

# **Nesting Trends of Sea Turtles in National Seashores along Atlantic and Gulf Coast Waters of the United States**

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### **Abstract**

National Seashores provide important nesting and foraging habitats for endangered and threatened sea turtles inhabiting the Atlantic and Gulf coast waters of the United States. Successful recovery of these species depends on effective monitoring and protection. We examined protocols and efforts of sea turtle nest monitoring programs at six National Seashores and eight states in the southeastern U.S. National Seashores included Cape Hatteras, Cape Lookout, Cumberland Island, Canaveral, Gulf Islands, and Padre Island. States included North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. We compared annual fluctuations in sea turtle nesting levels among National Seashores and between seashores and surrounding states for years 1989 through 1997 or 1998. We investigated influences on sea turtle nesting activities. Data and information presented were provided by researchers and officials at National Seashores, various state agencies, regional fishery councils, and the U.S. Fish and Wildlife Service.

In most cases, annual fluctuations in documented sea turtle nesting at National Seashores generally reflected annual fluctuations in nesting in the surrounding state. In most areas and for most species, the numbers of documented nests remained stable or increased slightly during the study period. Primary influences on nesting activity documented at National Seashores were similar to influences noted in surrounding states, and included tidal inundation, erosion, commercial fishing, vehicle use, human disturbance, predation, and artificial lighting.

Maximizing consistency in monitoring protocols between organizations involved in sea turtle recovery enables researchers to more accurately determine the impact of

conservation efforts and to devise more effective strategies for achieving recovery goals. Consistency in monitoring programs at most seashores and states and coordination of monitoring activities between the seashores and states had improved by 1989. Index Nesting Beach Survey (INBS) programs, utilizing standardized monitoring techniques to assess nesting trends, have been in place at most nesting beaches in Florida, Georgia, and North Carolina for the last 10 years. With the exception of the Mississippi District of Gulf Islands National Seashore, patrols for sea turtle nests are now conducted daily throughout the monitoring season at the six National Seashores in the southeastern U.S. However, there are minor differences in monitoring methods outside of INBS areas and differences in methods for measuring reproductive success both among National Seashores and between seashores and surrounding states. We recommend standardized measures and calculations of reproductive success, centralized documentation of survey effort, and long-term consistency in monitoring across locations and years. We also recommend that the National Seashores continue to conduct nest protection measures authorized by state and federal permits that take into consideration National Park Service mandates and policies, meet local needs, and have been deemed effective through research or monitoring results. However, these recommendations are contingent on adequate and consistent funding of sea turtle nest monitoring and protection programs.

# Contents

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Title .....	ii
Abstract.....	ii
Contents.....	iv
Figures and Tables .....	v
Problem Statement and Introduction.....	1
Objectives .....	4
Methods.....	4
Project Personnel/Cooperators and Partners .....	6
Project Facilities/Equipment and Study Areas .....	7
Results and Discussion.....	7
MONITORING EFFORTS AND PROTOCOL.....	7
MEASURES OF REPRODUCTIVE SUCCESS.....	15
ANNUAL FLUCTUATIONS AND TRENDS IN LOGGERHEAD NESTING.....	19
ANNUAL FLUCTUATIONS AND TRENDS IN GREEN NESTING.....	33
ANNUAL FLUCTUATIONS AND TRENDS IN OTHER SEA TURTLE NESTING.....	38
INFLUENCES ON SEA TURTLE NESTING.....	41
Conclusion and Recommendations.....	48
Budget Requirements.....	53
Project Schedule .....	53
Expected Products.....	53
Literature Cited.....	54
Acknowledgements .....	55
APPENDIX A. NATIONAL SEASHORES OF THE SOUTHEASTERN U.S.....	57
APPENDIX B. SOUTHEAST NESTING NRPP PROJECT QUESTIONNAIRE.....	58
APPENDIX C. SEA TURTLE NESTING AT NATIONAL SEASHORES IN THE SOUTHEASTERN U.S., 1989-1998, AS REPORTED BY THE NATIONAL PARK SERVICE AND THE U.S. FISH AND WILDLIFE SERVICE.....	59
APPENDIX D. SEA TURTLE NESTING OUTSIDE OF NATIONAL SEASHORES IN THE SOUTHEASTERN U.S., 1989-1998, AS REPORTED BY STATE AND FEDERAL SOURCES <sup>A</sup> .....	60
APPENDIX E. COMMERCIAL FOOD SHRIMP TRAWLING SEASONS IN STATE AND FEDERAL WATERS OF THE SOUTHEASTERN U.S., AS REPORTED BY STATE AND FEDERAL SOURCES. <sup>A</sup> .....	61

## Figures and Tables

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Figure 1. Sea turtle nests (all species) found at Padre Island National Seashore compared to patrol effort, measured as the number of kilometers patrolled, for 1989-1998.....	14
Table 1. Annual rates of reproductive success, measured as percent emergence <sup>1,2</sup> or percent hatching <sup>3,4</sup> , at Cape Hatteras National Seashore (CAHA), Cape Lookout National Seashore (CALO), North Carolina (excluding National Seashores), Cumberland Island National Seashore (CUIS), Canaveral National Seashore (CANA), and Padre Island National Seashore (PAIS) combined with Texas.....	18
Figure 2. Annual fluctuations in hatchling emergence documented at Cape Hatteras National Seashore (CAHA), at Cape Lookout National Seashore (CALO), and in the remainder of North Carolina, 1989-1997.....	20
Figure 3. Annual fluctuations in hatchling emergence documented at Cape Hatteras (CAHA), Cape Lookout (CALO), and Cumberland Island (CUIS) National Seashores, 1989-1997.....	20
Figure 4. Annual fluctuations in loggerhead nests found at Cape Hatteras National Seashore (CAHA) and in North Carolina (excluding National Seashores), 1989-1998.....	23
Figure 5. Annual fluctuations in loggerhead nests found at Cape Lookout National Seashore (CALO) and in North Carolina (excluding National Seashores), 1989-1998.....	23
Figure 6. Annual fluctuations in loggerhead nests found in South Carolina, 1989-1997.....	24
Figure 7. Annual fluctuations in loggerhead nests found at Cumberland Island National Seashore (CUIS) and in the remainder of Georgia, 1989-1998.....	26
Figure 8. Annual fluctuations in loggerhead nests found at Canaveral National Seashore (CANA) and in Florida (excluding National Seashores), 1989-1997.....	28
Figure 9. Annual fluctuations in loggerhead nests found at Gulf Islands National Seashore, Florida District (GUIS-FL) and in Florida (excluding National Seashores), 1989-1997.....	28
Figure 10. Annual fluctuations in loggerhead nests found at Canaveral National Seashore (CANA) and the remainder of the South Florida Nesting Subpopulation, 1989-1997.....	29
Figure 11. Annual fluctuations in loggerhead nests found at Gulf Islands National Seashore, Florida District (GUIS-FL) and the remainder of the Florida Panhandle Nesting Subpopulation, 1989-1997.....	29
Figure 12. Annual fluctuations in loggerhead nests found at Gulf Islands National Seashore, Mississippi District (GUIS-MS) and at Gulf Islands National Seashore, Florida District (GUIS-FL), 1989-1998.....	30
Figure 13. Annual fluctuations in loggerhead nests found at Cape Hatteras National Seashore (CAHA), Cape Lookout National Seashore (CALO), and Cumberland Island National Seashore (CUIS), 1989-1998.....	32
Figure 14. Annual fluctuations in green turtle nests found at Cape Hatteras National Seashore (CAHA), at Cape Lookout National Seashore (CALO), and in the rest North Carolina, 1989-1998.....	34

Figure 15. Annual fluctuations in green turtle nests found at Canaveral National Seashore (CANA) and in Florida (excluding National Seashores), 1989-1997..... 36

Figure 16. Annual fluctuations in green turtle nests found at Gulf Islands National Seashore, Florida District (GUIS-FL) and in Florida (excluding National Seashores), 1989-1997. .... 36

Figure 17. Annual fluctuations in green turtle nests found at Canaveral National Seashore (CANA), Gulf Islands National Seashore, Florida District (GUIS-FL), Cape Hatteras National Seashore (CAHA), and Cape Lookout National Seashore (CALO), 1989-1998..... 37

Figure 18. Annual fluctuations in leatherback turtle nests found at Canaveral National Seashore (CANA) and in the remainder of Florida, 1989-1997..... 39

Figure 19. Annual fluctuations in Kemp's ridley turtle nests found at Padre Island National Seashore (PAIS) and in the remainder of Texas, 1989-1998..... 40

## Problem Statement and Introduction

National Seashores, under the administration of the National Park Service, play a crucial role in sea turtle conservation efforts. Five species of marine turtles found in U.S. Atlantic and Gulf coast waters utilize these areas. National Seashores allow for perpetual, comprehensive protection of nesting beaches and provide an opportunity for long-term research. The National Park Service can develop and implement conservation strategies on multiple levels, with objectives tailored for one population, one species, one region, or all seashores.

Six National Seashores located along the Atlantic and Gulf coast waters of the southeastern U.S. serve as the focus of this study (Appendix A). The six National Seashores include Cape Hatteras, Cape Lookout, Cumberland Island, Canaveral, Gulf Islands, and Padre Island. Considering these six areas collectively, loggerhead sea turtles (*Caretta caretta*) nest more frequently than any other sea turtle species. These National Seashores encompass nesting grounds for at least three demographically independent cohorts of loggerhead sea turtles. The Northern Nesting Subpopulation ranges from North Carolina south to northeastern Florida, the South Florida Nesting Subpopulation is located in southern Florida, and the Florida Panhandle Nesting Subpopulation is found in northwestern Florida (Encalada et al., 1998; Turtle Expert Working Group, 1998).

Cape Hatteras, Cape Lookout, and Cumberland Island National Seashores provide protection for the Northern Nesting Subpopulation of loggerhead sea turtles (Encalada et al., 1998; Turtle Expert Working Group, 1998). This smaller nesting group is extremely important as a source of male hatchlings since, due to temperature-dependent sex determination, the warmer temperatures of Florida result in a majority of female hatchlings (Ackerman, 1997). Canaveral National Seashore is located within the second largest nesting assemblage of loggerhead sea turtles in the world and provides important nesting habitat for members of the South Florida Nesting Subpopulation (Turtle Expert Working Group, 1998). Both the Florida and Mississippi districts of Gulf Islands National Seashore provide nesting habitat for loggerhead turtles. Although fewer nests are found at Gulf Islands than at some of the other National Seashores, the Florida district (and perhaps Mississippi district) serves as a nesting refuge for loggerheads from the

Florida Panhandle Nesting Subpopulation. Although loggerhead turtles nest at Padre Island National Seashore, very few nests are found each year and the Nesting Subpopulation for these turtles is currently unknown.

Considering the six National Seashores collectively, green sea turtles (*Chelonia mydas*) nest in second greatest abundance. Canaveral National Seashore provides important nesting habitat for green turtles. Green turtle nests have also been recorded at Cape Hatteras, Cape Lookout, Gulf Islands Florida District, and Padre Island National Seashore.

Of the six National Seashores, Kemp's ridley sea turtle (*Lepidochelys kempi*) nests have only been documented at Padre Island. Also, Padre Island National Seashore is the only site in the United States where Kemp's ridleys nest on a regular basis. A few leatherback sea turtle (*Dermochelys coriacea*) nests are found at Canaveral National Seashore each year. Leatherback nesting was also recorded at Cape Hatteras National Seashore in 1998 and at Padre Island National Seashore in the 1930's and 1940's. The first hawksbill sea turtle (*Eretmochelys imbricata*) nest documented in the state of Texas was found at Padre Island National Seashore in 1998. During the 1998 monitoring season, four sea turtle species—Kemp's ridley, green, loggerhead, and hawksbill—were documented nesting at Padre Island National Seashore. Diversity of nesting sea turtle species is greater at Padre Island National Seashore than at the five other National Seashores.

Together, these six National Seashores provide valuable nesting and foraging habitat for all sea turtle species found in the Atlantic and Gulf coast waters of the U.S. Monitoring and protection of sea turtles, their nests, and their habitats have long been priorities for these areas. All National Seashores operate under the policies and mandates of the National Park Service, but individual seashores may implement different protocols and develop specific objectives. However, monitoring and protection programs undertaken by the National Seashores must be conducted in accordance with appropriate state and U.S. Fish and Wildlife Service permits.

Currently, changes in the number of sea turtle nests found each year provide the most reliable and widely-used index of population size and status for most sea turtle species (National Research Council, 1990; Turtle Expert Working Group, 1998).



Comparisons of nesting, hatching, and other monitoring information are critical for measuring the impact of conservation efforts on species recovery. Additionally, analysis of monitoring information on regional, population, and species levels can help identify any changing or emerging factors that may threaten marine turtle populations already at risk. However, the accuracy and value of these analyses are greatly influenced by the quality of information gathered from different areas by different organizations on a long-term basis.

Survey methods (including survey frequency and the dates that surveys begin and end each season) greatly influence the numbers of nests that are enumerated for various sea turtle species. Monitoring and protection efforts within the National Seashores and states have been conducted by various private and public organizations. The intensity and scope of these efforts have varied between areas and years, largely due to budget and time constraints, but the efforts have become increasingly effective and coordinated at the state and federal levels. Index Nesting Beach Survey (INBS) programs, utilizing standardized monitoring techniques to assess nesting trends, have been in place in Florida, Georgia, and North Carolina since 1989. Implementation of INBS programs has greatly increased the compatibility of monitoring programs among the participating seashores and surrounding states. However, there continues to be differences in monitoring protocols for areas not participating in INBS programs, spatial and temporal differences in the amounts of monitoring effort, and differences in measures of reproductive success. Continued efforts to maximize the compatibility of information gathered in different areas and by different organizations over multiple years will further improve the effectiveness of recovery efforts and provide the best chance for monitoring and protecting sea turtle populations.

A variety of nest protection measures are conducted at the six National Seashores and in the eight states. Nest protection activities undertaken at the National Seashores depend largely on activities authorized by state and federal permits, National Park Service mandates and policies, local/regional needs, and funding availability.

We examined general monitoring procedures used at six National Seashores along the U.S. Atlantic and Gulf coasts, comparing procedures among seashores and between seashores and states involved in sea turtle recovery efforts. We assessed annual

fluctuations in nesting levels, comparing each seashore to the state in which it is located. Trends in nesting levels were examined. We investigated influences on sea turtle nesting and hatching success. Finally, we used the results of these analyses to prepare a series of recommendations. Information gained through this study will be provided to the National Park Service to help enhance their monitoring and protection strategies so that the limited funds and resources allotted to each program can be targeted toward activities that offer the best chance to aid with recovery efforts.

## **Objectives**

1. Assess annual fluctuations in sea turtle nest counts and hatchling emergence at the six National Seashores.
2. Compare annual trends in sea turtle nest counts at the six National Seashores with overall trends from the states in which they are located.
3. Identify and evaluate factors affecting trends in nest counts, distributions, and hatchling emergence in the six National Seashores. Among the factors that will be investigated are beach lighting, changes in nesting habitat, vehicular traffic, nighttime beach usage, commercial fishing, and predation.

## **Methods**

We examined general procedures used and results of monitoring efforts at six National Seashores and in the states surrounding those seashores. National Seashores included were Cape Hatteras (CAHA), Cape Lookout (CALO), Cumberland Island (CUIS), Canaveral (CANA), Gulf Islands (GUIS), and Padre Island (PAIS). States included were North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas.

Researchers and officials at each of six seashores and four states were contacted by phone, fax, or e-mail and asked to complete a Southeast Nesting Project questionnaire (Appendix B). These biologists provided information on number of nests found,

reproductive success, nest monitoring procedures, and influences on sea turtle nesting activities. The U.S. Fish and Wildlife Service's National Sea Turtle Coordinator also provided information for these states, as well as documentation on nesting recorded in Alabama, Mississippi, and Louisiana. Personnel at Bon Secour National Wildlife Refuge, Alabama provided additional information on sea turtle nesting at their refuge.

Officials at marine fishery management agencies in eight states were contacted regarding shrimp fishery regulations. Information was provided on the duration of shrimp fishery seasons and on specific area closures within state waters. Officials at the South Atlantic and Gulf of Mexico Fishery Management Councils were also contacted, and provided information on shrimp fishing seasons in federal waters.

Prior to 1989, monitoring of sea turtle nesting in the southeastern U.S. was generally fragmented and inconsistent. However, by 1989, monitoring efforts and methods improved substantially in most areas involved in this study. Accordingly, documentation of sea turtle nesting prior to 1989 was not included in comparisons among seashores and between seashores and states.

Nesting information for years 1989-1998 was compiled and analyzed. Turtle nests found at National Seashores were separated and removed from state records to allow comparisons between the seashores and the remainders of each state (Appendices C and D). Annual changes in the number of nests found at each seashore were compared to changes in the remainder of the state, excluding National Seashores. Any emerging trends in annual fluctuations of nest counts were examined.

Researchers at each National Seashore and within each state provided anecdotal information on factors influencing nesting and hatching success. Some quantitative information on nests affected by these factors was also provided. This information was compiled and compared within seashores and between seashores and states.

All qualitative and quantitative results presented in this report are derived directly from information provided by researchers and officials completing the Southeast Nesting Project questionnaire, unless otherwise indicated. Information presented on sea turtle nesting at Bon Secour National Wildlife Refuge was provided by the U.S. Fish and Wildlife Service's National Sea Turtle Coordinator and Bon Secour National Wildlife Refuge personnel. Information presented regarding shrimp fishery regulations was

provided by the South Atlantic Fishery Management Council, Gulf of Mexico Fishery Management Council, North Carolina Division of Fisheries, South Carolina Department of Natural Resources, Georgia Department of Natural Resources, Florida Marine Fisheries Commission, Alabama Department of Conservation and Natural Resources, Mississippi Department of Marine Resources, Louisiana Department of Wildlife and Fisheries, and Texas Parks and Wildlife Department.

## **Project Personnel/Cooperators and Partners**

This project was completed by Jody L. Mays, Biological Technician, National Park Service, and Donna J. Shaver, Research Biologist, U.S. Geological Survey. Data were provided by Sandra L. MacPherson, National Sea Turtle Coordinator, U.S. Fish and Wildlife Service; Ruth Boettcher, North Carolina Sea Turtle Coordinator, North Carolina Wildlife Resources Commission; Marcia Lyons, Natural Resource Specialist, Cape Hatteras National Seashore, National Park Service; Jeff Cordes, Resource Management Specialist, Cape Lookout National Seashore, National Park Service; Sally Murphy, South Carolina Sea Turtle Coordinator, South Carolina Department of Natural Resources; Adam MacKinnon, State Sea Turtle Technician, Georgia Department of Natural Resources; Jennifer Bjork, Resource Management Specialist, Cumberland Island National Seashore, National Park Service; Dr. Robbin Trindell, Florida Sea Turtle Coordinator, Florida Department of Environmental Protection; John Stiner, Resource Management Specialist, Canaveral National Seashore, National Park Service; Mark Nicholas, Resource Management Specialist, Gulf Islands National Seashore, Florida District, National Park Service; Gary Hopkins, Resource Management Specialist, Gulf Islands National Seashore, Mississippi District, National Park Service; Bon Secour National Wildlife Refuge; South Atlantic Fishery Management Council; Gulf of Mexico Fishery Management Council; North Carolina Division of Fisheries; South Carolina Department of Natural Resources; Georgia Department of Natural Resources; Florida Marine Fisheries Commission; Alabama Department of Conservation and Natural Resources; Mississippi Department of Marine Resources; Louisiana Department of Wildlife and Fisheries; and, Texas Parks and Wildlife Department.

## **Project Facilities/Equipment and Study Areas**

No field sampling was undertaken for this project by the authors. Data provided by others were analyzed at Padre Island National Seashore. Areas for which nesting and reproductive success data were compared include six National Seashores (Cape Hatteras, Cape Lookout, Cumberland Island, Canaveral, Gulf Islands, and Padre Island) and eight states (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas).

## **Results and Discussion**

### **Monitoring Efforts and Protocol**

The need to regularly monitor sea turtle nesting in the southeastern U.S. was realized by 1964, when Jim Richardson began monitoring Little Cumberland Island in Georgia. However, widespread monitoring on a regular basis did not begin until the late 1970's. By 1989, most nesting beaches in the southeastern U.S. were included in monitoring efforts (Turtle Expert Working Group, 1998). Due in large part to budget constraints, amounts of monitoring effort and monitoring protocols have varied spatially and temporally at many nesting beaches. However, the intensity and consistency of methods for monitoring sea turtle nesting in the U.S. have improved substantially in recent years, particularly since the Index Nesting Beach Survey (INBS) program was instituted for major nesting beaches in Florida, Georgia, and North Carolina in 1989.

### **Cape Hatteras (CAHA), Cape Lookout (CALO), and North Carolina**

In 1986, North Carolina began monitoring sea turtle nests on a statewide basis under the direction of the Nongame and Endangered Wildlife Program of the North Carolina Wildlife Resources Commission. At CAHA, nest monitoring began in 1978. CALO initiated a nest monitoring program in 1976.

North Carolina, CAHA, and CALO currently participate in, and follow, INBS protocols. In North Carolina, daily patrols are conducted generally from May through August. All-terrain vehicles (ATVs) are used for surveys on most beaches, although patrols are also conducted on foot or by truck in some areas. Protocol has changed little since monitoring began, although the amount of effort has increased. The number of hours spent monitoring sea turtle nesting activities is recorded by individual volunteer projects, but no centralized documentation of survey effort is maintained. At CAHA, patrols are now conducted each morning from June through August using an ATV or a truck. Effort, measured as the number of hours spent and the distance traveled during nesting patrols, has increased every year. However, annual levels of patrol effort have not been calculated. A variety of methods were used for sea turtle nest monitoring at CALO between 1976 and 1989. Since 1990, CALO has conducted daily patrols from June through mid-August using an ATV. No documentation of the amount of effort has been maintained.

At CAHA, CALO, and in the rest of North Carolina, most nests are left *in situ* (untouched where deposited on the beach), with no environmental conditions monitored. However, at times, a large percentage of the nests located in North Carolina are moved to increase protection for them. Nests found at CAHA may be moved if deposited in areas below the debris line marking the typical high tide or in areas with heavy artificial lighting, erosion, or vehicle traffic. At CALO, nests in danger of repeated inundation are relocated to higher ground. In the remainder of North Carolina, nests may be relocated if deposited in areas where high levels of inundation, erosion, or vehicle and foot traffic occurs (North Carolina Wildlife Resources Commission, unpubl. guide).

Flat wire screens are placed over some nest sites found both at CALO and in North Carolina. Wire cages may also be placed over some nest sites in North Carolina (North Carolina Wildlife Resources Commission, unpubl. guide). Both of these devices, which are designed to protect nests from predation, are self-releasing, with openings large enough to allow turtle hatchlings to emerge and escape. Nests found at CAHA may be cordoned off to divert vehicle traffic, but no enclosures are used to protect nests from predation. No trapping or hunting to control nest predators is conducted at CAHA, at CALO, or on a statewide basis in North Carolina.

## **South Carolina**

No National Seashores are located in South Carolina. Sea turtle nesting has been monitored in South Carolina since the mid-1970's. South Carolina's Department of Natural Resources has monitored sea turtle nesting using aerial surveys, beginning in 1980. These aerial surveys are done on a 5-year schedule. Twelve surveys are conducted each year for 3 consecutive years, then four surveys are conducted each year for 2 consecutive years (Hopkins-Murphy et al., in press). Approximately half of the state's coastline is also surveyed on the ground by numerous volunteer projects. These ground surveys are performed daily by foot, ATV, or truck. No documentation of the amount of survey effort has been maintained for ground surveys. However, aerial survey effort has been consistent, following a 5-year schedule, since 1980.

Surveyed areas encompass about 70% of sea turtle nests laid in the state. Most of these nests are left *in situ*. However, many of these nests are relocated if found in areas of heavy development or tidal inundation. In 1997, approximately 41% of all nests found were relocated. Others may be protected from predation using a flat, self-releasing screen or a self-releasing hatchery fence. In most areas, no trapping or hunting for nest predators is conducted.

## **Cumberland Island (CUIS) and Georgia**

Efforts to monitor and protect sea turtle nesting in Georgia are coordinated by the Georgia Department of Natural Resources, Nongame/Endangered Wildlife Program. Surveys for nests have been conducted by a variety of agencies, beginning in 1964. Since 1989, when Georgia (including CUIS) began participation in the Index Nesting Beach Survey (INBS) program, surveys have covered 84% of the Georgia coast. Ten of the fifteen areas monitored are patrolled every day (seven daily, three nightly); four areas are patrolled bi-weekly; and one is patrolled on an irregular basis. Patrols are conducted by truck, airplane, Honda Mule, ATV, bicycle, or on foot. The amount of time spent conducting nesting surveys has been recorded, but annual levels of survey effort have not been determined. At CUIS, complete surveys of the entire island began in 1994. Patrols are conducted daily during the monitoring season, primarily using an ATV. Annual

levels of survey effort are not calculated, although survey effort has been consistent since 1994.

Most nests found at CUIS are left *in situ*. Specific nests at risk of tidal inundation and nests that have been partially depredated may be relocated. Self-releasing wire screens are placed over some nests in areas with a high frequency of raccoon predation. Predators are also controlled by trapping or hunting as needed. Nest protection measures vary in the remainder of Georgia. On some Georgia beaches, self-releasing protective screens are secured over the nest site. Some nests are relocated if deposited in areas prone to heavy tidal inundation, erosion, or predation. In other areas, no protection measures are implemented. Raccoons and feral hogs are trapped and shot year-round in Georgia with varying intensity, while ghost crabs are sometimes trapped if they become a problem during the sea turtle nesting season.

#### **Canaveral (CANA), Gulf Islands - Florida District (GUIS-FL), and Florida**

In 1979, the Florida Marine Research Institute (FMRI), within the Florida Department of Environmental Protection, implemented a statewide monitoring program for sea turtles. CANA began surveying for sea turtle nests in 1984. GUIS-FL implemented a monitoring program in 1989.

When sea turtle monitoring began in Florida, methodologies and survey efforts varied considerably both between areas surveyed and between years. Due to these variations, information collected prior to 1989 may not be viable for examining changes in sea turtle populations (Meylan et al., 1995). Beginning in 1989, when the Index Nesting Beach Survey (INBS) program was initiated, monitoring efforts increased and became more consistent. The program is designed to collect information viable for analyzing population trends, and focuses on consistent, long-term monitoring efforts (Meylan et al., 1995). The INBS program in Florida now involves 32 nesting beaches (total shoreline length 392 km), representing over 80% of sea turtle nesting in the state. Statewide monitoring seasons run from mid-May through August for Index Beaches, but can begin anywhere from January to August and end anywhere from May to December on other beaches. Although surveys are conducted daily on Index Beaches, survey effort on other beaches ranges from 7 days per week to 1 day per year (Meylan et al. 1995,



Florida Marine Research Institute, unpubl. data). Surveys on most Florida beaches are conducted each morning on foot or using an ATV, although some areas may conduct patrols by truck. Survey effort is measured as the amount of beach monitored each year.

At CANA, the same general protocol has been followed since nest monitoring began. This seashore follows the INBS survey protocol from mid-May through August, conducting ATV patrols on a daily basis. But CANA also monitors before and after this period, resulting in ATV patrols on most days between 8 May and 30 September in most years. Annual totals of survey effort, measured in terms of the number of hours spent surveying for nests, have not been calculated. However, survey effort has been consistent each year since 1990.

At GUIIS-FL, only aerial surveys were conducted in 1989. From 1990-1993, surveys were conducted every 2-3 days using an ATV. Since 1994, ATV surveys have been conducted daily. Patrols were conducted from May through August between 1989 and 1993. Beginning in 1994, patrols have been conducted from May until October or November. Effort has been relatively consistent since 1994.

Most of the nests found at CANA, GUIIS-FL, and in the rest of Florida are left *in situ*, with no environmental conditions monitored. At both seashores, a flat, self-releasing mesh screen is secured over the nest site as soon as it is identified. In the remainder of Florida, nests at high risk for tidal inundation may be relocated, while nests at high risk for predation are protected with wire screens or cages (Florida Department of Environmental Protection, unpubl. guide). At CANA, limited trapping is also conducted in problem areas for predators that learn to dig underneath the protective nest screen; predators are live trapped and released elsewhere at CANA. At GUIIS-FL, trapping and hunting of canine predators is done intensively but on a seasonal basis. Limited use of chemical controls for fire ants near nest sites is practiced in the remainder of Florida (Florida Department of Environmental Protection, unpubl. guide).

## **Gulf Islands - Mississippi District (GUIS-MS), Alabama, Mississippi, and Louisiana**

Sea turtle nesting at GUIS-MS has been monitored on a systematic basis since 1990. It is apparently the only sea turtle nest monitoring project currently conducted in Mississippi. At GUIS-MS, aerial surveys are conducted once per week from May through September each year. If tracks are observed, then nesting is verified on the ground. No documentation of the amount of survey effort is maintained, although effort has remained relatively consistent.

All nests found at GUIS-MS are left *in situ*, with no environmental conditions monitored. Nests are not relocated and no protective measures are implemented. No trapping for predators is conducted. Nests are checked 10 days and 75 days after being identified. If eggshells are seen at the surface of a nest site, then the nest is excavated and predation or hatching is verified. However, many nests are inaccessible after hatching due to tropical storms and hurricanes.

No National Seashores are located in Alabama or Louisiana. Little information is available on sea turtle nesting in these states. In 1989 and 1990, biologists conducted limited sea turtle nesting surveys of Louisiana's Breton and Delta National Wildlife Refuges by air and on foot. Eight loggerhead nests were found in 1989 and one loggerhead nest was found in 1990 at Breton and Delta National Wildlife Refuges (Fuller, unpubl. report; Fuller and Lohoefer, 1990).

In Alabama, two to three loggerhead nests were found at Dauphin Island each year between 1995 and 1997. Sea turtle nesting has been monitored at Bon Secour National Wildlife Refuge since 1994. Surveys are conducted 3 days per week from early June through mid- to late August. Most nests are left *in situ*, with no environmental conditions monitored. Nests deposited in areas at high risk for inundation or human disturbance are relocated. Some nests are protected from predation using flat, self-releasing screens. Nests found at Bon Secour National Wildlife Refuge in Alabama are checked for hatching 75 days after the lay date.

## **Padre Island (PAIS) and Texas**

PAIS began patrols for sea turtle nests in 1986. Currently, PAIS conducts the only monitoring project specifically for sea turtle nesting in Texas. However, biologists conducting patrols (once or twice a week) for stranded turtles elsewhere in Texas remain observant for nesting. Additionally, beach visitors report a large percentage of the sea turtle nestings documented on the Texas coast, within and outside of PAIS.

Patrol effort has increased significantly since monitoring began in 1986. Both the number of hours spent patrolling and the number of kilometers traveled during patrols have been documented each year since 1986 and have increased since that time. In 1990, the area patrolled by PAIS staff and volunteers expanded from the 104 km length of PAIS to include the remaining 24 km of Gulf beach shoreline on North Padre Island, north of PAIS. Since that time, PAIS patrols have covered the entire 128 km length of North Padre Island. From 1986 through 1990, patrols at PAIS were conducted 2-3 days per week using a variety of methods, including trucks, military HUM-Vs, and airplanes. Beginning in 1991, patrols were done daily, using ATVs, military surplus Mules, and trucks (Shaver, unpubl. report). Since 1993, ATVs have been either the primary or only vehicle type used for patrols.

PAIS patrols are conducted primarily to detect nesting by Kemp's ridley sea turtles, the sea turtle species found nesting most frequently on the Texas coast. The PAIS patrol strategy and data parameters collected are patterned after monitoring efforts ongoing for Kemp's ridley turtles at their primary nesting beach in Rancho Nuevo, Mexico. Because one of the primary objectives of the PAIS monitoring program is to actually examine nesting Kemp's ridley turtles for tags (in an attempt to determine if they are part of the experimental project to establish a secondary nesting colony) and because Kemp's ridley tracks disappear much more quickly than do tracks of other sea turtle species that nest in the U.S., PAIS and Rancho Nuevo patrols repeatedly traverse the target area on patrol days.

A comparison of the number of kilometers traveled during nesting patrols to the number of nests found at PAIS each year indicates that, in general, documented nesting has increased with increasing patrol effort (Figure 1). Nests found per hour patrolled