SEA TURTLE NESTING ACTIVITY ON MASONBORO ISLAND, NORTH CAROLINA
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Final Report to North Carolina National Estuarine Research Reserve

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INTRODUCTION

Masonboro Island is a 13 km barrier island located approximately 9 km southeast of Wilmington, North Carolina. The island is separated from Wrightsville Beach to the north by the Masonboro Inlet and from Carolina Beach to the south by the Carolina Beach Inlet. Although this region of the southeastern coast of North Carolina is a popular tourist destination and communities in this area are growing rapidly, Masonboro Island is currently undeveloped and protected as a part of the federal National Estuarine Research Reserve System (National Oceanic and Atmospheric Administration).

During the late spring and summer, loggerhead sea turtles (*Caretta caretta*) come ashore on Masonboro Island to lay eggs. Surveys of sea turtle nesting activity at Masonboro Island were conducted from 1999 to 2001, and again from 2006 - 2008. During the 1999-2001 monitoring period, an ATV was used to patrol the entire length of the island daily from May through August, and an annual average of 22.0 ± 6.9 nests was documented (Piatkowski, 2002). During the 2006-2008 monitoring period, only the northern 6.5 km of beach were monitored by foot patrols daily during the summer nesting season. An annual average of 20.6 ± 5.1 (range 15 - 25) nests was recorded for the northern portion of the island during this period (Southwood et al., unpublished data). Wrightsville Beach to the north and Carolina Beach to the south typically have less than one-third the number of nests documented at Masonboro Island in a given year (Fahey and Busovne, personal communication). Reduced artificial lighting and limited human activity may make Masonboro Island a preferred nesting site for sea turtles along this relatively populated section of coastline.

Given the importance of Masonboro Island for regional sea turtle nesting activity, continued monitoring and protection of beach habitat at this site is a conservation and management priority. This report documents our efforts to monitor sea turtle nesting activity and hatching success at Masonboro Island during the 2009 nesting season.

MATERIALS AND METHODS

Two survey coordinators, Ms. Jessica Snoddy and Mr. Tim Burns, were hired to organize volunteers and conduct daily patrols of the northern half of Masonboro Island during the 2009 nesting season. We had seven UNCW undergraduate students, seven UNCW graduate students, two UNCW employees, and eleven community volunteers assist with beach patrols; 352 volunteer hours were contributed towards completion of this project (Table 1). We used a 16-foot jon boat to transport volunteers and supplies from the Wrightsville Beach Boat Ramp to Masonboro Island for daily beach patrols at sunrise, weather permitting. Patrols typically took 2

to 4 hours to complete. The GPS locations of nests and false crawls observed during each patrol were recorded, and all nests were marked with wooden stakes, flags, and a sign that designated a turtle nest was present at the site. Three stakes were used to mark a nest, one stake 5 m directly behind the center of the nest, and a stake on either side of the first stake, 6 m from the center of the nest at an angle. Figure 1 is a photograph detailing the staking procedure used. If a camera was available, pictures were taken of the tracks and body pit.

Previous surveys have shown a high level of fox predation on nests at Masonboro Island. In 2008 we initiated a study to assess the efficacy of wire box cages and flat plastic screens in preventing fox predation, and we elected to continue this work during the 2009 season. Box-cages were constructed of metal wire with a mesh size of 5cm x 10cm and had dimensions of 57cm width x 79cm length x 40cm height. One of the nests laid during the 2009 season was protected using a wire box cage buried to a depth of 29 – 36cm around the nest chamber (Fig. 2). Two nests were protected using flat plastic screens with dimensions of 350cm x 350cm and mesh size of 5cm x 10cm. Screens were laid flat over the nest, covered with 10 – 15cm of sand, and secured with plastic stakes (Fig. 2). Three nests had been completely depredated by the time of discovery, and therefore no protection measures were taken.

Thermochron i-Button data loggers (Maxim Integrated Products, Sunnyvale, CA) were buried adjacent to two nests (nest #2 and nest #3). Instruments were buried within 40 cm of the center of nest and at a depth of approximately 30 cm. These instruments recorded temperature every 30 minutes over the course of the entire incubation period. Actual nest temperatures may be slightly higher than temperatures recorded by the temperature data loggers due to metabolic heat production of developing hatchlings, particularly during the last third of incubation. Discrepancies will be taken into account during data analyses and interpretation.

Our survey of nesting activity on Masonboro Island began on May 29th, 2009 and our last day of beach patrol was on November 21st, 2009. During this time, 85 patrols were completed. The beach was monitored for signs of new nests and marked nests were checked for signs of predation attempts, inundation, and hatchling emergence. The last new nest was documented on August 12th, 2009 but we continued periodic patrols into November so that we could monitor hatching activity and excavate nests. Nests excavations were conducted a minimum of 72 hours after the documented date of emergence. If no signs of hatching emergence were apparent, the nest was excavated 80 days or more after the date that nest was discovered. During the excavations, the contents of the nest chamber were examined to determine the total number of eggs laid (clutch size), number of hatched eggs, number of unhatched eggs, and number of dead hatchlings. The percent emergence (number of hatchlings that emerged from nests/clutch size) was calculated using these data.

RESULTS

Nine false crawls (Table 2) and six nests (Table 3) were discovered during daily patrols of Masonboro Island between the dates of May 29th and August 12th, 2009. Based on available data on crawl characteristics, we assume that all nests were laid by loggerhead sea turtles. Figure 3 shows a map of Masonboro Island marked with GPS coordinates of nests. Individual crawl records for both nests and false crawls were forwarded to Ms. Wendy Cluse, the Assistant Sea Turtle Biologist at the North Carolina Wildlife Resources Commission.

Nests #1, #4, and #5 were completely depredated prior to discovery. Nest #1 had been laid before initiation of patrols in late May. Nest #4 was discovered completely depredated the morning after it had been laid. Nest #5 was discovered by a volunteer who noticed egg shells strewn along the sand. The appearance of the egg shells indicated that the nest had been laid several days to weeks earlier, and perhaps the turtle tracks had been overlooked due to the large amount of human foot traffic (sand disturbance) in this section of the beach. Nests #2 and #6 were discovered in a partially depredated state soon after they had been laid. Plastic screens were placed over these two nests to prevent further depredation. Neither of these nests showed direct evidence of hatching, as indicated by sand depression and/or hatchling tracks. An inventory of nest #2 conducted at day 84 of incubation revealed only 8 eggs in the nest, none of which showed signs of significant embryo development. An inventory of nest #6 at day 101 of incubation revealed 75 eggs in various stages of development. None of the eggs were viable. Nest #3 was intact at the time of discovery, and a wire box cage was installed over this nest to prevent depredation of eggs by foxes. Nest #3 was the only nest for which direct evidence of hatching was observed. Incubation time for nest #3 was 63 days. Of the 138 eggs in the nest, 122 hatched and emerged from the nest (88.4% emergence success).

Sand temperatures adjacent to nests # 2 and #3 were monitored with miniature data loggers (Thermochron iButton, Maxim Inc.) over the course of incubation. The temperature profile for nest #3, the only nest to produce hatchlings this season, is presented in Figure 4. In addition to retrieving the two temperature data loggers deployed this season, we also retrieved a data logger that had been deployed in 2008 and was presumed to be lost in Tropical Storm Hannah. This instrument was returned to us by a citizen who found it while walking along the central portion of Masonboro Island.

DISCUSSION AND RECOMMENDATIONS

We documented only 6 nests on the northern half of Masonboro Island in 2009, compared with 15 nests in 2008, 22 nests in 2007 and 25 nests in 2006. Although some inter-annual variability is typical for sea turtle nesting activity at a given beach, the downward trend observed over the last few years at Masonboro Island is discouraging. One possible explanation for the decrease in sea turtle nesting activity is an increase in human presence on the island. Historically, the majority of sea turtle nests have been laid along the northern portion of the island where the beach slopes gently and there is less of a berm. This section of the beach is also the most popular for human recreational activity, and at certain times during the summer can be quite crowded. A long-term study of human recreational activity and presence along various sections of the beach might provide some insight into the distribution of turtle nests along the length of the island and potentially explain trends in nesting data.

Trends in sea turtle nesting activity at Masonboro Island may also be related to the cycle of sand deposition and subsequent erosion. There has been considerable beach erosion and habitat loss at Masonboro Island over the past several decades. Littoral transport of sand and sediment is from north to south along southeast coast of North Carolina. Over the past 60 years, the U.S. Army Corp of Engineers has constructed jetties at the southern end of Wrightsville Beach and the northern end of Masonboro Island in order to maintain and improve the navigability of Masonboro Inlet, as well as to reduce beach erosion at Wrightsville Beach. These measures resulted in interruption of longshore drift and severe beach erosion at Masonboro

Island. Through efforts coordinated by the U.S. Army Corp of Engineers, both Wrightsville Beach and Masonboro Island receive sediment transfer from dredging projects in Masonboro Inlet at 3-5 year intervals. For many years, sediment was transferred solely to Wrightsville Beach, however in recent years the degree of erosion at Masonboro Island has warranted preferential disposal of sand at this site.

Habitat loss due to beach erosion may have negative impacts on sea turtle reproduction at Masonboro Island, and replacement of sediment loss due to littoral drift may be a necessary measure in order to maintain sea turtle nesting at this site. There are several important factors to consider, however, when implementing beach restoration measures. Disposal of sand and sediment dredged from waterways necessarily changes the physical properties and characteristics of the beach. Large scale changes in geomorphological features, such as the slope and width of the beach, are altered by sand disposal and this may affect beach selection and nesting behavior of sea turtles (Mortimer, 1982). Additionally, physical properties of deposited sediment, such as grain size, shape and color, may differ from sediment already present on the beach. Sediment composition and characteristics may have an impact on the nest environment of developing eggs and hatchlings, particularly with regards to respiratory gas diffusion and incubation temperatures (Mann, 1978; Yntema and Mrosovsky, 1982; Ackerman, 1997). A detailed investigation of beach habitat characteristics, sea turtle nesting activity, and hatchling success throughout a cycle of sand disposal and subsequent erosion would provide valuable information on the effects of beach restoration on reproductive efforts and success of sea turtles at Masonboro Island.

Fox predation on sea turtle eggs has become a concern at several nesting beaches in our region. Red foxes have been sighted on Masonboro Island by survey coordinators and volunteers, however, the total number of foxes present on Masonboro Island has not been documented. This year, three of the six nests laid were completely destroyed by foxes prior to discovery. The two nests that were partially depredated had 0% emergence success, so fox activity ultimately destroyed these nests as well. Only one of the six nests laid (16.7%) was unaffected by fox activity. We had hoped to continue our study of the efficacy of various types of protective measures in preventing fox depredation on sea turtle nests this year. Unfortunately, the low number of nests and rapid discovery of nests by foxes prevented a thorough investigation of caging vs. screening as a means to protect eggs. These same factors also limited our ability to assess reproductive variables such as clutch size, incubation time, and percent emergence.

Analyses of sand temperature data are ongoing, and we hope to deploy more temperature data loggers during the 2010 season. We feel that a continuation and expansion of our nest temperature study is warranted, and hope to involve a UNCW undergraduate Honors student or Directed Independent Study student in this project during Summer 2010. Masonboro Island lies at the northern extent of the nesting range for these species, and temperatures experienced by eggs during incubation are lower than those experienced at nesting beaches in the southern extent of the range. Sea turtles display temperature-dependent sex determination, such that sex ratios of hatchlings are determined by the nest temperature during the middle third of incubation (Ackerman, 1997). For loggerhead turtles, the pivotal temperature at which 50% males and 50% females are produced is 29.2°C (Mrosovsky, 1988). Temperatures below 29.2°C produce mostly male hatchlings and temperatures above 29.2°C produce mostly female hatchlings. Lower incubation temperatures at northern nesting beaches result in male-biased hatchling sex ratios, which counterbalances the highly female-biased sex ratios at southern nesting beaches (Heppell et al., 2003). Beaches at the northern extent of the loggerhead turtle's nesting range may take on increasing importance should the effects of climate change become more pronounced.

Continued monitoring of sea turtle nesting activity at Masonboro Island is warranted, based on results of our 2006 - 2009 surveys. A long-term database on nesting characteristics and hatching success at this site would contribute greatly to our knowledge of sea turtle reproductive efforts in North Carolina. Additionally, we think it would be worthwhile to explore feasible ways to expand our survey to include the entire island and to assess impacts of beach erosion and sand disposal on sea turtle nesting habitat and reproductive success at Masonboro Island.

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Figure 1. Stake configuration used to mark nests on Masonboro Island during the 2009 nesting season.

Figure 2. Wire box cage (A) and plastic screen (B) used to protect eggs from fox predation. Plastic screen is not visually detectable once it is installed (shown outlined in black in photo).

(A)

(B)

Figure 3. Map of Masonboro Island showing locations of nests. Nests depicted in orange were depredated (either partially or fully) and nests depicted in green were not depredated.

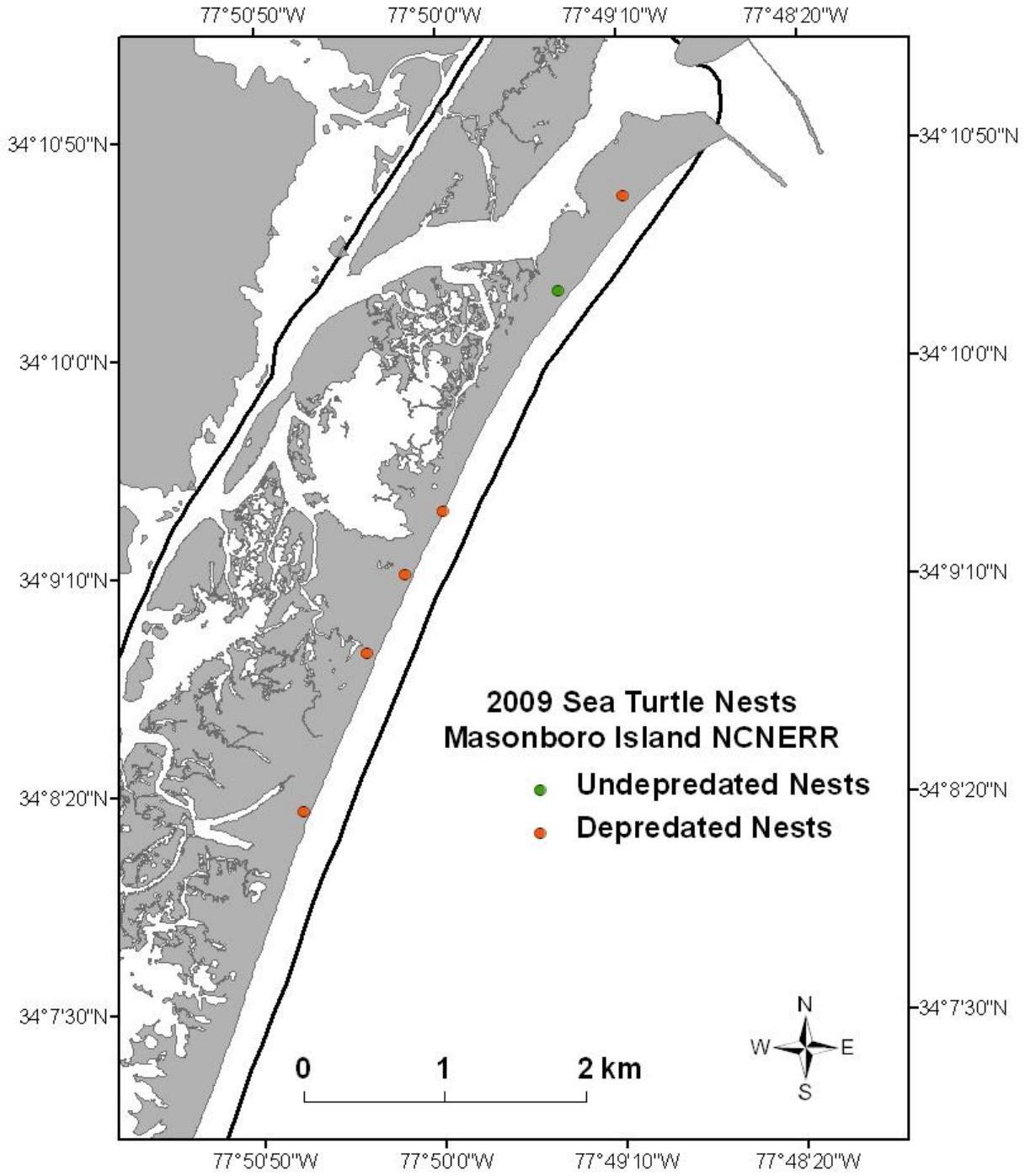

Figure 4. Sand temperature at a depth of 30 cm immediately adjacent to nest # 3. Temperature readings were recorded every 30 minutes for the duration of the 63 day incubation period. Small magnitude fluctuations represent diel changes in sand temperature and large scale fluctuations represent weather events. This nest was protected by a wire cage and had an 88.4% hatching success.

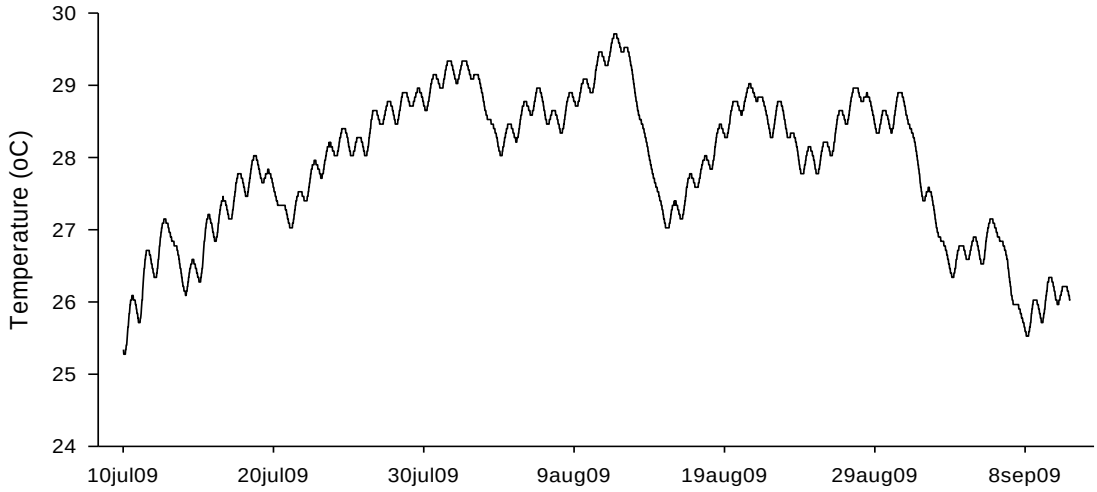

Table 1. Volunteers for 2009 Masonboro Island nesting beach survey. A total of 352 volunteer hours were contributed towards the nest monitoring program in 2009. Seven UNCW undergraduate students, seven UNCW graduate students, two UNCW employees, and eleven community members volunteered their time to monitor Masonboro Island for sea turtle nests.

	Volunteer	Affiliation	Hours
1	Belfer, Kim	UNCW Marine Quest	7.5
2	Capps, Andrew	UNCW grad	3.25
3	Coe, Jennifer	UNCW undergrad	15.5
4	Farrell, Travis	UNCW grad	1
5	Fonvielle, Wende	Community	13
6	Glowa, Jim	Community	11.5
7	Goldgeier, Eileen	UNCW employee	5
8	Gumina, Stephanie	UNCW grad	11.5
9	Harden, Leigh Anne	UNCW grad	20.5
10	Hoadley, Kenny	UNCW grad	4.5
11	Jimenez, Ana	UNCW grad	34.75
12	Lee, Kayla	UNCW undergrad	4.5
13	Meador, Beth	UNCW undergrad	4
14	Osowski, Linda	Community	25
15	Osowski, Michael	Community	25
16	Pinion, Ashley	UNCW undergrad	2.75
17	Rittenmeyer, Ken	Community	2.5
18	Rittenmeyer, Pat	Community	32.25
19	Smitherman, Tyler	UNCW grad	1.5
20	Snoberger, Will	Community	6
21	Sweeney, Bill	Community	5.5
22	Sweeney, Michelle	Community	13.5
23	Sweeney, Zach	Community	15.25
24	Tommerdahl, Anna	UNCW undergrad	63
25	Tommerdahl, Jake	Community	3.75
26	Torres, Lyssa	UNCW undergrad	16.75
27	Wuilliez, Nelisa	UNCW undergrad	2.75

Table 2. GPS coordinates and crawl width for aborted nesting attempts (false crawls) by sea turtles on Masonboro Island during the summer of 2009.

	Date	Latitude	Longitude	Crawl width (cm)
1	6/14/2009	N 34.1771	W 77.8175	118
2	7/10/2009	N 34.1714	W 77.8228	84
3	7/10/2009	N 34.1681	W 77.8255	95.5
4	7/22/2009	N 34.1594	W 77.8316	73.1
5	7/22/2009	N 34.1610	W 77.8306	79.2
6	7/22/2009	N 34.1631	W 77.8291	73.1
7	7/28/2009	N 34.1600	W 77.8312	114
8	8/10/2009	N 34.1579	W 77.8323	84.5
9	8/10/2009	N 34.1537	W 77.8350	80

Table 3. Summary of nest coordinates, caging efforts, depredation events, and emergence success for the 6 loggerhead sea turtle nests laid on Masonboro Island during the summer of 2009.

Nest	Date Laid	Latitude	Longtitude	Crawl Size (cm)	Depredation	Management	Incubation Period (days)	Number of Eggs In Nest At Inventory	Emergence Success (%)
1	Unknown	N 34.1526	W 77.8361	Unknown	complete (fox)	no management	–	–	–
2	06/28/2009	N 34.1572	W 77.8333	96.5	partial, at discovery (fox) 6/28/2009	plastic screen	84	8	0
3	07/10/2009	N 34.1708	W 77.8239	87	–	wire cage	63	138	88.4
4	07/12/2009	N 34.1383	W 77.8440	98	complete (fox) 07/12/2009	no management	–	–	–
5	Unknown	N 34.1765	W 77.8185	Unknown	complete (fox)	no management	–	–	–
6	08/12/2009	N. 34.1478	W 77.8389	90	partial, at discovery (fox) 08/12/2009	plastic screen	101	75	0