

***MARTIN COUNTY BEACH RENOURISHMENT
AND DUNE RESTORATION PROJECTS
RESULTS OF 2005 SEA TURTLE MONITORING***



Prepared for Martin County

by

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INTRODUCTION

The northernmost 6.8 km of Martin County's coastline underwent beach renourishment (6.6 km) and dune restoration (0.2 km) projects during the spring of 2005. These projects served to restore county beaches after the passage of Hurricanes Frances and Jeanne in September of 2004. This report summarizes the results of the 2005 sea turtle nest protection and monitoring programs conducted by Ecological Associates, Inc. (EAI) in support of the beach and dune projects.

Sea turtle nesting surveys have been conducted in a consistent manner on Hutchinson Island every year since 1981 (ABI, 1994; Ernest and Martin, 1999; EAI, 1998, 2000a, 2000b, 2002, 2003, and 2004). Nourishment first occurred on the Martin County portion of Hutchinson Island during the winter of 1995/1996. During the 1995, 1996 and 1997 sea turtle nesting seasons, a comprehensive study of the effects of beach nourishment was conducted. This study included both physical and biological components and addressed all aspects of sea turtle reproduction from the emergence of adult females onto the beach through the emergence of hatchlings from their nests. This study provided a complete year (1995) of pre-construction data and two years (1996 and 1997) of post-construction data. The results of this comprehensive study have been presented in three reports (EAI, 1997a and 1997b; Ernest and Martin, 1999). Though physical variables were not monitored during the subsequent three years (1998-2000), sea turtle nesting and nest reproductive success were monitored and the results summarized in three reports (EAI, 1998, 2000a and 2000b).

In the spring of 2001, a 1.4-km-long section of beach along the southern portion of the original 1995/1996 nourishment project area was renourished. In accordance with permit conditions for this project, a sea turtle nest relocation program was instituted prior to and during construction and turtle nest monitoring was required following project construction. In the spring of 2002, another 0.8-km-long section of beach immediately north of the 2001 project area was renourished. Again, a turtle nest relocation/protection program was conducted prior to and during construction while a program to monitor nesting and nest reproductive success continued after construction was completed. Results of the 2001 and 2002 nest relocation programs as well as subsequent monitoring of nesting and reproductive success from 2001 through 2004 were reported by EAI (2002, 2003, 2004a and 2004b).

In conformance with permit conditions for the 2005 beach and dune projects, a construction-phase sea turtle nest relocation program and a post-construction-phase sea turtle nesting and reproductive success monitoring program were implemented. Results of these programs are reported herein. Where appropriate, data from the beach renourishment project were compared to historical data and data from a nearby natural beach. Because of the small size of the dune restoration project and the fact that this area was not delimited prior to 2005, such comparisons were not made for this project.

METHODS

Personnel

Ecological Associates, Inc. (EAI) performed all sea turtle monitoring activities associated with the 2005 Martin County Beach Renourishment and Dune Restoration Projects. All EAI personnel were authorized under Florida Fish and Wildlife Conservation Commission (FWC) Marine Turtle Permit #010. The following individuals participated in the monitoring program:

- R. Erik Martin (Scientific Director)
- Mark Mohlmann (Senior Biologist)
- Carrie K. Crady (Staff Biologist)
- Brenda Boddiger (Staff Biologist)
- Nicole Desjardin (Staff Biologist)
- Serina Jones (Staff Biologist)
- Gwendolyn Oberholtzer (Staff Biologist)
- Matthew Simmons (Staff Biologist)
- Barbara Stadden (Field Technician)

Study Area

For the initial beach nourishment in 1995/1996, three treatments (one control and two nourished sites) were established prior to the project. Each consisted of three 1-km-long Index Nesting Beach Survey (INBS) zones. After construction was complete, the North Treatment (INBS zones Z, AA, and BB) was tilled in accordance with U.S. Army Corps of Engineers standard protocol while the South Treatment (INBS zones CC, DD, and EE) was not tilled (Figure 1). The control site (INBS zones V, W, and X), located in St. Lucie County approximately 0.5 km north of the nourished area, was neither nourished nor tilled.

During 2005, a 6.6 km section of beach south of the Martin/St. Lucie County line was renourished. This section of beach included a large portion of Zone Y; all of Zones Z, AA, BB, CC, and DD; and most of Zone EE. The southernmost 120 meters of zone EE were not renourished, but did receive a large stockpile of sand during a dune restoration project. This project, the Martin County Dune Restoration Project, occurred concurrently with the Martin County Beach Renourishment Project and encompassed a 180 meter long stretch of beach including the southern 120 meters of Zone EE and the northern 60 meters of Zone FF. Nesting and reproductive success data for the dune restoration project area are reported separately from data for the beach renourishment project in this report. Also, since only the southern 0.68 km of Zone Y is within Martin County, this is the only portion that was included in the renourishment project. Only data from this portion (Zone YM) are included in the nesting and reproductive success summaries in this report.

In contrast to the original 1995/1996 nourishment project, the entire length of the 2005 renourished beach was tilled when construction was complete, so separate treatments were not designated. Additionally, the control site in St. Lucie County underwent a dune restoration project during spring of 2005, so it could not be used as a control for the Martin County Beach Renourishment Project. A different stretch of untreated beach north of the project area (INBS Zones K, L, M, and N) was therefore used as a control for the purpose of identifying renourishment project effects on nesting and reproductive success. This control beach is 4.0 km long and located 10.5 km north of the renourishment project, outside of the influence of other beach and dune restoration projects.

Nest Relocation/Protection

Beginning 28 February, the planned 6.8-km-long beach/dune construction area was monitored nightly from 2100 to 0600 hours for the presence of nesting turtles. Surveys were conducted on ATV (all-terrain vehicle). Any nests within the beach renourishment/dune restoration area were relocated to a natural beach south of all construction. The nest relocation program continued until all renourishment/restoration activities were completed (30 April). Relocated nests were marked and monitored according to procedures described below in the Nest Marking and Monitoring section. The reproductive success of each nest was determined using the methods described below in the Nest Excavation and Determination of Reproductive Success section.

Nesting Surveys

During the post-construction period, early morning nesting surveys of the study area were conducted daily from 1 May through 16 September using ATVs. During the surveys, nesting and non-nesting emergences (false crawls) evident from the previous night and above the last high tide line were enumerated by species and survey section. An attempt was also made to map the location of each nest and false crawl using a hand-held GPS unit. Each false crawl was assigned to one of the following categories: non-digging crawl, abandoned body pit, or abandoned egg chamber. Where possible the cause of the false crawl was determined and recorded.

An index that relates the number of nests to the number of false crawls in a defined area is useful in assessing the post-emergence suitability of a nesting beach. The index used during this study is termed "nesting success" and is defined as the percentage of total female emergences onto the beach that resulted in nests. Nesting success was calculated by dividing the total number of nests by the total number of emergences (nests and false crawls combined) and multiplying by 100 percent. Only those crawls above the previous high tide line were included in the calculations.

Scarp Monitoring

One day each week between 4 May and 14 September, beach escarpments (scarps) were monitored within the beach renourishment area. Scarps were procedurally

defined as near-vertical changes in beach profile having a height of 18 inches or more and a shore-parallel length of 100 feet or more. The length and average height of each scarp were estimated and a height measurement was taken at the location that appeared to represent the maximum scarp height.

Nest Marking and Monitoring

After construction was complete, all sea turtle nests were left *in situ*. Throughout the post-construction monitoring period, all leatherback nests and every other green turtle nest encountered within the beach renourishment area were marked for eventual determination of reproductive success. In an attempt to mark a sufficient number of loggerhead nests for statistical analyses, every sixth nest in the beach renourishment area was marked. Because of its small size, all nests in the Martin County Dune Restoration area were marked.

Prior to marking, each nest mound was carefully excavated by hand to locate the clutch. Then a small triangle of wooden stakes was placed around the center of the clutch. The triangle consisted of one 120-cm-long stake placed either north or south of the clutch and two 60-cm-long stakes placed on the opposite side of the clutch. After the 120-cm-long stake was driven into the sand, the distance from the beach surface to the top of the stake (stake height) was measured and recorded. All three stakes were then connected with brightly colored surveyor's tape. If the eggs in a leatherback or green turtle nest could not be located without causing considerable disturbance to the nest site, the entire nest mound was circled with 60-cm-long stakes and a 120-cm-long stake placed north or south of the estimated clutch location. If, after several digging attempts, the eggs could not be located in a loggerhead nest in the beach renourishment area, then the next nest encountered during the survey was marked. Again, all nests in the dune restoration area were marked.

Using a geographically sequential inventory, every marked nest was monitored daily through 16 September. Nests were examined for signs of depredation, excavation by another turtle, vandalism, hatchling emergence, and nest loss due to wave action. After 16 September, nests were monitored three days per week through 21 October. Monitoring was discontinued from 22 through 25 October due to the passage of Hurricane Wilma. After 25 October, nests were monitored periodically until the last nest was evaluated on 7 November.

Occasionally nesting turtles inadvertently excavate nests that have been previously deposited. The eggs in the marked nest may be disturbed or even destroyed when this occurs. In other instances, turtles may nest immediately adjacent to, or on top of, a marked nest. In this case, it may not be possible to distinguish the eggs in the marked nest from the eggs in the adjacent nest during evaluation. For these reasons, if a marked nest was excavated by a turtle, or had a nest deposited immediately adjacent to or on top of it, it was excluded from further analysis.

Nest barriers were repaired and replaced as necessary. Stakes were periodically washed out by high tides or vandalized. Unless all three stakes were missing, the location of the clutch could typically be determined based on recorded information. If all three stakes were washed out, the nest was presumed completely destroyed.

Hatchling emergence was evidenced by an emergence depression or tracks emanating from within the nest barrier. Incubation period was calculated as the inclusive number of days between the date the nest was recorded and the date signs of hatchling emergence were first observed. Only those nests for which date of first emergence could accurately be determined were included in the analysis of incubation period.

During daily monitoring, observations for evidence of hatchling disorientation and misorientation (collectively referred to as disorientation) events were also made. Such events are indicated by hatchling tracks that deviate from a direct path to the ocean. All observed events, whether from marked or unmarked nests, were recorded.

Nest Excavation and Determination of Reproductive Success

Marked nests were excavated no sooner than 72 hours after the first sign of hatchling emergence and after one day of no new emergences. If no signs of emergence were observed, loggerhead and green turtle nests were evaluated after an incubation period of 70 days and leatherback turtle nests were evaluated after a period of 80 days. Nest excavation was occasionally delayed for nests exposed to cooler temperatures (e.g., shaded locations) to provide all viable hatchlings an opportunity to emerge without human intervention.

Prior to excavating a nest, a final measurement was taken from the beach surface to the top of the 120-cm-long stake. This measurement was used to determine the change in the sand level over the nest during its incubation period.

During excavation, sand was removed from above the egg chamber and placed to one side. One side of the excavation cavity was maintained at ambient beach level. The contents of the egg chamber were carefully removed to prevent fragmentation of hatched eggshells and damage to unhatched eggs. When removing nest contents, care was taken not to excavate beyond the bottom of the egg chamber.

When all nest contents had been removed, a stake was placed across the top of the excavation cavity, both ends resting at ambient beach level. Final clutch depth was then determined by measuring vertically from the deepest point of the egg chamber to the bottom edge of the stake over the opening. Net sand shift during the period from nest deposition to final hatchling emergence was calculated by subtracting the final stake height measurement from the initial stake height. This net value was subtracted from the final clutch depth to yield initial clutch depth.

Nest contents were carefully examined and assigned to one of the following categories: hatched egg (HE), unhatched egg (UE), pipped egg with live hatchling (PL),

pipped egg with dead hatchling (PD), live hatchling (LH) and dead hatchling (DH). All live hatchlings were handled and released in accordance with FWC guidelines. The clutch size (CS) was calculated as follows: $CS = HE + UE + PL + PD$.

Two commonly used measures of reproductive success, hatching success and emerging success, were calculated based on nest contents. Hatching success (HS) is defined as the percentage of eggs within the clutch that produced hatchlings that successfully extricated themselves from the eggshell ($HS = [HE \div CS] \times 100$ percent). Emerging success (ES) is defined as the percentage of eggs within the clutch that produced hatchlings that emerged from the nest prior to nest excavation ($ES = \{[HE - (LH + DH)] \div [CS]\} \times 100$ percent).

Comparisons Between the Renourished Beach and a Natural Beach

In order to identify changes in nesting that may have been related to the 2005 beach renourishment project, loggerhead nesting activity was compared between the renourished beach and the control beach before and after renourishment. Data were available for INBS Zones Z through EE (the 2005 renourished beach) and INBS Zones K through N (the control beach) from 1991 through 2005. The period from 1991 through 1995 was considered baseline since Zones Z through EE were first nourished in 1996. Since historical data for Zone Y were not separated by county and since approximately half of Zone Y was outside of Martin County (and, therefore, outside of the 2005 renourishment area), Zone Y was excluded from these comparisons. Likewise, the 150-meter long portion of Zone EE that was outside of the 2005 renourishment project was not delimited prior to 2005. However, since this portion only represents 15 percent of Zone EE and less than 3 percent of Zones Z through EE, it was determined that it was more appropriate to include Zone EE in its entirety than to exclude it.

In addition to the comparisons of nesting activity, comparisons of reproductive success of nests were also made between the renourished beach and a natural beach during 2005. Only loggerhead turtles nested in sufficient numbers within the study area to allow adequate sample sizes for comparisons of reproductive success between beaches. In order to provide an adequate sample size from a natural beach, reproductive success data from untreated INBS Zones Q, R, and S were combined with data from Zones K through N.

RESULTS – BEACH RENOURISHMENT AREA

Escarpment Monitoring

Beach escarpments were present within the project area during 9 of the 21 weekly surveys (Table 1). Scarps were present during every survey month and were observed in all zones except E5.

Nesting Activity on the Renourished Beach

Nesting activity within the renourished area is summarized on a monthly basis in Table 2. The first crawl, a leatherback false crawl, was observed on 15 March and the last, a green turtle false crawl, was observed on 18 September (Table 3). A total of 968 loggerhead, 25 green turtle, and 75 leatherback turtle nests were recorded along the renourished beach during 2005. The approximate location of each nest and false crawl is shown in Figures 2 and 3.

Nesting success was 31.5 percent for loggerheads, 14.4 percent for green turtles, and 57.3 percent for leatherbacks (Table 3). Of the 2,104 loggerhead false crawls recorded, 1,551 showed no signs of digging, 518 had abandoned body pits, and 35 had abandoned egg chambers. Of the 149 green turtle false crawls, 108 showed no signs of digging, 39 had abandoned body pits, and two had abandoned egg chambers. There were 56 leatherback false crawls; 45 showed no signs of digging, seven had abandoned body pits, and four had abandoned egg chambers.

Of the 2,104 loggerhead false crawls, 191 (9.1 percent) were associated with obstructions (Table 3). Most (169) occurred at scarps, ten occurred at dune crossovers, six at dune/sand fences, three at debris, two at a building, and one at a nest marker. Eleven (7.4 percent) of the 149 green turtle false crawls were associated with obstructions (nine at scarps, one at a sand fence and one at a dune crossover). Eight (14.3 percent) of the 56 leatherback false crawls occurred at obstructions (three at scarps, four at the dredge pipe during construction and one at a large, man-made hole on the beach).

Loggerhead Nesting Activity on the Renourished Beach Versus a Natural Beach

Loggerhead nesting activity on the renourished beach (Zones Z-EE) was compared to nesting activity on the control beach (Zones K-N) from 1991 through 2005. Annual nest numbers for 2005 were relatively low on both beaches when compared to the previous 14 years (Figure 4). This is consistent with the overall trend for Florida – loggerhead nest numbers during 2005 were the second lowest on record for the past 17 years based on Index Nesting Beach Survey data (FWC, Fish and Wildlife Research Institute, 2006).

During baseline years (1991-1995), annual nest numbers on the renourished beach varied from 81 nests lower to 173 nests higher than the control. During 2005, there were 73 more nests on the renourished beach than on the control beach. So, the relationship of the renourished beach to the control beach during 2005 was similar to the relationship during baseline years with respect to nest numbers.

The numbers of nests laid annually should not be used independently when evaluating the post-emergence suitability of available nesting habitat. An equivalent number of nests on two different beaches could result from widely divergent numbers of emergences. Thus, nesting should be viewed in relation to the total number of emergences. The percentage of emergences resulting in nests is termed nesting success.

During 2005, annual loggerhead nesting success values at both the renourished (30.7 percent) and control (40.4 percent) beaches were the lowest on record for the 15-year period (Figure 5). Low nesting success on the control beach was most likely due to changes in beach/dune topography and the loss of dune vegetation associated with the passage of Hurricanes Frances and Jeanne during September 2004. These changes persisted through the 2005 nesting season. Low nesting success on the renourished beach was most likely due to changes in beach conditions associated with the 2005 beach renourishment project as well as the loss of dune vegetation associated with the 2004 hurricanes.

Ernest and Martin (1999) found that sediment compaction, beach profile, sediment temperatures, and the frequency and extent of scarps were affected by the initial 1995/1996 beach nourishment project on Hutchinson Island. A change in one or more of these variables most likely contributed to the observed reduction in nesting success on the renourished beach during 2005.

As previously stated, escarpments were present on the renourished beach during every survey month and a number of loggerhead false crawls were associated with those scarps. Though encounters with scarps contributed to low nesting success on the renourished beach, other factors must have also played a role since eliminating false crawls associated with scarps only increases nesting success in Zones Z-EE from 30.7 to 32.5 percent. It is likely that changes in sediment compaction, beach profile, and/or sediment temperatures also contributed to the low nesting success on the renourished beach.

Reproductive Success of Relocated Turtle Nests

During the construction phase of the project (1 March through 30 April), twenty-six leatherback nests were relocated to a hatchery and all but one hatched (Table 4). None of the relocated nests were washed out. Mean hatching and emerging success values for these nests were 53.6 and 48.4 percent, respectively. One nest was excluded from the analysis of reproductive success because it was discovered and relocated 16 days after it was deposited and it was inadvertently excavated sooner than 72-hours after hatching.

Reproductive Success of *In-Situ* Loggerhead Turtle Nests

During 2005, a total of 166 loggerhead turtle nests on the renourished beach were marked for eventual determination of reproductive success (Table 3). The contents of 126 of these nests were excavated and evaluated (Table 5). The contents of 37 nests (22.3 percent of all loggerhead nests marked) were washed out prior to hatching. Additionally, one nest was washed out after hatching but before evaluation, one nest was nested on by another turtle, and one was buried by excessive accretion of sand. Though the contents of washed-out nests could not be evaluated, it is assumed that the hatching and emerging success of these nests was 0.0 percent.

The initial clutch depths of all 126 excavated nests were determined. The mean clutch depth of these nests was 55.0 cm (range 38.0 – 74.0 cm). No abnormal egg chambers were noted.

Hatching and emerging success for all evaluated loggerhead nests in the project area during 2005 are presented in Table 6. Excluding washed-out nests, mean hatching and emerging success values were 51.1 and 47.2 percent, respectively. In comparison to a natural beach (33 nests from Zones K, L, M, N, Q, R, and S), reproductive success on the renourished beach was lower. Mean hatching and emerging success on the natural beach during 2005 were 63.2 and 61.0 percent, respectively. A t-test for independent samples revealed that mean hatching success was not significantly different between the renourished and natural beaches [$t_{(157)} = -1.81, p = .072$] although mean emerging success was significantly different [$t_{(157)} = -2.13, p = .035$]. Significantly lower emerging success on the renourished beach may have been due to differences in one or more physical variables between the renourished and natural beaches. Ernest and Martin (1999) reported differences in moisture content and sediment temperature between nourished and control sites after the 1995/1996 nourishment project on Hutchinson Island. Differences in these or other physical variables during 2005 may have been responsible for the lower emerging success on the renourished beach.

The inclusion of washed out nests in calculations disproportionately reduced reproductive success on the renourished beach compared to the natural beach during 2005. On the nourished beach where 22.3 percent of marked nests were washed out, mean hatching and emerging success values were reduced to 39.5 percent and 36.5 percent, respectively. On the natural beach where only 3 of 40 nests (7.5 percent) were washed out, mean hatching and emerging success were only reduced to 57.9 and 55.9 percent, respectively. Ernest and Martin (1999) also found a higher incidence of nest wash-outs on recently nourished beaches versus natural beaches after the 1995/1996 nourishment project on Hutchinson Island.

Reproductive Success of *In-Situ* Green and Leatherback Turtle Nests

During 2005, 16 green turtle nests were marked for eventual determination of reproductive success (Table 3). Of these, nine were evaluated for reproductive success (Table 5). Three nests were washed out and the clutch could not be located in four nests. The average initial clutch depth of eight of the evaluated nests was 77.3 cm (range: 70.0 – 89.5 cm). No egg chamber abnormalities were observed. Excluding any washed out nests, mean hatching and emerging success values were 63.0 and 59.4 percent, respectively (Table 7). Including the three washed out nests, mean hatching and emerging success values dropped to 47.3 and 44.5 percent, respectively. Because of the small number of nests evaluated, no meaningful comparisons were possible.

In addition to the 26 leatherback nests that were marked after relocation, 49 leatherback nests were marked and left *in-situ* (Table 5). Of these 49 nests, 12 were washed out, the clutch could not be located in 14, two hatched but the nest contents were too decomposed to accurately evaluate, and one had stakes removed by vandals. A total

of 22 nests could be evaluated for initial clutch depth (Table 3). The mean depth of these nests was 78.9 cm with a range of 50.0 to 107.0 cm. No egg chamber abnormalities were noted. The 20 nests that were evaluated for reproductive success had mean hatching and emerging success values of 59.4 and 52.4 percent, respectively (Table 8). Including the 12 washed-out nests reduced mean hatching and emerging success values to 37.2 and 32.7 percent, respectively. As with green turtles, too few leatherback nests were evaluated to allow meaningful comparisons.

Hatchling Disorientation

Within the 2005 project area, ten marked nests (7.1 percent of those that showed signs of hatchling emergence) were disoriented. In addition to these, one unmarked nest also showed signs of hatchling disorientation. A detailed report concerning each disorientation event was submitted to the FWC Tequesta Field Laboratory and to the Martin County Environmental Division.

RESULTS – DUNE RESTORATION AREA

Nesting activity within the dune restoration area is summarized on a monthly basis in Table 9. The first crawl, a loggerhead false crawl, was observed on 6 May and the last, another loggerhead false crawl, was observed on 1 September (Table 10). A total of 38 loggerhead and 3 leatherback turtle nests were recorded along the restored dune area during 2005. The approximate location of each nest and false crawl is shown in Figures 2 and 3.

Nesting success was 33.6 percent for loggerheads, 0.0 percent for green turtles, and 100.0 percent for leatherbacks (Table 10). Of the 75 loggerhead false crawls recorded, 48 showed no signs of digging, 25 had abandoned body pits, and two had abandoned egg chambers. Of the four green turtle false crawls, three showed no signs of digging and one had an abandoned egg chamber. There were no leatherback false crawls.

Of the 75 loggerhead false crawls, 23 (30.7 percent) were associated with obstructions (Table 10). Most (18) occurred at dune scarps, two occurred at beach scarps, two at nest markers, and one at a zone marker. None of the four green turtle false crawls were associated with obstructions.

No nests were laid in the dune restoration area during the construction phase of the project so no nests were relocated. All 41 sea turtle nests that were laid within the dune restoration area after construction were marked for eventual determination of reproductive success (Table 10). The contents of 30 loggerhead and two leatherback nests were excavated and evaluated (Table 11). The contents of 5 loggerhead nests (13.2 percent of those marked) were washed out prior to hatching. Additionally, the contents of three loggerhead and one leatherback nest could not be evaluated because the clutch could not be located, the contents were decomposed, or another turtle nested on the

marked nest. Though the contents of washed-out nests could not be evaluated, it is assumed that the hatching and emerging success of these nests was 0.0 percent.

The initial clutch depths of all excavated nests were determined. The mean clutch depth was 55.8 cm (range 34.0 – 77.0 cm) for loggerhead nests and 73.0 cm (range 59.0 – 87.0 cm) for leatherback nests. No abnormal egg chambers were noted.

Hatching and emerging success values for all evaluated loggerhead nests in the dune restoration area are presented in Table 12. Excluding washed-out nests, mean hatching and emerging success values were 46.4 and 40.7 percent, respectively. These values were reduced to 40.4 and 34.9 percent, respectively, when washed-out nests were included.

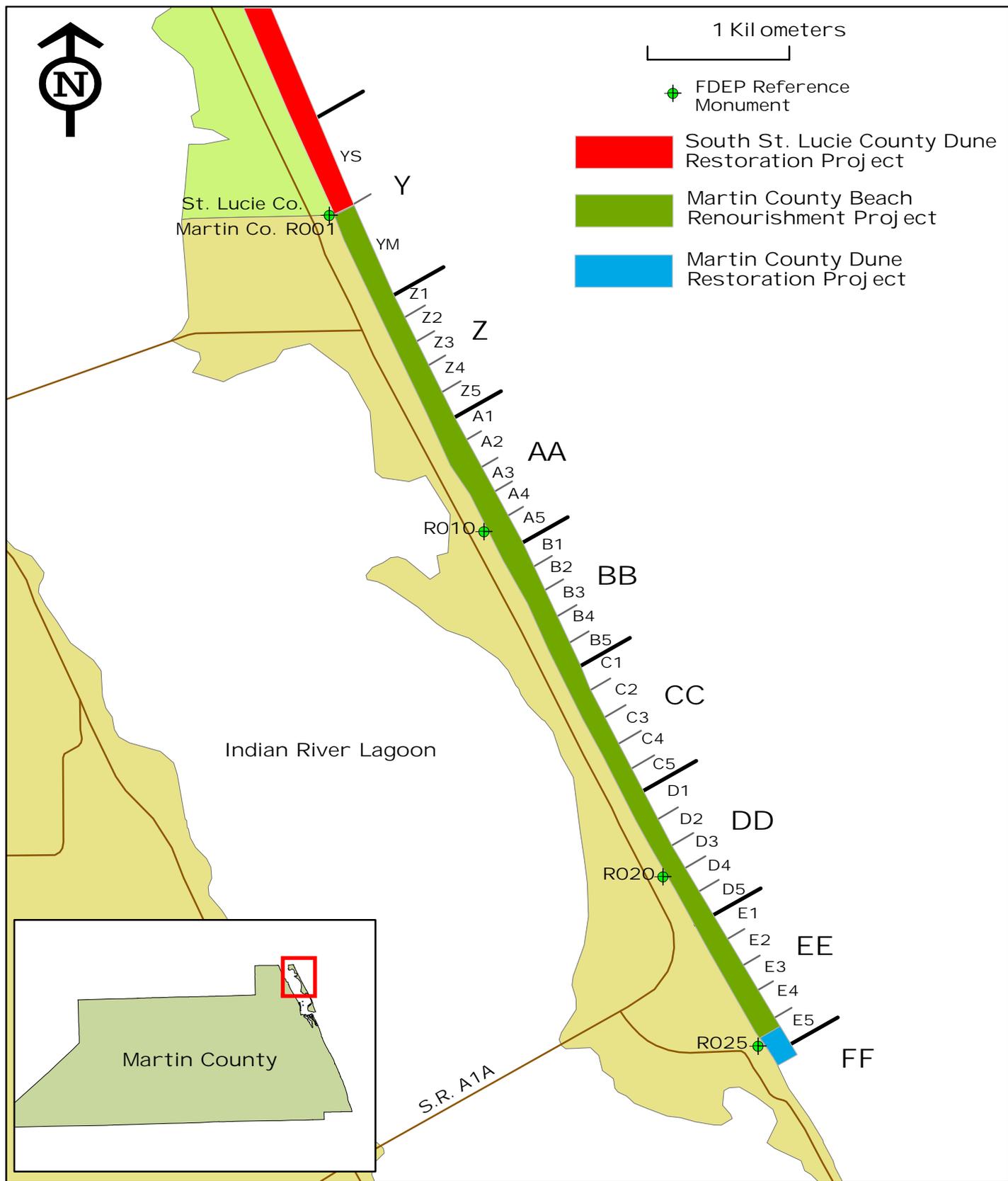
Mean hatching and emerging success values for the two evaluated leatherback nests were 70.0 and 69.3 percent, respectively. If the washed-out nest is included in calculations then the means are reduced to 46.7 and 46.2 percent, respectively.

A total of 29 loggerhead and two leatherback nests in the dune restoration area showed signs of hatchling emergence. None of these nests were disoriented.

LITERATURE CITED

- ABI (Applied Biology, Inc.). 1994. Florida Power & Light Company, St. Lucie Unit 2 annual environmental operating report 1993. Volume 1. AB-631. Prepared by Applied Biology, Inc. for Florida Power & Light Co., Juno Beach.
- EAI (Ecological Associates, Inc.). 1995. Martin County Beach Nourishment Project, 1994 Sea Turtle Nesting Survey and Nest Evaluation Program. Ecological Associates, Inc., Jensen Beach, Florida. 13 pp. + tables, figures and appendices.
- _____. 1997a. Martin County Beach Nourishment Project, Sea Turtle Monitoring and Studies, 1995 Annual Report. Ecological Associates, Inc., Jensen Beach, Florida. 39 pp. + tables, figures and appendices.
- _____. 1997b. Martin County Beach Nourishment Project, Sea Turtle Monitoring and Studies, 1996 Annual Report. Ecological Associates, Inc., Jensen Beach, Florida. 61 pp. + tables, figures and appendices.
- _____. 1998. Martin County Beach Nourishment Project: Results of 1998 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 12 pp. + tables and figures.
- _____. 2000a. Martin County Beach Nourishment Project: Results of 1999 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 11 pp. + tables and figures.

- EAI (Ecological Associates, Inc.). 2000b. Martin County Beach Nourishment Project: Results of 2000 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 12 pp. + tables and figures.
- _____. 2002. Martin County Beach Renourishment Project: Results of 2001 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 12 pp. + tables and figures.
- _____. 2003. Martin County Beach Renourishment Project: Results of 2002 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 12 pp. + tables and figures.
- _____. 2004a. Martin County Beach Renourishment Project: Results of 2003 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 16 pp. + tables and figures.
- _____. 2004b. Martin County Beach Renourishment Project: Results of 2004 Sea Turtle Monitoring, Hutchinson Island, Florida. Ecological Associates, Inc., Jensen Beach, Florida. 16 pp. + tables and figures.
- Ernest, R.G., and R.E. Martin. 1999. Martin County Beach Nourishment Project, Sea Turtle Monitoring and Studies, 1997 Annual Report. Ecological Associates, Inc., Jensen Beach, Florida. 93 pp. + tables, figures and appendices.
- FWC, Fish and Wildlife Research Institute. 2006. Annual Trends in Florida's Sea Turtle Nesting. http://research.myfwc.com/features/view_article.asp?id=10690. 17 March 2006.
- StatSoft. 2000. Statistica for Windows 95/98/2000/NT, Version 5.5. StatSoft, Inc., 2300 East 14th Street, Tulsa, OK, 74104.

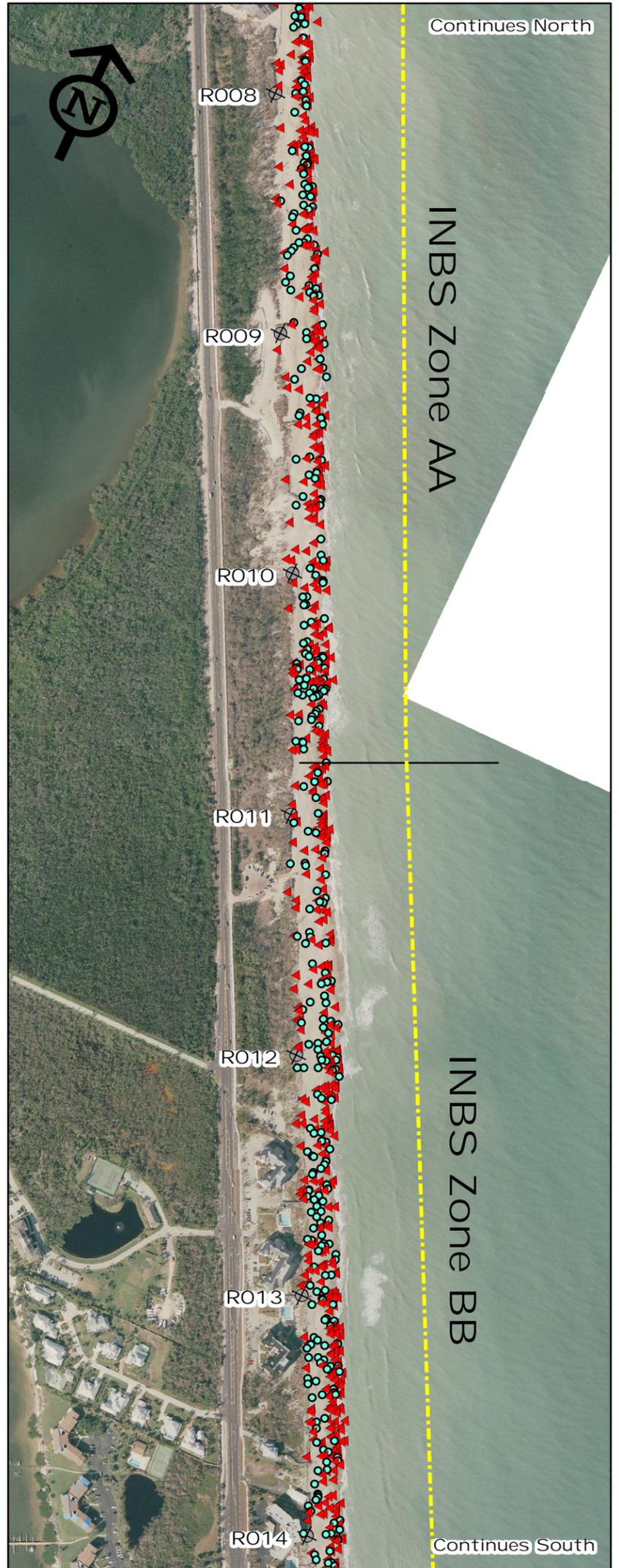
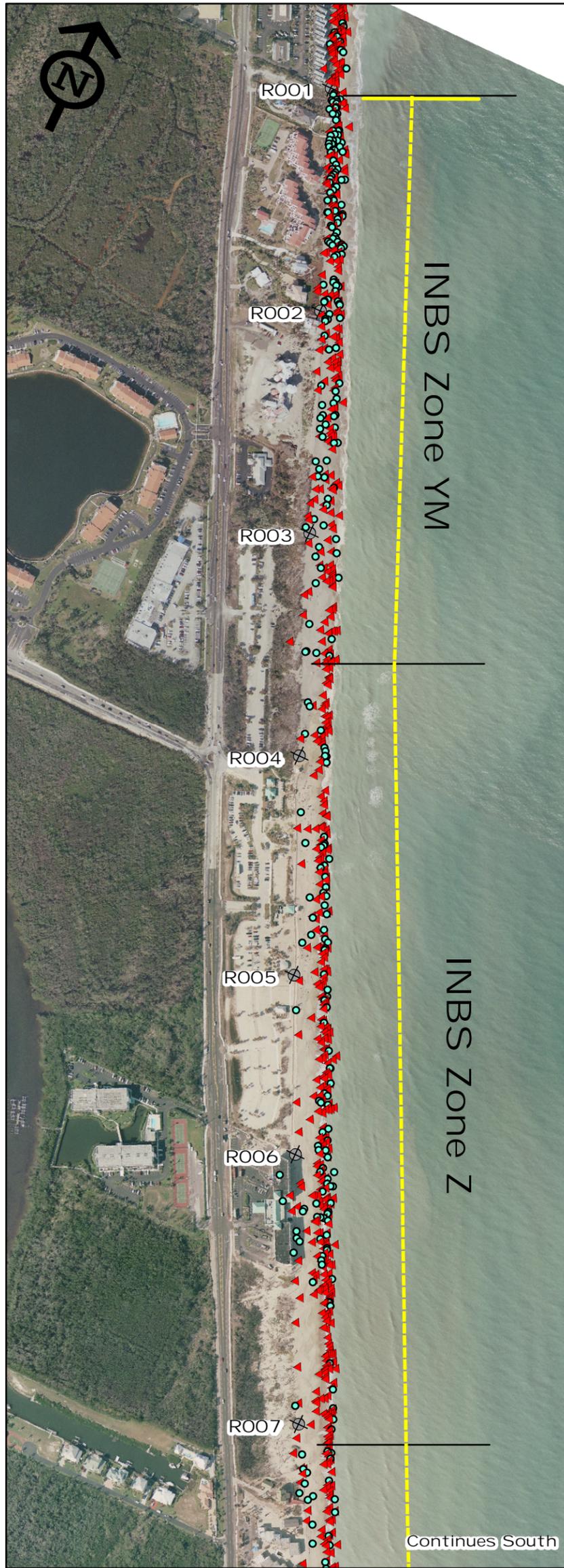


Figure

1

Location of 2005 Martin County Beach Renourishment and Dune Restoration Projects In Relation To Index Nesting Beach Survey (INBS) Zones Y Through FF





Legend

Loggerhead Crawls

● Nest

▲ False Crawl

— Limits of 2005 Martin County Beach Renourishment Project

— Limits of 2005 Martin County Dune Restoration Project

Note:

Reliable GPS Data Not Available for 30 Loggerhead nests and 96 false crawls within the Martin County Beach Renourishment and Dune Restoration Project Areas.

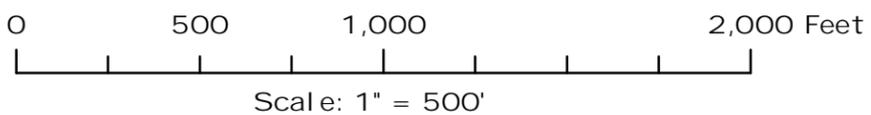


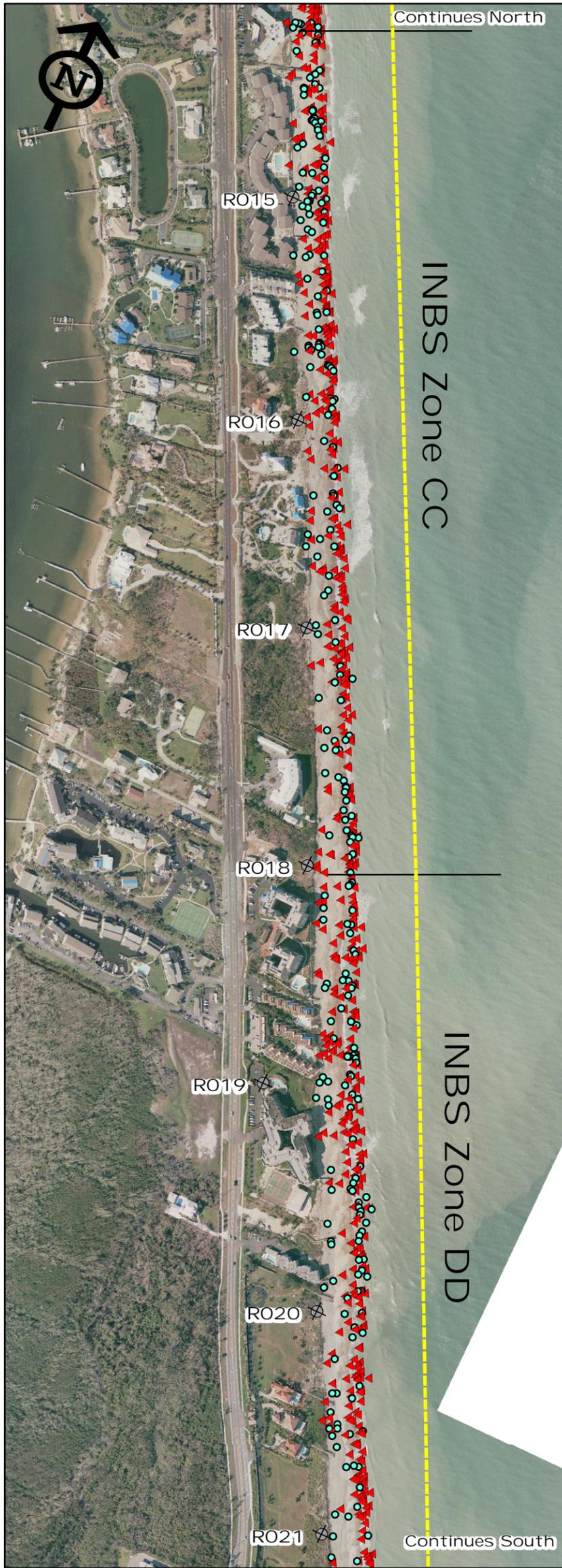
Figure 2A

Location of Loggerhead Turtle Crawls In Relation To the 2005 Martin County Beach Renourishment and Dune Restoration Project Areas and Index Nesting Beach Survey (INBS) Zones YM through FF

2005 Martin County Beach Renourishment Project Hutchinson Island, Martin County, FL

Photo: Martin County Information Technology Services, January 2005





- Legend
- Nest
 - ▲ False Crawl
 - Limits of 2005 Martin County Beach Renourishment Project
 - Limits of 2005 Martin County Dune Restoration Project

Note:
 Reliable GPS Data Not Available for 30 Loggerhead nests and 96 false crawls within the Martin County Beach Renourishment and Dune Restoration Project Areas.

0 500 1,000 2,000 Feet
 Scale: 1" = 500'

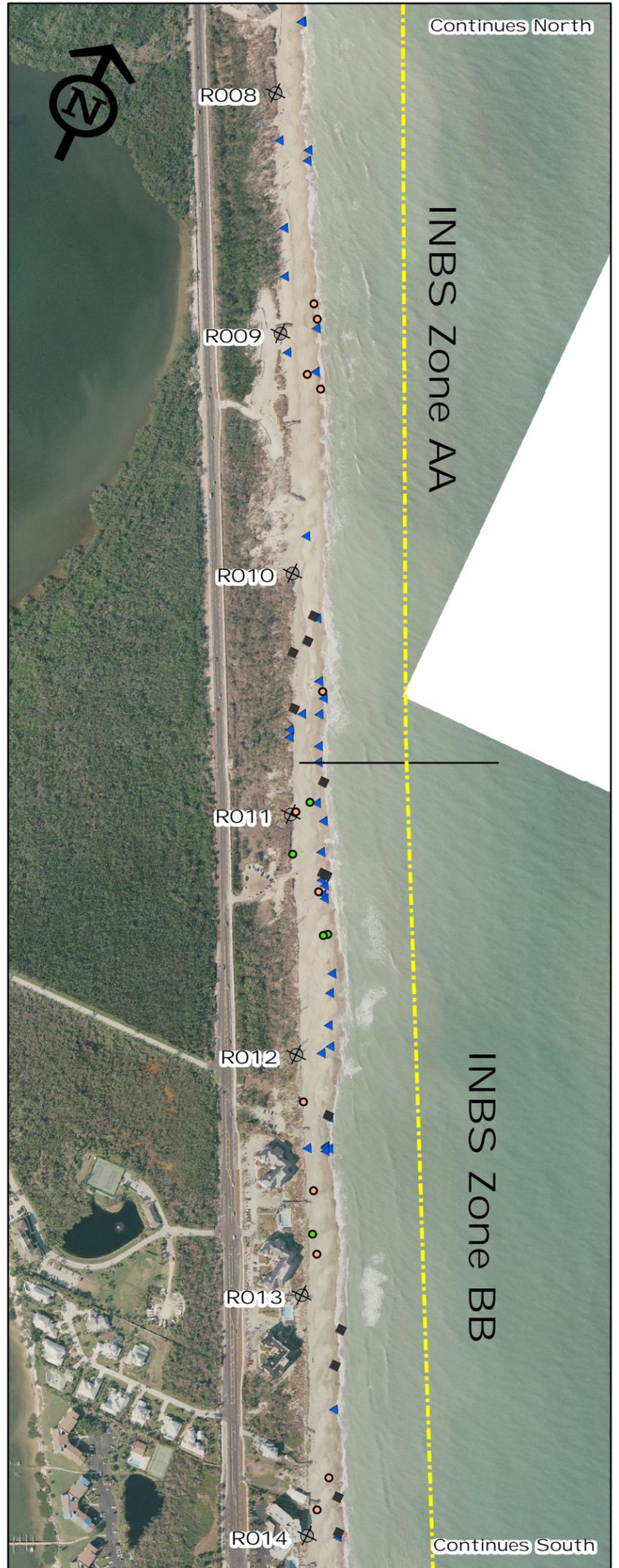
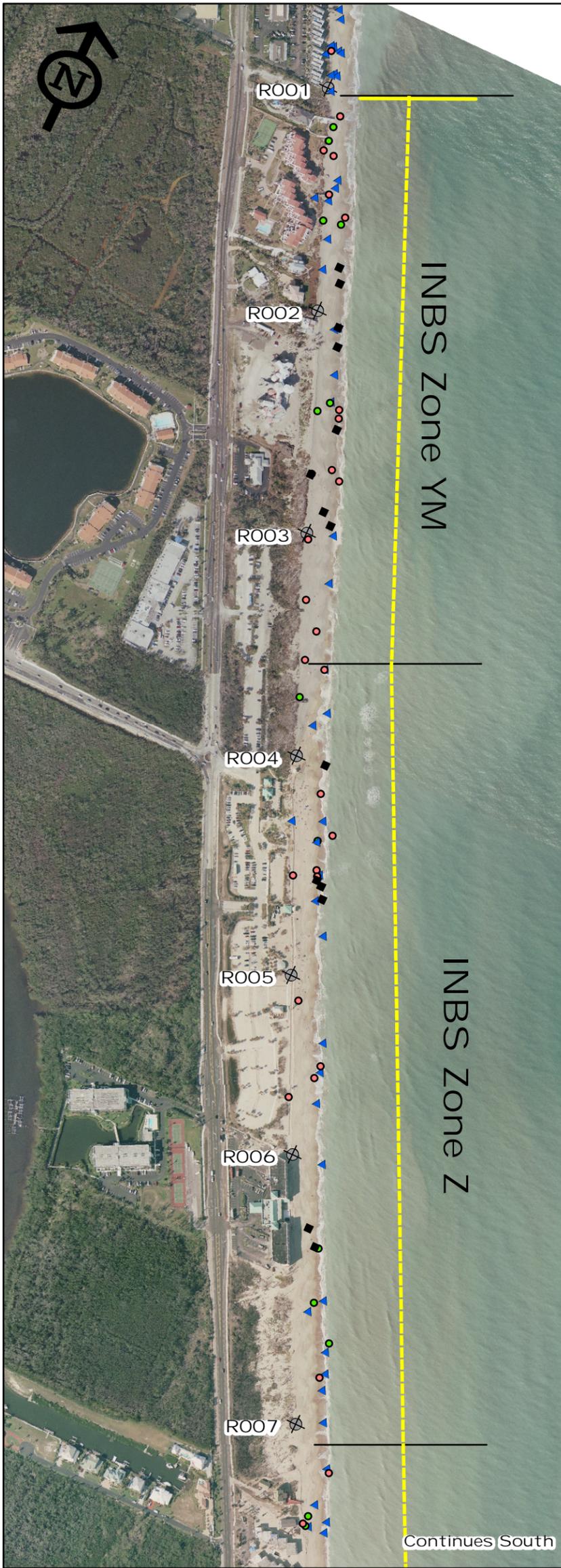
Figure 2B

Location of Loggerhead Turtle Crawls In Relation To the 2005 Martin County Beach Renourishment and Dune Restoration Project Areas and Index Nesting Beach Survey (INBS) Zones YM through FF

2005 Martin County Beach Renourishment Project Hutchinson Island, Martin County, FL

Photo: Martin County Information Technology Services, January 2005





- Legend
- Green Turtle Crawls
 - Nest
 - ▲ False Crawl
 - Leatherback Crawls
 - Nest
 - False Crawl
 - Limits of 2005 Martin County Beach Renourishment Project
 - Limits of 2005 Martin County Dune Restoration Project

Note:
 Reliable GPS Data Not Available for 7 green turtle false crawls, 2 leatherback nests, and 2 leatherback false crawls within the Martin County Beach Renourishment and Dune Restoration Project Areas.

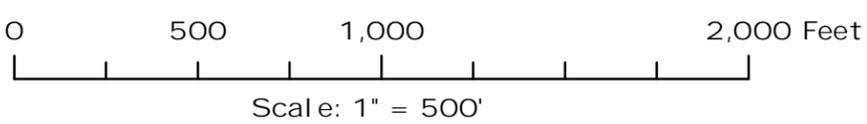


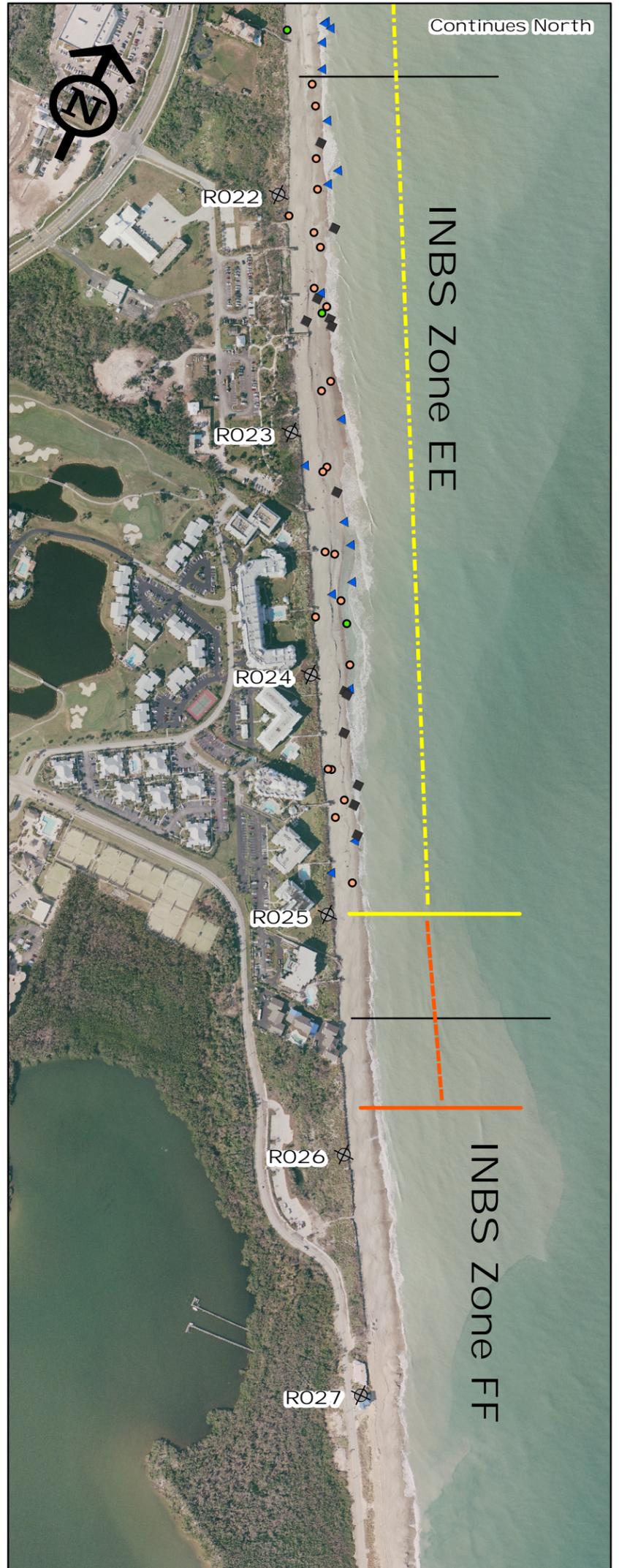
Figure
3A

Location of Green Turtle and Leatherback Crawls In Relation To the 2005 Martin County Beach Renourishment and Dune Restoration Project Areas and Index Nesting Beach Survey (INBS) Zones YM through FF

2005 Martin County Beach Renourishment Project Hutchinson Island, Martin County, FL

Photo: Martin County Information Technology Services, January 2005





- Legend
- Green Turtle Crawls
 - Nest
 - ▲ False Crawl
 - Leatherback Crawls
 - Nest
 - False Crawl
 - Limits of 2005 Martin County Beach Renourishment Project
 - Limits of 2005 Martin County Dune Restoration Project

Note:
 Reliable GPS Data Not Available for 7 green turtle false crawls, 2 leatherback nests, and 2 leatherback false crawls within the Martin County Beach Renourishment and Dune Restoration Project Areas.

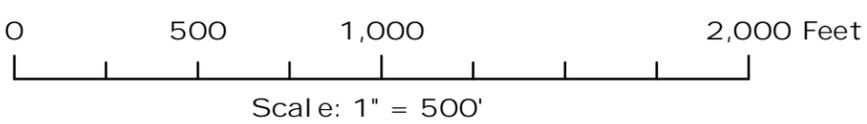


Figure 3B

Location of Green Turtle and Leatherback Crawls In Relation To the 2005 Martin County Beach Renourishment and Dune Restoration Project Areas and Index Nesting Beach Survey (INBS) Zones YM through FF

2005 Martin County Beach Renourishment Project Hutchinson Island, Martin County, FL

Photo: Martin County Information Technology Services, January 2005



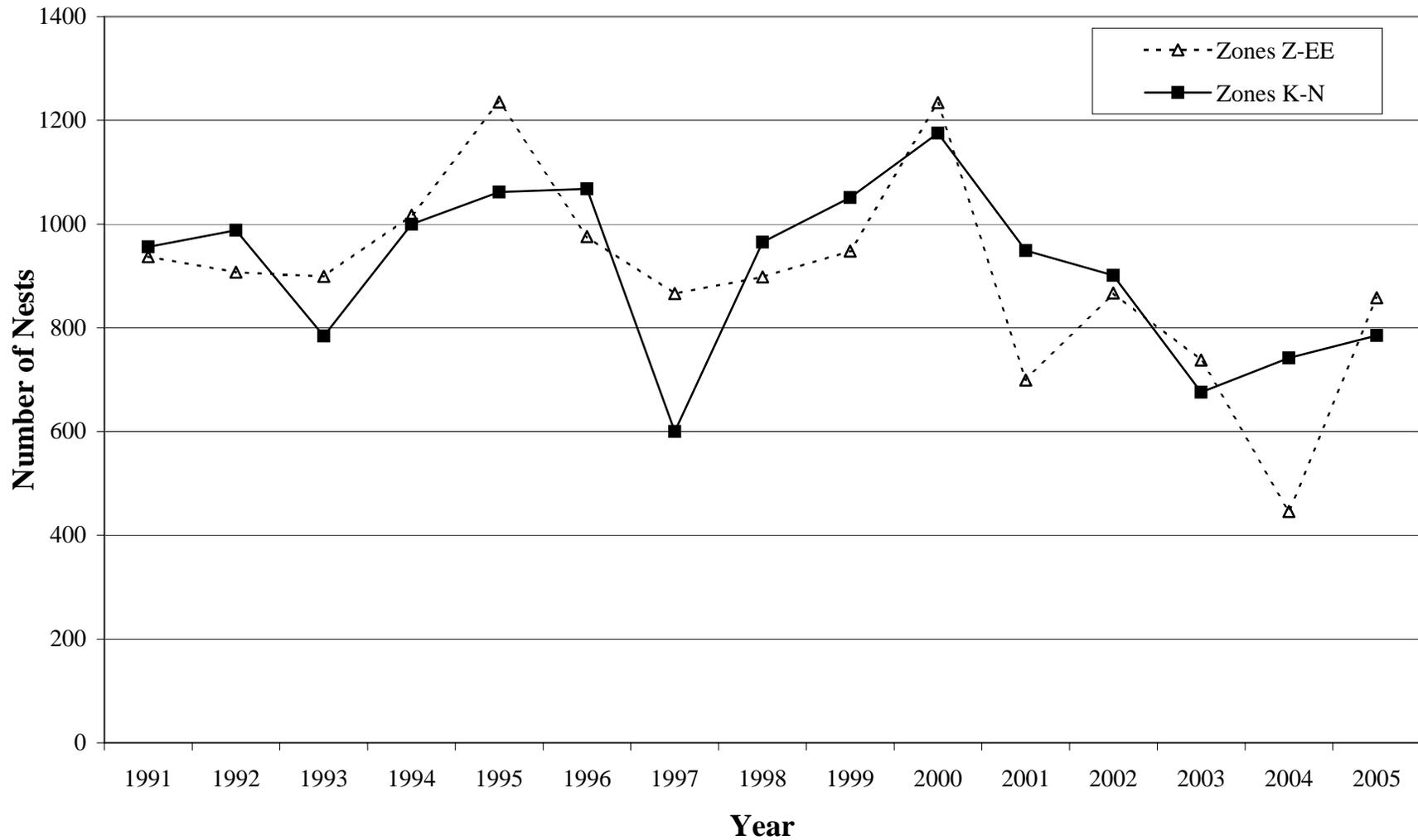


Figure 4. Annual numbers of loggerhead turtle nests along six kilometers of beach (Zones Z-EE) within the 2005 Martin County Beach Renourishment Project and four kilometers of control/natural beach (Zones K-N). The Martin County Beach Renourishment Project was completed on 30 April 2005 at the beginning of the 2005 loggerhead nesting season. Zones Z-EE were first nourished just prior to the 1996 nesting season so 1991-1995 represent baseline years. Portions of Zones Z-EE were renourished just prior to the 2001 and 2002 nesting seasons. Data Source: Ecological Associates, Inc. and Quantum Resources, Inc.

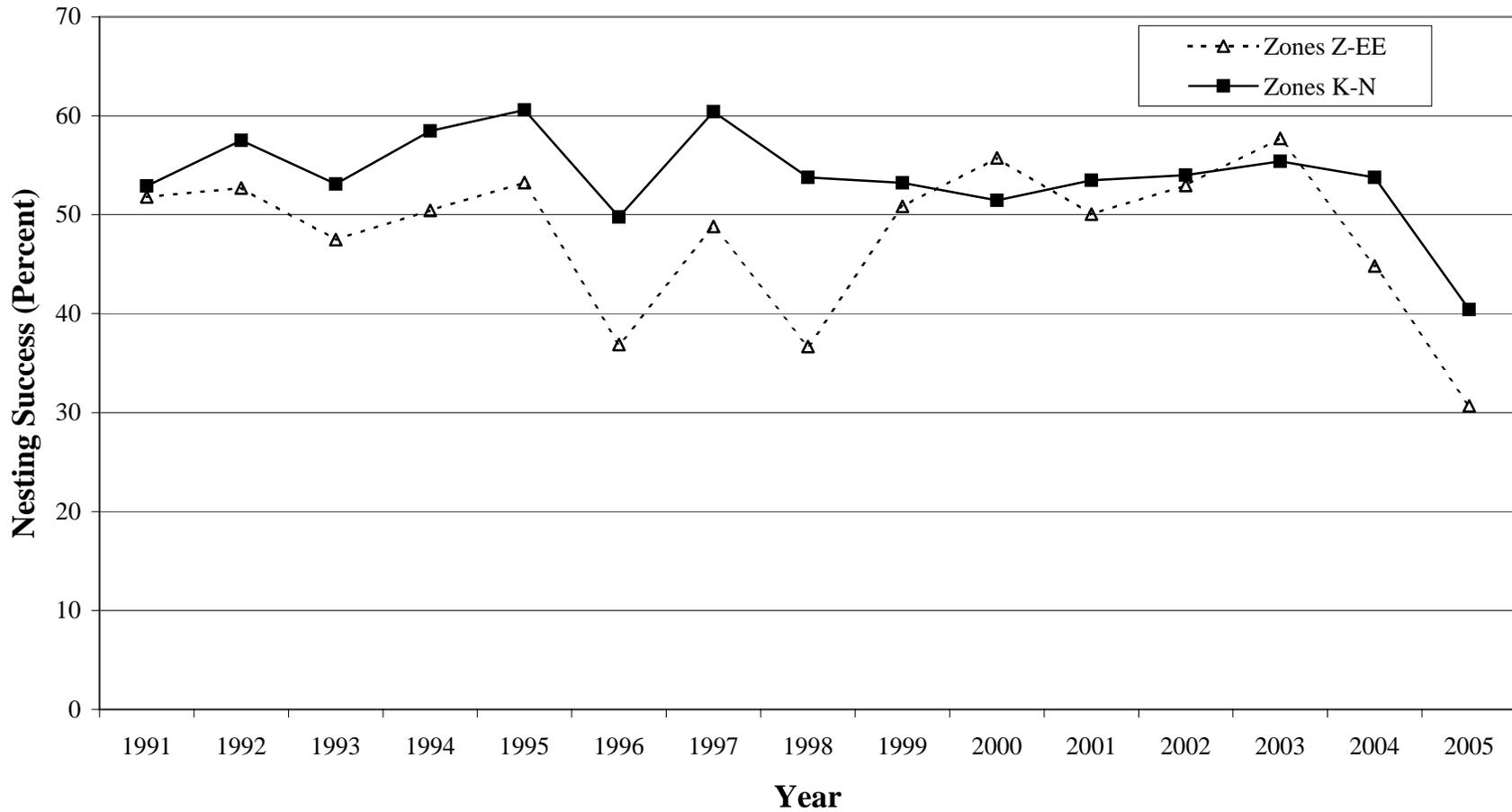


Figure 5. Annual loggerhead turtle nesting success along six kilometers of beach (Zones Z-EE) within the Martin County Beach Renourishment Project and four kilometers of control/natural beach (Zones K-N). The Martin County Beach Renourishment Project was completed on 30 April 2005 at the beginning of the 2005 loggerhead nesting season. Zones Z-EE were first nourished just prior to the 1996 nesting season so 1991-1995 represent baseline years. Portions of Zones Z-EE were renourished just prior to the 2001 and 2002 nesting seasons. Data Source: Ecological Associates, Inc. and Quantum Resources, Inc.

TABLE 1**SUMMARY OF ESCARPMENT MONITORING¹
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date of Survey	EAI Survey Zone²	Scarp Length (feet)	Average Height (inches)	Maximum Height (inches)
5/4/05	No Scarps That Meet Definition			
5/5/05	No Scarps That Meet Definition			
5/11/05	No Scarps That Meet Definition			
5/18/05	No Scarps That Meet Definition			
5/25/05	YM	695	24-48	26
6/2/05	YM	170	<24	24
	B1-B2	155	24-48	28
	C5	130	<24	23
6/8/05	YM	865	24-48	36
6/15/05	YM	640	24-48	28
	YM-Z2	1,150	24-48	53
	Z3	450	<24	21
	Z4-A2	2,490	24-48	40
	A4	400	<24	Not taken
	B1-C1	3,040	>48	61
	C1-C3	8,160	24-48	40
	C3-D2	3,200	>48	54
	D2-D3	1,060	24-48	38
	E2-E3	315	24-48	48
6/22/05	No Scarps That Meet Definition			
6/29/05	No Scarps That Meet Definition			
7/6/05	No Scarps That Meet Definition			

TABLE 1 (CONTINUED)

Date of Survey	EAI Survey Zone²	Scarp Length (feet)	Average Height (inches)	Maximum Height (inches)
7/13/05	YM	280	>48	57
	Z5-A3	3,250	24-48	30
	A4-C1	8,145	24-48	46
	C1-E4	9,000	24-48	74
7/20/05	YM	370	>48	>48
	YM-Z1	560	24-48	63
	A4-A5	405	24-48	38
	B1-B3	1,170	24-48	37
	B4-B5	1,150	>48	24
	C3-C5	1,120	24-48	38
7/27/05	No Scarps That Meet Definition			
8/3/05	No Scarps That Meet Definition			
8/10/05	No Scarps That Meet Definition			
8/17/05	No Scarps That Meet Definition			
8/24/05	No Scarps That Meet Definition			
8/31/05	YM	590	24-48	45
	YM-A4	5,840	24-48	48
	A4-A5	815	<24	24
	A5-C1	3,460	24-48	45
	C1-E4	9160	24-48	45
9/7/05	C5-D5	3,070	24-48	42
	E2-E3	385	24-48	29
9/14/05	A2-A3	300	24-48	56
	C4-C5	755	24-48	29
	E1-E2	990	24-48	51

¹ Scarps are defined as near vertical changes in elevation greater than 18 inches high and over 100 feet long.

² See Figure 1 for zone locations.

TABLE 2

SUMMARY OF SEA TURTLE NESTING ACTIVITY - 2005
MARTIN COUNTY BEACH RENOURISHMENT PROJECT

Monthly Nesting Activity ¹						
Survey Month	Loggerhead		Leatherback		Green Turtle	
	Nests	False Crawls	Nests	False Crawls	Nests	False Crawls
March	0	0	5	4	0	0
April	0	3	21	19	0	0
May	164	379	29	25	0	0
June	404	723	18	5	4	10
July	325	815	2	3	15	86
August	75	181	0	0	5	49
September	0	3	0	0	1	4
Total	968	2,104	75	56	25	149

Number of Nests Marked & Evaluated ²						
Survey Month	Loggerhead		Leatherback		Green Turtle	
	Marked	Analyzed	Marked	Analyzed	Marked	Analyzed
March	0	0	5	0	0	0
April	0	0	21	0	0	0
May	27	0	29	3	0	0
June	66	2	18	14	3	0
July	58	43	2	30	9	0
August	15	76	0	18	3	4
September	0	35	0	10	1	7
October	0	10	0	0	0	3
November	0	0	0	0	0	2
Total	166	166	75	75	16	16

Number of Marked Nests Washed Out			
Survey Month	Loggerhead	Leatherback	Green Turtle
March	0	0	0
April	0	0	0
May	0	3	0
June	0	1	0
July	2	1	0
August	19	5	1
September	14	2	2
October	2	0	0
Total	37	12	3

¹ Includes relocated nests and one nest deposited below previous high tide.

² Includes both relocated and *in-situ* nests that were washed out, vandalized, or in which eggs could not be located upon excavation.

TABLE 3**SUMMARY OF SEA TURTLE NESTING ACTIVITY¹ – 2005
MARTIN COUNTY BEACH RENOURISHMENT PROJECT**

Nesting Activity	Loggerheads	Leatherbacks	Green Turtles
Date of First Crawl	04/29/05	03/15/05	06/20/05
Date of Last Crawl	09/01/05	07/09/05	09/18/05
Date of First Nest	05/01/05	03/17/05	06/20/05
Date of Last Nest	08/19/05	07/04/05	09/06/05
Number of Nests	968	75	25
Total False Crawls (FCs)	2,104	56	149
FCs with no signs of digging	1,551	45	108
FCs with abandoned body pits	518	7	39
FCs with abandoned egg chambers	35	4	2
Total FCs at Obstructions ²	191	8	11
FCs at Scarps	169	3	9
FCs at Dune Crossovers	10	0	1
FCs at Dune/Sand Fences	6	0	1
FCs at Debris	3	0	0
FCs at Buildings	2	0	0
FCs at Dredge Pipes	0	4	0
FCs at Man-Made Hole in Beach	0	1	0
FCs at Nest Markers	1	0	0
Total Emergences	3,072	131	174
Nesting Success ²	31.51%	57.25%	14.37%
Number of Nests Marked	166	75 ³	16
Number of Nests with Clutch Depth	126	22	8
Average Initial Clutch Depth (cm)	55.0	78.9	77.3
Range in Initial Clutch Depths (cm)	38.0 – 74.0	50.0 – 107.0	70.0 – 89.5
Abnormal Egg Chambers	0	0	0

¹ Only includes nests and false crawls above the previous high tide line, except one leatherback nest deposited below the previous high tide line.

² Nesting Success is the percentage of crawls above the high tide line that resulted in nests.

³ Includes 26 relocated nests and 49 *in-situ* nests.

TABLE 4

**REPRODUCTIVE SUCCESS OF RELOCATED LEATHERBACK TURTLE NESTS
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
03/19/05	06/14/05	87	95	34	60	0	1	3	0	35.79	32.63
03/28/05	06/19/05	83	77	40	30	1	6	6	0	51.95	44.16
03/28/05	UNK ¹	UNK ²	109	3	106	0	0	0	0	2.75	2.75
03/30/05	06/17/05	79	122	79	31	2	10	19	2	64.75	47.54
04/02/05	06/25/05	84	49	19	30	0	0	6	1	38.78	24.49
04/02/05	NA ³	NA ³	40	0	40	0	0	0	0	0.00	0.00
04/03/05	06/25/05	83	84	48	25	0	11	2	1	57.14	53.57
04/07/05	UNK ¹	UNK ²	30	5	25	0	0	1	0	16.67	13.33
04/09/05	06/26/05	78	88	51	30	7	0	3	2	57.95	52.27
04/10/05	06/26/05	77	98	66	32	0	0	0	1	67.35	66.33
04/10/05	06/26/05	77	61	52	6	1	2	6	0	85.25	75.41
04/10/05	06/23/05	74	87	76	11	0	0	2	0	87.36	85.06
04/13/05	06/28/05	76	83	38	27	3	15	9	0	45.78	34.94
04/13/05	06/29/05	77	56	7	49	0	0	5	0	12.50	3.57
04/13/05	06/29/05	77	74	59	2	3	10	9	0	79.73	67.57
04/14/05	06/26/05	73	78	54	22	0	2	3	0	69.23	65.38
04/14/05	06/28/05	75	77	63	14	0	0	2	1	81.82	77.92
04/15/05	UNK ¹	UNK ²	41	7	34	0	0	0	0	17.07	17.07
04/24/05	07/04/05	71	77	26	15	0	36	7	0	33.77	24.68
04/25/05	07/04/05	70	86	62	22	0	2	1	0	72.09	70.93
04/25/05	07/06/05	72	52	45	7	0	0	0	0	86.54	86.54
04/28/05	07/06/05	69	88	76	11	0	1	3	0	86.36	82.95
04/30/05	07/07/05	68	67	56	11	0	0	0	0	83.58	83.58

TABLE 4

**REPRODUCTIVE SUCCESS OF RELOCATED LEATHERBACK TURTLE NESTS
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
04/30/05	07/07/05	68	61	54	7	0	0	1	3	88.52	81.97
04/30/05	07/12/05	73	86	14	72	0	0	1	0	16.28	15.12
N		21	25	25	25	25	25	25	25	25	25
MINIMUM		68	30	0	2	0	0	0	0	0	0
MAXIMUM		87	122	79	106	7	36	19	3	88.52	86.54
MEAN		75.76	74.64	41.36	28.76	0.68	3.84	3.56	0.44	53.56	48.39
STANDARD DEVIATION		5.37	21.99	24.87	23.32	1.6	7.97	4.28	0.82	29.62	29.46

¹ No signs of hatchling emergence

² Unable to determine

³ Did not hatch.

TABLE 5

**FATES OF MARKED SEA TURTLE NESTS¹ ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT – 2005**

Fate		Loggerhead	Leatherback	Green Turtle	Total
Evaluated	Hatched	109	20	6	135
	Hatched without Signs of emergence	11	0	2	13
	Did not hatch	6	0	1	7
	Total Evaluated	126	20	9	155
Not Evaluated	Washed out	37	12	3	52
	Clutch not located	0	12	4	16
	Depredated	0	0	0	0
	Stakes Vandalized	0	1	0	1
	Nested on by another turtle	1	0	0	1
	Hatched, Not Analyzed ²	1	2	0	3
	Hatched, Clutch Not Located	0	2	0	2
	Buried ³	1	0	0	1
	Total Not Evaluated	40	29	7	76
Total Marked		166	49	16	231

¹ Does not include 26 leatherback nests that were relocated from the renourished beach to a natural beach. Of these, 24 hatched with signs of emergence, one did not hatch, and one was excluded from analysis because it was inadvertently excavated within 72 hours of emergence.

² The contents of one loggerhead nest were washed out after hatchling emergence but before excavation/evaluation and the contents of two leatherback nests could not be evaluated due to decomposition.

³ Excessive accretion of sand over nest precluded successful excavation of nest contents.

TABLE 6

**REPRODUCTIVE SUCCESS OF LOGGERHEAD TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
05/01/05	06/27/05	57	165	156	2	2	5	9	0	94.55	89.09
05/04/05	07/05/05	62	63	42	21	0	0	0	0	66.67	66.67
05/07/05	07/05/05	59	130	127	3	0	0	0	0	97.69	97.69
05/10/05	07/08/05	59	138	132	5	0	1	0	0	95.65	95.65
05/11/05	07/08/05	58	131	113	16	0	2	0	0	86.26	86.26
05/11/05	07/11/05	61	150	65	84	0	1	0	0	43.33	43.33
05/12/05	07/07/05	56	138	126	12	0	0	0	0	91.30	91.30
05/12/05	07/07/05	56	176	169	5	0	2	0	1	96.02	95.45
05/18/05	07/12/05	55	112	110	1	0	1	2	2	98.21	94.64
05/19/05	07/13/05	55	111	97	14	0	0	1	0	87.39	86.49
05/21/05	07/17/05	57	108	64	44	0	0	2	0	59.26	57.41
05/22/05	07/17/05	56	148	96	20	2	30	0	4	64.86	62.16
05/22/05	NA ¹	NA ¹	125	0	125	0	0	0	0	0.00	0.00
05/23/05	07/17/05	55	160	151	9	0	0	7	0	94.38	90.00
05/24/05	07/17/05	54	78	72	6	0	0	0	0	92.31	92.31
05/25/05	07/17/05	53	111	106	3	0	2	0	0	95.50	95.50
05/26/05	07/18/05	53	130	119	9	0	2	1	0	91.54	90.77
05/27/05	07/18/05	52	149	112	8	0	29	5	1	75.17	71.14
05/27/05	07/18/05	52	123	94	22	0	7	2	0	76.42	74.80
05/27/05	07/18/05	52	118	90	21	0	7	4	0	76.27	72.88
05/27/05	07/21/05	55	111	103	5	0	3	1	3	92.79	89.19
05/28/05	07/22/05	55	147	68	71	0	8	4	1	46.26	42.86
05/29/05	07/22/05	54	103	74	22	0	7	1	5	71.84	66.02

TABLE 6

**REPRODUCTIVE SUCCESS OF LOGGERHEAD TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
05/30/05	07/21/05	52	72	61	11	0	0	0	0	84.72	84.72
05/30/05	07/23/05	54	144	51	71	0	22	2	2	35.42	32.64
05/31/05	UNK ²	UNK ³	121	96	14	0	11	0	3	79.34	76.86
06/01/05	07/24/05	53	103	95	6	1	1	1	0	92.23	91.26
06/01/05	07/23/05	52	119	57	44	0	18	3	1	47.90	44.54
06/01/05	07/25/05	54	102	92	7	1	2	1	0	90.20	89.22
06/01/05	07/26/05	55	125	84	19	0	22	2	22	67.20	48.00
06/02/05	07/24/05	52	105	81	21	0	3	0	0	77.14	77.14
06/03/05	07/25/05	52	68	60	8	0	0	0	0	88.24	88.24
06/04/05	07/26/05	52	108	91	6	0	11	1	5	84.26	78.70
06/04/05	07/25/05	51	116	84	6	0	26	1	2	72.41	69.83
06/04/05	07/24/05	50	99	93	3	0	3	1	0	93.94	92.93
06/05/05	07/28/05	53	115	72	39	0	4	4	0	62.61	59.13
06/05/05	07/28/05	53	128	125	2	1	0	14	6	97.66	82.03
06/05/05	07/25/05	50	111	81	23	1	6	0	29	72.97	46.85
06/05/05	07/27/05	52	72	62	4	0	6	0	5	86.11	79.17
06/06/05	07/27/05	51	101	72	15	0	14	2	5	71.29	64.36
06/06/05	07/27/05	51	99	82	2	0	15	2	1	82.83	79.80
06/07/05	07/28/05	51	84	63	18	0	3	1	6	75.00	66.67
06/07/05	07/30/05	53	57	54	3	0	0	0	0	94.74	94.74
06/08/05	08/01/05	54	174	52	104	1	17	2	3	29.89	27.01
06/09/05	08/04/05	56	85	77	4	0	4	1	3	90.59	85.88
06/09/05	07/28/05	49	106	79	17	0	10	4	10	74.53	61.32

TABLE 6

**REPRODUCTIVE SUCCESS OF LOGGERHEAD TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
06/10/05	07/30/05	50	112	78	17	0	17	3	6	69.64	61.61
06/10/05	07/30/05	50	108	17	82	2	7	6	2	15.74	8.33
06/12/05	08/01/05	50	102	33	40	0	29	4	15	32.35	13.73
06/13/05	UNK ²	UNK ³	114	50	64	0	0	0	0	43.86	43.86
06/14/05	08/04/05	51	105	78	14	2	11	1	2	74.29	71.43
06/14/05	08/07/05	54	91	75	3	0	13	2	4	82.42	75.82
06/14/05	08/07/05	54	87	38	29	1	19	1	6	43.68	35.63
06/15/05	08/12/05	58	117	23	90	0	4	0	3	19.66	17.09
06/15/05	08/07/05	53	93	43	46	0	4	2	1	46.24	43.01
06/17/05	08/14/05	58	125	2	123	0	0	0	0	1.60	1.60
06/17/05	08/07/05	51	101	88	11	0	2	1	0	87.13	86.14
06/18/05	08/10/05	53	144	56	80	0	8	3	3	38.89	34.72
06/19/05	08/19/05	61	93	28	63	0	2	0	0	30.11	30.11
06/19/05	08/14/05	56	94	4	85	0	5	0	1	4.26	3.19
06/20/05	08/13/05	54	86	3	83	0	0	0	0	3.49	3.49
06/20/05	08/11/05	52	102	30	62	1	9	3	6	29.41	20.59
06/20/05	08/12/05	53	109	1	108	0	0	0	0	0.92	0.92
06/21/05	08/12/05	52	126	22	97	2	5	1	5	17.46	12.70
06/21/05	08/11/05	51	84	61	22	0	1	0	0	72.62	72.62
06/21/05	08/13/05	53	140	19	104	0	17	0	5	13.57	10.00
06/22/05	08/12/05	51	90	3	84	0	3	0	0	3.33	3.33
06/22/05	NA ¹	NA ¹	105	0	105	0	0	0	0	0.00	0.00
06/22/05	08/12/05	51	130	70	53	1	6	8	1	53.85	46.92

TABLE 6

**REPRODUCTIVE SUCCESS OF LOGGERHEAD TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
06/22/05	08/10/05	49	90	80	9	0	1	0	0	88.89	88.89
06/22/05	08/12/05	51	106	54	24	0	28	2	0	50.94	49.06
06/23/05	08/12/05	50	125	68	51	1	5	2	2	54.40	51.20
06/23/05	08/11/05	49	145	86	17	0	42	3	5	59.31	53.79
06/23/05	08/12/05	50	119	22	73	23	1	8	0	18.49	11.76
06/23/05	08/11/05	49	103	37	44	0	22	3	1	35.92	32.04
06/24/05	08/12/05	49	126	72	49	3	2	4	2	57.14	52.38
06/24/05	UNK ²	UNK ³	109	4	102	0	3	0	0	3.67	3.67
06/25/05	08/13/05	49	134	100	23	1	10	1	2	74.63	72.39
06/25/05	08/14/05	50	143	24	119	0	0	0	2	16.78	15.38
06/26/05	08/13/05	48	109	58	14	0	37	1	2	53.21	50.46
06/26/05	08/13/05	48	119	45	66	0	8	0	10	37.82	29.41
06/27/05	08/13/05	47	99	60	25	1	13	1	6	60.61	53.54
06/27/05	08/14/05	48	92	91	1	0	0	0	0	98.91	98.91
06/27/05	08/16/05	50	119	52	41	0	26	16	2	43.70	28.57
06/28/05	08/14/05	47	100	65	6	0	29	3	1	65.00	61.00
06/28/05	08/14/05	47	96	88	5	0	3	0	1	91.67	90.63
06/28/05	08/14/05	47	80	60	10	0	10	3	3	75.00	67.50
06/29/05	08/14/05	46	92	33	50	0	9	0	5	35.87	30.43
06/29/05	08/16/05	48	123	42	63	0	18	0	7	34.15	28.46
06/30/05	08/17/05	48	105	38	55	0	12	6	5	36.19	25.71
06/30/05	08/17/05	48	77	27	48	0	2	0	2	35.06	32.47
07/01/05	08/18/05	48	175	45	128	0	2	1	6	25.71	21.71

TABLE 6

**REPRODUCTIVE SUCCESS OF LOGGERHEAD TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
07/02/05	08/19/05	48	103	51	45	0	7	1	2	49.51	46.60
07/04/05	08/19/05	46	102	56	41	2	3	9	10	54.90	36.27
07/04/05	08/19/05	46	115	72	21	3	19	8	4	62.61	52.17
07/05/05	08/20/05	46	69	22	41	0	6	4	8	31.88	14.49
07/06/05	UNK ²	UNK ³	93	7	75	0	11	0	1	7.53	6.45
07/06/05	08/23/05	48	95	21	62	0	12	6	1	22.11	14.74
07/06/05	08/23/05	48	Nest contents washed out after hatching but before excavation/evaluation.								
07/07/05	08/23/05	47	71	32	36	0	3	7	2	45.07	32.39
07/07/05	UNK ²	UNK ³	115	2	110	0	3	0	0	1.74	1.74
07/07/05	08/23/05	47	124	30	91	0	3	2	2	24.19	20.97
07/08/05	UNK ²	UNK ³	91	7	84	0	0	0	1	7.69	6.59
07/11/05	UNK ²	UNK ³	77	1	76	0	0	0	1	1.30	0.00
07/11/05	09/14/05	65	130	2	126	0	2	0	0	1.54	1.54
07/12/05	09/01/05	51	86	42	36	1	7	0	1	48.84	47.67
07/16/05	08/30/05	45	94	47	25	3	19	8	12	50.00	28.72
07/17/05	09/05/05	50	116	19	96	0	1	1	4	16.38	12.07
07/19/05	09/05/05	48	162	74	62	1	25	3	4	45.68	41.36
07/19/05	NA ¹	NA ¹	119	0	119	0	0	0	0	0.00	0.00
07/21/05	09/07/05	48	124	20	99	1	4	7	1	16.13	9.68
07/22/05	09/10/05	50	124	49	69	0	6	1	0	39.52	38.71
07/22/05	UNK ²	UNK ³	98	4	89	0	5	0	2	4.08	2.04
07/23/05	NA ¹	NA ¹	76	0	76	0	0	0	0	0.00	0.00
07/25/05	09/15/05	52	88	28	60	0	0	0	0	31.82	31.82

TABLE 6

**REPRODUCTIVE SUCCESS OF LOGGERHEAD TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
07/25/05	09/12/05	49	95	56	35	1	3	1	0	58.95	57.89
07/26/05	09/17/05	53	99	7	80	0	12	1	2	7.07	4.04
07/27/05	09/14/05	49	112	54	49	0	9	0	0	48.21	48.21
07/27/05	09/16/05	51	123	8	114	0	1	0	4	6.50	3.25
07/29/05	09/15/05	48	124	101	20	0	3	1	1	81.45	79.84
07/29/05	UNK ²	UNK ³	93	43	34	0	16	0	0	46.24	46.24
07/31/05	UNK ²	UNK ³	104	6	97	0	1	0	0	5.77	5.77
08/01/05	NA ¹	NA ¹	95	0	95	0	0	0	0	0.00	0.00
08/03/05	09/25/05	53	129	45	82	0	2	1	1	34.88	33.33
08/06/05	UNK ²	UNK ³	105	3	102	0	0	0	0	2.86	2.86
08/11/05	10/04/05	54	124	119	2	1	2	1	0	95.97	95.16
08/12/05	NA ¹	NA ¹	100	0	99	0	1	0	0	0.00	0.00
N		110	126	126	126	126	126	126	126	126	126
MINIMUM		45	57	0	1	0	0	0	0	0.00	0.00
MAXIMUM		65	176	169	128	23	42	16	29	98.91	98.91
MEAN		51.8	110.8	56.8	46.1	0.5	7.4	1.8	2.4	51.05	47.15
STANDARD DEVIATION		3.76	23.58	38.66	37.72	2.13	8.92	2.82	4.08	32.08	32.09

¹ Did not hatch

² No signs of hatchling emergence

³ Unable to determine

TABLE 7

**REPRODUCTIVE SUCCESS OF GREEN TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
06/23/05	8/13/2005	51	165	95	33	2	35	5	3	57.58	52.73
06/30/05	8/20/2005	51	116	61	22	0	33	6	10	52.59	38.79
07/02/05	8/22/2005	51	123	57	45	0	21	9	3	46.34	36.59
07/25/05	NA ¹	NA ¹	146	0	132	0	14	0	0	0.00	0.00
07/26/05	9/13/2005	49	123	61	57	0	5	1	1	49.59	47.97
07/26/05	9/19/2005	55	150	135	15	0	0	3	0	90.00	88.00
08/17/05	UNK ²	UNK ³	96	81	15	0	0	0	0	84.38	84.38
08/28/05	UNK ²	UNK ³	114	104	8	1	1	1	0	91.23	90.35
09/06/05	10/30/2005	54	116	111	5	0	0	0	0	95.69	95.69
N		6	9	9	9	9	9	9	9	9	9
MINIMUM		49	96	0	5	0	0	0	0	0.00	0.00
MAXIMUM		55	165	135	132	2	35	9	10	95.69	95.69
MEAN		51.8	127.7	78.3	36.9	0.3	12.1	2.8	1.9	63.04	59.39
STANDARD DEVIATION		2.23	21.60	39.39	39.63	0.71	14.39	3.23	3.30	30.85	32.34

¹ Did not hatch

² No signs of hatchling emergence

³ Unable to determine

TABLE 8

**REPRODUCTIVE SUCCESS OF LEATHERBACK TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
05/01/05	07/08/05	68	91	78	9	0	4	2	6	85.71	76.92
05/05/05	07/16/05	72	64	51	12	0	1	1	0	79.69	78.13
05/10/05	07/17/05	68	84	75	7	0	2	1	3	89.29	84.52
05/11/05	07/18/05	68	89	49	40	0	0	0	3	55.06	51.69
05/12/05	07/21/05	70	92	30	42	0	20	1	4	32.61	27.17
05/13/05	07/20/05	68	Nest contents could not be evaluated due to decomposition								
05/14/05	07/23/05	70	112	87	4	0	21	0	2	77.68	75.89
05/16/05	07/21/05	66	94	54	38	0	2	0	3	57.45	54.26
05/17/05	07/27/05	71	83	15	43	0	25	0	2	18.07	15.66
05/17/05	07/24/05	68	74	67	5	0	2	1	9	90.54	77.03
05/18/05	07/24/05	67	94	27	39	0	28	1	4	28.72	23.40
05/20/05	07/28/05	69	84	47	28	0	9	1	13	55.95	39.29
05/20/05	07/25/05	66	98	69	16	0	13	4	2	70.41	64.29
05/21/05	07/18/05	58	Nest contents could not be located after hatchling emergence.								
05/22/05	07/28/05	67	94	82	2	0	10	0	1	87.23	86.17
05/26/05	07/30/05	65	Nest contents could not be evaluated due to decomposition.								
05/27/05	08/03/05	68	58	54	4	0	0	0	0	93.10	93.10
05/27/05	08/03/05	68	87	10	67	0	10	1	5	11.49	4.60
05/29/05	08/05/05	68	54	26	20	0	8	0	25	48.15	1.85
05/31/05	08/16/05	77	88	34	27	0	27	0	0	38.64	38.64
06/05/05	08/09/05	65	63	57	4	0	2	0	2	90.48	87.30
06/05/05	08/09/05	65	69	36	24	0	9	0	3	52.17	47.83
06/06/05	08/11/05	66	Nest contents could not be located after hatchling emergence.								

TABLE 8**REPRODUCTIVE SUCCESS OF LEATHERBACK TURTLE NESTS ON THE RENOURISHED BEACH
MARTIN COUNTY BEACH RENOURISHMENT PROJECT 2005**

Date Nest Deposited	Date First Hatchling Emerged	Incubation Period	Clutch Size	Hatched Eggs	Unhatched Eggs	Pipped Eggs with Live Hatchlings	Pipped Eggs with Dead Hatchlings	Live Hatchlings	Dead Hatchlings	Hatching Success	Emerging Success
06/10/05	08/15/05	66	87	23	43	0	21	0	6	26.44	19.54
N		24	20	20	20	20	20	20	20	20	20
MINIMUM		58	54	10	2	0	0	0	0	11.49	1.85
MAXIMUM		77	112	87	67	0	28	4	25	93.10	93.10
MEAN		67.7	83.0	48.6	23.7	0.0	10.7	0.7	4.7	59.44	52.36
STANDARD DEVIATION		3.34	14.82	22.96	18.32	0.00	9.62	0.99	5.73	26.84	29.69

TABLE 9

**SUMMARY OF SEA TURTLE NESTING ACTIVITY - 2005
MARTIN COUNTY DUNE RESTORATION PROJECT**

Monthly Nesting Activity ¹						
Survey Month	Loggerhead		Leatherback		Green Turtle	
	Nests	False Crawls	Nests	False Crawls	Nests	False Crawls
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	9	12	2	0	0	0
June	15	27	1	0	0	0
July	9	23	0	0	0	2
August	5	12	0	0	0	2
September	0	1	0	0	0	0
Total	38	75	3	0	0	4

Number of Nests Marked & Evaluated ²						
Survey Month	Loggerhead		Leatherback		Green Turtle	
	Marked	Analyzed	Marked	Analyzed	Marked	Analyzed
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	9	0	2	0	0	0
June	15	0	1	0	0	0
July	9	12	0	1	0	0
August	5	15	0	1	0	0
September	0	8	0	1	0	0
October	0	3	0	0	0	0
November	0	0	0	0	0	0
Total	38	38	3	3	0	0

Number of Marked Nests Washed Out			
Survey Month	Loggerhead	Leatherback	Green Turtle
March	0	0	NA
April	0	0	NA
May	0	0	NA
June	0	0	NA
July	0	0	NA
August	1	0	NA
September	3	0	NA
October	1	0	NA
Total	5	0	NA

¹ Includes only crawls above the previous high tide.

² Includes nests that were washed out, nested on by other turtles, or in which eggs could not be located upon excavation.

TABLE 10**SUMMARY OF SEA TURTLE NESTING ACTIVITY¹ – 2005
MARTIN COUNTY DUNE RESTORATION PROJECT**

Nesting Activity	Loggerheads	Leatherbacks	Green Turtles
Date of First Crawl	05/06/05	05/10/05	07/15/05
Date of Last Crawl	09/01/05	06/24/05	08/30/05
Date of First Nest	05/10/05	05/10/05	NA
Date of Last Nest	08/10/05	06/24/05	NA
Number of Nests	38	3	0
Total False Crawls (FCs)	75	0	4
FCs with no signs of digging	48	NA	3
FCs with abandoned body pits	25	NA	0
FCs with abandoned egg chambers	2	NA	1
Total FCs at Obstructions ²	23	NA	0
FCs at Beach Scarps	2	NA	0
FCs at Dune Scarps	18	NA	0
FCs at Zone Markers	1	NA	0
FCs at Nest Markers	2	NA	0
Total Emergences	113	3	4
Nesting Success ²	33.63%	100.00%	0.00%
Number of Nests Marked	38	3	NA
Number of Nests with Clutch Depth	31	2	NA
Average Initial Clutch Depth (cm)	55.8	73.0	NA
Range in Initial Clutch Depths (cm)	34.0 – 77.0	59.0 – 87.0	NA
Abnormal Egg Chambers	0	0	NA

¹ Only includes nests and false crawls above the previous high tide line, except one leatherback nest deposited below the previous high tide line.

² Nesting Success is the percentage of crawls above the high tide line that resulted in nests.

TABLE 11

**FATES OF MARKED SEA TURTLE NESTS IN THE RESTORED DUNE AREA
MARTIN COUNTY DUNE RESTORATION PROJECT – 2005**

Fate		Loggerhead	Leatherback	Total
Evaluated	Hatched	28	2	30
	Hatched Without Signs of Emergence	1	0	1
	Did Not Hatch	1	0	1
	Total Evaluated	30	2	32
Not Evaluated	Washed out	5	0	5
	Clutch Not Located	1	1	2
	Depredated	0	0	0
	Stakes Vandalized	0	0	0
	Nested on by Another Turtle	1	0	1
	Hatched, Not Analyzed ¹	1	0	1
	Total Not Evaluated	8	1	9
Total Marked		38	3	41

¹The contents of one loggerhead nest could not be evaluated due to decomposition.