635/D-168

GULF ISLANDS NATIONAL SEASHORE

SEA TURTLE NESTING REPORT

1994-1999

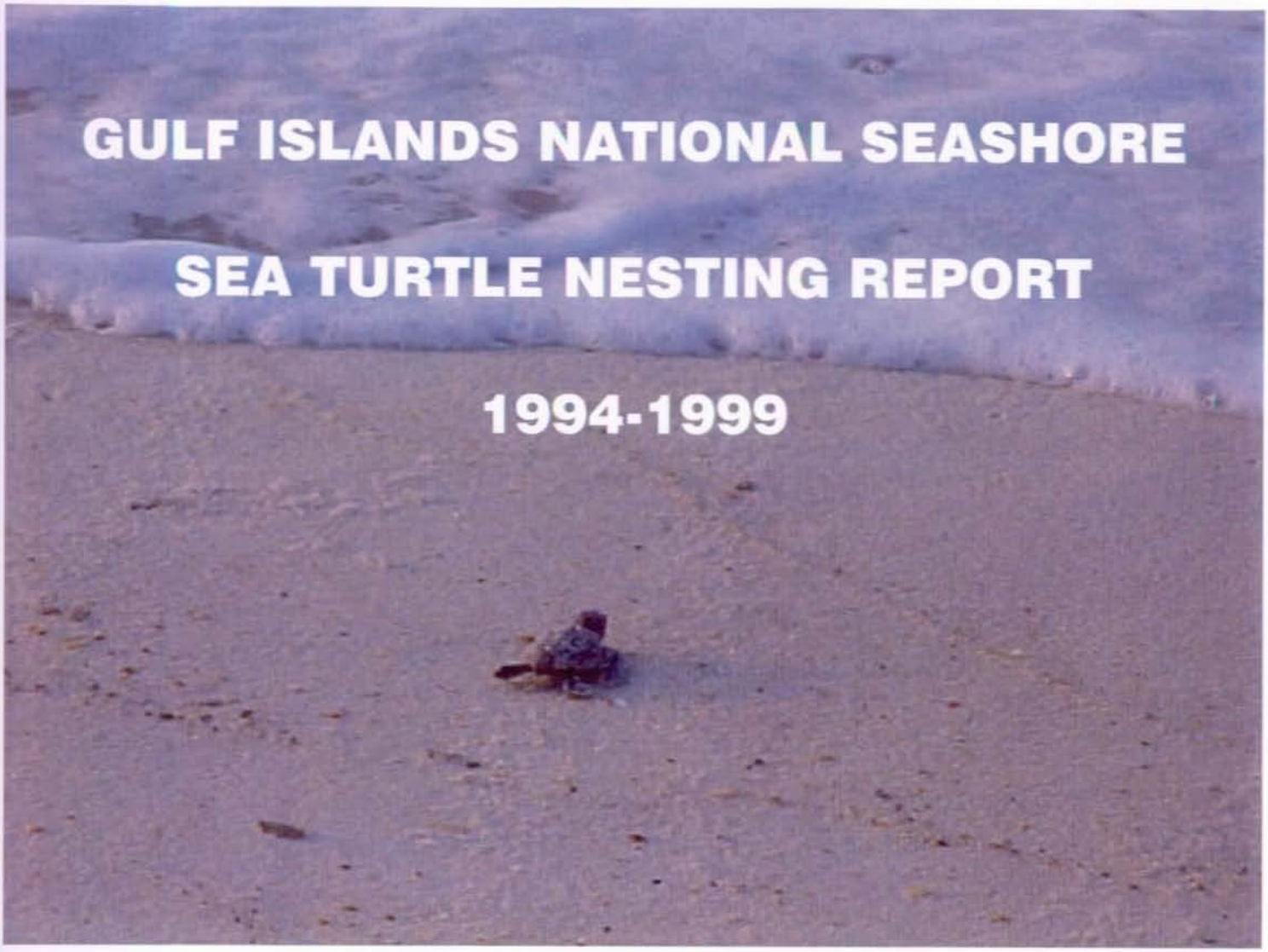


Photo by Steve Blankman

National Park Service
Gulf Islands National Seashore
1801 Gulf Breeze Pkwy.
Gulf Breeze, FL 32561

SEA TURTLE NESTING REPORT GULF ISLANDS NATIONAL SEASHORE FLORIDA DISTRICT 1994-1999

MARK NICHOLAS
BIOLOGIST
GULF ISLANDS NATIONAL SEASHORE
GULF BREEZE, FL 32561

ABSTRACT

This report is a summary of the National Park Service's efforts to document sea turtle nesting activity in Gulf Islands National Seashore in Northwest Florida from 1994-1999. While this program has been ongoing for ten years, it was not until 1994 that a daily documentation of sea turtle nesting activity occurred. Each year the accuracy and efficiency of the patrols has increased, particularly in 1998 when a Student Conservation Associate (SCA) and a seasonal biological technician (bio-tech) were added to the staff. The 1999 season had two more additional bio-techs on hand, bringing available resource management staff to a total of 5. The monitoring program relies on volunteers to do the majority of beach patrolling, with a typical year involving 20 or more volunteers patrolling over 35.7 km of beach daily. During this six year period, 243 nests were documented, 221 were loggerhead (*Caretta caretta*), 12 were green (*Chelonia mydas*), one was a Kemp's ridley (*Lepidochelys kempi*) and 9 were listed as unknown. Nesting typically occurs from mid-May until mid-August; the most active period is late June through early July. Incubation times range from a mean of 73 days (n=16, SD = 7.7) in 1994 to 59 days in 1999 (n=46, SD = 5). There is a general trend of shorter incubation times over the last 5 years. Hatching success also varies depending on several factors such as predation, nest site location, tropical weather and above normal tides. Several nests were lost in 1995 from Tropical Storm Dean and Hurricanes Allison, Erin and Opal. Due to morphological changes brought on by Opal, several nests were inundated by water in 1996. Others were relocated to higher ground within 12 hours of being laid. Hatching success rates for these relocated nests averaged 83%. There were also an unusually high number of false crawls in 1996 on these hurricane-impacted beaches, up 287% from previous years. Nests are impacted by predators, with the number one predator the exotic red fox (*Vulpes vulpes*). Fox depredated 30% of the nests in 1994, 57% in 1995, 13% in 1996, 54% in 1997 and 17% in 1998. No depredation occurred in 1999. When a nest does successfully hatch, a large portion of the hatchlings are disoriented due to direct and indirect lighting sources from developed areas, such as the City of Pensacola, Pensacola Naval Air Station, Pensacola Beach and Perdido Key. Efforts are directed towards nest sitting at hatch time, but this is unpredictable and very time consuming. In 1996, an increase in efforts to prevent disorientation met with mixed results. There were 13 nest hatches observed by park staff and volunteers, and 1215 hatchlings were observed entering the Gulf of Mexico. Some hatches were missed by just hours and others by as much as a day. By 1999, 3499 hatchlings were observed by staff or volunteers entering the Gulf of Mexico from the park beaches. An additional 868 hatchlings were observed entering the water on Pensacola Beach. Without this increased effort, disorientation would have been allowed to continue on numerous nests with high levels of hatchling mortality almost certainly being the end result. This problem will most likely continue as dune regeneration is a slow process and urban development in the area around Gulf Islands National Seashore's (GUIS) Florida District shows no signs of abating.

ACKNOWLEDGEMENTS

This report was made possible by a group of volunteers who are dedicated to the preservation of sea turtles. Numerous hours were volunteered during the early morning to look for sea turtle nests. Volunteers also spent time watching nests during hatch time to help prevent depredation and disorientation of the hatchlings. Without these volunteers, it would not be possible to locate all of the turtle nests within Gulf Islands National Seashore's Florida District. This data is invaluable and the efforts of the volunteers are greatly appreciated. These people can take great pride in the fact that they not only care about a magnificent animal, but that they are willing to go the extra distance and take an active role in the preservation and protection of marine turtles. A special thanks goes to volunteers: SCA Kerin Berry, Steve Blankman, Al Buell, Lisa Cich, J. Cozzi, SCA Troy Davis, Richard Everett, Harv Dickey, Graduate Student Andrew Diller, Michelle Diller, Tom Garner, Reia Guppy, Chris Englert, SCA Aliya Ercelawn, Myron Grissom, Dave Harley, Carol Harrison, Graduate Student Allen Jacks, Rhonda Jacks, Dan Johnson, Hera Konstantinou, Thad Kopec, Penny Lundgren, Carol Melton, Pete Mellin, Sara Moorehouse, Alex Nicholas, Junior Ranger Jack Nicholas, Sandy Nicholas, Gigi Naggatz, Jeff Naggatz, Kaitlin Naggatz, Wendy Riles, Paul Rodriguez, Roxanne Sellers, Wayne Sellers, Lois Silberstein, James Stegall, Melanie Waite, Sean Waite, and Valerie Walker.

A special note of recognition to the Biological Technicians of Resource Management who have worked with complete commitment to sea turtle preservation at all hours of the day and night: Kerin Berry, Joanna Cezniak, Troy Davis and Robin Russell, as well as Resource Management Specialist Riley Hoggard.

CONTENTS

	Page
Abstract	ii
Acknowledgments	iii
Time Line	1
Introduction	3
Procedures	6
Nest Relocation	8
Incubation Temperature Study	10
Results/Discussion	12
Depredation	22
Tropical Weather	25
Disorientation	30
Strandings	32
Conclusion	34
Literature Cited	35

GRAPHS

Graph 1.	Nest Totals 1989-1999	12
Graph 2.	Nest Totals 1994-1999	13
Graph 3.	First & Last Nest 1994-1999	14
Graph 4.	Monthly Nest Totals 1994-1999.....	14
Graph 5.	Monthly Nest Totals 1994-1999.....	15
Graph 6.	False Crawls 1994-1999	15
Graph 7.	Mean Incubation Days	16
Graph 8.	Nest Hatching Success	16
Graph 9.	Hatching Success *in situ* vs. Moved	17
Graph 10.	Nest Relocation Totals	17
Graph 11.	Hatchlings Observed Entering Gulf	18
Graph 12.	Incubation Temperatures	19
Graph 13.	Temperature	20
Graph 14.	Depredation	24
Graph 15.	Nests Lost to Tropical Weather	25
Graph 16.	Disorientation Levels	30

TABLES

Table 1.	Depredated Nests 1994-1999.....	37
Table 2.	1994 Turtle Data	38
Table 3.	1995 Turtle Data	39
Table 4.	1996 Turtle Data	40
Table 5.	1997 Turtle Data	41
Table 6.	1998 Turtle Data	42
Table 7.	1999 Turtle Data	43

MAPS

Map 1.	1996 - District GPS Turtle Nest Locations.....	44
Map 2.	1997 –District GPS Turtle Nest Locations.....	45
Map 3.	1998 –District GPS Turtle Nest Locations.....	46
Map 4.	1999 - District GPS Turtle Nest Locations.....	47
Map 5.	1999 – Crawl Over State Road 399.....	48

APPENDIX

A	1999 Field Guide	49
B	Project Proposal	60

PENSACOLA BEACH ADDENDUM

Sea Turtle Nesting Activity on Pensacola Beach
1996-1998
By Aliya Ercelawn 65

TIME LINE:

In 1994, Park Resource Management Specialist (PRMS) Riley Hoggard conducted the marine turtle-nesting program with approximately 20 volunteers. In 1995, District Resource Management Specialist (DRMS) Mark Nicholas arrived and was handed most of the field duties. Again, about 20 volunteers were used to patrol the beaches. Hurricane Erin struck on August 3rd 1995. Hurricane Opal hit on October 4th of 1995, and both the Santa Rosa Area (SR) and the Fort Pickens Area (FP) were closed to the public for an extended period of time. The road through the Santa Rosa area was closed for a 14-month period while the red clay roadbed was removed and a new road installed. The Fort Pickens area remained closed until the road was rebuilt and the area was re-opened 8 months later. Operations were conducted out of the headquarters building in Naval Live Oaks.

In 1996, DRMS Nicholas again coordinated the field duties and recruited graduate student Allen Jacks who worked on his Masters Degree while attending the University of West Florida. As a result of the SR road closure, only DRMS Nicholas, Allen Jacks and volunteer/park employee Penny Lundgren were able to traverse the old roadbed into the SR area by 4-wheel drive vehicle to complete the beach patrols.

In early 1996, PRMS Hoggard was approached by the Santa Rosa Island Authority (SRIA) about the possibility of providing daily turtle patrols on Pensacola Beach. This was needed in order for SRIA to conduct FEMA-related activities on the beach, specifically the sifting of beach sand to remove hurricane debris. The construction of a berm for the length of Pensacola Beach was also planned. Hoggard and 3 volunteers from the University of West Florida (UWF) were used to oversee the Pensacola Beach patrols for the summer of 1996.

A contract was let in 1997 and SRIA paid GUIS $10,000 to provide biologists and work under the park's FDEP permit #032. The biologists provided training to SRIA staff and were tasked with overseeing the daily turtle patrols.

For the 1997 season, the park hired SCA Troy Davis to supervise the Pensacola Beach patrols. This position was also used to assist the GUIS patrols. This was the beginning of a positive relationship with SRIA and the beach community. Graduate student Andrew Diller from UWF was recruited to work on GUIS marine turtle data for his masters' degree. A study on the incubation temperatures within loggerhead nests was begun. Nine nests were probed with temperature recorders made by Onset. For about a one-month period late in the summer, Navarre Beach was patrolled by park staff to cover for the permitte who could not complete the runs due to logistical problems.

In 1998, another SCA position was filled by Aliya Ercelawn. The developing positive relationship with SRIA officials, local beach businesses as well as Gulf Power was furthered. The public began to become aware of the problems associated with turtle hatchlings and artificial lighting. GUIS received project money from SERO to hire Troy Davis as a seasonal bio-tech for turtle-related activities. In September of 1998, Hurricane Georges closed Fort Pickens Road for approximately one month. While the majority of the road was intact, large quantities of sand

were deposited along the first four miles of the road. All morning surveys by volunteers in the district were halted at that time. The nest incubation study continued through the 1998 season.

The 1999 season had the addition of two temporary bio-tech positions (Robin Russell and Troy Davis) funded with hurricane money, a seasonal position on the second year project money (Joanna Cezniak) for turtles and the SCA position (Kerin Berry) for the Pensacola Beach monitoring. The incubation study continued for a third season.

INTRODUCTION:

Gulf Islands National Seashore (GUIS) is located in the northeastern portion of the Gulf of Mexico. It is comprised of two districts, one located in Mississippi and the other in Florida. All of the work for this project was conducted within the Florida District. The Florida District has three separate beaches that are used by marine turtles for nesting: Santa Rosa, Fort Pickens and Perdido Key. The Santa Rosa area consists of 12.2 km of shoreline on Santa Rosa Island. Fort Pickens is comprised of 12.3 km of beach, and is located west of Pensacola Public Beach on Santa Rosa Island. The 11.2 km of shoreline of the Perdido Key area is located on Perdido Key, which is located west of Santa Rosa Island. These three areas comprise the 35.7 km of shoreline within the Florida district, which are subject to nesting activities.

There are five species of sea turtles which utilize the beaches of the Gulf of Mexico and the Atlantic Ocean for nesting activities. These are the loggerhead (*Caretta caretta*), the green (*Chelonia mydas*), the leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempi*), and the hawksbill (*Eretmochelys imbricata*). All of these turtles are protected by the Endangered Species Act of 1973, which allows them special protection and heightened conservation awareness. In Florida all of these species are listed as Endangered, except for the loggerhead, which is listed as Threatened.

Within the Florida District of GUIS, the predominant number of sea turtles nests are from loggerhead turtles. There are usually a couple of green turtle nests in this region every other year. In 1998, there was the first documented nesting of a Kemp's Ridley in the park. It occurred at 1500 hours on May 31, 1998 at the Perdido Key area. Although there have been numerous sightings of leatherbacks and Kemp's ridley turtles offshore and inshore of GUIS, there have been no recorded nests from leatherback species within GUIS. There have been no recorded nests or sightings of hawksbill turtles within the area.

In the preliminary years of the monitoring program, the goal was to identify nesting trends in the area. There were no ground-based daily patrols of each beach. In 1989 the survey method was a combination of weekly aerial surveys and a ground patrol every two to three days by staff members and Park Service Volunteers. In 1990-91 this changed to a completely ground-based patrol in the Florida District, while the aerial survey remains the method in the Mississippi District due to logistical problems associated with offshore islands. Ground patrols in the Florida District were conducted every second or third day during this period. (Zimmerman and Hopkins, 1992).

By 1994, monitoring was being conducted at each area within the Florida District approximately seven times per week from mid-May to mid-August. There were some problems with marking suspected nests and identifying the species involved in several nests. Some crawls were marked as nests but eggs or hatchlings were never found. This was typically due to high water removing the nest site marking stakes, which made relocation of the nest troublesome.

The exact location of the egg cavity is difficult to determine for most volunteers. As a result, in 1994-95, attempting to locate eggs so they could be moved prior to the arrival of tropical weather systems proved difficult. Without the exact position being known, an area roughly 6X6 ft.

needed to be excavated by hand. This was a recurring problem, and it proved very difficult to locate nests prior to the arrival of Hurricane Erin in 1995. Few egg chambers were located the evening before the storm and numerous nests were lost to the storm the following day. The egg chamber location problem was alleviated by 1996, when most nests were rechecked by the resource management specialist or a UWF graduate student volunteer. This ensured accurate marking of egg chamber locations. This was further improved in the summer of 1998, when a biological technician, SCA and a graduate student were available to assist in the locating of eggs. By 1999, there were two temporary bio-techs, one seasonal bio-tech, an SCA and a graduate student.

Beginning in the summer of 1996, park personnel and volunteers were used to patrol Pensacola Beach. The park entered into an agreement with the Santa Rosa Island Authority to have park biologists patrol their beach in exchange for $10,000 per year. This money was used to hire an SCA in the summers of 1997, 1998 and 1999 to oversee the patrols of the public beach. The SCA supervised the maintenance employees of SRIA and rode with them on patrols every other day. The SCA was also used in the parks turtle-monitoring project. These Pensacola Beach patrols were conducted from the east border of the Fort Pickens Area to approximately the UWF property adjacent to the Santa Rosa Area of the park. (*See the addendum at the end of the report for a more detailed report of Pensacola Beach turtle monitoring.*)

The 1996 sea turtle nesting season followed two major hurricanes, which passed through the northern coast of the Gulf of Mexico in 1995. Hurricane Erin moved over the Pensacola, Florida area on August 2, 1995. Two months later, on October 4, 1995, Hurricane Opal passed slightly east of Pensacola. This rare occurrence left much of the Northern Gulf Coast in ruin, with damage estimates of $3.7 billon (Mayfield and Lawrence, 1996). The entire Gulf Islands National Seashore is located within the path of both storms, and was severely impacted by the hurricanes.

Besides structural damage, these two hurricanes left the local Gulf Coast beaches in almost complete disarray. The storm surge of Hurricane Opal destroyed most of the primary dune line along the beach. In some areas, the island was completely leveled by the over wash. Foredunes that were almost 5 meters above sea level were reduced to approximately 1.5 meters. (Stone, 1996) Roads into the Santa Rosa area were closed for 14 months while the Fort Pickens area did not re-opened until 8 months after the storm.

The summer of 1996 witnessed little tropical storm activity in the Florida District. However, seven nests were lost or destroyed by Tropical Storm Josephine. There was a large increase in the number of false crawls on Perdido Key.

Hurricane Danny impacted the 1997 nesting season. This hurricane persisted for 72 hours and numerous turtle nests were washed out into the Gulf, inundated with seawater or buried beneath from 1-3 feet of sand.

Hurricanes Earl and Georges adversely impacted the 1998 season. Three nests were moved into coolers and hatched in the Ranger Station at Fort Pickens. These nests were moved prior to the arrival of Hurricane Georges. One of the nests hatched during the hurricane, and due to heavy

surf, were released by park staff from a 40 foot United States Coast Guard (USCG) vessel 5 miles off shore. This hurricane forced the closure of Fort Pickens Road due to sand covering the road, in places up to four feet deep.

The 1999 season was only slightly impacted by Hurricane Bret off of SW Texas, in which two nests were relocated to avoid loss from erosion. Tropical Storm Harvey resulted in two more nest relocations due to erosion. One nest on Perdido Key was covered by 1.5 feet of sand and was extensively overwashed during Bret and Harvey. The nest had 0% hatch.

PROCEDURES:

Since the 1994 season, the following procedures have been the norm. The sea turtle survey begins on the 15th of May each year. The beach survey procedures are the same for all subdistricts in order to provide consistency. Surveys are conducted as early in the morning as possible after sunrise. ATV's are used to patrol the beach and record approximate distances from the starting point to the nests. The beaches are marked with half-mile markers for references. Any nests, false crawls, depredation, strandings, or hatching events are recorded using the proper data sheets.

When a nest is located, the location is recorded as a distance from the starting point. The identification of species by crawl type, crawl width, total length of the crawl and any signs of predation are recorded. The nests are marked with a sign and two upland reference stakes. The sign is placed three or four feet seaward of where the volunteer estimates the egg cavity to be located. Beginning in 1996, nest sites are examined by staff and egg cavities are located to ensure accurate marking of the nest. After locating the eggs, the sand is carefully packed back in on top of the eggs. A four foot piece of screen with 4"x2" mesh is buried 4-6 inches deep over the probable location of the egg cavity to deter predation. A drawing of the immediate area and crawl are made and placed in the data book. Since the 1996 season, all nest sites are recorded at a later date with a Differential Global Positioning System (DGPS) by park staff.

Due to depredation on Perdido Key, night patrols were begun in 1996 to locate nests or nesting females prior to the arrival of the fox/coyote. Patrols were begun after dark. Red lens covers were used over the ATV lights on dark nights and no lights were used on moonlit nights.

The Resource Management Specialist checked any nests that were judged to be in jeopardy from flooding/erosion by the volunteers. Occasionally nests were excavated by hand and relocated to a location with less potential to be damaged; time frames and procedures were followed according to prior published recommendations (Limpus et al , 1979). Nests were only relocated if they were in obvious danger and could be moved within 12 hours of being laid. Nests that could not be relocated in this time frame were generally left at their original location. After 14 days of incubation a nest is once again eligible for relocation.

During the 1996 and 1997 season, after approximately 60-65 days have passed, nests were checked as frequently as possible in addition to the normal morning surveys. In 1998 and 1999, nests were checked at about the day 50 mark. This was due to the lowering of the mean incubation times from 1994 to 1999. (Graph 6)

Nests are checked by visual observation of the nest site. The process of "coning" indicates the collapse of the cavity containing the hatchlings. This indicates the hatchlings are close to the surface and should emerge that evening or by the following evening. Staff also listen for digging sounds from within the nest site by simply placing a towel over the nest and placing one's ear on the sand above the egg cavity. A stethoscope can also be used to listen for hatchling activity. If the hatchlings are in the process of digging to the surface as a group, noises emanating from the cavity are detected easily. The sound is unmistakable. However, if they are not active, no noises will be heard. Usually the latter is the case, so a prolonged period of monitoring may be

necessary to detect any movement. If "scratching" noises are obvious, the nest is checked frequently that night and successive nights until hatching occurs. In between observations, the immediate nest site area is vacated so as not to hinder the hatch.

Beginning in 1996, restraining screens were left over the nest while staff checked other nests. This screen would temporarily detain the hatchlings until the staff member returned an hour or two later to release the hatchlings. In 1997, nests were screened for hours while staff members slept. This usage was increased in 1998 and in 1999 with an average of several nests being screened for several nights.

If a nest hatches while it is being observed, the hatchlings are afforded the chance to crawl to the Gulf of Mexico on their own. If disorientation occurs and persists, the turtles are moved closer to the water until disorientation ends. If a hatched nest is discovered on a morning patrol, tracks are counted and directions recorded. All data of the hatching event is recorded.

Three days after hatching, the nest is excavated for an assessment. All hatched eggs are counted, unhatched eggs are opened and recorded as either having or not having development. The developmental stage, based on a 1-9 scale which corresponds to a 6 day sequence until pipping stage, is recorded (LeBuff, 1990). Any live hatchlings found are held in coolers with sand and released that evening.

(Refer to Appendix A, 1999 Field Guide)

Nest Relocation

As a result of the 1995 season, which was marred by hurricane-induced mortality from erosion/flooding, each season up to 25% of the nests are relocated to higher ground. Nests that are deposited below one of the most recent high water marks are relocated as soon as possible. The cause of this seemingly poor nest site selection by the female loggerheads is unknown, but disorientation from the loss of most of the primary dune field from Hurricane Opal may be a possible explanation. These dunes may have shielded the female turtles from the light pollution from the Pensacola area that floods the northern sky on most nights. As turtles are known to be light sensitive, the movement up the beach to a proper nesting site may be interrupted by the glow.

Most nests are moved within the 12-hour time period of egg deposition. Occasionally, the moving process is not started within the recommended 12-hour time slot. In 1997, one nest was not located until the second day's morning patrol and was relocated at the 36-hour mark, due to imminent danger of flooding. The previous day's patrol was cancelled due to bad weather. By the time the eggs were located, they had developed the typical white spot on the top; a characteristic of eggs over 24 hours old. Nests greater than 48 hours old have not been relocated. After a 2-week period of time elapses, nests can be then be moved.

The movement of the eggs is done with great care. A cooler or the turtle gear box is used to move/store the eggs. The lid is used to shade the eggs during the movement process. Large temperature changes need to be avoided. After the eggs are located, approximately one inch of sand from the original nest location is placed in the bottom of a cooler. The eggs are then moved one by one. The eggs are moved with great care but in a timely manner. The eggs are moved so as not to rotate or roll them. The eggs are located in the cooler so that the top of the nest is in the lower left corner. The eggs are placed in rows to the right and working away from the first row established. A second layer may be needed, depending on the number of eggs in the nest. Typically the second layer only extends ½ way across the first layer and as a result sand must be placed adjacent to the last row to prevent them from rolling forward. The eggs are not covered with sand. Most of the eggs need to remain relatively sand free to simulate conditions within the original nest. (*See photo on next page*)

The new nest location is typically excavated just north of the original site, above the high tide line. Simply moving the nest a fair distance to the north is not sufficient to avoid flooding in some areas of the park. An elevated dune area to the north must be located to construct the new nest cavity. This is done to avoid high water/flooding of the low-lying areas of the back dune area during tropical systems when water is forced over the beach berm and is held behind the berm. Flooding also occurs when high southerly winds occur during high tides.

The new nest cavity is dug about 8 inches in diameter. It is dug to about 18-22 inches of depth, with the bottom 10 inches being enlarged to the diameter of about 12 inches. This will form a vase shaped hole. The bottom of the nest should be about 22 inches deep. The top of the egg cavity should be located approximately 10-12" below the level of the surrounding sand. The eggs can then easily be deposited one by one so that the original bottom is put in the bottom of the new nest. The original top will go in last becoming the top eggs of the new nest. After the eggs

have been deposited, the cavity is filled with sand from the bottom of the cooler. The sand is compressed by hand with slight to moderate pressure. The surrounding sand is used to fill in the remainder of the hole.

When hurricanes and tropical storms approach, nests are occasionally moved after a 2-week period of incubation. These nests are moved if they are judged to be in a position where they will erode into the Gulf of Mexico or flood from high surf. Nests are moved to higher ground in the same manner as described earlier.



Loggerhead Nest Relocation
Photo by: Thad Kopec

Incubation Temperature Study

A study of incubation temperatures started in 1997. This study was begun to determine the temperatures at which the nests were incubating on the beaches, and eventually determine the pivotal temperature for loggerhead nests in the park.

The temperature at which the egg is incubated determines the sex of reptile offspring. Generally, higher temperatures produce females and cooler temperatures produce males. The pivotal temperature is the temperature at which 50 % of the hatchlings will be male and 50 % will be female. This sex of the hatchling is determined during the middle third of the incubation time (Yntema and Mrosovsky. 1982).

During the 1997 season, 9 nests were probed with Onset Stowaway temperature recorders. Four nests were probed at Santa Rosa, 3 nests at Perdido Key, one on Pensacola Beach and one at Fort Pickens. The probes were placed at mid-nest height of the egg chamber immediately adjacent to the egg cavity. This was completed on the morning the nests were laid. The nest at Fort Pickens had two probes adjacent to it, one probe on the top and one on the bottom. Temperatures were recorded hourly. Probes have an accuracy of +/- 0.2 degrees C. (Onset Computer Corporation,)

In 1998, a combined study with graduate students Martha Maglothin from the University of Florida, Andrew Diller from the University of West Florida, and most public land managers in the Panhandle of Florida, was begun to examine incubation temperatures region wide and to determine in a lab by bloodwork analysis the pivotal temperature for loggerhead turtles.

For this part of the study, two sand temperature transects, located ½ mile apart were established on Perdido Key. Each transect had a mid-beach site and a high beach site. Three probes were placed at each site. Temperatures of the sand were recorded hourly at depths of 30 cm., 40cm, and 50cm. Five loggerhead nests were also probed with Onset Tidbits. One probe was installed on the bottom and one on the top of the eggs. A third probe was placed in the nest after 4-8 eggs were removed from the side of the nest and replaced after the probe was inserted. This probe would record incubation temperatures of the center of the clutch in order to record metabolic heat generated by the eggs. Three probes were place 2 feet away from the nest at the same depths to record sand temperatures in the same area but without any heat associated with the incubating eggs.

The same study was conducted again in 1999, but three sand temperature transects were used instead of two. The original 2 transect sites were maintained and the third was added to the east. Six nests were completed with temperature probes in the same manner as 1998, but only one probe was installed outside the nest at mid-egg depth. The final 2 nests (PK711199 and PK730199) were collected and hatched in a lab in the care of graduate student Martha Maglothin of the University of Florida. Fluid samples were taken from the eggs. Blood samples were taken from the hatchlings. This will be used to determine the sex of the hatchlings.

Current research on other loggerhead populations shows a pivotal temperature of about 29 to 30 degrees C (Yntema and Mrosovsky. 1982). The results from 1997 seem to indicate all the nests in the park incubated below these pivotal temperatures, indicating a high percentage of males

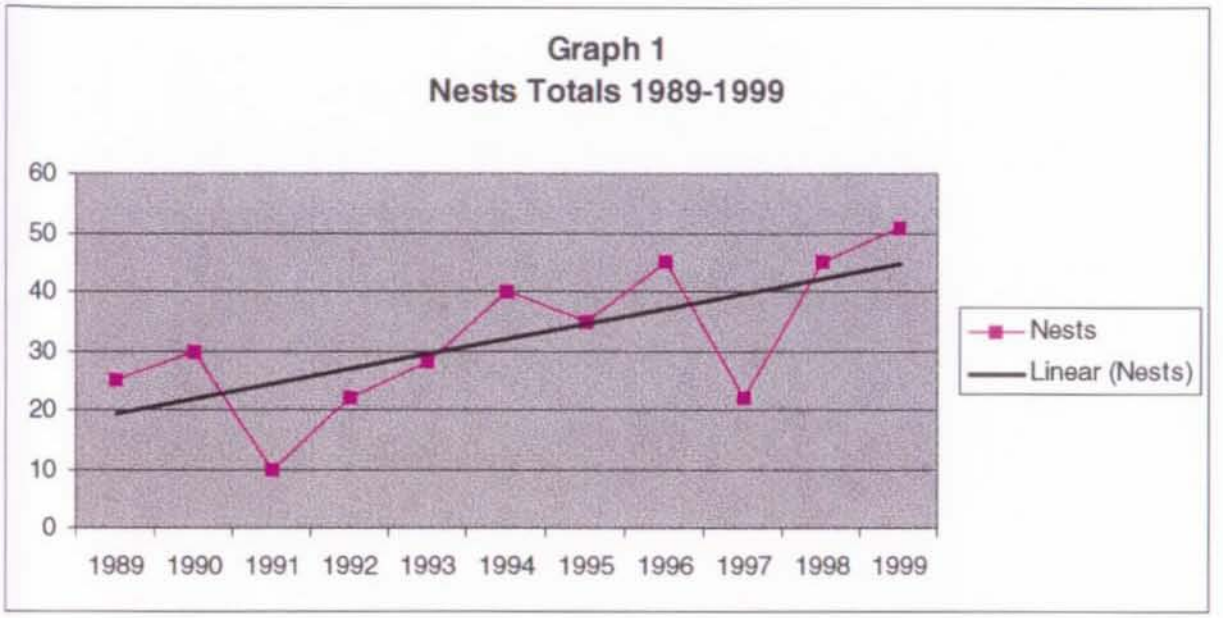
were produced from park nests. By 1998, incubation temperatures approached the pivotal temperatures, indicating a more evenly based clutch, with as many males as females. In 1999, incubation temperatures again increased and possibly exceeded the pivotal temperatures, indicating that possibly more females were produced than males. These are preliminary results. Maglothin and Diller are doing a more in depth look at the data in two separate reports.

Maglothin and Diller's thesis are pending.

(Refer to Appendix B, Project Proposal)

RESULTS/DISCUSSION:

The nest totals for each year of the program since 1989 are depicted by Graph 1. As mentioned earlier, the accuracy of nest totals from 1989-1993 is subject to speculation. The trend line on the graph demonstrates this point. While it may indicate an actual increase in nest numbers per year since 1989, it is speculated that it actually represents an increase in the accuracy of the monitoring.



The nest totals for 1994-1999 are shown in Graph 2. In 1994, there were 40 nests along the three areas of GUIS. Of these 40 nests, 3 were green turtle nests, 28 were loggerhead turtle nests, and 9 were of unknown origin. The number of nests in 1995 declined slightly to 35 nests. This total was comprised of 34 loggerhead turtle nests, and one green turtle nest. The 1996 season had 45 nests in the survey region, 42 loggerhead and 3 green turtle nests. Only 22 loggerheads nested in 1997. The 1998 season had 5 greens, one Kemp's ridley and 44 loggerheads. For the 1999 season, once again, only loggerheads nested in the odd year, with 51 confirmed nests. (GUIS field data).

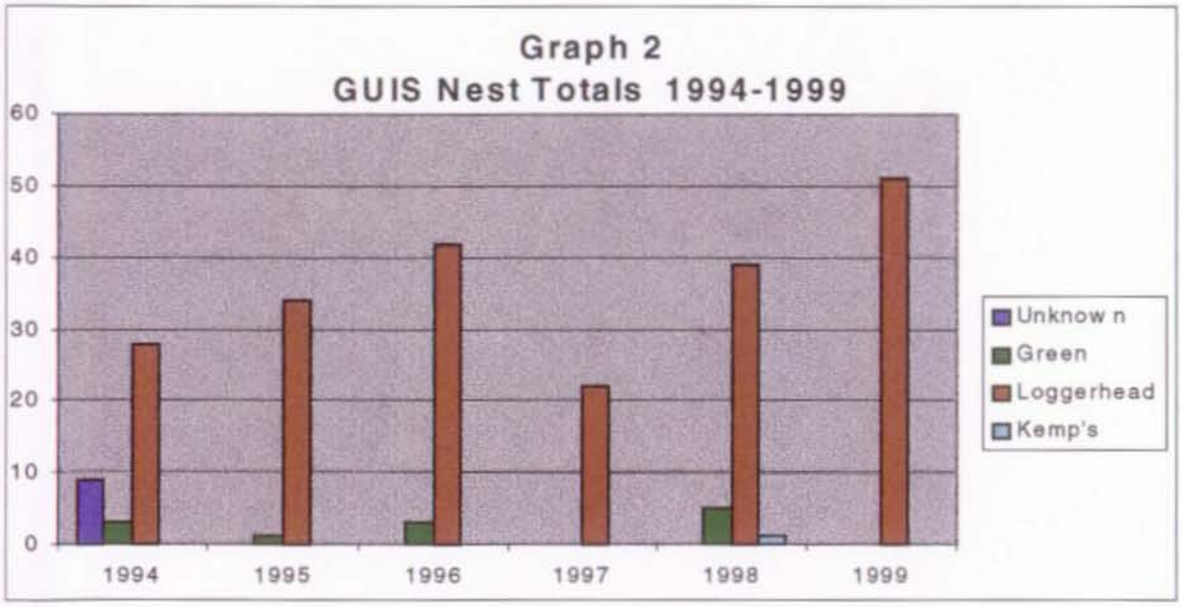
The decline in 1995 may be attributed to biological and environmental factors. Sea turtles in this region are suggested to nest every two to three years and not on an annual basis (Lebuff,1990; Bjorndal, 1982). A fluctuation such as this should be seen in the nesting total from year to year, and may help to explain the decrease in 1995. This possible trend requires further examination through more years of accurate surveys, and should not be assumed based solely on the six years of accurate data available. Another factor to consider is the occurrence of two hurricanes which moved through the area in 1995. There were no nests recorded after Hurricane Erin on August 4, 1995. These hurricanes may have prematurely ended the 1995-nesting season.

The nest totals from 1996-99 lend support to the notion of a shortened nesting season in 1995. There were eight nests in August of 1996 and there were 6 in 1994 (Graph 4B). There were expectations of nests in August for 1995, which did not occur. If nesting activity were to continue into August 1995, the totals for 1995 would approach that of 1994 and 1996-99.

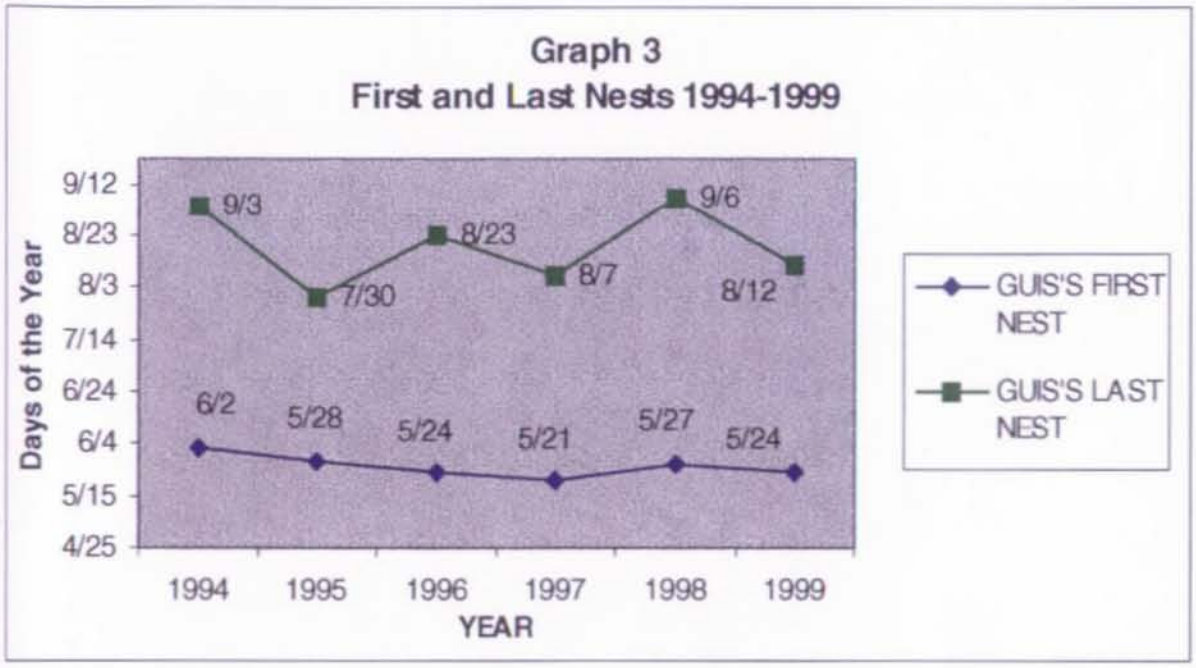
The 1997 season recorded the fewest number of loggerhead nests since the survey was begun. Three breeding age female loggerheads were discovered stranded at the beginning of the nesting season. If these three were part of that years breeding population, then GUIS could have expected an additional 9 to 12 nests for the season. No green turtle nests were documented.

The 1998 nest totals rebounded to slightly above the normal trend. Green turtles again nested in the park. The first documented nesting of a Kemp's ridley occurred on the afternoon of May 31st over at the Perdido Key area of the park.

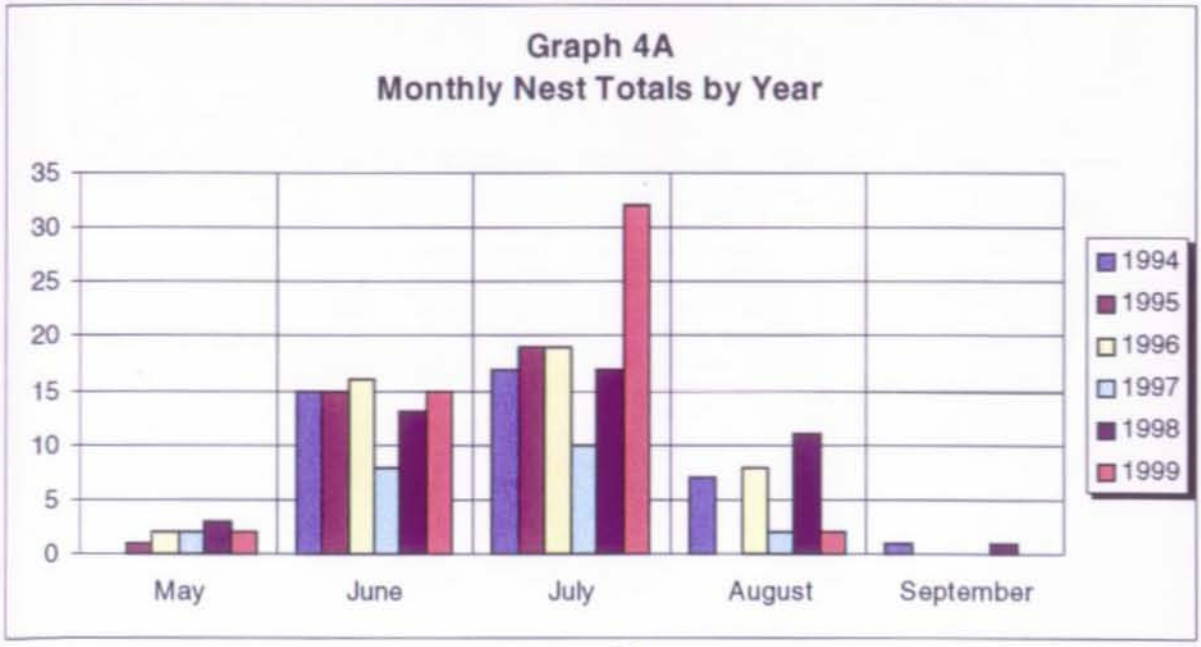
The 1999 season recorded the highest number of nests in the park to date. All 51 nests were loggerhead turtles.

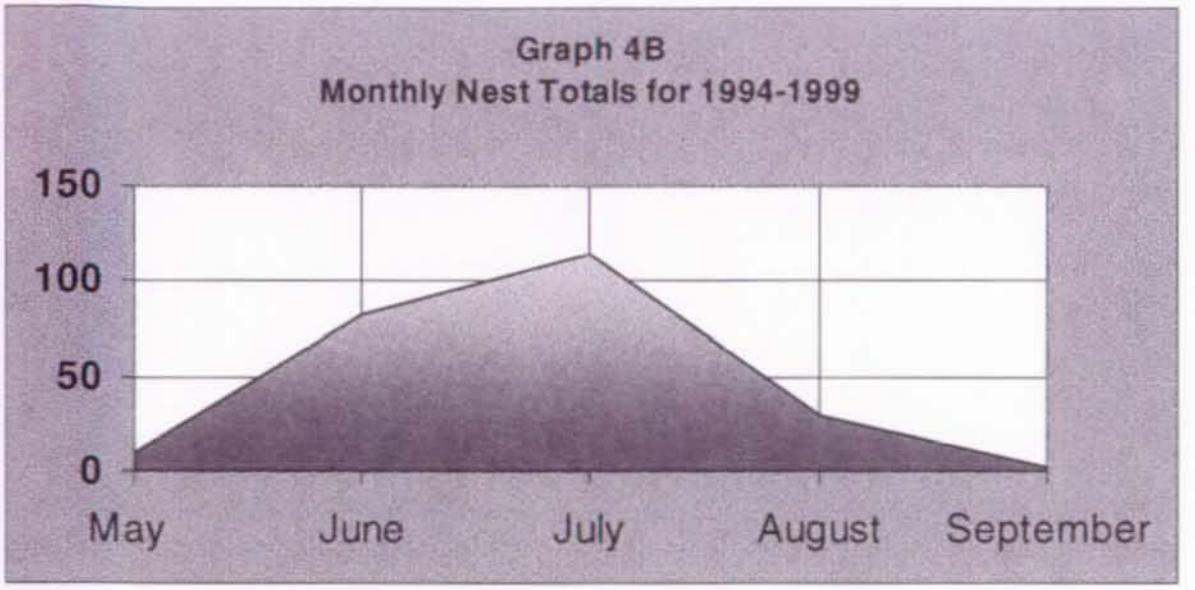


Graph 3 indicates the first and last recorded nest of each season. The data presented are for each year of the survey. The beach patrols begin around May 15, which is slightly before the initial nest is laid. These beach patrols are continued through September so that no late nests are missed and to check for nests that have hatched.

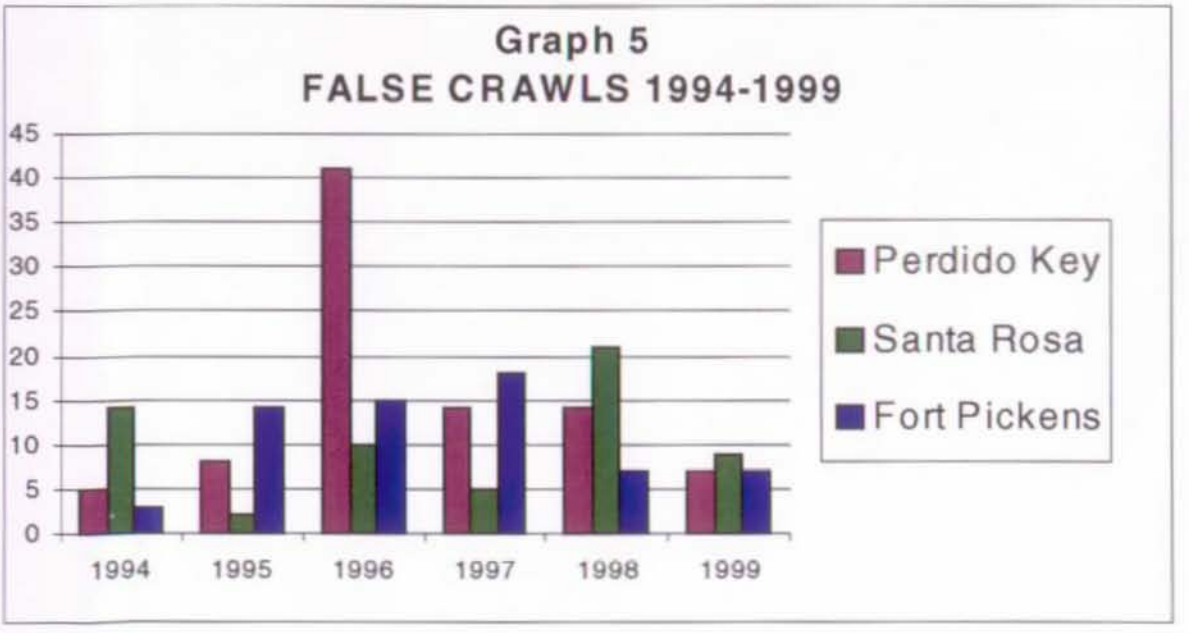


Graph 4A is the nest totals of 1994 through 1999, depicted on a monthly scale. Graph 4B is the monthly nest totals for all years. This trend coincides with the conventional nesting season in this area of May to September. The distribution of nest laying by month is slightly skewed to the left, as the peak is reached in June-July, and a rapid decline follows in August.

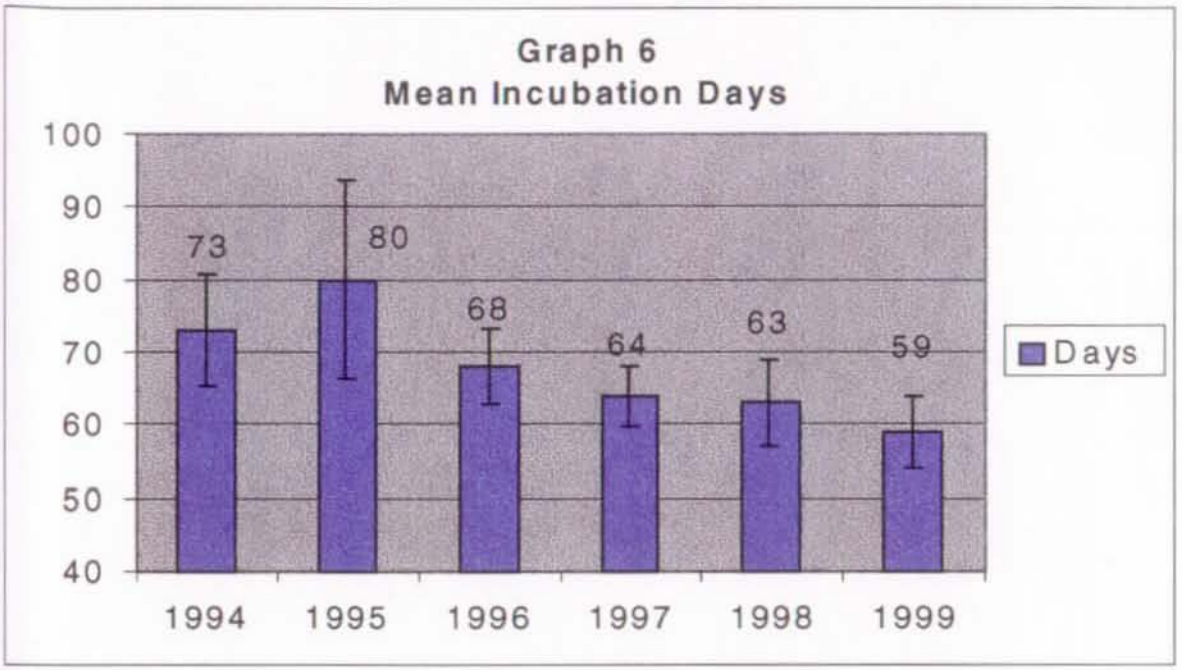




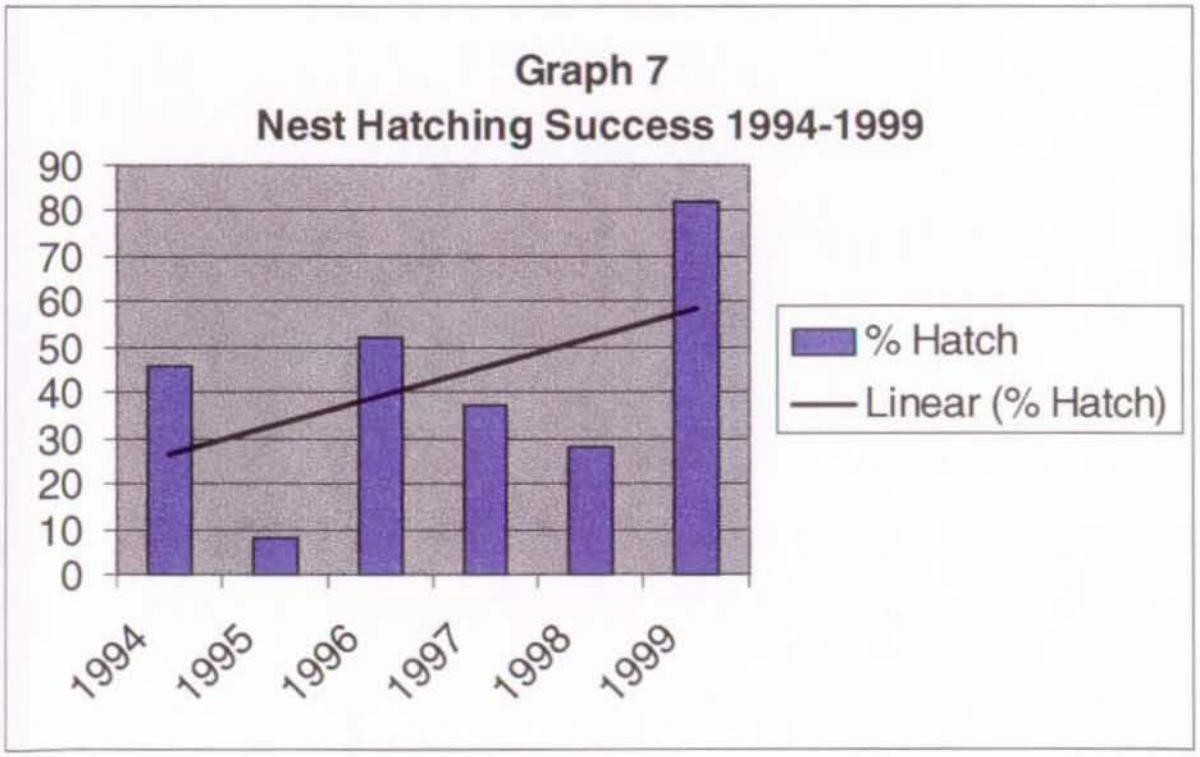
Graph 5 shows the totals for false crawls from 1994-1999. This graph shows a significant increase in the number of false crawls in the Perdido Key Area in 1996, post 1995 Hurricanes Erin and Opal. The Perdido Key area had 5 miles of the eastern end of the island renourished in 1990 with 7.1 million cubic yards of spoil.



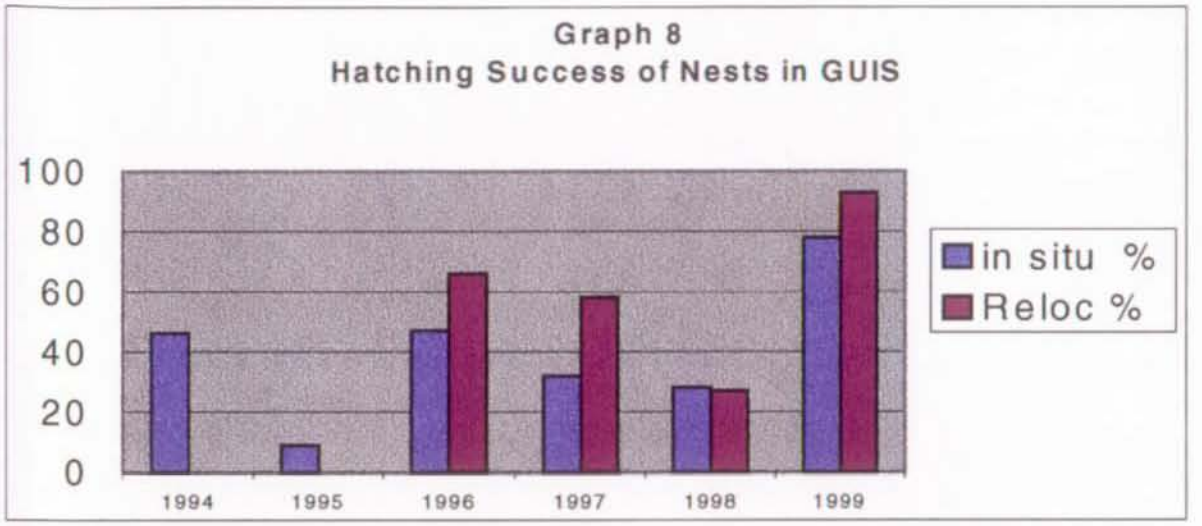
Graph 6 shows the decrease in recent years of mean incubation lengths of the nests.



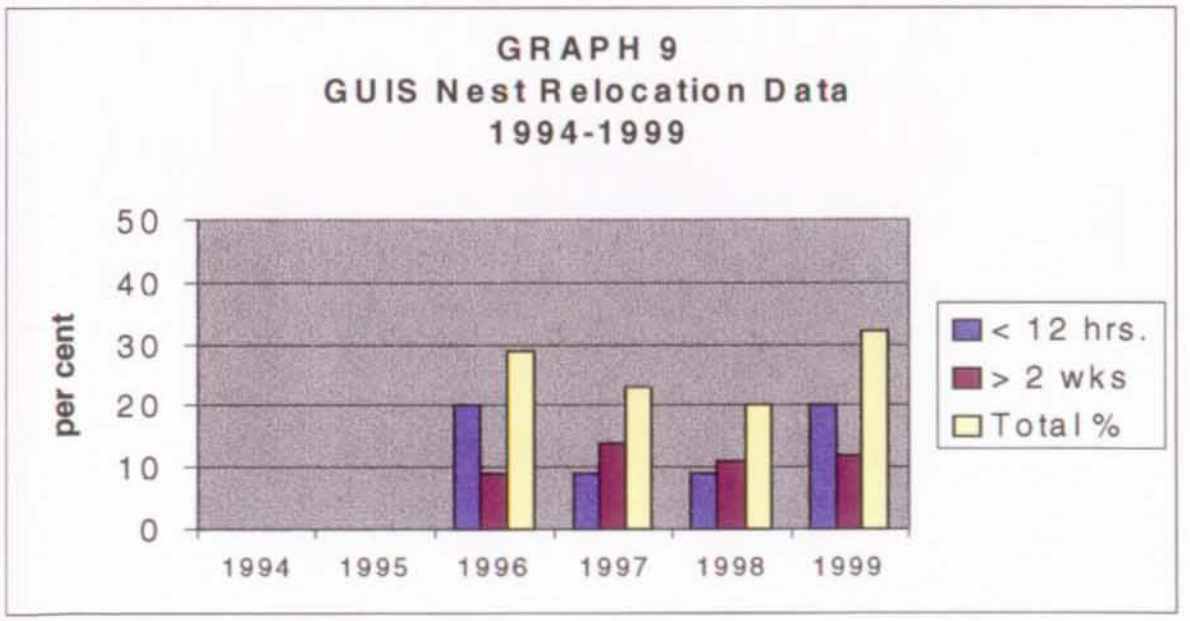
Graph 7 shows the overall success rates of nests within the park from 1994-1999.



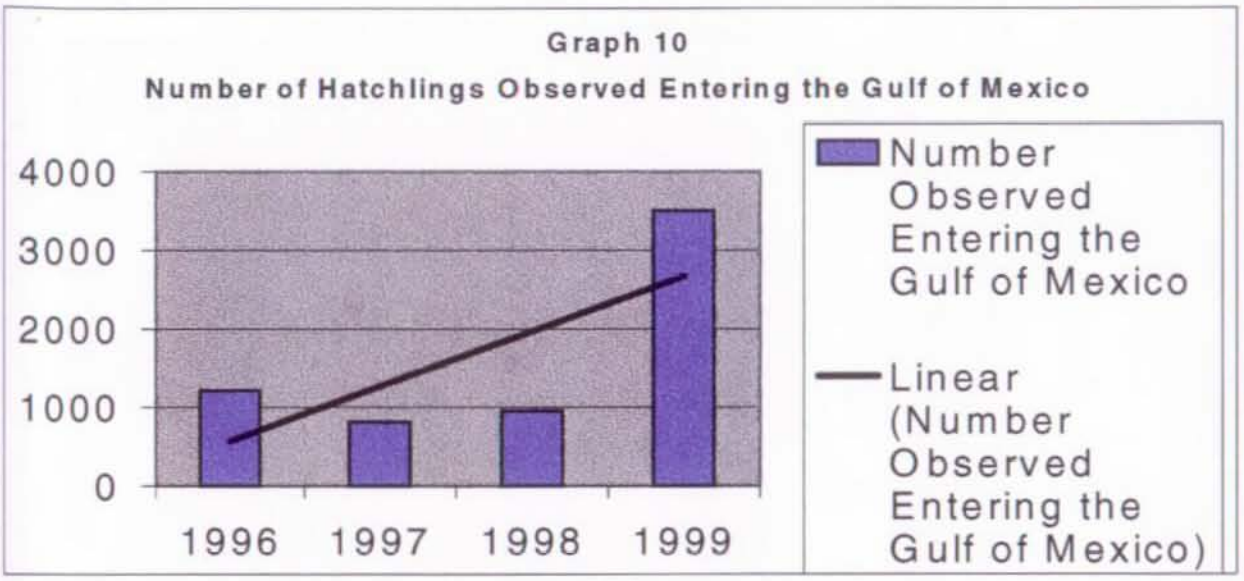
Graph 8 compares success of *in situ* vs. relocated nests. Relocated nests typically have a higher hatching success than *in situ* nests. This is mostly due to tropical weather systems that create high surf and erosion on local beaches.



Graph 9 shows the percentage of nests relocated in the park. In 1997, one nest was moved that was past the 12-hour mark. The nest was relocated without incident and hatched at day 60, 4 days earlier than the mean for that year. This nest had a 97% hatch rate. Another nest in the 1999 season was moved at about the 36-hour mark as well, with a 93% hatch rate. Both of these nests are included in the "<12 hours" category for Graph 9. The nests that are in the > 2 week category are nests that were relocated due to approaching hurricanes or natural erosion. These nests are typically relocated to higher ground immediately north of the original site.

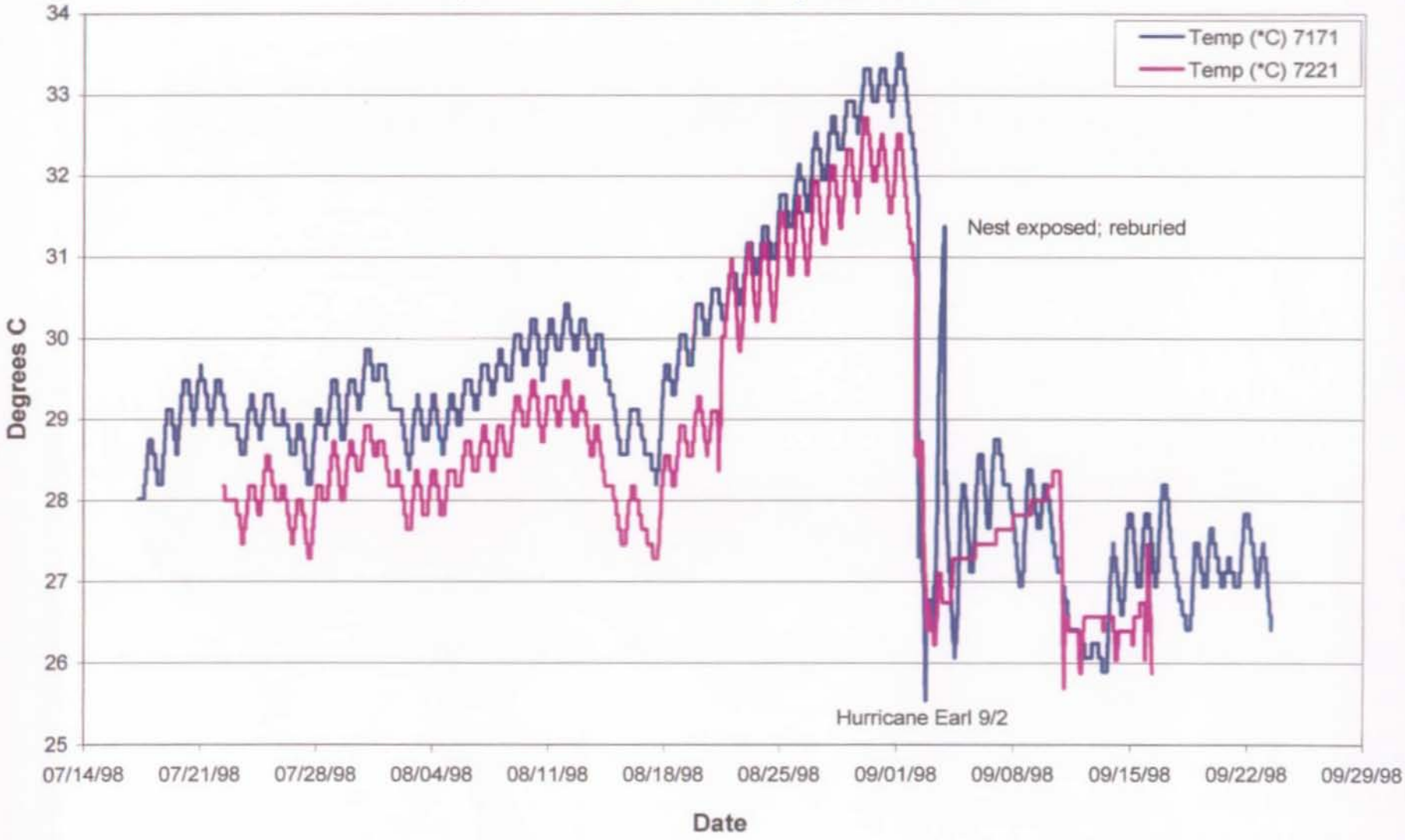


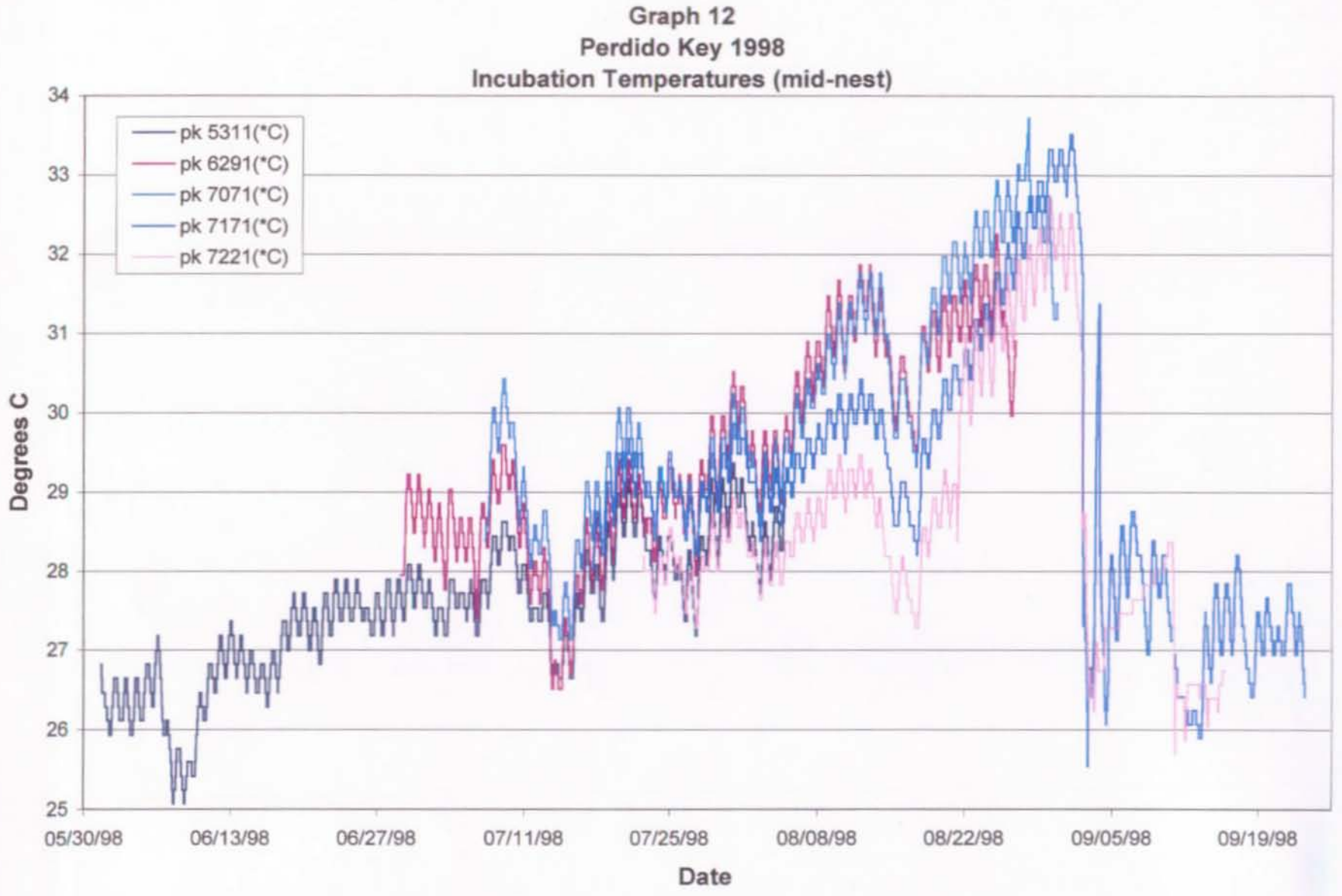
Graph 10 depicts the numbers of hatchlings observed entering the Gulf of Mexico. This graph is a reflection of the amount of hours spent monitoring nests to prevent disorientation caused by light pollution. By 1999, the vast majority of nests are watched by staff and volunteers when hatch time approaches. As a result, a large percentage of the hatchlings are observed entering the Gulf.



Graph 11- 12 These graphs show temperatures from different nests from 1997-99.

Graph 11
Perdido Key 1998
Temperature of Nests Affected by Hurricane Earl




Graph 12
Perdido Key 1998
Incubation Temperatures (mid-nest)
pk 5311(°C)
pk 6291(°C)
pk 7071(°C)
pk 7171(°C)
pk 7221(°C)
Degrees C
34
33
32
31
30
29
28
27
26
25
05/30/98
06/13/98
06/27/98
07/11/98
07/25/98
08/08/98
08/22/98
09/05/98
09/19/98
Date

In 1996, night patrols came across 2 female loggerheads nesting. Nest # PK612196 and PK619296 were video taped post egg deposition. During the summer of 1998, 4 nesting loggerheads were observed by staff (PK629198, PK630198, PK707198 and PK717198). The female that nested on Perdido Key on July 17th was a tagged turtle, tag # SS7707. She was flipper tagged by University of Florida researcher Meg Lamont on Eglin AFB property on Cape San Blas, Florida on June 15th, 1998. Five nesting loggerheads were observed in 1999 (PK615199, PK619199, PK625199, PK629199 and PK706199).

Tables 2, 3, 4, 5, 6 and 7 list data collected for each nest for the 1994-1999 seasons.

Maps 1, 2, 3 and 4 show turtle nests GPS locations of the 1996-99 nests for the District.

Problem Areas: Depredation, Tropical Weather and Disorientation

Depredation:

Perhaps the largest perennial problem for any sea turtle monitoring and conservation program is hatchling mortality. One of the largest threats within the Gulf Islands National Seashore is the depredation of nests and hatchlings. The major predator of sea turtle nests within GUIS is the Red Fox (*Vulpes vulpes)* (GUIS field data). This is an exotic species and the park is conducting removal efforts to minimize impacts to the turtles. Other known native predators of nests and hatchlings include ghost crabs, raccoons, coyotes and shorebirds. To alleviate depredation, GUIS is permitted by the State of Florida to use self-releasing screens over the nests, as described in the procedures. Some fox have managed to dig around the protective screen and tunnel into the egg cavity. Others were discouraged by the screen and ended their efforts.

Efforts to control depredation of sea turtle nests by exotic red fox in the Florida District of GUIS began in June of 1995. Fox were hunted along the north and south beaches, as well as behind the primary dune line. Flashlights were used to spot fox by illuminating their eyes. Patrols on ATV's were conducted primarily at Perdido Key after dark.

In 1995, fox were profuse on Perdido Key. Fox tracks were found in all areas of the island. An estimate of their numbers based on track counts and sightings on the island was approximately thirty animals. (Nicholas, pers. observation. 1995)

Patrols typically began at sunset and would continue until about 2400 hours. At first a .22 cal rifle was used to eradicate red fox. This proved ineffective, as it was difficult to hit the target at night with just one projectile. The rifle had to be aimed while simultaneously holding a flashlight on the fox, making it very cumbersome.

A short barreled 12-gauge shotgun was used as a replacement. While this provided a larger impact area, the effective range was considerably less than that of the rifle. At ranges of 20-25 meters, fox that were hit managed to leave the area. This occurred repeatedly. Typically the fox would call out indicating it was hit. When this sound was heard, it was counted as a hit. Upon moving to the area where the fox was hit, relocation of the fox proved difficult. This usually occurred in areas of thick scrub, which afforded the fox good hiding conditions. Occasionally, this occurred over white sand, which allowed an easy sighting of the wounded fox.

A long barreled 16 gauge shotgun was then used. This proved to be the most effective means of hitting and killing a fox. However, if the fox was not hit at a range of less than 25 meters, it again was capable of leaving the area while wounded. Fox tend to bleed very little when shot, so tracking was almost impossible.

As a result of some fox eluding gunfire, the fox soon learned that an ATV indicated danger. As a result, getting close to fox soon became difficult. Upon sighting or hearing the ATV, they soon began to flee into the dunes immediately.

Trapping was then attempted with large live traps. Different baits were used with no success. Trapping as a whole proved unsuccessful and no fox were caught. Only raccoons would enter the traps.

The following is a summary of some of the effort put forth to control fox on the islands of the Florida District. Removal efforts started on June 7th, 1995. The first fox were not shot until the night of June 23rd, 1995. On this night three fox were hit but none were located. On June 27th, one fox was hit but not found. On June 29th, one fox was shot, found and buried. On July 7th and 12th, three fox were hit each night. On August 1st, four fox were hit. On August 23rd, one fox and one cat were hit. On August 30th, one fox was shot and buried at Fort Pickens. In 1995, a total of sixteen fox were hit by gunfire at Perdido Key and one at Fort Pickens.

In 1996, little effort was devoted to the hunting of fox. Instead, efforts were directed at patrolling the south beach to find turtle nests before the fox could locate the nests. Patrols were typically conducted once a week from 2200 hours until about 0500 hours. Five nests were discovered on patrol before the fox could locate and depredate the nests. Numerous night patrols were conducted later in the summer during hatch time to prevent depredation and disorientation of hatchlings. This worked well but was time consuming. This effort appears to have reduced the amount of nests depredated by fox significantly. (Graph 16) Night patrols also reduced the amount of depredation of hatchlings later in the summer. Several hatches were witnessed on Perdido Key during night patrols. Numerous others were missed due to the long hours involved and the shortage of staff. The presence of staff at the nests afforded the hatchlings the chance to make it into the surf without succumbing to disorientation from artificial lighting or being consumed by fox. In our absence, hatchlings were often predated or disoriented.

Fox were still occasionally shot in the summer of 1996. On July 23rd, one fox was shot and buried on Perdido Key. On July 31st, two fox were hit at Santa Rosa, one was buried and the other was not found. On September 17th, one fox was hit and buried at Santa Rosa.

The presence of an ATV on the south beach at night seemed to force the fox to abandon searching for food on the south beach for several hours. This allowed nests to be found early in the morning intact when patrols were stopped before dawn, due to fatigue or weather. No depredation occurred, as the fox were most likely foraging in other areas. Nests that were depredated at Perdido Key typically occurred on evenings when no night patrols were conducted. No nests were depredated when patrols were conducted.

In 1997, night patrols were conducted once a week by staff. Volunteers occasionally did one other night patrol. Fox were not actively hunted; efforts were again directed at arriving at nests prior to the arrival of the predators. Two nests were found just after fox located the eggs and began to consume them. Both of these nests were located around 0300-0400 hrs on the initial patrol, with complete depredation being averted. One nest had 12 eggs consumed while the other had 18.

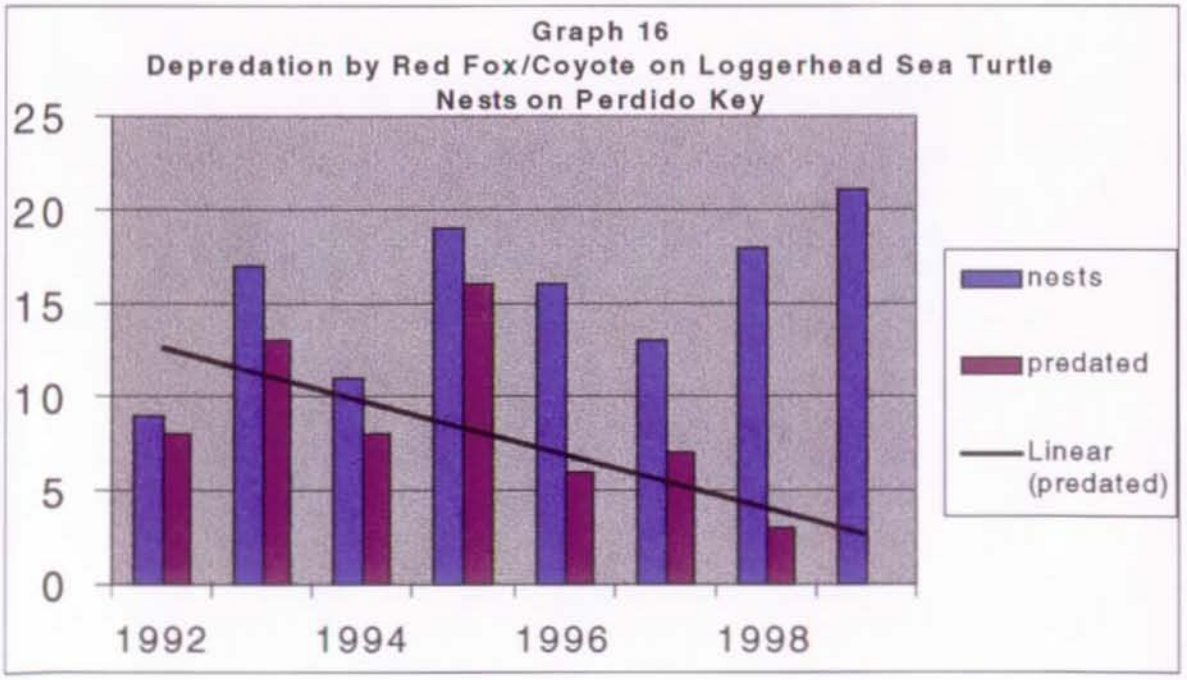
In 1997, one red fox was shot at Perdido Key on July 2.

In 1998, one female red fox was shot at Fort Pickens on May 7th.

Trapping was begun on Perdido Key in cooperation with trappers from USDA APHIS and RM staff on May 13, 1998. On May 14th, one red fox pup was removed from the point area. On the 15th an adult male red fox was removed. On June 5th, one male coyote was removed. A juvenile female was removed on June 8th and a juvenile male on June 10th. On June 29th, a female red fox and a female coyote were trapped.

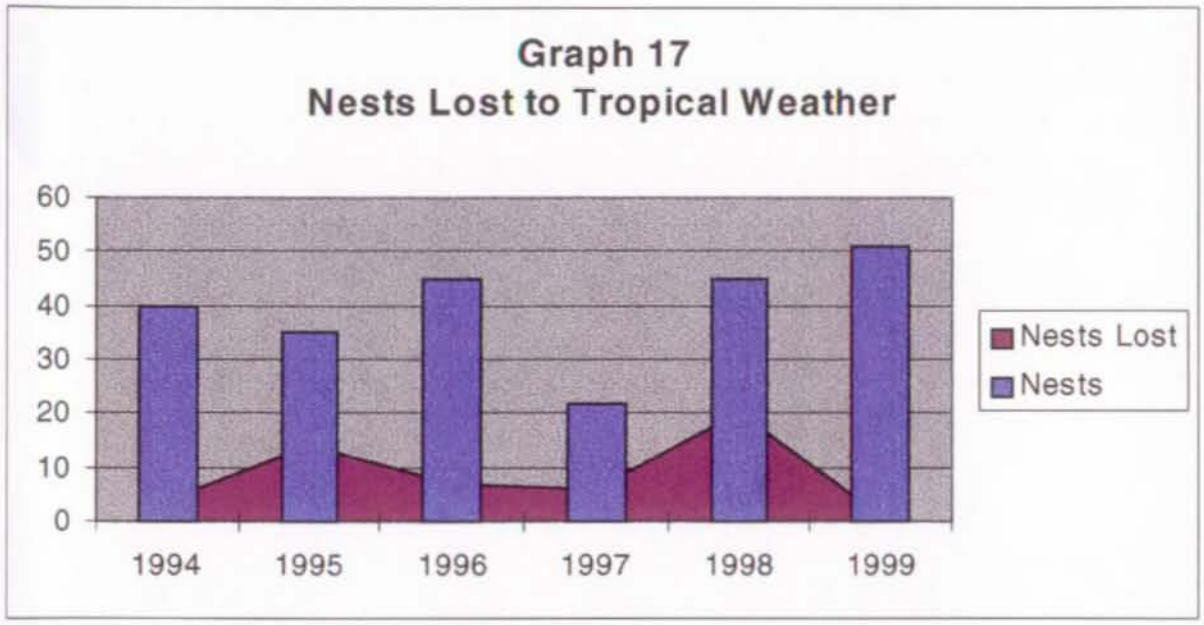
Trapping was again conducted at Perdido Key beginning in May of 1999. On May 5th, three red fox were removed, 2 male and 1 female. Another male fox was removed on May 6th. During late October, 2 coyotes and one red fox were removed.

Table 1 (page 37) is a list of the nests that were depredated during the 1994-1996 seasons. From this table, it is evident that predators are a major threat to the survival of sea turtle nests. In 1994, 30% of nests park wide were partially or completely depredated by red fox. In 1995, 31% of the nests were completely lost to predation, all of which were in the Perdido Key subdistrict. Another 26% of the nests that season were partially depredated; therefore, 57% of the nests park wide in 1995 were partially or completely depredated. In 1996, this percentage was greatly decreased to 13%. Only two nests were completely depredated, and four more were partially depredated, once again all were on Perdido Key. In 1997, 7 of 13 nests were depredated on Perdido Key. In 1998 there were three partial depredations by fox in the Perdido Key area. The 1999 season had zero depredation of sea turtle nests park wide. The amount of depredation that occurred solely on Perdido Key is reflected in graph 16.



Tropical Weather:

A grim result in the 1994-1998 period of sea turtle nesting seasons was the impacts of high water from tropical storms and hurricanes. In 1994, Tropical Storm Alberto washed out four nests and possibly several others. In 1995, Tropical Storm Dean and Hurricanes Allison, Erin and Opal all caused high waters that flooded and eroded at least 14 nests. Tropical Storm Josephine most likely was the demise of up to seven nests in 1996; three were lost to erosion and four were flooded or inundated with salt or rainwater. In 1997, Hurricane Danny destroyed at least six nests. In 1998, Hurricanes Earl and Georges together destroyed 19 of 45 nests, for a total of 42% of the nests. (See images on pages 28 and 29) The 1999 season was relatively storm free, with four nests being moved and one flooded due to high surf from Hurricane Bret off of Texas and Tropical Storm Harvey off of South Florida.



Although hurricanes are a recognized threat, "no data has been gathered, however, on either the immediate or the long term effects of hurricanes on adult sea turtles or their nesting beaches" (Milton et al, 1994). This should be an important concern to sea turtle biologists everywhere, because of the overlap of hurricane season (June-Nov) and sea turtle nesting season (May-Nov.).

There has been some research conducted on the immediate effect of hurricanes on sea turtle nests. The effects of Hurricane Hugo in 1989, and Hurricane Andrew in 1992, in regards to mortality of nests laid before the hurricanes have been reported (Starbird and Hillis, 1992; Milton at al. 1994). Hurricane Andrew caused 86% total mortality in nests from south Florida (Shaw et al. 1994). The greatest mortality was due to beach flooding associated with the hurricane produced storm surge, and sand accretion on top of nests (Milton et al. 1994).

The 1995 nesting activity from the three subdistricts of GUIS was analyzed to assess the impacts of hurricanes. There were 35 nests between the three subdistricts in 1995. Of these 35, three

were lost to Tropical Storm Dean, Hurricane Erin destroyed five, and six were lost to Hurricane Opal. This results in a 40% net loss of nests due to severe tropical storm damage in 1995.

Nests that were not washed out, but inundated with water, experienced numerous hatchlings expiring in their eggs. Based on the developmental stages, some of these embryos were within days of hatching. This mortality was most likely due to the effects of high water covering the eggs, which inhibited gas exchange.

In 1994-95, numerous nests were searched for but were not relocated for assessment due to the removal of nest markers by the associated storm. Beach patrols were continued to locate any nest hatching activity from a "lost" nest. If no signs of hatching were observed, the nest was assumed to be completely removed or expired from the high water of the storm.

The two hurricanes of 1995 destroyed most of the primary dune line throughout the GUIS survey areas. The lack of dunes and altered beach profile coincides with an increase of false crawls in the area for 1996. In 1994 there were 22 documented false crawls and 24 in 1995. The 1996 nesting season had 66 documented false crawls. This is a 287% increase from the previous two years. (Graph 5) An increased false crawl ratio has been reported on other hurricane-impacted beaches (Starbird and Hillis, 1992).

The 1996-1999 seasons witnessed a series of poor nest site selections by adult female turtles. A large portion of the nests were laid at or below the rack line which indicates the highest point of wave action. These nests were in danger of being washed over by waves during a high water event, which could prolong incubation times or kill the whole nest. Also, nests laid in these locations were threatened by erosion, as the beaches were shortened during the summer. For these reasons, more nests had to be relocated in 1996-99 than in any previous period, an activity that was not standard at GUIS. (Graph 9)

The change in beach profile has also created large areas where pools of water will occasionally accumulate. These pools are extremely dangerous to any nest which may be in or near these areas. Several nests were laid in these areas in 1996. A few were moved to higher ground to prevent the flooding of the nests. Some were left in place, for various reasons. The original nest site is given priority, unless it is fairly obvious it will perish from high water. Nests that were relatively close to the water but on high berm were usually left in place. Another reason was that although a few nests were in precarious positions, they could not be moved within the proper time frames that are required to move a nest with a high level of success.

Nests that were moved in 1996 did not seem to suffer any ill effects from the relocation process. In fact, their hatching success rate was higher than nests left *in situ, 66%* versus 47%. This trend continued until 1998 when Hurricanes Earl and Georges destroyed nests even if they were relocated. In that year it was 27% for relocated nests vs. 28% *in situ*. However, in 1999 the relocated nests again did better than the *in situ* nests, 92% vs. 78%. (Graph 8)

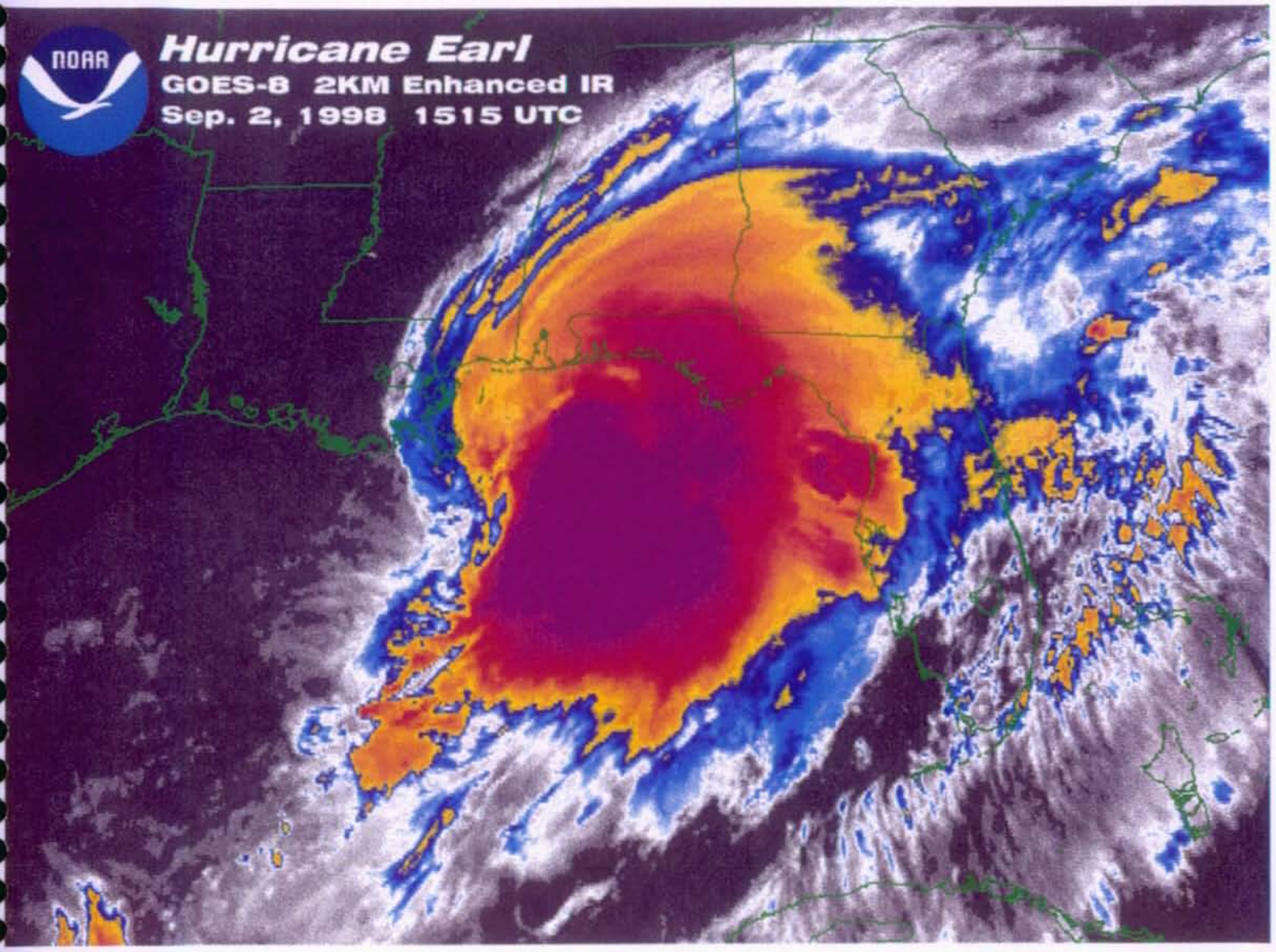
However, there is currently no way to understand the long-term effects that nest movement has on hatchlings as they mature. For instance, does it affect the female hatchlings ability to return to the area to nest upon the animals maturity? Does it lower survivability chances for hatchlings

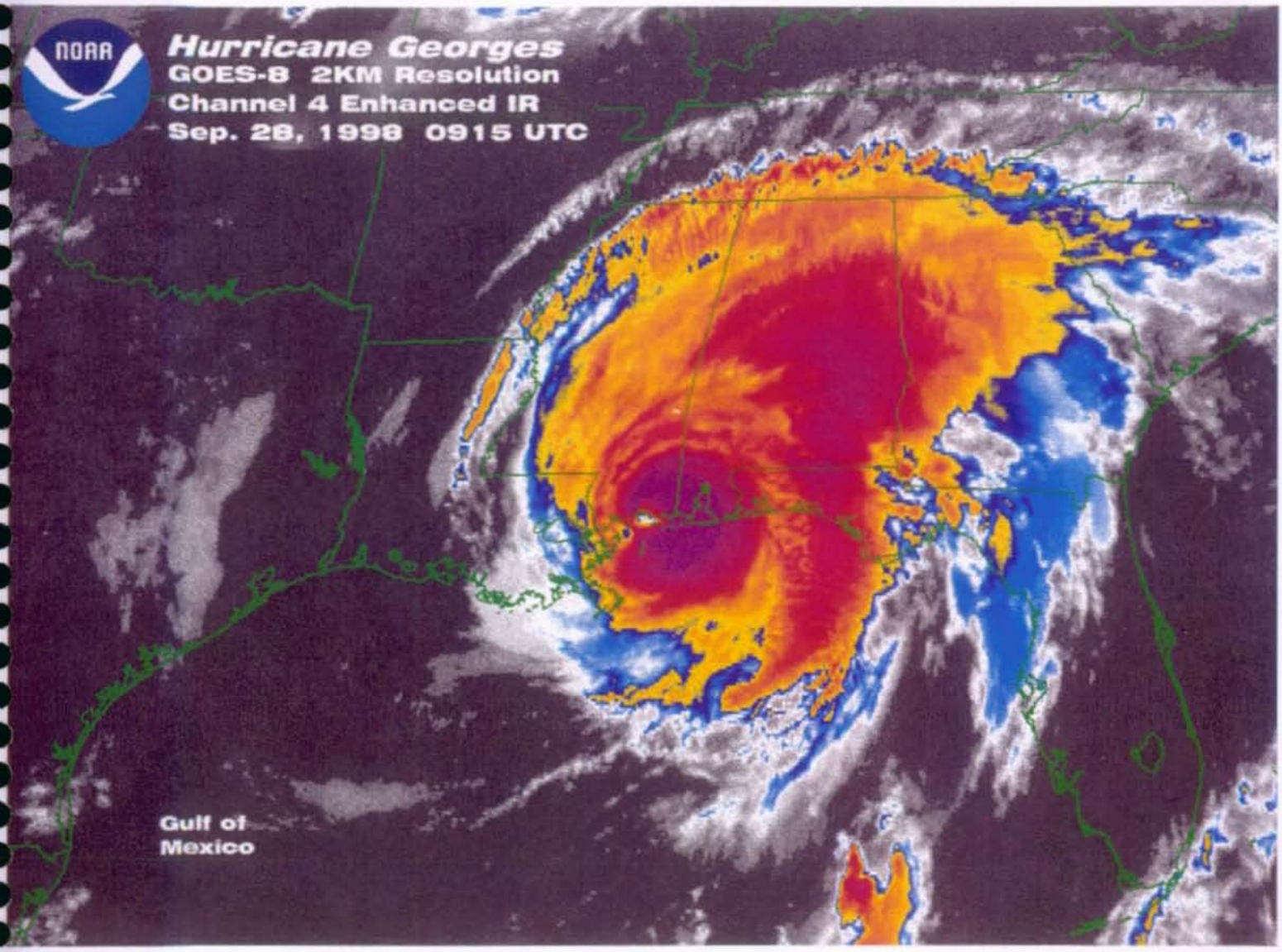
in their pelagic stage? Are we interfering with the natural process of nature selecting against females that nest low on the beach? The staff feels that the importance of increasing the number of hatchlings that enter the Gulf of Mexico over rides any of the above concerns.

The staff also considers the fact that none of the District's beaches are in a natural state. Santa Rosa and Fort Pickens have roads through the primary dune field and occasionally out on the active beach area. This has an impact on the shape of the beach, which has an impact on how much water a nest receives from high water. Perdido Key has been re-nourished with dredged material from Pensacola Bay, so that beach has been altered as well. When these factors are considered, it appears as though the park will continue to be relocating up to 25-30% of the nests in the near future.

As the beach reshapes through coastal processes, some other hindrances arise to adult and incubating sea turtles. Hillis (1990) noted that an eroded berm 1.5 to 2.0 meters high developed after Hurricane Hugo in 1989. This eroded berm, which looked like a sheer cliff at times, was also observed at GUIS in 1996. The escarpment was 1.0 to 1.5 meters at times and remained until it was smoothed by high waves several months later. A steep berm such as this could hinder adult turtles from gaining access to the beach.

In 1997, PB609197 was inundated with seawater as the hatchlings were digging their way out of the egg chamber. RM personnel prior to the inundation checked the nest. While these personnel were with another nest that was hatching in the Fort Pickens Area, the wave action, on-shore winds and tide cycle allowed water to pool over the nest. When RM personnel found the nest it was under 1 foot of water. Upon digging into the nest area, hatchlings were pulled from the sand and placed in a bucket. Most hatchlings were lethargic or motionless. In all, 68 hatchlings were recovered. After an hour in the bucket, the hatchlings were checked. Most were moving about energetically and 55 were released. Thirteen lethargic hatchlings were brought to the Gulfarium in Destin, Fl for later release. Only nine survived the ordeal and were released 10 days later near the Fort Pickens Ranger Station.

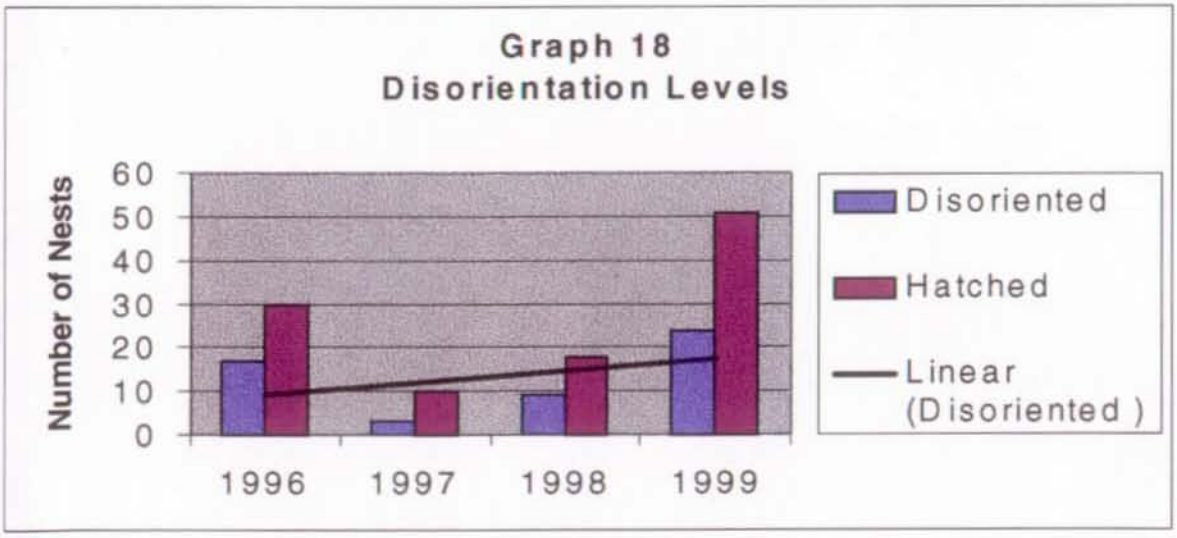

NOAA
Hurricane Earl
GOES-8 2KM Enhanced IR
Sep. 2, 1998 1515 UTC


NOAA
Hurricane Georges
GOES-8 2KM Resolution
Channel 4 Enhanced IR
Sep. 28, 1998 0915 UTC
Gulf of
Mexico

Disorientation:

Each year a few nests are missed during the morning patrols. This is usually the result of morning surveys that are missed due to severe weather or weather the previous evening has erased the crawl. If rain or high winds erase the crawl, it is impossible to locate the nest. In 1996 there was at least one nest that was missed, PK701196. A morning patrol later in the summer discovered the hatch. In 1999 there were two unmarked nests in the park and one on Pensacola Beach.

The level of hatchling disorientation due to artificial lighting is alarmingly high. In 1996, 17 of 30 nests experienced a level of over 25% of the hatchlings being disoriented. In 1997, 3 of the 10 nests that hatched were disoriented. In 1998, 9 of 18 nests that hatched were disoriented. Twenty-five of the 50 nests in 1999 experienced disorientation. Most hatchlings that become disoriented typically end up as food items for local predators. Disoriented hatchlings also afford predators in the back dune area the ability to track turtles back to the nest site. Other hatchlings become desiccated from the sun as the day transpires. Only the nests that hatch with sufficient moonlight are producing hatches where a majority of hatchlings make it into the Gulf of Mexico. Nests that hatch on nights with low levels of moonlight, either from cloud cover or moon phase, are almost certain to have high levels of disorientation. (Graph 18)



In an effort to lower disorientation levels, in 1996 and 1997, GUIS placed two-foot high black screens behind nests that are in areas with problem lighting. This can lower the amount of light that hatchlings are subjected to viewing upon emerging from the nest. This can help to a limited extent, but hatchlings have strayed off course after leaving the area protected by the screen. Screening to the water's edge is not practical, as wave action during a high tide will pull the screening down. This practice was discontinued in 1998.

While nest sitting at hatch time by staff and volunteers has been on going, it increased substantially in 1997 and again in 1998 and 1999. This can be reflected in the increase in the number of hatchlings witnessed entering the Gulf of Mexico.

Three adult female loggerhead turtles became severely disoriented after depositing their eggs on local beaches in 1996. The turtles crawled behind what was left of the primary dune line and then wandered in a direction opposite or parallel to the beach. Two of these occurrences were in the Fort Pickens area and the other was outside GUIS at Pensacola Beach. All three animals crossed major roads. One loggerhead turtle (FP710196) in the Fort Pickens area nested about a ¾ of a mile east of the ranger station and then crawled across Fort Pickens Road and entered Escambia Bay to the north. Visitors on the road discovered the loggerhead that had nest FP616196 at 0130 hrs. A park ranger transported the animal to the waters edge after it crawled for ¼ of a mile and it became apparent she would not find the Gulf on her own. She was transported in an ATV trailer. She was released with out any incident. PB716196 was the third disoriented adult turtle. She crawled across 399 and ended up in the swales just east of the Sugar Bowl development on Pensacola Beach. She was transported by front-end loader to the water. She crawled off into the Gulf unassisted.

The following year another turtle (FP807197) became disoriented in the ranger station area and crawled for 1/3 of a mile before entering the Gulf of Mexico. A local sheriff's deputy found a female (PB610197) on the road shoulder near the Sugar Bowl on Pensacola Beach. This female was transported in a pick-up truck to the water's edge. She then crawled into the Gulf with no apparent problems.

In 1998 a loggerhead (FP523198) became confused after nesting at the east end of Fort Pickens Area on Pensacola Beach and crawled for 0.28 of a mile before reentering the water at 0700 hrs.

Another female (SR624199) on the UWF property in 1999 crawled for over 1/3 of a mile. She crossed state road 399 four times. The turtle was observed on the beach at 0700 and shortly there after crawled into the Gulf of Mexico unassisted. (See map 5.)

Strandings:

In 1995 there were three strandings in the area, one adult loggerhead, one sub-adult loggerhead and one juvenile loggerhead.

In 1996 there were three strandings, two adult loggerheads and one Kemp's ridley. One of the loggerheads, an adult female, was found on Pensacola Beach entangled in heavy monofilament fishing line in May. She was most likely in the area to breed. A rather disturbing behavior by local cobia fishermen may have been the cause of her entanglement and death. These fishermen are known to follow marine turtles in local waters in the hopes of catching cobia that tend to swim in association with the turtles. Casts are made directly at the turtles in hopes of luring the cobia into striking the bait. It is inevitable that a mistake will be made, and the turtles will become entangled or hooked.

In 1997 there were six sub-adult loggerheads and six adult loggerhead turtles. The first adult was on April 29th, a male turtle. This stranding was the result of a boat hit. Four of the other five were females; boats struck most. One turtle was too decomposed to determine the sex. The last adult stranding was on July 14th. It appears that the adults were of breeding age and the strandings could be responsible for the decrease in nesting for the summer of 1997. (Graph 2)

In 1998 there were 5 strandings; one was unknown, one was a Kemp's ridley, one was a leatherback and two were loggerheads. The leatherback was discovered on Pensacola Beach on July 11th, the day of a US Navy Blue Angel air show. There were numerous pleasure and military boats in the area of Pensacola Beach. The turtle was struck and killed by a boat. The wound was fresh and the blood was red, indicating a recent wound. One of the loggerheads had a large (8cm length) stainless steel fishing hook in the lower esophagus.

In 1999 there were 4 green, 4 loggerhead and three Kemp's ridley stranded. The first green was a fresh dead turtle that appeared to have been hit by a boat. The carapace was cracked open in a rather large area. Fresh seagrass was in the stomach indicating the animal had recently fed and that it was healthy at the time of death. See photo:



Green Sea Turtle that was Struck by a Boat
NPS Photo by: Mark Nicholas

CONCLUSION

There were more documented nests within GUIS in 1999 than in any previous year. The 1999 season also witnessed the highest hatching success since the monitoring effort began. The higher nest levels may just be the result of improved surveys, but it comes as good news after an overall low success period for the previous 5 years of reproductive seasons.

The depredation of eggs from sea turtle nests is a serious problem at GUIS. Depredation of nests can be decreased by removal of some of the fox/coyote population, but this is currently problematic due to a variety of reasons described earlier. Regularly monitoring the beaches at night is another part to the solution, i.e., beating the foxes to the nests. But this requires personnel to complete the patrols. There are currently no permanent full time biological technicians in the park. Positions are currently seasonal with a dependence on project money.

Depredation of hatchlings that are emerging from the nest can be lowered by consistently monitoring nests on nights when hatching is expected. This is a difficult and time-consuming procedure, as some nests do not hatch until several nights after the suspected hatch night. Volunteers and staff can become less resolute after a couple of monotonous nights. The problem of depredation of hatchlings is further compounded by disorientation, which increases their exposure to predators and the environment.

Solutions to the disorientation of hatchlings by lights are being explored. This problem is not one that can be solved by GUIS alone. It will involve a combined effort by biologists, local government and residents throughout the area. Without a reduction in ambient light, hatchling disorientation will continue and thereby reduce chances for overall species survival.

As a result of Hurricanes Erin, Opal, Danny and Georges altering beach profiles, and the ever increasing amount of light pollution from development, hatchling and adult disorientation will continue in the near future. It may be lessened to some degree when the dunes rebuild to pre-Opal levels or ambient light levels are lowered through a local lighting ordinance. The current morphology of the beaches will allow flooding problems to continue and persist over the next couple of turtle seasons. Some nests will most likely require being moved to higher ground to avoid inundation. All nests in poor or less than optimal positions should not be moved, but a portion should be moved to help ensure that overall nest success is not drastically low. The 1996-99 period proved nests can be relocated and have very good hatching success rates as the end result.

Each year several turtles are found stranded (dead) on local beaches. A few of these are breeding females. The causes of the mortality vary and some are the result of boat hits, fishing gear and for some, no cause can be determined. This indicates pollution, natural causes or possibly asphyxiation, ie. submersion in shrimp nets. This population of turtles is very small, with each individual breeding female turtle contributing a relatively high percentage to the total of each seasons eggs. The loss of breeding females before their time from human causes is a large factor contributing to the decline of these species. This report recommends a required boating course/license for all boaters in the State of Florida, possible limits on the amount of horsepower that engines can have on boats, stricter enforcement of illegal fishing methods and a higher commitment to public education.

LITERATURE CITED

Bjorndal, K.A., ed. (1982) Biology and Conservation of Sea Turtles. Smithsonian Institution Press: Washington, D. C. pp. 615.

Gulf Islands National Seashore (1996) Gulf Islands National Seashore Sea Turtle Monitoring Program Field Guide. National Park Service. Unpubl.

Hillis, Z.M. (1990) Buck Island Reef National Monument Sea Turtle Research Program: 1989- The year of hawksbills and hurricanes. In: Proc. Tenth Ann. Workshop on Sea Turtle Biol. Conserv. NOAA Tech. Mem. NMFS-SEFC-278: 15-18.

Lebuff, C.R. (1990) The Loggerhead Turtle in the Eastern Gulf of Mexico. Sanibel, FL: Caretta Research. pp. 216.

Limpus, C.J., V. Baker and J.D. Miller (1979) Movement induced mortality of Loggerhead eggs. Herpetologica. 35(4): 335-338.

Mayfield, M. and M. Lawrence. 1996. 1995 Atlantic Hurricane Season Summary. In: Hurricane Preparedness: Facing the reality of more and bigger storms. Eighteenth Annual National Hurricane Conference. Lawrence S. Tait, editor. pp. 1-5.

Milton, S.L., S. Loene-Kabler, A. Schulman, and P. L. Lutz (1994) The effects of Hurricane Andrew on the sea turtle nesting beaches of south Florida. In: Proc. Fourteenth Ann. Symp. Sea Turtle Biol. Conserv. NOAA Tech. Mem. NMFS-SEFSC-351:81.

Mrosovsky, N. (1988) Pivotal temperatures for loggerhead turtles (*Caretta caretta*) from northern and southern nesting beaches. Can. J. Zool. 66: 661-669

Onset Computer Corporation (1996) Optic Stowaway Temp User's Manual. Onset Computer Corporation. pp. 5.

Reinhold, T.A. (1994) Distribution and abundance of nesting marine turtles utilizing the Gulf Islands National Seashore, Florida District. A report to Gulf Islands National Seashore. Unpubl.

Shaw, S.L., A.A. Schulman, and P.L. Lutz (1994) The effects of Hurricane Andrew on a monitored *Caretta caretta* nesting beach. In: Proc. Thirteenth Ann. Symp. Sea Turtle Biol. Conserv. NOAA Tech. Mem. NMFS-SEFSC-341:170-171.

Starbird, C. and Z.M. Hillis (1992) The effects of Hurricane Hugo on the nesting

behavior of hawksbill sea turtles on Buck Island Reef National Monument, U.S. Virgin Islands. Proc. Eleventh Ann. Symp. Sea Turtle Biol. Conserv. NOAA Tech. Mem. NMFS-SEFSC-302:114-115.

Stone, G.W. (1996) Researchers study impact of Hurricane Opal on Florida coast. Amer. Geophysical Union. 77(19): 181, 184.

Yntema, C.L., and N. Mrosovsky (1982) Critical periods and pivotal temperatures for sexual differentiation in loggerhead sea turtles. Can. J. Zool. 60: 1012-1016.

Zimmerman, C.S. and G.W. Hopkins (1992) Sea Turtle Nesting Monitoring Handbook. Gulf Islands National Seashore, Florida-Mississippi. Unpubl.

TABLE 1

List of Nests Predated by Fox/Coyote
1994-1999

	1994	1995	1996	1997	1998	1999
Complete Depredation:	PK 6291 PK 7281 PK 8041	PK 6031 PK 6102 PK 6201 PK 6222 PK 7061 PK 7151 PK 7241 PK 7242 PK 7261 PK 7281 PK 7301	PK 5241 PK 7151	PK7271	NA	NA
Partial Depredation:	PK 6161 PK 6221 PK 6281 PK 6301 PK 7231 SR 6021 SR 6141 SR 6181 SR 6242 SR 6292 SR 8031	PK 6272 PK 6291 PK 7031 PK 7062 PK 7101 FP 5281 FP 6031 FP 6061 FP 6121 FP 6271 FP 6281	PK 5271 PK 6071 PK 6211 PK 7031 PB6231	PB8211 PK5211 PK6081 PK6251 PK7021 PK7101 PK7251 PK7311	PK6101 PK6131 PK6171	NA

Table 2

1994 GUIS Turtle Data

District	Nest #	Species	Location	Incub. Dys	# Eggs	#Predated	# w/o dev	# w/devel	#hatched	% hatch	Disorient
Santa	6021	loggerhd	5.3 w	79	77	crab	5	0	72	94	no
Rosa	6111	unknown	0.6e	TS Alberto	unknown	none	unknown	unknown	0	0	NA
	6141	loggerhd	4.1w	82	100	fox	1	20	79	79	yes
	6181	loggerhd	4.5w	85	145	crab 2	21	30	94	65	yes
	6241	loggerhd	1.5w	lost	unknown	none	unknown	unknown	unknown	unk	NA
	6242	loggerhd	0.2w	70	129	crab 2	2	0	127	98	no
	6261	loggerhd	1.7e	TS Alberto	unknown	none	unknown	unknown	0	0	NA
	6291	unknown	2.5w	TS Alberto	unknown	none	unknown	unknown	0	0	NA
	6292	loggerhd	4.1w	64	89	fox	6	0	83	93	yes
	7082	loggerhd	3.0e	unknown	unknown	none	unknown	unknown	unknown	unk	NA
	7091	green	1.8w	71	155	crab 1	95	7	53	34	no
	7161	loggerhd	0.7w	67	105	none	2	1	102	97	no
	7211	loggerhd	2.55e	83	101	none	2	1	98	97	unknown
	7212	loggerhd	3.2w	66	162	none	5	0	157	97	unknown
	7241	green	2.6w	70	157	none	10	51	96	61	no
	7261	loggerhd	4.2w	lost	unknown	none	unknown	unknown	0	0	NA
	7281	loggerhd	0.3e	lost	unknown	none	unknown	unknown	unknown	unk	NA
	7291	loggerhd	0.8w	69	100	none	1	0	99	99	no
	8031	green	2.8w	73	156	fox	52	1	103	66	yes
	8101	unknown	1.1e	lost	unknown	none	unknown	unknown	unknown	unk	NA
	8111	loggerhd	4.7w	lost	unknown	none	unknown	unknown	unknown	unk	NA
	8281	loggerhd	2.59w	NA	131	none	90	41	0	0	NA
	9031	loggerhd	3.0w	lost	unknown	none	unknown	unknown	unknown	unk	NA
n=	**23**			**12**	**13**		**13**	**13**	**12**	**17**	
Sum				**879**	**1607**	**3 of 23**	**292**	**152**	**1163**		**4 of 10**
Mean				**73.3**	**123.6**		**22.5**	**11.7**	**68**	**58**	
Perdido	6161	unknown	3.2e	NA	unknown	fox 27	12	4	0	0	NA
Key	6221	unknown	5.0e	82	unknown	fox	unknown	unknown	50+	unk	yes
	6281	unknown	3.5e	unknown	unknown	fox 11	unknown	unknown	unknown	unk	NA
	6291	unknown		NA	unknown	complete	NA	NA	0	0	NA
	6301	loggerhd	1.7e	unknown	unknown	fox 50-60	unknown	unknown	unknown	0	NA
	7061	loggerhd	2e	unknown	unknown	attempted	unknown	unknown	unknown	unk	NA
	7071	loggerhd	0.5e	61	unknown	none	0	2	21	unk	NA
	7191	loggerhd	0.75e	unknown	123	none	18	3	102	83	unknown
	7231	loggerhd	3.5e	unknown	unknown	fox	unknown	unknown	unknown	unk	NA
	7281	unknown	3.3e	NA	unknown	complete	NA	NA	0	0	NA
	8041	unknown	3.0e	NA	unknown	complete	NA	NA	0	0	NA
n=	**11**			**2**	**1**		**3**	**3**	**1**	**6**	
Sum				**143**	**123**	**9 of 11**	**245**	**9**	**123**		**1 0f 1**
Mean				**71.5**	**123**		**10**	**1**	**21**	**14**	
Fort	6081	loggerhd	0.25w	TS Alberto	unknown	none	unknown	unknown	0	0	unknown
Pickens	7071	loggerhd	5.5e	66	104	none	5	0	99	95	yes
	7251	loggerhd	1.25e	80	140	none	36	52	52	37	unknown
	7281	loggerhd	2.5e	unknown	unknown	none	unknown	unknown	unknown	unk	unknown
	8111	loggerhd	0.5w	unknown	unknown	none	unknown	unknown	unknown	unk	unknown
	8131	loggerhd	0.5e	unknown	unknown	none	unknown	unknown	unknown	unk	unknown
n=	**6**			**2**	**2**		**2**	**2**	**2**	**3**	
Sum				**146**	**244**	**0 of 6**	**41**	**52**	**151**		**1 0f 1**
Mean				**73**	**122**		**20.5**	**26**	**50**	**44**	
TOTAL											
n=	**40**			**16**	**16**		**18**	**18**	**15**	**26**	
Sum				**1168**	**1974**	**12 of 40**	**363**	**213**	**1437**		**6 of 12**
Mean				**73**	**123.4**		**20.2**	**11.8**	**55**	**46**	
Std Dev				**7.7**	**27.3**		**29.6**	**18.5**	**51**	**43**	

Disorient- a "yes" implies greater than 25% of nest experienced disorientation

Table 3

1995 GUIS Turtle Data

District	Nest #	Species	Location	Incub. Dys	# Eggs	#Predated	# w/o dev	# w/devel	#hatched	% hatch	Disorient	Moved
Santa	6061	loggerhd	4.5w	63	75	none	0	0	75	100	unknown	
Rosa	6301	loggerhd	0.75e	75	98	none	37	1	60	61	no	
	7041	green	0.5w	Hurr. Erin	NA	none	NA	NA	0	0	NA	
	7051	loggerhd	0.25e	Hurr. Erin	NA	none	NA	NA	0	0	NA	
	7052	loggerhd	2.55e	Hurr. Erin	NA	none	NA	NA	0	0	NA	
	7071	loggerhd	3w	Hurr. Erin	NA	none	NA	NA	0	0	NA	
	7072	loggerhd	4.6w	68	98	none	49	1	48	49	no	
	7101	loggerhd	0.5e	Hurr. Erin	NA	none	NA	NA	0	0	NA	
	7131	loggerhd	2.5e	Hurr. Erin	115	35 fox	NA	NA	0	0	NA	<12 hrs
n=	9			3	4		3	3	3	9		
Sum				206	386	1 of 9	86	2	183		0 of 2	1 of 11
Mean				68.7	96.5		28.7	0.7	20	23		
Perdido	6031	loggerhd	4e	NA	NA	Complete	NA	NA	0	0	NA	
Key	6102	loggerhd	2.5e	NA	NA	Complete	NA	NA	0	0	NA	
	6201	loggerhd	3.25e	NA	NA	Complete	NA	NA	0	0	NA	
	6221	loggerhd	2.75e	NA	NA	Complete	NA	NA	0	0	NA	
	6271	loggerhd	0.5e	98	116	none	93	17	6	5	NA	
	6272	loggerhd	4.5e	98	103.8 +/-1(	fox 12	11	1	1	1	NA	
	6291	loggerhd	5.25e	Hurr. Opal	NA	none	NA	NA	0	0	NA	
	6301	loggerhd	6.5e	95	107	none	91	12	4	4	NA	
	7031	loggerhd	4.5e	Hurr. Opal	NA	none	NA	NA	0	0	NA	
	7061	loggerhd	3.5e	NA	NA	Complete	NA	NA	0	0	NA	
	7062	loggerhd	4e	Hurr. Opal	NA	fox	NA	NA	0	0	NA	
	7101	loggerhd	2.5e	85	103.8 +/-1(	fox 6	52	0	22	21	unknown	
	7151	loggerhd	2.5e	NA	NA	Complete	NA	NA	0	0	NA	
	7201	loggerhd	2.5e	Hurr. Opal	NA	none	NA	NA	0	0	NA	
	7241	loggerhd	1.5e	NA	NA	Complete	NA	NA	0	0	NA	
	7242	loggerhd	2.5e	NA	NA	Complete	NA	NA	0	0	NA	
	7261	loggerhd	2.5e	NA	NA	Complete	NA	NA	0	0	NA	
	7281	loggerhd	1e	NA	NA	Complete	NA	NA	0	0	NA	
	7301	loggerhd	4e	NA	NA	Complete	NA	NA	0	0	NA	
n=	19			4	2		4	4	4	19		
Sum				376	223	14 OF 19	247	30	33			
Mean				94	111.5		61.8	7.5	2	2		
Fort	5281	loggerhd	1.2w	TS Dean	NA	fox 3	NA	NA	0	0	NA	
Pickens	6031	loggerhd	1.2w	75	127	fox 4	4	114	5	4	NA	
	6061	loggerhd	1.25e	79	103.8 +/-1(	fox 7	1	30	25	24	unknown	
	6121	loggerhd	3.7e	TS Dean	NA	fox 7	NA	NA	0	0	NA	
	6271	loggerhd	1.7e	63	94	fox 4	65	1	24	26	unknown	
	6281	loggerhd	2.7e	Hurr. Opal	NA	fox 8	NA	NA	0	0	NA	
	7151	loggerhd	2.55e	TS Dean	NA	none	NA	NA	0	0	NA	
n=	7			3	2		3	3	3	7		
Sum				217	221	6 OF 7	70	145	54			
Mean				72.3	110.5		23.3	48.3	8	8		
TOTAL												
n=	35			10	8		10	10	10	35		
Sum				799	830	21 OF 35	403.0	177	270			1 of 35
Mean				79.9	103.8		40.3	17.7	8	8		
Std Dev				13.6	16.1		35.8	35.3	18	21		

Disorient- a "yes" implies greater than 25% of the nest experienced disorientation

Table 4

1996 GUIS Turtle Data

District	Nest #	Species	Loc	Hatch Date	Incub Days	# Eggs	#Predated	# without develop	# with develop	# hatch	% hatch	Disorient	# in Water	Moved
Santa	6111	loggerhd	1.3e	817	67	102	none	15	3	84	82	YES	84	no
Rosa	6141	loggerhd	0.22e	816	63	104	none	4	0	100	96	YES	2	< 12 hrs
	6142	loggerhd	1.3e	823	70	118	none	6	4	108	92	YES	42	no
	6171	loggerhd	0.1w	826	70	127	none	2	15	110	87	NO	NA	no
	6211	loggerhd	0.45w	822	62	140	none	15	3	122	87	YES	NA	no
	6212	loggerhd	1.8w	NA	NA	111	none	103	8	0	0	NA	NA	no
	6251	loggerhd	2.65e	828	64	113	none	4	19	88	78	NO	89	> 2 wks
	7021	loggerhd	1.1w	919	79	120	none	105	7	8	7	YES	2	no
	7071	loggerhd	0.55e	NA	NA	149	none	149	0	0	0	NA	NA	no
	7072	loggerhd	0.7w	909	65	93	none	3	0	90	97	YES	90	no
	7073	loggerhd	4.25w	913	68	102	none	5	56	41	40	YES	7	no
	7074	loggerhd	0.65w	910	65	94	none	3	10	81	86	YES	81	no
	7161	loggerhd	0.65w	919	65	123	none	4	0	119	97	NO	119	no
	7171	green	2.6e	918	63	171	none	11	0	160	94	YES	158	no
	7191	loggerhd	2.2w	917	60	95	none	2	0	87	92	unknown	1	< 12 hrs
	7251	loggerhd	2.15w	930	67	110	none	10	0	100	91	unknown	12	< 12 hrs
	8061	loggerhd	1.45e	1020	75	111	none	21	4	86	77	NO	78	< 12 hrs
	8111	green		NA	TS Josephine	175	none	17	158	0	0	NA	NA	no
	8121	loggerhd		NA	TS Josephine	NA	none	NA	NA	NA	NA	NA	NA	no
n=	**19**				**15**	**18**		**18**	**18**	**15**	**18**			
Sum					**1003**	**2158**	**NONE**	**479**	**287**	**1384**		**9 of 15**	**765**	
Mean					**66.9**	**119.9**		**27**			**67**			
Perdido	5241	loggerhd	3.7e	NA	NA	NA	Complete	NA	NA	0	0	NA	NA	no
Key	5271	loggerhd	6.4e	NA	NA	114	fox 7	101	6	0	0	NA	NA	no
	6051	loggerhd	0.05w	810	67	134	none	2	0	132	99	YES	2	< 12 hrs
	6071	loggerhd	2.4e	822	77	92	fox 30	44	3	10	11	NA	NA	no
	6121	loggerhd	6.0e	819	69	114	none	4	0	110	96	YES	102	no
	6191	loggerhd	0.1e	821	63	129	none	3	3	123	95	unknown	1	no
	6192	loggerhd	5.1e	819	61	129	none	5	0	124	96	YES	NA	< 12 hrs
	6211	loggerhd	0.78e	825	65	107	fox 52	33	4	18	17	NO	1	no
	7011	loggerhd	0.15e	909	68	96	none	6	4	86	90	YES	NA	no
	7031	loggerhd	5.7e	NA	NA	74	fox 7	67	0	0	0	NA	NA	> 2 week
	7032	loggerhd	1.3e	911	70	106	none	2	1	103	97	YES	103	no
	7071	loggerhd	0.4e	NA	TS Josephine	NA	none	NA	NA	NA	NA	NA	NA	no
	7072	loggerhd	2.7e	911	66	95	none	1	29	65	68	YES	3	no
	7151	loggerhd	5.5e	NA	NA	NA	Complete	NA	NA	0	0	NA	NA	no
	7161	loggerhd	4.1e	NA	TS Josephine	125	none	125	0	0	0	NA	NA	no
	8121	loggerhd	2.45e	1029	78	111	none	15	62	34	31	NO	29	< 36 hrs
n=	**16**				**10**	**13**		**13**	**13**	**10**	**15**			
Sum					**684**	**1426**	**6 of 16**	**408**	**112**	**805**		**6 of 10**	**241**	
Mean					**68.4**	**109.7**		**31**	**9**	**54**	**47**			
Fort														
Pickens	6151	loggerhd	2.8w	830	75	100	none	30	47	23	23	YES	6	> 2 wks
	6161	loggerhd	0.15e	NA	NA	107	none	2	105	0	0	NA	NA	no
	6271	loggerhd	4.7e	828	62	118	none	11	2	105	89	NO	105	< 12 hrs
	7101	loggerhd	2.85e	NA	NA	99	none	99	0	0	0	NA	0	> 2 wks
	7191	loggerhd	0.09e	930	73	126	none	64	35	27	21	YES	NA	no
	7301	loggerhd	3.65e	NA	TS Josephine	NA	none	NA	NA	0	0	NA	NA	no
	8011	loggerhd	0.13e	1006	66	114	none	6	2	106	93	unknown	10	no
	8051	loggerhd	1.8e	1017	73	101	none	4	8	89	88	NO	89	< 12 hrs
	8141	loggerhd	1.35e	NA	TS Josephine	92	none	4	88	0	0	NA	NA	no
	8231	green	1.0w	NA	TS Josephine	120	none	39	81	0	0	NA	NA	no
n=	**10**				**5**	**9**		**9**	**9**	**5**	**10**			
Sum					**349**	**977**	**NONE**	**259**	**368**	**350**		**2 of 5**	**210**	
Mean					**69.8**	**108.6**		**29**	**41**	**35**	**31**			
TOTALS														
n=	**45**				**30**	**40**	**6 of 45**	**40**	**40**	**30**	**43**	**17 of 30**		**13**
Sum					**2036**	**4561**		**1146**	**767**	**2539**			**1216**	
Mean					**67.9**	**114.0**		**29**	**19**	**59**	**52**			
Std Dev					**5.2**	**20.2**		**40**	**35**	**51**	**43**			

Disorient- a "yes" implies greater than 25% of nest experienced disorientation

in Water- hatchlings "observed" entering water

Table 5

1997 GUIS Turtle Data

DISTRICT	NEST #	Species	Loc	Incub Days	# Eggs	#Predated	# without develop	# with develop	# hatch	% hatch	Dis-oriented	# in Water	Moved
Santa	6191	loggerhd	.9W	66	120	Y GC	70	19	11	9	N	NA	> 2 WKS
Rosa	6301	loggerhd	W	NA	116	N	115	1	0	0	NA	NA	N
	6302	loggerhd	W	66	135	N	19	6	110	81	Y	110	N
	7151	loggerhd	W	60	124	N	0	4	120	97	N	119	36 HRS
	7152	loggerhd	W	NA	127	N	126	1	0	0	NA	NA	N
	7271	loggerhd	W	63	126	N	9	0	117	93	Y	117	N
n=	**6**			**4**	**6**		**6**	**6**	**4**	**6**			
Sum				**255**	**748**	**1 of 6**	**339**	**31**	**358**	**280**	**2 of 4**	**346**	**2 OF 6**
Mean				**64**	**125**		**57**	**5**	**60**	**47**		**115**	
Perdido	5211	loggerhd	1.3E	NA	NA	Fox 26	12	8	NA	UNK	NA	10	> 2 WKS
Key	6081	loggerhd	5.3E	Danny	NA	Fox 30	NA	NA	NA	0	NA	NA	N
	6141	loggerhd	2.5E	Danny	NA	N	NA	NA	NA	0	NA	NA	N
	6161	loggerhd	3.2E	Danny	NA	N	NA	NA	NA	0	NA	NA	N
	6251	loggerhd	6.2E	Danny	NA	Fox 11	NA	NA	NA	0	NA	NA	N
	6291	loggerhd	1.8E	60	71	N	22	1	48	68	NA	44	> 2 WKS
	7021	loggerhd	4.8E	Danny	NA	Fox 18	NA	NA	NA	0	NA	NA	N
	7101	loggerhd	5E	Danny	NA	N	NA	NA	NA	0	NA	NA	N
	7131	loggerhd	.75E	66	142	N	106	17	19	13	N	NA	N
	7251	loggerhd	4E	NA	NA	Fox>70%	NA	NA	NA	UNK	NA	2	N
	7271	loggerhd	.75E	NA	NA	Fox - all	NA	NA	NA	0	NA	NA	N
	7301	loggerhd	5.5E	63	91	N	5	0	86	95	Y	86	N
	7311	loggerhd	.75W	61	UNK	Fox	4	12	70	UNK	N	70	N
n=	**13**			**4**	**3**		**5**	**5**	**4**	**10**			
Sum				**250**	**304**	**7 of 13**	**149**	**38**	**204**	**176**	**1 of 3**	**212**	**2 OF 13**
Mean				**63**	**101**		**29**	**8**	**68**	**18**		**52**	
Fort	5271	loggerhd	.5W	74	124	N	45	2	69	56	N	59	<12 HRS
Pickens	8031	loggerhd	.1W	62	118	N	5	0	113	96	N	109	N
	8071	loggerhd	.25E	61	92	N	1	1	90	98	N	90	N
n=	**3**			**3**	**3**		**3**	**3**	**3**	**3**			
Sum				**197**	**334**	**0 of 3**	**51**	**3**	**272**	**250**	**0 OF 3**	**258**	**1 OF 3**
Mean				**66**	**111**		**17**	**1**	**91**	**83**		**86**	
Totals													
n=	**22**			**11**	**13**	**8 of 22**	**14**	**14**	**11**	**19**	**3 of 10**	**816**	**4 OF 22**
Sum				**702**	**1386**		**539**	**72**	**853**				
Mean				**64**	**116**		**39**	**5**	**66**	**37**			
Std Dev				**4**	**21**		**46**	**6**	**46**	**44**			

Disorient- a "yes" implies greater than 25% of nest experienced disorientation
in Water- hatchlings "observed" entering water

Table 6

1998 GUIS TURTLE DATA

District	Nest #	Species	Loc	Hatch Date	Incub Days	# Eggs	#predated	# without develop	# with develop	# hatch	% hatch	Dis-oriented	# in Water	Moved
Santa Rosa	5271	loggerhd	1.5 W	8/9	75	108	Y	2	2	104	96	N	16	N
	6171	green	1.5 E	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	N
	6271	loggerhd	2.5 W	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	6272	green	3 E	8/31	65	114	N	62	2	50	44	Y	49	N
	6281	loggerhd	0.5 W	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	6301	loggerhd	2 W	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	7061	loggerhd	2.5 E	NA	NA	145	0	16	129	0	0	NA	0	> 2 wks
	7151	loggerhd	4 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	7161	loggerhd	2.5 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	7261	loggerhd	3.5 W	NA	Georges	NA	NA	NA	NA	0	0	NA	NA	> 2 wks
	7281	loggerhd	1.5 W	NA	H Earl	88	NA	1	87	0	0	NA	NA	<12 hrs
	8061	loggerhd	2 W	NA	Georges	NA	NA	NA	NA	0	0	NA	NA	< 12 hrs
	8071	loggerhd	.5 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	8101	loggerhd	4 W	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	8102	loggerhd	2 E	NA	Georges	152	NA	7	145	0	0	NA	NA	N
	8181	green	2 E	NA	NA	151	0	20	131	0	0	N	0	N
	8191	loggerhd	1.5 E	NA	Georges	NA	NA	NA	NA	0	0	NA	NA	N
	8231	loggerhd	1.5 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	9061	loggerhd	3.5 W	NA	NA	92	(8 CRAB)	1	91	0	0	NA	NA	N
n=	19			2	2	5		5	5	2	18			
Sum					140	850	0 OF 19	101	355	154		1 of 2	65	4 of 19
Mean					70	121		20	84	9	8		22	
Perdido Key	5311	Kemp's	3 E	8/3	64	130	0	108	7	15	11	Y	11	N
	6101	loggerhd	1.5 E	8/18	69	119+/-2	Fox # UNK	5	0	30	25	N	30	N
	6131	loggerhd	6.3 E	NA	H Earl	NA	Fox - 48+	NA	NA	0	0	NA	NA	N
	6171	loggerhd	1.5 E	8/16	60	119+/-2	Fox # UNK	19	2	69	58	Y	0	N
	6241	loggerhd	.6 E	8/26	64	113	0	5	2	106	94	Y	106	N
	6291	loggerhd	.5 E	8/26	57	107	1 -crab	11	2	94	88	Y	0	N
	6301	loggerhd	4.5 E	8/26	57	131	0	2	0	129	99	Y	129	N
	7071	loggerhd	1 E	8/29	54	141	Y	2	0	139	99	Y	2	N
	7091	loggerhd	5.3 E	UNK	UNK	104	0	4	67	33	32	UNK	1	N
	7121	loggerhd	2 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	7171	loggerhd	2 E	NA	NA	124	0	5	119	0	0	NA	0	> 2 wks
	7172	loggerhd	3.5 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	7201	loggerhd	4.5 E	9/15	56	109	0	7	18	84	77	N	84	< 12 hrs
	7221	loggerhd	4.5 E	NA	NA	77	0	7	70	0	0	NA	NA	N
	7291	loggerhd	6.2 E	9/29	62 +/-2	95	0	2	8	85	90	N	85	> 2 wks
	7311	loggerhd	3 E	NA	Georges	NA	NA	NA	NA	0	0	NA	NA	< 12 hs
	8061	loggerhd	4.6 E	NA	H Earl	NA	NA	NA	NA	0	0	NA	NA	N
	8111	loggerhd	2.5 E	NA	Georges	NA	NA	NA	NA	0	0	N	NA	N
n=	18			9	8	10		12	12	10	18			
Sum					481	1131	48+	177	295	784		6 of 10	448	4 of 18
Mean					60	113		15	25	44	37		41	
Fort Pickens	5271	loggerhd	3 E	8/4	69	94	0	9	0	85	90	N	85	N
	6171	loggerhd	1.8 W	8/18	62	119	0	62	5	52	44	Y	51	N
	6221	loggerhd	1.5 W	8/29	68	95	0	41	3	51	54	Y	51	N
	7011	loggerhd	.5 E	NA	NA	142	2-3 crab	1	9	94	66	NA	0	N
	7051	loggerhd	4 E	NA	H. Earl	NA	NA	NA	NA	NA	0	NA	NA	NA
	7221	green	2.5 E	9/21	61	170	0	24	4	142	83	N	142	N
	8061	green	.5 E	10/5	61+/- 4	145	0	22	9	114	80	N	114	> 2 wks
	8161	loggerhd	3.5 W	NA	NA	NA	NA	NA	NA	NA	0	NA	NA	NA
n=	8			5	4	6		6	6	6	6			
Sum						765	0 OF 8	159	30	538		2 of 6	443	1 of 8
Mean					65	128		27	5	90	52		74	
Totals														
n=	45			16	16	21	3			18	42	9 of 18		9
Sum						2746		437	680	1476			956	
Mean					63	119		19	36	35	28		48	
Std Dev					6	25		27	51	48	38		49	

Disorient- a "yes" implies greater than 25% of nest experienced disorientation
in Water- hatchlings "observed" entering water

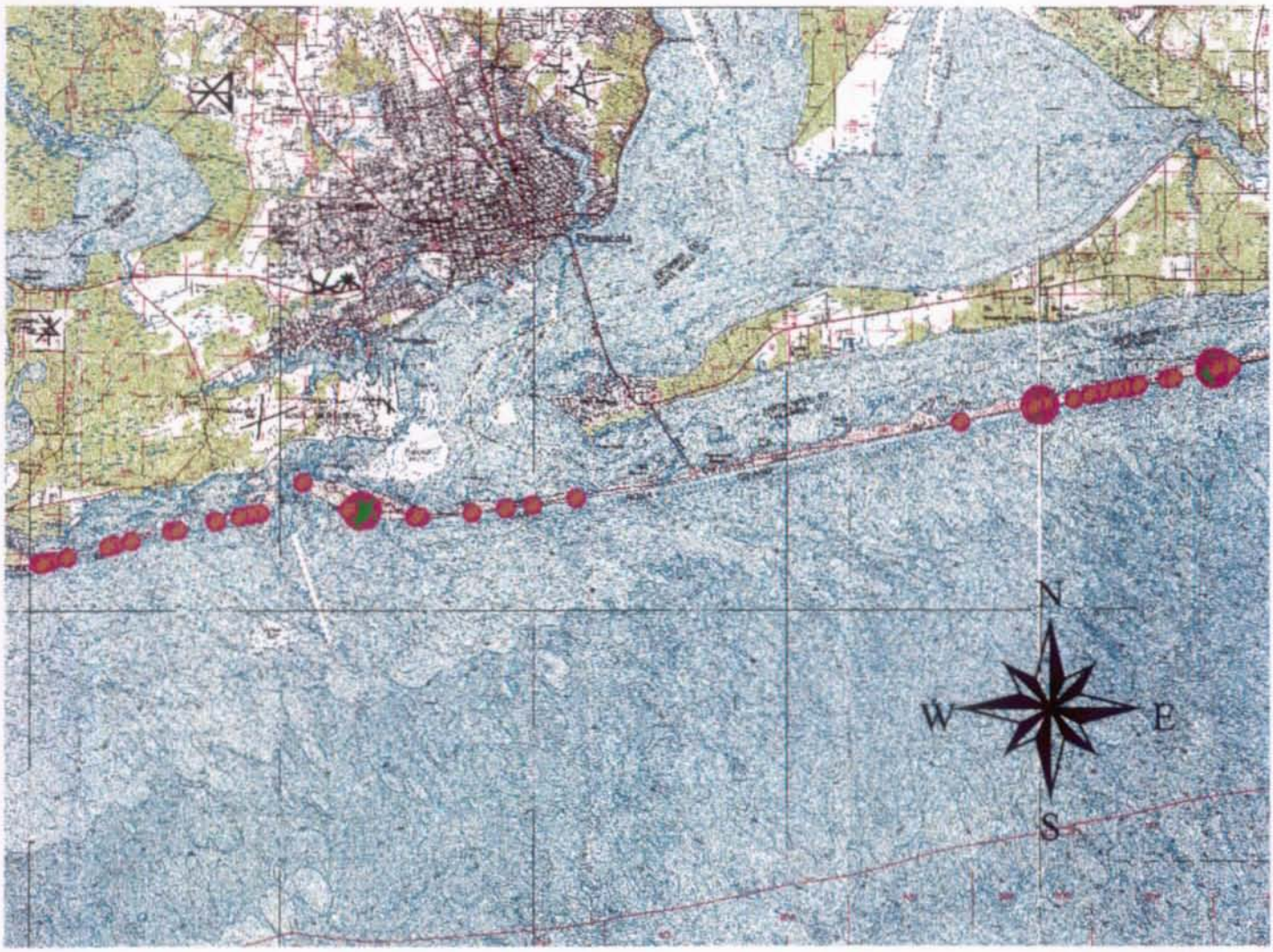
Table 7

1999 GUIS TURTLE DATA

District	Nest #	Species	Loc	Hatch Date	Incub Days	# Eggs	#Predated	# without develop	# with develop	# hatch	% hatch	Dis-oriented	# in Water	Moved
Santa	5311	loggerhd	2.5W	8/7	68	121		6	2	113	93	Y	112	N
Rosa	6071	loggerhd	.75E	8/14	68	129		1	2	126	97	Y	56	N
	6081	loggerhd	2W	8/13	66	108		5	1	102	94	N	1	<12hrs
	6201	loggerhd	2.75W	8/25	66+2	119		1	0	118	99	Y	118	N
	6202	loggerhd	2.5E	8/22	63	105		4	1	100	95	N	100	N
	6241	loggerhd	4.5E	8/27	64	116		6	1	109	94	N	109	N
	7011	loggerhd	0	8/27	57	119	(4 CRAB)	10	3	106	89	N	0	N
	7012	loggerhd	3E	8/28	58	114		3	3	108	95	N	3	N
	7031	loggerhd	3.5W	9/3	62	65		28	2	35	54	Y	35	N
	7041	loggerhd	2.25E	8/31	58	99		2	2	95	95	N	9	N
	7042	loggerhd	0	8/31	58	116		13	2	101	87	N	100	N
	7051	loggerhd	2E	NA	NA	101		97	4	0	0	N	0	N
	7091	loggerhd	1.25E	9/8	61	89		52	3	34	38	N	27	N
	7101	loggerhd	3W	9/4	56	146		6	4	136	93	Y	134	<36 hr
	7102	loggerhd	3W	9/9	62avg	107	(1 CRAB)	1	1	105	98	Y	8	N
	7111	loggerhd	1E	9/7	58	89		48	0	41	46	unk	3	N
	7112	loggerhd	0	9/8	59	94		0	4	90	96	N	0	N
	7161	loggerhd	.75E	9/9	55	128		2	2	124	97	N	124	N
	7171	loggerhd	4.5W	9/12	57	86		2	2	82	95	N	82	N
	7191	loggerhd	.5W	9/12	55	102		3	1	98	96	N	97	<12hrs
	7221	loggerhd	4.5W	9/15	55	98		2	0	96	97	N	96	>2wks
	7271	loggerhd	4.75E	9/23	58	126		3	6	117	93	N	103	>2wks
	7301	loggerhd	0	9/29	61	103		2	7	94	91	N	94	>2wks
	8121	loggerhd	2.0E	10/21	70	91		4	8	79	87	N	77	>2wks
n=	**24**			**23**	**21**	**24**		**24**	**24**	**23**	**24**		**24**	
Sum					**1267**	**2571**	**0 of 24**	**301**	**61**	**2209**		**6 of 24**	**1488**	**7 of 24**
Mean					**60**	**107**		**13**	**3**	**92**	**84**		**62**	
Perdido	5241	loggerhd	1.5E	7/31	68	121	(2 CRAB)	2	2	117	97	Y	117	N
Key	6031	loggerhd	1.5E	8/7	65	128	(3 CRAB)	19	2	107	84	Y	107	<12hrs
	6111	loggerhd	0	8/14	64	144		17	3	124	86	Y	123	N
	6151	loggerhd	4E	8/10	56	123		8	3	112	90	Y	111	N
	6191	loggerhd	.5E	8/18	60	134		54	2	78	58	Y	78	N
	6251	loggerhd	.25E	8/21	57	114		4	1	109	96	N	108	N
	6252	loggerhd	3E	8/24	62	82		38	1	43	52	N	43	N
	6291	loggerhd	3.5E	8/22	54	117	(1 CRAB)	42	26	49	42	N	39	N
	7061	loggerhd	5E	8/30	55	115		5	0	110	96	Y	103	N
	7091	loggerhd	1.5E	9/5	58	135		3	0	132	98	Y	131	N
	7111	loggerhd	0	9/7	58	46		7	0	39	85	N	39	LAB
	7121	loggerhd	.25W	9/10	60	125		2	2	121	97	Y	97	N
	7131	loggerhd	5E	9/4	53	68		4	0	64	94	Y	64	<12hrs
	7141	loggerhd	.75E	9/10	58	89		2	1	86	97	N	86	N
	7161	loggerhd	5.5E	9/5	51	129		1	6	122	95	Y	14	N
	7171	loggerhd	.75E	9/12	57	113		2	0	111	98	Y	111	N
	7172	loggerhd	6E	9/9	54	88		27	1	60	68	Y	9	N
	7191	loggerhd	2.25E	9/8	51	115		6	4	105	91	Y	97	N
	7251	loggerhd	6E	9/17	54	123		9	1	113	92	N	110	<12hrs
	7301	loggerhd	.25E	9/17	49	93		3	0	90	97	N	89	LAB
	8061	loggerhd	6E	Harvey	NA	115		24	91	0	0	NA	0	N
n=	**21**			**20**	**20**	**21**		**21**	**21**	**20**	**21**		**21**	
Sum					**1144**	**2317**	**0 of 20**	**279**	**146**	**1892**		**13 of 20**	**1676**	**3 of 18**
Mean					**57**	**110**		**13**	**7**	**90**	**82**		**80**	
Fort	6031	loggerhd	1.5E	8/6	64	99		3	1	95	96	Y	9	<12hrs
Pickens	6151	loggerhd	1.5E	8/17	63	84		5	0	79	94	Y	79	<12hrs
	6241	loggerhd	2.5W	9/1	69	139	(4 CRAB)	41	7	91	65	Y	60	N
	7011	loggerhd	.25E	9/5	66avg	126		85	5	36	29	Y	3	N
	7171	loggerhd	2.5E	9/12	57	89		3	1	85	96	Y	84	<12hrs
	7201	loggerhd	4E	9/12	54	109		9	0	100	92	N	100	<12hrs
n=	**6**			**6**	**5**	**6**		**6**	**6**	**6**	**6**		**6**	
Sum					**307**	**646**	**0 of 6**	**146**	**14**	**486**	**6**	**5 of 6**	**335**	**4 of 6**
Mean					**61**	**108**		**24**	**2**	**81**	**79**		**56**	
TOTALS														
n=	**51**				**46**	**51**	**0**	**51**	**51**	**49**	**51**	**24 of 51**		**16 of 51**
Sum					**2718**	**5534**		**726**	**221**	**4587**			**3499**	
Mean					**59**	**109**		**14**	**4**	**90**	**82**		**69**	
Std Dev					**5**	**21**		**21**	**13**	**33**	**24**		**45**	

Disorient - a "yes" implies greater than 25% of nest experienced disorientation
in water - hatchlings "observed" entering water

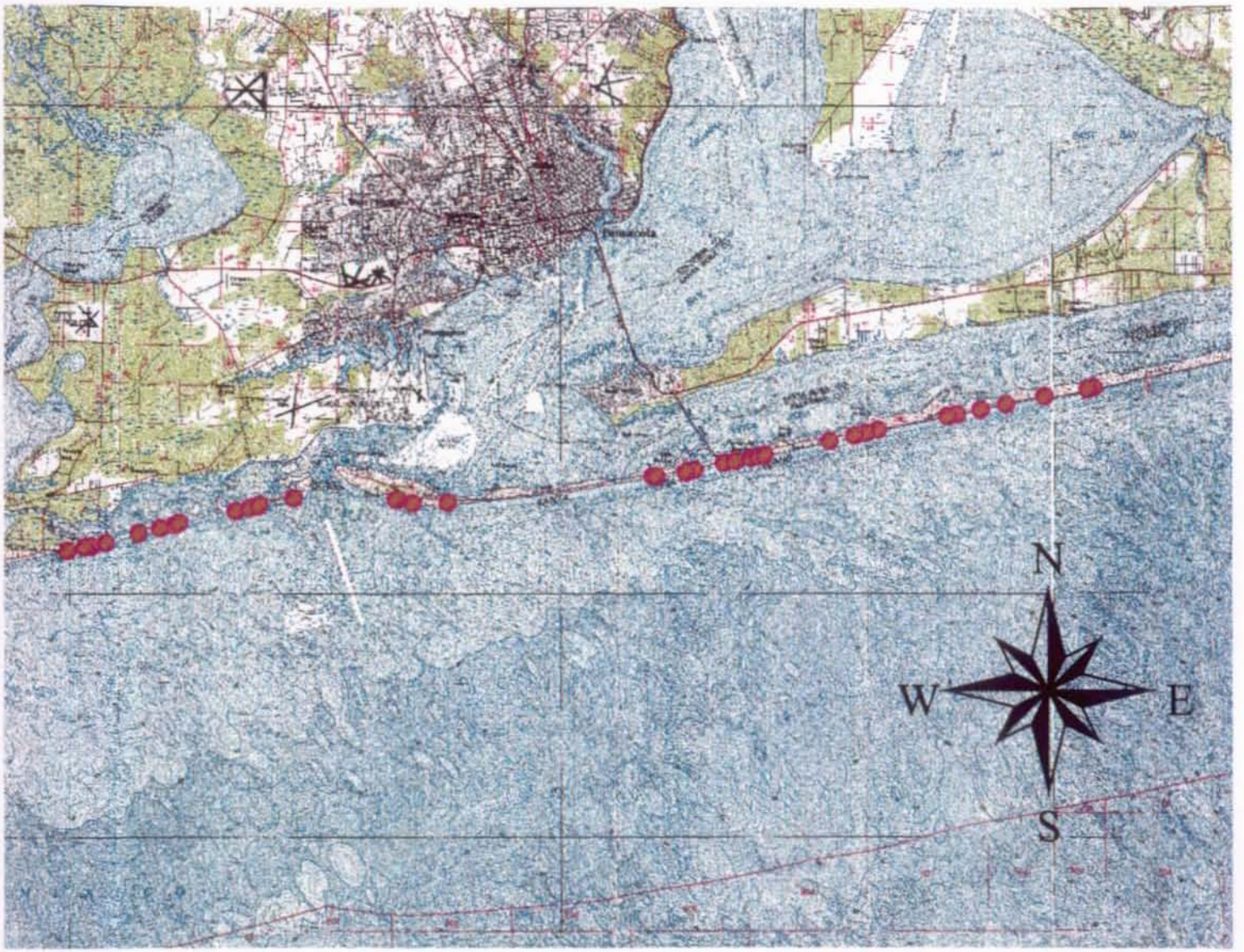
Map 1
Gulf Islands National Seashore
1996 Marine Turtle Nests



10 0 10 Miles

- 1996 Loggerhead Nests
- 1996 Green Nests

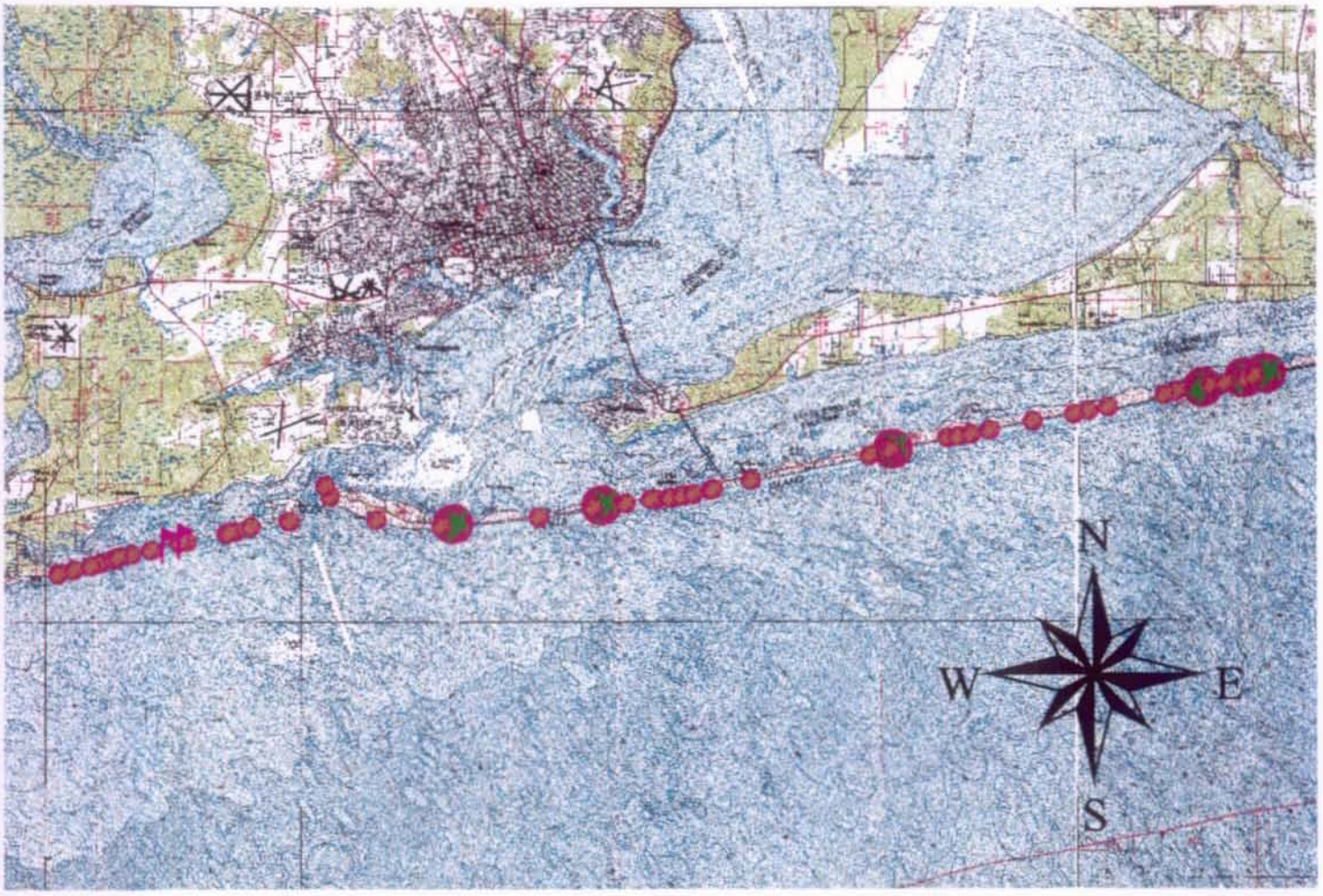
Map 2
Gulf Islands National Seashore
1997 Marine Turtle Nests



10 0 10 Miles

- 1997 Loggerhead Nests
- 1997 Loggerhead Nests

Map 3
Gulf Islands National Seashore
1998 Marine Turtle Nests



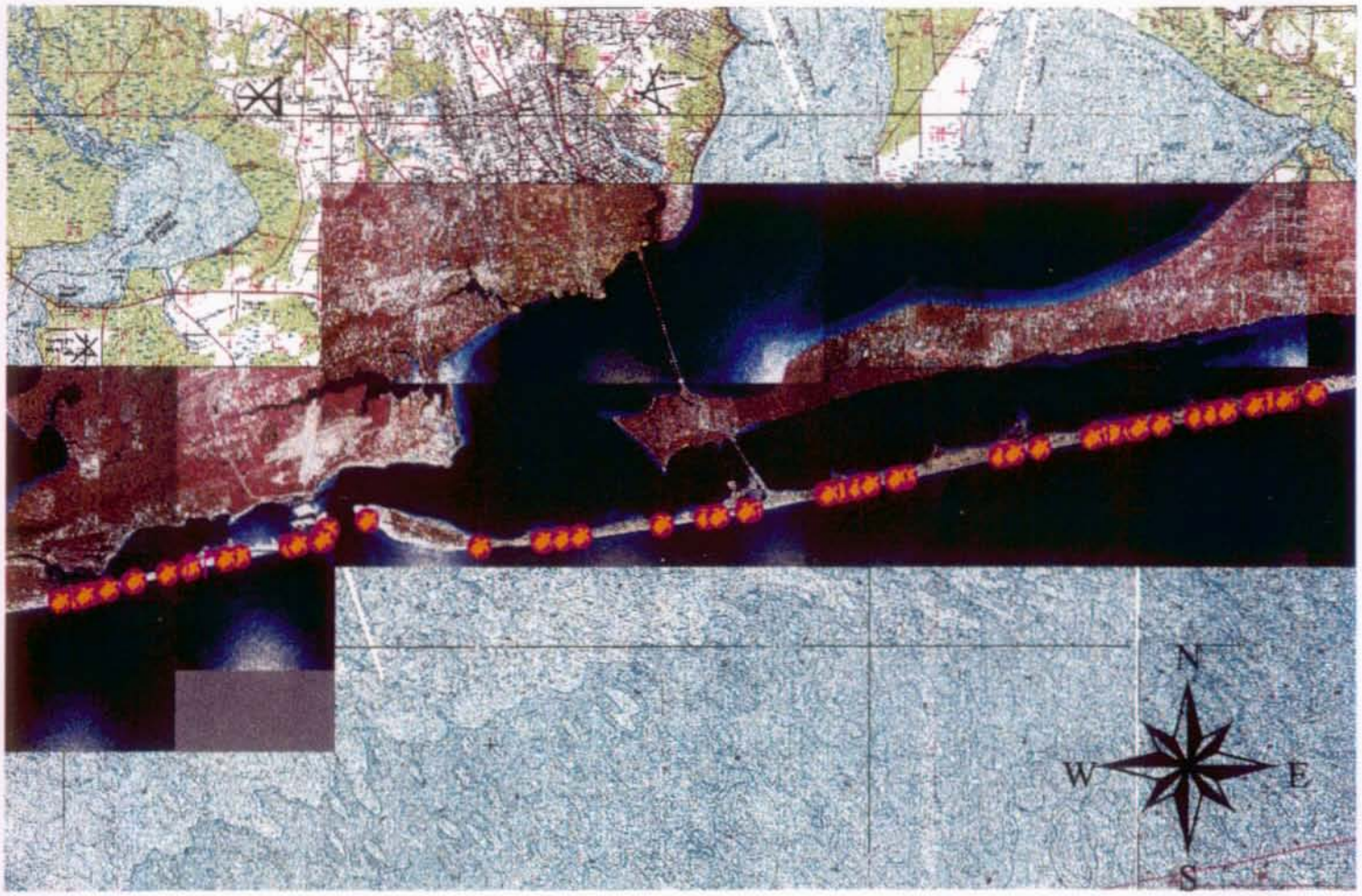
5 0 5 10 Miles

Temperature Transect

1998 Loggerhead Nests

1998 Green Nests

Map 4
Gulf Islands National Seashore
1999 Marine Turtle Nests



5 0 5 10 Miles

Temperature Transect

1999 Loggerhead Nests


SR624199 Crawl and Nest
Total Length of Crawl = 0.33 miles
1:4000
Photo from 1994
State Road 399
200 0 200 400 Feet
SR624199 Nest
SR624199 Crawl

Gulf Islands National Seashore - Florida District

1999 Sea Turtle Monitoring Field Guide

Objectives: The monitoring program is being conducted to provide annual data on the distribution and abundance of sea turtle nesting activity within the National Seashore. In addition, information is gathered to develop estimates of reproductive success and on the factors affecting that success.

Sea Turtle Nesting Survey

Survey Schedule

1. For 1999, surveys will begin May 15th and conclude some time in September or October.
2. The surveys should be accomplished as early in the day as possible, ideally beginning at or before 7:00 AM.
3. If a volunteer can not perform the patrol on the assigned day, it is their responsibility to find a substitute from the volunteer list. If you cannot find a substitute, call Mark Nicholas or Troy Davis as soon as possible. If you miss your patrol for what ever reason(weather, vehicle problems, etc.) call Mark, Troy or Park Dispatch(916-3010).

Survey Methods

1. All Terrain Vehicles(ATV's) will be used to survey the beaches. These vehicles will be located at each of the three Ranger Station locations. Begin the survey at the same starting point each time, most commonly on the beach immediately adjacent to the Ranger Station where the ATV is stored. Patrol slightly shoreward along the most recent high water mark. Maintain a slow to moderate speed so that no turtle crawls are missed. Locations of nests on the beach will be estimated from PVC markers on the beaches. The beaches are marked with PVC poles every half of a mile. The poles will be marked with consecutive letters starting with the letter A.

2. During the survey, be alert for tracks, stranded turtles, nests uncovered by predators, hatchlings, etc. - any evidence of a sea turtle incident. Visually relocate and check any nests found during previous surveys to keep their locations familiar and to evaluate the progression of the nest. Please make notes of any bird nesting activity you observe and inform the Resource Management Specialist. **Be careful not to drive through a bird nesting area.** Do not ride over vegetated areas.

If it is high tide during your survey, do not attempt to drive the ATV through the water. Also, do not drive the vehicle over the dunes or vegetation. If there is a path wide enough for the ATV to drive through without vegetation in the way, use the path to circumvent the area where there is no beach. Backtrack on foot if necessary to survey the area that was missed.

3. If no turtle incidents were observed, remember to fill in a line on the **"Daily Activity"** sheet stating what happened on that day. **Wash up and refuel the ATV.** A bulletin board will be located in each ATV storage area. If a nest is located, record it on the bulletin board. This will allow a quick and easy way for the next surveyor to see what nests are out on the beach. If any materials are missing or in short supply, contact the Program Coordinator (Mark or Troy) or leave a message at the Ranger Station.

Investigating Nesting Incidents

1. When evidence of a nesting event is encountered, stop and record the location of the nest in reference to the PVC beach markers. Record this location on the report form.

2. Evaluate the incident as thoroughly as possible. Attempt to identify the species of the turtle (by the appearance of the tracks, either loggerhead or green) using the ID sheets provided. Measure the crawl width in at least three different areas, record the average width (see instruction sheet). Record the distance from current water level to the nest site. This does not need to be exact(water level fluctuates with each wave) but it should be fairly accurate. Also note if the nest is above or below the rack line(highest debris line on the beach). If it is suspected to be a green, photographs of the crawl and nest site should be taken (cameras will be provided). Place a stake or sign that has the nest number on it in the photo frame.

Look for evidence of a body pit. A body pit will look like a roughly circular area of disturbed sand which may or may not be slightly lower than surrounding areas. If no body pit is discovered, the crawl will be assumed to be a false crawl. There may be slightly disturbed areas along the crawl without a nest present. This can occur when the turtle makes an abrupt change in direction of travel. Every false crawl will be recorded on a report form but will not be marked. **Erase** the turtle tracks so it is not recounted the next morning.

3. If a conspicuous area of disturbed sand is found (body pit), we will assume that a nesting event has occurred. Nests will not be disturbed (dug) to verify the presence of eggs. The incident will be recorded and marked as a nest. If in fact there were no eggs deposited at the site, the data sheet can be changed from a nest to a false crawl after confirmation post hatch time. Complete the investigation by marking the nest and scattering sand over the body pit and the crawl with sand from adjacent areas.

4. Occasionally, a nest may be found that has been dug into by predators or possibly uncovered by beach erosion. If you find a nest where eggs, or the remains of eggs are visible, the incident will be reported as a nest. If the nest was predated, the nest must be checked for viable eggs. Do not assume the nest has been totally predated.

If a nest is partially depredated, the remaining eggs can be reburied with the necessary precautions. Eggs must be rinsed off with freshwater to remove all albumen and other fluids that came from the damaged eggs. Rough handling and turning of the eggs should be avoided. The nest cavity, if still intact, should be cleaned out down to clean sand before the eggs are replaced. Do not dig to deep. Occasionally most eggs can be left in place and only the top few need to be removed, cleaned and returned to the nest. The nest should then be filled with moist sand. Compress the sand with your hands using slight to moderate pressure. Damaged eggs and shells should be removed from the area.

If the nest was totally depredated, fill in the hole and clean up the area. Fill in a nest report but do not mark the nest. Be sure to erase the crawl. If you do not erase the crawl, the person surveying the next day may record another predated nest. This happened a few times in 1995. Also, if you find an area where eggs are strewn about and there is a hole dug in the sand, this is not a new nest unless there is a crawl. Without a crawl, it is an old depredated nest that has been dug up again.

If the eggs have been exposed as a result of erosion, call Mark, Troy or Riley. The movement of the eggs needs to be done with great care. Use a cooler or the turtle gear box to store the eggs. Use the lid to shade the eggs. Put approximately one inch of sand from the nest location in the bottom of the container. Move the eggs one by one. Move the eggs with care but in a timely manner. Do not rotate or roll the eggs. Store the eggs in the cooler so that the top of the nest is in the lower left corner. Place the remaining eggs in rows working away from you. A second layer may be needed. In this case, be

sure to put some sand adjacent to the last row to prevent them from rolling. Do not cover every egg with sand. The center eggs need to remain relatively sand free to simulate conditions within the original nest. The eggs can then easily be deposited in the opposite way so that the original bottom is put in the bottom of the new nest. The original top will go in last becoming the top eggs of the new nest. A new nest location can be excavated above the high tide line. Dig a hole about 8 inches in diameter. When you reach about 15 to 18 of depth, enlarge the diameter to about 12 inches. This will form a vase shaped hole. The bottom of the nest should be about 22 inches deep. The top of the egg cavity should be located approximately 10"-12" below the level of the surrounding sand. Large temperature changes need to be avoided. After the eggs have been deposited, fill with sand from the bottom of the cooler. Compress the sand with your hands with slight to moderate pressure. Use surrounding sand to fill in the remainder of the hole.

Mark these nests in accordance with the general guidelines for a positive nest. Do not hesitate to go for help if a nest is found opened on the beach. Cover and mark the nest as best as you can before you leave the area for help. Contact any park personnel and have them call the Resource Management Specialist.

5. If you feel a nest, due to its location on the beach, is in danger of being inundated by daily tides or lost through erosion, report this possibility to the Resource Management Specialist as soon as possible. **Do not** move the nest unless you are **completely** confident the nest will be harmed before someone can arrive. Notify the Resource Management Specialist on any decision.

Marking Nests

After evaluating the nest site, mark all nests (except those completely destroyed by predators or erosion) using the following methods:

1. Determine egg cavity location. This can be usually be done by following these steps. First, determine the direction of travel along the crawl, locate a body pit, locate an escarpment in the shape of an arc at the front of the pit. Typically the female faces away from the water during nesting, although this is not always the case. The escarpment is the result of the last thing the female turtle does during the egg laying process. Before heading back to the water, the turtle will use her front flippers to dig sand out and to spread it over the nest area. As a result, the egg cavity is usually centered behind this escarpment, approximately 3-5 feet back. Occasionally it may be further, if the turtle was moving forward while covering the nest site.

2. Drive a wooden stake in the seaward face of the nearest adjacent dune (or open beach if no dunes are present). Place the stake so that it can be relocated later. Distance from the nest should be kept to a reasonable distance (20 feet or less). Do not drive the stakes so deep that they cannot be seen. Leave app. 2 feet of the stake exposed.

3. Place a second stake about 10-15 feet behind (landward) the first one in a straight line from the egg cavity. The line of sight down the two stakes should be pointing directly at the egg cavity in the body pit. An easy way to do this is to lay the tape out from the egg cavity and go past the first stake to the location where the second stake will be placed. Drive this stake in along side of the tape.

4. Write the nest number and your initials on both stakes with an indelible ink marker. Make these numbers large. As time goes by the numbers fade. It is easier to read a large faded number than it is to read small faded numbers. The nest number is generated by combining the month, day, and the number of nests evaluated during that day's survey. For example: The first nest evaluated on the June 6th survey would be 6061. The second nest evaluated that day would be 6062. The first nest evaluated on July 23 would be 7231, etc.

5. Measure the exact distance from the egg cavity (or center of body pit) to the closest stake using a tape measurer. Also, measure the distance between the stakes. Record these measurements on the data sheet.

6. A third stake, which bears a warning sign, is placed exactly 3 feet seaward of the center of the body pit, in line of sight with the first two stakes. Record the nest number and initials on this stake as well. If three feet seaward will locate the stake within the body pit, place the sign four or five feet seaward from the suspected location of the egg cavity. **Do not drive a stake into the area of the body pit.**

7. Measure the width of the crawl in three separate areas of the crawl. Record the average width on the data sheet.

8. All nests will be screened with a four foot piece of welded rod screening to help prevent predation. Center the screen over the suspected egg cavity location and trace the outline of the screen. Remove the screen and scrap off 4-6 inches of sand. Place the screen in the depression and cover with sand.

9. Record all of the measurements and actions taken to mark the nest in the ACTION TAKEN section of the report form. Please be accurate and complete! Remember, these measurements will be needed to relocate the nest after two months have passed.

Recording Data

1. Completely fill in the SEA TURTLE NESTING SURVEY REPORT form for all incidents before resuming your survey. An incident is an event where a turtle comes on to the beach, this could be a false crawl or a nest. Be as complete and accurate as possible. Pay particular attention to describing the location of the nest and how the nest was marked. A diagram of the site showing the shape of the crawl and the location and shape of the nest relative to the waterline and dunes is a must. Follow the instructions provided, and use the back of the sheets for additional information or maps/diagrams. A separate form should be used for each incident encountered on the patrol.

2. If a stranded (dead) sea turtle is found, use the SOUTHEASTERN SEA TURTLE STRANDING NETWORK REPORT form. Instructions are enclosed.

Reporting Incidents

1. Maintain the completed report forms in the field notebook. **Do not hesitate to contact the Resource Management Specialist if anything unusual is encountered or if problems or questions arise.**

2. Make every attempt to investigate all reports of sea turtle activity from park employees, visitors, etc. If you do not have time to investigate yourself within a reasonable amount of time, call Mark, Troy or Riley so that other arrangements can be made.

Necessary Equipment

Field notebook with report forms and instructions
Hammer
Tape measurer
Wooden stakes
Indelible ink marker
4' x 4' metal screens
Fresh water container

Sea Turtle Nest Monitoring and Assessment

Routine Monitoring of Nest Sites

1. All sea turtle nests will be monitored throughout the incubation period (approximately 70 days) on a daily basis. This monitoring is for the purpose of identifying the incidence of depredation, damage from beach erosion, or disturbance by human activities.

2. Each surveyor will be responsible for locating all existing nests on the beach they patrol. When a marked nest is observed, drive up to it and make sure all stakes are readable and in good condition. This will help to eliminate the chances of loosing a nest. If a stake or sign is missing, replace it or notify the Resource Management Specialist. All nest should be noted daily in the log as being checked; (had three nests to locate today, 7041,7042 and 8111, all three are in good condition, nest 7042 is missing a stake, notified Mark Nicholas).

3. Monitoring will be accomplished by a quick visual inspection of each nest site. Sites will be evaluated for evidence of depredation (tracks and digging activity, ghost crab holes), human disturbance (digging, tire tracks), beach erosion or washovers, or any other indication of nest site disturbance; (nests # 7041 and 7082 were washed over by a distance of 10 feet from high surf, notified Riley Hoggard). Record this data on the sheets. During monitoring, try to confine all activities to the rear (landward) side of the nest to reduce the amount of tracks (obstacles) the hatchlings will need to negotiate. This includes vehicle tracks.

4. If any evidence of disturbance is seen, record all observations from the site on a NESTING SURVEY REPORT using the most appropriate sections of the report. Please be complete. Do not fill in a report if there is no evidence of disturbance.

Daily Monitoring at Expected Time of Hatching

1. Beginning at the 60th day from initial discovery, each nest will be monitored more closely on a daily basis. This intensive regime of monitoring will be conducted to determine the precise duration of incubation, and to gather data on the emergence of hatchlings, depredation, and possible affects from artificial lighting (hatchling disorientation).

2. Monitoring will be conducted through a daily on-site visit to each nest in the early morning hours. Nest sites will be evaluated to determine if hatching has occurred by looking for the tracks of hatched turtles which have left the nest. In general, the majority of hatchlings will leave the nest as a group during the night. This will appear as a clutter of small, approximately 2" wide tracks which radiate out from the nest. The area where the egg are located will usually appear collapsed.

3. Carefully assess the site if hatching appears to have occurred. In most cases a great deal of information can be gleaned from a close inspection of the site. Look for evidence of depredation such as ghost crab, bird, or fox tracks and any indication of turtle remains. Look for evidence of hatchling disorientation. Note any tracks which deviate from a straight course to the

water and attempt to follow any tracks which have headed in the wrong direction to ascertain their fate.

4. In many cases, the emergence of hatchlings from the nest will occur over the course of several nights. The majority will exit the first night, but smaller numbers may emerge for a couple of subsequent nights. Monitoring of nest sites will be continued for at least two additional days following the initial discovery of hatching.

5. Record all observations made at the site on the NEST MONITORING AND ASSESSMENT REPORT in the appropriate sections. Please be as complete as possible. Any information which can be learned about the fate of the hatchlings after they emerged from the nest will be of great value. Do not fill in a report if there is no evidence of hatching.

Final Nest Assessment

1. All nests will be assessed at the conclusion of the nesting process to gather data on overall nesting success. This assessment will be conducted by the Resource Management Specialist.

2. In general, the final assessment will be conducted three days after hatchlings have been documented as emerging from the nest. In cases where emergence was not observed from positive nests, the nest site will be excavated at approximately day 80 (from initial discovery). Nests are relocated using the location data from the original survey reports in conjunction so please be accurate.

3. When excavated, the sites are evaluated to determine the fate of the nest. The data collected includes, at minimum, the total number of eggs found in the nest (both hatched and unhatched), the presence of any hatchlings which did not exit the nest, the number of unhatched eggs with embryonic development, the number of unhatched eggs without embryonic development, and any evidence regarding factors which may have affected the nest, ie. ghost crab burrows, vegetation roots, etc.

4. Some of the unhatched eggs will be collected and forwarded to the U.S. Fish and Wildlife Service for contaminant analysis and determination of embryonic development.

5. Results of the assessment will be recorded on the NEST MONITORING AND ASSESSMENT REPORT using all appropriate sections. Please be complete in recording all observations and data gathered during the assessment.

6. All marking and protection materials (stakes, metal plates, screens) will be located and removed when the assessment has been completed.

Instructions for Sea Turtle Monitoring Report

REPORTED BY: The name of the person conducting the survey.

NEST NUMBER: Assign a nest number based on the month and day of survey, and the number of nests encountered on that day's survey. For example: The second nest found on June 18th would be 6182. The 1st nest found on July 25 would be 7251. etc.

SUBDISTRICT: Fort Pickens, Santa Rosa, or Perdido Key

DATE and TIME: Write the date and time that the survey began.

LOCATION:

DISTANCE FROM START POINT: Enter the ATV's odometer reading from the starting point or approximate distance from 1/2 markers. Record the direction traveled, either east or west.

WEATHER: Brief description of weather conditions during survey.

LOCATION DESCRIPTION: Fully describe the area where the incident occurred using landmarks, relative position on the beach, etc. For example: "nest is located approximately 1 mile west of Langdon Beach facility, approx. 20 feet seaward of the base of the primary dunes.

INCIDENT TYPE: Circle the appropriate type of incident:

False Crawl - Tracks only. No indication of any disturbed area or digging activity.

Nest - An area of highly disturbed sand with a depression along the line of tracks.

Species: Circle appropriate species

CRAWL MEASUREMENTS: Fill in the information required, record units used (metric or English)

SIGNS/STAKES: Fill in the information required

PREDATION: Circle appropriate answer. Fill in information lines.

ADDITIONAL COMMENTS: Fully describe the nesting incident. What you see, what others may have told you, any visible evidence, unusual conditions, etc. Also, fully describe what actions you took to document the incident, determine the type of incident, and mark the nest. Please be complete!

DRAW A DIAGRAM: A must!

GULF ISLANDS NATIONAL SEASHORE SEA TURTLE MONITORING REPORT

REPORTED BY: _____ NEST NUMBER:_____

SUB DISTRICT: SANTA ROSA PERDIDO KEY FORT PICKENS

DATE:_____ TIME: _____ am / pm

LOCATION: _____mi East/West WEATHER:_____

Description:_____

_____

_____

INCIDENT TYPE: NEST FALSE CRAWL

SPECIES: LOGGERHEAD (Caretta caretta) GREEN (Chelonia mydas) OTHER:_____

CRAWL MEASUREMENTS: ALTERNATING SYMETRICAL
CRAWL WIDTH:_____ in / cm
Distance of Body Pit from water line _____ ft / m
Distance of Body Pit from vegetation line _____ ft / m

SIGNS / STAKES
Position of Sign : _____ feet / meters from center of body pit
Position of First Stake:_____ feet / meters from sign.
Position of Second Stake:_____ feet / meters from sign.

PREDATION: YES NO
Type: _____
Number of destroyed eggs: _____
Comments: _____

_____

ADDITIONAL
COMMENTS:_____

_____

_____

_____

DRAW A DIAGRAM ON THE BACK OF THE PAGE.

Instructions for Nest Assessment Report

Date and Time Write the date and time of the observation and/or assessment.

Nest Number Enter the nest number that was assigned to the nest when initially discovered.

Subdistrict Fort Pickens, Santa Rosa, or Perdido Key.

Reported By The name of the person making the observation/assessment.

Depredation Use this section to completely describe any evidence of depredation observed. Attempt to identify the species of predator involved (fox, raccoon, ghost crab, etc.) and describe the current condition of the nest. Evaluate the nest for presence of unhatched, viable eggs.

Disorientation Use this section to completely describe any evidence of hatchling disorientation such as the direction of hatchling tracks away from the water, dead hatchlings found, reports of disoriented hatchlings from other observers, etc. Please try to gather as much information about this type of incident as possible.

Total Number of Eggs Found Record the total number of eggs found during the nest assessment, both hatched (empty egg shells) and unhatched.

Number of Hatched Eggs Record the number of hatched/empty egg shells found during the nest assessment.

of Unhatched Eggs with Embryonic Development Record the number of unhatched eggs where embryonic development is apparent, ie. where a partially developed turtle is present in the egg.

of Unhatched Eggs without Embryonic Development Record the number of undersized eggs and eggs where no embryonic development is visible.

Comments Use this section to record any other observations which do not fit into the above sections, such as visible evidence of a successful hatchling dispersal, loss of nests from erosion, human disturbance, etc.

GULF ISLANDS NATIONAL SEASHORE

SEA TURTLE NEST MONITORING AND ASSESSMENT REPORT

DATE: TIME: NEST NUMBER:

SUBDISTRICT: REPORTED BY:

PREDATION: _____

DISORIENTATION: _____

TOTAL NUMBER OF EGGS FOUND _____

NUMBER OF HATCHED EGGS _____

OF UNHATCHED EGGS W/ EMBRYONIC DEVELOPEMENT _____

OF UNHATCHED EGGS W/O EMBRYONIC DEVELOPEMENT _____

COMMENTS: _____

Sea Turtle Biology and Conservation References

Nelson, D.A. 1988. Life history and environmental requirements of loggerhead sea turtles. U.S. Fish and Wildlife Service Biological Report 88 (23). U.S. Army Corps of Engineers TR EL-86-2 (Rev.). 34 pp.

Pritchard, P. et al 1983. Manual of sea turtle research and conservation techniques, Second Edition. K. A. Bjorndal and G. H. Balazs, Editors. Center for Environmental Education, Washington, D.C. 126 pp.

Dodd, C. Kenneth, Jr. 1988. Synopsis of the biological data on the loggerhead sea turtle Caretta caretta (linnaeus 1758). U.S. Fish and Wildlife Service Biological Report 88 (14). 110 pp.

LeBuff, Charles, R., Jr. 1989. The loggerhead sea turtle in the eastern Gulf of Mexico. Caretta Research, Inc. Sanibel, FL. 236 pp.

PROJECT STATEMENT

GUIS-N-020.001

Title: PROTECT/MONITOR THREATENED AND ENDANGERED SEA TURTLES

Funding Status: Funded: 9.22 Unfunded: 28.00

Servicewide Issues: N02 (T&E ANIMAL) N20 (BASELINE DATA)

N-RMAP Program Codes: W03 (THREATENED/ENDANGERED SPECIES)

Park GPRA Goals: Ia2 (3), Ib2 (6)

Introduction

Gulf Islands National Seashore has over 35 kilometers of beach used by T&E species such as the loggerhead and green sea turtles for nesting. Nesting occurs from mid-May until early September. Many of the nests are predated by the non-native red fox each year. Park beaches also have severe light pollution from surrounding urban development. Turtle hatchlings become disoriented when exposed to unnatural lighting sources and typically travel in the wrong direction, resulting in nearly 100% mortality in some nests. As a result, these resources are being severely impacted and a reduced number of viable hatchlings are being added to the Gulf of Mexico populations.

Another factor affecting local populations may be the production of a male-biased population. The sex of sea turtles is determined during the middle third of embryonic development. Higher temperatures result in female phenotypes, lower temperatures result in male phenotypes. The pivotal temperature (half male/half female) for loggerhead sea turtles is between 29 and 30 degrees C (Yntema and Mrosovsky, 1982). Nest temperatures below this will produce a higher male to female ratio while temperatures above it will produce a higher female to male ratio. The park currently has little data on nest temperatures but initial data suggest nest temperatures that average below the pivotal temperature, thus producing a majority of males.

Problem Statement

The park currently uses one resource manager and over twenty part time volunteers to patrol the beaches for turtle events. While volunteers are dedicated, they are not full time staff. As a result, holes in coverage result and follow-up evaluations are often not possible. In addition, no effective means of predator removal is currently possible as at least two staff are required. This loss of coverage results in a very low productivity of viable hatchlings. Turtles hatched at the park contribute to the NW population in the Gulf. Conventional wisdom suggests that, when nesting, females loggerhead turtles return to the geographic locality in which they were hatched. If few turtles are produced on the natal beaches of Gulf Islands due to hatchling mortality and those that are produced have male-skewed sex ratios, there will be few females to return upon maturity to

nest. The lack of females with a natal/nesting focus on NW Gulf beaches would represent a serious loss to the population. The low hatchling survivability and the sex ratio of the park's hatchlings thus have wide-ranging implications for the entire Gulf population.

Objectives

This project proposes to increase the number of viable hatchlings reaching the Gulf of Mexico by increasing the amount of beach coverage, nest evaluations and protection, and reduction of non-native predators. The park will also gain a more thorough understanding of the temperature characteristics of area sea turtle nests.

Sex ratios of hatchling turtles is a significant factor in the continued survival of the species. Nest temperature monitoring will identify trends in gender production and can be used in the continued evaluation and revision of the recovery plans. If the trends are dangerous to the population's long-term reproductive health, they can be addressed as early as possible. Waiting until sex ratio-related problems appear in the adults will take years due to the relatively slow maturation and reproductive cycle of sea turtles. Temperature probes and monitoring programs provide an early and inexpensive method of monitoring a demographic process that has significant consequences for long-term survival of the species.

Methods

Morning patrols are conducted by volunteers and staff to locate sea turtle nests on all 35 kilometers of beach in the Florida District. Park staff will conduct morning as well as night patrols in areas with predation problems to locate nests prior to impact. Predator control devices such as screens can then be put into place. Predator removal efforts will also be conducted by full time staff according to the park SOP, volunteers cannot take part in such activities. Temperature recorders will be placed adjacent to the egg cavity according to procedures established by the Fish and Wildlife Service (FWS) and FL Department of Environmental Protection (FDEP). Temperature data will be recorded at a minimum of once an hour. Data will be downloaded following nest hatch. All nests will be evaluated for possible light impact and efforts taken to remove or reduce offending sources. Nests at risk will be continuously monitored at hatch time to prevent disorientation.

Products

Predation rates of nests will be lowered as a result of an increase in nest protection and predator removal. Hatchling disorientation rates will be lowered with an increase in coverage of nests during late hours. Yearly summaries of data will be published for internal use by the park and external use by academic institutions and other government agencies. If a highly skewed male production is discovered, results will be forwarded to FDEP and FWS for discussion/action.

BUDGET AND FTE's

FUNDED

	Source	Activity	Fund Type	Budget ($1000s)	FTEs
1998	PKBASE-NR	MON	One-time	7.12	0.00
	PKBASE-NR	MON	Recurring	2.10	0.20
			Total:	9.22	0.20

UNFUNDED

		Activity	Fund Type	Budget ($1000s)	FTEs
Year 1:	RG-RM-NAT	RES/MON	Recurring	14.5	0.50
Year 2:	RG-RM-NAT	RES/MON	Recurring	13.5	0.50
			Total:	28.00	1.00

Bibliography

Yntema, C.L., and N. Mrosovsky. 1982. Critical periods and pivotal temperatures for sexual differentiation in loggerhead sea turtles. Can. J. Zool. 60: 1012-1016

Mrosovsky, N. 1988 Pivotal temperatures for loggerhead turtles (Caretta caretta) from northern and southern nesting beaches. Can. J. Zool. 66: 661-669

PROJECT CRITERIA RESPONSE SUPPLEMENT GUIS-N-020.001

1. **Significance of the Resource or Issue to the Park..**

Sea turtles are currently listed as threatened and endangered species under the Endangered Species Act of 1973. The National Park Service's Management Policies directs park managers to identify and promote the conservation of all federally listed species.

2. **Severity of Resource Threat, Problem, or Need(s).**

Without an increase in coverage of beaches during the nesting season to prevent predation and disorientation, sea turtle hatchling mortality will remain at current levels or increase. Of the 2486 known eggs laid in the park in 1997, only 847 hatched successfully. This is only 34% of the possible production.

3. **Problem Definition and Information Base.**

It has been shown in prior park data that an increase in coverage by full time staff will result in an increase of viable hatchling production.

4. **Feasibility.**

Increases in coverage of the beach during the night in 1996 lowered red fox predation levels from 21 nests in 1995 to 6 in 1996. Mortality from hatchling disorientation can be lowered by simply increasing coverage of nests during hatch time with trained staff. Of the ten temperature probes used in 1997, all ten deployments were successful and provided pioneering temperature data for NW Florida.

5. **Problem Resolution.**

By increasing the amount of effort into predator removal, predation rates will be lowered. The increase in coverage will also lower mortality from disorientation and flooding. As the nest temperature data is compiled and studied, decisions can be made on future management needs.

6. **Transferability.**

Temperature data and protocols will be shared with other NW Florida sea turtle permit holders at biannual meetings. Data will also be presented at the annual symposium on sea turtle biology and conservation.

7. **Cost Effectiveness.**

Over twenty volunteers are used in the park's efforts to document and protect sea turtle nests. Staff devoted solely to the sea turtle I&M project is needed for adequate coverage and supervision. Temperature probes are slightly over $100 per unit and can be used for several years. Data acquired by these probes may prove priceless for the conservation of the NW Florida population of loggerhead and green sea turtles.

8. **Project Support.**

The park currently uses over twenty volunteers and one full time staff to work on the project. Transportation for beach surveys is provided by the park as is other logistical support for the volunteers.

Sea Turtle Nesting Activity on Pensacola Beach

1996-1998

Aliya Ercelawn
Yale School of Forestry and Environmental Studies
205 Prospect St. New Haven, CT. 06511

Abstract

In 1996, the National Park Service, specifically Gulf Islands National Seashore Florida District, formed a partnership with Santa Rosa Island Authority to monitor sea turtle nesting activity on Pensacola Beach, FL. This report analyzes the results of the monitoring and compares nesting trends with sea turtle activity on nearby Gulf Islands National Seashore Florida property for 1996-1998. Nesting activity by loggerhead and green sea turtles fluctuated from year to year on Pensacola Beach and GUIS. Green sea turtles consistently chose nesting sites higher up on the beach and in less developed areas than the loggerhead sea turtles. Nesting was primarily nocturnal, with peaks of activity in June and July. The average incubation period was about 66 days for loggerhead sea turtles, slightly less for green sea turtles. Asynchronized emergence of hatchlings was very common. The timing and number of tropical storms and hurricanes in the area critically affected hatching success. Relocation of nests by trained personnel within appropriate time periods did not seem to negatively impact hatching success. High mortality of hatchlings was often due to disorientation from artificial lighting along the coastline. Successful protection of sea turtle nesting activity must include measures to minimize the impacts of artificial lighting and loss of nesting habitat due to continued development of Pensacola Beach.

Introduction

Population growth and corresponding development along Florida's coastline has been increasing at a phenomenal rate. The percent of Florida's population living in coastal counties has increased from 59.0% in 1920 to 77. 8% in 1990; this upward trend is expected to continue into the 21st century (Florida Department of CommunityAffairs 1996a). In 1993, 76% of all building permits issued in Florida were for coastal areas (Florida Department of Community Affairs 1996b). The disproportionate growth and development in coastal areas is primarily due to aesthetic reasons, proximity to recreational resources, and economic opportunities afforded by tourism and port access (Florida Department of Community Affairs 1996b).

This intensity of human activity has had critical ramifications for threatened and endangered species, such as marine turtles, which use the beaches and/or coastal waters. Three species--the loggerhead sea turtle (*Caretta caretta*), the green sea turtle (*Chelonia mydas*), and the leatherback sea turtle (*Dermochelys coriacea*)--nest regularly on Florida's beaches and two other species--the hawksbill sea turtle (*Eretmochelys imbricata*) and Kemp's ridley (*Lepidochelys kempii*)--have been documented in the coastal waters (Meylan *et al.* 1995).

In order to minimize human impacts and increase protection for the nesting sea turtles and their hatchlings, Florida Chapter 161 Statutes regulate the nature and timing of coastal construction activities occurring during the nesting season-May 1 through October 31. One critical requirement is that morning surveys must be conducted daily before any regular construction activities (such as mechanical beach cleaning) can begin (Memorandum of Agreement 1997).

Pensacola Beach, a developed section of Santa Rosa Island, is the site of regular nesting by loggerhead sea turtles and infrequent nesting by green sea turtles. Prior to 1996, however, Pensacola Beach lacked an official sea turtle monitoring program. National Park Service staff checked nests on a sporadic basis, primarily when a nest was reported by the public. The efforts to regularly monitor sea turtle nesting activity began in earnest in May 1996. The National Park Service agreed to cooperate with Santa Rosa Island Authority (SRIA) in documenting and monitoring sea turtle nests on Pensacola Beach from May 1- October 31 (Memorandum of Agreement 1997).

The purposes of this report are threefold. They are:

1) to determine patterns in loggerhead and green nesting activities on Pensacola Beach over a three year time span--1996 to 1998;
2) to compare nesting trends on Pensacola Beach, a developed area, with nesting on three adjacent protected zones-the three Florida subdistricts of Gulf Islands National Seashore (Santa Rosa, Fort Pickens, and Perdido Key);and
3) to identify the major factors, natural and anthropogenic, that may be negatively affecting nesting success on these beaches.

Monitoring Procedure

The area surveyed and the procedure used to conduct the surveys on Pensacola Beach changed slightly during the period from 1996-1998. The area surveyed in 1996 and 1998 extended 12.1 km- from the eastern boundary of the Fort Pickens area of Gulf Islands National Seashore eastward to the western boundary of the University of West Florida (UWF) property. In 1997, 13.5 km were surveyed for the majority of the season since the UWF property was included in the Pensacola Beach nesting patrol. During the 1996 season, patrols using 4x4 vehicles began shortly before sunrise. Because these vehicles did not provide a clear view of the beach and it was difficult to see in the dark, in following years surveys were conducted on ATVs and began promptly after sunrise. Barring inclement weather, morning patrols were conducted 7 days a week during the nesting season.

In order to assist and provide experienced biological support to the SRIA employees, NPS personnel patrolled regularly with them. During the 1996 season, surveys were conducted by an SRIA employee, accompanied daily by a trained Park Service employee or volunteer. During the 1997 and 1998 season, an SRIA employee was accompanied by an SCA (Student Conservation Associate) three to four times a week. The SCAs are employed and supervised by the National Park Service. Any turtle activity on days when the SCA volunteer wasn't along was immediately reported to and investigated by National Park Service biologists.

Both false crawls and nests were recorded. If there was a crawl but no evidence of a body pit, the crawl was recorded as a false crawl. For each false crawl, 1) the species was identified based on the appearance of the tracks (asymmetrical vs.symmetrical); 2) the average crawl width was determined using measurements in three different areas; and 3) a diagram of the crawl was drawn. The crawl was then erased to prevent it from being recounted during subsequent patrols.

If a body pit was discovered, it was recorded as a nest. For each nest 1) the species was identified; 2) the average crawl width was determined (in 1997 and 1998); 3) the distance of the nest from the water line and from the vegetation was recorded; 4) the position of the nest was recorded using a GPS unit (in 1997 and 1998); and 5) a diagram showing the position of the nest relative to the water line, vegetation/dune line and surrounding reference points was drawn. The nest area was not usually disturbed to determine the location of the egg cavity. However, if a nest seemed to be in danger of being washed away or flooded due to high tides/storm surges, trained park personnel relocated the eggs to a position further north on the beach. In order to prevent impaired development, relocation of eggs only occurred within 12 hours of deposition or after two weeks of development.

In order to minimize disturbances to the nest by the public, the area was marked. Surveyor's ribbon was tied to four stakes placed in a rectangle around the body pit. A NPS turtle nest sign warning people not to disturb the area was placed on the south side of the nest.

All nests were visually checked during the morning surveys to monitor for signs of disturbance by human activities, signs of predation, damage from erosion or flooding, etc. As the incubation period progressed, the nest was also closely monitored for signs of hatching. If tracks were present, they were followed to determine if the hatchlings

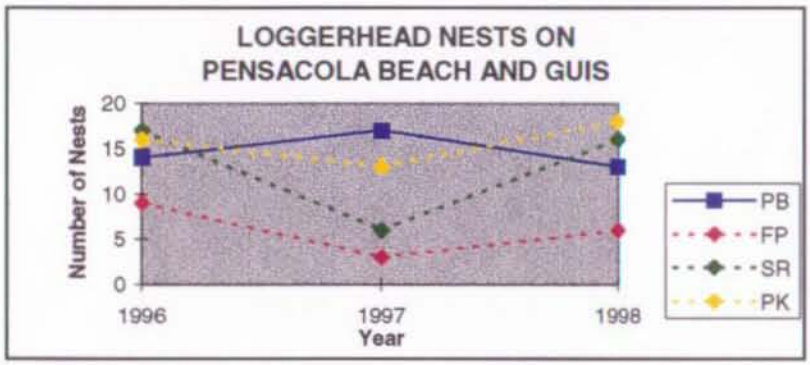
headed straight to the water, or if they became disoriented and succumbed to predators, dehydration or being run over by a vehicle. During the 1997 and 1998 season, park personnel also listened for signs of hatchling activity at night once a nest passed the 59 day incubation mark. If light pollution seemed to be a particular problem for a nest, a restraining screen was placed over the nest after sunset, checked regularly for hatchling emergence, and removed by sunrise. Hatchlings that seemed to be heading in the wrong direction were escorted closer to the water until they stopped showing signs of disorientation.

Nests were excavated and assessed one to three days after hatchlings were first observed emerging from the nest. Any live hatchlings still present in the nest were released at the water's edge during the night. For each nest, any incidences of predation or disorientation were determined, along with the total number of eggs in the nest, the number of hatched eggs, the number and development stage of unhatched eggs, and if possible, the number of hatchlings that entered the water.

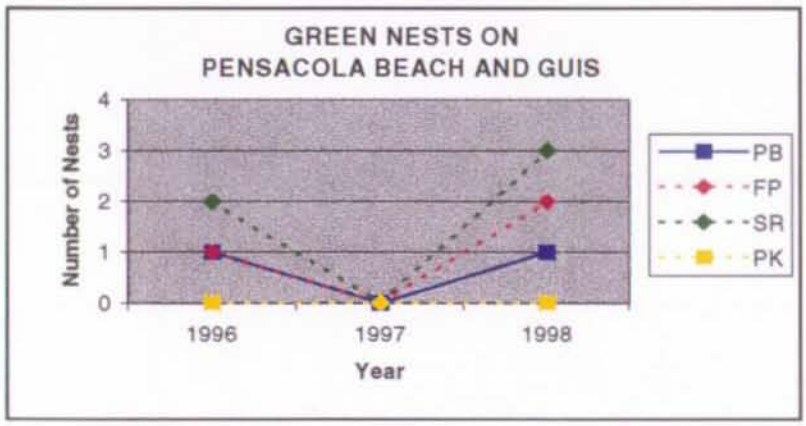
Results

Nesting Survey

In 1996 there were 14 recorded nests on Pensacola Beach, 13 of which were loggerhead sea turtles and one that was a green sea turtle. In 1997, the number of nests documented increased slightly to 19 nests. Seventeen of the nests were loggerheads. The species type for the other two nests was not positively identified. In 1998, there were a total of 13 nests, all loggerheads except for one green. While the GUIS subdistricts also showed annual fluctuations in nest numbers, they showed the inverse pattern in loggerhead nesting with a high in 1996 (N=42) and 1998 (N=40) and a low in nesting in 1997 (N=22). Nesting by greens was minimal on both Pensacola Beach (1 in 1996 and 1998, 0 in 1997) and Park property (3 nests in 1996, 0 nests in 1997, and 5 nests in 1998), with similar annual fluctuating patterns. *Refer to Graphs 1 and 2.*



Graph 1. A comparison of successful loggerhead nesting attempts on Pensacola Beach and the three subdistricts (Fort Pickens, Santa Rosa and Perdido Key) of Gulf Islands National Seashore (GUIS).

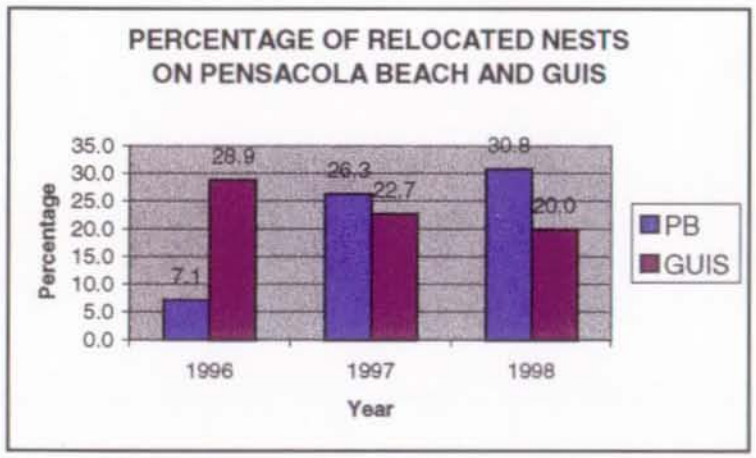


Graph 2. A comparison of successful green nesting attempts on Pensacola Beach and the three subdistricts (Fort Pickens, Santa Rosa and Perdido Key) of Gulf Islands National Seashore (GUIS).

All of the emergences did not result in successful nesting by the females. Aborted nesting attempts, "false crawls", were observed each year. Over all three years, 32% of recorded loggerhead turtle emergences and 33% of green turtle emergences resulted in false crawls on Pensacola Beach. In general, loggerhead false crawls were more prevalent on GUIS beaches, ranging from 18% to 53% higher than on Pensacola Beach. As false crawls close to the surf line can be overlooked or washed out by the time of the morning surveys, these figures should be regarded as minimal estimates.

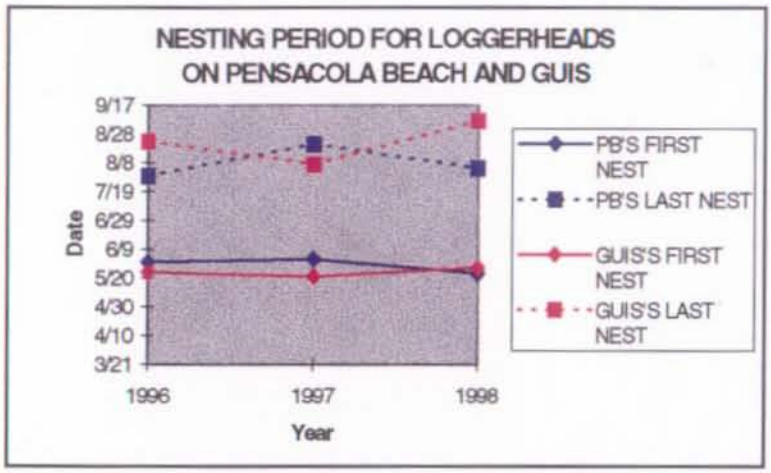
The distribution of loggerhead turtle nests did not show any distinct patterns. Loggerheads nested on both undeveloped and developed sections of Pensacola Beach, with nest sites ranging anywhere from 10ft to >100 ft from the high water mark. The green turtles seemed to be less tolerant of developed areas. The nests during this period were all laid on the eastern, undeveloped sections of Pensacola Beach and on Park property. They chose sites >50 ft from the high water mark, near or in the dune line. *Refer to Maps 2 and 3 on pages 45 and 46.*

Nesting by loggerheads and greens was nocturnal with one exception: In 1997, a female loggerhead nested just after sunrise on Pensacola Beach. Occasional day nesting has been reported on GUIS beaches as well. The percentage of Pensacola Beach nests that have required relocation has slowly increased over the years. Erosion of nesting beach areas, due primarily to coastal development and active hurricane seasons, has increased the nests' vulnerability to being regularly inundated by salt water or washed away. All of the relocated Pensacola Beach nests were loggerheads and only one of GUIS's was a green. The green turtles tended to crawl further up the beach before laying their eggs. *Refer to Graph 3.*

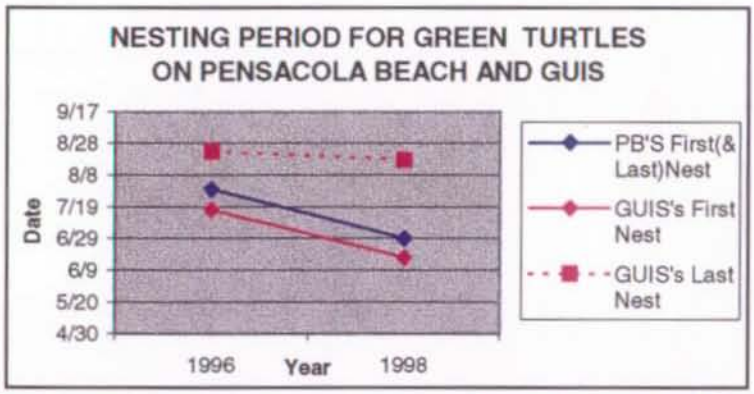


Graph 3. Percentage of nests that were relocated due to environmental threats on Pensacola Beach and GUIS.

The length of the nesting season varied from year to year, with loggerhead nesting activity on Pensacola Beach beginning as early as May 23 in 1998 and ending as late as August 21 in 1997. Peak periods of activity on Pensacola Beach and GUIS occurred in June and July. Green turtles commenced nesting 5 to 8 weeks later than loggerheads on Pensacola Beach and GUIS property. *Refer to Graphs 4 and 5.*



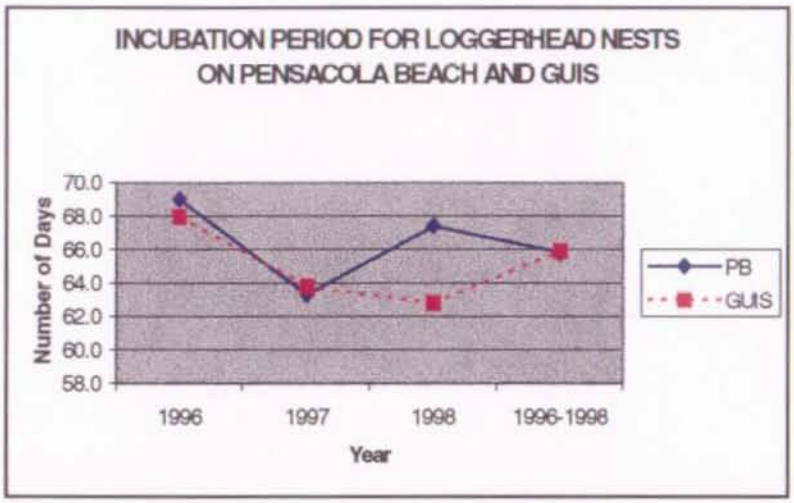
Graph 4. Initial and final dates of loggerhead nesting activity on Pensacola Beach and GUIS.



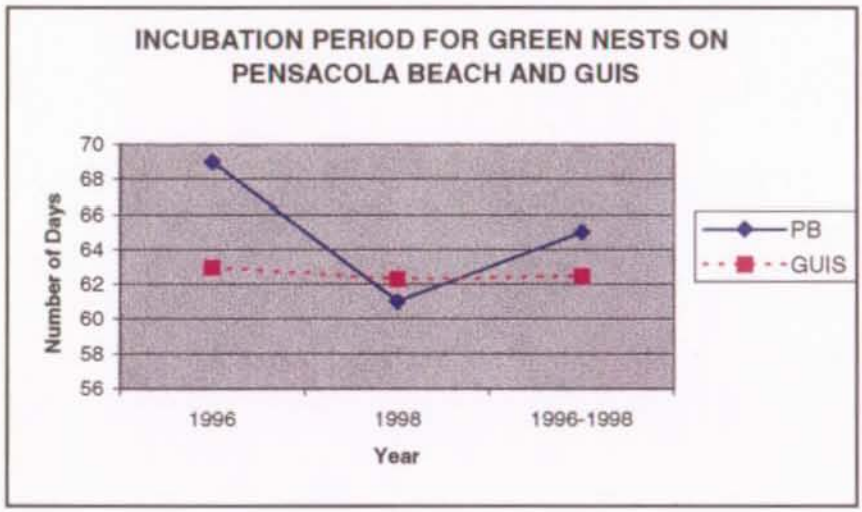
Graph 5. Initial and final dates of green turtle nesting activity on Pensacola Beach and GUIS. Note: There were no green turtle nests in 1997.

Hatching

Incubation period could not be accurately determined for all of the nests. Average incubation duration for the three year span averaged 66 days for both PB loggerhead nests (N=22, R=57-77) and GUIS loggerhead nests (N=53, R=54-79). The average incubation period for green nests was slightly shorter and less variable than for loggerhead nests: PB nests=65 days (N=2, R=61-69) and Park nests=63 days (N=4, R=61-65). Moving the nests did not seem to consistently shorten or lengthen the development time; the average incubation period for relocated nests was also 66 days for both GUIS and Pensacola Beach nests over the three year period. *Refer to Graphs 6 and 7.*



Graph 6. Average incubation period from year to year for loggerhead nests on Pensacola Beach and GUIS.



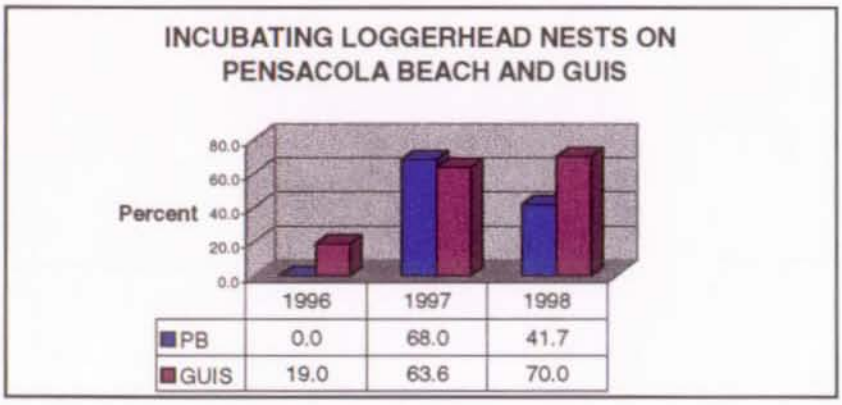
Graph 7. Average incubation period from year to year for green nests on Pensacola Beach and GUIS.

Emergence of hatchlings from the nest cavity is hypothesized to be in response to declining sand temperatures. We found that the hatchlings emerged during the night between 1730 hrs and 730hrs. From each nest they emerged on more than one night and did not emerge as a single group. Emergence asynchrony was also seen for nests on nearby GUIS beaches (Unpublished GUIS data). It was very common, upon excavation of the nest, to find a few live/dead hatchlings still in the egg chamber. Presumably having pipped later or being less active, these hatchlings were unable to make it to the surface. Those still alive were taken down to the water's edge and released at night.

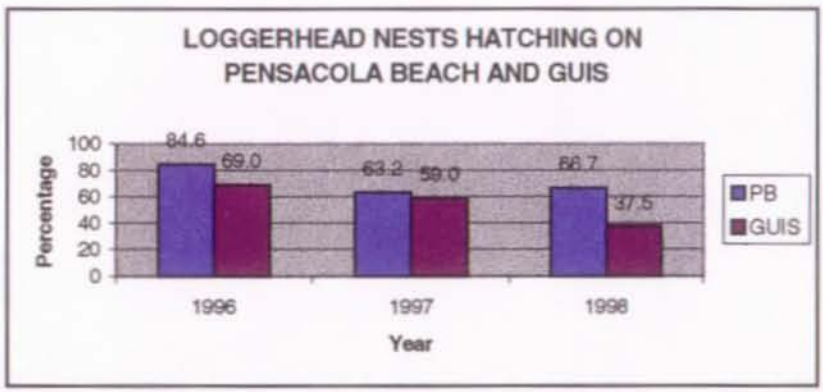
The number of nests that successfully produce young is profoundly affected by the timing and number of tropical storms and hurricanes. In 1996, there were no hurricanes in the area but Tropical Storm Josephine passed through around October 7.

By that time, 11 of the 13 loggerhead nests and the one green nest on Pensacola Beach had hatched. Records do not show the fate of two other loggerhead nests, but it is assumed that they did not hatch. In 1997, Hurricane Danny (Category 1) came through the area around July 18 when 13 of the 19 nests were still incubating. Six nests were washed away. A total of twelve nests hatched that year. In 1998, there were 5 nests (all loggerheads) incubating on Pensacola Beach when Hurricane Earl (Category 2) made landfall in Panama City. Four of those nests were washed away. The eggs in the remaining loggerhead nest were in the process of pipping as Hurricane Georges (Category 2) made its approach at the end of September. To protect them, we transferred the eggs to an insulated cooler where they successfully hatched during the hurricane. Due to heavy surf conditions, they were released by boat 3 miles offshore. Nine nests (8 loggerhead nests and 1 green nest) hatched that year.

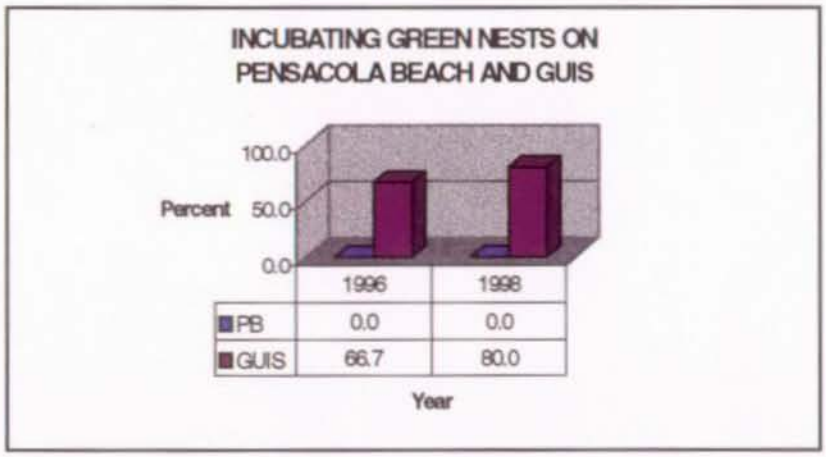
In comparison to Pensacola Beach, the percentage of nests hatching on Park property was considerably lower for each year during the 1996-1998 period. The timing of the nests and the arrival of hurricanes can explain these results. In 1996 and 1998, the percentage of loggerhead and green nests still incubating at the time of T. S. Josephine '96/Hurricane Earl '98/Hurricane Georges '98 was higher on GUIS than on Pensacola Beach. Correspondingly, the total number of nests that hatched during those seasons was considerably lower for Park nests due to nests being lost from erosion and flooding. In 1997, a slightly higher proportion of Pensacola Beach loggerhead nests than Park nests were incubating when Hurricane Danny came through. However, since a lower percentage of Park nests were relocated that season (*Graph 3*), they were more vulnerable to being washed away. *Refer to Graphs 8-11.*



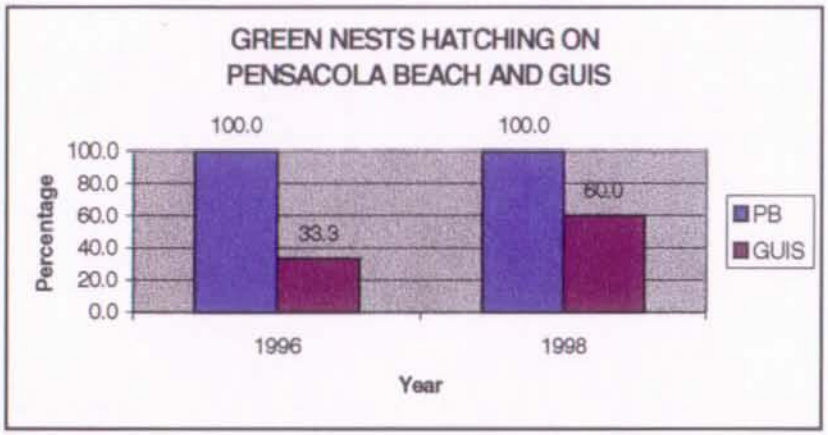
Graph 8. Percentage of loggerhead nests incubating on Pensacola Beach and GUIS during Tropical Storm Josephine in 1996, Hurricane Danny in 1997, and Hurricane Earl/Georges in 1998.



Graph 9. Percentage of loggerhead nests that produced emerging hatchlings on Pensacola Beach and GUIS during the 1996-1998 seasons.

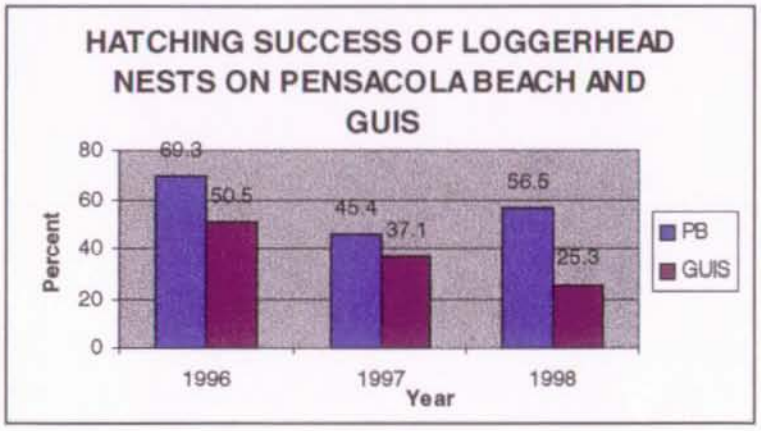


Graph 10. Percentage of green nests incubating on Pensacola Beach and GUIS during Tropical Storm Josephine in 1996 and Hurricane Earl/Georges in 1998.

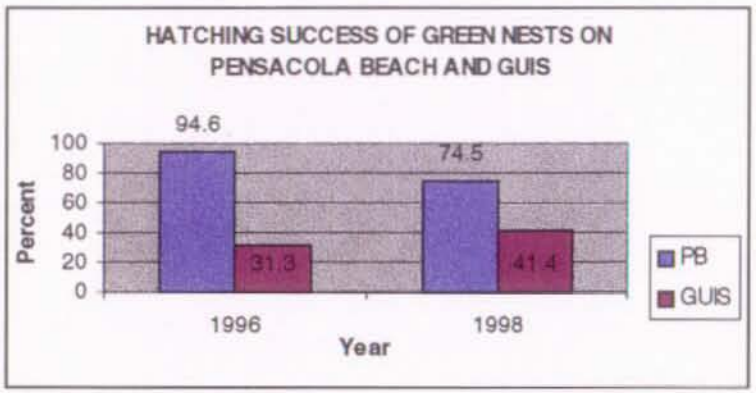


Graph 11. Percentage of green nests that produced emerging hatchlings on Pensacola Beach and GUIS during the 1996-1998 seasons.

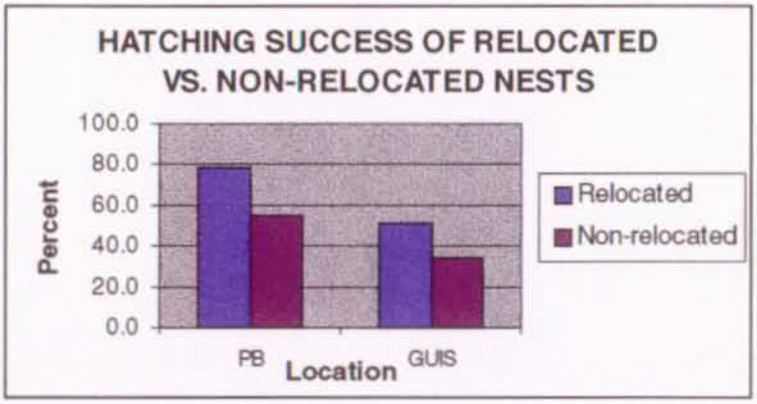
Hatching success was defined as the percentage of hatchlings that emerged from the eggs. Hatching success was calculated for the nests for which we had complete data. Mean loggerhead hatching success on Pensacola Beach was 69.3% in 1996, dropping to 45.4% in 1997 and 56.5% in 1998 due to hurricane damage (primarily by nests being washed out to sea, but also by inundation and sand accretion) from Danny '97 and Earl '98. Hatching success for green and loggerhead nests was consistently lower on GUIS beaches for all three years. This difference can again be explained by looking at Graphs 8-11; there were higher proportions of incubating nests during the time of tropical storms/hurricanes in the park, where as most Pensacola Beach nests had hatched prior to the arrival of the storms. *Refer to Graphs 12 and 13.*



Graph 12. Hatching succuss of loggerhead nests on Pensacola Beach and GUIS during the 1996-1998 seasons.



Graph 13. Hatching success of green nests on Pensacola Beach and GUIS during the 1996-1998 seasons.



Graph 14. A comparison of hatching success for (green and loggerhead) relocated nests and nests left in situ on Pensacola Beach and GUIS during 1996-1998.

A comparison of moved nests versus nests in situ revealed that relocation of eggs (within 12 hours of deposition or after 2 weeks) did not negatively affect hatching success. Average hatching success was actually higher for relocated Pensacola Beach and GUIS nests, primarily due to increased protection from high tide/storm damage. *Refer to Graph 14.*

Examination of eggs from nest excavations revealed the following reasons for hatch failure: infertility, developmental arrest/abnormalities, microbial infections and drowning due to inundation. It was impossible to distinguish, through cursory visual examination, truly infertile eggs from those containing embryos dying at an initial stage

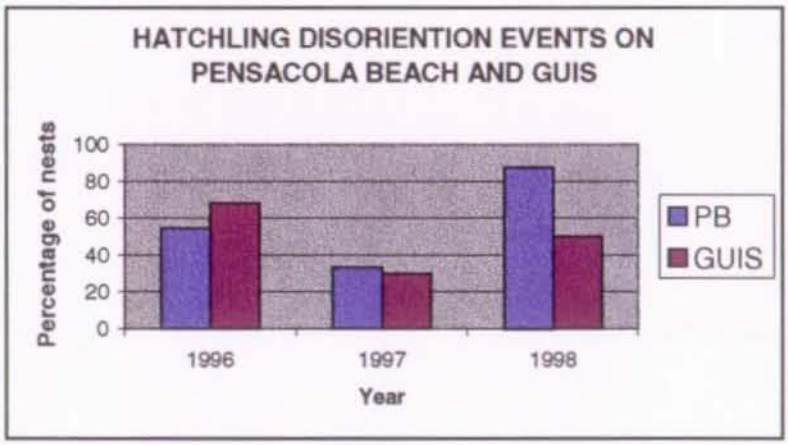
of development. As a result, the number of infertile eggs was probably overestimated. *Refer to Appendix A.*

The number of hatchlings actually reaching the water could only be calculated as minimal estimates. Staffing and time constraints, combined with variable hatching times, meant that observers could not be present at every hatch. *Refer to Table 1.*

	Pensacola Beach		GUIS	
	Loggerhead	Green	Loggerhead	Green
1996	446	37	1058	158
1997	796	N/A	816	N/A
1998	689	120	651	305
Total	**1931**	**157**	**2525**	**463**

Table 1. Number of hatchlings reaching the water based on visual observations of hatchlings and track counts.

Disorientation due to artificial lighting constituted the primary deterrent for successful entry of hatchlings into the Gulf. Nests where over 25% of the hatchlings became confused in their attempts to reach the ocean were not uncommon. In fact over 57% of the PB nests for which hatchling orientation data is available during the 1996-1998 seasons fell into this category. Due to ambient light from surrounding developed areas (Pensacola Beach, Gulf Breeze, Perdido Key, NAS, city of Pensacola), nests hatching on Park property also showed disorientation (54.7% over the three-year time span). *Refer to Graph 15.*



Graph 15. Percentage of observed hatching nests (green and loggerhead) that had >25% disoriented hatchlings from a nest.

Discussion

The primary purposes of monitoring a protected species are to determine trends in survival and reproduction, identify forces which may be negatively or positively affecting its recovery, and assess the success of conservation and management practices. As sea turtles are long-lived, have a high maturation age and nest in cycles, monitoring over the long term is critical for an accurate determination of the above. Therefore, due to the short time-frame covered in this report (three nesting seasons), any observable trends should be regarded as preliminary patterns to be verified or revised over the long-term.

Nonetheless, there are still some important generalizations to be drawn from the results of the 1996-1998 nesting seasons on Pensacola Beach and GUIS. They are as follows:

(I) Hurricanes and tropical storms are part of the natural system. They play a role in survivability of nests and hatchlings. Erosion and flooding can significantly lower success rates of nests that are left *in situ,* and if severe enough, have negative impacts on nests that have been relocated to higher ground. Nests that are laid early in the season and hatch before the arrival of hurricanes can have higher levels of success than the nests laid later in the season. This fits with the natural history of marine turtles (loggerheads and greens) in that they lay 3-4 nests a season. If one or two nests are lost to storms later in the season, there may have been 1-2 nests that were laid earlier in the season that may survive to perpetuate the species.

(II) Careful relocation of eggs by trained personnel within 12 hours of deposition or after 2 weeks of development does not seem to negatively impact hatching success. Moving a nest to a higher location on the beach can even improve hatching success in specific cases. The accelerated erosion of coastline due to several successive active hurricane seasons has resulted in increasingly narrow nesting areas. The erosion on Pensacola Beach is particularly severe because of the additional factor of development. The loss of available nesting habitat has resulted in nests being laid closer to the high water mark; without relocation, these nests are much more vulnerable to being inundated or washed away, even in the absence of a hurricane during the incubation period. ***However, recognizing that moving eggs could potentially have other subtle impacts (e.g., on sex determination, nest site fidelity, etc.), relocation should only be considered as a last resort.***

(III) The number of eggs laid and hatching success is meaningless if the hatchlings never make it into the Gulf. Disorientation due to artificial lights on Pensacola Beach has caused high levels of hatchling mortality. Hatchlings emerging on a night without a full moon inevitably become severely disoriented, due to the high density of lights directly visible from the beach. Disorientation events also occur frequently on GUIS property because of ambient lighting from the city of Pensacola, NAS, Perdido Key, Pensacola Beach, and Navarre; however, because the sky-glow is sometimes shielded by dunes and direct lighting of the beach is absent, the number of disorientation incidents is usually lower and the state of disorientation is often temporary. Efforts to prevent disorientation and prevent mortality by the use of restraining screens (as described in the methods section) have been successful as a stop-gap measure, but do not rectify the underlying problem. ***Mitigation of the lighting problem will require:***

1) education of the public as to the link between lights and hatchling mortality; 2) continued cooperation between SRIA, the NPS, and Gulf Power to encourage voluntary reduction of lighting that is attractive and visible to turtles; and 3) possibly implementation of a lighting ordinance, if all else fails.

(IV) Nests on Pensacola Beach constitute a relatively high proportion of total nests for the local area (which includes Perdido Key, Fort Pickens, Santa Rosa, Pensacola Beach, and University of West Florida property)--over 20% for each season during 1996-1998. Since nesting densities are low throughout the area, compared to beaches further east in the Panhandle and in south Florida, this highlights the importance of protecting nesting activity and nesting habitat on Pensacola Beach. ***Land-use plans for Pensacola Beach should consider very carefully how continued development will affect the sea turtle populations in the area.***

Due to a sincere commitment by all parties concerned, monitoring and protection of nests and hatchlings on Pensacola Beach has significantly improved over the years. While this report shows that sea turtles are still far from being unaffected by human influences, it is also evident that with responsible stewardship, use of these areas by people and by sea turtles need not be mutually exclusive.

Acknowledgements

My sincere thanks to Mark Nicholas and Troy Davis for their patience, their efforts to make sure the surveys went smoothly, and their ability to make me laugh when things weren't going so smoothly; to Riley Hoggard for his smiling answers to my numerous questions; and to all the SRIA staff who were involved, particularly Russell, Alan Bell, and Debbie Norton for their true interest in helping to protect the sea turtles on Pensacola Beach.

References

Florida Department of Community Affairs. 1996a. *Florida Assessment of Coastal Trends.* At http://www.fcpm.fsu.edu/FACT/index.html.

Florida Department of Community Affairs. 1996b. *Florida State of the Coast Report.* At http://www.fcpm.fsu.edu/FSOC/index.html.

Memorandum of Agreement. 1997. National Park Service and Santa Rosa Island Authority.

Meylan, A., B. Schroeder, and A. Mosier. 1995. *Sea Turtle Nesting Activity in the State of Florida.* Florida Marine Research Institute Publications/DEP, FL.

Nicholas, M. and A. Jacks. 1997. *Sea Turtle Nesting Report-Gulf Islands National Seashore Florida District 1994-1996.* National Park Service, FL.

APPENDIX A
1996 SEA TURTLE NESTING ACTIVITY ON PENSACOLA BEACH

Nest #	Species	Date Found	Time	Monitored	Recovered	Moved	Crawl Width	Predation/Type	Date Hatch	Incub Days	Total # Eggs	# Hatched	# Developed	# Undeveloped	% Hatch	Disoriention?	# in Water
PB1	Loggerhead	5/31/96	6:30	Y	Y	N	UNK	Y: GC/Birds/Fox	8/14/96	75	145	92	47	6	63.4	Y	20
PB1A	Loggerhead	NA	NA	N	N	N	UNK	UNK	8/7/96	UNK	UNK	UNK	UNK	UNK	UNK	Y	80
PB2	Loggerhead	6/11/96	6:11	Y	Y	N	UNK	N	UNK	UNK	101	88	2	11	87.1	N	88
PB2A	Loggerhead	NA	NA	N	N	N	UNK	Y: GC/Birds	8/19/96	UNK	UNK	UNK	UNK	UNK	UNK	Y	UNK
PB3	Loggerhead	6/17/96	6:30	Y	Y	N	UNK	UNK	UNK	UNK	113	17	38	58	15.0	UNK	UNK
PB4	Loggerhead	6/18/96	6:11	Y	Y	N	UNK	N	8/26/96	69	99	88	2	9	88.9	N	88
PB5	Loggerhead	6/23/96	6:25	Y	Y	Y: > 2 weeks	UNK	Y: Fox	8/27/96	65	97	31	UNK	UNK	UNK	N	21
PB6	Loggerhead	6/25/96	6:25	Y	UNK	N	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK
PB6A	Loggerhead	NA	NA	N	Y	N	UNK	Y:GC/Birds	9/11/96	UNK	107	51	1	55	47.7	Y	33
PB7	Loggerhead	7/5/96	6:25	Y	Y	N	UNK	Y:GC/Birds	9/10/96	67	91	87	2	2	95.6	N	87
PB8	Loggerhead	7/16/96	6:10	Y	Y	N	UNK	N	UNK	UNK	91	56	13	22	61.5	N	UNK
PB9	Loggerhead	7/20/96	5:45	Y	UNK	N	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK	UNK
PB10	Green	7/30/96	6:10	Y	Y	N	UNK	Y:GC/Birds	10/7/96	69	166	157	0	9	94.6	Y	37
PB10A	Loggerhead	NA	NA	N	Y	N	UNK	Y:GC/Birds	9/5/96	UNK	101	96	1	4	95.0	Y	29

1997 SEA TURTLE NESTING ACTIVITY ON PENSACOLA BEACH

Nest #	Species	Date Found	Time	Monitored	Recovered	Moved	Crawl Width	Predation/Type	Date Hatch	Incub Days	Total # Eggs	# Hatched	# Developed	# Undeveloped	% Hatch	Disoriention?	# in Water
PB1	Unknown	6/2/97	6:00	Y	N	N	UNK	N	N/A	N/A	UNK	0	UNK	UNK	0	N/A	0
PB2	Loggerhead	6/10/97	7:30	Y	N	N	UNK	N	N/A	N/A	UNK	0	UNK	UNK	0	N/A	0
PBUK1	Loggerhead	N/A	N/A	N	Y	Y>2 Weeks	UNK	Y-GC	8/12/97	UNK	UNK	14	UNK	UNK	UNK	N	4
PB3	Loggerhead	6/13/97	6:00	Y	Y	N	UNK	N	8/18/97	66	105	103	0	2	98.1	N	102
PB4	Loggerhead	6/22/97	10:00	Y	Y	N	36	N	8/29/97	68	57	8	38	11	14.0	Y	8
PB5	Loggerhead	6/22/97	22:00	Y	N	N	36	N	N/A	N/A	UNK	0	UNK	UNK	0	N/A	0
PB6	Loggerhead	6/25/97	6:30	Y	Y	N	38	N	8/29/97	65	112	86	7	19	76.8	N	86
PB7	Loggerhead	6/25/97	6:45	Y	N	N	39	N	N/A	N/A	UNK	0	UNK	UNK	0	N/A	0
PB8	Loggerhead	6/27/97	6:50	Y	N	N	30	N	N/A	N/A	UNK	0	UNK	UNK	0	N/A	0
PBUK2	Loggerhead	N/A	N/A	N	Y	Y>2 WKS	UNK	N	UNK	UNK	UNK	UNK	UNK	UNK	UNK	N/A	UNK
PB9(UWF)	Loggerhead	6/27/97	8:00	Y	Y	N	39	Y-Birds	8/29/97	63	90	88	0	2	97.8	Y	88
PB10	Unknown	7/8/97	8:30	Y	N	N	UNK	N	N/A	N/A	UNK	0	UNK	UNK	0	N/A	0
PB11	Loggerhead	7/10/97	7:30	Y	Y	N	38	N	9/15/97	67	85	84	0	1	98.8	N	84
PB12	Loggerhead	7/24/97	6:45	Y	Y	N	UNK	Y-BIRDS	9/20/97	58	103	102	0	1	99.0	Y	75
PB13	Loggerhead	8/3/97	11:45	Y	Y	Y<12HRS	UNK	N	10/1/97	60	125	78	14	33	62.4	N	78
PB14	Loggerhead	8/9/97	6:15	Y	Y	N	36	N	UNK	UNK	UNK	UNK	UNK	UNK	UNK	N/A	64
PB15	Loggerhead	8/9/97	7:25	Y	Y	Y<12HRS	33	N	10/10/97	62	102	91	1	10	89.2	N	90
PB16	Loggerhead	8/14/97	6:12	Y	Y	N	UNK	N	10/10/97	57	UNK	UNK	UNK	UNK	UNK	N/A	33
PB17(UWF)	Loggerhead	8/21/97	8:00	Y	Y	Y<12HRS	34	Y-FOX	10/27/97	67	UNK	UNK	UNK	UNK	UNK	N/A	84

1998 SEA TURTLE NESTING ACTIVITY ON PENSACOLA BEACH

Nest #	Species	Date found	Time	Monitored	Recovered	Moved	Crawl Width	Predation/Type	Date Hatch	Incub Days	Total # of Eggs	# Hatched	# Developed	# Undeveloped	% Hatch	Disoriention?	# In water
PB1	loggerhead	5/23/98	0625	Y	Y	Y<12 hrs	36	Y-GC	7/29/98	67	114	98	2	14	86.0	Y	88
PB2	loggerhead	6/2/98	0625	Y	Y	N	34	Y-GC/BIRDS	8/8/98	67	128	120	0	8	93.8	Y	70-75
PB3	loggerhead	6/7/98	2030	Y	Y	N	35	N	8/12/98	66	140	122	4	14	87.1	Y	122
PB4	loggerhead	6/8/98	2100	Y	Y	Y<12 hrs	32	N	8/24/98	77	76	61	8	7	80.3	Y	61
PB5	loggerhead	6/14/98	0722	Y	Y	N	33	Y-GC/BIRDS	8/24/98	71	121	110	10	1	90.9	Y	45
PB6	loggerhead	6/25/98	0626	Y	Y	Y<12 hrs	31	Y-GC	8/30/98	66	119	111	1	7	93.3	N	111
PB7	loggerhead	6/25/98	0743	Y	Y	Y<12 hrs	36	Y-GC	8/27/98	63	125	71	4	50	56.8	Y	71
PB8	green	6/29/98	0715	Y	Y	N	37	N	8/29/98	61	161	120	3	38	74.5	Y	120
PB9	loggerhead	6/30/98	0605	Y	N	N	32	N	N/A	N/A	UNK	0	UNK	UNK	N/A	N/A	0
PB10	loggerhead	7/15/98	2200	Y	N	N	31	N	N/A	N/A	UNK	0	UNK	UNK	N/A	N/A	0
PB11	loggerhead	7/22/98	0621	Y	N	N	36	N	N/A	N/A	UNK	0	UNK	UNK	N/A	N/A	0
PB12	loggerhead	7/25/98	0620	Y	Y	N	36	N	9/25/98	62	130	116	12	2	89.2	N/A	116
PB13	loggerhead	8/4/98	0640	Y	N	N	30	N	N/A	N/A	UNK	0	UNK	UNK	N/A	N/A	0