = 0.024) and number of traps set (rho = 0.38, p = 0.032); the former due to longer trapping time with increased hunting time. Turtles seen but not caught are negatively correlated with number of traps set (rho = -0.40, p = 0.024), as is hunting catch (rho = -0.43, p = 0.014); more time spent setting and checking traps may decrease the intensity of searching for turtles. All other correlations among hunting and trapping variables are nonsignificant (p > 0.05). Because hunting catch is not significantly related to hunting hours (rho = -0.31, p = 0.083), we compared the numbers of hand captures per day between 1995 and 1975 independent of the numbers of hunting hours.

Recaptures

During the early 1970s, 49 turtles were marked of which 4 were recaptured during that period. In 1995, 20 turtles were marked and 2 of these were recaptured. These represent similar recapture rates (for marked turtles recaptured vs. marked turtles not recaptured between the two periods, Fisher's p = 0.56). Also in 1995, a turtle marked in 1983 was recaptured. For all 7 recaptures, time intervals between first and second captures ranged from 2 weeks to 12 years. Small recapture samples, and lack of information concerning immigration and emigration, do not permit the estimation of population sizes by mark-recapture indices.

Population Structure

We captured more turtles by hand than by trap (Table 1). All juveniles were caught by hand. For both periods combined, sex ratios of trap captures and hand captures were significantly different (Fisher exact test, p = 0.007).

In 1995 the male to female ratio for all capture methods combined was 2.6:1, and for hand captures only was 1.2:1. In the 1970s the sex ratio for all capture methods combined was 1.1:1, and for hand captures only was 0.87:1. In 1995, the sex ratio of trap captures was 7:0. The sex ratios (hand capture only) were not significantly different between time periods (Fisher exact test, p = 0.45).

Table 1. 1970s and 1995 North Tivoli Bay painted turtle capture method ratios separated by sex and age. Only the initial capture is recorded.

Sex	Hand		Trap		Total	
	1970s	**1995**	**1970s**	**1995**	**1970s**	**1995**
Male	13	6	4	7	17	13
Female	15	5	1	0	16	5
Juvenile	4	1	0	0	4	1
Totals	32	12	5	7	37	19

In 1995 the adult to juvenile ratio was 11:1 (only 1 juvenile was caught). In the 1970s the adult to juvenile ratio was 7:1. The adult to juvenile ratios (hand captures only) were not significantly different between periods (Fisher exact test, p = 0.58).

The annulus counts (approximate ages) of turtles captured in 1995 ranged from 3 to 14+ years (the maximum age was due to a turtle recaptured after 12 years and thus of partially known age). The median age was 4. The ages of turtles captured during the 1970s in Tivoli North Bay ranged from 2 years to 10+ years, with a median of 5. Many turtles could not be aged accurately due to worn scutes.

Body Condition

The frequencies of scars, anomalous scutes, damaged or missing claws and leeches in 1995 are shown in Table 2. In 1995, no leeches were found on individuals without scars, and the association between scars and leeches was significant (Fisher exact test, p= 0.015). Scars and missing or damaged claws combined were nonsignificantly more frequent in males than in females (p = 0.09, Fisher exact test). During the 1970s, data on scars, anomalous scutes, missing or damaged claws and leeches were not recorded consistently, therefore we have not compared the frequencies between periods.

Table 2. The number of anomalous scutes, scars, teethmarks, leeches and damaged claws for males and females in 1995. The values in parentheses represent sample size.

	Anomalous Scutes	Scars	Teethmarks
Males	3(12)	10(13)	6(10)
Females	1(6)	2(6)	2(2)

	Damaged Claws	Leeches
Males	4(12)	4(13)
Females	0(6)	0(5)

The relationship of weight to length is an index to body condition. Two-way ANOVA indicated that neither log CL nor log weight differed between time periods (F = 1.03, p = 0.318 for log CL; F = 0.012, p = 0.914 for log weight), although both log CL and log weight differed significantly between the sexes (F = 21.1, p = 0.000076 for log CL; F = 37.8, p = 0.000001 for weight).

The 1995 sample had lighter body weight relative to carapace length than the 1970s sample (Figure 2). We performed ANCOVA with sex and time period as the

independent variables, log weight as the dependent variable, and log carapace length as the covariate. The influence of sex on weight was significant (p = 0.000031), as was the influence of period on weight (p = 0.00352); the interaction of sex and time period was not significant (p = 0.346).

Table 3. The minimum, maximum, mean and median carapace length and weight for males, females, and juveniles in both time periods. (The weights for many 1970s juvenile turtles were not recorded, and the table is based on the available measurements.)

Sex	Carapace length (mm)		Weight (g)	
	1970s	1995	1970s	1995
Males				
Minimum	104	101	150	155
Maximum	129	145	300	325
Mean	115	125	206	238
Median	112	126	200	230
Females				
Minimum	138	124	400	255
Maximum	148	163	475	550
Mean	143	144	426	393
Median	142	143	402	375
Juveniles				
Minimum	79	74	100	64
Maximum	110	74	175	64
Mean	94	74	126	64
Median	95	74	103	64

Habitat Use

Table 5 shows the distribution of captures (all population classes) by area within North Bay for the two periods. The distribution was significantly different in 1995 than in the 1970s ($X^2 = 4.04$, df = 1, $p < 0.05$). Habitats where we found painted turtles in both periods (IB, IC, Big Pool) had slightly narrower creek widths, and water depths were more shallow than those habitats where turtles were found in the 1970s but not in 1995 (Table 6). The substrate softness was similar in both habitats. No vegetation data were collected in the 1970s. Many of the plants prominent in painted turtle habitat in North Bay are species reported eaten by painted turtles (Ernst et al. 1994).

Table 4. The number of individuals in each size class (mm) for males, females and juveniles in both time periods.

Size Range	MALE		FEMALE		JUVENILE	
	1970s	1995	1970s	1995	1970s	1995
70-89	0	0	0	0	3	1
90-109	9	1	0	0	5	0
110-129	10	6	0	1	1	0
130-149	1	6	9	3	0	0
150-169	0	0	7	2	0	0

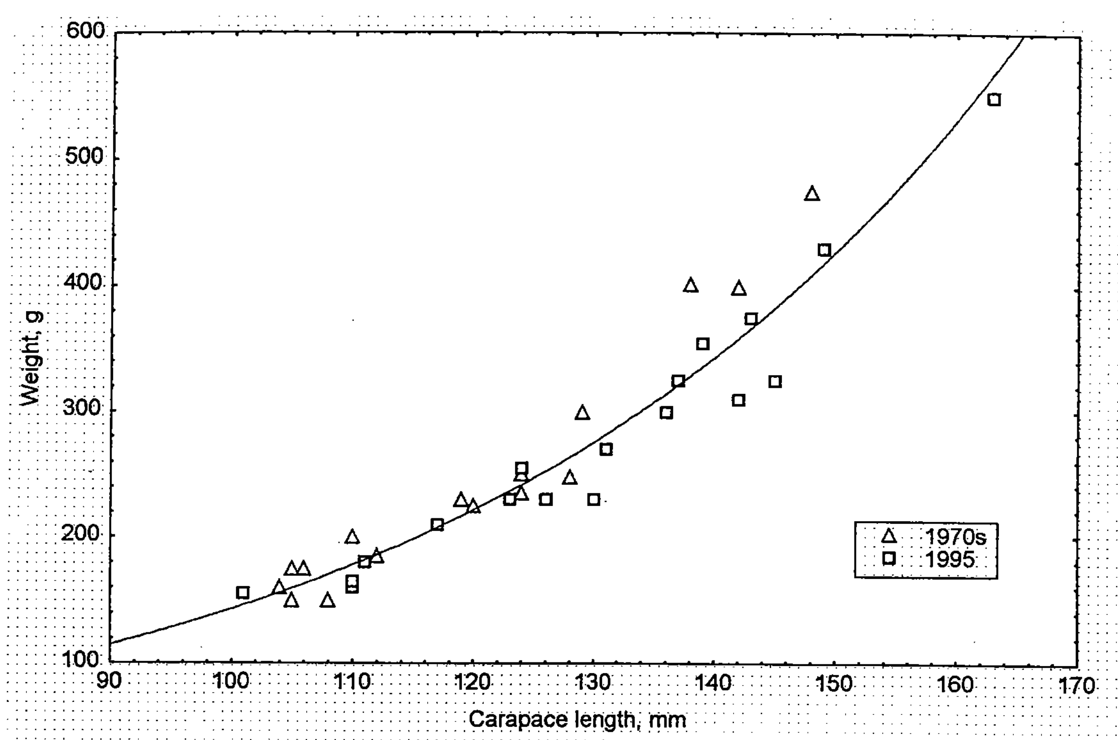


Figure 2. North Bay painted turtle length-weight relationship for both time periods.

Table 5. Capture location of painted turtles in Tivoli North Bay for both time periods.

Location	Year	
	1995	1970s
South Pool	0	15
Big Pool	6	7
Pool I	0	1
IA	0	1
IB	5	4
IC	9	4
ID	0	8
Total	20	40

Table 6. Aquatic plants, channel width, substrate softness and average water depth in channels IB, IC, ID and South Pool (see Figure 1). 0 = absent; 1 = sparse; 2 = medium; 3 = dense

Plant Species	IB	IC	ID*	South Pool
Ceratophyllum demersum	2	3	3	1
Elodea nuttallii & canadensis	1	0	1	3**
Myriophyllum spicatum	2	3	2	1
Najas flexilis	0	3	0	0
Nuphar luteum	0	3	0	1
Pontederia cordata	0	0	0	1
Potamogeton perfoliatus	0	0	1	0
Trapa natans	1	0	0	1
Vallisneria americana	3	3	3	3
Zosterella dubia	1	2	1	2
Sum of plant ranks	10	17	11	13
Average channel width (m)	13	12.7	24	18.7
Average substrate softness (cm)	29.4	17	17	26
Avg. relative bottom elev. (cm)	31	52	-100	6

* Only found along edges of channel
** Only dense in one small section, otherwise sparse

DISCUSSION

Capture Rates and Recapture Rates

Painted turtle capture rates in North Bay are low compared to data from nontidal habitats. For example, a Michigan study had a CPUE of 90 turtles/day (3512 captures in 38 days of field work) (Frazer et al. 1991), and a Pennsylvania study had a CPUE of 180/day (359 in 2 days) (Ernst 1971). Our CPUEs for the two periods were 1/day and 0.71/day. Recapture rates reported in the literature for nontidal habitats vary widely (the data must be interpreted cautiously because a recapture rate represents the interaction of turtle and human factors). Gibbons (1968a) reported 408 recaptures of 258 marked individuals in 2 years; however, Ernst (1971) reported only 9 recaptures of 359 painted turtles. Our recapture rates were 8% and 10%. Although our data are insufficient for direct estimates of population size, the low capture rates indicate a low population density. The low recapture rates could be due to high rates of movement in and out of areas sampled, marking of a small segment of the population, or behavior (e.g., concealment in soft sediments) that makes the turtles hard to find. Riverine populations of painted turtles may have low densities or high turnover rates (e.g., Ernst 1971, MacCulloch and Secoy 1983, Norman 1989). There are no published studies of estuarine populations for comparison.

The lower hunting CPUE in 1995 may be due to less experienced field workers (Rozycki and Edelson); however, we think this was compensated for by the presence of 2 workers compared to 1 worker in 1975, and to the fact that Kiviat's field work in 1975 was focused on snapping turtles probably resulting in a lower CPUE of painted turtles. Rates of immigration and emigration at Tivoli North Bay are unknown, but painted turtles have been seen moving in and out of the Bay under the railroad bridges (Kiviat, personal observations) and there are painted turtles in the supratidal pools and tidal wetlands of Cruger Island (Kiviat, personal observations). Painted turtles could also move through the tidal swamp between North Bay and

South Bay (260 m), and overland between the tidal mouth of Stony Creek and the ponded reach of Stony Creek above Kidd Lane (300 m).

Population Structure

The abundance of juveniles and their apparency varies among painted turtle populations. Ernst (1971) reported a 42:1 adult:juvenile ratio, and Bayless (1975) a 5:1 ratio. These ratios may not be representative of the actual population, but may be a result of the difficulty in finding and catching juveniles (Ernst et al. 1994). Ream and Ream (1966) and Gibbons (1970) have also attributed sex ratio bias to sampling method.

Younger painted turtles occur in shallower waters (Congdon et al. 1992), which probably offer shelter from predation. The regular tidal flooding of North Bay could either expose small juveniles to predation or force them into dense emergent vegetation where they are hard to find. High rates of predation on nests, as was reported by Tinkle et al. (1981), Snow (1982), and Ernst et al. (1994), could result in a smaller proportion of juveniles in the population.

The sex ratio of hand captures should be indicative of the population sex ratio; we can think of no reason why hand capture would be sex-biased. An unequal sex ratio can be caused by predation of female painted turtles during nesting (Erikson and Scudder 1947), increased emigration during nesting (Tinkle et al. 1981), or unusual incubation temperatures (Schwarzkopf and Brooks 1985). A decrease in the proportion of juveniles or females in a turtle population could be an early warning of stress. We do not see clear signs of either problem, but larger samples and more years of observation may be needed to detect changes such as these.

Body Condition

The frequencies of anomalous scutes, scars, and damaged claws can indicate the level of predation, birth defects, or other stresses in a population. We found a higher frequency of scars and injuries in males than in females in 1995. Kiviat (1980) found a higher frequency of damaged claws in larger male snapping turtles in North Bay and attributed this to intermale aggression. Male dominance or territoriality has not been reported in the painted turtle, although aggressive behavior has been observed during basking (Bury et al. 1979, Lovich 1988). Possibly, males in North Bay are differentially vulnerable to snapping turtle predation due to behavior differences between males and females. Presence of mammal (species unknown) teethmarks in 7 of 13 males, and 2 of 6 females indicates a high rate of predation attempts and probably a high rate of successful predation.

The 1995 turtles were lighter relative to CL than the 1970s turtles. A decrease in body weight could result from deterioration of the food supply, increased predation pressure, increased competition, disease, intoxication, or another unfavorable change in the environment. The high frequency of scars suggests predation may be affecting body weight.

Habitat Use

In the 1970s, 15 painted turtles were captured in South Pool and we caught (or saw) none there in 1995. In the 1970s, Kiviat considered South and Big pools to be among the best painted turtle habitats in North Bay. Since then, both of these extensive, predominantly intertidal pools have become shallower due to sediment deposition (Kiviat, personal observations). Reduced habitat volume, vegetation development, or increased accessibility to predators may have reduced painted turtle use of South Pool (South Pool adjoins upland, tidal swamp, and the railroad, and may be more vulnerable to predator intrusion than Big Pool, IB, or IC).

Limiting Factors

Several aspects of our data suggest a population under stress: 1. Low rates of trap and hand capture, and of observations of non-captured turtles, in both periods; 2. Few juveniles observed; 3. Decrease in body weight between periods; and 4. High frequency of scars (mammal teethmarks) in 1995. We believe both natural and anthropogenic stresses are affecting the population, and that stress was the same or greater during the second sampling period. The observed patterns could have been influenced by capture techniques as well as random fluctuations. Tidal fluctuation and soft sediments make field work in estuarine marshes difficult; these factors combined with low population density may explain the paucity of research on turtles (other than the diamondback terrapin) in tidal marshes.

"Natural" factors that could be limiting the North Bay population include predation, habitat, and microclimate. Sheltered, soft-bottom areas that do not drain at low tide provide spring and summer habitat for the painted turtle. This habitat is restricted in North Bay, and two such areas, South Pool and Big Pool, have become smaller due to sediment deposition during the past two decades. Even in the pond-like habitats, submerged and floating-leaved plants have been sparse in both time periods.

There was an explosion in the Hudson Valley raccoon population between the two periods. The raccoon is generally the most important predator of all life stages of the painted turtle (Ernst et al. 1994). The snapping turtle is abundant in North Bay (Kiviat 1980 and personal observations) and is potentially an important predator of juvenile and possibly adult painted turtles.

Temperatures of the sediment surface and shallow water can exceed 40° C in summer (Kiviat 1980). The critical thermal maximum for the painted turtle is ca 40-42° C (Ernst et al. 1994).

Human factors that could affect the painted turtle population include harvest, railroad mortality, and pollution. Everett Nack (personal communication) collected ca 25-50 painted turtles for the pet trade from the north end of North Bay annually from the mid-1950s to ca 1980. Nack perceived a decline in the painted turtle population during that period. This harvest could have affected the population throughout North Bay, and the recovery after cessation of collecting could have been slow. Railroad borders more than half of the perimeter of North Bay. We have no estimates of the numbers of painted turtles that die from being run over or from heat and dessication when trapped between the tracks. The study area is contaminated by PCBs, herbicides, and metals. At least the PCBs are environmental endocrine disruptors and emydid turtles are sensitive to this type of pollutant impact (Bergeron et al. 1994, Palmer and Palmer 1995, Colburn et al. 1996).

Preliminary results from a study of painted turtles in a freshwater tidal marsh on the Patuxent River (Jug Bay Wetlands Sanctuary of the Chesapeake Bay National Estuarine Research Reserve in Maryland) reveal higher catch rates and greater seasonal concentration of turtles (both in the marsh in early spring, and on the nesting grounds) (Chris Swarth et al., unpublished data). We do not yet know to what extent the differences are due to milder climate, lack of PCB pollution, or reduced predation (fewer raccoons and snapping turtles).

In the northeastern United States, female painted turtles can live to 30+ years but lay only 2-10 eggs in a nesting season, and not all females nest each year (Ernst et al. 1994). The long life span and low reproductive rate could make the painted turtle vulnerable to the environmental stresses mentioned and cause population response to lag behind environmental change. In addition to the painted turtle, many larger aquatic or wetland tetrapods that typically frequent northeastern estuaries are absent or rare in the Hudson River (Kiviat, unpublished data). We believe the painted turtle population of Tivoli North Bay offers opportunities for analysis of this mystery.

RECOMMENDATIONS

We recommend that a long term study be initiated on the painted turtle population in Tivoli North Bay. Hunting and trapping procedures should be standardized, especially the number of hunting hours per field day and the number of traps set. More effort should be expended in early spring when catch rates are highest. In addition to a fixed number (5 or more) of standard hoop traps, we suggest that at least 4 additional hoop traps (or fyke nets) with wings be set to intercept turtles across the entire width of a creek or pool. We recommend the use of radiotelemetry, which could provide information on immigration and emigration, habitat use and home range through the year, and locations of nesting sites. We also recommend comparative studies in other northeastern estuaries to see if painted turtle populations have similar characteristics, or if there are differences associated with pollution, latitude, or other environmental factors.

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