

1996 MARINE TURTLE NESTING SUMMARY CANAVERAL NATIONAL SEASHORE

INTRODUCTION

Between 3,000 and 4,000 sea turtle nests are deposited at Canaveral National Seashore (CANA) each year. These are primarily loggerhead (Caretta caretta), with a lesser number of green (Chelonia mydas) and an occasional leatherback (Dermochelys coriacea) nest.

Nest depredation is a serious threat to sea turtle nests at CANA. In the early 1980's, over 90 percent of the nests were being depredated, primarily by raccoons (Procyon lotor) (McMurtray 1986). To protect the nests, while allowing the raccoon to remain as an important part of the seashore ecosystem, the park implemented a nest screening program in 1984.

In the summers of 1993 and 1994, the University of Georgia (UGA) compared three methods of nest protection - nest screening, predator removal and conditioned-taste-aversion (Ratnaswamy 1995; Warren 1996). Nest screening was found to be the most effective protection strategy of the three, as well as the method most compatible with the National Park Service mandate to maintain and enhance natural ecosystems. Therefore, CANA will continue the nest screening program, while striving to exceed the 60 percent hatching rate targeted in the recovery plans for the loggerhead and green sea turtles (NMFS and USFWS 1991).

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 11.25 miles of beach is situated in Volusia County and the southern 12 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 the beach 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 May 7, the park initiated patrols on four-wheeled all-terrain vehicles (ATV's) to record sea turtle emergences (nests and false crawls) and to screen nests. The 24 miles of beach was divided into two 12 mile segments, each covered by a team consisting of a ranger and a volunteer. The 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 03 (South District) and August 08 (North District), 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 (undepredated, 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

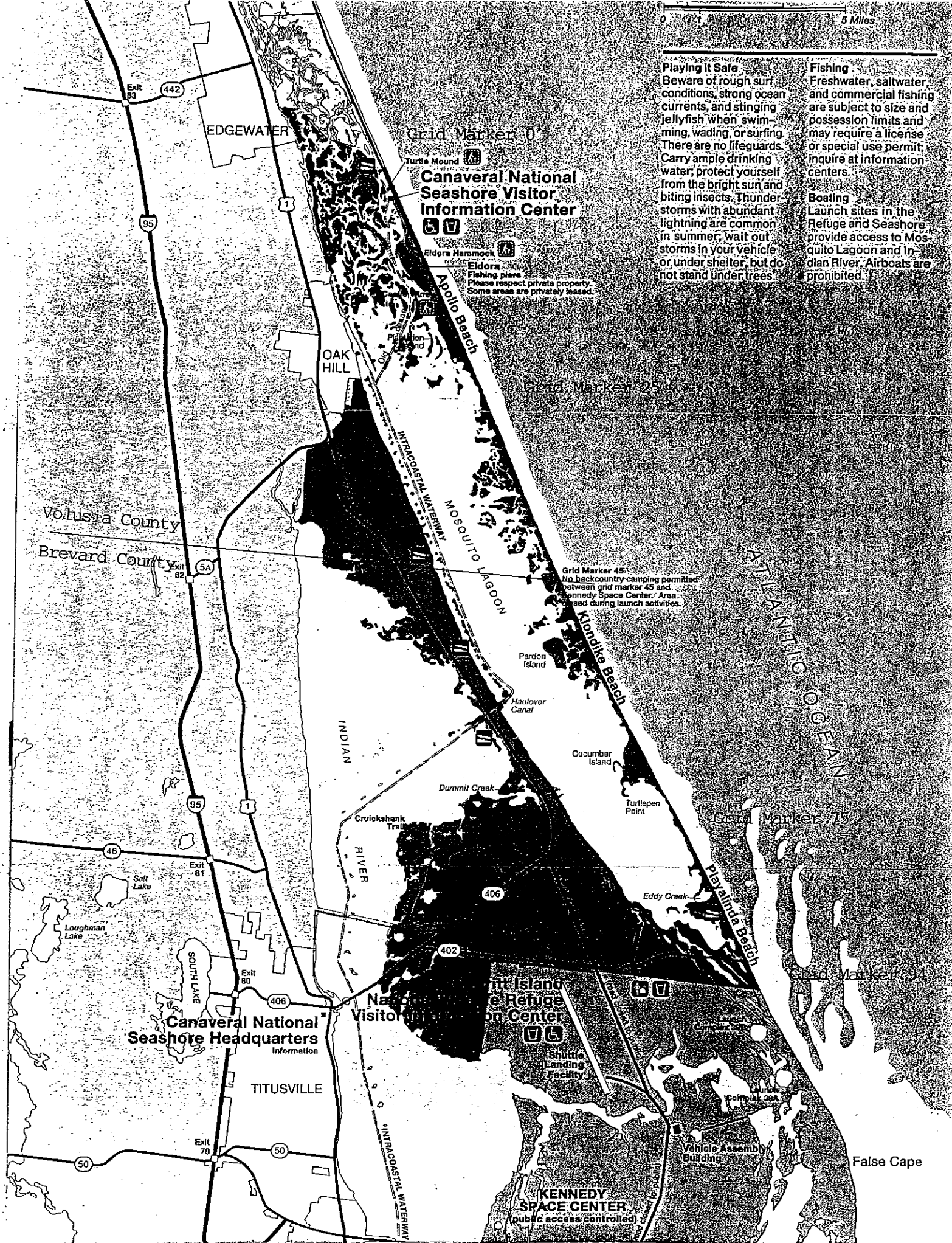


Figure 1. Canaveral National Seashore (dark gray)

large enough to allow hatchlings to emerge while discouraging raccoon attempts 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, the number of depredated eggs counted and all broken eggs removed from the beach. The latter was done to deter raccoons from easily relocating any remaining eggs and to prevent counting depredations more than once. If a significant number of viable eggs remained, the nest was cleaned and covered with clean sand.

The stake for every tenth nest was marked with white spray paint for easy identification. After a minimum of 65 days or evidence of hatching the nests were excavated and the following information recorded: number of hatchlings emerged (empty eggshells), number of unhatched eggs, number of live hatchlings in nest, number of dead hatchlings in nest and number of 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.

Nests were relocated, if time permitted, for one of two 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. 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 had learned to tunnel under the screens or that repeatedly depredated unscreened nests. All raccoons were captured using Tomahawk live-traps.

RESULTS

Nesting and False Crawl Totals

A total of 3485 sea turtle nests were deposited at CANA in 1996 - 3260 loggerhead, 222 green and three leatherback (Table 1). Overall nest density was 86.9 per kilometer for the loggerhead and 5.9 per kilometer for the green.

The total number of loggerhead false crawls was 2470 or 65.9 per kilometer, a false crawl to nest ratio of 1:1.32 (Table 1). There were 288 green false crawls or 7.7 per kilometer, a false crawl to nest ratio of 1:0.77.

As in former years, the greatest concentration of nesting was noted in the southern half of CANA with 59% (2044) of the nests occurring in the South District (Brevard County) and 41% (1441) in the North District (Volusia County) (Table 1). Nesting densities were 105.6/km and 79.4/km respectively.

Grids 87-92 in the southernmost three miles of the park exhibited six of the eight highest nesting totals, ranging from 57 to 75 nests per grid (Figures 2a and 2b). The false crawl total was highest in grid 86 with 91. The next highest false crawl totals were 59 in grid 85 and 56 in grid 87.

Initial Sighting and Nests Screened

In 1996, 92 percent (3198) of the 3485 nests deposited at CANA were screened, comprising 2960 undepredated and 238 partially depredated nests (Table 2, Initial Encounter). This included three leatherback, 206 green and 2989 loggerhead nests.

Eight percent (256) of the loggerhead nests were totally depredated and seven percent (227) were partially depredated prior to discovery (Table 2, Initial Encounter). An additional 15 (<01%) loggerhead nests were found a day or more after deposition; 13 were undisturbed and two were partially depredated.

Of the 222 green sea turtle nests, three (01%) were totally depredated and 11 (05%) were partially depredated prior to discovery (Table 2, Initial Encounter). Thirteen green nests were discovered fully intact a day or more after deposition. None of the three leatherback nests was depredated.

Table 1. 1996 MARINE TURTLE CRAWL SURVEY

OVERALL

	LOGGERHEAD	GREEN	LEATHERBACK	TOTAL
Nests	3260	222	3	3485
False Crawls	2470	288	3	2761
Nest Density	86.9/km	5.9/km	-	92.9/km
FC Density	65.9/km	7.7/km	-	73.6/km
FC to Nest Ratio	1:1.32	1:0.77	-	1:1.26

DISTRIBUTION BY DISTRICT

North District (Volusia County)

	LOGGERHEAD	GREEN	LEATHERBACK	TOTAL
Nests	1352	89	0	1441
False Crawls	945	78	0	1023
Nest Density	74.5/km	4.9/km	-	79.4/km
FC Density	52.1/km	4.3/km	-	56.4/km
FC to Nest Ratio	1:1.43	1:1.14	-	1:1.41

South District (Brevard County)

	LOGGERHEAD	GREEN	LEATHERBACK	TOTAL
Nests	1908	133	3	2044
False Crawls	1525	210	3	1738
Nest Density	98.6/km	6.9/km	0.2 km	105.6/km
FC Density	78.8/km	10.9/km	0.2 km	89.8/km
FC to Nest Ratio	1:1.25	1:1.06	1:1.0	1:1.18

Figure 2a.
Nests, False Crawls Depredations and Tunneling Activity, Grids 0-44
(South District). 1996

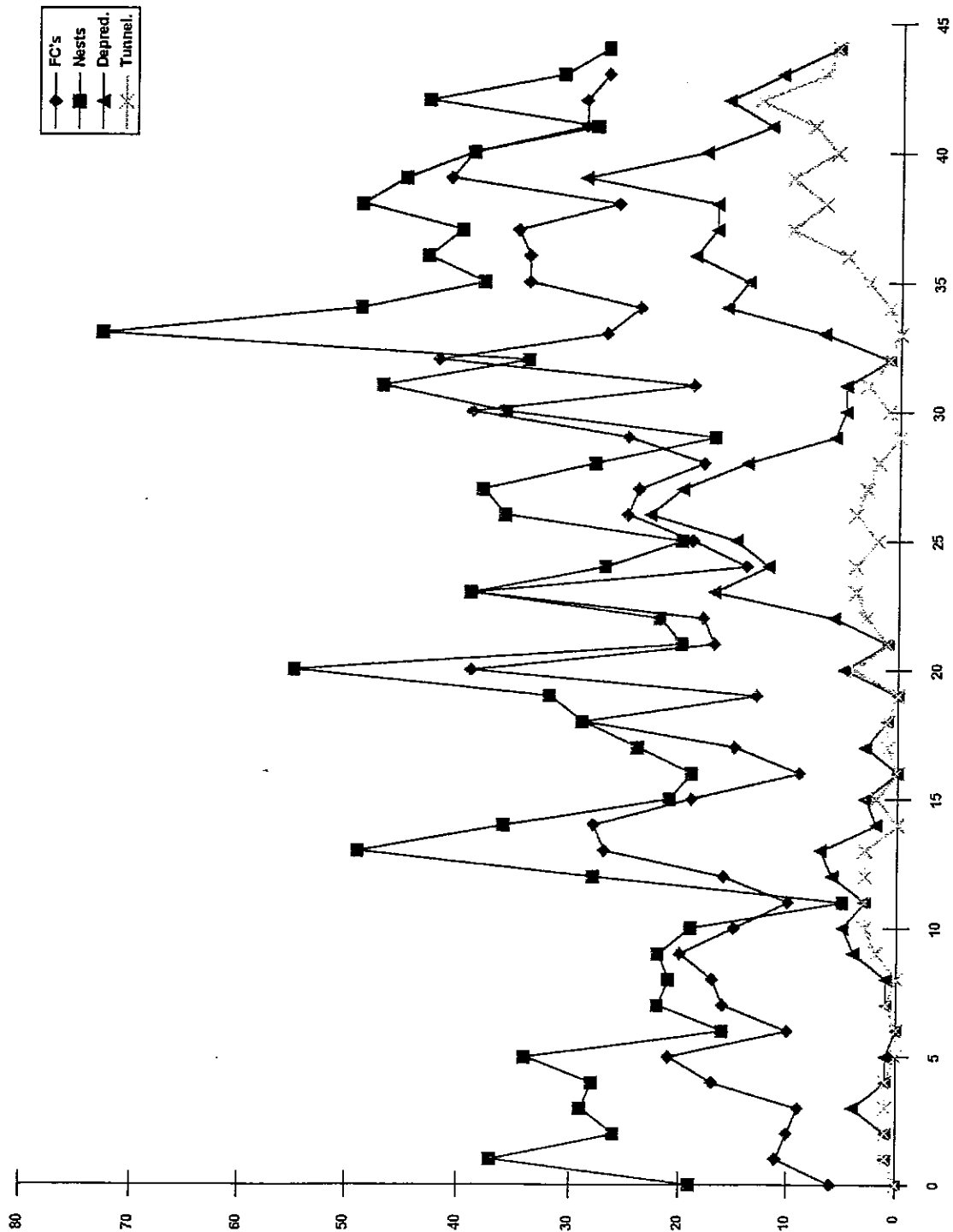


Figure 2b.
 Nests, False Crawls Depredations and tunneling Activity, Grids 45-94
 (South District). 1996

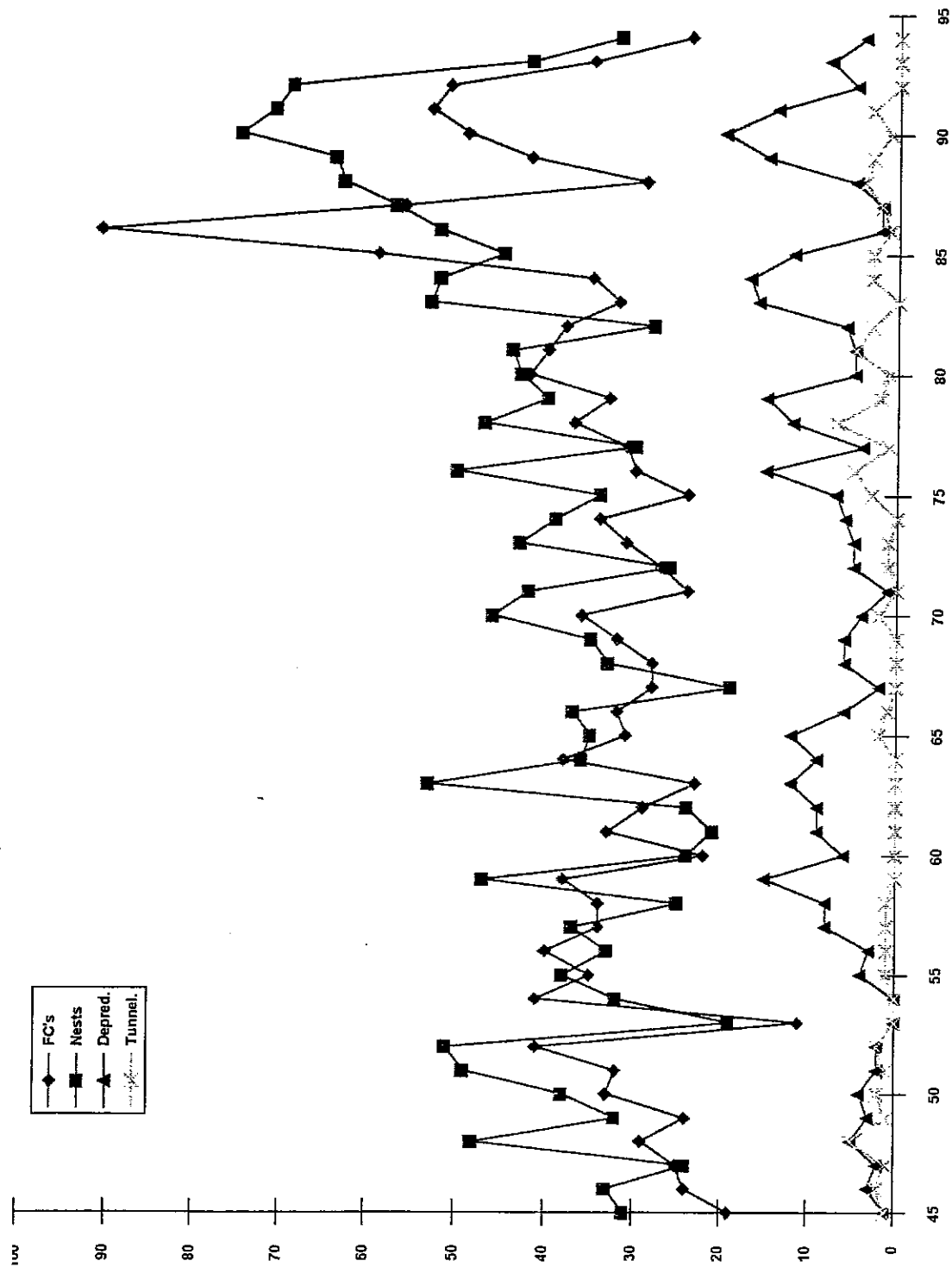


Table 2. 1996 NEST TREATMENT AND DEPREDACTION

INITIAL ENCOUNTER

	Loggerhead	Green	Leatherback	Total
Not Dep/screened	2762 (85%)	195 (88%)	3	2960 (85%)
Part Dep/screened	227 (07%)	11 (05%)	0	238 (07%)
Total Depredation	256 (08%)	3 (01%)	0	259 (07%)
Not Dep/not screened	13 (<01%)	13 (06%)	0	26 (<01%)
Part Dep/Not screened	2 (<01)	0	0	2 (<01%)
TOTAL	3260	222	3	3485

Part = Partial Dep = Depredation

SUBSEQUENT DEPREDACTION

Screened Nests (Tunneling)

North District	119	1	-	122 (10%)
South District	60	5	0	65 (03%)
TOTAL	179	6	0	185 (06%)

Unscreened Nests (28)

North & South District	0	1	0	1 (04%)
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OVERALL DEPREDACTION (ALL NESTS)

North District	333	10	-	343 (24%)
South District	331	10	0	341 (17%)
TOTAL	664	20	-	684 (20%)

Partial Versus Total

Partial Depredation	298 (09%)	15 (07%)	0	313 (09%)
Total Depredation	366 (11%)	5 (02%)	0	371 (11%)
TOTAL	664 (20%)	20 (09%)	0	684 (20%)

Subsequent Depredations

Six percent (185) of the screened nests were depredated by raccoons that had learned to tunnel underneath the screens (Table 2, Subsequent Depredation). Tunneling was significantly higher in the North District, with 10 percent (121) of the screened nests being depredated versus three percent (64) in the South District. Of the 28 unscreened nests discovered a day or more after deposition, none were depredated.

Only 21 nests were recorded as being depredated more than once (CANA files). This indicates that the effort to clean up and screen partially depredated nests does protect remaining eggs and if the clutch has not been fouled too badly by broken eggs may allow some to hatch.

Overall, including both initial and subsequent depredations, 664 (20%) of the loggerhead and 21 (09%) of the green nests were either partially or totally depredated during the 1996 season (Table 2, Overall Depredation). Specifically, 11 percent (366) of the loggerhead nests were totally depredated and nine percent (298) were partially depredated, while two percent (5) of the green nests were totally depredated and seven percent (15) were partially depredated.

As in past years, the majority of depredations occurred in the North District, where 24% (343) nests were depredated compared to 17% (341) in the South District (Table 2, Overall Depredation).

A total of seven problem raccoons were removed from the beach during the nesting season.

Monitored Nests

Every tenth nest was marked excavation after the incubation period to determine hatching success. Of the 342 marked loggerhead nests, 291 (nine percent of the total number deposited) were excavated (Table 3). Thirty seven marked nests were not relocated and 14 others were so severely depredated that an egg count could not be made. Twenty three percent (67) of the marked loggerhead nests were depredated (14 percent partially and nine percent totally).

Average clutch size for the 291 excavated loggerhead nests was 110.5 eggs/clutch (Table 3). Hatching success for the total number of eggs counted (including depredated eggs) was 57.5 percent.

Table 3. HATCHING SUCCESS OF MARKED NESTS

	Loggerhead	Green	Leatherback
Nests Marked	342	15	3
Nests Excavated	291	43	3
Total Eggs	31,154	5,472	256
Ave. Clutch Size	110.5	124.4	85.3
Hatchlings Emerged	17,914	3,376	70
Hatching Success	58.6%	64.5%	27.3%
Nests Partially	40 (14%)	4 (09%)	0
Nests Destroyed	27 (09%)	0	0
Unknown Fate	37 (11%)	3 (07%)	0

DISCUSSION

A two year study by the University of Georgia, comparing three nest protection strategies at CANA, confirmed that nest screening was most effective and compatible with the NPS mandate to maintain natural ecosystems (Ratnaswamy 1995; Warren 1996). In 1996, CANA obtained base funding to support the sea turtle nest screening program. This will enable the park to provide nest protection on a long-term basis while allowing the raccoon to remain as a vital component of the seashore ecosystem.

Prior to the 1995 nesting season, CANA established a goal to screen as many nests as possible. The largest previous amount screened was 62 percent in 1992 (Table 4). There was some concern that this might prove too great a task; however, in 1995 and 1996, 95 and 92 percent of the nests were screened, respectively. It is inevitable that a certain amount of nests will be destroyed by predators before they can be located. However, the results of the past two years demonstrate that a well trained staff with adequate equipment can protect a significant percentage of nests, even in years with large nest numbers, such as 1995.

Comparison to Former Years

The number of loggerhead nests drop from a record high of 4121 in 1995 to 3260 in 1996, a decline of 21 percent (Table 5). On the other hand, green sea turtle nesting increased from 47 in 1995 to 222 in 1996, an increase of 470 percent, and the third highest nesting total recorded since 1985. If the pattern of alternating high and low numbers continues for the green turtle, as exhibited in Table 4, green nesting totals should drop significantly in 1997. The three leatherback nests equaled a previous high observed in 1986.

The false crawl to nest ratio for the loggerhead sea turtle was 1:1.32, very similar to the 1:1.36 noted in 1995 (Table 6). The green false crawl to nest ratio, showed a relative increase in false crawls with a value of 1:0.77 in 1996 compared to 1:1.21 in 1995.

Twelve of the 15 green sea turtle nests marked for excavation were evaluated; the remaining three were of unknown fate (Table 3). Two of the twelve nests were partially depredated. Average clutch size for the excavated nests was 115.2 eggs and hatching success was 61.1 percent.

Thirty one additional green nests, not originally marked for evaluation, were excavated. When these numbers are added to those of the 12 marked nests, the totals are 3,376 hatched eggs out of a total of 5,472, for an average clutch size of 124.4 eggs and a hatching success of 64.5 percent. Four (nine percent) of the 43 nests were partially depredated.

All three of the leatherback nests were excavated. Clutch sizes were 72, 79 and 105 eggs, with an average of 85.3 eggs/clutch (Table 3.) Of the 256 eggs laid, 70 hatched for a hatching success of 27.3 percent. None of the leatherback nests were depredated.

An estimated number of loggerhead hatchlings was calculated, based on the hatching success of marked nests. This was done as follows:

$(57.5\% \text{ hatchling success}) \times (110.5 \text{ eggs/clutch}) \times (3260 \text{ nests}) = 207.132 \text{ hatchlings.}$

For the green sea turtle, an estimated number of hatchlings was calculated as follows:

$(61.1\% \text{ hatchling success}) \times (115.2 \text{ eggs/clutch}) \times (222 \text{ nests}) = 15,626 \text{ hatchlings.}$

Table 4. AMOUNT OF SCREENING AND DEPREDACTION OF SCREENED NESTS.

1984 - 1996

YEAR	NESTS	NESTS SCREENED	SCREENED NESTS DEPREDATED (%)	ESTIMATED OVERALL DEPREDACTION (%)
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 5. TURTLE NESTING AT CANAVERAL NATIONAL SEASHORE. 1984-1995.

Y EAR	LOGGERHEAD	GREEN	LEATHERBACK	UNKNOWN	TOTAL
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.

Table 6. False Crawl to Nest Ratio

1984 - 1996

Year	Loggerhead	Green	Overall
1996	1:1.32	1:0.77	1:1.26
1995	1:1.36	1:1.21	1:1.36
1994	1:1.60	1:1.38	1:1.58
1993	1:1.46	1:1.87	1:1.46
1992	1:1.43	1:1.10	1:1.39
1991	1:1.10	1:1.66	1:1.10
1990	1:1.31	1:1.17	1:1.30
1989	1:1.53	1:3.00	1:1.55
1988	1:0.94	1:1.16	1:0.94
1987	1:1.02	1:0.72	1:1.015
1986	1:0.98	1:0.76	1:0.97
1985	1:1.22	1:1.02	1:1.20
1984	--	--	1:1.24

The overall depredation rate was 19.7 percent, exceeding the 1995 and 1994 totals of 14.8 and 18.7 percent, respectively; but lower than the 1993 figure of 28.6 percent (Table 4). Percentage of screened nests depredated (5.7 percent) was also above 1995 and 1994 values (4.8 and 4.3 percent, respectively), but less than 1993 (7.6 percent).

The overall depredation rate for any given year is influenced by several factors - size of the raccoon population; number of experienced raccoons in the population who have learned to dig up sea turtle eggs and to tunnel under screens; experience of the screening crews; number of South District beach closures due to NASA space shuttle activities; and number of high tides or storm events that prohibit beach patrols and remove protective sand from the nests. Screening efforts in 1996 were hampered by several high tide events and hurricane warnings, which prevented beach patrols and exposed nests, in mid-July, late August and early September.

In 1996, 57.5 percent of the loggerhead and 61.1% of the green sea turtle eggs counted in marked nests hatched. This compares to 70 and 72 percent respectively in 1995 and 70 and 81 percent in 1994 (CNS 1994; 1995). One probable reason for the lower hatching totals in 1996 is several high tide events that inundated nests for extended periods. These tides were due to the influence of several storm events along Florida's coast. The National Weather Service categorized the year 1996 as an extremely active year for hurricanes and tropical depressions in the Western Atlantic.

Another notable event in 1996 was an upwelling of cold water along the coast between July 26 - August 5. Water temperatures dropped to between 57 and 64 degrees Fahrenheit and were actually lower than temperatures along the coast of Maine during the same period. A sharp drop in nesting activity on CANA's beach was observed during this period.

Beyond having a major impact upon depredation rate, the park has little control over hatching success. Weather and tide related factors, which are beyond man's control, have a major influence on hatching success and will cause it to fluctuate from year to year. The park's objective is to do what it can each year, within the constraints of its mission, to protect threatened and endangered sea turtles on its beaches. The rest must be left to nature.

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