

2004 MARINE TURTLE NESTING SUMMARY

CANAVERAL NATIONAL SEASHORE



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ABSTRACT

Canaveral National Seashore experienced an unusual sea turtle nesting season in 2004. Nesting totals were the lowest since 1988, a span of 17 years. Four hurricanes impacted hatching success and washed away over 1000 nests. A total of 2542 sea turtle nests were deposited at CANA in 2004 - 2281 loggerhead, 255 green, and 6 leatherback. Nest densities were 59.6 per kilometer for the loggerhead, 6.7 per kilometer for the green and 0.16 per kilometer for the leatherback. Number of nests exceeded false crawls for the loggerhead and leatherback (ratios of 1.32 and 1.60 to 1) Over 99% of the nests were screened to exclude predators. During the season, less than one percent of the nests were partially or totally depredated prior to discovery and 4.2% of the nests were depredated after screening. Overall depredation rate for all nests was 5.0%. Every twentieth loggerhead, all green, and all leatherback nests were marked for excavation. Hatching success rates of 71.9%, 30.4% and 41.1% were recorded for the loggerhead, green and leatherback sea turtles, respectively. The unusually low hatching rate for the green turtle was caused by inundation from high tides associated with the hurricanes.

INTRODUCTION

Canaveral National Seashore (CANA) is an important nesting area for several species of threatened and endangered sea turtles. These are primarily the loggerhead (*Carretta caretta*), with a lesser number of green (*Chelonia mydas*) and an occasional leatherback (*Dermochelys coriacea*). In 1982 a hawksbill nest was documented (CANA Files) and in 2003 a Kemp's ridley nest was recorded. (CANA 2003 nesting summary)

Nest depredation, primarily by raccoons, is a serious threat. Depredation rates exceeded 90 % in the early 1980's (McMurtray 1986). In 1984, the park implemented a nest screening program to protect nests, while allowing the raccoon to remain as an integral part of the seashore ecosystem. In 1993 and 1994, the University of Georgia compared three methods of nest protection, screening, predator removal and conditioned-taste-aversion (Ratnaswamy 1995; Warren 1996). They found screening to be most effective and compatible with National Park Service guidelines and objectives.

2004 was the 21st year for CANA'S sea turtle nest protection program. Since 1995, park staff has screened over 90% of the several thousand nests deposited each year, reducing nest depredation to as low as 5.6 % in 2003. The park's goal each season is to achieve the 60% hatching rate targeted in the loggerhead and green sea turtle recovery plans (NMFS and USFWS 1991) without removing predators from their important role in the barrier island ecosystem.

A two year study was initiated by The University of Florida in 2003 to provide information on the foraging grounds and genetic characteristics of CANA'S nesting loggerhead population. Skin and scute samples were collected for analysis in the northern half of the park. Similar work

was done by Dynamac Inc. from Kennedy Space Center along the southern portion of CANA'S beach.

STUDY SITES AND METHODS

Canaveral National Seashore is located along the east-central coast of Florida with Bethune Beach to the north and Kennedy Space Center to the south (Figure 1). The northern 18.1 kilometers (11.25 miles) of beach is situated in Volusia County and the southern 20.2 kilometers (12.5 miles) in Brevard County.

The beach is essentially undeveloped with only a few artificial lights and a number of boardwalks to protect the dune vegetation. The dune is well developed along most of its length and is stabilized by a thick growth of sea oats (*Uniola paniculata*), sea grape (*Coccoloba uvifera*), saw palmetto (*Serenoa repens*) and other dune species. The beach was divided into 94 quarter-mile long grids by placing numbered four by four posts along the dune line. These grids provide a reference point for documenting nest locations.

The beach is closed to the public between sunset and sunrise except for occasional guided turtle walks. These walks are limited in size to minimize disturbance to the nesting turtles.

On April 27, 2004, the park initiated periodic patrols on four-wheeled all-terrain vehicles (ATV's) to record sea turtle emergences (nests and false crawls) and to screen nests. Regular patrols of both districts were implemented on May 13, 2004. The 24 miles of beach was divided into two 12 mile segments, each covered by a team consisting of a ranger and a volunteer. Teams worked from 11:00 p.m. to 7:00 a.m., seven nights a week. In addition, daytime patrols were conducted at least three times a week to document any subsequent depredations to recorded nests. On August 24, 2004, patrols were switched to 4:00 a.m. to noon, due to a decrease in nesting and to enhance nest excavation activities.

Initial data collected for each nest included: date, nest number, species, grid, number of eggs depredated and sighting/treatment. Sighting/treatment referred to the condition of the nest upon discovery (un-depredated, partially depredated or totally depredated) and the subsequent treatment (nest screened or left unscreened). Each nest was marked with a numbered stake for later identification. Date and grid location of each false crawl was also recorded.

The screening procedure consisted of placing a 4 feet x 4 feet wire mesh screen over the nest and staking down the corners with three foot sections of #3 rebar. The rebar was bent over near one end to form a 70 degree angle. The 2 inches x 4 inches mesh size was large enough to allow hatchlings to emerge while discouraging attempts by predators to reach the eggs. Partially depredated nests that retained a significant number of intact eggs had the broken eggs removed and were covered with clean sand.

During daytime patrols, all new nest depredations were recorded, number of depredated eggs counted and broken eggs removed from the nest site. The latter was done to deter predators from



easily relocating any remaining eggs and to prevent counting depredations more than once. If a significant number of viable eggs remained, broken eggs were removed and the nest was re-covered with clean sand.

Other data recorded during the incubation period included evidence of hatching, tampering with screens or stakes by humans, if the nest was covered by water at some point and if the nest was washed away.

The stake for every twentieth loggerhead and every green and leatherback nest was painted white for ready identification. After a minimum of 70 days, or 3 days after evidence of hatching, these nests were excavated and the following information recorded: number of hatchlings emerged (empty eggshells), number of unhatched eggs, number of live or dead hatchlings in nest and number of live or dead pipped eggs (hatchling still partially in eggshell). Depredated eggs recorded during daytime runs were added to the total of unhatched eggs prior to analysis. This data was then used to calculate average hatching success for the entire beach.

One hundred and sixty (160) nests were relocated for one of three reasons: 1) the nest was located at the base of a heavily traveled boardwalk; 2) the nest cavity and eggs had been fouled by the contents of broken eggs; 3) the nest was in imminent danger of erosion. Pits approximating the natural nest cavity were dug near the base of the dune. The eggs were then carefully transferred, buried and screened in the usual manner.

An attempt was made to remove individual raccoons that learned how to repeatedly tunnel under the screens. These raccoons were captured using Tomahawk live-traps.

RESULTS

Nesting and False Crawl Totals

A total of 2542 sea turtle nests were deposited at CANA in 2004 - 2281 loggerheads, 255 greens, and 6 leatherbacks (Table 1). Overall nest density was 59.6 per kilometer for the loggerhead, 6.7 per kilometer for the green and 0.16 per kilometer for the leatherback.

The total number of loggerhead false crawls was 1727 or 45.1 per kilometer, a false crawl to nest ratio of 1:1.32 (Table 1). There were 255 green false crawls or 6.7 per kilometer, a false crawl to nest ratio of 1:1. One leatherback false crawls were recorded, or 0.03 per kilometer, for a false crawl to nest ratio of 1:6.0

As in former years, the greatest concentration of nesting was noted in the southern half of CANA, with 63% (1603) of the nests occurring in the South District (Brevard County) and 36.9% (939) in the North District (Volusia County) (Table 1). Nesting densities were 79.4 and 51.9 per kilometer respectively. Figures 2a and 2b show the number of nests and false crawls by individual grids for the entire beach.

Initial Sighting and Nests Screened

In 2004, 99.8% (2536) of the 2542 nests deposited at CANA were screened, comprising 2369 un-depredated and 17 partially depredated nests (Table 2, Initial Encounter). This included 2281 loggerhead, 255 green, 6 leatherback nests, and one Kemp's ridley. Six loggerhead, no leatherback and no green nests were depredated prior to discovery (Table 2, Initial Encounter).

Table 1. 2004 Marine Turtle Crawl Survey, Canaveral National Seashore.

Overall

	Loggerhead	Green	Leatherback	Total
Nests	2281	255	6	2542
False Crawls (FC)	1727	255	1	1983
Nest Density (nest/km)	59.6	6.7	0.16	66.4
FC Density (FC/km)	45.1	6.7	.03	51.8
FC to Nest Ratio	1:1.32	1:1	1:60	1:1.28

Distribution by District

North District (Volusia County)

	Loggerhead	Green	Leatherback	Total
Nests	855	82	2	939
False Crawls	498	83	0	581
Nest Density (nest/km)	47.2	4.5	0.1	51.9
FC Density (FC/km)	27.5	4.6	0	32.1
FC to Nest Ratio	1:1.72	1:0.99	0	1:1.62

South District (Brevard County)

	Loggerhead	Green	Leatherback	Total
Nests	1426	173	4	1603
False Crawls	1229	172	1	1402
Nest Density (nest/km)	70.6	8.6	0.2	79.4
FC Density (FC/km)	60.8	8.5	.05	69.4
FC to Nest Ratio	1:1.16	1:1.01	1:4.0	1:1.14

Figure 2a. Number of nests, false crawls, depredations and tunneling activity in grids 0 - 44, Canaveral National Seashore 2004

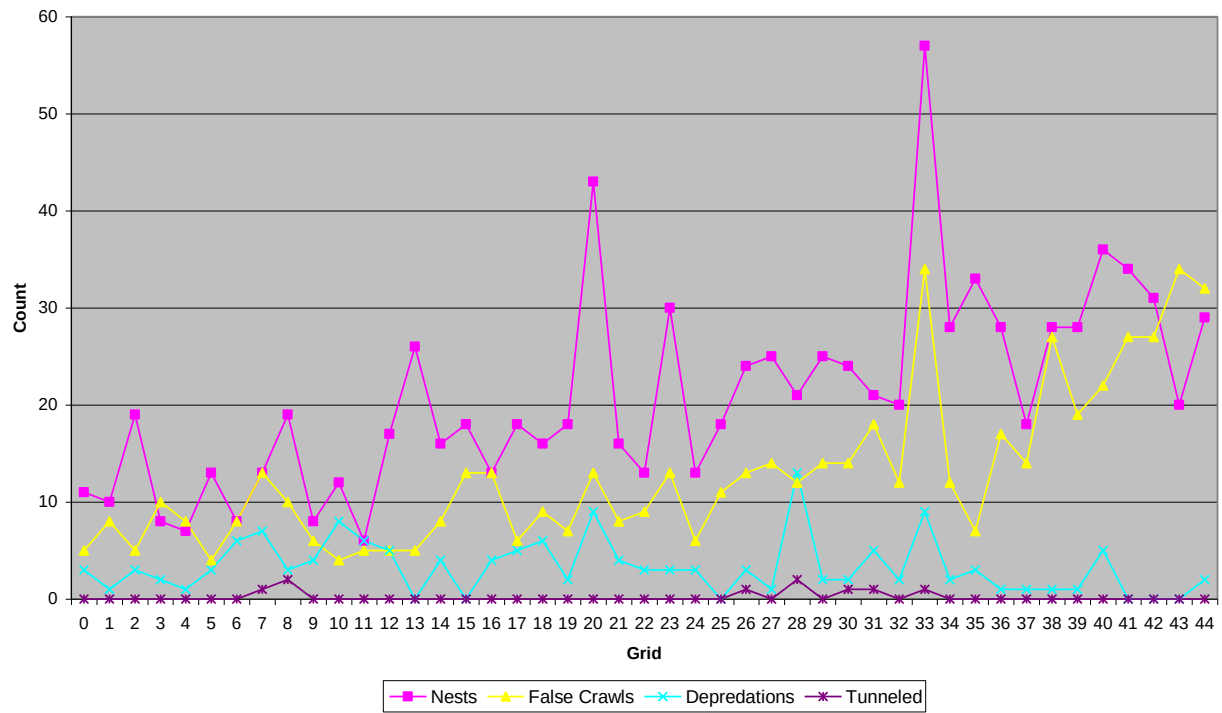


Figure 2b. Nests, False Crawls, Depredations and Tunneling Activity in grids 45 - 94, Canaveral National Seashore 2004

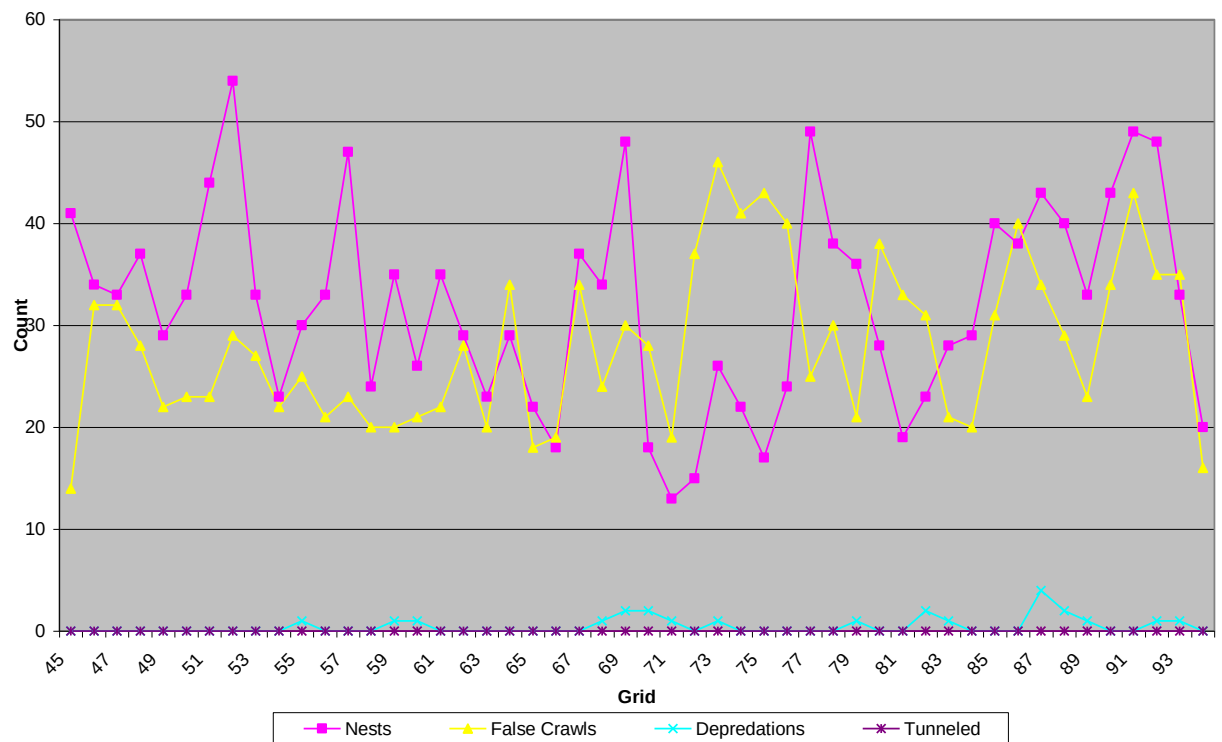


Table 2. Nest Treatment and Depredation- 2004 Canaveral National Seashore.

Initial Encounter

	Loggerhead	Green	Leatherback	Total
Not Dep/Screened	2258	255	6	2519
Partial Dep/Screened	17	0	0	17
Total Depredation	6	0	0	6
TOTAL	2281	255	6	2542

Dep=Depredation

Subsequent Depredation (G,I)

Screened Nests

	Loggerhead	Green	Leatherback	Total
North District	83	2	0	85 (9.1%)
South District	21	0	0	21 (1.3%)
Total	104	2	0	106 (4.2%)

Overall Depredation (Initial Encounter and Subsequent Depredation)

All Nests

	Loggerhead	Green	Leatherback		Total
Partial Depredation	116(5.1%)*	2 (<01%)	0		118(4.6%)
Total Depredation	11 (<01%)	0	0		11 (<01%)
Total	127 (5.6%)	2 (<01%)	0		129 (5.1%)

* Percentages in species columns are derived from total number of nests for that species

^ Percentages in Total column are derived from total number of nests for all species (2542)

By District

	Loggerhead	Green	Leatherback	Total
North District	105	2	0	107 (11.4%)*
South District	22	0	0	22 (1.4%)*
Total	127	2	0	129 (5.1%)

* Percentages are derived from total number of nests in each district

Subsequent Depredations

Slightly over four percent (106) of the screened nests were partially or totally depredated by predators that reached through the top of the screens to get the upper layers of eggs or tunneled underneath the screens (Table 2, Subsequent Depredation). The depredation rate was higher in the North District with 9.1% (85) of the screened nests depredated, versus 1.3% (21) in the South. Twenty-six (1.0%) of the nests were depredated more than once after initial screening (CANA files).

Overall Depredations

The overall depredation rate for both screened and unscreened nests and initial and subsequent depredations was 5.1%; 5.6% (127) of the loggerhead and less than 01% (2) of the green nests (Table 2, Overall Depredation, All Nests). Specifically, 11 of the loggerhead nests were totally depredated and 116 were partially depredated. Both of the green nests were partial depredations.

As in past years, the highest percentage of depredations (partial and total) occurred in the North District, where 11.4% (107) of the nests were depredated, compared to 1.4% (22) in the South District (Table 2, Overall Depredation, By District).

Hatching Success

Every twentieth loggerhead nest was marked for excavation after the incubation period to determine hatching success. Of the 125 marked loggerhead nests, 69 (55%) were excavated (Table 3). One hundred and twenty (120) of these were un-depredated and five (5) were partially depredated. Fifty-six (45%) were eroded by the storms (Table 3). None of the marked nests were totally destroyed by predators.

Hatching success was 73.2% for the un-depredated loggerhead nests and 33.6% for the two partially depredated nests. Combining the two yielded a hatching success rate of 71.9%. Average clutch size was 106.5 eggs.

A large number of nests (56 or 44.8%) were washed away by the hurricanes; however, an estimated 1220 loggerhead nests were laid in sufficient time before the storms to make it through the incubation period. Therefore, an estimated number of loggerhead hatchlings produced on CANA'S beach in 2004 can be calculated as follows:
 $(71.9\% \text{ hatchling success}) \times (106.5 \text{ eggs/clutch}) \times (1220 \text{ nests}) = 93,420 \text{ hatchlings}.$

Every green nest was marked for excavation. Since they were laid later in the season than the loggerhead nests only 10 (3.9%) of the 255 marked nests were excavated (Table 3). The other 245 were washed away by the hurricanes. Four were partially depredated by predators prior to the storms.

Average clutch size of the 10 excavated green nests was 101.8 eggs. Hatching success was 30.4% (275 hatchlings). Since so few nests had sufficient time to extend through the incubation period, an estimate was not made for total number of hatchlings for the entire beach.

Five of the six leatherback nests were excavated. Average clutch size was 74.0 eggs and hatching success was 41.1% (Table 3). One nest was of unknown fate.

Table 3: Hatching Success of Marked Nests- 2004 Canaveral National Seashore.

	Loggerhead	Green	Leatherback
Nests marked	125	255	6
Nests Excavated	69	10	5
Total Eggs	7346	1018	370
Ave. Clutch Size	106.5	101.8	74
Hatchlings Emerged	5288	309	152
Hatching Success	71.9%	30.4%	41.1%
Eroded/Washed out	56	245	1

DISCUSSION

Nesting and False Crawl Totals

The 2004 season exhibited the lowest number of sea turtle nests in 17 years (Table 4). As expected, the number of green nests increased from 2003, following the distinctive biennial up-and-down pattern noted since 1989 (Figure 3). However, the total of 255 nests was much lower than expected, based on the increasing totals in 1998, 2002 and 2002. Loggerhead numbers were the lowest recorded since 1988 (Table 4). This reduced number, plus a four year decline since 2000, has sea turtle biologists concerned about a possible negative trend. Hopefully this is just a temporary phenomena and nesting activity will increase over the next few years. The six leatherback nests were the least observed since 1998.

Loggerhead nests exceeded nests for the sixteenth time in the past 20 years, with a ratio of 1.32 nests per every false crawl (Table 5). The leatherback nest total exceeded false crawls for the fourteenth time in 15 years with a ratio of 1.24 nests per false crawl (Table 5). The green pattern continued to be less predictable than the other two species. In 2004 the ratio was 1.1 (Table 5).

Screening Activity and Nest Depredation

Ninety nine percent (3305) of the sea turtle nests deposited at CANA in 2004 were screened. Overall nest depredation dropped from 14.4% in 2002 to 5.6% in 2003 (Table 6). This was the lowest amount since 1994. The depredation rate has fluctuated between 29.9 and 5.6% since 1993, when daytime runs were implemented to detect subsequent nest depredations.

Tunneling activity, digging under the screens to reach the eggs, also decreased from 8.3% in 2002 to 4.4% in 2002 (Table 6). This too was the lowest value since 1994. The efficiency of the seasonal employees may be a key factor for the low depredation rate; all had extensive

experience with the nest screening program from prior years. Since 1985, tunneling has ranged from 18.7% in 1988 to 1.9% in 1990. The unusually high value in 1988 was almost twice that of any prior year.

Table 4: Sea Turtle Nest Totals- 1984-2004.Canaveral National Seashore.

YEAR	LOGGERHEAD	GREEN	LEATHERBACK	KEMPS	UNKNOWN	TOTAL
2004	2281	255	6			2542
2003	3229	74	16	1		3320
2002	3161	857	8			4026
2001	3257	7	10			3274
2000	3892	662	9			4563
1999	4501	5	9			4515
1998	3976	427	5			4408
1997	2702	21	4			2727
1996	3260	222	3			3485
1995	4121	47	1			4169
1994	3886	364	2			4252
1993	3140	28	0			3168
1992	3279	298	0			3577
1991	4074	25	1			4100
1990	3922	185	1			4108
1989	3091	41	1			3133
1988	2203	43	0		4	2250
1987	1670	90	1		15	1776
1986	3349	22	3			3374
1985	2389	94	0		25	2508
1984	*					2125

* = Individual breakdown not available.

Taken from yearly Sea Turtle Nesting Summaries, 1984-2004 Canaveral National Seashore
Titusville, Florida

Figure 3. Green Sea Turtle nesting totals, Canaveral National Seashore 1985-2004.

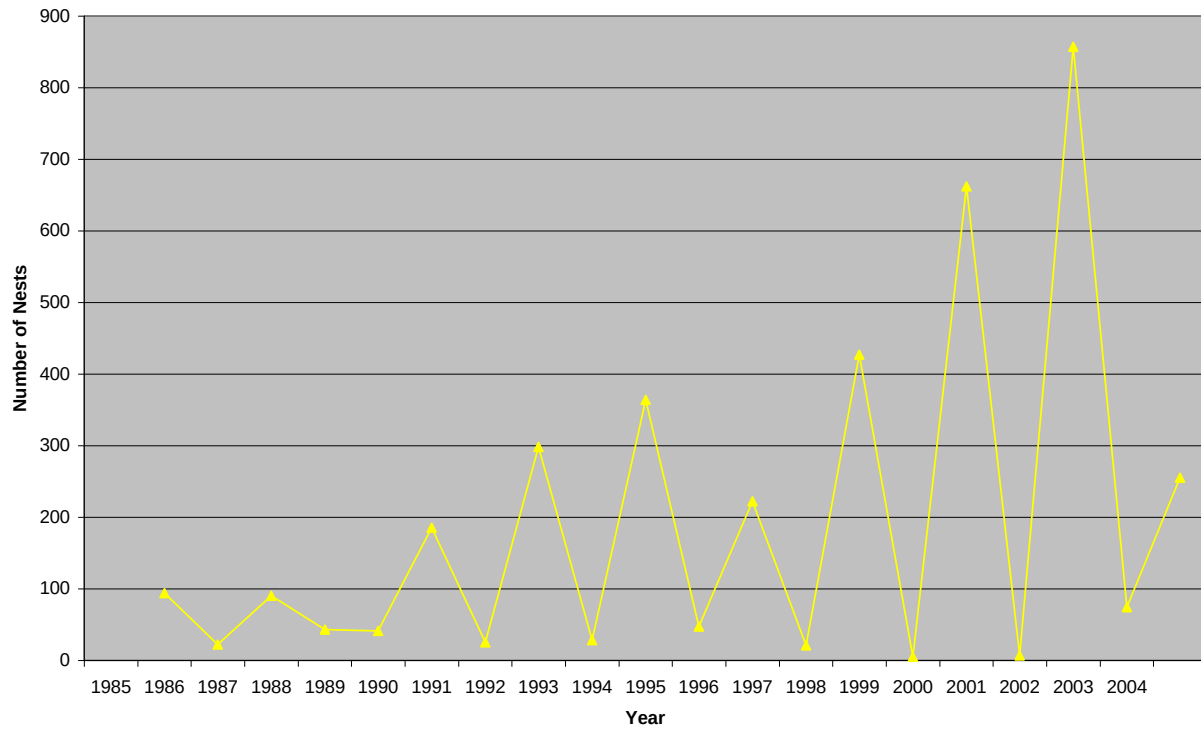


Figure 4. Loggerhead Sea Turtle nesting totals, Canaveral National Seashore 1985-2004.

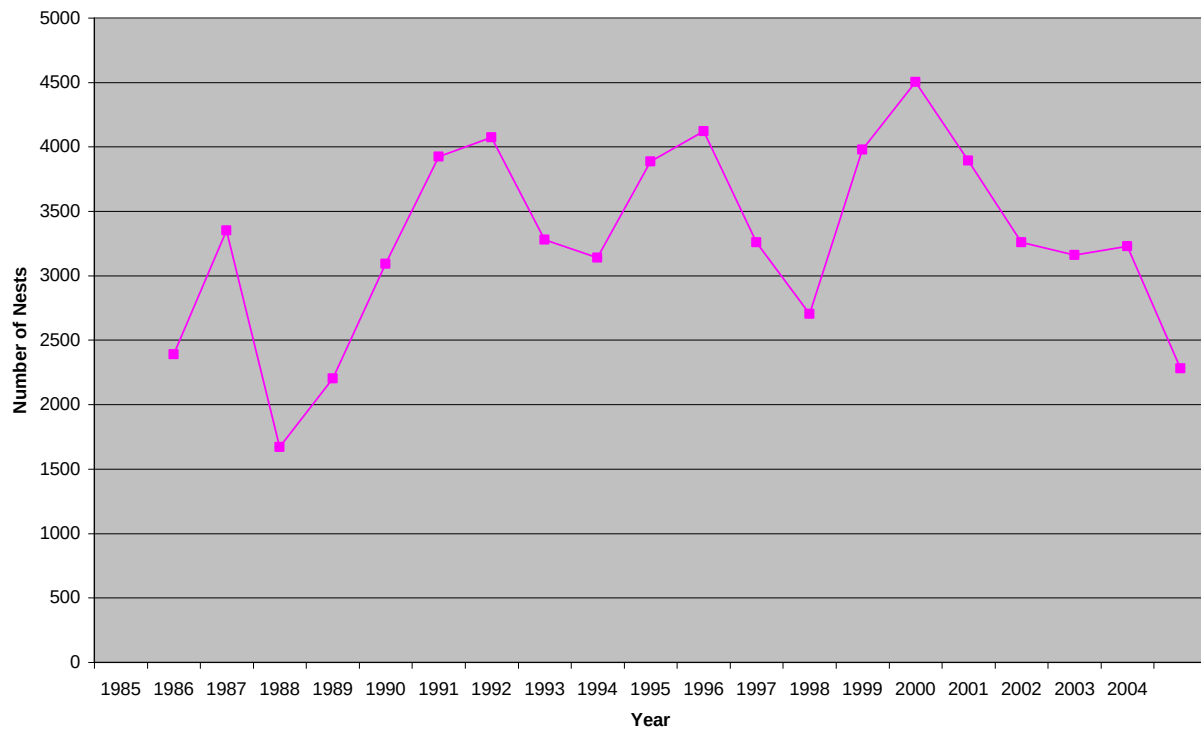


Table 5. False Crawl to Nest Ratio- 1984-2004.Canaveral National Seashore.

<u>Year</u>	<u>Loggerhead</u>	<u>Green</u>	<u>Leatherback</u>
2004	1:1.32	1:1	1:2.4
2003	1:2.21	1:1.16	1:2.66
2002	1:0.95	1:1.27	1:2.66
2001	1:1.54	1:0.70	1:5.00
2000	1:1.02	1:0.71	1:3.00
1999	1:1.20	1:0.63	1:3.00
1998	1:0.99	1:0.52	1:0.63
1997	1:1.19	1:0.72	0:4.00
1996	1:1.32	1:0.77	1:1.00
1995	1:1.36	1:1.21	0:1.00
1994	1:1.60	1:1.38	0:2.00
1993	1:1.46	1:1.87	--
1992	1:1.43	1:1.10	--
1991	1:1.10	1:1.66	0:1.00
1990	1:1.31	1:1.17	1:1.00
1989	1:1.53	1:3.00	--
1988	1:0.94	1:1.16	--
1987	1:1.02	1:0.72	0:1.00
1986	1:0.98	1:0.76	0:3.00
1985	1:1.22	1:1.02	--
1984	--	--	--

Taken from yearly Sea Turtle Nesting Summaries, 1984-2004, Canaveral National Seashore
Titusville, Florida.

Table 6. Amount of Screening and Depredation of Screened Nests- 1984-2004.
Canaveral National Seashore

YEAR	NESTS	NESTS SCREENED	SCREENED NESTS DEPREDATED (%)	ESTIMATED OVERALL DEPREDATION (%)
2004	2542	2536 (99%)	6.8	6.6
2003	3320	3307 (99%)	4.4	5.6
2002	4026	3957(98%)	8.3	14.4
2001	3274	3207 (98%)	9.9	19.9
2000	4563	4304 (94%)	7.2	23.0
1999	4515	4311 (95%)	8.2	22.2
1998	4408	4233 (96%)	7.2	19.3
1997	2727	2510 (92%)	9.6	29.9
1996	3485	3198 (92%)	5.7	19.7
1995	4169	3975 (95%)	4.8	14.8
1994	4252	1724 (41%)	4.3	18.7
1993	3168	1221 (39%)	7.6	28.6
1992	3579	2213 (62%)	4.3 *	11.6 *
1991	4100	1507 (37%)	3.3 *	13.9 *
1990	4108	1547 (38%)	1.9 *	9.2 *
1989	3132	1030 (33%)	3.4	17.5
1988	2250	887 (39%)	18.7	64.1
1987	1776	766 (43%)	7.2	58.7
1986	3374	1517 (45%)	3.7	47.3
1985	2508	1023 (41%)	5.0	41.7
1984	2125	213 (19%)	----	65.0

* Daytime runs to check secondary nest depredation were not conducted on a regular basis.

Table 7. Comparison of Hatching Success With Previous Years- 1996-2004.
Canaveral National Seashore

	Loggerhead	Green	Kemps	Leatherback
2004	72%	30% (N/A)	-	41% (N/A)
2003	71% (N/A)	59% (N/A)	95% (N/A)	61% (N/A)
2002	57% (55%)	60%(N/A)	-	43% (N/A)
2001	64% (62%)	-	-	31.5% (N/A)
2000	61% (56%)	56% (N/A)	-	38% (N/A)
1999	62% (53%)	64% (55%)	-	29% (N/A)
1998	64% (62%)	71% (N/A)	-	56% (42%)
1997	55% (49%)	51% (N/A)	-	23% (N/A)
1996	59% (53%)	65% (N/A)	-	27% (N/A)

() Percentages in parentheses are adjusted hatching rates, adding in average clutch size for totally depredated nests.

Weather and Tidal Influences

The 2004 season will not be soon forgotten. Four hurricanes battered central Florida, starting with Charley on August 13. Since Charley came from the southwest, there was no storm surge to erode or inundate nests; however, it did bring heavy rain. Hurricane Frances was a different story, coming from the east on September 5. It made landfall about 100 miles south of CANA, causing extremely high tides, heavy rain and removing three to four feet of sand from the beach. Of the approximately 1276 (1058 loggerhead and 218 green) nests on the beach when Frances hit, only 243 (140 loggerhead, 83 green and 20 unknowns) could be located afterwards. Hurricane Ivan, while not nearly as strong, brought more rain on September 12. On September 25, Hurricane Jeanne, making landfall in almost the identical spot as Frances, applied the final blow. Surveys after Jeanne found no remaining nests.

In the interval between Frances and Jeanne, 33 additional nests were deposited, 30 green and 3 loggerhead. None of these appear to have survived Jeanne.

While over half of the loggerhead nests made it through the incubation period before the hurricanes hit, only a hand full of the green nests (less than 10) had been on the beach for 60 days or more. Compounding the problem, green nesting activity had been delayed by unusually cold ocean temperatures in mid-summer. In a normal year, a greater percentage of green nests would have hatched by early September when Hurricane Frances hit. As a result, while loggerhead hatching success was 72% (the highest recorded at CANA since 1996), green success was only 30% (the lowest recorded at CANA since 1996) (Table 7).

Leatherback hatching success for the five nests evaluated was 41% (Table 7). While lower than last year, it was above five of the previous eight years.

While searching for surviving sea turtle nests after hurricane Frances, the carcasses of 348 Cory's shearwaters were counted along CANA'S 24 miles of beach. Oddly, hardly any brown pelicans, gulls or terns were noted. Presumably the latter species were able to obtain shelter while the shearwaters, being an open ocean species, sustained the full fury of the wind and rain.

Genetic Analysis of Nesting Loggerheads

For the second consecutive year, Kimberly Reich, of the University of Florida, collected skin and scute samples from 50 nesting loggerhead sea turtles in the northern half of the park. She was assisted by CANA Student Conservation Association (SCA) interns. Skin samples are currently being analyzed for stable isotopes and mtDNA sequences and scute samples are being analyzed for stable isotopes. The purpose is to help determine what foraging areas are contributing CANA's breeding loggerheads and if, as suspected, CANA lies along the boundary of two distinct loggerhead sub-populations.

ACKNOWLEDGEMENTS

Canaveral National Seashore's sea turtle nest screening program would not be possible without the effort of many dedicated people. The seasonal employees, Kristin Kniefl, Michael Daley and Sean McKenna, patrolled the beach each night, dealing with high humidity, bothersome insects and unexpected obstacles, but always accomplished the task. The four Student Conservation Association (SCA) resource assistants--Kristin Harrison, Tracy Hamm, Nick Osman, and Marc Roush--provided regular depredation patrols and maintained the large database. John Stiner, Kristin Harrison, and Tracy Hamm analyzed data and wrote the final report. And then there were the many volunteers who sacrificed sleep and comforts to support the cause of sea turtle preservation. Thanks to you all.

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