

A geographic comparison of diversity among nesting female diamondback terrapins
(*Malaclemys terrapin*) in morphology and reproduction along Long Beach Island and North
Sedge Island, New Jersey

Sarah Moss

Save Barnegat Bay Student Grant Program

August 15, 2014

Abstract:

The estuaries surrounding Barnegat Bay and Long Beach Island are diverse ecosystems that are home to many species, including the diamondback terrapin (*Malaclemys terrapin*). Females prefer to nest in areas of little vegetation and direct sunlight typically associated with disrupted sites or residential areas. The increase in human populations along the New Jersey Shore, especially during the summer months, coincides with terrapin nesting season and may significantly impact the nesting ecology of diamondback terrapins. Nesting ecology varies with geographic location and as such it is important to conduct more studies about local populations in order to better understand the life history traits of the terrapins nesting on the beaches of the New Jersey coast, primarily along Long Beach Island, NJ (LBI) and in the Barnegat Bay Estuary, NJ. This study collected data in the field in LBI in order to analyze nesting female diamondback terrapin body size, nest site location and reproductive output. The 2014 LBI nesting season data collected is compared to that of the 2014 nesting season data on North Sedge Island in the Barnegat Bay Estuary.

Introduction:

Estuaries are important geographical areas where partially enclosed bodies of water, typically rivers, connect to oceans. Many areas surrounding estuaries are extremely ecologically diverse as they are areas of transition between fresh and salt water. These areas are influenced by tides but are sometimes protected by barrier islands (<http://water.epa.gov>). The New Jersey Shore, our primary locus of study, consists of barrier island peninsulas that serve as vacation destinations for thousands of people each year. Long Beach Island is home to over 20,000 year round residents and over 100,000 residents during the summer months (www.visitlbiregion.com). Another well-known recreation site is North Sedge Island. Located in the middle of Barnegat Bay (Figure 1.0), the island is comparatively untouched by humans except for small groups that visit the island for educational or recreational activities. Located in

the Barnegat Bay area Long Beach Island and North Sedge Island are also home to many species, including the diamondback terrapin (*Malaclemys terrapin*). The diamondback terrapin is an estuarine emydid turtle with a geographical range from Massachusetts to the Gulf of Mexico (Feinberg and Burke 2003). Diamondback terrapins are a model estuarine species or good bioindicators of estuarine health as they are the native to estuaries with marsh or wetland ecosystems and may be impacted by anthropomorphic influences (Blanvillain et al. 2007).

The Northern Diamondback terrapin (*Malaclemys terrapin terrapin*) has a lifespan of 20 to 40 years. Males become reproductively mature at approximately five years of age, and females range between eight to ten years of age (Burger 1977). Mating and nesting season take place between May and early August. Females prefer to nest in areas of little vegetation and direct sunlight typically associated with disrupted sites or residential areas (Kolbe and Janzen 2002). Clutch sizes, or how many eggs are laid by a female, are between 4 to 20 eggs. Past studies have examined nesting ecology and nesting components such as site selection and fidelity and reproductive output in terms of clutch size (Burger 1977; Gibbons et al. 2001; Roosenburg 1996; Roosenburg and Dunham 1997; Roosenburg and Kelley 1996). There is little documentation of nesting habits and reproductive outputs of terrapins in New Jersey and none along LBI. Today, nesting females face many human threats such as habitat fragmentation or destruction and road traffic (Joyal et al. 2001; Szerlag and McRobert 2007). Females are also commonly displaced by development and boat or kayak traffic. The increase in human activity along the New Jersey Shore, notably during the summer months of the terrapin nesting season, may significantly impact the nesting ecology of diamondback terrapins. Nesting ecology varies with geographic location, and as such it is important to conduct more studies about local populations in comparison with other near-by studies in order to better understand the life history traits of terrapins nesting on LBI. These studies are used to create and develop site appropriate

conservation plans (Burger 1976). This study used data collected in the field throughout Long Island Beach and North Sedge Island, NJ to analyze nesting female diamondback terrapins.

Methods:

Data collection for the Barnegat Bay Student Research Program took place from late May through August 1st on the northern section of Long Beach Island (Figure 2.0) and North Sedge Island (Figure 3.0). Data was recorded on a standardized data sheets and entered weekly into an Excel spreadsheet for analysis. Relocation of clutches was conducted according to the permits awarded to the Terrapin Nesting Project. The handling of turtles was in accordance of the permits allocated to Dr. Wnek by the NJ Division of Fish and Wildlife. Upon encountering nesting females, each was identified using a pre-established notch code and Passive Integrated Transponder (PIT) tag reader (125 and 134 Hz). This study followed the protocol described by Wnek (2010) and when no PIT tag was located the female turtle was then tagged in accordance with the protocol set by Buhlmann and Tuberville (1998). Morphometric measurements followed the protocol described by Wnek (2010). A tree caliper (40 cm) was used to determine carapace and plastron width and length. A balance (2000 g +/- 1 g) was used to establish the weight of the nesting female. Soil type descriptions followed the protocol set by Wnek (2010). Every known site where a female has nested was recorded using a global positioning system (GPS) device. When relocating a nest, the number of eggs was recorded. Clutch relocation was designed to follow the protocol of the Terrapin Nesting Project 2013. Each relocated nest was labeled by date, approximate time laid, and turtle identification number. Statistical analysis to identify nesting patterns along LBI was completed using the software SPSS. To compare nesting female body size to weight, a one-way ANOVA was used. To compare clutch sizes of LBI to North Sedge Island, a two sample t-test was used.



Figure 1.0 A map of Barnegat Bay.



Figure 2.0 A map of Long Beach Island, NJ. The yellow indicate the hatcheries of the Terrapin Nesting Project.



Figure 3.0 A map of Sedge Island, NJ.

Results:

The 2014 LBI nesting season was one of the most active nesting seasons recorded to date. The northern end of LBI had a total of 109 female sightings. There were 36 previously tagged females, two of which returned more than once (Table 1.0). There were 73 new tagged females, five of which were sighted twice (Table 2.0). The most common nesting sites on LBI and North Sedge Island were where the nesting turtles had direct access to land (Figures 4.0 & 5.0). In

order to assess growth of terrapin, this study compared weight to the straight-carapace length of individuals. The results revealed a positive ($P < 0.0001$) significant correlation (Figure 6.0). For North Sedge Island, the 2014 nesting season resulted in 74 captured female terrapins. Data has been recorded on Sedge Island since 2002; as a result, Sedge Island had many more previously tagged turtles than LBI, and only six newly tagged females (Table 3.0).

<u>Individual</u>	<u>Sighting 1</u>	<u>Sighting 2</u>	<u>Sighting 3</u>
KNOWX	6/10	6/23	7/15
AKM	6/26	7/11	-

Table 1.0 Previously identified returning females on LBI.

<u>Individual</u>	<u>Sighting 1</u>	<u>Sighting 2</u>
ALMP	6/10	7/11
ALMX	6/10	6/30
BCLM	6/12	6/17
HJLM	6/17	7/9
BJKV	6/26	7/11
LMOW	6/27	7/15

Table 2.0 Newly identified returning females on LBI.



Figure 4.0 Nesting sites along the northern end of LBI indicated in blue.

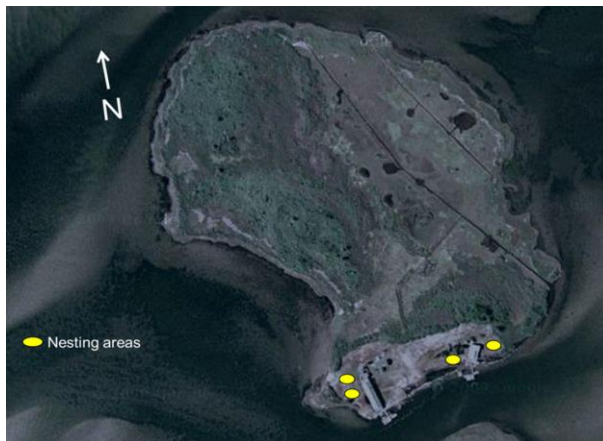


Figure 5.0. Nesting sites along North Sedge Island indicated in yellow.

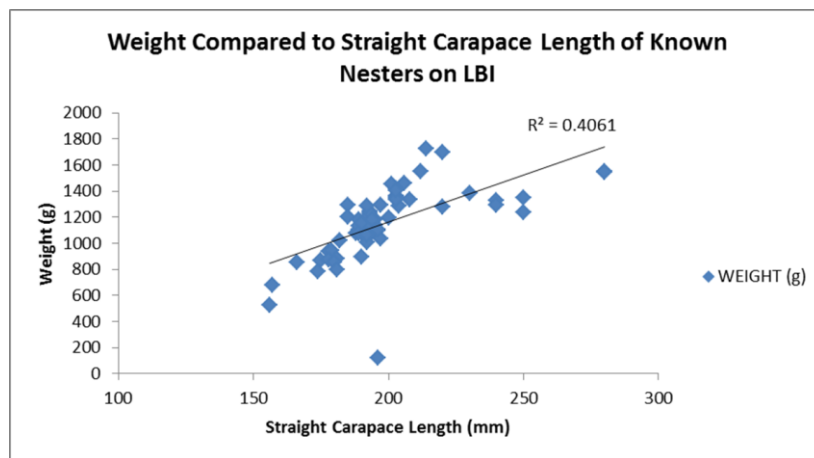


Figure 6.0 Weight compared to Straight Carapace Length on LBI, NJ.

	Total Individuals	Previously tagged	Newly tagged	Mean SCL (mm)	Mean Clutch Size
LBI	109	36	73	197.2	12.9
Sedge	74	68	6	196.0	12.6

Table 3.0 The 2014 nesting season summary of LBI and Sedge Island, NJ.

Discussion:

The New Jersey Shore during the summer months is a very popular vacation spot to many U.S. residents, as well as international tourists (www.VisitNJ.org). This study’s results show that the 2014 nesting season on LBI was the most active to date. This positive trend may a result of the increased amount of public outreach and education. Signs were posted throughout LBI in public places and local businesses to educate the human population about the terrapin one. An exhibit highlighting diamondback terrapins was placed in the Barnegat Light House State Park Visitor’s Center. The study’s research efforts were augmented by observations of

local residents and vacationing pedestrians, many of whom observed a turtle while walking or bike riding. While the most common nesting sites on LBI and North Sedge Island were where the nesting turtles had direct access to land (Figures 4.0 & 5.0), nesting females did not typically nest where there was a high volume of boat traffic or kayak launching and landing. This indicates that the nesting females prefer to nest in areas where there is limited human activity. In many instances on LBI, females came up private boat ramps in residential areas. Most commonly many turtles happened to come to land to nest in areas with a high volume of pedestrian traffic. We assume that the typically high and thick brush blocked the view of main pedestrian roadways to turtles and therefore the nesting females were unaware of human activity. The high volume of people may have aided in the increased number of reported sightings. Further conservation efforts are needed in these areas to educate the public to report sightings and to prevent road mortality. Although there were an increased number of reported sightings, there were many times where people had observed a turtle but did not call to report the turtle. In addition, there were a handful of incidences when an unidentified nesting female was located, but the research team was unable to mark the individual.

One of the main aspects of the team's research was to assess the overall health of the diamondback terrapin population on LBI. A positive correlation between weight and length may be used as an indication of health and growth of nesting females. When conducting this comparison there was a significant correlation between length and weight ($P < 0.0001$). This indicates that the longer the individual the more they will weigh which is typical in healthy populations (Figure 6.0). Long Beach Island is approximately 2 miles south of North Sedge Island. When comparing the clutch size of LBI to North Sedge Island the resulting P value was less than 0.05 indicating that clutch sizes are not significantly different. Therefore it is possible that the turtles nesting on LBI are similar to those nesting on North Sedge Island.

Finally, we are continuing to strongly publicize our recommendations in order to minimize impacts to terrapins. During nesting season females typically will not come to shore if there are significant disturbances such as people or boats. Although it is unlikely that sensitive nesting beaches will close to the public during the summer months, limiting boat traffic and kayak launching around sensitive nesting areas will allow for more suitable nesting area to become available. Another issue discovered is that it is common practice for people to leave crab traps submerged for long periods of time. While the traps are submerged, terrapins may enter the traps to feed on bait and are unable to escape, leading to drowning (Roosenburg & Green, 2000). The use By-catch Reduction Devices when crabbing will reduce the amount of terrapins caught in traps. Our most impactful recommendation is that residents on LBI near high density nesting areas convert a section of their yards to sand. On LBI, many homes have a clay substrate or weed filter paper covered in stones used for landscaping. These common landscaping techniques greatly inhibit terrapin nesting. Terrapins may attempt to nest several times before selecting a nest site location (Burger 1977; Standing et al. 1999). If common landscaping techniques are used, the females must increase their nesting attempts and become stressed. The reduction or elimination of these landscaping techniques will allow more areas for the terrapins to nest as there are no protected beaches on LBI. Overall, this study highlighted the barriers faced by terrapins seeking to nest on Long Beach Island and North Sedge Island, and provides some understanding of simple activities that can be undertaken by the local community to improve the improve the long term viability of the New Jersey terrapin population.

Literature Cited

- Blanvillain, G., Schwenter, J. A., Day, R. D., Point, D., Christopher, S. J., Roumillat, W. A., and Owens, D. W. (2007). Diamondback terrapins, *Malaclemys terrapin*, as a sentinel species for monitoring mercury pollution of estuarine systems in South Carolina and Georgia, USA. *Environmental toxicology and chemistry*, 26(7), 1441-1450.
- Buhlmann, K.A. and Tuberville, T.D. 1998. Use of passive integrated transponder (PIT) tags for making small freshwater turtles. *Chelonian Conservation and Biology* 3(1): 102-104.
- Burger, J. 1976. Behavior of hatchling diamondback terrapins (*Malaclemys terrapin*) in the field. *Copeia* 4: 742-748.
- Burger, J. 1977. Determinants of hatching success in diamondback terrapin, *Malaclemys terrapin*. *American Midland Naturalist* 444-464.
- Feinberg, J. A., and Burke, R. L. (2003). Nesting ecology and predation of diamondback terrapins, *Malaclemys terrapin*, at Gateway National Recreation Area, New York. *Journal of Herpetology* 37(3), 517-526.
- Gibbons, J.W., Lovich, J.E., Tucker, A.D., FitzSimmons, N.N, and Greene, J.L. 2001. Demographic and ecological factors affecting conservation and management of the diamondback terrapin (*Malaclemys terrapin*) in South Carolina. *Chelonian Conservation and Biology* 4(1): 66-74.
- Joyal, L.A., McCollough, M., and Hunter, M.I. Jr. 2001. Landscape ecology approaches to wetlands species conservation: a case study of two turtle species in southern Maine. *Conservation Biology* 15:1775-1762.
- Roosenburg, W.M. 1996. Maternal conditions and nest site choice: an alternative for the maintenance of environmental sex determination? *American Zoologist* 36:157-168.
- Roosenburg, W.M. and K.C. Kelley. 1996. The effect of egg size and incubation temperature on growth in the turtles, *Malaclemys terrapin*. *Journal of Herpetology* 30: 198-204.
- Roosenburg, W. M., and Dunham, A. E. 1997. Allocation of reproductive output: egg-and clutch-size variation in the diamondback terrapin. *Copeia* 290-297.
- Roosenburg, W. M., & Green, J. P. (2000). Impact of a bycatch reduction device on diamondback terrapin and blue crab capture in crab pots. *Ecological Applications* 10(3): 882-889.
- Sierra Club. 2014. Terrapin Nesting Project. Retrieved from <http://content.sierraclub.org/grassrootsnetwork/teams/terrapin-nesting-project-0>
- Southern Ocean County Chamber of Commerce, Inc. (2014). Long Beach Island Region NJ. Retrieved from <http://www.visitlbiregion.com/>
- Standing K.L, Herman, T.B., and Morrison, I.P. 1999. Nesting ecology of Blanding's turtle

(*Emydoidea blandingii*) in Nova Scotia, the northeastern limit of the species' range. Canadian Journal of Zoology 77 (10):1609-1614.

State of New Jersey Division of Travel and Tourism, www.VisitNJ.org

United States Environmental Protection Agency. (March 06, 2012). Water: Estuaries and Coastal Watersheds. Retrieved from <http://water.epa.gov/type/oceb/nep/about.cfm>

Wnek, J. P. 2010. Anthropogenic impacts on the reproductive ecology of the diamondback terrapin, *Malaclemys terrapin* (Doctoral dissertation, Drexel University).

Conservation Recommendations

This study highlighted the barriers faced by terrapins seeking to nest on Long Beach Island and North Sedge Island, and provides some understanding of simple activities that can be undertaken by the local community to improve the long term viability of the New Jersey terrapin population. Most of our recommendations are easily implemented and inexpensive. Our first recommendation is the use of By-Catch Reduction Devices (BRDs) on commercial-style crab pots to reduce terrapin mortality. Another recommendation is to seasonally close terrapin nesting areas or at least minimize boat and kayak traffic along shoreline areas where nesting female terrapins access nest sites. Our most impactful recommendation is that residents on LBI near high density nesting areas convert a section of their yards to sand 18” deep and remove filter fabric that can prevent terrapins from nesting.