

ANNUAL REPORT – 1999 SEASON

DRY TORTUGAS NATIONAL PARK SEA TURTLE MONITORING PROGRAM MONROE COUNTY, FLORIDA

November 26, 1999

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ABSTRACT

The 1999 Dry Tortugas Sea Turtle Monitoring Program recorded a total of 545 turtle crawls. Of these crawls, 536 (98.3%) were by loggerheads (*Caretta caretta*), and nine (1.7%) were by green turtles (*Chelonia mydas*). A total of 249 nests and 296 false crawls were documented within the park, with seven nests and two false crawls identified as green. The greatest amount of turtle activity was recorded on East Key (54.3%), followed by Loggerhead Key (35.4%). The average loggerhead incubation period was 54.6 days (SD = 3.5; $r = 48-68$; $n = 184$), with an average clutch size of 102.7 eggs (SD = 23.4; $r = 30-162$; $n = 207$). The average incubation period of green turtle nests was 52.2 days (SD = 2.1; $r = 48-54$; $n = 6$), with an average clutch size of 127.7 eggs (SD = 7.7; $r = 121-140$; $n = 6$). Severe weather, spring high tides and high watertables inundated 49 nests with seawater. Twenty-six of these nests were lost completely to tidal erosion. The average hatching success of inventoried nests was 78.7% (SD = 20.5%; $r = 0.0-99.0\%$; $n = 213$) with an average release rate of 77.2% (SD = 20.9%; $r = 0.0-99.0\%$; $n = 213$). The average loggerhead hatching success was 78.5% (SD = 20.7%; $r = 0.0-99.0\%$; $n = 207$), with a release rate of 76.9% (SD = 21.1%; $r = 0.0-99.0\%$; $n = 207$). The average green turtle hatching success was 87.4% (SD = 6.2%; $r = 80.8-97.9\%$; $n = 6$), with a release rate of 87.6% (SD = 6.2%; $r = 80.8-97.9\%$; $n = 6$). The green turtle release rate was slightly greater than the hatching success due to live pipped eggs that were not classified as hatched. An estimated 22,022 eggs were examined this season, with an estimated 17,060 hatchlings entering the Gulf of Mexico.

During the last five seasons of daily monitoring, the Dry Tortugas Sea Turtle Monitoring Program has recorded 2,881 turtle crawls, comprised of 1,245 nests and 1,636 false crawls. An estimated 100,064 eggs have been excavated, with 75,944 hatchlings estimated to have entered the Gulf of Mexico. Researchers have recorded 3,959 turtle crawls – 1,605 nests and 2,354 false crawls – within the park since 1982.

PREFACE AND ACKNOWLEDGMENTS

This report contains the results of sea turtle activity recorded in Dry Tortugas National Park during the 1999 nesting season. While some comparisons are made among the 1995 through 1999 nesting seasons, a full analysis of population trends is beyond the scope of this work. In order to facilitate future data comparisons among sea turtle nesting seasons in Dry Tortugas National Park, this report closely follows the form and content of previous annual reports by Kate Mansfield and Russell Reardon.

The Dry Tortugas Sea Turtle Monitoring Program currently operates under the marine turtle permit (TP #024) issued by the Florida Fish and Wildlife Conservation Commission (FWCC) to Brian Lockwood of Biscayne National Park. Tissue sampling from nest contents was authorized this season under the marine turtle permit (FFWCC - TP #016) issued to Dr. Karen Bjorndal of the Archie Carr Center for Sea Turtle Research (ACCSTR) at the University of Florida.

Volunteers played a major role in data acquisition. Much gratitude is extended to the Dry Tortugas staff, residents and volunteers who assisted with data collection throughout the 1999 nesting season. The program utilized the help of 34 volunteers, totaling over 460 hours of service. Without their help and support, such a successful season of data collection would not have been possible. The following individuals are recognized for their assistance above and beyond the call of duty: **Lisa Appugliese, Roy Appugliese, Kelly Bulyis, Larry Coughanour, Lela Dodson, Nina Fell, Marysa Malone, Palmer Mason, Joakim Monstad, Sandy Moss and Janet Taylor.**

And finally, the 1999 Program could not have occurred without the support of those listed below. A very special thanks is extended to:

Deputy Superintendent **Larry Belli** for providing support and funding, not only for research this season, but also for presentations at two conferences in March 1999;

Maintenance Foreman **Mark Foster** and Supervisory Ranger **Paul Taylor** for enabling the project to proceed as smoothly and comfortably as possible, even though things were often sprung upon them in last minute fashion;

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Russell Reardon
Dry Tortugas National Park
November 1999

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INTRODUCTION:¹

Dry Tortugas National Park:

Encompassing seven islands and 100 square miles (26 km²) of ocean, Dry Tortugas National Park (DRTO) is situated at 24°38' N latitude and 82°52' W longitude, approximately 70 miles (113 km) west of Key West, Florida (Figure 1). The islands of DRTO include Garden Key, Loggerhead Key, East Key, Bush Key, Hospital Key, Long Key and Middle Key (Figure 2). Because of its historic abundance of sea turtles, the area was first named "Las Tortugas" by Spanish explorer Ponce de Leon in 1513. The name was later changed to the "Dry Tortugas" in order to warn mariners of the lack of fresh water on the islands.

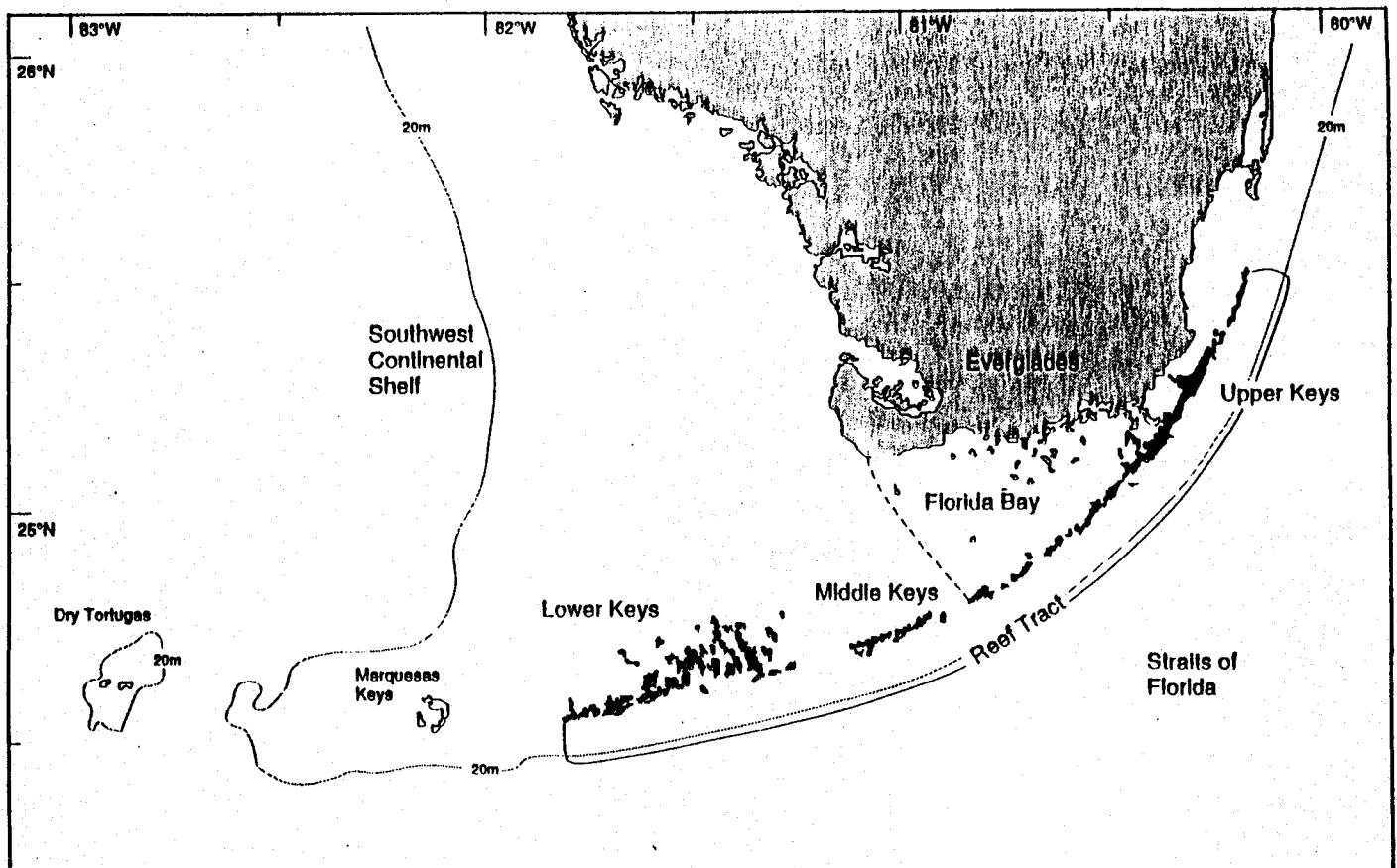


FIGURE 1. The Location of the Dry Tortugas in Reference to the Florida Keys and Mainland Florida (adapted from NOAA, 1995).

¹ The INTRODUCTION has been adapted from the author's previous collaborative reports (Mansfield & Reardon, 1996; Reardon & Mansfield, 1997).

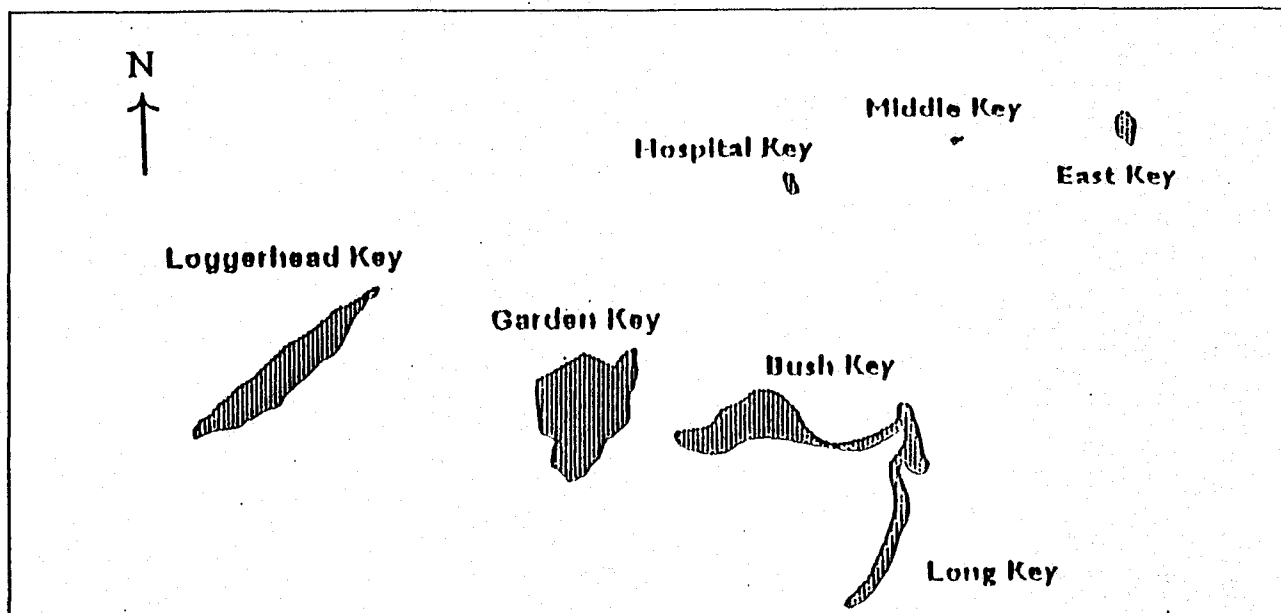


FIGURE 2. The Islands within Dry Tortugas National Park, Dry Tortugas, Florida (adapted from Boykin, 1995).

Many references have been made by mariners, soldiers and prisoners to the great number of loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles found within the Dry Tortugas. These turtles provided food for mariners in the region for hundreds of years. It has been documented that Ponce de Leon harvested 170 green turtles from these waters, provisioning boats to feed his crew (Gifford, 1934). With the construction of Fort Jefferson on Garden Key between 1846 and 1875, regular harvesting of sea turtles began by workers and soldiers stationed in the Dry Tortugas. A "turtle corral" was constructed in the fort's moat to keep turtles fresh for slaughter by the garrison commissary (Dawson & Williams, 1985). Turtle eggs were collected from nests on Loggerhead Key for use in foods such as puddings (Holder, 1892). Records in the National Archives indicate that soldiers stationed at Fort Jefferson consumed over 39,588 pounds of turtle meat between 1858 and 1859 (Dawson & Williams, 1985).

During the 1800's, a market for turtle meat and eggs arose in Key West, developing into a full-scale fishery by the early 1900's. During the 1950's, the Dry Tortugas became the primary fishing area for the Key West-based pink shrimp (*Penaeus duorarum*) industry. The mortality of the turtle populations within the Dry Tortugas increased further with the incidental catch of turtles in shrimp trawls. Among "juveniles, subadults and breeders in coastal waters, the most important human-associated source of mortality is incidental capture in shrimp trawls, accounting for more deaths than all other human activities combined" (National Research Council, 1990).

In 1908, the Dry Tortugas was designated as a bird preserve, the Dry Tortugas Keys Reservation, for the protection of the many pelagic and migratory species utilizing the islands. In 1935, President Franklin Delano Roosevelt declared Fort Jefferson a National Monument, falling under

the care and jurisdiction of the National Park Service, Department of Interior. With the establishment of Fort Jefferson as a National Monument, sea turtles and their nests became protected within monument boundaries. Robert Budlong, one of the first Monument Superintendents/Custodians stationed at the fort, referenced the sea turtle activity found on East and Hospital keys during the early 1940's, citing efforts to protect the turtle nests within Fort Jefferson National Monument from poaching. Enforcement was minimal, however, due to a lack of resources. Budlong estimated that very few sea turtle nests went unmolested (Budlong, 1943).

In 1992, Fort Jefferson National Monument became Dry Tortugas National Park, encompassing some 85 acres (34 ha) of land and 100 square miles (260 km²) of ocean.

Physical and vegetative features of the Dry Tortugas:

The islands of DRTO have been formed by the accumulation of calcareous sand and coralline rubble generated by the fringing coral reefs that protect and cover a large area within the Dry Tortugas (Stone, 1993). Situated within three large reef formations, the islands are arranged in "a loose ring around an elliptical lagoon" accessed by three channels up to 80 feet (25 m) in depth (Williams & Dawson, 1984) (Figure 3). Turtle, shoal and manatee (*Thalassia*, *Halodule* and *Syringodium spp.*) seagrass beds can be found flanking all islands within the Dry Tortugas, with *Thalassia* being the climax species (ibid.). The islands are very dynamic, changing shape and size seasonally as a result of winds, currents and wave action. With the exception of Garden and Loggerhead keys, the islands have an elevation of less than four feet (1.2 m) above mean high tide (Robertson, 1964). The total beach length within the Dry Tortugas varies seasonally between three and four miles (4.8 - 6.4 km).

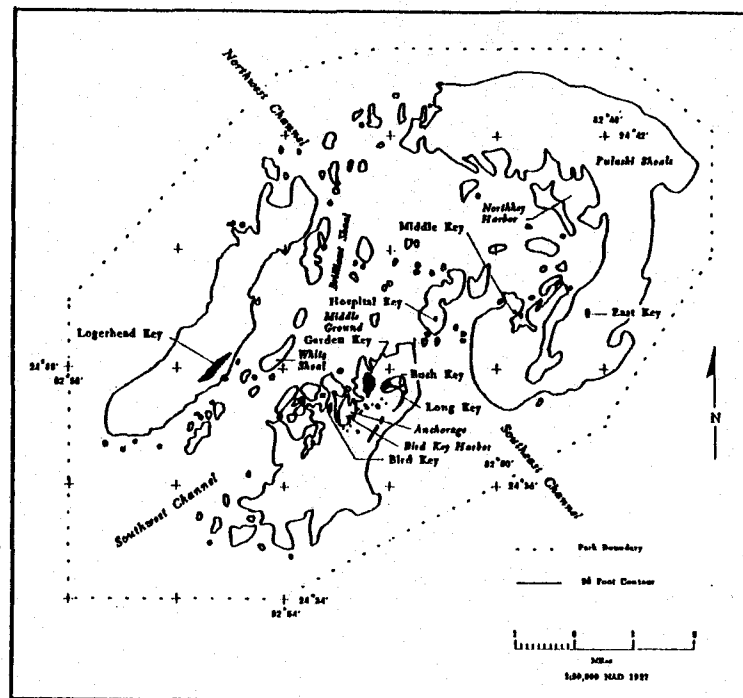


FIGURE 3. The Location of Channels and Shoals within Dry Tortugas National Park, Dry Tortugas, Florida (adapted from Murphy, 1993).

Over 200 species of terrestrial plants have been recorded in DRTO, of which approximately 25% are considered native to the area. On the smaller islands (including East, Hospital and Bush keys), the most abundant native species include beachberry (*Scaevola plumieri*), dune elder (*Iva imbricata*), sea oats (*Uniola paniculata*) and sea lavender (*Argusia gnaphalodes*) (Stoddart & Fosberg, 1981). In 1910, Australian pine (*Casuarina equisetifolia*) was introduced to Loggerhead Key, quickly spreading throughout the island by the 1940's, becoming the dominant island vegetation by the 1980's. Ongoing efforts to eradicate *Casuarina* were begun in the mid-1990's. Other exotic species inhabiting Garden and Loggerhead keys include sisal (*Agave spp.*) and Pacific beachberry (*Scaevola taccada*). For a description of the physiography of each key, please refer to Appendix A.

Previous turtle research:

Since the early 1980's, National Park Service biologists have been monitoring sea turtle nesting activity within DRTO; however, the 1995 through 1998 nesting seasons mark the first four years that personnel performed season-long nesting surveys on each island. Prior to 1995, research and monitoring of turtle activity occurred from 1980 through 1985 and since 1990. Based on unpublished records of this research on file at Fort Jefferson, seasonal surveys prior to 1995 did not encompass the entire nesting season and ranged from just five days of survey to three months of monitoring – including some nest inventories.

From 1980 through 1983, aerial population surveys were conducted in conjunction with limited daytime beach surveys. During the 1983, 1984 and 1985 nesting seasons, Richard Dawson and David Williams of the National Park Service conducted nighttime tagging surveys of nesting loggerhead and green turtles on East Key and daytime nesting surveys on Loggerhead Key. Their efforts targeted the historic regional peak of nesting: June and July. A total of 44 loggerhead and two green turtles were tagged. Dawson estimated a conservative East Key nesting population of 40 loggerheads and two green turtles (Dawson & Williams, 1985).

Beginning in 1990, Student Conservation Association and AmeriCorps personnel, along with park volunteers, refined monitoring techniques, increased the frequency of field sampling, and increased the amount of data collected in a process that has produced a long term, comprehensive sea turtle monitoring program for Dry Tortugas National Park. A standardized and site specific monitoring protocol manual was developed in 1996 – revised in 1997 – which is compatible with state permit regulations as well as the monitoring protocol developed and implemented at Biscayne National Park. This compatibility between the two water-based National Parks will help facilitate data comparisons and perhaps the sharing of monitoring personnel.

The Dry Tortugas Sea Turtle Monitoring Program (DTSTMP) was instituted to serve four primary functions: 1) to establish and maintain a baseline inventory and monitoring program for sea turtle nesting and hatching activities within DRTO, 2) to identify and monitor the temporal and spatial distribution of sea turtle activity within the park and its waters, 3) to participate in and support the Sea Turtle Stranding and Salvage Network (STSSN) year-round and 4) to identify the natural and anthropogenic threats to sea turtles, their nests and hatchlings, devising means to mitigate these threats.

Both loggerhead and green turtles nest within the park, though loggerheads are far more common. Since season-long studies began in 1995, data have been collected suggesting the Dry Tortugas supports the largest loggerhead rookery within the Florida Keys and perhaps the largest green turtle rookery in Monroe County. During the 1995 through 1998 nesting seasons, 2,026 loggerhead crawls and 310 green turtle crawls were documented. Seventy-eight green turtle nests were observed in 1998, indicating that the green turtle population is much larger than the Dawson and Williams estimate of two nesting females. With six to 13 nests recorded per week during July, at least 13 green turtles utilized park beaches in 1998 (Reardon, 1998).

Sub-adult and juvenile hawksbill turtles (*Eretmochelys imbricata*) are frequently spotted on the reefs and grassbeds flanking Fort Jefferson; however, adult hawksbills are rarely observed. There have been reports from local commercial fishermen and seaplane pilots of both leatherbacks (*Dermochelys coriacea*) and Kemp's ridleys (*Lepidochelys kempii*) traveling through Gulf waters in and around DRTG.

METHODS AND MATERIALS:²

The 1999 Dry Tortugas Sea Turtle Monitoring Program was conducted by three Research Associates from the University of Florida, assisted by 34 volunteers contributing over 460 hours of service. Daily nesting and hatching surveys were conducted on beaches within Dry Tortugas National Park from April 9 through October 9, 1999. Additional nesting surveys were conducted weekly through November 15, 1999.

Beach indexing:

Prior to the 1999 nesting season, the shorelines of East and Loggerhead Keys were surveyed for the replacement of PVC reference markers lost to erosion during the winter. These markers, located at 30-meter intervals from starting points established in 1995, are used to geographically reference each instance of turtle activity. Each 30-meter interval is marked with a numbered PVC pipe driven into the sand one to three meters landward of the vegetation line. In addition, the shorelines and index markers of the islands were mapped this season with a Global Positioning System (GPS) in an effort to produce highly detailed maps through Geographic Information System (GIS) software. However, due to the unrelated resignation of the Everglades National Park geographer working on the project, the maps could not be produced.

During the winter, the south end of East Key experienced severe erosion resulting in the loss of the area's index markers. Subsequent accretion, however, allowed the replacement of markers 2 through 5 and 12 through 15. Three additional reference markers – 9A, 9B and 9C – added in 1998 in order to facilitate crawl documentation on the island's elongated northern end were again utilized this season. The index markers on East Key for the 1999 season ranged from Marker 2 to

² Complete monitoring protocols and detailed methodology can be found in the Dry Tortugas National Park Sea Turtle Monitoring Program Manual (Mansfield & Reardon, 1997).

9C on the eastern shore and 9C to 15 on the western shore, delineating approximately 570 meters of beach.

Similar winter erosion followed by accretion on Loggerhead Key claimed the island's southernmost index markers, necessitating the replacement of markers 77 through 80. Accretion of the northern tip of the island created a narrow spit, extending some 120 meters. Two additional reference markers – 40A and 40B – were installed in order to facilitate crawl documentation on the extended north tip. The 1999 index markers on Loggerhead Key ranged from Marker 1 to 40B on the western shore, and 40B to 80 on the eastern shore, delineating approximately 2,400 meters of beach.

On both East and Loggerhead keys, the 30-meter intervals were grouped into "sectors" and alphabetically ascribed letters. The 30-meter intervals were grouped into 60-meter sectors on East Key and 90-meter sectors on Loggerhead Key. In prior seasons, this grouping established eight such sectors on East Key, ranging from Sector A located between index markers 16 and 2, including the south tip of the island, to Sector H between index markers 14 and 16. Sectors A and H were greatly reduced in size this season due to the island's northern migration. East Key's index markers and sectors are illustrated in Figure 4.

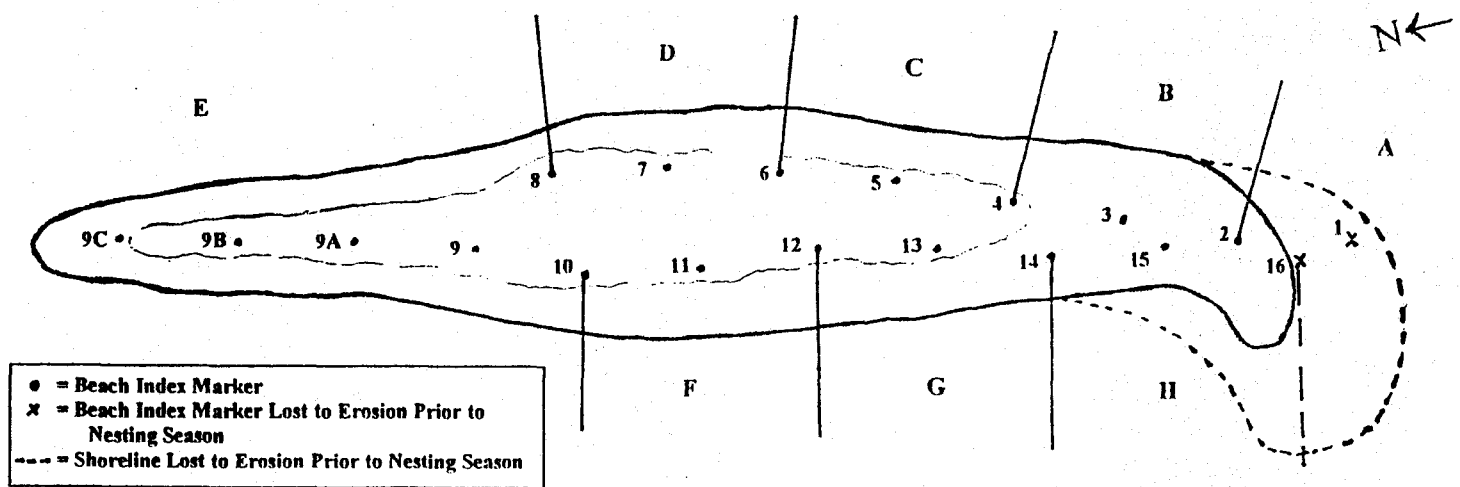


FIGURE 4. Location of Index Markers and Sectors on East Key, Dry Tortugas National Park, 1999.

On Loggerhead Key, 27 sectors were established ranging from Sector A between index markers 1 and 4, continuing around the island in 90-meter intervals to Sector AA, between index markers 79 and 1. Loggerhead Key's index markers and sectors are illustrated in Figure 5.

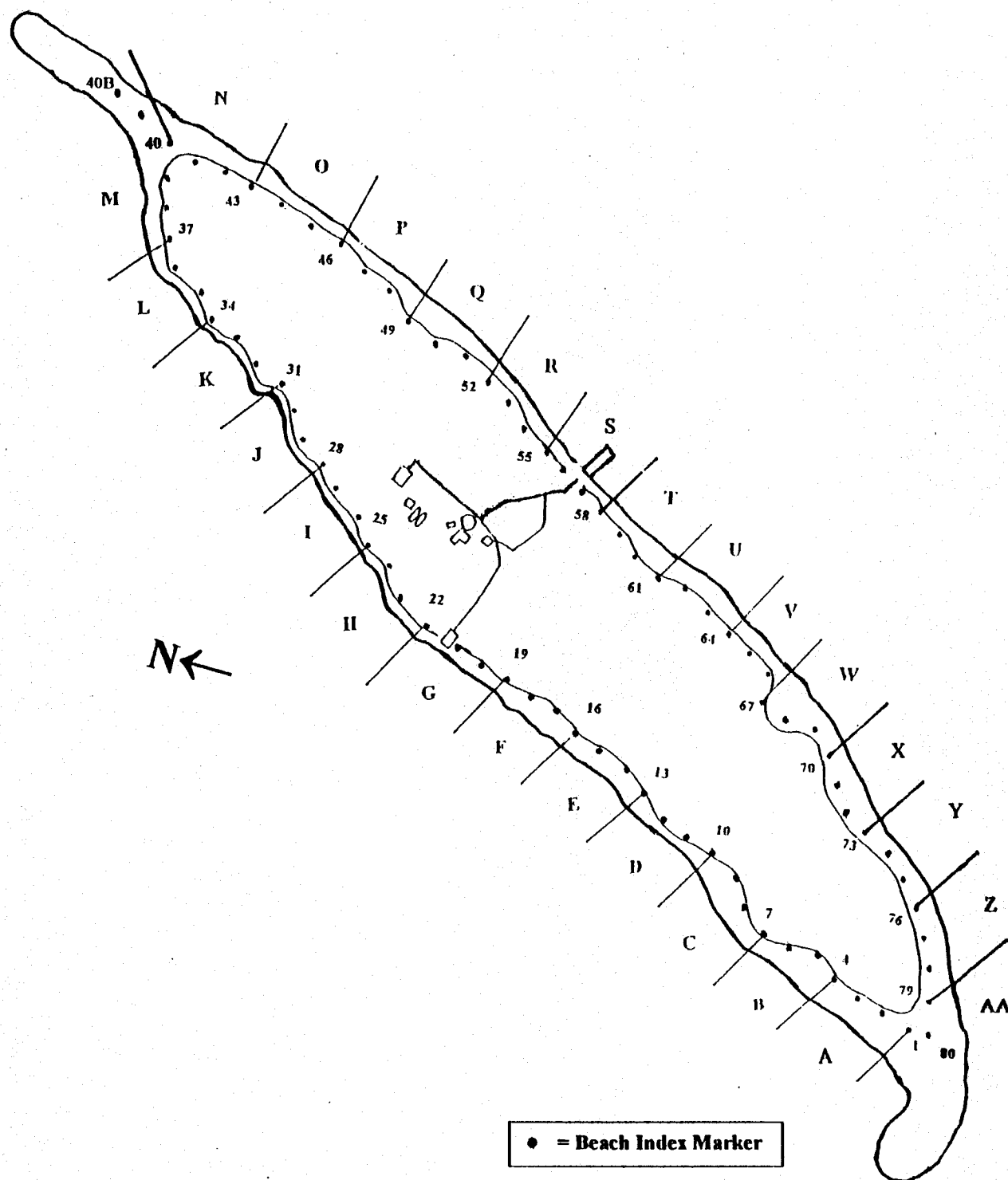


FIGURE 5. Location of Index Markers and Sectors on Loggerhead Key, Dry Tortugas National Park, 1999.

Bush, Garden, Hospital, Middle and Long keys were not indexed due to their small sizes, their historic lack of significant turtle activity and/or the extensive tidal influence on their beach profiles. Total beach length within the Dry Tortugas is estimated to vary seasonally between three and four miles (4.8 – 6.4 km).

Beach patrols:

The beaches of East, Loggerhead, Garden, Hospital, Middle, Bush and Long Keys were patrolled daily – weather and seas permitting – from April 9, 1999 through October 9, 1999. After which time, patrols continued weekly through November 15, 1999.

The beaches of East, Loggerhead and Garden keys were surveyed on foot. Hospital Key was surveyed by boat in order to ensure that the masked boobies (*Sula dactylatra*) were not disturbed. Landfall was not made on Hospital Key unless crawl activity was observed. Middle Key was surveyed by boat; by late July the island was completely awash at all but the lowest tides. Bush Key was surveyed by powerboat or kayak so as not to disturb the nesting sooty terns (*Sterna fuscata*), brown noddies (*Anous stolidus*) and brown pelicans (*Pelicanus occidentalis*). Landfall was not made on Bush Key unless crawl activity was observed. In addition to kayak surveys, Long Key was walked in its entirety three times each week as turtle tracks in the coral rubble were difficult to discern from the water. Care was taken to avoid disturbing nesting noddies and magnificent frigatebirds (*Fregata magnificens*) when patrolling Long Key.

Crawl data:

Patrols began early in the morning (0700 hours) and continued until late afternoon. Every instance of turtle activity occurring on the islands the previous night was recorded on a standardized data sheet (Appendix B). Crawls were evaluated to determine whether nesting had occurred. Criteria for the positive identification of a nest included the presence of a sand escarpment created by the front flippers of the turtle during nest site obliteration, as well as the corresponding misted mound of sand covering the nest site and emerging tracks (FDEP, 1994). Crawls meeting these criteria were recorded as nests, whereas crawls lacking these characteristics were identified as false crawls.

Each crawl was assigned a number representing the chronological order in which it was observed (crawl numbers represented both nests and false crawls). Each nest site was marked with a wooden stake on which the crawl number was recorded. Stakes were placed landward of the estimated clutch location. All nests were left *in situ*. A crawl that could not be positively identified as a nest – but in which the possibility of nesting could not be ruled out – was recorded as "undetermined" and staked as a potential nest.

Measurements of distance and direction from the nearest beach index markers to the nest or false crawl were recorded. These measurements were made using a 30-meter transect tape and a handheld bearing compass. Nests were measured from index markers to the stake marking the clutch, whereas false crawls exhibiting digging activity were measured to the last abandoned body pit. On beaches lacking index markers, crawl site distances and bearings were measured from permanent structures or other points of reference located along the beach. These

objects included prominent features such as signposts, trees and large bushes.

The condition of each nest was monitored throughout the incubation period. Any signs of depredation, tidal wash or erosion were recorded on the data sheets. All data was transferred to a computerized database (MS Excel 97) located at Fort Jefferson, Garden Key.

Hatching data:

After 45 days of incubation, each nest was monitored closely for signs of hatchling emergence. Emergence was characterized by a small, bowl-like depression in the sand and hatchling tracks in the immediate vicinity. Care was taken to check nests following rain and other weather conditions that may have induced daytime emergence. Evidence of first hatchling emergence was recorded for each nest on a standardized nest inventory data sheet (Appendix C).

Three days after the first signs of emergence, researchers excavated nests to perform nest inventories and embryonic development surveys of clutch contents. If emergence was not observed, the nest was excavated by hand after 70 days incubation. After at least 85 days post-deposition, shovels were used to locate the clutch. Sites initially labeled "undetermined" were reclassified as "nests" if either emergence was observed or after a 70-day incubation period the eggs were located. "Undetermined" nest sites at which neither emergence was observed nor eggs located after extensive excavation were reclassified as "false crawls."

Depression, emergence and excavation dates were recorded for each nest, as well as any inundation or depredation that may have occurred. All nest contents were examined and recorded, including numbers of live and dead hatchlings, live and dead pipped eggs, egg fragments (50% in size and greater) and unhatched eggs. If live hatchlings were found, they were placed seaward of the excavation and allowed to crawl to the water. Live pipped eggs were placed in a sand-filled bucket and transported to Fort Jefferson to allow for complete hatching and yolk sack absorption. Subsequent release of these hatchlings was in accordance with FFWCC marine turtle permit guidelines.

The number of hatched eggs was determined by counting the number of egg fragments greater than 50% in the nest. The total number of eggs was then calculated by adding the number of hatched eggs to the total number of pipped, depredated and unhatched eggs. The hatching success rate was determined by dividing the number of hatched eggs by the total number of eggs. The estimated number of hatchlings released from each nest was determined by subtracting the number of dead hatchlings from the sum of the number of hatched and live pipped eggs. The release rate was then calculated by dividing the number of hatchlings released by the total number of eggs within the nest. Incubation period was determined by the number of days elapsing between egg deposition and first observed emergence.

Embryonic development surveys were performed on all unhatched eggs. Each unhatched egg was opened and examined. The percentage of embryonic development was recorded on a standardized data sheet (Appendix D). The determination of the percent embryonic development was based on criteria established by the Caretta Research Project based in Savannah, Georgia (Appendix E).

Once nest inventories and embryonic development surveys were completed, nest contents were re-buried and nest stakes removed. All hatching data was transferred to a computerized database (MS Excel 97) located at Fort Jefferson, Garden Key.

Exotic plant data:

To accompany the ongoing *Casuarina equisetifolia* eradication project on Loggerhead Key, data was collected throughout the nesting season on negative impacts to sea turtle activity resulting from downed *Casuarina* trees, woody debris and roots. The type of disturbance was noted for each impacted crawl. A crawl was considered impacted if the turtle encountered *Casuarina* trees, woody debris or roots while crawling or digging anytime during the nesting attempt.

Stranding data:

The location and condition of stranded sea turtles found on the beaches or in the waters of DRTO were recorded on standardized data sheets provided by the Sea Turtle Stranding and Salvage Network (STSSN) based in Tequesta, Florida (Appendix F). Curved length and width measurements of each stranded turtle's carapace were taken, as were photographs of the carcass. The completed stranding forms were faxed and mailed to the STSSN coordinator with the FFWCC in Tequesta, Florida.

Specimen Collection:

As an additional feature of the 1999 monitoring program, dead loggerhead and green turtle hatchlings and embryos were collected during nest excavations throughout the season in order to obtain tissue samples for genetic analyses at the University of Florida. If a dead hatchling or embryo was not available, yolk was obtained from a whole, unhatched egg. Collection was authorized under the marine turtle permit (FFWCC - TP #016) issued to Dr. Karen Bjorndal of the Archie Carr Center for Sea Turtle Research. Specimens were individually bagged in re-sealable freezer bags and placed in the freezer until tissue-sampling materials arrived. Muscle tissue was subsequently taken from the neck region of each specimen using a 6mm biopsy punch and placed into vials containing SED buffer (Saturated NaCl, 250mM EDTA pH 7.5, 20% DMSO). The protocol for collecting tissue for genetic analyses was supplied by the University of Florida (Appendix G).

The mitochondrial DNA sequences obtained from the tissue samples will be analyzed in a study of reproductive migratory behavior and population structure. A similar study of Caribbean hawksbills was published in *Molecular Ecology* (Bass *et al.*, 1996). Specifically, the analyses will determine the haplotypes of nesting females in order to evaluate the relationship of sea turtles nesting in the Dry Tortugas to other nesting colonies and to determine if the DRTO nesting population should be considered a separate management unit for conservation purposes.

RESULTS:

Nest and False Crawl Data

Park overview:

Turtle activity was documented on each of the seven islands within Dry Tortugas National Park during the 1999 nesting season: East, Loggerhead, Bush, Long, Hospital, Middle and Garden keys. This is the first time that turtle activity has occurred on all seven islands within a single season. A total of 545 crawls were documented, comprised of 249 nests and 296 false crawls. East Key hosted the majority of the turtle activity, with 54.3% of this season's activity. Loggerhead Key was the second most active island with 35.4% of the total activity, followed by Bush Key, Long Key, Hospital Key, Middle Key and Garden Key, respectively (Figure 6).

One hundred twenty-one (48.6%) of the 249 nests, occurred on East Key, with 111 nests (44.6%) occurring on Loggerhead Key, 11 (4.4%) on Bush Key, three (1.2%) on Long Key and three (1.2%) on Hospital Key. Of the 296 false crawls recorded, 175 (59.1%) were located on East Key, 82 (27.7%) on Loggerhead Key, 14 (4.7%) on Long Key, 10 (3.4%) on Bush Key, seven (2.4%) on Hospital Key, five (1.7%) on Middle Key and three (1.0%) on Garden Key. The greatest nest success occurred on Loggerhead and Bush keys, respectively (Table 1).

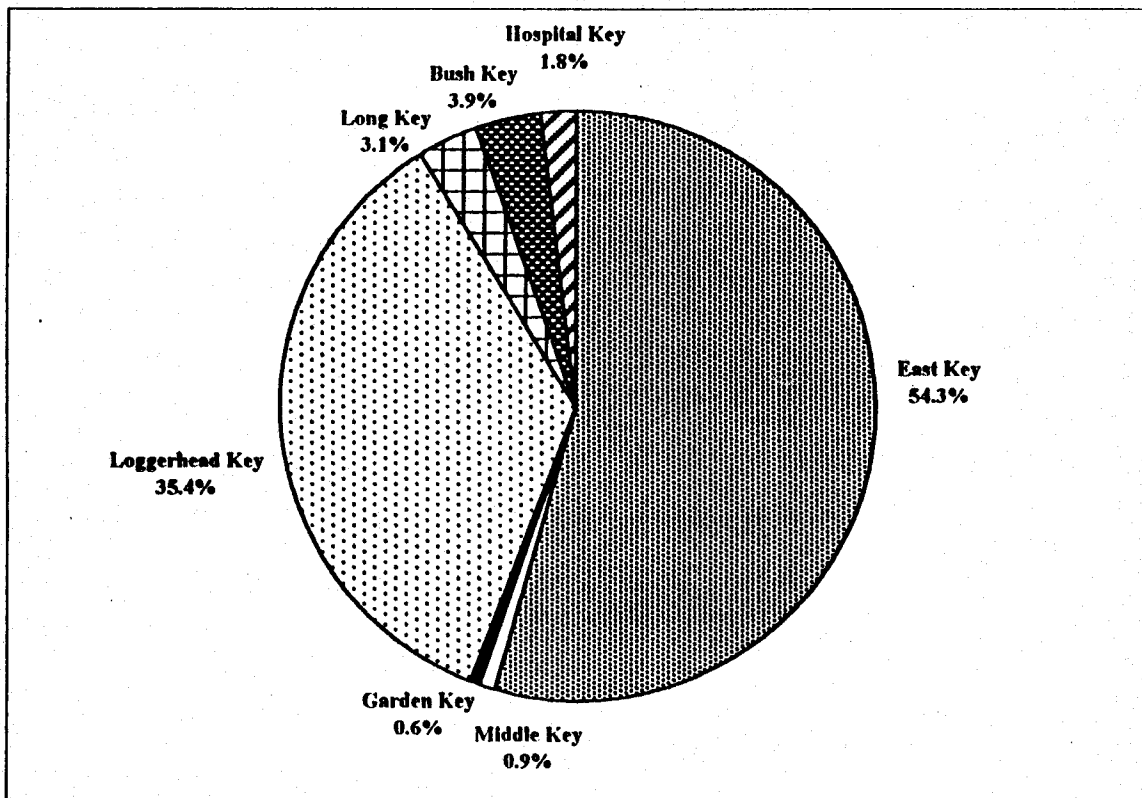


FIGURE 6. Geographic Distribution of Sea Turtle Activity, Dry Tortugas National Park, 1999.

TABLE 1. 1999 Sea Turtle Crawl Activity, Dry Tortugas National Park.

Location	Total Activity	Nests	False Crawls	Nest Success*
East Key	296	121	175	40.9%
Loggerhead Key	193	111	82	57.5%
Bush Key	21	11	10	52.4%
Long Key	17	3	14	17.6%
Hospital Key	10	3	7	30.0%
Middle Key	5	0	5	0%
Garden Key	3	0	3	0%
Park Totals:	545	249	296	45.7%

***Nest Success = (number of nests/total number of crawls) x 100**

Species overview:

Of the 545 crawls recorded within DRTO, 536 (98.3%) were identified as loggerhead and nine (1.7%) were identified as green turtle crawls. Of the 249 nests recorded this season, 242 were identified by track and nest site as loggerhead nests, and seven were identified as green turtle nests. Of the 296 false crawls, 294 were identified by track and body pit as loggerhead, and two were identified as green turtle false crawls.

Loggerhead turtles: Though loggerhead activity was observed on all seven islands, East and Loggerhead keys hosted a combined 89.6% of the loggerhead turtle activity this season. The overall nest success for loggerheads utilizing park beaches was 45.1%. Hosting more nests than false crawls, the greatest loggerhead nest success rates occurred on Loggerhead (56.5%) and Bush (52.4%) keys (Table 2).

Green turtles: Green turtle activity, comprised of seven nests and two false crawls, occurred only on Loggerhead Key this season. The nest success rate for green turtles was 77.8% (Table 3).

TABLE 2. 1999 Loggerhead Turtle (*Caretta caretta*) Activity, Dry Tortugas National Park.

Location	Total Activity	Nests	False Crawls	Nest Success*
East Key	296	121	175	40.9%
Loggerhead Key	184	104	80	56.5%
Bush Key	21	11	10	52.4%
Long Key	17	3	14	17.6%
Hospital Key	10	3	7	30.0%
Middle Key	5	0	5	0%
Garden Key	3	0	3	0%
Park Totals:	536	242	294	45.1%

*Nest Success = (number of nests/total number of crawls) x 100

TABLE 3. 1999 Green Turtle (*Chelonia mydas*) Activity, Dry Tortugas National Park.

Location	Total Activity	Nests	False Crawls	Nest Success*
East Key	0	0	0	0%
Loggerhead Key	9	7	2	77.8%
Bush Key	0	0	0	0%
Long Key	0	0	0	0%
Hospital Key	0	0	0	0%
Middle Key	0	0	0	0%
Garden Key	0	0	0	0%
Park Totals:	9	7	2	77.8%

*Nest Success = (number of nests/total number of crawls) x 100

Annual comparison of crawl activity:

A comparison of the 1995 through 1999 nesting data shows great seasonal variability in the number of green turtle nests, while the number of loggerhead nests has remained relatively stable (Figure 7). Since a record 278 loggerhead nests were documented by Boykin in 1995, the number of nests observed annually has remained near 200. This season, however, the number increased slightly, approaching 250 nests. In contrast, annual green turtle activity has fluctuated dramatically, with a substantial number of nests recorded in years 1996 and 1998 and little activity recorded in 1995, 1997 and 1999. The data suggest that the even-year population of green turtles nesting in DRT0 is significantly larger than the odd-year nesting population.

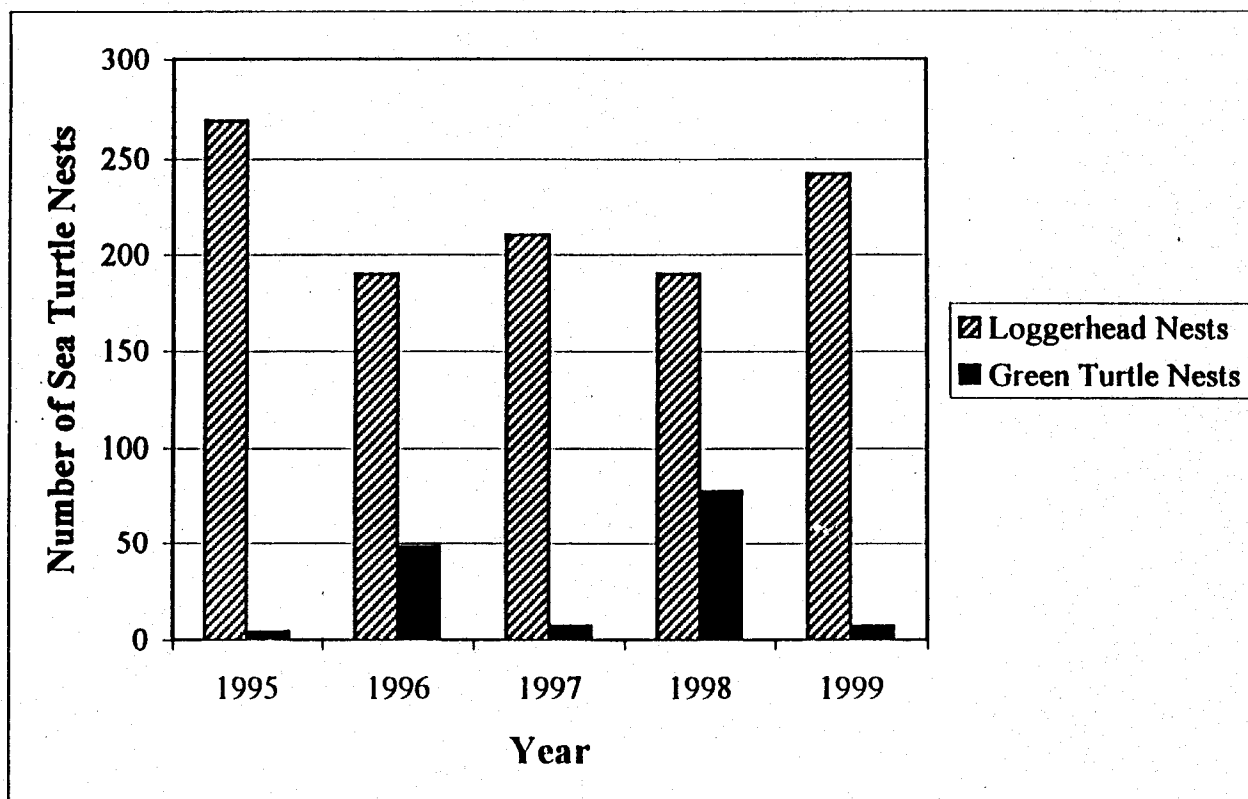


FIGURE 7. Annual Number of Sea Turtle Nests Recorded by Dry Tortugas Sea Turtle Monitoring Program, Dry Tortugas National Park, 1995 - 1999.

Monthly distribution of crawl activity:

Loggerhead nesting activity began on April 23, 1999 with two false crawls: one false crawl on Garden Key and one on Bush Key. The first loggerhead nest was recorded three days later, April 26, on East Key. The Loggerhead Key green turtle activity began with a nest on June 23, 1999. The final loggerhead and green turtle nests occurred on August 15 on Loggerhead Key. The monthly distribution of nests and false crawls occurring within Dry Tortugas National Park is illustrated in Figure 8. As observed in 1995 through 1997, the number of DRT0 nests this season peaked in June. Nesting in 1998, peaked in July, attributed largely to the record amount of green turtle activity that year.

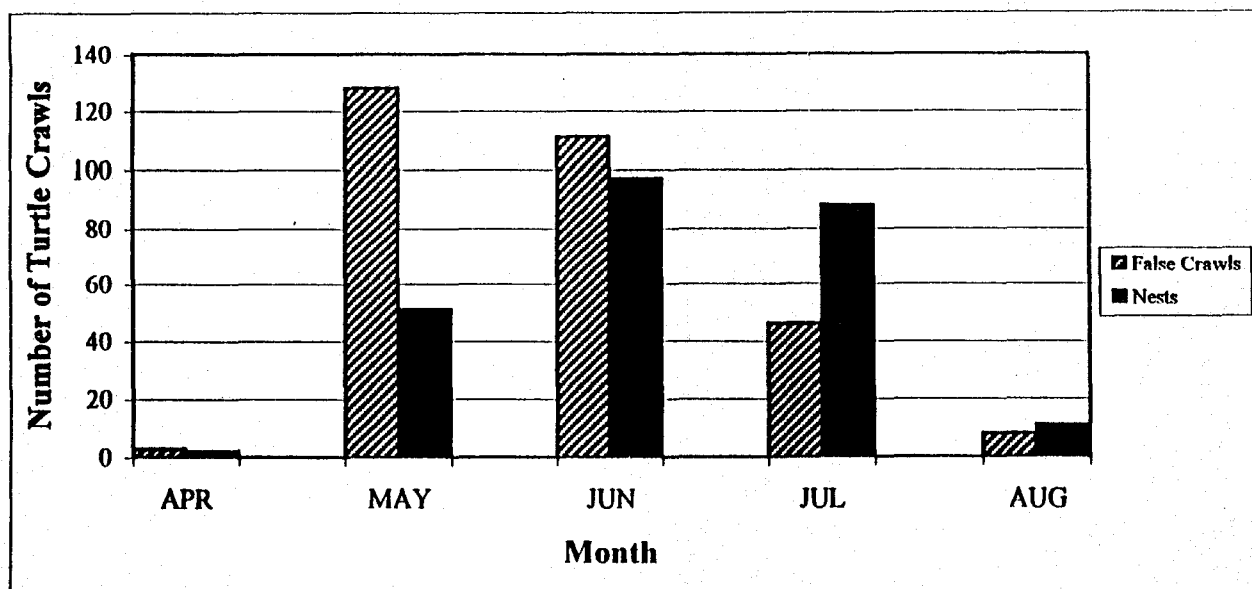


FIGURE 8. Monthly Distribution of Sea Turtle Crawl Activity, Dry Tortugas National Park, 1999.

Loggerhead nesting activity was documented from April through August, with nesting peaking during June (Figure 9). This reflects a similar peak season for loggerheads as observed in the four previous seasons of the program. Green turtle nesting activity occurred from June through August, peaking in July (Figure 10). This reflects a similar peak for green turtles as observed in seasons 1995, 1996 and 1998. Green turtle nesting peaked in August during 1997.

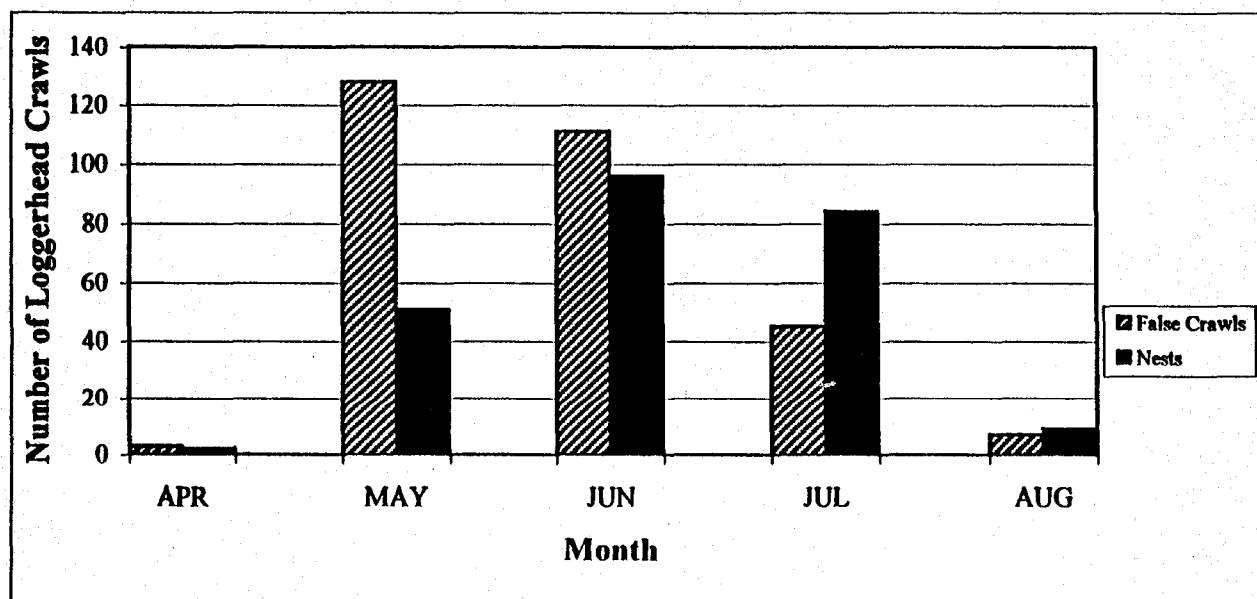


FIGURE 9. Monthly Distribution of Loggerhead Turtle (*Caretta caretta*) Activity, Dry Tortugas National Park, 1999.

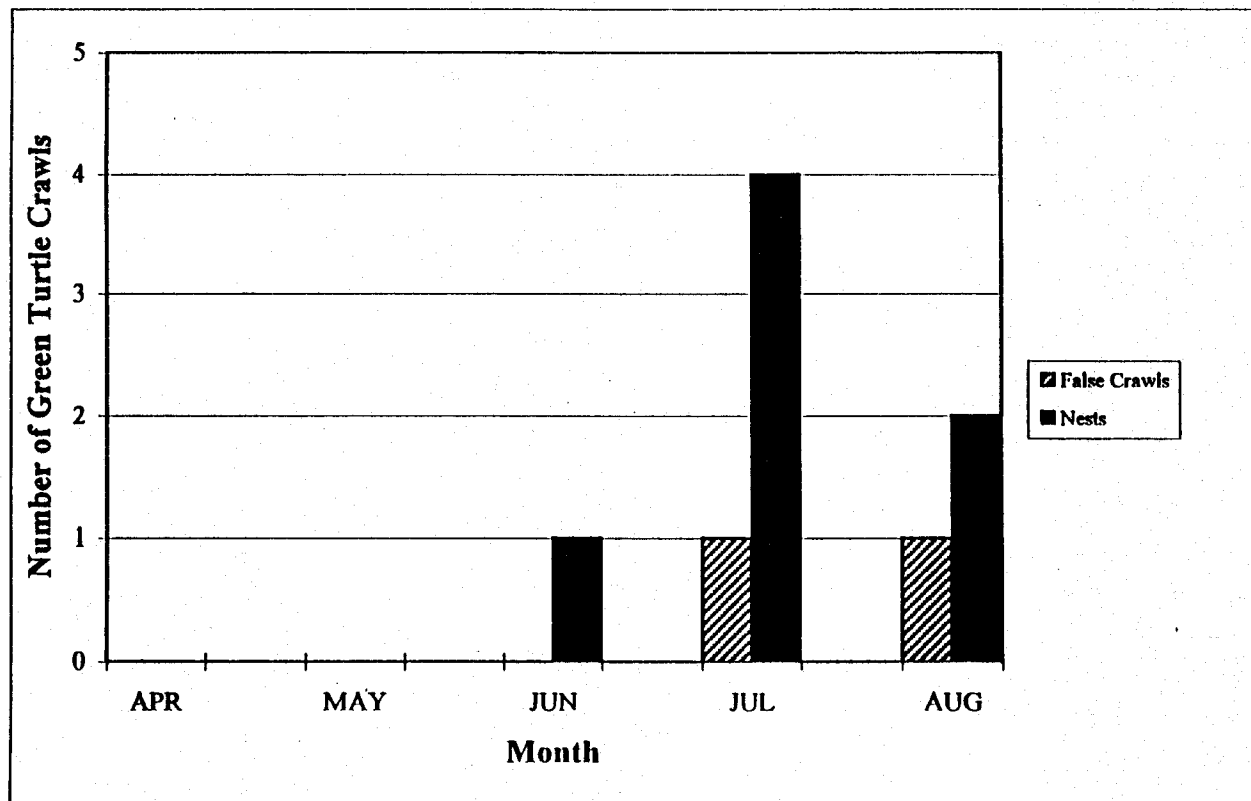


FIGURE 10. Monthly Distribution of Green Turtle (*Chelonia mydas*) Activity, Dry Tortugas National Park, 1999.

The average number of loggerhead nests recorded per calendar week during the 17 weeks of the 1999 loggerhead nesting season was 14.2 nests, with the three full calendar weeks of June (beginning June 6) hosting 28, 18 and 30 nests, respectively. The average number of green turtle nests recorded per calendar week during the nine weeks of green nesting was 0.8 nests, with one nest recorded each week during seven of the nine weeks.

Geographic distribution of crawl activity:

East Key: Green turtle activity was not observed on East Key this season. Loggerhead crawl activity occurred on East Key throughout the sandy beachfront within all sectors (A through H). A small loggerhead female, witnessed by Reardon and volunteer Lisa Appugliese as having only a nub of a left rear flipper, produced 57 false crawls this season on East Key. Though she was persistent, the missing limb prevented the excavation of a suitable egg chamber, causing her to abort each nesting attempt. Of the 296 documented crawls, 127 (42.9%) occurred on the elongated north end of the island, Sector E. The least activity (4.1%) was recorded within Sector B (Figure 11). It should be noted, however, that the recent northward migration of the island has greatly altered the size of the island's end sectors. Sector E, which encompasses the entire north tip, was nearly three times larger than the standard 60-m sector. Conversely, sectors A and H on the southern end were greatly reduced in area.

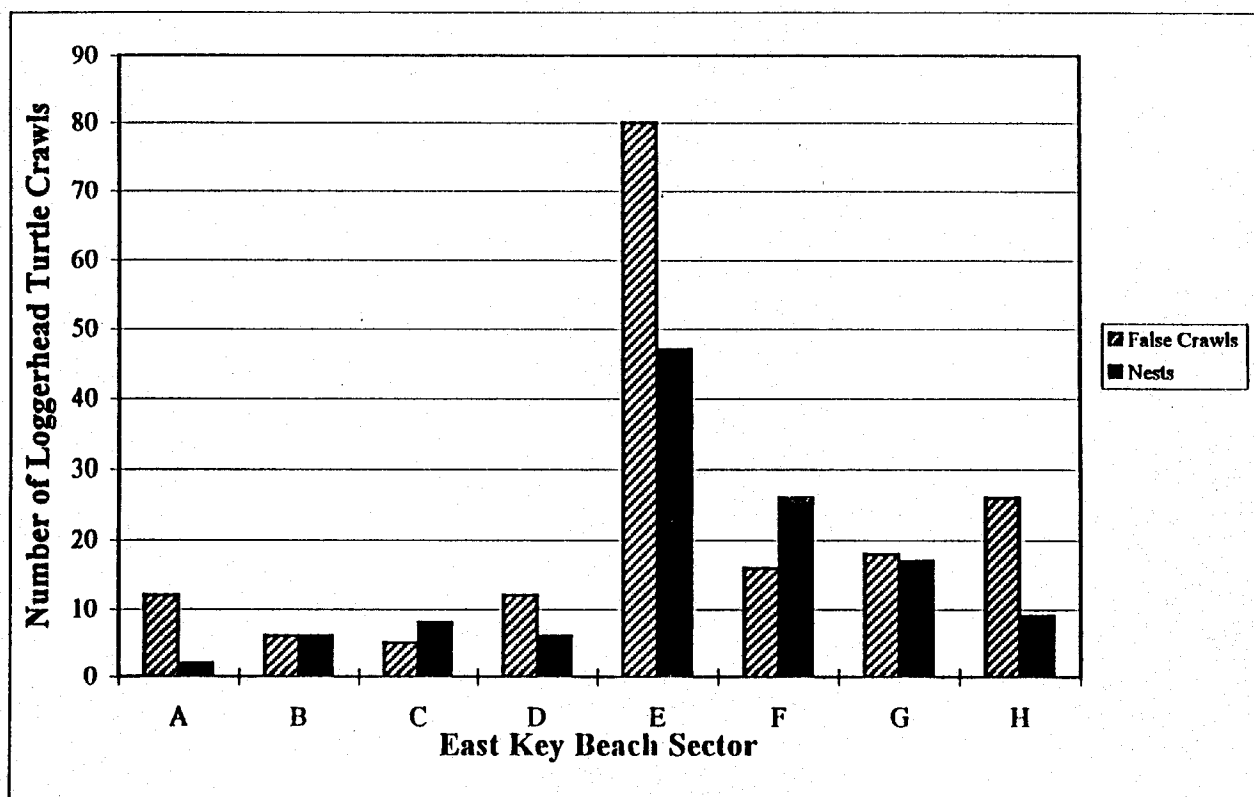


FIGURE 11. Geographic Distribution of Sea Turtle Crawl Activity, East Key, Dry Tortugas National Park, 1999.

Loggerhead Key: Crawl activity on Loggerhead Key occurred throughout the sandy beachfront within all sectors except Sector S containing the wooden pier (Figure 12). The same usage pattern was observed during 1998. Crawl activity was greatest on the ends of the island. Sectors A and AA – the south end – contained 13.5% and 8.8% of the crawl activity, respectively. Sector M on the north tip contained 9.3% of the crawl activity. The greatest number of nests, 21, occurred in Sector A, whereas the greatest number of false crawls, 11, occurred in Sector M.

Loggerhead turtle activity occurred within all sectors except S and T. The majority of the nesting occurred on the southernmost end of the island, with Sector Y through Sector C hosting 49.0% of the loggerhead nests (Figure 13). The majority of the green turtle activity occurred on the northeast end of the island with sectors M through P hosting five out of the seven green turtle nests (Figure 14).

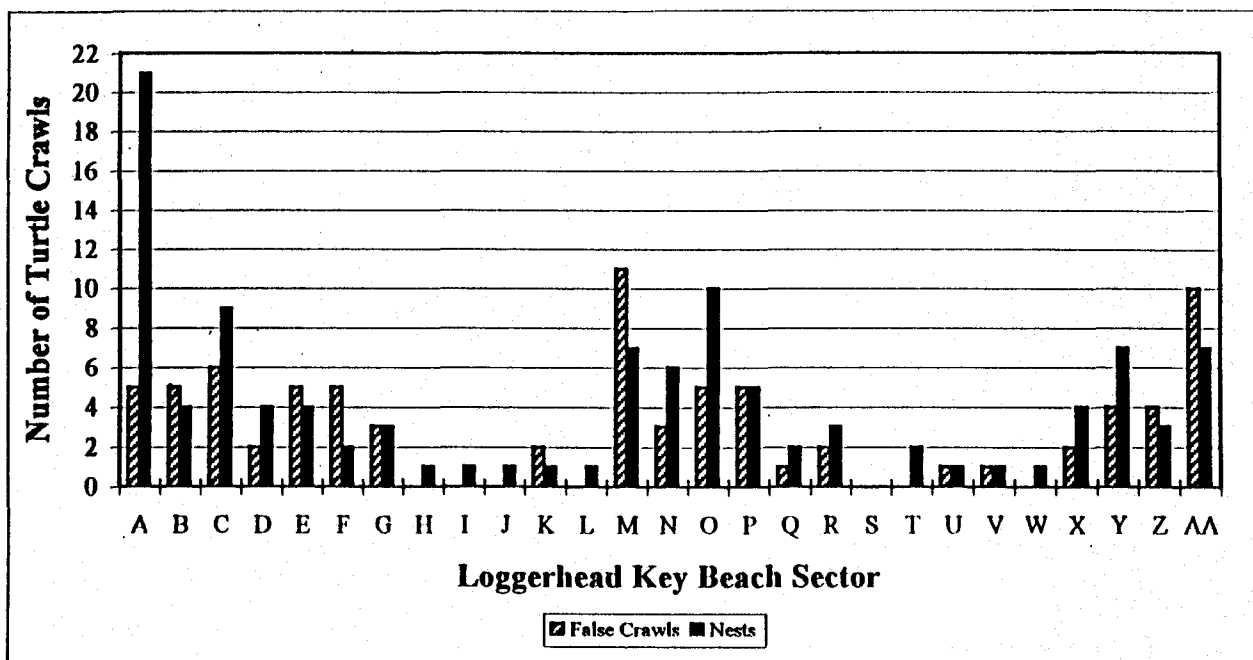


FIGURE 12. Geographic Distribution of Sea Turtle Crawl Activity, Loggerhead Key, Dry Tortugas National Park, 1999.

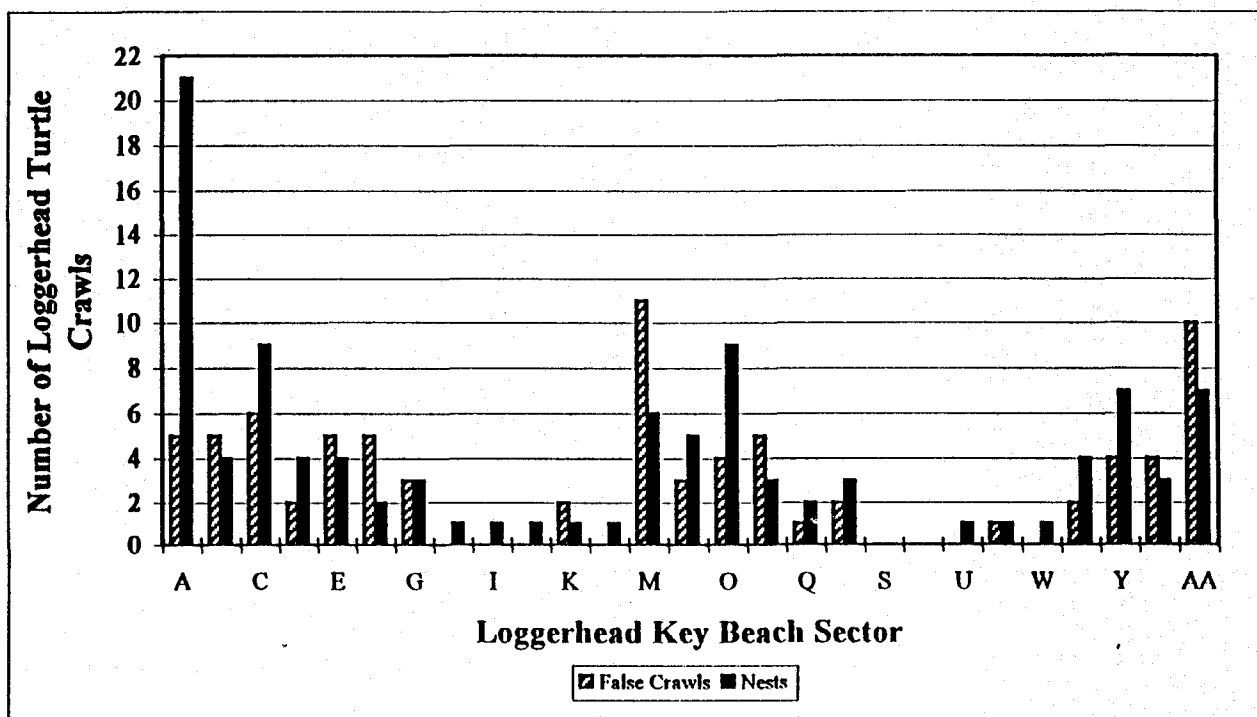


FIGURE 13. Geographic Distribution of Loggerhead Turtle (*Caretta caretta*) Activity, Loggerhead Key, Dry Tortugas National Park, 1999.

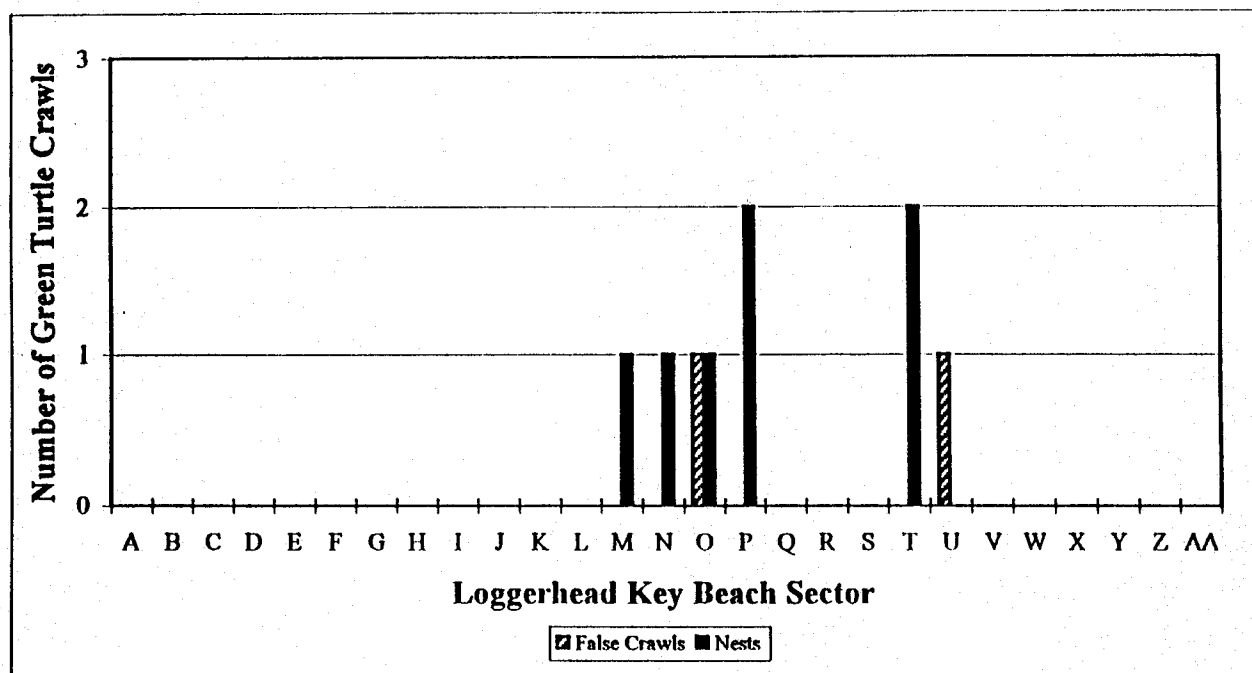


FIGURE 14. Geographic Distribution of Green Turtle (*Chelonia mydas*) Activity, Loggerhead Key, Dry Tortugas National Park, 1999.

Bush Key: Crawl activity on Bush Key was located along the northern shore of the island only. No activity was observed on the harbor-side this season. Ten false crawls and 11 nests were recorded, with the majority of the activity occurring on the beaches east of the brown pelican rookery.

Long Key: Crawl activity occurred along the rubbly eastern shore of Long Key, north of the magnificent frigatebird rookery. Three nests and 14 false crawls were recorded. This marks only the second time that crawl activity has been documented on Long Key; a single nest was observed in 1996.

Hospital Key: Crawl activity – three nests and seven false crawls – occurred on all portions of Hospital Key.

Garden Key: Crawl activity on Garden Key consisted of three false crawls: two on the south beach and one on the north.

Middle Key: Crawl activity – five false crawls – occurred on all portions of Middle Key.

Tidal Impacts and Inundation:

Over the course of the 1999 nesting season, 49 nests were inundated by seawater due to the watertable, spring high tides or storm surges. Twenty-six of these nests were lost to beach erosion; 18 nests were washed yet remained in tact; and five nests were inundated due to seawater intrusion from the watertable. DRTO was spared from direct hits by major storm systems this season, although several nests were lost to erosion as Tropical Storm Harvey passed near the area late in

September. Erosion resulting from Hurricane Irene, which struck the lower Keys on October 15, was not a factor as nest inventories had been completed.

Over the course of the season, however, erosion did claim 26 (10.4%) of the DRTO nests. Down from a record high loss of 51 nests (19.0%) in 1998, the number of eroded nests this season paralleled the losses to erosion documented in 1996 and 1997: 23 nests (9.7%) and 22 nests (10.1%), respectively. All three nests on Hospital Key were lost this season; however, as in previous seasons, the north and south ends of both East Key and Loggerhead Key hosted the greatest amounts of washed and eroded nests. Figures 15 and 16 show the geographic distribution of inundated nests on East and Loggerhead keys.

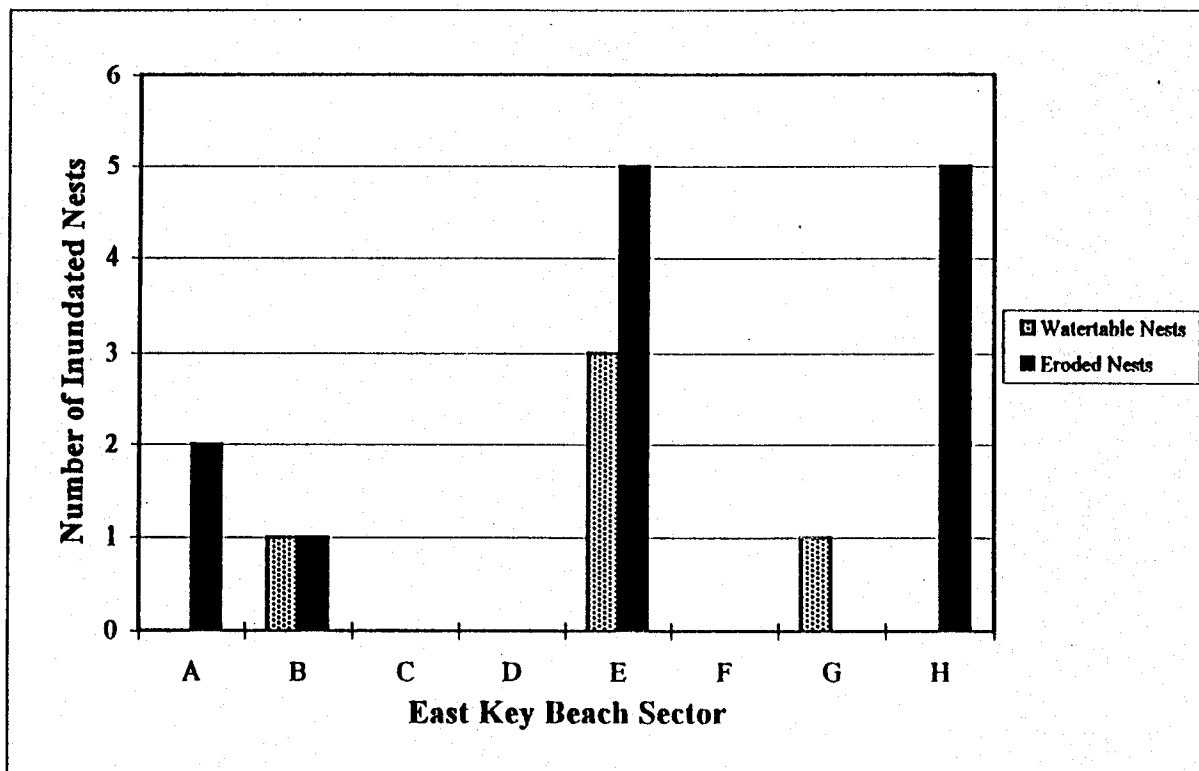


FIGURE 15. Geographic Distribution of Sea Turtle Nests Inundated by Seawater, East Key, Dry Tortugas National Park, 1999.

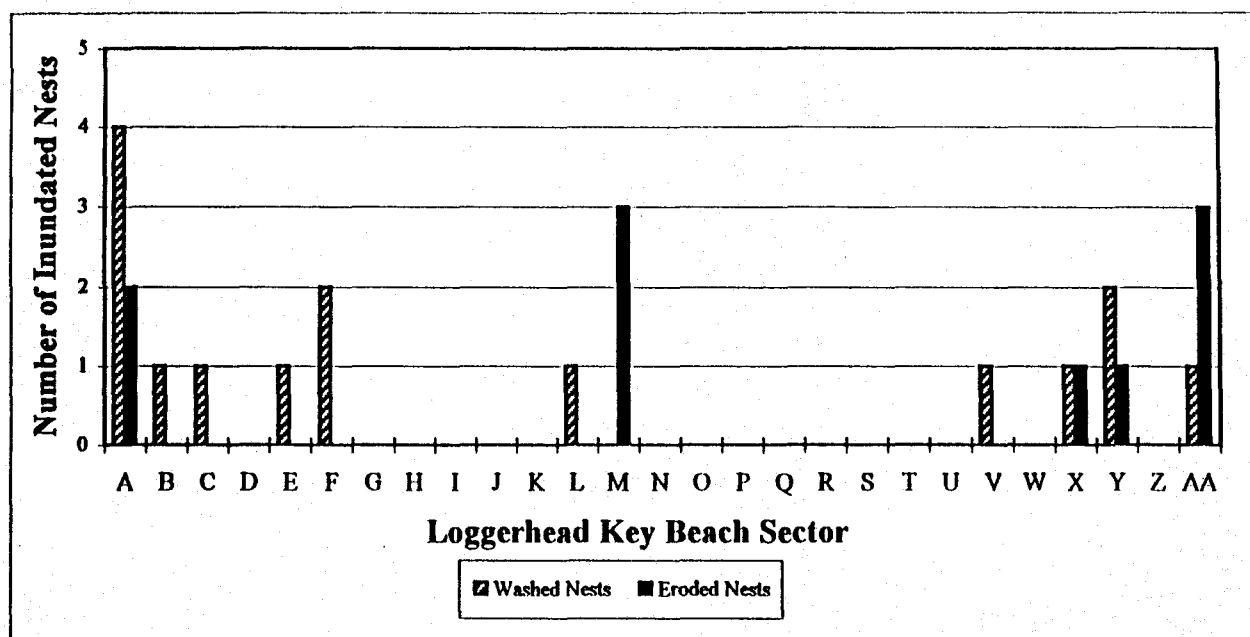


FIGURE 16. Geographic Distribution of Sea Turtle Nests Inundated by Seawater, Loggerhead Key, Dry Tortugas National Park, 1999.

Hatching Data

Park overview:

A total of 249 nests were observed within Dry Tortugas National Park in 1999. Clutch contents were examined from 213 (85.5%) of these nests. Thirty nests could not be inventoried as they were eroded by tidal activity prior to excavation. Six nests could not be inventoried as they were partially or totally decimated by subsequent nesting attempts during the season.

From the 213 inventoried nests, a total of 22,022 eggs were documented, including 4,111 (18.7%) unhatched eggs. A total of 347 dead hatchlings were found within nest cavities, and 38 were found dead post-emergence. Predation was minimal with seven eggs and 64 hatchlings (16.6% of the total dead hatchlings) depredated by ghost crabs (*Ocypode quadrata*) and laughing gulls (*Larus atricilla*) during 1999.

An estimated 17,408 hatched eggs were excavated, with an estimated 17,060 hatchlings released to the Gulf of Mexico. This yielded a 1999 hatching success and release rate of 78.7% (SD = 20.5%; $r = 0.0-99.0\%$; $n = 213$) and 77.2% (SD = 20.9%; $r = 0.0-99.0\%$; $n = 213$), respectively. Excluding the 20 inventoried nests that were inundated by seawater, the hatching success increased to 82.2% (SD = 14.0%; $r = 28.8-99.0\%$; $n = 193$), with a release rate of 80.8% (SD = 14.5%; $r = 28.8-99.0\%$; $n = 193$). The average incubation period for DRTO nests this season was 54.6 days (SD = 3.5; $r = 48-68$; $n = 190$).

Species overview:

Loggerhead turtles: Of the 242 loggerhead nests recorded this season, 207 (85.5%) were inventoried, documenting an estimated 21,256 eggs. A total of 4,046 eggs (19.0%) failed to hatch. Some 346 dead hatchlings were found within nest cavities, and 38 were found dead post-emergence. Predation was minimal with seven eggs and 64 hatchlings (16.7% of the total dead loggerhead hatchlings) depredated by ghost crabs and laughing gulls. An estimated 16,737 eggs hatched, with 16,388 hatchlings entering the Gulf. The average hatching success and release rates for loggerheads were 78.5% (SD = 20.7%; $r = 0.0-99.0\%$; $n = 207$) and 76.9% (SD = 21.1%; $r = 0.0-99.0\%$; $n = 207$), respectively. Excluding the 20 inventoried nests that were inundated by seawater, the loggerhead hatching success increased to 82.0% (SD = 14.2%; $r = 28.8-99.0\%$; $n = 187$), with a release rate of 80.6% (SD = 14.7%; $r = 28.8-99.0\%$; $n = 187$). The average clutch size was 102.7 eggs (SD = 23.4; $r = 30-162$; $n = 207$). The average incubation period for loggerhead nests was 54.6 days (SD = 3.5; $r = 48-68$; $n = 184$).

Green turtles: Six of the seven green turtle nests observed in 1999 were inventoried, documenting an estimated 766 eggs. One nest was lost to erosion and could not be inventoried. Sixty-five eggs (8.5%) failed to hatch. One hatchling was found dead within a nest. No predation was observed. A total of 671 eggs were recorded as hatched, and two were recorded as live-pipped. An estimated 672 hatchlings entered the Gulf. The average hatching success and release rates for green turtles in DRTO were 87.4% (SD = 6.2%; $r = 80.8-97.9\%$; $n = 6$) and 87.6% (SD = 6.2%; $r = 80.8-97.9\%$; $n = 6$), respectively. Note the release rate exceeds the hatching success rate because the eggs recorded as "live-pipped" produced hatchlings that were subsequently released. In accordance with FFWCC guidelines, a pipped egg is classified as neither hatched nor unhatched. The average clutch size was 127.7 eggs (SD = 7.7; $r = 121-140$; $n = 6$). The average incubation period for green nests was 52.2 days (SD = 2.1; $r = 48-54$; $n = 6$).

A summary of loggerhead and green turtle hatching data is presented in Table 4.

TABLE 4. 1999 Summary of Loggerhead (*Caretta caretta*) and Green Turtle (*Chelonia mydas*) Hatching Data, Dry Tortugas National Park.

Data Category:	Loggerhead Turtle (<i>Caretta caretta</i>)	Green Turtle (<i>Chelonia mydas</i>)
Total Nests	242 nests	7 nests
Total Nests Inventoried (n)	207 nests	6 nests
Total Eggs	21,256 eggs	766 eggs
Total Unhatched Eggs	4,046 eggs	65 eggs
Total Depredation	7 eggs; 64 hatchlings	0 eggs; 0 hatchlings
Total Eggs Hatched	16,737 eggs	671 eggs
Average Hatching Success	78.5% (SD = 20.7%; r = 0.0-99.0%)	87.4% (SD = 6.2%; r = 80.8-97.9%)
Total Entering Gulf	16,388 hatchlings	672 hatchlings
Average Release Rate	76.9% (SD = 21.1%; r = 0.0-99.0%)	87.6% (SD = 6.2%; r = 80.8-97.9%)
Average Incubation	54.6 days (SD = 3.5; r = 48-68; n = 184)	52.2 days (SD = 2.1; r = 48-54; n = 6)
Average Clutch Size	102.7 eggs (SD = 23.4; r = 30-162)	127.7 eggs (SD = 7.7; r = 121-140)

Geographic distribution of hatching activity:

East Key: Of the 121 nests on East Key, 103 were inventoried, yielding an estimated 9,792 eggs. A total of 1,841 eggs (18.8%) failed to hatch. One hundred eighty-one dead hatchlings were found: 155 within nest cavities and 26 post-emergence. Six eggs and 58 hatchlings were depredated by ghost crabs and laughing gulls. A greater number of laughing gulls was observed on East Key this season than in any of the previous four seasons of the project. An estimated 7,785 eggs hatched, with 7,613 hatchlings entering the Gulf. The average hatching success and release rates on East Key were 78.7% (SD = 21.7%; r = 0.0-98.7%; n = 103) and 77.0% (SD = 22.0%; r = 0.0-98.7%; n = 103), respectively. The average incubation period was 55.5 days (SD = 3.9; r = 49-68; n = 94).

Loggerhead Key: Of the 111 nests on Loggerhead Key, 96 were inventoried, yielding an estimated 10,771 eggs. A total of 1,710 eggs (15.9%) failed to hatch. One hundred ninety-five hatchlings were found dead: 183 within nest cavities and 12 post-emergence. One egg and six hatchlings were depredated by ghost crabs. An estimated 8,730 eggs hatched, with 8,563 hatchlings entering the Gulf. The average hatching success and release rates on Loggerhead Key were 80.8% (SD = 15.9%; r = 3.6-99.0%; n = 96) and 79.3% (SD = 16.7%; r = 3.6-99.0%; n = 96), respectively. The average incubation period was 53.6 days (SD = 2.9; r = 48-61; n = 93).

Bush Key: All 11 nests on Bush Key were inventoried, yielding an estimated 1,091 eggs. A total of 271 eggs (24.8%) failed to hatch. Six hatchlings were found dead within nest cavities, and no predation was observed. An estimated 814 eggs hatched, with 808 hatchlings entering the Gulf. The average hatching success and release rates on Bush Key were 74.0% (SD = 19.3%; r = 41.8-96.8%; n = 11) and 73.5% (SD = 19.7%; r = 40.7-96.8%; n = 11), respectively. The average incubation period was 54.5 days (SD = 2.1; r = 53-56; n = 2).

Long Key: All three nests on Long Key were inventoried, yielding and estimated 368 eggs. Two of the nests, however, were inundated regularly by tidal wash and had no emergence. A total of 289 eggs (78.5%) from the three nests failed to hatch. No predation was observed. An estimated 79 hatched eggs were documented from the single successful clutch, with 76 hatchlings entering the Gulf. Three dead hatchlings were found within the nest. Hatching success and release rates were 89.8% and 86.4, respectively. The incubation period was 56 days.

Hospital Key: All three nests on Hospital Key were lost to erosion prior to emergence.

Embryonic development of unhatched eggs:

Each of the 4,111 unhatched eggs from the 213 inventoried nests was examined for embryonic development. The development categories and corresponding amounts of unhatched eggs are presented in Figure 17. The majority (57.6%) was found to have no development. Of the unhatched eggs surveyed, 229 (5.6%) showed bacterial growth (as evidenced by a pinkish-purple coloration within the egg). Ninety-five (41.5%) of these unhatched eggs with bacterial growth were from the 20 nests that had been inundated with seawater.

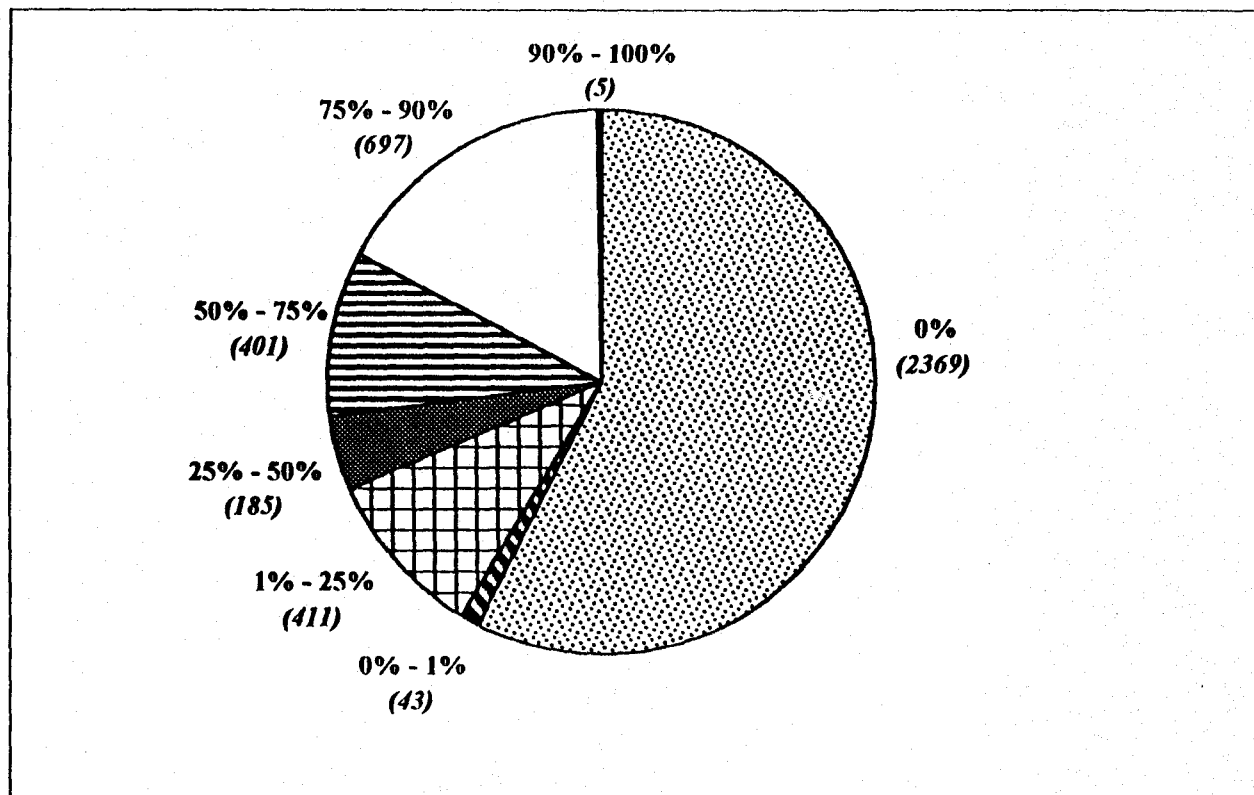


FIGURE 17. Distribution of Embryonic Development in Unhatched Sea Turtle Eggs (n = 4,111), Dry Tortugas National Park, 1999 [numbers in () indicate unhatched eggs].

Tidal impacts and inundation:

Twenty of the 49 nests inundated with seawater this season were inventoried, documenting an average hatching success of 45.5% (SD = 37.7; $r = 0.0-95.2\%$; $n = 20$) and an average incubation of 55.5 days (SD = 4.4; $r = 51-68$; $n = 12$). Five of the inundated nests – all on East Key – were impacted by seawater intrusion. Excavations of these nests had to be performed during low tides in order to reduce the watertable in the clutch cavity. Three of the five nests recorded zero percent hatching success.

The date of initial tidal inundation was documented for 13 nests. Figure 18 shows embryonic development for these nests, grouped by the number of days incubation prior to initial inundation. The number of days elapsing from nest deposition to first recorded washing ranged from 14 to 50 days.

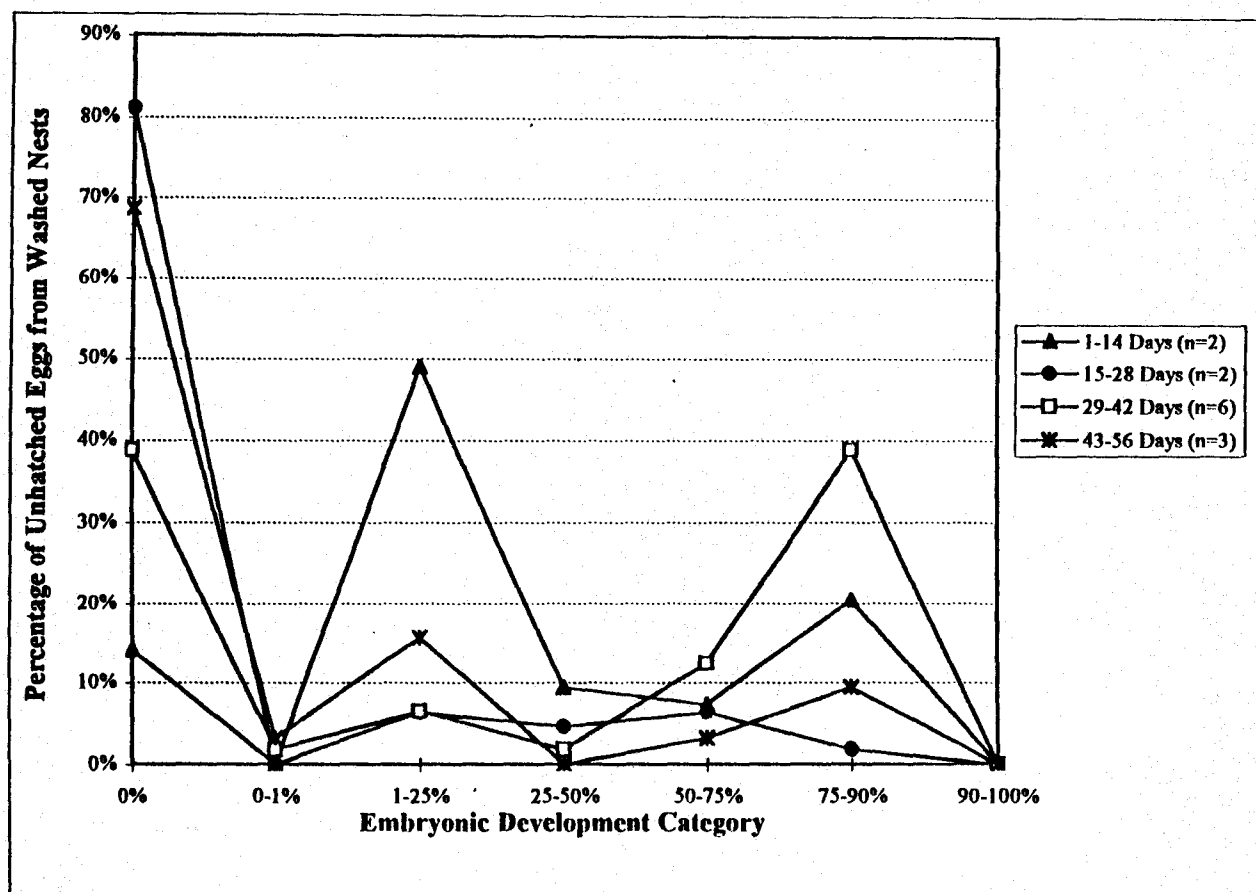


FIGURE 18. Percentage of Unhatched Sea Turtle Eggs per Embryonic Development Category for 13 Nests Inundated with Seawater (grouped by number of days incubation prior to initial inundation), Dry Tortugas National Park, 1999.

Exotic plant data:

Downed *Casuarina* trees, branches and/or roots adversely impacted 25 crawls on Loggerhead Key this season. This constitutes 13.0% of the island's turtle activity. Though up from last season, impacted activity remained less than that observed in 1996 and 1997: 20.1% and 18.0%, respectively (Figure 19). Fourteen (12.6%) of the island's nests and 11 false crawls (13.4%) were impacted by *Casuarina*. Sea turtles encountered downed trees on the beach and returned directly to the water on five different occasions over the course of the season. Documentation of each impacted crawl is presented in Appendix H.

Prior to the 1999 nesting season, a crew from Everglades National Park was to conduct a prescribed fire on Loggerhead Key, burning slash piles and removing woody debris from the nesting beaches, concentrating their efforts on the north end of the island. Unfortunately, due to scheduling conflicts, the burn was not conducted, and downed trees and slash piles continued to reduce portions of suitable nesting habitat throughout the season. Correspondingly, the majority of the impacted crawls were along both shores of the northern half of the island. Sixteen impacted crawls were documented in sectors J through R, where as eight impacted crawls occurred in sectors B through F (Figure 20).

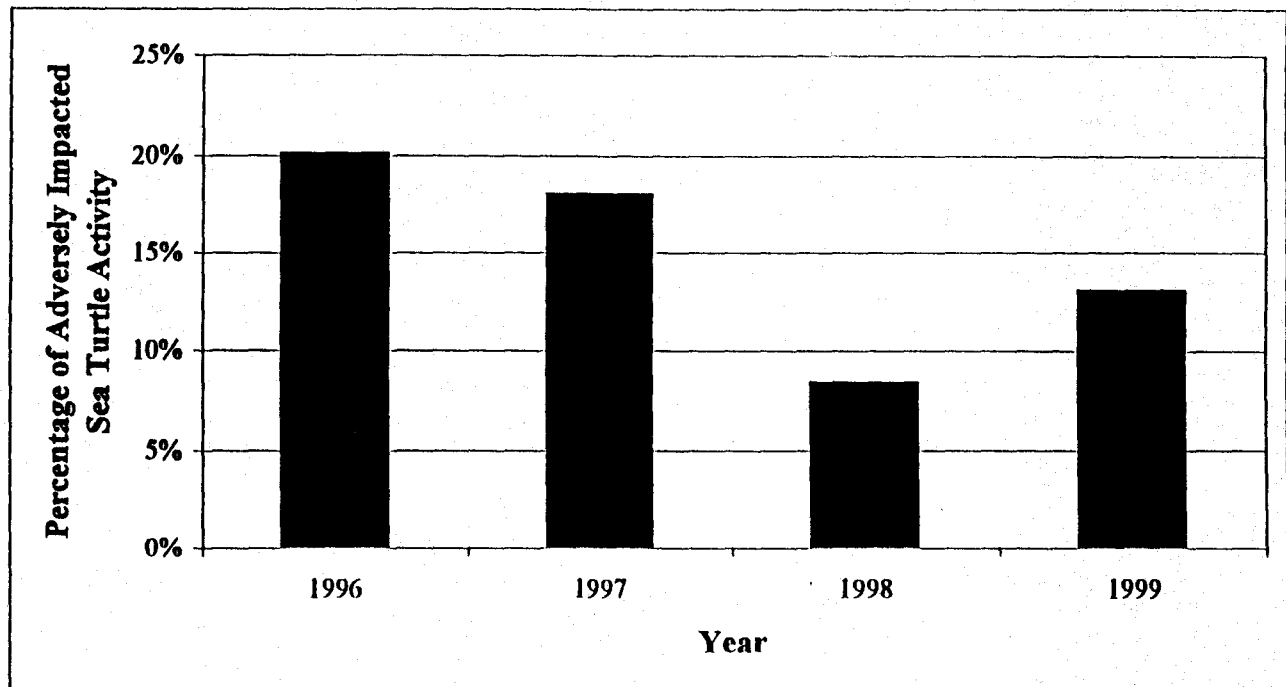


FIGURE 19. Percentage of Loggerhead Key Sea Turtle Activity Adversely Impacted by *Casuarina equisetifolia*, Dry Tortugas National Park, 1996 - 1999.

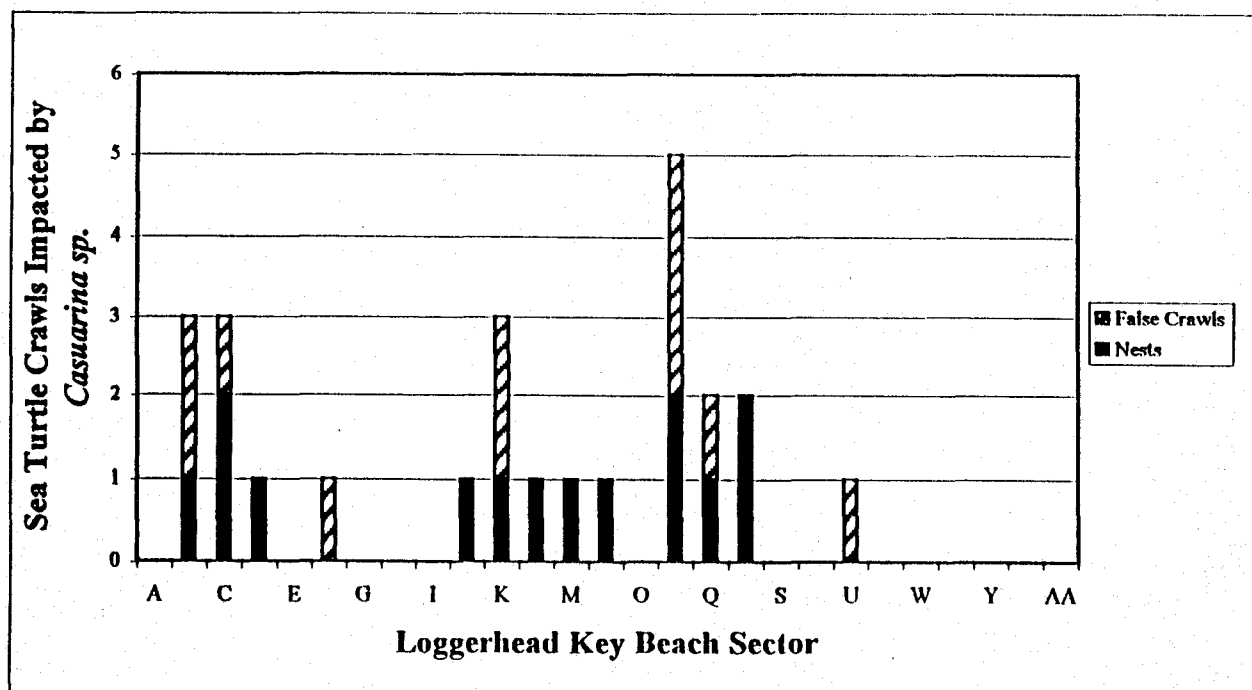


FIGURE 20. Geographic Distribution of Sea Turtle Crawls Impacted by *Casuarina equisetifolia* on Loggerhead Key, Dry Tortugas National Park, 1999.

Stranding data:

To date, two turtles have been reported as DRTO strandings in 1999. A hawksbill turtle washed ashore south of the pier on the eastern shore of Loggerhead Key on January 17, 1999. The carcass, severely decomposed, was documented by Ranger Roy Appugliese and buried in place. The cause of death could not be determined externally, and a necropsy was not performed.

The second stranding, a moderately decomposed juvenile hawksbill, washed ashore on the southern tip of Loggerhead Key on July 25. Documentation of the stranding was completed by Yvette Anderson. The cause of death could not be determined externally, and a necropsy was not performed (Table 5).

TABLE 5. 1999 Sea Turtle Strandings, Dry Tortugas National Park.

Stranding No.	Date	Species	Location	Condition Found
1	01/17/99	Hawksbill	Pier at Loggerhead Key	Severely decomposed
2	07/25/99	Hawksbill	South tip of Loggerhead Key	Moderately decomposed

Specimen Collection Data:

Tissue samples from 158 loggerhead and six green turtle specimens were obtained this season. Thirty-five samples consisted of egg yolk only.

Because UF researchers were initially interested in tissue samples from different nesting females, hatchlings were collected throughout the season and arranged by date of nest deposition in order to identify a 10-day period – a conservative nesting interval – in which the maximum number of specimens was obtained. One green turtle and 39 loggerhead specimens were obtained in a single 10-day period corresponding to nests laid June 19 through June 28. It is likely that these 40 hatchlings are the progeny of different females. The tissue samples were delivered to the University of Florida on September 10, 1999.

Subsequently, tissue samples from the remaining 124 specimens were requested by the university. These additional samples are to be delivered in December 1999. A detailed listing of the samples supplied to UF for genetic analyses is presented in Appendix I.

DISCUSSION AND RECOMMENDATIONS:

In its fifth season of comprehensive study, the Dry Tortugas Sea Turtle Monitoring Program has obtained further data reinforcing its 1995 suggestion that DRTO supports the largest loggerhead rookery within the Florida Keys and the largest green turtle rookery within Monroe County, Florida. However, without tagging studies, the size of the loggerhead and green turtle nesting populations in the Dry Tortugas can only be inferred from the observed nesting intensity.

The average loggerhead nesting interval in Florida is 13 days (LeBuff, 1990). Correspondingly, a tagging study conducted in the early 1980's documented an average loggerhead nesting interval on East Key of 13.1 days (Williams & Dawson, 1984). An estimate of individual nesting females could be made by counting the number of nests observed within a 13-day period. However, as 13 days is only an average, using a more conservative 10-day period increases confidence that individual nesters are not counted twice. Conservatively, based on the number of nests observed in a single 10-day period, at least 39 loggerheads utilized park beaches this season.

Data collected since 1995 have shown great seasonal variability in the number of green turtle nests observed in DRTO, with little nesting activity recorded in the odd years – 1995, 1997 and 1999 – and record amounts documented in the even years – 1996 and 1998. Since two to three years may elapse before a sea turtle returns to nest, trends in nesting activity tend to be cyclic (Van Meter, 1983). The data collected suggest a two-year cycle for green turtles in the Dry Tortugas, with a significantly larger even-year nesting population. The nesting interval of green turtles in Florida ranges between 11 and 14 days (LeBuff, 1990). With three green nests recorded during a single 10-day period, three or more green turtles may have utilized park beaches this season.

The islands of the Dry Tortugas provide excellent sea turtle nesting habitat that is free from many of the anthropogenic disturbances found elsewhere: armored beaches, light pollution, nighttime pedestrians, etc. Furthermore, devoid of mammalian nest predators such as raccoons and hogs, park nests achieve great hatching success. In addition to critical nesting habitat, the Dry Tortugas – with continued monitoring efforts – could provide valuable life history information on the nesting populations of endangered green and threatened loggerhead sea turtles. To this end, the 1999 DTSTMP provided researchers at the University of Florida with tissue samples needed for a study on sea turtle reproductive migratory behavior and population structure. Results from genetic analyses will be used to evaluate the relationship of sea turtles nesting in the Dry Tortugas to other nesting colonies and to determine if the DRTO nesting population should be considered a separate management unit for conservation purposes.

Though Garden Key hosted three false crawls this season, no nesting occurred on the island for the first time since season-long surveys began in 1995. Whether this is a function of the increasing overnight visitation remains to be determined. During this same time period, however, campground usage on Garden Key has nearly doubled, increasing to some 5,300 camper-nights in 1999 (Taylor, 1999). Monitoring for adverse impacts to sea turtles brought about by the park's newfound popularity will be especially important in upcoming years as park visitation continues to climb.

Two primary environmental factors that threatened nesting sea turtles, nests and/or hatchlings in 1999 were tidal wash and the reduction of suitable nesting habitat due to *Casuarina*. Since data collection on inundation began in 1996, the number of nests lost each season to beach erosion has remained near 10%, excluding the 1998 season when direct hits by two major storm systems contributed to a 19.0% loss. The islands of the Dry Tortugas are extremely dynamic, changing shape and size on a seasonal basis. Observations made over the course of this and previous seasons indicate that the majority of the inundated nests occurs on the north and south tips of both East Key and Loggerhead Key. These areas should be targeted if relocation efforts become permitted and necessary.

Although the number of inundated nests decreased from last season, there was an increase in *Casuarina* impacted crawl activity on Loggerhead Key. The majority of these adverse impacts was due to downed trees and woody debris remaining from the massive clear-cutting conducted in 1998. Prior to the 1999 nesting season, an Everglades National Park burn crew was to conduct a prescribed fire, burning slash piles and removing woody debris from the nesting beaches, concentrating their efforts on the north end of the island. Unfortunately, due to scheduling conflicts, this burn was not possible, and downed trees and slash piles reduced portions of suitable nesting habitat. The result was an increase over last season in the amount of adversely impacted crawl activity. In November 1999, after the nesting season, the Everglades Fire Crew burned much of this woody debris. Although live *Casuarina* trees have successfully been removed, beach erosion exposing the remaining root masses will be a problem for years to come. Future removal efforts should concentrate on exposed root masses along the shore prior to sea turtle nesting season.

The 1999 turtle program operated under a cooperative agreement (CA 5280-9-9016) between the National Park Service and the University of Florida that went into effect on April 1, 1999, to remain in effect for a period of three years – subject to funding. The agreement shifts the administration

and management of the program to the university, enabling it to reach its full potential by utilizing the expertise offered through that institution. This arrangement also increases the likelihood of employing personnel with the appropriate background in sea turtle research. To date, however, there is no base funding to ensure the continuation of monitoring efforts. Without a firm commitment of financial support from natural resource managers at Everglades National Park (EVER), the future of the program remains uncertain.

Two issues – beyond funding – that must now be addressed by the university regarding monitoring at DRTMO are the continuity of data collection and the certification of motorboat operators. Maintaining the established monitoring protocols (at the minimum) is necessary to facilitate future comparisons among the seasons. An effective method of achieving this continuity is to overlap project personnel from year to year. The university's own renowned turtle researcher, Dr. Archie Carr, staffed his field station at Tortuguero, Costa Rica with "a long run of students, mostly from the University of Florida, who peopled the camp in changing combinations, with at least one from the year before going back each year to break in the new ones arriving" (Carr 1967). A similar system should be maintained at the DRTMO "camp," as on-site NPS personnel have neither the time nor the turtle research experience to train a succession of new arrivals. It should be noted that at least one experienced turtle researcher must be on-site from April through November, accompanied by a second researcher mid-May through mid-September, in order to maintain the current level of monitoring.

The second issue to be addressed by the university is boating. There are seven islands hosting sea turtle activity in Dry Tortugas National Park, accessible only by boat. Turtle researchers coming to DRTMO must be experienced boat operators. This is a position requirement, not merely a desirable qualification. Prior to operating National Park Service vessels, all operators must be certified through the Department of Interior Motorboat Operators Certification Course (DOI - MOCC). This extensive course includes classroom sessions, exams and boating practicals. Researchers who are not certified will not be allowed to use NPS vessels. It should be noted that the DOI - MOCC will not be offered on-site; and without boat-certified researchers, there will be no Dry Tortugas Sea Turtle Monitoring Program.

The DTSTMP was represented at two symposia in March of this year: The 19th Annual Symposium on Sea Turtle Biology and Conservation, South Padre Island, Texas and The 10th Conference on Research and Resource Management in Parks and on Public Lands (George Wright Society), Asheville, NC. A listing in the "Technical Reports" section of the April 1999 *Marine Turtle Newsletter* No. 84 resulted in six requests – to date – for the 1996 *Annual Report*, by Mansfield and Reardon. These requests originated domestically from Florida and Minnesota and internationally from Italy (2), England and Colombia. Copies of the 1996 report, as well as the more recent 1998 *Annual Report*, were sent in reply. The response generated by this single entry may be indicative of greater interest in the DTSTMP by others in the field. Perhaps now – with five seasons of data – it would be appropriate to present the program's initial findings through various scientific publications.

The Dry Tortugas Sea Turtle Monitoring Program has been focused on monitoring and conservation. Now, under the direction of the Archie Carr Center for Sea Turtle Research at the University of

Florida, there is great potential to expand upon this research in future seasons. With the continued cooperation of the National Park Service and ACCSTR, the DRTO project could be developed into a premiere sea turtle research program. The resources in this relatively undeveloped study-site lend themselves well to this end; the convictions of both institutions will be the determining factor in the future success of the program.

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APPENDIX A

Dry Tortugas National Park Island Physiography: East Key, Loggerhead Key, Garden Key, Hospital Key, Bush Key, Long Key and Middle Key

The following island descriptions have been adapted from Davis, 1942 and Boykin, 1995.

East Key: Ranging in size from nine to 12 acres (3.6 - 4.8 ha), East Key is dominated by sea lavender (*Argusia gnaphalodes*), native beach-berry (*Scaevola plumieri*), bay cedar (*Suriana maritima*), sea oats (*Uniola paniculata*), dune elder (*Iva imbricata*), sandbur (*Cenchrus spp.*), sea purslane (*Sesuvium portulacastrum*) and railroad vine (*Ipomea pes-caprae*). East Key fluctuates in size and shape seasonally, but it has maintained a dune plateau of approximately three feet (1 m) in elevation.

Loggerhead Key: Approximately 30 acres (12 ha) in size, Loggerhead Key is the largest and highest island – approximately four to six feet (1.25-1.75 m) in elevation. Beach rock flanks the east central and western shores where the rock is exposed at low tide. Until 1998, the dominant vegetation was Australian pine (*Casuarina equisetifolia*), with prickly pear cactus (*Opuntia stricta*), spider lily (*Hymenocallis latifolia*), Spanish bayonet (*Yucca aloifolia*) and sisal (*Agave spp.*) growing in the understory of these trees. The *Casuarina* has been removed as part of an ongoing exotic species management program. The east and west shores of Loggerhead Key are eroding and accreting seasonally, with sand spits forming and shifting on the south and north tips of the island.

Garden Key: Approximately 16 acres (6.4 ha) in size, Fort Jefferson encompasses all but five acres (2 ha) of Garden Key. Beaches extend from the northeast shore east and south towards the southwest shore and are punctuated by human-made structures and development. These beaches erode and accrete seasonally and have been altered by dredging operations. Numerous exotic plant species may be found throughout this Key.

Hospital Key: This island is a small, shifting sandbar varying in size from one half to one acre (0.2 – 0.4 ha). It is estimated that Hospital Key has an elevation of 1.5 feet (0.5 m) and is three quarters surrounded by indurated beach rock. A small patch of sea purslane is present on the highest point of the island. Hospital Key is very dynamic, often completely awash during tropical storms.

Bush Key: Approximately 20 acres (8 ha) in size, Bush Key is host to native plant species such as sea purslane, bay cedar and sea lavender. Two stands of red and black mangrove (*Rhizophora mangle* and *Avicennia germinans*) are also present on the island. A sand spit extends westward towards Garden Key, and a coralline rubble ridge extends eastward and connects with Long Key.

Long Key: Located east of Garden and Bush keys, Long Key is approximately one acre (0.4 ha) in size and composed of coralline rubble. First described as a small, low-lying shoal, it now has several dune-like ridges of up to three feet (1 m) in elevation. A red mangrove stand occupies the southwest region of the island.

Middle Key: This low, crescent shaped sand bar located between Hospital and East Keys is primarily awash during the summer months. Due to frequent inundation, Middle Key is unsuitable for vegetative growth.

APPENDIX B

CRAWL#: _____

DATE: _____

NEST#: _____

TIME: _____

DRY TORTUGAS NATIONAL PARK 1999 SEA TURTLE NESTING SURVEY

NAME: _____

PACES/100 meters: _____

ISLAND: _____

BEACH (S,W,NE,etc.): _____

CRAWL TYPE (circle one): False Crawl Nest Undetermined

SPECIES (circle one): Loggerhead Green Hawksbill Undetermined

COMMENTS:

DEPREDATION (circle one): Total Partial None

NUMBER OF EGGS DEPREDATED (count shells 50% and greater): _____

COMMENTS:

LOCATION ON BEACH: (CHANGE UNITS IF PACING DISTANCES)

NEAREST MARKER NUMBER: _____^A NEXT NEAREST MARKER: _____^B

DIRECTION OF CRAWL FROM MARKER: A: _____ B: _____

DISTANCE FROM MARKER TO CRAWL: A: _____ m B: _____ m

DISTANCE FROM HIGH TIDE LINE: _____ m

CRAWL WIDTH: _____ m

CRAWL DIAGRAM:

STAKE#:

STAKE#:

REMARKS:

APPENDIX C

NEST#: _____

Dry Tortugas National Park 1999 Nest Inventory

NAME: _____

TIME OF INVENTORY: _____

ISLAND: _____

BEACH (S,W,NE,etc.): _____

NEST DATA:

NEST DATE: _____

CHECK DATE (+45 DAYS): _____

EMERGENCE DATE: _____

EXCAVATION DATE: _____

NEST COVER (circle one): Full sun Partial shade Full shade

DEPREDATION (circle one): Yes No

EXCAVATION DATA:

SPECIES(circle one): Loggerhead Green Hawksbill Undetermined

A) TOTAL EGGSHELLS (>50%): _____

B) LESS: LIVE HATCHLINGS INSIDE NEST: _____

C) LESS: DEAD HATCHLINGS INSIDE NEST: _____

D) EQUALS: TOTAL HATCHLINGS EMERGED (A-B-C): _____

HATCHLINGS OUTSIDE NEST: E) LIVE: _____ F) DEAD: _____

G) TOTAL HATCHLINGS ASSUMED TO ENTER THE GULF (A-C-F+H): _____

H) LIVE PIPPED EGGS: _____

I) DEAD PIPPED EGGS: _____

J) DEPREDATED EGGS: _____

K) UNHATCHED EGGS IN NEST: _____

L) TOTAL EGGS EVALUATED IN NEST (A+H+I+J+K): _____

HATCHING SUCCESS ($100 \times A/L$): _____ % RELEASE RATE ($100 \times G/L$): _____ %

INCUBATION PERIOD: _____ DAYS

APPENDIX D

Dry Tortugas National Park 1999 Development Survey

Name: _____

Date of Survey: _____

Nest Number: _____

Total Eggs in Nest: _____

Unhatched Eggs: _____

% Dev.	0%	0 - 1%	1 - 25%	25- 50%	50- 75%	75- 90%	90-100%
Tally							
Total							

Total Pipped	Number Depredated	Total Bacteria (Pink)
Live: Dead:		

APPENDIX E

The Criteria for Determining Embryonic Development in Unhatched Eggs

Each unhatched egg must be opened and examined. The degree of embryonic development is based on the following criteria:

0% Development: Presence of a plain yellow yolk; if decomposing, it may have a scrambled egg or cottage cheese-like appearance.

0 to 1% Development: The presence of blood spots only.

1 to 25% Development: The presence of blood spots with surrounding white mass; possibly the presence of small pin-sized eye spots; a turtle shaped embryo up to one quarter the size of a normal hatchling.

25 to 50% Development: These embryos will be one quarter to one half the size of a normal hatchling. Development is based on what percent the embryo has developed in terms of 100%. These embryos will be small, fully formed turtles attached to a yolk sack larger than the embryo.

50 to 75% Development: These embryos will be half to three quarters the size of a full hatchling; yolk sacks will be slightly smaller than the embryo.

75 to 90% Development: Embryos will appear more than three quarters the size of a hatchling; yolk sacks will be smaller than the embryo, however a full sized embryo will still have a relatively large yolk sack attached.

90 to 100% Development: Embryo will be full sized with little to no yolk sack.

The criteria used by the Caretta Research Project (4405 Paulsen St., Savannah, Georgia 31405) for determining the degree of embryonic development in unhatched loggerhead sea turtle eggs is based on the following papers:

Yntema, C. L. & N. Mrosovsky, 1980. Sexual differences in hatchling loggerheads (*Caretta caretta*) incubated at different controlled temperatures. *Herpetologica* (1): 33-36.

McGehee, M. A., 1979. Factors affecting the hatching success of loggerhead sea turtle eggs. MS Thesis, University of Central Florida. 252 p.

Maloney, J. E. *et al.*, 1990. The environment for the development of the embryonic loggerhead turtle (*Caretta caretta*) in Queensland. *Copeia* 1990 (2): 378-387.

APPENDIX F

SEA TURTLE STRANDING AND SALVAGE NETWORK - STRANDING REPORT

PLEASE PRINT CLEARLY AND FILL IN ALL APPLICABLE BLANKS. Use codes below. Measurements may be straight line (caliper) and/or over the curve (tape measure). Measure length from the center of the nuchal notch to the tip of the most posterior marginal. Measure width at the widest point of carapace. CIRCLE THE UNITS USED. See diagram below. Please give a specific location description. INCLUDE LATITUDE AND LONGITUDE.

Observer's Full Name _____ Stranding Date _____
year month day

Address / Affiliation _____

Area Code / Phone Number _____

Species _____ Turtle Number By Day _____

Reliability of I.D.: (CIRCLE) Unsure Probable Positive Species Verified by State Coordinator? Yes ☐ No ☐

Sex: (CIRCLE) Female Male Undetermined How was sex determined? _____

State _____ County _____

Location (be specific and include closest town) _____

Latitude _____ Longitude _____

Condition of Turtle (use codes) _____ Final Disposition of Turtle (use codes) _____

Tag Number(s) (include tag return address and disposition of tag) _____

Remarks (note if turtle was involved with tar or oil, gear or debris entanglement, wounds or mutilations, propellor damage, papillomas, epizoa, etc.) continue on back if necessary

MEASUREMENTS: CIRCLE UNITS

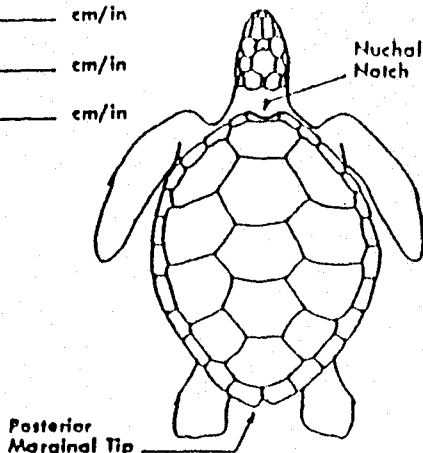
Straight Length _____ cm/in

Straight Width _____ cm/in

Curved Length _____ cm/in

Curved Width _____ cm/in

Mark wounds,
abnormalities,
and tag locations



CODES:

SPECIES:

CC = Loggerhead
 CM = Green
 DC = Leatherback
 EI = Hawksbill
 LK = Kemp's ridley
 UN = Unidentified

CONDITION OF TURTLE:

0 = Alive
 1 = Fresh dead
 2 = Moderately decomposed
 3 = Severely decomposed
 4 = Dried carcass
 5 = Skeleton, bones only

FINAL DISPOSITION OF TURTLE:

1 = Painted, left on beach
 2 = Buried: on beach / off beach
 3 = Salvaged specimen: all / part
 4 = Pulled up on beach or dune
 5 = Unpainted, left on beach
 6 = Alive, released
 7 = Alive, taken to a holding facility

APPENDIX G

PROTOCOL: COLLECTING TISSUE WITHOUT REFRIGERATION FOR GENETIC ANALYSIS*

Mailing and Freight Address: Department of Fisheries and Aquatic Sciences, Univ. of Florida,
7922 NW 71st Street, Florida USA 32653

Phone: 352-392-9617 ext. 267 or 280 (office), 352-846-1088 (fax)

MATERIALS FOR COLLECTING TISSUE

- SED buffer: Saturated NaCl; 250 mM EDTA pH 7.5; 20% DMSO
- screw-cap tubes or other sealed storage containers
- razor blade or scalpel, or biopsy punch
- disposable gloves
- betadine and gauze

TISSUE SOURCE

Almost any tissue will suffice, but the preferred sources are (1) ripe or developing eggs for fish and invertebrates; (2) muscle tissue. We have a separate protocol for blood, which can also be preserved without refrigeration. Tissues that have been previously frozen are acceptable.

Biopsy punch protocol: 1. Wait until female turtle has dropped several eggs into the chamber. 2. Wipe the dorsal surface of the hind flipper 5-10cm from the carapace with betadine. 3. Press the biopsy punch firmly into the flesh and rotate one complete turn. 4. Pull off the tissue punch with a pair of tweezers and place into the tissue buffer. 5. Label the tube (Locality including State, County, location on beach; Collection date; ID number of turtle; ID number of collector). 6. Wipe the punched area again with betadine and sterilize the tweezers with alcohol.

METHOD FOR COLLECTING TISSUE

1. Collect a few grams of tissue. If collecting sample from a stranded turtle, a piece the size of a large marble is generally sufficient. If using a biopsy punch for collections from live animals, one "punch" from an 8mm diameter punch will suffice. If collecting from moribund nestlings, take a large marble size piece of tissue from the neck region.
2. Chop the tissue a few times with a razor blade to increase penetration of buffer.
3. Add tissue to labeled tube with SED buffer.
4. Samples can be stored at room temperature for several months, or in a refrigerator for at least a year. Avoid extended exposure to heat or sunlight.
5. Prior to shipping, reseal the tubes carefully and double wrap in an airtight plastic bag (ziploc or equivalent) to prevent leakage.
6. Ship samples by air freight or express mail.

Note 1: SED buffer is nontoxic, nonflammable, and can be stored indefinitely at room temperature. Since this buffer contains saturated salt (NaCl), you may find a white precipitate in some tubes. This does not affect the ability of the buffer to preserve tissue.

Note 2: Handling SED buffer without gloves may result in exposure to DMSO. This substance soaks into skin very rapidly and is commonly used to alleviate muscle aches. However, DMSO will produce a vague garlic/oyster taste in the mouth along with a comparable breath odor. If you don't like this flavor or anticipate a romantic encounter, we recommend that you wear gloves.

*protocol modified from 1) Amos, B. and A.R. Hoelzel. 1991. Long-term preservation of whale skin for DNA analysis. Rep. Int. Whal. Comm. Special Issue 13:99-103; and 2) Proebstel, D.S., R.P. Evans, D.K. Shiozawa, and R.N. Williams. 1993. Preservation of nonfrozen tissue samples from a salmonine fish *Brachymystax lenok* (Pallas) for DNA analysis. Journal of Ichthyology 9:9-17.

APPENDIX H

Sea Turtle Activity Impacted by *Casuarina equisetifolia* on Loggerhead Key, Dry Tortugas National Park, 1999 (N indicates nest, FC indicates false crawl).

Crawl No.	Beach Sector	Impact of <i>Casuarina equisetifolia</i>
29 FC	Q	Encountered stumps and debris and altered course.
35 FC	C	Encountered stumps and debris; altered course; attempted to nest in debris.
64 FC	P	Encountered downed tree and roots and returned to water.
74 FC	K	Crawled into embankment of overhanging roots and downed trees.
104 N	Q	Encountered stumps and altered course.
206 N	D	Crawled into debris.
214 FC	P	Crawled over downed, partially buried tree.
221 N	C	Attempted to nest in debris; encountered roots; altered course.
236 N	M	Crawled into embankment of overhanging roots and downed trees.
271 N	L	Crawled into embankment of overhanging roots and downed trees.
280 FC	B	Crawled into dense debris and downed trees and returned to water.
301 N	K	Crawled into embankment of overhanging roots and downed trees.
311 N	J	Crawled into embankment of overhanging roots and downed trees.
320 FC	F	Crawled into downed tree and began digging; abandoned the attempt.
329* N	P	Crawled over downed tree.
393 FC	B	Encountered a stack of downed trees and returned to water.
411 FC	K	Crawled into embankment of overhanging roots and downed trees.
424 N	P	Encountered debris and returned to water.
430 N	R	Crawled over stacked debris.
466 N	C	Crawled over downed tree.
478 N	B	Encountered roots sticking out of sand from downed tree.
494 N	R	Encountered downed tree and altered course.
503 FC	P	Encountered debris and returned to water.
530*FC	U	Encountered stumps and debris and altered course.
534*N	N	Encountered debris and altered course.

* Denotes green turtle (*Chelonia mydas*) activity.

APPENDIX I

1999 Sea Turtle Tissue Samples Supplied to the University of Florida from Dry Tortugas National Park, 1999.

Nest No.	Nest Date	Species	Island	Excavation Date	Biopsy Date	Comments
94	5/25/99	Cc	EK	7/27/99	11/16/99	
97	5/26/99	Cc	EK	8/5/99	11/16/99	
106	5/29/99	Cc	EK	7/27/99	11/16/99	
113	5/29/99	Cc	LH	7/27/99	11/16/99	
114	5/29/99	Cc	LH	7/30/99	11/16/99	
130	5/30/99	Cc	LH	7/30/99	11/16/99	
132	5/29/99	Cc	LK	7/27/99	11/16/99	
135	5/31/99	Cc	EK	7/31/99	11/16/99	
143	5/31/99	Cc	EK	8/6/99	11/16/99	
145	5/31/99	Cc	LH	7/27/99	11/16/99	
146	5/31/99	Cc	LH	7/28/99	11/16/99	
148	5/31/99	Cc	LH	7/27/99	11/16/99	
151	6/1/99	Cc	EK	7/30/99	11/16/99	
154	6/1/99	Cc	EK	7/30/99	11/16/99	
159	6/1/99	Cc	LH	8/1/99	11/16/99	
160	6/1/99	Cc	BK	7/30/99	11/16/99	
164	6/2/99	Cc	EK	8/2/99	11/16/99	
172	6/3/99	Cc	EK	7/31/99	11/16/99	
175	6/3/99	Cc	EK	8/5/99	11/16/99	
180	6/4/99	Cc	EK	8/2/99	11/16/99	
197	6/5/99	Cc	EK	8/1/99	11/16/99	
200	6/6/99	Cc	EK	8/4/99	11/19/99	
201	6/6/99	Cc	EK	8/2/99	11/18/99	
205	6/7/99	Cc	EK	8/13/99	11/18/99	
206	6/7/99	Cc	LH	7/28/99	11/19/99	
210	6/6/99	Cc	BK	7/30/99	11/19/99	
216	6/8/99	Cc	LH	7/29/99	11/19/99	
218	6/9/99	Cc	EK	8/6/99	11/19/99	
220	6/9/99	Cc	LH	8/2/99	11/18/99	
221	6/9/99	Cc	LH	8/2/99	11/19/99	
223	6/9/99	Cc	LH	8/4/99	11/19/99	
224	6/8/99	Cc	BK	8/3/99	11/19/99	
225	5/29/99	Cc	BK	8/3/99	11/18/99	Nest date unknown; tracks very weathered; discovered 6/9
226	6/10/99	Cc	EK	8/10/99	11/19/99	
228	6/10/99	Cc	LH	8/7/99	11/18/99	
233	6/11/99	Cc	EK	8/7/99	11/18/99	Yolk for specimen
234	6/11/99	Cc	LH	8/6/99	11/18/99	
236	6/11/99	Cc	LH	8/2/99	11/19/99	Yolk for specimen
242	6/11/99	Cc	LH	8/8/99	11/18/99	
245	6/12/99	Cc	EK	8/18/99	11/18/99	Yolk for specimen

APPENDIX I (Continued)

1999 Sea Turtle Tissue Samples Supplied to the University of Florida from Dry Tortugas National Park.

Nest No.	Nest Date	Species	Island	Excavation Date	Biopsy Date	Comments
247	6/12/99	Cc	EK	8/10/99	11/19/99	
249	6/12/99	Cc	EK	8/13/99	11/19/99	
250	6/12/99	Cc	LH	8/8/99	11/19/99	
251	6/12/99	Cc	LH	8/10/99	11/18/99	
252	6/12/99	Cc	LH	8/10/99	11/18/99	
253	6/12/99	Cc	LH	8/9/99	11/19/99	
254	6/13/99	Cc	EK	8/12/99	11/19/99	
256	6/13/99	Cc	EK	8/10/99	11/18/99	
257	6/13/99	Cc	EK	8/12/99	11/18/99	
258	6/13/99	Cc	LH	8/6/99	11/18/99	
263	6/14/99	Cc	EK	8/13/99	11/18/99	Yolk for specimen
264	6/14/99	Cc	LH	8/12/99	11/18/99	
265	6/15/99	Cc	EK	8/10/99	11/19/99	Yolk for specimen
266	6/15/99	Cc	EK	8/10/99	11/19/99	
269	6/16/99	Cc	EK	8/11/99	11/18/99	
271	6/16/99	Cc	LH	8/16/99	11/18/99	
274	6/17/99	Cc	EK	8/14/99	11/19/99	
275	6/17/99	Cc	EK	8/16/99	11/19/99	
279	6/17/99	Cc	EK	8/12/99	11/18/99	
288	6/19/99	Cc	LH	8/15/99	9/2/99	
290	6/19/99	Cc	LK	8/18/99	9/2/99	
294	6/19/99	Cc	BK	8/16/99	9/2/99	
300	6/20/99	Cc	LH	8/13/99	9/2/99	
301	6/20/99	Cc	LH	8/14/99	9/2/99	
302	6/21/99	Cc	EK	8/18/99	9/2/99	
305	6/21/99	Cc	EK	8/17/99	9/2/99	
308	6/21/99	Cc	LH	8/20/99	9/2/99	
310	6/21/99	Cc	LH	8/19/99	9/2/99	
311	6/21/99	Cc	LH	8/14/99	9/2/99	
312	6/22/99	Cc	EK	8/18/99	9/2/99	Yolk for specimen
314	6/22/99	Cc	EK	8/21/99	9/2/99	
316	6/22/99	Cc	EK	8/20/99	9/2/99	
319	6/22/99	Cc	LH	8/22/99	9/2/99	
321	6/22/99	Cc	LH	8/16/99	9/2/99	
322	6/23/99	Cc	EK	8/24/99	9/2/99	Yolk for specimen
323	6/23/99	Cc	EK	8/19/99	9/2/99	
326	6/23/99	Cc	EK	8/21/99	9/2/99	
327	6/23/99	Cc	LH	8/20/99	9/2/99	
329	6/23/99	Cm	LH	8/23/99	9/2/99	
331	6/23/99	Cc	LH	8/19/99	9/2/99	

APPENDIX I (Continued)

1999 Sea Turtle Tissue Samples Supplied to the University of Florida from Dry Tortugas National Park.

Nest No.	Nest Date	Species	Island	Excavation Date	Biopsy Date	Comments
332	6/23/99	Cc	LH	8/15/99	9/2/99	Yolk for specimen
333	6/23/99	Cc	LH	8/15/99	9/2/99	
334	6/23/99	Cc	LH	8/22/99	9/2/99	Yolk for specimen
335	6/24/99	Cc	EK	8/20/99	9/2/99	
342	6/24/99	Cc	LH	8/15/99	9/2/99	
344	6/24/99	Cc	LH	8/21/99	9/2/99	
345	6/24/99	Cc	BK	8/18/99	9/2/99	Yolk for specimen
346	6/25/99	Cc	EK	8/23/99	9/2/99	
347	6/25/99	Cc	EK	oblit.	9/2/99	
350	6/25/99	Cc	LH	8/19/99	9/2/99	
354	6/26/99	Cc	EK	8/20/99	9/2/99	
360	6/26/99	Cc	LH	8/21/99	9/2/99	
368	6/27/99	Cc	EK	8/21/99	9/2/99	
369	6/27/99	Cc	EK	8/23/99	9/2/99	
370	6/27/99	Cc	LH	8/20/99	9/2/99	
374	6/28/99	Cc	EK	8/26/99	9/2/99	
375	6/28/99	Cc	EK	8/19/99	9/2/99	
380	6/28/99	Cc	LH	8/21/99	9/2/99	
381	6/28/99	Cc	LH	8/22/99	9/2/99	
391	6/30/99	Cc	EK	8/30/99	11/17/99	
399	7/3/99	Cc	EK	9/6/99	11/18/99	Yolk for specimen
400	7/3/99	Cc	EK	8/30/99	11/17/99	
401	7/3/99	Cc	EK	8/29/99	11/17/99	
402	7/3/99	Cc	EK	8/28/99	11/17/99	
403	7/3/99	Cc	EK	8/26/99	11/17/99	Yolk for specimen
405	7/3/99	Cc	EK	oblit.	11/17/99	Yolk for specimen
407	7/3/99	Cc	LH	8/30/99	11/17/99	Follicle-like strand
413	7/4/99	Cc	EK	8/26/99	11/17/99	
414	7/3/99	Cc	LH	8/27/99	11/17/99	
415	7/3/99	Cc	LH	8/28/99	11/17/99	
416	7/3/99	Cc	LH	8/28/99	11/17/99	Yolk for specimen
418	7/3/99	Cc	LH	8/31/99	11/17/99	Yolk for specimen
420	7/4/99	Cc	LH	8/27/99	11/17/99	
422	7/2/99	Cc	BK	8/30/99	11/17/99	Yolk for specimen
423	7/5/99	Cc	LH	8/27/99	11/17/99	
424	7/5/99	Cc	LH	8/28/99	11/18/99	
426	7/5/99	Cc	EK	8/27/99	11/17/99	
427	7/6/99	Cc	EK	8/31/99	11/17/99	Yolk for specimen
428	7/6/99	Cc	LH	9/3/99	11/17/99	Yolk for specimen
430	7/7/99	Cc	LH	8/28/99	11/17/99	

APPENDIX I (Continued)

1999 Sea Turtle Tissue Samples Supplied to the University of Florida from Dry Tortugas National Park.

Nest No.	Nest Date	Species	Island	Excavation Date	Biopsy Date	Comments
432	7/8/99	Cc	EK	9/3/99	11/17/99	Yolk for specimen
433	7/8/99	Cc	EK	8/30/99	11/18/99	Yolk for specimen
434	7/8/99	Cc	EK	8/31/99	11/17/99	Yolk for specimen
436	7/9/99	Cc	EK	9/3/99	11/17/99	
437	7/9/99	Cc	EK	8/31/99	11/17/99	
438	7/9/99	Cc	EK	9/5/99	11/18/99	
439	7/9/99	Cc	EK	9/5/99	11/17/99	
441	7/9/99	Cm	LH	9/3/99	11/17/99	Yolk for specimen
442	7/10/99	Cc	EK	9/5/99	11/17/99	Yolk for specimen
447	7/12/99	Cc	EK	9/6/99	11/17/99	Yolk for specimen
450	7/13/99	Cc	EK	9/5/99	11/18/99	
451	7/13/99	Cc	EK	9/5/99	11/18/99	Yolk for specimen
457	7/13/99	Cc	LH	oblit.	11/16/99	Combined with 537...specimen obtained...believe from 457
460	7/13/99	Cc	BK	9/11/99	11/18/99	Yolk for specimen
462	7/14/99	Cc	EK	9/6/99	11/18/99	Yolk for specimen
470	7/14/99	Cc	LH	oblit.	11/18/99	
471	7/15/99	Cc	EK	9/11/99	11/18/99	
478	7/16/99	Cc	LH	9/6/99	11/18/99	
484	7/18/99	Cc	LH	9/11/99	11/18/99	Yolk for specimen
485	7/19/99	Cc	EK	9/11/99	11/18/99	
486	7/19/99	Cc	EK	9/14/99	11/18/99	
490	7/19/99	Cc	BK	9/11/99	11/18/99	
491	7/20/99	Cc	EK	9/13/99	11/18/99	
492	7/20/99	Cc	EK	9/15/99	11/18/99	Yolk for specimen
494	7/21/99	Cc	LH	9/12/99	11/18/99	
495	7/22/99	Cc	EK	9/15/99	11/18/99	
502	7/24/99	Cc	EK	9/14/99	11/16/99	Yolk for specimen
511	7/25/99	Cc	LH	9/18/99	11/16/99	Yolk for specimen
513	7/25/99	Cm	LH	9/19/99	11/16/99	
516	7/27/99	Cc	LH	9/29/99	11/16/99	Yolk for specimen
518	7/27/99	Cc	BK	9/23/99	11/16/99	Yolk for specimen
519	7/28/99	Cc	LH	washout	11/16/99	
520	7/30/99	Cc	EK	9/26/99	11/16/99	
521	7/30/99	Cc	EK	N/A	11/16/99	
524	7/31/99	Cc	EK	9/22/99	11/16/99	Yolk for specimen
525	7/31/99	Cc	LH	9/26/99	11/16/99	
528	8/1/99	Cc	EK	washout	11/16/99	
531	8/3/99	Cc	EK	10/2/99	11/16/99	
533	8/4/99	Cc	LH	N/A	11/16/99	Yolk for specimen
534	8/4/99	Cm	LH	9/29/99	11/16/99	

APPENDIX I (Continued)

1999 Sea Turtle Tissue Samples Supplied to the University of Florida from Dry Tortugas National Park.

Nest No.	Nest Date	Species	Island	Excavation Date	Biopsy Date	Comments
536	8/6/99	Cc	LH	10/9/99	11/16/99	
540	8/12/99	Cc	LH	10/5/99	11/16/99	
544	8/15/99	Cm	LH	10/5/99	11/16/99	
545	8/15/99	Cc	LH	10/8/99	11/16/99	