CAPE LOOKOUT NATIONAL SEASHORE

2006 SEA TURTLE MONITORING PROGRAM

Jeff Cordes
Michael Rikard

National Park Service
Cape Lookout National Seashore
131 Charles Street
Harkers Island, NC 28531

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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 turtle nests in North Carolina. 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 2006 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. 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 4-5 days a week beginning April 15 and daily from June 1 to September 30. Each patrol began early enough so that the island was checked for turtle activity by 12:00 PM. Shackleford Banks was monitored two or three times a week. For detailed information on procedures used in the 2006 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 are considered in danger of erosion or tidal flooding. In 2006, nests laid in locations likely to flood were relocated to a higher elevation on the primary dune. Relocated nests were moved into designated areas and vehicles were detoured to the backroad 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 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 were monitored for hatching activity through November. Nests were excavated after hatching to determine nest success.

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 2006 was on May 17 and the last on August 24, for a 99 day nesting season. A total of 267 activities were documented of which there were 131 nests, 9 digs, and 127 crawls, (Table 1; see Appendix I for activity definitions). Two sea turtle species nested in the park with a total of 128 loggerhead turtle nests and 3 green turtle nests found.

Table 1. 2006 ACTIVITIES BY STUDY AREA

	North Core Banks	South Core Banks	Shackleford Banks	CALO Total
NESTS	60	57	14	131
DIGS	1	6	2	9
CRAWLS	73	50	4	127

Figure 1. Cape Lookout Turtle Activities 1990-2006

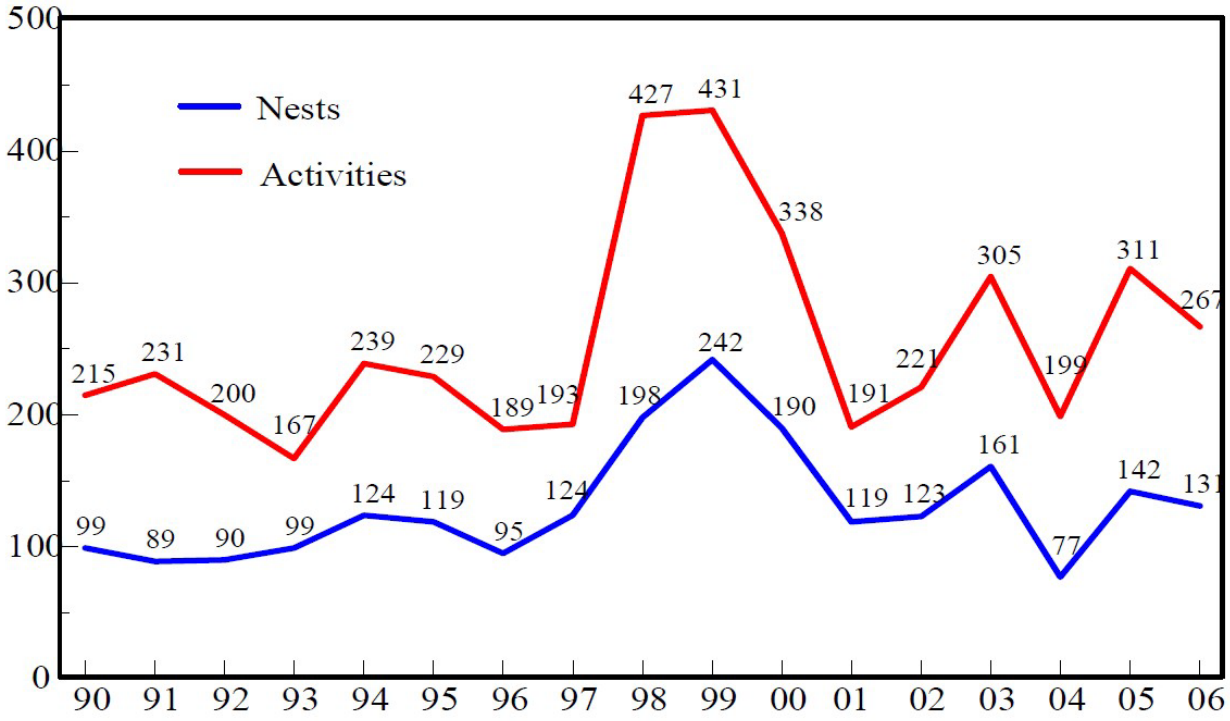
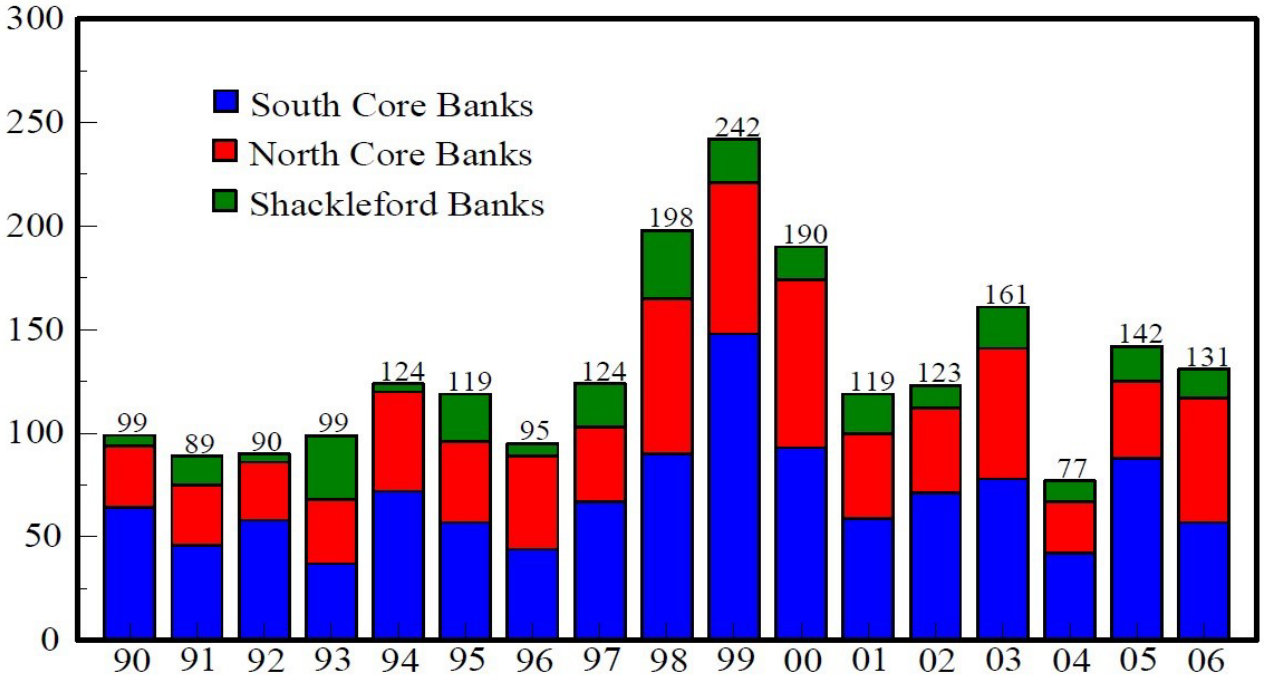


Figure 2. Turtle Nests 1990-2006



The number of nests found in 2006 was right at the annual average for CALO (Fig. 2). The greatest concentration of nests in the park occurred between Mile 42 and 45 on SCB (Fig. 3). Almost half of all the nests on the island were in this three mile area south of the lighthouse. The green turtle nests were found at 13-16 day intervals and were probably from a single female (Table 2). Nest #66 on SCB was possibly a green turtle nest but the nest was washed away before hatch and this could not be confirmed.

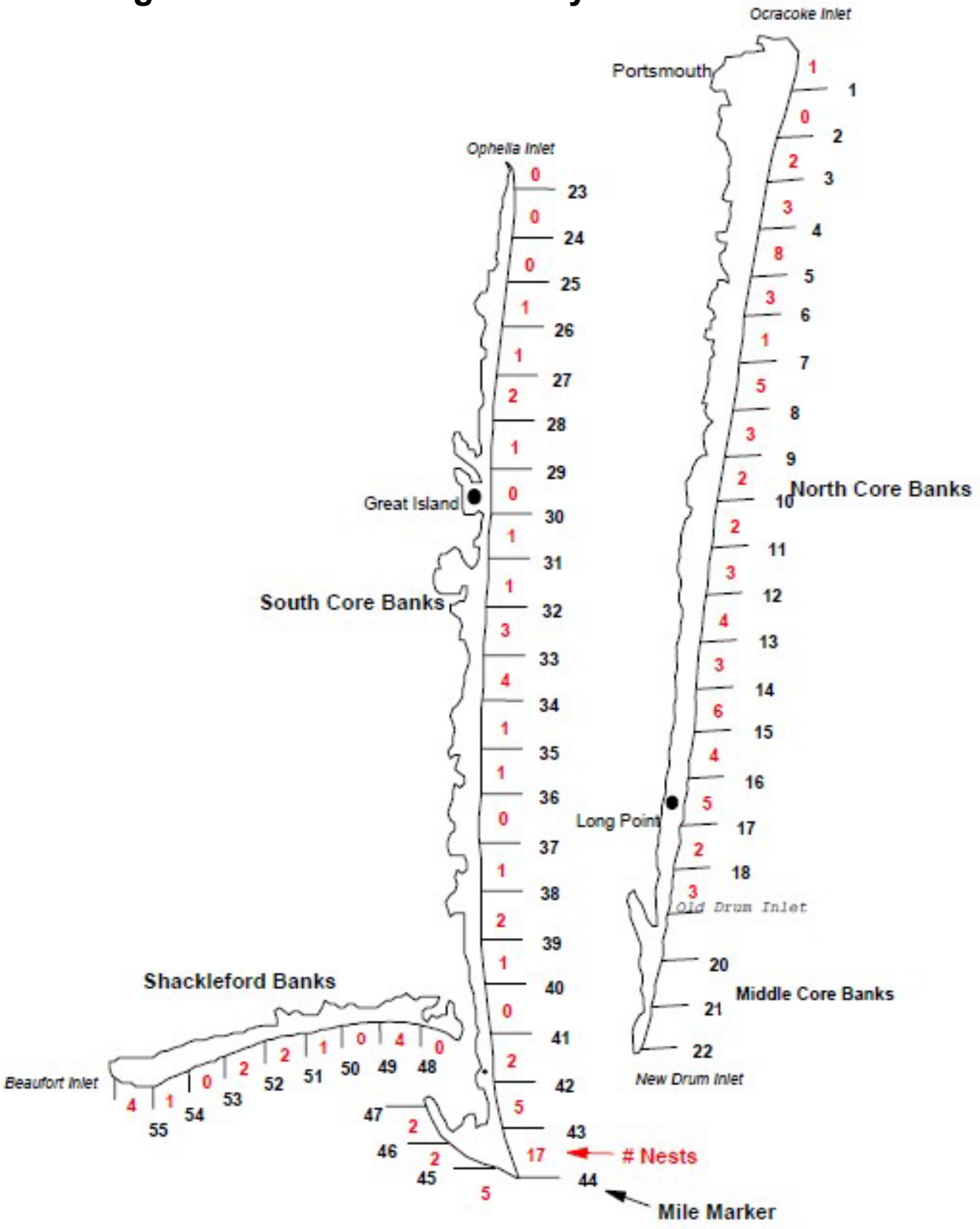
Table 2. Green Turtle Nesting Intervals

Date	Activity Type	Island
July 11	Unconfirmed nest	SCB
July 27	Nest	SCB
August 9	Nest	NCB
August 24	Nest	SCB

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.

Figure 3. 2006 Turtle Nests by Mile Section



The last nest was excavated on November 1. The average clutch size was 125 eggs. It took an average of 61 days for nests to incubate. 73% of the counted eggs produced hatchlings that made it out of the nest (emergence success), the highest for any one nest being 98% and lowest 0%. A total of 14,808 eggs were counted. Thirteen nests were washed away or buried with the numbers of eggs unknown. 10,843 of these eggs hatched and produced hatchlings that emerged or were released from the nest (Table 3). Flooding during Tropical Storm Ernesto and high tides in September had an impact on the 2006 nesting season, particularly in the southern sections of the park. A total of 44 nests were flooded by the ocean. Nineteen nests were washed away or failed to hatch due to flooding.

Table 3. SEA TURTLE HATCH SUMMARY 1990-2006

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%

*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 66% in 2006. This figure includes 13 nests with unknown egg numbers that were washed away 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.

Table 4. 2006 ACTIVITY SUMMARY BY STUDY AREA

	NCB	SCB	SH	TOTALS
NESTS	60	57	14	131
RELOCATED	33(55%)	18(31%)	0	51(39%)
AVERAGE CLUTCH	126 eggs	123 eggs	131 eggs	125 eggs
EMERGE SUCCESS	77%	71%	61%	73%
ESTIMATED TOTAL EMERGENCE SUCCESS (including nests with unknown egg totals)	77%	59%	48%	66%
AVERAGE INCUBATION	61 days	61 days	63 days	61 days
# LOST TO FLOODING	3	13	3	19
# LOST TO PREDATORS	0	0	0	0

In 2006, 39% of the nests were relocated, the second lowest percentage since 1988. The emergence rate for relocated nests was 31% better than the estimated rate for untreated nests (Table 5). Almost

one quarter of the nests not relocated failed to hatch.

Table 5. EMERGENCE SUCCESS OF RELOCATED VS. NON-RELOCATED NESTS BY STUDY AREA IN 2006

RELOCATED	NCB	SCB	SH	CALO Total
Nests	33	18	0	51
Eggs	4,132	2,245	0	6,377
Hatchlings	3,558	1,896	n/a	5,454
Emergence Rate	86%	84%	n/a	85%
NON-RELOCATED				
Nests	27	39	14	80
Eggs	3,438	3,546	1,447	8,431
Hatchlings	2,285	2,219	885	5,389
Emergence Rate	66%	63%	61%	64%
Estimated Total Emergence Rate	66%	46%	48%	54%

Since 1990 emergence success has been slightly better for relocated nests (Table 6). The presence of elevated relocation areas and the impacts of major storms have been the key factors in the success of relocated nests.

In 2006, no nests were completely lost to predators. One nest was dug into by raccoons prior to hatch but the nest was later washed away so the number of eggs lost to predation was unknown. A second nest was dug into by raccoons after it hatched. Both incidents occurred on SCB south of the lighthouse.

Table 6. 1990-2006 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
AVERAGES	*55*	*66%*	*66% (55%)*	*88*

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

Four nests had roots in the egg chamber destroy eggs or trap hatchlings. Artificial lights attracting hatchlings was not known to be a problem.

Off-road vehicles disregarding beach closures threaten the survival of hatchlings. Nine violations of vehicle closures for turtle nests were documented by resource management staff. These vehicles drove between posts and the ocean at low tides or drove through posts and rope. On SCB one hatchling from Nest# 103 was run over and killed by a vehicle that illegally drove though the closure.

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. Nest relocation is the primary management tool used to enhance hatching success in the park. In 2006, the park met this goal because of high hatch rates in relocated nests and a season relatively free of major storms.

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. However, the beach profile at CALO makes nests laid in the back swale area of the beach likely to be flooded for long lengths of time during high tides and storms. Rather than just reducing hatching success of these nests, in the majority of cases nests in these areas that are repeatedly flooded are likely to fail completely. The best management decisions can only be made by evaluating the local conditions and their potential effect on nesting success.

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 one strandings occurred at CALO in 2006. All strandings were reported to the NCWRC and were documented with a "Sea Turtle Stranding and Salvage Network" stranding report. Loggerhead turtles accounted for the majority of the strandings (35). There were also 16 green turtles, eight Kemp's Ridleys, and two unknown. The month of June had the greatest number of strandings (Table 7). Twenty one (34%) of the strandings were found on the soundside of the islands, the remainder on the ocean beach.

Five live sea turtle strandings occurred in the park in 2006. All were loggerheads and were transported out of the park and sent to the Topsail Turtle Hospital.

Table 7. 2006 SEA TURTLE STRANDINGS AT CAPE LOOKOUT NATIONAL SEASHORE

	NCB	SCB	SH	HI	TOTAL
January	0	1	0		1
February	1	0	0		1
March	0	0	0		0
April	1	1	4		6
May	3	2	6		11
June	3	6	5	1	15
July	1	3	0		4
August	0	2	2		4
September	1	1	0		2
October	2	0	2		4
November	1	3	1		5
December	1	7	0		8
Total for 2006	13	26	20	1	61

Injuries or abnormalities were recorded on each stranding report. Five turtles were missing part or all of a flipper, two were missing their head, six had carapace damage, two had prop scars, and three had other wounds. The remaining turtles showed no apparent cause of death.

Turtles were scanned for Passive Integrated Transponder (PIT) tags. PIT tags or metal tags were found in one loggerhead turtle (Table 8). All or parts of some turtles were salvaged for NOAA Fisheries researchers.

Table 8. TAGGED SEA TURTLES FOUND AT CALO IN 2006

Stranding #	Date Found	Island	Metal Tags #	PIT tag #
06-30	14 June	SCB	RRS237 & RRS236	45???79064F

Table 9. CALO SEA TURTLE STRANDINGS 1990 – 2006

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

Table 10. CALO TURTLE STRANDINGS BY SPECIES 1990-2006

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

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. The park should continue their traditional relocation standards of moving nests that the monitoring staff believes are likely to be flooded.

2. All park staff and volunteers involved with turtle monitoring should be given complete training in current monitoring procedures.

3. 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. The park should to continue to work in cooperation with the North Carolina Maritime Museum and Cape Lookout Environmental Education Center to educate visitors about sea turtles.

APPENDIX I

2006 SEA TURTLE PROGRAM PROCEDURES

2006 SEA TURTLE PROGRAM PROCEDURES

The basic procedures for the 2006 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.

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

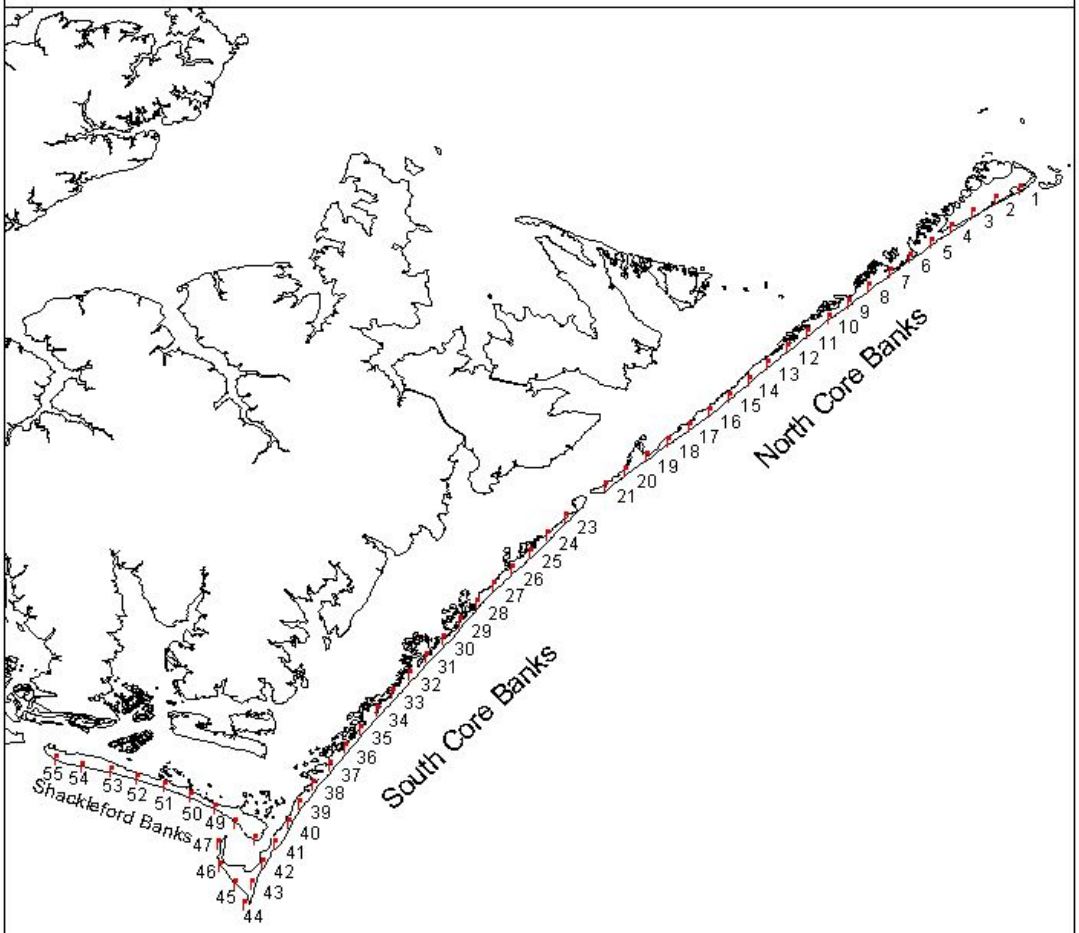
ATTACHMENT 1

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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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_____
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.

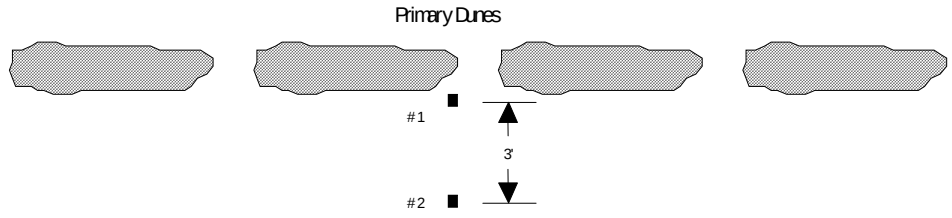
Latitude/ Longitude- If the nest is relocated, record the latitude and longitude of the new nest location using the GPS unit.

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:

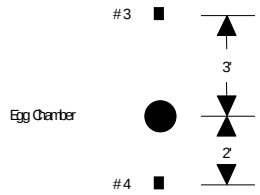
1) Nest stakes are PVC, range stakes may be wooden or PVC

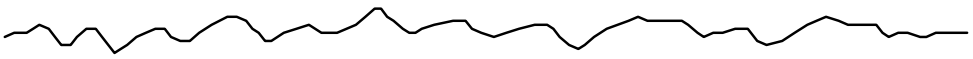
2) Stakes 1 through 4 must be on a straight line.

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

Legend

■ - Stake





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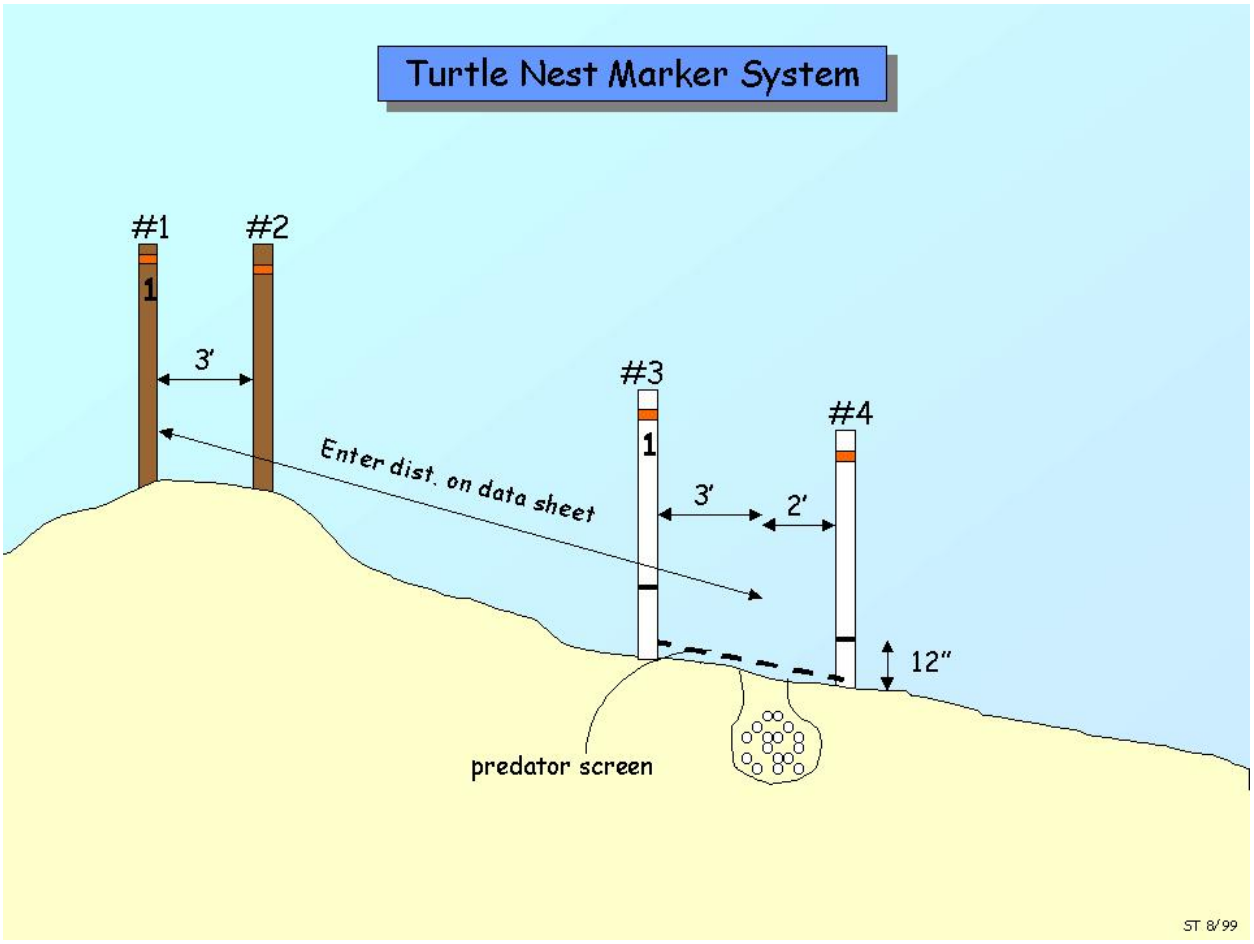
ATTACHMENT 4A

TURTLE NEST MARKER SYSTEM



ATTACHMENT 5- MASTER LOG OF SEA TURTLE NESTING ACTIVITIES 2006

_____*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.

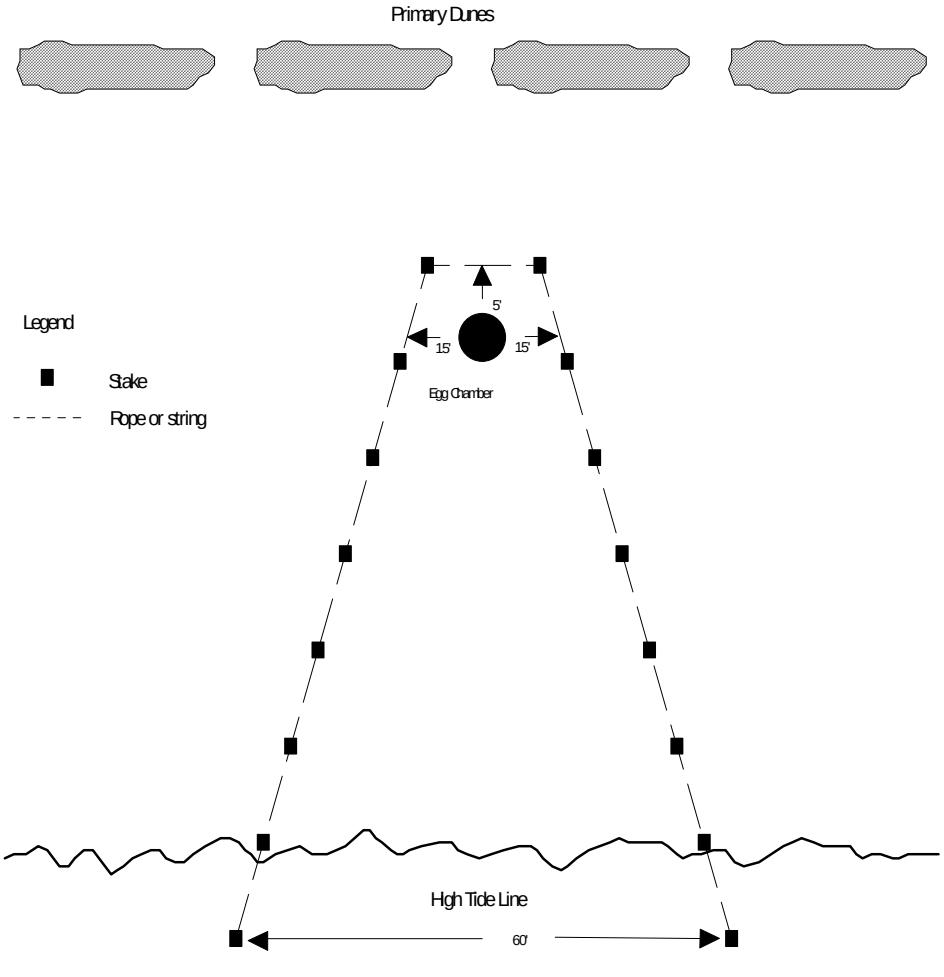
Depression Date. This date is taken by direct observation.

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.

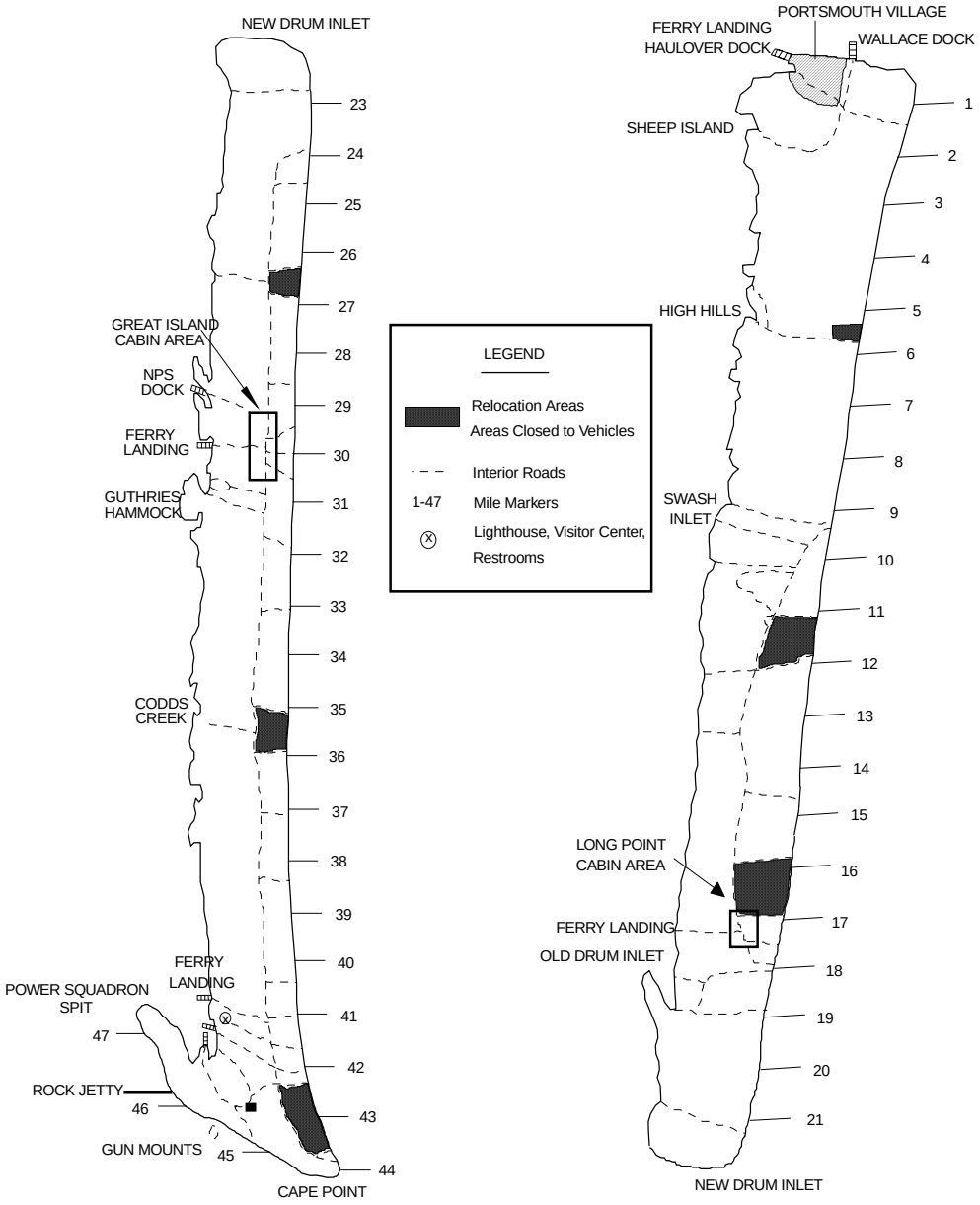
6. **Crawl Identification:** Surveyors will identify and record all "new" crawls by species and as nests or false crawls. False crawls will only be counted if the extend above the most recent high tide line. Crawl data will be reported by beach sector. The preferred length of beach sector is 1 km or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

2006 INDIVIDUAL NEST DATA

Table 11. North Core Banks Sea Turtle Nesting Data-2006

#	Date	Mile	Relocated Mile	Hatch Date	Incubation Days	# Eggs	# Hatchlings	% Emerge	Comments
2	29-May	13.8		5-Aug	68	130	115	88	
3	30-May	12.4		11-Aug	73	111	42	38	
14	8-Jun	12.5		11-Aug	64	162	40	25	
15	9-Jun	7.1	5.3	11-Aug	63	126	110	87	
16	9-Jun	5.5		10-Aug	62	145	132	91	
18	11-Jun	7.8	5.3	20-Aug	70	156	128	82	
20	12-Jun	9.4				150	138	92	
23	17-Jun	17.7		15-Aug	59	122	83	68	
24	17-Jun	4.4	5.3	20-Aug	64	149	128	86	
25	17-Jun	11.1	11.3	16-Aug	60	130	120	92	
26	17-Jun	4.1				134	34	25	Abnormal Eggs
28	18-Jun	16.2	16.2			130	108	83	
29	19-Jun	10.6				103	92	89	
33	21-Jun	2.1				96	0	0	Flooded
35	23-Jun	17.6	16.6	20-Aug	58	142	136	96	
38	23-Jun	3.2	5.3	23-Aug	61	138	132	96	
39	24-Jun	11.5		20-Aug	57	105	101	96	
49	27-Jun	15.9	15.9	24-Aug	58	137	115	84	
50	29-Jun	16.2		27-Aug	59	146	135	92	
53	1-Jul	5.0				130	109	84	
55	2-Jul	14.7				132	0	0	Flooded
56	2-Jul	13.9				145	126	87	
58	2-Jul	12.2	11.8	27-Aug	56	122	118	97	
59	2-Jul	4.7	5.1	30-Aug	60	122	120	98	
61	3-Jul	4.7	5.1	4-Sep	63	151	128	84	
64	4-Jul	15.9				104	78	75	

69	5-Jul	0.4	5.2	4-Sep	61	128	122	95	
#	Date	Mile	Relocated Mile	Hatch Date	Incubation Days	# Eggs	# Hatchlings	% Emerge	Comments
70	6-Jul	4.6	5.3			139	131	94	
76	7-Jul	3.0	5.3	4-Sep	59	143	93	65	
78	8-Jul	18.1	16.7	4-Sep	58	97	94	97	
80	8-Jul	8.0		29-Aug	52	88	82	93	
81	9-Jul	15.9				147	144	98	
82	11-Jul	4.9				126	16	13	Flooded
84	12-Jul	4.8		13-Sep	63	149	63	42	Roots in Nest
87	13-Jul	7.3	5.3	23-Sep	62	120	115	96	
88	14-Jul	11.8	11.8			151	135	89	Roots in Nest
89	15-Jul	3.1	5.3			95	70	74	
90	16-Jul	7.3	5.3			151	144	95	
94	18-Jul	16.6	16.6	12-Sep	56	120	108	90	
95	18-Jul	14.7	15.9	14-Sep	58	125	123	98	
96	19-Jul	14.1				135	0	0	Flooded, 128 Hatchlings Drowned
97	19-Jul	6.1	5.3	23-Sep	66	107	84	78	
98	20-Jul	18.6	16.6	21-Sep	63	98	57	58	
102	22-Jul	12.8		17-Sep	57	127	123	97	
104	22-Jul	8.3	5.3	30-Sep	70	122	114	93	
108	23-Jul	14.1		17-Sep	56	127	122	96	
110	25-Jul	10.2	11.3	27-Sep	64	76	73	96	
111	25-Jul	9.1	11.3	18-Sep	55	82	72	88	
112	25-Jul	5.3	5.3	23-Sep	60	143	112	78	
113	26-Jul	18.1	16.9	22-Sep	58	128	116	91	
119	27-Jul	4.1				140	60	43	
120	28-Jul	2.1	5.1	3-Oct	67	144	100	69	Roots in Nest
121	30-Jul	8.1	5.3	5-Oct	67	146	127	87	
124	31-Jul	13.3	11.8	30-Sep	61	113	109	96	

125	1-Aug	15.9				96	93	97	
128	4-Aug	7.8	5.3			125	116	93	
#	Date	Mile	Relocated Mile	Hatch Date	Incubation Days	# Eggs	# Hatchlings	% Emerge	Comments
129	9-Aug	16.9				159	155	97	Green Turtle Nest
131	12-Aug	16.2				137	122	89	
132	16-Aug	14.8		26-Oct	71	92	80	87	Roots in Nest
133	17-Aug	14.6	15.9			76	0	0	Cold Temperatures Stopped Development

Table 12. South Core Banks Sea Turtle Nesting Data-2006

#	Date	Mile	Relocated Mile	Hatch Date	Incubation Days	# Eggs	# Hatchlings	% Emerge	Comments
1	24-May	45.4		30-Jul	67	131	118	90	
2	1-Jun	43.3		2-Aug	62	163	145	89	
5	5-Jun	38.4		17-Aug	73	138	1	1	Flooded, 110 Hatchlings Drowned
8	9-Jun	43.1		10-Aug	62	151	129	85	
11	11-Jun	43.3				140	40	29	Flooded
12	12-Jun	30.0				136	3	2	Flooded
13	14-Jun	44.3	43.4	11-Aug	58	105	98	93	
15	17-Jun	33.1	35.3	16-Aug	60	138	131	95	
16	17-Jun	35.4	35.3	18-Aug	62	123	108	88	
17	18-Jun	43.2		14-Aug	57	135	129	95	
18	19-Jun	34.7	35.3	19-Aug	61	101	94	93	
19	21-Jun	44.2	43.4	15-Aug	55	149	122	82	
20	22-Jun	35.0		24-Aug	63	121	113	93	
24	24-Jun	32.2				108	96	89	
26	25-Jun	39.1		29-Aug	65	51	48	94	
28	26-Jun	43.6		24-Aug	59	148	139	94	
32	26-Jun	44.6					0	0	Flooded and Buried 9/1
33	27-Jun	26.6		31-Aug	65	98	69	70	

35	1-Jul	43.3		24-Aug	54	145	135	93	
43	2-Jul	43.3		24-Aug	53	149	142	95	
#	Date	Mile	Relocated Mile	Hatch Date	Incubation Days	# Eggs	# Hatchlings	% Emerge	Comments
44	2-Jul	41.2					0	0	Flooded, Washed Away 9/13
46	3-Jul	44.3	43.3	29-Aug	57	143	122	85	
48	4-Jul	33.7					0	0	Flooded, Washed Away 9/11
49	4-Jul	44.2	43.3	28-Aug	55	151	145	96	
52	6-Jul	32.9		30-Aug	55	94	84	89	
53	6-Jul	35.5				97	2	2	Flooded
55	6-Jul	42.1	43.2	28-Aug	53	108	100	93	
59	8-Jul	42.0		5-Sep	59	125	118	94	
62	9-Jul	43.6		2-Sep	55	163	113	69	Flooded, 32 Hatchlings Drowned
64	10-Jul	43.3					0	0	Washed Away
66	11-Jul	31.1					0	0	Washed Away, possible Green Turtle
67	11-Jul	42.0				138	5	4	Flooded, 121 Hatchlings Drowned
68	13-Jul	35.1	35.4	5-Sep	54	108	101	93	
70	13-Jul	41.0	43.3	6-Sep	55	139	134	96	
71	15-Jul	43.3				136	128	97	
78	18-Jul	37.6					0	0	Flooded, Washed Away 9/11
79	18-Jul	27.3				101	0	0	Flooded
80	19-Jul	43.3					0	0	Washed Away 9/12
82	21-Jul	25.5	26.5	21-Sep	62	113	50	44	Flooded, 54 Hatchlings Drowned
83	22-Jul	43.1		28-Sep	68	110	4	4	Flooded
86	23-Jul	33.3	35.2	25-Sep	64	112	106	95	
87	27-Jul	28.2	26.6	29-Sep	64	124	105	85	
88	27-Jul	46.0		4-Oct	69	46	10	22	Green Turtle Nest, Flooded
89	27-Jul	43.4	43.4	24-Sep	59	135	127	94	6 Hatchlings to NC Aquarium @PNS
91	29-Jul	32.0	35.2	29-Sep	62	118	114	97	
92	29-Jul	33.4				84	0	0	Flooded

93	29-Jul	42.9		27-Sep	60	87	73	84	
95	29-Jul	43.5		2-Oct	65	137	98	71	
#	Date	Mile	Relocated Mile	Hatch Date	Incubation Days	# Eggs	# Hatchlings	% Emerge	Comments
100	3-Aug	38.1	35.4			125	123	98	
103	3-Aug	43.5	43.3	5-Oct	63	125	116	93	
104	6-Aug	42.3				152	50	33	Flooded
105	7-Aug	27.1		16-Oct	70	126	105	83	
106	7-Aug	45.4	42.9			128	0	0	Washed Away
107	8-Aug	43.3					0	0	Washed Away
108	10-Aug	43.6		14-Oct	65	136	122	90	Daytime Emergence
110	14-Aug	35.3					0	0	Washed Away 9/14
113	24-Aug	46.3					0	0	Green Turtle Nest, Washed Away 9/1

Table 13. Shackleford Banks Sea Turtle Nesting Data-2006

#	Date	Mile	Hatch Date	Incubation	# Eggs	# Hatchlings	% Emerge	Comments
3	6-Jun	51.8	8-Aug	63	138	119	86	
4	7-Jun	55.1			135	97	72	
5	17-Jun	48.9			144	139	96	
6	20-Jun	48.5	22-Aug	63	143	7	5	Most Eggs Undeveloped
7	22-Jun	55.6			114	98	86	
8	6-Jul	51.8			91	85	93	
9	6-Jul	48.7			153	3	2	Most Eggs Undeveloped
12	18-Jul	55.6				0	0	Washed Away 9/1
13	18-Jul	50.3			135	125	93	
15	20-Jul	52.9			165	2	1	Flooded and Buried
16	25-Jul	54.2				0	0	Washed Away 9/1
17	27-Jul	48.5			107	99	92	

18	1-Aug	52.3			122	111	91	
19	8-Aug	55.0				0	0	Washed Away