COLLIER COUNTY
COMMUNITY DEVELOPMENT AND ENVIRONMENTAL SERVICES DIVISION

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COLLIER COUNTY
SEA TURTLE PROTECTION PLAN
ANNUAL REPORT – 2004

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ABSTRACT

Collier County was responsible for the daily survey of 23.7 miles (38.1 km) of beach for sea turtle activities during the 2004 sea turtle season (May through October). The Collier County Environmental Services Department (ESD) surveyed 16.9 miles (27.2 km) of beach including Barefoot, Vanderbilt, Park Shore, and Marco Island. The ESD documented 378 nests in 2004; a decrease from 504 nests in 2003. Under contract to Collier County, the Conservancy of Southwest Florida documented 61 nests on the 5.6-mile (9.0 km) City of Naples beach. Delnor-Wiggins Pass State Park (DNWP) documented 11 nests on 1.2-mile (1.9 km) beach. The incidence of disorientations for the 2004 nesting season was 0.8% of the documented nests (approximately 151 hatchlings). This was a decrease from 3% (approximately 550 hatchlings) in 2003. Hurricanes and other storm events inundated 24% (90) of the nests, and 59% (222) of the nests were washed away. 0.8 percent (3) of the nests were depredated, a decrease from 18% (90) in 2003. A total of 11,585 hatchlings were estimated to have reached the Gulf of Mexico, which represents a sharp decrease compared to 32,418 hatchlings that reached the Gulf in 2003. The number of strandings in Collier County in 2004 (34) represented a 56% decrease from 78 in 2003.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ATV	All Terrain Vehicle
BG	Bonita Grande – Upland Sand Source
BI	Big Island – Upland Sand Source
CCCL	State Coastal Construction Control Line
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSWF	The Conservancy of Southwest Florida
DNR	Florida Department of Natural Resources (now called FWC)
DNWSP	Delnor Wiggins State Park
ERJ	E.R. Jahna – Upland Sand Source
ESD	Collier County Environmental Services Department
FPL	Florida Power & Light Company
FWC	Florida Fish and Wildlife Conservation Commission
GPS	Global Positioning System
HWL	High Water Line

IUCN	International Union for the Conservation of Nature and Natural Resources
NAD	North American Datum
NERR	National Estuarine Research Reserve
NMFS	National Marine Fisheries Service
NOV	Notice of Violation
P&R	Collier County Parks and Recreation Department
PSA	Public Service Announcement
STSSN	Sea Turtle Stranding and Salvage Network
TED	Turtle Excluder Device
USFWS	United States Fish and Wildlife Service

SECTION 1

INTRODUCTION

Sea turtles have inhabited the earth for millions of years. They are believed to have evolved from marsh dwelling species that existed between the Upper Triassic and the Jurassic periods (190 –135 million years ago). Fossil records indicate an early transition from the marsh into the marine environment. By the Cretaceous period (65 million years ago) four families of sea turtles were distributed throughout the oceans of the world (Pritchard, 1979). Today marine turtles are limited to two families: Cheloniidae (six species) and Dermochelyidae (one species) (National Research Council, 1990).

Sea turtles are air-breathing reptiles that emerge from the sea and deposit their eggs on tropical and subtropical beaches around the world. The loggerhead sea turtle (*Caretta caretta*) is the most abundant nesting sea turtle species in Collier County. Loggerheads, named for their disproportionately large head, emerge on Florida's beaches from May through August to lay their eggs. Clutches, containing an average of 100 eggs, incubate for approximately two months before hatchlings, less than two inches in length, emerge and head to the water. Within 12 to 30 years loggerhead turtles reach sexual maturity and return to the beach to lay eggs every two to four years. It is estimated that only one hatchling in 1,000 will survive to repeat this cycle.

All but one species of sea turtle [Australian flatback (*Natator depressus*)] is listed as endangered and/or threatened by one or more of the following agencies: U.S. Fish and Wildlife Service (USFWS), Florida Fish and Wildlife Conservation Commission (FWC),

and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Furthermore, the loggerhead sea turtle is classified by the International Union for the Conservation of Nature and Natural Resources [IUCN (although without statutory authority)], as a 'vulnerable' species (Groombridge, 1982). Extensive exploitation by man for food, leather, decorative pieces, cosmetics and other uses, as well as incidental catch by commercial fisheries have drastically decreased populations of all remaining sea turtle species.

Coastal development and natural erosion have significantly reduced the number of suitable nesting beaches. Developed beaches used by nesting sea turtles can become hazardous to emerging hatchlings. Human disturbances on nesting beaches include: human activity, artificial lighting, erosion induced by shoreline hardening with seawalls, rock revetment, beach renourishment, vehicular traffic on or near the beach, beach raking, pollution, shading of beaches by large buildings and exotic vegetation, beach furniture and recreational accessories, as well as egg and hatchling predation associated with human activities (Carr and Ogren, 1960; Daniel and Smith, 1947; Dickerson and Nelson, 1989; Mann, 1978; Mortimer, 1987; Mortimer and Portier, 1989; Moulding and Nelson, 1988; National Research Council, 1990; Nelson, 1988; Nelson, 1991; Nelson and Dickerson, 1989; Nelson *et al*, 1987; Raymond, 1984b; Salmon and Wynekin, 1990; Schmeltz and Mezich, 1988; Witherington, 1990; Witherington, 1991; Witherington and Bjorndal, 1991). Sea turtles have encountered some or all of these problems on many of Florida's beaches, including Collier County. As human activity and development on nesting beaches increases, a more complete understanding of the plight of the sea turtle must be developed so that remedial actions can be taken.

Collier County is responsible for surveying 23.7 miles (38.1 km) of beach for sea turtle activities. The Environmental Services Department (ESD) monitored 16.9 miles (27.2 km) of shoreline on Barefoot, Vanderbilt, Park Shore, and Marco Island. The remaining 5.6 miles (9.0 km) of beach in the City of Naples is subcontracted to the Conservancy of Southwest Florida (CSWF). Delnor-Wiggins Pass SRA surveys 1.2 miles (1.9 km) of beach within the park boundary. The surveyed beaches not included in this report are Keewaydin Island (monitored by the CSWF), Cape Romano Complex (monitored by the ESD and Rookery Bay NERR), and Coconut and Sea Oat Islands (monitored by Rookery Bay NERR).

The purpose of the Collier County Sea Turtle Protection Program is to protect nests and collect data on sea turtle nesting and hatching activities in order to fulfill permit requirements for beach raking and beach renourishment. Protecting sea turtle nests also allows beachfront property owners to obtain permits for certain activities seaward of the State Coastal Construction Control Line (CCCL).

This report details the methods established by the ESD with updates based on the Florida Fish and Wildlife Conservation Commission Sea Turtle Conservation Guidelines (FWC, 2002). The report includes an analysis of sea turtle emergences, effects of beach renourishment, historical trends, nesting and hatching, depredation, disorientations, beach lighting, strandings, and public awareness. Program research and management recommendations are also provided.

SECTION 2

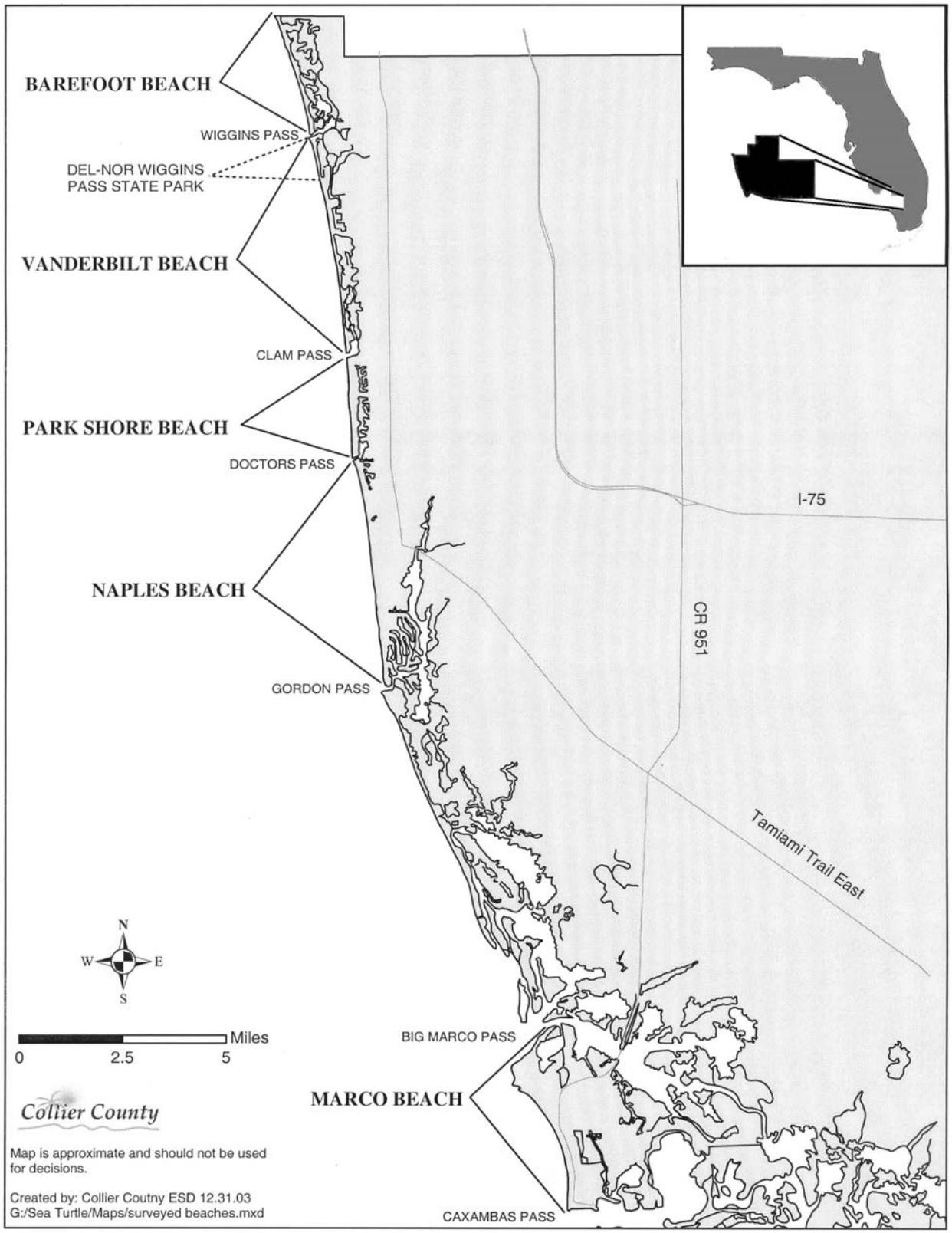
SEA TURTLE MONITORING PROGRAM

2.1 STUDY AREA

Collier County, Florida is the southern terminus of the southwest barrier island chain that begins at Anclote Key in Pasco County, 175 miles (282 km) to the north. The Collier barrier island coastline extends 37 miles (60 km) from the Lee/Collier County line, southward to Cape Romano. The beaches comprise a wide variety of physiographic types including a coastal headland, barrier beach ridge, barrier islands, migrating overwash ridges, and a coastal cape. Ten major barrier beach units are recognized in the County, separated by nine tidal passes. Five of the ten barrier beach units are surveyed daily (May 01–October 31) for sea turtle activities including Barefoot, Vanderbilt (including Delnor-Wiggins Pass State Park), Park Shore, City of Naples, and City of Marco Island beaches (Figure 2.1.1).

Since 1990, beach renourishment activities have occurred in Collier County. The following sections outline the year (1990–2004), DNR monument location, and sand source (hydraulic, mechanical, or upland) for each renourishment event. Hydraulic sand is transported by pipe from an offshore sand source or from a pass, with seawater as a transport medium. Mechanical sand is excavated from a pass with a clamshell bucket, stockpiled and placed onto the beach. Upland sand is trucked from an inland quarry and spread onto the beach.

Figure 2.1.1. Collier County Surveyed Beaches, 2004.



2.1.1 Barefoot Beach

Barefoot Beach is the northern-most beach unit in Collier County. It encompasses 3.1 linear miles (5.0 km) of barrier beach extending from the County line south to Wiggins Pass (DNR monument R-1 to R-16). The Barefoot Beach unit is surveyed for sea turtle activities as part of the Wiggins Pass Inlet Management Plan, renourishment associated with dune restoration on Lely Barefoot beach, and to assist in the permitting process for the maintenance of Wiggins Pass. Table 2.1.1.1 summarizes the renourishment history of Barefoot Beach since 1990.

Table 2.1.1.1. Barefoot Beach Renourishment History.

Year	DNR Location	Sand Source	Cubic Yards	Linear Feet of Beach
1990	R-13 to R-14	Hydraulic	33,460	1000
1991	250’ North R-13 to 30’ North R-15	Hydraulic	34,010	2,264
1998	R-12.5 to R-13.5	Hydraulic	11,980	913
2002	250’ North R-8 South 250’	Upland (ERJ) *Dune Only	n/a	ca. 500
2002	250’ North R-5.5 South 250’	Upland (ERJ)	n/a	ca. 500

* Upland sand placed into dune only, this is not a beach renourishment.

2.1.2 Vanderbilt Beach / Delnor-Wiggins Pass State Park

The Vanderbilt Beach coastal barrier unit includes 4.7 miles (7.6 km) of beach from Wiggins Pass south to Clam Pass (DNR monument R-17 to R-41.5). The northern most mile of the Vanderbilt Beach unit, Delnor-Wiggins Pass State Park (R-17 to R-22.5) is surveyed for sea turtle activities by park staff. The data from Delnor-Wiggins is included in this report. Vanderbilt Beach is surveyed for sea turtle activities as part of permit requirements for beach restoration, beach raking, maintenance dredging of

Wiggins Pass and Clam Pass, and to allow for special events periodically requested by beachfront property owners. Table 2.1.2.1 summarizes the renourishment activity of Vanderbilt Beach and Delnor-Wiggins Pass State Park since 1990.

Table 2.1.2.1. Vanderbilt Beach and Delnor-Wiggins Renourishment History.

Year	DNR Location	Sand Source	Cubic Yards	Linear Feet of Beach
1994	*R-18 to R-19	Hydraulic	35,250	1,000
1995	*R-19 to R-20	Hydraulic	46,580	1,000
1996	100’ North R-22.5 to R-29	Hydraulic	322,800	7,490
	R-29 to 50’ South R-30.5	Upland	3,000	1,588
	R-40 to R-41 (North of Clam Pass)	Mechanical	4,500	1,000
1998	*R-19 to R-20	Hydraulic	19,550	1,000
2000	*R-18 South 850’	Hydraulic	16,960	850
2002	*R-18 to 400’ South R-20	Hydraulic	50,614	2,400
	500’ South of R-23 to R30 (Dune Protection)	Upland (ERJ)	22,138	6,500
	150’ South R-39 415’ South (Dune Protection)	Upland (ERJ)	655	265
	500’ South R-36 to 322’ South R-38 (Dune Protection)	Upland (ERJ)	4,445	1,822

* Indicates an area within the Delnor-Wiggins Pass State Park.

2.1.3 Park Shore Beach

The Park Shore coastal barrier unit extends 3.2 miles (5.1 km) south from Clam Pass to Doctors Pass (DNR monument R-41.5 to R-57). Clam Pass County Park extends from Clam Pass southward approximately 2,000ft (610 m) to the Naples Cay development (R-42 to R-44). Park Shore Beach is monitored for sea turtle nesting activities as part of beach renourishment, beach raking, and maintenance dredging of

Clam Pass permit requirements. Table 2.1.3.1 summarizes the renourishment history of Park Shore Beach.

Table 2.1.3.1. Park Shore Beach Renourishment History.

Year	DNR Monument	Sand Source	Cubic Yards	Linear Feet of Beach
1995	Clam Pass to R-43.5	Mechanical	4,500	2,889
1996	Clam Pass to R-42.5	Mechanical	6,000	1,788
	350’ South R-50 to 350’ North R-54	Hydraulic	90,700	3,589
1997	Clam Pass to R-42.5	Mechanical	6,000	1,788
	350’ North R-48 to 350’ South R-50	Mechanical	8,000	2,751
1998	Clam Pass to 143’ North R-45	Mechanical	8,000	4,208
1999	Clam Pass to 270’ North R-42	Mechanical & Hydraulic	3,500	310
	430’ South R-42 to 250’ South R-43.5	Hydraulic	26,500	1,365
2000	R-50.5 to 100’ South R-53	Upland (ERJ)	35,000	2,600
2001	R-50.5 to R-54	Upland (ERJ)	28,268	3,500
2002	Clam Pass to 40’ South R-43	Hydraulic	11,725	1,975
	700’ South R-49 to 40’ South R-54	Upland (ERJ)	9,067	4,700

2.1.4 City of Naples Beach

The City of Naples beach unit encompasses approximately 5.6 miles (9.0 km) of shoreline from Doctors Pass south to Gordon Pass (DNR monument R-57.5 to R-89). The Conservancy of Southwest Florida monitors the City of Naples beach for sea turtle activities, contracted by Collier County, as part of the Beach Renourishment Program permit requirements. The City of Naples beach is also monitored for beach raking,

maintenance dredging of Doctors Pass and Gordon Pass, T-Groins at Doctors Pass and the Parker Webb Renourishment Program permit requirements. Naples beach monitoring results are included in this report and also in an annual report by the Conservancy of Southwest Florida. Table 2.1.4.1 summarizes the renourishment history of the City of Naples beach.

Table 2.1.4.1. City of Naples Beach Renourishment History.

Year	DNR Location	Sand Source	Cubic Yards	Linear Feet of Beach
1996	Doctors Pass (R-57) to 350' North R-78	Hydraulic	759,150	18,253
	R-69.5 to R-72	Upland/Hydraulic	55,000	2,438
1998	R-69.5 to R-72	Upland (BG)	8,820	2,438
	R-75 to 400' South R-76	Upland (BG)/Hydraulic	6,696	1,213
1999/ 2000	500' North R-63 to R-64 (Naples Beach Club)	Upland (BG)	8,036	1,500
	Doctors Pass (R-57) to R-58	Upland (BG)	6,804	1,000
2000	R-88 to R-89	Upland (BI)	6,000	1,000
2002	Doctors Pass (R-57) to R-68	Upland (ERJ)	45,047	11,000

2.1.5 City of Marco Island Beach

The City of Marco Island coastal barrier unit encompasses 7.1 miles (11.4 km) of beach, from inside Big Marco Pass [Hideaway Beach (DNR monument H-16 to H-1)] south to Caxambas Pass (DNR monument R-131 to R-148), and also includes an emerged vegetated shoal known as Sand Dollar Island. The City of Marco Island is a highly developed beach with many high-rise condominiums and hotels. This beach has been monitored for sea turtle activities since 1990, as part of the permit requirements for beach

renourishment, raking, special events conducted, and maintenance dredging of Caxambas Pass and the entrance of Collier Bay. Table 2.1.5.1 summarizes the renourishment history for the City of Marco Island.

Table 2.1.5.1. City of Marco Island Beach Renourishment History.

Year	DNR Monument	Sand Source	Cubic Yards	Linear Feet of Beach
1990	*H-3 to H-7	Hydraulic	70,000	2,063
	R-136.5 to R-138.5	Hydraulic	284,600	2,189
	R-142.5 to R-148	Hydraulic	715,400	5,533
1997	*130’ South H-9 to 45’ South H-11	Upland (BG)	1,000	1,345
	*370’ South H-1 to 131’ South H-3	Upland (BG)	4,000	1,636
	R-145.5 to R-148	Upland (BG)	80,000	1,781
1998	*H-9 to H-11	Upland (BG)	15,000	1,250
	*400’ South H-1 to H-2	Upland (BG)	10,000	900
1999	*H-1 to H-3	Upland (BG)	3,528	985
	R-148 South to Caxambas Pass	Upland (BG)	9,000	625
2000	*200’ North H-1 to H-3	Upland (BI)	3,600	950
		Hydraulic	2000	
2001	*H-1 to H-4	Upland (ERJ)	15,000	1,500
	*H-9 to H-13.5	Hydraulic	24,078	2,300
2002	R-136 to R-136.5	Upland (ERJ)	148	300
	*140’ South H-9 to 140’ North	Upland (ERJ)	359	280
2003	*200’ South H-1 to 40’ North H-4	Upland (ERJ)	11,096	1,740
	*H-9 to H-11	Upland (ERJ)	11,096	1,000

* Indicates an area within Hideaway Beach were the H-monuments are numbered consecutively from southwest to northeast.

2.2 METHODS AND MATERIALS

2.2.1 Surveys and Beach Zoning

Pre-season reconnaissance surveys of the monitored beaches were conducted annually in April. The objective of the surveys is to develop daily monitoring strategies, note the condition of the beaches, and zone the beaches for management purposes.

Wooden stakes were marked with the corresponding DNR monument numbers and placed within the dune area at approximately 500 ft (152 m) increments from the Lee/Collier County line south through Marco Island. Beaches were measured along the high tide line using a Rolatape survey wheel.

2.2.2 Daily Monitoring

Prior to beach raking, daily surveys for emergence activity were performed along the high water line (HWL) utilizing all-terrain-vehicles (ATVs) equipped with low-pressure tires. Upon discovery of an emergence, staff visually determined if the emergence resulted in a nest or a false crawl (non-nesting emergence). Nests and false crawls were sequentially numbered and mapped on 1:100 or 1:200 scale aerial photographs. Characteristics and measurements of the emergences were recorded on data sheets for evaluation (Figure 2.2.2.1 and Figure 2.2.2.2). A GPS reading was taken for each emergence location on a weekly basis for mapping.

All nests were marked with stakes, flagging tape, and a sign to provide protection and facilitate evaluations. Four 36-inch (91 cm) long wooden stakes were placed in the corners of each disturbed area. Yellow ribbon with the word " caution" printed on it, was then placed around the stakes and a Sea Turtle Nest Sign (Figure 2.2.2.3) is affixed to alert and direct beach rakers and the public away from nests.

Nests laid in areas known for high predation are covered with a protective screen. Nest screening is applied on undeveloped portions of Barefoot, Vanderbilt, and Park Shore beach. Screening involved anchoring a self-releasing four-foot (1.2 m) square wire mesh screen over the clutch with metal tent stakes. The 2 by 4 inch screen openings (5.1 by 10.2 cm) were large enough to allow the natural escape of hatchlings, but were small enough to prevent mammalian depredation, in most cases are observed on a daily basis for evidence of predation. If a raccoon disturbed the sand under the screen, the sand was replaced, the area flattened out, and the event recorded. If fire ants were observed, they were gently swept off the nest.

Figure 2.2.2.1. Sea Turtle Nesting Form, 2004.

Nesting & Hatchling
Data Form 2004

NEST #_____
GPS REF #_____

Nesting Data

Date_____ Species_____

Did You Verify?: ☐ Map?: ☐ Log?: ☐

DNR Location: _____

Establishment_____

Renourished* or Natural

Distance(ft) from:

MHW_____ Vegetation / Structure_____

Structure Type: _____

Scarp: No or Yes : Height_____ : Sloped or Vertical

Length_____ Crawl over scarp: Yes or No

Nest cover: Full sun Partial shade Total shade

Relocated: Yes or No

If Relocated, Why:_____

Screened / Caged: No or Yes Date:_____

Investigator_____

Egg Chamber Data

A. Hatched eggs (1+2+3) ☐

1. Emerged _____2. Alive_____3. Dead_____

B. Unhatched eggs (4+5+6) ☐

4. Undeveloped_____5.Dead embryo_____6.Dep._____*

C. Pipped eggs (7+8) ☐

7. Dead _____ 8. Alive _____

D. Total Eggs (A+B+C) ☐

E. Hatching Success (A / D) ** ☐

F. Emergence Success (1 / D)** ☐

Nest Material: _____% Sand ____% Shell _____ % Root

*Include total depredated from the back of this page.
** To be completed in office

Renourishment Data*

Year of Renourishment: _____

Type of Sand: Upland Hydraulic Mechanical

Eggs deposited in renourished sand: Yes or No

Sand sample taken from chamber: Yes or No

Embryo Stages

30 _____ **29** _____ **28**_____

27 _____ **26** _____ **25**_____

24 _____ **23** _____ **22**_____

21 _____ **< 21** _____

Undetermined _____

Emergence Data

Expected Date_____Actual_____

Incubation_____Date excavated_____

Clutch Depth(in)_____Width_____

Investigator_____

Disorientation Data

Disoriented Hatchlings: _____ Date: _____

Dead _____ # Alive _____ Source _____

DEP form filled out? Yes or No

Crawl Diagram

* Draw scarps!

NEST # _____

DEPREDATION FORM

Please record EACH occurrence of predator interaction!

Date	Species	Digging or Tracks	Through or Under Screen	Location of Ants / Ghost Crabs 1.beach surface 2.Upper cavity 3. lower cavity 4. Throughout	# of Eggs Depredated	# of Hatchlings Depredated
				Total :		

INUNDATION LOG

Nest #	Date	Cause of Inundation	Complete or Partial

Washed Out Log

Nest #	**Date**	**Cause of Nest Being Washed Away**	**Complete or Partial**

Figure 2.2.2.2. Sea Turtle False Crawl Form, 2004.

Crawl # _____ GPS Ref _____ Date: _____ Species _____ Pitting: No or Yes Egg Cavity: No or Yes # Of Egg Cavities _____ Depths _____ DNR Location: _____ Establishment: _____ Natural Upland Hydraulic Mechanical Renourishment Year _____ Feet From : MHW _____ Vegetation / Structure _____ Structure Type: _____ Site Material: Sand Shell Vegetation Scarp: No or Yes : Height _____ : Sloped or Vertical Scarp Length: _____ Crawl over scarp Yes or No Investigator: _____ Describe Any Possible Reasons For False Crawl:_____ _____ _____	Crawl Diagram:
Crawl # _____ GPS Ref _____ Date: _____ Species _____ Pitting: No or Yes Egg Cavity: No or Yes # Of Egg Cavities _____ Depths _____ DNR Location: _____ Establishment: _____ Natural Upland Hydraulic Mechanical Renourishment Year _____ Feet From : MHW _____ Vegetation / Structure _____ Structure Type: _____ Site Material: Sand Shell Vegetation Scarp: No or Yes : Height _____ : Sloped or Vertical Scarp Length: _____ Crawl over scarp Yes or No Investigator: _____ Describe Any Possible Reasons For False Crawl:_____ _____ _____	Crawl Diagram:

DO NOT DISTURB

SEA TURTLE

NEST

VIOLATORS SUBJECT TO FINES AND IMPRISONMENT

FLORIDA LAW CHAPTER 370

No person may take, possess, disturb, mutilate, destroy, cause to be destroyed, sell, offer for sale, transfer, molest, or harass any marine turtle or its nest or eggs at any time.

Upon conviction, a person may be imprisoned for a period of up to 60 days or fined up to $500, or both, plus an additional penalty of $100 for each sea turtle egg destroyed or taken.

U.S. ENDANGERED SPECIES ACT OF 1973

No person may take, harass, harm, pursue, hunt, shoot, wound, kill, trap, or capture any marine turtle, turtle nest, and/or eggs, or attempt to engage in any such conduct.

Any person who knowingly violates any provision of this act may be assessed a civil penalty up to $25,000 or a criminal penalty up to $100,000 and up to one year imprisonment.

SHOULD YOU WITNESS A VIOLATION, OBSERVE AN INJURED OR STRANDED TURTLE, OR MISORIENTED HATCHLINGS, PLEASE CONTACT FWC AT

1-888-404-FWCC OR *FWC (MOBILE PHONE)

FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
MARINE TURTLE PROTECTION PROGRAM

COASTLINE 386-761-1414

2.2.3 Nest Monitoring and Evaluation

Daily monitoring for hatched nests began as the first nest approached its expected hatch date (approximately 50 days). All nests were observed for signs of hatching, such as an obvious depression in the sand or hatchling tracks around the nest. Each nest was excavated for evaluation approximately 72 hours (3 days) following signs of the first emergence or, in the case of unhatched nests, 70 days from deposition or 80 days if the nest was inundated with water from high tides and storm events.

Excavation included removing all contents from the egg cavity by hand. The depth of the egg cavity was measured and recorded. Data from each nest evaluation was recorded on ESD Sea Turtle Nesting Forms (Figure 2.2.2.1). Empty eggshells accounted for live hatchlings that escaped from the nest, live turtles found within the nest, and dead turtles found within the nest. Unhatched eggs included undeveloped eggs, dead embryos, and eggs depredated prior to hatching. Pipped eggs refer to hatchlings (dead or alive) that puncture the eggshell but did not fully emerge from the shell. Unhatched eggs were opened and inspected to determine the stage of development at the time of death. If live hatchlings were found in the nest, they were either released immediately or transferred to a bucket of moist sand for night release, depending on the presence or absence of predatory birds in the area. Hatchling releases were conducted according to the Florida Fish and Wildlife Conservation Commission Sea Turtle Conservation Guidelines (FWC, 2002.

Nests were also inspected for evidence of predation. If signs of predation were discovered, the information is recorded. The collection of predator data aids in

quantifying and determining the extent nest predation in Collier County, and assist in management and predation efforts.

2.2.4 Data Analysis

Sea turtle emergence and hatchling data were compiled using the relational database Microsoft Access. Maps were produced using ArcMap and Collier County Property Appraiser's aerial photographs taken in 2004. Shoreline and monument points were based on North American Datum (NAD), 1927 and converted to NAD 1983, Florida State Plane Coordinate East Zone. Shoreline data and emergence locations were collected with a Trimble GeoExplorer Global Positioning System (GPS). Graphs and plots were created using Microsoft Excel.

Data was compared for all monitored beaches through single factor analysis of variance (ANOVA) testing. Relationships between beach characteristics were analyzed using t-test; Wilcoxon rank-sum test in the case of Normality Test failure. Significance determinations were made at the $P < 0.05$ probability level. Data was analyzed with personal computers utilizing Microsoft Excel and Microsoft Access.

Data was analyzed at each study area for factors relating to both nest and hatching characteristics. Nesting factors included nests per emergences (nesting success), emergences per mile (e/mi.), and nest placement characteristics. Factors relating to hatching success included cavity depth, incubation duration, egg counts, inundation, and depredation. Linear regression analysis was used to search for any factors directly affecting hatching success. Plots were prepared showing comparisons between and within study areas. Comparisons among beach types were based on emergences,

historical trends, seasonal timelines, emergence distributions, egg counts, clutch characteristics, and predation.

2.3 RESULTS AND DISCUSSION

2.3.1 Emergences

Sea turtles emerged upon Collier County beaches from May 4, 2004 through August 8, 2004. A total of 734 emergences (378 nests and 356 false crawls) occurred along the 23.7 miles (38.1 km) of the daily surveyed shoreline. A breakdown of emergence activity for each beach is listed in Table 2.3.1.1. Aerial maps showing emergence location by beach are available as an additional appendix separate from this report. A breakdown of emergences per mile on each beach is illustrated in Table 2.3.1.1. Barefoot beach recorded the most sea turtle activity with an average of 51 emergences per mile. The City of Naples beach received the least activity with an average of 18 emergences per mile followed by The City of Marco Island at 22 emergences per mile.

Table 2.3.1.1. Emergences, 2004.

	Barefoot	Delnor Wiggins	Vanderbilt	Park Shore	Naples	Marco	Total
Total Nests	84	11	90	73	61	59	378
Total False Crawls	73	38	45	64	39	97	356
Total Emergences	157	49	135	137	100	156	734
Nest / Emergence (%)	54%	22%	67%	53%	61%	38%	52%
Beach Length (mi.)	3.1	1.2	3.5	3.2	5.6	7.1	23.7
Emergences / mi.	51	41	39	43	18	22	31
Nests / mi.	27	32	26	23	11	8	16
False Crawls / mi.	24	32	13	20	7	14	15

Figure 2.3.1.1. Sea Turtle Emergences in Collier County, 2004.

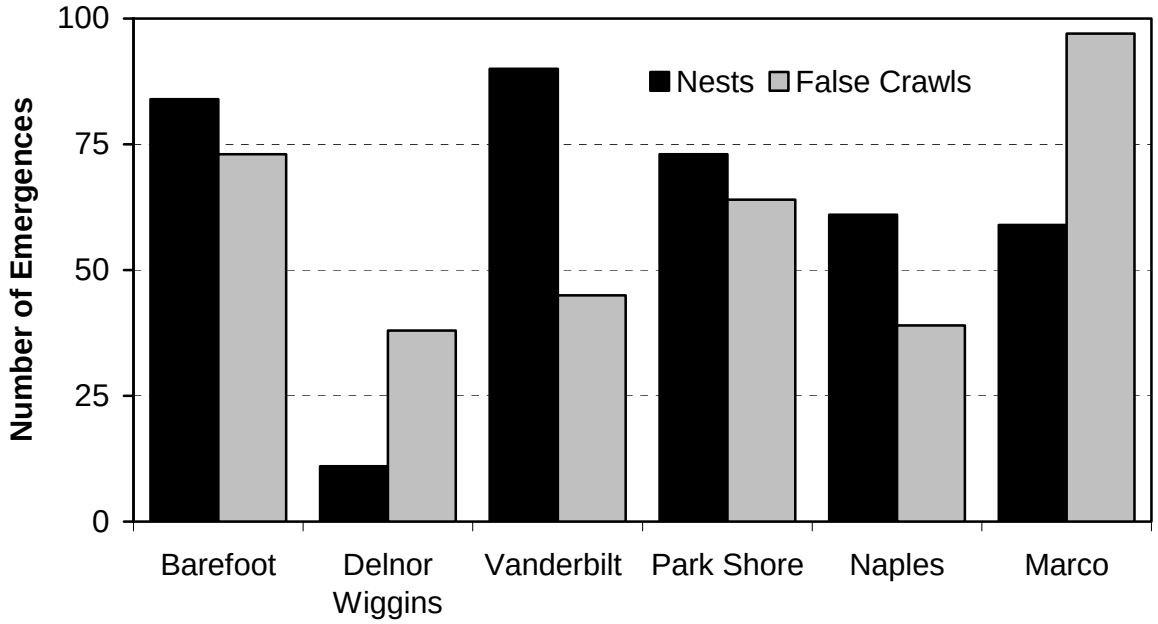


Table 2.3.1.1 illustrates a high degree of variation in total nests and false crawls between beaches. This variation is difficult to explain since nest-site selection of the female turtle is still poorly understood. Some important factors in site selection include, but are not limited to: beach compaction, artificial lighting, human activity, structures on the beach, and scarps.

Above normal beach compaction can impede nest excavation contributing to the rejection of a nesting site, thus increasing the number of false crawls and aborted egg cavities on renourished beaches (Raymond, 1984a; Nelson, 1991). All renourished beaches are tilled to mitigate this problem, however, depending on the sand composition, rainfall, vehicles on the beach, including raking, compaction may result throughout the sea turtle season.

Witherington (1991) found that the “presence” of lights in beach areas “sharply reduce” the number of sea turtles that emerge to nest. Human activities on the beach can

also contribute to the disruption of nest site selection by adult sea turtles (LeBuff, 1990; Kraus, 1992). Obstacles in the paths of emerging turtles may contribute to the failure of a nesting attempt. These obstacles include, but are not limited to: scarps, beach furniture, seawalls, boardwalks, stairs, fences, pilings, groins, sand castles, sand pits, Australian pine trees (*Casuarina* spp.), and boats stored on the beach.

Abandoned nesting attempts (false crawls) are a common occurrence for loggerheads and have been recorded at all nesting beaches (Dodd, 1988). Raymond (1984b) reported that on natural beaches, 46% to 49% of emergences resulted in false crawls. The 356 false crawls in Collier County represents 48% of the total emergences, a decrease from 53% recorded in 2003. It is unknown if this finding is due to low overall nesting numbers or some other environmental or human factor.

It is possible that a limited number of false crawls occur from the female's instinctive preferences for a specific site. These are false crawls not provoked by human disturbance and interference; but by physical factors such as temperature, sand composition, and possibly other unknown characteristics.

2.3.2 Effects of Beach Renourishment

Figure 2.3.2.1 compares the 2004 nests and false crawls per mile on natural and renourished beach areas on the combined beaches of Barefoot, Vanderbilt (including Delnor Wiggins Pass State Park), Park Shore, City of Naples, and City of Marco Island. The data does not indicate a significant nesting preference between natural (non-renourished) beach and renourished beach. When examining this figure, there appears to be a difference between the mean 14.4 nests per mile on natural beach and the 17.5 nests per mile on renourished beach. The relationship between nests and false crawls per mile

on natural, hydraulic (including mechanical renourished), and upland renourished beaches are illustrated in Figure 2.3.2.2. The ratios of nests to false crawls per mile on natural beach is 7:8 while ratios on hydraulic and upland renourished beach are approximately 3:4 and 2:1 respectively. The ratio of nests to false crawls per mile on Hydraulic/Upland Mix renourished beaches is 1:1.

Figure 2.3.2.1. Natural Versus Renourished Beaches, 2004

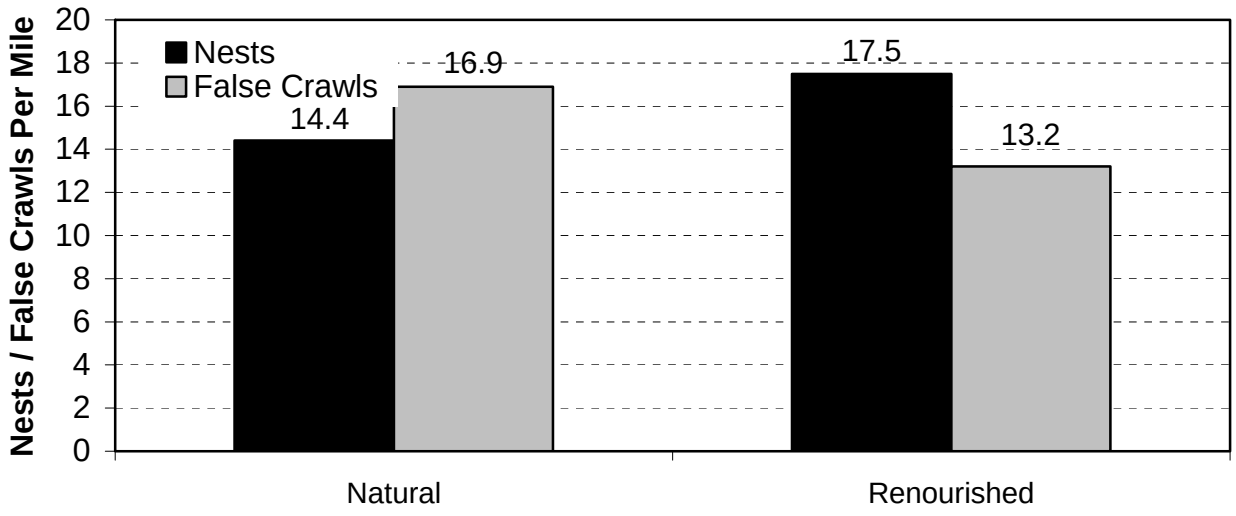
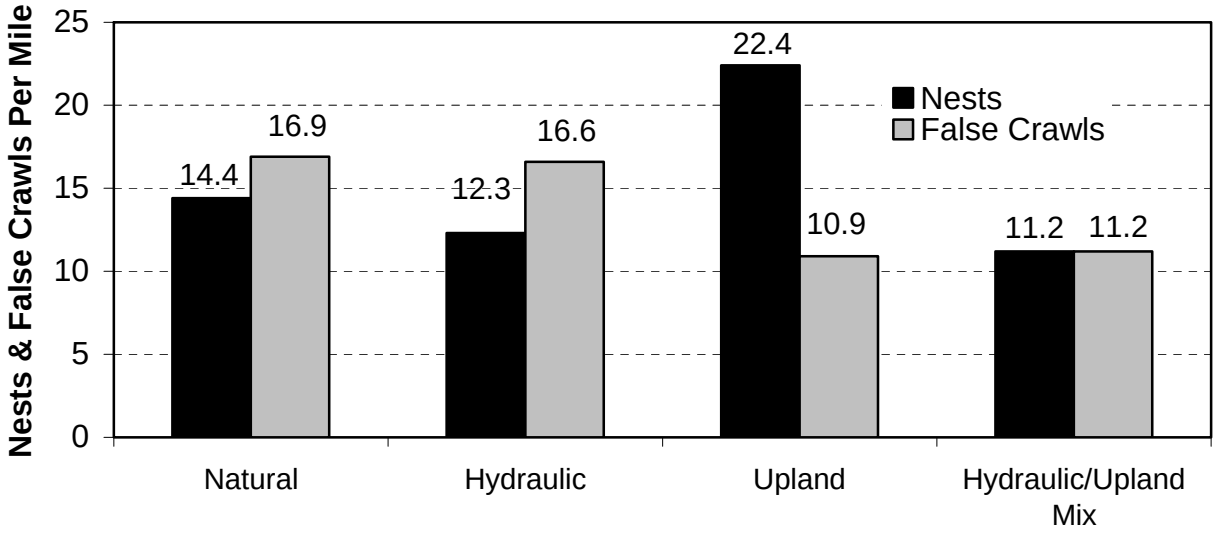


Figure 2.3.2.2. Natural Versus Hydraulic, and Upland Renourished Beaches, 2004.



Dodd (1998) reported that loggerhead sea turtle nest site selection might be influenced by "micro-habitat cues" that initiate the nesting process. Microhabitat cues may be significantly different on renourished beaches when compared to natural, non-renourished beaches, and these differences may influence nesting preferences and success. Collier County beaches are continually nourished and renourished, therefore, continued research and data collection is imperative. Studying the historical nesting data from different sand types will ensure the best selection of sand to reduce negative impacts of future renourishments.

2.3.3 Historical Trends

Marco Island beach was first surveyed for sea turtle activities in 1990, followed by Barefoot in 1991 and Clam Pass Park (from Clam Pass south to Seagate beach access) in 1992. In 1994, the "Collier County Sea Turtle Protection Program" was developed to survey mainland beaches in response to area-wide beach renourishment and beach raking. Consecutive years of consistent data collection will assist biologists in detecting local population trends of loggerhead sea turtles, and the local impacts of beach renourishment.

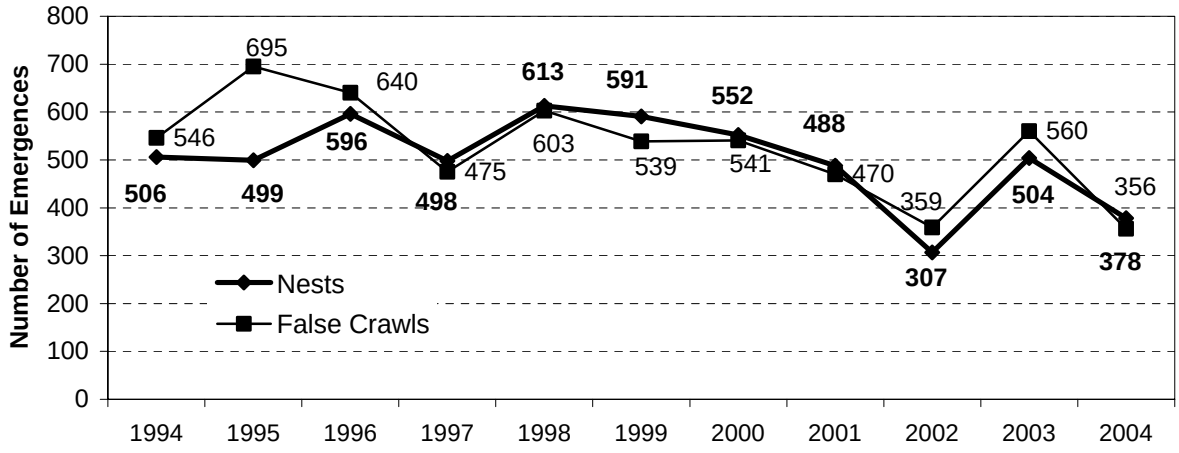
Most loggerhead sea turtles do not nest every year. In the "Synopsis of the Biological Data on the Loggerhead Sea Turtle", Dodd (1988) compiled studies reporting that 90% of loggerhead sea turtles nest on a 2 to 4 year cycle. This factor requires many years of consistent data collection before any trends can be accurately detected. Historical sea turtle emergences are presented in Table 2.3.3.1 and Figures 2.3.3.2 – 2.3.3.6 for all beaches.

Table 2.3.3.1. Historical Trends of Sea Turtle Nests and False Crawls (FCs), 1990–2004.

Beach Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Barefoot Nests	*	62	71	64	102	105	106	117	108	104	96	104	62	88	84
Barefoot FCs	*	62	129	75	98	146	74	93	90	89	85	84	28	66	73
Delnor Nests	*	*	*	*	*	*	29	22	29	33	17	23	15	21	11
Delnor FCs	*	*	*	*	*	*	37	22	24	33	32	25	22	49	38
Vanderbilt Nests	*	*	*	*	131	156	155	141	186	170	167	125	90	159	90
Vanderbilt FCs	*	*	*	*	122	214	143	118	175	111	136	118	131	125	45
Park Shore Nests	*	*	*	*	153	110	166	134	150	106	154	105	81	122	73
Park Shore FCs	*	*	*	*	107	165	145	120	133	119	186	79	75	188	64
Naples Nests	*	*	*	*	59	73	62	45	49	87	68	52	31	59	61
Naples FCs	*	*	*	*	120	90	76	51	70	74	70	49	49	52	39
Marco Nests	35	46	35	33	61	55	78	39	91	91	50	79	28	55	59
Marco FCs	38	124	99	98	99	80	165	71	117	113	52	115	54	80	97
Total Nests	35	108	106	97	506	499	596	498	613	591	552	488	307	504	378
Total FCs	38	186	228	173	546	695	640	475	603	539	541	470	359	560	356

Note: *Full beach not monitored or data not available.

Figure 2.3.3.1. Collier County Annual Emergences, 1994–2004.



Note: Delnor-Wiggins Pass SRA emergence data is not included in 1994 and 1995 emergences.

Figure 2.3.3.2. Barefoot Annual Emergences, 1991–2004.

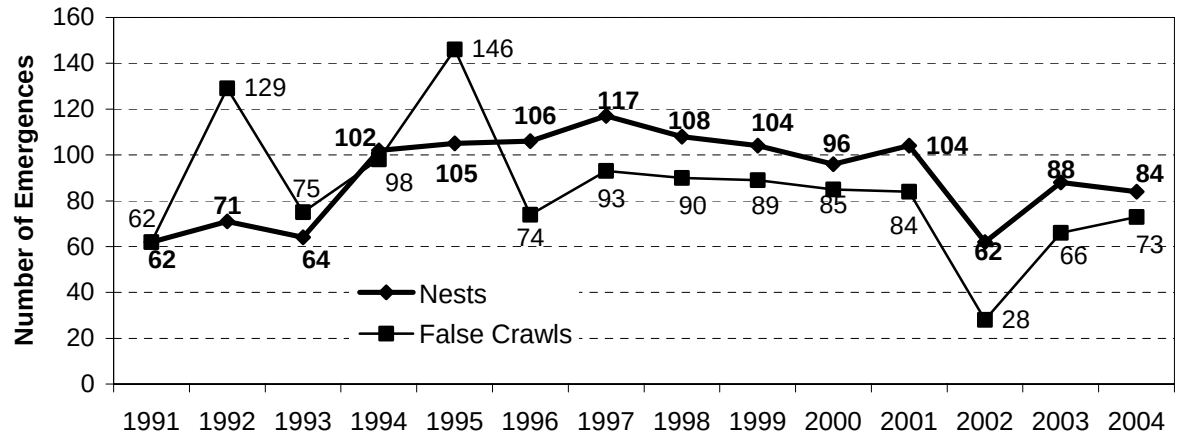


Figure 2.3.3.3. Delnor-Wiggins Pass SRA Annual Emergences, 1996–2004.

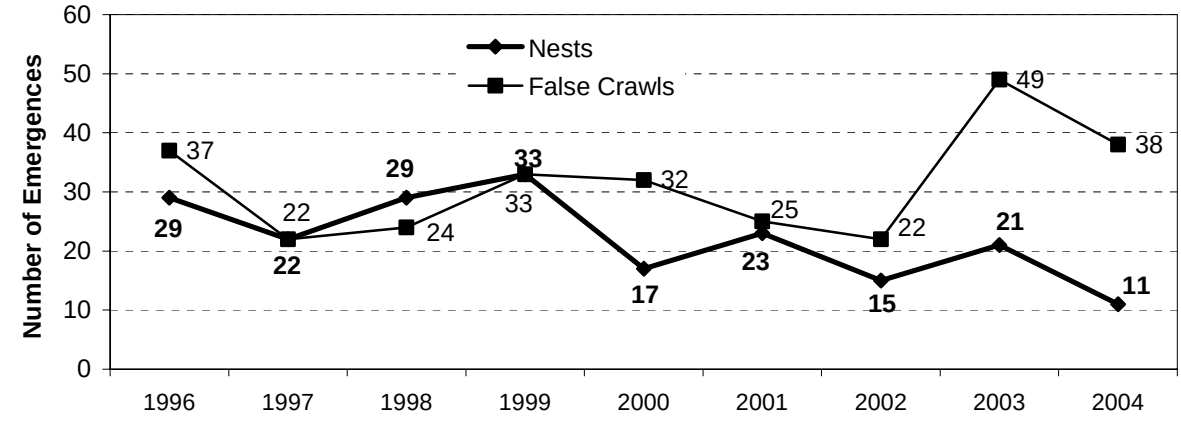


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Figure 2.3.3.4. Vanderbilt Beach Annual Emergences, 1994–2004

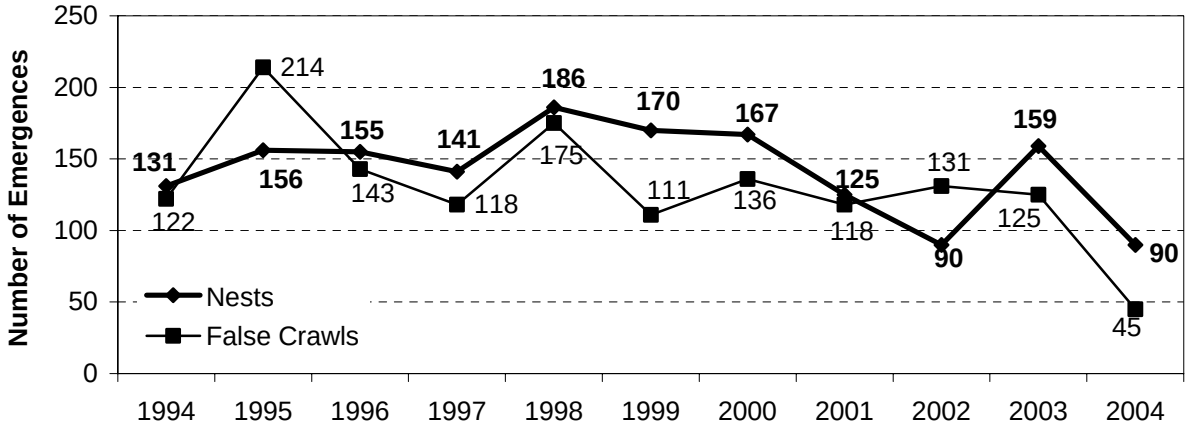


Figure 2.3.3.5. Park Shore Annual Emergences, 1994–2004.

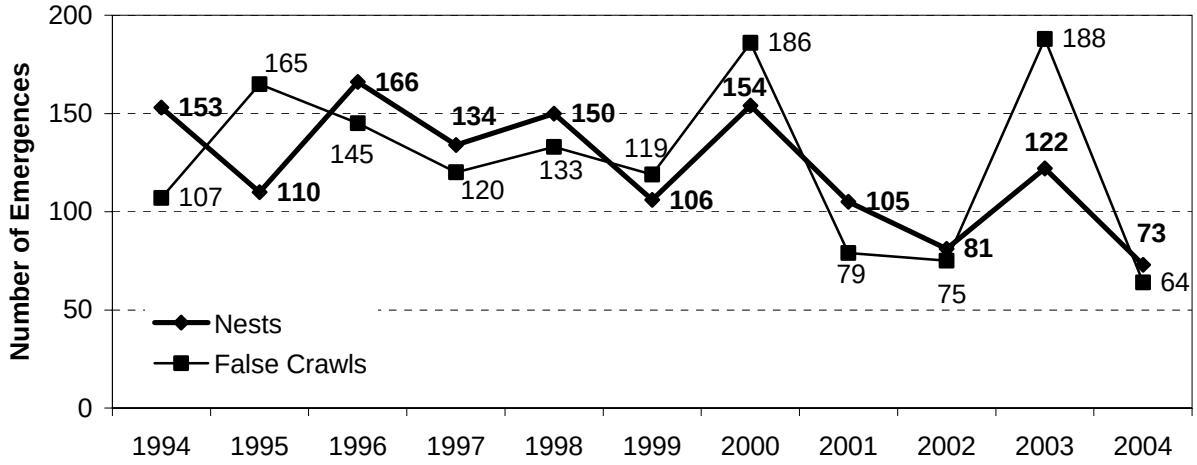


Figure 2.3.3.6. City of Naples Beach Annual Emergences, 1994–2004.

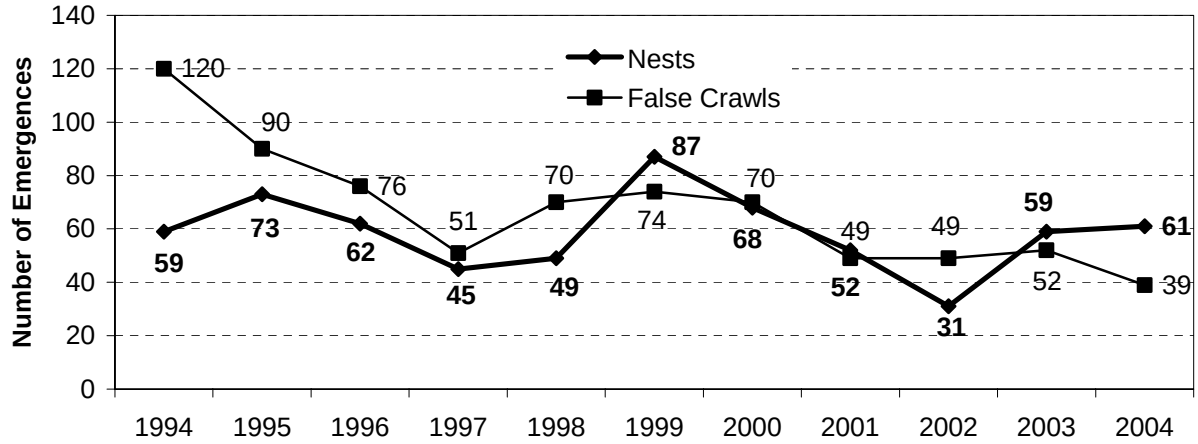
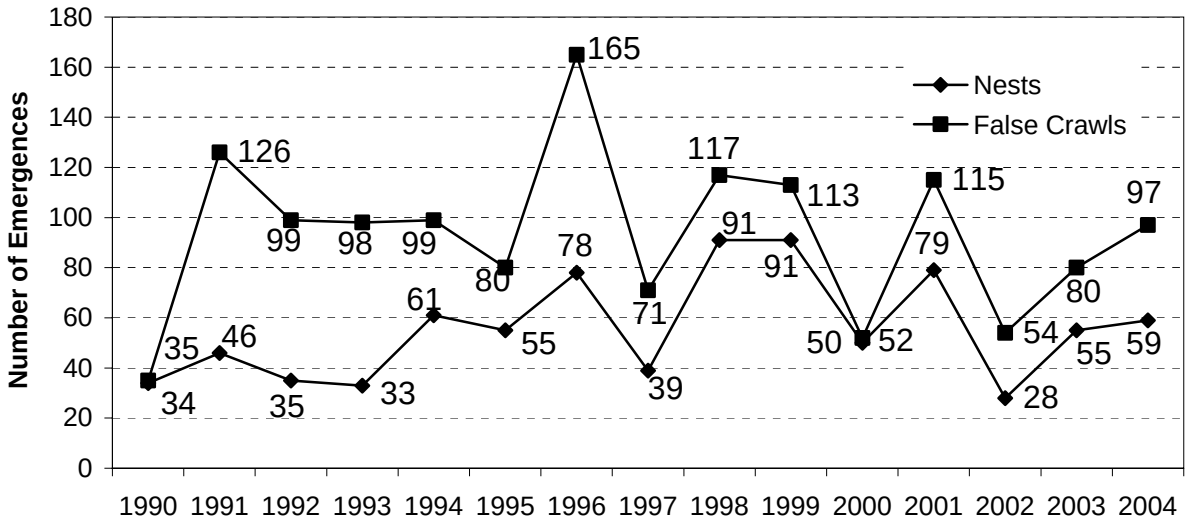


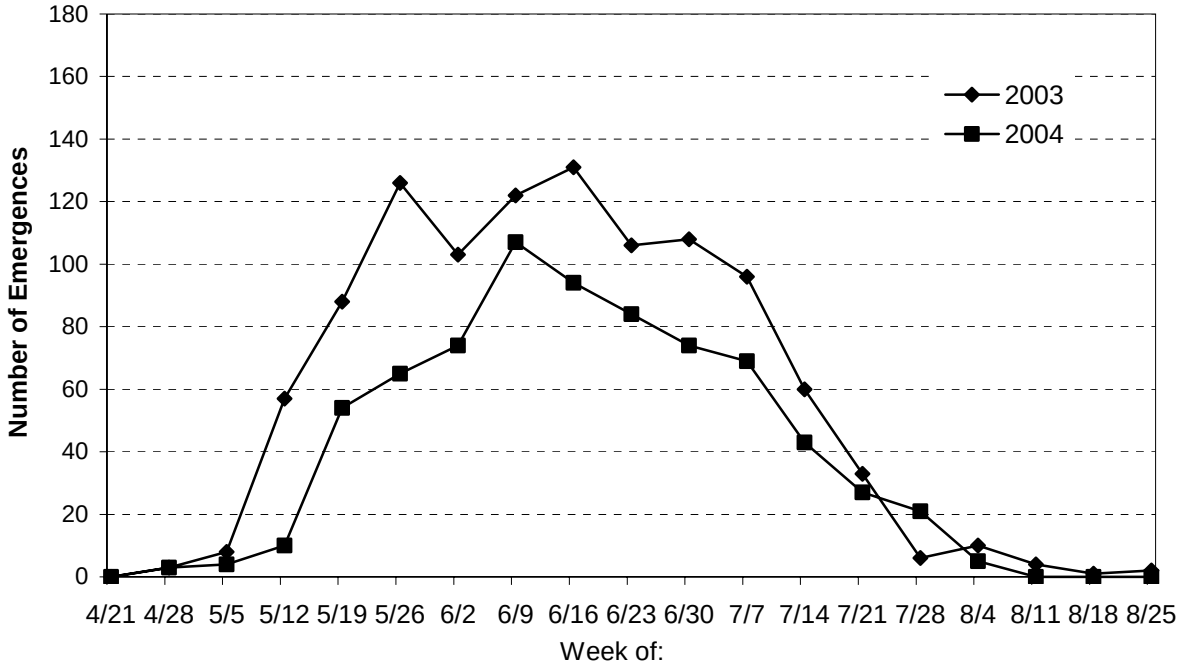
Figure 2.3.3.7. City of Marco Island Annual Emergences, 1990–2004.



Weekly Emergence Analysis

Sea turtle weekly emergence (nests and false crawls) trends are depicted in Figure 2.3.4.1 for 2003 and 2004. The graph shows only one peak of sea turtle emergences in 2004, 107 emergences were recorded for the second week of June. 2004 data revealed that the peak of season occurred two weeks later than the previous year, likely due to lower water temperatures at the beginning of the nesting season. Average water temperatures are normally 81 degrees by the first week of May, however, this did not occur until May 24th this season. A double peak has been observed in prior years.

Figure 2.3.4.1. Collier County Emergences Per Week, 2003–2004.



2.3.5 Clutch Depth

Measurements of the egg cavity were taken for each excavated nest when possible. Clutch depths were recorded from 143 of the 378 nests deposited. The clutch width was measured from the widest portion of the egg cavity and the clutch depth was measured from the sand surface to the firm bottom of the egg cavity.

No significant difference was found when the clutch depths were compared between renourished and non-renourished beachs ($p = 0.12$; $df = 1,142$; $F = 2.43$). This agrees with the 2003 analysis ($p = 0.27$, $F = 3.86$), and 2002 ($p = 0.07$, $F = 3.21$) where no significant difference was found between renourished and non-renourished beaches. When comparing the clutch depth of nests placed in each of the three sand sources present on renourished beaches (hydraulic/mechanical, and upland) and natural non-renourished beaches, no significant difference was found ($p = 0.21$; $df = 2,142$; $F= 1.54$, see table 2.3.5.1) and 2003 ($p=0.07$, $F = 3.02$). This differs from 2002 where a significant difference was found between hydraulic, mechanical, and upland sand types versus natural non-renourished beaches ($p = 1.31exp-4$, $F = 9.2$).

For this report, hydraulic and mechanical hydraulic renourished beaches were combined for analysis because they come from the same source (nearshore Gulf of Mexico or inside passes). When comparing hydraulic/mechanical renourished with natural non-renourished beaches, no significant difference was found ($p = 0.44$; $df = 1,82$; $F = 0.59$). Again, no significant difference was found when comparing upland renourished with natural non-renourished beaches ($p = 0.08$; $df = 1,115$; $F = 3.06$).

Table 2.3.5.1. Clutch Depth in Renourished Sand Types, 2004.

	Natural	Hydraulic	Upland
Mean Clutch Depth (Inches)	19.0	19.4	20.0
Number of Nests	60	27	56

2.3.6 Hatching Evaluation

In 2004, 378 nests were marked for evaluation. Of these nests, the ESD, CSWF, and DNWSP staff evaluated a total of 143 nests. Two hundred and twenty nests (58%) were lost due to storms during the 2004 season, and tidal flooding inundated 24% (n = 91) of the nests. Tidal flooding and washed out nests combined accounted for 82% of all nests compared to 35% in 2003, 29% in 2002, and 78% in 2001.

The average number of eggs per nest (clutch size) was 110 (range = 60–164) an increase from 100 in 2003, 107 in 2002, and 101 in 2001. Loggerhead sea turtles average 110 to 120 eggs per nest throughout their range, but the clutch size is highly variable (Ernst *et al.*, 1994).

Table 2.3.6.1. Collier County Mean Clutch Size, 2004.

	Barefoot	Delnor Wiggins Pass	Vanderbilt	Park Shore	Naples	Marco
Mean Egg Count / Nest	107	99	103	123	108	112

A total of 17,190 eggs were deposited into the evaluated nests and 11,585 hatchlings emerged successfully (Table 2.3.6.2). The total number of hatchlings released includes 11,023 that emerged on their own and 562 that were found alive in the nest cavity.

Table 2.3.6.2. Nest / Hatchling Evaluations by Beach Unit, 2004.

	Barefoot	Delnor Wiggins Pass	Vanderbilt	Park Shore	Naples	Marco	Total
Total Nests	84	11	90	73	61	59	378
Lost Nests	51	6	54	49	48	12	220
Total Eggs	3,543*	496	3,729*	2,967	1,404	5,051	17,190
Emerged Hatchlings	2,274	260	2,974	1,911	704	2,900	11,023
Hatchlings Alive in Nest	139	0	80	83	36	224	562
Hatchlings Dead in Nest	170	87	43	169	77	202	748
Undeveloped Eggs	230	122	379	99	104	486	1,420
Dead Embryos	107	27	182	461	403	984	2,164
Predated Eggs	600	0	11	200	0	3	814
Pipped Live Eggs	6	0	15	18	13	38	90
Pipped Dead Eggs	21	0	47	26	67	214	375
Overall Hatch Success of Evaluated Nests	73%	70%	83%	73%	58%	66%	72%
Overall Hatchling Emergence Success	64%	52%	80%	64%	50%	57%	64%

* Barefoot total numberof eggs are off by four eggs and Vanderbilt is off by two due to nests depredated but then washed out by storm events.

Unhatched eggs (4,392) were opened to identify fertility and embryonic development. Dead embryos comprised 49% of the unhatched eggs, depredated eggs made up 19%, and the remaining 32% were labeled as undeveloped due to lack of evidence of advanced embryological development. The undeveloped eggs may be a result of infertility or early embryological death. Each dead embryo was carefully inspected and the developmental stage was determined based on the 30 stages described by Miller (1985). Stages 1 through 20 are difficult to distinguish and were recorded together and labeled as “less than stage 21”. Stages 21 through 30 are determined relatively easily with the naked eye and were recorded separately. Embryos too

decomposed for identification were labeled as “undetermined”. Of the dead embryos, 13% (n = 277) were undetermined and 8% (n = 181) were less than 21. The highest percentage (26%, n = 575) of dead embryos was at stage 29. Sixty-two percent (62%, n = 115) of the nests containing dead embryos were inundated with seawater from the tide at some point during the incubation period.

The mean incubation rate of 60 days is a decrease from 63 days in 2003, as well as a decrease from 64 days in 2002. When comparing the types of renourishment, there was a significant difference in the mean incubation rate between natural sand and upland renourished sand (p = 1.01exp-8; df = 1,108; F = 38.63, Table 2.3.6.4). The majority of the upland sand renourishment took place within 2001 and 2002. There was no significant difference between natural sand and hydraulic (including mechanical) renourished sand mean incubation rates (p = 0.08; df = 1,175; F = 3.97). Finally, there was a significant difference in the mean incubation rate between nests that were fully exposed to the sun and nests that were shaded by vegetation or buildings (p = 3.29exp-3; df =1,133; F = 8.96).

Table 2.3.6.4. Mean Incubation Rate in Natural and Renourished Sand Types, 2004.

	Natural	Hydraulic/Mechanical	Upland
Mean Incubation Rate (days)	62	61	58
Number of Nests	52	24	57

The incubation success of a nest was measured by its overall hatching success and emergence success. The hatching success was calculated as the number of hatched eggs including live hatchlings and dead hatchlings found in the nest divided by the total egg count. The emergence success was calculated as the number of naturally emerged

hatchlings divided by the total egg count. The mean hatching success was 71% (Table 2.3.6.5), which repeats the percentage from last year, but is an increase from 66% in 2002 and 65% in 2001. The hatching success of nests found on natural, non-renourished beaches versus renourished beaches was found to be significantly different (p = 6.59exp-3; df =1,155; F = 7.59). When comparing the hatching successes on natural non-renourished beaches with those of upland sand renourished beaches, a strong statistical difference was found (p = 8.57exp-3; df = 1,126; F = 7.13). No significant difference in hatching success was found when comparing natural beaches with hydraulic renourished beaches (p = 0.13; df = 1,93; F = 2.36).

Table 2.3.6.5. Hatching and Emergence Success in Natural and Renourished Sand, 2004.

Natural Sand or Renourishment Type	Natural	Hydraulic/ Mechanical	Upland	Overall
Mean Hatching Success	63%	75%	78%	71%
Mean Emergence Success	56%	61%	73%	63%

The mean emergence success is 63% for all beaches and all sand types. There is a significant statistical difference between emergence success in natural and renourished sand beaches (p = 1.76exp-2; df = 1,155; F = 5.76).

2.3.7 Nest Predation

Human destruction and poaching, depredation by raccoons (*Procyon lotor*), fire ants (*Solenopsis invicta*), ghost crabs (*Ocypode quadrata*), and unknown predators affected 3% (13 nests) of the total nests; a decrease from 18% (90 nests) in 2003. Most depredations occurred on Barefoot Beach, where seven nests (8%) were depredated. The

breakdown of nests depredated (13) included: seven nests (54%) that were caused exclusively by raccoon, two (15%) by fire ants, one (8%) by unknown predators, and one by ghost crabs (8%). Two nests (15%) were found completely poached by humans. There was a decrease in major predators in 2004, including gray fox, raccoon, fire ant and ghost crab predation.

The damage caused by predators to sea turtle eggs was minimal, relative to the overall success. Of 17,190 eggs deposited in 2004, 814 (5%) were lost to predators, a increase from 858 (2%) in 2003. Fox depredation of eggs decreased to 0% from 54% in 2003, and 21% in 2002. Raccoon depredation of eggs also decreased to 3% from 17% in 2003, and decreased from 12% in 2002. Table 2.3.7.1 provides a breakdown of egg predation during 2004. Nest screening, nuisance animal trapping and relocation efforts combined with the great loss of nests caused by storms may have contributed to this year's very low depredation rate.

Table 2.3.7.1. Egg Depredation in Collier County, 2004.

Predator(s)	Number of Eggs Taken	Percentage By Predator
Raccoons	600	73.7%
Humans	200	24.6%
Ghost crab	2	0.2%
Fire Ants	3	0.4%
Unknown	9	1.1%
Total	814	100%

Predators only minimally affected hatchlings, with 12 (0.1%) taken from a total of 12,333 hatchlings. All of the predation of hatchlings occurred from fire ants. Table 2.3.7.2 provides a breakdown of hatchling predation during 2004.

Table 2.3.7.2. Hatchlings Depredated in Collier County, 2004.

Predator(s)	Number of Hatchlings Taken	Percentage by Predator
Fire Ants	12	100%
Total	12	100%

Nuisance wildlife control measures have been instituted for the past several years, although accurate data has been difficult to obtain. In addition to removal by local trappers the ESD staff also assisted in removal of predators. Gray fox predation efforts had a marked effect on the 2003 nests and eggs, but not a significant impact upon sea turtle hatchlings. In 2004 the ESD staff removed five raccoons, two feral cats and two opossum from Vanderbilt beach. An additional three raccoons were removed from Barefoot beach. In 2002 and 2003 the ESD staff had seen an apparent increase in gray fox predation efforts, possibly reflecting a population increase, or a general switch to dune habitats from nearby urban areas. While this increase in predation is counterproductive to ESD turtle conservation efforts, the presence of this species may have its benefits. Preliminary observations indicate that the presence of gray fox may help to deter raccoon predation attempts in some instances. More observational and analytical data is needed to confirm such a relationship. No gray fox depredation occurred in 2004.

2.3.8 Effects of Storm Events

Four major storms affected the nests with inundations and wash outs including a storm on July 20, Hurricane Charley, and storm events caused by Hurricanes Frances and Jeanne. The first incident occurred on July 20th, a strong west wind combined with high tides and rain inundated 65 nest on Collier County beaches and washed away 23.

Hurricane Charley passed through the offshore waters of Collier County on August 13th pushing a storm surge onto the beaches. The effects of this storm included high winds, high waves, rain, and very high tides that eroded and inundated much of the county's beaches. The storm only lasted one day but was the strongest hurricane this area of Southwest Florida had experienced in over four decades. The damage to turtle nests was severe. Hurricane Charley inundated 22 nests and washed away 183, a total of 48% of the season's nests.

On September 5th and 6th the effects of Hurricane Frances were felt along the beaches with gusty strong winds and high tides, causing more havoc to the few nest that were left. The storm event caused by the hurricane inundated four nests and washed away 13.

The last storm that affected the beaches of Collier County was Hurricane Jeanne on September 27th. The destruction caused by the storm was relatively minor with only one nest lost to the storm. The following graphs show the impacts of the storms to turtle nests for each of the Collier County Beaches (2.3.8.1), and inundations caused by each storm (2.3.8.2).

Figure 2.3.8.1 Nests Inundated and Washed Out Per Beach

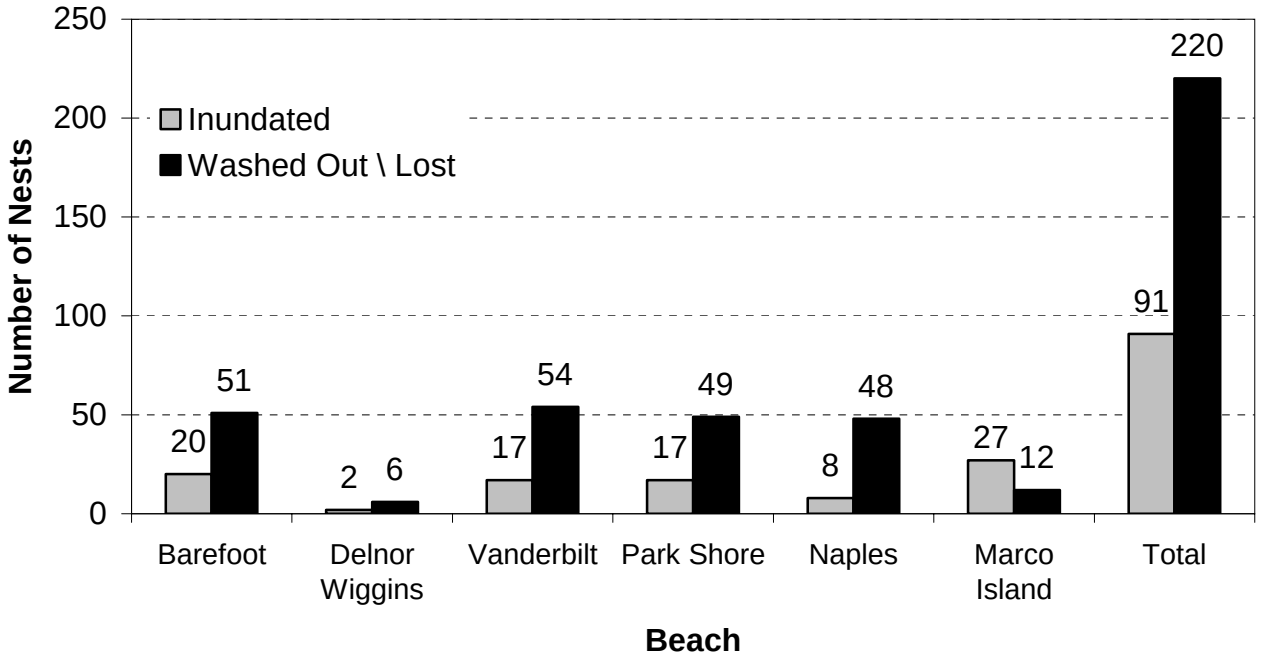
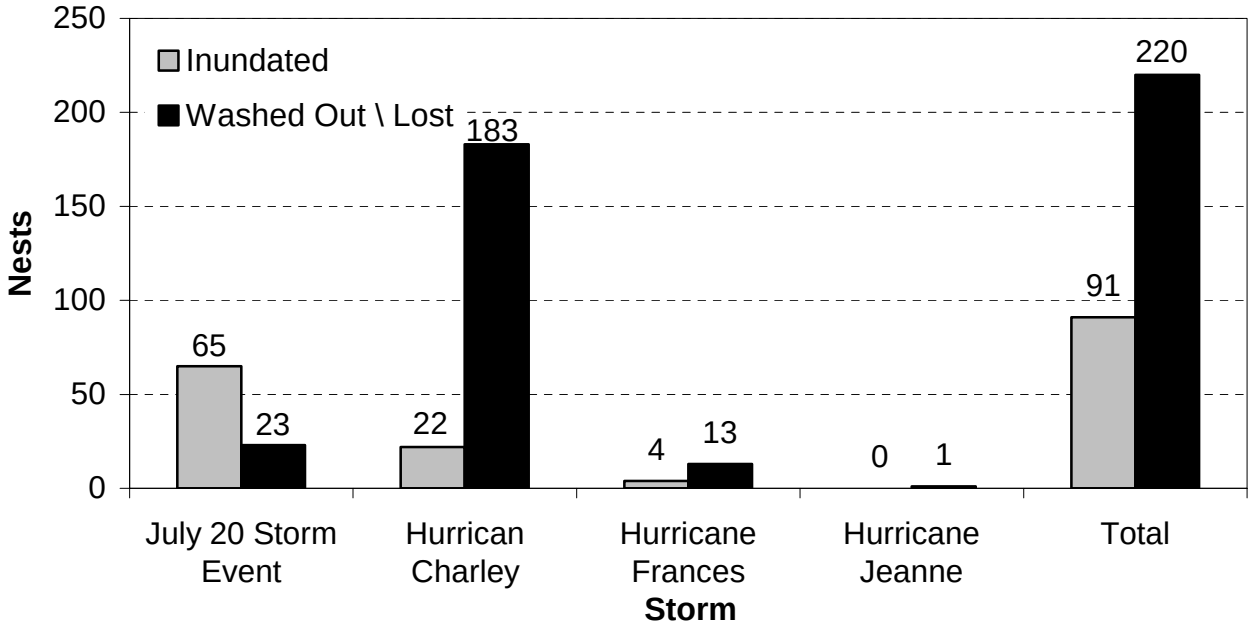


Figure 2.3.8.2. Nests Inundated and Washed Out Per Storm Event.



SECTION 3

BEACH LIGHTING PROGRAM

Artificial lighting on nesting beaches, distant sources of illumination ("city glow") and other sources of light pollution can interfere with the normal nesting behavior of sea turtles and cause hatchling orientation problems. Light pollution has been proven to discourage sea turtles from emerging out of the water to nest (Witherington, 1996). The negative effects of artificial lights on hatchling sea turtles are well documented (Danial and Smith, 1947; Dickerson and Nelson, 1989; Witherington, 1990). Artificial lighting interferes with a hatchling sea turtle's ability to correctly orient, causing them to crawl towards sources of the light pollution (disorientations). Disorientations affect sea turtles by leaving them vulnerable to dehydration, exhaustion, and predation (Witherington, 1999). Nest site selection itself may predispose some nests to risks of disorientation (see Section 2.3.5). Hatchling loggerhead turtles appear to be more susceptible to disorientation on wider beaches where nests are placed further from the vegetation, implying a protective benefit of the dune vegetation, by shading landward light sources.

In accordance with the "Collier County Sea Turtle Protection Regulations" (Land Development Code Sec.3.10, 1994), the ESD developed a program to minimize the damages caused by light pollution. The program is composed of an annual mail-out in early April, a second reminder several weeks later, night lighting compliance inspections, violation notices, and code enforcement action. The annual mail-out is a sea turtle information package sent to beachfront establishments that illustrates the importance of shielding or turning off lights during sea turtle nesting season, suggests inexpensive methods of reducing and minimizing beach lighting, and reminds the reader to remove

any obstacles to nesting and hatching sea turtles such as beach furniture or recreational accessories. A lighting reminder postcard is also sent several weeks later.

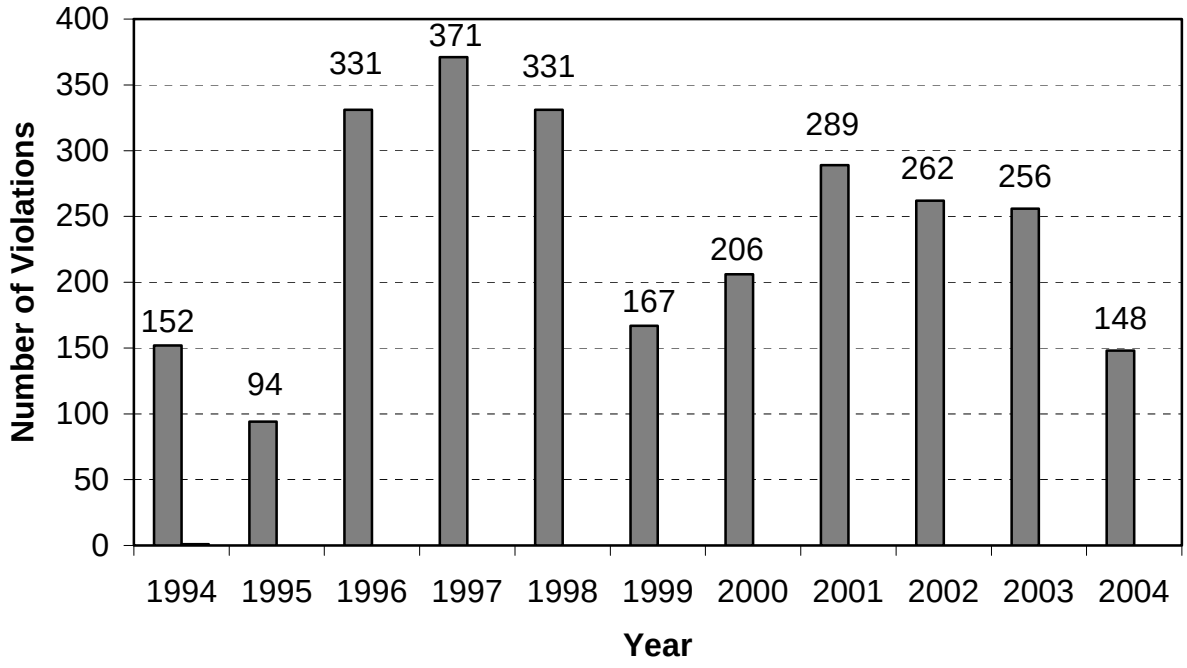
Throughout sea turtle nesting season (May 01 – October 31), the ESD staff conduct monthly lighting compliance inspections. Light sources that create a visible shadow on the beach are considered a violation. When a violation is identified, efforts are made to work with the property managers and owners to correct the problem. First time violators receive phone notification of the problem; second time offenders are sent a non-compliance letter; violations with no attempt to correct are sent a to Collier County's Code Enforcement Department for formal action. If the violation is not corrected when the Code Enforcement Inspector arrives, the establishment receives formal "Notice of Violation". Additional violations may result in citations and court actions. Table 3.1 is a breakdown of lighting violations caused by beachfront establishments. During the 2004 season, the ESD documented 139 lighting violations, a 45% decrease from the 254 violations documented in 2003. The decreased amount of violations this year is partly due to the fact that the beaches were not monitored during the months of August and September due to intensive washouts caused by storms. Figure 3.1 shows historical beach lighting violations

Table 3.1. Beach Lighting Violations By Month in Collier County, 2004.

	May	June	July	August	September	Totals
Barefoot Beach	6	4	9	*NI	*NI	19
Vanderbilt Beach	4	2	3	*NI	*NI	9
Park Shore Beach	8	4	5	*NI	*NI	17
City of Naples Beach	20	18	22	*NI	*NI	60
Marco Island Beach	19	18	2	4	*NI	43
Totals By Month	57	46	41	4	*NI	148

*NI= No inspections were done on these beaches in September since most nests had already emerged or were washed away by storms.

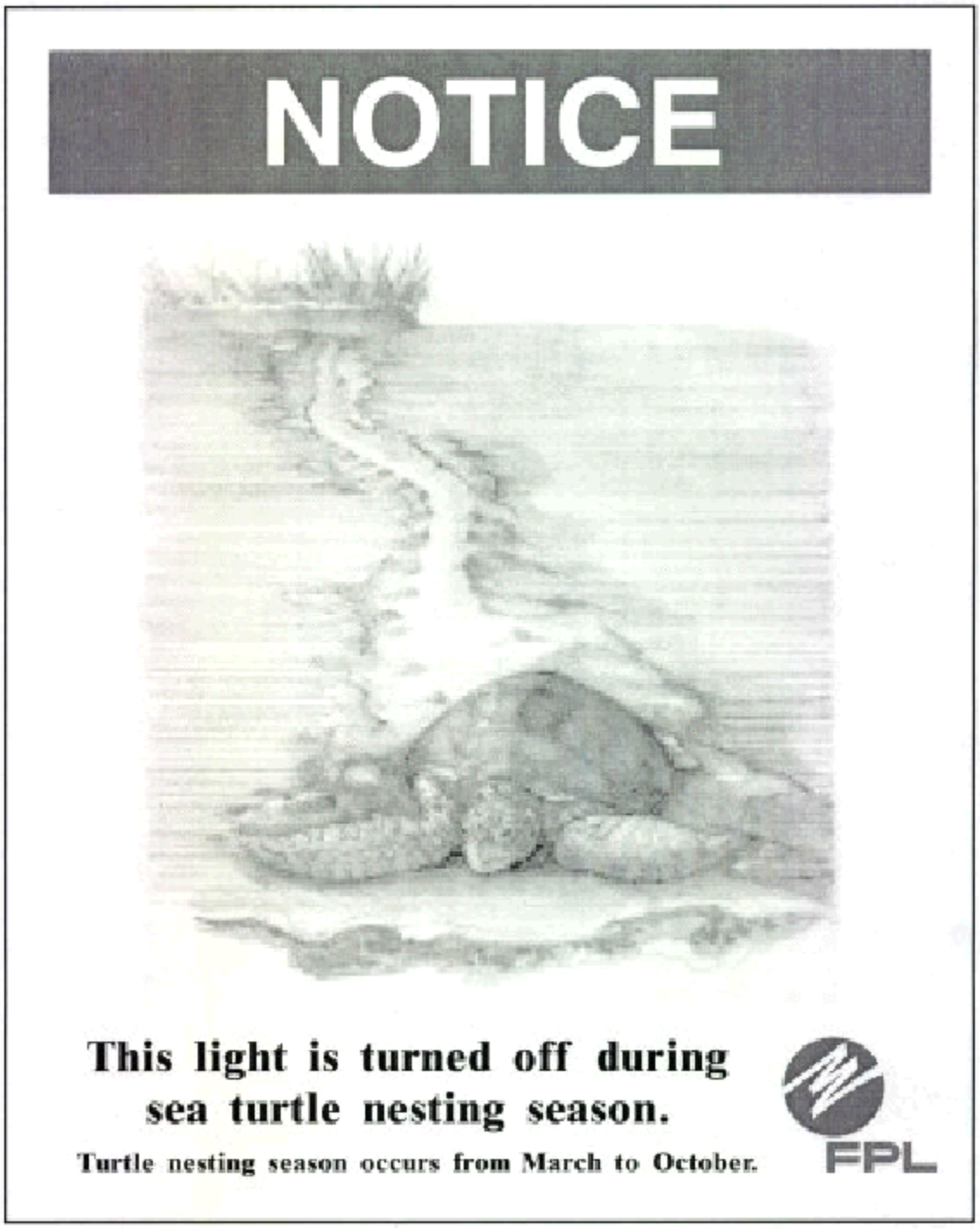
Figure 3.1 Historical Beach Lighting Violations, 1994–2004.



In 2003, Florida Power and Light Company (FPL) replaced 21 beach access lights and the roadway lighting along Moorings Residents Beach with 70-watt Cobra Cutoff fixtures. Cobra Cutoffs are recommended by the state based on the Coastal Roadway Lighting Manual (Ecological Associates, Inc., 2002). The fixtures are effective, if positioned properly, in managing streetlights so they are not harmful to sea turtles yet

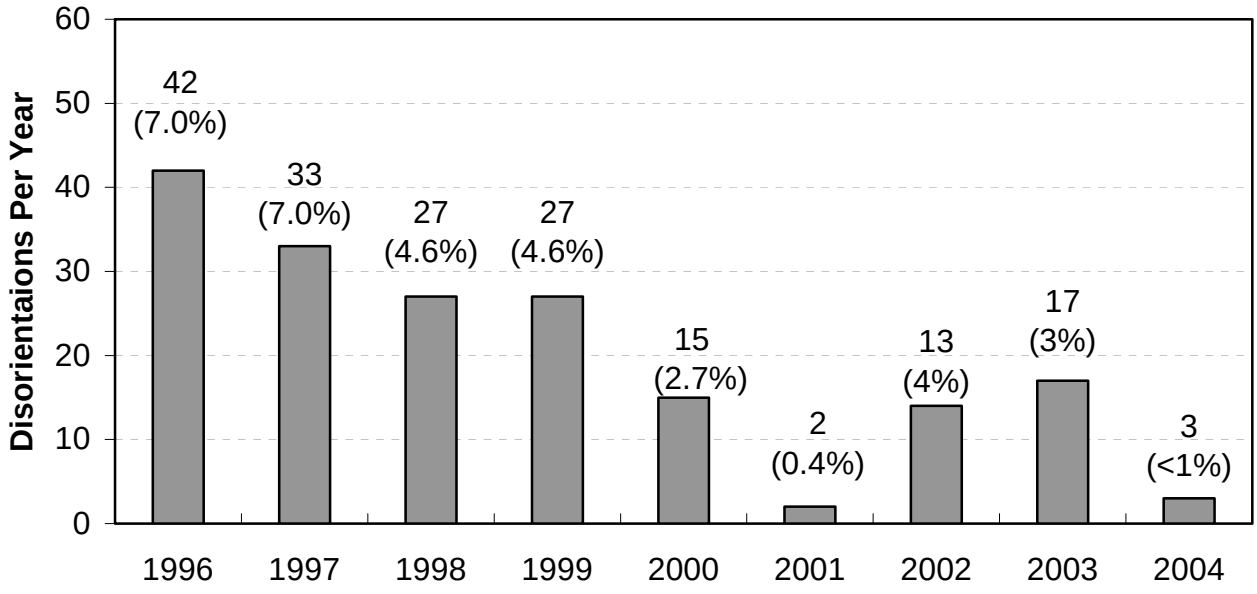
meet safety standards for vehicular and pedestrian traffic. Each light was assessed individually upon the night instillations and adjusted so that no light spilled onto the beach. Lights that were not replaced were shut off and a sign was affixed to the pole to alert beach goers that the light was off for sea turtle season (Figure 3.2).

Figure 3.2. FPL Light Out Notice.



By working with property owners, managers, and renters, the beach lighting program decreased the amount of hatchling sea turtles affected by light pollution. In 1996, ESD staff documented 42 disorientations (7% of the nests), since that time the amount of disorientations have decreased. In 2004, there were 3 disorientations (<1% of the nests) caused by severe beach lighting violations. One incident resulted in 23 hatchlings disorienting. One hatchling was found dead while the remaining 22 hatchings were found alive around the property of the Edgewater Beach Hotel. Another disorientation occurred on Hideaway where 10 hatchlings were found dead and the resident was fined $6,000.00. The third violation occurred on Park Shore Beach. Approximately 20 hatchlings disoriented and one was found dead. No obvious lighting source was found for this disorientation. The decrease in disorientations from the 2003 season is partially due to the high number of nests lost to storm events. Figure 3.3 shows a yearly decrease in disorientations beginning one year after the initiation of the beach lighting program and continuing through 2004.

Figure 3.3. Disoriented Nests in Collier County, 1996–2004.



In addition to documenting lighting violations, ESD staff also recorded objects left on the beach that could be an obstacle to nesting and hatchling sea turtles. The Collier County Land Development Code section 3.13.3 requires that any structure such as beach furniture, not requiring a building permit, be removed from the beach nightly. Objects left on the beach over-night were documented and a NOV sticker adhered to the object to inform the owner of the need for furniture or equipment to be removed (Figure 3.4). In 2004, there were 554 violations during the sea turtle season. Nine lighting violations had Code Enforcement involvement. A hotel on Vanderbilt beach received a $250.00 citation. The remaining eight violations did not result in any fines. The ESD staff hopes to reduce this number by notifying people of the harm furniture and other equipment can cause on nesting or hatchling sea turtles. Table 3.2 shows the amounts of beach furniture violations documented throughout the season. Not included in the table is a motorcycle found on the City of Naples Beach.

Table 3.2. Beach Furniture Violations, 2004.

	Boats	Chairs	Tables	Tents	Umbrellas	Totals
Barefoot Beach	1	44	6	0	0	51
Marco Island Beach	9	158	2	12	17	198
City of Naples Beach	1	184	0	1	4	191
Park Shore Beach	0	12	0	0	0	12
Vanderbilt Beach	2	82	6	4	7	101
Total	13	480	14	17	28	553

Figure 3.4. Notice of Violation Sticker.

Collier County Government
WARNING NOTICE OF VIOLATION

May 01 through October 31 is sea turtle season throughout the State of Florida. Sea turtles are protected by local, State and Federal regulations and it is a criminal act to disturb sea turtles, their eggs, nests and/or habitat.

After 9:30 pm no person shall leave beach furniture unattended on the beach (LDC Sec. 3.13.7.3; 3.13.9) These items may interfere with the movement or may entangle these endangered species.

The following acts are strictly prohibited and enforced by County Code Enforcement officers.

1. Taking, harming or disturbing sea turtles, their eggs, nest and/or habitat.

2. The placement of tents, chairs or other obstructions on the beach at night.

3. The use of any type of lights including bonfires and fireworks.

4. Driving on the beach without a valid vehicle on the beach permit.

Sea turtles need a beach free of obstructions and must not be disturbed. Should we find this obstruction left on the beach for a 24 hour period we will consider it derelict and remove it from the beach. If you have any questions regarding this notice please call the Collier County Environmental Services Department at (941) 732-2505.

SECTION 4

SEA TURTLE STRANDING AND SALVAGE PROGRAM

Stranded sea turtles are those that wash ashore or are found floating, dead or alive in a weakened condition. The ESD has been actively involved in assisting the Florida Fish and Wildlife Conservation Commission's (FWC) Sea Turtle Stranding and Salvage Network (STSSN) with data collection on dead, sick or injured sea turtles since 1994. Prior to 1994, not all strandings in Collier County were reported and many sea turtles were disposed of without notification to the ESD or the FWC. The FWC is required to send all stranding data to the National Marine Fisheries Service (NMFS) on a weekly basis. The NMFS uses this data to further our knowledge of sea turtle biology, species composition, distribution, seasonality, migratory patterns, habitat use and sources of mortality.

Sources of sea turtle mortality include, but are not limited to the following: incidental catch by commercial fisheries (trawling gear, gill nets, drift nets, long lines and crab traps), entanglement and ingestion of marine debris, boat strikes, poaching, injury from shark attack, disease, and natural causes. The cause of mortality is determined when possible and used to identify ways of aiding in population sustainability. The STSSN program is critical to the future conservation and recovery efforts of sea turtles.

In 2004, 39 sea turtles were reported stranded along the Collier County coastline, representing a 50% decrease of the strandings reported in 2003 (n=78). Strandings occurred every month (Figure 4.2).

Figure 4.1. Collier County Sea Turtle Strandings, 1996–2004.

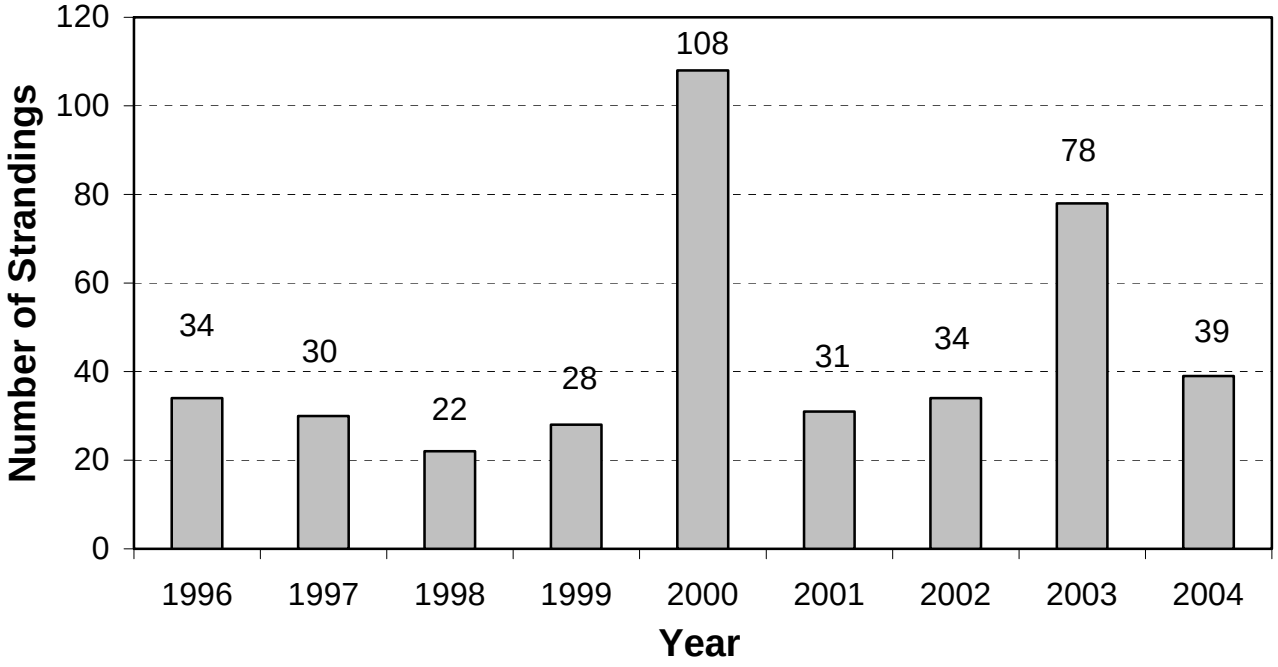
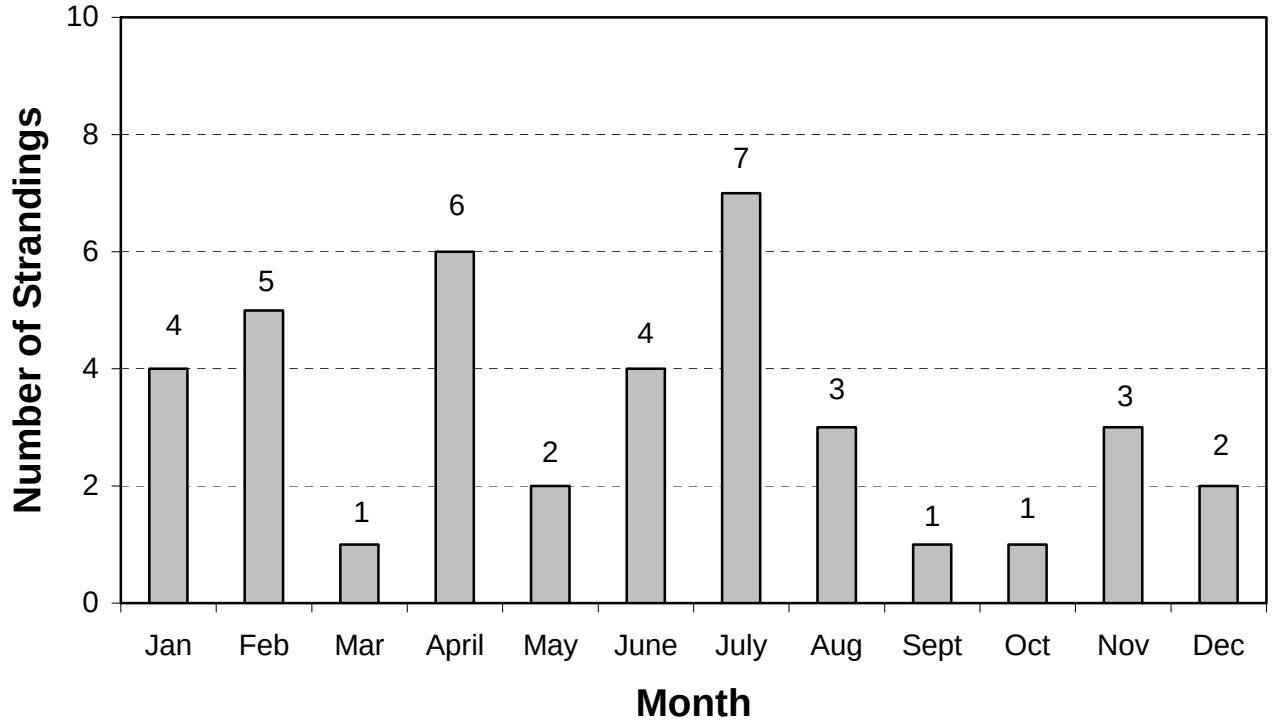


Figure 4.2. Collier County Monthly Sea Turtle Strandings, 2004.



Strandings in 2004 included 29 loggerheads, five (5) Kemp's ridleys' and three (3) green sea turtles. Four of the 39 sea turtles were alive at the time of stranding and consisted of two (2) loggerheads, (1) kemps ridley and one (1) green sea turtle. One stranded loggerhead died in route to a rehabilitation facility, one loggerhead was rehabilitated at Clearwater Marine Aquarium and was returned to Collier County Gulf of Mexico waters in January 2005. The kemps ridley is still at the CMA for rehabilitation. The green sea turtle was taken to C.R.O.W. for rehabilitation and was released.

Abnormalities of dead and live sea turtles ranged from boat and/or obvious propeller damage with visible markings or hull paint (13), shark bites (1), crab trap entanglement (1), stuck in mangroves after nesting (1), large fishing hook lodged in its throat and was severely emaciated (1) and fibropapillomas (1). The remaining turtles either had no obvious cause of death or were too decomposed to assess. In many cases it is not known if boat damage or shark bites were the cause of death or a post-mortem injury.

Increased public awareness of the reporting requirements may result in better coverage for the STSSN. Stranding and salvage personnel are not in the field on a daily basis outside of the nesting season and rely on the Florida Marine Patrol and the public for stranding locations. Stranded sea turtles outside the developed beaches may not be found or reported, some are lost at sea, and others buried by persons unfamiliar with the reporting procedures. The ESD responded to 28 of the 39 sea turtle strandings. The other strandings were responded to by the following organizations: the Conservancy of Southwest Florida (6), Delnor-Wiggins Pass State Park (1), and Rookery Bay NERR (4).

SECTION 5

PUBLIC AWARENESS

A vital step in sea turtle protection is public awareness of the problems turtles encounter. The ESD staff provides important public education to curious beachgoers while working on the beach. In 2004, ESD staff responded to the inquiries of approximately 3,128 people during morning surveys.

Public awareness is also accomplished through public presentations and displays. The ESD provides this service for local organizations and schools, upon request. A list of presentations performed is provided in Appendix II. Sea turtle web pages containing updated information on nest/false crawl counts, beach lighting, strandings, and general information are published on the department website (www.colliergov.net/esd).

The ESD staff, along with artwork donated by Planet8Digital (Planet8Digital.com), created a sea turtle brochure to educate the public about sea turtles and ways they can get involved with sea turtle protection. The brochures are distributed when stopped for questions during morning surveys and at presentations. The ESD staff has also developed several other public awareness materials, which include: magnets, pencils, memo boards, beach lighting reminding post cards, LED flashlights with a whistle, mighty grip jar openers, and bumper stickers. The public awareness materials were developed with funds from the Florida Fish and Wildlife Conservation Commission's, Marine Turtle Grants Program and administered by the Caribbean Conservation Corporation (CCC). The Marine Turtle Grants Program is based on the proceeds from the sale of sea turtle license plates.

During the 2004 sea turtle season, a kiosk display was placed at City of Marco Islands' Residence Beach, the City of Naples Pier, Delnor-Wiggins Pass State Park, and

at Barefoot Beach Preserve County Park. The display was updated weekly with the current sea turtle activity for each beach and for the entire county. The poster also displayed general sea turtle information and included the ESD's website address and contact information.

The Collier County Government Access Channel aired a 64-second Public Service Announcement (PSA) on the local cable channel TV 11 and donated over $76,000 worth of airtime. The PSA was broadcast daily from May 10 to September 19 2004. The County Bulletin Board also aired a PSA broadcast throughout the day. The ESD staff also conducted several interviews with local TV channels and they are listed in Appendix II.

Present plans include reproduction of brochures and bookmarks due to their popularity, beach lighting postcards that remind residents about there lights during season, and production of a children's ruler with a marine life picture depicted on one side. Public awareness incentives will hopefully be funded with assistance from a FWC Marine Turtle Grants Program.

SECTION 6

SUMMARY

Adult loggerhead sea turtle (*Caretta caretta*) emergences were recorded on Collier County beaches from May 4th through August 10, 2004. A total of 378 nests and 356 false crawls were identified on Barefoot Beach, Delnor-Wiggins Pass State Park, Vanderbilt Beach, Park Shore Beach, City of Naples Beach, and City of Marco Island.

The 2004 data revealed that the peak of season occurred two weeks later than the previous year. A double peak has been observed in years prior. The summary for each beach is given in Table 6.1.

Table 6.1. Summary of All Monitored Beaches, 2004.

	Barefoot	Delnor Wiggins Pass	Vanderbilt	Park Shore	Naples	Marco Island	Total
Beach Length (miles)	3.1	1.2	3.5	3.2	5.6	7.1	23.7
Nests	84	11	90	73	61	59	378
Nests / Mile	27	9	26	23	11	8	17
False Crawls	73	38	45	64	39	97	356
False Crawls/ Mile	24	32	13	20	7	14	18
Mean Clutch Depth (in)	19	22	20	20	20	19	20
Nests Depredated	7	0	2	2	0	2	13
Nests Inundated	20	2	17	17	8	27	91
Nest Washed Out	51	6	54	59	48	12	220
Mean Incubation (days)	61	61	58	63	61	60	61
Disoriented Nests	0	0	0	1	1	1	3
Mean Hatching Success	73%	70%	83%	73%	58%	66%	72%
Mean Emergence Success	64%	52%	80%	64%	50%	57%	64%
Eggs Deposited	3,543	496	3,729	2,967	1,404	5,051	17,190
Hatchlings Emerged	2,274	260	2,974	1,911	704	2,900	11,023

Data showed no nesting preference for the natural (non-renourished) beach areas. In natural beach areas, a mean of 14.4 nests/mile were recorded while 17.5 nests/mile were recorded on renourished beach areas (Table 6.2). There was no significant difference found when the clutch depths were compared between renourished and non-renourished beach areas. Types of renourished sand used showed no significant correlation to clutch depth this year. Mean incubation rates showed to be slightly shorter in renourished beach areas.

Table 6.2. Summary of Natural Versus Renourished Beach Areas, 2004.

	Natural Beaches	Renourished Beaches	All Beaches
Beach Length (mile)	11.8	11.9	23.7
Nests	169	209	378
Nests Per Mile (mean)	14.3	17.5	15.9
False Crawls	199	157	356
False Crawls Per Mile (mean)	16.9	13.2	15.0
Mean Clutch Depth (in)	19.8	19.6	20.1
Mean Incubation (days)	62.3	58.9	60.3
Disoriented Nests	0	3	3
Mean Hatching Success	63%	78%	72%

In 1996, ESD staff documented 42 disorientations, which made up 7% of the total nests in the county. In 1997, 33 disorientations were recorded (7% of total nests). Disorientations decreased to 27 (5% of total) in 1998, 27 (4%) in 1999, 15 (3%) in 2000, 2 (<1%) in 2001,13 (4%) in 2002, 17 (3%) in 2003 and 3(<1%) in 2004.

In 2004, 13 nests (3%) were depredated, a decrease from 90 nests (18%) in 2003. Most depredations occurred on Barefoot Beach where 7 nests (8%) were depredated. The

primary predators in 2004 were raccoon (7 nests (54%)), fire ants (2 nests (15%)), unknown predators (1 nest (8%)), ghost crabs (1 nest (8%)) and humans two nests (15%).

In 2004, 39 sea turtles were reported stranded along the Collier County coastline, representing a 50% decrease from the 78 strandings in 2003. Species composition includes 29 loggerheads (*Caretta caretta*), 5 Kemp's ridleys (*Lepidochelys kempi*), 3 green turtles (*Chelonia mydas*).

Public awareness activities included 3,128 interactions with people during morning turtle surveys. It also includes presentations at local organizations and schools. The ESD staff has created a sea turtle brochure as well as several other public awareness materials, which include: magnets, pencils, memo boards, beach lighting reminding post cards, LED flashlights with a whistle, mighty grip jar openers, and a bumper sticker. These public awareness materials were developed with funds from the Florida Fish and Wildlife Conservation Commission, Marine Turtle Grants Program. The Marine Turtle Grants Program is based on proceeds from the sale of sea turtle license plates and is administered by the Caribbean Conservation Corporation.

"Public Service Announcements" were aired on the Collier County Access Channel. Present plans include reproduction of brochures and bookmarks due to their popularity, and production of a children's ruler with a marine life picture depicted on one side.

SECTION 7

GOALS AND RECOMMENDATIONS

1. Work with the City of Naples to ensure the proper shielding and placement of lights as they re-develop the beach accesses.
2. Locate additional funding sources so the ESD may expand public awareness programs and conduct additional research projects.
3. Continue to encourage dune vegetation enhancement as a method of shielding "necessary" lights.
4. Continue our strong efforts to minimize furniture left on the beach during sea turtle nesting season.
5. Improve historical analysis to identify trends.
6. Create an additional method of marking nests prior to a storm event that would allow us to easily locate nest site after the storm passes.
7. Provide a sign for the Pier, City Dock , and boat ramps on how to untangle sea turtles from fishing line/hooks and include emergency contact information.
8. Provide a more intense excavation/evaluation training session for other cooperation entities.
9. Place an education display on sea turtle conservation at the new Naples Preserve.

SECTION 8

ACKNOWLEDGMENTS

This report is dedicated to Jason Seitz for his five years of hard work and dedication to the Collier County Sea Turtle Protection Program.

The Environmental Services Department would like to extend our thanks and appreciation to the following persons and organizations for their contributions: Harold Saylor, Mary & Richard Nelson, Susan & John Gerig, Julie Shoaf, Beverly Shipe and the countless other volunteers and community service students for their volunteer services; Melissa Hennig, Doug Suitor, Mac Hatcher, Bill Lorenz, and Cheri Rollins, ESD staff; Ron Hovell and Al Madsen, Tourism; Summer Brown, Code Enforcement; David Addison and interns of the CSWF; Dr. Jon Staiger, and Dr. Gary Pettit of City of Naples; Carolyn Shaw and staff of Delnor-Wiggins Pass State Park; Robbin Trindell, Meghan Conti, Karrie Singel and Ed de Maye of the FWCC; Jill Schmid, Cheryl Metzger, Pam Keyes and the Friends of Rookery Bay NERR volunteers; Kady Arnold, Collier County Public Affairs; Nancy Richie, City of Marco Island; Glenn Harmon, Clearwater Marine Aquarium; Anthony Toro and Albert Prano of Planet 8 Digital for their outstanding effort and time spent designing artwork for our public awareness materials.

The ESD would also like to extend appreciation to the Tourist Development Council, the Collier County Board of County Commissioners; the Beach Nourishment/Maintenance Committee; and others we may have failed to mention.

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