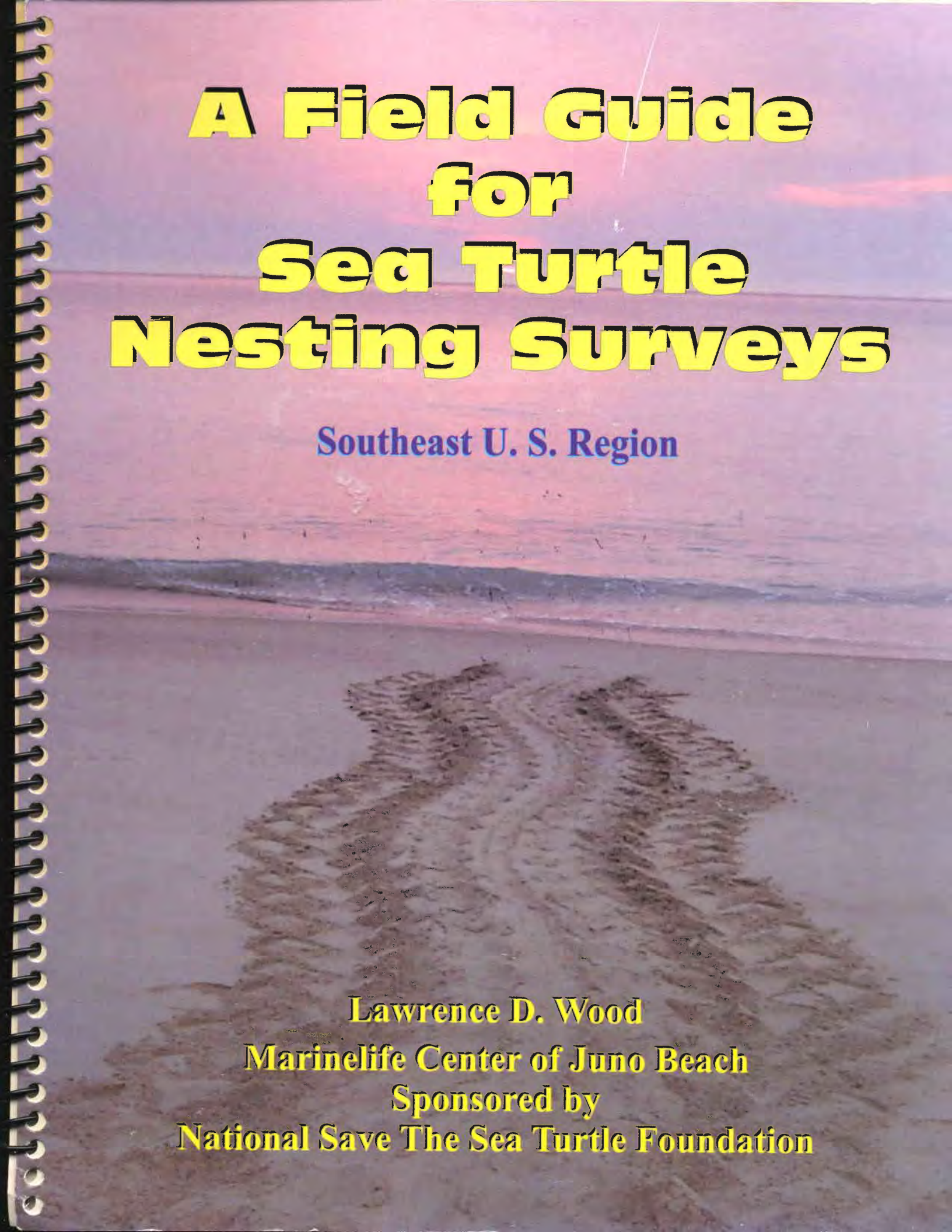

# A Field Guide for Sea Turtle Nesting Surveys

## Southeast U. S. Region

Lawrence D. Wood
Marinelife Center of Juno Beach

Sponsored by
National Save The Sea Turtle Foundation

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SAVE THE SEA TURTLE
FOUNDATION

INTERNATIONAL
SAVE THE SEA TURTLE, SA

The National Save the Sea Turtle Foundation and the International Save the Sea Turtle Foundation, S.A. are proud to have participated in the production, publishing and distribution of *A Field Guide for Sea Turtle Nesting Surveys* by Lawrence D. Wood.


# Our Goal

## Education The Primary Goal

It is our hope that through education we can help guarantee that the children of tomorrow can enjoy the wonderful benefits of the natural environment that our children enjoy today. Many species of marine life have already become extinct. Gone forever. Our education programs concentrate on marine life, but we also support legitimate organizations, schools, and groups involved in efforts to save our oceans, reefs and beaches. It is our responsibility as human beings to provide future generations with the same wonders of nature that we enjoy and unfortunately have taken for granted.

## Protection Preserving The Fragile Ecosystem

Sea turtles are an endangered or threatened species of marine life. Sea turtle populations have been seriously reduced worldwide through a number of human influences. Breeding populations of adult sea turtles have been diminished by capture for meat, eggs, leather, oils and tortoise shell jewelry. Our developed coastal areas have eroded natural nesting habitats. The mortality rate from long line fishing, shrimping, discarded nets, fishing line, pollution and powerboat injuries has taken its toll.

The Federal Endangered Species Act passed in 1973 states that "no person may take, harass, harm, hunt, pursue, shoot, wound, kill, trap, capture, or attempt to engage in any such conduct to marine turtles, turtle nests, and/or turtle eggs." We sponsor, fund, support and participate in sea turtle research and protection programs.

## Awareness Keeping Our Issues In The Public Eye

Founded in 1987 as a conservative organization established to work toward assuring the survival and recovery of the world's marine life and sea turtle population, we have accepted our mission and set our goals. The members, staff and volunteers of the National Save The Sea Turtle Foundation are constantly working and contributing to the efforts of our many public awareness programs.

**NSTSTF plans to accomplish its goals by providing funds and facilities to:**

1. *SUPPORT* scientific research on physiology, ecology, and management.
2. *PROVIDE* information to the public and management authorities to help them establish effective conservation and public awareness programs in this area.
3. *PROMOTE* public awareness and education programs through cooperation with organizations and individuals who share our objectives.

1987 NATIONAL SAVE THE SEA TURTLE FOUNDATION 17 YEARS 2004

**NATIONAL SAVE THE SEA TURTLE FOUNDATION**
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# A Field Guide for Sea Turtle Nesting Surveys

## Southeast U. S. Region

by Lawrence D. Wood

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# Table of Contents

# Introduction


Lawrence D. Wood

I'll never forget the day, just a few weeks after I started working at the Marinelife Center, that my new boss took me to the messy garage "out back" and showed me the old, rickety three-wheeled cycle that would be my transport to conduct something called sea turtle nesting surveys. Little did I know how well I would get to know that machine, and believe it or not, I still have a rusty old ATC on site, though it doesn't see the action it used to in today's world of water-cooled, fully automatic, four-wheel-drive ATV's. After figuring out how to repair and subsequently ride that little red bike, I had to figure out how to tell turtle tracks from the myriad of footprints, piles, holes, and vehicle tracks that are always present on our beach. So off I went to visit with esteemed turtle surveyor Eric Martin in Jensen Beach who took me out on his survey area to show me these mysterious tracks, but to no avail. Too early in the season, no nests that day. I remember asking him what a turtle track *would* look like if one *was* there, and he did his best to illustrate in the sand. Since then, I've seen a few tracks. I have been fortunate to survey the busy beaches of Juno and Jupiter for many years, and have seen just about every imaginable variation on the nesting theme. The sometimes arribada-like nesting that occurs on these beaches make wonderful training grounds for turtle surveyors, and I have had the pleasure of taking many out to our beach to learn 'the ropes'. Thus the idea for this manual.

It is hoped that this publication will be a useful resource to both trainers and trainees of nesting beach management. Projects vary from place to place; some new, some older, some with experts, some with newcomers. There will be new projects to come on beaches that are not yet studied, and activities will be added to some already underway. For those starting 'from scratch', I've included tips to get started that have worked well for organizations over the years. For more established projects, this manual can serve as a training tool that can be brought to the beach for quick reference. The information presented here is consistent with the Guidelines for Sea Turtle Nesting Surveys that have been developed by the Florida Fish and Wildlife Conservation Commission (FWC), and it is extremely important that all sea turtle projects coordinate their efforts closely with the appropriate regulatory agencies. This manual is intended to compliment, not replace, existing sources of official nest survey information, and permitted individuals in Florida should refer to FWC Guidelines for official permit requirements.

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Special thanks to reviewers Jeanette Wyneken, Paul Davis, Carly Pfistner, Eric Martin, Meghan Conti, Blair Witherington, Frank Wojack and Wayne Kurian; photographers Doug Perrine, Mark Conlin, Jeanette Wyneken, Anja Burns, Chris Johnson, the U. S. Fish and Wildlife Service and Sam Cassaro, Graphics.


Published by: The National Save The Sea Turtle Foundation, Inc.

# *How to Use This Manual*

The track and nest identification portion of this manual (pages 16-25) can be used as a dichotomous key, and are color coded by species. The two most basic, and most important, pieces of information to be gleaned from nest surveys are what kind of turtle left the track, and whether or not the crawl resulted in a successful nest. These questions are addressed sequentially in this manual, and the reader can follow the instructions given on each page for each species. The colored tabs in the upper right hand side of each page in this section represent different species; red for loggerhead, green for green, and black for leatherback turtles. These tabs allow the reader to quickly thumb to the pages that contain information or examples for the desired species.

**Loggerhead**

**Green**

**Leatherback**

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# *Who's Who of Atlantic Sea Turtles*

**Leatherback** ***(Dermochelys coriacea)***
Largest of sea turtles, listed as endangered June 2, 1970.

**Green** ***(Chelonia mydas)***
Hunted extensively for its meat, listed as endangered July 28, 1978.

Photo by Anja Burns

**Loggerhead** ***(Caretta caretta)***
Most active nester in Florida, listed as threatened July 28,1978.

Photo by Anja Burns

**Hawksbill** ***(Eretmochelys imbricata)***
Hunted extensively for its ornate shell, listed as endangered on June 2, 1970.

Photo by USFWS

**Kemp's Ridley** ***(Lepidochelys kempii)***
Rarest of all sea turtle species, listed as endangered December 2, 1970.

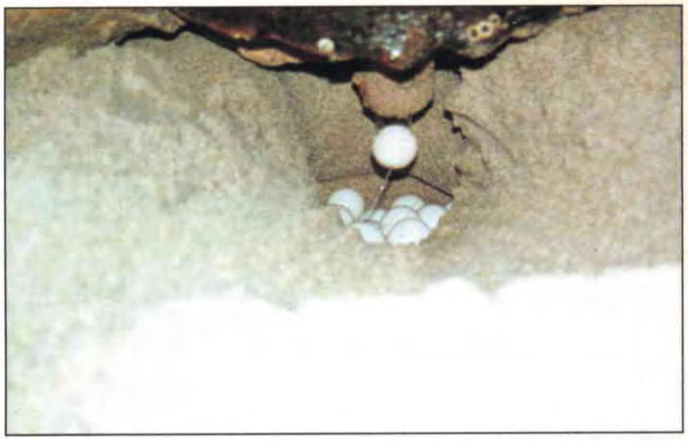
**Olive Ridley** ***(Lepidochelys olivacea)***
Not found in Florida waters. Listed as endangered July 28, 1978.

# *The Nesting Process*

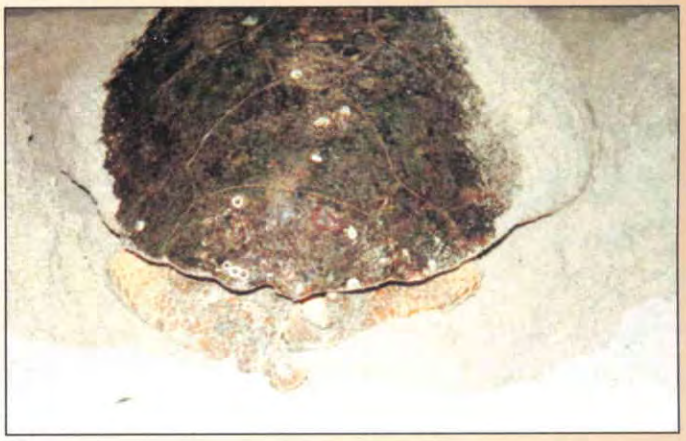
All sea turtle species proceed through a similar set of behaviors when nesting. A clear understanding of the process can be very helpful in crawl identification.

**Step 1: Coming ashore.** Turtles very cautiously emerge from the surf and begin to crawl up the beach. It is not unusual for the turtle to return to the water at this time without nesting.

**Step 2: Choosing a site.** The turtle first creates a "body pit" by pushing aside the soft, dry surface sand. She then uses her rear flippers to dig an egg chamber. The nest site typically will be between the high tide line and dune vegetation.



**Step 3: Laying eggs.** The turtle will typically deposit anywhere from 50 to 180 eggs into the chamber via a duct known as the ovipositor. The eggshells are pliable and well-lubricated.



**Step 4: Covering the eggs.** The turtle will scoop the sand she previously excavated back over the eggs, gently but firmly pressing the sand down as she goes.

**Step 5: Making the nest mound.** The turtle camouflages the nest by vigorously throwing sand behind her with powerful front flipper strokes.

**Step 6: Return to the water.** The turtle returns to the sea after completing the nest mound. She will most likely nest several times through the season, but not return for 1-4 years.

# *What You'll Need for Daytime Surveys*

The type of survey you are conducting will determine what supplies you'll need to get the job done efficiently. Some surveys can be "low-tech", while others require more sophisticated equipment.


## Suggested Equipment List:

| | |
|---|---|
| Camera | Insect repellent |
| Stakes | Magic markers |
| Spray paint | Water resistant paper |
| Flagging tape | Drinking water |
| Measuring tape | GPS machine/batteries |
| Mallet | First Aid Kit |
| Sunscreen | Clipboards |
| Pens/pencils | Rain gear |
| Medical gloves | Permits/data sheets |

Stranding/disorientation report forms

All Terrain Vehicles (ATV's) can be an important piece of equipment for surveys on long stretches of beach. Remember, however, that these vehicles can be dangerous to both the operator and the beach environment if not operated properly. Take some time for training, safety instruction, and practice.


*Hint:* ATV tracks can be handy for distinguishing between "new" and "old" turtle tracks. The ATV tracks "on top of" the turtle tracks (arrows) in the above picture tell us that the crawl was documented previously. Covering turtle tracks with ATV tracks is especially helpful on high-density nesting beaches.

# *Getting the Beach Ready*

It's a good idea to divide the beach into standard segments, which are referred to as "zones" or "reaches", which should be kept consistent through seasons. This way, the number of turtle crawls per area can be calculated and then compared with other nesting beaches from year to year. Standard distances such as miles, half-miles or kilometers are best. It can be helpful to further divide the zones into sub-zones for more accurate location references (e.g. "zone 2b" is more descriptive than just "zone 2") and for easier and closer measurements to nest stakes. Install markers or mark permanent structures (with permission) to establish your zones, and record their location with precise GPS or survey techniques. Hint: put important marker stakes in deep near the dune crest, they'll last longer.

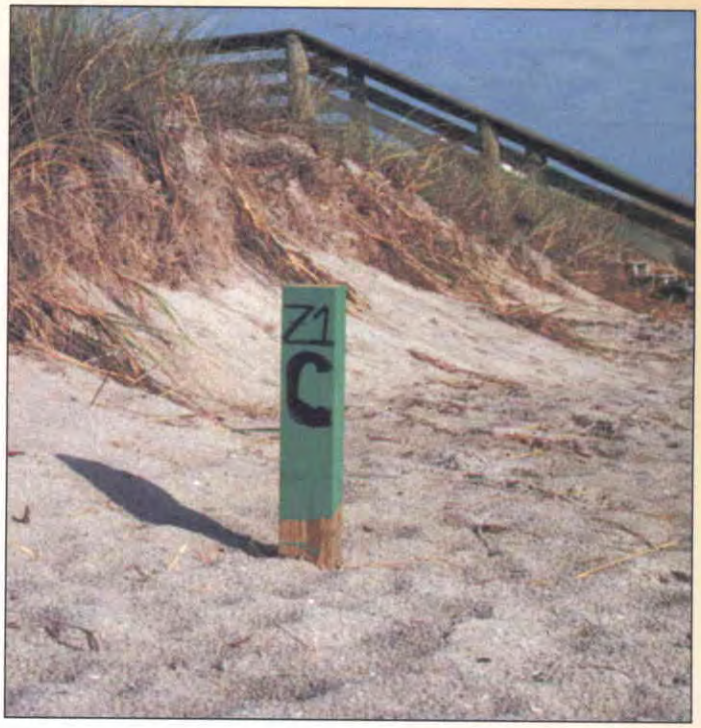
Man-made structures can serve as reference points on a beach, but more accurate zone dividers are preferable.


Large, conspicuous zone markers that can be seen from a distance make it easier to determine where you are on your beach.

## Quick Reference:

1 mile= 5,280 feet
1/2 mile = 2,640 ft.
1 mile = 1.609 KM
1 KM = 3,280.8 ft.
1 KM = 0.621 mile

Measuring wheels are handy for measuring zones, but can be inaccurate in the sand. Measure several times to ensure accuracy.




Wooden 4x4's placed deep in the sand are a relatively inexpensive way of delineating zones and sub-zones.

# *Organizing the Data*

Keeping track of the data collected on nesting surveys can be a big job, especially on very active beaches. There are two primary pieces of information that can be very helpful to identify individual nests: the species responsible and some sort of code unique to each nest. Just as nesting beaches and research efforts vary widely, so can the "codes" used by the individuals and organizations doing the work. Choose ones that make the most sense for you and your organization. The following example is used by the Marinelife Center on our nesting beach, and has worked well for many years.

There are three species that regularly nest in our region. Each marked nest is numbered sequentially either by species or by location. It is not necessary to label nests that will not be eventually evaluated.

## Loggerheads:

The loggerhead nests are categorized by half-mile zone, such that each marked nest is numbered sequentially **per zone.** Thus, the first loggerhead nest marked in zone 1 each year is called Z1-01. When we arrive in zone two, we start the count again, such that the first loggerhead nest marked in zone 2 is labeled Z2-01. This continues for all 11 of our zones. Subsequent marked nests in each zone are sequentially numbered from there, such that the second nest marked in zone 1 is labeled Z1-02, the second in zone 2 is Z2-02, etc., all the way through the season.

## Greens and Leatherbacks:

Since green and leatherback nesting numbers are much smaller each year, they are sequentially numbered as encountered, regardless of location. The latin acronym for each species is a convenient code, Cm representing greens, and Dc representing leatherbacks. They are then numbered Cm-01 (or Dc-01) through Cm or Dc- ??, the total for the season.

Each nest marked for evaluation can then be organized by species and/or location. Each nest has its own data sheet, which contains all of the information gathered for that nest throughout its incubation. See the sample data sheet on page 40.

The data can then be transferred to an electronic database of your choice for easy reporting or statistical analyses. Hint: written notes on the nest's progress should be kept on its data sheet, not in the database. Create disturbance codes in the database, such as a "predated" or "washed out" column with a Y/N or checked box corresponding to each nest's entry. This way, queries can be designed to quickly identify any desired set of impacts without having to find them one nest at a time. *Remember:* Nesting data can become very important to local conservation challenges, sometimes unexpectedly. Keeping the data well organized and safely stored can make "all the difference" when it's really needed.

# *Data Management*

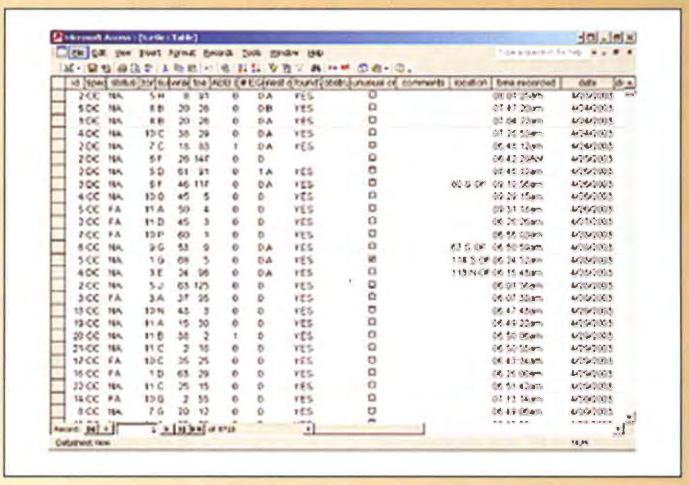
## Data, data, and more data!

Sea turtle research generates a lot of information (data)! The collection, storage and reporting of data is very important and is critical in the management of sea turtle nesting beaches and populations. The easiest and most efficient way to manage this data is through the use of a computer based data management system. A program such as Microsoft Access, Microsoft Excel or Apple's Filemaker software allows data to be easily input, queried, and exported with relative ease.

## Why use such a system?

- Many regulatory agencies now require data to be submitted in an electronic format.
- Data are easily checked, entered and verified.
- Data are valuable - need to be preserved for many years in the future.

Software allows fast reporting! - sea turtle researchers and conservation communities often need data in a timely manner to make management decisions.



Access database displaying turtle crawls

## Database Design:

An electronic data storage system can be as simple as an Excel file with tables representing crawls and excavation data or a relational database with many tables linked by common fields. The type of system used at the Marinelife Center is a relational database. Design can get more complex when you use a relational database, but the system allows maximum flexibility.

Whichever database program or system you use, the most critical step in using it is to design your database structure carefully. The way you structure your data will affect every other action. It will determine how easy it is to enter information into the database; how well the database will trap errors and exclude duplicate records; and how easily you will be able to get data out of the database. When database design is complete, be sure to design paper datasheets that mimic the format of the computerized system as this will ensure the ease of data entry, and reduce entry errors.

## Backing up and archiving:

Electronic data can be a lot easier and safer to backup and archive than paper datasheets. (Imagine having to make 2 or 3 copies of datasheets!) Data should be backed up in at least two locations daily, and archived off-site at least weekly. CD's, DVD's, and portable hard drives allow very fast and reliable backups which are easily stored in a safe place. Computers still do crash and often delete data - develop a backup strategy and stick to it!


Example of web based database system used by permit holders in Palm Beach County, Florida, USA

## Help and support links:

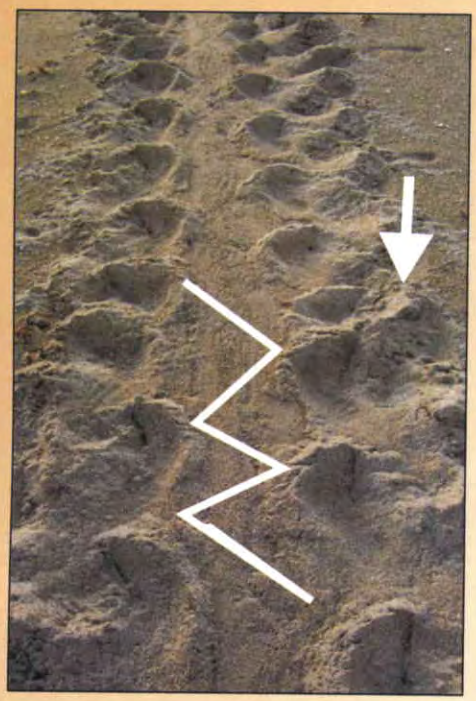
- http://www.filemaker.com - Filemaker software
- http://www.microsoft.com/office/access/default.asp - Microsoft Access software
- http://www.geekgirls.com/menu_databases.htm - nice introduction to database design and use

Countless books and websites devoted to database design

# *What Type of Turtle?*

***Different species leave different tracks.***

# Loggerhead



This turtle moved toward the bottom of the picture. Notice the alternating footfalls made by the rear flippers, and minimal front flipper tracks.

The tracks can appear "scrunched" when on a slope. They often retain the alternating appearance, helping with I.D.

This turtle moved toward the top of the picture. Drag marks are sometimes present from the tail or plastral barnacles.

Loggerhead turtles are the most common sea turtles to nest on the beaches of the southeast U. S. region. Approximately 85,000 loggerhead nests are tallied annually in the state of Florida alone. They use **alternating** footfalls as they move across the sand from and back to the water. The relatively short front flipper marks are almost completely covered by the rear flipper marks as the turtle moves forward. The rear flipper marks appear staggered, or alternating, across the track and resemble "commas" in the sand. The direction the turtle moved in can also be determined by the direction the sand was pushed by the flippers.

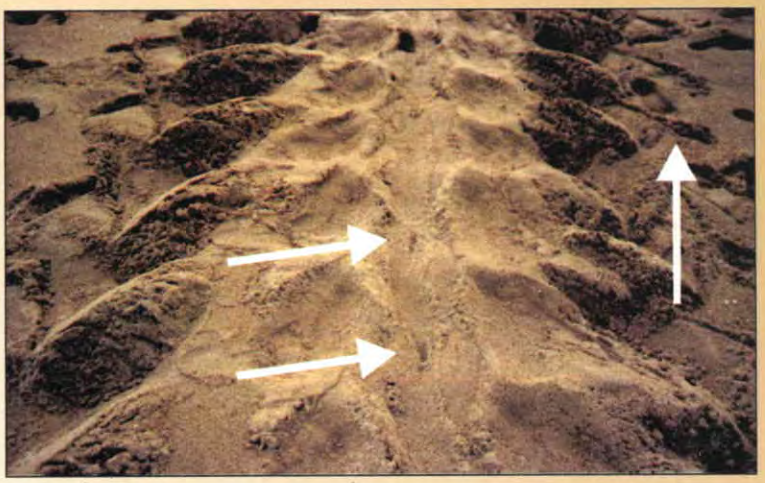
**Got loggerhead tracks?**

**Yes:** Go To Page 20 **No:** Go To **Next Page**

# *What Type of Turtle?*

## Green Turtles

Notice the symmetrical pattern to the track, and the prominent front flipper marks. This turtle was moving toward the top of the picture.



Notice the tail drag and "poke" (arrows) in the center of the track. This turtle was moving toward the top of the picture.

Green turtles move along the beach by pushing with all four flippers at the same time. The large front flipper marks are distinguishable from the rear flipper marks and appear **symmetrical**, *not* alternating or staggered like the loggerhead track. Green turtle track widths range from 95-144 cm (37.4 - 56.7 in.) and average about 119 cm (46.8 in.), and are commonly marked along the mid-line with small indentations from the tail dragging and poking the sand.

**Got green turtle tracks?**

**Yes:** Go To Page 23 **No:** Go To **Next Page**

# Leatherback

Leatherbacks leave symmetrical, non-alternating flipper marks in the sand, often with noticeable tail drag marks. This turtle was moving toward the top of the picture.

Leatherbacks often leave winding, curving tracks.

The tracks are much wider than those of green or loggerhead turtles, ranging from 5½ to 7 feet , plenty of room to fit an entire ATV or ATC within their width.

Leatherbacks are the largest turtle to nest on Florida's beaches, and therefore have the **largest tracks**, sometimes exceeding six feet in width. Leatherbacks, like greens, use all four flippers simultaneously to crawl along the beach, and leave **symmetrical**, *not* alternating flipper marks. Leatherbacks often leave curved, sinusoidal, and even circular paths, especially on the return to the water.

**Got leatherback tracks?**

**Yes:** Go To Page 25 **No:** Go To Page 16

# *What Type of Turtle? Confusing Tracks*

There are times when we come across tracks that are difficult to decipher. They are usually the result of a turtle that has deformed or missing flippers. How successful the turtle is at nesting can depend on the kind of injury or deformity. The characteristics of the crawl will also vary depending on which flipper(s) are abnormal. Use your best judgement on these given the clues that are available. Consider the time of year, the track width, and the body pit (if present) to help you determine what kind of turtle was responsible for the crawl.

This green turtle is missing its left rear flipper. Notice the "one-sidedness" of the track. Even if we hadn't seen the turtle, her nest mound revealed her species.

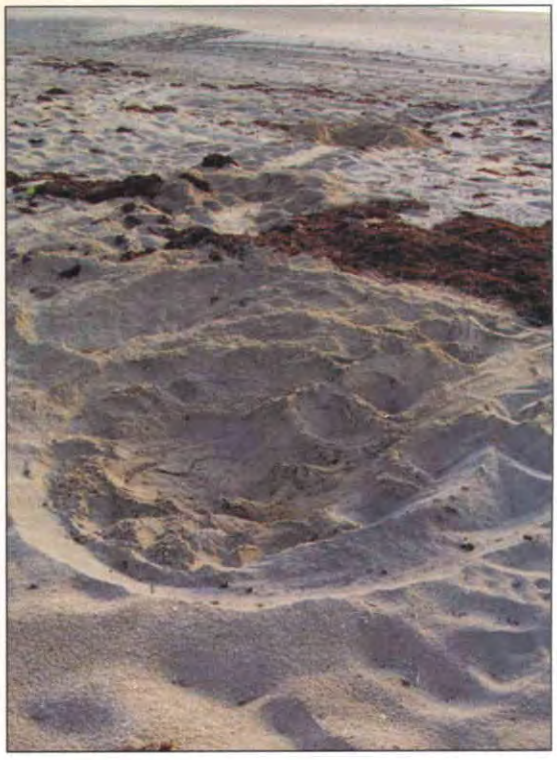
The track above is difficult to identify, it seems to have characteristics of both loggerheads and greens, with no nest area to provide extra clues. If you simply can't tell, mark it as "unknown" on your data sheet. Conversely, the photo to the right can be identified as a loggerhead with a partially missing right rear flipper.

# *Did She Nest?*

*Remember: Turtle nest mounds can come in a variety of shapes and sizes!*

# Loggerhead

Turtles may abort the nesting process at any stage of the process. Typically, however, if the turtle deposited eggs she will then perform a series of predictable behaviors. The nest site will have certain characteristics if the turtle performed those behaviors. The most revealing behavior is the creation of the nest mound. The turtle uses her front flippers to throw sand behind her on top of the egg clutch as she moves away from the egg chamber. This front flipper action leaves one mound of sand that is wider than the track itself, and sand that appears to have been misted or sprayed back by a powerful motion. The marks left by the turtle in the sand reveal clues to her behavior, and if examined carefully will enable us to accurately determine what the turtle did the night before.



These are typical nest sites of loggerheads. The nest mound and "borrow pit" are roughly circular in shape, and the sand appears to have been thrown backward.

**Is there a single mound of sand wider than the track with evidence of misted or thrown sand?**

**Yes: This is a nest**

**No: This is a non-nesting emergence**

**Not Sure?: Go To pages 21 & 22**

Some nest mounds appear long and skinny, but are still wider than the track itself.

# *Did She Nest?*

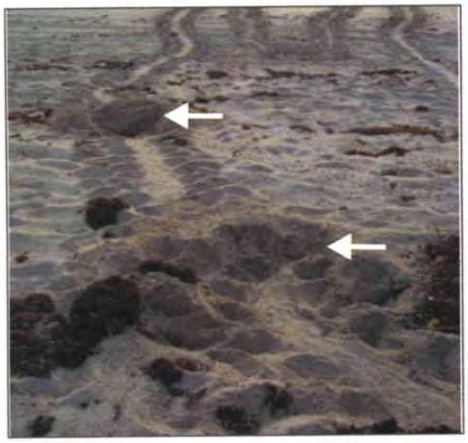
# Loggerhead

When turtles leave the water to nest, they may or may not complete the entire process. One of the more challenging parts of nesting research can be determining whether or not the turtle actually deposited eggs while she was on the beach.

Non-nesting emergences, known to many in the field as "false crawls", are not at all uncommon. False crawls typically represent 40% of the total number of emergences. Just like nests, false crawls come in a variety of shapes and sizes, some being easier to determine than others. False crawls can be categorized by how far into the process the turtle advanced before aborting the attempt.

If there is no evidence that the turtle stopped crawling or started creating a body pit before returning to the water, we can conclude that this was a "false crawl", or non-nesting emergence.

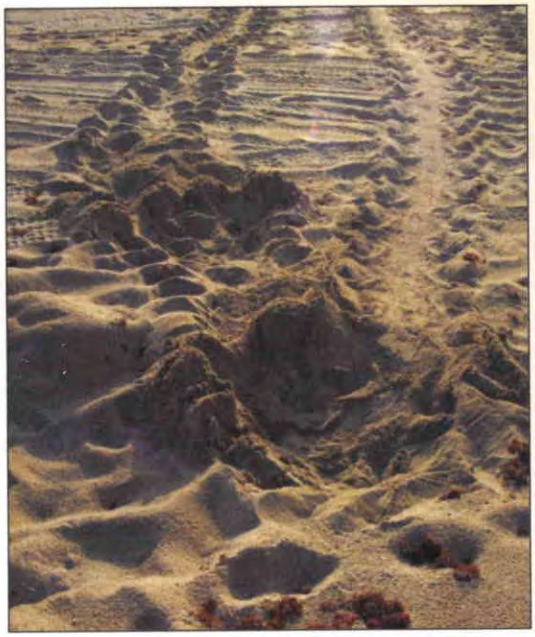
In order to eliminate tide cycle bias from the data, we do not count any crawls that do not cross the most recent high tide line.



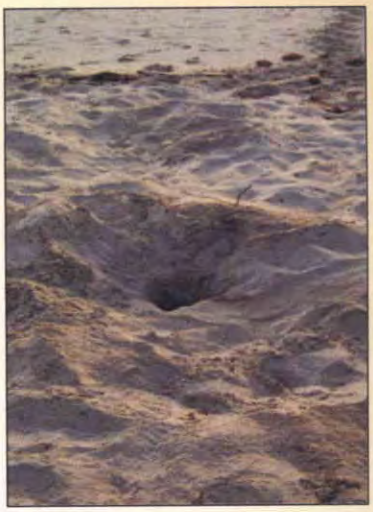
This turtle dug two body pits and started with egg chambers, but moved on without nesting in either one.

***Hint:*** a turtle will not dig another body pit nor move significantly landward after laying eggs.

Notice how the tracks of these loggerhead turtles do not exhibit evidence that the turtle did any digging at all. These turtles did not lay eggs.



No eggs here! Notice the lack of misted sand and no circular borrow pit.



Sometimes abandoned egg chambers can be mistaken for poached nests. The absence of post-nesting behavior and human activity (bucket, foot, or hand prints) rule out that possibility.

# *Did She Nest?*
## Loggerhead

Both of these photos depict **abandoned body pits,** where the turtle started to create the body pit/egg chamber, but **did <u>not</u> nest.** Notice the *lack* of circular body pit and misted sand.

**FALSE CRAWLS**

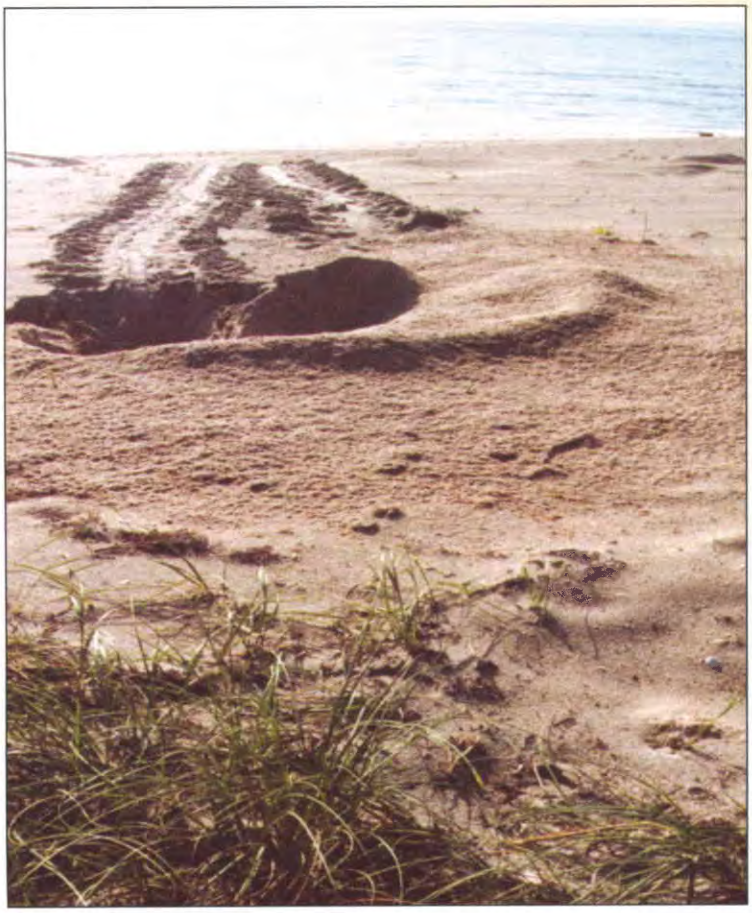
**NEST**

This crawl is unusual in that the turtle moved landward for a few feet after completing the nest mound. Even so, the wide area of thrown sand (arrow) gives it away as a successful nest. Be sure to take the time to look at the *entire* crawl before making a final determination.

# *Did She Nest?*
## Green Turtles

Green turtles spend more time and effort during the nesting process than loggerheads do. The extensive body-pitting can often make a false crawl look like a nest.

Green turtle nests often look like a bomb exploded on the beach. All of **these photos are of successful nests.**



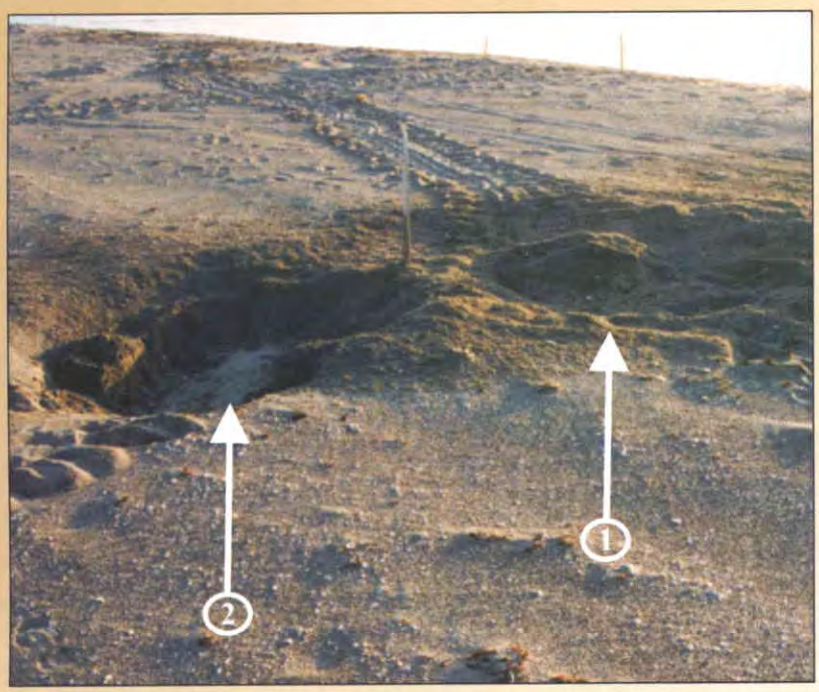
**Is there a deep, round body pit and lots of thrown sand?**

**Yes: This is a nest**

**No: This is non-nesting emergence**

**Not Sure?: Go To page 24**

# *Did She Nest?*
## Green Turtles




This picture shows two **abandoned body pits** (arrows), notice the amount of thrown sand. The key is to recognize the extent of thrown sand and depth of the body pit. Notice also the track continuing up the beach to position 2: if she had nested in position 1, she would have returned to the water afterwards.

This body pit is not nearly large enough to constitute a successful nest: **this is a false crawl.**

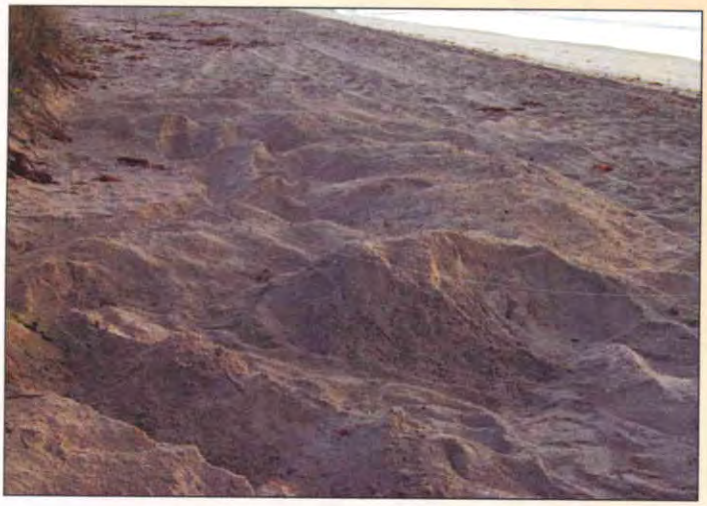
This is a tough one! Digging activity in an embankment can hide our clues. Digging by hand to verify would be a good idea for this type of crawl. This one was a **false crawl.**

Though the body pit is not as deep as usual, the length of this nest area would indicate a **successful nest.**

# *Did She Nest?*

# Leatherback

Leatherback nests cover a wide area, sometimes over 400 square feet of thrown sand! No other turtle has such a large nest area, though green turtle nest depressions can be much deeper. Leatherbacks rarely false crawl, so it's a good idea to assume eggs are there unless the turtle appeared not to have stopped at all. These are all photos of successful nests.



Notice the "orientation loop" that this turtle performed after nesting. This is a trait common in leatherbacks.

**Is there evidence of nesting activity?**

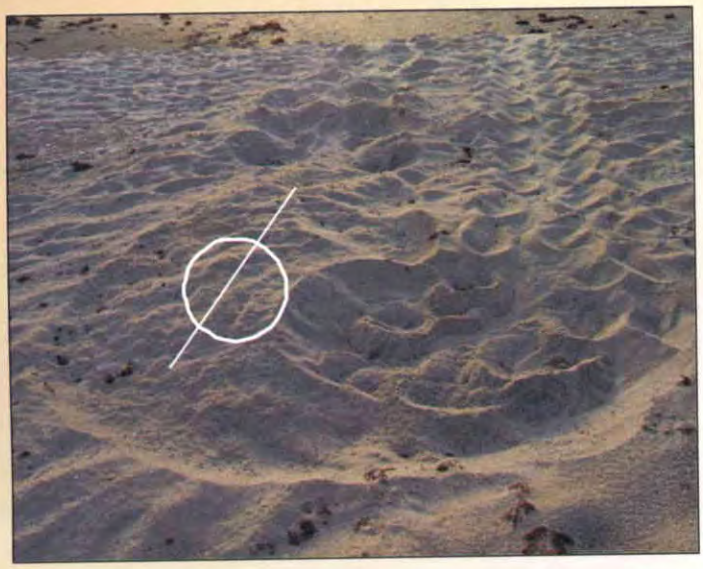
**Yes**: Assume it's a nest
**No**: It's a false crawl

# *Where Are The Eggs?*

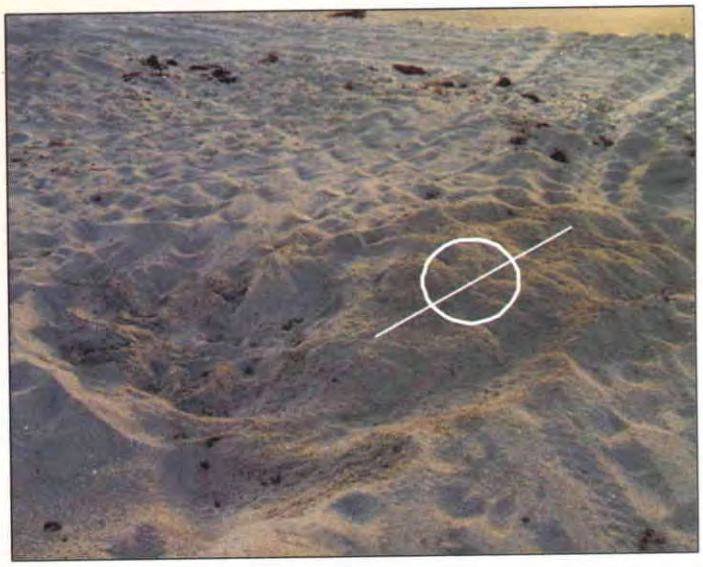
# Loggerhead

There are times when researchers might want to locate the egg chamber. It may be to verify that the crawl resulted in a nest, to relocate the clutch, or perhaps to mark the nest a certain distance from the exact location of the eggs.

To locate the egg clutch, determine the mid-line of the incoming crawl, or where the middle of the turtle was throughout the crawl and mound. The eggs are usually under the highest part of the mound. Dig straight down **by hand** (never shovels or other tools) in a scooping fashion to minimize disturbing the nest site. Dig as narrow, cylindrical hole as possible. The sand will feel consistently packed until you approach the clutch. The sand will feel loose, less packed and "give way" just as you reach the top of the egg chamber. Feeling the presence of one egg with one finger is sufficient to verify the presence of the clutch, there should be no need to remove or uncover the eggs. If the nest is to remain in that location, carefully replace the removed sand with cool, moist sand to mimic the "mom" turtle's behavior; loosely packed just above the clutch, well packed the rest of the way up (use your fist to gently compress the sand above the clutch as you fill it in).



Crawls in which the turtle turned sharply or crawled back over the mound create a challenge in trying to locate clutches. Try to envision the turtle's position each step of the way. The line in the above picture represents the mid-line of the turtle crawl, and the circle depicts the highest part of the mound.



Long, stretched-out nest mounds are easier to evaluate since mid-lines and mound heights are more easily seen. Again, the circle represents the best place to start looking for the eggs.

*Remember:* Finding clutches can be tricky! It may take several holes to locate the clutch. It is best to do as neat a job as possible, so if you are unsuccessful the first couple of digs you can re-evaluate the crawl. If you make too much of a mess, you may not find the mid-line or mound height again. If you are still unsuccessful after several digs, re-evaluate the characteristics of the crawl... it may have been a false one!

# *Where Are The Eggs?*

## *Loggerhead Examples*

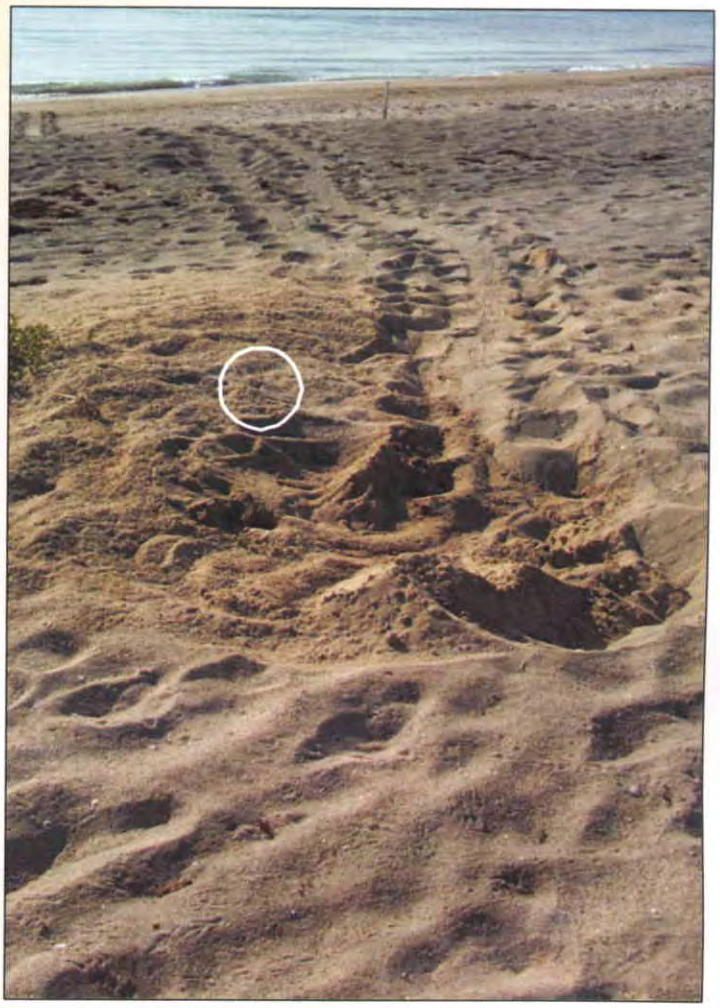
Nests come in a variety of shapes and sizes. The circles represent good places to start looking for egg chambers. Notice the width of the mounds are wider than the tracks themselves. The arrows in the above photo highlight two egg chambers the turtle abandoned before nesting.

# *Loggerhead Examples Continued...*

Sometimes, the turtle will continue up the beach for a short distance after nesting. Rely on the mound characteristics in these cases: **this one is a good nest.**

This turtle crawled over part of the mound. The part that remains will have to suffice to evaluate this crawl. **The misted sand and circular body pit indicate a nest.**

Both of these photos depict common nest mound shapes. As with the others, imagine the mid-line of the crawl, then find the highest part of the mound. Whenever possible, try to watch the turtles during the nesting process to familiarize yourself with the movements that create the marks seen the following morning. Always remain behind the turtle while watching, and never shine flashlights on the beach.



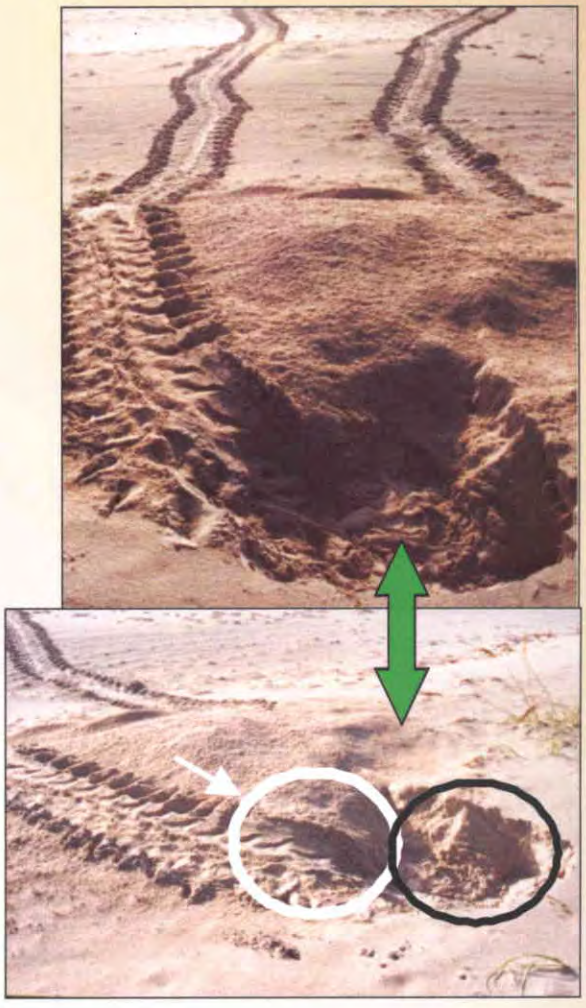
# *Where Are The Eggs?*

## Green Turtles

Green turtle nests, like the others, can come in a variety of shapes and sizes. The egg chambers are deeper than loggerheads, so remember to dig at least 24 inches to find the clutch.

A neat trick for finding green clutches is to envision the body pit as a circle, then "flip" the diameter of the body pit over the mound: The opposite side of the resulting figure 8 is a great place to start looking for the eggs.

This researcher found the clutch on the first try using the "imaginary circle" technique.



Green turtle nesting activity has increased dramatically over the last few years in Florida, and may continue to do so. Managing green turtle nesting can be time consuming, so choose an appropriate sample size if nest content data are needed.

# *Where Are The Eggs?*

## Leatherback

Got all day? It can be a real challenge finding leatherback clutches because of three things: the size of the area of disturbed beach, the tendency for leatherbacks to crawl in circular "orientation loop" patterns over the top of the nest area, and the depth of the clutch. Your best bet is to find the midline of the crawl, pick the highest part of the mound, and hope for the best!

This turtle's nest mound is nearly as long as the width of the entire beach!

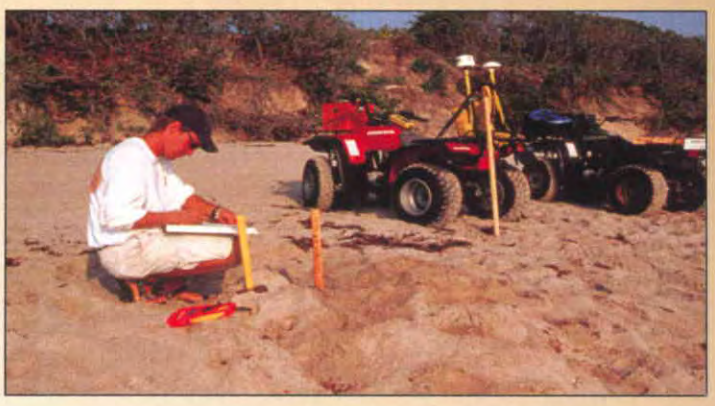
The arrows are on the approximate mid-line of the mound, the circle would be a good place to start digging.

This turtle circled back over the nest mound before returning to the water. Try to envision the path the turtle took before the orientation loop as a guide to where to start digging. The circled area is a good first step.

# *Marking A Nest*

There may be more than one reason for marking a sea turtle nest. Though marking nests is sometimes for protecting them from beach pedestrians or equipment, it is usually done to gather nest success data. Each marked nest can be observed daily for disturbances, and subsequently excavated after hatching for a reproductive success evaluation.

***Hint:*** The longer the stake, the harder it is to hammer into the beach, but also the harder it is for disruptive or naïve beach pedestrians to remove.

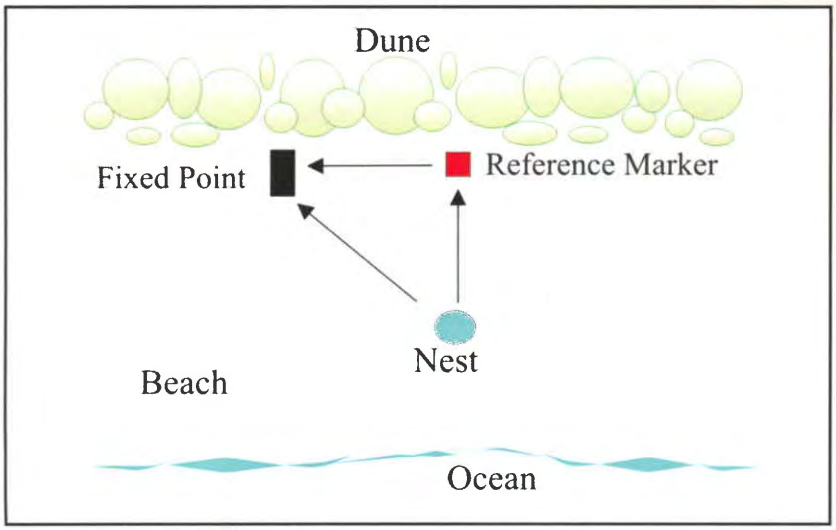


The egg chamber must be located if the survey requires highly accurate marker placement, usually 12 inches behind the clutch. If not, place the marker far enough from the nest mound to avoid the eggs.

*Hint:* If it is not necessary for a specific reason to mark a nest, don't! Marking a nest does attract attention to it (good and bad)-- it may be better off left unseen by curious or ill-intentioned humans. Some predators such as raccoons can learn to use nest markers to find eggs!

## Oh No! The Marker Is Missing!

There are some tricks to re-finding a nest whose marker is missing. If measurements are taken from fixed points to the nest location at the time of marking, you can find that spot again by re-measuring. A "reference" marker for each nest placed a certain distance from the primary nest marker, usually at the dune line, can be helpful.




If you can't find the clutch for some reason, place the marker in your best-guess location, but first dig the hole for the stake by hand to ensure the stake does not hit the eggs. Write "NF" (not found) on the stake so you know that you did not find the clutch. Then, look closely at the nest area each day starting at 47 days of incubation. If the emergence becomes visible, then move the stake to 12" behind the emergence spot for subsequent nest content excavation.

***How many nests should I mark or inventory?***

The Florida Fish and Wildlife Conservation Commission's Marine Research Institute has published a method for choosing sample nests that will provide for sufficient statistical power. Refer to Appendix 1 of the "Nest Productivity Protocol" section of the INBS Guidelines for Marine Turtle Permit Holders.

# *Relocating and Protective Marking*

Some circumstances require that additional measures be taken to protect nests. Such areas include those with persistent lighting problems, high predation rates, beaches with high foot or machinery traffic, or areas where construction may disturb incubating nests. Additional protective measures include nest relocation, sometimes to a hatchery, nest caging, and conspicuous markings that can include roped-off areas and signage.

Photo by Ecological Associates

Photo by Ecological Associates


Depending on the need, nests can be marked in a variety of ways. Flagging tape attached to three or four stakes surrounding the nest is a very conspicuous marking technique. The tape must be maintained throughout the incubation period since weathering will most likely occur. Keep the public in mind when marking nests – how well-maintained they are reflects on the persons or oganization responsible for surveying that beach. Be sure to remove all stakes and tape after use.

Though considered a last resort for some sea turtle managers, hatcheries can be used in areas where additional protection is warranted for relocated nests. Nests should be placed at least 36 inches apart and clearly marked. Sea turtles naturally spread their nests along coastlines, and as a result, there is concern that concentrating the hatchlings' emergence location may also concentrate predators. If possible, choose several locations for self-releasing hatcheries so the hatchlings do not all enter the ocean at the same site.

Small durable signs can be attached to nest stakes to inform the public about sea turtle conservation. These usually provide phone numbers for additional information, and warn of the legal ramifications of tampering with sea turtles and/or their nests.

## Relocating Nests:

Nest relocation should only be considered if the eggs or hatchlings have little or no chance of survival at their natural nest site (such as nests deposited below high tide lines, nests adjacent to brightly lit beachfront areas, or nests placed in construction areas). It is important to mimic the natural nest conditions for each clutch chosen for relocation. Once the clutch has been located, place the eggs one at a time into a container with moist sand lining the bottom, then keep them shaded. Eggs should not be rotated while being excavated and reburied. **Do not relocate eggs after 9:00 AM the following morning after the eggs were laid.** After approximately 12 hours in the sand, the embryo within the egg becomes increasingly susceptible to damage and/or death during relocation. Carefully examine and measure the depth of the original nest, then dig another just like it in a suitable place on the beach, above the high tide line but not in vegetation. Place each egg carefully (maintaining its orientation) into the new egg chamber. Place moist sand above the egg clutch, and gently pack it with your fist. Keep adding sand and firmly packing it until you have reached the surface of the beach. The nest should then be marked for eventual evaluation. You must have State authorization to relocate nests, keeping in mind that the Florida FWC does not generally authorize nest relocation for lighting problems.

# *Caging Nests*

Cages can be used to protect nests from predators, to prevent hatchlings from becoming disoriented on brightly illuminated beaches, or to retrieve hatchlings for research purposes. There are two basic types of cages, though they may be constructed of different authorized materials. The first is the *self-releasing* type, in which the hatchlings can escape without intervention. These are best when predator control is the purpose for the cage. The other is called a *restraining* cage, in which the hatchlings are detained inside the cage after emerging. (Obviously, restraining cages require careful monitoring by sea turtle personnel, and should be checked **at least** each night between 11:00 PM and 1:00 AM, then again between 5:00 and 7:00 AM beginning 45 days after the nest was deposited.) It's a good idea to check as often as possible, especially on rainy days since hatchlings do sometimes emerge during the day. An alternative to daytime checking is to open the seaward portion of the cage each morning, then subsequently closing it again each evening. All hatchlings retrieved from restraining cages should be released at a suitable beach site as soon as possible after dark. Cages can be designed to be both self-releasing and restraining by creating a "window" of escape just above the surface of the beach on the seaward side of the cage.

This is a restraining cage, and must be monitored carefully for signs of emergence.

This is a 2' by 2' self-releasing cage made with galvanized wire mesh with 2" by 4" openings. Hatchlings can escape at any time.

Place the cage directly over the egg clutch, then trace the edges with your hand. Dig a 12" deep trench for the cage walls, then place the cage in the trench. Fill in the trench with sand, and its done!

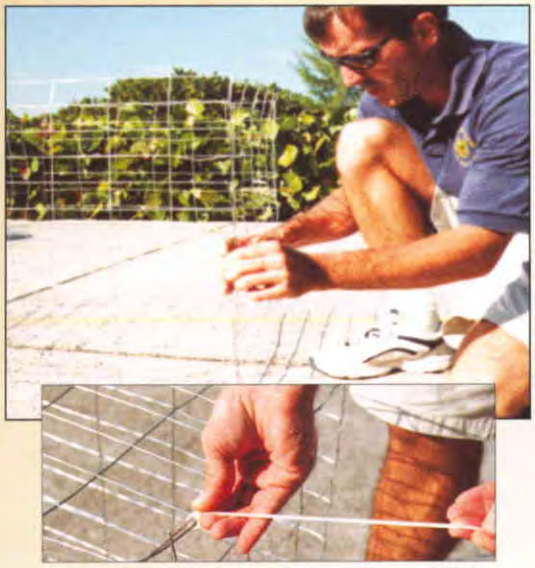
# *Building Self-releasing Nest Cages*

Cages are easy to build. You can choose your dimensions, but 2' x 2' or 2' x 3' will suffice. The cage should be built at least 2' tall, so it can be buried around the nest at least 1' deep. The following instructions are specifically for self-releasing, 2' x 2' square and round designs. A 50' roll of 4' wide galvanized welded wire mesh costs about $25. It is preferable to have the wider part of the 2" x 3" opening parallel to the sand, providing slightly wider escape spaces, but the cage will still work either way.


Galvanized welded wire with 2" x 3" mesh is perfect for building cages. It's available at most hardware stores and comes in a variety of lengths and widths. Four foot wide rolls are great for 2' x 2' cages.

1.
For a 2' x 2' square cage, use wire cutters to cut two 4' x 2' strips, and one 2' x 2' piece for the top.

2.
Bend both 4' x 2' strips down their center, creating an "L" , these pieces together will form the sides of the cage.



3.
Connect the sides and top together with sturdy tie-wraps. It only takes a few minutes to complete the cage.

Round cages are also easy to build. Just roll the screen until a 2-3' diameter is reached, then cut and connect the seam. The holes in the mesh will be oriented differently, leaving 2 inch wide spaces for the hatchlings to escape.

# *Predation*

Sea turtle eggs and hatchlings are often consumed by predators as they incubate, hatch, emerge, and dash for the water. Though sometimes discouraging, natural predation is a normal part of sea turtle biology. In fact, the reproductive strategies employed by sea turtles are by in large the result of millions of years of heavy predation on nesting beaches. As such, it is only necessary to intervene where extreme rates of nest loss occur.

Mammalian predators such as raccoons, foxes, armadillos and skunks are the most common predators of turtle nests. Some additional predators may be present in certain areas. Broken eggshells, dead hatchlings, and the footprints of the "guilty parties" are evidence of a depredated nest. Birds and crabs often consume the leftovers. Markers specific to depredated nests can be used to map these events and/or prevent documenting the same event twice. Try to determine the species responsible if possible. Remaining eggs can be reburied, while hatchlings can be either released or transported to a rehabilitation facility.

The impact of ants on sea turtles has received an increasing amount of attention over the last few years. Though there are several species present on beaches, it is primarily the imported red fire ant *Solenopsis invicta* that has been implicated in hatchling mortality. Be careful when excavating nests that contain fire ants, they sting! Surgical gloves can minimize your risk of being bitten. Ant infestation usually occurs to nests that are near the dune or covered with debris. Keeping nest areas free of organic debris can help minimize fire ant activity. If fire ant control chemicals are used, do not place them directly on the nest.

In most cases, there is no need to take action against predators. However, in areas where at least 10% of the nests are depredated, managers may choose to trap and relocate nuisance predators or cage nests. Some have even used "decoy" eggs infused with hot sauce to discourage mammalian predators! Off-the-shelf fire ant killers can be used to reduce fire ant predation, and should be placed either early in the morning or late in the afternoon. Do not place any chemical directly on the nest. *Coordinate all predator control efforts with your state permit office.*

# *They Hatched!*

In addition to nest counts, some turtle surveys also obtain incubation time and/or nest survivorship data. We can identify a hatched nest on the beach by looking for the tracks left by the hatchlings as they crawled (hopefully) to the water. Loggerhead, green, and leatherback hatchling tracks can be distinguished from one another. These tracks will also tell us if any or all of the hatchlings were disoriented, which should be recorded immediately and reported to the appropriate authorities.

A bowl shaped depression in front of a marked stake indicates that the eggs have hatched. Hatchling tracks are easy to see if they have not been erased by wind, rain, or tides. Put the date of the emergence on the stake and wait 72 hours before excaveting the nest. Bright colored paint or flagging helps remind your personnel which nests will soon be ready to excavate.

Loggerhead, green, and leatherback hatchlings can easily be distinguished from one another. However, small numbers of hawksbills also nest on Florida beaches, so keep an eye out for them. Hawksbills, like greens, only have 4 costal scutes on their carapace, loggerheads have 5.

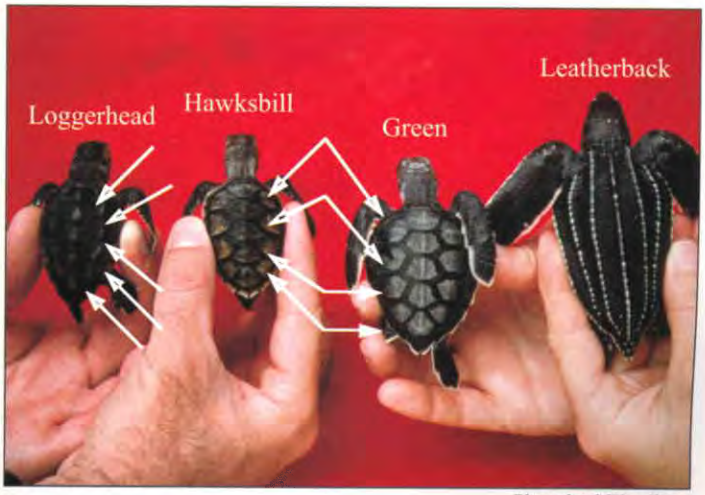
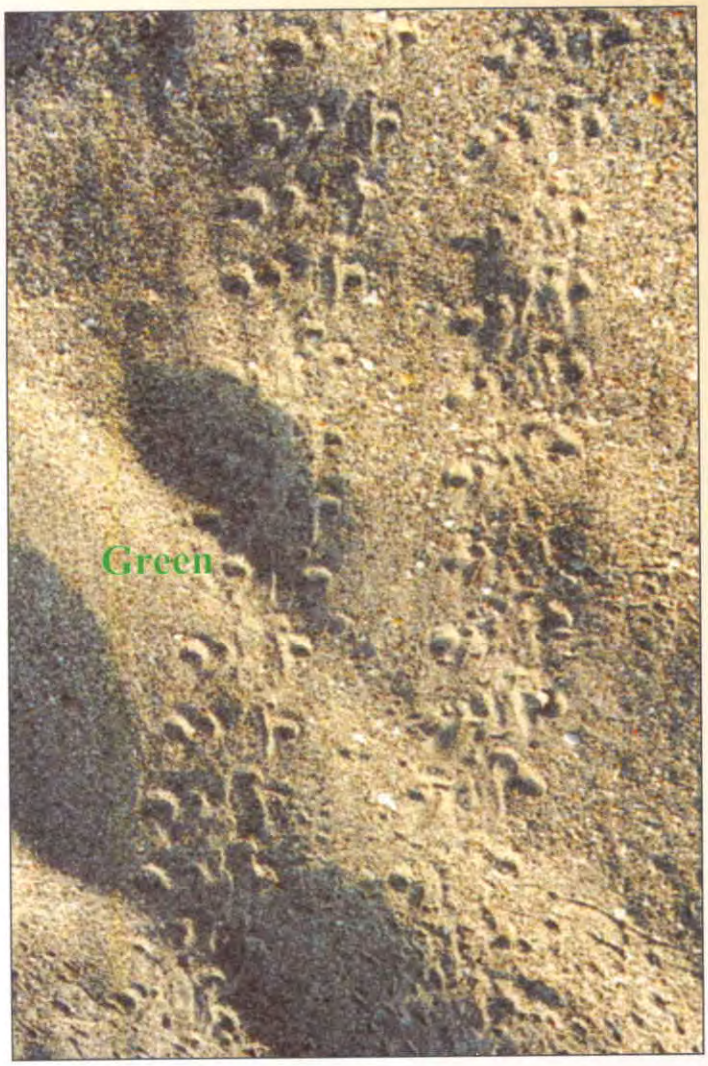


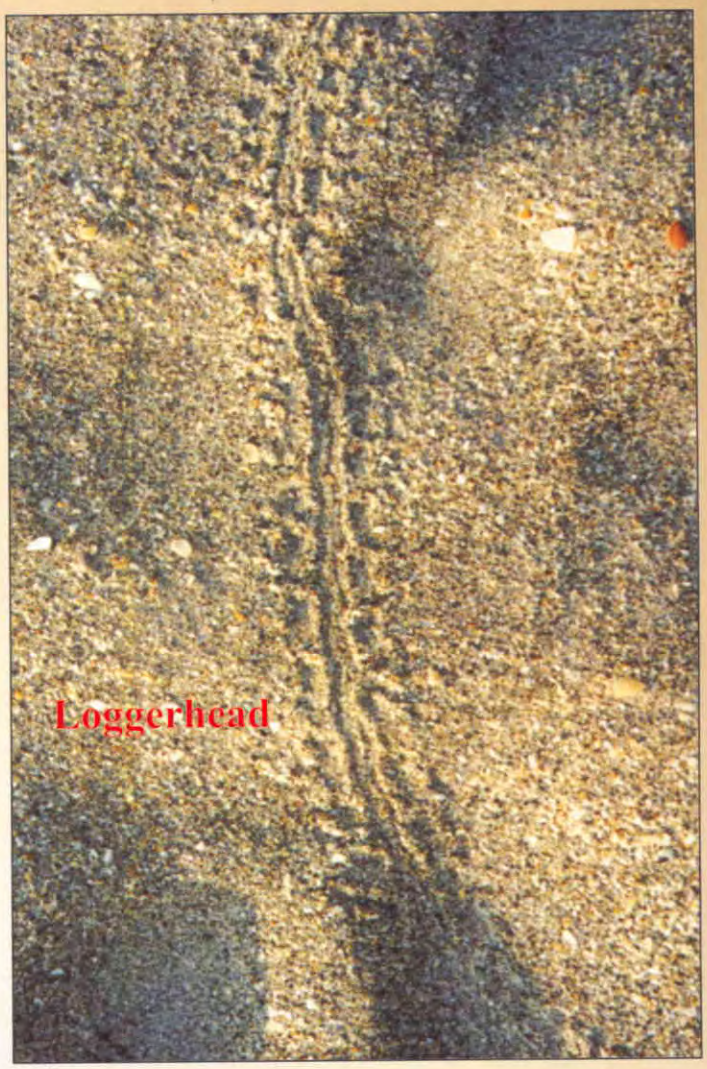

Photo by J.Wyneken

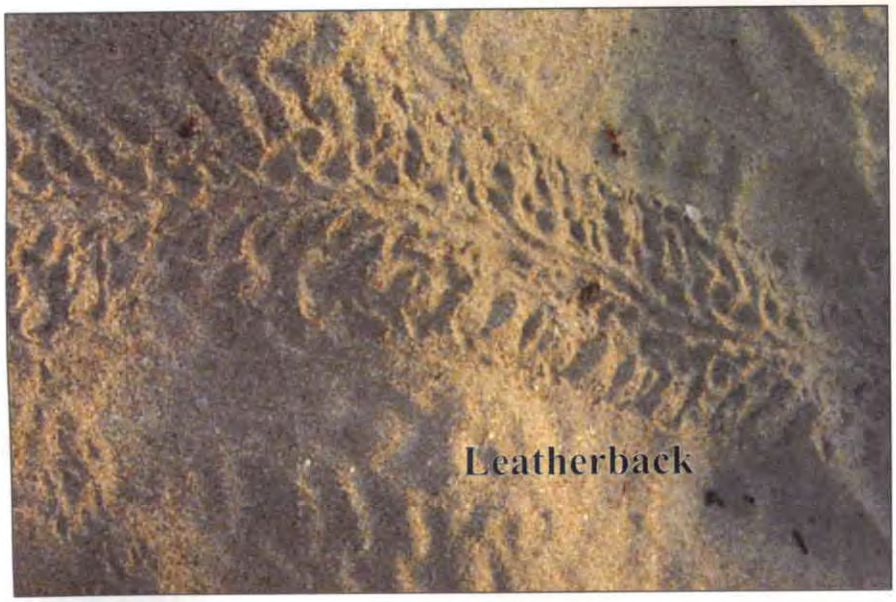
Green turtle nests often still have a visible body pit and nest mound even after two months of incubation! Hatchling tracks are different (see next page) for each species, and can reveal what type of turtles emerged from an unmarked nest.

# *Hatchling Tracks*

It is inevitable that even with stringent survey and nest marking procedures, sometimes nests "get by" our best efforts. It can therefore be useful to distinguish hatchling tracks so that we can identify what species emerged from an unmarked nest. Hatchling tracks are easily erased by wind or rain, and are much more difficult to see on hard-packed or fine-grain beaches.




Leatherback hatchlings crawl with a symmetrical gait. They are also the largest, and leave tracks that are 3-4 inches wide with a trough in the middle. Both loggerhead and green turtle hatchlings crawl with an alternating gait, however the green turtle tracks are significantly wider with more pronounced and discrete front and rear flipper marks. Loggerheads have the smallest flippers for their size, therefore leaving a tighter, "boxier" look to the track, very much like their adult counterparts.

# *Disorientation*

One of the most serious concerns of sea turtle managers along nesting beaches is the disorientation of hatchling and adult turtles that results from coastal lighting. It is a common misconception that hatchlings "follow the moon" into the ocean when they emerge from their nests. Although moonlight certainly can help, it is more complicated than that, and research has shown that the hatchlings use visual cues to compare horizons, and do their best to run away from the tallest, darkest horizon they see. The lower, lighter horizon found over the ocean then becomes their preferred destination. It is very important to gather accurate information on disorientation events so that corrective measures can be taken and future events prevented.

## Some definitions:

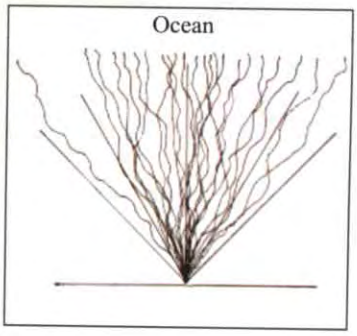
**Disorientation:** Loss of the ability to maintain constant directional movement, regardless of overall heading.

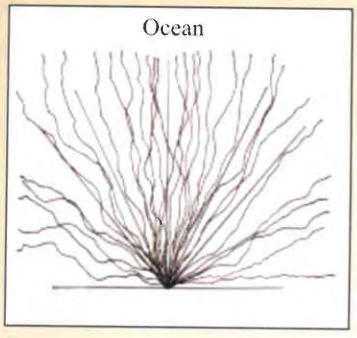
**Misorientation:** Travel in any direction other than the general vicinity of the appropriate destination.

**Note:** These distinctions can be useful in determining the cause of inappropriate directional movement, and should <u>all</u> be reported on disorientation forms provided by state agencies.

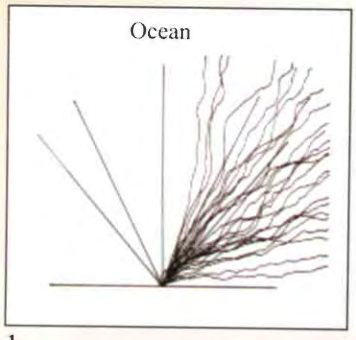
## Describing Disorientation:

There are two important aspects of hatchling disorientation, the "spread" of hatchling tracks and the "direction" they moved in. The *spread* refers to the angle from the nest encompassed by the outermost hatchling tracks. The *direction* refers to the average direction of the group. These two aspects combined are used to determine the severity of a disorientation event. The orientation pattern shown in the diagram on the right would not be considered a "disorientation".

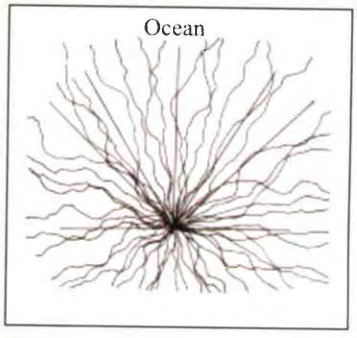



a




b

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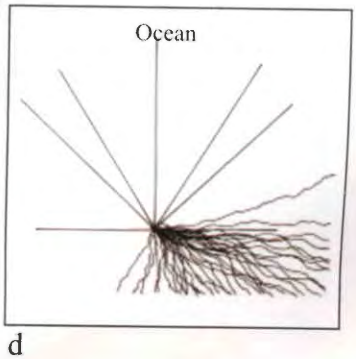



d

"Moderate" disorientation can be described in two ways. If the spread of hatchling tracks deviates from the most direct path to the sea by (a) 90°- 180°, or if the average direction taken deviates from the most direct path by (b) 30°- 90°.

"Severe" disorientation describes hatchling track spread that deviates from the most direct path to the sea more than 180° (c) or if the average direction taken is more than 90° from the most direct path to the sea (d).

# *Excavating A Hatched Nest*

In order to determine how successful the nest was, the contents can be removed and sorted. It is standard procedure to wait three full days after the signs of first emergence to disturb the nest, since it sometimes takes several days for the hatchlings to naturally escape. The contents are usually divided into the following categories: hatched eggs, unhatched eggs, pipped eggs (with live or dead hatchlings remaining), live hatchlings, dead hatchlings, and undersized yolkless eggs. Check out the sample data sheet on page 40. If no signs of emergence are seen, wait until the 70th day of incubation for loggerhead and green turtles, and the 80th day for leatherbacks.

Undersized, yolkless eggs are not unusual in leatherback nests. They are sometimes called "spacers". Their function, if any, remains a mystery.

Arrange the nest contents into piles of hatched, unhatched, etc., then count the number in each pile as you return them to the nest chamber. You may want to use surgical-type gloves, this stuff can be very smelly, and potentially cause infection in cuts or eyes if wiped. Only count egg shells that are at least 1/2 there. Disregard shell fragments.

This egg is "pipped"

## What should I do with live hatchlings?

Though situations may vary from place to place and time to time, it's a good idea to retain live hatchlings in a warm, dark environment (*not* in water) until they can be released from the beach after dark. If they appear too weak for release, contact a sea turtle rehabilitation center or the appropriate authorities for transport.

This egg is "hatched"

# Sample Data Sheet For Nesting Surveys

Observer _____ Excavator _____

Date _____ Species _____ Nest I.D. _____

Zone/Subzone _____ Distance From High Tide Line _____ Dune _____

Description of Location _____

_____

_____

_____

_____

Date of First Emergence _____ Date of Excavation _____

# Hatched Eggs _____
# Unhatched Eggs _____
# Pipped Live _____
# Pipped Dead _____
# Live Hatchlings _____
# Dead Hatchlings _____
# "Spacers" _____

Notes: _____

_____

_____

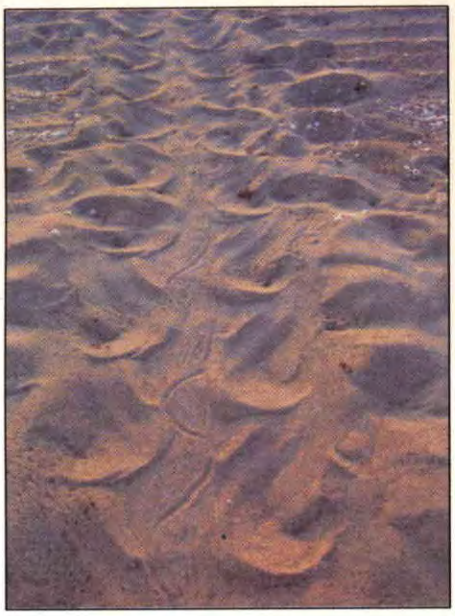
_____

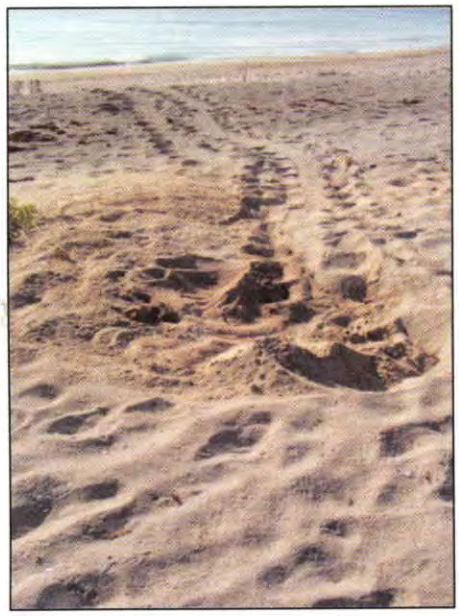
_____

_____

# Quick Reference

## Loggerhead





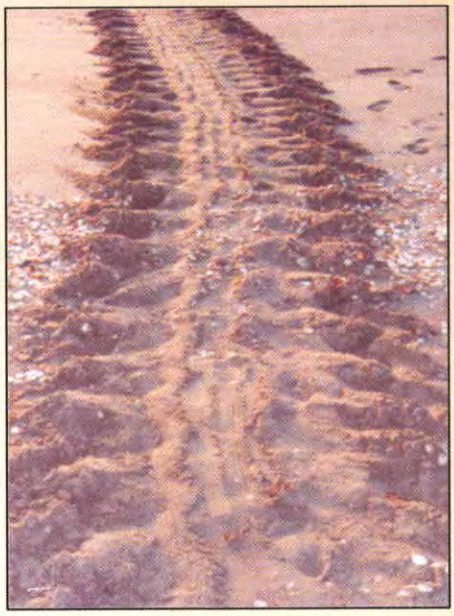
Alternating flipper marks

Narrow track

Shallow body pit

Misted sand

## Green



Symmetrical flipper marks

Tail drag and/or poke

Deep body pit

Large area of misted sand

## Leatherback

Symmetrical flipper marks

Very wide tracks

Shallow but large nest area

Curvy, looping tracks