



# **Escambia County**

## **2019 Marine Turtle Nest Monitoring Report**



**Mark Nicholas, Program Manager**

## ABSTRACT

In 2019, there were 25 loggerhead (*Caretta caretta*) nests, one Kemp's ridley (*Lepidochelys kempii*) and one green (*Chelonia mydas*) nest on Pensacola Beach (PB). There was also a total of 19 false crawls, with thirteen of the false crawls coming from loggerhead turtles and six were from green turtles. There were nine loggerhead nests recorded on Perdido Key (PK) along with 5 loggerhead false crawls. Tropical Storm Barry impacted incubating nests in mid-July through erosion and flooding of nests. The mean hatch success for all nests on Pensacola Beach, was 36.5% while mean emergence success was 34.8%. Mean hatch success for all nests on Perdido Key, was 18.5%, while mean emergence success was 18.4 %. One nest on Pensacola Beach was emergency relocated during the 2019 season when it was found by patrol with exposed eggs due to erosion. All other nests on PB remained *in situ* as part of the post construction (i.e. nourishment) year three survey requirements. No nests were deposited below the Most Recent High Tide Line (MRHTL) on Perdido Key, so none were relocated. In addition to 3 reported adult disorientation events, artificial lighting negatively affected 43% of applicable Pensacola Beach nests (n = 6 of 14); 13 nests were not applicable due to the absence of viable offspring (0% hatch success) and/or lack of evidence of hatchling orientation due to high winds, rain and tides. Artificial lighting impacted 67% of applicable Perdido key nests (n=2 of 3); 6 nests were not applicable due to the absence of viable offspring (0% hatch success). The low nest hatching success rates are attributed to turtles frequently nesting above the Most Recent High Tide Line (MRHTL) but below normal storm tide lines. Nests cannot be relocated, per the guidelines of the Florida Fish and Wildlife Commission (FWC), if laid low unless they are below the MRHTL. Additionally, a total of 6 marine turtle strandings were documented throughout 2019 in Escambia County (2 greens, 2 loggerhead, and 2 Kemp's ridley).

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## INTRODUCTION

The Pensacola Beach area of Santa Rosa Island encompasses approximately 8.1 miles of Northwest Florida's gulf coast, providing nesting habitat suitable to marine turtles. Historically, loggerhead (*Caretta caretta*; CC) and green (*Chelonia mydas*; CM) turtles are the two species documented to nest at this site. Additionally, Kemp's ridley (*Lepidochelys kempii*; LK) nesting was confirmed at this site for the first time during the 2018 season. Pensacola Beach has averaged 14 nests per season ( $SD \pm 9$ ) since annual surveys began, with 2019 exhibiting a nest count of 27 (Fig. 1).

In order to mitigate for the erosion evident along this shoreline, beach nourishment occurred during the 2016 nesting season on Pensacola Beach. Nest relocations for conservation purposes, with the exception of emergency relocation of nests encountered while actively washing out, were not authorized during the 2019 season as part of the post construction (i.e. nourishment) year-three survey requirements provided by Florida Fish and Wildlife Conservation Commission (FWC) and the United States Fish and Wildlife Service (USFWS). Post nourishment year-three surveys recorded the total number of emergences, escarpments  $\geq 18$ " encountered during nesting attempts, reproductive success, adult and hatchling disorientation, and nest loss due to erosion and/ or inundation on nourished and non-nourished (i.e. filled and unfilled, respectively) sections of Pensacola Beach. A nest productivity sheet for project monitoring regulatory permits was submitted to FWC upon their request. This data will be used to assess the effects of nourishment projects on marine turtle nesting and productivity in addition to monitoring the suitability of nourished beaches for nesting habitat.

The Perdido Key area is 6 miles in length and is utilized by loggerhead turtles. Historically this area was patrolled by the FL State Park personnel, until prior to the 2018 season. For the 2019 season, Escambia lands on Perdido Key were covered under permit #032.

## METHODS

### Survey Area

The Pensacola Beach turtle patrol is delineated on the west end by the Fort Pickens area of GUIS and on the east end by the Santa Rosa area of GUIS. Patrols began at boardwalk 22C located immediately east of White Sands condos, advanced to the designated eastern limit, and then progressed west to complete the survey at Park West.

Perdido Key is delineated on the west end by the Florida-Alabama state line. The east end is the boundary with the Gulf Islands National Seashore. A center portion is Florida State Park land and nests are not recorded for this area.

### **Crawl Identification and Data Collection**

Daily morning surveys, also referred to as patrols, were conducted between 01 May and 24 September 2019 on Pensacola Beach. Perdido Key patrols also began on May 1 but ended on September 6, 2019 due to mechanical issues with the UTV. Patrols were completed by permitted staff and volunteers. The PB patrol utilized a 4-seat UTV (John Deere Gator) beginning between 0500 – 0600 hours, or first light, and lasting 2-3 hours. Perdido Key utilized a Polaris UTV. Each section of beach was covered twice on patrol to provide a level of quality control and eliminate missed crawls; once driving below the high tide line (HTL), and once above.

During a collaborative pre-season meeting, it was decided to continue asking chair and umbrella vendors to install white boards to be initialed daily by patrol after one pass to ensure set-ups were not occurring prior to clearance. White boards were located at Margaritaville, core Casino Beach public access between Holiday Inn and Hilton, Portofino and Gulf Winds. White boards were not utilized on Perdido Key.

Data was collected for each nesting and non-nesting emergence event (i.e. false crawl). All data was entered into a database for storage and analysis. Successful nesting attempts were confirmed on PB by locating the clutch of eggs as egg verification was a post-nourishment requirement. Nest numbers were denoted numerically following the sequence in which they were discovered, e.g. the first nest laid on Pensacola Beach was denoted as 'PB01' while the second nest encountered by patrol on Perdido Key was denoted as 'PK02'. Data collected for each emergence included species, incident type (nest or false crawl), distance of the body pit to both the most recent high tide and vegetation lines, whether the nest was relocated, distances from the egg cavity to the nest sign and reference stakes, whether a predator screen was deployed and date if applicable, and location defined as 1) proximity to notable landmarks such as boardwalks and 2) GPS positioning of all nests at the clutch location. GPS positions were also taken for obstructed and/or disoriented emergences. Crawls that contained loops, meandered parallel to the shoreline greater than 100 feet, and/or or traveled inland post-nesting were indicative of disorientation. Maps containing point data for each nest were generated using Google Earth. A diagram was also illustrated for each emergence event. Daily logs were filled out to document survey completion.

### **Nest Marking and Monitoring**

After clutch location was confirmed by patrol, nests were marked with a sign, a square enclosure, and two reference stakes. Nest relocation for conservation purposes was not authorized on PB nor occurred on PK during the 2019 season due to 1) no opportunistic encounters of nests laid below the Most Recent High Water Line (MRHWL) and 2) adherence of post beach nourishment year-three survey protocol provided by FWC and USFWS for PB.

Nests were monitored throughout the incubation period and checked daily by morning patrol for evidence of predation, over wash, erosion, and other disturbances. Additionally, nests were monitored for signs of hatching during morning surveys beginning day 50 of the incubation period to determine the precise duration of incubation, and to gather data on hatchling emergence, predation, and to document disorientation events. Visual emergence signs include a collapse or depression over the egg cavity and a cluster of small, approximately 2" wide tracks radiating from the nest site.

Nighttime nest monitoring (spot checking) was conducted for the 2019 season. No detaining screens were utilized for hatchling disorientation mitigation work.

### **Assessments**

Nests were assessed 72 hours after the initial hatching event. Nests that were flooded and where emergence signs were not evident were assessed at day 80 of the incubation period. During assessment, nests were excavated and the number of hatched (defined as an intact shell greater than 50%), unhatched and pipped eggs was recorded, along with the number of live and dead hatchlings found in the nest at the time of excavation (Appendix B). Unhatched eggs were opened and the presence or absence of development was noted. All contents were reburied in the nest chamber. Any hatchlings alive in the nest were released to crawl into the Gulf of Mexico (hereafter referred to as the Gulf) prior to 0900 if  $\leq 10$  hatchlings were present. In the event  $> 10$  hatchlings were located in the nest during assessment they were either 1) held in a container with 1" of moist sand and kept in a cool, dark place until released that night, or 2) reburied with nest contents and allowed an additional 48 – 72 hours to emerge prior to assessment.

### **Analyses**

Beach success, reproductive success and productivity were determined for the 2019 season. Beach success was defined as the proportion of nests to all emergences:



$$\text{Beach Success \%} = \text{Nests} / (\text{Nests} + \text{False Crawls})$$

Weighted mean hatch and emergence success rates were calculated for assessed nests on Pensacola Beach as follows:

$$\text{Weighted Mean Hatch Success \%} = \text{Total \# Hatched Eggs All Nests} / \text{Total \# Eggs Laid All Nests}$$

$$\text{Weighted Mean Emergence Success \%} = \text{Total \# Emerged Hatchlings All Nests} / \text{Total \# Eggs Laid All Nests}$$

Median hatch and emergence success were also calculated to represent central tendency due to non-normal distribution. This measure was determined by listing the data in ascending order and identifying the number in the middle of the dataset. Median can also be calculated using the following formula:

$$\text{Median hatch or emergence success \%} = [(\text{Total \# of Applicable Nests} + 1) / 2] \text{th, where 'th' means the } n\text{th number in the set when listed in ascending order}$$

Nest success was defined as the proportion of nests yielding hatch success  $\geq 10\%$ . Productivity was defined as the total number of emerged hatchlings estimated from all nests during the 2019 season. Observed egg loss, hatchling loss and percentage of hatchlings and/or tracks witnessed entering the Gulf was evaluated.

## RESULTS AND DISCUSSION

### **Crawl Activity and Beach Success**

Nesting occurred between 22 May and 30 August on PB and between 30 May and 03 August for PK. The 2019 season witnessed 27 nests and 19 false crawls on Pensacola Beach, yielding a beach success of 60% compared to the 23 year average beach success of 65% (Fig. 7; Fig 8.). One Kemp's ridley nests was identified confirming utilization of this site as nesting habitat. One green nested on PB and there were also 6 false crawls from greens. The remaining nesting and non-nesting emergences were identified as loggerheads. All 27 nests remained *in situ* upon initial location. One emergency relocation was performed. Two of the loggerhead nests and the one green nest occurred on the University of West Florida (UWF) property.

Of these emergences, 22 nests (1 Lk; 21 Cc) and 12 false crawls (Cc) occurred on filled areas; 2 nests (Cc) occurred on the unfilled area stretching from White Sands Condos west approximately 0.40 miles

(Fig. 9). This is a historically stable to accretional area that required no fill during the 2016 nourishment project. Two loggerhead and one green nest occurred on UWF, which is east of the project area.

### **Missed Nests**

No unknown or “missed” nests, defined as a nest unidentified on patrol the morning after deposition but located some time during incubation or hatch, were documented this season.

### **Reproductive Success and Productivity**

In 2019, a total of 25 loggerhead nests, 1 green and 1 Kemp's ridley nests were laid on Pensacola Beach and monitored throughout incubation. The average length of incubation on PB was 62 days ( $n = 15$ ), with the shortest incubation period observed at 56 days for PB18. The longest incubation length was for PB29 that was partially washed out. The average clutch size was 102 eggs, ranging from 67 - 134 (Table 2). Of the 27 monitored nests, 21 were assessed, 5 were completely lost to erosion or tidal inundation (i.e. tidal impacts). One was partially lost to tidal impacts, 0 were identified as infertile, and 0 experienced egg predation by a source other than ghost crab.

In 2019, a total of 9 loggerhead nests occurred on PK. The average length of incubation on PK was 57 days ( $n = 3$ ). The average clutch size was 89 eggs, ranging from 53 -114 (Table 2). Of the 9 monitored nests, 6 were assessed, 3 were completely lost to erosion or tidal inundation (i.e. tidal impacts). Zero were identified as infertile, and 0 experienced egg predation by a source other than ghost crab.

A total of 13 nests produced viable offspring during the 2019 season on Pensacola Beach. Perdido Key had 3 of the nine nests produce hatchlings. Mean hatch success for PB was 36.5% ( $SD \pm 43\%$ ) and PK was 18.5% ( $SD \pm 36\%$ ). Compared with historical data obtained annually on PB since 1996, hatch success was very low this year compared to the 23 year average of 72.2% ( $SD \pm 14.3\%$ ) (Figure 11).

The total number of hatchlings witnessed entering the Gulf from PB was approximately 608. Only 5 hatchlings were witnessed on PK from the 3 nests that hatched.

### **Effects of Erosion, Inundation and Tropical Weather**

Direct impact of tides on a large number of incubating nests this season may be due to a high number of low beach nests. Relocation of nests on PB was not permitted by FWC per the post-nourishment protocol. No nests were located below the MRHTL on PK so none were relocated higher on the beach.

One named storm adversely impacted marine turtle nests this season. In mid-July, storm surge from Tropical Storm Barry flooded a total of 14 nests (52%) on PB and 4 of those were lost to erosion. On PK, Barry flooded 6 of 9 (67%) nests and 2 were lost to erosion. PB had further erosion problems from unnamed storms and had 2 more nests impacted, with one lost completely to erosion and a second losing roughly half of the eggs, before the remaining eggs were relocated.

In total, 16 of 27 nests on PB experienced tidal impacts to include erosion, repeated wash over and/or inundation. Of these 16 impacted, 6 nests experienced total loss and one was partially washed out. (Table 2).

PB nests hatched at a rate of 36.5%, down from the average of 72%. PK hatch success was only 18.5%.

### **Predation**

Predation rates were low throughout 2019. Canine, feline, armadillo, ghost crab, raccoon and various avian tracks were observed on Pensacola Beach in the 2019 season. Egg predation was confirmed for two nests this season, attributing as a loss of 5 confirmed eggs to ghost crabs.

While egg and hatchling predation by ghost crabs was only observed at two nests, it is likely greater loss occurred that was not observed and can be attributed to ghost crabs. Burrows were noted in close proximity to several of the nest sites, however, loss sub-surface cannot be accurately confirmed. Data sheets include field notes regarding ghost crab activity. Missing eggs/hatchlings could be attributed to either unknown predation events or heavy rain that may have washed out tracks from daytime and nighttime rainfall emergencies.

### **Nest Relocations**

The average distance of nests on PB to the water line was 59 feet (SD  $\pm$  35.4 feet) and 71 feet (SD  $\pm$  30.9 feet), respectively. Variance was high for both variables. While nests within 50 feet of the MHW were routinely relocated over past seasons, no nests were relocated upon initial discovery during 2019 due to post-nourishment year-three monitoring protocols and guidelines outlined in the FWC Marine Turtle Handbook stating only nests deposited seaward of the MRHTL are candidates for relocation (FWC 2016).

One emergency relocation was performed this year. Nest PB29 was found washing out on patrol and the remaining eggs were salvaged and moved.

### **Light Pollution and Disorientation**

Hatchling disorientation was defined as > 5 hatchlings from a given nest orienting > 45° from the most direct path to the Gulf post-emergence (FWC 2016). In addition to 3 reported adult disorientation events, artificial lighting negatively affected 43% of applicable Pensacola Beach nests (n = 6 of 14; Fig. 18; Table 4 and 5); 48% of total nests (n = 13) were not applicable due to the absence of viable offspring (0% hatch success) and/or lack of evidence of hatchling orientation due to high winds, rain and tides. Eight nests (30% of total nests) did not experience hatchling disorientation this season.

In addition to one reported adult disorientation events, artificial lighting negatively affected 67% of applicable Perdido Key nests (n = 2 of 3; Table 6 and 7); 67% of total nests (n = 6) were not applicable due to the absence of viable offspring (0% hatch success) and/or lack of evidence of hatchling orientation due to high winds, rain and tides. One nest (11% of total nests) did not experience hatchling disorientation this season

Adult and hatchling disorientation reports are provided annually to FWC for evaluation. The most commonly noted sources of disorientation on reports provided to FWC during the 2019 season were interior and exterior lighting of various homes and condominiums. Additional probable/possible sources of hatchling and adult disorientation are listed in Tables 4-7.

### **Obstructed Nesting Events**

There was only one obstructed nesting attempt on PB and 6 occurred on PK. These typically involve beach furniture, or boardwalks. Light pollution and physical obstruction by personal belongings left out overnight are disruptive factors for nesting turtles. Events that cause such interference typically occur annually during Memorial Day, Independence Day, and Blue Angels Airshow festivities. Although the “Leave No Trace” beach ordinance was passed by Escambia County Commissioners in the summer of 2015, permits grant exemption to visitors participating in special events. The high density of tents and other beach equipment left up during special event weekends obscures the view of morning patrol.

### **Post-nourishment year three summary**

Pensacola Beach was tilled in early March, 2019. This was completed to benefit nesting turtles by reducing compaction rates on the nourished beach areas.

Post nourishment year-three surveys recorded the total number of emergences, reproductive success's, adult and hatchling disorientation, and lost nests due to erosion and/ or inundation on nourished and non-nourished (i.e. filled and unfilled, respectively) sections of Pensacola Beach. Additional variables were included in the database such as false crawl stage of abandonment, distance to dune lines and vegetation and whether individuals encountered escarpments  $\geq 18$ " during emergence (Table 1). This data will be used to assess the effects of nourishment projects on marine turtle nesting and productivity in addition to monitoring the suitability of nourished beaches for nesting habitat by FWC.

### **Strandings**

There were 6 reported strandings in Escambia County in 2019; 2 loggerhead, 2 Kemp's ridley and 2 greens. The RPI program, established by the Loggerhead Marine Life Center in Juno Beach, assists pier operators and fisherman that respond to hooked turtles. Program objectives include increasing public education and pier signage, scheduling routine piling and on deck clean-ups, providing nets so operators can assist hooked or entangled turtles, and to provide proper training so reporting and transport of hooked turtles to rehabilitation facilities occurs.

## **CONCLUSIONS AND RECOMMENDATIONS**

Disorientation rates were likely underestimated due to lack of observation of direction of travel by hatchlings post-emergence. Significant time elapsed between emergence and monitoring by morning patrol, in which tracks were often erased by wind and rain events.

### **Limiting Disruption**

Human and vehicular presence on nesting beaches during darkness has the ability to disrupt nesting turtles and their hatchlings. Encountering an emerged turtle by happenstance can cause her to abandon nesting or choose a less suitable site. While vehicles are operated at night for public safety, some of the vehicles present are removing trash and debris for 'Leave No Trace'. Further evaluation

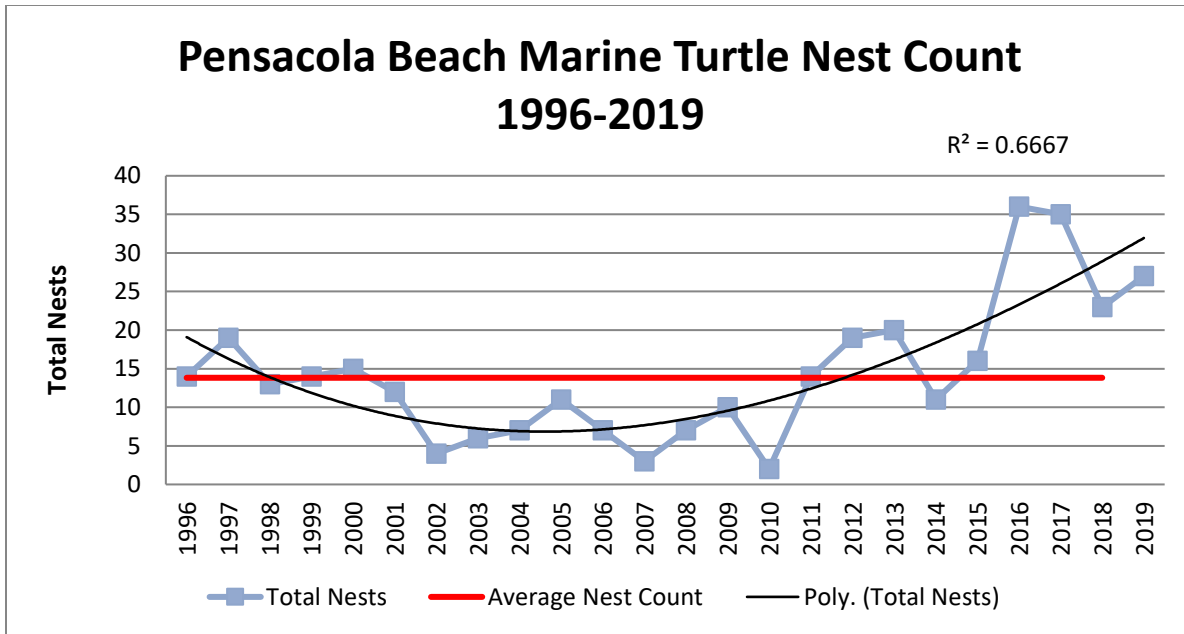
into whether the benefits of current 'Leave No Trace' operations outweigh the risks to marine turtles may be warranted due to possible conflicts with nesting marine turtles.

### **Volunteer Time**

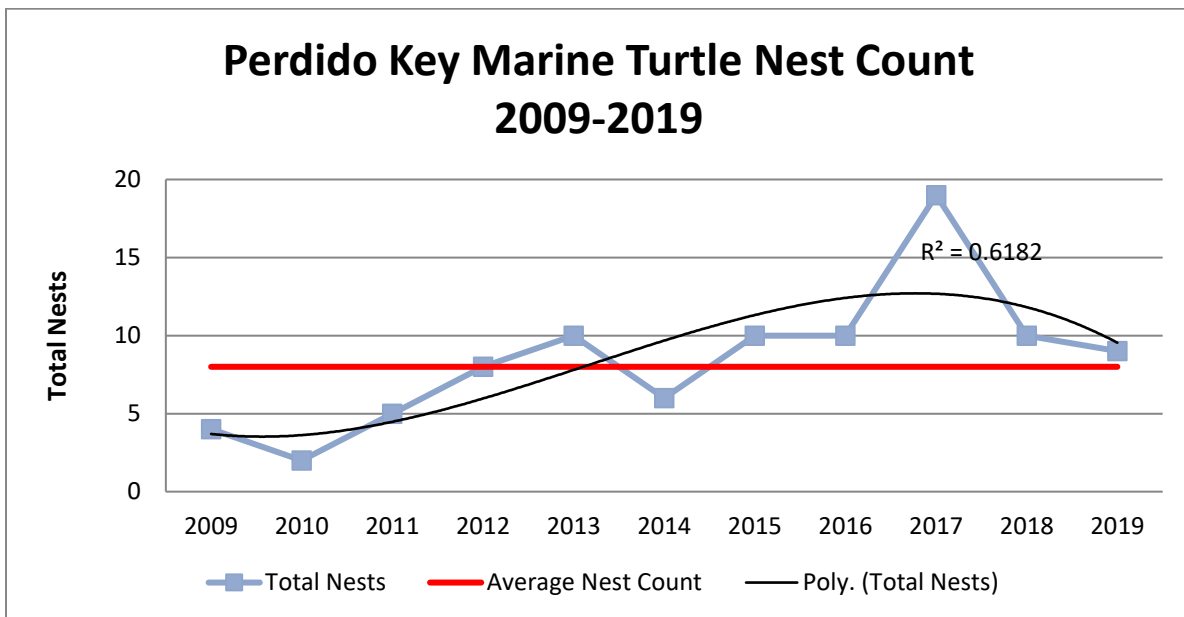
Volunteers collectively submitted approximately 700 hours for conducting marine turtle nesting surveys and another 250 hours on monitoring activities. Key issues that require dissemination to the public include how to reduce disorientation caused by artificial lighting, strandings caused by fisherman on and off piers, and improper waste disposal. Continuing to utilize permitted volunteers for stranding response and transport will be a beneficial use of volunteer resources and increase chances of survival for sick and injured marine turtles.

### **Training**

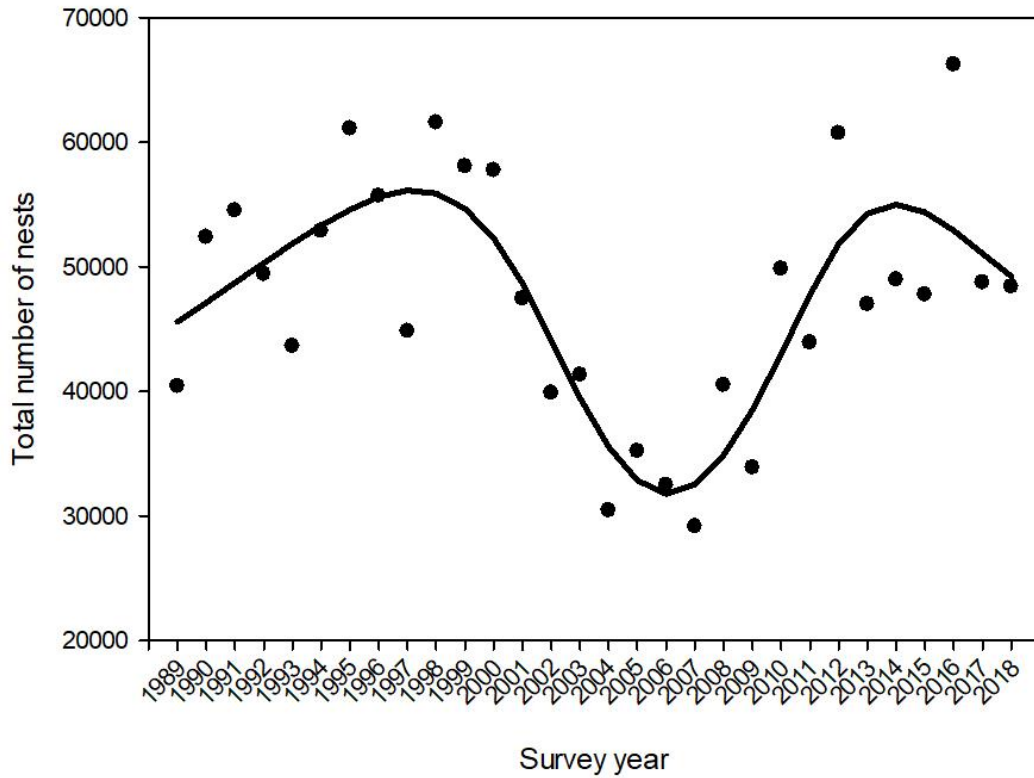
Training is recommended for employees of Escambia County public works and vendors prior to commencement of the 2020 nesting season. Training provided by the 2020 marine turtle permit holder should include 1) crawl and nest identification, 2) how to respond to and report nests, injured wildlife, and stranded turtles (hooked turtles and those washed ashore), and 3) who to report events to for proper response.



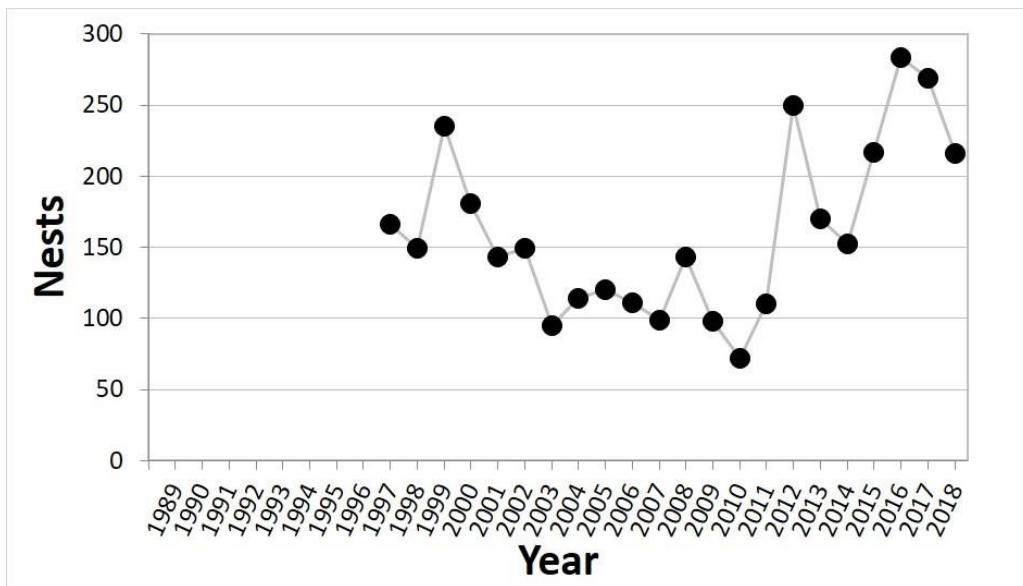
**Figure 1:** Pensacola Beach annual marine turtle nest count trend from the 1996 - 2019 seasons. Pensacola Beach has averaged 14 nests per season ( $SD \pm 9$ ) since annual surveys began, with 2019 exhibiting a nest count of 27. The best-fit trend line is displayed (polynomial;  $R^2 = 0.6667$ ).



**Figure 2:** Perdido Key annual marine turtle nest count trend from the 2009 - 2019 seasons. Perdido Key has averaged 8 nests per season ( $SD \pm 4.5$ ) since 2009. The best-fit trend line is displayed (polynomial;  $R^2 = 0.6182$ ).

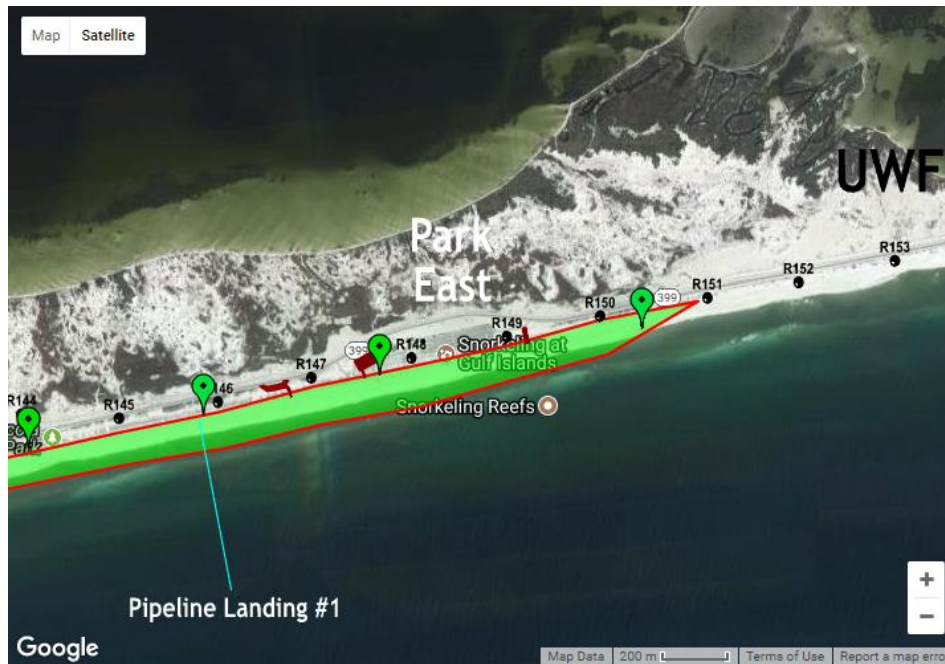


**Figure 3:** Statewide nesting loggerhead trend data, 1987 – 2018. Total of 27 core index nesting beaches across Florida follow standardized data collection methods to represent statewide trends.



**Figure 4:** Florida panhandle nesting loggerhead trend data, 1997 – 2018. Panhandle index beaches are excluded from the set of core index nesting beaches throughout the rest of the state (FWC 2018).





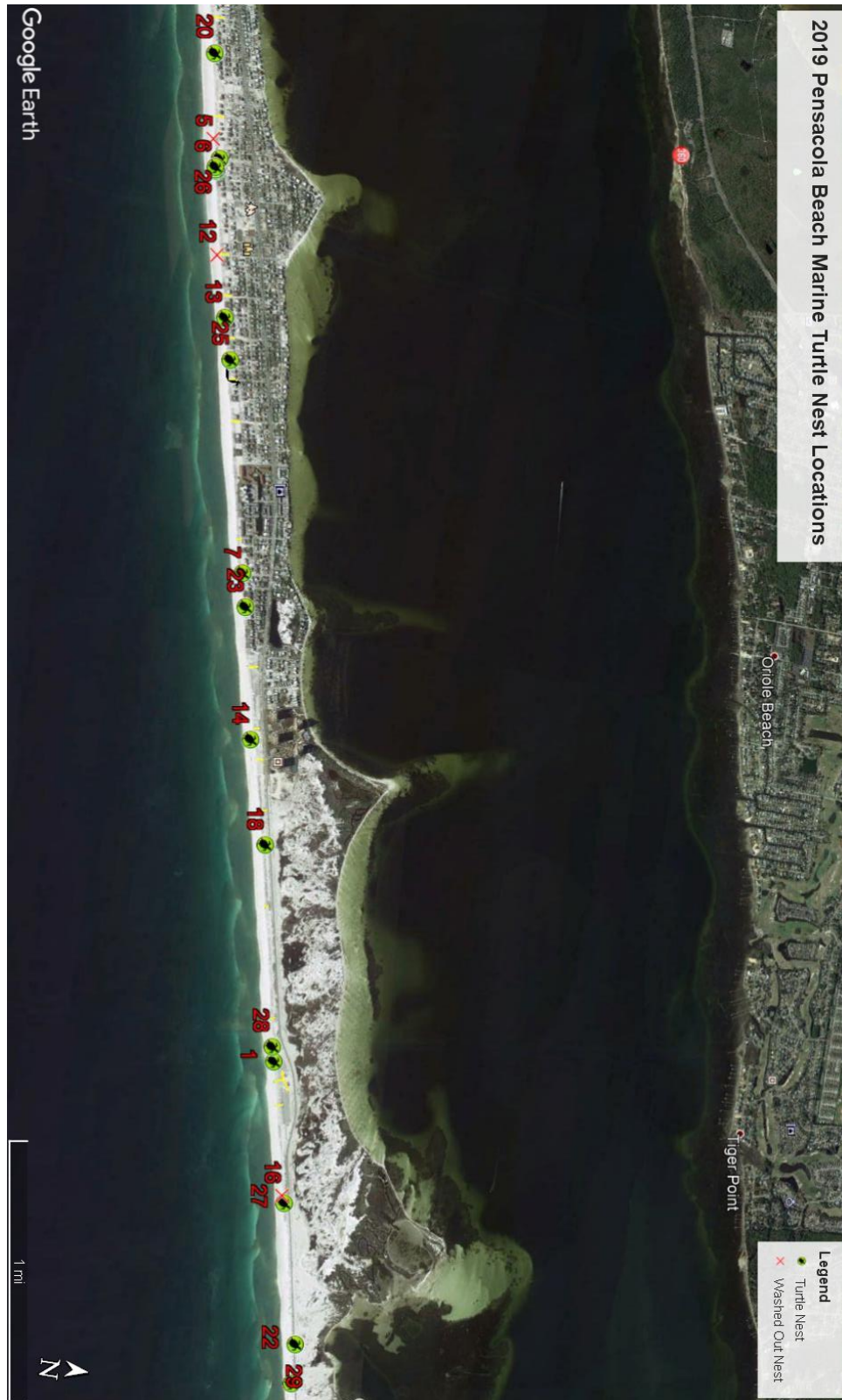
**Figure 5:** Easternmost segment of the Pensacola Beach 2016 nourishment project. Filled area extended into UFW property (denoted in green). (map property of Olsen Associates, Inc).



**Figure 6:** Area unfilled during 2016 Pensacola Beach nourishment (map property of Olsen Associates, Inc). Unfilled area begins at the easternmost point of White Sands Condos and extends west approximately 0.4 miles. Green shading denotes filled area.

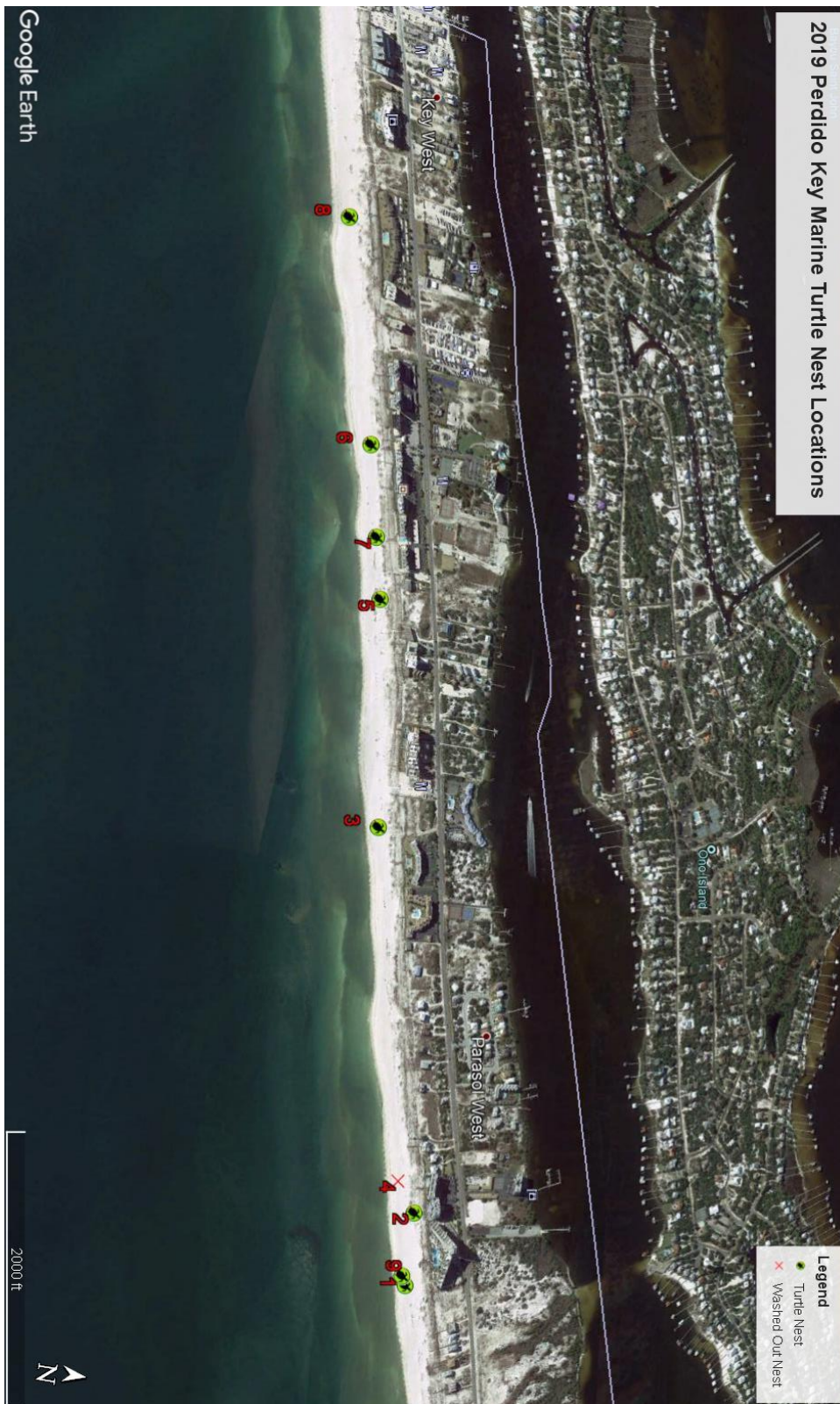


**Figure 7:** GIS map displaying Pensacola Beach west side marine turtle nest locations for the 2019 season.

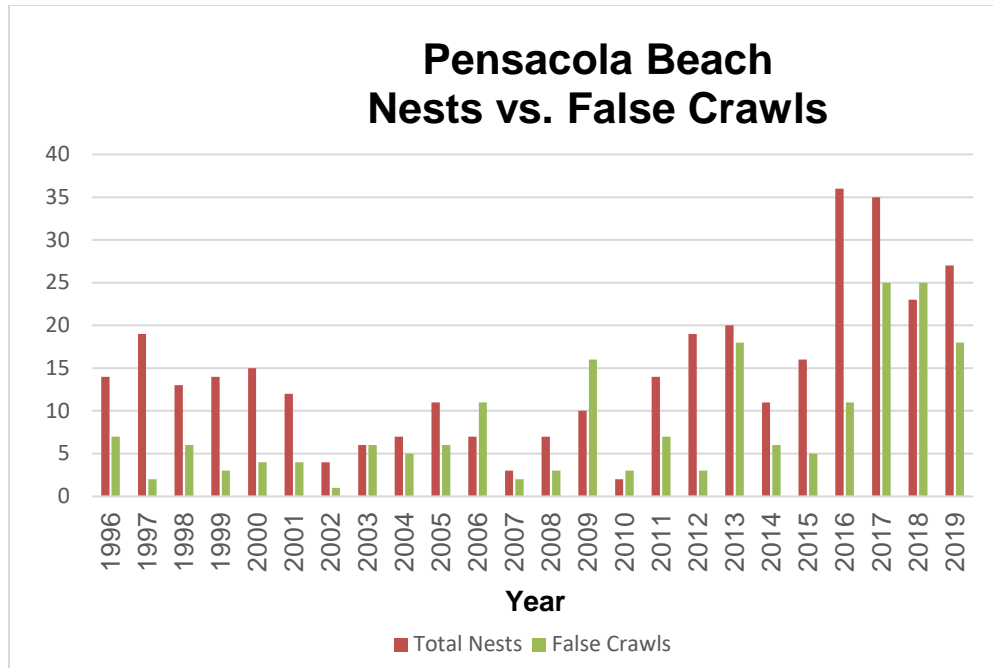


**Figure 8:** GIS map displaying Pensacola Beach east side marine turtle nest locations for the 2019 season.

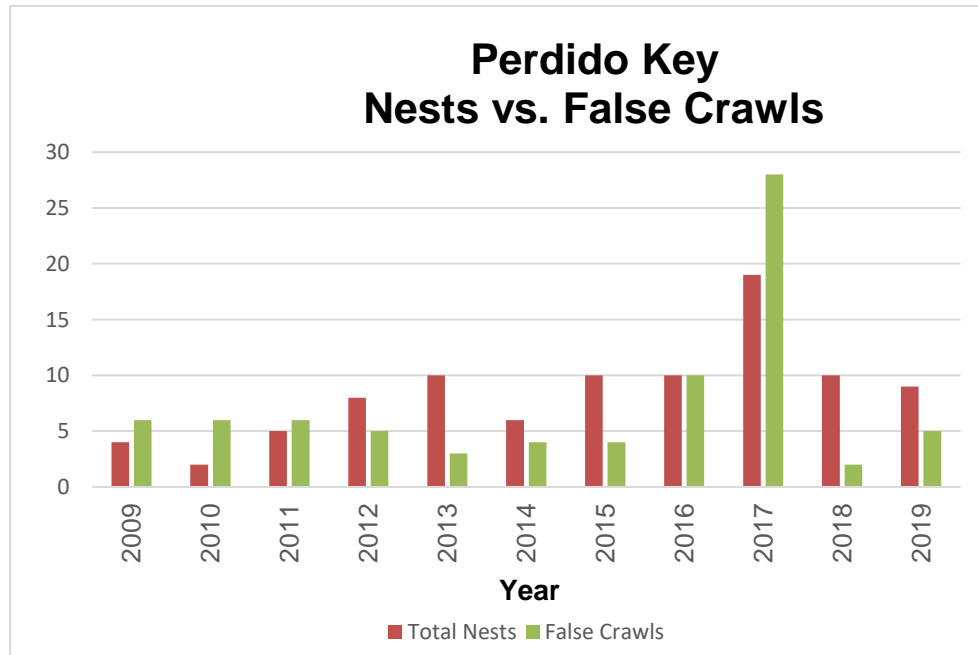




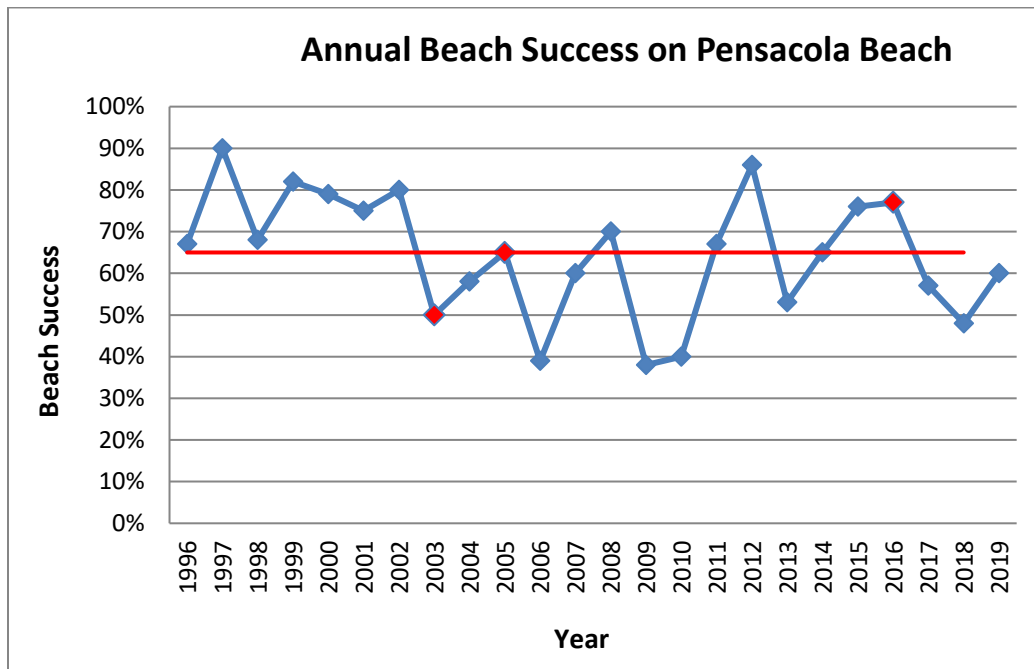
**Figure 9:** GIS map displaying Perdido Key marine turtle nest locations for the 2019 season.



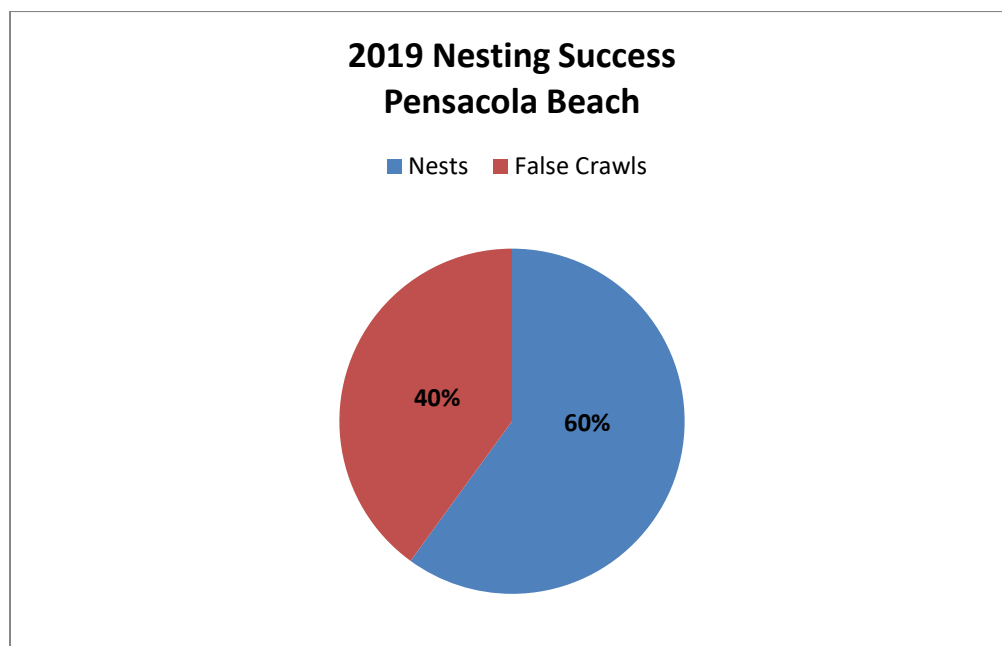
**Figure 10:** Marine turtle emergence data from Pensacola Beach including the number of nests compared to the number of non-nesting emergences (i.e. false crawls), 1996 - 2019.



**Figure 11:** Marine turtle emergence data from Perdido Key including the number of nests compared to the number of non-nesting emergences (i.e. false crawls), 2009 - 2019.

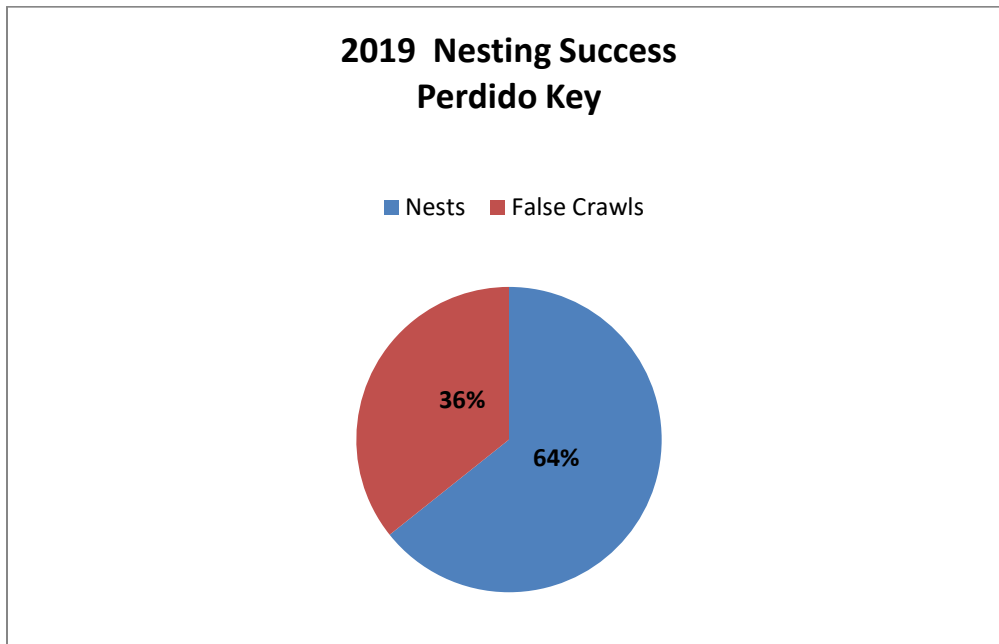
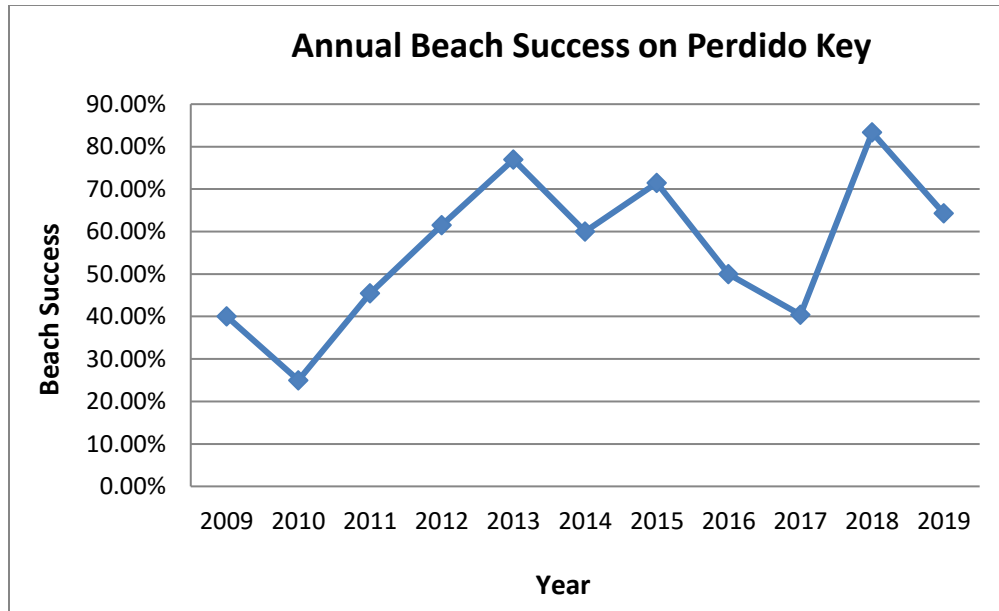


a.

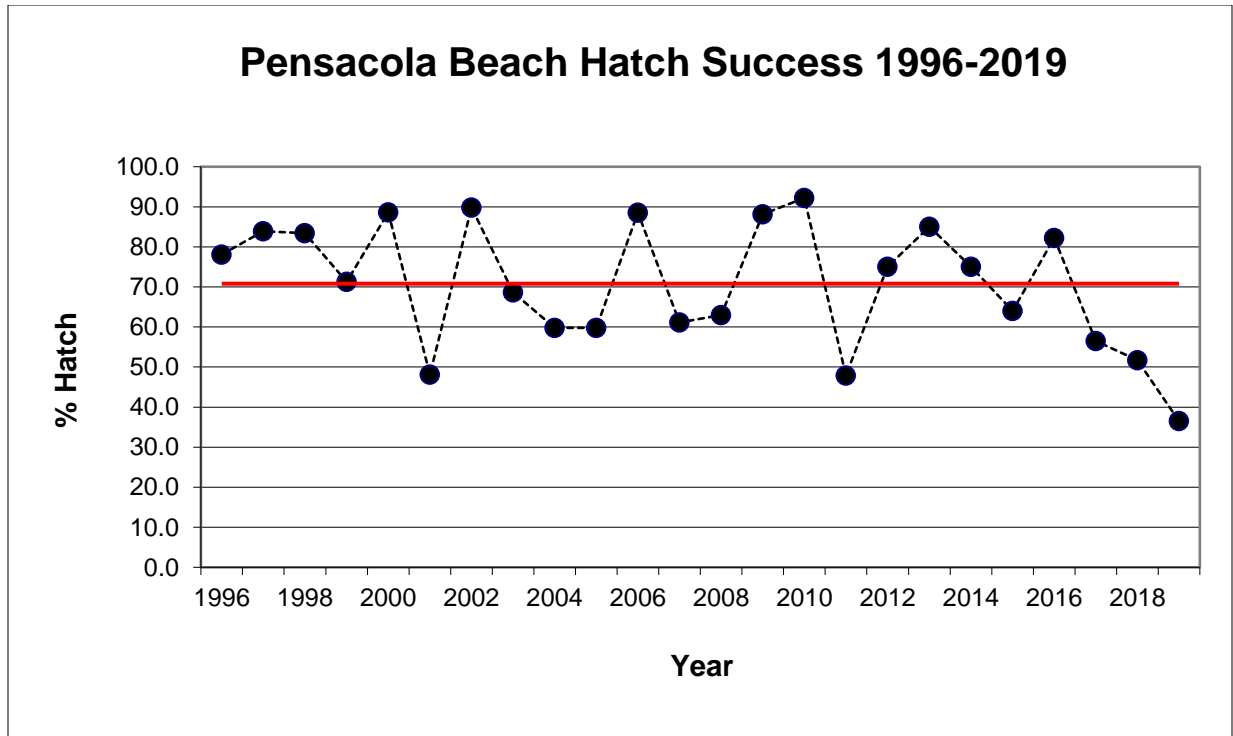


b.

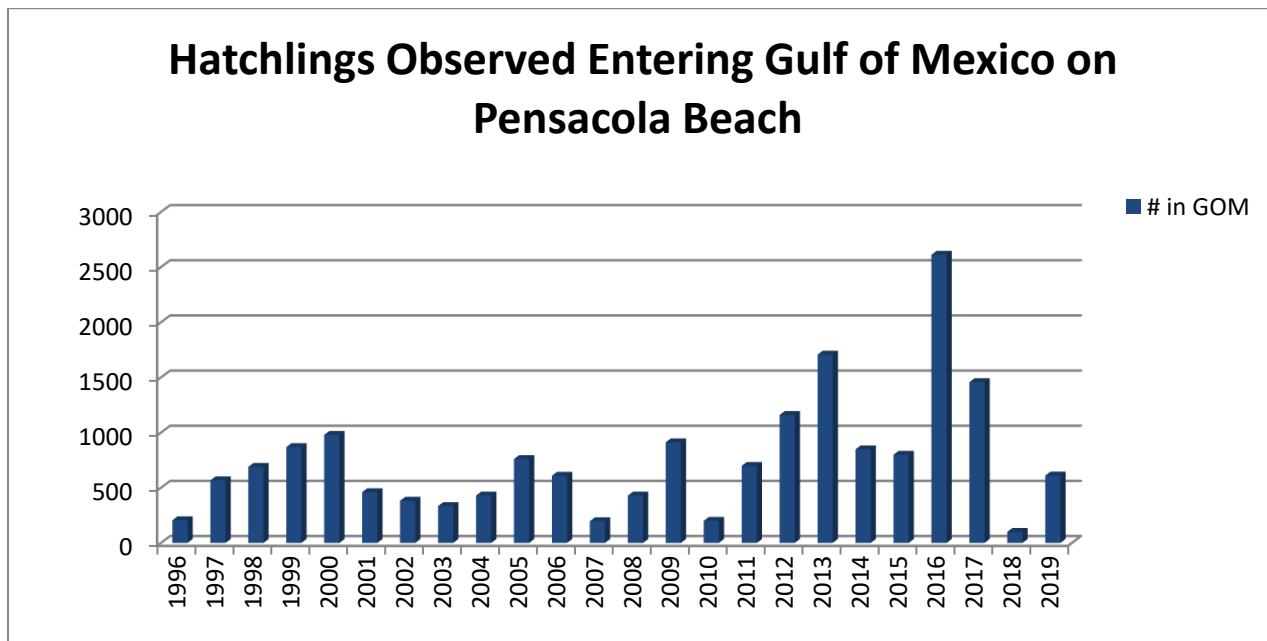
**Figure 12:** Annual beach success data from Pensacola Beach, 1996-2019 (a). Beach success is defined as the proportion of nests laid to the total number of crawls. Beach nourishment project years are represented by red data points (2003, 2005, and 2016). Beach success for 2019 was 60%, compared to the 23 year average of 65%. (b). Proportion of nests to false crawls for 2019.



**Figure 13:** Annual beach success data from Perdido Key, 2009-2019 (a). Beach success is defined as the proportion of nests laid to the total number of crawls. Beach success for 2019 was 64%. Proportion of nests to false crawls for 2019 is also depicted (b). Proportion of nests to false crawls for PK in 2019.



**Figure 14:** Annual weighted mean hatch success (% hatch) from the 1996 - 2019 nesting seasons on Pensacola Beach. Mean hatch success for the 2019 season was 36.5% (SD  $\pm$  43%). Long-term monitoring efforts have established a 24 year mean hatch success of 70.8% (SD  $\pm$  15.8%).



**Figure 15:** Number of hatchlings observed entering the Gulf of Mexico from the 1996 - 2019 nesting seasons on Pensacola Beach.



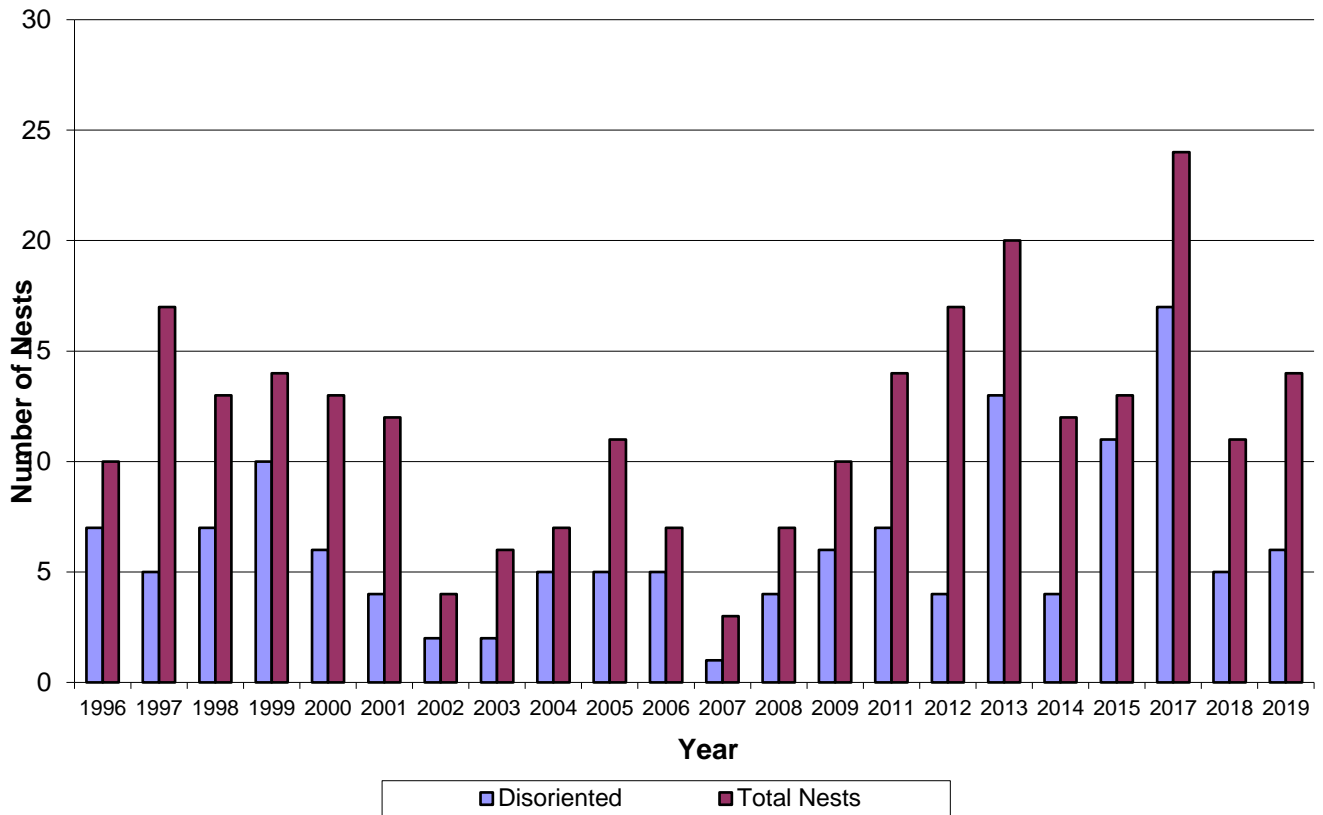


**Figure 16:** Photograph of PK01 where the turtle had an obstructed nesting attempt due to wooden beach chair furniture. The nest was within 32 feet of the water and was impacted from TS Barry and produced zero hatchlings.



**Figure 17:** Photograph of nest PB02 near Holiday Inn Express. This nest was lost to erosion from Tropical Storm Barry. It was laid only 40 feet from the water.

## Pensacola Beach Disoriented Nests 1996 - 2019



**Figure 18:** Comparison of marine turtle nests with hatchling disorientation to the total number of nests per season from 1996-2019 on Pensacola Beach. Disorientation data is not shown for the 2010 and 2016 seasons due to relocation of all incubating nests offsite during the 2010 Deepwater Horizon oil spill and 2016 nourishment project. Hatchling disorientation was defined as nests with  $\geq 5$  hatchlings crawling at  $> 45^\circ$  angle from the direct path to the water. Hatchlings were required to crawl  $\geq 10$  feet to be classified as disoriented.





**Figure 19:** Hatchling tracks traveling southbound from PB06, on 11 August with 80% moon.





**Figure 20:** Photograph of Kemp's ridley female on Pensacola Beach on 09 June, 2019.



**Figure 21:** Nest PB01 was afforded additional protection due to Memorial Day crowds at Park East. Storm surge resulting from Tropical Storm Barry flooded the nest in mid July. This nest had a zero percent hatch.



**Figure 22:** Photograph illustrating a loggerhead nest PB23. This nest was located 125 feet from the waters edge and hatched at 99%.



**Figure 23:** Photograph illustrating the crawl of an adult loggerhead associated with nest PK02, that became disoriented post nesting and crawled for a distance of 1100 feet to the east before returning to the Gulf.





**Figure 24:** PK08 hatch





**Figure 25:** Nest PB26 view photographed from a drone. (Photo courtesy of Steve Luppert)





**Figure 26:** Photograph of a Kemp's ridley stranding on Escambia Bay.





**Figure 27:** Photograph of marine debris found on a green turtle stranding, MAN20190617-01. The line was wrapped around the head and front flippers of an 83 cm carapace green turtle.

**Table 1: 2019 Pensacola Beach marine turtle nesting data summary.**

Pensacola Beach 2019		Date	Species	Hatch Date	Incub Days	# Eggs	# without develop	# with develop	# Hatched	# Emerged	% Hatch Emerge	Adult Dis. (Y/N)	Hatching Dis. (Y/N)	Tidal Impact (Y/N)	# in water witnessed	Apx. Tracks to GDM	Relocated (Y/N)	Crawl width (in)	Distance dunetleg (ft)	Distance from water ≥18" scarp (ft)	Project Area	Latitude	Longitude	
	1	5/22	Cc	NA	NA	110	0	51	59	0	0%	N	NA	Y	NA	NA	N	33	85	65	N	Y	30.346397000	87.088558000
	2	5/30	Cc	NA	Bary	114	0	NA	NA	0	0%	Y	NA	Y	0	0	N	32	90	40	N	Y	30.328616000	87.151635000
	3	6/3	Cc	NA	Bary	114	0	NA	NA	0	0%	Y	NA	Y	0	0	N	30	95	65	N	Y	30.328608000	87.170377000
	4	6/7	Cc	8/11	65	118	0	5	72	41	35%	N	Y	Y	4	20	N	38	55	62	N	N	30.327951000	87.155441000
	5	6/8	Cc	NA	NA	105	0	12	93	0	0%	N	NA	Y	0	0	N	39	79	32	N	Y	30.334645000	87.118912000
	6	6/8	Cc	8/11	63	84	0	4	30	50	60%	N	N	Y	1	49	N	32	61	58	N	Y	30.334978000	87.117090000
	7	6/9	Lk	8/6	58	109	2	29	21	55	50%	N	N	N	50	0	N	NA	1	65	N	Y	30.340151687	87.090735000
	8	6/15	Cc	NA	NA	100	0	10	90	0	0%	N	NA	Y	0	0	N	40	46	58	N	Y	30.329294000	87.148000000
	9	6/15	Cc	NA	NA	89	0	4	85	0	0%	N	NA	Y	0	0	N	33	83	56	N	Y	30.346498000	87.057847000
	10	6/29	Cc	9/2	65	92	0	21	0	71	77%	N	Y	Y	1	25	N	37	44	77	N	Y	30.335048000	87.168360000
	11	6/29	Cc	NA	NA	92	3	0	92	0	0%	N	NA	Y	0	0	N	38	62	52	N	Y	30.346351000	87.088739600
	12	7/1	Cc	NA	Bary	114	0	NA	NA	0	0%	Y	NA	Y	0	0	N	30	111	44	N	Y	30.335989000	87.111343000
	13	7/2	Cc	9/8	68	132	0	117	10	5	4%	N	N	N	83	0	N	42	83	77	N	Y	30.338656000	87.107303000
	14	7/4	Cc	9/11	69	80	0	24	58	22	28%	N	N	Y	4	4	N	30	105	60	N	Y	30.342191000	87.079800000
	15	7/9	Cc	NA	NA	92	0	92	0	0	0%	N	NA	Y	0	0	N	37	101	73	N	Y	30.325356000	87.176753000
	16	7/11	Cc	NA	Bary	114	0	NA	NA	0	0%	N	NA	Y	0	0	N	35	76	38	n	Y	30.348146000	87.048644000
	17	7/14	Cc	9/11	59	94	0	3	0	91	97%	N	N	N	91	0	N	42	5	61	N	Y	30.328836500	87.150778000
	18	7/14	Cc	9/8	56	84	0	1	0	83	99%	N	N	N	80	0	N	39	0	95	N	Y	30.343920000	87.072938000
	19	7/14	Cc	9/18	66	67	0	66	0	1	1%	N	N	N	0	1	N	37	21	58	N	N	30.328253000	87.154500000
	20	7/15	Cc	9/17	64	100	0	18	1	81	81%	N	Y	N	78	3	N	44	33	100	N	Y	30.3333915000	87.124531000
	22	7/20	Cm	9/19	61	134	0	0	0	130	111	N	Y	N	32	38	N	43	0	148	N	N	30.350247000	87.039620000
	23	7/22	Cc	9/19	59	76	0	1	0	75	74	N	NA	N	2	0	N	38	16	115	N	Y	30.340620000	87.086570000
	25	7/26	Cc	9/24	60	100	0	1	1	98	87	N	Y	N	64	10	N	40	24	165	N	Y	30.337540000	87.104630000
	26	7/27	Cc	9/26	61	122	0	4	0	118	118	N	N	N	118	0	N	38	78	75	N	Y	30.338010000	87.116938000
	27	7/27	Cc	9/26	61	99	0	12	0	87	86	N	Y	N	0	0	N	39	57	77	N	N	30.348296000	87.048133000
	28	8/8	Cc	NA	NA	114	0	NA	NA	0	0%	N	NA	Y	0	0	N	42	92	52	Y	Y	30.346167000	87.089537000
	29	8/30	Cc	NA	NA	114	0	21	6	0	0%	N	NA	Y	3	0	N	40	90	48	N	N	30.350370000	87.030701000
n=	27	27	27	27	15	27	27				27	27	27	27	14	27	27	27	27	27	27	27	27	
sum						2763	5	496	618	1008	962		3	6	16	611	150	0			1	22		
mean						62	102				36.5%							37	59	71				
StDev						3.773	16.6				0.42878	0.41407						35.43	30.97					

**Table 2:** 2019 Perdido Key marine turtle nesting data summary.

Perdido Key 2019	Nest #	Date Laid	Species	Hatch Date	Incub Days	# Eggs	# Eggs Predicted	# without develop	# with develop	# Unhatched (including pipped)	# Hatched	# Emerged	% Hatch	% Emerge	Adult Dis. (Y/N)	Hatching Dis. (Y/N)	Tidal Impact (Y/N)	# in water witnessed (approx.)	Aprox. Trans to GOM	Relocated (Y/N)	Crawl width (m)	Distance from water (ft)	Distance from water ≥ 18" scarp (ft)		Latitude	Longitude
1	530	Cc	NA	NA	NA	114	NA	NA	NA	NA	0	0	0%	0%	N	NA	Y	0	0	N	38	175	32	N	30.28198000	-87.465319000
2	64	Cc	831	57	61		N	33	7	41	20	20	33%	100%	Y	Y	N	5	1	N	32	90	40	N	30.28626300	-87.46656300
3	69	Cc	NA	NA	NA	93	0	9	84	84	0	0	0%	0%	N	NA	Y	0	0	N	34	47	37	N	30.283991600	-87.46661700
4	618	Cc	NA	Bary	114	0	NA	NA	NA	NA	0	0	0%	0%	N	NA	Y	0	0	N	37	94	33	N	30.28781000	-87.48777180
5	620	Cc	816	57	62	5	21	1	22	40	40	40	65%	100%	N	N	Y	0	40	N	36	79	32	N	30.28218600	-87.50272400
6	77	Cc	NA	NA	53	0	2	50	52	1	0	0	2%	0%	N	NA	Y	0	0	N	36	135	65	N	30.28243600	-87.50663400
7	78	Cc	NA	NA	103	0	103	0	103	0	0	0	0%	0%	N	NA	Y	0	0	N	43	115	20	N	30.28291000	-87.50430000
8	727	Cc	922	57	90	0	2	0	2	88	88	88	98%	100%	N	Y	N	0	71	N	38	105	51	N	30.28112300	-87.51261600
9	83	Cc	NA	NA	114	NA	NA	NA	NA	NA	0	0	0%	0%	N	NA	Y	0	0	N	40	180	31	N	30.28310000	-87.46569700
n=	9												9	9	9	3	9			9	9	9				
sum						804	5	170	142	304	149	148			1	2	7	5	112	0				0		
mean					57	89							16.5%	18.4%							37	113	38			
SDev						24.7							0.3672								3.22	43.71	13.10			

**Table 3:** Proportion of hatchlings witnessed entering the Gulf of Mexico on Pensacola Beach throughout the 1997 - 2019 marine turtle nesting seasons. Count excludes tracks observed entering the Gulf.

Year	Hatchling Count Witnessed	Total Hatchling Count	% Witnessed
1997	567	654	87
1998	689	929	74
1999	868	1101	79
2000	979	1311	75
2001	460	478	96
2002	382	414	92
2003	334	433	77
2004	429	465	92
2005	753	771	98
2006	609	768	79
2007	197	198	99
2008	429	436	98
2009	912	962	95
2011	698	795	88
2012	1142	1460	78
2013	1707	1851	92
2014	848	1108	77
2015	799	1041	78
2016	2612	2822	93
2017	1457	1895	77
2018	100	1130	9
2019	611	1008	61

**Table 4:** Adult disorientation events on Pensacola Beach in 2019.

Nest ID	Location/Landmark	Date of Event	Moon Phase	Entered Gulf Unassisted Y/N	Probable/Possible Source	Comments
PB02	Holiday Inn Express	31-May	waning crescent	Y	Casino Beach area and urban glow from Pensacola	Crawled east for 750ft, including two 360 degree loops
PB03	Gulf Winds Condos	3-Jun	new moon	Y	Condo lights and urban glow	Initially turned SE towards Gulf, then turned NE away from Gulf, crawled east 330ft, then turned south to Gulf again.
PB12	25 yards east of walkover 25B	1-Jul	waning crescent	Y	no point sources identified, likely urban glow of Casino Beach and Pensacola combined	Emerged, traveled due north 40ft to nest, then crawled west for approximately 50ft and completed 3 loops before returning to Gulf.

**Table 5: Hatchling disorientation events on Pensacola Beach in 2019.**

Nest ID	Location/Landmark	Date of Event	Moon Phase	# Disoriented hatchlings (observed)	# of Non-disoriented hatchlings (observed)	% Disoriented	# Disoriented hatchlings witnessed entering GOM	Probable/Possible Source	Comments
PB04	White Sands Condos	11-Aug	1st Quarter	Apx. 30 tracks	Apx. 20 tracks	NA	2 hatchlings	Street light, condominium lights, sky glow	Nest found hatched on morning patrol. 20 out of 30 tracks to the SE made it to Gulf (others continued east). Apx. 11 went N and 8 of those turned NW. 3 went E and then NE (due to FEMA beam). Weather made tracking difficult. No other hatchlings found.
PB10	Walker 25A	2-Sep	Waxing Crescent	Apx. 46 tracks	4 tracks	NA	7 hatchlings, plus 14 tracks that eventually turned south	west toward PB core area/Casino Beach, east toward homes and condos	4 went N (1 found in pool and released in AM), 4 went S, 13 went east with 4 turnings S, 39 went west with 10 turnings S into Gulf. Of those 39, 6 were found by beachgoers and put in Gulf.
PB14	Pondino	11-Sep	Waxing Gibbous	Apx. 15 tracks	3 tracks	NA	1 hatchling	mostly condo lights, but some affected by sky glow to the west	Nine tracks went north (1 hatchling found alone), 3 went west, and 3 went south
PB20	near Avenida 12	17-Sep	waning gibbous	Apx. 62 hatchlings	18 hatchlings	78%	All 62 hatchlings	308 Arida Dr., sky glow to the east, and Casino Beach to the west	Apx. 60 of the 60 emerged slowly turned NE and two travelled west. All hatchlings made it into Gulf. Hatchlings that were swept back on beach by swash all wanted to go due north, several requiring repeat attention. Moon had not risen yet.
PB22	UMF property (Cm)	19-Sep	NA (daytime)	Apx. >50	38 tracks	NA	16 hatchlings	NA: Day time hatch	Nest hatched approx. 1700. Public observed hatchling crossing CRC99, rescued 16. A search at 1900 found no more hatchlings, only many tracks headed N, 38 tracks to the south, and 21 dead on the road.
PB22	UMF property (Cm)	24-Sep	waning crescent	16 hatchlings	0	NA	16 hatchlings	sky glow too many lights	Clutch located on 9/24: 16 hatchlings were found in nest, detained by rooks. All 16 crawled N and NW, even after being taken closer to water's edge.
PB25	1206 Arida Dr.	24-Sep	waning crescent	53 hatchlings	0	100	53 hatchlings	condo lights, sky glow from Casino Beach area	Hatchlings emerged and all crawled N or NW, allowed to crawl for 10 feet, then moved by permitted volunteers closer to water. All swam south.
PB25	1206 Arida Dr.	25-Sep	waning crescent	Apx. 25 tracks	Apx. 10 tracks	NA	6	street light, houses, and sky glow	29 tracks observed on morning patrol: 16 went N or NW, 13 went NE towards Arida Dr (1 found by public on the street). Volunteers found 6 live hatchlings between 1300 and 1301. Arida and 3 more predated by ghost crabs. Apx. 10 tracks went ESE, then SE, then in Gulf.
PB27	near Park East	26-Sep	waning crescent	Apx. 10 tracks	0	NA	0	NE towards sky glow	A coyote was present and appeared to have tracked down all hatchlings. From assessment data, it seems coyote may have consumed more at nest site.



**Table 6:** Adult disorientation events on Perdido Key in 2019.

Nest ID	Location/Landmark	Date of Event	Moon Phase	Entered Gulf Unassisted Y/N	Probable/Possible Source	Comments
PK02	Perdido Key, Eden Condominium	4-Jun	New moon	yes	condominium (interior and exterior), sky glow/urban glow	Turtle came up due north and nested in dune, then proceeded south and quickly east, the NE, then east behind Eden condo. She was north of primary dune line, did separate 360 degree loops, then proceeded east again for a few hundred feet and then eventually turned south. Crawl length measured at approximately 240 feet.

**Table 7:** Hatchling disorientation events on Perdido Key in 2019.

Nest ID	Location/Landmark	Date of Event	Moon Phase	# Disoriented hatchlings (observed)	# of Non-disoriented hatchlings (observed)	% Disoriented	# Disoriented hatchlings witnessed entering GOM	Probable/Possible Source	Comments
PK02	Sea Spray East Condo	31-Jul	New moon	20 to NW	4	NA	4	peaking lot, condominium (interior and exterior), sky glow/urban glow	Nest found hatched at 0500. Twenty hatchlings emerged, with tracks to the NW. One turned south, then west N, then W, then SE to the Gulf. Four hatchlings found by condos, one to the NW, one in the garage to the north, one on boardwalk to the NE, and one to the NE between condos. Sixteen hatchlings unaccounted for.
PK08	Perdido Key	22-Sep	Waning Crescent	1	0	NA	1	condominium (interior and exterior), sky glow/urban glow	Hatchlings emerged and approximately five went to the NNE. Another 7 went N. And a turtle 5 went to the NW. One hatchling was found at 0700 in a dune to the NW. Windy conditions made tracking very difficult. It appeared most went south to the Gulf.

## APPENDIX A



## MARINE TURTLE MONITORING REPORT

CIRCLE:    PK        PB

NEST NUMBER \_\_\_\_\_

REPORTED BY: \_\_\_\_\_

DATE: \_\_\_\_\_ TIME: \_\_\_\_\_ AM/PM

WEATHER \_\_\_\_\_

LOCATION: \_\_\_\_\_ YARDS/MILES EAST/WEST OF

MARKER: \_\_\_\_\_

DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

**SPECIES:** (circle one)  
Cc = Loggerhead  
Cm = Green  
Dc = Leatherback  
Lk = Kemp's Ridley

**INCIDENT TYPE:**

NEST  
FALSE CRAWL

MOST RECENT  
HIGH TIDE LINE:  
ABOVE  
BELOW

**DISTANCE OF BODY PIT  
FROM:** (feet/ meters)

WATER LINE: \_\_\_\_\_

VEGETATION LINE: \_\_\_\_\_

**SIGNS/STAKES:** from  
center of body pit/egg cavity  
(feet / meters)  
Sign: \_\_\_\_\_

From the sign:  
1<sup>st</sup> stake \_\_\_\_\_

2<sup>nd</sup> stake \_\_\_\_\_

**CRAWL MEASUREMENTS:**  
ALTERNATING  
SYMMETRICAL

WIDTH: \_\_\_\_\_ IN/CM

**PREDATOR SCREENED:** \_\_\_\_ YES \_\_\_\_ NO \_\_\_\_\_ DATE

**RELOCATED:** \_\_\_\_ YES \_\_\_\_ NO    If YES Proceed to back of form

**ADDITIONAL COMMENTS:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

PLEASE DRAW A DIAGRAM BELOW

### NEST'S INCUBATION INCIDENTS

DATE	WASHED OVER PAST SIGN (# of FEET)	PREDATION / TYPE (ghost crabs/fox/coyote)	NAME & OTHER INCIDENTS OR COMMENTS
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		
	YES NO		

**RELOCATION INFORMATION:** Nest Relocated BY: \_\_\_\_\_

TIME EGGS OUT: \_\_\_\_\_ TIME EGGS IN: \_\_\_\_\_ # of EGGS: \_\_\_\_\_

Original Nest: depth to **TOP** of Eggs: \_\_\_\_\_ cm depth to **BOTTOM** of Eggs: \_\_\_\_\_ cm **WIDTH** at top: \_\_\_\_\_ cm

Relocated Nest: depth to **TOP** of Eggs: \_\_\_\_\_ cm depth to **BOTTOM** of Eggs: \_\_\_\_\_ cm **WIDTH** at top: \_\_\_\_\_ cm

Relocated Nest LOCATION: \_\_\_\_\_

COMMENTS: \_\_\_\_\_

# **APPENDIX B** Nest Assessment Data Sheet **SEA TURTLE NEST ASSESSMENT REPORT**

v.09.13.2017

DATE:	TIME:	NEST NUMBER:
LOCATION:	REPORTED BY:	

**RELOCATED:** Y / N

<12 HOURS / > 2 WEEKS

**PREDATION:**

NEST: \_\_\_\_\_

HATCHLING: \_\_\_\_\_

**DISORIENTATION:**

\_\_\_\_\_

\_\_\_\_\_

**ADDITIONAL COMMENTS:**

\_\_\_\_\_

\_\_\_\_\_

TOTAL EGGS FOUND	_____	LIVE IN NEST	_____
HATCHED EGGS	_____	DEAD IN NEST	_____
UNHATCHED W/ DEVELOPMENT	_____	% HATCH SUCCESS	_____
UNHATCHED W/O DEVELOPMENT	_____	DAYS INCUBATED	_____
PIPPED ALIVE	_____	WITNESSED ENTERING GULF	_____
PIPPED DEAD	_____	EMERGED	_____
		GHOST CRAB PREDATION	_____

- The # of hatched eggs + unhatched eggs + pipped alive & dead = # of eggs in nest
- Hatched eggs do not include "pipped" eggs

**HATCHING** (please initial all entries)

DATE	TIME in GOM	#HATCHLINGS	DISORIENTED	UNDER SCREEN	ROOTS	OBSERVER	COMMENTS

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