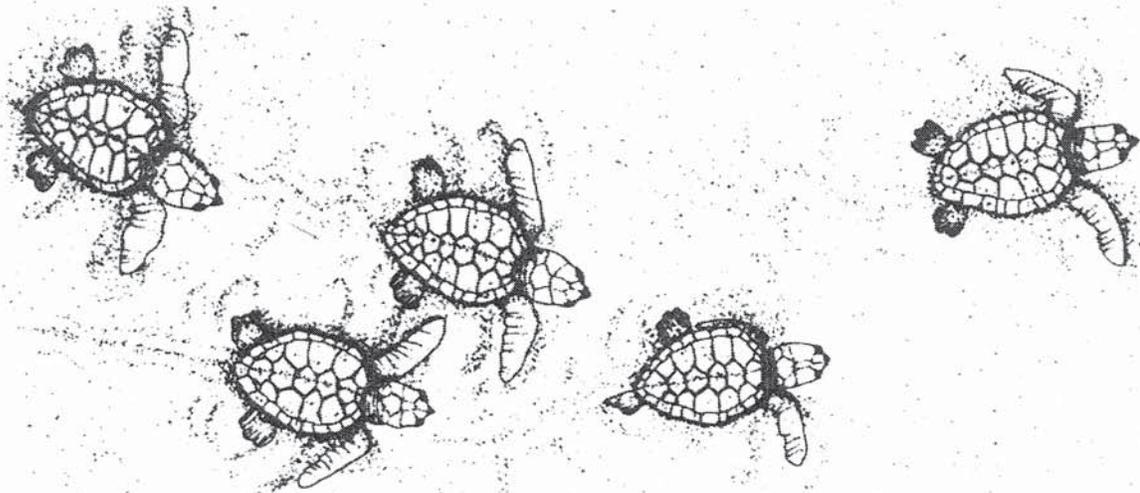


HANDBOOK FOR SEA TURTLE VOLUNTEERS IN *NORTH CAROLINA*



COASTAL FAUNAL DIVERSITY PROGRAM

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

1751 Varsity Drive
Raleigh, NC 27606

Revised: 2006



ABOUT THIS HANDBOOK

The North Carolina Wildlife Resources Commission gratefully acknowledges the contribution of volunteers toward the protection of sea turtles in the State. Without our volunteers, we would be ineffective in our efforts to assure the future of these animals.

This Handbook was developed to aid volunteers and other participants in the NC Sea Turtle Project in conducting biologically sound management projects to benefit sea turtles and to help ensure their compliance with laws pertaining to rare and endangered species at all levels of government. Volunteers are urged to become familiar with these laws and how they pertain to their activities. Note that all sea turtle species that occur in the US are listed in the Endangered Species Act. As such, it is unlawful for anyone to work with them unless they are either issued a permit from the WRC or are working under someone who has such a permit. If in doubt, please contact the WRC for further information.

Funds for printing and distributing this material were provided by the *North Carolina Nongame and Endangered Wildlife Fund*. This fund is made possible through voluntary contributions by taxpayers through the Check-Off system on their State Income Tax returns.

Materials in this handbook were originally compiled and edited by:

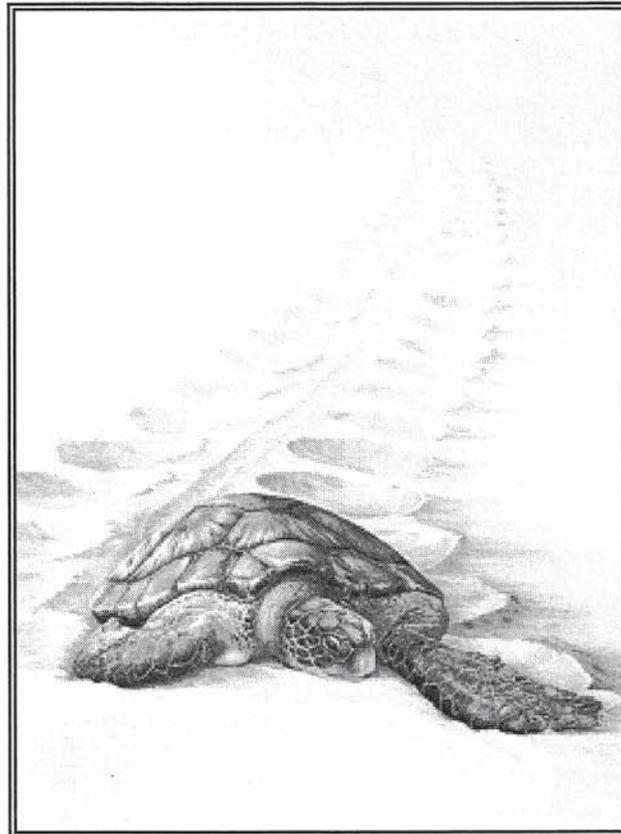
Tom Henson & Ruth Boettcher
North Carolina Nongame and Endangered Wildlife Program

The handbook was updated in March 2006 by

Matthew Godfrey
Sea Turtle Project Biologist
Coastal Faunal Diversity Program
North Carolina Wildlife Resources Commission

Wendy Cluse
Sea Turtle Project Assistant Biologist
Coastal Faunal Diversity Program
North Carolina Wildlife Resources Commission

These are guidelines, and meant to provide you with appropriate protocols when dealing with sea turtles in North Carolina. Occasionally, you will be faced with exceptional or extraordinary circumstances that are not covered in these pages. In all cases of uncertainty, please make every attempt to contact the Sea Turtle Project Biologist or Assistant Biologist BEFORE doing anything. We are also open to suggestions and discussions concerning any topic related to sea turtle management in North Carolina or elsewhere. Please don't hesitate to call or email!!



©Gary Hodges

GUIDELINES FOR SEA TURTLE VOLUNTEERS IN NORTH CAROLINA

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION COASTAL FAUNAL DIVERSITY PROGRAM

INTRODUCTION

There are seven species of marine turtle that exist in the world. Five of these occur in North Carolina waters. The most abundant species in North Carolina is the loggerhead (*Caretta caretta*) that nests annually on our beaches. Additionally, immature loggerheads occur in our State's nearshore and inshore waters virtually year round. Green turtles (*Chelonia mydas*) are less frequent but regular nesters in North Carolina. Immature green turtles are found throughout North Carolina's coastal waters, but in fewer numbers than loggerheads. Juvenile and sub-adult Kemp's ridleys (*Lepidochelys kempii*) are also encountered in nearshore areas and estuaries – adults have been observed nesting on North Carolina beaches only twice to date. Leatherbacks (*Dermochelys coriacea*) are seen passing through our waters primarily in May and June as they migrate north along the Atlantic coast. Although there are few historical records of leatherback nests in North Carolina, nesting by this species has been observed in nearly each year since 1998. A fifth species, the hawksbill (*Eretmochelys imbricata*), has been documented in the state but it is rather rare. All species of marine turtles that occur in North Carolina are protected under the Endangered Species Act of 1973. Loggerhead and green sea turtles are listed as "threatened" and the other three species are all listed as "endangered" under both federal and state law. All five species are listed as endangered or critically endangered by the World Conservation Union (www.iucnredlist.org).

The Endangered Species Act prohibits activities that are detrimental to the welfare of sea turtles and other protected animals and assesses penalties of up to \$100,000.00 and/or one year in prison for violations. A volunteer who is issued a sea turtle permit (or works under someone who has been issued such a permit) by the North Carolina Wildlife Resources Commission (NCWRC) is responsible under the Endangered Species Act for any actions taken that may affect the turtle, including any actions taken by anyone who may be assisting. It is mandatory that everyone involved in management and protection of sea turtle nests and handling of injured or sick turtles, be aware of the life history of marine turtles and what actions are acceptable and consistent with the Endangered Species Act. As a rule, **management and protection should be undertaken in a manner that will minimize impacts on the natural order of reproduction**. In order to help our volunteers meet these serious responsibilities, the NCWRC makes this handbook available to permit holders and others involved in sea turtle protection efforts in North Carolina.

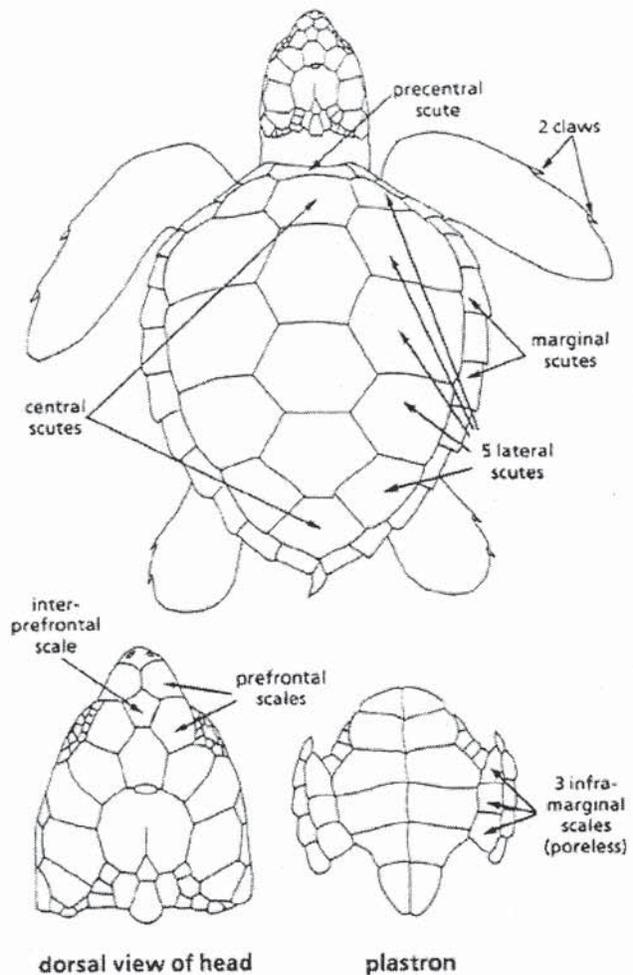
IDENTIFICATION

SPECIES DESCRIPTIONS

LOGGERHEAD SEA TURTLE

(Caretta caretta)

Distributed throughout the world. Primary nesting populations: Oman, Southeastern USA, Brazil, Australia, and Cabo Verde. The loggerhead is reddish brown in color, has 5 pairs of lateral plates with the first touching the nuchal scute, and 3 inframarginal scutes without any pores. The head is large relative to the body, the upper jaw is pointed and **not** hooked, and there are usually more than two prefrontal scutes between the eyes. Adult loggerheads in the southeastern United States have an average curved carapace length (CCL) of 98.6 cm (38.6 in.) and an average weight of 113 kg (250 lb.). The most common loggerheads found in North Carolina are immature turtles with a CCL between 51 - 76 cm (20 - 30 in.). **Juveniles that have a CCL of less than 45 cm (18 in.) are rare in North Carolina or anywhere along the US Atlantic coast.** Hatchlings are dark brown above and light brown or tan beneath. They typically have 3 dorsal keels and 2 plastral keels. The CCL at hatching is approximately 4.1 - 4.8 cm (1.6 - 1.9 in.).



LOGGERHEAD TRACK/CRAWL CHARACTERISTICS:

Track Width: 65-100 cm (26-40 in.).

Type of Track: Moderately deeply cut with alternating (asymmetrical) diagonal marks made by front flippers.

Preferred Beach Type: Extensive mainland beaches and barrier islands; moderately steep beach profile preferred.

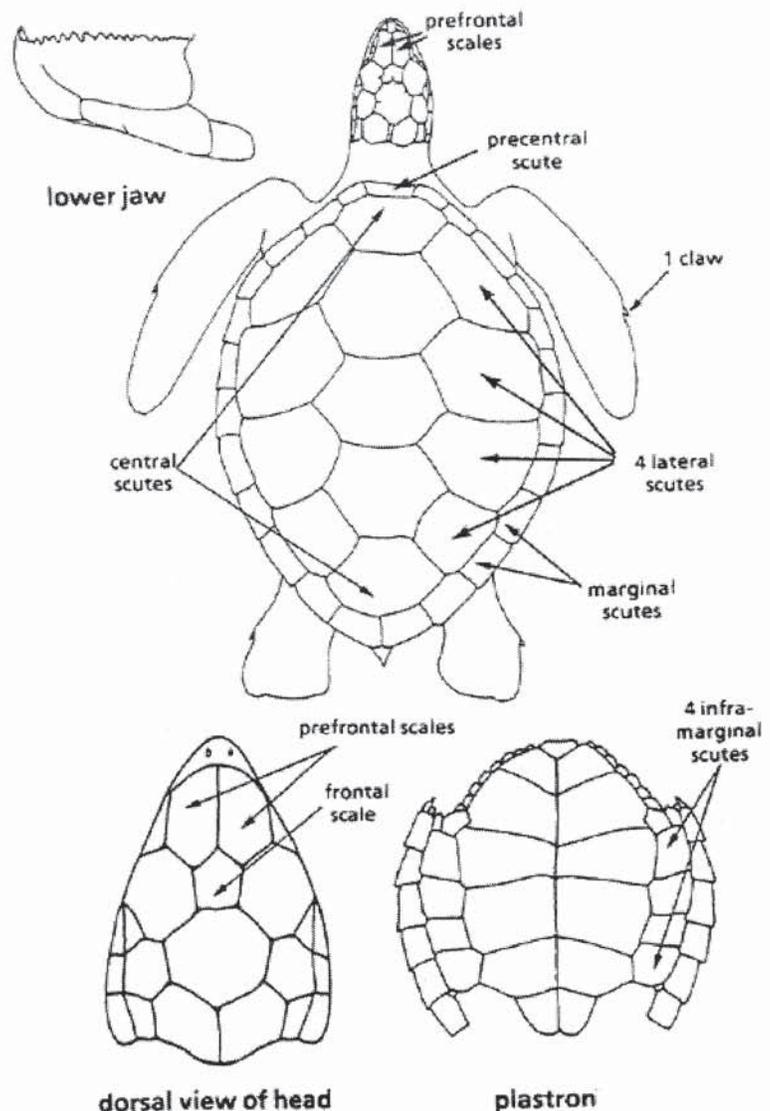
Average clutch size: 120 eggs

Egg diameter: 4 cm (1.5 in.).

GREEN SEA TURTLE

(*Chelonia mydas*)

Distributed throughout the world. Primary nesting populations located in Australia, Ascension Island, Costa Rica, Brazil, Guinea-Bissau, New Caledonia, etc. The green turtle is brown in coloration and derives its name from the color of its fat. The carapace varies from light to dark brown and is often mottled in appearance with radiating streaks or dark brown blotches present. The underside is light colored (creamy white in juveniles). There are 4 pairs of lateral plates that do not overlap and the first plate does not touch the nuchal scute. The head appears small relative to the body, has a rounded beak, and usually **only 1 pair of elongated prefrontal scutes between the eyes**. Adult green turtles in the southeastern United States have an average CCL of 108 cm (42 in.) and an average weight of 135 kg (300 lb.). Small juveniles with a CCL between 23 - 51 cm (9 - 20 in.) are common in North Carolina. Hatchlings are dark brown to black above and creamy white to yellow beneath. Hatchling flippers are often black and edged in white. Hatchling carapaces are flat in profile, lack a pronounced dorsal keel and have a CCL of approximately 5 cm (2 in.).



GREEN TURTLE TRACK/CRAWL CHARACTERISTICS:

Track Width: Typically 1 m (39 in.).

Type of Track: Deeply cut with **symmetrical diagonal marks** made by simultaneous movement of the front flippers with a center drag mark from the tail. Green turtles form much larger and deeper body pits than loggerheads and often dig multiple pits in a single crawl.

Preferred Beach Type: Generally large, open beaches.

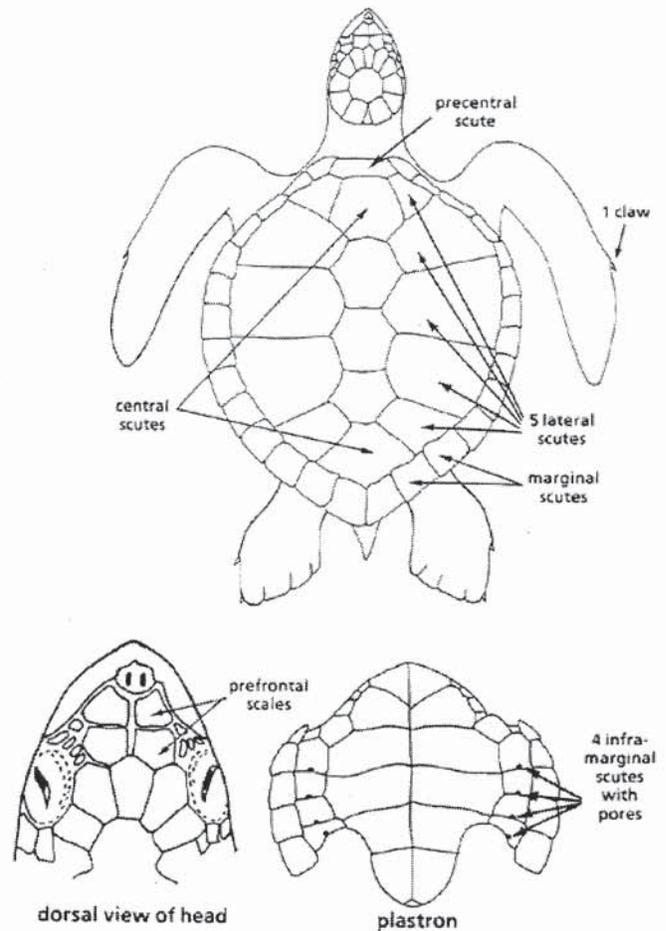
Average clutch size: Variable, average = 111 in Tortuguero, Costa Rica and sometimes more than 200 in the Atlantic.

Egg diameter: 5 cm (2 in.).

KEMP'S RIDLEY SEA TURTLE

(Lepidochelys kempii)

Distributed in the Gulf of Mexico and North Atlantic. Primary nesting population: Tamaulipas state, Mexico, with small numbers regularly nesting along the Gulf coast of Texas. Kemp's ridleys are the smallest of all living sea turtles and also the least numerous. They primarily nest on only one section of beach on the Gulf of Mexico coast of Mexico, near the border with Texas. The ridley has a dull grayish-brown (or greenish-gray), almost circular carapace (**shell width is often equal to or greater than the length**) with 5 or more pairs of lateral plates; the first plate usually touches the nuchal scute. Kemp's ridleys have 4 inframarginal scutes **with small pores**. The head is more slender than that of the loggerhead, **the upper jaw has an obvious hook**, and there are usually more than two pairs of prefrontal scutes between the eyes. Adult ridleys have an average CCL of 69 cm (27 in.) and weigh between 36 - 45 kg (80 - 100 lb.). Juveniles with a CCL between 25 - 51 cm (10 - 20 in.) are the most common size classes found in North Carolina. Hatchlings are completely dark gray in coloration, except for a short streak of light gray along the trailing edges of the front flippers. Three dorsal, tuberculate ridges and 4 plastral ridges are present. The CCL at hatching is approximately 3.8 - 4.4 cm (1.5 - 1.75 in.).



KEMPS RIDLEY TRACK/CRAWL CHARACTERISTICS:

Track Width: Typically 31 in. (80 cm).

Type of Track: Very shallow with alternating (asymmetrical) diagonal marks made by front flippers. **Nests often in the daytime.**

Preferred Beach Type: Western Gulf of Mexico, Rancho Nuevo.

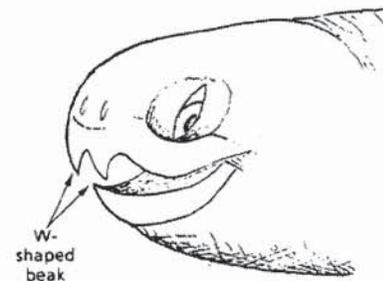
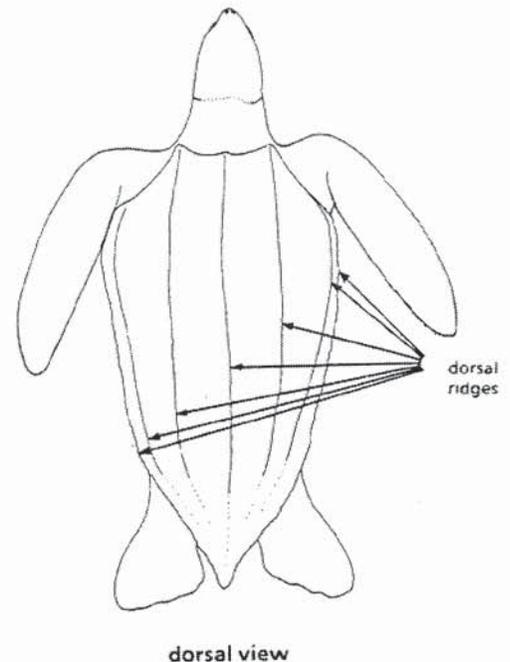
Average clutch size: 105 eggs

Egg diameter: 1.5 in. (4 cm).

LEATHERBACK SEA TURTLE

(Dermochelys coriacea)

Distributed throughout the world. Primary nesting populations: Suriname, French Guiana, Gabon, Trinidad, Costa Rica, Panama, Indonesia, India. This species is the most distinctive and the largest of all living turtles. It is generally an open sea or pelagic species but the migration of different species of jellyfish (its primary prey) brings it into nearshore areas. Seven prominent ridges are located on the carapace and 5 less prominent ridges are found on the plastron. **No scutes are present**, instead a smooth, slate-black to bluish-black leathery skin covers the carapace and plastron. Irregular patches of white are predominant on the plastron and pink patches can be found on the throat, shoulder, and head regions. **No scutes are found on the head** and 2 notches are found in the upper jaw. The CCL of leatherbacks typically found in North Carolina ranges between 124 - 165 cm (49 - 65 in.) with weights exceeding 270 kg (600 lb.). Hatchlings are predominantly black with white along the outer edges of the flippers and the dorsal and ventral ridges. The body is covered with numerous small beady scales and the tail is keeled above. The CCL at hatching is approximately 6.4 - 7.6 cm (2.5 - 3 in.).



LEATHERBACK CHARACTERISTICS

TRACK/CRAWL

Track Width: 50 or more inches. (125+ cm).

Type of Track: Deeply cut with symmetrical diagonal marks made by simultaneous movement of the front flippers, with a central drag mark from the tail. The nest site is usually a large disturbed area, and re-entry track is wavy, curved, and sometimes with circular loops.

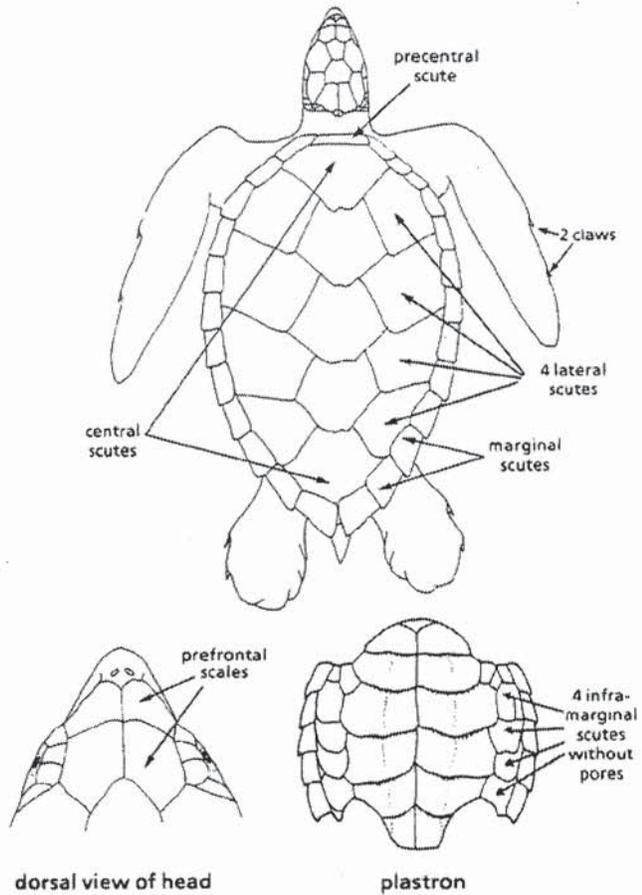
Preferred Beach Type: Dynamic beaches with deep entries.

Average clutch size: 100 eggs (**including many small misshapen yolkless eggs**)

Egg diameter: 2.5 in. (6 cm).

HAWKSBILL SEA TURTLE (*Eretmochelys imbricata*)

Distributed throughout the world. Primary nesting locations: Australia, Seychelles, Mexico, Guadeloupe, Brazil. The hawksbill is rare in North Carolina waters. There have been >20 confirmed reports of this species and all were small turtles (CCL < 35 cm or 14 in.). Their heads are slender and **they have a pronounced bird-like beak**. The general coloration of the shell is yellowish brown with a yellow, brown and black sunburst or tortoise-shell pattern. **The large scutes on the carapace overlap except in very old turtles.** A longitudinal keel is present in the center of the carapace. There are four pairs of lateral scutes, none of which touch the nuchal scute. Adult hawksbills have a CCL of 30 - 44 in. (76 - 112 cm) and weigh between 95 - 165 lb. (43 - 74 kg).



***Other and more detailed diagrams and keys
for identifying turtles can be found in Appendix II.***

NEST MANAGEMENT

NESTING BEHAVIOR

Female loggerheads, green turtles and leatherbacks usually come ashore to nest at night. Although nearsighted when they are out of the water, adult female sea turtles nevertheless can distinguish movement and light, and can be easily frightened and discouraged from laying eggs. The best way to avoid disturbing a nesting female is to not use a flashlight or camera/video flash when on the beach at night. If you must absolutely use a light, place a red filter over the flashlights or ATV lights. This is because the eyes of sea turtles are least sensitive to longer visible wavelengths of light (greater than 600 nm, which is red). If you see a female coming out of the surf, immediately turn off all lights and do not move. Wait until she has moved up the beach beyond you and has started digging before you move again.

If you wish to get a closer look at a nesting female, wait patiently for her to finish digging the nest cavity and slowly approach her from the rear when she has begun to lay eggs. On approach, do not shine lights directly on her eyes and stay away from her head. Turtles have very strong jaws and can break a bone or sever a finger if threatened. Do not touch her while she is nesting, unless you have been permitted to apply tags. Once she begins covering her nest, you should move away and extinguish all lights. The presence of artificial lights can cause her to become disoriented (move randomly) or even misoriented (move in a directed but incorrect direction). If you encounter a disoriented turtle, there are some things that will help you get her headed in the right direction. For example, by gently applying pressure on the right rear flipper you can get her to turn to the left. By gently applying pressure on the left flipper you can get her to turn to the right. Sometimes just by walking on one side of her you can get her to turn the other way. If a flashlight is available, you can remove the red cover, position yourself between the turtle and the water, and lure her into the water with the flashlight pointed downward but not at her eyes. Usually, all one needs to do is get her moving towards the ocean and she will continue in the correct direction on her own. If none of these methods work, a large canvas, along with the help of several people, can be used to drag or carry her to the water.

NEST SITE IDENTIFICATION

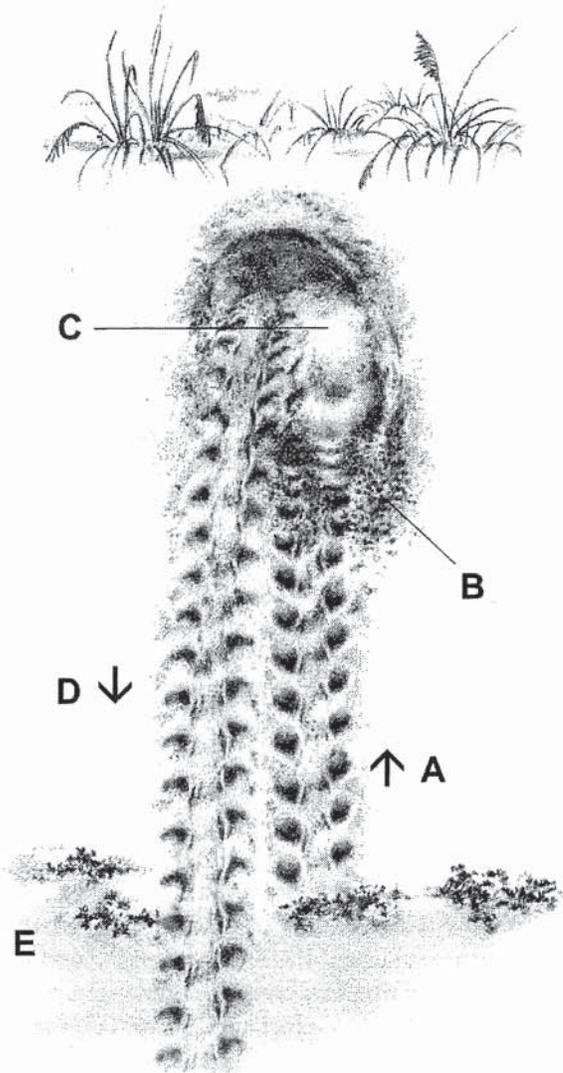
When conducting daily monitoring of a nesting beach, try to patrol the beach as soon as possible after sunrise. When a crawl is found on the beach, determine whether or not the crawl resulted in a nest (non-nesting crawls are also known as false crawls, half-moons and dry-runs). In most cases, non-nesting crawls are easily distinguished from nesting emergences because there will be little to no disturbed or excavated sand associated with the crawl. However, females will sometimes begin digging a nest chamber, give up and return to the water without laying any eggs. She may even make several separate nesting attempts, leaving a series of abandoned nest cavities before returning to the water. Under these circumstances, it is difficult to visually identify these crawls as non-nesting events. Here are some tips on finding the location in the crawl where eggs are most likely to have been laid:

You can distinguish between the arrival and departure crawl by looking for the direction that the sand is pushed in while the turtle was crawling (A and D in the figure). Also, examining the tracks and their relationship to the high tide line (E) can help determine the arrival crawl. Once determined, follow the arrival crawl up to the area where the sand is disturbed.

In the disturbed sand area (B and C in the figure), there may be two “body pits” or differentiated areas of digging. The primary body pit is the larger of the two (C) and usually the turtle makes this just before digging the nest chamber. The smaller chamber (B) is made after nesting, when the turtle covers and camouflages the site. False crawls with disturbed sand usually will not have a well-defined secondary body pit.

Still facing in the direction of the turtle’s approach, begin your search for the egg chamber approximately two feet at the midline into the disturbed area that forms the primary bodypit (i.e. start digging about half-way between B and C in the figure). Expand your search outward from this point until you find the eggs or decide that the crawl was a non-nesting emergence.

To find the eggs, gently and systematically dig by hand; the sand covering the nest will “give way” as you probe with your fingers. **Stop digging as soon as you see or feel the first layer of eggs.** Do not use a probe (a thin, but sturdy rod with a pointed end) to find a nest – it greatly increases the likelihood of accidentally puncturing several eggs. After verifying the presence of eggs, quickly cover up eggs with moist sand (do not allow dry sand to fall in the nest cavity) and replace the layer of dry sand over the nest. **Do not remove any eggs from the chamber, unless it has been determined that the nest must be relocated (see Relocation section below).** Note that for leatherback nests, it is often difficult to locate the egg chamber, due to the depth of the eggs and the large area of sand disturbance associated with the leatherback’s nesting process. In all cases where it is not possible to locate a clutch of eggs laid by a leatherback (or any other species that you suspect successfully made a nest), you should assume that it is a nest and mark off the entire area for protection during incubation. Once the leatherback nest emerges, you should be able to follow the tracks of the hatchlings back to the precise nest location for eventual excavation (see below).



NEST PROTECTION PROCEDURES

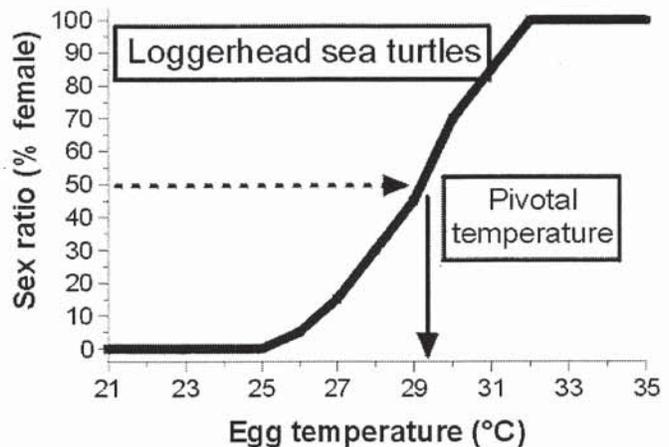
Nests may need to be protected if raccoon or fox predation is high or the area is subject to heavy foot, vehicular traffic or severe erosion. Listed below are steps to take to help protect nests on the beach.

1. Nests should be marked in a manner that will allow you to find them later and also monitor the level of the sand. Curious beach walkers often try to read what is on a marker so signs should be placed where it can be read without stepping on the nest. Seaward of the nest is usually best. Some suggestions for marking nests are:
 - » Place two stakes an equal known distance from the center of the nest. When you want to locate the nest later, attach a length of string equal to the known distance to each stake and make an arc in the sand. Where the arcs cross should be the site of the nest.
 - » Place two more stakes so that a square is formed around the nest site. Completely encircle the poles with construction tape or twine with pieces of brightly colored material attached to it so that the twine is visible.
 - » Mark the original level of sand on all stakes with a permanent marker.
2. The use of wire screening has been effective with most mammalian predators. The advantage is that there is little disturbance to the nest and incubation and hatchling emergence is not permanently affected if the proper wire and methods are used. Use a one-yard square piece of welded metal, 2 in. by 4 in. mesh and anchor it with notched stakes over the nest. The 4-inch side of the wire opening should be parallel with the water line. If the predators learn to dig into the nest from the side, bend the sides of the screen down so that a five-sided cage is formed. Covering the wire with sand will hide it from passers-by and predators.
3. Excess sand may blow over a nest making it difficult or impossible for hatchlings to emerge. Monitor nest markers to determine if this is a problem (the original sand height should have been marked in permanent ink on the stakes when the nest was first laid). Reduce the depth of sand over the nest to its original level if it has increased appreciably (more than 12 in. or 30.5 cm).
4. In situations where nests are incubating on beaches that also have regular motor vehicle traffic, the nests must be marked with adequate buffer zones to avoid incidental crushing. Each nest should be marked such that a 50 foot buffer zone is allowed on all sides of the nest during incubation. Additionally, when hatchlings are expected to emerge, a 50 foot wide corridor from nest to the ocean must be created and kept vehicle free from late afternoon to dawn. During expected emergence, all tire ruts between the nest and ocean must be smoothed at the end of each afternoon.

INCUBATION AND HATCHING

Eggs incubate in the sand for approximately 2 months. The incubation period varies throughout the nesting season and is largely dependent on local weather conditions. Cool ambient temperatures prolong incubation periods whereas hot temperatures shorten the development time. Other factors such as humidity and oxygen levels can also affect the incubation period of a nest. There is no set time or date when a nest should hatch. **Do not dig into a nest prior to emergence.** Not only will this potentially cause harm to the hatchlings, it will also affect the standardized monitoring database.

The incubation period is a critical time for marine turtles. Approximately 6-12 hours after deposition, the embryo becomes attached to the top of the eggshell. After this point, the embryo is highly sensitive to movement, and can be dislodged if the egg is rotated. This will result in the death of the embryo. Temperature within the nest is an important factor during development. Most notably, the temperature of the eggs during the middle third of incubation influences the direction of sexual differentiation in all sea turtles. For loggerheads in North Carolina, warmer temperatures (>84.6 °F or >29.2 °C) produce more females, while cooler temperatures (<84.6 °F or <29.2 °C) produce more males. Constant temperatures of 84.6 °F or 29.2 °C will produce equal numbers of both sexes; this is called the **pivotal temperature**. Nest temperature is influenced by sand color and grain size, physical structure of the beach, local climate and how much metabolic heat is generated by the development of the embryos. The mechanism for sex determination is not known precisely, but it appears to be linked to the regulation of aromatase, an enzyme that converts testosterone (a male hormone) or its precursors to estrogen (a female hormone).



In the egg, the embryo develops in a folded position, as do most vertebrates. The yolk sac remains external to the embryo throughout incubation. At the end of incubation, each hatchling will slit the eggshell with a temporary “egg tooth” (or caruncle) on the tip of the beak. When the baby turtle hatches from its egg, it is still folded and the egg sac is still external to the body. Over the course of the next few days, the hatchling will straighten out and the yolk sac will be absorbed into the body cavity via a hole in the plastron (an “umbilical” hole). Most of the eggs in a single nest hatch at the same time, and the hatchlings work together to ascend the sand column above the nest cavity. The residual yolk provides important energy for this activity. Hatchlings become inactive in response to high temperatures, so when they reach the surface of the sand, they will wait until the temperatures have cooled before emerging onto the beach. Cooler surface sand temperatures usually correspond to nightfall, although on cloudy rainy days, emergences can occur during the daytime because rain will cool the surface of the sand. Nighttime emergences are thought to a) provide protection from high lethal temperatures on the beach during the day, and b) help to avoid diurnal predators such as most birds. Once emerged, the hatchlings orient

towards the sea using visual cues, specifically light gradients, and they scramble quickly towards the ocean. Once in the water, they swim without pause for 24-48 hours, as a way to get beyond the predator-filled coastal zone. Many hatchlings are eaten during this period.

The remaining yolk in the hatchlings powers this post emergence "frenzy". Loggerhead hatchlings have shown an affinity for sargassum once they enter a major oceanic current such as the Gulf Stream, presumably because they can hide among the vegetation and also find food there. The period of time they spend drifting passively in open ocean currents amid floating seaweed is referred to as the "lost year" and has been estimated to last anywhere from 2 to 10 years. Genetic studies have shown that loggerheads produced on beaches in the SE USA will use coastal areas around the Macaronesian Islands (the Azores, Madeira, the Canary Islands, and Cabo Verde) as feeding grounds as mid-sized juveniles, after which they return to the northwest Atlantic feeding grounds (such as Pamlico Sound and the Chesapeake Bay). Using bone-ageing techniques, researchers now estimate that it takes 20-30 years for loggerheads to reach maturity.

NEST RELOCATION

WHEN TO MOVE A NEST

For reasons outlined above, turtle nests should be allowed to incubate at their original location if there is any reasonable likelihood of survival. Relocation must be considered as a last resort in terms of nest management. In most cases, nests that are naturally laid in areas with heavy foot or vehicular traffic can be marked so that they are avoided by beach goers. If a nest is laid near a bright light that may misorient hatchlings, ask the appropriate party if the light can either be turned off or shaded, at least around the time of expected emergence. If you need assistance with lighting problems, please call the Sea Turtle Project Coordinator. Nests should be moved **only** when one or more of the following situations exist:

- » The nest is below the average high tide line where **regular** inundation will result in embryonic mortality.
- » The nest is laid in an area known to be susceptible to erosion.
- » The nest is laid under a sloughing escarpment and is subject to being buried too deeply.
- » The nest is laid in an area in which unusual, but lawfully conducted, human activities pose a serious threat to nests, such as emergency dune pushing following a major storm event. When these situations arise, the local sea turtle volunteers will be notified by the NCWRC and given instructions on nest relocation protocol that may be unique to the situation at hand.

HOW TO MOVE A NEST

Relocated nests may have a lower hatching rate than natural nests, but careful and timely handling and transport of eggs will reduce this risk. The shorter amount of time between laying and relocation, the better the chances that successful emergence will occur. Beach patrols should be made as early in the morning as possible. If you determine that relocation is absolutely necessary, use the following guidelines:

1. Find the egg chamber by using the methods described in the section entitled NEST SITE IDENTIFICATION.
2. Try to move nests within 6 hours after they are laid or **before 9:00 AM the following morning at the very latest**. Embryos have a better chance for development when relocation is accomplished within that time period.
3. Take extreme care not to rotate eggs in any way during handling. Maintain the original orientation throughout the relocation process. It is sometimes helpful to place a small light pencil mark on the top to help maintain the original orientation. **Do not use ink** since it may contain solvents harmful to the embryo if it permeates the eggshell.
4. Excavate the eggs by hand, not with a shovel. Place them in a rigid container (for example, a bucket) with a 2 - 3 inch layer of moist sand on the bottom. When all the eggs are in the container, cover them with a layer of moist sand or moistened towel. Keep excavated eggs shaded on hot, sunny days. If you have enough of them, chicken egg cartons are also a good method for transporting sea turtle eggs to the new relocation site.
5. Relocate the nests as close to the original nest site as possible, while at the same time avoid making clusters of nests. Concentrating nests in a small area may attract predators and/or alter natural sex ratios. Additionally, nests should be relocated to areas above the high tide line that are relatively free of vegetation. Invasion of the nest by roots will prevent the hatchlings from emerging from the nest.
6. Dig the new egg chamber by hand or with a trowel to the same depth and dimensions of the original nest. Round out the bottom with a cockle shell so that the shape of the nest is similar to a round-bottomed flask or inverted light bulb.
7. Relocate the eggs into the new egg chamber by transferring them one at a time while continuing to maintain each egg's original orientation. Try to wipe off any excess sand, because airspace between the eggs in the chamber is important for respiration. After all the eggs have been transferred, cover them with moist sand excavated from the new nest chamber. Dry sand should not be allowed to fall into the egg chamber. Once the eggs are reburied to the upper level of the surrounding moist sand, gently pat the sand surface above the eggs with your hand. Replace the dry sand over this area to the depth present before you began.

8. Mark the nest's new location following the steps listed in the preceding section entitled NEST PROTECTION PROCEDURES.

Hatcheries will not be permitted except in extreme situations where predation is high or erosion is severe. Use of hatcheries must be approved in advance by NCWRC.

HATCHLING PROTECTION PROCEDURES

Although it is a relatively short interval, the timing and circumstances of hatchling emergence and dispersal is critical to survival. For this reason, the emergence of hatchlings should mimic the natural situation as closely as possible.

- Allow nests with possible hatchlings in it to complete the incubation process undisturbed. ***Do not dig into a nest to see if hatchlings are ready to emerge.*** The premature opening of a nest could attract predators or alter the physical environment of the nest resulting in the death of hatchlings.
- ***Nest excavations will be conducted a minimum of 72 hours after a mass emergence of hatchlings (boil) or 80 days after laying, whichever comes first*** (see below for an important exception). If the nest exhibits a trickle hatch (a few hatchlings emerge each night over 3 day period) then wait ***a minimum of 120 hrs. (5 days)*** after first hatchling emergence or until the majority of all hatchlings have emerged.
- Because cooler sand temperatures delay hatching and emergence, ***a nest that has been subjected to tidal inundation, excessive rainfall, or cool fronts should not be excavated until 90 days after egg deposition or at least 120 hours (5 days) after first emergence. This includes nests laid late in the season (August 01 or later).***
- If predators have entered a nest, determine if there are any eggs left intact and allow any live hatchlings to make their way to the ocean (see section entitled HATCHLING RESCUE AND RELEASE). If viable eggs are present, immediately remove spilled egg contents from the nest chamber. Carefully clean "dirty" eggs by gently rubbing them with dry sand (***do not wash eggs in water!***). Take extreme care to avoid rotating the eggs during this procedure. Rebury all intact eggs and screen the nest.
- Hatchlings that are disoriented by lights should be taken to a darker portion of the beach for release. Allow them to crawl a moderate distance to the water. A flashlight shining on the ground at the water's edge can sometimes overcome the effects of other lighting and attract hatchlings in the proper direction. Do not shine the light directly on the hatchlings.
- Hatchlings that emerge from the nest when nearshore water temperatures are below 50 °F or 11 °C stand a poor chance of survival. When faced with this situation, collect the hatchlings as they emerge and place them in a rigid container lined with several inches of moist sand. Bring the hatchlings inside a warm (60 – 65 °F or 16-18 °C), quiet, dark room and partially cover their container with a moist towel (***do not cover the container completely to avoid***

suffocation). Call the Sea Turtle Project Biologist or Assistant Biologist immediately for instructions on what to do with the turtles.

POST-HATCHING NEST EXCAVATION AND ANALYSIS

Excavate a nest only after a minimum of 72 hours have passed since the first emergence or 80 days after deposition whichever comes first (longer in cool and/or wet weather; see section entitled HATCHLING PROTECTION PROCEDURES). You should use latex or vinyl gloves when cleaning a nest: it protects hatchlings from your bacteria, and protects you from any bacteria in the nest, not to mention keeping your hands from smelling “distinctive” for the next few days.

The point of excavation is to determine the success of the eggs in the nest. There are two basic measures: hatching success and emergence success. The main difference between the two is how the live hatchlings found remaining in the nest are classified. For consistency with other projects in the USA and elsewhere, the WRC Sea Turtle Program will report emergence success, although it may be necessary in some cases to calculate hatching success.

Nest excavation protocol:

1. Using gloves, gently begin digging into the depression left by the hatched nest. When you feel the sand “give way” you have broken into the nest chamber. You may immediately find hatchlings that are entangled in roots or perhaps constrained by compacted sand. Do not pull on the hatchlings, but try to work them free by breaking the roots or loosening the sand. If the young turtles appear unharmed, follow release procedures listed in the next section entitled HATCHLING RESCUE AND RELEASE. ***Be sure to verify species when you find hatchlings in the nest.***
2. Carefully scoop out all contents of the nest. Be sure to verify that no extra eggshells or eggs remain on the sides of the “bowl” of the nest cavity. If you encounter many (>15) live hatchlings before reaching any eggs or eggshells, or find a mix of many (> 15) live, vigorous hatchlings, unhatched eggs and a few eggshells, quickly cover the egg chamber with moist sand and return the site to its original condition. Wait at least 48 hours before excavating again. If fewer than 15 hatchlings are encountered during the initial excavation, follow hatchling release procedures listed in the following section entitled HATCHLING RESCUE AND RELEASE.
3. Once you have collected all the material from the excavated nest, separate nest contents into the following groups:
 - A. Live hatchlings (LH)
 - B. Dead hatchlings (DH)
 - C. Pipped eggs with dead hatchlings (PE)
 - D. Whole unhatched eggs (UE)
 - E. Whole eggshells (ES) (>50% of the whole shell)
 - F. Small eggshell pieces (< 50% of the whole shell). *Note that this group of shells is not used in the overall calculations later on.*

Pipped eggs are those in which some part of the hatchling has broken through the egg but is not completely free of its eggshell. Pipped eggs range from those with just a small hole to those with large tears. ***Pipped eggs are not hatched eggs.*** See the note at the end of this section for instructions on what to do with live pipped eggs and live hatchlings whose yolk sacs are not completely absorbed. For reporting purposes, all pipped live hatchlings that survive to be released are counted as LH. Any that subsequently die are counted as PE. Don't forget to add the shell of live pipped hatchlings to the ES category.

4. You can calculate **total clutch size (TCS)** by summing the numbers of groups C-E (above), that is

$$\text{TCS} = (\text{PE} + \text{UE} + \text{ES})$$

Please calculate total clutch size based on nest excavation, even if you know original clutch size from nest relocation.

5. Calculate emergence success by the following formula:

$$\frac{\text{ES} - (\text{LH} + \text{DH} + \text{PE} + \text{UE})}{\text{TCS}} \times 100$$

6. After you are finished, place unhatched eggs, dead hatchlings, and eggshells back in the nest and cover them up. The debris left in an emerged sea turtle nest is thought to be an important source of energy for the resource-poor dune system.

PIPPED EGGS WITH LIVE HATCHLINGS: If the nest contained live pipped eggs, or live hatchlings with prominent yolk sacs perform these steps. Rebury the contents of the nest at the bottom of the egg chamber. Add a 3 - 4 inch layer of clean moist sand. Place the viable pipped eggs and live hatchlings with visible yolk sacs on this layer of sand and add more clean, moist sand over them. Cover the area with dry sand and keep the nest location marked. Wait one week before excavating again to complete the nest analysis. If you encounter this scenario when ambient temperatures and/or nearshore water temperatures are below 50° F, place the viable specimens in a rigid container lined with moist sand and bring them inside a warm (70° - 75° F), dark, quiet room. Partially cover the container with a damp towel and call the Sea Turtle Project Biologist immediately for further instructions on what to do with the turtles.

IN ALL CASES OF MANIPULATIONS OF PIPPED EGGS WITH HATCHLINGS, PLEASE NOTE ALL ACTIONS TAKEN AND FINAL RESULTS ON COMMENTS SECTION OF NEST EXCAVATION SHEET.

See Appendix VIII for a sample data sheet to record information on each nest encountered.

HATCHLING RESCUE AND RELEASE

This activity includes salvaging live hatchlings (primarily disoriented hatchlings encountered on the beach or those found at the bottom of excavated nests) and ensuring they reach the water safely. Due to the short duration of the swimming frenzy period, hatchlings should be released as soon as possible following rescue. All hatchlings found during darkness are to be released immediately. All hatchlings found disoriented or at the bottom of nests during daylight excavation are to be released the same evening or night. **Do not hold hatchlings in water.** If you must wait until nightfall to release the hatchlings, place them in a cooler or bucket lined with damp sand and partially cover with a moist towel in a near-dark environment. Once they are in a holding container, the hatchlings should not be handled or disturbed until they are ready for release. Disturbance can increase unnecessary expenditure of limited energy stores. It is best to keep the hatchlings in a dark, quiet, temperature-controlled area.

Release all hatchlings after dusk. Allow them to crawl to the water on their own. **Do not toss hatchlings beyond the waves breaking on the beach.** Occasionally, individual hatchlings may need assistance in reaching the water. In such cases, they may be moved closer to the water's edge or placed in the shallows and allowed to swim off on their own.

In some cases, weak hatchlings may need to be held for slightly longer periods to allow them to recover. This should not be a routine event. If hatchlings require further holding, please contact the Sea Turtle Project Biologist immediately for instructions on what to do with the turtles.

ACTIONS NOT ALLOWED UNDER NCWRC PERMIT

Engaging in any of the following activities is unlawful and could result in revocation of the permit and/or law enforcement action.

- » Incubating eggs in artificial containers of any kind.
- » Relocating nests for reasons other than outlined in the Nest Relocation section above (page 15).
- » Keeping eggs or hatchlings in any kind of structure (sheds, garages, homes, etc.) or for any period of time except by special permission or per instructions given by the NCWRC.
- » Moving nests landward of any obstacle that would prevent an unencumbered route to the sea for the hatchlings.
- » Premature opening of the nest.
- » Detaining hatchlings from moving to the sea once they have emerged.

CROWD CONTROL

Historically, problems have occurred on the beach when there have been excessively large crowds during a nesting or hatching event. Although the presence of large crowds can make excavations more challenging, they also are a great opportunity for raising public awareness of sea turtle conservation. The following guidelines are

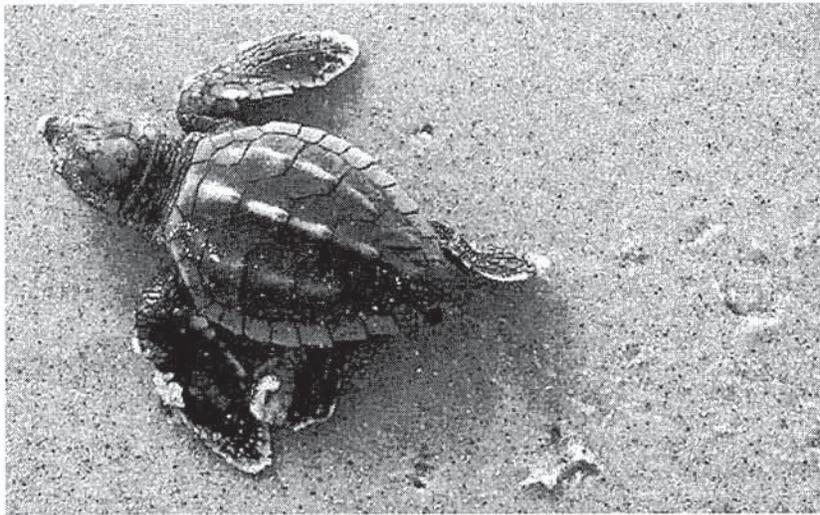
provided for managing large crowds that may be encountered on the beach during a nesting event or nest excavation.

1. The NCWRC Sea Turtle Project will furnish you with an official badge that will inform the public that you are duly authorized to perform sea turtle management activities. Please wear it at all times during your turtle activities!
2. Nesting event: Keep people at least 20 ft. from the female and make sure they remain behind the turtle at all times. Do not try to approach her when there is a large crowd of people. Inform them as to what is happening and ask them not to take pictures since the flash can cause the turtle to become disoriented. If necessary, you may remind them that all species of sea turtle are protected by federal law and thus it is a crime to disturb them during their nesting process. You can always ask your local police department for help in crowd control – chances are good that the officers will be interested in the nesting event too!
3. Hatching event: Have one person act as an interpreter and have them circulate through the crowd informing people on what is happening and recruiting people out of the crowd to inform late arrivals. Use some sort of barrier such as string or construction tape to restrain the crowd from a fan-shaped alleyway for the hatchlings to use to get to the water. Short lawn fencing might also be used in the same manner, but do not leave it on the beach when no one is present. A low (4 in. or less) ridge of sand can be raked up to form a fan shaped alley which will keep the hatchlings moving toward the water. You can also drag your foot to make two parallel lines leading from the nest to the water – ask people to remain outside the two lines while the hatchlings make their way to the ocean while inside the lines.
4. When possible, periodically run articles in the local newspapers informing people about the life history of the turtles and what will happen if they are caught molesting or inhibiting nesting females or emerging hatchlings.
5. Organized public education presentations or lectures are a good way to keep crowds to a minimum or at least manageable. Slide shows to various groups such as Realtors, community service organizations, city administrators, etc. can help facilitate crowd control. Contact the Sea Turtle Project Biologist for more information about obtaining education materials.

REPORTING

All permit holders must submit an annual report of all activities involving sea turtles or their nests. In the case of sea turtle nest beach management projects, annual reports are made on forms developed by the NCWRC Sea Turtle Project. These forms are distributed at the Annual State Sea Turtle Workshop and are also available from the Sea Turtle Project Biologist. Reports should be neat and legible and should include all information collected from each nest as indicated on the form. ***The annual report should be submitted by December 1 of each year as required in the permit.*** Information collected is important to managing sea turtles in a biologically sound

manner. In addition, all permit holders are strongly urged to submit their data in electronic format to the Sea Turtle Project Biologist, who may be contacted for more details.



Loggerhead hatchling from a nest on Bogue Banks, NC.

SEA TURTLE STRANDING AND SALVAGE

INSTRUCTIONS FOR REPORTING DEAD TURTLES

Information on the numbers and causes of trauma to sea turtles is vital to their protection. Therefore, participation in the Sea Turtle Stranding and Salvage Network is a vital and serious activity. It is extremely important that all dead and injured turtles be reported as soon as possible and that an attempt be made to ascertain cause of death. Stranding report forms are available from the Sea Turtle Project Biologist and should be filled out as accurately and completely as possible. The stranding form is at the end of this handbook, and thorough instructions for completing it can be found in Appendix IV.

When you are alerted of a stranded turtle, please respond directly by going to the turtle stranding as rapidly as possible to avoid losing the animal on the next high tide. If you are unable to respond right away, contact the Sea Turtle Project Biologist immediately – an alternate responder will be arranged. When inspection and measuring of the turtle is complete, do one of the following: (1) salvage the carcass; (2) paint the carapace and bury it above the high tide line; (3) paint the carapace and contact the city maintenance department to dispose of the carcass; (4) apply brightly colored spray-paint to the carapace to prevent duplicate reporting and leave it on the beach (if the carcass is in the water or near the water line, try to pull it further up the beach to avoid having it wash back out to sea). Please make an effort to salvage or bury the carcass. Please photograph all carcasses (at least a top-down photograph of the dorsal side of the turtle, and any injuries, if present), and submit photos (digital or physical) with stranding reports. **Additionally, all Kemp's ridleys and all turtles with tags, no matter what condition, must be salvaged for further investigation.** Contact the Sea Turtle Project Biologist or Assistant Biologist for instructions on salvaging carcasses in your area **before** placing carcasses in a freezer.

After attending to the stranding(s), report the event(s) to the Sea Turtle Project Biologist by telephone or via email. All strandings encountered should be reported to the Biologist within 24 hours of the event. Have the following information on hand when phoning in a report: date when the stranding was first reported; species; a description of the stranding location (include whether it was an oceanside or inshore stranding); and a description of injuries, wounds, or other peculiarities that may indicate cause of death. Following the telephone report, send the **original** completed stranding report form(s) and photographs to the Biologist as soon as possible.

INSTRUCTIONS AND GUIDELINES FOR HANDLING LIVE STRANDED TURTLES

LIVE STRANDING RESPONSE OBJECTIVES

The objective of rapid response to live stranded turtles is to begin treatment and rehabilitation as rapidly as possible. The sooner that an injured or sick turtle begins to receive treatment, the better the chance of a successful recovery. Response measures will vary depending on the condition of the turtle, time of day (or year), environmental conditions, etc. Common to all situations, however, will be the need for the responder(s) to:

- attempt to establish and maintain contact with Sea Turtle Project Biologist and/or Assistant Biologist – emergency pager number: **252-247-8117**.
- respond rapidly;
- enlist local assistance (e.g., law enforcement to aid with crowd control);
- evaluate the condition of the animal;
- arrange to take action (release, transport to a holding facility, disposition of carcass, and data collection);

North Carolina has two full-time sea turtle rehabilitation centers that successfully treat and release dozens of sick or injured turtles each year. Additionally, the NC Aquariums and the NCSU College of Veterinary Medicine provide excellent support for treating live stranded turtles. Together with the Sea Turtle Biologists, the people associated with the institutions above are the most suited to administering care and first aid. If you are responding to a sick or injured sea turtle, your job is to keep the animal as safe and calm as possible until the trained responders can arrive or be met somewhere. Remember, your first response should be to call the emergency pager (**252-247-8117**) and stay in constant contact with one of the Sea Turtle Biologists – they will instruct you on what to do. Please read the following section before responding to a stranding. The information below is designed to help you understand what kinds of things that the biologists, veterinarians, or rehabilitators may ask you when first responding to a live stranding. Also note that **all strandings (including live strandings) require a duly complete stranding report**. The most important information to be filled out is the date and location of the stranding, plus any other specific information related to the disease or injury of the turtle. Also, remember to **wear latex gloves at all times when handling injured or sick turtles**.

GUIDELINES FOR RESPONDING TO LIVE STRANDED TURTLES ON THE BEACH

Approach. Observe the turtle's behavior before making the approach. Advance slowly, calmly, and cautiously avoiding loud noises, abrupt movements, or bright lights. Debilitated sea turtles are not likely to be aggressive, but people have been bitten, scratched, or slapped hard with a flipper. Also, be aware of the fact that you may be responding to a nesting female on the beach that was mistaken for a live stranded animal.

Assessment of condition. Conduct a thorough and systematic external visual examination of the turtle – **if any injuries on carapace are noted, do not move the turtle**. Beginning at the head, examine skull, eyes, nose, mouth, and neck. Next, inspect flippers and survey entire carapace. **Do not flip the turtle unless instructed to do so**. Following initial visual inspection, you may be instructed to move the turtle as part of transporting it to a rehabilitation center or you may be asked to remain where you are until help arrives.

First aid on the beach. This involves giving simple supportive care by relieving distress and making the animal as comfortable as possible. In many cases, such efforts can improve the animal's chances of recovery significantly. The key is to prevent

further injury and keep the animal comfortable, while minimizing handling and disturbance.

Standard First Aid Procedures (applies to all stranded turtles irrespective of injury or health class):

- A. Keep turtle's skin (including area around the eyes), carapace, and plastron moist with either clean freshwater or seawater. This can be achieved using one or more of the following methods:
 - (1) Place wet towels over the turtle - make sure towels are in contact with all portions of the body including carapace, flippers, and neck (NOTE- USE ONLY DRY TOWELS IN WINTER OR WHEN AMBIENT AIR-TEMPERATURES ARE LESS THAN °60 F)
 - (2) Regularly and gently spray the top sides of animal with a spray bottle (this method is especially useful in keeping the area around the eyes moist and/or avoiding soaking treated injuries); (EXCEPT IN WINTER OR WHEN AMBIENT AIR-TEMPERATURES ARE LESS THAN °60 F)
 - (3) Regularly and gently pour water from a bucket over the entire turtle including head (EXCEPT IN WINTER OR WHEN AMBIENT AIR-TEMPERATURES ARE LESS THAN 60 °F);
 - (4) If water is not available or in winter/cold temperatures, retain moisture by applying liberal amounts of KY gel (**not Petroleum jelly**) on skin, carapace, and plastron - **avoid the eyes, nose, and injured areas**.
- B. If the turtle's carapace is injured, do not attempt to elevate. Await further instruction from the Biologists or rehabilitators.
- C. During warm months, if the turtle cannot be taken off the beach immediately (e.g., when you are waiting for a vehicle to transport the animal to a holding facility), create a sun barrier using a tarp, large towel, or beach umbrella.
- D. For probable cold-stunned animals, move the turtle to a warm (not hot) environment (no greater than 60 °F) as soon as possible and keep them covered in **DRY** towels. Cold-stunned turtles require slow warming in water (no more than half a degree per hour); this should be left up to the holding facility.
- E. In the event the turtle swallowed a fish hook, the protruding line should not be cut unless absolutely necessary. In this case, leave at least 2 feet of line attached to the ingested hook. Cutting the line too closely makes it difficult for rehabilitators or veterinarians to successfully remove the hook.
- F. Record injuries and respiratory activity on stranding sheet and be prepared to transmit this information by telephone.
- G. If instructed, transport the turtle to a holding facility as soon as possible.

Each live stranded turtle should be treated on a case-by-case basis; therefore, be sure to follow those instructions given by the Project Biologists or rehabilitation staff specific for that animal.

TRANSPORT

Unless you are authorized to transport, do not attempt to move a live injured or diseased turtle. Transporting juvenile and subadult sea turtles in a kiddie pool or large plastic bin effectively restricts movement and allows the animals to be kept wet without soaking the vehicle. Place wet towels or foam padding on the floor of the pool before putting the turtle in, to keep its ventral side moist and prevent any sliding motion. **Do not transport turtles in water.** Turtles may also be carried in the back of pick-up trucks, station wagons, vans, etc. without a holding vessel (as will often be the case with large turtles) provided an observer is on hand to make sure the turtle does not injure itself, damage the vehicle, or crawl somewhere it should not. In these situations, place dry foam padding on the floor where the turtle will ride. Lay a tarp over the foam padding to protect the padding and keep the inside of the vehicle from getting soaked when wetting the animal with a spray bottle (for the sake of the vehicle, use freshwater only). To prevent overheating on hot days, it is imperative that the turtle is kept moist and there is sufficient airflow in the vehicle. On cold days (<60° F), the animal should be transported inside the vehicle (~60 °F), and only dry towels should be used.

Transport procedures:

1. Carefully move the turtle from the beach to the vehicle. Small turtles that sustained no injuries may be carried by hand. Large or severely injured turtles should be carried in a plastic box, on an inflexible board or in some type of stretcher (in cases of carapace damage, you can dig out some sand from underneath the animal and slip the board underneath the plastron, to facilitate lifting and minimizing potential further damage). When moving turtles (no matter what size), remain out of reach of thrashing flippers and snapping jaws.
2. Keep turtle moist either with wet towels or a spray bottle (**except in cold weather**).
3. Assess condition of turtle every 15 - 30 minutes; establish whether turtle is breathing or not.
4. Drive slowly and avoid making quick stops or sharp turns.
5. Upon arrival at the holding facility, submit a copy of the stranding form (and any ingested or entangled material that may have been cut and saved from turtle) to the waiting staff.
6. Submit completed stranding form to Sea Turtle Project Biologist as soon as possible. Do not rely on rehabilitation facility staff to take measurements. It is best to fully complete form before transport, while waiting for vehicle or other coordination.

At Home Care. In the event that a holding facility is not open, you may have to keep the turtle at your home for the night. **Only individuals with a Sea Turtle Permit are allowed to keep sea turtles on their property for rehabilitation purposes.** The Sea Turtle Project Biologists or rehabilitators will provide you with instructions on how to best keep the turtle. In some cases, you will be asked to keep the turtle in freshwater overnight to allow the animal to rehydrate. Water depth will depend on condition of the turtle (almost invariably it will be shallow water at most). Do not try to feed the turtle.

IMPORTANT TELEPHONE NUMBERS

Wildlife Resources Commission Personnel:

Sea Turtle Project Emergency Pager	252-247-8117
Matthew Godfrey, Sea Turtle Project Biologist (w & h)	252-728-1528
Wendy Cluse, Assistant Sea Turtle Project Biologist (w & h)	252-725-5328
David Allen, Coastal Faunal Diversity Project Leader	252-448-1546

Sea Turtle Rescue and Rehabilitation:

Call the Sea Turtle Project Biologist and/or Assistant Biologist first (see above). If they out of reach call:

For events between: Cape Lookout NS to the NC/SC border

Karen Beasley Sea Turtle Rescue and Rehabilitation Center	910-328-3377
Karen Beasley Sea Turtle Rescue and Rehabilitation Center PAGER.....	910-397-3377
Jean Beasley, Topsail Turtle Project Director	910-328-1000

For events between: Ocracoke to the NC/VA border

Network for Endangered Sea Turtles Hotline	252-441-8622
Network for Endangered Sea Turtles Hotline PAGER	252-480-9660

NC Aquariums:

Fort Fisher Aquarium.....	1-866-301-3476
Pine Knoll Shores Aquarium	1-866-294-3477
Roanoke Island Aquarium	1-866-332-3475

Law Enforcement Hotlines:

NC Division of Marine Fisheries Hotline	1-800-682-2632
NC Wildlife Resources Commission Hotline.....	1-800-662-7137

APPENDIX I

INFORMATION SOURCES FOR SEA TURTLE BIOLOGY AND CONSERVATION

INTERNET:

<http://www.seaturtle.org>

This site contains a wealth of information concerning sea turtles, including the Marine Turtle Newsletter, a directory of sea turtle workers, an image library, book reviews, and links galore. This is a good place to start on a general search on sea turtles.

<http://www.euroturtle.org>

This site gives a good overview of the biology and conservation of sea turtles, with a focus on the Mediterranean. There is a section devoted to education and public awareness.

<http://www.turtles.org>

This is another site devoted to sea turtles, although with a focus on green turtles from Hawaii. It has great underwater photos of turtles, and lots of information on fibropapillomatosis.

<http://webluis.fcla.edu/cgi-bin/cgiwrap/fclwlv3/wlv3/DGref/DBST/CM2/P1basic>

This is the online search tool for the Sea Turtle Bibliography from the Archie Carr Centre for Sea Turtle Research of the University of Florida. You can use it to find publications about sea turtles.

<http://www.sefsc.noaa.gov/seaturtlepublications.jsp>

This is where the NMFS has available all NOAA publications related to sea turtles in the Atlantic Basin.

http://emys.geo.orst.edu/main_pages/database.html

This is an online database for information on ALL species of turtles (nearly 300!).

NC-CTURTLE

This LISTSERV is meant to facilitate communication among the project coordinators, biologists, educators, researchers, and volunteers. Anyone involved with sea turtles in North Carolina can join NC-CTURTLE, graciously hosted by www.seaturtle.org (many thanks to Michael Coyne). We encourage all volunteers in the North Carolina Sea Turtle Project to join, as much important information and various announcements are made via NC-CTURTLE. To join, simply send a message to godfrey@coastalnet.com and ask to be included on the NC-CTURTLE address list.

BOOKS

There are many books on sea turtles, from kids books to coffee table book to more serious scientific books. The following is a partial list of some of the more recent books on sea turtles – you will find more if you go to www.amazon.com and search under “sea turtle”

P. L. Lutz and J. A. Musick (editors). 1996. *The Biology of Sea Turtles*. CRC Press, Boca Raton, Florida.

P. L. Lutz, J. A. Musick, and J. Wyneken (editors). 2002. *The Biology of Sea Turtles Vol. II*. CRC Press, Boca Raton, Florida. ISBN: 0849311233

K. A. Bjorndal (editor). 1982. *Biology and Conservation of Sea Turtles*. Smithsonian Institution Press, Washington. (Note: reprinted in 1995) ISBN: 1560986190

K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly (editors). 1999. *Research and Management Techniques for the Conservation of Sea Turtles*. IUCN/SSC Marine Turtle Specialist Group Publication No. 4, 1999 (online version of all chapters available here: <http://www.iucn-mtsg.org/publications/> - click on the blue cover halfway down the page).

Bolten, A.B. and B.E. Witherington. 2003. *Loggerhead Sea Turtles*. Smithsonian Books, Washington DC ISBN: 1588341364

J.R. Spotila. 2004. *Sea Turtles: A Complete Guide to Their Biology, Behavior, and Conservation*. Johns Hopkins University Press, Baltimore ISBN: 0801880076

Gulko, D. and K.L. Eckert. 2004. *Sea Turtles: An Ecological Guide*. Mutual Publishing ISBN: 1566476518.

Rathmell, D. and B.J. Bergwerf. 2005. *Carolina's Story: Sea Turtles Get Sick Too!* Sylvan Dale Publishing ISBN: 0976494302

Davidson, O.G. 2001. *Fire in the Turtle House: The Green Sea Turtle and the Fate of the Ocean*. PublicAffairs ISBN: 1586480006

Sweet, M. and M. Sweet. 2005. *Hawaiian Sea Turtles*. Pacifica Island Art ISBN: 0975872125.

APPENDIX II

**KEY FOR IDENTIFYING SEA TURTLE SPECIES
IN THE WESTERN NORTH ATLANTIC**

A. Shell black and leathery with longitudinal ridges:
-----**LEATHERHBACK**-----



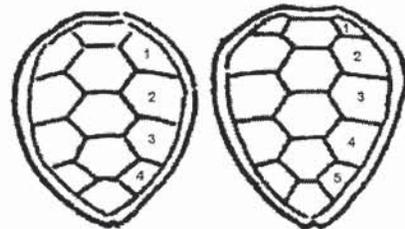
A. Shell not black and is hard-----B.



B. Costal (lateral) scute pairs usually 4-----C.

B. Costal (lateral) scute pairs 5 or more -----D.

C. Two large scutes (one pair) between eyes, shell smooth, mouth normal, shell color light brown with starburst patterns, top of flippers and head light brown in color -----**GREEN**-----

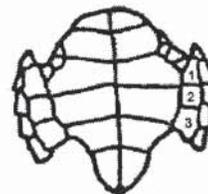


C. Four scutes (2 pairs) between eyes, scutes overlapping on carapaces, shell dark brown with light brown blotches. Top of flippers and head dark to black -----**HAWKSBILL**-----



D. Lower shell (plastron) has 3 inframarginals, colors of upper shell (carapace), head and flippers are reddish brown -----**LOGGERHEAD**-----

D. Lower shell (plastron) has 4 inframarginals with pores, upper shell (carapace), head, and flippers are greenish gray or dark gray-----E



E. Costal (lateral) scutes usually 5 pairs
-----**KEMP'S RIDLEY**-----



E. Costal (lateral) scutes usually 6 or more
-----**OLIVE RIDLEY**-----

APPENDIX III

FAQ (Frequently Asked Questions)
experienced on the beach by volunteers, with recommended answers:

Concerning nest excavation:

Q. Why do some eggs not hatch from the nest?

A. Most eggs are fertilized and viable when laid. However, during the approximately 60 days of incubation, there are many environmental factors that can arrest development of the eggs. These include: temperature extremes (especially for those eggs closest to the surface of the sand), bacterial or fungal attack, predation by crabs or insects, tidal inundation, accidental trampling of the nest, plant roots.

Q. What is the average clutch size?

A. The average number of eggs per nest for loggerheads is about 110 eggs, although as many as 198 eggs in one nest were seen in North Carolina. For green turtles, it is about 120 eggs. For leatherbacks, the average number of eggs is about 80, not including the 20 or so small, yolkless eggs common to this species.

Q. How long does it take for the eggs to hatch?

A. It takes around two months, but the exact time depends on the temperature of the sand: warmer sand means faster incubation.

Q. How many of the hatchlings will survive?

A. Good question! This is one of the mysteries of sea turtles, although most people assume it is somewhere around 1 out of every 1000 hatchlings will make it to adulthood.

Q. How can you tell what the sex is?

A. You can't just by looking at them. In fact, sea turtles do not have sexually dimorphic sex chromosomes, so you can't even tell by looking at their genes. The sex of sea turtles is determined by incubation temperature of the eggs: warmer temperatures produce more females, cooler temperatures produce more males. In NC, the "pivotal temperature" (the temperature that produces 50% of each sex) is about 29.25 °C (or 84.65 °F).

Q. Where do the hatchlings go once in the ocean?

A. It isn't entirely known, because there are very few observations of sea turtles between the stages of hatchling and "dinner-plate" size. Once they reach this size, they are seen in the waters around Macaronesia (Cape Verde, Canary, Azores, and Madeira islands). It is assumed that before arriving there, the small turtles float passively along major North Atlantic currents, near the Sargasso Sea.

Concerning nesting females:

Q. How old is the nesting turtle?

A. Nobody knows for sure, since they are not marked when they leave the beach as hatchlings. Some researchers think that it takes about 30 years minimum for loggerheads to reach the age of maturity, although any nesting female may be older

than that. For green turtles, minimum age of maturity in the wild is around 30 years. For leatherbacks, it seems to be much shorter: ~10 years.

Q. Why is she crying?

A. Their “tears” are part of their means of exuding excess salt that accumulates from drinking seawater. They “cry” all the time, including in the water, but it is just more difficult to see the tears underwater.

Q. Does she come back to guard the eggs?

A. No. Once the female is finished covering, she will leave the eggs to their fate on the beach. Under normal conditions, the eggs should successfully produce hatchlings, although some predators or weather conditions can reduce hatching success.

Q. How often do the females lay eggs?

A. Usually, loggerheads and green turtles can lay several nests in one season, but they do not usually reproduce in consecutive years. Leatherbacks can lay up to 12 nests in one season, but they also do not nest in consecutive years. Kemp’s ridleys usually nest a few times, often in consecutive years.

Q. Where do they go between this nest and the next one they lay?

A. They will make nests every two weeks or so during the nesting season, and between nesting events they usually pick a spot offshore and remain there, mostly inactive, until it is time to nest again. Between nesting seasons, they can migrate long distances to feeding grounds. Several loggerhead females from NC have been tracked after their last nest of the season, and most went to the Chesapeake Bay for several weeks before moving south during the winter. Most adult female loggerheads appear to remain close to the Atlantic seaboard of the US.

Concerning stranded turtles:

Q. Can you tell what caused the death of a turtle?

A. Actually, it is easier to rule out possible causes of death than identify the precise mortality factor. Turtle deaths in NC waters can be the result of various factors, including accidental capture by fishing nets or lines, boat strikes, accidental capture by dredging boats, ingestion of marine debris or pollution. Some sea turtles that are sick or injured also end up beached on land, and these turtles can undergo treatment at the Karen Beasley Sea Turtle Hospital on Topsail Island or the NEST Rehabilitation Center on Manteo Island.

Q. Can I take home a piece of shell or a part of the skeleton?

A. All sea turtles in the US are protected by federal law, and it is against the law to possess any live turtles or their parts, unless you have a permit that specifically says that you can hold on to parts of sea turtles.

Q. If I see a dead or injured sea turtle on my beach, what should I do?

A. Please call your local police department; they will know who to contact. In fact, if you see any dead or injured marine mammals (dolphins, whales, seals) or other wildlife, please contact your local police department.

APPENDIX IV

INSTRUCTIONS ON FILLING OUT A STRANDING FORM

OBSERVERS FULL NAME: This is the person who handled the turtle in the field. Please include your middle initial if you have one. Records are partially indexed by observers' initials.

STRANDING DATE: This is the date the stranded turtle was first reported or encountered. If you did not investigate until a later date, please make this known in the remarks section.

ADDRESS/AFFILIATION and AREA CODE/PHONE NUMBER: Because we may need to contact you for clarification of the reported data, please give us an address and phone number where we can most easily reach you.

TURTLE NUMBER BY DAY: This is used to keep track of more than one turtle investigated on a single day by the same individual. Your first turtle of the day is 01, second of same day is 02, etc.

PHOTOS TAKEN?: Check YES if photos were taken of the stranded turtle. You are encouraged to take photos and submit them with the stranding form or via e-mail.

SPECIES VERIFIED BY STATE BIOLOGIST?: If the species was verified by the Sea Turtle Project Biologist and/or Assistant Biologist, check yes; if not, check no.

SEX: This will most often be undetermined, as immature sea turtles cannot be sexed externally. If you circle male or female, please measure the portion of the tail that extends beyond the carapace's posterior tip and record the measurement in the adjacent blank (for adult turtles only).

HOW WAS SEX DETERMINED?: If sex was determined by necropsy, please check "necropsy". If you circle male or female and do not give a reason, we must code the sex as undetermined.

STATE: Enter "NC".

COUNTY: Enter the county where the turtle stranded.

LOCATION: Please be as specific as possible and use a reference point that can be found on a NOAA navigation chart. Local names or landmarks not found on most charts do not help us pinpoint a location. Good reference points are inlets, fishing piers, cape points, light houses, watertanks, etc. Also, indicate if the stranding was inshore or on the ocean beach. Keep in mind, the stranding location is one of the most important data items on the form.

LATITUDE/LONGITUDE: If you are familiar with latitudes and longitudes and you have a navigation chart (or GPS unit), please include the latitude/longitude of the stranded turtle. Positions are coded to the nearest tenth of a minute (e.g. 34° 42.8 minutes N and 76° 36.3 minutes W). LORAN positions can be converted, but it will speed data entry if you give the lat/long instead. If you cannot provide accurate lat/longs, please leave these spaces blank. It then becomes even more important to give a good location description that can be pinpointed on a chart.

CONDITION OF TURTLE: If the turtle seems intermediate between two stages of decomposition, pick the one that fits best. If you specify two conditions, we will pick one without seeing the turtle you are reporting.

FINAL DISPOSITION OF TURTLE: Check the most appropriate box to indicate what you did with the turtle. If the carapace was painted, please indicate what color paint was used. If samples were taken from the turtle, please note what exactly

was taken under code 3 (salvaged) and also note what was done with the remainder of the carcass.

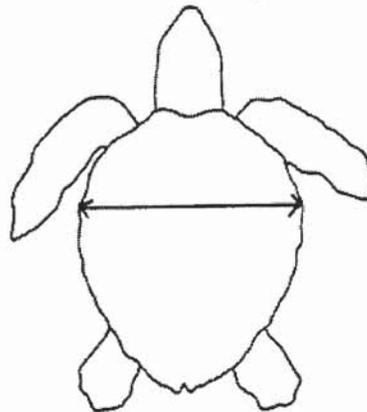
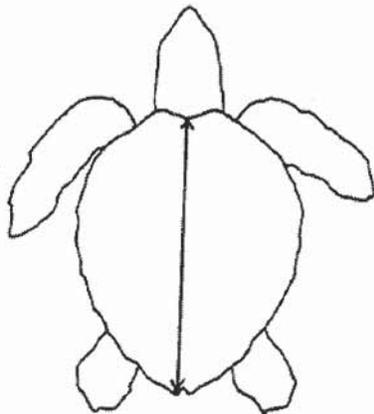
TAG NUMBER(S): Record any metal tag numbers (if found) and the flippers they were found on. Be sure to write down the return address on the back side of the tag. If PIT tag scanner is available, carefully scan front flippers and shoulders and record any positive ID numbers. If living tags are present, record the scute location (and take a photo if possible). Check "NO" for Coded Wire Tag Scan (there is only one magnetometer available, and it is used by fisheries observers). If the turtle is a tagged, live stranded animal, leave the tags in place. If the tagged animal is dead, carefully cut the tags from flippers with a knife and send them with the front flippers to the Sea Turtle Project Biologist, along with the completed stranding report.

REMARKS: This space is for your notes. The more information you include, the easier it will be for us to code the record. Use the back of the data sheet to continue your remarks if needed. Note anything unusual about the stranding; some of the more common anomalies are listed on the sheet. ***IF NO ANOMALIES WERE FOUND, WRITE THIS DOWN.*** Use the diagrams in the lower left hand corner to indicate flipper damage, wounds, tag locations or anything else you want to note about the turtle.

MEASUREMENT BOX: Enter the measurements in the correct blanks (straight and/or curved length and width). Be sure to circle the units you used as centimeters (cm) or inches (in). We strongly encourage all stranding network participants to take measurements in centimeters. In order to standardize measurements, please measure according to the method explained on the following page. Note that only straight-line measurements taken with tree calipers will be accepted. Many of the stranding volunteers will be able to provide only accurate over-the-curve measurements taken with a tape measure (see measuring instructions in Appendix V). If your measuring method differs from the one described, please write down how you measured the turtle.

APPENDIX V

Standardized method for measuring carapace and width



Carapace length

Straight length (SCL) = measured with calipers:

Curved length (CCL) = measured with flexible measuring tape

NOTCH-TIP = distance from the center of the nuchal notch to the longest tip of the posterior marginal scute.

NOTCH-NOTCH = distance from center of nuchal notch to posterior notch

Carapace width

Straight width (SCW) = measured with calipers:

Curved width (CCW) = measured with flexible measuring tape

Curved width is always the widest point across the plastron perpendicular to the midline of the body running from head to tail.

Note: For curved measurements, lay measuring tape OVER any barnacles or other epibionts (i.e. do not go around barnacles and do not knock them off).

For leatherback turtles, lay a sufficiently long measuring tape from nuchal notch to the tapering end of the carapace (the "peduncle"), on either the left or right side of the central keel of the carapace.

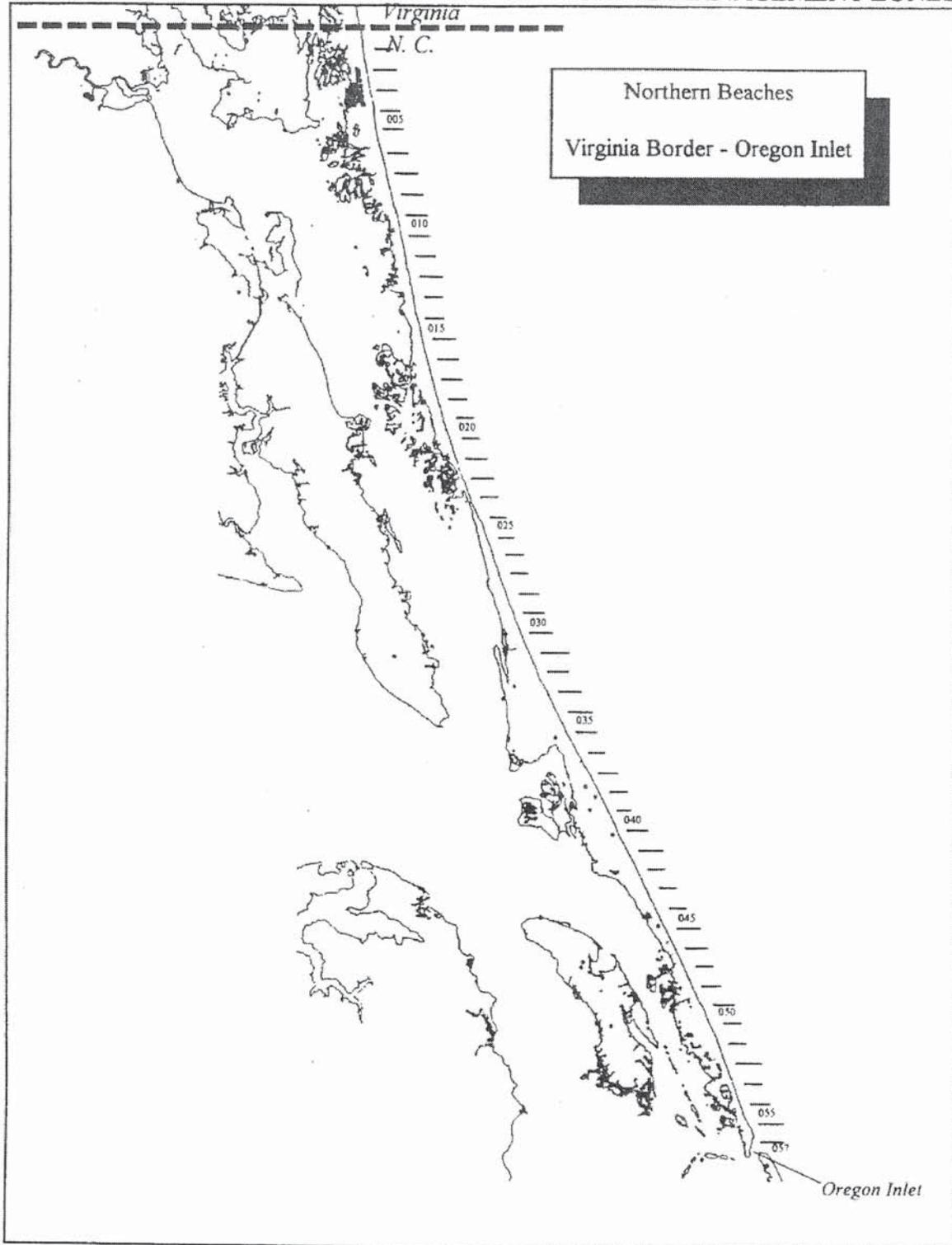
APPENDIX VI

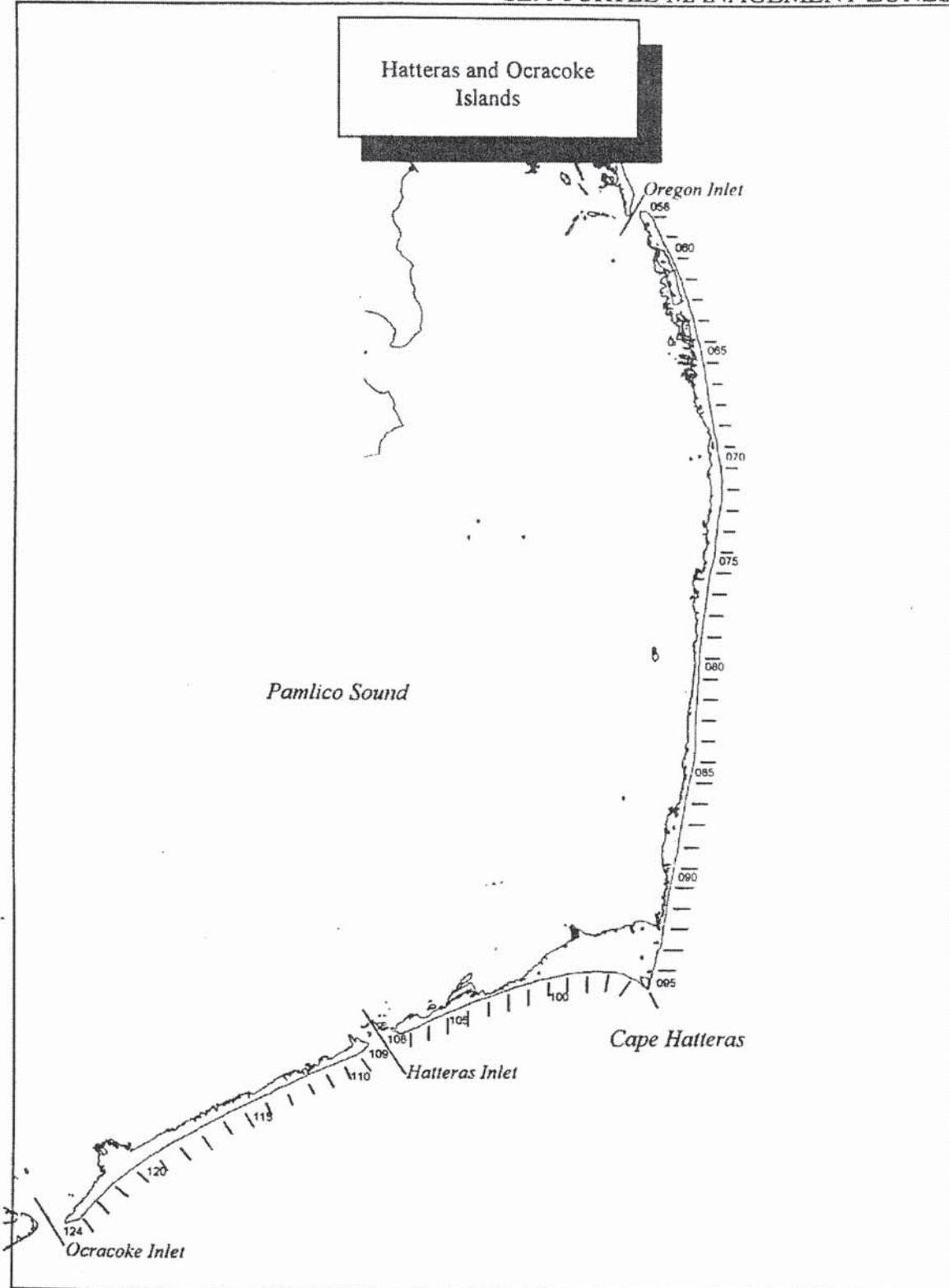
SEA TURTLE MANAGEMENT ZONE DESIGNATIONS

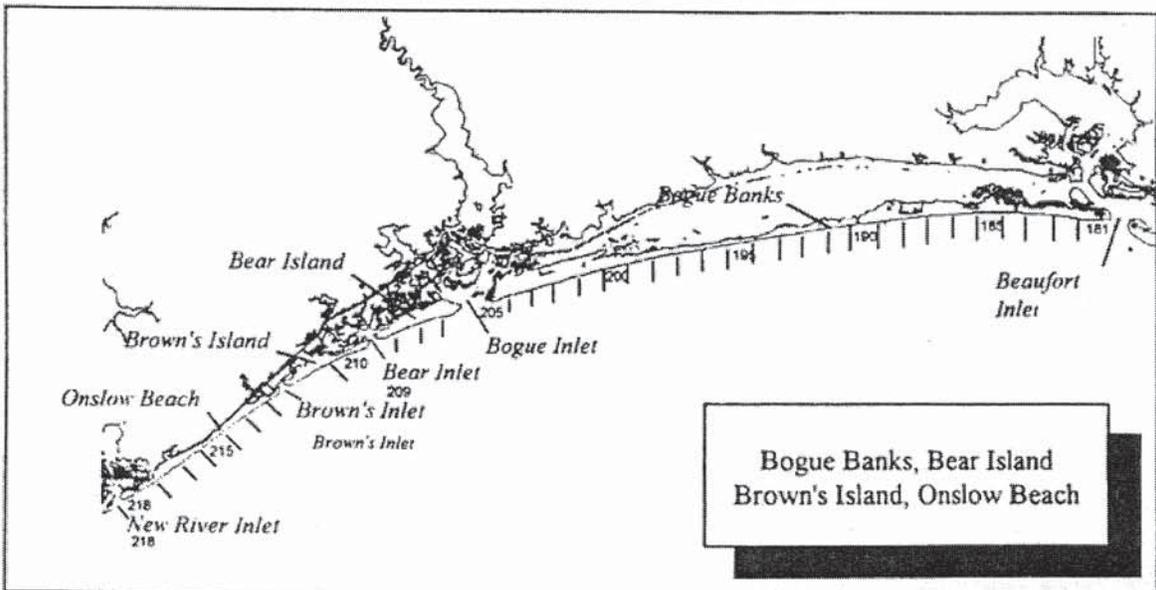
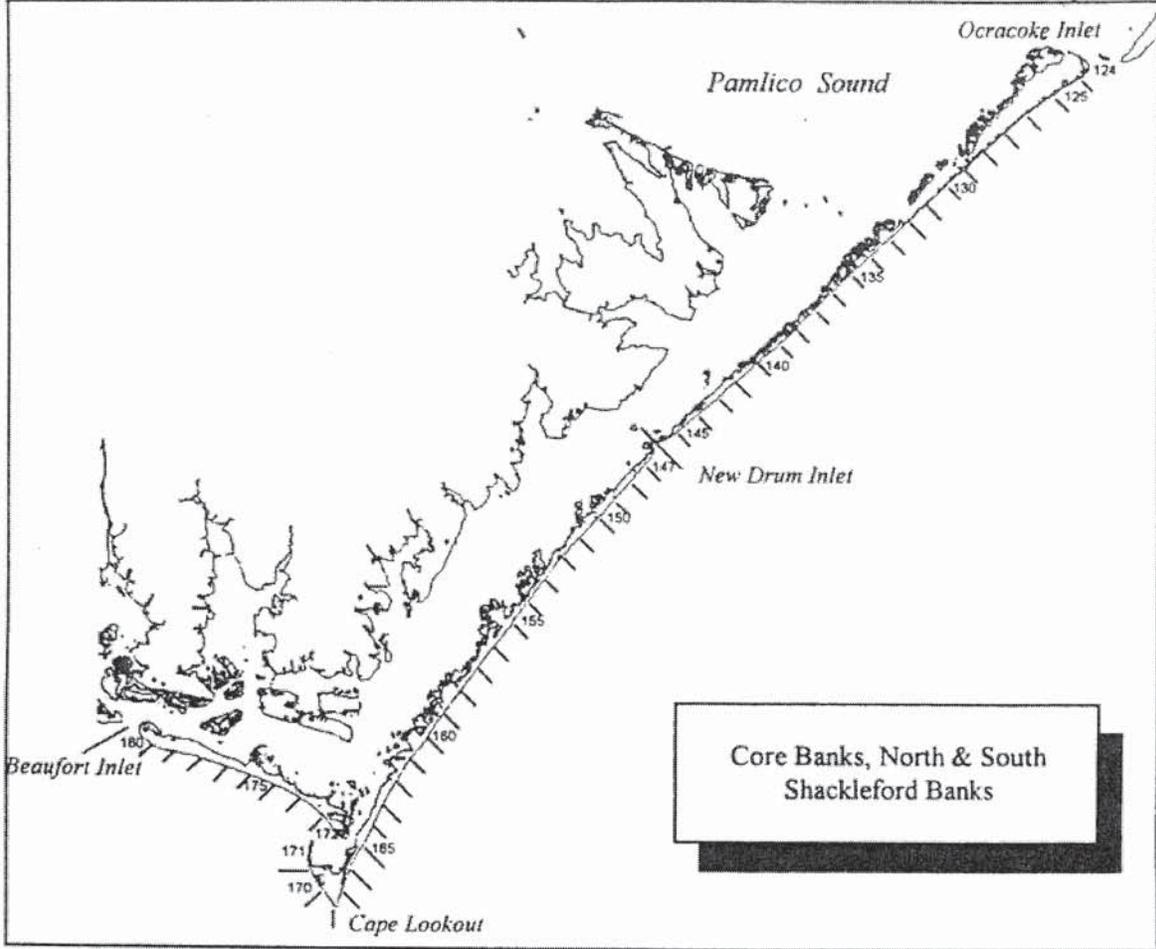
North Carolina Wildlife Resources Commission Coastal Faunal Diversity Program

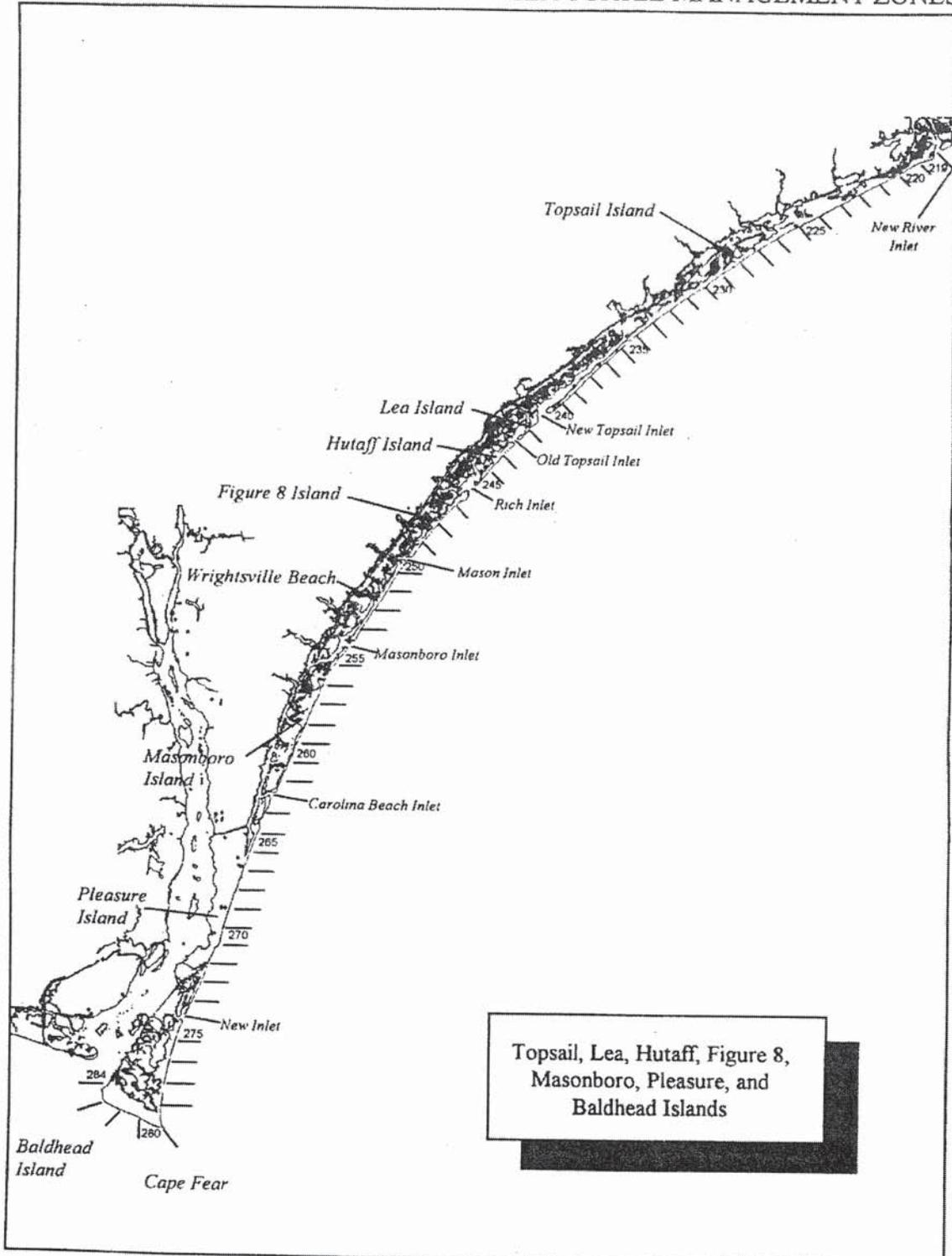
Zones for reporting sea turtle nests have been established throughout the coast of North Carolina. Zones are one-mile segments of beach numbered sequentially from North to South and/or East to West. These zones should be used in reporting all sea turtle nests in North Carolina. The following are zone designations according to beach divisions (barrier islands).

Beach Division	N or E limit	S or W limit	Start	End
Northern Beaches	VA line	Oregon Inlet	1	57
Hatteras Island	Oregon Inlet	Hatteras Inlet	58	108
Ocracoke Island	Hatteras Inlet	Ocracoke Inlet	109	124
Core Banks North	Ocracoke Inlet	New Drum Inlet	125	146
Core Banks South	New Drum Inlet	Barden Inlet	147	171
Shackleford Banks	Barden Inlet	Beaufort Inlet	172	180
Bogue Banks	Beaufort Inlet	Bogue Inlet	181	205
Bear Island	Bogue Inlet	Bear Inlet	206	209
Brown's Island	Bear Inlet	Brown's Inlet	210	211
Onslow Beach	Brown's Inlet	New River Inlet	212	218
Topsail Island	New River Inlet	New Topsail Inlet	219	240
Lea Island	New Topsail Inlet	Old Topsail Inlet	241	242
Hutaff Island	Old Topsail Inlet	Rich Inlet	243	245
Figure Eight Island	Rich Inlet	Mason Inlet	246	249
Wrightsville Beach	Mason Inlet	Mansboro Inlet	250	254
Mansboro Island	Mansboro Inlet	Carolina Beach Inlet	255	262
Pleasure Island	Carolina Beach Inlet	New Inlet	263	274
Bald Head Island	New Inlet	Cape Fear River	275	284
Oak Island	Cape Fear River	Lockwoods Folly Inlet	285	297
Holden Beach	Lockwoods Folly Inlet	Shallotte Inlet	298	305
Ocean Isle	Shallotte Inlet	Tubbs Inlet	306	311
Sunset Beach	Tubbs Inlet	Mad Inlet	312	313
Bird Island	Mad Inlet	Little River Inlet	314	314









APPENDIX VIII

INDIVIDUAL CRAWL RECORD

CRAWL DATE: _____ (for all crawls discovered *after* midnight, enter the date the crawl was found. For all crawls found/reported *before* midnight, enter the next day's date.

CRAWL TYPE (check one): =FALSE CRAWL or =NEST

SPECIES (check one): Loggerhead Green turtle Leatherback Kemp's ridley

CRAWL NUMBER: _____

TREATMENT (check one)

	=0-No treatment
	=1-Relocated
	=2-wired in place
	=3-Relocated and wired

CRAWL LOCATION: _____

CRAWL WAS FOUND IN SEA TURTLE NEST MANAGEMENT ZONE _____

CRAWL LATITUDE _____ LONGITUDE _____ WAYPOINT # _____

RELOCATED NEST LOCATION: _____

REL. SITE LATITUDE _____ LONGITUDE _____ WAYPOINT # _____

REASON FOR MOVING NEST _____

NUMBER OF EGGS RELOCATED: _____ NEST DEPTH _____ in./cm.

TRANSPONDER BALL BURIED WITH NEST? Y / N _____ TIME NEST WAS MOVED _____

TIDAL INNUNDATION				
Enter "Y" if nest was washed by the tide, enter "N" if nest was not washed by the tide for each day during incubation.				
Day 1	Day 21	Day 41	Day 61	Day 81
Day 2	Day 22	Day 42	Day 62	Day 82
Day 3	Day 23	Day 43	Day 63	Day 83
Day 4	Day 24	Day 44	Day 64	Day 84
Day 5	Day 25	Day 45	Day 65	Day 85
Day 6	Day 26	Day 46	Day 66	Day 86
Day 7	Day 27	Day 47	Day 67	Day 87
Day 8	Day 28	Day 48	Day 68	Day 88
Day 9	Day 29	Day 49	Day 69	Day 89
Day 10	Day 30	Day 50	Day 70	Day 90
Day 11	Day 31	Day 51	Day 71	
Day 12	Day 32	Day 52	Day 72	
Day 13	Day 33	Day 53	Day 73	
Day 14	Day 34	Day 54	Day 74	
Day 15	Day 35	Day 55	Day 75	
Day 16	Day 36	Day 56	Day 76	
Day 17	Day 37	Day 57	Day 77	
Day 18	Day 38	Day 58	Day 78	
Day 19	Day 39	Day 59	Day 79	
Day 20	Day 40	Day 60	Day 80	

Total number of days nest was washed over:

SEA TURTLE STRANDING AND SALVAGE NETWORK – STRANDING REPORT

OBSERVER'S NAME / ADDRESS / PHONE:
 First _____ M.I. _____ Last _____
 Affiliation _____
 Address _____

 Area code/Phone number _____

Year 20__ __ Month __ __ Day __ __
 Turtle number by day __ __

 State coordinator must be notified within 24 hrs;
 this was done by phone (252)725-5328
 email (wmc3@vol.com)

SPECIES: (check one)
 CC = Loggerhead
 CM = Green
 DC = Leatherback
 EI = Hawksbill
 LK = Kemp's ridley
 UN = Unidentified
 CHECK UNIDENTIFIED IF NOT POSITIVE: DO NOT GUESS
 PHOTOS TAKEN? YES NO
 Species verified by Project Biologist? YES NO

SEX: (check one)
 Undetermined
 Female Male
 How was sex determined?
 Necropsy
 Tail length (adult only)
 Length of tail beyond carapace _____ cm / in

STRANDING LOCATION: Offshore (Atlantic or Gulf beach) Inshore (bay, river, sound, inlet,
 State _____ County _____
 Location (be specific): _____

 LATITUDE: _____ LONGITUDE: _____

CONDITION (check one)
 0 = Alive
 1 = Fresh dead
 2 = Moderately decomposed
 3 = Severely decomposed
 4 = Dried carcass
 5 = Skeleton, bones only

FINAL DISPOSITION:
 1 = Left on beach where found; painted? Yes* No(5)
 2 = Buried: on beach / off beach;
 carcass painted before buried? Yes* No
 3 = Salvaged: all / part(s), what/why? _____

 4 = Pulled up on beach/dune; painted? Yes* No
 6 = Alive, released
 7 = Alive, taken to rehab. facility, where? _____

 8 = Left floating, not recovered; painted? Yes* No
 9 = Disposition unknown, explain _____

 *If painted, what color? _____

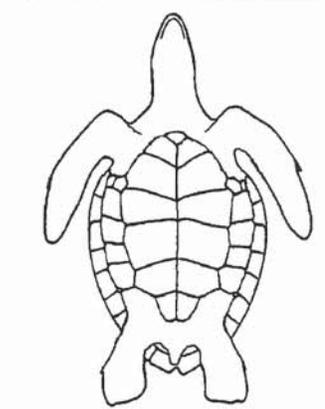
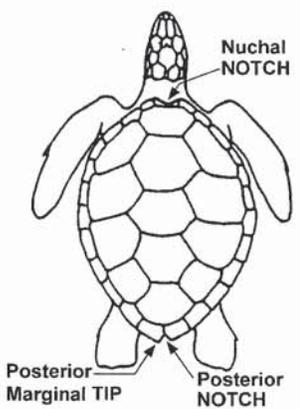
TAGS: CONTACT STATE COORDINATOR BEFORE DISPOSING OF ANY TAGGED ANIMAL
 Flipper tags present? Yes No
 Check all 4 flippers. If found, record tag number(s) / tag location / return address

PIT tag scan? Yes No
 If found, record number / tag location

 Coded wire tag scan? Yes No
 If positive response, record location (flipper)

 Checked for living tag? Yes No
 If found, record location (scute number & side)

CARAPACE MEASUREMENTS (see drawing)
 Using calipers Circle unit
 Minimum length (NOTCH-NOTCH) _____ cm / in
 Straight width (Widest Point) _____ cm / in
 Using non-metal measuring tape Circle unit
 Curved length (NOTCH-TIP) _____ cm / in
 Minimum length (NOTCH-NOTCH) _____ cm / in
 Curved width (Widest Point) _____ cm / in
 Circle unit
 Weight actual / estimated _____ kg / lb



Mark wounds / abnormalities on diagrams at left and describe below (note tar or oil, gear or debris entanglement, propeller damage, epibiota, papillomas, emaciation, etc.). **Please write down something, even if no wounds / abnormalities are found.**
