

SEA TURTLE NESTING ACTIVITY ON MASONBORO ISLAND, NORTH CAROLINA MAY – NOVEMBER 2007

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. 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)

Surveys of sea turtle nesting activity at Masonboro Island were conducted from 1999 to 2001, and again in 2006 and 2007. 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 2006-2007 monitoring period, only the northern 6.5 km of beach were monitored by foot patrols daily from May through September. An annual average of 23.5 ± 2.1 nests was recorded for the northern portion of the island during this period (Southwood et al., unpublished data). For comparison, Wrightsville Beach to the north had an annual average of 4 nests and Carolina Beach to the south had an annual average of 6.5 nests during this period (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. Funds provided by the North Carolina Estuarine Research Reserve were used to monitor sea turtle nesting activity and hatching success at Masonboro Island during the 2007 nesting season.

MATERIALS AND METHODS

Two survey coordinators, Ms. Caitlin McKinstry and Mr. James Casey, were hired to organize volunteers and conduct daily patrols of the northern half of Masonboro Island during the 2007 nesting season. We had 2 undergraduate student volunteers from UNCW and 19 community volunteers assist with beach patrols; 397.5 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 2.5 to 4.5 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.

Given the high level of fox predation on nests during the 2006 season, we elected to conduct an experiment to assess the efficacy of wire cages in preventing fox predation during the 2007 season. Box-cages were constructed of metal wire with a mesh size of 2" x 4" and had dimensions of 24" width x 32" length x 24" height. Cages were buried to a depth of 12 to 16 inches and surrounded the nest chamber (Fig. 1), which was carefully located by hand. Approximately half the nests were protected with these wire cages and the remaining nests were left uncovered.

Our survey of nesting activity on Masonboro Island began on May 11th, 2007 and our last day of beach patrol was on November 11th, 2007. During this time, 77 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 16th, 2007 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 number of eggs laid and the percent of eggs that hatched (hatching success). The total number of eggs or the clutch size, was determined by combining the number of hatched eggs shells (whole eggs shells >50%) and unhatched eggs.

RESULTS

A total of 11 false crawls (Table 2) and 22 nests (Table 3) were discovered during daily patrols of Masonboro Island from May 11th to August 16th, 2007. Based on available data on crawl characteristics, we assume that the majority of nests were laid by loggerhead sea turtles. Given the very wide crawl width associated with Nest #19, it is possible that this nest was laid by a green sea turtle. Figure 2 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.

Eight nests were depredated by foxes (Fig. 3). Four of the depredated nests were caged and four were uncaged (Table 3). Direct evidence of hatching was observed for 6 nests (i.e., sand depression or hatchling tracks). Incubation time for these nests ranged from 62 – 78 days, with an average of 66 ± 6 days. Hatching success for these nests ranged from 59.1% to 90.4% with an average of $73.2 \pm 11.5\%$ ($\bar{X} \pm SD$). There was no direct evidence of either predation or

a successful hatchout for 8 nests. The beach was not patrolled every day this summer due to foul weather or other circumstances, so we may have missed predation or emergence events that occurred during gaps in our patrols of the beach. Nests for which there was no sign of predation or emergence were excavated a minimum of 80 days after the date that nest was first discovered. No evidence of a nest chamber or eggs could be found for 3 of these nests (nests #2, #4 and #5), raising the possibility that these sites were false crawls that were mistakenly identified as nests. Nest 19 was washed away by the high tide on 11/11/07 and no data was collected on hatching success. Hatching success for the remaining 4 nests for which egg chambers were located ranged from 0% to 97.9% with an average of $52.9 \pm 40.2\%$ ($\bar{X} \pm SD$).

DISCUSSION AND RECOMMENDATIONS

Results from our project and previous surveys show that Masonboro Island is an important nesting site for sea turtles in coastal North Carolina. In fact, there were more sea turtle nests laid on Masonboro Island than on any other beach in our immediate region. Twenty-five nests were laid on the northern 6.5 km of Masonboro Island during the 2006 nesting season, and 22 nests were laid during the 2007 nesting season. Adjacent populated beaches to the north (Wrightsville Beach) and south (Carolina Beach) have much lower numbers of sea turtle nests, suggesting that Masonboro Island is a preferred nesting habitat for sea turtles in this region. Based on these results, we feel that continued monitoring of Masonboro Island and implementation of additional conservation measures are warranted.

Our survey of nesting activity on Masonboro Island was limited by logistical constraints. Masonboro Island is an uninhabited barrier island that can only be reached by boat. In the past, graduate student researchers have transported an ATV to the island daily on a 16 foot flat-bottomed boat so that they could patrol the entire length of the island. The boat that we had access to for this field season was not suitable for transporting an ATV, and concerns over volunteer safety and liability swayed us towards limiting our survey to walking patrols of the northern 6.5 km of the island. Although previous research has shown that the majority of the nests are laid on the northern half of the island, it is quite possible that some nests were laid on the southern half of the island as well, so our estimates of nesting activity on Masonboro Island are conservative.

Fox predation on sea turtle eggs has become a concern at several nesting beaches in our region. During the 2006 nesting season, 13 of the 25 nests (52%) that were laid on Masonboro were depredated by foxes. James Casey directly observed one red fox on the Island (Fig. 3) and Dr. Anthony Snider located a den in the middle portion of the Island, however, the total number of foxes present on Masonboro has not been documented. This year, 7 of 22 nests (31.8%) were depredated. The lower predation rate may reflect a decrease in the number of foxes on the island. The cages did not seem to afford any additional protection from predation, as 4 of the 8 depredated nests were caged. There may be some variability in the methods that volunteers and survey coordinators used to deploy cages that made some cages more or less effective than others. For the 2008 nesting season we will strive to standardize cage deployment. We are also planning to test some new plastic screen designs that may be more effective than the traditional wire cages.

In addition to taking GPS coordinates of nest sites, this year each nest was clearly marked with stakes, flags, and signage so that we could easily relocate the nest to assess emergence time

and hatching success. We collected some valuable data regarding clutch size, incubation time, and hatching success, although there were some gaps in our data due to missed beach coverage (Table 3). Average clutch size for loggerhead turtles at Masonboro Island (81.1 ± 30.5) was a bit lower than the average clutch size of 120 eggs reported for this species (NCWRC 2006). The average incubation period (66 ± 6) of loggerhead nests at Masonboro was similar to the species average of 60 days (NCWRC 2006). Several factors affected hatching success of nests, including predation, bacterial growth on eggs, and infiltration of roots into the nest cavity.

Continued monitoring of sea turtle nesting activity at Masonboro Island is warranted, based on results of our 2006 and 2007 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. There has been considerable beach erosion and habitat loss at Masonboro Island over the past several decades due to interruption of littoral sand transport by jetties constructed at the northern end of the Island. Through efforts coordinated by the U.S. Army Corp of Engineers, Masonboro Island receives sediment transfer from dredging projects in Masonboro Inlet at 3-5 year intervals. 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, which in turn may affect sea turtle nesting patterns and the nest environment experienced by hatchlings. 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. We have applied for funds from the USFWS and the University of North Carolina Wilmington Center for Marine Science for the equipment necessary to conduct detailed geomorphological surveys at Masonboro Island.

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REFERENCES

- Ackerman, R.A. 1997. The nest environment and embryonic development of sea turtles. In: *The Biology of Sea Turtles*, Vol. 1 (eds Lutz, P.L. and Musick, J.A.), pp 83-106. CRC Press, Boca Raton.
- Heppell, S.S., Snover, M.I., Crowder, L.B. 2003. Sea turtle population ecology. In: *Biology of Sea Turtles*, Vol. 2 (eds Lutz, P.L., Musick, J.A., Wyneken, J.), pp 275-306. CRC Press, Boca Raton.
- Mrosovsky, N. 1988. Pivotal temperatures for loggerhead turtles (*Caretta caretta*) from northern and southern population nesting beaches. *Canadian Journal of Zoology* 70: pp 530-538.
- North Carolina Wildlife Resources Commission (NCWRC). 2006. Handbook for Sea Turtle Volunteers in North Carolina.
- Piatkowski, D. 2002. Effects of beach nourishment on the nesting environment of loggerhead sea turtles (*Caretta caretta*). M.Sc. Thesis, University of North Carolina Wilmington.

Figure 1. Wire cages were placed over 12 sea turtle nests on the northern end of Masonboro Island in attempts to deter fox predation of eggs.



Figure 2. Map of Masonboro Island marked with GPS locations for all nests documented during the 2007 nesting season.

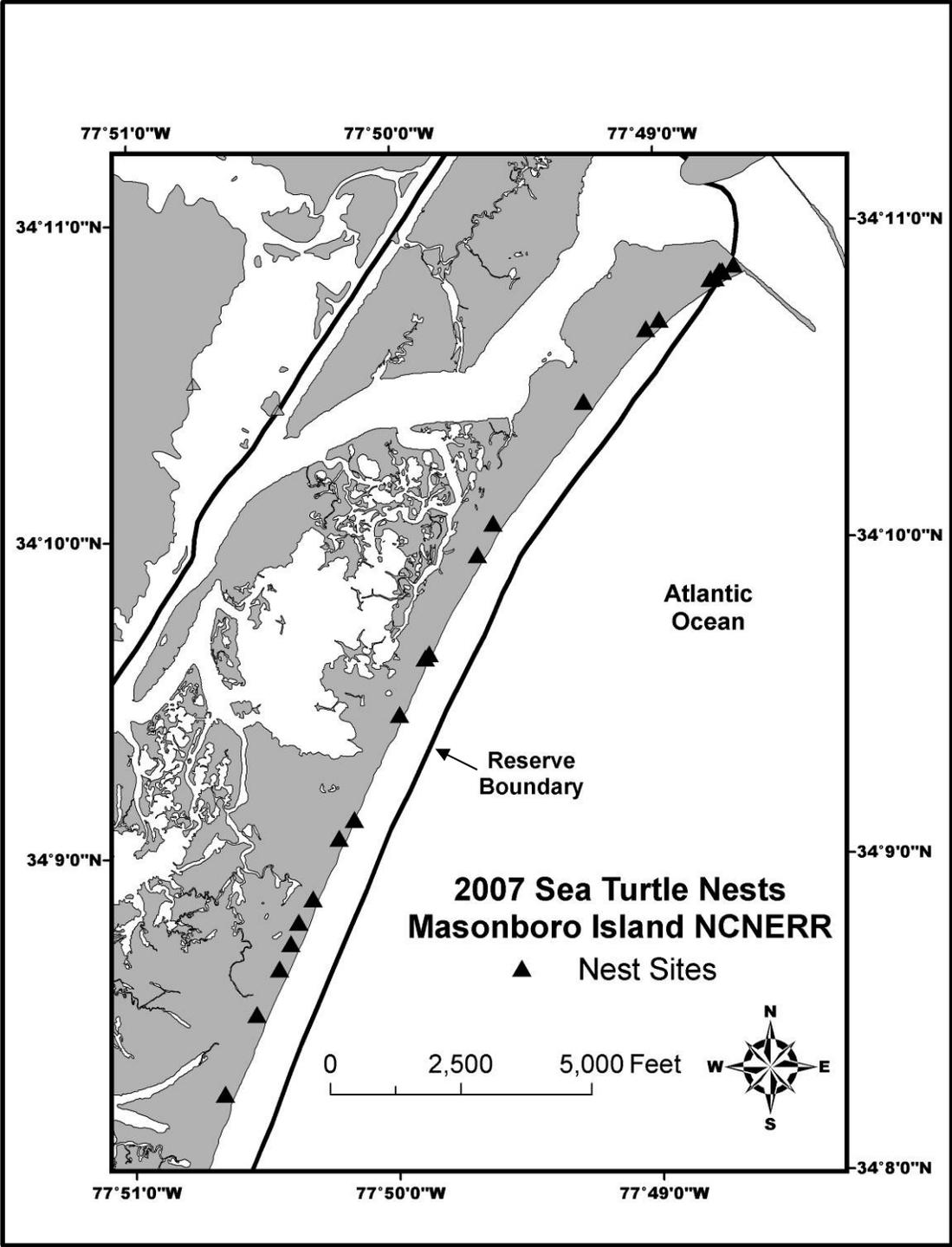


Figure 3. Fox observed by James Casey on Masonboro Island (a) and an example of a depredated nest (b).

(a)



(b)



Table 1. Volunteers for 2007 Masonboro Island nesting beach survey. A total of 397.5 volunteer hours were contributed towards the nest monitoring program in 2007.

	Volunteer	Affiliation	Hours
1	Boyle, Erin	Community	24.25
2	Bieschenk	Community	4.75
3	Bennett, Sarah	Community	29
4	Busovne, Nancy	Community	8.5
5	Cheney, Brie	Community	4.75
6	Ellenburg, Jessi	Community	20.75
7	Fonvielle, Wende	Community	15
8	Gould, Andrew	Community	39
9	Jeter, Peyton	UNCW	40
10	Linehan, Karen	Community	17.25
11	McHough, Kristal	Community	12.5
12	McNally, Kerry	Community	4.5
13	McKinstry	Community	4.5
14	Osowski, Mike	Community	23
15	Osowski, Linda	Community	23
16	Rittenmyer, Pat	Community	48
17	Sullivan, Annie	Community	4.5
18	Vaiden, Claire	UNCW	54.5
19	Westfall, Harold	Community	7.5
20	Westfall, Darlene	Community	7.5
21	Kayla (Bennett's Friend)	Community	4.75

Table 2. GPS coordinates and crawl width for aborted nesting attempts (false crawls) by sea turtles on Masonboro Island during the summer of 2007.

	Date	Species	Latitude	Longitude	Crawl Width
1	5/30/2007	Loggerhead	N34° 09.068'	W077° 50.220'	NA
2	6/15/2007	Loggerhead	N34° 09.134'	W077° 50.183'	103 cm
3	6/15/2007	Loggerhead	N34° 09.058'	W077° 50.229'	101.6 cm
4	6/25/2007	Loggerhead	N34°10.794'	W077°48.832'	87 cm
5	6/25/2007	Loggerhead	N34° 10.735'	W077° 48.929'	87 cm
6	6/26/2007	Loggerhead	N34° 08.815'	W077° 50.366'	NA
7	6/28/2007	Loggerhead	NA	NA	80 cm
8	7/6/2007	Loggerhead	N34°10.705'	W077°48.972'	86 cm
9	7/9/2007	Loggerhead	N34°10.532'	W077°49.148'	NA
10	7/24/2007	Loggerhead	N34°10.671'	W077°49.018'	NA
11	7/24/2007	Loggerhead	N34°10.817'	W077°40.797'	NA

Table 3. Summary of nest coordinates, caging efforts, depredation events, and hatching success for the 22 sea turtle nests laid on Masonboro Island during the summer of 2007. All nests were presumed to be laid by loggerhead turtles (*Caretta caretta*).

	Date	Latitude	Longitude	Crawl Width	Management	Depredated	Hatchling Emergence	Number of eggs in nest	Hatching success*
1	6/5/2007	N34° 10.052'	W077° 48.740'	NA	Caged	8/10/2007 (fox)	NA	-	-
2	6/5/2007	N34° 10.838'	W077° 48.740'	94 cm	Caged	no	not observed	not located	-
3	6/6/2007	N34° 10.840'	W077° 48.739'	71 cm	Caged	8/15/2007 (fox)	NA	-	-
4	6/6/2007	N34° 10.816'	W077° 48.784'	91 cm	Caged	no	not observed	not located	-
5	6/7/2007	N34° 10.689'	W077° 48.981'	NA	Caged	no	not observed	not located	-
6	6/15/2007	N34° 08.730'	W077° 50.407'	96.3 cm	Un-caged	no	not observed	52	0.0%
7	6/19/2007	N34° 08.650'	W077° 50.451'	92.5 cm	Caged	no	8/24/2007	79	79.7%
8	6/25/2007	N34° 10.841'	W077° 48.750'	92.5 cm	Un-caged	8/3/2007 (fox)	NA	-	-
9	6/28/2007	N34° 08.797'	W077° 50.376'	NA	Un-caged	no	9/2/2007	60	70.0%
10	7/5/2007	N34°09.640'	W077°49.869'	63 cm	Caged	no	9/7/2007	114	90.4%
11	7/9/2007	N34°08.257'	W077°50.662'	84 cm	Un-caged	no	not observed	121	56.2%
12	7/9/2007	N34°10.661'	W077°49.032'	NA	Un-caged	9/29/2007 (fox)	NA	-	-
13	7/9/2007	N34°10.819'	W077°48.766'	NA	Un-caged	no	not observed	94	97.9%
14	7/10/2007	N34°09.062'	W077°50.219'	92 cm	Caged	no	9/28/2007	71	64.8%
15	7/20/2007	N34°10.433'	W077°49.272'	99 cm	Caged	10/4/2007 (fox)	NA	-	-
16	7/23/2007	N34°09.450'	W077°49.984'	94 cm	Un-caged	10/4/2007 (fox)	NA	-	-
17	7/23/2007	N34° 09.238'	W077° 49.984'	97 cm	Un-caged	no	9/28/2007	66	59.1%
18	8/2/2007	N34° 08.508'	W077° 50.539'	63.5 cm	Caged	no	10/4/2007	121	75.2%
19	8/2/2007	N34° 08.871'	W077° 50.320'	109.2 cm	Un-caged	no	NA	**	**
20	8/3/2007	N34°09.627'	W077°49.884'	96 cm	Un-caged	10/4/2007 (fox)	NA	-	-
21	8/15/2007	N34°10.861'	W077°48.696'	87 cm	Caged	10/12/2007 (fox)	NA	-	-
22	8/16/2007	N34°09.952'	W077°49.681'	98 cm	Caged	no	not observed	33	57.6%

Percent of eggs that had hatched over total number of eggs in nest. Remaining eggs were not pipped due to a variety of reasons discussed in text.

** Nest washed away in high tide.