

Secretive Marsh Sparrows: Understanding Nest Site Selection and Risk to Population on Ring Island

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Saltmarsh (*Ammodramus caudacutus*) and Seaside Sparrows (*Ammodramus maritimus*) have experienced population declines in recent years with higher rates of coastal land loss and increased flooding. There are limited data on local nest site selection and nest success for these secretive species but this information is necessary for restoration and conservation plans. Point counts and nest surveys were conducted on Ring Island between June 25-July 17, 2019 to locate and characterize nest sites and territories. Nest characteristics included species, GPS location, nest height, vegetation composition, elevation, and distance from water. The study area was found to support over 10 pairs of Seaside Sparrows and at least one pair of Saltmarsh Sparrows. Active nests were checked weekly to investigate nest success but all monitored nests failed when tides reached over 1.56 m. The majority of nests (83%) were found within 15 m of the water, at elevations 0.59-1.12 m, and all were less than 15 cm off the ground. Nest sites had higher percent cover of >18 cm *Spartina alterniflora* compared to control sites ($P=0.56$) but no differences were detected for elevations between sites ($P=0.89$). Results from this study indicate that sparrows are limited by the amount of suitable nesting habitat on the island in areas where the nest is less prone to flooding. Further investigation is needed to supplement results from this study to better understand the nesting requirements and limiting factors for these species within this region.

Factors affecting spatial and temporal trends in diamondback terrapin (*Malaclemys terrapin*) road crossings

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Diamondback terrapins are the only North America species of turtle to live their entire life in the salt marsh. During the nesting season, females must leave the salt marsh to find high ground to lay their eggs. This study aimed to find whether tide, time of day, creek distance from the road, or presence of a barrier fence were associated with when and where terrapins crossed Stone Harbor Boulevard. For this study data were collected from 2017-2019 by driving Stone Harbor Boulevard five times a day, during the nesting season, to search for dead and alive terrapins. The time, date and location of all terrapins were recorded when found. Using ArcGIS, spatial and temporal analyses identified a large hotspot of activity in front of the Wetlands Institute, due mainly to live encounters. Increased activity was found during, falling and rising tides, between 8-10 am ($p < 0.01$). Inconclusive results were found on the effect of barrier fencing on crossing locations along Stone Harbor Boulevard and no significant correlation was seen between creek distance from road and crossing frequency. Going forward continuous stretches of fence may prove more effective than fragmented sections and adding another road patrol to the day when falling and rising tides are at times of day when terrapins are most active.

Factors Impacting Nest Survival of a Common Tern (*Sterna hirundo*) Nesting Habitat

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Human development and sea level rise have placed added pressure on coastal nesting birds as their nesting habitat is being restricted to smaller areas. Common Terns are a species of special concern in the state of New Jersey due to being at risk from this habitat loss. To help offset this loss, an elevated

nesting habitat was constructed on Ring Island for use by numerous coastal nesting birds. These man-made habitats are increasing in importance and proper management will allow for greater nesting success. To better understand the factors that influence nest survival rates at the Ring Island site, a study comparing predation, elevation, vegetation and nest density in a colony of nesting terns was completed. Longevity of 115 nests in 2019 was compared throughout 6 transects with a diverse range of conditions. Predation levels were higher in 2019 than 2018 and added predation pressure caused significant nest loss that increased throughout the season. Differing nest site conditions had varying effects on how protected nests were from predators. Vegetation growth also exceeded previous levels. A significant relationship between immediate area vegetation cover and survival length of nests was found ($p=.0019$) with more cover associated with a longer survival length. Extended area vegetation did not have a significant relationship with survival length ($p=.0631$). Average distance to 5 nearest neighbors also did not have a significant relationship with survival length ($p=.5652$).

Examining Diamondback Terrapin (*Malaclemys terrapin*) Use of Salt Pannes

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Salt pannes are depressions of mud in a salt marsh that are devoid of vegetation and can be flooded with water or evaporated depending on tide and time of year. Salt pannes are scattered throughout the marsh, creating pockets of abundant life. These pockets of water, food, and shelter may serve as safe havens for diamondback terrapins as they are also free of predators, boats, and crab traps. They may be key areas for female terrapins during travels from distant creek homelands to nesting sites. The objectives of this initial study were to determine if *Malaclemys terrapin* were present in pannes (N=4) at The Wetlands Institute and explore trends among terrapins using these pannes. I conducted head-count surveys each morning and afternoon and used hoop and dip nets to capture terrapins. Air temperature, water temperature, weather, and salinity were also recorded. Captured terrapins were sexed, approximately aged, and palpated to determine gravidity. Terrapins were documented in all pannes, though the probability of presence varied among pannes ($p<0.001$). Temperature, weather, and salinity were not significant indicators of terrapin presence ($p>0.05$). One factor that significantly affected terrapin presence ($p<0.001$) was date, with presence decreasing as the nesting season ended. Similarly, adult gravid females were the majority in all pannes. A recommendation for future studies is to start just before nesting season begins. This should give a clearer view on the significance of nesting to panne presence, while also providing a larger sample size of terrapins.

Diamondback terrapin nesting mound usage and barrier fence effectiveness

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The northern diamondback terrapin (*Malaclemys terrapin terrapin*) is facing population destabilization, due in part to additive mortality from roadways. Artificial nesting mounds and barrier fencing can encourage females to nest without facing danger from roadways. Both conservation strategies were employed at a site in Avalon, NJ known as a hotspot for terrapin activity. To learn if terrapins were successfully using a newly constructed nesting mound, and if nests were being predated, five Moultrie camera traps were placed onsite from June 19 to July 14. The corrugated tubing barrier fence used in Avalon and surrounding areas was tested against a flexible plastic barrier material, Animex, in 10-minute escape trials. Detections indicated that terrapins were accessing and nesting on the mound (N), though

predators and disturbances were also detected. Relative abundance index was calculated for species seen on the mound, showing that humans and terrapins were the most abundant species present at the site. Chi square analysis of terrapin behavior revealed that despite human disturbance, terrapins were choosing to utilize the mound. Analysis of arena trial escape attempts did not find a clear difference in effectiveness, but found that the individual terrapins used in each trial, as well as the order in which the trials took place did have an effect. Nesting mounds can be effective conservation tools to prevent a high density of terrapin nests, but they must be maintained properly. While no clear difference in effectiveness was found between barrier fence materials, Animex was more expensive than the corrugated tubing and harder to install, but may be harder to climb over or under.

Predicting water level and temperature of the wetlands and possible implications for Diamondback Terrapins (*Malaclemys terrapin*)

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The wetlands provide ecological stability, protecting coastal communities from storm surges and flooding and serving as home to unique species such as diamondback terrapins. Greenhouse gases such as CO₂, CH₄, and N₂O are released into the atmosphere from anthropogenic fossil fuel use at a higher rate than ever before. This increase in greenhouse gases is leading to warmer atmospheric temperatures, rising sea levels, and increased flooding. As the sea levels and water temperature continue to rise, diamondback terrapins and other wetland organisms are being exposed to more extreme conditions. To understand changing conditions in the marsh and potential implications for juvenile terrapins, I conducted interpolation analysis by creating a heat map of maximum weekly water temperature and water level data collected July – October 2017 and 2018 at four wells on The Wetlands Institute property. Conditions varied within and between years (all $p < 0.01$), with weeks 2, 4, 5, 7, 8, 11, 12, and 13 having significantly different water levels. There was a strong correlation of high water levels and new/full moon occurrences. Weeks 11 and 12 had significantly different water temperatures between 2017 and 2018, where 2018 was hotter than 2017. My findings indicate that high water temperatures occur farthest from Scotch Bonnet Creek while high water levels occur closest to Scotch Bonnet Creek. The distribution of radio-tracked terrapins did not vary significantly by water temperature ($\chi^2 = 2.23$, $p = 0.69$) or water level ($\chi^2 = 3.20$, $p = 0.53$), however they tended to be found in warmer, shallow water.