Proceedings of the 13th Biennial Coastal Zone Conference
Baltimore, MD
July 13–17, 2003

DIAMONDBACK TERRAPIN NESTING ON THE POPLAR ISLAND ENVIRONMENTAL RESTORATION PROJECT

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Keywords: Nesting, habitat restoration, Poplar Island, diamondback terrapin, *Malaclemys terrapin*

INTRODUCTION

Environmental restoration manipulates degraded habitats with the goal of reestablishing ecosystem form and function in the target area. Effective restoration requires rebuilding both physical and biotic components of the landscape that are essential to ecosystem process. Included in coastal zone restoration is the consideration of species that must cross the land water interface to successfully complete their life cycle. Examples include many marine mammals that calve on shore, shore birds that feed at the interface and aquatic turtles that come ashore to nest in areas free from inundation. One such species is the diamondback terrapin, an estuarine turtle found in the coastal regions of the gulf and eastern United States.

The Poplar Island Project is a unique opportunity to understand how large scale ecological restoration projects affect turtle populations. We initiated a long-term monitoring program to track the response of a terrapin population to the Poplar restoration project. We can learn how creating new nesting and juvenile habitat will affect terrapin populations. Furthermore we can contribute to understanding the ecological impact of Poplar Island and other large scale restoration projects on turtle populations.

BACKGROUND

Poplar Island is a large scale ecological restoration project that uses dredged material to reconstruct an eroded island in Middle Chesapeake Bay. One hundred years ago the island consisted of more than 400 hectares of upland and wetland habitats. During the past 100 years the island has eroded and only three small (<4 hectares) islands remained. The Army Corps of Engineers has built a stone-covered dike perimeter that will be filled with dredged material from the Baltimore Harbor approach to rebuild the island. The goal is to restore the habitat and its associated wildlife that existed on Poplar Island.

One species targeted in the restoration project is the diamondback terrapin, *Malaclemys terrapin.* These emydid turtles inhabit the Poplar Island archipelago. However, the persistent erosion has greatly reduced the nesting and juvenile habitat. Thus, the local terrapin population may be below their former levels. By rebuilding the island and providing nesting and juvenile habitat, terrapin populations in the islands my increase as more habitat becomes available. Terrapin nesting habitat includes accessible sandy areas above the mean high tide. Juvenile habitat includes salt flats and fringe marsh common along the Chesapeake shoreline.

As with many of the species that inhabit Poplar Island, terrapins began nesting on the island prior to completion of the restoration. We initiated our study by surveying potential nesting areas for terrapin nesting activity and following these nests throughout development to monitor the hatching success and hatchling quality.

METHODS

We surveyed potential nesting areas on Poplar Island daily to locate terrapin nests shortly after oviposition. Global position systems (GPS) identified the location of each nest. Surveys began on June 4th and continued until July 31st when the last terrapin nest was discovered. After 50 days, each of the know nests were surrounded with a 0.5-0.75 m diameter 20 cm aluminum flashing. After surrounding each nest, they were checked several times daily for emerging hatchlings. Because surveys for nests were initiated well after the start of the nesting season, we constructed a drift fence to catch hatchlings from unobserved nests, particularly those hatchlings that were likely to end up in areas still under construction. We measured carapace length, plastron length, maximum height and width (± 0.1 mm), and mass (± 0.01 g) of all hatchlings. We gave all hatchlings a cohort mark by notching the marginal scutes and we injected each with coded a wire tag for individual identification. We released hatchlings in newly created wetlands near the beaches where they hatched.

After ten or more days when the last hatchling emerged, we excavated the nest and counted all unhatched eggs. We documented eggs that did not complete development and hatchlings that did not emerge successfully. Occasionally, we discovered remaining hatchlings which were removed from the nest and counted as successful individuals. In late October, we excavated remaining nests that had produced hatchlings and determined the fate of remaining eggs. We left intact nests that had not produced hatchlings to prevent over-wintering hatchlings from emerging prematurely.

RESULTS

During 2002, we discovered 68 terrapin nests in two main nesting areas on Poplar Island (figure 1). Nesting occurred in areas where the retaining dike was made of sand or accretion had created large sandy areas. The major nesting area was opposite Coaches Island (figure 1). There were two likely reasons for the high levels of nesting activity here. First, the retaining dike is made of sand without rock reinforcement and terrapins could see and easily access suitable nesting habitat. We found no indications of nesting along areas of the shoreline where rock reinforcement prevented terrapins from accessing suitable nesting areas on the island. Second, the shoreline of Coaches Island opposite Poplar appears to be excellent terrapin nesting habitat, although we did not conduct any surveys on Coaches Island to confirm nesting there. Terrapins may have been familiar with the nesting areas on Coaches Island and then been drawn to Poplar because of the easy access and sandy shores.

Figure 1. Locations of terrapins nests (yellow dots)on Poplar Island. The northern end of the island is not shown because no nests were found there. Data include all nest discovered during the Summer and Autumn of 2002.

The second nesting area was a sandy shore that had formed via natural sand accretion against the stone retaining wall on the eastern shore of the island (figure 1). In this area there was a high level of terrestrial activity by terrapins, however nests were difficult to locate in the small sandy areas between rocks. One additional nest was discovered at the western side of the island (figure 1).

Fifty nests were discovered shortly after oviposition that were used to evaluate nest survivorship. Of the 50 nests, 40 produced hatchlings, 2 produced no hatchlings and 8 remained and were suspected to contain overwintering hatchlings. Of the 42 nests that emerged or were excavated, 95% produced hatchlings. Thirty nests were sufficiently studied to present data of egg survivorship. We documented 305 hatchlings and evidence of 24 undeveloped eggs or dead hatchlings from the 30 nests. These data suggest that the average clutch size was 10.97 eggs per clutch and that eggs had a mean hatching success rate of 92.7% with several nests having apparent 100% survivorship.

We captured 565 hatchlings on Poplar Island between August 1 and 12 October 2002. Ringed nests produced 323 hatchlings, 222 were caught by the drift fence and 20 hatchlings were caught by hand or were discovered in nests that were identified by emerging hatchlings. We located 18 nests by the emergence of hatchlings. This was possible at Poplar Island because the emerging hatchlings left a distinct tracks that led to a depression or an actual hole which erodes quickly on the sand beaches where terrapins usually nest.

Hatchlings had a mean plastron length of 27.7 mm (S.D. 1.57), mean carapace length of 31.3 mm (S.D. 1.61), mean carapace width of 16,5 mm (S.D. 1.53) and a mean carapace height of 16.5 mm (S.D. 1.12). The mean mass of hatchlings was 7.52 g (S.D. 0.96). One hundred and nineteen hatchlings (21%) had shell scute pattern anomalies. The scute anomalies included extra marginal, vertebral, pleural and plastron scutes.

CONCLUSIONS

Portions of Poplar Island are excellent terrapin nesting habitat. This is supported by the large number of nests, high nest survivorship, and the high hatching rate during 2002. Nests survivorship was much higher than normal because of the lack of nest predators on the island. Raccoons, foxes, and otters are known terrapin nest predators, sometimes depredating 95% of the nests (Roosenburg, 1994). Additionally, the lack of raccoons on Poplar minimized the risk to nesting females that also may be depredated by raccoons (Seigel, 1980, Roosenburg personal observation). Thus, the project is successfully creating terrapin nesting habitat.

Nesting was restricted areas where terrapins could access nesting sites. The stone dike around Poplar is a barrier that prevents terrapins from accessing many potential nesting sites. As wetland cells are completed and the exterior dike breached to provide water flow, terrapins are likely to enter the cells and begin nesting on mid-level portions with suitable habitat. During 2002, nesting sites could only be accessed by traversing dikes without rock. Because of the incomplete construction and below water elevation of many cells, most of the nesting occurred on or in close proximity to the dikes (figures 1).

Because of the high nest survivorship, there was strong recruitment. Hatching success was comparable to nearby terrapin nests that had survived predators (Roosenburg, 1992). We based hatching success on estimates of clutch size determined at the time of hatchling emergence. A more accurate determination of hatching success and clutch size could have been obtained by excavating nests and counting eggs immediately after oviposition and comparing these values with the number of hatchlings from the nest. We estimated clutch size on Poplar at 11 eggs which is less than the mean of 13 eggs observed in the Patuxent River of Maryland (Roosenburg and Dunham, 1997). Additionally, clutch size may have been lower on Poplar because of the greater potential for disturbance of nesting females. Heavy equipment using dike roads during construction may have disturbed females while nesting, resulting in incomplete nests. We encountered several apparently incomplete nests with less than 5 eggs.

One interesting aspect of terrapin nesting on Poplar Island was the rate of nest overwintering. As of 31 October, 8 (16%) nests had not emerged suggesting that the hatchlings will overwinter in the nest and emerge in the following spring. Little is know about terrapin overwintering and the how it affects nest survivorship. Most terrapin nesting areas are sandy strips close to the water and high spring tides force hatchlings to emerge in the Autumn (Roosenburg, unpublished). Overwintering in the nest can occur for two reasons. First, many nests produced during July do not complete development until late September. All nests overwintering on Poplar were laid after the July 1. Second, substrates of inland sites, including Poplar, typically have a lower sand content and are harder and more compact. The compact soil makes it more difficult for the hatchlings to dig and they may not be able to emerge before cooler Autumn temperatures cause overwintering.

Poplar Island hatchlings were similar in size and mass to those captured in the Patuxent River in Maryland (Roosenburg, unpublished). The 21% frequency of shell scute anomalies on the hatchlings was higher than expected. The frequency of shell anomalies on Poplar was most likely due to warmer incubation temperatures. The summer of 2002 was one of the warmest summers on record, particularly during July and August when most embryos developed. Second, there was little vegetation on Poplar that could provide shaded, cooler incubation environments (Jeyasuria et al., 1994). Warmer incubation temperatures previously have been shown to cause higher frequencies of shell anomalies in terrapins (Herlands et al, 2003). Although shell anomalies have been associated with higher incubation temperatures there is no evidence to suggest that shell anomalies have detrimental effects in terrapins or other turtles.

The initial success of terrapin use of Poplar Island indicates that similar projects may create terrapin nesting habitat. One of the major factors threatening terrapin populations throughout their range is the loss of nesting habitat to development and shoreline stabilization (Roosenburg, 1991; Siegel and Gibbons, 1995). Projects such as Poplar Island that combine the beneficial use of dredged material and ecological restoration have the potential to create habitat similar to what has been lost to erosion and human practices. With proper management, areas such as Poplar Island may become areas of concentration for terrapins and thus provide a source population for the terrapin recovery through out the Bay.

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