CAPE LOOKOUT NATIONAL SEASHORE

2007 SEA TURTLE MONITORING AND MANAGEMENT REPORT

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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 2007 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 currently divided into five barrier islands. The northernmost island, North Core Banks (NCB) is approximately 19 miles long, extending from Ocracoke Inlet to Old Drum Inlet. From Old Drum Inlet to New Drum Inlet is a 3-mile long island of land formerly connected to NCB known unofficially as Middle Core Banks (MCB). In 2005 an inlet formed during Hurricane Ophelia creating a ¾ mile long island south of New Drum Inlet known as Ophelia Island. South Core Banks (SCB) extends southward from Ophelia Inlet almost 25 miles to Barden Inlet. The Core Banks have a northeast to southwest orientation and exhibit a low profile landscape. The fifth island, Shackleford Banks (SH) 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

Three of the five islands comprising the Seashore were regularly monitored for turtle nesting activity. The area between Old Drum Inlet and Ophelia Inlet was not accessible by vehicle and was only monitored irregularly from May-August. 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 enough so that the island was checked for turtle activity by 12:00 PM. Shackleford Banks was monitored by foot only once a week. For detailed information on procedures used in the 2007 Sea Turtle Program refer to Appendix I.

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 is considered in danger of erosion or tidal flooding. In 2007, 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 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 I, Attachment 7).

NESTING RESULTS

The first recorded nesting activity in 2007 was on May 1 and the last on September 1, for a 124 day nesting season. A total of 173 activities were documented of which there were 85 nests, 2 digs, and 86 crawls, (Table 1; see Appendix I for activity definitions). Three sea turtle species nested in the park with a total of 70 loggerhead turtle nests, 8 green turtle nests, and 7 leatherback nests found.

Table 1. 2007 ACTIVITIES BY STUDY AREA

	North Core Banks	South Core Banks	Shackleford Banks	CALO Total
NESTS	21	56	8	85
DIGS	2	0	0	2
CRAWLS	22	62	2	86

Figure 1. Cape Lookout Turtle Activities 1990-2007

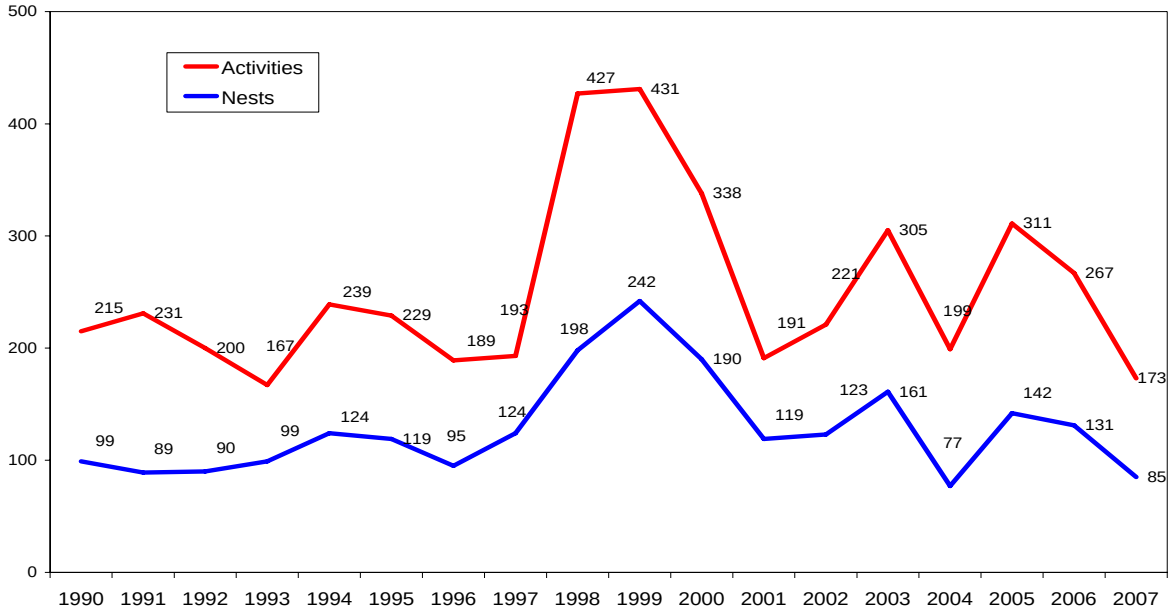
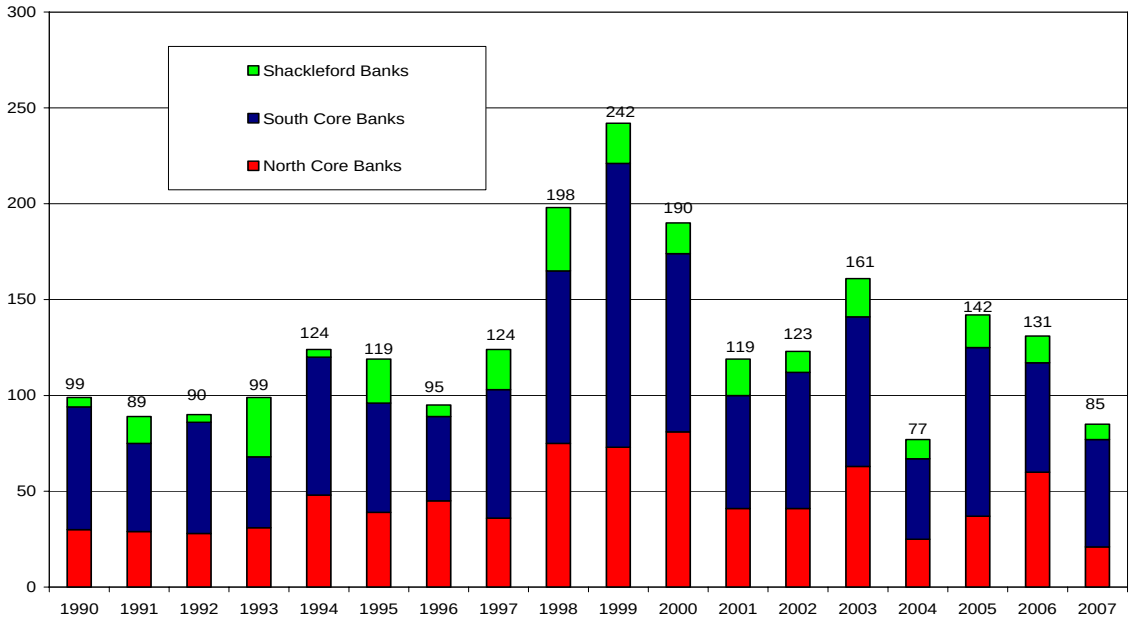


Figure 2. Turtle Nests 1990-2007



The number of nests found in 2007 (85 nests) was below the annual average for CALO (128 nests) (Fig. 1 and 2). The greatest concentration of nests in the park occurred between Mile 41 and 44 on SCB (Fig. 3). More than half of all the nests on the island were in this three mile area south of the lighthouse. The Leatherback turtle nests were found at 9-12 day intervals and were probably from a single female (Table 2). Eggs from the May 1st leatherback dig were not located initially, cool spring temperatures and repeated storm over wash flooding may have precluded hatching of suspected eggs. The green turtle nesting intervals suggest at least two nesting females (Table 3).

Table 2. Leatherback Turtle Nesting Intervals

Date	Activity Type	Island
May 1	Unconfirmed nest, Dig	NCB
May 13	Nest	SCB
May 22	Nest	SCB
May 31	Nest	SCB
June 9	Nest	SCB
June 18	Nest	SCB
June 27	Nest	NCB
July 7	Nest	SCB

Table 3. Green Turtle Nesting Intervals

Date	Activity Type	Island
June 24	Nest	SCB
June 28	Nest	NCB
July 13	Nest	SCB
July 18	Nest	SCB
July 20	Nest	SCB
August 4	Nest	SCB
August 6	Nest	SCB
August 21	Nest	SCB

Figure 3. 2007 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, often it can be determined if predators, human disturbance or environmental occurrences have adversely affected a nest. Individual nest data are in Appendix II.

The hatching results are first reported here as a combination of all species. The results by species are presented later in the report. A known total of 8,759 eggs, 6550 hatchlings, and 224 hatched dead were counted. The total hatch success, number of total eggs divided by number of total hatchlings, was 75%. The total emergence success of 72% (6326 emerged) was calculated by subtracting the total hatched dead from the total hatchlings and dividing by the total of eggs (Table 4). This is the same calculation for each individual nest emergence success (Appendix 1, Attachment 3). The emergence success range was from 0% to 99%. The average clutch size was 109 eggs. It took an average of 60 days for nests to incubate. Only one nest was washed away with the numbers of eggs unknown. On SCB four nests were destroyed by raccoon predation with the number of eggs unknown and ten nests suffered minor predation. A total of 19 nests were flooded by the ocean from one to five days. Ten of these 19 nests hatched, eight failed to hatch, and one was unknown. The emergence success for these 19 flooded nests was 39%. One of these flooded nests that failed to hatch was a nest laid on the sound side of Cape Lookout Bight.

Table 4. SEA TURTLE HATCH SUMMARY 1990-2007

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%

*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 that wasn't relocated, 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.

To provide a more accurate emergence success rate we have calculated an estimated emergence success of 68% in 2007 (Table 4). This figure includes 4 nests with unknown egg numbers that were lost to predation before hatching and 1 nest that was washed away. 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. SCB with five lost nests at an average clutch of 107 equals 535 eggs with 0% emerge success (Table 5).

Table 5. 2007 ACTIVITY SUMMARY BY STUDY AREA

	NCB	SCB	SH	TOTALS
NESTS	21	56	8	85
# KNOWN EGGS	2401	5458	900	8759
AVERAGE CLUTCH	114 eggs	107 eggs	113 eggs	109 eggs
EMERGE SUCCESS	76%	68%	86%	72%
ESTIMATED TOTAL EMERGENCE SUCCESS (including nests with unknown /averaged {535} egg totals)	76%	62%	86%	68%
AVERAGE INCUBATION	60 days	63 days	58 days	60 days
# LOST TO FLOODING	0	1	0	1
# LOST TO PREDATORS	0	4	0	4

In 2007, 24% of the nests were relocated, the lowest percentage since 1990. The emergence rate for relocated nests was 79% and the emergence rate for non-relocated nests was 70% (Table 6). The estimated emergence success for non-relocated nests was 65% which accounts for the four nests lost to raccoons and one lost to flooding.

Table 6. EMERGENCE SUCCESS OF RELOCATED VS. NON-RELOCATED NESTS BY STUDY AREA IN 2007

RELOCATED	NCB	SCB	SH	CALO Total
Nests	11	9	0	20 (24%)
Eggs	1244	1052	n/a	2296
Hatchlings	957	895	n/a	1852
# Hatch Dead	8	22	n/a	30
Emergence Rate	76%	83%	n/a	79%
NON-RELOCATED				
Nests	10	47	8	65 (76%)
Eggs	1157	4406	900	6463
Hatchlings	944	2974	780	4720
# Hatch Dead	63	128	3	194
Emergence Rate	76%	64%	86%	70%
Estimated Total Emergence Rate	76%	58%	86%	65%

Since 1990 emergence success has been slightly better for relocated nests (Table 7). The presence of elevated relocation areas and the impacts of major storms have been the key factors in the success of relocated nests. This year there were no major storm impacts during the sea turtle nesting and hatching period. The one nest that was lost to flooding was from a minor swell and flood event. In addition the majority of nests were maternally placed high on the beach or on the dunes.

Predation

In 2007, four nests were completely lost to predators. These nests were dug into by raccoons either before hatch or during hatching. These predation incidents were total losses and no reliable data could be gathered. These four incidents occurred on SCB south of the lighthouse. Ten other nests suffered minor raccoon predation. Twelve nests suffered minor ghost crab predation.

Table 7. 1990-2007 EMERGENCE SUCCESS FOR RELOCATED vs. NON-RELOCATED NESTS

YEAR	PERCENT OF NESTS RELOCATED	EMERGENCE RATE-RELOCATED	EMERGENCE RATE-NON RELOCATED*	% 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
AVERAGES	*53*	*67%*	*67% (58%)*	*90*

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

Three nests had roots in the egg chamber that destroyed eggs or trapped hatchlings. Sand deposition partially buried one nest and along with flooding may have prevented hatching. Hatchlings from two nests on SCB south of the lighthouse appeared disorientated and crawled north parallel to the shore. Some tracks eventually did turn to the ocean.

Hatch Results by Species

The 70 loggerhead, seven leatherback, and eight green turtle emergence success was 73%, 59% and 77%, respectively (Table 8.). Six of the seven confirmed leatherback nests hatched. The leatherback dig on NCB couldn't be confirmed as a nest. A nest was confirmed on nearby Ocracoke Island on April 18 and an obvious false crawl was recorded on NCB the day before this dig was recorded on May 1. Given this information of a 14 day interval the dig was probably a nest, but was omitted from our calculations. Seven of the eight green nests hatched. One was lost to flooding. The leatherback incubation range was from 69 days to 90 days with an average of 78 days. The green turtle incubation range was from 62 to 69 days with an average of 65 days.

Table 8. Loggerhead, Leatherback, and Green Sea Turtle Hatch Summary, 2007.

	Loggerhead	Leatherback	Green
NESTS	70	7	8
# EGGS	7316	620	823
# HATCHLINGS	5537	373	640
# HATCH DEAD	212	7	5
EMERGENCE SUCCESS	73%	59%	77%
AVERAGE CLUTCH	110 eggs	88 eggs	118 eggs
AVERAGE INCUBATION	57 days	78 days	65 days

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. Eighty four violations of vehicle closures for turtle nests were documented by resource management staff for the seashore. NCB accounted for 70 of these violations and SCB had 14 violations recorded. These vehicles drove between posts and the ocean at low tides or drove through posts and rope. On SCB nest # 111 was urinated and defecated on with paper left on site.

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 the principal 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 2007, the park only needed to relocate 20 nests that were threatened with tidal flooding or erosion. The remaining 65 nests were laid high on the beach or on the dunes. In addition the nesting season was relatively free of major storms. These above factors provided for a 76% hatch rate and a 73% emergence rate for loggerheads to achieve this recovery plan objective.

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 pilot study in 2007 in cooperation with NCWRC to measure sand temperature and nest temperatures. Six HOBO temperature data loggers were placed on Shackleford and North Core Banks in late May to record sand temperatures throughout the nesting season. Additional HOBO data loggers were deployed in early July. Both relocated and non-relocated nests on NCB and SCB received two data loggers in the nest and in the sand three feet away. In 2008 we plan to use what we learned this summer and place HOBO data loggers in nests throughout the whole nesting season and report the results.

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.

Sixty four strandings occurred at CALO in 2007. All strandings were reported to the NCWRC and were documented with a "Sea Turtle Stranding and Salvage Network" stranding report. Green turtles accounted for the majority of the strandings (38). There were also 19 loggerhead turtles, one Kemp's Ridleys, and six unknown. The month of December had the greatest number of strandings when there was a cold stun event on SCB (Table 9). Twenty eight (43%) of the strandings were found on the soundside of the islands, the remaining 36 (56%) on the ocean beach.

Seven live sea turtle strandings occurred in the park in 2007. Six were cold stunned on 12/07/07. All were greens and were transported out of the park and sent to the Topsail Turtle Hospital or the Pine Knolls Shore NC Aquarium.

Table 9. 2007 SEA TURTLE STRANDINGS AT CAPE LOOKOUT NATIONAL SEASHORE

	NCB	SCB	SH	HI	TOTAL
January	0	1	1	0	2
February	0	0	1	0	1
March	0	1	0	0	1
April	1	3	1	0	5
May	0	4	2	1	7
June	1	2	5	0	8
July	3	2	0	1	6
August	2	4	0	0	6
September	2	2	0	0	4
October	0	3	0	0	3
November	0	2	1	0	3
December	5	10	3	0	18
Total for 2007	14	34	14	2	64

Turtles were scanned for Passive Integrated Transponder (PIT) tags. PIT tags or metal tags were found in one green turtle and one loggerhead (Table 10). All or parts of some turtles were salvaged for NOAA Fisheries researchers. Tables 11 and 12 provide stranding data by island and species from 1990 to 2007.

Table 10. TAGGED SEA TURTLES FOUND AT CALO IN 2007

Stranding #	Species	Date Found	Island	Metal Tags #	PIT tag #
07-04	Loggerhead	06-Mar	SCB	RRS 206	unknown
07-55	Green	07-Dec	SCB	none	4853271A32

Table 11. CALO SEA TURTLE STRANDINGS 1990 – 2007

YEAR	NCB	SCB	SHACK	OTHER	TOTAL
1990	11	18	14		43
1991	8	8	4		20
1992	18	16	10	1	45
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

Table 12. CALO TURTLE STRANDINGS BY SPECIES 1990-2007

YEAR	LOGGERHEAD	GREEN	KEMP'S RIDLEY	LEATHERBACK	HAWKSBILL	UNKNOWN
1990	33	7	1	2	0	0
1991	16	2	1	0	0	1
1992	30	13	1	1	0	0
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

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.
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. Implement sand and nest temperature study in cooperation with NCWRC for the complete nesting seasons of 2008 and 2009.
7. Revise Cape Lookout National Seashore Sea Turtle Program Procedures to include guidelines for leatherback and green sea turtle nests.

APPENDIX I

2007 SEA TURTLE PROGRAM PROCEDURES

2007 SEA TURTLE PROGRAM PROCEDURES

The basic procedures for the 2007 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. 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: Activities are labeled as nests when eggs have been found. 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 3.5' to 4' 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: Activities are considered digs when the turtle excavates a body pit or disturbs a large amount of sand but no eggs are found. 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.

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.

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. 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 found near or below the high tide line or in other areas likely to flood should be relocated. Areas on North and South Core Banks will be designated as relocation areas and nests will be moved to the 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 or wait until 14 days after the date the nest was laid. The following procedures should be followed for relocating nests.

1. Dig a nest cavity, approximately 18" deep and 12" wide in a suitable location.
2. Place approximately 6" of cool sand (from the nest cavity) in the bottom of a bucket.
3. When relocating a nest, be careful not to rotate the eggs.
4. Gently move the eggs from the nest into the pail.
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, 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 locating 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.

After 50 days have passed the turtle monitoring staff will erect a funnel-shaped barricade around those nests/digs not in protected areas 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 hatch. 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, 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) or excavate the nest 75 days after the date laid if there has been no sign of hatching. 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 the 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. After 75 days excavate the site to determine the presence or absence of eggs.

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

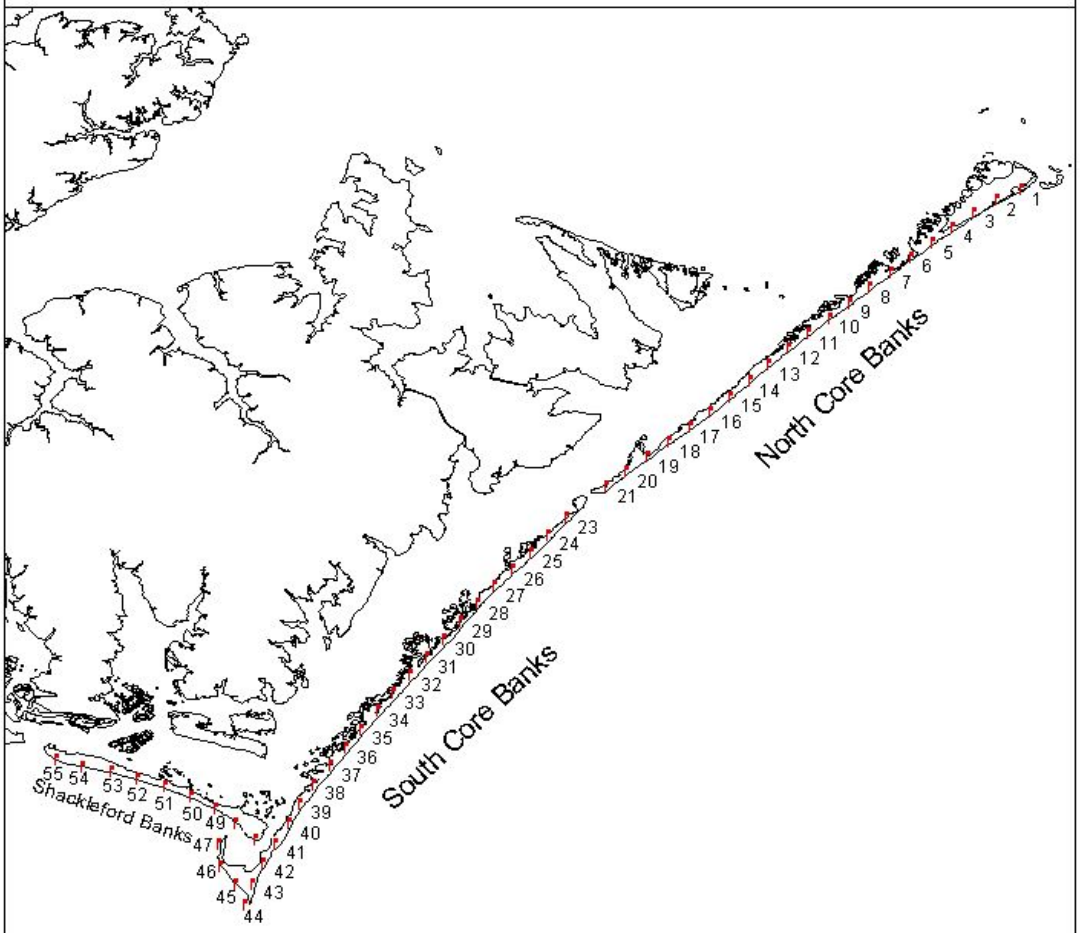
ATTACHMENT 1

EQUIPMENT AND MATERIALS
FOR
SEA TURTLE NEST MONITORING PROGRAM

ITEM	DESCRIPTION	QUANTITY
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)	
GPS Unit		
Binder	for data sheets	

Attachment 2- Mile Marker System

Cape Lookout National Seashore



National Park Service
Cape Lookout National Seashore
Resource Management

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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. Mileage can also be determined using the "nearest waypoint" feature on the GPS unit.

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.

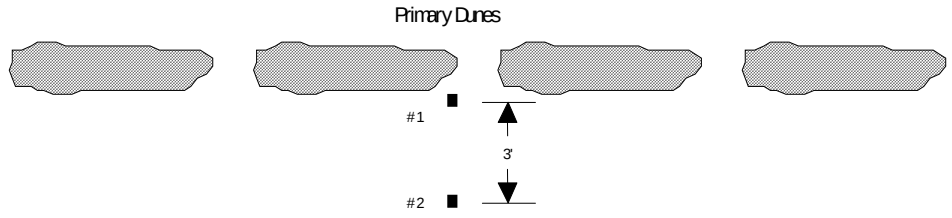
Latitude/ Longitude- If the nest is relocated, record the latitude and longitude of the new nest location using the GPS unit.

Predation- Record ghost crab or raccoon 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:

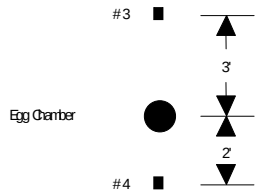
1) Nest stakes are PVC, range stakes may be wooden or PVC.

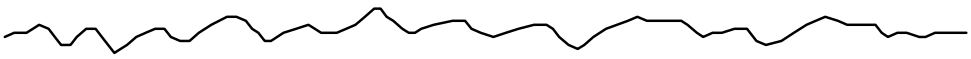
2) Stakes 1 through 4 must be on a straight line.

3) Stakes 3 and 4 should have orange reflector tape on top.

Legend

■ - Stake





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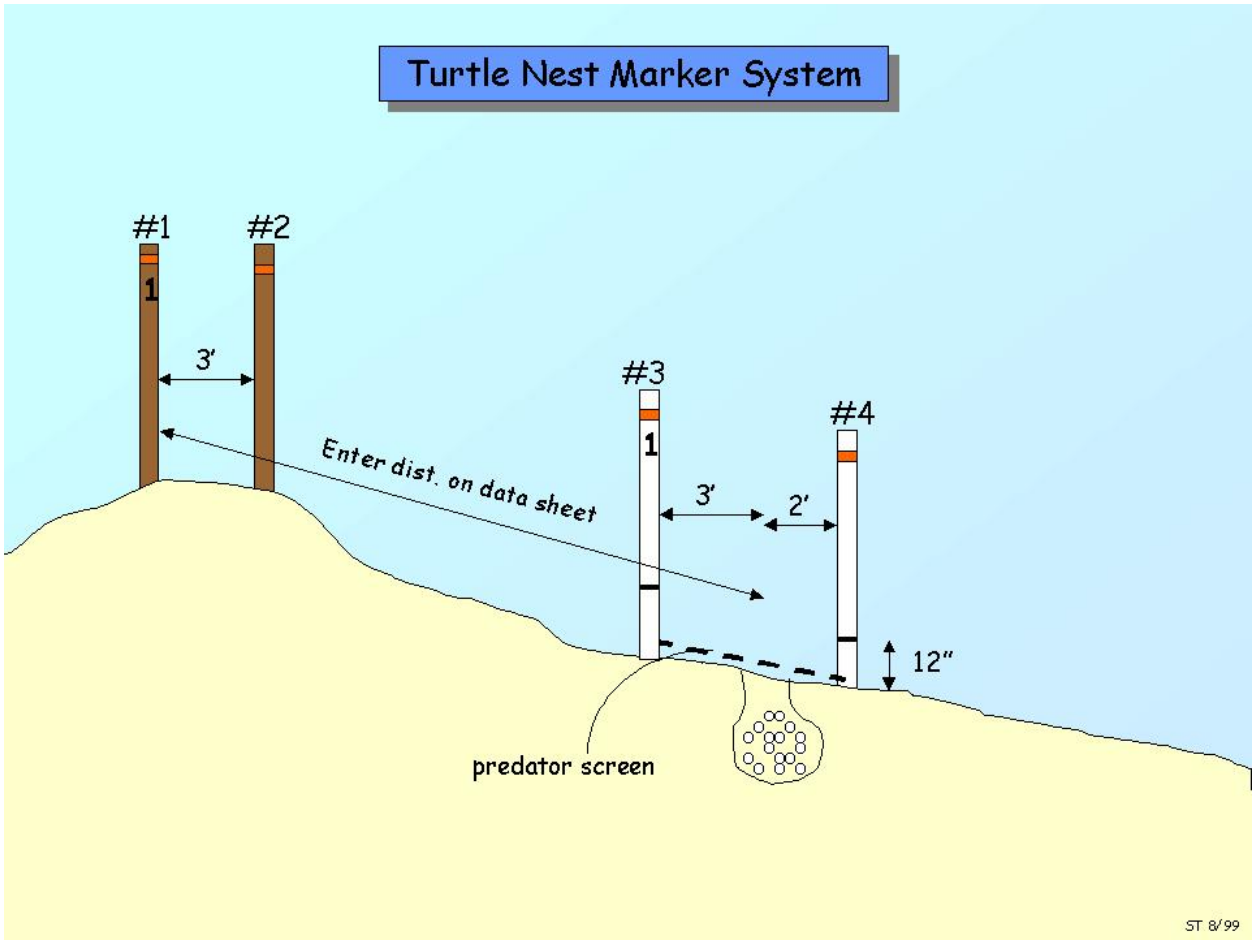
ATTACHMENT 4A

TURTLE NEST MARKER SYSTEM



ATTACHMENT 5- MASTER LOG OF SEA TURTLE NESTING ACTIVITIES 2007

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

Activity Number	N	D	C	Location Original	Location Relocated	Latitude	Longitude	Date Occurred	Barricade Date	Estimated Hatch Date	Depress Date	Actual Hatch Date	Date Excavated

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 Decimal Degree format.

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.

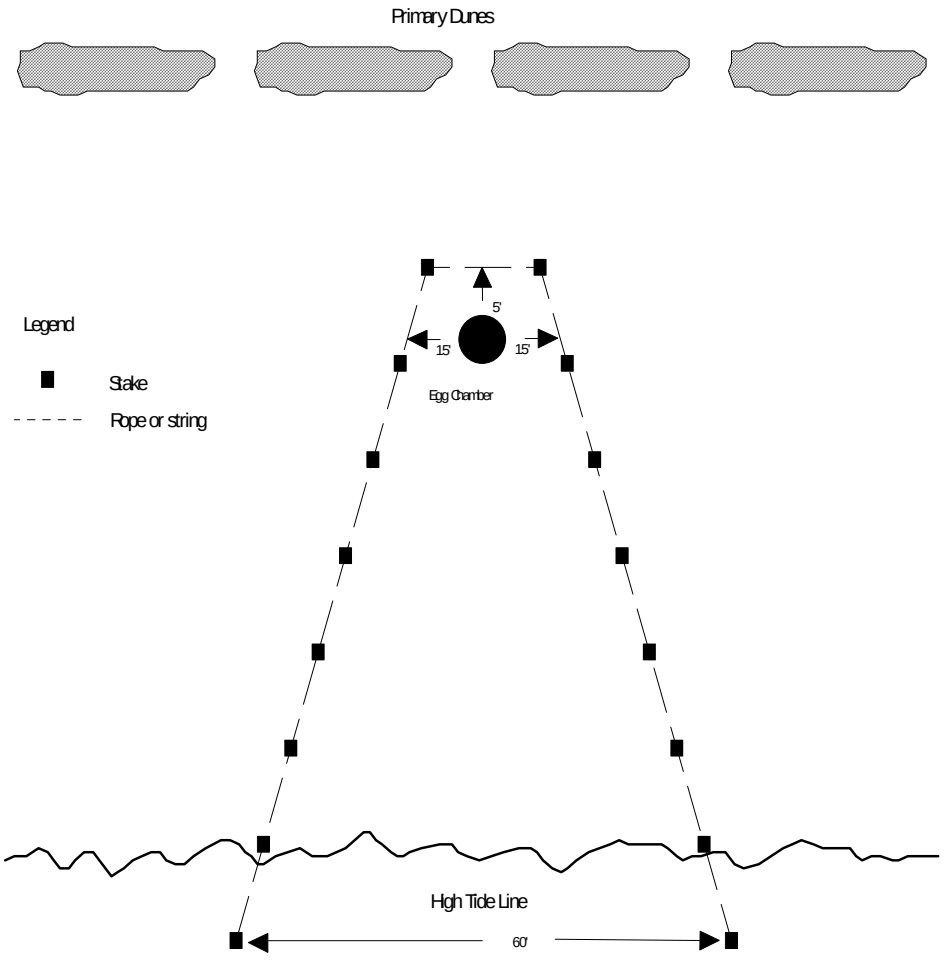
Depression Date. This date is taken by direct observation.

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 the main hatch.

ATTACHMENT 6

NEST BARRICADE



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.

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.

   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.

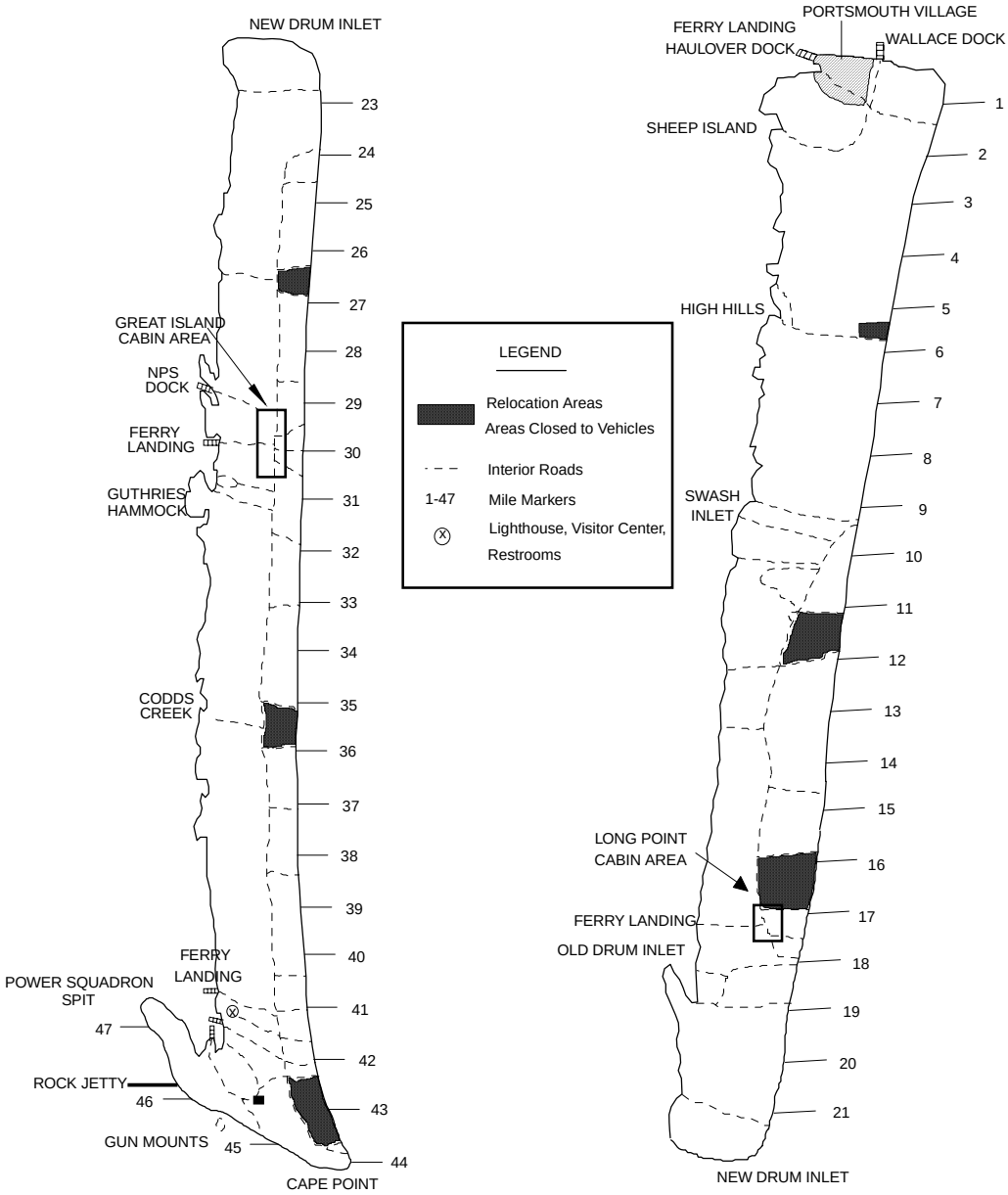
6. **Crawl Identification:** Surveyors will identify and record all "new" crawls by species and as nests or false crawls. False crawls will only be counted if the extend above the most recent high tide line. Crawl data will be reported by beach sector. The preferred length of beach sector is 1 km or 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



APPENDIX II

2007 INDIVIDUAL NEST DATA

Table 11. North Core Banks Sea Turtle Nesting Data-2007

#	Date	Mile	Relocated Mile	Hatch Date	Incubation	# Eggs	# Hatchlings	# Hatch dead	% Emerge	Comments
2	1-May	9.3			n/a					DC - dig, no hatch, heavy overwash & standing water on site
8	20-Jun	15.23		18-Aug	59	151	128	0	84	
9	24-Jun	7.58	5.31	unk	unk	131	43	0	32	ghost crab predation 6/24
10	25-Jun	11.52	11.52	22-Aug	58	97	81	0	84	ghost crab predation
11	25-Jun	4.39	5.67	19-Aug	55	125	118	1	94	ghost crab predation 6/25
12	27-Jun	17.3		7-Sep	72	100	70	1	69	DC- human dist @ hatch?, lots of footprints, nest depression surrounded by seashells
13	28-Jun	4.14		2-Sep	66	148	142	2	97	CM-18 released alive, tangled in veg roots
15	2-Jul	15.65	15.17	23-Aug	52	112	109	1	97	root invasion
17	5-Jul	15.25		unk	unk	109	106	0	97	ghost crab predation and flooded by tide
18	15-Jul	14.47		unk	unk	108	81	57	22	
19	15-Jul	4.32		unk	unk	115	113	0	98	
20	16-Jul	10.03		18-Sep	64	91	87	0	96	ghost crab predation
22	17-Jul	15.29	15.29	7-Sep	52	124	118	0	95	
24	20-Jul	6.61	5.62	unk	unk	106	105	2	97	
28	25-Jul	8	8	24-Sep	61	104	94	0	90	
32	30-Jul	8.23	8.05	25-Sep	57	107	99	1	92	ghost crab predation
35	31-Jul	18.38		25-Sep	56	156	155	0	99	ghost crab predation
36	3-Aug	17.68	18.08	unk	unk	116	105	2	89	
37	3-Aug	18.07		3-Oct	61	66	59	1	88	
41	13-Aug	16.82		unk	unk	113	3	2	89	
44	17-Aug	9.39	11.25	22-Oct	66	87	85	1	97	
45	1-Sep	12.75	11.87	n/a	n/a	135	0	0	0	

Table 12. South Core Banks Sea Turtle Nesting Data-2007

#	Date	Mile	Relocated Mile	Hatch Date	Incubation	# Eggs	# Hatchlings	# Hatch dead	% Emerge	Comments
1	13-May	27.9		11-Aug	90	76	52	2	66	DC
3	22-May	31.4		14-Aug	84	84	36	1	42	DC
4	23-May	43.2	42.4	28-Jul	66	113	109	0	97	
5	23-May	43.3		6-Aug	75	83	79	0	95	
6	31-May	43.1	42.5	3-Aug	64	111	54	3	46	
7	31-May	42.3		14-Aug	75	84	62	1	73	DC- hatchlings went towards lighthouse &/or eaten by raccoons or ghost crabs
10	8-Jun	43.49	43.44	3-Aug	56	155	153	8	94	8/6 17 found dead on top of nest (raccoon or ghost crabs)
12	8-Jun	42.3		16-Aug	69	123	97	0	79	
14	9-Jun	43.42		12-Aug	64	125	125	0	100	
15	9-Jun	41.97		11-Aug	63	unk	unk		unk	need excavation information, raccoon predation
16	9-Jun	41.34		25-Aug	77	97	78	1	79	DC
25	17-Jun	39.43		unk	unk	unk	unk		unk	numbers are not known due to several days of heavy raccoon predation
26	17-Jun	43.09		unk	unk	unk	unk		unk	nest heavily predated by raccoons & ghost crabs, unk if hatched or predated
27	17-Jun	43.49		12-Aug	56	86	79	0	92	8/12 28 dead hatchlings found headless on top of nest (raccoon predation)
28	18-Jun	42.5		26-Aug	69	97	75	1	76	DC - 28 spacer eggs, roots in nest
32	19-Jun	41.78		15-Aug	57	66	52	0	79	
36	22-Jun	43.07		unk	unk	unk	unk	0	unk	numbers are not accurate due to several days of heavy raccoon predation, flooded 2 days

#	Date	Mile	Relocated Mile	Hatch Date	Incubation	# Eggs	# Hatchlings	# Hatch dead	% Emerge	Comments
37	22-Jun	43.6	42.87	23-Aug	62	118	114	0	97	raccoon & ghost predation; flooded 3 days
39	24-Jun	33.26		27-Aug	64	74	64	1	85	CM - raccoon predation
40	24-Jun	39.73		22-Aug	59	119	114	0	96	
44	24-Jun	44.3		22-Aug	59	147	145	18	86	flooded 1 day, 11 hatchlings went outside closure
47	26-Jun	41.8		25-Aug	60	132	123	0	93	
48	26-Jun	42.6		19-Aug	54	125	117	0	94	
50	26-Jun	33.4		n/a	n/a	102	30	30	0	nest flooded 4 days,30 dead hatchlings found in nest
51	26-Jun	41.9		26-Aug	61	99	64	0	65	
53	30-Jun	36.86	35.94	21-Aug	52	139	124	0	89	raccoon predation
56	1-Jul	31.94	35.03	25-Aug	55	67	67	0	100	raccoon & ghost crab predation
58	3-Jul	39.13		27-Aug	55	88	75	0	85	raccoon predation, flooded 2 days
62	5-Jul	41.84		26-Aug	52	78	71	0	91	
63	6-Jul	25.12		n/a	n/a	114	0	0	0	flooded 4 days, no hatch
65	6-Jul	38.67		5-Sep	61	104	101	3	94	raccoon predation
67	7-Jul	36.26		4-Sep	59	103	101	2	96	
68	7-Jul	25.65		n/a	n/a	82	0	0	0	DC - eggs all unhatched, flooded 5 days
72	9-Jul	43.51		unk	unk	137	112	0	82	
74	10-Jul	43.44		n/a	n/a	136	0	0	0	nest flooded for 3 days
76	13-Jul	41.7	43.02	unk	unk	104	72	10	60	nest flooded for 3 days
77	13-Jul	41.8		17-Sep	66	139	125	1	89	CM
78	14-Jul	31.44		unk	unk	107	86	2	79	flooded 3 days
79	17-Jul	29.29		unk	unk	91	18	8	11	flooded 4 days
80	18-Jul	42.7		unk	unk	93	58	0	62	CM
86	20-Jul	42.76		14-Sep	56	113	81	0	72	flooded 3 days; ghost crab & raccoon predation
87	20-Jul	43.3		n/a	n/a	unk	unk		unk	CM -lost to storm on 10/1, flooded 3 days

#	Date	Mile	Relocated Mile	Hatch Date	Incubation	# Eggs	# Hatchlings	# Hatch dead	% Emerge	Comments
94	22-Jul	42.5		27-Sep	67	138	124	1	89	flooded 2 days by tide
95	23-Jul	24.92		25-Sep	64	104	85	0	82	
100	27-Jul	31.05	26.58	27-Sep	62	117	92	1	78	
103	30-Jul	23.27		25-Sep	57	118	41	0	35	
105	31-Jul	43.02		unk	unk	105	65	55	10	flooded 4 days
106	31-Jul	36.7		n/a	n/a	88	0	0	0	flooded 3 days, all eggs undeveloped
107	12-Aug	43.4		9-Oct	58	115	102	0	89	
108	3-Aug	44.09	43.45	27-Sep	55	128	110	0	86	raccoon tracks to nest site, no digging
109	4-Aug	25.85		5-Oct	62	134	46	1	34	CM - flooded 3 days
111	5-Aug	43.47		n/a	n/a	63	0	0	0	flooded 5 days, 8" of sand deposition, human disturbance of site
112	6-Aug	27.6		unk	unk	100	76	0	76	CM, ghost crab predation
113	8-Aug	25.32		9-Oct	62	91	86	0	95	
116	21-Aug	30.05		29-Oct	69	135	129	0	96	CM
118	21-Aug	42.36		n/a	n/a	111	0	0	0	nest laid on soundside beach, flooded for 5 days, water in nest, eggs undeveloped

Table 13. Shackleford Banks Sea Turtle Nesting Data-2007

#	Date	Mile	Relocated mile	Hatch Date	Incubation	# Eggs	# Hatchlings	# Hatch dead	% Emerge	Comments
1	7-Jun	50.83		3-Aug	57	130	107	2	81	
2	7-Jun	52.88		6-Aug	60	108	75	0	69	
4	19-Jun	52.9		18-Aug	60	76	75	0	99	
5	21-Jun	51.28		18-Aug	58	131	108	0	82	
6	28-Jun	49.5		24-Aug	57	112	101	0	90	
8	2-Jul	49.1		unk	unk	117	109	0	93	
9	5-Jul	52.9		31-Aug	57	85	80	1	93	8/31-1 dead hatchling on surface
10	14-Jul	52.76		7-Sep	55	141	125	0	89	1 hatch dead in ghost crab hole