

CAPE LOOKOUT NATIONAL SEASHORE

2009 SEA TURTLE MONITORING AND MANAGEMENT REPORT



An atypical seven hole loggerhead nest hatch.

NPS Photo 2009

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INTRODUCTION

Cape Lookout National Seashore (CALO) began monitoring marine turtles in 1976. Baseline data was collected for a portion of South Core Banks during an extensive six-year study from 1978 - 1983. Nesting turtles were tagged and nests marked during nightly patrols. Since 1984 Cape Lookout has conducted daytime monitoring to document strandings, protect nest sites, relocate nests in danger of being flooded and protect hatchlings. Cape Lookout is a significant northern nesting beach and supports among the highest number of loggerhead sea turtle (*Caretta caretta*) nests in North Carolina. The seashore also provides nesting habitat for leatherback (*Dermochelyes coriacea*) and green (*Chelonia mydas*) sea turtles. Each year data have been collected, analyzed, and presented to management in hopes of better protecting our marine turtle population. This report will summarize the 2009 project, consolidate many years of data and make recommendations for management of these federally protected species. In addition to providing CALO with management data, the information gathered on CALO beaches continues to be an important link for many state, federal, and private Atlantic coast sea turtle managers.

COOPERATING AGENCIES

Cape Lookout National Seashore cooperates with numerous agencies, including the North Carolina Wildlife Resources Commission (NCWRC), the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) on sea turtle protection. The North Carolina Sea Turtle Program Coordinator receives all original stranding reports and annual nesting activity reports. NCWRC also issues Cape Lookout National Seashore an Endangered Species permit for possession and disposition of stranded marine turtles and relocation of nests.

SITE DESCRIPTION

Cape Lookout National Seashore is located in the southern Outer Banks of North Carolina between Beaufort and Ocracoke Inlets. The park is now currently divided into three barrier islands. The northernmost island, North Core Banks (NCB) is approximately 23 miles long, extending from Ocracoke Inlet to Ophelia Inlet. South Core Banks (SCB) extends southward from Ophelia Inlet almost 24 miles to Barden Inlet. The Core Banks have a northeast to southwest orientation and exhibit a low profile landscape. The third island, Shackleford Banks (SB) is 9 miles long and has an east-west orientation with a higher dune system and larger areas of vegetation. All islands in the park are subject to constant and dramatic change by the actions of wind and waves.

METHODS

All three of the islands comprising the Seashore were regularly monitored for turtle nesting activity. With the closure of Old Drum Inlet and New Drum Inlet in March 2009, the entire seashore was monitored for sea turtle activity. Student Conservation Association interns and NPS staff patrolled NCB and SCB daily beginning May 1 to September 15 for nesting activity. Each patrol began early in the morning so that the island was checked for turtle activity by 12:00 PM. Shackleford Banks was monitored twice a week. For detailed information on procedures used in the 2009 Sea Turtle Program refer to Appendix III.

Nest losses to tidal flooding and predation are the primary threats to nesting success at CALO. Nests laid in the tidal wash zone, primary berm, and back swale are considered in danger of erosion or tidal flooding. In 2009, nests laid in locations likely to repeated flooding were relocated to a higher elevation on the primary dune. Relocated nests were moved into designated areas and

vehicles were detoured to the back road around these areas when nests neared hatching. Smaller vehicle detours were erected around those nests that were not relocated and were outside other vehicle closures. Vehicle closures provide a rut-free corridor from the nest site to the ocean, preventing hatchlings from being run over or becoming entrapped in tire ruts and dying from predation or desiccation. Camping and campfires were not permitted in the closures to prevent disturbance of hatchlings by artificial lights.

Nests relocated onto the primary dunes and into beach closures may introduce factors that increase egg and hatchling mortality. Sea oats (*Uniola paniculata*) are dominant on the primary dunes and their roots invade the nest. Hatchlings that emerge from nests located high on the primary dunes may be exposed to mainland lights and may travel toward the lights away from the ocean. Records were therefore kept of hatchlings entangled in roots and eggs destroyed by roots in the egg chamber. Hatchling tracks that were observed to go away from the ocean were also noted. Finally, relocating nests into a single beach closure increases the risk of a large loss due to storms, pathogens, or predation. Any sign of predation was noted and the approximate numbers of eggs or hatchlings destroyed were recorded. To discourage raccoon (*Procyon lotor*) predation, wire screens anchored by rebar were placed over all nests. Wire cages were used, if needed, on nests between the lighthouse and Power Squadron Spit, the area with the most problems from raccoons in the past. Nests and digs were monitored for hatching activity through November. Nests were excavated after hatching to determine nest success. Digs were treated as nests through the nesting and hatching time frame. If the dig hatched it was added to the nest category and if it failed to show hatching activity after 75 days the site was excavated. It then was classified as a nest if eggs were found or as a crawl

if no eggs were found.

RESULTS

The monitoring procedures used at CALO prior to 1990 were significantly different than those used after that year. Records from those years will not be included in this report. 1990 marked the beginning of monitoring procedures following the USFWS Index Nesting Beach program (See Appendix III, Attachment 7).

NESTING RESULTS

The first recorded nesting activity in 2009 was on May 25 and the last on August 28, for a 95 day nesting season. A total of 298 activities were documented of which there were 141 nests and 157 crawls, (Table 1; see Appendix III for activity definitions). Two sea turtle species nested in the park with a total of 140 loggerhead turtle nests and 1 green turtle nest.

Table 1. 2009 ACTIVITIES BY STUDY AREA

| | North Core Banks | South Core Banks | Shackleford Banks | CALO Total |
|--------|------------------|------------------|-------------------|------------|
| NESTS | 61 | 69 | 11 | 141 |
| CRAWLS | 92 | 61 | 4 | 157 |

The number of nests found in 2009 (141 nests) was above the annual average for CALO (128 nests) (Fig. 1 and 2). South Core Banks continued to have more nests than the other islands in 2009, though only eight more than NCB. Nesting on SCB was spread out, however, there was a higher occurrence of nests south of the lighthouse between mile 41 and 44, 30 nests (Fig. 3). The greatest

nesting density on NCB occurred mid-island between mile 10 and mile 15, 27 nests. The natural closing of Old Drum Inlet and New Drum Inlet allowed for daily sea turtle monitoring from mile 19 to mile 22.5 for the first time since 1999. In 2009 there were seven nests from mile 19 to mile 22.

Figure 1. Cape Lookout Turtle Activities 1990-2009

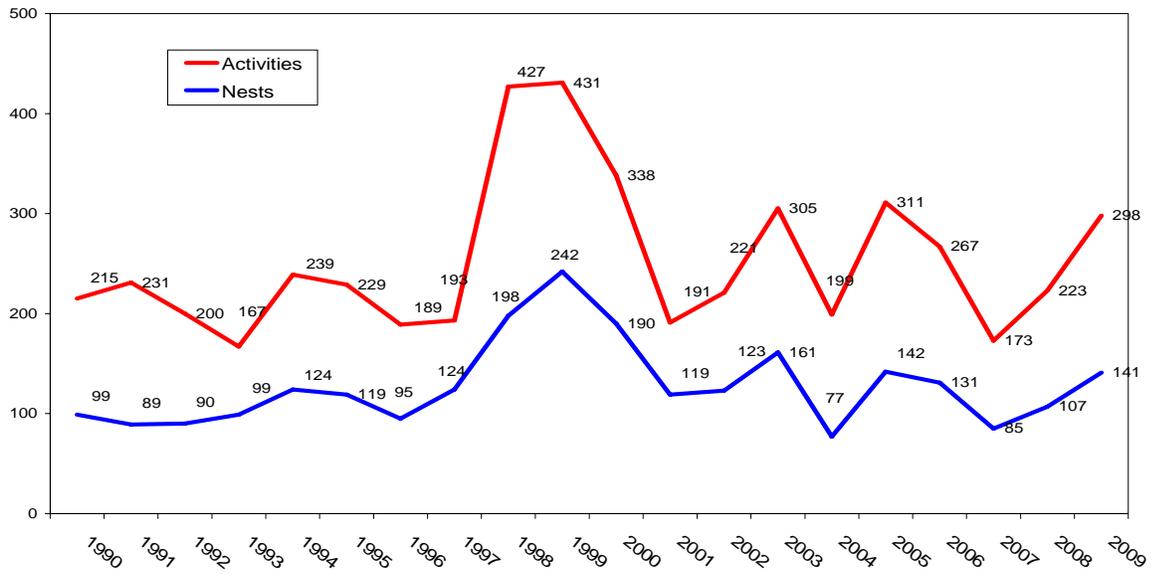


Figure 2. Turtle Nests 1990-2009

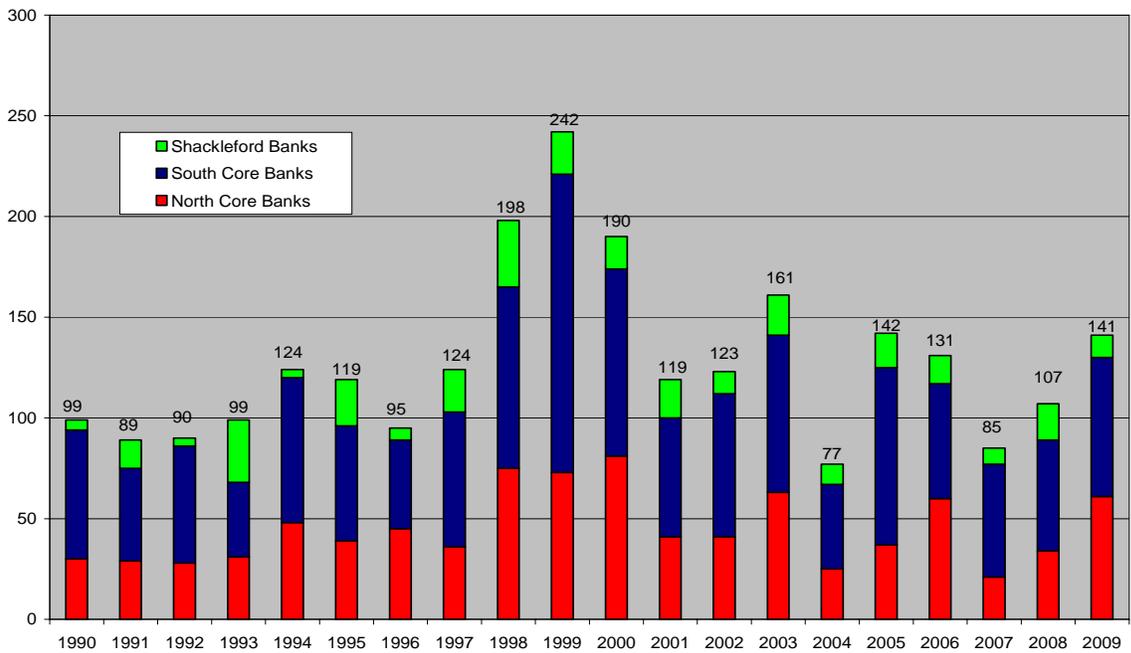
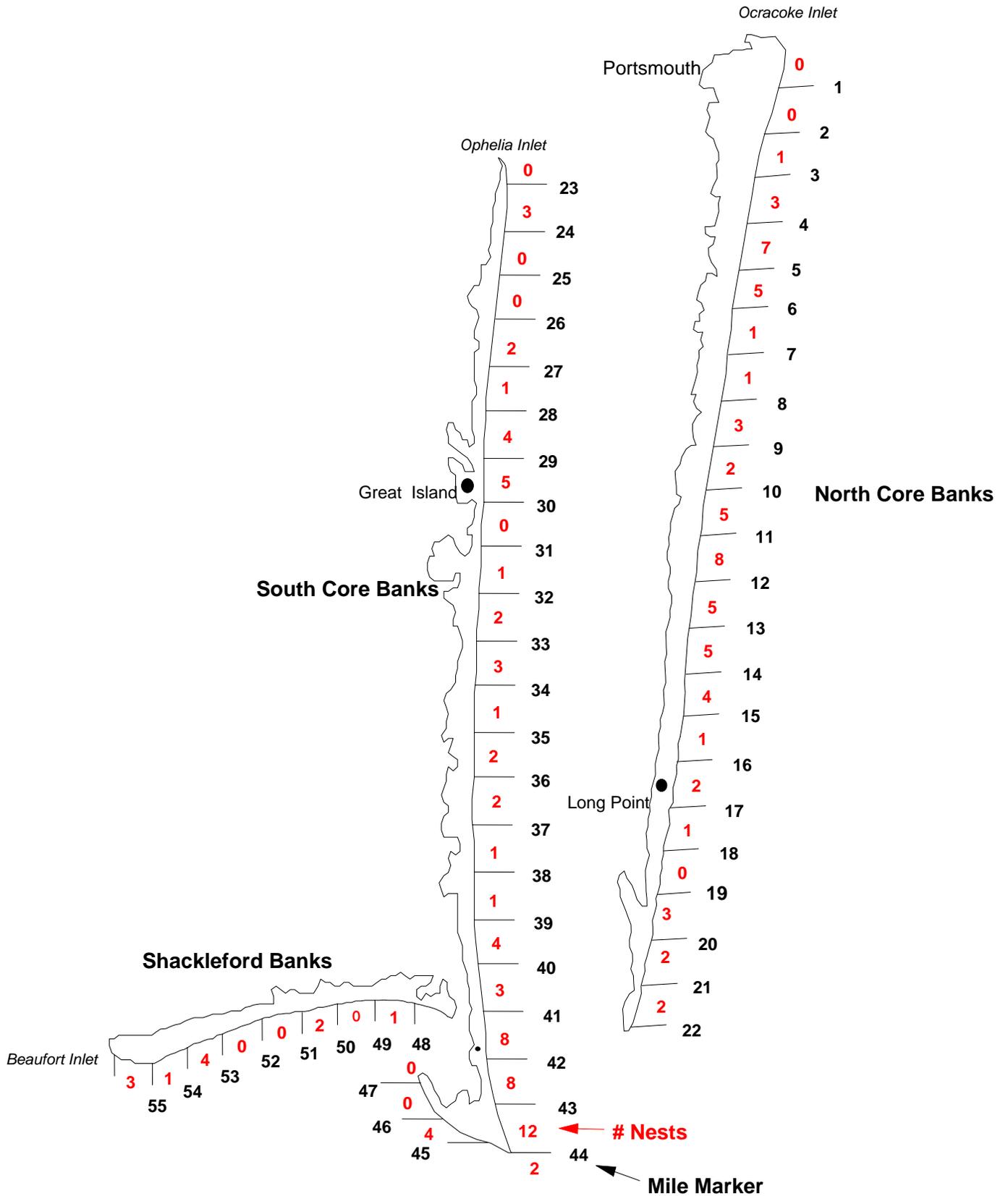


Figure 3. 2009 Turtle Nests by Mile Section



HATCHING RESULTS

Follow-up of nesting activity involved observing nest and dig sites for signs of hatching, recording relevant data, and excavating the site. By collecting hatch information, it can often be determined if predators, human disturbance or environmental occurrences have adversely affected a nest. Individual nest data are in Appendix I.

Hatching results are first analyzed as a combination of all species. The results by species are presented later in the report. Nest hatching began on August 1st and ended on October 18th, for a 79 day nest hatching period. The last nests were excavated on November 16th at day 80 of incubation. A known total of 15,130 eggs, 7,774 hatchlings, and 200 hatched dead were counted. The total hatch success, number of total eggs divided by number of total hatchlings, was 51%. The total emergence success of 50% (7574 emerged) was calculated by subtracting the total hatched dead from the total hatchlings and dividing by the total of eggs (Table 2). This is the same calculation for each individual nest emergence success (Appendix III, Attachment 3). The emergence success range was from 0% to 100%. The average clutch size was 116 eggs. It took an average of 64 days for nests to incubate. Eleven nests were washed away with the numbers of eggs unknown. No nests were depredated by raccoons in the seashore in 2009. Eleven nests suffered some ghost crab predation on SCB and six nests had ghost crab predation on NCB. A total of 77 nests were over-washed by the ocean, 49 nests from one to three days and 29 nests four times or more. Forty six of these 77 nests hatched. The emergence success for these 77 flooded nests was 37%.

Table 2. SEA TURTLE HATCH SUMMARY 1990-2009

| Year | Nests | Avg. Clutch | Flooded | Avg. Incu | Eggs | Emerged | EMR %* | Est.Total EMR%** |
|------|-------|-------------|---------|-----------|--------|---------|--------|------------------|
| 1990 | 99 | 115 | 1 | 57 | 10,376 | 7,369 | 71% | 69% |
| 1991 | 89 | 115 | 6 | 62 | 8,393 | 5,197 | 62% | 61% |
| 1992 | 90 | 114 | 4 | 63 | 9,419 | 6,791 | 73% | 71% |
| 1993 | 99 | 115 | 9 | 59 | 10,365 | 7,544 | 74% | 74% |
| 1994 | 124 | 120 | 3 | 62 | 14,459 | 11,296 | 79% | 79% |
| 1995 | 119 | 115 | 38 | 57 | 12,357 | 6,157 | 51% | 47% |
| 1996 | 95 | 115 | 16 | 65 | 10,091 | 5,602 | 57% | 53% |
| 1997 | 124 | 122 | 3 | 63 | 14,824 | 10,740 | 73% | 73% |
| 1998 | 198 | 114 | 39 | 62 | 19,672 | 13,315 | 69% | 61% |
| 1999 | 242 | 116 | 90 | 62 | 23,224 | 11,751 | 53% | 44% |
| 2000 | 190 | 111 | 2 | 67 | 19,527 | 13,471 | 69% | 65% |
| 2001 | 119 | 113 | 5 | 65 | 12,358 | 9,555 | 79% | 75% |
| 2002 | 123 | 119 | 7 | 61 | 13,657 | 10,758 | 79% | 75% |
| 2003 | 161 | 119 | 45 | 65 | 16,440 | 10,067 | 61% | 53% |
| 2004 | 77 | 104 | 36 | 64 | 7,309 | 3,139 | 43% | 40% |
| 2005 | 142 | 111 | 54 | 60 | 12,423 | 6,569 | 53% | 42% |
| 2006 | 131 | 125 | 19 | 61 | 14,808 | 10,843 | 73% | 66% |
| 2007 | 85 | 109 | 19 | 60 | 8,759 | 6326 | 72% | 68% |
| 2008 | 107 | 111 | 60 | 60 | 11063 | 6868 | 62% | 57% |
| 2009 | 141 | 116 | 77 | 64 | 15130 | 7574 | 50% | 46% |

*emergence success for nests with known egg and hatch totals

**includes an estimate of egg totals for nests lost and not excavated

Calculating a true emergence success for the year always proves to be difficult. Raccoons may dig into a nest at hatching making it impossible to know how many turtles escaped from the nest. A nest may be washed away, thus an emergence success of zero is known but the original number of eggs laid is not known. The emergence success reported is for those nests in which the number of eggs laid and the number of emerged turtles is known.

In order to account for the eleven nests lost with unknown egg counts we have calculated an estimated emergence success of 46% in 2009 (Table 2). This figure includes eleven nests with unknown egg numbers that were lost to erosion before hatching. The average clutch size for each island was given to those nests as the number of eggs, allowing them to be calculated into the estimated emergence success. The seashore total of eleven lost nests at an average clutch of 116 equals 1276 eggs with 0% emerge success (Table 3).

Table 3. 2009 ACTIVITY SUMMARY BY STUDY AREA

| | NCB | SCB | SH | TOTALS |
|--|----------|----------|---------|----------|
| NESTS | 61 | 69 | 11 | 141 |
| # KNOWN EGGS | 6537 | 7741 | 852 | 15130 |
| # EMERGED | 2772 | 4226 | 576 | 7574 |
| AVERAGE CLUTCH | 119 eggs | 119 eggs | 85 eggs | 116 eggs |
| EMERGE SUCCESS | 42% | 54% | 68% | 50% |
| # ESTIMATED EGGS | 7251 | 8217 | 937 | 16406 |
| ESTIMATED TOTAL EMERGENCE SUCCESS (including nests with unknown /averaged egg totals) | 38% | 51% | 61% | 46% |
| AVERAGE INCUBATION | 65 days | 63 days | 64 days | 64 days |
| # LOST TO FLOODING | 6 | 4 | 1 | 11 |
| # LOST TO PREDATORS | 0 | 0 | 0 | 0 |

In 2009, 25% of the nests were relocated. The emergence rate for relocated nests was 61% and the emergence rate for non-relocated nests was 46% (Table 4). The estimated emergence success for non-relocated nests was 41% which accounts for the eleven nests lost to erosion.

Table 4. EMERGENCE SUCCESS OF RELOCATED VS. NON-RELOCATED NESTS BY STUDY AREA IN 2009

| <i>RELOCATED</i> | NCB | SCB | SH | CALO Total |
|--------------------------------|------|------|-----|------------|
| Nests | 18 | 16 | 1 | 35 (25%) |
| Eggs | 2091 | 1866 | 82 | 4039 |
| Hatchlings | 1075 | 1351 | 70 | 2496 |
| # Hatch Dead | 8 | 6 | 0 | 14 |
| Emergence Rate | 51% | 72% | 85% | 61% |
| <i>NON-RELOCATED</i> | | | | |
| Nests | 43 | 53 | 10 | 106 (75%) |
| Eggs | 4446 | 5875 | 770 | 11091 |
| Hatchlings | 1731 | 3039 | 508 | 5278 |
| # Hatch Dead | 26 | 158 | 2 | 186 |
| Emergence Rate | 38% | 49% | 66% | 46% |
| Estimated Total Emergence Rate | 33% | 45% | 59% | 41% |

Since 1990 the twenty year average emergence success has been equal (66%) for non-relocated nests and relocated nests (Table 5). However the estimated emergence rate of non-relocated nests, which accounts for erosion and predation lost nests, is lower on average than relocated nest by nine percentage points.

Predation

In 2009, no nests were completely lost to predators. There was no raccoon predation recorded on nests in the seashore. Typically SCB nests have experienced some form of raccoon predation in recent years. In 2007 14 nests were predated and in 2008 eight nests were predated on SCB. On NCB zero nest were predated in 2007 and only 2 nests were predated in 2008. Seventeen nests suffered minor ghost crab predation in the seashore in 2009.

Table 5. 1990-2009 EMERGENCE SUCCESS FOR RELOCATED vs. NON-RELOCATED NESTS

| YEAR | PERCENT OF NESTS RELOCATED | EMERGENCE RATE-RELOCATED | EMERGENCE RATE-NON RELOCATED* | PERCENT OF NESTS EXCAVATED |
|-----------------|----------------------------|--------------------------|-------------------------------|----------------------------|
| 1990 | 69 | 71% | 74% (67%) | 94 |
| 1991 | 63 | 57% | 76% (72%) | 97 |
| 1992 | 43 | 71% | 76% (74%) | 97 |
| 1993 | 54 | 74% | 73% (73%) | 90 |
| 1994 | 79 | 80% | 73% (73%) | 96 |
| 1995 | 55 | 61% | 38% (31%) | 86 |
| 1996 | 73 | 56% | 64% (48%) | 89 |
| 1997 | 74 | 69% | 86% (86%) | 95 |
| 1998 | 59 | 77% | 55% (41%) | 85 |
| 1999 | 51 | 49% | 59% (40%) | 79 |
| 2000 | 63 | 66% | 74% (61%) | 93 |
| 2001 | 50 | 81% | 76% (68%) | 89 |
| 2002 | 45 | 73% | 84% (77%) | 93 |
| 2003 | 41 | 47% | 75% (58%) | 86 |
| 2004 | 44 | 63% | 23% (20%) | 97 |
| 2005 | 34 | 42% | 61% (42%) | 79 |
| 2006 | 39 | 85% | 64% (54%) | 90 |
| 2007 | 24 | 79% | 70% (65%) | 95 |
| 2008 | 30 | 57% | 64% (57%) | 92 |
| 2009 | 25 | 61% | 46% (41%) | 92 |
| <i>AVERAGES</i> | <i>51</i> | <i>66%</i> | <i>66% (57%)</i> | <i>91</i> |

* Number in parentheses is an estimate including nests with unknown egg totals

Seven nests had roots in the egg chamber that destroyed eggs or trapped hatchlings. Sand deposition partially buried 28 nests and along with flooding may have prevented hatching. Hatchlings from one nest on SCB at mile 45.37 appeared disorientated and crawled parallel to the shore in tire ruts outside the closure for 0.5 mile on both sides of the nest. Ghost crab tracks appeared to follow these hatchling tracks. Similarly two nests (# 1 at mile 12.2 & #21 at mile 9.02) on NCB had hatchling tracks going in multiple directions and outside hatching closures.

Hatch Results by Species

The 140 loggerhead and one green turtle emergence success was 50% and 0%, respectively (Table 6.). Green turtle nests accounted for 1 % of total sea turtle nests. The one green nest was on South Core Banks at Cape Point, mile 44.2. This nest was flooded by Hurricane Bill swell and received four feet of sand deposition. It did not hatch and the eggs were undeveloped.

Table 6. Loggerhead and Green Sea Turtle Hatch Summary, 2009.

| | Loggerhead | Green |
|--------------------|------------|----------|
| NESTS | 140 | 1 |
| # EGGS | 14993 | 137 |
| # HATCHLINGS | 774 | 0 |
| # HATCH DEAD | 200 | 0 |
| EMERGENCE SUCCESS | 50% | 0% |
| AVERAGE CLUTCH | 116 eggs | 137 eggs |
| AVERAGE INCUBATION | 64 days | n/a |

Human Disturbance

Off-road vehicles disregarding beach closures threaten the survival of hatchlings. Hatchlings are at risk of being directly crushed and/or becoming trapped in tire ruts. At night vehicle lights could disorientate hatchlings. Twenty violations of vehicle closures for turtle nests were documented by park resource staff on SCB. There were no records for NCB from park resource staff. These vehicles drove between posts and the ocean at low tides or drove through posts and rope. Park Law Enforcement staff issued two citations and one written warning for sea turtle closure violations.

DISCUSSION

An objective of the *Recovery Plan for U.S. Population of Loggerhead Turtle* is to implement nest protection measures "to ensure (a) greater than 60 percent hatch rate." This should be done using the "least manipulative method ... to avoid interfering with known or unknown biological processes."

Tidal flooding continues to be a threat to nesting success at CALO due to a low beach profile.

Nest relocation is the primary management tool used to enhance hatching success in the park. In 2009, park staff relocated 35 nests that were threatened with repeated flooding or erosion. The remaining 106 nests were laid high on the beach or on the dunes. The nesting and hatching season spanned from May 25th to October 18th, 147 days. Eight nests were still actively incubating after October 18th, but did not hatch. While the nesting and hatching season was free of direct major storm impacts, there were 11 nests that were lost to storm systems. These included nest losses to Hurricane Bill, Hurricane Danny, and other low pressure storm swells and high tides along the banks. In addition, these storm swells and high tides flooded and buried nests. This along with relatively cool summer weather and high tide anomalies may have caused the low emergence rate. The hatch rate and emergence rate for 2009 is 51% and 50% respectively. Non-relocated nests had a lower emergence rate (46%) than relocated nests (61%) in 2009. The 20 year long term trend shows an equal emergence rate for non-relocated nests (66%) and relocated nests (66%).

Research in other parts of the loggerhead turtle's nesting range has found benefits from some tidal inundation of nests. Cooler temperatures may produce more male hatchlings and the hatchlings may be more likely to survive. In order to study these findings in North Carolina and CALO, we began a

study in 2007 in cooperation with NCWRC to measure sand temperature, nest temperatures and sex ratios of hatchlings. In 2009, ten HOBO temperature data loggers were placed on Shackleford, South Core Banks, and North Core Banks in May to record sand temperatures throughout the nesting season. Thirty seven nests received HOBO temperature data loggers. Both relocated and non-relocated nests on NCB, SCB, and SB received one data logger in the nest and one in the sand three feet away. We plan to report on the results in the near future.

In the winter of 2008 and spring of 2009, 149 raccoons were removed from South Core Banks as part of predator population study by researchers from North Carolina State University and the U.S. Geological Survey. Raccoon predation on SCB has been a persistent problem. Over the last ten years (1999 to 2008) raccoon predation has been recorded for all but one year, 2004. In 2009, no raccoon predation occurred.

US Fish and Wildlife Service Biological Opinion and Performance Measures

The USFWS provided CALO a biological opinion that included two performance measures on sea turtles for the Interim Protected Species Management Plan. We met the sea turtle false crawl to nest ratio is less than or equal to 1:1 (annually) requirement. In 2009, there were 157 false crawls and 141 nests for a ratio of 1.1:1. The second performance measure states we should have 20 percent or greater of the state's total sea turtle nests for the last five years. There was an average of 690 nests for the previous five years in North Carolina. In 2009 CALO had 20% of the state's total sea turtle nests for the last five years.

STRANDINGS

Collecting information from stranded turtles is also an important phase of the CALO Sea Turtle Monitoring Program. Research has indicated that sea turtle population stability is much more sensitive to change in the large juvenile stage (subadult) than in earlier stages. The key to improving the outlook for this population lies in reducing mortality in large juveniles. CALO documents strandings, collects data for the N.C. Sea Turtle Project Coordinator and the National Marine Fisheries Service (NMFS) and assists in the transportation of live strandings to rehabilitation facilities.

One hundred seventeen strandings occurred at CALO in 2009. All strandings were reported to the NCWRC and were documented with a “Sea Turtle Stranding and Salvage Network” stranding report. Juvenile green turtles accounted for the majority of the strandings (66). There were also 36 loggerhead turtles, 14 Kemp's Ridleys, and one unknown. Sixty turtles stranded on the ocean shore and 56 turtles stranded on the inshore soundside. There were 14 live strandings, with 12 that appeared cold stunned in December. Two live strandings took place in the summer. They were both greens and loggerheads and were transported out of the park and sent to the Topsail Turtle Hospital or the Pine Knolls Shore NC Aquarium. Turtles were scanned for Passive Integrated Transponder (PIT) tags. No PIT tags or metal tags were found in 2009. Tables 7 and 8 provide stranding data by island and species from 1993 to 2009.

Table 7. CALO SEA TURTLE STRANDINGS 1993 – 2009

| YEAR | NCB | SCB | SHACK | OTHER | TOTAL |
|------|-----|-----|-------|-------|-------|
| 1993 | 18 | 12 | 10 | 3 | 43 |
| 1994 | 22 | 27 | 12 | 1 | 62 |
| 1995 | 11 | 23 | 9 | | 43 |
| 1996 | 29 | 33 | 29 | | 91 |
| 1997 | 21 | 18 | 17 | 1 | 57 |
| 1998 | 20 | 21 | 20 | 2 | 63 |
| 1999 | 21 | 58 | 14 | 1 | 94 |
| 2000 | 28 | 47 | 24 | 2 | 102 |
| 2001 | 30 | 24 | 10 | | 64 |
| 2002 | 13 | 38 | 19 | 1 | 71 |
| 2003 | 13 | 30 | 21 | | 64 |
| 2004 | 20 | 39 | 18 | 1 | 78 |
| 2005 | 15 | 35 | 21 | | 71 |
| 2006 | 14 | 26 | 20 | 1 | 61 |
| 2007 | 14 | 34 | 14 | 2 | 64 |
| 2008 | 22 | 110 | 16 | 2 | 149 |
| 2009 | 48 | 55 | 12 | 2 | 117 |

Table 8. CALO TURTLE STRANDINGS BY SPECIES 1993-2009

| YEAR | LOGGERHEAD | GREEN | KEMP'S RIDLEY | LEATHERBACK | HAWKSBILL | UNKNOWN |
|------|------------|-------|------------------|-------------|-----------|---------|
| 1993 | 29 | 6 | 5 | 2 | 0 | 1 |
| 1994 | 30 | 24 | 5 | 2 | 0 | 1 |
| 1995 | 27 | 7 | 6 | 1 | 0 | 2 |
| 1996 | 63 | 21 | 4 | 3 | 0 | 0 |
| 1997 | 49 | 1 | 7 | 0 | 0 | 0 |
| 1998 | 43 | 8 | 12 | 0 | 0 | 0 |
| 1999 | 36 | 41 | 15 | 2 | 0 | 0 |
| 2000 | 46 | 40 | 11 | 4 | 0 | 1 |
| 2001 | 38 | 15 | 9 | 2 | 0 | 0 |
| 2002 | 33 | 26 | 5 | 7 | 0 | 0 |
| 2003 | 44 | 9 | 7 | 2 | 1 | 1 |
| 2004 | 45 | 28 | 4 | 1 | 0 | 0 |
| 2005 | 37 | 21 | 6 | 0 | 2 | 5 |
| 2006 | 35 | 16 | 8 | 0 | 0 | 2 |
| 2007 | 19 | 38 | 1 | 0 | 0 | 6 |
| 2008 | 29 | 116 | 2 | 0 | 0 | 3 |
| 2009 | 36 | 66 | 14 | 0 | 0 | 1 |

MANAGEMENT RECOMMENDATIONS

1. CALO should continue to use the US Fish and Wildlife Service's Index Beach standards for conducting sea turtle monitoring to provide data comparable to previous nesting seasons.
2. The park should continue their relocation standards of moving nests that the monitoring staff believes are likely to be flooded repeatedly.
3. Evaluate established nest relocation areas before nesting season in April to determine suitability and nest relocation options.
4. All park staff and volunteers involved with turtle monitoring should be given complete training in current monitoring procedures.
5. Educational efforts should continue to be directed toward park visitors to prevent inadvertent disturbance to nesting females, eggs, and hatchlings. This should include posted signs, site bulletins, and interpretive programs to include nest excavations. The park should to continue to cooperate with the North Carolina Maritime Museum to educate visitors about sea turtles.
6. Evaluate sand and nest temperature study in cooperation with North Carolina Wildlife Resource Commission.

APPENDIX I
2009 INDIVIDUAL NEST DATA

Table 9. North Core Banks Sea Turtle Nesting Data-2009

| # | Date | Mile | Relocate d Mile | Hatch Date | Incubation days | Total # Eggs, (TC) | # Hatchlings, (H) | # hatch dead, (HD) | % Emerge, (H-HD/TC) | Comments |
|----|--------|-------|--------------------|---------------|--------------------|--------------------------|-------------------------|--------------------------|---------------------------|--|
| 1 | 25-May | 12.2 | | 3-Aug | 70 | 140 | 76 | 0 | 54% | GC predation 8/3, several hatchlings tracks were found 30 yds from nest going south outside closure |
| 2 | 29-May | 21.42 | 15.5 | 7-Aug | 70 | 119 | 35 | 3 | 27% | some roots in nest |
| 3 | 1-Jun | 17.7 | | 7-Aug | 67 | 156 | 115 | 1 | 73% | 7/25 overwash |
| 4 | 2-Jun | 4.52 | | 9-Aug | 68 | 105 | 4 | 0 | 4% | 6/23, 7/23, overwash |
| 5 | 3-Jun | 13.5 | | 9-Aug | 67 | 144 | 40 | 0 | 28% | 7/23, 7/25, overwash. GC pred.8/7. Saved 1 hatchling stuck in wire. |
| 7 | 4-Jun | 12.5 | | unk | unk | 89 | 7 | 0 | 8% | 3 eggs GC pred. 7/21,7/23,7/25 flooded |
| 10 | 5-Jun | 4.6 | | 10-Aug | 66 | 138 | 107 | 1 | 77% | |
| 12 | 11-Jun | 13.33 | | 15-Aug | 65 | 114 | 87 | 0 | 76% | 7/14 overwash |
| 13 | 13-Jun | 14.15 | | 20-Aug | 68 | 60 | 53 | 1 | 87% | 7/23,7/25 overwash |
| 21 | 14-Jun | 9.02 | | 19-Aug | 66 | 136 | 110 | 0 | 81% | 6/23, July 1,5,11,19,23,25, 8/21 overwash, Hatchlings went in every direction. |
| 22 | 15-Jun | 14.06 | | 10-Aug | 56 | 125 | 113 | 2 | 89% | originally a dig, nest was N of posts approx. 2' |
| 26 | 16-Jun | 3.09 | 4.63 | n/a | n/a | 85 | 0 | 0 | 0% | nest flooded for days from H Bill |
| 27 | 16-Jun | 4.66 | 4.78 | n/a | n/a | 148 | 0 | 0 | 0% | relocated nest was not deep enough to hold all eggs, placed in 3 diff. holes under screen. GC destroyed 3 eggs, 6/23, 7/19 overwash. Flooded for days from H Bill. |
| 28 | 17-Jun | 15.6 | 15.13 | 20-Aug | 64 | 128 | 122 | 0 | 95% | 8/21 overwash |
| 34 | 18-Jun | 19.1 | 15.31 | 19-Aug | 62 | 139 | 127 | 0 | 91% | 7/23 overwash. 1 hatchling stuck in eelgrass and wire, released |
| 36 | 18-Jun | 10.4 | | 20-Aug | 63 | 147 | 139 | 0 | 95% | 2 screens found at excavation, 17 live |

| | | | | | | | | | | |
|----|--------|-------|------|--------|-----|-----|-----|-----|-----|---|
| | | | | | | | | | | hatchlings |
| 38 | 19-Jun | 20.6 | | unk | unk | unk | unk | unk | unk | 7/22,7/25,8/21.8/28.8/29 overwash. Lost to H. Bill. |
| 40 | 19-Jun | 13.9 | 15.1 | 17-Aug | 59 | 127 | 121 | 0 | 95% | |
| 55 | 26-Jun | 8.01 | | n/a | n/a | 133 | 0 | 0 | 0% | 7/2 GC, |
| 57 | 27-Jun | 20.3 | | n/a | n/a | 85 | 0 | 0 | 0% | |
| 59 | 27-Jun | 14 | | unk | unk | 138 | 7 | 0 | 5% | 8/26 overwash |
| 60 | 27-Jun | 4.64 | | n/a | n/a | 119 | 0 | 0 | 0% | 7/22,7/23.8,21 overwash |
| 61 | 28-Jun | 13.5 | | 9-Sep | 73 | 150 | 38 | 5 | 22% | 15 pipped UH, 7/23, 8/26 overwash |
| 62 | 29-Jun | 11.5 | | 2-Sep | 65 | 92 | 85 | 0 | 92% | |
| 64 | 29-Jun | 10.32 | 11.3 | 2-Sep | 65 | 88 | 87 | 0 | 99% | 9/3 crab predation although it may have hatched |
| 67 | 29-Jun | 7.49 | 5.18 | n/a | n/a | 138 | 0 | 0 | 0% | 7/23 overwash |
| 72 | 2-Jul | 3.84 | 5.19 | n/a | n/a | 115 | 0 | 0 | 0% | 7/22 overwash |
| 73 | 3-Jul | 8.01 | 5.17 | 4-Sep | 63 | 126 | 109 | 1 | 86% | 7/23 overwash |
| 78 | 4-Jul | 5.42 | | 9-Sep | 67 | 156 | 2 | 0 | 1% | |
| 80 | 4-Jul | 5.05 | | n/a | n/a | unk | | | 0% | 7/23, lost to Hurricane Bill (8/21) |
| 82 | 5-Jul | 4 | | n/a | n/a | 115 | 0 | 0 | 0% | 7/23, 8/21,8/29,9/4,9/5,9/12 overwash |
| 84 | 5-Jul | 11.5 | | n/a | n/a | unk | | | 0% | 7/19 eroded/washed away. |
| 88 | 9-Jul | 5.99 | 5.17 | n/a | n/a | 108 | 0 | 0 | 0% | 7/10 overwash |
| 89 | 10-Jul | 12.4 | | n/a | n/a | 133 | 0 | 0 | 0% | |
| 90 | 10-Jul | 10.77 | | unk | unk | 117 | 8 | 6 | 2% | 7/22,7/23,8/29,9/11,9/12,9/13 overwash |
| 92 | 11-Jul | 4.42 | | n/a | n/a | 139 | 0 | 0 | 0% | 7/22,7/23,8/21,8/29,9/4,9/5,9/12 overwash |
| 94 | 13-Jul | 11.5 | | 16-Sep | 65 | 108 | 104 | 1 | 95% | 9/18 one hatchling track, 9/20 dead hatchling found brought in for sample |
| 96 | 15-Jul | 10.67 | | n/a | n/a | 117 | 0 | 0 | 0% | 9/19 GC hole. 9/22 finished roping and dug out. |
| 97 | 16-Jul | 12.9 | | 19-Sep | 65 | 120 | 114 | 0 | 95% | overwash 7/21 8/21. |
| 98 | 16-Jul | 11.1 | 11.3 | 23-Sep | 69 | 68 | 67 | 1 | 97% | overwash 7/23, |
| 99 | 17-Jul | 8.75 | 5.16 | 24-Sep | 69 | 118 | 103 | 2 | 86% | overwash 7/10. |

| | | | | | | | | | | |
|-----|--------|-------|------|--------|-----|-----|-----|---|-----|--|
| 102 | 19-Jul | 21 | | n/a | n/a | unk | | | 0% | lost to hurricane Bill. |
| 103 | 19-Jul | 11.3 | | 28-Sep | 71 | 116 | 104 | 0 | 90% | overwash 7/24, 8/29, 9/5, 9/12, 9/14. 9/22 |
| 105 | 19-Jul | 5.25 | | 9-Sep | 52 | 144 | 127 | 9 | 82% | |
| 109 | 21-Jul | 4.73 | 5.15 | unk | unk | 112 | 104 | 0 | 93% | overwash 7/10 |
| 111 | 21-Jul | 13 | 11.9 | 19-Sep | 60 | 92 | 88 | 1 | 95% | |
| 113 | 22-Jul | 12.7 | | unk | unk | 136 | 119 | 0 | 88% | roots in nest |
| 114 | 22-Jul | 3.7 | 5.14 | unk | unk | 137 | 5 | 0 | 4% | |
| 115 | 23-Jul | 19.4 | | n/a | n/a | 109 | 0 | 0 | 0% | overwash 8/29, 9/9, 9/12, 9/17, 9/19. |
| 127 | 25-Jul | 6.2 | 5.13 | unk | unk | 128 | 107 | 0 | 84% | |
| 131 | 28-Jul | 11.1 | | 28-Sep | 62 | 89 | 82 | 0 | 92% | no closure-hatched into tire ruts |
| 138 | 8-Aug | 2.79 | | n/a | n/a | 107 | 0 | 0 | 0% | overwash 8/21,8/26,9/5,9/12 |
| 139 | 2-Aug | 19.9 | | n/a | n/a | unk | | 0 | 0% | Washed away during hurricane Bill swells |
| 140 | 2-Aug | 10.05 | | n/a | n/a | 116 | 0 | 0 | 0% | overwash 8/21, 8/29, 9/5, 9/12, 9/17, 9/19, 9/22. |
| 143 | 5-Aug | 9.05 | | n/a | n/a | 126 | 0 | 0 | 0% | overwash 8/21. sand deposition. |
| 144 | 5-Aug | 5.01 | | 1-Oct | 57 | 102 | 90 | 0 | 88% | premature excavation on 9/15. |
| 145 | 9-Aug | 16.5 | | unk | unk | unk | | | unk | washed away by tide on 10/22 |
| 146 | 16-Aug | 14.15 | | n/a | n/a | 111 | 0 | 0 | 0% | overwash 8/26, roots in nest |
| 147 | 21-Aug | 11.3 | 11.3 | n/a | n/a | 115 | 0 | 0 | 0% | |
| 148 | 27-Aug | 16.5 | | n/a | n/a | 112 | 0 | 0 | 0% | roots in nests |
| 152 | 28-Aug | 11.2 | | n/a | n/a | 102 | 0 | 0 | 0% | overwash 9/12, 9/17, 9/18. |

Table 10. South Core Banks Sea Turtle Nesting Data-2009

| # | Date | Mile | Relocated Mile | Hatch Date | Incubation days | Total # Eggs, (TC) | # Hatchlings, (H) | # hatch dead, (HD) | % Emerge, (H-HD/TC) | Comments |
|----|--------|-------|----------------|------------|-----------------|--------------------|-------------------|--------------------|---------------------|--|
| 1 | 28-May | 43.44 | | 1-Aug | 65 | 126 | 94 | 0 | 75% | |
| 7 | 2-Jun | 45.97 | | 5-Aug | 64 | 134 | 127 | 0 | 95% | ghost crab tracks next to hatchling tracks & cat tracks in area |
| 12 | 4-Jun | 41.84 | | 7-Aug | 64 | 153 | 120 | 0 | 78% | |
| 13 | 4-Jun | 41.57 | | 8-Aug | 65 | 109 | 15 | 1 | 13% | 3 ft of sand deposition on nest, received several days of overwash |
| 14 | 7-Jun | 41.27 | | 8-Aug | 62 | 139 | 124 | 0 | 89% | possible ghost crab predation |
| 18 | 7-Jun | 43.53 | | 8-Aug | 62 | 157 | 102 | 2 | 64% | |
| 19 | 8-Jun | 45.37 | | 12-Aug | 65 | 109 | 98 | 0 | 90% | hatchlings tracks found for 1/2 mile in tire ruts on either side of nest |
| 20 | 8-Jun | 45.58 | 41.91 | 17-Aug | 70 | 95 | 85 | 0 | 89% | |
| 22 | 9-Jun | 27.44 | 26.94 | 19-Aug | 71 | 133 | 59 | 0 | 44% | 74 unhatched eggs were all undeveloped |
| 24 | 11-Jun | 31.33 | | 20-Aug | 70 | 74 | 19 | 0 | 26% | nest was saturated - heavy, wet sand |
| 25 | 11-Jun | 42.95 | | 7-Aug | 57 | 119 | 115 | 0 | 97% | |
| 26 | 12-Jun | 40.68 | | 13-Aug | 62 | 109 | 95 | 1 | 86% | several holes found morning of 8/13 in nest area each with 1 live hatchling; sand was heavy & compacted from rains |
| 28 | 14-Jun | 23.91 | | 10-Aug | 57 | 112 | 100 | 0 | 89% | 6-14 ghost crab predation |
| 29 | 15-Jun | 23.64 | 26.9 | 20-Aug | 66 | 79 | 71 | 0 | 90% | 8-22 overwash from H. Bill |
| 30 | 16-Jun | 33.29 | | 18-Aug | 63 | 139 | 125 | 0 | 90% | 8-21 raccoon tracks over nest site but no signs of digging or shell fragments |
| 34 | 18-Jun | 35.62 | | n/a | n/a | 122 | 0 | 0 | 0% | 8-22 & 8-23 overwash from H. Bill plus 2 ft of sand deposition |
| 35 | 18-Jun | 41.55 | | 20-Aug | 63 | 104 | 6 | 0 | 6% | remaining eggs were undeveloped |
| 36 | 18-Jun | 42.99 | | n/a | n/a | 145 | 0 | 0 | 0% | 8-21 thru 8-25 received heavy overwash |

| | | | | | | | | | | |
|----|--------|-------|-------|--------|-----|-----|-----|-----|-----|--|
| | | | | | | | | | | from H. Bill plus 3 ft of sand deposition; 8-29 overwashed from TS Danny |
| 37 | 19-Jun | 42.01 | | unk | unk | 140 | 3 | 1 | 1% | 8-22 thru 8-24 received overwash from H. Bill plus 6 inches of sand deposition; 8-29 overwashed from TS Danny; 8-28, 9-30 & 8-31 ghost crab predation |
| 38 | 20-Jun | 40.12 | 41.94 | 19-Aug | 60 | 140 | 132 | 1 | 94% | |
| 39 | 21-Jun | 23.75 | | unk | unk | 96 | 26 | 0 | 27% | 6-23 ghost crab predation; 8-22 overwash from H. Bill; 8-28 & 8-29 overwash from TS Danny |
| 40 | 21-Jun | 42.41 | | 20-Aug | 60 | 157 | 143 | 0 | 91% | |
| 43 | 24-Jun | 39.29 | | 26-Aug | 63 | 85 | 66 | 1 | 76% | 8-22 mild overwash from H. Bill |
| 46 | 25-Jun | 39.45 | | 20-Aug | 56 | 86 | 50 | 2 | 56% | |
| 50 | 25-Jun | 43.3 | | 26-Aug | 62 | 108 | 94 | 0 | 87% | 8-22 thru 8-24 overwash from H. Bill + 10" of sand deposition |
| 51 | 25-Jun | 43.4 | | 24-Aug | 60 | 96 | 88 | 0 | 92% | 8-22 thru 8-24 overwash from H. Bill, 8-25 ghost crab predation |
| 55 | 26-Jun | 33.36 | | 26-Aug | 61 | 112 | 92 | 4 | 79% | 8-22 overwash from H. Bill |
| 56 | 26-Jun | 41.14 | | 22-Aug | 57 | 131 | 124 | 0 | 95% | |
| 58 | 26-Jun | 43.45 | | unk | unk | 148 | 146 | 141 | 3% | 8-22 & 8-23 under pool of water from H. Bill plus 1 ft sand deposition; 8-29 overwash from TS Danny |
| 59 | 27-Jun | 29.62 | | 28-Aug | 62 | 99 | 92 | 2 | 91% | |
| 64 | 29-Jun | 43.57 | 41.95 | 29-Aug | 61 | 99 | 85 | 1 | 85% | 6-29 & 8-31 ghost crab predation |
| 67 | 30-Jun | 44.49 | | n/a | n/a | 103 | 0 | 0 | 0% | 8-21 thru 8-25 received heavy overwash from H Bill plus 2 ft sand deposition; 8-29 overwash from TS Danny |
| 69 | 2-Jul | 39.83 | 41.93 | 28-Aug | 57 | 140 | 136 | 0 | 97% | |
| 71 | 2-Jul | 43.39 | | n/a | n/a | unk | unk | unk | 0% | 8-21- 8-25 overwash from H Bill, 1 ft sand deposition; 8-29 overwash from TS Danny; 8-25, 8-30 & 8-31 crab predation; 9-3 nest lost to Northeaster storm |
| 72 | 3-Jul | 43.79 | 42.1 | 1-Sep | 60 | 154 | 144 | 3 | 92% | 8-22 overwashed from H Bill |

| | | | | | | | | | | |
|----|--------|-------|-------|--------|-----|-----|-----|-----|-----|--|
| 74 | 5-Jul | 29.64 | 26.83 | 8-Sep | 65 | 123 | 117 | 0 | 95% | 8-22 overwashed from H Bill |
| 75 | 5-Jul | 32.13 | | n/a | n/a | 150 | 0 | 0 | 0% | 8-21-8-25 overwash & sand deposition from H. Bill; 8-28 thru 8-30 overwash from TS Danny; 9-3 steep erosion cliff forming in front of nest from Northeaster; erosion and overwash continuing 9-5 thru 9-16 |
| 80 | 9-Jul | 36.69 | 35.38 | 8-Sep | 61 | 110 | 107 | 0 | 97% | 8-22 heavy overwash from H Bill; 9-9 ghost crab predation; 1 dead hatchling found on sand surface next to nest |
| 81 | 9-Jul | 41.75 | | 9-Sep | 62 | 109 | 100 | 0 | 92% | 9-9 ghost crab predation |
| 82 | 10-Jul | 29.51 | 27.59 | 15-Sep | 67 | 116 | 49 | 0 | 42% | 8-22 overwashed from H Bill, 9-18 overwash |
| 84 | 10-Jul | 28.94 | | n/a | n/a | 154 | 0 | 0 | 0% | 8-22 & 8-23 under pool of water from H Bill plus 1/2 inch of sand deposition; 9-18 overwash w/pooling on top of nest; 9/23 eggs partially developed embryos |
| 86 | 13-Jul | 41.85 | 41.87 | 7-Sep | 56 | 118 | 88 | 1 | 74% | nest was relocated onto dune face - some root bound eggs and hatchlings found |
| 88 | 15-Jul | 40.7 | | n/a | n/a | 140 | 0 | 0 | 0% | 8-22 & 8-23 heavy overwash from H Bill (probably under pool of water); 9-3 thru 9-6, 9-9, 9-11, 9-19 9-22 overwashed; 9-14 ghost crab predation |
| 89 | 15-Jul | 42.63 | | n/a | n/a | 136 | 0 | 0 | 0% | 8-22 & 8-23 nest under water from H Bill plus 1 ft of sand deposition; 9-12, 9-16, 9-17, 9-18, 9-19 9-21 overwash |
| 90 | 15-Jul | 44.2 | | n/a | n/a | 137 | 0 | 0 | 0% | CM,8-21 thru 8-25 heavy overwash from H Bill (nest under water during & around high tide) plus 4 ft of sand deposition; 8-29 overwashed from TS Danny |
| 91 | 16-Jul | 26.37 | | n/a | n/a | unk | unk | unk | 0% | 8-22 nest washed away from H Bill |
| 92 | 16-Jul | 43.3 | | 19-Sep | 65 | 129 | 122 | 0 | 95% | 8-22 thru 8-24 overwashed from H Bill plus 1 ft of sand deposition |
| 93 | 17-Jul | 28.49 | 27.55 | 17-Sep | 62 | 112 | 109 | 0 | 97% | 8-22 overwashed from H Bill; 8-25 overwashed |

| | | | | | | | | | | |
|-----|--------|-------|-------|--------|-----|-----|-----|-----|-----|--|
| 94 | 17-Jul | 45.42 | 42.15 | 17-Sep | 62 | 119 | 103 | 0 | 87% | 8-22 overwash from H Bill; 9-12 overwash; 9-14 ghost crab predation |
| 95 | 19-Jul | 33.5 | | 22-Sep | 65 | 84 | 78 | 1 | 92% | 8-22 overwash from H Bill; 9-23 observed ghost crab pulling hatchling out of nest cavity |
| 97 | 20-Jul | 29.31 | | unk | unk | 159 | 3 | 0 | 2% | 8-22 & 8-23 nest underwater from H Bill plus 3' of sand deposition; 8-29 overwash from TS Danny; 9-12, 9-13, 9-16,9-17,9-18, 9-22 overwash; 9-18 ORV violation |
| 98 | 22-Jul | 37.65 | | n/a | n/a | 114 | 0 | 0 | 0% | 8-22 & 8-23 heavy overwash and pooling from H Bill, 8-29 overwashed from TS Danny; 9-8, 9-12, 9-16, 9-18 overwashed |
| 99 | 22-Jul | 39.37 | | unk | unk | 110 | 101 | 0 | 92% | roots in nest |
| 107 | 26-Jul | 26.98 | | unk | unk | 138 | 50 | 1 | 36% | 8-22 & 8-25 overwash from H Bill; 8-29 overwash from TS Danny; 8-31, 9-12,9-17, 9-18, 9-19, 9-22 overwash |
| 108 | 26-Jul | 36.19 | | 28-Sep | 64 | 102 | 84 | 0 | 82% | ghost crab predation on 9/28 |
| 113 | 26-Jul | 43.24 | | n/a | n/a | unk | unk | unk | 0% | 8-22 thru 8-25 overwash from H Bill plus 1 ft sand deposition; 8-28 & 8-29 overwash from TS Danny; 8-29 & 8-30 overwash; 9-4 nest completely washed away |
| 115 | 27-Jul | 32.91 | | n/a | n/a | 113 | 0 | 0 | 0% | 8-21 & 8-22 overwash with pool of water on top of nest during high tide due to H Bill |
| 116 | 28-Jul | 42.97 | | 2-Oct | 66 | 120 | 118 | 0 | 98% | 8-22 & 8-24 overwash from H Bill, front PVC washed out & 2 front rebar of pred screen exposed but nest cavity still intact |
| 118 | 29-Jul | 42.9 | | n/a | n/a | unk | unk | unk | 0% | 8-22 overwash plus 1 ft sand deposition from H Bill; 8-28 Overwash from TS Danny; Northeast storm - nest completely lost on 9-8 |
| 119 | 30-Jul | 38.9 | | 2-Oct | 64 | 130 | 124 | 0 | 95% | nest partly in vegetation, roots in nests |
| 120 | 31-Jul | 35.87 | | n/a | n/a | 97 | 0 | 0 | 0% | 8-22 thru 8-25 heavy overwash from H Bill; 8-28 & 8-29 overwash from TS |

| | | | | | | | | | | |
|-----|--------|-------|-------|--------|-----|-----|-----|---|-----|--|
| | | | | | | | | | | Danny; 9-4 thru 9-9, 9-11, 9-16,9-17, 9-18, 9-19, 9-21, 9-22 overwash |
| 122 | 2-Aug | 34.42 | | n/a | n/a | 92 | 0 | 0 | 0% | 8-22 & 8-23 heavy overwash & some erosion from H Bill; 9-18 overwash |
| 124 | 3-Aug | 28.79 | | 12-Oct | 70 | 136 | 80 | 0 | 59% | 8-22 under water plus 1/2 ft sand deposition from H Bill; 9-12, 9-17 , 9-18 overwash |
| 125 | 6-Aug | 41.84 | 41.85 | 9-Oct | 64 | 80 | 66 | 0 | 83% | |
| 126 | 10-Aug | 43.31 | | 18-Oct | 69 | 124 | 115 | 1 | 92% | 8-22 thru 8-24 overwash from H Bill |
| 127 | 12-Aug | 28.26 | | n/a | n/a | 101 | 0 | 0 | 0% | 8-22 & 8-23 heavy overwash & pooling from H Bill; 8-28 & 8-29 overwash from TS Danny; 8-30, 9-5, 9-12,9-17, 9-18 overwash |
| 128 | 15-Aug | 43.27 | 42.22 | n/a | n/a | 135 | 0 | 0 | 0% | 8-21 thru 8-24 overwash plus 3 ' sand deposition from H Bill; 8-28 & 8-29 from TS Danny; 8-30 overwash; 9-2 erosion cliff formed in front of nest, eggs removed & relocated; 9-18 overwash |
| 129 | 17-Aug | 42.35 | | n/a | n/a | 88 | 0 | 0 | 0% | 8-22 & 8-23 overwash & 8" of sand deposition from H Bill; 8-29 overwash from TS Danny; 9-18 overwash |
| 130 | 19-Aug | 29.83 | 27.61 | n/a | n/a | 113 | 0 | 0 | 0% | 8-22 under standing water from H Bill; 9-21 ghost crab predation |

Table 11. Shackleford Banks Sea Turtle Nesting Data-2009

| # | Date | Mile | Relocated Mile | Hatch Date | Incubation days | Total # Eggs, (TC) | # Hatchlings, (H) | # hatch dead, (HD) | % Emerge, (H-HD/TC) | Comments |
|----|--------|-------|----------------|------------|-----------------|--------------------|-------------------|--------------------|---------------------|---|
| 1 | 5-Jun | 48.94 | | 6-Aug | 62 | 135 | 86 | 1 | 63% | |
| 3 | 12-Jun | 56.35 | | unk | unk | 3 | 3 | 0 | 100% | 3 egg nest only partially covered |
| 5 | 19-Jun | 55.4 | | 20-Aug | 62 | 60 | 53 | 0 | 88% | flooded on 7/23 and 7/24 |
| 6 | 25-Jun | 55.47 | | n/a | n/a | unk | unk | unk | unk | lost to hurricane Bill around expected hatch date of 8/24 |
| 9 | 10-Jul | 53.57 | | 11-Sep | 63 | 103 | 98 | 1 | 94% | flooded on 8/22, 8/23, 8/29, 6 inch sand deposition |
| 10 | 8-Jul | 50.3 | | n/a | n/a | 83 | 0 | 0 | 0% | flooded by tide on 8/22,8/23, 8/29 and 6 inch sand deposition on 8/22 |
| 11 | 9-Jul | 50.29 | | unk | unk | 100 | 1 | 0 | 1% | flooded on 7/23,8/22, 8/23, 8/29, 1-2 feet sand deposition on 8/22 and 8/23 |
| 12 | 12-Jul | 53.13 | | 13-Sep | 63 | 106 | 97 | 0 | 92% | flooded on 8/22,8/23,8/29 and sand deposition on 1 foot on 8/22 |
| 13 | 12-Jul | 53.81 | | 25-Sep | 75 | 103 | 99 | 0 | 96% | flooded by tide on 8/22, 8/23, 8/29 |
| 14 | 22-Jul | 53.58 | | 24-Sep | 64 | 77 | 71 | 0 | 92% | flooded by tide on 8/22, 8/23, 8/29 |
| 15 | 7-Aug | 54.92 | 54.24 | 8-Oct | 62 | 82 | 70 | 0 | 85% | relocated nest flooded on 8/22,8/23,8/29 |

APPENDIX II
2009 GIS SEA TURTLE ACTIVITY MAPS

Figure 4. 2009 North Core Banks Sea Turtle Activities.

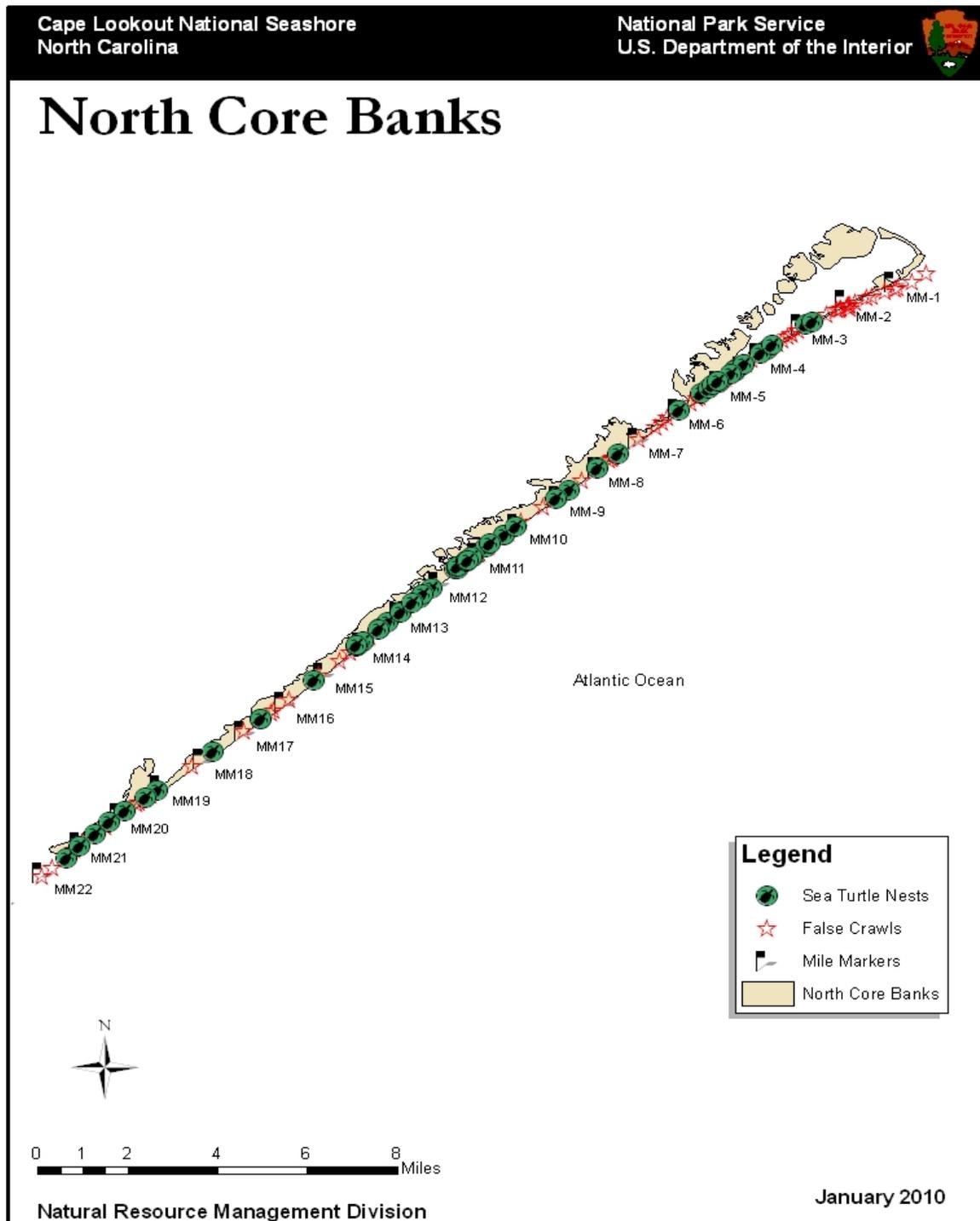


Figure 5. 2009 South Core Banks Sea Turtle Activities.

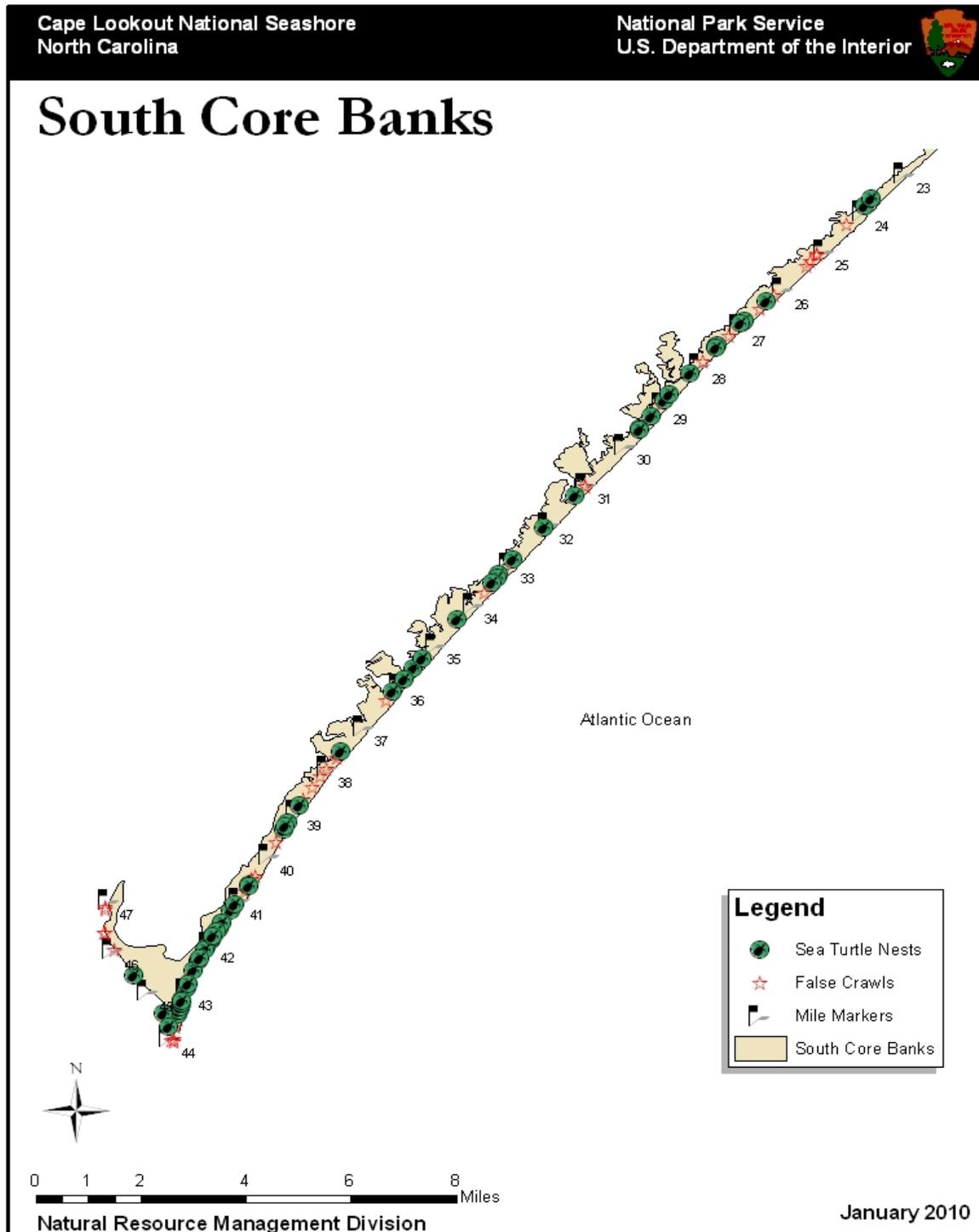
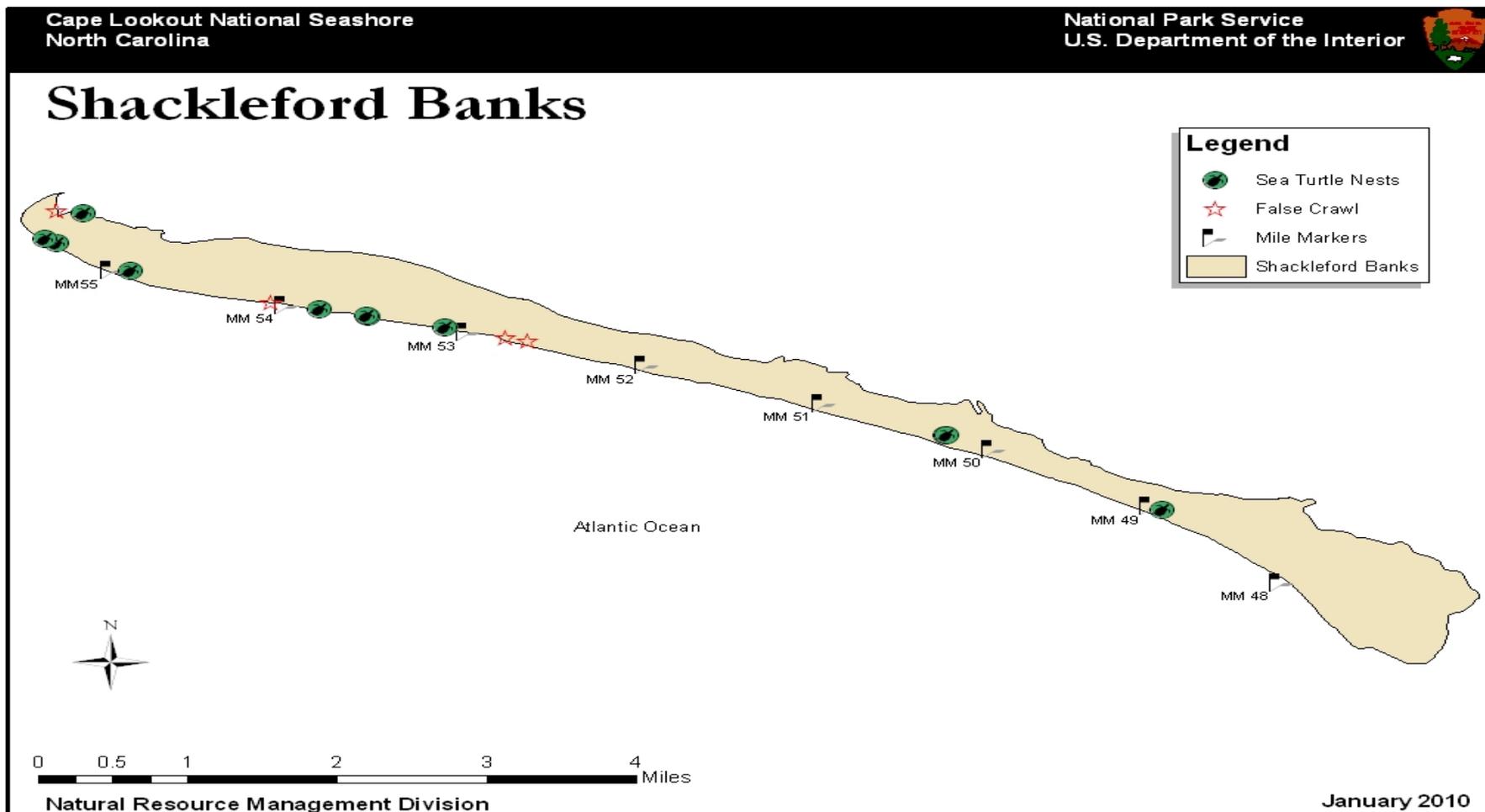


Figure 6. 2009 Shackleford Banks Sea Turtle Activities.



Appendix III

2009 SEA TURTLE PROGRAM PROCEDURES

2009 SEA TURTLE PROGRAM PROCEDURES

The basic procedures for the 2009 sea turtle program are outlined below. The monitoring program encompasses both turtle nesting activity and turtle strandings. The primary goal of the program is to ensure continued survival of sea turtles. This is done by:

- collecting data that can be used by the NPS and other organizations in developing sea turtle conservation programs
- protecting sea turtle nests and hatchlings

These procedures outline the basic organization of monitoring staff, describe field identification of nesting activities, and provide instructions on the monitoring system. In order to standardize data collection methodology and provide year to year consistency of data collection Cape Lookout will adopt the U.S. Fish and Wildlife's "Index Nesting Beach Survey Protocol". This protocol is given in Attachment 7.

ORGANIZATION OF MONITORING PROGRAM STAFF

The organization of the sea turtle monitoring staff is as follows:

Resource Management Specialist (RMS)

- Oversees the total program and assures all permits are current
- Acts a liaison with other agencies
- Represents CALO at public hearings regarding sea turtles
- Reviews and routes turtle related reports to appropriate authorities

Field Coordinator

- Reviews turtle activity reports
- Checks nest sites for proper marking
- Provides field guidance on locating nests, relocations, marking and follow-up
- Assures turtle monitoring staff are carrying out the program as described in the procedures
- Purchases related supplies and equipment
- Schedules staffing requirements
- Ensures follow-up checks are conducted on all nests and digs
- Completes the annual turtle program summary report

TYPES OF NESTING ACTIVITIES AND FIELD IDENTIFICATION TECHNIQUES

Nesting activity is defined as any terrestrial activity by sea turtles possibly related to nesting. These techniques were developed for loggerhead sea turtles, the majority of activities. See additional notes for other species. There are three types of nesting activities. Determining the type of nest activity is the initial step in field observations. The types of nesting activities and field techniques for identifying them are:

Nest: Nesting occurs when eggs have actually been laid. Usually, there is a body pit associated with a nest. A body pit is a large shallow depression or disturbance made in the beach from the turtle's initial digging activities; loggerhead body pits are about 2.5' in diameter and 6" deep. There are tracks associated with nesting activity. Loggerhead tracks are approximately 2' wide.

Choose the most likely spot(s) in the body pit and carefully dig down 10 to 15 inches by hand to locate the nest. You may determine the most likely spot by determining the direction of the turtle crawl and digging on the trailing edge of the body pit. The actual nest may be anywhere in or at the edge of the body pit. A methodical approach may be the easiest and most effective way of locating nests. Place surveyor flags in a circle around the area in which the nest is most likely to be found. Such a circle should encompass an area larger than the typical body pit. Divide the circle into quarters and excavate one quarter at a time. Do not refill any portion of the circle until either the nest is found or the entire circle has been checked. Nests are often difficult to find; you may have to dig several times to locate the nest. If eggs are found, do not disturb them unless the nest is to be relocated, refill the nesting area with sand. Pack the sand tightly; this is important for proper incubation.

Dig: A dig occurs when the turtle excavates a body pit or disturbs a large amount of sand but an egg chamber is unconfirmed. A nest is occasionally misidentified as a dig because an egg chamber is difficult to find, often because the body pit is indistinct or obscured by the turtle's activities. For this reason, every "dig" will be accurately marked, recorded, and monitored just as if it is a confirmed nest, except that the screening will not be installed

Crawl: Crawls are defined as turtle tracks that are not associated with any type of digging activity by the turtle. Crawls will only be counted if they extend above the most recent high tide line. Also referred to as a false crawl.

TURTLE NESTING ACTIVITY MONITORING SYSTEM

A uniform system to locate, mark, and record turtle nesting activity is necessary for coordinating staff efforts in collecting related data. This will enhance the long-term value of the data collected by making it easier to analyze and retrieve data. Equipment and materials needed for the monitoring program are listed in attachment 1.

Mile Markers: Mile markers are the primary means of recording locations of sea turtle nesting activity. It facilitates determining concentrations of nesting activity and relocating nests for follow-up. Beach areas are marked at one-mile intervals. Attachment 2 shows the "mile marker locations." More information on using the markers is contained in the instructions for completing the "Turtle Nest Data Sheets" (Attachment 3A).

Marking Nesting Activity Sites: Techniques for marking each activity are given below.

Nest Marking: Each nest is marked with four stakes. Stake #4 is placed two feet from the seaward side of the egg chamber. Stake #3 is placed three feet from the dune side of the egg chamber. Stake #1 is placed at the primary dune line and perpendicular to the shoreline (See attachments 4 and 4A). Stake #2 is placed three feet from the seaward side of stake #1 and in line with stakes #1, 3 and 4.

If the nest is laid behind the dune line, also place an extra stake at least 25' seaward of stake #4 so that it may be seen from the beach but not be below the high tide line.

The nest number will be written in waterproof ink on stakes number 1 and 3. This will facilitate identifying nests at a later time. This number is assigned from the "Activity No." column of the "Master Log of Sea Turtle Nesting Activity" (Attachment 5 and 5A). When marking a nest or dig measure 12" up from the surface of the sand at stakes #3 and 4 and mark the stakes at this height with a line completely around the stake using a permanent marker. Observe the mark daily for drastic sand deposition or erosion. Around the time of hatch, level sand over the nest to the original 12" mark.

Dig Marking: Digs will be marked the same as nests. Since the location/existence of any associated nest is in doubt, use the center of the body pit for the nest as a reference in setting stakes. This will require that you carefully excavate the stake locations by hand to check for presence of eggs prior to setting stakes.

Crawl Marking: Simply flag the highest point of the crawl. The flag should be removed when the tracks are no longer visible.

Recording Nesting Activity: Records of sea turtle nesting activity are kept on "Turtle Nest Data Sheets" (Attachment 3) and the "Master Log of Sea Turtle Nesting Activities" (Attachment 5 and 5A). Individual data sheets are used for each nest and dig. The log is used to summarize and keep track of turtle activities. Attachment 3A provides instructions on completing data sheets.

GPS Locations: The latitude and longitude of all activities will be recorded using a Garmin GPS unit. To mark a position press "mark" and "enter." The waypoint number should be the same as the activity number on the Master Log.

Relocating Nests: Nests laid at or below the high tide line or in areas where they are likely to be washed away will be relocated. Three areas on each island will be designated as closed to vehicles

and nests will be relocated into the closed area closest to the original nest site. Attachment 8 indicates which areas will be closed to vehicles for relocation purposes. Nests on Shackleford Banks will be relocated to the nearest suitable area.

Nests should be relocated within 12 hours after the eggs were laid. The following procedures should be followed for relocating nests.

1. When relocating a nest, be careful not to rotate the eggs.
2. Gently move the eggs from the nest into the pail.
3. Measure the dimensions of the nest chamber, depth to top of eggs, width of chamber, and depth to bottom of nest chamber. Use these dimensions to recreate the new nest chamber.
5. Fill in the original excavation and mark with a surveyor flag. After wind, rain, or tide has erased the tracks, remove the surveyor flag.
6. Transport the eggs preferably by foot to the new nest site. If the eggs must be moved by vehicle to the nearest relocation area, do so slowly and try to minimize jarring.
7. The eggs should be placed in the new nest site in the same layered fashion as the original nest.
8. Cover the eggs with sand.

This process should be completed quickly so that the temperature of the eggs will not change drastically.

PROTECTING NESTS

Nest protection will start as soon as the nest is discovered. "Digs" will be treated as "nests." Each nest will be staked/marked as described in attachments 4 and 4A. The main purpose of the stakes is to warn ORV Drivers away from nests and facilitate relocating nests later.

Place a 3' by 3' (2"x 4" mesh) screen over each nest. The 4" side of the wire opening should be parallel with the waterline. Anchor the four sides down with steel rebar and cover with 1" to 2" of sand. The screen is designed to protect the nest from raccoon predation. Some nests on SCB will be covered with a 3'x3'x2' wire cage to prevent raccoons from digging through the screen. Bury the edges of the cage about 6" and anchor it with rebar. Digs do not receive screening since rebar anchors could puncture unlocated eggs.

After 50 days have passed the turtle monitoring staff will erect a funnel-shaped barricade around those nests/digs not in protected areas (i.e. single nest) from the nest to a point at least 15 feet below the high tide line and smooth any ORV tracks in the enclosure. (The barricade should extend down to a point where the sand is usually hard enough to prevent formation of tire ruts). Attachment 6 diagrams the closure. This action provides a natural beach surface for the hatchlings to crawl to the ocean, protecting them from becoming trapped in ORV tracks. This barricade is removed after the nest is excavated. Barricade stakes will also be wrapped in orange or red reflector tape.

FOLLOW-UP ON NESTS AND DIGS

Follow-up of nesting activity involves excavating nests, looking for signs of turtle hatching, retrieving temperature HOBOS, and recording related data.

Follow-up of nesting activity begins fifty days after the nest was laid. Smooth the sand over and around the nest to a height equal to the original sand level indicated by the 12" line on stakes #3 and 4. This facilitates observing the small (2" to 4" inch) depression usually formed in the sand above the nests when hatching begins. Smoothing the sand also facilitates observing hatchling tracks. Excavate the nest on the fifth day after a major hatch (indicated by distinctive hatchling tracks), 10 days after the depression forms, or excavate the nest 75 days after the date laid if there has been no sign of hatching. Digs will be excavated after 75 days to determine if the activity was a nests or a crawl. If many live hatchlings are found in the nest, simply refill the nest with sand and continue to check until hatching occurs. Check the condition of the hatchlings prior to placing them back in the nest. If the egg yoke sack has not been fully absorbed by the hatchlings, then place them back in the nest, cover lightly with sand and allow them to complete this process. If the hatchlings are weak and or dehydrated (plastrons concave) they should be released as soon as possible. If there are hatchlings with fully absorbed egg yokes found in the nest after the main hatch, release them in the evening hours, preferably after dark. Such hatchlings should be allowed to crawl at least a short distance of beach and enter the ocean under their own power. Create/maintain a clear path to the ocean for the hatchlings; visitors should be kept back from the hatchlings to avoid stressing them. *It is a violation of our permit to dig into nests prior to hatch.*

When motionless hatchlings (apparently drowned) are located in a recently flooded nest, the following resuscitation efforts should be attempted.

1. Remove the hatchling from the water.
2. Invert hatchlings (head lower than tail).
3. Stimulate hatchlings by slight compressions of the plastron.
4. Raise the head to provide an open airway.
5. Continue stimulating for approximately 15 minutes.

If the hatchlings regain consciousness, monitor their progress and assist them in reaching the surf.

During late fall excavations, if sluggish turtles are located well after the 75-day normal incubation period, these measures may be taken.

1. Remove the turtles from the nests.
2. Allow them to warm on the sand or in a warm tidal pool until they become more active.

3. Assist the turtles to hard packed sand near the surf. If the turtles do not respond, the N.C. Aquarium may be telephoned for possible long-term care.

Digs are monitored daily beginning 10 days prior to estimated hatch date and ending at hatch or 75 days from date of lay, whichever occurs first. Look for signs of a depression or hatchling tracks within a 15-foot radius of the nest stakes.

Complete the "Hatching Data" section of the Turtle Nest Data Sheet. Remove the turtle nest stakes.

NOTES ON GREEN AND LEATHERBACK SEA TURTLES

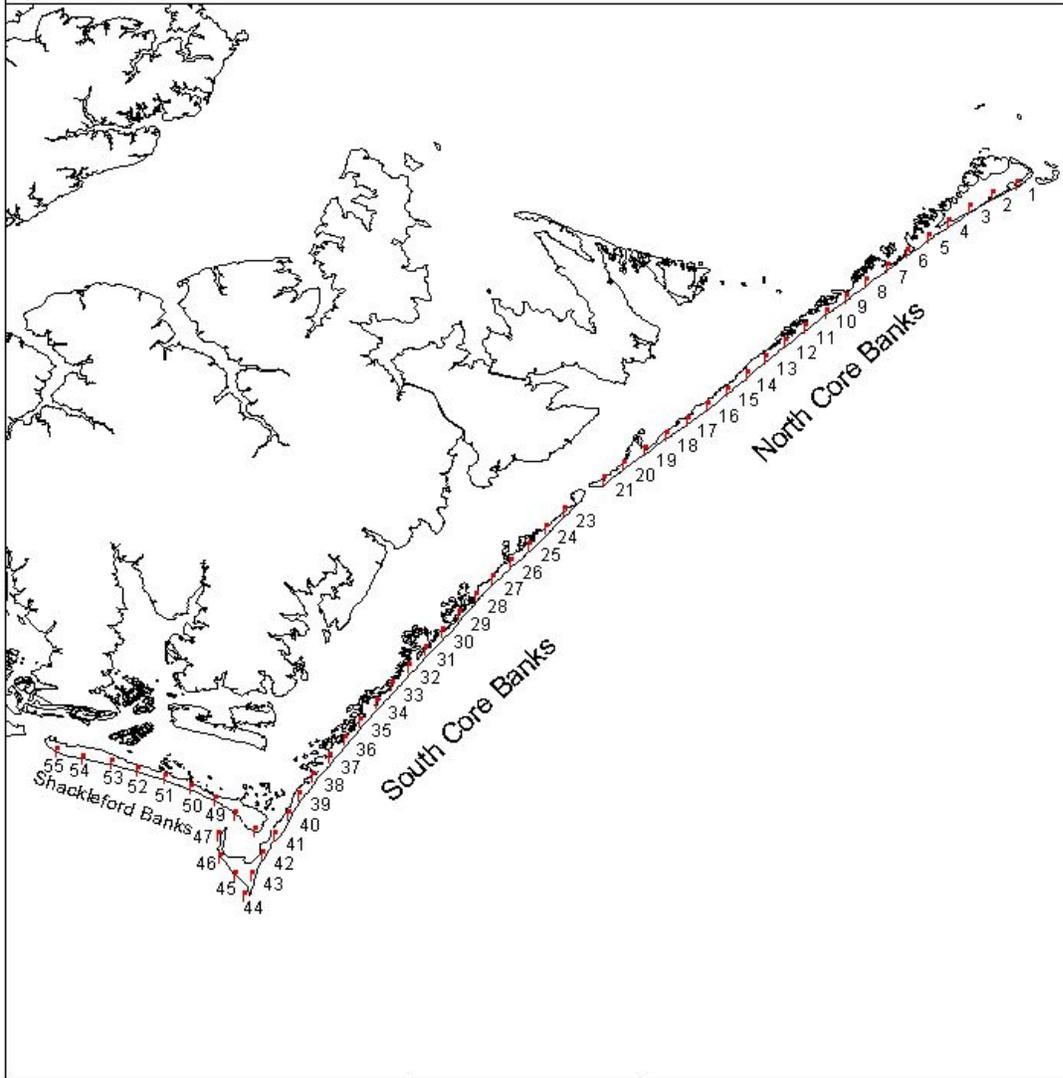
While 99% of the sea turtle nests at Cape Lookout are loggerhead nests, we do provide nesting habitat for green and leatherback sea turtles. We may have green turtle nests every year in low numbers and can occur throughout the summer. Leatherback nests occur less frequently, about every other year and typically occur in late spring and early summer. In 2007 there was a leatherback activity on April 30. In general these turtles are treated the same as the loggerheads except for some important differences. Both the green and leatherback nest are laid deeper in the sand, leatherback eggs can be up to a meter deep. The green eggs are slightly bigger than loggerheads and the leatherback eggs are at least double the size of loggerheads. Leatherback eggs often go unconfirmed due to their depth and the body pit size. Incubation for leatherback eggs is longer from 60 to 110 days. Incubation for green nests is also longer from 64 to 69 days.

ATTACHMENT 1

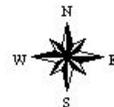
**EQUIPMENT AND MATERIALS
FOR
SEA TURTLE NEST MONITORING PROGRAM**

| <u>ITEM</u> | <u>DESCRIPTION</u> | <u>QUANTITY</u> |
|------------------------|---|------------------------------|
| Marker stakes | PVC 1 1/4" x 5' post and Wood 2"x2"x5' post | 2 per nest 2 per nest |
| Post hole diggers | | |
| Turtle monitoring kit | in pack, with contents as described below | 1 for each island |
| Orange reflective tape | 2" wide | |
| Tape measure | 100' | |
| Marker | waterproof (permanent ink or paint) | |
| Pens | | |
| Clip board | standard size | |
| Binder | for data sheets | |

Attachment 2- Mile Marker System Cape Lookout National Seashore



National Park Service
Cape Lookout National Seashore
Resource Management



Plot date: December 1, 2000 c:\my documents\gisbase\maps.apr

ATTACHMENT 3

TURTLE NEST DATA SHEET

CAPE LOOKOUT NATIONAL SEASHORE

NAME _____

_____ *North Core Banks* _____ *South Core Banks* _____ *Shackleford Banks*

Activity _____ (check one)
Number _____ Date _____ Nest _____ Dig _____ Turtle Observed? Y/N Species _____

Original Nest

Location (tenths of mile): _____

Site Desc. _____

Dist. above high tide _____

Distance below high tide _____

Dist. dune stake to nest _____

Relocated Nest

Location (tenths of mile): _____

Site Desc. _____

Dist. above high tide _____

Date and Time Relocated _____

Dist. dune stake to nest _____

of Eggs Relocated _____

Latitude _____ N

Longitude _____ W

Nest Damage/Predation (prior to hatchling emergence)

Date eroded/washed away _____

Date(s) flooded by tide _____, _____, _____, _____, _____, _____.

Human disturbances (circle one): ORV, Dug-up, Other _____

Ghost crab predation (date)? _____, _____, _____.

Raccoon predation (date)? _____, _____, _____.

HATCHING DATA

Dates nest hatched: _____ (circle major hatch date)

Excavated by _____ Date nest excavated _____

Hatched eggs, from which hatchlings escaped from egg H = _____

Hatched dead,
hatched from egg but dead in nest HD = _____

Unhatched eggs, includes turtles pipped dead..... UH = _____

Total eggs in Clutch (H+UH) TC = _____

Emergence success (H-HD/TC) ES = _____ %

Live Hatchlings released from nest LH = _____

ATTACHMENT 3A

INSTRUCTIONS FOR COMPLETING "TURTLE NEST DATA SHEET"

Activity Number - This number is assigned on the chronological order that the nesting activity (nest, dig, crawl) occurred in the area being monitored (South Core Banks, North Core Banks, or Shackleford Banks). For example, the number one would be entered for the first nest laid on North Core Banks (NCB); a three would be entered if it was the third nest laid on NCB.

Mileage - Mile Markers are the primary tools used in determining location. Mileage is obtained by using the mile markers and the ATV's odometer. For example, mileage of a nest that is .2 mile south of mile marker 40 on SCB is entered as 40.2. Refer to Attachment 2 for a diagram of the marker system.

Site Desc. - Descriptions such as "nested in grass", "nested among dunes", or "nest relocated to front of primary dune", etc. may be entered here.

Dist. above/below high tide - Give the distance in feet from the estimated high tide line.

Dist. dune stake to nest - This is the distance from the base of the stake farthest from the nest (stake #1), to the center of the egg chamber. This distance is measured following the natural grade between the stake and nest.

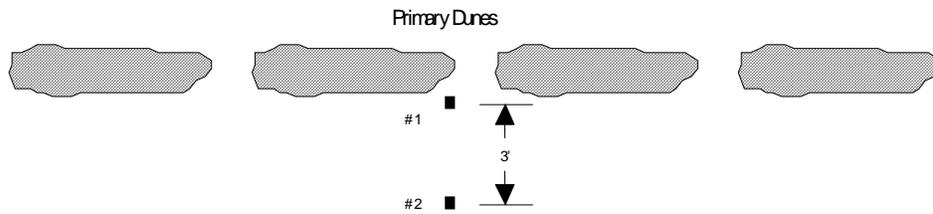
Latitude/ Longitude- If the nest is relocated, record the latitude and longitude of the new nest location using the GPS unit.

Predation- Record ghost crab predation if eggshells are found on the surface.

Emergence success - Percent of the eggs that hatched and produced turtles that emerged or were released from the nest.

ATTACHMENT 4

TURTLE NEST MARKER SYSTEM

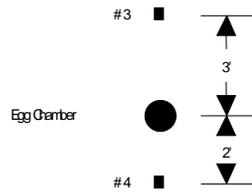


NOTES

- 1) Nest stakes are PVC, range stakes may be wooden or PVC
- 2) Stakes 1 through 4 must be on a straight line.
- 3) Stakes 3 and 4 should have orange reflector tape on top.

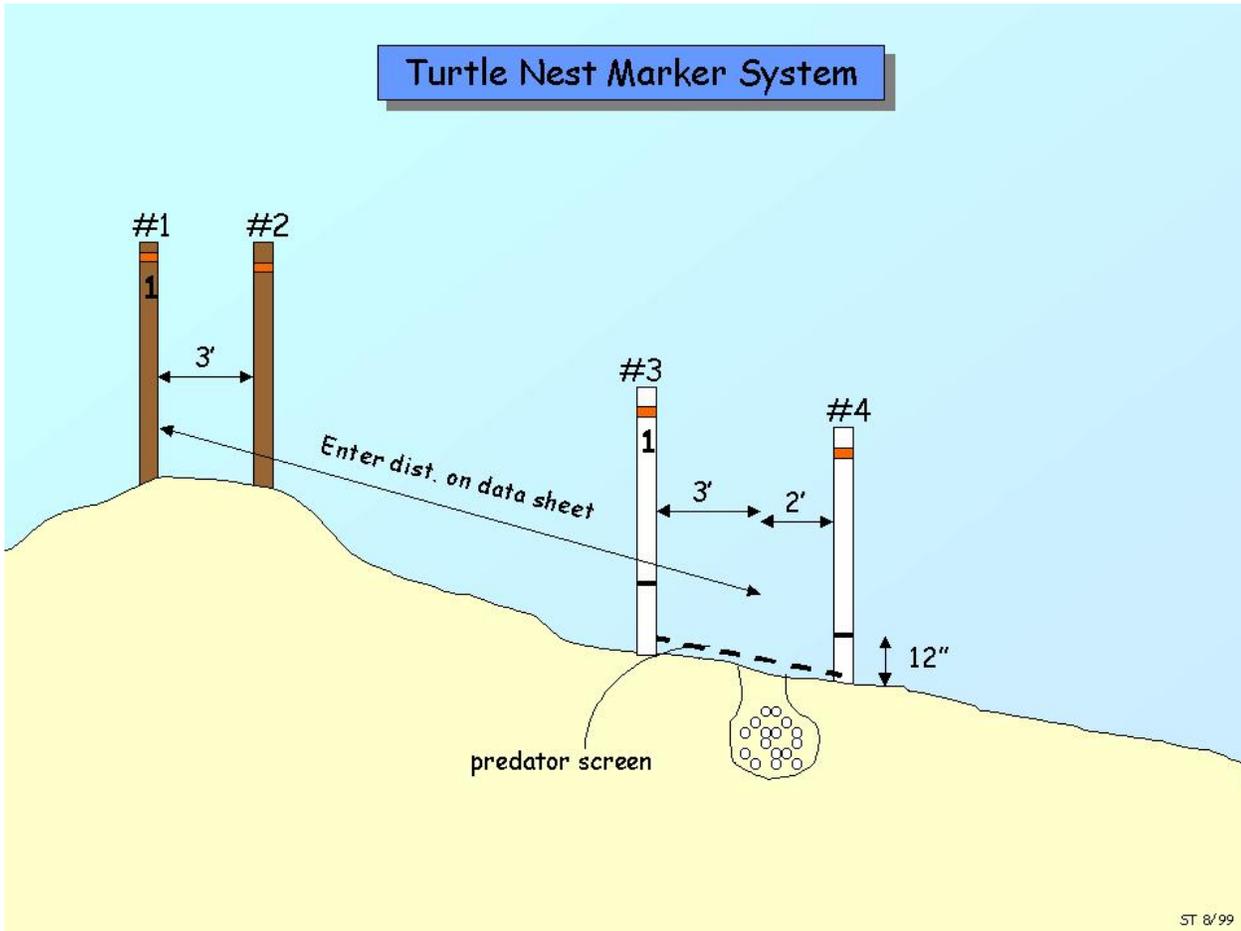
Legend

■ - Stake



ATTACHMENT 4A

TURTLE NEST MARKER SYSTEM



ATTACHMENT 5A

Instructions for Master Log of Sea Turtle Nesting Activities

Activity Number. This number is assigned sequentially and entered as the "Activity Number" on the turtle nest data sheet completed for each nest, dig, or crawl (N, D, or C) observed.

Location. Enter "mile" to the nearest tenth as entered on "Turtle Nest Data Sheet" in the "location" block for the original nest site and the relocated nest site.

Latitude and Longitude. Use a GPS unit to obtain the location. Record the location in DD.MMMMM format. Mark and save activity sequentially in GPS unit.

Date Occur. This is the date the activity is discovered.

Barricade Date. Add 50 days to the "Date Occurred" date to get this date. Smooth/level the sand over the egg chamber to facilitate observing formation of a "depression", an indication of hatching.

Estimated Hatch Date. This date is obtained by adding 60 days to the "Date Occurred." Start looking for a "nest depression" ten days before this date; continue watching the nest until either evidence of hatching occurs or 75 days have passed.

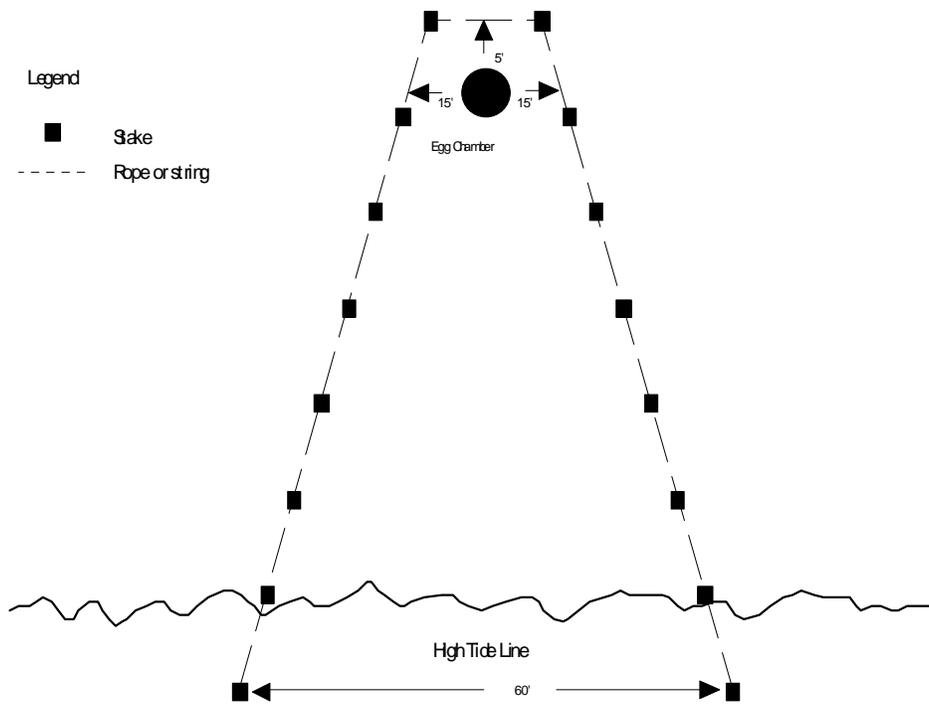
Depression Date. This date is taken by direct observation.

Actual Hatch Date. The day most hatchling tracks were observed or the day of the main emergence of hatchlings from the nest. If no sign of hatching was observed, excavate 75 days after the "Date Occurred".

Date Excavated. This is the date the nest was excavated by CALO personnel. Excavate five days after nest hatches.

ATTACHMENT 6 NEST BARRICADE

Primary Dunes



NOTES

- Approx 15' between posts
- Nest markers not shown

ATTACHMENT 7

U.S. FISH AND WILDLIFE SERVICE INDEX NESTING BEACH PROTOCOL

1. **Survey Consistency:** Standardization of data collection methodology and year to year consistency of data collection efforts are crucial to the long term success of the project. Adherence to the protocol outlined herein is necessary to eliminate survey bias. Deviations from this protocol must be relayed to project leaders in order to accurately interpret the data base.
2. **Survey Period:** All index beaches (east and west coast) south of and including Cape Canaveral National Seashore will be surveyed 15 May - 31 August of each year. All index beaches north of Canaveral National Seashore will be surveyed 1 June - 15 August of each year. Additional requirements for Cape Lookout National Seashore include monitoring from 1 May- September 15.
3. **Survey Time:** Surveys should be conducted in the early morning hours, preferably beginning at dawn.
4. **Survey Frequency:** There are several options, but one option must be selected and adhered to. Options are:
 - a. Seven (7) days per week. All crawls are marked daily to avoid duplicate counts on subsequent survey days. This is Cape Lookout National Seashore's option.
 - b. Six (6) days per week with randomized non-survey day and no "marking" of crawls on the non-survey day. Randomized non-survey days have been generated and will be provided by USFWS. Data is not reported from the non-survey day or from the survey immediately following the non-survey day. In other words, six (6) survey days without "marking" on the non-survey day result in 5 daily reported counts per week.
 - c. Six (6) days per week with randomized non-survey day and "marking" of crawls on the non-survey day. Randomized non-survey days have been generated and will be provided by USFWS. All crawls present on the non-survey day are "marked" prior to sundown. Data is reported from the survey day immediately following the non-survey day. Six (6) survey days with "marking" on the non-survey day result in 6 daily reported counts per week.
5. **Unplanned Missed Survey Days:** For projects surveying six days per week, an unplanned missed survey day may be substituted for a scheduled random non-survey day within the same week, provided the non-survey day has not already occurred. For all other situations follow

the procedures above in 4(b) and 4(c) as appropriate. Explain in remarks section of data report form for the affected week.

6. **Crawl Identification:** Surveyors will identify and record all "new" crawls by species and as nests or false crawls. False crawls will only be counted if they extend above the most recent high tide line. Crawl data will be reported by beach sector. The preferred length of beach sector is 1 km or 1/2 mile. Sectors must be identified with a unique numbering or lettering system.
7. **Crawl Verification:** Nest and false crawl determinations should be based on observable crawl characteristics. Digging for verification should not be routinely carried out. Probing for verification purposes is strongly discouraged.
8. **Data Reporting:** Data will be recorded on CALO Turtle Nest Data Sheets. Annual Sea Turtle Nesting Reports will be submitted to: NC Sea Turtle Program Coordinator

Attachment 8

Relocation Areas for Sea Turtle Nests

