

**CAPE HATTERAS NATIONAL SEASHORE  
SEA TURTLE  
2010 ANNUAL REPORT**



“Cold-stunned” loggerhead found alive on Ocracoke, during a mass stranding event (2/6/2010).

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## INTRODUCTION

Five species of sea turtles can be found along the Cape Hatteras National Seashore (CAHA) – the loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp’s ridley (*Lepidochelys kempii*). In the 1970’s, the leatherback, Kemp’s ridley and hawksbill were listed under the Federal Endangered Species Act (ESA) as endangered and the loggerhead as threatened (likely to become endangered within the foreseeable future). The green, listed on July 28, 1978, is designated as threatened in its entire range except in the breeding populations in Florida and on Mexico’s Pacific coast, where it is listed as endangered.

Non-breeding sea turtles of all five species can be found in the near-shore waters during much of the year. CAHA lies near the extreme northern limit of nesting for three of the five sea turtle species including: the loggerhead, green, and leatherback; loggerheads being the most common. Annual nest numbers have fluctuated greatly within the last 25 years with only 11 nests recorded in 1987, and a maximum of 153 nests in 2010. The Kemp’s ridley and hawksbill are not known to nest at CAHA, but are known to occur here through strandings. The occasional Kemp’s Ridley nest has been documented in North Carolina.

CAHA follows management guidelines defined by the North Carolina Wildlife Resources Commission (NCWRC) in the *Handbook for Sea Turtle Volunteers in North Carolina*, as well as species recovery plans. In December 2008, the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) signed off on a new recovery plan for the Northwest Atlantic population of loggerheads. While this document did not change any of CAHA’s management protocols, it did provide more information on the status of the species in the area.

The beaches of CAHA have been monitored since 1987 for nesting activity. The quality of surveys has improved over time and has developed into the current standardized protocols. Each year data has been collected and analyzed to gain a better understanding of sea turtle use within CAHA. This report summarizes the monitoring results for 2010.

### **Consent Decree**

In October 2007, Defenders of Wildlife and the National Audubon Society, represented by the Southern Environmental Law Center (plaintiffs) filed a lawsuit against the National Park Service (NPS) alleging inadequacies in the management of protected species at CAHA as specified by the 2007 Interim Protected Species Management Strategy (Interim Strategy) and the failure of CAHA to comply with the requirements of the ORV executive orders and NPS regulations regarding ORV use. On April 30, 2008, a settlement agreement that had been reached between all parties to the lawsuit was approved by the U.S. District Court as a consent decree (CD). The purpose of the CD was to provide additional protection measures pending the development of an ORV management plan and special regulation.

The CD affected management of sea turtle nests and public recreation near nests and altered the protocols in the Interim Strategy in the following ways:

- Nighttime driving is restricted between the hours of 10 pm-6 am, from May 1 – September 15. After September 15 nighttime driving is allowed only with a NPS permit for no fee. In winter months (November 1 – May 1) nighttime driving is not restricted.
- After September 15, all unhatched turtle nests on ORV beaches that have reached their hatch window (50 – 55 days of incubation) receive a full beach closure between the hours of sunset and 6 am, in addition to the fencing methodology described in the Interim Strategy. A full beach closure extends from the water to the dune line, thus prohibiting ORV access behind these nests. After final excavation of these nests, the closure is removed.

## **COOPERATING AGENCIES**

CAHA cooperates with the NMFS and USFWS on sea turtle protection. All original stranding reports and annual nesting activity reports are submitted to the North Carolina Sea Turtle Program Coordinator at the NCWRC. An annual permit is issued to CAHA by NCWRC under the authority of the USFWS for the possession and disposition of stranded marine turtles and relocation of nests.

## **SITE DESCRIPTION**

CAHA is located along the northern Outer Banks region of North Carolina. Consisting of more than 30,000 acres distributed along approximately 67 miles of shoreline, it is part of a dynamic barrier island system. Federal ownership in CAHA extends from ocean to sound across three barrier islands—Bodie, Hatteras, and Ocracoke—spanning Dare and Hyde counties. Eight village enclaves are excluded from CAHA boundaries. The villages include Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras on Hatteras Island and Ocracoke Village on Ocracoke Island. On the oceanside of the villages, federal ownership was established as a 500-foot strip measured landward from the mean low water at the time of acquisition. Fishing piers located in Rodanthe, Avon, and Frisco have historically been operated as concessions within CAHA. However, the Frisco Pier is currently inactive due to storm damage. The Avon Pier is currently the only location to remain operational as an NPS concession. The 5,880-acre Pea Island National Wildlife Refuge, located at the northern end of Hatteras Island, is within the authorized boundary of CAHA, but owned and administered for refuge purposes by the USFWS.

## **METHODS**

### **Nest Activity**

Oceanside beaches of CAHA were patrolled daily from May 1 to October 1 in search of turtle crawls/nesting activity and strandings (protocols dictate that daily patrols must continue until September 15; in 2010 daily patrols went until October 1 due to the potential for late nests). After October 1, the beaches were surveyed three to four times a week for possible late nests and/or hatchling emergence events from possible missed nests through November 15. After October 1, all remaining known nests were checked daily for hatchling emergence events.

CAHA staff monitored approximately 67 miles of shoreline covering Bodie, Hatteras, and Ocracoke Islands. For purposes of sea turtle management, Bodie Island District extends from Ramp 1 to Ramp 30; Hatteras District from Ramp 30 south to Hatteras Spit; and Ocracoke District from Hatteras Inlet south to Ocracoke Inlet (see Appendix D, Map 1). The Hatteras District is further delineated as Hatteras North, which encompasses the area from Ramp 30 to Cape Point, and Hatteras South, which extends from Cape Point to Hatteras Inlet. Morning surveys began as early as possible (between 5:00 am and 6:30 am) so that all beaches had been patrolled by no later than 10:30 am. Nests were considered confirmed when the nest cavity with eggs was located.

Nests were either left in place (*in situ*) or relocated for environmental reasons. In general, nest relocation has been discouraged under recommendations of NCWRC and USFWS; therefore, relocation was confined to nests that were threatened with loss from erosion and nests that were laid below the high tide line that would receive frequent tidal inundation. Nests were also moved if they had sustained any incident that resulted in egg contents dripping into the egg chamber, such as high predation or being crushed by an ORV. Some nests were relocated during the approach of storm events. In these cases, verbal permission was obtained from NCWRC for each individual nest.

A transponder ball was buried 45 cm in front of all nests sites. A series of three PVC poles were placed in line with and behind the nest with measurement distances recorded. The nest site was protected with symbolic fencing comprised of four to eight 2"x2" wooden posts with signs stating the area was closed to entry for a sea turtle nest and should not be disturbed. String with flagging was placed between the sign posts and the area was monitored for signs of violations, predation and washover events during daily morning patrols. Additionally, all active nests were checked during daily patrols.

Between 50-55 days of incubation, closures were expanded to encompass the area 30-50 feet duneward of the nest site down to the tide line. Width of the expanded closures (running parallel to the shoreline) varied from 75/150/350 feet, depending on the type and level of recreational use on that site. For example, a nest on a remote beach would receive a closure of 75 feet in width; a nest in a heavy pedestrian use area, such as a village, would be 150 feet in width; and a nest in an ORV area would be 350 feet in width. If a nest was located on a beach open to ORV use, large signs were posted to notify drivers that the established closure included the shoreline at all tides. When possible, an ORV corridor was maintained duneward of the nest, except for nests that remained beyond September 15, which all received full beach closures. Reflective arrows and detour signs were clearly posted to alert drivers of the change in traffic pattern. If a nest was laid high up on the beach or in the dunes and did not allow for traffic to be detoured around it, the beach was completely closed from dune to the surf as well as for a width of 350 feet. The perimeter of the closure was well posted and large signs warned visitors near ORV ramps of "No through traffic to the next ramp". The public was notified of closures that would temporarily limit ORV traffic through weekly access reports distributed by CAHA. The reports were posted at Park Visitor Centers and ramps and distributed to local businesses. Many of the local fishing and ORV groups also posted this information on their fishing web boards. Areas with limited or no access were also clearly marked on CAHA's website, which contained a link to Google Earth, allowing people to find out about changes to access. Within turtle closures, all vehicle tracks

were smoothed over manually with rakes or with a steel mat attached to an UTV, so as not to impede hatchlings attempting to reach the surf (NMFS, USFWS 2008).

As hatchlings can become disorientated by artificial light, silt fencing was installed at most nest sites 50-55 days into incubation in order to block sources of light pollution from nearby villages or ORV's operating with headlights after dark. The fencing was placed in a "U" shape behind the nest and extended oceanward to the high tide line. Sites were then checked on a daily basis for hatching events. Most nests hatched during the evening/night hours either in one event, known as a "boil", or intermittently over several nights, known as a "trickle."

In the event of approaching storms that threatened turtle nests, several measures were taken. Silt fencing has the potential to funnel ocean overwash onto a nest site. To avoid this potential damage to the nests, all silt fencing was removed from nest sites prior to impending storms. After the storm passed, silt fencing was replaced for active nests. Prior to overwash from storms, all nests that had shown signs of hatching or emergence (i.e. a depression was present or the nest already had some emergence) were excavated early. Hatchlings that have already "pipped" out of their eggs have little chance of surviving overwash, so they were removed from the nest before storm overwash occurred. Hatchlings were held until after the storm had passed and then released. In certain circumstances, some nests were relocated in the approach of a major storm event. NCWRC was consulted prior to any nest being relocated for this reason.

With the exception of the nests that washed out, all nests were examined after hatching to determine productivity rates. Nests were excavated no earlier than 72 hours after hatching, except in cases when nests were excavated early due to impending storms. After storm activity, nests that were known to be dead were excavated and removed. In cases where hatching events or dates were unknown, or if a nest failed to hatch, nest cavities were unearthed 80-90 days after the lay date in accordance with NCWRC guidelines. In some cases late in the season (November and December), nests may incubate beyond 90 days and still hatch. In these cases, the nests were left in place until they hatched or were confirmed to no longer be viable. Closures were promptly removed after completion of each nest excavation.

### **Stranding Events**

All species of sea turtles that stranded on CAHA in 2010 were documented in cooperation with NCWRC, USFWS, and NMFS. Handling and collection permits were issued to CAHA by NCWRC and all reports were submitted to them within 24 hours of stranding events. Live animals were transported to a permitted rehabilitation facility for immediate care. A stranding report was completed for each animal (live and dead) documenting such information as species, condition, sex, carapace measurements, tags, wounds or abnormalities, and evidence of fishing gear entanglement or other possible causes leading to injury or death. When possible, photos were taken of each stranding. For dead strandings, samples were collected for ongoing DNA and aging studies. Flippers, eyes and muscle tissue were collected and transferred to the NMFS Beaufort laboratory. When possible, stranded turtles were necropsied by CAHA staff in order to determine sex, health condition, and occurrences of human interaction. All strandings are documented in Appendix C. The locations of the strandings, that had GPS coordinates, are documented in Appendix D, Maps 12-16.

In 2009 and 2010, CAHA also worked with the North Carolina Department of Marine Fisheries (DMF) to identify and necropsy sea turtle incidental takes by the flounder fishery in Pamlico Sound. The turtles that were found dead by DMF fisheries observers were brought to CAHA for analysis and documentation. Samples and stranding reports were sent to NCWRC within 24 hours.

During the winter months, CAHA received numerous cold-stunned strandings (live and dead). These strandings were most commonly found on the soundside shoreline. Due to the number of live strandings in the winter months, CAHA worked with volunteers and staff members to develop standardized survey protocol to locate and respond to these animals. Dead strandings were sampled and necropsied, while live strandings were immediately taken to the Roanoke Island Animal Clinic in Manteo, NC (or other accredited rehabilitation facility) for triage and blood work.

### **DNA Study**

In 2010, CAHA, along with all other North Carolina, South Carolina, and Georgia beaches, participated in a genetic mark-recapture study of Northern Recovery Unit nesting female loggerheads using DNA derived from eggs. The study was coordinated by the Georgia Department of Natural Resources, the University of Georgia, and NCWRC. Results from this study will provide estimates of annual nesting population size, clutch frequency, and remigration of females as well as characterize the scale of nest site fidelity and population structure. A single egg was taken from each of the 146 loggerhead nests and the one unknown nest for this study (total of 147 eggs).

### **Lighting Project**

In 2009 CAHA received a grant from Eastern National in order to carry out research designed to assist biologists in better understanding the effect of artificial lighting on the sea-finding behavior of emerging hatchlings. The objectives of this project were to (1) record the effects of varying artificial lights on hatchlings; (2) determine possible differences in artificial lighting effects on hatchlings from the northern range of the loggerhead turtle and hatchlings from other nesting areas of the loggerhead range; and (3) to determine the best possible options for beachfront lighting along the ocean shoreline of CAHA in order to begin implementation of a lighting management plan. In 2010 this research project continued with additional funds provided by Eastern National. With these funds, CAHA recruited and trained an SCA volunteer to help staff implement the project.

### **Volunteer Project**

In an effort to involve the public in sea turtle management, CAHA continued two of the sea turtle volunteer programs begun in 2009. Due to infrastructure changes within the Resource Management Division early in 2010, the volunteer program only had two components this year instead of three.

The first program was designed to allow volunteers to assist biologists with public interpretation and “nest sitting.” Nest-sitters watched over nests that were likely to hatch, helped minimize disturbance to hatchlings attempting to reach the ocean, prevented predation from ghost crabs and mammalian predators, educated the public in sea turtle life history, and explained sea turtle

management practices at CAHA. Volunteers also assisted staff by teaching the general public about sea turtle biology during public excavations.

The second volunteer program was developed to have volunteers assist staff members in the response to cold-stunned sea turtle strandings. Since CAHA receives so many cold-stunned strandings, the volunteers in this program helped patrol areas difficult to access by park employees such as soundside areas in the villages, in order to look for turtles as well as transport them to the rehabilitation facility if the animal was alive.

## **RESULTS**

### **Nesting**

Sea turtle nest numbers at CAHA vary from year to year. The yearly nest numbers used in this report were taken from a thorough search of CAHA's turtle database and represent the most accurate turtle management data for CAHA (Figure 1). Additionally, in the spring of 2010, staff biologists met with biologists from NCWRC to review and fix known discrepancies between the two agencies's nesting databases. As a result of this meeting, some prior year nest totals have been changed. These changes reflect the most accurate data as compiled by CAHA and NCWRC.

The first recorded nesting activity for the 2010 season occurred on Hatteras Island with a loggerhead nest on June 1. The last recorded nest of the season was laid on Hatteras Island on September 6. In some years there are nests that are only located at the time of their hatching, known as "missed nests". This year no "missed nests" were documented. The 2010 sea turtle nesting season lasted for 98 days. A total of 267 activities were documented of which 153<sup>1</sup> were confirmed nests and 114 were false crawls (Table 1). The 153 nests on CAHA (147 loggerhead nests, and six green nests) constituted 17.3 % of North Carolina's total of 882 nests. In 2010 the state documented a total of 882 nests comprised of 848 loggerhead nests, 18 green nests, two leatherback nests, two Kemps' ridley nests, and 12 unknown species' nests, (Table 2).

Of the confirmed nests found this season, 86 (56.2%) were found in Hatteras District, 48 (32.4%) were found in Ocracoke District<sup>2</sup>, and 19 (12.4%) were found in the Bodie District (Figure 2). One of the nests from the Hatteras District (NH31) was found 2.3 miles southwest of Ramp 55 on the soundside of Hatteras Spit. Morning turtle patrols do not consistently survey this area, as soundside nests in the state are rare. The nest was relocated to an oceanside beach. For maps of all turtle nests and false crawls refer to Appendix D, Maps 2-11.

There were several storms that caused severe damage to sea turtle nests on CAHA in 2010, resulting in a total of six nests that could not be excavated due to storm activity. All six of these nests were assumed to have 0% hatching or emergence success as the storms hit prior to any documented emergence.

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<sup>1</sup> In total, 266 activities and 152 nests were documented. NO14 was created by staff with eggs from a nesting loggerhead that was hit and killed by an ORV. Although this is an artificial nest, it is included in the nest totals since it is likely the turtle would have nested on CAHA if it had not been hit. From this point in the document forward, NO14 is included in the nest total (153) and all calculations unless otherwise specifically indicated.

<sup>2</sup> This Ocracoke total (48) includes NO14.

Figure 1. CAHA Sea Turtle Nest Numbers from 2000-2010.

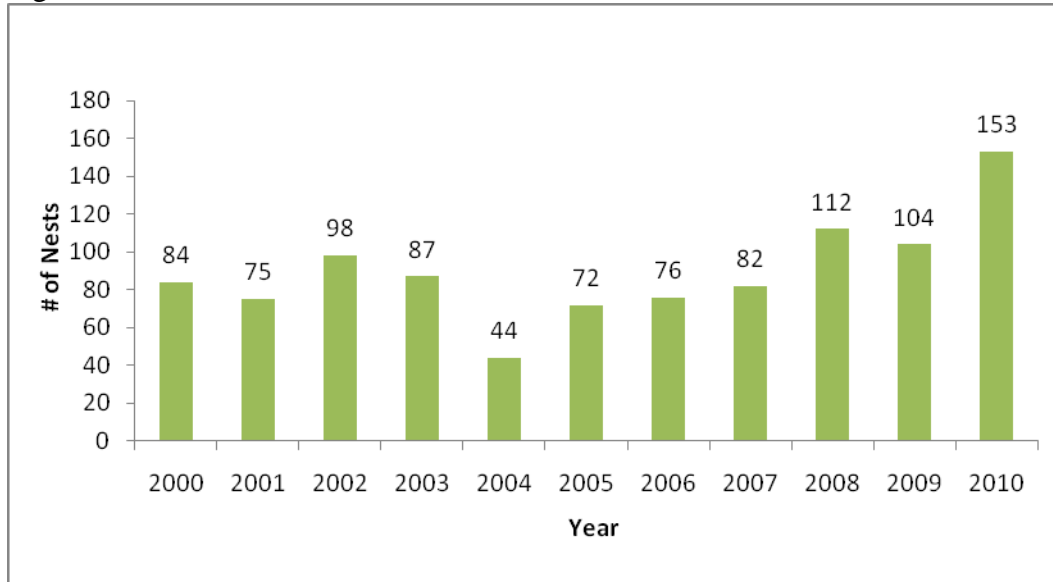


Table 1. Nest Activity by District in 2010.

	<b>Bodie</b>	<b>Hatteras</b>	<b>Ocracoke</b>	<b>CAHA Total</b>
<b>Nests</b>	19	86	48	153
<b>False Crawls</b>	7	74	33	114

Table 2. Percentage of Total Nests for North Carolina (2000-2010).

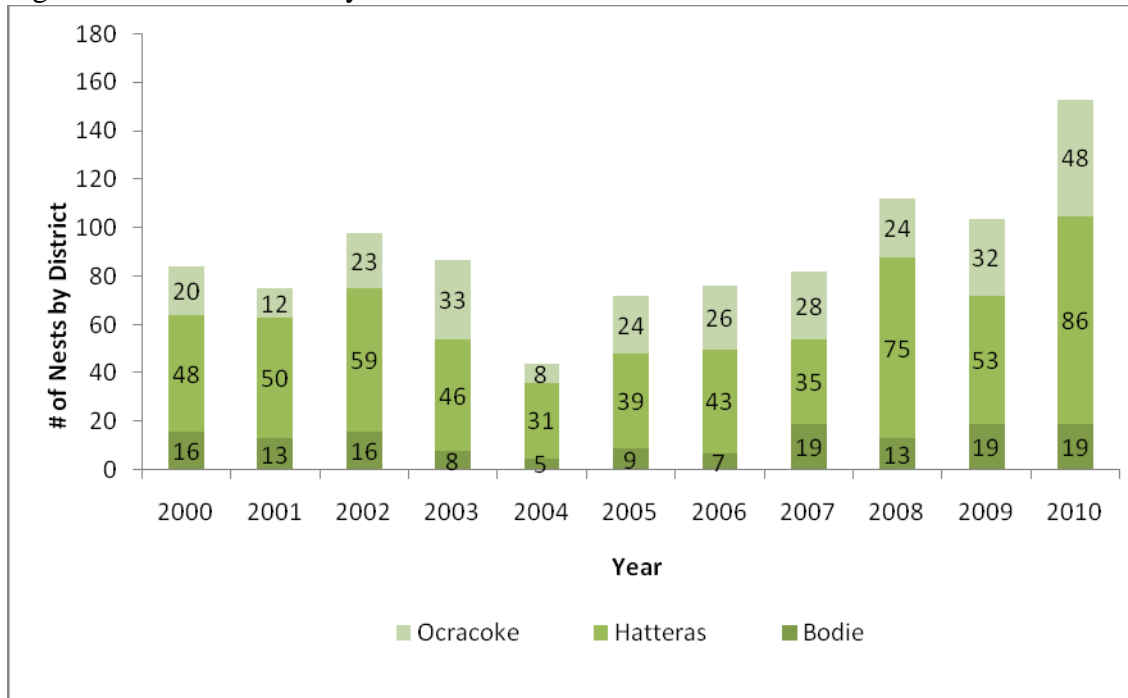
<b>Year</b>	<b>CAHA Nests<sup>1</sup></b>	<b>NC Nests<sup>2</sup></b>	<b>%</b>
<b>2000</b>	84	780	10.8
<b>2001</b>	75	664	11.3
<b>2002</b>	98	710	13.8
<b>2003</b>	87	867	10.0
<b>2004</b>	44	342	12.9
<b>2005</b>	72	666	10.8
<b>2006</b>	76	773	9.8
<b>2007</b>	82	566	14.5
<b>2008</b>	112	912	12.3
<b>2009</b>	104	622	16.7
<b>2010</b>	153	882	17.3

<sup>1</sup>From CAHA database (please note that nest totals have changed for 2002, 2004, and 2005)

<sup>2</sup>From NCWRC (please note that nest totals have changed for many year's totals)



Figure 2. Nest Numbers by District from 2000-2010.

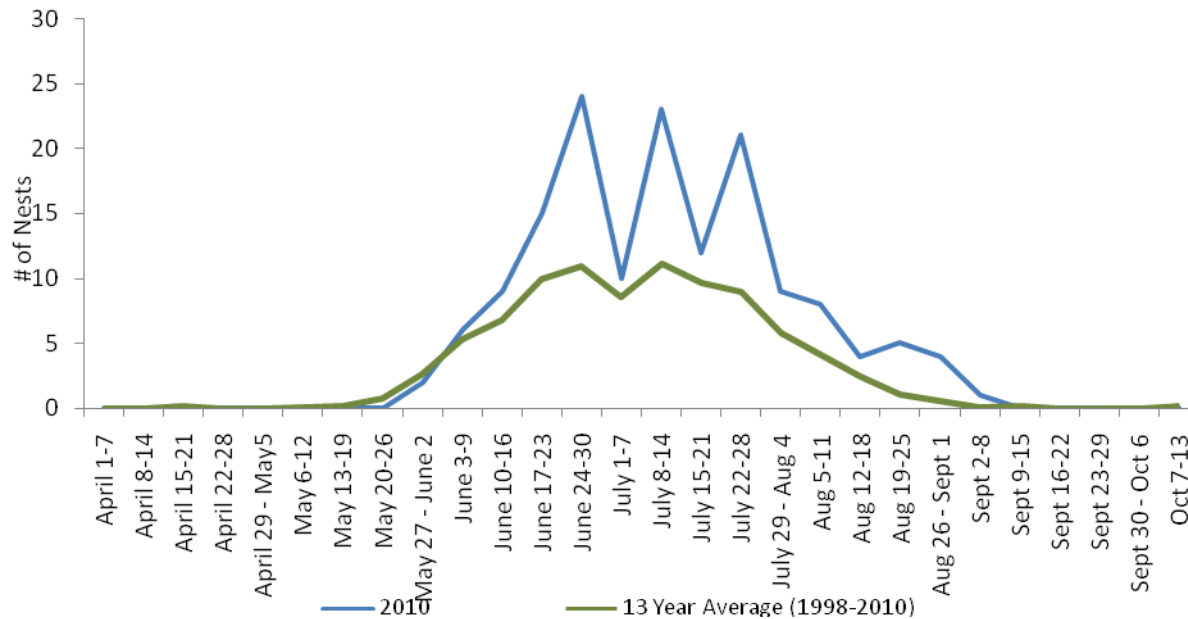


### Nests by Lay Date

In early 2009, the negotiated rulemaking natural resources subcommittee requested information about the number of nests laid throughout the nesting season. The purpose was to draw conclusions about which weeks during the nesting season were the most nests laid. The following graph (Figure 3) indicates the dates that nests were laid during the 2010 season in comparison to CAHA's 13 year average (1998–2010). Nests that did not have known lay dates (i.e. were found only when hatchlings emerged) are not included in this graph. It is important to note that these numbers are potentially misleading. Prior to 2007, turtle patrols were conducted between May 15 and Sept 1. Prior to 2006, patrols did not begin until June 1. Any nests found before the start date or end date of turtle patrol were found by chance (i.e., reported by visitors, staff on the beach performing other duties, etc.) since no coordinated, scheduled patrols were conducted. It is unknown how many nests were missed during these times. Beginning in 2007, the USFWS has required CAHA to begin patrols May 1 and continue until September 15 in order to reduce the chance of missed early and late nests. In both 2009 and 2010 patrols continued until October 1.

Individual lay dates for 2010 nests can be found in Appendix A.

Figure 3. Nest Numbers by Lay Date for 2010 and the 13 Year Average (1998–2010).<sup>1</sup>



### False Crawls

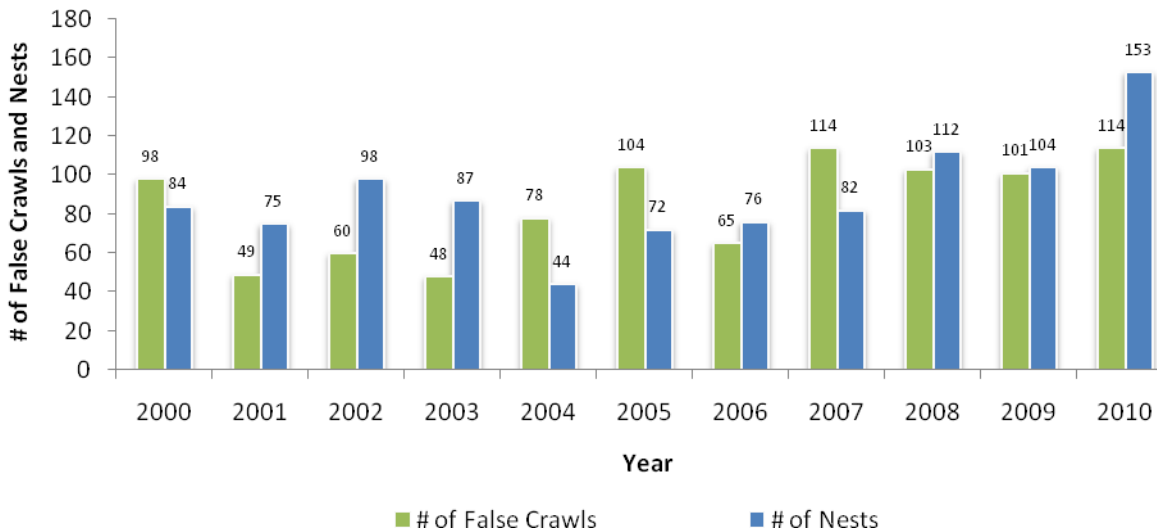
During the 2010 breeding season, 114 false crawls or aborted nesting attempts were recorded (Table 1). False crawls accounted for 42.7% of the total turtle activities within CAHA. Of the 114 false crawls, 74 (64.9%) were documented in the Hatteras District, 33 (28.9%) in the Ocracoke District, and seven (6.1%) in the Bodie Island District. There was one documented green turtle false crawl (CH71) while loggerheads accounted for the remaining 113 false crawls.

In 2010, 114 false crawls and 153 nests were documented (Figure 4), resulting in a 0.75:1 false crawl to nest ratio. Therefore CAHA met the target level of a false crawl to nest ratio of less than or equal to 1:1 annually, which is a performance measure in CAHA’s USFWS Biological Opinion (BO). CAHA has met the desired target level in seven of the last 11 years (Table 3).

Table 3. False Crawl to Nest Ratios for CAHA (2000-2010)

Year	# of False Crawls	# of Nests	Ratio
2000	98	84	1.17 : 1
2001	49	75	0.65 : 1
2002	60	98	0.61 : 1
2003	48	87	0.55 : 1
2004	78	44	1.77 : 1
2005	104	72	1.44 : 1
2006	65	76	0.86 : 1
2007	114	82	1.39 : 1
2008	103	112	0.92 : 1
2009	101	104	0.97 : 1
2010	114	153	0.75 : 1

Figure 4. Nests to False Crawls by Year for CAHA (2000-2010)



### Nests and False Crawls by Beach Type

Resource Management staff recorded the type of beach each nest and false crawl was located on at the time the activity occurred (Table 4). This has become of particular interest as people have attempted to correlate recreation activities with the propensity for turtles to have successful nesting attempts. Nine separate beach types were identified and used to categorize the nests and false crawls. The descriptions of these beach types are listed below:

- ORV: ORV open access site
- Village: Village beaches (Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras)
- Ped High: High use pedestrian only access beaches outside of villages (Lifeguarded beaches, beaches in front of campgrounds, and beaches within 0.2 miles of an access parking lot).
- Ped Low: Low use pedestrian only access beaches (any part of the beach that is not open to ORVs, not in a village, does not receive high visitation, and is not closed for resource management activity).
- Limited: Beaches that are open, but access is limited due to one or more resource management closures.
- Ped Cor: Beaches that are designated as a pedestrian corridor.
- RC-Ped Cor: Nest or false crawl extends into a resource closure (RC) that is located duneward of a pedestrian corridor.
- RC-Ped: Pedestrian only access beaches outside of villages that are closed for resource management activity.
- RC-ORV: ORV access beaches that are closed due to resource activity.

It is important to recognize that these beach types changed on a daily basis during nesting and hatching season. Therefore, there is not a 'total miles of beach' per beach type. Due to this

limitation, it is difficult to make a definitive assessment on how the level of recreation influences sea turtle nesting activity.

Table 4. Nests and False Crawls by Beach Type on CAHA in 2010

Beach Type	# of Nests by Management District			# of False Crawls by Management District		
	Bodie	Hatteras	Ocracoke	Bodie	Hatteras	Ocracoke
ORV	8	35	20	0	23	14
Village	4	18	N/A	2	12	N/A
Ped High	0	0	10	0	2	5
Ped Low	0	9	15	0	10	10
Limited	2	2	0	0	0	0
Ped Cor	0	0	0	0	0	0
RC-Ped Cor	0	0	0	0	1	0
RC-Ped	0	1	2	0	1	3
RC-ORV	5	21	1	5	25	1

### DNA Study

As described above, in 2010 CAHA participated in a DNA study conducted by researchers at the University of Georgia. One egg from each nest, including NO14, was taken and sampled for maternal DNA. This allowed each nest from North Carolina, South Carolina, and Georgia to be “assigned” to a nesting female. This research ultimately will answer questions about the total number of nesting females in the population, the number of nests each female lays per season, how far apart nests are, and other important information that is important to understanding the population dynamics of sea turtles.

Currently, the results of this study are preliminary and remain copyright of the project coordinators. However, they have provided the following information:

- Of the 153 samples CAHA collected, 24 have so far been analyzed. From the 24 samples, 16 unique individuals have been identified. Of those 16 individuals, eight had known nests *only* at CAHA. The other eight individuals laid at least one nest at CAHA, but also nested on another beach.
  - Four turtles nested at both CAHA and Cape Lookout National Seashore (CALO).
  - One turtle nested at both CAHA and Emerald Isle, NC.
  - One turtle nested at both CAHA and Bald Head Island, NC.
  - One turtle nested at both CAHA and a beach in South Carolina.
  - One turtle nested at both CAHA and a beach in Georgia.

### Nest Relocation

Of the 152 nests, 91(59.9%) were protected at the original nest site and 61 (40.1%) were relocated (Table 4). Nests were relocated in all districts. The highest number of relocations took place in the Hatteras District where 33 of the 86 nests in the district were relocated (38%). In the Bodie District 12 of the 19 nests (63%) were relocated and 16 of the 47 nests (34%) on Ocracoke were relocated (Table 5). Of the 61 relocated nests, all but two nests (NO15 and NH31) were moved because of natural factors such as being laid at or below the high tide line or due to erosion occurring in the area. NO15 was relocated after being run over by an ORV (see page 24 for further discussion on this nest). NH31 was relocated to the oceanside of the beach after being

laid on the soundside of Hatteras Spit. The nest was moved due to concerns about nest protection and monitoring, soundside flooding, and the ability for hatchlings to successfully make it to the ocean (see page 19 for further discussion on this nest).

Table 5. Relocated Nests by Management District in 2010

<b>Nest Type</b>	<b>Bodie</b>	<b>Hatteras</b>	<b>Ocracoke</b>	<b>Total</b>
In Situ Nests	7	53	31	91
Relocated Nests	12	33	16	61
<b>Total</b>	<b>19</b>	<b>86</b>	<b>47</b>	<b>152</b>

A total of 11 nests were moved during the approach of an impending storm. Of these nests, eight are not considered to be relocated, as the majority of their incubation occurred in their original location. These nests include NH44, NH45, NH48, NH60, NH62, NH63, NH67, and NO10. The remaining three nests were all relocated when they were found (day one of incubation) and then moved again in the approach of a storm. These three nests are reflected in Table 5 and include NH66, NH74, and NBI01.

### **Hatching<sup>3</sup>**

Follow-up of nesting activity involved observing nest sites for signs of hatching, recording relevant data (i.e. overwashes, violations), and excavating the site. Nests were excavated no earlier than 72 hours post-hatching, unless it was felt that an early excavation was needed in order to uncover live hatchlings that were entombed due to environmental conditions or in the approach of an impending storm.

For sea turtles, there is a difference between hatching success and emergence success. Emergence success is the total number of hatchlings, relative to the total number of eggs in a nest, that emerge from their nest *on their own*. Any live hatchlings that are found during excavations are not considered to have “emerged”. Emergence success can be calculated using the following formula:

$$\frac{\text{Total \# of Eggshells} - (\text{\# of Live Hatchlings} + \text{\# of Dead Hatchlings})}{\text{Total Clutch Size}} \times 100$$

Hatching success is the percentage of eggs in a nest that produce live hatchlings. This includes any live hatchlings that are found during excavations, which means it also includes any hatchlings that were removed from nests prior to storm events. Hatching success can be calculated using the following formula:

$$\frac{\text{Total \# of Eggshells} - \text{\# of Dead Hatchlings}}{\text{Total Clutch Size}} \times 100$$

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<sup>3</sup> The calculations in this Hatching section do not incorporate the data from NO14. NO14’s success is reported separately at the end of the section.

In order to determine Total Clutch Size, the # of eggshells is added to the # of unhatched eggs. In this report, an effort has been made to show both the hatching and emergence success for each nest, as well as CAHA as a whole.

Of the 152 nests, 111 (73%) nests had a hatching success of greater than or equal to 1%<sup>4</sup> and 104 (68%) nests had an emergence success of greater than or equal to 1%<sup>5</sup>. The average clutch size for nests at CAHA was 110.9<sup>5</sup>.

Six excavations could not be conducted due to storm activity which resulted in the nests being washed out (NH40, NH69, NH81, NH84, NBH16, and NO41). Nests took an average of 57 days to incubate (average calculated from the 92 nests with known lay and emergence dates). Some emergences may have gone undetected because of low emergence rates or as a result of rain, wind, or tide. Figure 5 shows the average time it took nests to incubate based on the week they were laid.

In 2010, the overall emergence success was 48.1%, and the overall hatching success was 54.6%. A total of 16,300 eggs were laid<sup>6</sup> and 7,843 (48.1%) of these eggs produced hatchlings that emerged from the nests on their own (Table 6). An additional 1,060 live hatchlings were discovered during nest excavations and were released. The overall percentage of eggs that produced hatchlings (“hatching success”) is therefore 54.6%.

See pages 19-27 for discussion on how storm activity and other factors influenced the success of nests in 2010. For detailed information regarding specific numbers, dates and locations refer to Appendix A for nests and Appendix B for false crawls.

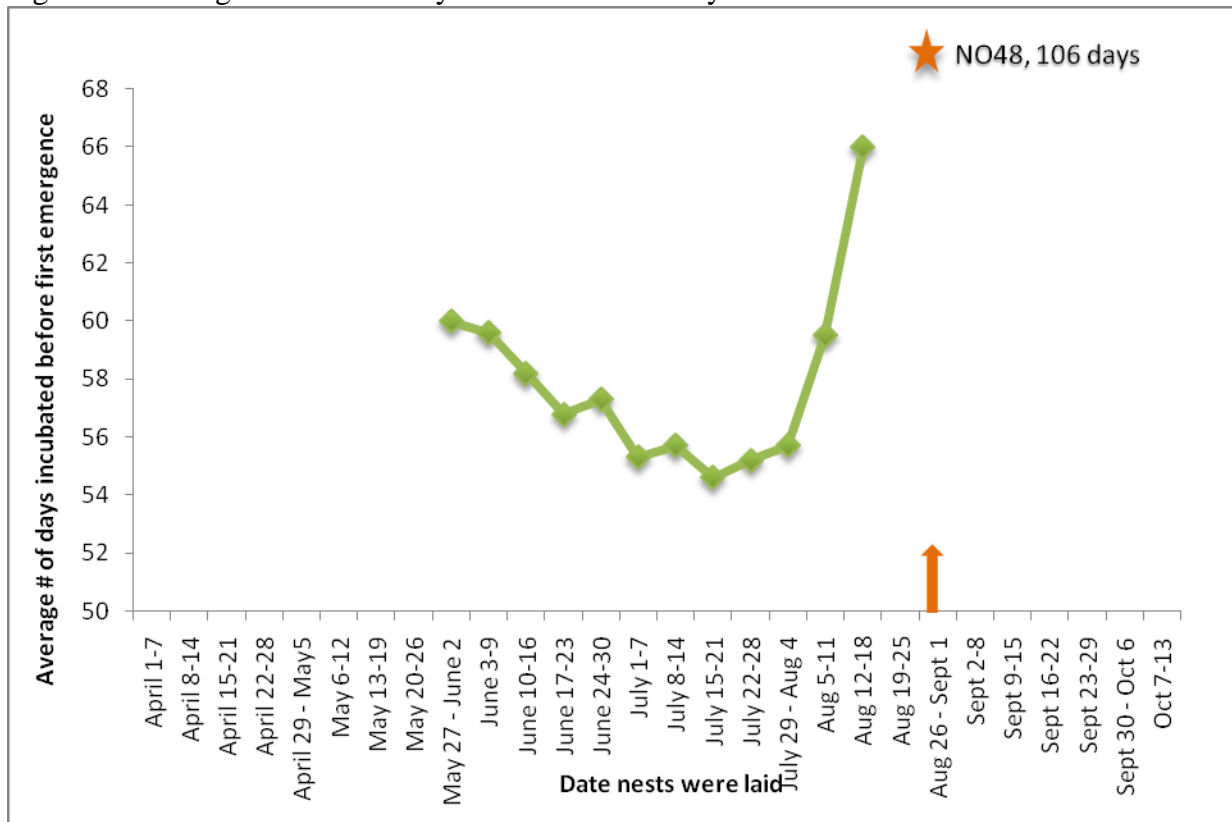
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<sup>4</sup> Assumes that all nests that were washed out (NBH16, NH40, NH69, NH81, and NH84) have 0% success.

<sup>5</sup> Average calculated from 147 nests with known clutch sizes (total of 16,300 eggs). Excludes NO14, NH40, NH69, NH81, NH84 and NO41. Although NBH16 was washed out and could not be excavated, the total clutch size from this nest was known since it was a relocated nest.

<sup>6</sup> Excludes nests with unknown clutch sizes.

Figure 5. Average Incubation Days of Nests in 2010 by Week Nests were Laid.<sup>1</sup>



<sup>1</sup>This graph was created by calculating the average incubation days for each nest that was laid during the defined weeks. In total, 90 nests had lay dates and emergence dates. Nests that were excavated early due to storms are excluded, as the hatchlings from those nests did not emerge on their own. NO14 is also not included since there is no definitive lay date. NO48 is not included in the 90 nests, but did produce one live hatchling found at the time of excavation at day 106 of incubation. Although this hatchling did not emerge on its own, it illustrates that late-laid nests still have the potential for success, even after more than 90 days of incubation.

Table 6. Sea Turtle Hatch Summary 2001-2010.

Year	Nests	Avg. Clutch	Average Incubation (days)	Total Eggs	# Emerged	EMR%
2001	75	111.7	64.5	6257	3402	54%
2002	99	108.7	58.6	10108	7201	71%
2003	87	115.7	69.1	4627	2708	58%
2004	43	103.4	58.5	2999	1609	53%
2005	73	114.6	58	6072	4142	68%
2006	76	114.8	62.9	7059	4444	63%
2007	82	112.1	60.7	9078	6075	58%
2008	112	109.0	59.7	11573	5965	52%
2009	104	114.9	65	11121	3430	31%
2010	152	110.9 <sup>2</sup>	57	16300 <sup>1</sup>	7843	48%

<sup>1</sup>Calculated from the 147 nests with known clutch sizes. Excludes NH40, NH69, NH81, NH84 and NO41. Although NBH16 was washed out and could not be excavated, the total clutch size from this nest was known since it was a relocated nest.

### Relocated Nest Success

All nests that were relocated had known clutch sizes (none washed out) and in total represented 6,544 eggs. Of these eggs, 3,558 hatchlings emerged for an emergence success of 54.4% for relocated nests. An additional 335 live hatchlings were found and released during excavations, resulting in a hatching success of 59.5% for relocated nests.

### NO14 Nest Success

Due to the fact that NO14 is a unique situation, it has been separated from the above data. These eggs were transferred from the deceased adult loggerhead that was crushed by an ORV. The eggs were carefully removed from the body cavity of the animal; therefore, they never went through the process of being laid. Additionally, it is unknown how long the turtle was dead before the eggs were removed, although it is estimated at several hours. The eggs were placed in an artificial nest two hours after the turtle was found. It was unknown at the time whether there was any chance for the nest to have success. For these reasons, the data from this nest is being reported separately.

The total clutch size of NO14 was 107 eggs. Upon discovery, 15 eggs had been broken when the carapace of the adult female was crushed. Some of these broken eggs were found outside the body cavity. The remaining 92 eggs were placed in an artificially created nest. The nest hatched on August 30, 67 days after discovery. This incubation time is substantially longer than other nests that were laid during the same time period. Five hatchlings emerged on their own for an emergence success of 4.7%. One additional live hatchling was found during the excavation, resulting in a hatching success of 5.6%. Of the 86 unhatched eggs, 82 had no development and four stopped developing early in incubation. See page 24 for further discussion on this nest.

### **Strandings**

During much of the year, both breeding and non-breeding sea turtles can be found in nearby waters, especially inshore sounds. A stranded turtle is a non-nesting turtle that comes to shore either dead, sick or injured. Stranding information assists regulatory agencies in implementing and modifying conservation measures, as well as provides vital biological information about the health of the species.

In 2010, 444 stranded sea turtles were documented (Table 7, Figure 6) of which 117 (27%) were on ocean beaches and 327 (73%) were on the soundside shoreline.

Strandings on the oceanside were easily found and responded to, whereas most of the soundside shoreline was only monitored for strandings in accessible areas (i.e., ORV areas, pedestrian beaches, and soundside ramps). Therefore it is likely that there are a high number of soundside strandings that are not reported.

Park-wide, 100 strandings (22.8%) were identified as loggerhead, 108 (24.6%) were Kemp's ridley, 235 (52.6%) were green, one (0.002%) was unknown, and none were hawksbills, or leatherbacks.

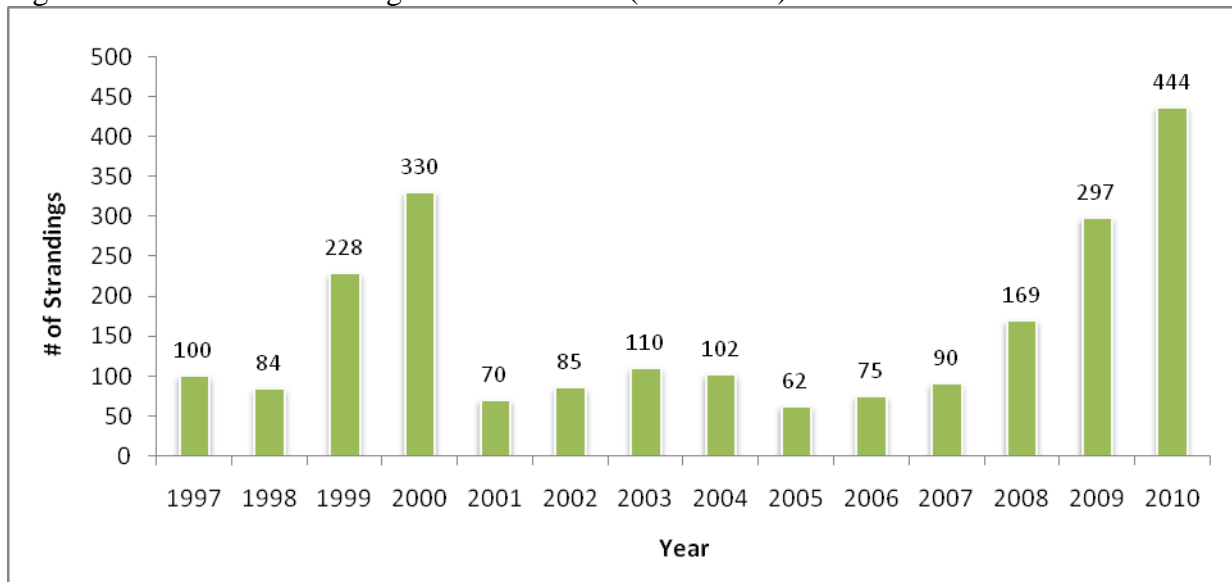


Table 7. Sea Turtle Strandings at CAHA (1997-2010).

Year	Stranding Totals	Species Composition						Location	
		Logger-head	Kemp's Ridley	Green	Leather-back	Hawksbill	Unk.	Ocean	Sound <sup>1</sup>
1997	100	65	17	11	3	0	4	unk.	unk.
1998	84	45	26	10	2	0	1	unk.	unk.
1999	228	150	56	22	0	0	0	140	88
2000	330	252	31	43	2	0	1	240	90
2001	70	41	11	11	4	1	2	46	23
2002	85	54	6	23	0	0	2	54	31
2003	110	87	8	11	2	1	1	88	21
2004	102	38	11	42	5	0	6	47	55
2005	62	33	3	20	1	1	4	41	22
2006	75	45	11	16	2	0	1	65	10
2007	90	32	5	50	1	0	2	46	44
2008	169	39	34	94	2	0	0	39	130
2009	297	53	57	183	2	0	2	109	188
2010	444	100	108	235	0	0	1	117	327

<sup>1</sup> Soundside strandings include any strandings found on inlets, spits, interior islands, soundside village beaches and soundside shorelines.

Figure 6. Sea Turtle Stranding Totals at CAHA (1997-2010).



Of the total strandings, 379 (85%) turtles were dead when found. Of the 65 live strandings, all were transferred to the North Carolina Aquarium on Roanoke Island or a similar facility for rehabilitation. Most of these live strandings were a result of ‘cold stunning’ when water temperatures become too cold for sea turtles to function normally. In several occurrences, these turtles had pre-existing conditions that made them more susceptible to a cold stun event. Examples of pre-existing conditions include old boat strike wounds, plastic (e.g. wrappers, toys) in the gastrointestinal tract, etc. Seven of the 65 live strandings died in rehab (10.8%). All

turtles that died after being found alive were necropsied by CAHA, Roanoke Island Aquarium, or NCWRC.

Necropsies were performed by CAHA staff on 303 of the 379 strandings that were found dead (80%). Additionally, some strandings have been frozen and saved for later necropsy training sessions. Cause of death in most cases was unknown; however 14 strandings had obvious signs of human interaction (prop wounds, hooks, or plastic<sup>7</sup>). Additionally, 11 turtles had signs of fisheries interactions from entanglement or drowning (as determined by NCWRC biologists—often evidenced by remaining gear or obvious entanglement lesions around the neck or flippers). Cold temperatures attributed to 185 strandings (both live and dead). Only live and fresh dead strandings were conclusively determined to be cold stuns. The mortality of dead strandings that were found around the same time that were not fresh are listed as CBD (cannot be determined), but are also most likely due to cold temperatures. On February 6, CAHA responded to 19 live turtles found on Ocracoke beaches. These turtles were part of a mass cold-stun event that lasted several days and stretched into CALO. See page 27 for further information on this event.

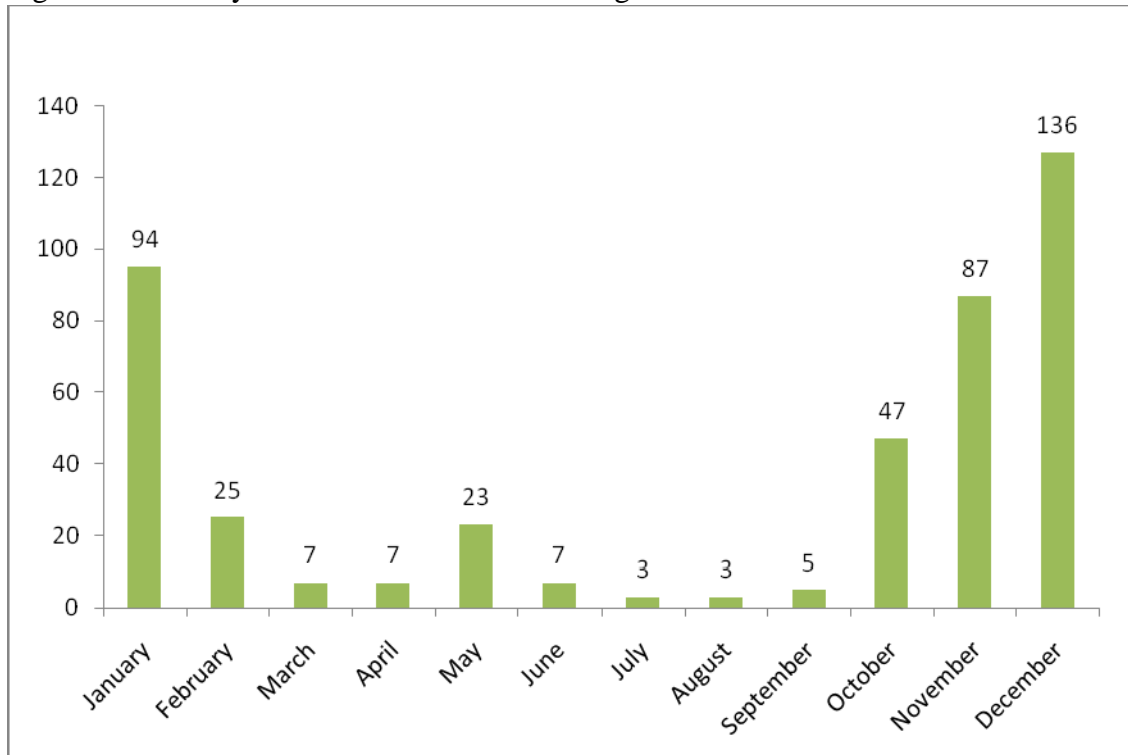
CAHA staff also assisted with an additional 13 strandings that are not included in the above stranding totals. One of these strandings is a Kemp's ridley from Portsmouth Island, CALO, and is therefore included in their totals. Another two strandings are loggerhead post-emergent hatchlings (one dead, one alive) that washed back onto shore several miles from where they hatched. See page 24 for more information on these two hatchlings. Three live strandings were brought to CAHA from DMF Fisheries Observers on Pamlico Sound. All three strandings were reported on and taken to rehab and released as part of a cooperative effort between agencies to document turtles impacted by the inshore flounder fishery. The remaining seven strandings were all from Portsmouth Island, CALO, and are included in their totals.

The largest number of strandings occurred in the month of December, when 136 turtles were documented (Figure 7). “Cold stunned” strandings occurred throughout the winter months (November–February) and were found predominantly on the soundside.

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<sup>7</sup> Also includes the turtle that was hit and killed by an ORV, Cc-MDB-10-06-24-01.

Figure 7. Monthly Total of Sea Turtle Strandings at CAHA in 2010.



Injuries and abnormalities for each stranded turtle were recorded on a stranding report. Samples, including eyes, flippers, tags, and muscle samples were collected from stranded turtles according to NCWRC guidelines. Most turtles in 2010 were responded to by NPS staff or volunteers. Some turtles were responded to and reported by DMF biologists in the area. Turtles that stranded soundside in the villages are included in the stranding totals.

## DISCUSSION

### Discovery of a Soundside Nest

On the morning of July 6, morning patrollers finished their south Hatteras run at the tip of Hatteras Spit. Since it was low tide, they continued around the spit to the soundside to look for any sea turtle strandings (this area has a high level of documented strandings and is checked whenever possible). While making their way northeast along the sound they discovered tracks leading to a body pit. The tracks were consistent with that of a loggerhead turtle. Upon digging, the technicians discovered eggs. After consultation with the Lead Wildlife Biologist the decision was made to relocate this nest to the oceanside beach. Given the unique situation, it was unknown whether the eggs would be viable if left in the mud/sand substrate they were laid in. It was also unknown how soundside flooding would affect the success of the nest. Additionally, there were concerns about staff's ability to adequately sign and monitor the nest *in situ* since it was in a difficult location to reach. After the relocation the nest was monitored daily. The nest hatched on August 27 with a 95% emergence success. It is unknown whether there are other nests that have been laid on the soundside but missed. CAHA staff will continue to survey the soundside of Hatteras Spit when and where possible.

## **Storm Activity**

Loss of nests to storm events continues to negatively impact hatching and emergence success. During the 2010 season, CAHA felt the effects of Hurricane Daniele, Earl, and Igor, Tropical Storm Colin, and several other nor'easters. Dates with exceptionally large high tides included August 7-9 (Tropical Storm Colin), August 13-16, August 30-September 3 (Hurricanes Daniele and Earl), and September 19-21 (Hurricane Igor). There were a total of six nests that were washed out entirely or could not be found post-storms (NBH16, NH40, NH69, NH81, NH84, and NO41). All of these nests were assumed to have 0% emergence and 0% hatching success due to storm activity. An additional 31 nests saw a severe decrease in nest success (little or no hatching success) due to Hurricane Danielle and/or Hurricane Earl. There were 15 other nests that also experienced reduced nest success due to storm overwash, but the decrease could not be correlated with one particular storm event.

As sea turtle eggs move into the later stages of development, they have less chance of withstanding inundation. Clutches of eggs that were in earlier stages of incubation have a higher chance of survival from overwash. However, since so many nests were in advanced development stages around the time of the storms, they were unable to survive the impacts of storm overwash. The NCWRC biologist was consulted prior to conducting any mid-season relocation and/or early excavations (prior to impending storms) in order to save nests and/or pre-emergent hatchlings from overwash that would have resulted in mortality. A total of 11 nests that were highly likely to suffer extreme washover and inundation resulting in high mortality were relocated in the approach of major storm activity.

Early excavations (in the approach of imminent storms) were performed on only those nests that had shown signs of hatching (depression and/or previous emergence). Also, nests that had similar lay dates as already hatched nests were checked for hatchlings and/or pipped eggs. Prior to storm activity, 22 nests<sup>8</sup> were excavated early, resulting in 714 hatchlings. Without conducting early excavations, the overall hatching success of 54.6% would have been approximately 50.2%. Post-storm, all remaining nests were checked for compaction, which can cause live hatchlings to become entombed in the egg chamber.

## **Predation**

Sea turtle nests and hatchlings were predated at multiple nest sites in 2010 by both ghost crabs and mammalian predators. There was no red fox predation this year as occurred in 2007. Cat tracks were found in and around turtle closures throughout the season, particularly in the villages. Many of these incidents occurred on nights when hatchlings were known to emerge. It is unknown exactly how many hatchlings during the season were predated by domestic/feral cats. In 2010, CAHA Resource Management staff continued to trap predators such as fox, coyote, mink, feral cats, opossum, and raccoons within the CAHA boundary year-round. Predator control efforts at CAHA are focused on areas where predation of protected species has been known to occur.

Loss of eggs and hatchlings to ghost crabs continues to be documented. In 2010, 53 nests had recorded predation loss due to ghost crabs (eggs, hatchlings, or both). There were numerous

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<sup>8</sup> Total includes NH23, NH24, NH25, NH26, NH27, NH28, NH29, NH32, NH33, NH34, NH38, NH39, NH41, NH43, NH45, NH60, NH61, NH62, NH63, NH66, NH70 and NH76.

incidents where ghost crab tracks were found within the silt fencing on nights when hatchlings were known to emerge. It is unknown how many total hatchlings were predated by ghost crabs in 2010, but at least eight were found and documented. During excavations, a total of 277 eggs<sup>9</sup> (1.7%) were found to have been predated. Ghost crab predation was found on all districts. In some cases, ghost crabs were found within the nest cavities predated on hatchlings during excavation.

### **Other Egg Mortality**

Upon excavation, nine nests were found to have unhatched eggs with the egg contents exhibiting a bright pink color and/or aqua blue color (yolk sac, amniotic fluid, etc.). The locations of these nests were predominantly in the Hatteras District, but one nest in the Bodie District and one nest on Ocracoke were also affected.

It was hypothesized that the unusual color was or came from bacteria or fungus. It is unclear if the pink substance was the cause of the eggs' mortality or if the substance only showed up in eggs which were unhatched. A possible study into identifying the species of the bacteria and/or fungus and their effects on loggerhead eggs, is in the planning stage.

### **Temperature**

Cold temperatures affected the success of several nests during the 2010 season. Beginning in mid-October, air temperatures occasionally dropped to a level that made it difficult for hatchlings to make it from a nest to the water. In the case of NH82, hatchlings were first documented to have emerged on October 21. However, after this initial emergence, temperatures cooled to the point that made it difficult for the remaining hatchlings to leave the nest. After it was determined that the water temperatures in the area were still high enough, the last 30 hatchlings were collected from the nest and released. A similar incident was documented at NH80.

Three nests (NBH17, NH83, and NO48) had no success due to cold temperatures. In all three of these nests, the eggs showed that they continued to incubate up until the point that cold temperatures stopped the development of the embryos. During the excavations it was found that the majority of the eggs contained late stage dead hatchlings. Had air and sand temperatures not dropped, it is likely that these nests would have hatched with good success.

In the case of NO48, during the excavation on December 13 (day 106 of incubation) one live pipped hatchling was found. The hatchling was not released since it was still partially encased in its eggshell and water temperatures were too low. The decision was made to transport the hatchling to the North Carolina Aquarium on Roanoke Island for triage, observation, and eventual release. However, the hatchling died before being transported. Although this nest had no hatching or emergence success, it does illustrate the potential for late-laid nests to still have success. In other circumstances, this nest may have hatched. It is therefore important from a management perspective to understand that nests that incubate into November/December should still be managed since success is possible.

Although normal protocol indicates that nests with no known emergence should be excavated 80-90 days into incubation, CAHA staff has found that it is important to not attempt to excavate

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<sup>9</sup> This total does not include any predation that may have occurred to eggs that washed out and were not excavated.

late season nests until at least 100 days into incubation. If eggs are found to still be viable at 100 days, eggs should be checked every 10 days until the nest shows signs of hatching or the eggs are found to longer be viable. Nests that show signs of hatching after air and water temperatures have dropped below certain thresholds should be excavated, and live hatchlings transported to the Aquarium or other facility until release (generally into the Gulf Stream).

### **Human Disturbance**

It is unknown to what extent human activities disrupted nesting activities. Although CAHA remains open to pedestrians 24 hours a day, CAHA staff are not available around the clock to safeguard and monitor all the various natural resources.

Many visitors at CAHA, especially in front of the villages, left their recreational beach equipment and chairs or loungers on the beach overnight. This equipment and furniture can cause turtles to forgo laying eggs by hampering or trapping animals attempting to locate a nesting site (NMFS, USFWS 1991). This is the tenth season that Resource Management staff has tied notices to personal property found on the beach after dawn, advising owners of the threats to nesting sea turtles as well as safety issues and NPS regulations regarding abandoned property. The date and time items were tagged was clearly written on each tag. Items left on the beach 24 hours after tagging were removed by NPS staff. Not all tagged items were removed within 24 hours as staff patrolling on UTVs could not safely remove the property from the beach. At other times, not all abandoned property could be removed because of the abundance encountered and staff availability.

Beaches fronting villages are closed to ORV use in the summer months to provide for the safety of an increased pedestrian population. While many of these beaches were wide enough to support sea turtle nesting, the high amount of human activity and density of development, including lighting within the villages, make these beaches less than optimal nesting sites for nesting turtles. With an increase in visitor use, the potential of human disturbance of nesting turtles increases. There continue to be concerns that turtles may be deterred from nesting on beaches of their first choice and forced to lay eggs at a less optimal location.

### **Artificial Lighting**

Artificial light is known to disturb nesting females and can disorient hatchlings. Outdoor lights, un-shaded indoor lights, beach fires and vehicle headlights outshine the natural glow of moonlight on the ocean waves, which can guide hatchlings away from the sea as well as possibly deter nesting females. Filter fencing is a high maintenance and costly response to lighting issues. Fencing is often washed out by incoming tides, buried by winds and/or completely uprooted by storm activity. Nest sites in their hatching window are checked and maintained daily; however, this does not help hatchlings at nest sites where the filter fence has been knocked down during the night. Hatchlings may become entangled in the fencing if it is not properly maintained. CAHA will continue to use the filter fencing until a better option is identified. Since 2005, the majority of all turtle nests within their hatching window have received filter fence treatment. This treatment was continued in 2010. There were no documented incidents of hatchlings becoming tangled in the fencing during this season. Filter fencing was removed from all nests prior to an impending storm for the safety of nests and emerging hatchlings.

### **Potential Incidental Take / Human Disturbance**

All species of sea turtles nesting on CAHA are protected under the Endangered Species Act of 1973. Under the ESA, “take” is any human induced threat to a species that is listed. Take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, capture or collect, or to attempt to engage in any such conduct.” On CAHA, this can include the death, harassment, or disorientation of nesting females and/or hatchlings due to human influence. It is difficult to document all of these potential take incidents, but those reported from the 2010 season are listed below.

NH03: This nest was laid on the night of June 7 in Buxton village next to the Cottage Avenue walkover. After laying a nest the female became disoriented and went over the walkover onto Cottage Avenue passing three houses and finally returning to the ocean. Visitors informed staff that there had been several people watching with cameras and flashlights. Buxton village is known to have several bright lights that face the beach. In 2008 lights from the village disoriented approximately 60 hatchlings which crawled over the duneline and into a parking lot and Highway 12. Several hatchlings were preyed upon by ghost crabs while at least one was run over by a vehicle on the road. Fifty hatchlings were found and released.

NO14<sup>10</sup>: During the night a nesting loggerhead was struck and killed by an ORV while attempting to nest between Ramp 70 and Ramp 72. The incident occurred between the night of June 23 and early morning hours of June 24. CAHA turtle patrol discovered the turtle at 6:00am on the morning of June 24 at 0.65 miles South of Ramp 70. The force of the impact exposed the turtles’ internal organs. Multiple eggs had been damaged in impact, however 92 eggs were relocated and a nest was artificially created for them. Due to the trauma the eggs experienced, the nest only produced six hatchlings. It is likely that the incident was caused by an ORV operating illegally – during the hours of nighttime driving restrictions as mandated by the CD. The incident is still under investigation.

NO15: On the same night as the incident involving NO14, a “freshly laid” unmarked nest was found to be run over at 0.48 miles South of Ramp 70 (just north of where the nesting turtle had been run over). The weight of the ORV crushed 12 eggs. The remaining 113 eggs were relocated to a new location, due to the threat of predation caused by the crushed eggs. The nest had a good success. The incident is still under investigation.

NBH04: This nest was laid in the Tri-Villages on June 20. During turtle patrol on July 1, the nest was found to have ATV tracks running through the closure and directly over the nest. String and flagging was broken at the entrance and exit points. The nest was immediately checked and no apparent damage to the eggs was found. Since the nest had mediocre success, it is possible that a degree of damage was sustained, however it is not known to what extent natural factors played into the success of the nest.

NH03: This nest reached its hatch window and was expanded July 28 and filter fencing was placed around the nest. During turtle patrol on July 29 the nest was found to have hatched, however it was discovered that the filter fencing was not actually surrounding the nest. The hatchlings experienced some disorientation from house lighting, but since this area has a narrow

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<sup>10</sup> The turtle from this incident has been documented as stranding Cc-MDB-10-06-24-01 in Appendix C.

section of beach the hatchlings all found their way to the water. At an unknown date someone entered the closure and removed the markers used by staff to identify specific nest locations and proceeded to replace them further north than the original position. Footprints were never documented. With the markers being moved the filter fencing was placed in the wrong position. The actual nest was found and the filter fencing was adjusted to protect the nest. On subsequent nights, emerging hatchlings did not experience any disorientation.

Unknown Nest: During morning patrol on August 5, a loggerhead hatchling washback was found run over by an ORV 2.0 miles South of Ramp 44. Another hatchling washback was found alive 100 feet away from the crushed hatchling. The live hatchling was released later that night and the dead hatchling was frozen for research. It is unknown whether the hatchling was alive or dead at the time that it was run over. As neither hatchling was found inside a closed area, this incident is not considered a closure or intentional violation. The area was searched thoroughly to ensure the two hatchlings did not come from a previously undocumented nest. No evidence of a nest could be found in the vicinity. It is likely that the two hatchlings came from either NH01 or NH02, both of which hatched during that time period.

CH71: This false crawl was found on the morning of August 7 in Frisco Village. It was evident that the nesting turtle had made three separate attempts to nest by digging three separate body pits. The following day a visitor contacted CAHA to ask about the turtle, and informed biologists that there had been several families watching with cameras and flashlights.

NH34: This nest was located 1.6 miles North of Ramp 38 in Avon Village. During turtle patrol on Aug 31 the nest was discovered to have hatched. Multiple pedestrian and dog tracks were found inside filter fencing. Multiple hatchling tracks ended abruptly at pedestrian footprints well above the high tide line.

NH35: This nest was laid during the early evening of July 8, one mile east of Ramp 49. The female was seen attempting to nest and a call went out to NPS law enforcement. Upon arrival, law enforcement found several pedestrians surrounding the turtle and a parked vehicle blocking the turtles' access to the upper beach. The public was removed from the area and resource management was called out. The nest was found, relocated and protected. It is possible the ORV blocking the route to the upper beach caused the sea turtle to deposit her eggs on the lower beach. The nest would not have survived *in situ*, as the bottom third of the nest was in the water table.

NH48: This nest was located between Ramp 43 and Ramp 44 on Hatteras Island. On the night of Sept 9, approximately 30 hatchlings came out of the protected filter fencing area and headed north from their nest toward Buxton. They exited the closure at the north end and then moved toward the water. About five of the hatchlings went into a tire track. It could not be determined what happened to these hatchlings, although it is likely that they were preyed upon.

### **Closure Violations**

In 2010, there were numerous violations of turtle closures, some more serious than others. Although closure signs were highly visible and could be read easily, law enforcement and resource management staff documented violations at turtle closures throughout the nesting and



hatching seasons. Entry into a turtle nesting area would require people to pass under, drive through flagged string tied between signed posts, or pass below signs by the tide line. Signs were posted as low on the beach as possible. Because of extremely high sign loss near the shoreline at all expanded turtle nests, the closure signs closest to the water were replaced with carsonite, which holds better in the moist sand. Although carsonite is extremely costly, staff roped them together so that if the tide washed them out, there was a better chance of recovering them.

The most common type of violation occurred with the entry of pedestrians in the intertidal zone of expanded turtle closures. At 50-55 days of incubation, when turtle closures are expanded, the new closure extends to the mean low tide line. Each nest was clearly marked on each side at the tide line that visitors should not walk in front of the nest. Access was nearly always available behind the nest at the dune line or behind the primary dune. However, due to the difficulty in keeping signs in below the high tide line, many visitors walked in the intertidal zone in front of nests. It is unknown how many, if any, hatchlings were affected by the huge number of visitors in the intertidal zones. This problem was reported most often on Village beaches, popular pedestrian beaches (such as Lighthouse Beach), and popular ORV beaches (such as near Ramp 49). As footprints are often washed out prior to the area being checked, this type of violation is likely under-documented.

It was found that some visitors also walked up into expanded turtle closures near the filter fencing and nest. For some observations, it was apparent that visitors ducked under string and flagging in order to enter/exit turtle closures. It is unknown if hatchlings were affected by the presence of visitors within closures. This type of violation was most reported in front of village beaches where a high number of visitors walked through closures to get to the other side of the closure where they could continue their walk. Some visitors walked up to and inside the protective filter fencing. The beach in these areas is fairly narrow, so most of the closures were full beach closures (after they were expanded). At NBH03 in the tri-village area, broken string and several sets of footprints inside the filter fencing leading up to the overwash marker was reported. At NH37 just South of Avon, pedestrian and dog tracks were documented very close the nest itself. At NH40 in Frisco, two sets of children's footprints found inside closure directly over nest cavity. At NH19 in Hatteras, broken string and multiple footprints were found inside closure near the nest cavity. In all these examples the nests were checked and no damage was sustained.

Domestic pets constitute another form of violation. In 2010 there were several reports of dogs and/or dog tracks within turtle closures. Often these were accompanied by multiple sets of footprints. Dogs were primarily found to be a problem in the tri-village area, Buxton, Frisco, Hatteras, and Lighthouse Beach. Domestic and/or feral cats continued to be a problem in 2010. Cat tracks were found within at least 36 turtle closures over the season, most commonly in the villages. Cat predation was difficult to document, but it is known that cats pose a serious threat to emerging hatchlings. In the Tri-Villages area, every nest had documented cat tracks though the closure.

ORV violations of turtle closures were relatively rare. There were several accounts of vehicles driving behind full-beach turtle closures. Also, there were several accounts of vehicles driving

below (i.e. ocean-side of) the expanded turtle closures in the morning before any washed out signs in the intertidal zone could be replaced. It is unknown how many hatchlings, if any, were affected by these actions, either by being run over or by being stuck in tire tracks. There were no observed losses to hatchlings to this type of violation.

There were three violations that were considered to be serious or intentional violations under the CD. These violations are listed below:

NO14<sup>11</sup>: During the night a nesting loggerhead was struck and killed by an ORV while attempting to nest between Ramp 70 and Ramp 72. The incident occurred between the night of June 23 and early morning hours of June 24. CAHA turtle patrol discovered the turtle at 6:00am on the morning of June 24 at 0.65 miles South of Ramp 70. The force of the impact exposed the turtles' internal organs. Multiple eggs had been damaged in impact, however 92 eggs were relocated and a nest was artificially created for them. Due to the trauma the eggs experienced, the nest only produced six hatchlings. It is likely that the incident was caused by an ORV operating illegally – during the hours of nighttime driving restrictions as mandated by the CD. The incident is still under investigation.

NO15: On the same night as the incident involving NO14, a “freshly laid” unmarked nest was found to be run over at 0.48 miles South of Ramp 70 (just north of where the nesting turtle had been run over). The weight of the ORV crushed 12 eggs. The remaining 113 eggs were relocated to a new location, due to the threat of predation caused by the crushed eggs. The nest had a good success. The incident is still under investigation.

NBH04: This nest was located in the Tri-Villages. During turtle patrol on July 1, the nest was found to have ATV tracks running through the closure and over the nest. String and flagging was broken at the entrance and exit points. The nest was immediately checked and no apparent damage to the eggs was found. Since the nest had mediocre success, it is possible that damage was sustained, however it is not known to what extent natural factors played into the success of the nest.

### **Cold Stun Event**

On February 5, 2010, CAHA staff and volunteers found and/or responded to 19 cold stunned turtles that had washed up on the beaches of Ocracoke. In all, 16 loggerhead, one green, and two Kemp's ridley sea turtles were transported to rehabilitation facilities and aquariums around the state. It was later found that this mass-stranding was part of a larger event that included more than 120 turtles, most of which were found on Portsmouth Island, part of CALO. Despite efforts to get to Portsmouth, due to severe weather and safety conditions, CALO staff were not able to respond until February 7 and 8, by which time the majority of the turtles on the island had already succumbed to the low temperatures. Some live turtles were found and transported to a rehabilitation facility, but all died soon after. The 19 turtles that were found on Ocracoke were the only ones to survive the event. On February 8, another live loggerhead was found on Ocracoke, and was transported to rehab. Unfortunately, this individual had to be euthanized due to damage sustained in both eyes.

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<sup>11</sup> The turtle from this incident has been documented as stranding Cc-MDB-10-06-24-01 in Appendix C.

This event was unusual, and does not represent the way most turtles are cold stunned. First, this event occurred entirely on the oceanside beaches, whereas most cold stunned turtles are found on the sound-side. Secondly, the vast majority of the turtles (both the ones found on Ocracoke and the ones found at CALO) were juvenile loggerheads. Although loggerhead sea turtles are the most common turtle in waters of North Carolina, they generally do not make up a high percentage of the cold stunned strandings (greens and Kemp's ridley sea turtles are more common). Third, this event occurred at the "end" of the cold-stun season, and was entirely unexpected.

This mass cold stun event is still under review by NCWRC. However, early hypotheses indicate that these turtles, mostly juvenile loggerheads, were moving with the Gulf Stream, which was considerably warmer than the near-shore waters. On February 5, a severe weather system changed the course of the Gulf Stream, causing these turtles to be trapped in cold water, thus causing the stranding event. Although there are no means to prevent this occurrence from happening again, CAHA staff will continue to patrol the ocean and sound-side beaches throughout the winter months to ensure that live strandings are found and transported as efficiently as possible.

#### **US FISH AND WILDLIFE SERVICE (USFWS) BIOLOGICAL OPINION (BO)**

In accordance with the BO received from USFWS August 14, 2006, Resource Management staff performed daily nest surveys on the ocean beach from May 1 to September 15 (daily surveys were actually continued to October 1 due to the potential for late nests; however, the BO only dictates that surveys continue to September 15). Daily nest checks were performed until the last nest was removed from the beach. This annual report fulfills the reporting requirements of the BO.

Performance measure targets for sea turtles consist of having a total of 10% of the statewide average number of nests for the previous five years and having a sea turtle false crawl to nest ratio of less than or equal to 1 : 1 annually. Re-initiation of consultation with USFWS is required if the total number of nests is fewer than 10% of the State's total annual nesting number and/or if the false crawl to nest ratio is greater than 1.3 : 1 annually. The first measure was met with 153 nests, making up 17.3% of the state's total (2010). The total of 153 nests represents 21.6% of the state's previous 5-year average (2005 to 2009, average of 707.8 nests per year). This is the highest percentage of nests (relative to state totals) that CAHA has ever documented. The second performance measure was met with a 0.75 : 1 false crawl to nest ratio. This is the third year in a row that CAHA has met this measure.

## **APPENDICES**

### **Appendix A: CAHA 2010 Sea Turtle Nest Activity**

### **Appendix B: CAHA 2010 Sea Turtle False Crawl Activity**

### **Appendix C: CAHA 2010 Sea Turtle Stranding Activity**

### **Appendix D: Maps**

- Map 1: 2010 Turtle Management Districts
- Map 2: 2010 Bodie Island Sea Turtle Nests
- Map 3: 2010 Bodie Hatteras Sea Turtle Nests
- Map 4: 2010 North Hatteras Sea Turtle Nests
- Map 5: 2010 South Hatteras Sea Turtle Nests
- Map 6: 2010 Ocracoke Sea Turtle Nests
- Map 7: 2010 Bodie Island Sea Turtle False Crawls
- Map 8: 2010 Bodie Hatteras Sea Turtle False Crawls
- Map 9: 2010 North Hatteras Sea Turtle False Crawls
- Map 10: 2010 South Hatteras Sea Turtle False Crawls
- Map 11: 2010 Ocracoke Sea Turtle False Crawls
- Map 12: 2010 Bodie Island Sea Turtle Strandings
- Map 13: 2010 Bodie Hatteras Sea Turtle Strandings
- Map 14: 2010 North Hatteras Sea Turtle Strandings
- Map 15: 2010 South Hatteras Sea Turtle Strandings
- Map 16: 2010 Ocracoke Sea Turtle Strandings

## **LITERATURE CITED**

National Marine Fisheries Service and Fish and Wildlife Services, 2008 *Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle*, National Marine Fisheries Service, Washington D.C.

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