COLLIER COUNTY
PUBLIC SERVICES DIVISION

PUBLICATION SERIES

PR-17-01

COLLIER COUNTY
SEA TURTLE PROTECTION PLAN
ANNUAL REPORT – 2017

Principal Investigators

Maura C. Kraus, Principal Environmental Specialist

Mary K. Toro, Environmental Specialist

Markus Hennig, Environmental Specialist

Prepared by
Parks and Recreation Division

Naples, Florida
February 2018

BOARD OF COUNTY COMMISSIONERS

Andy Solis, Esq.
CHAIRMAN
DISTRICT 2

William L. McDaniel Jr.
VICE-CHAIRMAN
DISTRICT 5

Burt L. Saunders	Penny Taylor	Donna Fiala
COMMISSIONER	COMMISSIONER	COMMISSIONER
DISTRICT 3	DISTRICT 4	DISTRICT 1

Leo E. Ochs Jr.
COUNTY MANAGER

PUBLIC SERVICES DEPRTMENT

Steve Carnell
DEPARTMENT HEAD

Barry Williams
PARKS AND RECREATION DIVISION DIRECTOR

Period of Investigation

April 2017 through October 2017

In addition to fulltime staff, the following part-time staff members provided invaluable field assistance:

Mary Nelson
Yesenia Olvera
Baylee Wolfesberger
Jackie Kleinhoffer

The project on which this publication is based was financed by the Collier County Board of County Commissioners and the Tourist Development Tax Fund for Category A:
Beach Renourishment and Pass Maintenance Projects

For additional information email: MauraKraus@colliergov.net

ABSTRACT

Collier County was responsible for the daily survey of 23.7 miles (38.1 km) of beach for sea turtle activities during the 2017 sea turtle season (May through October). The Collier County Parks and Recreation Division surveyed 16.9 miles (27.2 km) of beach including Barefoot, Vanderbilt, Park Shore, and Marco Island beaches. Staff documented 681 nests in 2017, a decrease from the 822 nests in 2016. Under contract to Collier County, the Conservancy of Southwest Florida documented 206 nests on the 5.6-mile (9.0 km) City of Naples beach. Forty nests were documented on the 1.2-mile (1.9 km) beach along Delnor-Wiggins Pass State Park. During the 2017 nesting season, 1.9% (18) of the documented nests disoriented. One hundred and sixty-six (17.9%) of the 927 were depredated, which is a slight increase from the one hundred forty-seven (12.8%) in 2016. A total of 44,366 hatchlings were estimated to have reached the Gulf of Mexico. The number of successfully emerged hatchlings represents a decrease compared to 51,317 hatchlings that reached the Gulf of Mexico in 2016. There were 31 recovered sea turtle strandings (dead or injured) in Collier County in 2017.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

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
CCPRD	Collier County Parks and Recreation Division
CROW	Clinic for the Rehabilitation of Wildlife
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

FDACS	Florida Department of Agriculture and Consumer Services
FWCC	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
SM	Stewart Mining (Immokolee)
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 approximately 30 - 35 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, large holes left on the beach, 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 Sea Turtle Protection Program within the Collier County Parks and Recreation Division (CCPRD) monitored 16.9 miles (27.2 km) of shoreline on Barefoot, Vanderbilt, Park Shore, and Marco Island beaches. 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 State Park survey 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 CCPRD and Rookery Bay NERR), Coconut and Sea Oat Islands (monitored by Rookery Bay NERR), and the Ten Thousand Islands (monitored by the US Fish and Wildlife Service.

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 CCPRD with updates based on the Florida Fish and Wildlife Conservation Commission Sea Turtle Conservation Guidelines (FWC, 2007). The report includes an analysis of sea turtle emergences, effects of beach renourishment, historical trends, nesting and hatching, depredation, storm effects, strandings, beach lighting, and public awareness. Program research and management recommendations are also provided.

SECTION 2

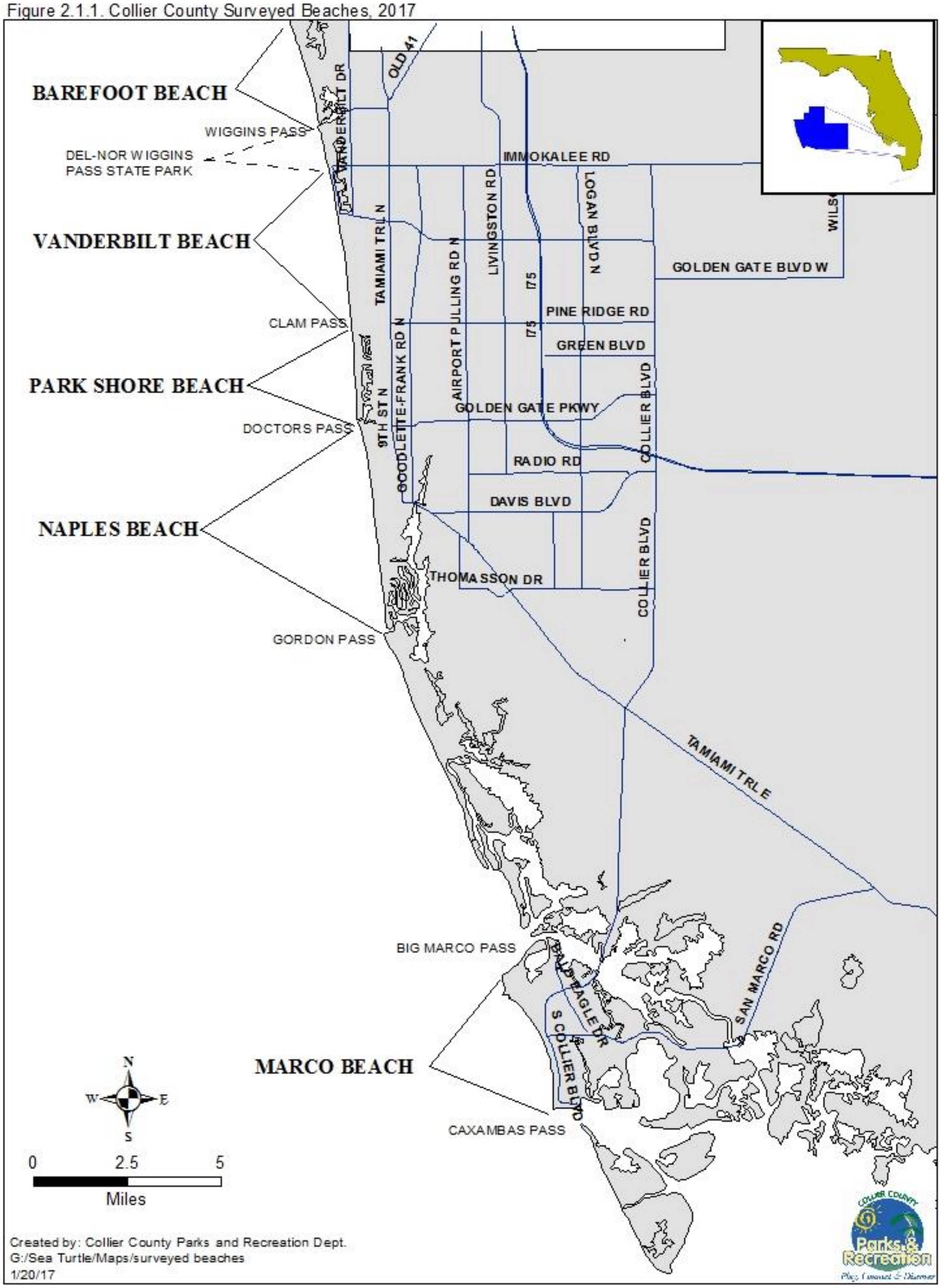
SEA TURTLE MONITORING PROGRAM

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 over-wash 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 years (1990–2016), 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, stockpiled and placed onto the beach. Upland sand is trucked from an inland quarry source and spread onto the beach.Figure 2.1.1. Collier County Surveyed Beaches, 2016.

Figure 2.1.1. Collier County Surveyed Beaches, 2017



2.1.1. Barefoot Beach

Barefoot Beach is the northern-most beach unit in Collier County, which encompasses 3.1 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 to comply with the Wiggins Pass Inlet Management Plan 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	1,000
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 2002	250’ North R-8 South 250’ 250’ North R-5.5 South 250’	Upland (ERJ) *Dune Only Upland (ERJ)	n/a n/a	ca. 500 ca. 500
2005	250’ South R-5 to 250’ South of R-8	Big Island *Dune Only	n/a	3,000
2013	R-12 to R-15.5	Hydraulic	50,000	3,500

ERJ indicates an upland sand source known as E.R. Jahna. * 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 to meet the permit requirements for beach restoration and beach raking. 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 R-29 to 50' South R-30.5 R-40 to R-41 (North of Clam Pass)	Hydraulic Upland Mechanical	322,800 3,000 4,500	7,490 1,588 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-20 500' South of R-23 to R30 (Dune Protection) 150' South R-39 415' South (Dune Protection) 500' South R-36 to 322' South R-38 (Dune Protection)	Hydraulic Upland (ERJ) Upland (ERJ) Upland (ERJ)	50,614 22,138 655 4,445	2,400 6,500 265 1,822
2006	R-22 to37	Hydraulic	178,442	14,900
2007	*R-18 south to 19.5	Hydraulic	48,405	1,591
2012	R-26 to R-30	Upland	12,000	4,000
2013	R-39A to R-41	Mechanical	9,626	1,500
2013	R-25A to R-36 + 300	Upland	78,752	10,800
2016	R-24 to R-30 and R-34.5 to R-36.5	Upland	43,670	8,000

* Indicates an area within the Delnor-Wiggins Pass State Park. ERJ is an upland sand source known as E.R Jahna.

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 (640 m) to the Naples Cay development (R-42 to R-44). Park Shore Beach is monitored for sea turtle nesting activities to comply with beach renourishment and beach raking 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-42.5 350' South R-50 to 350' North R-54	Mechanical Hydraulic	6,000 90,700	1,788 3,589
1997	Clam Pass to R-42.5 350' North R-48 to 350' South R-50	Mechanical Mechanical	6,000 8,000	1,788 2,751
1998	Clam Pass to 143' North R-45	Mechanical	8,000	4,208
1999	Clam Pass to 270' North R-42 430' South R-42 to 250' South R-43.5	Mechanical & Hydraulic Hydraulic	3,500 26,500	310 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-43 700' South R-49 to 40' South R-54	Hydraulic Upland (ERJ)	11,725 9,067	1,975 4,700
2006	R-45 to R-55	Hydraulic	140,336	10,543
2007	R-42 + 180 South to R-43 +500	Hydraulic	20,603	1,464
2011	R-45 to R-46	Upland (SM)	7,836	1,000
2013	R-42+180' south to R-43.5+225'	Mechanical	10,877	1,725
2016	R-42 south to 43.5	Hydraulic	5,500	1,500
2016	R-43.5 to R-47 and R-51 to R-53	Upland	27,000	5,500

ERJ indicates an upland sand source known as E.R. Jahna. SM indicates and upland sand source knows as Stewart Mining.

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 to R-89). The Conservancy of Southwest Florida monitors the City of Naples beach for sea turtle activities, contracted by Collier County, to meet the beach renourishment program permit requirements. 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 R-69.5 to R-72	Hydraulic Upland/Hydraulic	759,150 55,000	18,253 2,438
1998	R-69.5 to R-72 R-75 to 400' South R-76	Upland (BG) Upland (BG)/Hydraulic	8,820 6,696	2,438 1,213
1999/ 2000	500' North R-63 to R-64 (Naples Beach Club) Doctors Pass (R-57) to R-58	Upland (BG) Upland (BG)	8,036 6,804	1,500 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
2006	R-58.5 to R-77.5	Hydraulic	345,307	18,935
2010	R-57 to R57.5 +100 ft.	Upland (IM)	3,000	1,000
2011	R-57 to R-58.5	Upland (IM)	22,393	2,000
2012	R-61 to R-63.5	Upland (SM)	12,000	2,500
2013	R-57 to R-58.5 R-58 to R-72.1	Hydraulic Upland (SM)	22,393 69,993	1,500 8,424
2014	R-57 to R-58+325 R-59+300 to R-63+300 R-67+300 to R-69+500 R-71+50 to R-73+300 R-74+400 to R-78+400	Upland (SM)	3,000 25,000 5,000 8,000 11,500	15,725

BG indicates an upland sand source known as Bonita Grande. BI indicates an upland sand source known as Big Island. ERJ indicates an upland sand source known as E.R. Jahna. SM indicates an upland sand source known as Stewart Mining (Immokalee)

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). The City of Marco Island is a highly developed beach with high-rise condominiums and hotels. This beach has been monitored for sea turtle activities since 1990 to comply with the permit requirements for beach renourishment and raking. 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 R-136.5 to R-138.5 R-142.5 to R-148	Hydraulic Hydraulic Hydraulic	70,000 284,600 715,400	2,063 2,189 5,533
1997	*130’ South H-9 to 45’ South H-11 *370’ South H-1 to 131’ South H-3 R-145.5 to R-148	Upland (BG) Upland (BG) Upland (BG)	1,000 4,000 80,000	1,345 1,636 1,781
1998	*H-9 to H-11 *400’ South H-1 to H-2	Upland (BG) Upland (BG)	15,000 10,000	1,250 900
1999	*H-1 to H-3 R-148 South to Caxambas Pass	Upland (BG) Upland (BG)	3,528 9,000	985 625
2000	*200’ North H-1 to H-3	Upland (BI) Hydraulic	3,600 2000	950
2001	*H-1 to H-4 *H-9 to H-13.5	Upland (ERJ) Hydraulic	15,000 24,078	1,500 2,300
2002	R-136 to R-136.5 *140’ South H-9 to 140’ North	Upland (ERJ) Upland (ERJ)	148 359	300 280
2003	*200’ South H-1 to 40’ North H-4 *H-9 to H-11	Upland (ERJ) Upland (ERJ)	11,096 11,096	1,740 1,000
2005	H1 to H-9	Hydraulic	316,770	6,300
2007	R-144 to R-148 +549	Hydraulic	168,431	4,288
2010	H4 to H9	Hydraulic	130,000	2,500
2013	R-144 to R-148 H-12 to H-14	Hydraulic	104,000 25,000	4,730 1,000

* Indicates an area within Hideaway Beach were the H-monuments are numbered consecutively from southwest to northeast. BG indicates an upland sand source known as Bonita Grande. BI indicates an upland sand source known as Big Island. ERJ indicates an upland sand source known as E.R. Jahna

2.2. METHODS AND MATERIALS

2.2.1. Reconnaissance Surveys and Beach Zoning

Pre-season reconnaissance surveys of the monitored beaches were conducted in April, 2016. The objective of the surveys was to develop daily monitoring strategies, note the condition of the beaches, zone the beaches for management purposes, and conduct cone penetrometer readings to determine if the beaches required tilling pre-season.

Metal signs on 6’ metal posts were placed within the dune area in approximately 1,000 ft. increments from the Lee/Collier County line south to Marco Island at corresponding DNR survey markers. In addition, wooden stakes were installed 500 ft south of every DNR marker. Beaches were measured along the high tide line using a Rolatape measuring wheel.

2.2.2. Daily Monitoring

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). A GPS reading was taken for each emergence location. Nests and false crawls were sequentially numbered and mapped on aerial photographs. Characteristics and measurements of the emergences were recorded on data sheets for evaluation.

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 2.2.2.1.) was affixed to alert and direct beach rakers and the public away from nests. In addition, the stakes were marked with their direction (SW, NW, SE, NE) to facilitate clutch location if stakes were lost during storms.

Nests laid in areas known for high depredation, such as the undeveloped portions of Barefoot and Vanderbilt, beach were covered with a protective screen. Screening involved securing a 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 most mammalian depredation. Screened nests were observed on a daily basis for evidence of predation. If a predator 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 2017

Nesting & Hatchling Data Form 2016 GPS # N. ____________ W. ____________ NEST #______________

Nesting Data

Date____________ Species________________

Did You Verify? ☐ Map? ☐ Log? ☐

DNR Location: ____________________

Establishment: ____________________

Renourished* or Natural

Beach Zone (please circle): A (dune) B (berm) C (mhw)

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. Un-hatched eggs (4+5+6) ☐

4. Undeveloped_____ 5.Dead embryo______

6. Depredated Eggs _______ LOOK on the back.

C. Pipped eggs (7+8) ☐

7. Dead _________ 8. Alive _________

D. Total Eggs (A+B+C) ☐

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

Please note anomalies in hatchlings or un-hatched eggs

____

____

____

Renourishment Data*

Year of Renourishment: ____________

Type of Sand: Upland Hydraulic Mechanical

Eggs deposited in renourished sand: Yes or No

Embryo Stages

30 ________ **29** ________ **28**________

27 ________ **26** ________ **25**________

24 ________ **23** ________ **22**________

21 ________ **< 21** ________

Undetermined ________

Emergence Data

Expected Date_____ 80 Days______ Actual______

Incubation_________ Date excavated__________

Clutch Depth(in)_________ Width__________

Investigator______________________

Crawl Diagram

Draw scarps and obstructed nesting attempts (fill out form).

Disorientation Data

Disoriented Hatchlings: ____________ Date: ________

Dead ______ # Alive _______ Source ___________

DEP form filled out? Yes or No

Notes

DEPREDATION FORM

*Please record **EACH** occurrence of predator interaction. This includes root invasions and eggs destroyed by other nesting turtles*

Please Note* you may record occurrence of depredation of hatchlings but only those hatchlings that are depredated within the nest. The hatchlings should be recorded as dead hatchlings (#3) on the nesting sheet in the Hatched eggs section (A.).**

Date	Predator 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

ACCRETION LOG

Nest #	Date	Cause of Nest Being Affected by accretion	Complete or Partial

Figure 2.2.2.2. Sea Turtle Nesting Area Sign.

2.2.3. Nest Monitoring and Evaluation

Daily monitoring for hatched nests began as the first nest approached the expected hatch date (approximately 60 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 from high surf, excessive rainfall or shading.

Upon excavation, all contents of the egg cavity were removed by hand. The depth and width of the egg cavity was measured and recorded. Data from each nest evaluation was recorded on CCPRD Sea Turtle Nesting Forms. Empty eggshells accounted for live hatchlings that escaped from the nest and/or 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 embryonic 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 time of the day and 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, 2007).

Nests were also inspected for evidence of predation. If signs of predation were discovered, the information was recorded. The collection of predator data aids in quantifying and determining the extent of nest predation in Collier County. The data also helps to identify ways to mitigate predation. Washed out nests and inundations were also recorded after storm events and extreme high tides.

2.2.4. Data Analysis

Sea turtle emergence and hatchling data were compiled using the relational database Microsoft Access. Maps were produced using ArcGIS10.1 and Collier County Property Appraiser's aerial photographs taken in 2016. Shoreline data and emergence locations were collected with a Garmin GPS 76 marine navigator. Graphs and plots were created using Microsoft Excel. 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.

2.3. RESULTS AND DISCUSSION

2.3.1. Emergences

Sea turtles emerged on Collier County beaches from May 1, 2017 through August 22, 2017. A total of 2,132 emergences (927 nests and 1205 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 comparison of nests and false crawls for each beach segment is given in Figure 2.3.1.1. A breakdown of emergences per mile on each beach is illustrated in Table 2.3.1.1. Vanderbilt beach had the most sea turtle activity with an average of 151 emergences per mile. Marco Island beach received the least activity with an average of 45 emergences per mile.

Table 2.3.1.1. Emergences, 2017.

	Barefoot	Delnor Wiggins	Vanderbilt	Park Shore	Naples	Marco	Total
Total Nests	181	40	213	166	206	121	927
Total False Crawls	274	91	316	167	155	202	1205
Total Emergences	455	131	529	333	361	323	2132
Nest / Emergence (%)	39.8	30.5	40.3	49.8	57.1	37.5	43.5
Beach Length (mi.)	3.1	1.2	3.5	3.2	5.6	7.1	23.7
Emergences / mi.	147	109	151	104	64	45	90
Nests / mi.	58	33	61	52	37	17	39
False Crawls / mi.	88	76	90	52	28	29	51

Figure 2.3.1.1. Sea Turtle Emergences in Collier County, 2017.

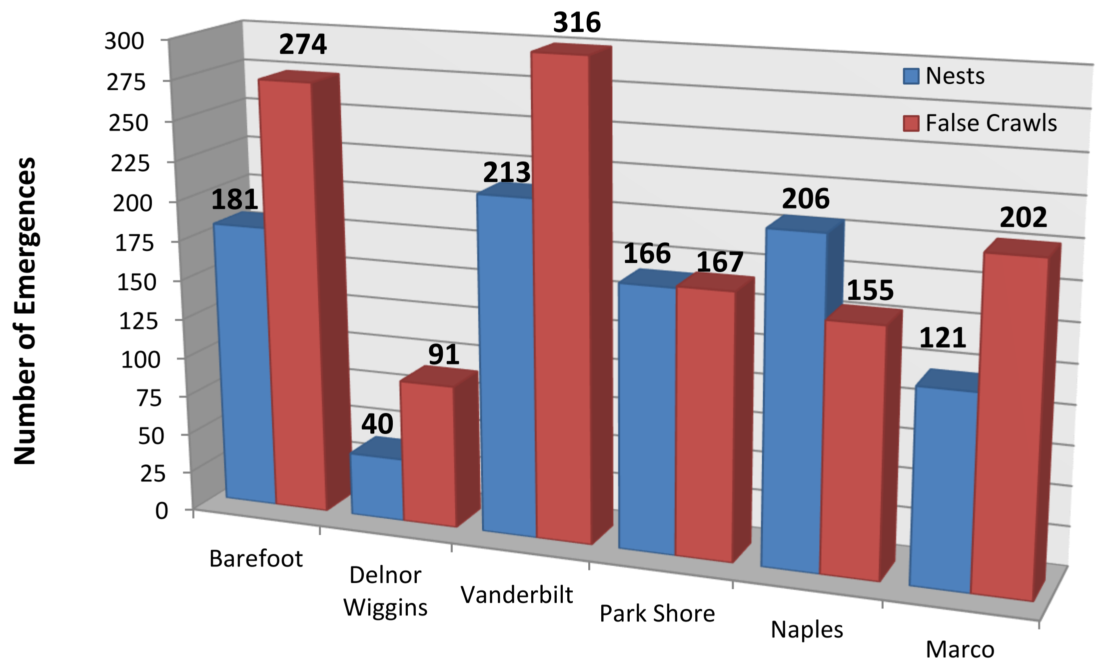


Figure.2.3.1.1. shows some variation in total nests and false crawls between beaches. This variation is difficult to explain since nest-site selection of the female turtle is still poorly understood. Some important factors include, but are not limited to: beach compaction, artificial lighting, human 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). 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, and boats stored on the beach.

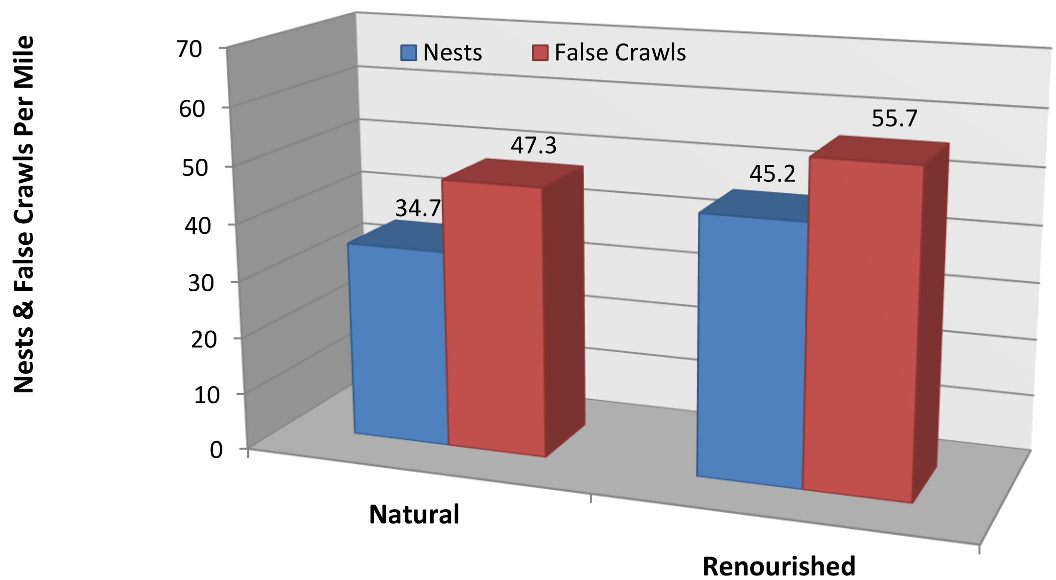
Abandoned nesting attempts (false crawls) are a common occurrence for loggerheads and have been recorded at all nesting beaches (Dodd, 1988). Raymond (1984b) reported that on natural beaches, 46% to 49% of emergences resulted in false crawls. The 1205 false crawls in Collier County, represents 56% of the total emergences. The reasons for the 2017 false crawl ratio may include: lighting violations, human activity, beach furniture, seawalls, compaction, dense roots, standing water on the beach and scarps.

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 2017 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.

Figure 2.3.2.1. Natural vs Renourished Beaches, 2017.



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. 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. Figure 2.3.3.1. reflects the overall County beach totals.

Table 2.3.3.1. Historical Trends of Sea Turtle Nests and False Crawls (FCs), 2002–2017.

Beach Unit	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Barefoot Nests Barefoot FCs	62 28	88 66	84 73	72 67	56 55	40 33	75 85	59 50	87 90	71 38	172 209	121 136	189 113	260 160	241 289	181 274
Delnor Nests Delnor FCs	15 22	21 49	11 38	15 46	10 12	18 20	17 33	22 36	20 20	18 15	46 62	30 54	42 35	58 69	54 103	40 91
Vanderbilt Nests Vanderbilt FCs	90 131	159 125	90 45	61 91	78 81	55 69	82 64	62 65	111 88	93 107	212 146	151 194	172 163	192 227	244 180	213 316
Park Shore Nests Park Shore FCs	81 75	122 188	73 64	40 58	68 78	67 60	73 52	50 43	86 74	90 69	188 198	114 153	160 113	128 123	258 289	166 167
Naples Nests Naples FCs	31 49	59 52	61 39	31 55	30 40	42 43	50 38	50 42	72 35	67 51	148 153	92 82	164 136	125 66	268 234	206 155
Marco Nests Marco FCs	28 54	55 80	59 97	39 75	56 107	40 96	34 52	54 94	46 90	65 124	52 75	93 166	73 107	118 164	79 193	121 202
Total Nests Total FCs	307 359	504 560	378 356	258 392	298 373	262 321	331 324	297 330	422 397	404 401	818 843	601 785	800 667	881 809	1144 1288	927 1205

Figure 2.3.3.1. Collier County Annual Emergences, 2002 – 2017.

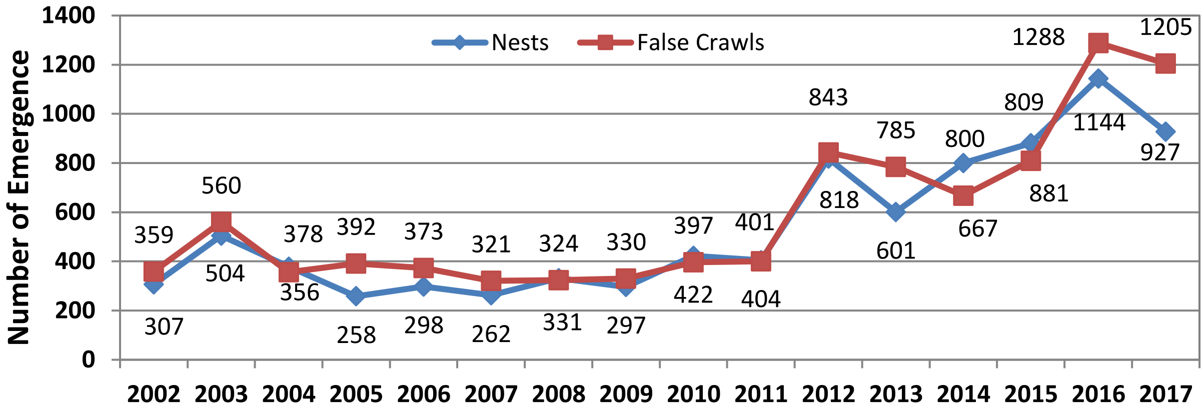


Figure 2.3.3.2. Barefoot Annual Emergences, 2002 – 2017.

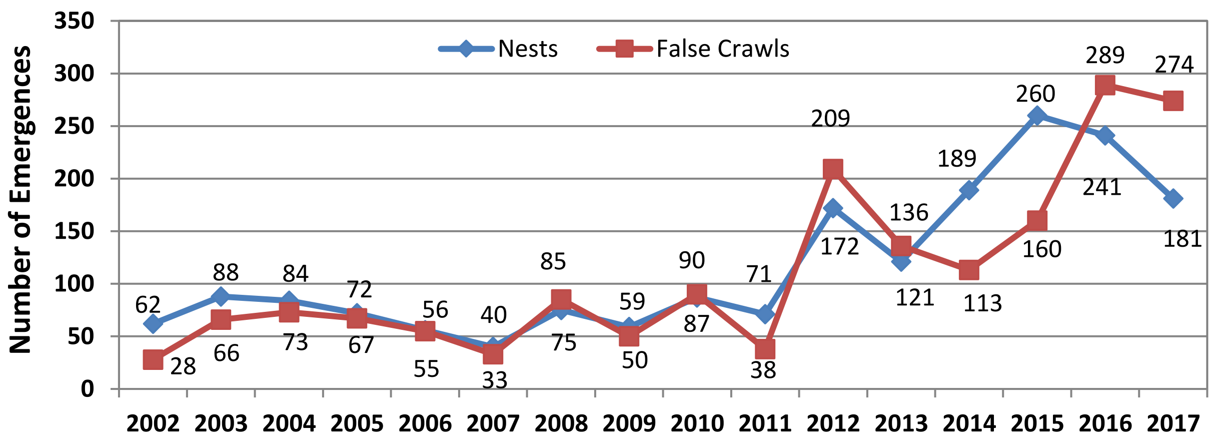


Figure 2.3.3.3. Delnor-Wiggins Pass State Park Annual Emergences, 2002 – 2017.

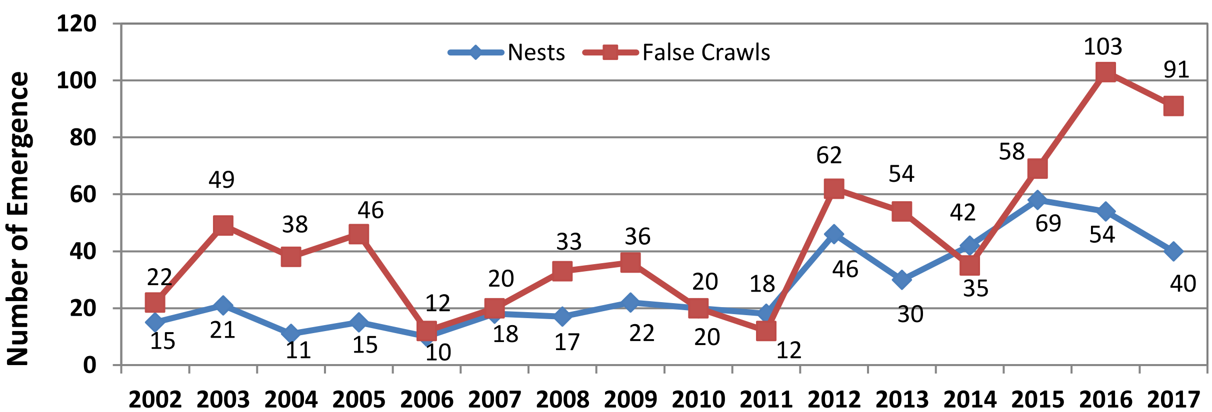


Figure 2.3.3.4. Vanderbilt Beach Annual Emergences, 2002 – 2017.

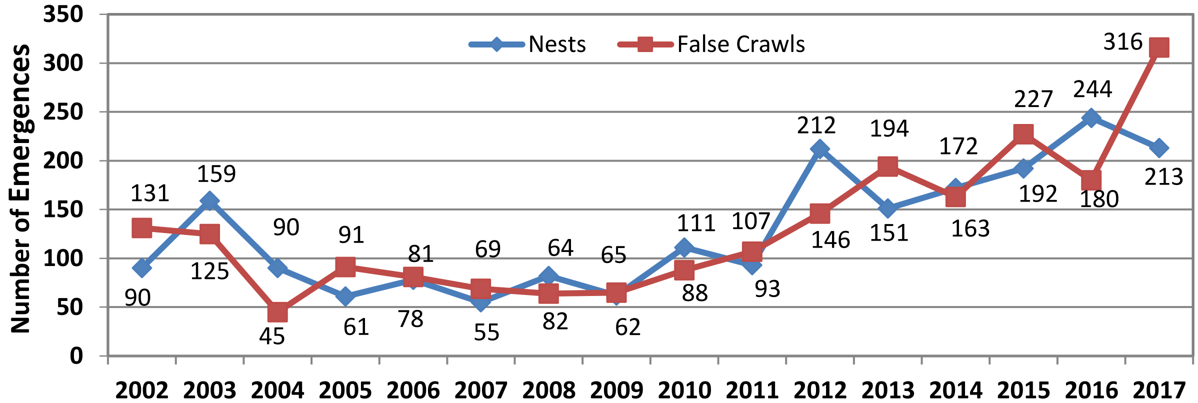


Figure 2.3.3.5. Park Shore Beach Annual Emergences, 2002 – 2017.

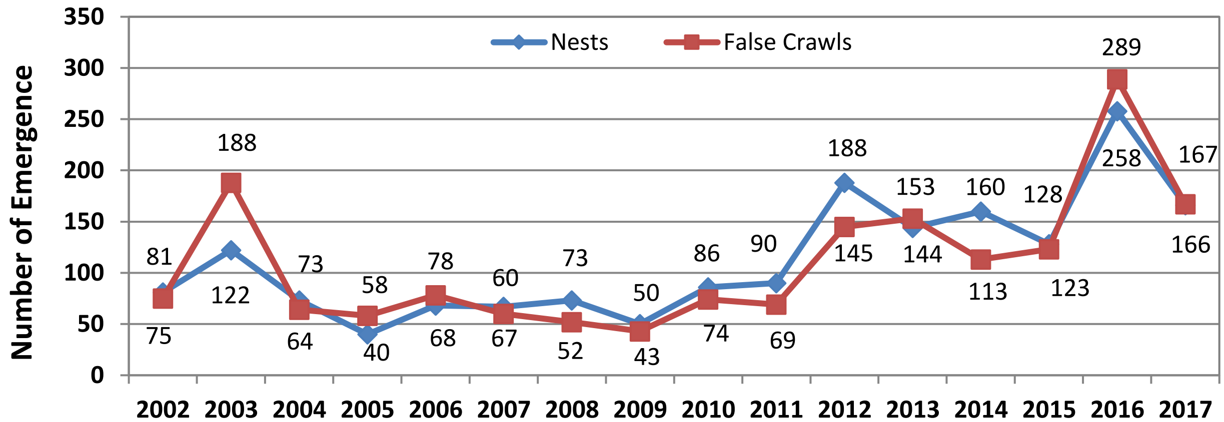


Figure 2.3.3.6. City of Naples Annual Emergences, 2002 – 2017.

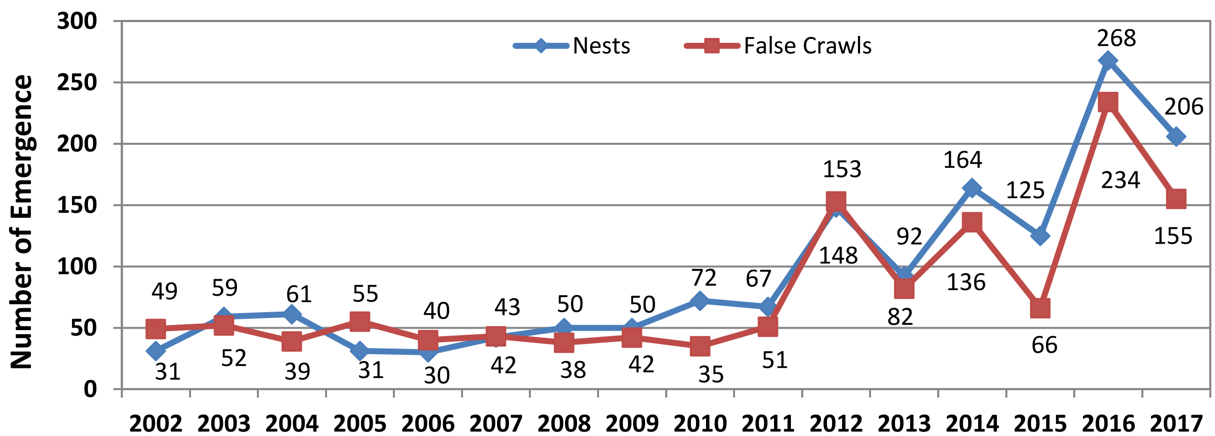
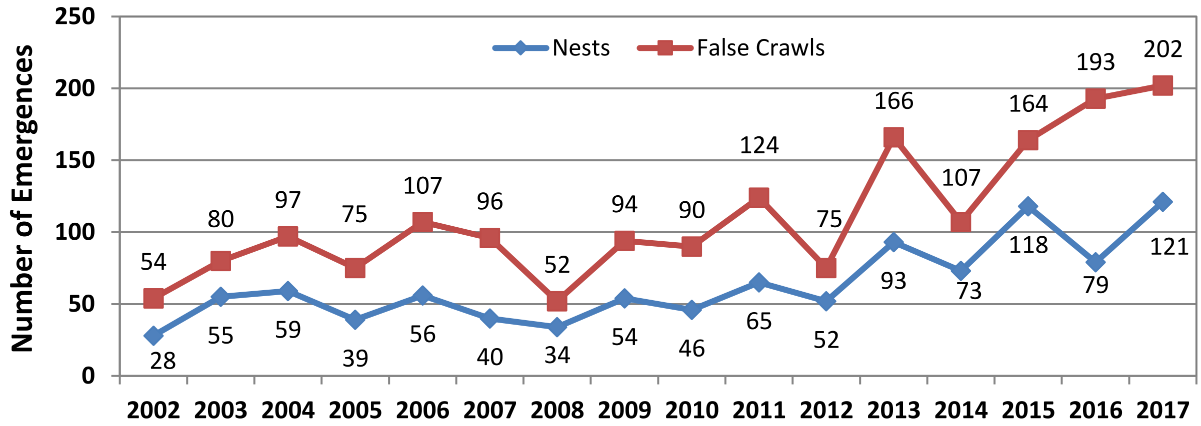


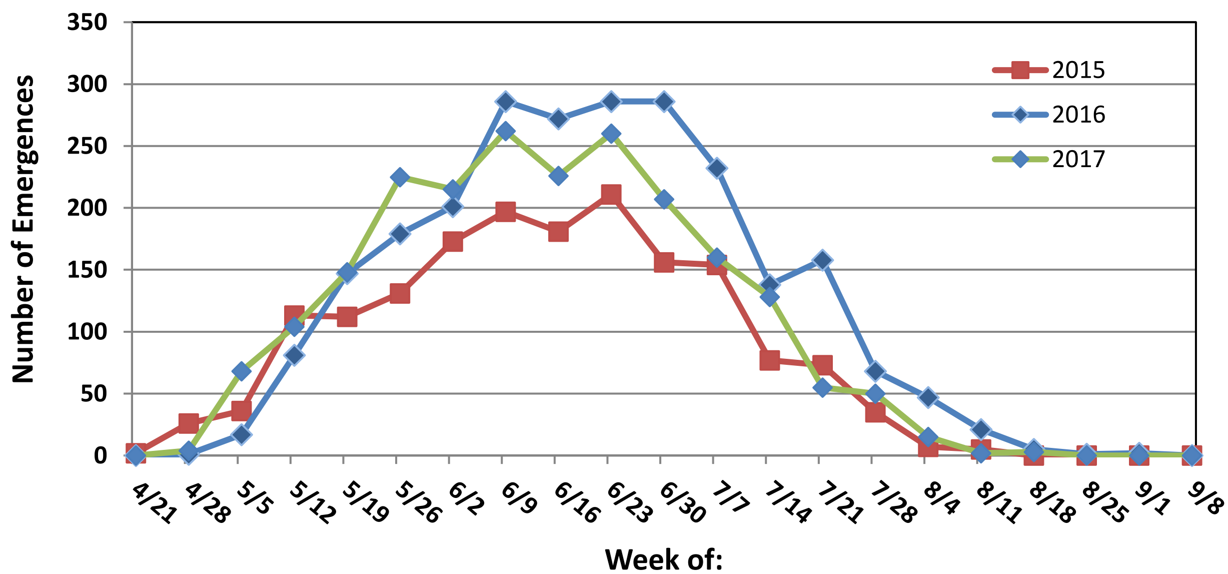
Figure 2.3.3.7. City of Marco Island Annual Emergences, 2002 – 2017.



2.3.4. Weekly Emergence Analysis

Sea turtle weekly emergence (nest and false crawls) trends are depicted in Figure 2.3.4.1. for 2015 - 2017. There are typically two peaks of sea turtle emergences for each season. This season's peaks occurred in the second and the fourth week of June.

Figure 2.3.4.1. Collier County Emergences per Week, 2015 –2017.



2.3.5. Clutch Depth

Measurements of the egg cavity were taken for each excavated nest when possible. Clutch depths were recorded from 568 of the 927 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. Clutch depth is measured to determine the performance of the renourished sand relative to the natural sand. There was a significant difference found when the clutch depths were compared between renourished and non-renourished beaches ($p=0.046$; $df = 1,566$; $F = 3.99$).

Table 2.3.5.1. Clutch Depth in Renourished Sand Types, 2017.

	Natural	Renourished
Mean Clutch Depth (Inches)	18.4	18.9
Number of Nests	301	267

2.3.6. Hatching Evaluation

In 2017, 927 nests were marked for evaluation. Of these nests, the CCPRD, The Conservancy of Southwest Florida, and Delnor-Wiggins Pass State Park staff evaluated 652. Two hundred thirty-eight (25.7%) were lost due to storms during the 2017 season. Tidal flooding inundated 285 (30.7%) of nests. Tidal flooding and washed out nests combined accounted for 523 (56.4%) of all nests compared to 47.6% in 2016.

The average number of eggs per nest (clutch size) was 100 (range = 2–162). 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, 2017.

	Barefoot	Delnor Wiggins Pass	Vanderbilt	Park Shore	Naples	Marco
Mean Egg Count / Nest	96.2	92.2	99.3	94.4	102.8	112.2

A total of 65,202 eggs were deposited into the evaluated nests and 44,366 hatchlings entered the Gulf of Mexico (Table 2.3.6.2.). The total number of hatchlings that entered the Gulf of Mexico includes 43,863 that emerged on their own and 503 that were found alive in the nest cavity.

Table 2.3.6.2. Nest / Hatchling Evaluations by Beach Unit, 2017.

	Barefoot	Delnor Wiggins Pass	Vanderbilt	Park Shore	Naples	Marco	Total
Total Nests	181	40	213	166	206	121	927
Lost Nests	37	17	47	45	69	23	238
Total Eggs	12,797	2,121	16,179	11,230	12,332	10,543	65,202
Emerged Hatchlings	7,714	1,559	8,970	8,685	9,510	7,425	43,863
Hatchlings Alive in Nest	174	4	67	50	70	138	503
Hatchlings Dead in Nest	424	14	100	256	211	152	1,157
Undeveloped Eggs	1,423	164	1,499	1,003	1,581	842	6,512
Dead Embryos	560	138	608	1,146	704	1,581	4,737
Predated Eggs	2,417	236	4,838	1	155	194	7,841
Pipped Live Eggs	15	1	2	1	7	10	36
Pipped Dead Eggs	70	5	95	88	94	201	553
Total Hatch Success	65%	74%	56%	80%	79%	73%	69.8%
Total Hatchling Emergence Success	60%	74%	55%	77%	77%	70%	67.3%

Unhatched eggs (19,090) were opened to identify fertility and embryonic development. Dead embryos (4,737) comprised 25% of the unhatched eggs, depredated eggs (7,841) made up 41%, and the remaining 34% were labeled as undeveloped (6,512) due to lack of evidence of 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".

The mean incubation rate for nests deposited in non-renourished areas was 61.2 days. The mean incubation rate for renourished sands (hydraulic, mechanical, and upland) was 62.5 days. There was a significant difference in the mean incubation rates between natural and renourished sands ($p = 1.42E\text{-}03$; $df = 1,553$; $F = 10.28$). There was no significant difference in the mean incubation rate when comparing nests that were fully exposed to the sun and nests that were shaded by vegetation or buildings ($p = 0.71$; $df = 1,553$; $F = 0.14$).

Table 2.3.6.3. Mean Incubation Rate in Natural and Renourished Sand Types, 2017.

	Natural	Hydraulic	Mechanical	Upland
Mean Incubation Rate (days)	61.2	65.0	68.4	62.2
Number of Nests	290	19	5	241

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 emergence success was 46.6% and the mean hatching success was 48.4% for all beaches and sand types (Table 2.3.6.5.). The emergence success of nests found on natural, non-renourished beaches versus renourished beaches was not significantly different ($p = 0.852$; df =1, 925; $F = 0.035$). When comparing the hatching successes on natural non-renourished beaches with those of renourished beaches, there was also not a significant difference found ($p = 0.600$; df =1, 925; $F = 0.274$).

Table 2.3.6.4. Hatching and Emergence Success in Natural and Renourished Sand, 2017.

Natural Sand or Renourishment Type	Natural	Renourished	Overall
Mean Hatching Success	49.1%	47.6%	48.4%
Mean Emergence Success	46.8%	46.3%	46.6%

2.3.7. Nest Predation

Depredation by raccoons (*Procyon lotor*), fire ants (*Solenopsis invicta*), ghost crabs (*Ocypode quadrata*), armadillos (*Dasypus novemcintus*), crows (*Corvus*), roots, and other nesting loggerheads (Caretta caretta) affected 17.9% of all nests (n=166). Most depredations occurred on Vanderbilt Beach, where 67 nests (31.5%) were depredated. The damage caused by predators to sea turtle eggs was significant. Of the 65,202 eggs deposited in 2017, 7,822 (12%) were lost to predators, which represents a slight increase in overall percentage from 8,292 (10.4%) in 2016. A total of 44 raccoons were removed from Barefoot Beach (April – June). Table 2.3.7.1 provides a breakdown of egg predation during 2017.

Table 2.3.7.1. Egg Depredation in Collier County, 2017.

Predator(s)	Number of Eggs Taken	Percentage By Predator
Raccoons	7,186	91.87
Raccoons and Ants	294	3.76
Raccoon and Ghost Crabs	100	1.28
Raccoon, Ghost Crabs & Fire Ants	106	1.35
Armadillo	2	0.03
Ants	3	0.04
Roots	49	0.63
Ghost Crabs	21	0.27
Ghost Crab and Fire Ants	6	0.08
Loggerhead	1	0.03
Loggerhead and Roots	12	0.15
Loggerhead, Fire Ants, & Roots	35	0.45
Crows	6	0.08
Humans	1	0.03
Total	7,822	100

2.3.8. Effects of Storm Events

Two major storms affected nests with inundations and wash outs. Storm effects from tropical storm Emily and hurricane Irma were felt along Collier County beaches. The first incident occurred on July31st – August 1st, 2017 when tropical storm Emily formed in the Eastern Gulf of Mexico. Bands of tropical storm force gusts affected the Collier County coastline. Hurricane Irma came ashore at 3:35PM on September 10th as a category 3 hurricane. Tropical storm Emily washed out 11 nests and inundated 167 nests. Hurricane Irma washed out 196 nests and ended the 2017 Sea Turtle Season.

The following graphs show the impacts of the storms to turtle nests for each of the Collier County beaches (Figure 2.3.9.1), and inundations caused by each storm (Figure 2.3.9.2)

Figure 2.3.8.1. Nests Inundated and Washed out Per Beach, 2017.

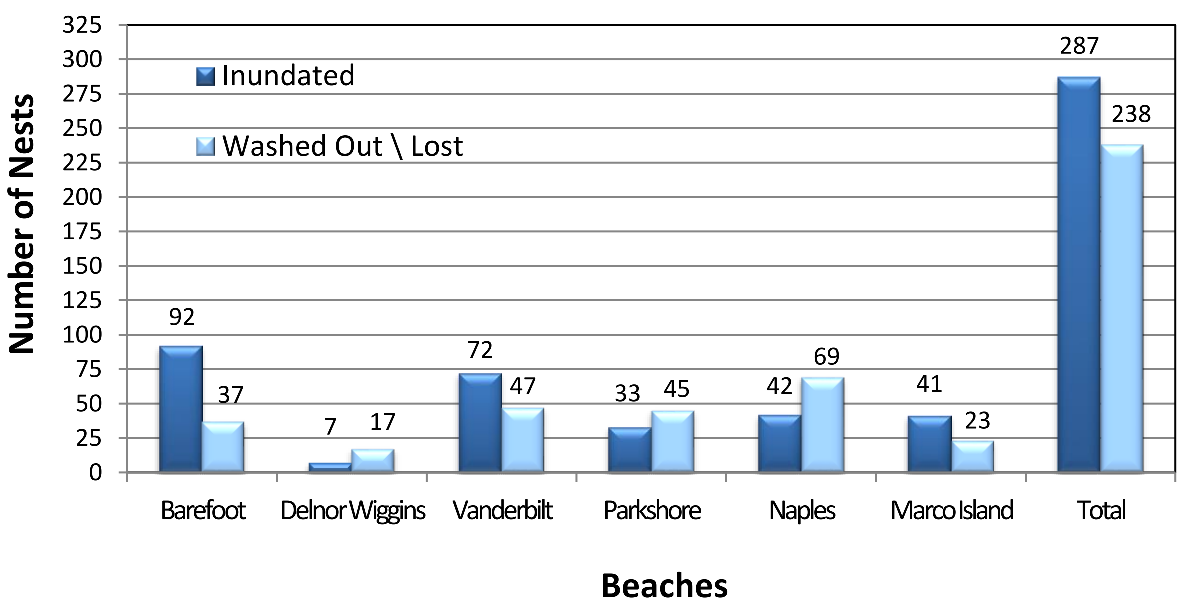
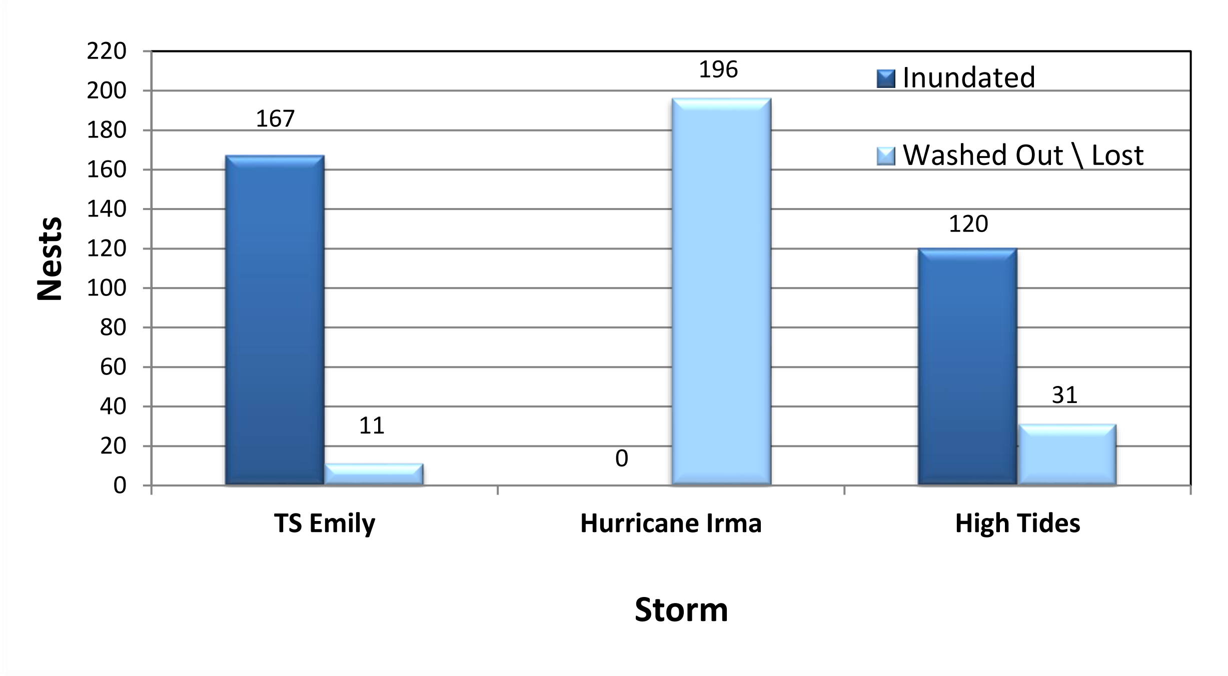


Figure 2.3.8.2. Nests Inundated and Washed out Per Storm Event, 2017.



SECTION 3

PUBLIC AWARENESS AND BEACH LIGHTING

Public education plays a vital role in sea turtle conservation. Many beach goers are unaware of the problems sea turtles encounter. The CCPRD staff provides an important link to knowledge and understanding of the characteristics and natural history of the sea turtles inhabiting our area. In 2017, staff responded to the inquiries of approximately 4,557 people during morning surveys and over 358 people during educational programs and exhibits. Through public presentations, mail distributions and related local events, the CCPRD staff works to make sea turtle conservation a community challenge which brings to light the importance of our common natural environment. Our local beaches are an important habitat requirement for sea turtles and making homeowners and visitors aware of the possible impact of artificial lighting is also an important aspect of the public education 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). 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.

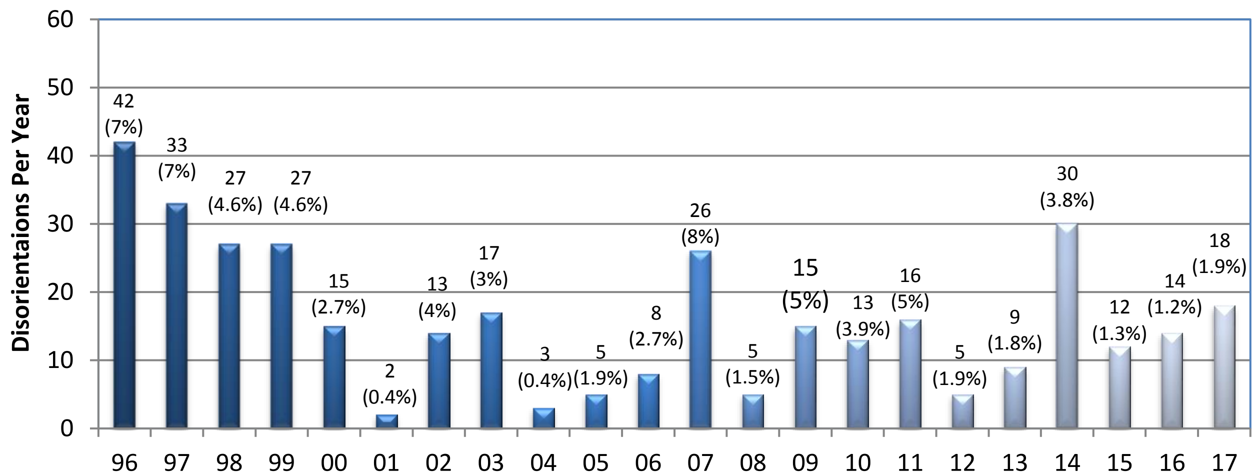
In accordance with the Collier County Land Development Code Sec. 3.04.00 "Protection of Endangered, Threatened or Listed Species", CCPRD manages a beach lighting compliance program developed to minimize the damages caused by light pollution. The program is composed of two annual mail-outs prior to season, night lighting compliance inspections, violation notices, and code enforcement action. The first annual mail-out is a sea turtle information package sent to beachfront homeowners and establishments. The mail-out illustrates the importance of shielding or turning off lights during sea turtle nesting season and suggests inexpensive methods of reducing and minimizing beach lighting. It also reminds the residents to remove any obstacles to nesting and hatching sea turtles such as beach furniture or recreational accessories, and reminds them to refrain from trimming beachfront vegetation during and prior to season.

Throughout sea turtle nesting season (May 01 – October 31), the CCPRD, Collier County Code Enforcement, City of Naples and Marco Island staff conduct monthly lighting compliance inspections. The monthly inspections are conducted as close to the new moon phase as possible. 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. Violations with no attempt to correct are sent 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" (NOV). Additional violations may result in citations and court actions.

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 has decreased. In 2017, there were 18 disorientations (1.9 % of the nests).

Figure 3.1. shows a yearly decrease in disorientations beginning one year after the initiation of the beach lighting program and continuing through 2017.

Figure 3.1. Disoriented Nests in Collier County, 1996–2017.



In addition to documenting lighting violations, CCPRD 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 10.02.06 requires that any structure such as beach umbrellas and furniture not requiring a building permit, be removed nightly from the beach. 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. Staff hopes to reduce this number by notifying people about the harm furniture and other equipment can cause on nesting or hatchling sea turtles.

SECTION 4

SEA TURTLE STRANDING AND SALVAGE PROGRAM

Stranded sea turtles are those which wash ashore or are found floating, dead or alive in a weakened condition. Collier County 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 staff 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, red tide, disease, and natural causes. The cause of mortality is determined when possible and used to identify ways of aiding in population sustainability; although it is estimated that only 27% of the carcasses are detected and therefore reported (Murphy, T.M. and Sally Hopkins Murphy, 1989). The STSSN program is critical to the future conservation and recovery efforts of sea turtles.

In 2017, 32 sea turtles were reported stranded along the Collier County coastline (Figure 4.2). Strandings occurred every month except January (Figure 4.1).

Figure 4.1. Collier County Monthly Sea Turtle Strandings, 2017

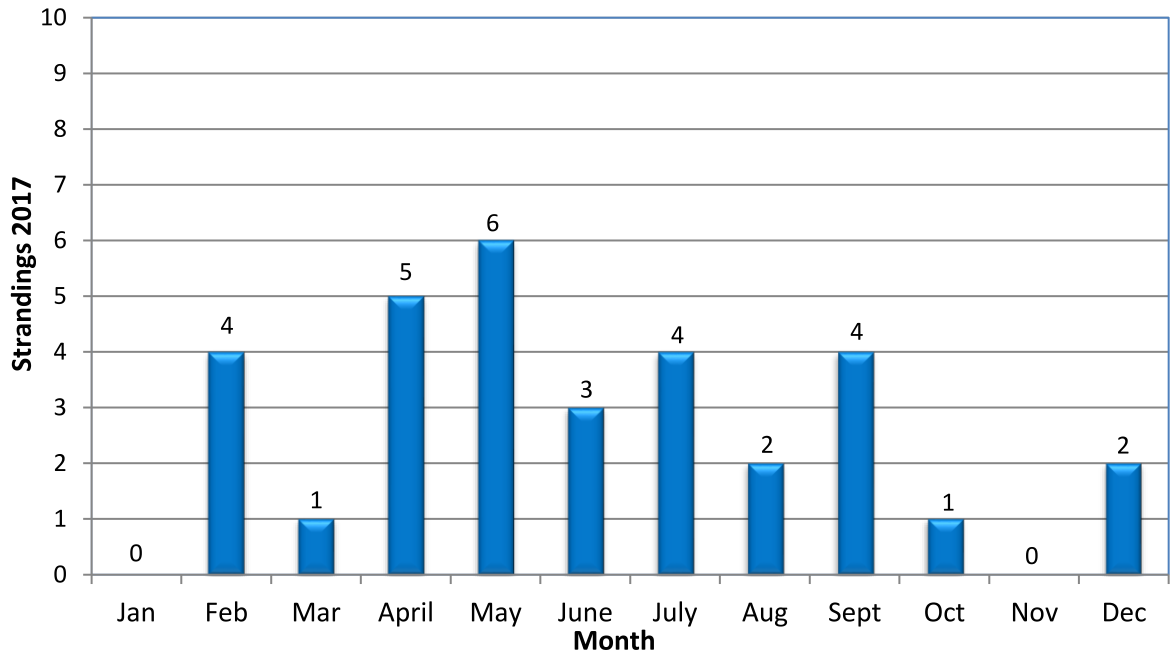
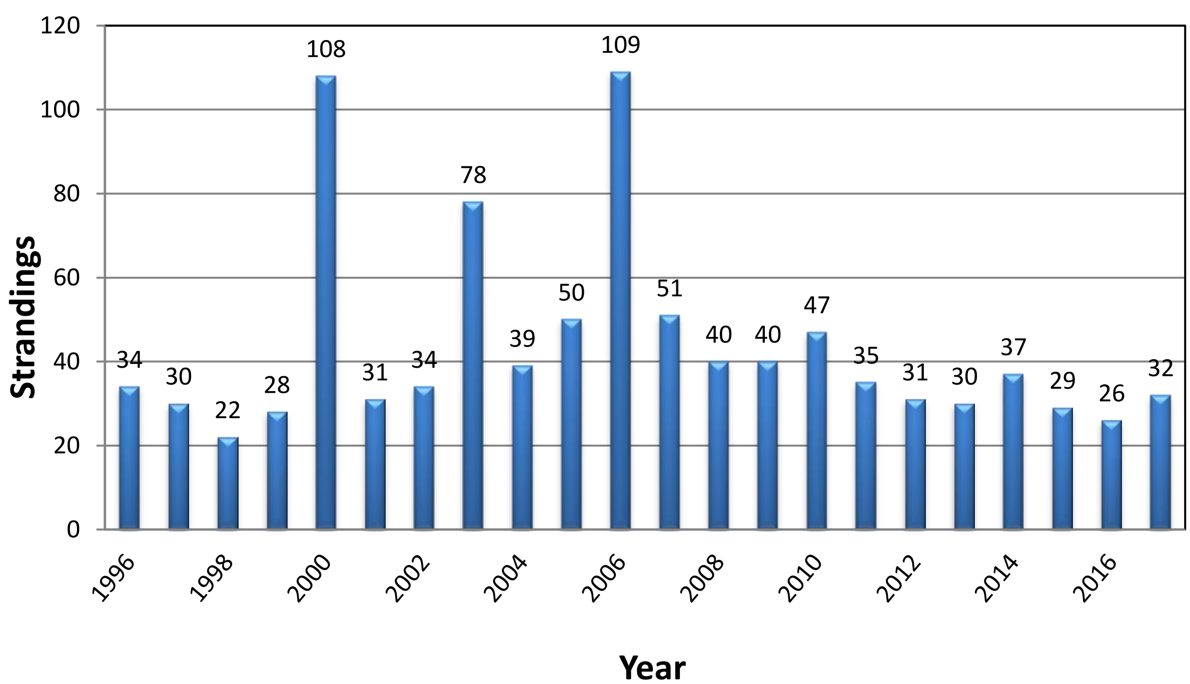


Figure 4.2. Collier County Sea Turtle Strandings, 1996-2017.



Strandings in 2017 included loggerheads (22), Kemp's ridleys' (3), and green sea turtles (7). Injuries and abnormalities of dead and live sea turtles ranged from boat and/or obvious propeller damage with visible markings or hull paint (7), shark bites (6), Fibropapilloma virus (1). No fishing line or crab trap entanglement were observed in 2017. 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.

Sea turtle strandings occurred throughout coastal Collier County both on beaches and floating in bays or canals. Beach strandings include Barefoot Beach (4), Vanderbilt Beach/ Del nor Wiggins (5), Park Shore/Clam Pass Park (6), City of Naples (5), Marco Island (5) Keewaydin Island (1) and Cape Romano Complex (4).

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 FWCC 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 Collier County Parks and Recreation Division responded to 24 of the 32-sea turtle strandings. Rookery Bay NERR responded to five strandings, the Conservancy of Southwest Florida staff responded to one stranding and Delnor Wiggins State Park responded to one stranded sea turtles.

SECTION 5

SUMMARY

Adult loggerhead sea turtle emergences were recorded on Collier County beaches from May 1 through August 22, 2017. A total of 927 nests and 1,205 false crawls were identified on Barefoot, Delnor-Wiggins Pass State Park, Vanderbilt, Park Shore, City of Naples, and City of Marco Island beaches. Weekly emergence data revealed two peaks of increased emergence activity in the second and the fourth weeks of June. The summary for each beach is given in Table 5.1.

Table 5.1. Summary of Monitored Beaches, 2017.

	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	181	40	213	166	206	121	927
Nests / Mile	58	33	61	52	37	17	39
False Crawls	274	91	316	167	155	202	1,205
False Crawls/ Mile	88	76	90	52	28	29	51
Mean Clutch Size	96.2	92.2	99.3	94.4	102.8	112.2	100.0
Nests Depredated	47	8	67	1	12	31	166
Nests Inundated	92	7	72	33	42	41	287
Nest Washed Out	37	17	47	45	69	23	238
Mean Incubation (days)	62.56	59.95	63.00	63.49	60.66	59.41	61.51
Disoriented Nests	0	0	2	5	4	7	18
Mean Hatching Success	65%	74%	56%	80%	79%	73%	69.8%
Mean Emergence Success	60%	74%	55%	77%	77%	70%	67.3%
Eggs Deposited	12,797	2,121	16,179	11,230	12,332	10,543	65,202
Hatchlings Emerged	7,714	1,559	8,970	8,685	9,510	7,425	43,863

In natural beach areas, an average of 35 nests per mile was recorded while 45 nests per mile were recorded on renourished beach areas (Table 5.2). There was a significant difference found when the clutch depths were compared between renourished and non-renourished beaches (p=0.046; df = 1,566; F = 3.99).

Table 5.2. Summary of Natural Beaches vs Renourished Beach Areas, 2017.

	Natural Beaches	Renourished Beaches	All Beaches
Beach Length (mile)	13.7	10	23.7
Nests	476	451	927
Nests Per Mile (mean)	34.7	45.2	39.1
False Crawls	649	556	1205
False Crawls Per Mile (mean)	47.3	55.7	50.8
Mean Clutch Depth (in)	18.4	18.9	18.6
Mean Incubation (days)	61.2	62.5	61.8
Mean Hatching Success	49.1%	47.6%	48.4%

In 2017, 65,202 eggs were deposited and 7,822 (12%) were lost to predation. This represents a slight increase in overall percentage from 8,292 (10.4%) in 2016. Thirty-two sea turtle strandings were responded to in 2017, including 22 loggerheads, three Kemp's ridleys and seven green sea turtles.

SECTION 6
ACKNOWLEDGMENTS

The Collier County Parks and Recreation Division would like to extend our thanks and appreciation to the following persons and organizations for their contributions: Richard Nelson, Beverly Ann Shipe, Scott Aldrich, Dan Flaherty, Marty and Debbie Roddy, and the countless other volunteers and community service students for their services. We would also like to thank David Addison, Kathy Worley and interns Jill Gorges, Maddy Kenton, Ivana Lezcano and Michelle Sparks of the Conservancy of Southwest Florida; Mark Nickoletti and staff of the Delnor-Wiggins Pass State Park; Robin Trindell, Meghan Koperski, Beth Mongiovi and Rhonda Bailey, FWC; Jill Schmid, Sarah Norris, Greg Curry, Rookery Bay NERR; Roger Jacobsen and the City of Naples Beach Patrol; Chadd Chustz, City of Marco Island; City of Marco Island's and Collier County Sheriff Departments Marine Units; and the FWCC Marine Patrol.

The CCPRD would also like to extend appreciation to the Tourist Development Council, the Collier County Board of County Commissioners, the Coastal Advisory Committee, and all others we may have failed to mention.

SECTION 7

REFERENCES

Carr, A. and L. Ogren. 1960. The ecology and migrations of sea turtles, IV. The Green Turtle in the Caribbean Sea. America Museum Natural History Bulletin. 121:1-48.

Daniel, R. and K. Smith. 1974. The sea-approach behavior of the neonate loggerhead turtle. Journal of Comparative Physiology and Psychology. 40:413-420.

Davis, G. and M. Whiting. 1977. Loggerhead Sea Turtle Nesting in Everglades National Park, Florida, U.S.A. Herpetologica. 33:18-28.

Dickerson, D. and D. Nelson. 1989. Beachfront lighting issues regarding sea turtles. Proceedings of Beach Preservation Technology. Florida Shore and Beach Preservation Association. Tampa, Florida.

Dodd, C. 1988. Synopsis of the Biological Data on the Loggerhead Sea Turtle, *Caretta caretta*. US Fish & Wildlife Service, Biol Rep. 88:1-110.

Erhart, L. 1979. Patterns of Sea Turtle Mortality on the East-central Florida Coast, 1977-1978. Florida Scientist, 42 (Supplement 1). pp 26.

Erhart, L. and P. Raymond. 1983. The Effects of Beach Restoration on Marine Turtles Nesting in South Brevard County, Florida. U.S. Army Corps of Engineers. Jacksonville, Florida.

Ernst, C., J. Lovich, and R. Barbour. 1994. Turtles of the United States and Canada. Smithsonian Institution Press. pp 59-73.

Florida Fish and Wildlife Conservation Commission. 2002. Sea Turtle Conservation Guidelines. Bureau of Protected Species Management. Tequesta, Florida.

Gallagher, R., M. Hollinger, R. Ingle, and C. Futch. 1972. Marine Turtle Nesting on Hutchinson Island, Florida in 1971. Florida Department of Natural Resources, Special Scientific Report. 37:1-11.

Groombridge, B., (Compiler). 1982. The IUCN Amphibia-Reptilia Red Data Book. Part 1. Testudines, Crocodylia, Rhynchocephalia. IUCN, Gland, Switzerland. 426 pp.

Johnson, A. 1970. Biology of the Raccoon in Alabama. Auburn University Agriculture Station Bulletin. 402:1-148.

Kraus, M. 1991. Marco Island Sea Turtle Monitoring. Collier County Environmental Services Division. Publication Series NR-SP-91-01.

Kraus, M. 1992. Human Disturbances and Protection of Sea Turtles on Nesting Beaches in Collier County. Collier County Environmental Services Division. Publication Series NR-B-93-02.

Kraus, M., J. Staiger, and D. Suitor. 1993. Observations on Loggerhead Sea Turtle Nesting at Three Beaches in Collier County. Collier County Environmental Services Division. Publication Series NR-B-93-02.

Kraus, M., D. Suitor, and L. Douglass. 1995. Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Environmental Services Division. Publication Series NR-SP-95-01.

Kraus, M, D. Suitor, and K. Maheuron. 1996-1999. Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Environmental Services Division. Publication Series NR-SP-96-01 - NR-SP-00-01

Kraus, M., P. Allman, and J. Seitz. 2000. Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Environmental Services Division. Publication Series NR-SP-01-01.

Kraus, M., J. Seitz, M. Toro, and S. Gonzalez. 2001-2003. Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Environmental Services Division. Publication Series NR-SP-02-01 – NR-SP-04-01.

Kraus, M., J. Seitz, M. Toro, M. Hennig and S. Gonzalez. 2004 Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Environmental Services Division. Publication Series NR- SP 05-01.

Kraus, M., M. Toro, M. Hennig and S. Gonzalez. 2005-2010 Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Environmental Services Division. Publication Series NR- SP 06-01 – PR-10-01.

Kraus, M., M. Toro, and M. Hennig. 2011 – 2016 Collier County Sea Turtle Protection Plan. Sea Turtle Monitoring Program. Collier County Parks and Recreation Department Publication Series PR-11-01 – PR-16-01.

LeBuff, C. 1990. The Loggerhead Turtle in the Eastern Gulf of Mexico. Caretta Research, Inc. Sanibel Island, Florida. 216 pp.

Mann, T. 1978. Impact of developed coastline or nesting and hatchling sea turtles in southeastern Florida. Florida Marine Resource Publication 33:53-55.

Miller, J. 1985. Embryology of marine turtles. In C. Gans, F. Billet and P. Maderson (eds), Biology of the Reptilia, Vol 14. Academic Press, New York. Pp 269-328.

Mortimer, J. 1987. Management and research needs: Research needed for the management of beach habitat. Proceedings of the Second Western Atlantic Turtle Symposium. US Department of Commerce, NOAA, NMFS, Southeast Fisheries Service, Panama City, Florida. Pp. 236-246.

Moulding, J., and D. Nelson. 1988. Beach renourishment issues related to sea turtle nesting. Proceedings American Water Resources Association: Symposium on Coastal Water Resources. Wilmington, NC. Pp 87-93.

Murphy, T.M. and S.R. Hopkins-Murphy. 1989. Sea Turtle and Shrimp Fishing Interactions: a summary and critique of relevant information. Center for Marine Conservation. Washington, D.C. 52 pp.

National Research Council. 1990. Decline of the Sea Turtle: Causes and Prevention. National Academy Press. Washington, DC. 259 pp.

Nelson, D. 1988. Life History and Environmental Requirements of Loggerhead Turtles. US Fish & Wildlife Service Biol Rep. 88:1-34.

Nelson, D. 1991. Issues associated with beach renourishment and sea turtle nesting. In Proceedings Fourth Annual National Beach Preservation Technology Conference. Charleston, SC. Pp 227-294.

Nelson, D. and D. Dickerson. 1989. Effects of beach renourishment on sea turtles. In Proceedings of the Ninth Annual Workshop of Sea Turtle Conservation. Jekyll Island, GA. NOAA Technical Memorandum NMFS-SEFC-232.

Nelson, D., K. Mauck, and J. Fletemeyer. 1987. Physical Effects of Beach Nourishment on Sea Turtle Nesting. Delray Beach, Florida. Technical Report EL-87-15.

Pritchard, P. 1979. Encyclopedia of Turtles. TFH Publications, Inc. Neptune, New York. 895 pp.

Raymond, P. 1984. The effects of beach restoration on marine turtles nesting in south Brevard County, Florida. University of Central Florida MS Thesis. Orlando, Florida. 121 Pp.

Ryder, J. 1997. Sea Turtle Monitoring Report, 1997. The Conservancy of Southwest Florida. Unpublished report. Naples, FL.

Salmon, M., and J. Wynekin. 1990. Do swimming loggerhead sea turtles (*Caretta caretta*) use light cues for offshore orientation? Marine Behavior and physiology. 17:233-246.

Schmeltz, G., and R. Mezich. 1988. A preliminary investigation of the potential impact of Australian pines on the nesting activities of the loggerhead turtle. In Proceedings of the Eighth Annual Workshop on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFC-214. pp 63-66.

Williams-Walls, N., O'Hara J., Gallagher R., Worth D., Peery B. and J. Wilcox. 1983. Spatial and temporal trends of sea turtle nesting on Hutchinson Island, Florida, 1971-1979. Bulletin of Marine Science. 33:55-66.

Witherington, B. 1990. Photo pollution on sea turtle nesting beaches: problems and next best solutions. In Proceedings of the Tenth Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFC.

Witherington, B. 1991. Orientation of hatchling loggerhead turtles at sea off artificially lighted and dark beaches. Journal of Experimental Marine Biology and Ecology. 149:1-11.

Witherington, B. 1999. Reducing Threats to Nesting Habitat. In Research and Management Techniques for the Conservation of Sea Turtles. Eckert, K., K. Bjorndal, F. Abreu-Grobois, M. Donnelly (Editors). IUCN/SSc Marine Turtle Specialist Group Publication No. 4, 1999.

Witherington, B. and K. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles *Caretta caretta*. Biological Conservation. 55:139-149.

Witherington, B. and R. Martin. 1996. Understanding, Assessing and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. FMRI Technial Report. St. Petersburg, Florida.