

CAPE LOOKOUT NATIONAL SEASHORE
2010 SEA TURTLE MONITORING AND MANAGEMENT REPORT



A loggerhead hatchling swimming in the surf zone.

NPS Photo 2010

Prepared by:
Jon Altman
National Park Service
Cape Lookout National Seashore
131 Charles Street
Harkers Island, NC 28531

TABLE OF CONTENTS

	Page
Introduction _ _ _ _ _	1
Cooperating Agencies _ _ _ _ _	1
Site Description _ _ _ _ _	2
Methods _ _ _ _ _	2
Results _ _ _ _ _	4
Nesting Results _ _ _ _ _	4
Hatching results _ _ _ _ _	8
Discussion _ _ _ _ _	14
Performance Measures _ _ _ _ _	15
Strandings _ _ _ _ _	16
Management Recommendations _ _ _ _ _	18
Appendix I - Individual Nest Data _ _ _ _ _	19
Appendix II - 2010 GIS Sea Turtle Activity Maps _ _ _	31
Appendix III -2010 Sea Turtle Program Procedures _ _ _	35

ACKNOWLEDGEMENTS

Cape Lookout National Seashore is grateful for the commitment of Student Conservation Association interns Mara Plato and Brittney Brown. The seasonal Biological Science Technicians Paula Daily, Tom Faughnan, Tracy Pickford, and Chris Bland provided invaluable contributions throughout the nesting season. The staff dedication and enthusiasm was crucial to the success of an intensive turtle-monitoring program.

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 (*Dermochelys 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 2010 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 monitored daily for turtle nesting activity. Student Conservation Association interns and NPS staff patrolled NCB and SCB daily in the early morning searching for nesting activity from May 1st to September 15th. Each patrol began early in the morning so that the island was checked for turtle activity by 12:00 PM. Shackleford Banks was monitored three times a week. For detailed information on procedures used in the 2010 Sea Turtle Program refer to Appendix III. In addition to these program procedures the seashore participated in a genetic mark-recapture study of nesting female loggerheads using DNA derived from eggs. The study was coordinated by the NCWRC for North Carolina and the included the other Northern Recovery Unit states of Georgia and South Carolina. One egg from each nest was collected and preserved so DNA could be sampled at the University of Georgia genetic laboratory. As part of this study sea turtle crawl and nest activity was entered onto an online database at Sea Turtle.org.

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. 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 75-80 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 2010 was on June 3 and the last on September 8, for a 98 day nesting season. A total of 291 activities were documented of which there were 157 nests and 134 false crawls, (Table 1; see Appendix III for activity definitions). Two sea turtle species nested in the park with a total of 153 loggerhead turtle nests and 4 green turtle nests.

Table 1. 2010 ACTIVITIES BY STUDY AREA

	North Core Banks	South Core Banks	Shackleford Banks	CALO Total
NESTS	45	82	30	157
CRAWLS	54	66	14	134

The number of nests found in 2010 (157 nests) was above the annual average for CALO (129 nests) (Fig. 1 and 2). South Core Banks continued to have more nests than the other islands in 2010. Nesting on SCB was spread out; however, there was a higher occurrence of nests south of the lighthouse between mile 41 and 44, 28 nests (Fig. 3). The greatest nesting density on NCB occurred mid-island between mile 9 and mile 13, 12 nests. Another concentration of nests on NCB occurred between mile 19 and mile 21, 10 nests. Shackleford Banks had 30 nests, which was the third highest on record.

Figure 1. Cape Lookout Turtle Activities 1990-2010

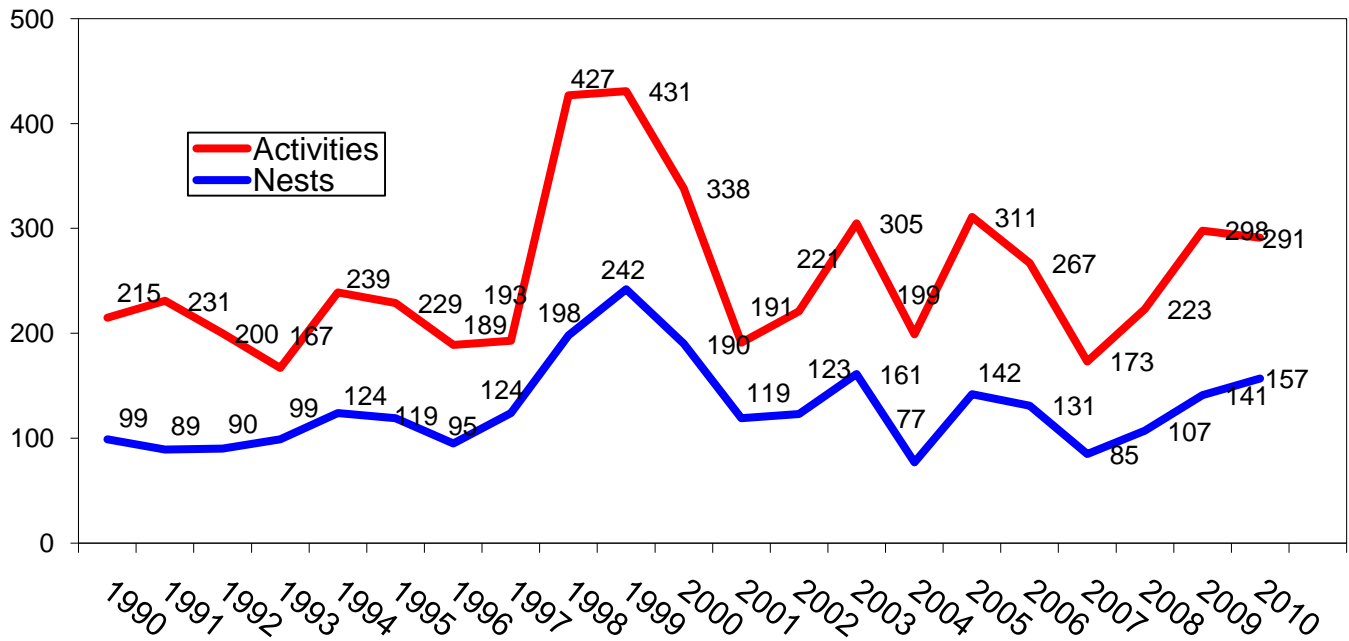


Figure 2. Turtle Nests 1990-2010

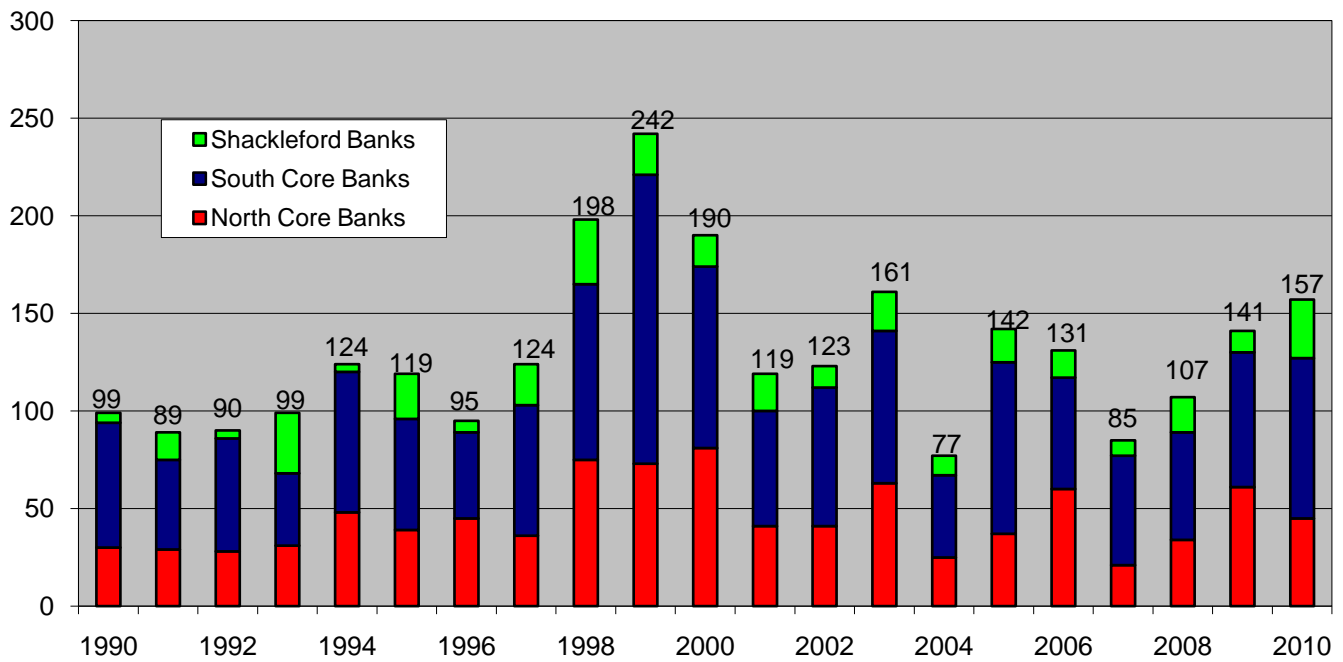
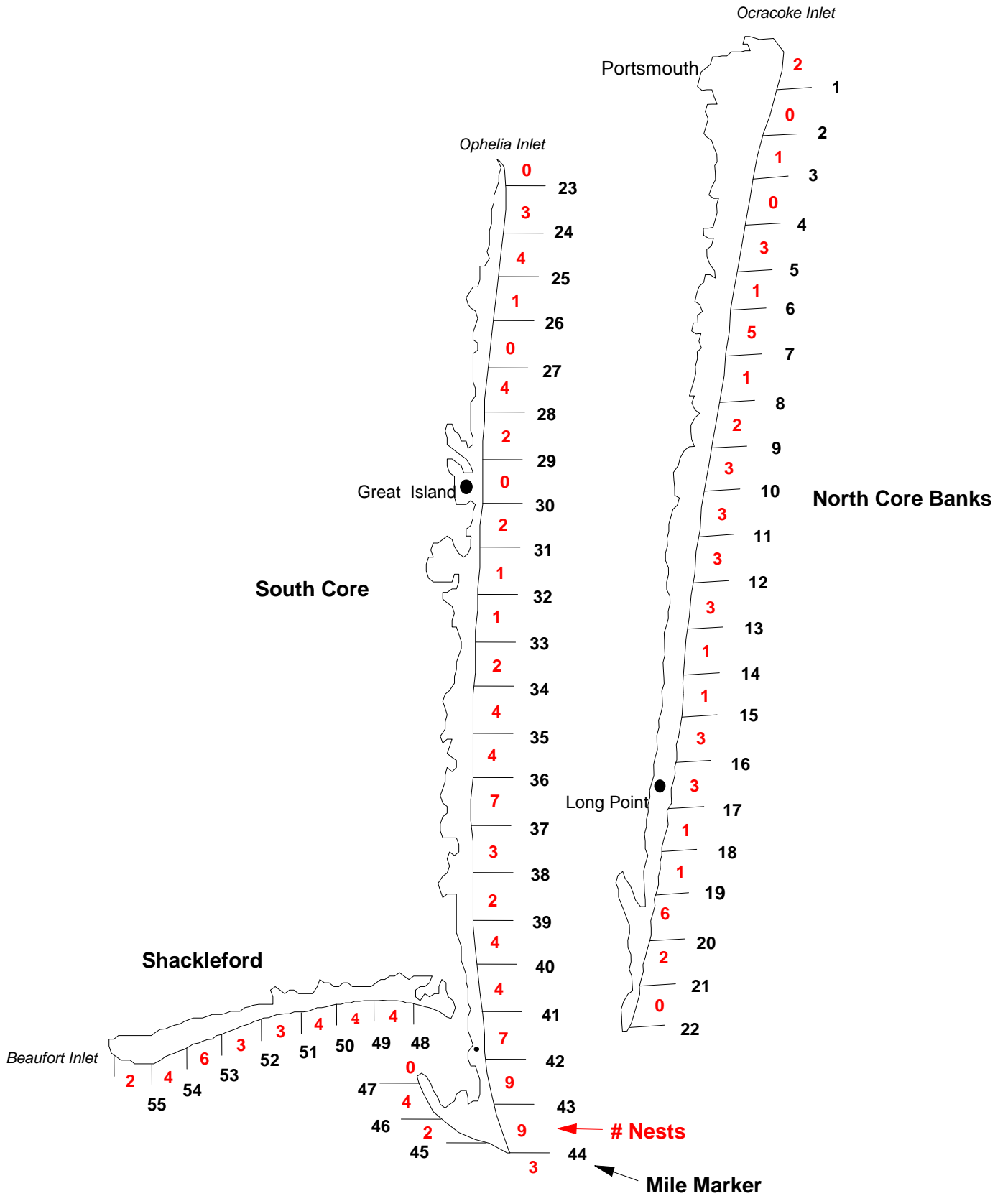


Figure 3. 2010 Turtle Nests by Mile Section



HATCHING RESULTS

Follow-up of nesting activity involved observing nest and dig sites for signs of hatching, recording relevant data, and excavating the site. The 149 nests (149 eggs) that were sampled for the DNA study are not included in hatching/emergence calculations for this report. Therefore emergence success will defer from results presented on seaturtle.org. 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 July 25th and ended on November 11th, for a 110 day nest hatching period. The last nest was excavated on November 28th at day 81 of incubation. A known total of 14,666 eggs, 8,465 hatchlings, and 509 hatched dead were counted. The total hatch success, number of total eggs divided by number of total hatchlings, was 58%. The total emergence success of 54% (7956 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 reported on seaturtle.org for Cape Lookout is 46%, which factors in the eggs lost to the DNA study and subtracts live hatchlings that were still in the nest. The seashore has not traditionally subtracted the live hatchlings in the nest and to remain consistent with 21 years of data will report emergence success based on the calculation in Appendix III, Attachment 3. The emergence success range was from 0% to 99%. The average clutch size was 105 eggs. It took an average of 57 days for nests to incubate. Sixteen nests were washed away with the numbers of eggs unknown. One nest was inventoried while it was in the process of washing out. The nest was lost but the clutch count was completed. Three nests suffered raccoon predation and two other nests

had raccoon tracks at the nests on NCB. There were no signs of raccoon presence or predation at nests on SCB or SB. Five nests suffered some ghost crab predation on NCB and three nests had ghost crab predation on NCB. A total of 80 nests were over-washed by the ocean, 30 nests from one to three days and 50 nests four times or more. Thirty one of these 80 nests hatched. The emergence success for these 80 flooded nests was 34%.

Table 2. SEA TURTLE HATCH SUMMARY 1990-2010

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%
2010	157	105	80	57	14666	7956	54%	49%

*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 sixteen nests lost with unknown egg counts we have calculated an estimated emergence success of 49% in 2010 (Table 2). This figure includes sixteen 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 sixteen lost nests at an average clutch of 105 eggs equals 1680 eggs with 0% emerge success (Table 3).

Table 3. 2010 ACTIVITY SUMMARY BY STUDY AREA

	NCB	SCB	SH	TOTALS
NESTS	45	82	30	157
# KNOWN EGGS	4261	7178	3227	14666
# EMERGED	2456	3333	2167	7956
AVERAGE CLUTCH	101 eggs	106 eggs	108 eggs	105 eggs
EMERGE SUCCESS	58%	46%	67%	54%
# ESTIMATED EGGS	4564	8556	n/a	16346
ESTIMATED TOTAL EMERGENCE SUCCESS (including nests with unknown /averaged egg totals)	54%	39%	n/a	49%
AVERAGE INCUBATION	57 days	58 days	56 days	57 days
# LOST TO FLOODING	3	13	1	17
# LOST TO PREDATORS	0	0	0	0

In 2010, 13% of the nests were relocated. The emergence rate for relocated nests was 75% and the emergence rate for non-relocated nests was 51% (Table 4). The estimated emergence success for non-relocated nests was 45% which accounts for the sixteen nests lost to erosion.

Table 4. EMERGENCE SUCCESS OF RELOCATED VS. NON-RELOCATED NESTS BY STUDY AREA IN 2010

<i>RELOCATED</i>	NCB	SCB	SH	CALO Total
Nests	15	4	2	21 (13%)
Eggs	1570	260	157	1987
Hatchlings	1267	170	79	1516
# Hatch Dead	23	0	1	24
Emergence Rate	79%	65%	50%	75%
<i>NON-RELOCATED</i>				
Nests	30	78	28	136 (87%)
Eggs	2691	6918	3070	12679
Hatchlings	1258	3513	2178	6949
# Hatch Dead	46	350	89	485
Emergence Rate	45%	46%	68%	51%
Estimated Total Emergence Rate	40%	38%	n/a	45%

Since 1990 the twenty one year average emergence success has been slightly higher (66%) for relocated nests than non-relocated nests (65%) (Table 5). However the estimated emergence rate of non-relocated nests, which accounts for erosion and predation lost nests, is 57%.

Predation

In 2010, 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 past 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. Eight nests suffered minor ghost crab predation in the seashore in 2010.

Table 5. 1990-2010 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
2010	13	75%	51% (45%)	89
<i>AVERAGES</i>	49	66%	65% (57%)	91

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

Eight nests had roots in the egg chamber that destroyed eggs or trapped hatchlings. Sand deposition partially buried 29 nests and along with flooding may have prevented hatching. Hatchlings from one nest on NCB at mile 11.99 appeared disorientated and crawled in tire ruts outside the closure on backroad towards a cabin. These hatchling tracks merged into vegetation. At nest 79 there were hatchling tracks outside closure in tire ruts on SCB.

Hatch Results by Species

The 153 loggerhead and four green turtle emergence success was 55% and 38%, respectively (Table 6.). Green turtle nests accounted for 2 % of total sea turtle nests. The four green nests were on South Core Banks. The nests were laid in August and September.

Table 6. Loggerhead and Green Sea Turtle Hatch Summary, 2010

	Loggerhead	Green
NESTS	153	4
# EGGS	14232	434
# HATCHLINGS	8261	204
# HATCH DEAD	469	40
EMERGENCE SUCCESS	55%	38%
AVERAGE CLUTCH	104	109 eggs
AVERAGE INCUBATION	57	65

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. Park law enforcement staff issued five citations, one written warning, and

six verbal warnings for sea turtle closure violations. These vehicles drove between posts and the ocean at low tides or drove through posts and rope.

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 2010, park staff only relocated 21 nests that were threatened with repeated flooding or erosion. The remaining 136 nests were above the high tide line on the beach or on the dunes. The nesting and hatching season spanned from June 3rd to November 11th, 162 days. One nest was still actively incubating after November 11th, but did not hatch. While the nesting and hatching season was free of direct major storm impacts, there were 17 nests that were lost to storm systems. These included nest losses to Hurricane Earl, Tropical Storm Nicole, and other low pressure storm swells and high tides along the banks. In addition, these storm swells and high tides flooded and buried nests. The hatch rate and emergence rate for 2010 was 58% and 54% respectively. Non-relocated nests had a lower emergence rate (51%) than relocated nests (75%) in 2010. The 21 year long term trend shows an emergence rate for non-relocated nests at 65% and relocated nests at 66%.

In 2010 eighty nests were flooded to some extent and 17 were washed away. Sand deposition after flooded events added extra sand that can make it difficult for hatchlings to emerge

through. While some tidal inundation may benefit and/ or not affect hatchlings, this years' repeated flooding was excessive and nests in problems sections of the beach should have been relocated. A more detailed guide to nest relocation will be developed for the 2011 nesting season.

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 2010, there were 134 false crawls and 157 nests for a ratio of 0.85:1. 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 751 nests for the previous five years in North Carolina. In 2010 CALO had 21% 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. 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.

Two hundred seventy five strandings occurred at CALO in 2010. All strandings were reported to the NCWRC and were documented with a “Sea Turtle Stranding and Salvage Network” stranding report. There were two mass stranding events. One occurred in early February with 90 turtles stranding on the oceanside of NCB. The second event occurred in early December with 59 turtles stranding in the Cape Lookout Bight. Loggerhead turtles accounted for the majority of the strandings (131). There were also 116 green turtles, and 27 Kemp's Ridleys. One hundred forty four turtles stranded on the ocean shore and 131 turtles stranded on the inshore soundside. There were 65 live strandings, with 58 that were cold stunned in December. Two live strandings took place in the summer. The live stranded turtles 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. Three PIT tags were found in 2010, 1 turtle from Florida and two from North Carolina. Tables 7 and 8 provide stranding data by island and species from 1993 to 2010.

Table 7. CALO SEA TURTLE STRANDINGS 1993 – 2010

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
2010	130	122	19	4	275

Table 8. CALO TURTLE STRANDINGS BY SPECIES 1993-2010

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
2010	131	116	27	0	0	0

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. A detailed guide to nest relocation identifying specific areas of beach susceptible to erosion and repeated flooding will be developed for the seashore for monitoring staff in 2011.
4. Evaluate established nest relocation areas before nesting season in April to determine suitability and nest relocation options.
5. All park staff and volunteers involved with turtle monitoring will be given complete training in current monitoring procedures.
6. 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.
7. CALO should continue with the DNA study of nesting females of the Northern Recovery Unit in 2011 and 2012.

APPENDIX I
2010 INDIVIDUAL NEST DATA

Table 9. North Core Banks Sea Turtle Nesting Data-2010

#	Date	Mile	Relocated Mile	Hatch Date	Incubation days	Total # Eggs, (TC)	# Hatchlings, (H)	# hatch dead, (HD)	% Emerge, (H-HD/TC)	Comments
2	3-Jun	11.33		25-Jul	52	93	32	3	31	Raccoon predation: 7/29 - 5 egg shells out of nest. Roots in nest.
3	6-Jun	8.6	5.14	8-Aug	63	110	106	10	87	
5	8-Jun	15.89		unk	unk	113	74	0	65	
6	8-Jun	12.08		unk	unk	92	87	0	95	Flooded: 8/8, 8/9.
7	8-Jun	5.26		unk	unk	126	112	1	88	
8	11-Jun	9.26	11.28	9-Aug	59	112	83	1	73	Raccoon predation: 8/9, 8/11.
9	12-Jun	12.44	11.25	9-Aug	58	146	140	0	96	Raccoon predation: 8/11.
13	15-Jun	6.71	5.12	13-Aug	59	91	70	2	75	
14	15-Jun	4.45	5.17	10-Aug	56	115	110	0	96	
19	16-Jun	4.81	5.22	15-Aug	60	110	51	0	46	
20	17-Jun	16.6	15.77	15-Aug	59	104	77	0	74	8/11: Raccoon dug at nest but no sign of predation. 8/19: Dead hatchling near nest.
21	18-Jun	19.53	15.69	15-Aug	58	91	84	1	91	
23	19-Jun	8.49		15-Aug	57	99	55	0	56	Flooded: 8/8, 8/9.
24	20-Jun	18.35		14-Aug	55	108	72	1	66	Opened 2 eggs during excavation - 1 unformed, 1 late stage.
25	20-Jun	19	15.76	unk	unk	124	107	0	86	8/20: Ghost crab hole at nest containing 1 hatchling.
27	21-Jun	10.21		14-Aug	54	117	90	0	77	Flooded: 8/8, 8/9, 8/16.
28	21-Jun	7.44		unk	unk	82	79	0	96	8/19: Nest depressed and raccoon tracks at nest.
30	22-Jun	15.71		unk	unk	129	0	0	0	Flooded: 7/12, 8/8, 8/9, 8/10, 8/11, 8/15, 8/16, 8/17, 8/22, 8/24, 8/26,

										8/28, 8/29, 8/30.
31	22-Jun	10.17	11.29	17-Aug	56	77	76	0	99	
38	23-Jun	19.47		unk	unk	103	93	1	89	
40	23-Jun	11.66		unk	unk	52	6	0	12	Flooded: 8/8, 8/9, 8/10, 8/11, 8/15, 8/16, 8/26, 8/28, 8/29.
41	25-Jun	6.96	5.32	22-Aug	58	111	96	8	79	Released hatchling died on the way to ocean.
44	28-Jun	2.17		unk	unk	128	0	0	0	Flooded: 8/8, 8/10, 8/15, 8/16, 8/28, 8/30. Upper eggs had some development, lower eggs did not.
45	29-Jun	0.73		unk	unk	136	8	2	4	Flooded: 8/8, 8/11, 8/15, 8/16, 8/28, 9/1.
48	3-Jul	19.37	15.7	30-Aug	58	68	67	0	99	
49	3-Jul	19.8		25-Aug	53	98	63	0	64	Lots of roots in nest. Many unformed eggs, 1 late stage turtle half in egg.
58	11-Jul	16.1		unk	unk	139	137	1	98	Flooded: 8/8, 8/9, 8/16, 8/29, 8/30, 9/1, 9/2, 9/3, 9/19, 9/20, 9/21, 9/22. Sand deposition: 8/8, 9/3, 9/9, 9/18, 9/23-removed 12".
60	12-Jul	20.39		n/a	n/a					9/3: Nest
61	12-Jul	20.59		n/a	n/a	88	0	0	0	Flooded: 8/8, 8/9, 8/10, 8/30, 9/1, 9/2, 9/3, 9/4, 9/5, 9/18, 9/19, 9/20, 9/21.
68	13-Jul	6.22		unk	unk	84	37	34	4	Flooded: 8/8, 8/28, 8/29, 8/30, 9/1, 9/2, 9/3, 9/4, 9/10, 9/11, 9/18, 9/19, 9/20, 9/21, 9/23.
70	14-Jul	6.12		unk	unk	55	0	0	0	Initially called a dig. Nest located 9/11. Flooded: 9/3, 9/18, 9/19, 9/20, 9/21. Sand deposition: 9/3, 9/11
74	17-Jul	11.99		9-Sep	54	77	67	0	87	Most of hatchling tracks go down driveway to 500' or so towards cabin

										where they are lost in the vegetation.
77	23-Jul	6	5.29	unk	unk	100	7	0	7	Flooded: 9/18, 9/19, 9/20, 9/21, 10/1.
80	23-Jul	0.32		n/a	n/a					8/8: Nest lost - PVC and screen washed away by TS Colin.
81	24-Jul	12.18	11.85	17-Sep	55	120	116	1	96	
82	28-Jul	17.22	15.53	24-Sep	58	91	77	0	85	Flooded: 9/19, 9/20, 9/21. Sand deposition: 9/3 -6".
83	28-Jul	14.77		n/a	n/a	104	0	0	0	Flooded: 8/8, 8/11, 8/16, 8/26, 8/29, 8/30, 9/1, 9/2, 9/3, 9/4, 9/5, 9/10, 9/11, 9/17, 9/18, 9/19, 9/20, 9/21, 9/22, 9/23, 10/1, 10/2. Sand deposition: 9/3 -10".
84	28-Jul	10.45		n/a	n/a	108	0	0	0	Flooded: 8/8, 8/30, 9/1, 9/2, 9/3, 9/19, 9/20, 9/21, 9/22, 9/23, 10/1, 10/2. Sand deposition: 9/3, 9/23 -removed 10", 10/1-removed 16".
85	28-Jul	9.06		n/a	n/a	121	0	0	0	G.C. 9/24, Flooded: 8/8, 8/30, 9/1, 9/2, 9/3, 9/19, 9/20, 9/21, 9/22, 9/23, 10/1, 10/2, 10/5, 10/6, 10/8, 10/9
86	30-Jul	13.05		25-Sep	57	126	106	0	84	
89	3-Aug	19.07		n/a	n/a	unk				9/30: Nest lost
91	6-Aug	16.58		unk	unk	104	94	3	88	sand deposition 9/3, G.C-10/19, flooded 9/1, 9/2, 9/3, 9/19, 9/20, 9/21, 10/1, 10/2
93	11-Aug	9.12		n/a	n/a	83	0	0	0	sand deposition 10/1, 10/2, 10/5, flooded 9/1, 9/2, 9/19, 9/20, 9/21, 10/1, 10/2, 10/5
95	14-Aug	4.61		n/a	n/a	60	46	0	77	released 46 live hatchlings, G.C. 10/8, flooded 9/19, 9/20, 9/21, 10/1
96	15-Aug	15.94		n/a	n/a	66	0	0	0	flooded on 8/30, 9/2, 9/3, 10/1, 10/2

Table 10. South Core Banks Sea Turtle Nesting Data-2010

#	Date	Mile	Relocated Mile	Hatch Date	Incubation days	Total # Eggs, (TC)	# Hatchlings, (H)	# hatch dead, (HD)	% Emerge, (H-HD/TC)	Comments
2	4-Jun	42.44		27-Jul	53	87	84	0	97	
4	7-Jun	36.05		unk	unk	91	59	0	65	Flooded by tide 8-8 through 8-10
10	11-Jun	24.67		5-Aug	55	118	76	9	57	Ghost crab predation 8-5, one hatchling found dead and one released
12	13-Jun	44.53		unk	unk	115	72	0	63	
13	14-Jun	43.36		unk	unk	140	129	0	92	Flooded by tide 8-9
17	15-Jun	43.29		10-Aug	56	156	146	0	94	
18	16-Jun	25.03		10-Aug	55	63	43	0	68	Roots in nest; embryo not collected
19	16-Jun	23.15		n/a	n/a	unk			0	nest washed away on 7/23
20	14-Jun	44.97		unk	unk	119	115	1	96	Collected dead hatchling 8-21
21	16-Jun	40.05		unk	unk	99	76	1	76	Flooded by tide 8-15 and 8-29
23	17-Jun	35.29		15-Aug	59	106	97	0	92	
24	17-Jun	34.98		10-Aug	54	117	108	0	92	Nest likely found one day late
25	18-Jun	30.40		16-Aug	59	87	87	6	93	
26	18-Jun	38.49		n/a	n/a	unk			0	nest washed away on 8/9
30	19-Jun	40.50		15-Aug	57	90	72	0	80	

31	20-Jun	36.58		n/a	n/a	125	0	0	0	Severe nest flooding; Flooded by tide 8-9, 8-10, 8-15, 8-16, and 8-28 through 9-1
35	21-Jun	27.73		unk	unk	124	20	1	15	Flooded by tide 8-8 through 8-10, 8-15, 8-16, and 8-25
37	23-Jun	34.60		unk	unk	75	69	0	92	Flooded by tide 8-9, 8-15, 8-29, and 8-30
41	24-Jun	30.23		unk	unk	57	7	0	12	Flooded by tide 8-30; Eggs mostly undeveloped
42	24-Jun	35.26		19-Aug	56	99	81	3	79	Human disturbance 8-23, footprints through nest
43	24-Jun	42.79		17-Aug	54	157	147	0	94	
46	25-Jun	46.62	42.3	unk	unk	43	33	0	77	Relocated Nest
47	26-Jun	23.94		n/a	n/a	unk			0	No data available - only two unhatched eggs retrieved; In water table, most likely a dead nest; Flooded by tide 8-16, 8-25, 8-31, and 9-1
48	26-Jun	41.50		25-Aug	60	120	113	0	94	
56	29-Jun	33.05		unk	unk	68	59	0	87	Root entanglement upon excavation, live hatchlings trapped in roots
57	30-Jun	39.34		24-Aug	55	140	137	0	98	Flooded by tide 8-9, 8-15, and 8-16
58	30-Jun	43.34		unk	unk	112	88	1	78	Dates flooded by tide 8-8, 8-9, 8-16, and 8-28 through 8-30; Ghost crab predation 8-21
59	1-Jul	36.36		unk	unk	121	104	0	86	Root entanglement, some eggs entirely enveloped in micro-roots
64	2-Jul	41.92		n/a	n/a	95	0	0	0	Sand deposition 8-15 and 9-3; Flooded by tide 8-8 through 8-10, 8-15, 8-16, 8-28 through 9-1, 9-5, 9-6, and 9-10- 9-13
65	2-Jul	41.95		n/a	n/a	99	0	0	0	Sand deposition 8-15 and 9-3; Flooded by tide 8-8 through 8-10, 8-15, 8-16, 8-28 through 9-1, 9-5, 9-6, and 9-1- 9-13

66	3-Jul	35.94		n/a	n/a				0	washed away on 9/3
67	4-Jul	31.12		unk	unk	66	42	18	36	Sand deposition 8-15 and 9-3; Flooded by tide 7-8, 8-9, 8-10, 8-13, 8-15- 8-17, 8-24, 8-26, 8-28-8-30, 9-5, 9-6, 9-10- 9-12, 9-16
68	4-Jul	43.64		unk	unk	105	8	0	8	flooded by tide 8-8- 8-10, 8-14-8-17, 8-23, 8-24, 8-26, 8-28-9-1, 9-10- 9-12
69	6-Jul	32.10		unk	unk	129	49	49	0	Sand deposition 9-3; Flooded by tide 8-8, 8-9, 8-28 through 8-30, 9-5, 9-6, 9-12, 9-13, and 9-19
70	7-Jul	43.45		n/a	n/a				0	nest washed away 9/3
71	7-Jul	37.13		unk	unk	104	88	0	85	Flooded by tide 8-31, 9-1, 9-19, 9-20, and 9-21; Sand deposition 9-3
72	7-Jul	36.50		n/a	n/a				0	washed away 8-14, Flooded by tide 7-23
75	11-Jul	38.12		unk	unk	122	115	15	82	Excavated early because fifteen hatchlings were found on surface of sand, four of which were headless
79	12-Jul	34.84		7-Sep	57	121	98	64	28	some hatchling tracks in tire ruts,Flooded by tide 8-29, 8-30; Sand deposition 9-3;
80	12-Jul	39.02		unk	unk	98	82	70	12	Flooded by tide 8-28, 8-29, and 9-19 through 9-21
81	12-Jul	41.67		n/a	n/a				0	nest washed away 9/3; Flooded by tide 8-9, 8-16, 8-26, and 8-30 through 9-1
83	12-Jul	42.19		n/a	n/a				0	nest washed away 9/3; Flooded by tide 8-8 through 8-10, 8-14 through 8-16, 8-25, and 8-28 through 9-1; Washed away 9-3
84	12-Jul	46.57		n/a	n/a	104	0	0	0	Flooded by tide 8-8, 8-9, 8-13, and 8-16; Relocated 8-27
88	14-Jul	23.42		unk	unk	102	63	39	24	Flooded by tide 8-8, 8-9, 8-16, 8-23, 8-25, 8-28- 9-1, 9-5, 9-6, 9-10, 9-11, and 9-19- 9-21

90	14-Jul	41.31		unk	unk	133	129	0	97	
91	15-Jul	46.71		unk	unk	90	39	24	17	Sand deposition 9-3; Flooded by tide 9-20
92	15-Jul	37.88		n/a	n/a	46	0	0	0	Flooded by tide 8-8, 8-9, 8-30- 9-1, 9-10, 9-11, 9-16, 9-20, 9-21; Part of nest possibly washed away with H. Earl
94	16-Jul	36.64		n/a	n/a	111	0	0	0	Flooded by tide 8-9, 8-29, 8-30, and 9-19 through 9-21; Sand deposition 9-3
96	19-Jul	27.76		n/a	n/a	99	0	0	0	Flooded by tide 8-15, 8-25, 8-28 through 9-1, 9-10, and 9-19 through 9-21; Sand deposition 9-3
97	20-Jul	44.64		n/a	n/a	124	0	0	0	
99	20-Jul	24.49		14-Sep	56	134	106	0	79	Flooded by tide 8-9, 8-15, and 8-29; Sand deposition 9-3
100	21-Jul	42.55		n/a	n/a	97	0	0	0	Flooded by tide 8-16, 8-28 through 8-30, 9-20, 9-21; Sand deposition 9-3 and 9-21
101	21-Jul	43.62		n/a	n/a	163	0	0	0	Flooded by tide 8-9, 8-15, 8-16, 8-29 through 9-1, 9-19 through 9-21, 10-1, and 10-2; Sand deposition 9-3 and 9-21
106	22-Jul	27.79		n/a	n/a				0	washed away 10/1
112	24-Jul	40.67		9/21/2010	59	110	107	0	97	Flooded by tide 9-20
114	24-Jul	41.30		unk	unk	116	76	0	66	Flooded by tide 10-1 and 10-2; Ghost crab predation 9-21
116	26-Jul	45.60		n/a	n/a	101	0	0	0	Flooded by tide 10-2 and 10-3; Sand deposition 9-3
117	28-Jul	27.71	27.55	10/6/2010	70	68	3	0	4	Flooded by tide 8-31, 9-1, 9-19- 9-21, 10-2, and 10-3; Two hatchlings released 10-6, prior to excavation, seen hatching
118	28-Jul	40.62		unk	unk	122	8	0	7	Flooded by tide 8-8, 8-9, 8-29 through 9-1, 9-19 through 9-21, 10-1, 10-2, and 10-3

119	28-Jul	43.57		n/a	n/a	112	0	0	0	Flooded by tide 8-8, 8-9, 8-16, 8-29, 8-30, 9-20, 9-21, and 10-1; Sand deposition 9-31 and 9-21
120	30-Jul	28.48		n/a	n/a				0	nest washed away 9/30
121	30-Jul	39.21		n/a	n/a	81	0	0	0	Flooded by tide 8-8, 8-9, 8-29, 8-30, 9-19, 10-1, 10-2, 10-3, 10-4, and 10-5
122	31-Jul	39.38		n/a	n/a				0	nest washed away 9/30; Flooded by tide 8-8, 8-9, 8-15, 8-29 through 9-1, and 9-19 through 9-21;
124	3-Aug	43.38		29-Sep	57	141	69	3	47	Flooded by tide 9-20, 9-21
125	3-Aug	42.05		n/a	n/a				0	Washed away 9-3;
126	3-Aug	24.21		n/a	n/a	102	0	0	0	Green, Eggs not developed, Flooded by tide 8-9, 8-29, 9-20, 9-21; Sand deposition 9-3 and 9-21
127	4-Aug	24.88		unk	unk	91	41	6	38	Flooded by tide 9-20, 9-21, 10-2, 10-3, and 10-6; Sand deposition 9-3, 9-21
129	4-Aug	36.28	35.75	unk	unk	47	41	0	87	root entanglement; Flooded by tide 9-20 and 10-1; Sand deposition 9-3
130	4-Aug	36.84		n/a	n/a				0	washed away 9/3; Flooded by tide 8-7, 8-9, 8-10, 8-14 through 8-17, 8-24, 8-25, 8-28 through 9-1
131	4-Aug	42.32		n/a	n/a				0	Washed away 9-30 or 10-1; Flooded by tide 8-9, 8-10, 8-15, 8-16, 8-25, 8-28 through 9-1, 9-10 through 9-12, 9-19, and 9-20;
134	6-Aug	45.26	42.30	28-Sep	53	102	93	0	91	Flooded by tide 9-20, 9-21
135	7-Aug	42.80		n/a	n/a	108	0	0	0	Flooded by tide 8-8, 8-9, 8-14 through 8-16, 8-26, 8-28 through 9-1, and 9-19 through 9-21
137	11-Aug	41.61		10/3/2010	53	113	102	0	90	minor root entanglement

138	11-Aug	43.82		n/a	n/a	114	0	0	0	Flooded by tide 8-29, 8-31, 9-1, 9-19 through 9-21, 10-1, and 10-2; Sand deposition 9-3
139	12-Aug	33.37		n/a	n/a	144	0	0	0	Flooded by tide 9-3, 9-10, 9-19, 9-21, 10-1, 10-2, and 10-3
141	12-Aug	46.00		unk	unk	98	93	0	95	
142	13-Aug	37.91		n/a	n/a	120	0	0	0	Flooded by tide 8-30, 9-11, 9-20, 9-21, 10-1, 10-2, and 10-3
143	14-Aug	35.07		10/6/2010	53	104	94	0	90	GREEN. 14 hatchlings found in tire ruts, all 14 released, yolk sac not absorbed
145	15-Aug	42.34		n/a	n/a	68	0	0	0	Flooded by tide 8-28, 8-29, 9-20, and 9-21
146	15-Aug	42.66		unk	unk	117	5	0	4	Flooded by tide 8-28, 9-21, 10-2 , mostly infertile eggs, some partial development
147	26-Aug	34.48		11-Nov	77	111	110	40	63	Green, 18 live hatchlings, 20 dead on beach-cold stunned, flooded on 10/2
148	8-Sep	28.96		n/a	n/a	117	0	0	0	Green, nest inventory on 11/28/10

Table 11. Shackleford Banks Sea Turtle Nesting Data-2010

#	Date	Mile	Relocated Mile	Hatch Date	Incubation days	Total # Eggs, (TC)	# Hatchlings, (H)	# hatch dead, (HD)	% Emerge, (H-HD/TC)	Comments
1	8-Jun	49.2		5-Aug	58	110	90	0	82	roots in nest, egg collected on 6/9, ghost crab predation on 7/30
2	7-Jun	49.3		5-Aug	59	117	92	0	79	egg collected on 6/9, ghost crab predation on 7/30
3	8-Jun	50.8		6-Aug	59	104	70	1	66	egg collected on 6/9, ghost crab predation on 7/30
4	9-Jun	54.52		5-Aug	57	90	73	0	81	
6	12-Jun	54.85		11-Aug	60	82	75	0	91	egg collected on 6/16
7	16-Jun	53.79		11-Aug	56	127	114	0	90	
10	23-Jun	50.55		11-Aug	49	103	81	0	79	
11	22-Jun	49.9		unk	unk	102	81	0	79	egg collected on 6/23
13	30-Jun	55.08		unk	unk	103	87	3	82	flooded on 8/7
14	27-Jun	52.2		25-Aug	59	109	94	0	86	
15	27-Jun	51.03		unk	unk	116	110	10	86	
16	27-Jun	49.95		25-Aug	59	102	100	0	98	
21	7-Jul	53.02		30-Aug	54	123	116	0	94	flooded on 8/7
22	7-Jul	52.65		30-Aug	54	80	78	0	98	flooded on 8/7
23	12-Jul	51.56		unk	unk	125	52	30	18	3 feet sand deposition on 9/3, flooded 8/7, 9/2, 9/3
24	12-Jul	48.41		unk	unk	120	51	0	43	18 live hatchlings released
26	15-Jul	53.27		7-Sep	54	98	57	19	39	flooded on 9/2, 9/3
27	13-Jul	52.99	53.52	7-Sep	56	72	52	0	72	relocated on 7/28 due to erosion scarp
28	14-Jul	50.6		unk	unk	109	85	25	55	egg collected on 7/15, flooded on 8/7,

										9/2, 9/3
30	19-Jul	53.99		unk	unk	82	33	0	40	flooded on 9/2, 9/3
31	21-Jul	55.69	54.56	17-Sep	58	85	27	1	31	flooded on 9/3
32	20-Jul	54.39		unk	unk	115	0	0	0	flooded on 8/7, 9/2, 9/3, 9/10-sand eroded away exposing eggs, 9 eggs broken open with partially developed dead embryos, egg collected on 7/21
33	21-Jul	51.02		unk	unk	120	99	0	83	
34	20-Jul	48.4		8-Sep	50	108	103	0	95	flooded on 9/2, 9/3, egg collected on 7/21
35	21-Jul	48.34		n/a	n/a	133	0	0	0	flooded on 9/2, 9/3, eggs infertile/no development
36	22-Jul	53.3		17-Sep	57	114	104	1	90	sand deposition on 9/3, flooded on 9/2, 9/3
37	28-Jul	54.93		n/a	n/a	87	0	0	0	sand deposition on 9/3, flooded on 8/7 9/2, 9/3, 9/20, 10/1
38	24-Jul	48.26		23-Sep	61	136	128	0	94	flooded on 9/15, 6 live hatchlings released, egg collected on 7/28
39	24-Jul	50.61		unk	unk	127	93	0	73	
44	unk	53.8		21-Aug	unk	128	112	0	88	missed nest, nest found after hatch

APPENDIX II
2010 GIS SEA TURTLE ACTIVITY MAPS

Figure 4. 2010 North Core Banks Sea Turtle Activities

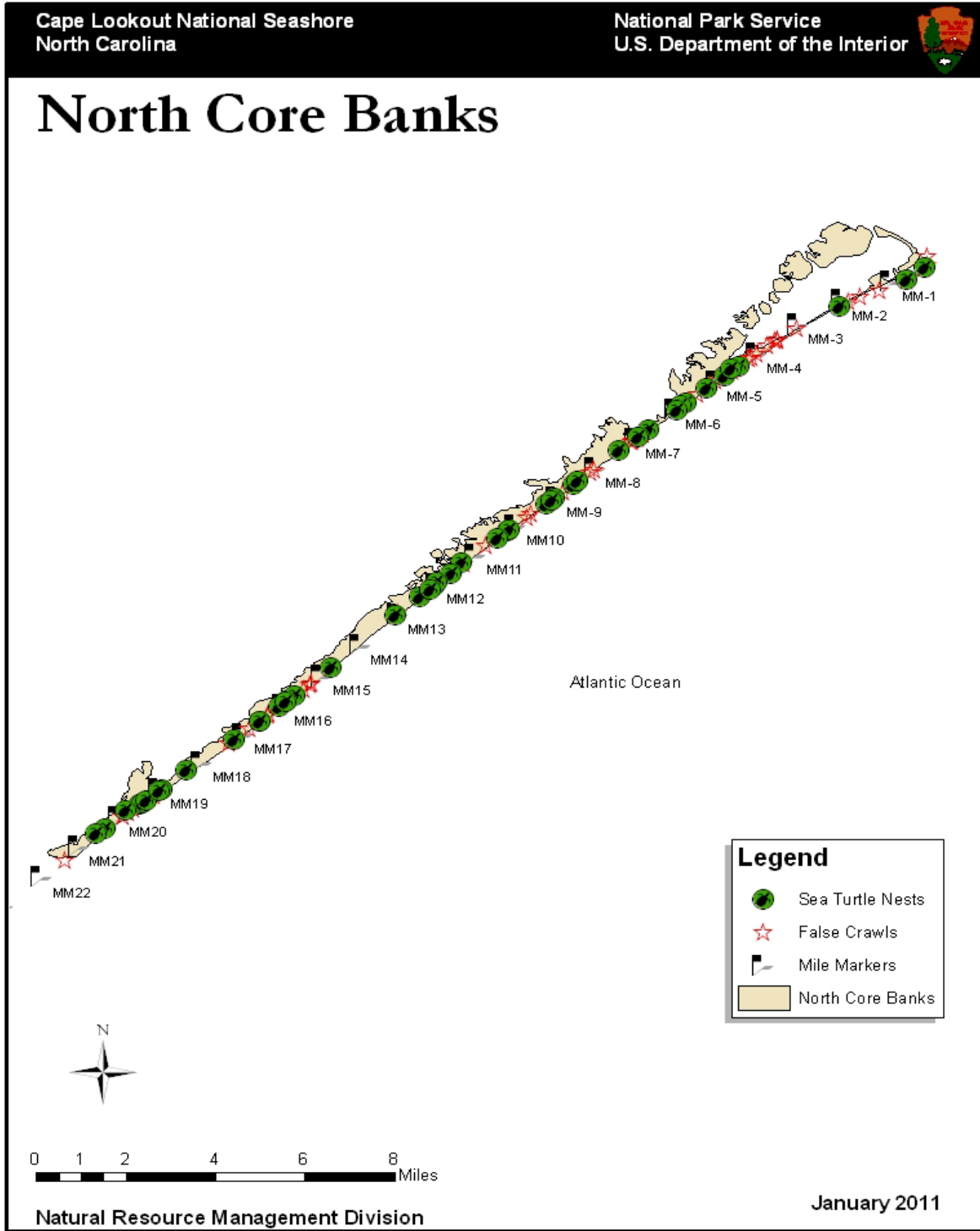


Figure 5. 2010 South Core Banks Sea Turtle Activities.

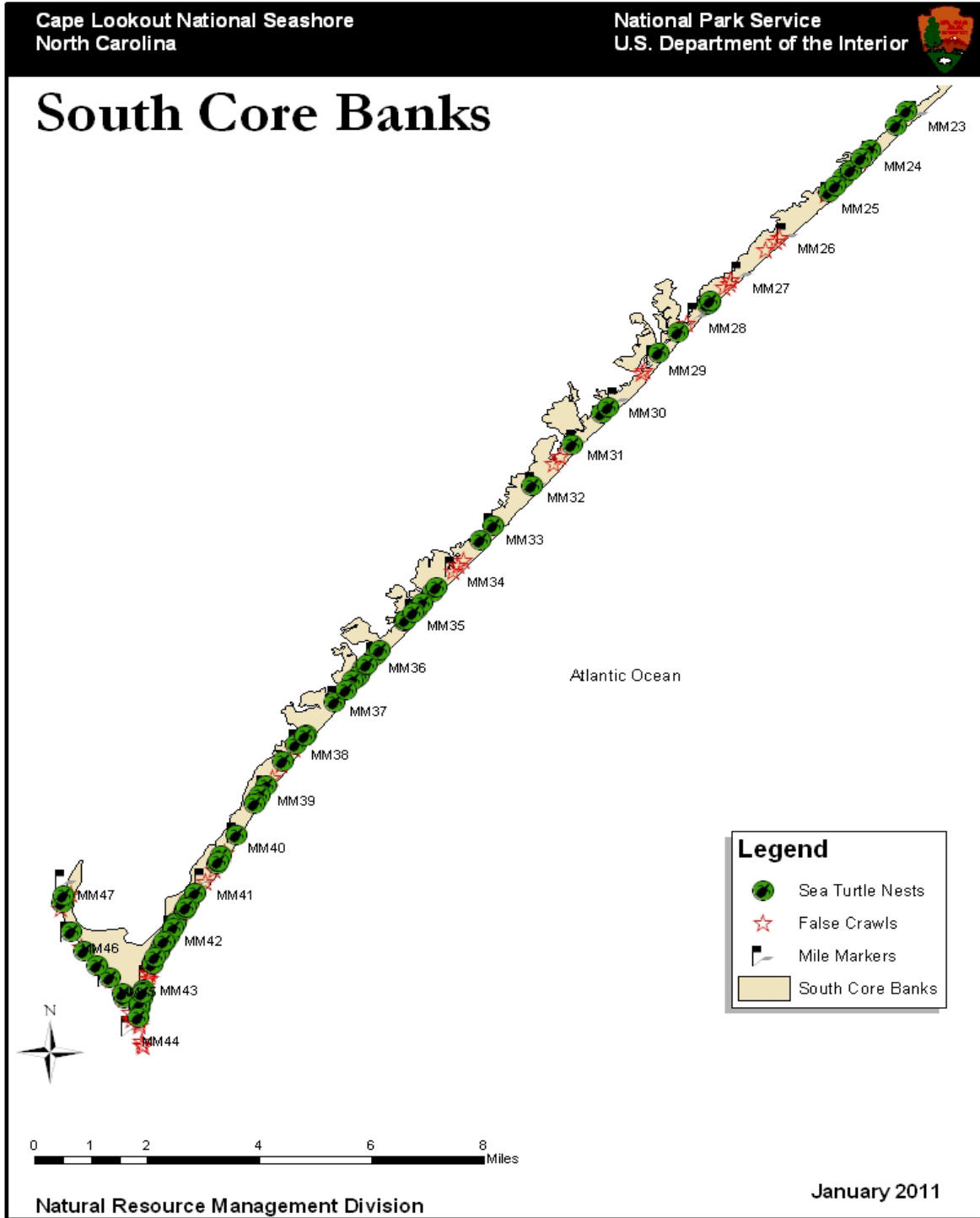
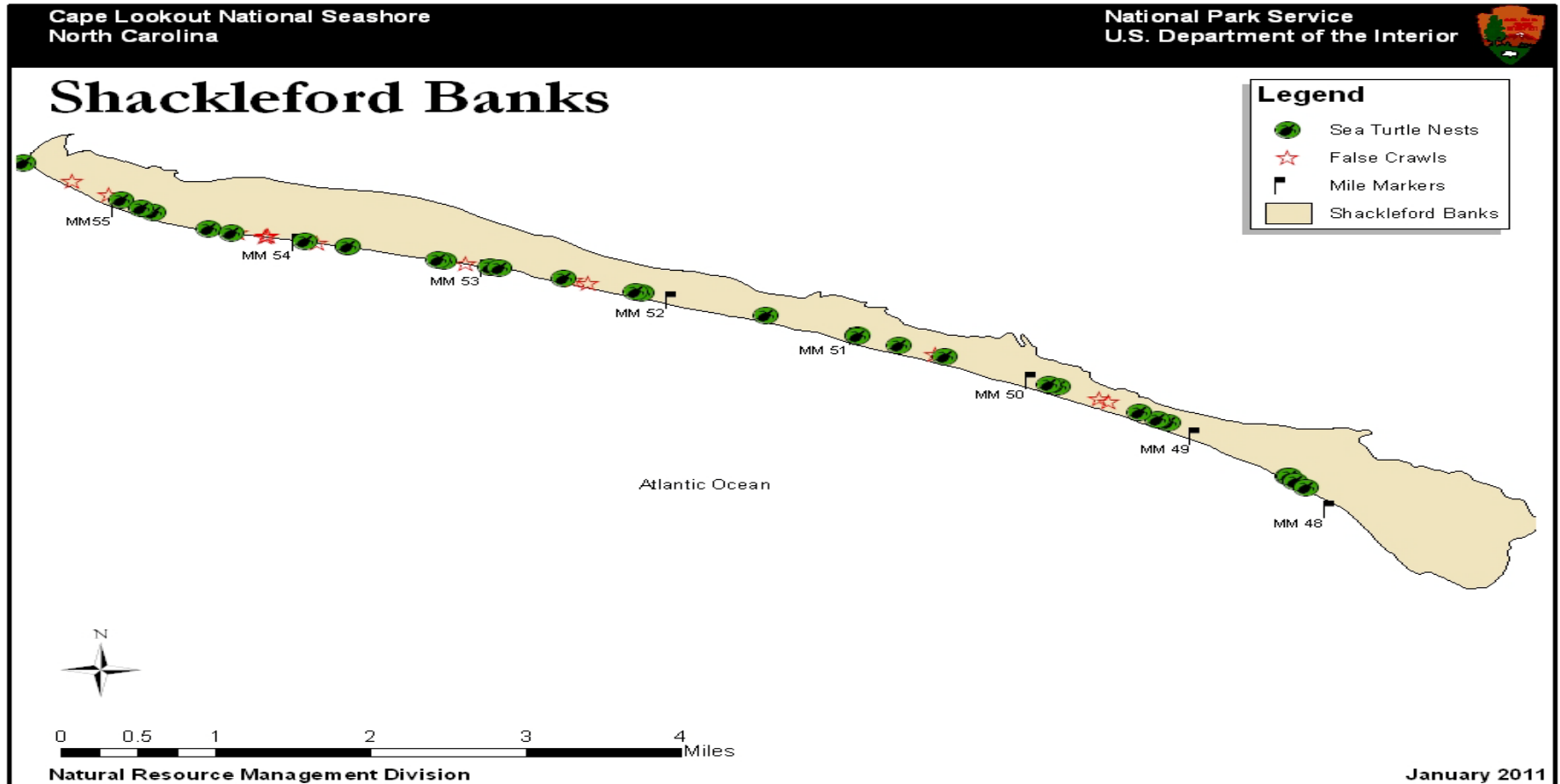


Figure 6. 2010 Shackleford Banks Sea Turtle Activities.



Appendix III

2010 SEA TURTLE PROGRAM PROCEDURES

2010 SEA TURTLE PROGRAM PROCEDURES

The basic procedures for the 2010 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. If no hatching is observed after day 75 dig out area with a shovel to determine if eggs are present or not. Make changes to datasheets to record nest or false crawl.

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

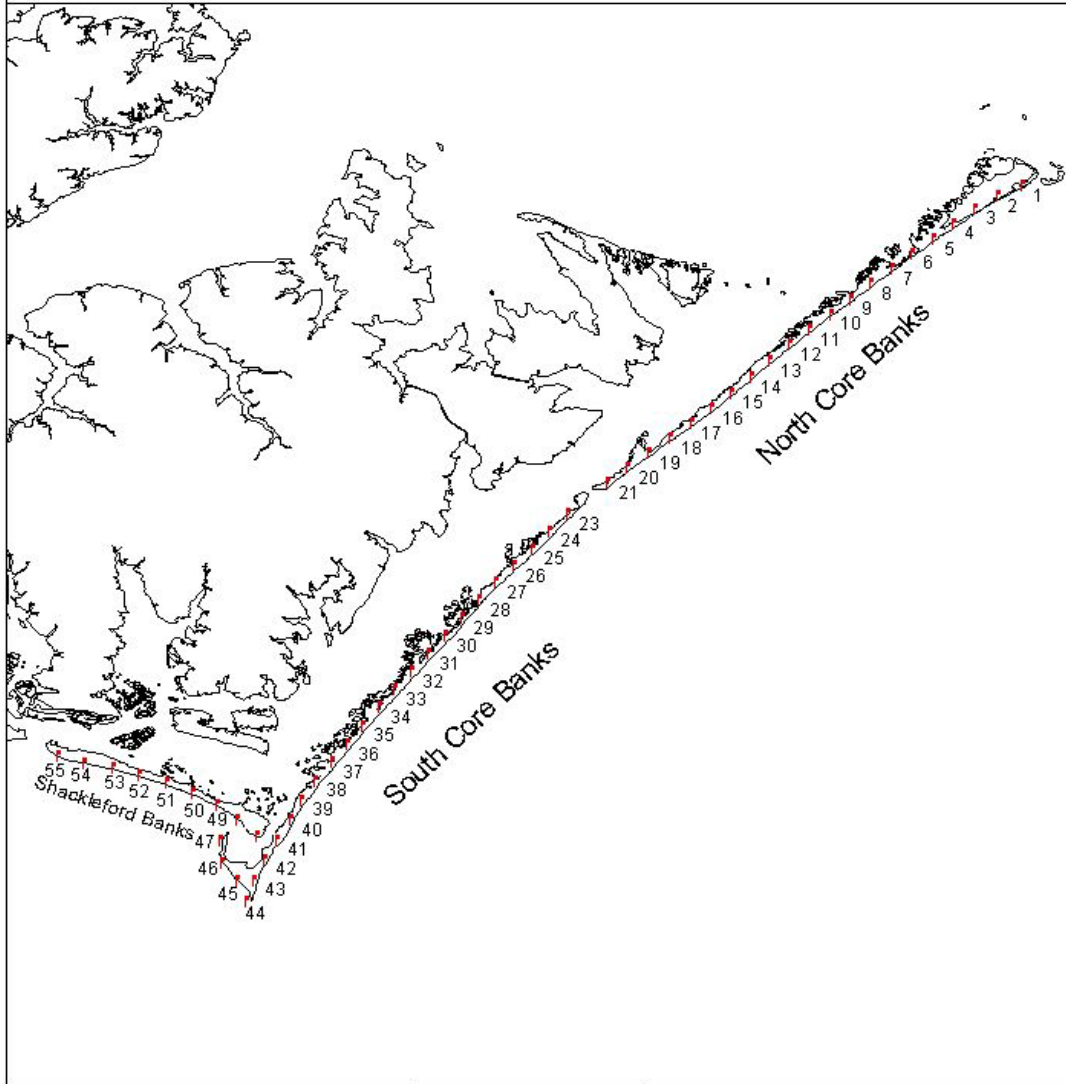
NOTES ON GREEN AND LEATHERBACK SEA TURTLES

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.

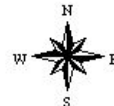
ATTACHMENT 1
EQUIPMENT AND MATERIALS
FOR
SEA TURTLE NEST MONITORING PROGRAM

<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\gis\base 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 _____

Relocated Nest _____

Location (tenths of mile): _____

Location (tenths of mile): _____

Site Desc. _____

Site Desc. _____

Dist. above high tide _____

Dist. above high tide _____

Distance below high tide _____

Date and Time Relocated _____

Dist. dune stake to nest _____

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.

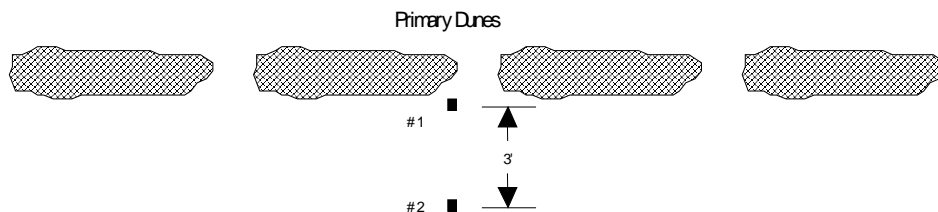
Dist. dune stake to nest - This is the distance from the base of the stake farthest from the nest (stake #1), to the center of the egg chamber. This distance is measured following the natural grade between the stake and nest.

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

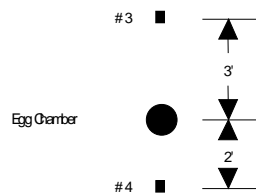


NOTES

- 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.

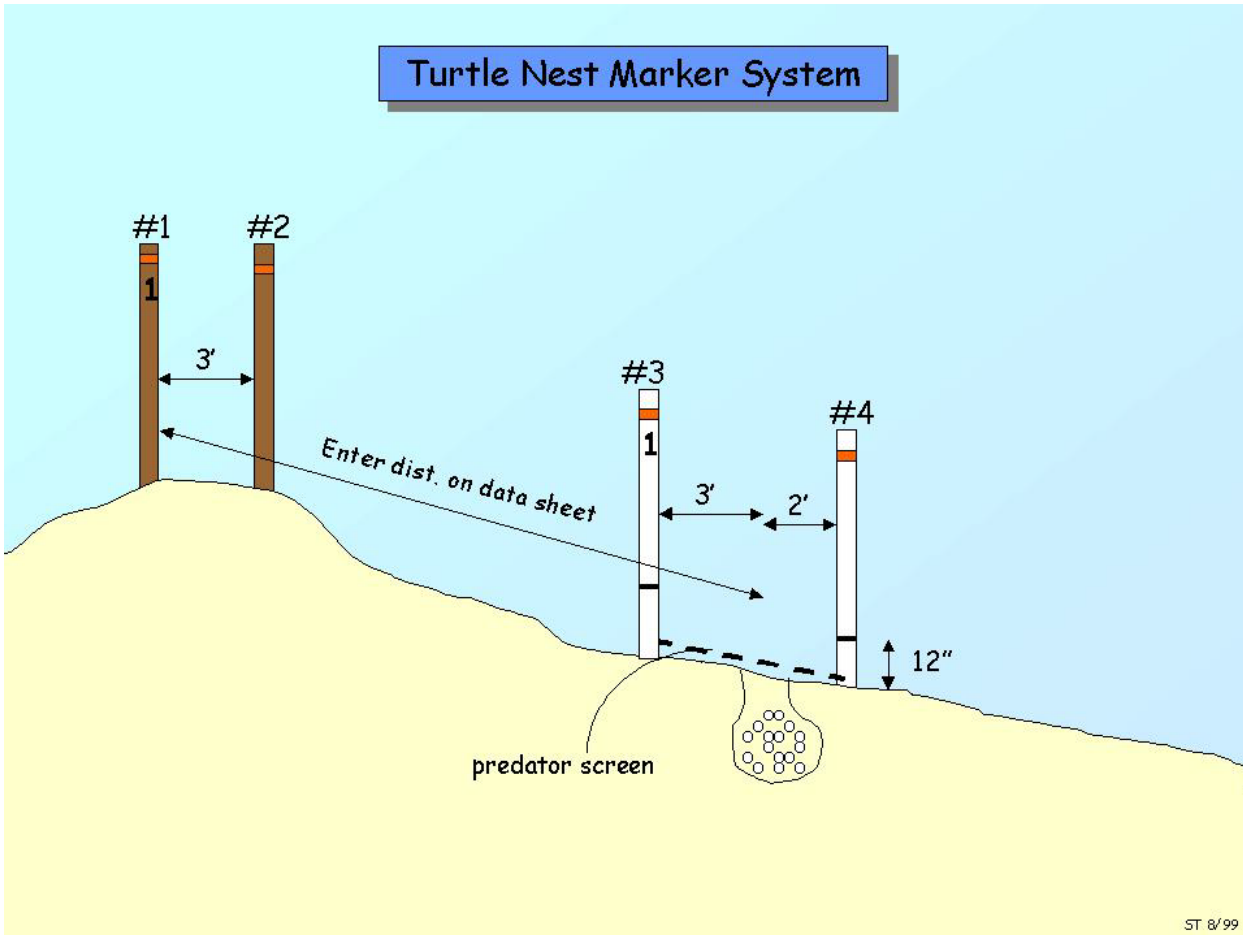
Legend

■ - Stake



ATTACHMENT 4A

TURTLE NEST MARKER SYSTEM



ATTACHMENT 5- MASTER LOG OF SEA TURTLE NESTING ACTIVITIES 2009

_____ *North Core Banks*

_____ *South Core Banks*

_____ *Shackleford Banks*

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

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. This is the original nest location.

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.

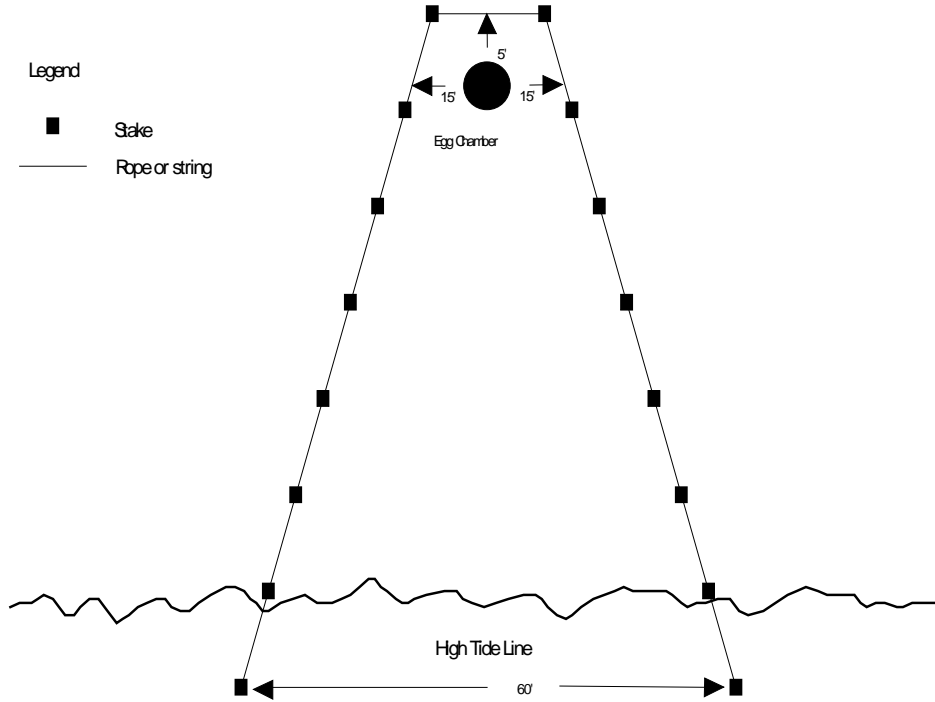
Depression Date. This date is taken by direct observation.

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

