

Dry Tortugas National Park Sea Turtle Monitoring Program

Prepared by:
Kate L. Mansfield
Russell Reardon

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SECTION 1.

INTRODUCTION

1.1 FLORIDA'S SEA TURTLES

Seven recognized species of sea turtles can be found within the subtropical and tropical waters of the world's oceans. Five species are known to spend time within Florida's state waters. These species include loggerheads (*Caretta caretta*), Kemp's ridleys (*Lepidochelys kempii*), greens (*Chelonia mydas*), hawksbills (*Eretmochelys imbricata*) and leatherbacks (*Dermochelys coriacea*). Of these, the loggerhead turtle is the most common. Female loggerheads are the only species of turtle that prefer nesting on beaches found within temperate regions, including the east and west coasts of Florida. Florida hosts the greatest loggerhead population in the northern hemisphere, the second largest population in the world. It is estimated that 90% of the loggerhead population nesting in the northern hemisphere nest on Florida's shores. Occasional nests by greens, hawksbills and leatherbacks may also be found along Florida's coast. These species, however, prefer nesting within the more tropical regions of the Caribbean and Gulf of Mexico, only passing through Florida's waters en route to more southern climates. For a key to the identification of these turtles, please refer to Section 3.

Loggerhead females have been observed to nest along the entire Florida coast. The mating season begins just off shore during mid to late April. The females will start coming ashore to nest beginning in May, continuing through August. As indicated by US Fish and Wildlife officials and the Florida Department of Environmental Protection (FDEP), peak nesting historically occurs during the months of June and July. Loggerhead sea turtles may lay between 75 and 150 eggs per clutch. Females can also nest multiple times within a season, averaging two to three nests per season.¹ Females may also return to nest on a cycle of every two to three years.² After an incubation period of 45 to 70 days, hatchlings will emerge from the nests and make their way down the beach to the ocean. The hatching season typically begins mid-July and may extend as late as mid-October.

During both the nesting and hatching seasons, many state, federal and private agencies perform nighttime and/or daytime beach patrols designed to collect data on the habits and activity of nesting sea turtles and their hatchlings along the Florida coast. This manual focuses specifically on the monitoring efforts of the National Park Service within the boundaries of Dry Tortugas National Park. The protocols for these efforts are based on the Marine Turtle Conservation Guidelines established by the Florida Department of Environmental Protection. Please refer to Section 4 for a copy of these guidelines.

1.2 SEA TURTLE NESTING BEHAVIOR

All sea turtles share similar behavior during nesting. However, the turtles found nesting within south Florida also have distinct characteristics that can be used to identify what species of

turtle nested on the beach. Typically, this can be accomplished through the examination of the tracks or the nest site left by the turtle. Becoming familiar with the "trademarks" of each turtle enables beach monitors to more accurately identify what species of turtle was present and whether or not the turtle laid eggs. The following is a step by step behavioral process that nesting sea turtles typically follow.

THE CRAWL: Generally, sea turtles will swim towards shore during the late afternoon or early evening just prior to sunset. At some point after nightfall, the nesting turtles will emerge from the ocean and crawl up the beach to a suitable nest site. It is possible to identify the species of turtle that emerged by the tracks left in the sand. Key crawl characteristics include:

- **Alternating** or **Simultaneous** right and left flipper marks
- **Presence** or **Absence** of tail marks down the center of the tracks
- Relative **Width** of tracks indicating the size of the turtle

Loggerhead tracks are smaller on average than green and leatherback tracks, averaging approximately 1.0 meters in width. Hawksbill tracks are also smaller than green and leatherback tracks, ranging between 0.50 to 0.80 meters in width. Both loggerheads and hawksbills exhibit **alternating** right and left flipper marks and no tail marks. Green turtles and leatherbacks exhibit **simultaneous** right and left flipper marks and the **presence** of tail marks down the center of their tracks.³ Green tracks are generally wider than loggerhead tracks and may range between 1.0 to 1.5 meters in width. Leatherbacks, the largest species of sea turtle, produce tracks that are easily distinguished by their size alone.

Tracks will also indicate the **direction** in which the turtle was traveling. Examining where the turtle pushed the sand back in an effort to move herself forward will aid in determining the direction the turtle was traveling. Determining the direction the turtle was moving helps to identify where she may have nested. With old tracks, or tracks that have been rained on, direction may be difficult to determine.

THE BODY PIT: Once a nesting site has been chosen, the female will prepare the nest site by clearing the sand or brush away with all four flippers. A body pit is then excavated by digging into the sand with the flippers and rotating the body around. Loggerhead turtles have relatively shallow body pits, if one can be found at all. One may commonly find a loggerhead body pit composed of only two, long, narrow hills of sand on either side of the turtle's tracks moving towards her nest site. Green turtles, however, have a characteristically large and deep body pit. Greens may leave a body pit that is one to two meters in diameter and up to 0.5 meters deep.⁴

THE EGG CHAMBER: Upon completing the body pit, the turtle begins excavating an egg cavity with her rear flippers. Using the rear flippers as shovels, the turtle will scoop out sand from the egg chamber, alternating flippers as she digs. Sand which is scooped out of the cavity is spread to the side of the hole. The depth of the egg chamber is determined by the length of the rear flippers.⁵ If a turtle is missing a large portion of one or both rear flippers, the chamber may be relatively shallow. The excavated shape of most egg chambers resembles an inverted light bulb (Figure 1).

Figure 1. The four part nest excavation cycle utilized by nesting loggerheads. Diagram adapted from D. Margaritoulis illustration in "The Loggerhead Turtle in the Eastern Gulf of Mexico" by Charles LeBuff, 1990.

LAYING THE EGGS: When the egg chamber has been completed, the turtle will then begin to deposit her eggs. Once a turtle has begun to lay her eggs, she becomes almost oblivious to any disturbance around her. Loggerhead turtles spread their rear flippers beside their nest during deposition. Once egg laying has commenced, loggerheads may be observed to slightly curl their rear flippers as eggs are deposited. This action is an indicator that the turtle has begun to lay her eggs and can be approached by researchers without disturbing her. Unlike the loggerhead, greens and leatherbacks extend their rear flippers behind them during egg deposition.⁶ While laying, the turtle may deposit a couple of eggs at a time as she fills her egg chamber. With shallow egg chambers some eggs may spill out on either side of the chamber. These eggs may be crushed by the turtle as she begins to cover the egg chamber with sand after deposition (Figure 2).

Average clutch size varies with each species. In Florida, according to Charles LeBuff of the Caretta Research Incorporated on Sanibel Island, Florida, the average loggerhead clutch is 120 eggs. Greens are known to lay between 80 and 220 eggs, hawksbills between 50 and 250 eggs and leatherbacks between 50 and 170 egg.⁷

COVERING THE EGGS: Once the turtle has deposited her eggs she will begin to cover the egg-filled chamber with sand, shoveling it and packing it down with her rear flippers. Some species slap or knead the sand, using the weight of their bodies to pack down the area.

NEST OBLITERATION: When a turtle has finished covering and packing the sand on top of her eggs, she will begin to swipe sand with her front flippers, flinging it back over the nest site. A turtle will **only** do this if she has laid her eggs.⁸ The resulting nest site will have a characteristic mound of sand over part of the turtle's tracks and nest site, as well as an escarpment where the turtle used her front flippers to scrape away the sand in order to fling it back over her nest. Leatherback and green turtles both leave characteristically large and widely flung mounds of sand. Once a turtle has covered her nest site she will crawl back to the ocean, leaving tracks as she exits the beach.

FALSE CRAWLS VS. NESTS: At times, a turtle may emerge from the ocean and not lay eggs. This event, characterized by an abandoned nesting attempt, is called a **False Crawl**. A false crawl occurs for a number of reasons, some of which include:

- She is disturbed by lights, noise or other unusual activities
- She encounters an obstacle while crawling up the beach
- She encounters roots, debris or rocks while digging
- The sand does not have the right consistency or moisture

A turtle may false crawl at any point during emergence due to the aforementioned reasons, up to the point where she begins to lay. A turtle may even complete her egg chamber and for some reason not deposit her eggs. The key factor that indicates whether the turtle laid her eggs or not is the **presence**

or **absence** of a mound of sand and the escarpment created when the turtle flung sand back over her nest site. A turtle **will not** obliterate her nest site if she has not deposited eggs.

1.3 HATCHLING BEHAVIOR

Depending upon the species, the time between egg deposition and hatchling emergence will range anywhere from 45 to 70 days.⁹ Within the first 12 hours after deposition, the vitelline membrane, the cell wall of the egg that plays an important role in gas exchange through the egg wall, attaches to the interior of the egg shell.¹⁰ If the egg's orientation is changed after this attachment forms, the membrane will detach from the egg wall, and embryonic development will cease.¹¹ Great care must be taken by surveyors if eggs are moved or relocated for any reason six to twelve hours after a turtle nested.

NEST EMERGENCE: Incubation time, or the time it takes for the eggs to fully develop into a hatchling, varies with each species as well as with surface temperatures. During the summer months, if the surface temperatures are unseasonably warm for a period of days, incubation time may be less than if temperatures are unseasonably cool. After incubating beneath the surface of the sand for approximately two months, the young turtles will begin to hatch out of their shells. Hatchlings may remain within the egg chamber several days after hatching. Hatchlings found in the process of breaking out of their shell are called **pipped**. The movement of fully hatched and pipped turtles while in the egg chamber serves to loosen the sand, allowing it to trickle down to the bottom of the nest. This process acts as an elevator for the hatchlings in that the sand filtering down to the bottom of the nest raises the hatchlings closer to the surface.

Emergence occurs primarily at night. "Beach surface soil temperatures ... and solar radiation [are] the key factor[s] in the timing of emergence by hatchling sea turtles. ... Once the upper beach soil cools after darkness or rainfall, the hatchlings erupt at the surface" en masse and proceed to crawl down the beach to the water.¹² Hatchlings orient themselves to light reflected off the water and the beach --- away from the darker vegetated areas typically found shoreward along the beach.¹³ Over a hundred hatchlings may emerge at once from a nest.

FRENZY: From the time of nest emergence up to 25 hours after entering the ocean, hatchlings remain in a state often referred to as a "frenzy." During this period, hatchlings remain swimming almost constantly, and it has been suggested that this behavior may serve to "get the hatchlings into deeper water and away from predators."¹⁴ Very little is known about sea turtles from the point that hatchlings enter the ocean until at least 20 years later when the females become sexually mature and come ashore again to nest. This lack of information makes sea turtle management and conservation extremely difficult.

1.4 LOCAL THREATS

The change in numbers of observed nests and nesting females recorded season to season is one of the best indicators of population changes and trends among sea turtles. Based on observed

trends, loggerhead populations on the east coast of the United States are in decline.¹⁵ Sea turtle mortality may be due to a number of factors, both natural and anthropogenic.

It has been estimated that within a clutch of 100 eggs, 85 will produce hatchlings, of which only two percent may survive to sexual maturity.¹⁶ The most prevalent cause of natural mortality for sea turtle eggs and hatchlings along the Florida coast is predation by crabs, such as ghost crabs (*Ocypode quadrata*), carnivorous mammals such as raccoons (*Procyon lotor*), fire ants (*Solenopsis spp.*), shore birds and carnivorous fish. Predation by ghost crabs and gulls (*Larus spp.*) is the most common predatory activity observed within Dry Tortugas National Park (DRTO). Indications of ghost crab predation include a ghost crab burrow in the vicinity of the nest site, broken shells near the entrance to the burrow, and broken shells within the clutch cavity prior to emergence. The crabs will attack hatchlings prior to emergence by burrowing into the nest cavity, as well as attacking those hatchlings that have already emerged from the nest. This type of predation is usually identified by the presence of decapitated hatchlings or hatchlings missing various limbs. Fire ant predation is also a potential threat within the Park. Fire ants will invade a nest just prior to and during hatching. The ants attack the mucus membranes of hatchlings, often killing the hatchlings in the process. Upon inventorying a nest where the hatchlings have been depredated by fire ants, surveyors will usually find fire ants within the nest cavity, as well as hatchlings (dead or alive) without eyes.

Shoreline erosion, severe tidal fluctuations and the effects of severe weather systems decrease the availability of prime nesting habitat. The prevalence of exotic vegetation and shoreline debris also serves to decrease the availability of the limited nesting habitat within DRTO. As a result, nesting females may be forced to abort nesting attempts or to deposit eggs in areas that may experience regular tidal wash or loss of beach. Tidal wash may result in the exposure of the egg chamber to the elements or regular saturation of the nest. Nests laid within such regions rarely produce many hatchlings as the environmental factors are unsuitable for successful development of the embryos. Beach erosion resulting from severe weather or development may also serve to drown nests that had initially been laid in safe areas. Extensive salt or fresh water inundation will kill developing embryos.¹⁷

Hatchlings orient themselves towards the ocean through various cues from the environment. One such cue is visual orientation towards light reflecting from the ocean, as well as the lighter sand of the beach versus the dark shadows created by shoreline vegetation. Should vegetation obscure the view of the water and beach from emerging hatchlings, the hatchlings may become disoriented and crawl into the vegetation rather than towards the water. This occurrence is characterized by hatchling tracks heading away from the ocean or open beach. Hatchlings may also become attracted to lights from docks and anchored boats.

When nests are laid in densely vegetated areas, not only are the hatchlings at risk of becoming ensnared in loose vegetation upon emergence, but they are also at risk of becoming entrapped within any roots that may have invaded the nest cavity. Prevented from emerging, the hatchlings may become dehydrated and die unless they are found within a few days after hatching.

Eggs, hatchlings and adult sea turtles are susceptible to mortality resulting from various human activities. Anthropogenic causes of sea turtle mortality range from coastal development and land use that may degrade or erode nesting habitat to artificial beachfront lighting that serves to disorient hatchlings, preventing them from reaching the ocean after emergence. Death may also

result from being hit by boats, the ingestion of (or entanglement in) solid waste dumped into the waters, and from entanglement in fishing nets and lines.

Among "juveniles, subadults and breeders in coastal waters, the most important human-associated source of mortality is incidental capture in shrimp trawls, which accounts for more deaths than all other human activities combined."¹⁸ Off the South Carolina, Georgia and northern Florida coasts, it has been estimated that the shrimping industry has been responsible for tens of thousands of dead loggerhead turtles each year from entanglement in shrimp trawls.¹⁹

1.5 SEA TURTLE CONSERVATION: FEDERAL MEASURES

Each of the five species of sea turtles found within Florida's state waters is protected under the Endangered Species Act (ESA) of 1973. As early as 1970, the Kemp's ridley, hawksbill and leatherback sea turtles were listed as endangered by the US Fish and Wildlife Service and later protected under the ESA.²⁰ By July 1978, both the loggerhead and green turtle species were listed as threatened species within US waters, with the Florida and Pacific green turtle populations listed as endangered.

The primary goals of the ESA are to provide the means by which both individual species and the habitats or ecosystems upon which these species are dependent may be conserved. Under the ESA, it is unlawful to harm, harass, take, trade or import live or dead endangered and threatened sea turtle species within the US and its territorial seas. Further, the ESA provides additional protection to endangered and threatened species populations through the designation of "critical habitats." Under the act, a critical habitat is defined as:

- (i) the specific areas within the geographical area occupied by the species...on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species upon a determination by the Secretary [of Interior or Commerce] that such areas are essential for the conservation of the species.²¹

Only the hawksbill and leatherback turtles have critical habitat designation under the act. The ESA also provides "for the acquisition and/or protection of turtle nesting habitat, [the] establishment of marine sanctuaries for turtle protection and [the] funding of sea turtle research and protection through grant-in-aid to states."²² Federally, the US Fish and Wildlife Service has jurisdiction over sea turtles while they are on land (this includes nesting females, eggs and hatchlings), and the National Marine Fisheries Service has jurisdiction over the turtles within US waters.²³

As mandated by amendments made to the Endangered Species Act in 1988, another principal goal of the ESA is to provide a scientific basis for the protection of the five endangered and threatened species of sea turtle through the study of the biology and behavior of these animals. It is important to note that the ESA and the 1988 Amendments specifying that scientific information be considered do not address the analysis of social, economic, political and cultural issues related to and affecting sea turtle conservation in the United States.

1.6 SEA TURTLE CONSERVATION: LOCAL MEASURES

As early as 1907, Florida enacted legislation providing for the protection of green and loggerhead turtles within coastal waters or on coastal beaches during the months of May through August. In 1953 additional legislation was enacted providing protection to sea turtle nests and eggs. "By 1963, this protection was extended to other sea turtles while such turtle is on the beaches of Florida or within one half mile seaward from the beaches during the summer months."²⁴ In effect, this protection created a closed season for turtle harvesting.

Today, Florida provides protection to sea turtles under the Marine Turtle Protection Act. This act supports the prohibitions outlined within the ESA and designates that any turtle accidentally caught during normal fishing activities must immediately be returned to the water alive, and that if in possession of any specimen, a special permit issued by the Division of Marine Resources must be in hand.²⁵ In 1971, the state established the Coastal Construction Control Line in an effort to slow the imminent degradation of many beaches within the state due to development. Shoreward of this line, the removal of beach soil or alterations to dunes and beach vegetation is strictly prohibited.²⁶ This legislation, in turn, serves to protect the nesting habitat of sea turtles on state shores.

Numerous turtle monitoring programs have been established throughout the coastal regions of Florida. These programs vary in sponsorship from the federal, state, and local levels to private organizations. The Florida Department of Environmental Protection, in cooperation with the US Fish and Wildlife Service and National Marine Fisheries Service, administers all turtle programs within the state of Florida, including the issuance of permits and the collection of sea turtle stranding information for the state. Many local coastal communities have also adopted city ordinances restricting the use of beachfront lighting during nesting and hatching seasons in an effort to reduce disorientation of emerging hatchlings.

SECTION 2.

DRTO: SEA TURTLE MONITORING

2.1 DRY TORTUGAS NATIONAL PARK

Located at 24°38' N latitude, and 82°52' W longitude, the Dry Tortugas is composed of seven islands situated approximately seventy nautical miles west of Key West (Figure 3). These keys include: Garden Key, Loggerhead Key, East Key, Bush Key, Hospital Key, Long Key and Middle Key (Figure 4). First named "Las Tortugas" by Ponce de Leon in June 1513, the Dry Tortugas is known for its historic abundance of sea turtles within adjacent waters. The name "Las Tortugas" was later changed to the Dry Tortugas in order to warn mariners of the lack of fresh water on the islands.

Many references have been made by mariners, soldiers and prisoners to the abundance of green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles found within the Dry Tortugas. These turtles have provided food for mariners in this region for hundreds of years. It is documented that Ponce De Leon harvested 170 green turtles from these waters, provisioning his boats to feed his crew.²⁷ 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. 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 in order to supplement their diet. A "turtle corral" was constructed in the fort's moat to keep turtles fresh for slaughter by the garrison commissary,²⁸ and eggs were collected from nests on Loggerhead Key where cooks used them in puddings.²⁹

Figure 3. The Location of the Dry Tortugas in Reference to the Florida Keys and Mainland Florida (adapted from NOAA, 1995).

Figure 4. The Islands Within Dry Tortugas National Park, Dry Tortugas, Florida (adapted from Boykin, 1995).

Records in the National Archives indicate that between the years of 1858 and 1859 over 39,588 pounds of turtle meat was consumed by soldiers stationed at Fort Jefferson.³⁰ 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 within shrimp trawls. This is currently one of the primary causes of sea turtle mortality within the United States.³¹

In 1908, the islands composing the Dry Tortugas became the Dry Tortugas Keys Reservation, establishing them as a bird preserve, protecting many of the migratory and pelagic birds that utilize the Dry Tortugas for nesting or as a rest stop along their migratory routes. 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 the Interior. With the establishment of Fort Jefferson as a National Monument, sea turtles and their nests also became protected within monument boundaries. Robert Budlong, one of the first Monument Superintendents/Custodians stationed at the fort, referenced the 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 of nest protection was minimal however, due to a lack of resources. Budlong estimated that very few turtle nests went unmolested.³² In 1992, Fort Jefferson National Monument became Dry Tortugas National Park encompassing over 100 square miles of ocean, including approximately 85 acres of land divided among the seven islands.

2.2 PHYSICAL AND VEGETATIVE FEATURES OF THE DRY TORTUGAS

The islands of the Dry Tortugas 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.³³ Situated within three large reef formations, the islands are arranged in "a loose ring around an elliptical lagoon,"³⁴ accessed by three channels up to 80 feet in depth (Figure 5). 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.³⁵ The islands are topographically very dynamic, changing shape and size on a seasonal basis. With the exception of Garden and Loggerhead Keys, the islands have an elevation of less than 4 feet above mean high tide.³⁶ The sediments forming these islands and their beaches are very susceptible to spring high tides, storm surges, changes in winds and currents, and heavy wave action. The total beach length within the Dry Tortugas varies between three and four miles.

Figure 5. The Location of the Channels and Shoals within Dry Tortugas National Park, Dry Tortugas, Florida (adapted from NOAA 11438, 1980).

Over 200 species of terrestrial plants have been recorded in the Dry Tortugas, approximately 25% of which 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*).³⁷ In 1910, Australian pines, *Casuarina equisetifolia*, were introduced to Loggerhead Key, quickly spreading throughout the island by the 1940's and becoming the dominant vegetation on the Key by the 1990's. Other exotic species inhabiting Garden and Loggerhead Keys include: sisal (*Agave spp.*), and Pacific beachberry (*Scaevola taccada*). The following is a description of the physiography of each key adapted from Davis, 1942 and Boykin, 1995:

East Key: Ranging in size from nine to twelve acres, East Key is dominated by sea lavender, native beach-berry, bay cedar (*Suriana maritima*), sea oats, dune elder, sandbur (*Cenchrus spp.*), sea purslane (*Sesuvium portulacastrum*), and railroad vine (*Ipomea pes-caprae*). East Key fluctuates in size and shape seasonally but has maintained a dune plateau of approximately one meter in elevation.

Loggerhead Key: Approximately 30 acres in size, Loggerhead Key is the largest and highest island (approximately 1.25 to 1.75 meters elevation) in the Dry Tortugas. Beach rock flanks the east central and western shores and is exposed at low tide. The island is overtaken by exotic Australian pines, with prickly pear cactus (*Opuntia stricta*), spider lily (*Hymenocallis latifolia*), Spanish bayonet (*Yucca aloifolia*), and sisal growing in the understory of these trees. 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: Sixteen acres in size, Fort Jefferson is situated on all but five acres of Garden Key. Beaches extend from the northeast shore east and south towards the southwest shore, and are punctuated by human made structures. 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. It is estimated that Hospital Key has an elevation of one half meter (two feet), 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 in size, Bush Key is host to such native plant species 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 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 one meter in elevation. A red mangrove stand occupies the southwest region of the island.

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

2.3 PREVIOUS TURTLE RESEARCH

Since the early 1980's, National Park Service biologists have been monitoring the sea turtle nesting activity within Park boundaries. The 1995 and 1996 nesting seasons marked the first two years that Park personnel have performed daytime nesting surveys on each island throughout the entire nesting season. Prior to 1995, research and monitoring of turtle activity occurred from 1980 through 1985 and from 1990 to present. 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 only five days of surveys to three months of monitoring, including crawl documentation and some nest inventories.

Between 1980 and 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, targeting their efforts to the historic regional peak of the nesting season: June and July. A total of 44 loggerhead and two green turtles were tagged. Dawson suggested a conservative nesting population estimate to be 40 loggerheads and two greens utilizing East Key for nesting.

Beginning in 1990, Student Conservation Association and AmeriCorps personnel, as well as Park Volunteers, refined the monitoring techniques and increased the frequency of field sampling in a process that has produced a long term, comprehensive sea turtle monitoring program for Dry Tortugas National Park. **The Dry Tortugas Sea Turtle Monitoring Program serves four primary functions: 1) to establish and maintain a baseline inventory and monitoring program for turtle nesting and hatching activities within the park; 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 the turtles, their nests and hatchlings, devising means to mitigate these threats.**

Both loggerhead and green turtles have been observed to nest within Park boundaries. Loggerheads are by far the most common with over 1,071 crawls (including both false crawls and nests) recorded by the Dry Tortugas monitoring program through 1996, compared to 130 green

turtle crawls. Sub-adult and juvenile hawksbill turtles (*Eretmochelys imbricata*) are frequently spotted on the reefs, grassbeds and even in the harbors and fort moat within the park; however, adult hawksbills are very rarely observed. There have been reports from regional fishermen and seaplane pilots of both leatherbacks (*Dermochelys coriacea*) and Kemp's ridleys (*Lepidochelys kempii*) traveling through Gulf waters in and around the park boundary.

2.4 BEACH INDEXING

Prior to the start of the nesting seasons, the shorelines of East and Loggerhead Keys will be measured off in 30 meter intervals using a 30 meter transect tape. These intervals are measured from starting points established during the 1995 nesting season and measurements are recorded in meters, as opposed to the 100 foot intervals used in 1995. These intervals are established for the purpose of mapping each instance of turtle activity recorded on the islands. Each 30 meter interval is marked with a numbered PVC pipe driven into the ground one to three meters landward of the vegetation line. On Loggerhead Key, these reference markers range from numbers 1 to 40 on the western shore, and 41 to 79 on the eastern shore, delineating approximately 2,370 meters of beach. On East Key, the markers range from 1 to 9 on the eastern shore and 9 to 15 on the western shore, marking off approximately 450 meters of beach.

Each of the 30 meter intervals on East Key is grouped into 60 meter sectors, with each sector ascribed a letter for the purpose of statistical analyses at the end of the season. On Loggerhead Key, the 30 meter intervals are grouped into 90 meter sectors, again with each sector ascribed a letter for the purpose of statistical analysis. Currently, seven such sectors are established on East Key, ranging from sector A located between index markers 14 and 2, including the south tip of the island, to sector G between index markers 12 and 14 (Figure 6). Loggerhead Key has 26 established sectors ranging from sector A between index markers 1 through 4, continuing around the island in 90 meter intervals to sector Z between index markers 76 and 1, including the entire south tip (Figure 7).

Figure 6. The Location of Beach Index Markers and Sectors on East Key, Dry Tortugas National Park (October 10, 1996).

Figure 7. The Location of Beach Index Markers and Sectors on Loggerhead Key, Dry Tortugas National Park, Dry Tortugas, Florida.

Towards the end of the 1996 season, bearings were taken between reference markers using a hand held compass. The distance from each marker to the high tide line was measured in meters, perpendicular to the vegetation line, using a 30 meter transect tape. These bearings and measurements are used to facilitate the placement and/or replacement of stakes for future nesting seasons, thereby ensuring continuity of data collection between seasons.

Bush, Garden, Hospital, Middle and Long Keys were not indexed due to the small size of their beaches, the historic lack of turtle activity occurring on the islands, and the extensive tidal influence on the beach profiles of Middle and Hospital Keys. Total beach length within the Dry Tortugas is estimated between three to four miles (range due to seasonal variation).

Time required to map off beaches: All day (7:00 a.m. until approximately 3:00 p.m.)

Personnel needed: 1-2

Equipment needed:

- A boat to access beaches
- Mallet
- 94 PVC pipes (3/4", cut to 3 foot lengths)
- Permanent marker
- 30 meter transect tape
- Hand held bearing compass
- List of bearings taken between markers in 1996
- VHF Radio
- Hat, sunscreen, plenty of water

2.5 NEST SURVEYS

The beaches of East, Loggerhead, Garden, Hospital, Middle and Bush Keys are patrolled daily for nesting activity, weather and seas permitting, beginning in mid-April and continuing throughout the entire season until the last nests on each island have hatched (usually late-October). East, Loggerhead and Garden Keys are surveyed on foot, with researchers walking each beach in its entirety. Hospital Key is surveyed by boat in order to ensure that the nesting masked boobies (*Sula dactylatra*) are not disturbed. Landfall is not made on Hospital Key unless crawl activity is observed. Middle Key is surveyed by boat unless the island is completely awash. Bush Key is surveyed by power boat and kayak until the end of July so as not to disturb the nesting sooty terns (*Sterna fuscata*), brown noddies (*Anous stolidus*), and brown pelicans (*Pelicanus occidentalis*). Landfall is not made on Bush Key unless crawl activity is observed. Beginning in August, in addition to boat patrols, Bush Key is walked in its entirety at least once per week. Long Key is surveyed when Bush Key is patrolled by kayak or on foot--a frequency ranging from daily surveys to once every two weeks. Care must be taken not to disturb the nesting magnificent frigatebirds (*Fregata magnificens*) when accessing Long Key.

Patrols begin early in the morning (0600 to 0700 hours) and continue until late afternoon. Every instance of turtle activity occurring on the islands the previous night is recorded on a standardized data sheet (Section 2.6). Indications of turtle activity include the presence of turtle tracks along the beach and/or heavily disturbed areas suggesting that nesting, or a nesting attempt, occurred. Each crawl is carefully evaluated to determine whether nesting occurred. Criteria for the positive identification of a nest include the presence of a sand escarpment created by the front flippers of the turtle while obliterating her nest site, as well as a mound of sand flung back over the potential nest site and her emerging tracks.³⁸ Crawls meeting these criteria are recorded as nests, while crawls lacking these characteristics are identified as false crawls.

All crawls are assigned a number representing the chronological order in which they are observed (crawl number represents both nests and false crawls). Each nest site is marked with a wooden stake on which the crawl number is recorded. Stakes are placed just landward of the estimated location of the clutch. All nests are left *in situ*. In cases where the crawl cannot be positively identified as a nest, but the possibility of nesting cannot be ruled out, the crawl is recorded as "undetermined" on the data sheets, and the site is staked as a potential nest. On Garden Key, due to heavy visitor use of the nesting beaches, all nests are marked off with four stakes and surveyor tape. The stakes are placed around the nest site and connected with the flagging tape, centering the estimated location of the clutch within the staked area. A Florida Department of Environmental Protection (FDEP) sea turtle nest sign is then stapled to one of the stakes marking each nest site on Garden Key.

Measurements of distance and direction from the nearest two beach index markers to each nest or false crawl are recorded. These measurements are made using a 30 meter transect tape and hand held bearing compass. Nest bearing and distance are recorded **FROM** the nearest two beach index markers **TO** the location of the stake marking the clutch. Likewise, false crawl bearings are taken **FROM** the markers **TO** either the last body pit of the crawl (if the turtle attempted to nest) or to the peak of the crawl if no digging is observed. On beaches lacking index markers, bearings and distances are recorded in reference to permanent structures or other points of reference located along the beach. These structures might include walls, signs, docks, etc.

The location of all crawls is also measured in reference to the spring high tide line indicated by the line of weed wrack washed on the beaches. Nests are measured from the stakes marking the clutch to the high tide line, and false crawls are measured either from the last body pit or peak of the crawl to the high tide line.

The condition of each nest and its wooden stake is monitored periodically throughout the incubation period. Any signs of predation, tidal wash or erosion are recorded on the standardized nesting data sheets. Where possible, the number of eggs depredated is recorded, as well as any instances where ghost crabs (*Ocypode quadrata*) have invaded the nest site. In cases where fire ants (*Solenopsis spp.*) have invaded nest cavities, AMDRO[®] is sprinkled around the site in accordance with FDEP regulations (see Section 4). All data is transferred to a computerized database (Excel 5.0) located at Fort Jefferson.

Time required to survey beaches: All day (7:00 a.m. until approximately 4:00 p.m.)

Personnel needed:

1

Equipment needed:

A boat to access beaches
Survey data sheets, pens
Wooden stakes
Permanent marker
30 meter transect tape
Hand held bearing compass
Backpack
VHF radio
Hat, sunscreen, plenty of water

2.6 DATA COLLECTION: NEST SURVEYS

Data sheets will be filled out for every instance of observed turtle activity on the survey beaches. Relevant information such as the survey date, name of the observer, beach name, type of crawl (i.e. nest or false crawl), and any signs of predation should be recorded. Please refer to Figures 8 and 9 for sample data sheets.

Crawl# or Nest#: As described earlier, all nest sites will be marked with wooden stakes indicating the numerical crawl number -- determined by the chronological order in which each crawl is found. This chronological order includes both nests and false crawls and does not differentiate between islands. This reference number is designated the "crawl number," but more specifically referred to as either the **Nest #** or **Crawl #**, depending upon the particular crawl type. For example, Crawl # 23 may reference a false crawl found on East Key, while Nest # 24 may reference a nest found on Loggerhead Key later that same day.

Paces/100m: Prior to the season, each surveyor will record how many of their paces it takes to walk a distance of 100 meters. This number is determined by measuring a distance of 100 meters with a measuring tape (100 meter transect tape) and having each surveyor walk that distance, counting the number of steps it takes them to walk from 0 meters to 100 meters. Surveyors should walk the 100 meter distance at least three times, counting and recording their paces each time. Compute the average number of paces recorded for the trials. This averaged number is recorded on the data sheet under "Paces/100m." (Note: Pacing is not as accurate as measuring with a transect tape. In no circumstance should distances to a **NEST** be paced! Pacing, however, may be used as a convenient measure of distance to **FALSE CRAWLS** in which no attempt at nesting was made).

Predation: The level of predation may be determined by evidence found at the nest site. **Total** predation is indicated by a completely excavated egg chamber with no intact eggs left in the nest. **Partial** predation is indicated by the presence of one or more broken shells, predator tracks (crab or gull), and often a hole dug into the egg chamber. In cases of partial predation, the entire nest is not depredated, and there should still be some eggs left in the nest site.

CRAWL#: _____

DATE: _____

NEST#: _____

TIME: _____

DRY TORTUGAS NATIONAL PARK
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:

PREDATION (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:

Figure 8. Sample Data Sheet: Sea Turtle Nesting Survey, Dry Tortugas National Park

CRAWL#: _____

DATE: _____

NEST#: _____

TIME: _____

DRY TORTUGAS NATIONAL PARK
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:

PREDATION (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:

Figure 9. Completed Sample Data Sheet: Sea Turtle Nesting Survey, Dry Tortugas National Park

Number of Eggs Depredated: In cases where predation has occurred and broken egg shells are present at the nest site, collect all scattered eggs and all broken eggs from the nest cavity if the egg chamber has been exposed. Cover the remaining eggs within the egg chamber with sand, carefully packing it down. Count all broken shells that are approximately 50% of their original size and greater. Record that number as the number of eggs depredated.

Nearest Marker ("A"): The number on the PVC reference marker nearest to the nest/false crawl is designated and recorded as "A" for additional data recording.

Next Nearest Marker ("B"): The number on the PVC reference marker that is the second closest to the nest/false crawl is designated and recorded as "B" for additional data recording. It is prudent and necessary to record the two markers that the crawl activity occurred between in order to determine which **Beach Sector** was utilized. Further, bearings and distances from both "A" and "B" will enable surveyors to relocate -- by triangulation -- the position of a nest stake in the event that the stake is removed or knocked out of place.

Direction of Crawl From Marker: It is very important to record the direction in which the crawl is located **FROM** both markers "A" and "B" on the beach. This is accomplished by standing at the marker, facing the crawl on the beach, and recording the direction of the crawl **FROM** the marker utilizing a hand held bearing compass. (Refer back to Section 2.5)

Distance From Marker to Crawl: Measure the distance from both markers "A" and "B" to the crawl site using a 30 meter transect tape. In cases where the distance from the marker to a nest site is being recorded, measurements may be made directly to the stake marking the nest site. Distances to nests should **always** be made with a transect tape. False crawls may be carefully paced, making sure that the person pacing the distance changes the units of measure on the data sheet from meters to paces. (Refer back to Section 2.5)

Distance From High Tide Line: Walking from the high tide line (indicated by the line of wrack washed up along the shore) perpendicular to the shoreline, measure the distance from the high tide line to the crawl site utilizing a 30 meter transect tape. When measuring the distance to a nest, this measurement may be made from the stake marking the nest site. Should the distance be paced, the person pacing must record the units as paces rather than meters.

Crawl Width: The approximate width of the crawl (front-left flipper track to front-right flipper track) should be measured with a meter tape. Locate a straight-line section of the crawl for the least amount of distortion. It may be necessary to take the average of several measurements.

Crawl Diagram: This space is provided for surveyors to sketch a diagram of the crawl observed on the beach, including reference markers, landmarks, locations of nearby nests, and any unusual characteristics. Notes and remarks may also be recorded in this area. A detailed sketch of the nest site will aid in locating the egg chamber when conducting the Nest Inventory. (see Section 2.11)

In addition to the datasheets, all observations and cumulative activity observed with each survey must be recorded daily in a waterproof logbook located at Fort Jefferson.

2.7 DATA COLLECTION: TIDAL IMPACTS

When surveying beaches, each instance of tidal wash over a nest should be recorded on the standardized nest survey data sheets and project logbook. It is important to record the first day that a nest is observed to have been inundated by saltwater, as well as every instance following first inundation. Signs of beach erosion, exposure of the nest cavity, and loss of eggs due to erosion should be recorded. Special attention should be made to reference beach sectors where erosion or severe tidal fluctuations are occurring. In the event that data reflecting tide table levels is collected, the following equipment will be needed:

Equipment needed:

- 20, 1.5" PVC pipe (4 feet in length)
- Fine mesh screening
- 20 aluminum meter sticks (narrow enough to fit into PVC pipes) with a string attached to one end
- 40, 1.5" stoppers (for both ends of pipes)
- Finely grated cork bits
- Water table data sheets (to be developed)

Both ends of the PVC pipes should be capped. At the bottom of the pipes, a "window" should be cut on one side and covered with the fine mesh. This allows water to flow into the pipes without sand and debris clogging window. The PVC pipes should be driven one meter into the ground (mesh end down), at a distance of one meter from randomly selected nest sites (at the time of first observation of the nests), making sure to keep the interior of the pipe free from sand. Pipes may need to be driven deeper for green turtle nests. A layer of cork bits should be sprinkled into the pipe, and the meter stick placed inside -- string end up. The cork bits will float in any water collecting inside the pipe and will mark the meter stick at the level at which the water has risen. Water levels should be recorded daily from the day of installation through the day of nest excavation. Cork bits may need to be replaced periodically throughout the season. The depth of the nests (after emergence) and the depth of the pipes should be recorded.

The number of pipes set out may vary, as 20 is only a suggested number. It is, however, important to randomly select nests for this survey. Other variations of this methodology may include establishing a transect line along the beach of targeted islands with pipes placed along this line at specific intervals. For example, pipes could be placed beginning at the high tide line (at the beginning of the season) at the southern tip of East Key, continuing every few meters shoreward to the vegetation line. The water table should be examined over the course of the entire season on a daily basis.

For more information concerning the implementation of this methodology, please contact Dave Addison, Biologist at the Conservancy, Incorporated in Naples, Florida (941-263-0223).

2.8 DATA COLLECTION: *CASUARINA* IMPACTS

Exotic plant specialists from the South Florida Research Center at Everglades National Park have been actively attacking the Australian Pines (*Casuarina equisetifolia*) on Loggerhead Key since 1994, in order to restore the native vegetation community. These trees are chemically girdled with herbicide Garlon, applied around the base of each trunk, and left to die in place.

In order to target beach problem areas, data is collected over the course of the nesting season on the impacts these exotic trees -- live or dead -- have on the nesting activity on Loggerhead Key. Every instance where a turtle crawl is impacted by *Casuarina* is recorded on the survey data sheets specific to the impacted crawl. A crawl is considered impacted by *Casuarina* if a) the turtle altered her course due to *Casuarina*; b) she encountered roots while digging her egg chamber resulting in a false crawl; c) she nested within the roots of the trees; d) she became trapped within the roots or fallen branches; e) branches fell upon an established nest site; f) or if hatchlings altered their course to the ocean due to encountering the branches or roots of fallen *Casuarina*.

2.9 NEST RELOCATION

As of the 1997 season, the Dry Tortugas Sea Turtle Monitoring Program is not permitted to perform nest relocations. In the event that relocation becomes a permitted activity in the Dry Tortugas, care should be taken to understand and follow the relocation guidelines established by the FDEP in the Marine Turtle Conservation Guidelines (see Section 4).

Time required to relocate a nest:	1-2 hours (personnel transportation excluded)
Personnel:	1-2
Equipment needed:	Large crate (enough to hold 150 eggs) 30 m transect tape, hand held bearing compass Nest data sheet, pen Towel or covering to protect eggs from sun

The surrogate egg chamber should be dug in advance of nest relocation, approximating the depth and size of the original chamber. It is important when relocating a nest to record both the original and relocated positions of the nest in reference to the beach index markers or other points of reference along the beach. It is also important to reduce the amount of exposure the eggs experience during the relocation process. It is highly recommended that only one person handle the eggs throughout the entire process, and that the eggs be covered at all times. Extreme care should be taken to maintain the orientation of the eggs at all times, since movement alone can kill developing embryos by disrupting fragile membranes attached to the egg shell.

2.10 HATCHING SURVEYS

All nests and potential nest sites are monitored for hatchling emergence after a 45 day incubation period. Evidence of emergence includes a bowl-like depression in the sand covering the egg chamber and the presence of hatchlings and/or hatchling tracks. Nests will be excavated three days after the first signs of emergence or -- in the event that emergence is not detected -- after an incubation period of 70 days. Nest contents will be examined and recorded on standardized nest inventory data sheets (see section 2.11).

Excavations should be performed carefully and with **bare hands**. Shovels, probes and other tools will not be used. Should numerous live hatchlings be encountered, quickly cover the nest with sand and return the nest site to its original condition. Hatchlings may not emerge from a nest all at once; rather, they may emerge in waves, sometimes a day or two apart. If numerous hatchlings are encountered during a nest inventory, **do not** proceed with the evaluation until at least two days have passed. If only a few hatchlings are found trapped within the nest, remove them from the nest cavity and release (see section 2.11). After a nest evaluation is complete, the nest contents (with the exception of live hatchlings to be released) should be reburied within the original nest cavity.

The hatching survey schedule will vary greatly year to year based on the number of observed nests and the dates they were laid. Nest inventories begin when the first nest hatches (mid-June) and continue through the hatching of the last nest of the season (late October).

Time required to survey nests:	Varies depending on number of nests and their location
Personnel needed:	1-2
Equipment needed:	A boat to access beaches Nest Inventory data sheets Embryonic Development Survey data sheets Nest location from Nesting Survey data sheet Latex surgical gloves (optional)

2.11 DATA COLLECTION: NEST INVENTORIES

Relevant information such as the inventory date, name of the observer, nest number, check date (45 day incubation period), and emergence date should be recorded in the blanks provided on the Nest Inventory Data Sheet. Please refer to Figures 10 and 11 for sample data sheets. (Note: The data for boldfaced items listed as "A - D" and "H - L" are used to complete the Summary Sheets for the FDEP at the end of the season.)

NEST#: _____

Dry Tortugas National Park
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

PREDATION (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 ($100 \cdot A/L$): _____ % RELEASE RATE ($100 \cdot G/L$): _____ %

INCUBATION PERIOD: _____ DAYS

REMARKS:

Figure 10. Sample Data Sheet: Nest Inventories, Dry Tortugas National Park

NEST#: _____

Dry Tortugas National Park
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
PREDATION (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 ($100 \cdot A/L$): _____ % RELEASE RATE ($100 \cdot G/L$): _____ %
INCUBATION PERIOD: _____ DAYS
REMARKS:

Figure 11. Completed Sample Data Sheet: Nest Inventories, Dry Tortugas National Park

Total Eggshells (A): Collect all eggshells found within the egg chamber. Count all broken shells that are approximately 50% of their original size and greater. Record that number as the total number of eggshells within the nest. These shells represent an approximate number of eggs that successfully hatched.

Live/Dead Hatchlings (B,C,E,F) : Count and record all live and dead hatchlings found inside the nest (B and C, respectively) and outside the nest (E and F, respectively). Place any live hatchlings in a covered bucket partially filled with moist sand and transport them to a dark, temperature controlled location. These hatchlings must be released as soon as possible, preferably after sunset. It is suggested that hatchlings "imprint" upon the beach where they hatched and/or pick up important environmental cues necessary in orienting to the open ocean; therefore, the hatchlings from the bucket must be released on the beach and allowed to crawl to the water. Some hatchlings may be too weak and/or deformed to make it to the water by themselves, requiring some human assistance. Hatchlings may be released from any beach accessible to the surveyor.

Surveyors may encounter hatchlings with yolk sacks still attached to their plastron (the underside of their shell). In this case, the hatchlings should be placed in a covered bucket with moist sand and allowed to remain there until the yolk sack is absorbed by the hatchling (see also live pipped turtles). Hatchlings should be held no more than one to two days.

Total Hatchlings Emerged (D=A-B-C): This is the estimated number of hatchlings that have actually emerged from the nest. Subtract the number of hatchlings found within the nest (B & C) from the number of eggshells (A).

Total Hatchlings Assumed to Enter the Gulf (G) : From the total number of eggshells recorded (A), subtract the number of dead hatchlings (C+F) and add the number of live pipped to be released (H). This number ($G=A-C-F+H$) represents the approximate number of hatchlings assumed to have made it safely to the ocean. (Note: This is a more accurate representation of the number of hatchlings that made it to the water than is reported to the FDEP on the Summary Sheets. The FDEP only requests the number of hatchlings emerged, which does not account for dead hatchlings outside the nest nor live pipped eggs that eventually hatch.)

Live or Dead Pipped Eggs (H or I): Pipped eggs are eggs in which the turtle has started to break through the eggshell but is not completely hatched free of it. If a live pipped turtle is found, it should be placed in a bucket with moist sand and covered with a moist paper towel to allow hatching. Once fully hatched it may be released on a beach and allowed to crawl to the water. (Note: Pipped eggs are considered neither hatched nor unhatched eggs.)

Depredated Eggs (J): This is the cumulative number obtained from observations around the nest site throughout the incubation period. In cases where predation has occurred and broken shells are present at the nest site, collect all scattered eggs and any broken eggs from the nest cavity if the egg chamber has been exposed. Cover with sand the exposed eggs remaining within the egg chamber, carefully packing it down. Count all broken egg shells that are approximately 50% of their original size and greater. Record that number as the number of eggs depredated.

Unhatched Eggs in Nest (K): Count and record the number of eggs found within the nest that have not hatched. This **does not** include pipped eggs. Unhatched eggs should be set aside until the completion of the embryonic development survey (Section 2.12).

Total Eggs Evaluated in Nest ($L=A+H+I+J+K$): Add the total number of eggshells recorded (A) with the total number of eggs pipped (H+I), depredated (J), and unhatched (K). This number represents the approximate number of eggs laid in the nest.

Hatching Success ($100 \cdot A/L$): This is the estimated percentage of the clutch that hatched. Divide the number recorded as the total number of eggshells (A) by the total number of eggs evaluated (L), and multiply 100.

Release Rate ($100 \cdot G/L$): This is the estimated percentage of the clutch that theoretically made it to the ocean. Divide the number recorded as hatchlings assumed to have entered the Gulf (G) by the total number of eggs evaluated (L), and multiply by 100. (Note: This figure could actually be greater than hatching success because it takes into account live pipped hatchlings that the State of Florida does not recognize as being hatched eggs.)

Incubation Period: This is calculated by adding the number of days elapsing from the first day the nest is observed through the first day of observed emergence.

2.12 DATA COLLECTION: DEVELOPMENT SURVEYS

Embryonic development surveys are performed on all unhatched eggs found within each nest. At the time of excavation, each unhatched egg is opened and examined, and the percent of embryonic development that occurred within the egg is recorded on standardized data sheets (Figure 12 and 13).

The determination of percent embryonic development is based on criteria established by the Caretta Research Project (4405 Paulsen St., Savannah, Georgia 31405) using 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 pp.

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

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:		

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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:		

33

The degree of embryonic development is determined as follows:

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 25% the size of a normal hatchling.

25 to 50% Development: These embryos will be 25-50% 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 a little 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 still attached.

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

Also record in the spaces provided on the Embryonic Development Survey datasheet the numbers of pipped eggs, depredated eggs, and eggs that contain bacteria. Bacteria is characterized by the presence of pinkish to purple coloration within the egg.

2.13 STRANDINGS

Dry Tortugas National Park Sea Turtle Monitoring Program supports and participates in the Sea Turtle Stranding and Salvage Network (STSSN). The STSSN is jointly managed in Florida by the National Marine Fisheries Service (NMFS) and the Florida Department of Environmental Protection (FDEP). Participation in this program involves the collection of information on turtles, dead and alive, that are found within Park waters, or stranded on land, and includes the completion of a stranding report for each individual turtle encountered. During normal activities, all park personnel are expected to be on the look out for turtle strandings.

The location and condition of any stranded turtle found within park boundaries is recorded on standardized data sheets provided by the STSSN based in Miami, Florida. Curved carapace measurements will be taken with measuring tapes, and photos of the carcass should be taken. All

completed reports are forwarded to the Florida STSSN Coordinator with FDEP based in Tequesta, FL. The address is:

Florida STSSN Coordinator
Florida Department of Environmental Protection
Florida Marine Research Institute
19100 SE Federal Highway
Tequesta, Florida 33469

Fax: 561-743-6228 Tel: 561-575-5407

If abnormal behavior is observed in a live turtle, DRTO personnel are requested to stay on the scene and contact the NMFS and/or FDEP to determine what actions need to be taken. The FDEP is required to report all strandings on a weekly basis to the NMFS. In order to meet this requirement, DRTO is required to notify the FDEP each time a stranded turtle is documented, on the day that the turtle is observed.

Time required to survey stranding: Half hour to fill out form; varies depending on location of turtle

Personnel needed: 1-2 (varies depending on size of turtle)

Equipment needed: Stranding forms
Measuring tape
Camera/film
Turtle identification key
Flagging/spray paint/shovel

2.14 DATA COLLECTION: STRANDINGS

If a dead turtle is encountered within the park boundaries, all DRTO personnel are expected to fill out a stranding report and forward it to the Resource Management Division. Please refer to Figures 14 and 15 for sample stranding forms.

Name: Be sure to include a middle initial. State databases cross reference observers by their initials.

Address/Phone: Dry Tortugas National Park, PO Box 6208, Key West, Florida 33041;
305-293-0152

Figure 14. Sample Data Sheet: Stranding Report Form

Figure 15. Completed Sample Data Sheet: Stranding Report Form

Species: This may be determined by examining the turtle in reference to the species ID sheets provided in each boat. When in doubt, secure the carcass in a known location or bring it back to headquarters for identification by Resource Management personnel. Refer to the codes at the bottom right of the data sheet when filling out the species information.

Turtle Number By Day: This is turtle number by day for each observer. For example, if Ranger Roy found two turtles on the same day, they would be recorded as numbers one and two respectively. If, on the same day, Wayne and Paul hit a turtle on their way to boundary marker "O," they would record that turtle as number one, since it is the first turtle they observed that day.

Sex: This will most often be undetermined as immature sea turtles cannot be sexed externally. Only in **mature males**, will you be able to determine sex by tail length. The tail of a mature male turtle extends well beyond the end of the carapace (shell). If the tail of the stranded turtle extends well beyond the carapace, MEASURE THE TAIL. Record that measurement in the space provided for "How sex was determined."

Condition of Turtle: Put only one number in this space. A fresh carcass is one that "does not smell, that you'd consider eating." Fresh carcasses are of special interest to stranding researchers and should be reported to Resource Management as soon as possible.

Tag Number: Examine both the front and rear flippers for evidence of tags or tag scars. Tag scars may be characterized by holes in the flipper where a tag was once secured. Also examine the carapace for bolt-like tags that may have been placed on the turtle. If the carcass is not saved, remove tags from the turtle and send them to FDEP along with the completed stranding form and photographs. Be sure to look underneath tags as many have addresses on them. Record both the tag number and address on the stranding form.

Measurements: Only curved measurements may be taken with a flexible measuring tape. The curved length may be determined by measuring the distance from the center of the nuchal notch to the posterior marginal tip (refer to diagram in measurement box on stranding form and Figure 16). The measuring tape should be placed flat against the shell for accuracy of measurement. The curved width may be determined by laying the measuring tape flat against the carapace at the widest point and perpendicular to the longitudinal body axis (see Figure 16). Be sure to circle the appropriate units of measurement (inches/centimeters).

When making the curved width measurements be sure to stand **OVER** and **BEHIND** the turtle to ensure that accurate measurements are made and that the measuring tape is perpendicular to the longitudinal axis of the turtle. If a turtle has sustained severe damage to its shell, do not attempt measurements, making note on the stranding form that the shell was too damaged for accurate measurements. Straight length and width of the carapace is determined only with the use of special calipers. Unless calipers are available at the Fort, only curved length and width should be recorded.

Remarks: Use this space to note any flipper damage/bruising, carapace wounds, entanglement in fishing lines (if possible, retain a sample of any line/netting the turtle may have been entangled in), or

fibropapillomas (tumors). Be sure to examine inside the turtle's mouth as tumors or hooks and line may be present. On the turtle diagram provided, sketch in the location of propeller damage, tumors and other unusual observations.

Photographs: When at all possible, take photographs of the carcass and submit them with the stranding forms. This is especially important if the turtle is difficult to identify due to severe decomposition. Take pictures of the top of the turtle (standing over the turtle if possible) and the plastron, or underside of the turtle. Also take photos of any unusual scarring, damage, fishing lines/hooks or other abnormalities.

2.15 DATA ENTRY

All sea turtle data will be recorded on a database at Fort Jefferson. To date, the 1995 - 1997 stranding and nesting information is located on the Excel 5.0 application on the computer in the main office. A back-up copy is also kept on disk. Future projects for turtle data may include recording Global Positioning System coordinates for all turtle activity (nests, false crawls and aerial observations) in order to create a Geographic Information System database for turtle activity within park boundaries.

2.16 PERMITTING

Each season, it is required by state and federal agencies that any turtle monitoring project apply for and obtain a turtle monitoring permit. Marine Turtle Permit applications are normally due by the end of the year prior to the season covered by the permit. The Dry Tortugas permit application should include coverage for the following activities: nesting surveys (daily); hatching surveys/nest inventories; relocation of nests in danger; release of hatchlings trapped within emerged nests; and participation in stranding and salvaging activities. Another area that the Dry Tortugas may be interested in receiving permitted approval for is the acquisition of specimens for educational purposes. The state contacts for obtaining such permits are as follows:

Alan Foley, Research Associate
Specialist
Florida Marine Research Institute
FDEP
100 Eighth Ave SE
St. Petersburg, Florida 33701-5095

(813) 896-8626

Beth Morford, Environmental
Bureau of Protected Species Management
FDEP
19100 SE Federal Highway
Tequesta, Florida 33469

(561) 575-5407

Usually all permitted projects are required to complete summary forms at the end of the season, detailing the activity observed during the season. These forms will be sent by the state permitting official towards the end of each season.

SECTION 3.

TURTLE IDENTIFICATION

3.1 INTRODUCTION

This section provides references for turtle identification. Information is provided for the identification of species by crawl, nest site and physical characteristics. When in doubt of the correct identification of a species, contact the FDEP. Other persons available for help with identification include Wendy Teas, of the NMFS and STSSN, (305) 361-5761, as well as Beth Morford of the FDEP, (561) 575-5407.

Further reference materials may be available in the park library.

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SECTION 4.

MARINE TURTLE CONSERVATION GUIDELINES

4.1 INTRODUCTION

The following is a copy of the Marine Turtle Conservation Guidelines issued by the Florida Department of Environmental Protection to permit holders. All surveyors should be familiar with these guidelines. The DRTO turtle program is based on the criteria outlined by these guidelines.