Levels of Green Turtle (*Chelonia mydas*)Hatchling Mortality Due to Entrapment in Vegetation and Seabird Burrows on East Island, French Frigate Shoals

Kimberly K. Berger

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OBJECTIVES

The main objective of this study was to determine the effect of vegetation and seabird burrows on the level of green turtle hatchling mortality at East Island, FFS. This was determined through several transections of the island. Random quadrates along the transections were studied for percent cover of vegetation, species of vegetation and relative abundance of each, the number of active and inactive seabird burrows, and the number of dead and/or trapped hatchlings found within each.

MATERIALS AND METHODS

MATERIALS:

1 50 meter measuring tape
2 8 meter long rope (for measuring quadrates)
compass
camera

To begin the study, the length of the island was measured from the SE to the NW point by running a meter tape the length of the island down the center. Based on this measurement, the length of the island was divided up into 15 equal sections, each transect being 30 meters apart. Thirteen transections were completed, due to the fact that the first and last sections were on the beach at each end of the island rather than on the berm (see figure 1). The first transect was started at the 30 meter mark. The tape was run the width of the island from the berm on the south side to the berm on the north side. A compass bearing was taken prior to laying the tape down to assure that the transect ran at a 30 degree angle. The next 12 transections occurred at each 30 meter increment along the length of the island (SE to NW) with a compass bearing again taken for each to assure that each transect was placed at a 30 degree angle. Along each transect a 2 m by 2 m quadrate was measured out every 15 m with each 15 m increment being the center of the quadrate. Along the transect the first quadrate was placed at the 0 m mark, the second at the 15 m mark, the third at the 30 m mark. In some cases, where the island was wider, a fourth quadrate was placed at the 45 m mark, and if feasible a fifth at the 60 m mark as well.

In each quadrate, the percent cover of vegetation was determined by examining and estimating the amount of ground covered by all species of plants. Next, within each quadrate the relative abundance of each species of plant and type of substrate was determined by first identifying each plant or substrate and then estimating how much of the percent cover that specific species contributed. Thirdly, seabird burrows were counted within each quadrate, separated into either active or inactive status. Inactive burrows were ones in which no bird was found, or traces of fresh feathers signifying that the burrow was currently occupied. Thus, active burrows were classified by fullfilling one or both of these conditions. These combined determined the total burrow density. Next, all inactive burrows were searched by reaching in

and pulling out the contents of the burrow (being careful not to collapse the burrow in the process), recording the number of hatchlings found. All active seabird burrows were looked into only and any hatchlings seen were recorded (as reaching in would disturb the birds). Lastly, the entire quadrate was searched for trapped and/or dead hatchlings in the vegetation and the number found recorded. Any live hatchlings found during the study were to be released on the beach immediately following the conclusion of the transect.

As a final measurement, the area of the island covered with vegetation was estimated. This was done to calculate roughly what portion of the island covered with vegetation was searched. Photographs were then taken to show the abundance of vegetation at the time the study was completed.

DATA

TABLE 1-EAST ISLAND ESTIMATED TOTAL AREA

MEASUREMENT	LENGTH	AVERAGE WIDTH	ESTIMATED AREA
entire island	430 meters	60 meters	25800 square meters
vegetation only	380 meters	40 meters	15200 square meters

TABLE 2-AREA SEARCHED ON EAST ISLAND

AREA MEASURED (EACH QUADRATE)	# OF QUADRATES SEARCHED	TOTAL AREA SEARCHED	% OF TOTAL AREA SEARCHED	TOTAL # OF QUADRATES IN VEGETATION	TOTAL AREA IN VEGETATION SEARCHED	% OF AREA IN VEGETATION SEARCHED
4 square meters	49	196 square meters	0.75	40	160 square meters	1.05

TABLE 3-EAST ISLAND STUDY; IDENTIFIED PLANTS AND SUBSTRATES FOUND WITHIN QUADRATES

ASSIGNED NUMBER	PLANT SPECIES AND SUBSTRATES
1	soil
2	coral sand
3	coral gravel
4	coral rubble
5	*Setaria verticillata*
6	*Portulaca lutea*
7	*Boerhavia repens*
8	*Tribulus cistoides*
9	*Eleusine indica*
10	*Sonchus oleraceus*
11	*Chenopodium oahuense*
12	*Malva parviflora*
13	*Lepturus repens var. repens*
14	*Chenopodium murale*
15	*Cyndon dactylon*
16	*Heliotropium curassavicum*

Table 3 lists the numbers which were given to plant species and substrates to save space on the field data sheet. The numbers correlate with table 4 as the substrate/ plant species #. Relative abundance for these plant species was calculated as the percent that particular plant species contributed to the total percent coverage of the quadrate. Relative abundance for the substrate is the percent of the quadrate that was covered by that particular substrate and is not included in the percent cover of vegetation.

TABLE 4-TRANSECT STUDY DATA

TRANSECT #	QUADRATE #	METER MARK #	% COVER OF VEGETATION	SUBSTRATE/PLANT SPECIES (#)/ RELATIVE ABUNDANCE # %	# OF ACTIVE BURROWS	# OF INACTIVE BURROWS	# OF LIVE HATCHLINGS IN BURROWS	# OF DEAD HATCHLINGS IN BURROWS	# OF LIVE HATCHLINGS IN VEGETATION	# OF DEAD HATCHLINGS IN VEGETATION	TOTAL NUMBER OF HATCHLINGS FOUND
1	1	0 M	0	4-100%	0	0	0	0	0	0	0
1	2	15 M	15	3-85%, 7-5%, 13-10%	0	0	0	0	0	0	0
2	1	0 M	0	2-100%	0	0	0	0	0	0	0
2	2	15 M	90	4-10%, 5-2%, 6-8%, 12-80%	0	0	0	0	0	0	0
2	3	30 M	60	3-40%, 5-25%, 6-10%, 10-20%, 12-5%	0	0	0	0	0	0	0
3	1	0 M	0	2-50%, 4-50%	0	0	0	0	0	0	0
3	2	15 M	75	2-5%, 4-20%, 5-20%, 6-4%, 12-50%, 14-1%	0	0	0	0	0	0	0
3	3	30 M	90	3-10%, 5-5%, 6-75%, 7-5%, 12-2%, 13-1%, 15-1%, 16-1%	0	0	0	0	0	0	0
3	4	45 M	85	4-15%, 5-25%, 7-15%, 8-40%, 12-5%	0	0	0	0	0	0	0
4	1	0 M	0	2-50%, 4-50%	0	0	0	0	0	0	0
4	2	15 M	40	2-30%, 4-30%, 5-7%, 6-1%, 7-1%, 10-1%, 13-30%	0	0	0	0	0	0	0
4	3	30 M	90	2-10%, 5-70%, 6-10%, 7-8%, 15-2%	0	0	0	0	0	0	0
4	4	45 M	99	4-1%, 5-1%, 7-18%, 8-60%, 13-20%	0	0	0	0	0	0	0
5	1	0 M	0	2-50%, 4-50%	0	0	0	0	0	0	0
5	2	15 M	30	2-50%, 4-20%, 5-1%, 6-1%, 7-1%, 12-2%, 13-25%	0	0	0	0	0	0	0
5	3	30 M	85	2-10%, 4-5%, 5-70%, 7-15%	0	0	0	0	0	1	1
5	4	45 M	95	4-5%, 5-50%, 6-25%, 12-15%, 13-5%	0	0	0	0	0	0	0
6	1	0 M	0	4-100%	0	0	0	0	0	0	0
6	2	15 M	2	2-20%, 3-50%, 4-10%, 5-2%, 12-1%, 13-17%	0	0	0	0	0	0	0
6	3	30 M	75	2-20%, 4-5%, 5-65%, 7-6%, 12-2%, 13-2%	0	0	0	0	0	0	0

TABLE 4- TRANSECT STUDY DATA (CONTINUED)

TRANSECT #	QUADRANT #	METER MARK #	% COVER OF VEGETATION	SUBSTRATE/ PLANT SPECIES (#)/ RELATIVE ABUNDANCE	# OF ACTIVE BURROWS	# OF INACTIVE BURROWS	# OF LIVE HATCHLINGS IN BURROWS	# OF DEAD HATCHLINGS IN BURROWS	# OF LIVE HATCHLINGS IN VEGETATION	# OF DEAD HATCHLINGS IN VEGETATION	TOTAL # OF HATCHLINGS FOUND
6	4	45 M	60	2-30%, 4-10%, 5-4%, 6-55%, 10-2%, 13-1%	0	0	0	0	0	0	0
7	1	0 M	0	4-100%	0	0	0	0	0	0	0
7	2	15 M	50	2-15%, 4-35%, 6-10%, 12-40%	0	0	0	0	0	0	0
7	3	30 M	80	3-20%, 5-50%, 10-1%, 12-29%	0	0	0	0	0	0	0
7	4	45 M	75	3-15%, 4-10%, 5-5%, 12-70%	0	0	0	0	0	0	0
8	1	0 M	0	4-100%	0	0	0	0	0	0	0
8	2	15 M	60	3-15%, 4-25%, 6-17%, 7-1%, 10-2%, 12-40%	0	0	0	0	0	0	0
8	3	30 M	50	2-25%, 4-25%, 5-19%, 6-1%, 12-30%	0	0	0	0	0	2	2
8	4	45 M	75	2-20%, 3-5%, 5-4%, 11-5%, 12-20%, 13-20%, 14-1%, 15-5%	1	1	0	1	0	0	1
9	1	0 M	0	2-100%	0	0	0	0	0	0	0
9	2	15 M	24	1-50%, 3-26%, 5-4%, 6-6%, 12-10%, 14-2%, 15-2%	0	0	0	0	0	0	0
9	3	30 M	85	3-15%, 7-1%, 12-77%, 14-5%, 15-2%	0	0	0	0	0	0	0
9	4	45 M	90	2-10%, 6-5%, 11-40%, 12-28%, 14-2%, 15-15%	1	2	0	0	0	0	0
10	1	0 M	2	2-70%, 4-28%, 10-1%, 12-1%	0	0	0	0	0	0	0
10	2	15 M	96	4-4%, 5-50%, 6-6%, 12-25%, 14-5%, 15-5%	0	0	0	0	0	0	0
10	3	30 M	85	2-15%, 9-25%, 12-35%, 14-25%	0	1	0	0	0	0	0
10	4	45 M	85	1-10%, 2-5%, 6-2%, 9-25%, 12-58%	0	0	0	0	0	0	0
10	5	60 M	85	3-10%, 4-5%, 6-40%, 9-5%, 12-10%, 11-30%	0	0	0	0	0	0	0
11	1	0 M	5	2-50%, 3-30%, 4-25%, 6-1%, 12-4%	0	0	0	0	0	0	0
11	2	15 M	80	3-20%, 5-50%, 6-2%, 12-25%, 14-3%	0	0	0	0	0	0	0
11	3	30 M	75	2-10%, 3-15%, 6-1%, 9-10%, 11-40%, 12-24%	0	1	0	0	0	0	0
11	4	45 M	95	2-5%, 9-40%, 11-25%, 12-30%	2	1	0	0	0	1	1
11	5	60 M	90	2-10%, 5-50%, 9-20%, 12-20%	1	1	0	0	0	0	0

TABLE 4- TRANSECT STUDY DATA (CONTINUED)

TRANSECT #	QUADRATE #	METER MARK #	% COVER OF VEGETATION	SUBSTRATE/ PLANT SPECIES/# RELATIVE ABUNDANCE	# OF ACTIVE BURROWS	# OF INACTIVE BURROWS	# OF LIVE HATCHLINGS IN BURROWS	# OF DEAD HATCHLINGS IN BURROWS	# OF LIVE HATCHLINGS IN VEGETATION	# OF DEAD HATCHLINGS IN VEGETATION	TOTAL # OF HATCHLINGS FOUND
12	.1	0 M	5	2-45%, 3-50%, 12-5%	0	0	0	0	0	0	0
12	2	15 M	20	2-40%, 3-40%, 5-15%, 12-5%	0	0	0	0	0	0	0
12	3	30 M	90	3-10%, 5-27%, 6-1%, 9-20%, 12-40%, 16-2%	0	0	0	0	0	1	1
12	4	45 M	11	2-74%, 4-15%, 6-1%, 15-10%	0	0	0	0	0	0	0
13	1	0 M	0	2-10%, 3-45%, 4-45%	0	0	0	0	0	0	0
13	2	15 M	2	2-48%, 3-20%, 4-30%, 10-1%, 12-1%	0	0	0	0	0	0	0
				TOTALS	5	7	0	1	0	5	6

FIGURE 1- EAST ISLAND; TRANSECT DIAGRAM

Figure 1 represents the thirteen transects which were run at 30 degree angles across the width of the island at 30 meter intervals. Note that two other transects are present but not numbered, these were the first and last transects in the fifteen equal divisions of the island which were not included in the study because they were located below the berm.

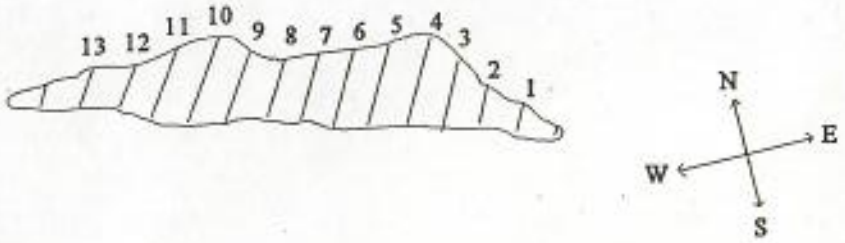

TABLE 5- TERN ISLAND, FFS RECORDED WEATHER DATA

	RECORDED RAINFALL						
YEAR	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	SEASON TOTAL
1986	3.7	0.47	0.81	8.05	1.53	1.18	15.74
1987	0.51	1.46	1.2	2.83	0.73	2.24	8.97
1988	4.38	0.71	2.53	1.65	1.84	1.08	12.19
1989	1.02	2.26	6.14	2.02	1.07	3.2	15.71
1990	0.95	1.89	1.08	0.85	1.00	3.75	9.52
1991	0.97	0.94	0.22	1.77	2.65	5.56	12.11
1992	1.19	1.4	3.51	2.63	6.43	0.4	15.56
1993	0.53	1.12	2.97	1.78	2.61	2.05	11.04
1994	1.81	0.48	2.27	1.31	1.39	8.38	15.64
1995	1.72	0.27	4.8	3.26	0.4	2.33	12.78
AVERAGE RAINFALL FOR NESTING SEASON							12.92

TABLE 5 lists the total rainfall recorded on Tern Island, FFS for the years of 1986 to 1995 during the green turtle nesting seasons. It is important to note that the total rainfall for October 1995 is only recorded until 17 October 95 when the study was completed. The average rainfall during the nesting season over the ten years shown has also been calculated.

RESULTS

After randomly searching East Island by way of 49 quadrates, a total of 6 hatchlings were found. Based on the total estimated area of the island covered with vegetation (15,200 square meters) and the area searched in the vegetation (160 square meters), approximately 1 percent of the vegetation on East Island was searched randomly (see tables 1 and 2). These quadrates do demonstrate the overall distribution of plant species, substrata, and burrow density. Via the thirteen transections, samples of the entire island were included in the quadrate searches.

The green turtle nesting season for 1995 in French Frigate Shoals showed an average amount of precipitation. Rainfall was recorded on Tern Island, FFS and totalled each month. This was then compared with the previous 9 nesting seasons (see table 5). Rainfall for the 1995 season totalled 12.76 inches of rainfall as of 17 October 1995. The average rainfall for the period between 1986 and 1995 during the nesting season was 12.92 inches. Therefore, it should be noted that this study was completed during a time of average rainfall. The abundance of vegetation was at an average level compared with other seasons. This study was completed during a time when the island was still very lush with vegetation, in order to demonstrate the level of mortality occurring when there was an average amount of vegetation posing a threat.

A total of 4 different substrate types were observed during the study (see table 3). Generally larger coral rubble was found near the berm and smoother coral sand or gravel was found near the interior of the island. Twelve different plant species were encountered during the quadrate searches. The most abundant were *Malva parviflora, Setaria verticillata,* and *Portulaca lutea.* On the SE side of the island *Tribulus cistoides* was also commonly found. *Eleusine indica* was more common on the NW side of the island. Table 4 shows the distribution and relative abundance of each substrate and plant species for each quadrate. Four of the five hatchlings found dead in the vegetation were found nearer the NW side of the island, tangled in the vegetation. Looking solely at the vegetation data it would seem that the presence of larger and taller plants as is found on the NW side of the island (*Lepturus repens var. repens, Setaria verticillata, Malva parviflora*) causes much more of a problem for hatchling entrapment than does the smaller ,vining plants seen on the SE side of the island (*Portulaca lutea, Tribulus cistoides, Boerhavia repens*). However, it should be noted that more nesting activity also occurs on the NW side of the island. So the greater number of trapped hatchlings found on this end of the island could correlate with a larger number of hatch pits present in the area.

During the study a total of 12 burrows were encountered (see table 4). Seven of these were inactive burrows which were thoroughly excavated to search for trapped hatchlings. Of these seven burrows only one hatchling was found dead, and no hatchlings were recovered alive. Five active wedge-tailed shearwater (*Puffinus pacificus*) burrows were encountered and searched by looking into the burrow. No live or dead hatchlings were found in any of these burrows. However, because active burrows were not thoroughly excavated, there is a possibility that a hatchling could have been present and not detected. The middle to NW side of the island showed the greatest burrow density (transect 8 through 11). The results show that with only 1/12 of the burrows encountered causing an entrapment problem, that they do not seem to pose too great of a

entrapment problem, that they do not seem to pose too great of a threat to hatchlings. However, it should be noted that 5/12 of these burrows were active, and therefore not completely searched.

The vegetation seems a greater threat than does seabird burrows. The interior of the burrows in most cases are made up of a soil or coral sand substrate, which would be a smooth surface for a hatchling to crawl through if it did wander in, making for an easier escape. Whereas the vegetation, in some cases has the ability to get entangled around their flippers, preventing the hatchlings from crawling, resulting in death. Possibly the hatchlings exert too much energy trying to maneuver through the vegetation, causing them to become exhausted and eventually die.

In conclusion, the seabird burrows do pose a threat to hatchlings, however the impact seems to be minimal in comparison with the vegetation. Entrapment in the vegetation, although it poses a greater threat to hatchlings than do the seabird burrows, does not seem to cause the hatchling mortality to be a high level. With a total of only 6 hatchlings found in 196 square meters searched, it can be deducted that the impact of lush vegetation and seabird burrows on hatchling mortality is minimal. Most hatchlings are in fact able to maneuver through and find their way to the ocean safely, even with these obstacles.

ACKNOWLEDGMENTS

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LITERATURE CITED

Tern Island Field Station, French Frigate Shoals 1993 and 1994 annual narrative.

Tern Island Field Station, French Frigate Shoals weather logs for the years of 1986 to 1995.

George-

The project went well, thank you for the idea. I will be in Honolulu on Nov. 16 to 21 and am interested in meeting with you and talking about my report and Turtle camp '96. I will call you then. Take care.

Kimberly Berger

P.S.- Thank you for the article and post card!

Green Sea Turtle Nesting Summary
Tern Island, French Frigate Shoals,
1995

INTRODUCTION

This document is a summary of green sea turtle (*Chelonia mydas*) nesting activity on Tern Island for the 1995 nesting season. Comparisons are made to studies conducted from 1986-1994. The main objectives for this monitoring were to approximate the number of nests laid as well as the nesting phenology for the season, map nest locations, excavate and release trapped hatchlings, determine clutch size, incubation period and hatching success of confirmed nests and check for entangled or entrapped adult turtles.

The work done since 1992 is a reduction of past monitoring efforts by refuge staff (see Niethammer 1991 report). It may be advisable to duplicate the more extensive monitoring effort in the future for comparative analysis.

STUDY AREA

Tern Island (23° 52'N, 166° 17'W) is located on the Northwestern edge of French Frigate Shoals, an atoll 490 nautical miles from Honolulu. Tern Island is approximately 3000 feet long by 120-200 feet wide, encased on the West, North and East sides by a sheet pile sea wall. The majority of nesting occurs on the south beach. There are two small coral rubble/sand beaches on the north side that allow limited access to nesting turtles. There is also a continually shifting sand beach located at the East end of the Island, see map.

METHODS

Dawn nest walks were conducted throughout the nesting and hatching season (May through December). These walks took 45 to 90 minutes to complete depending on nesting/hatching activity. Turtle nesting activity occurs primarily from sunset to sunrise, therefore, direct visual evidence of nesting (eggs seen or "pattycaking") was rarely seen. Nests were defined somewhat subjectively based on the type of diggings and tracks seen; evidence of a "backfill" with tracks leading directly back to the water was the strongest indication of a nest. The southern half of Tern Island has been mapped on a grid system: 10 meters increments East to West and 4 meters increments North to South. Nests were numbered and staked 1.5 meters inland from the nest, and the location was approximated on the above mentioned grid map. Any nests laid in an area of shifting sands (East Beach or either end of South Beach) were moved to a more stable beach area. Pre- and post-hatch pits were also noted during the morning walks. The emergence of hatchlings was indicated by a distinct depression in the sand, a post-hatch pit. The nests were excavated three days following

discovery allowing hatchlings four nights to emerge. In some cases nests were not excavated after four nights due to seal activity in the area. Any trapped hatchlings found were removed and released after dark the same day they were found. A nest was confirmed as hatched when it was excavated as a post-hatch pit and egg shell fragments and/or trapped hatchlings were found. Only nests that indicated signs of hatching, a post-hatch pit, were excavated. Nest contents were examined and counted to estimate clutch size and hatching success. The clutch size was determined by counting shell fragments, undeveloped eggs and fully and partially developed eggs. Hatching success was calculated by dividing the number of eggs that hatched by the total number of eggs laid. Appendices A was the data sheet used to record nesting information for the 1995 season.

RESULTS & DISCUSSION

The first known nest for the 1995 season was laid on 2 May, the last known nest was laid on 30 September. The first known hatching occurred on 27 July, the last known hatching occurred on 19 December (Table 1). There were an estimated 282 nests laid during 1995. Two hundred and fifty-one possible nests were identified and staked and 31 unmarked nests were discovered throughout the season. These unmarked nests were found through hatching evidence seen during morning walks. Of the 251 staked nests, 121 were confirmed hatched. Including the unmarked nests, the total number of confirmed nests was 152. The mean incubation length for 116 of the hatched nests was 68.6 days with a range of 44 - 88 days. Nest contents were not examined for 13 of the 152 confirmed nests due to seal activity. The mean clutch size for 139 of the nests was 88.5 eggs with a range of 40 - 168 eggs per nest. Hatching success for these nests was 81.8 (Table 2). Hatching success was also estimated for the 1993 and 1994 seasons by using mean clutch size data from the 1986-1991 and 1995 nesting data. (Tables 2 and 3). Of the 152 nests excavated, 93 had trapped hatchlings (61% of nests; range 1 - 21 per nest). A total of 329 trapped hatchlings were recovered and released during 1995. A comparison of the confirmed nests from 1986-95 is illustrated in Figure 1. The methods used for the 1986-91 Neithammer study were different than those used in 1992-95. The Neithammer study found a higher percentage of nests laid on the island due to the intensity of the follow-up procedures, excavating every staked nest. In 1992-95, only nests with post-hatch pits were excavated. Due to seals, nesting turtles and bird activity, pre- and post-hatch pits became rapidly obscured. It is highly likely that hatching evidence was missed on some nests during the past four seasons.

Throughout the months of July, August and September disoriented turtle hatchlings were occasionally found and removed from the runway.

There were no entangled turtles seen on Tern Island during the nesting season. However, six adult turtles were aided and one was found dead on Tern Island during the nesting season. Following are the descriptions of the individual situations:

On 18 June an untagged adult female turtle was found overturned on Crab Beach. Tracks indicated that she had tried to climb over the seawall and toppled over. The turtle was immediately righted and appeared unharmed as she quickly returned to the water.

On 19 June a dead adult female turtle was found wedged between the double seawall at the east end of Tern Island. The turtle was apparently swept through a hole at sea level in the outer seawall by strong waves. Aluminum grating covers the entire top portion of the double wall, ruling out the possibility that the animal fell into the cavity. The sands of East Beach continually shift along the entire east end of Tern, resulting in the occasional exposure of the eroded seawall which resembles a picket fence. The gaps in the wall are not wide enough for a turtle to access unless the animal was turned on its side. The body was torn open in the process of removing the carcass, releasing fully developed eggs. It appeared the turtle had been dead for at least 24 hours when found and powerful waves had heavily damaged the carcass. The curved carapace measured 99 centimeters.

On 23 June an adult female turtle was removed from the runway and released on South Beach. The animal had accessed the island from South Beach at meter marker 416, crossed the runway, dug a body pit on the north side, and was proceeding to wander aimlessly on the runway. Tags already present were: W866 LFL, W867 RFL. New tags placed on the turtle were: F630 LFL, F629 LHF, F628 LHF. An additional left front tag was attached due to the poor condition of the primary tag site.

On 28 June two adult female turtles were found just south of the runway on the east side of the woodshop. Both animals were guided back to South Beach. The first turtle had a small tumorous growth on the lower portion of the left eye. Tags placed on the animal were: F633 LFL, F632 RFL. Tags placed on the second animal were: F634 LFL, F635 RFL.

On 1 July a tagged adult female turtle was found crossing the runway. The tracks indicated that the turtle accessed the island at Shell Beach. The turtle was tagged and released on South Beach. The tags were as follows: F636 LFL and F637 RFL. On 3 July, the same turtle was found on the runway heading in a westerly direction. It appeared to have accessed the island from South Beach. The turtle was removed and released on South Beach. The turtle did not return to the water as normally observed but remained on the beach. Several hours later the turtle was found dead. A necropsy was performed and the results were sent to the NMFS Lab in Honolulu.

On 5 July a tagged adult female turtle was found along the seawall approximately 100 meters from the east end of the island. Her tracks indicated that she accessed the island at Shell Beach and traveled along the seawall. The turtle was released on South Beach. The turtle was previously tagged and moto-tooled indicating that she had been marked on East Island during turtle camp. The ID #s were as follows: moto-tool # : 166; A218 RFL, A217 LFL, G231 RHF, G229 LHF, A357 L3,4.

ACKNOWLEDGEMENTS

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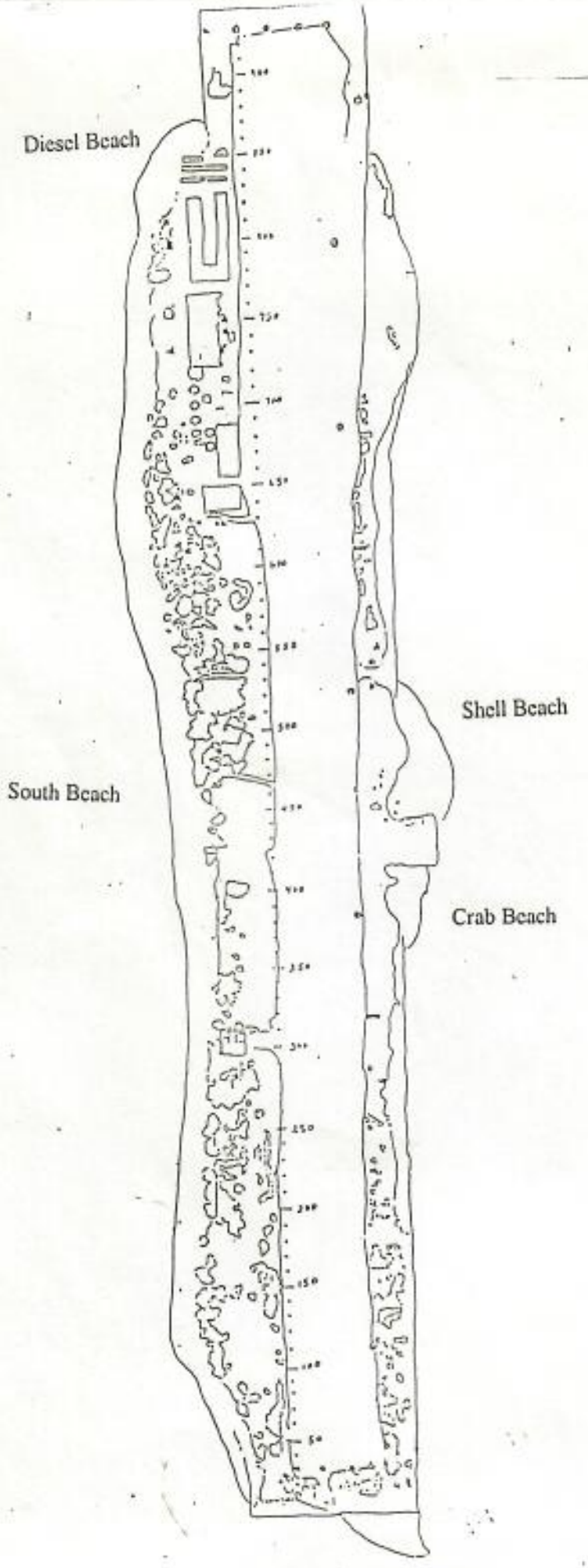
Diesel Beach
Shell Beach
South Beach
Crab Beach
East Beach

Table 1: Dates for the first and last nests laid and hatchling emergences for green turtles on Tern Island, French Frigate Shoals, Hawaii, 1986-95.

YEAR	LAY DATES		HATCHLING EMERGENCES	
	FIRST	LAST	FIRST	LAST
1986	6 June	22 September	15 August	16 November
1987	25 May	20 October	29 July	26 December
1988	26 April	1 October	8 July	9 December
1989	28 April	28 September	19 July	27 December
1990	9 May	25 September	13 July	17 December
1991	29 April	3 September	11 July	5 November
1992	27 April	11 October	20 August	22 January
1993	8 May	14 September	15 July	10 November
1994	4 May	5 September	25 July	11 January
1995	2 May	30 September	27 July	19 December

Table 2: Hatching success of green turtle nests at Tern Island, FFS, 1992-1995, calculated as a percentage by dividing the number of eggs hatched by the total number of eggs laid. Italized % show estimates of nest contents by using the mean clutch size data from the 1986-1991 and 1995 nesting seasons.

CATEGORY	1992	1993	1994	1995
Number of Confirmed Nests	81	51	69	152
Number of Eggs	*7,371*	*4,641*	*6,279*	12,041*
% Hatched Emerged	no data	*82.1*	*83*	79.0*
% Hatched Live-left in nest	*5.2*	*5.3*	*6.4*	2.5*
% Hatched Dead-left in nest	no data	*1.7*	*1.0*	0.3*
% Total Hatched		*89.1*	*90.4*	**81.8***
% Unhatched Developed	no data	*2.4*	*0.5*	5.6*
% Unhatched Undeveloped	no data	*8.5*	*9.1*	12.6*
% Total Unhatched		*10.9*	*9.6*	**18.2***

***Number based on the contents of 139 nests.**

Table 3: Data from green turtle nests at Tern Island, FFS, 1992-1995. No data indicates data was not collected for that category for that year.

CATEGORY	1992	1993	1994	1995
Number of Confirmed Nests	81	51	69	152
Number of Eggs	no data	no data	no data	12,041*
# Hatched Emerged	no data	no data	no data	9,514*
# Hatched Live-left in nest	385	244	403	294*
# Hatched Dead-left in nest	no data	78	64	37*
# Unhatched Developed	no data	113	29	675*
# Unhatched Undeveloped	no data	396	572	1,521*

***Number based on the contents of 139 nests.**

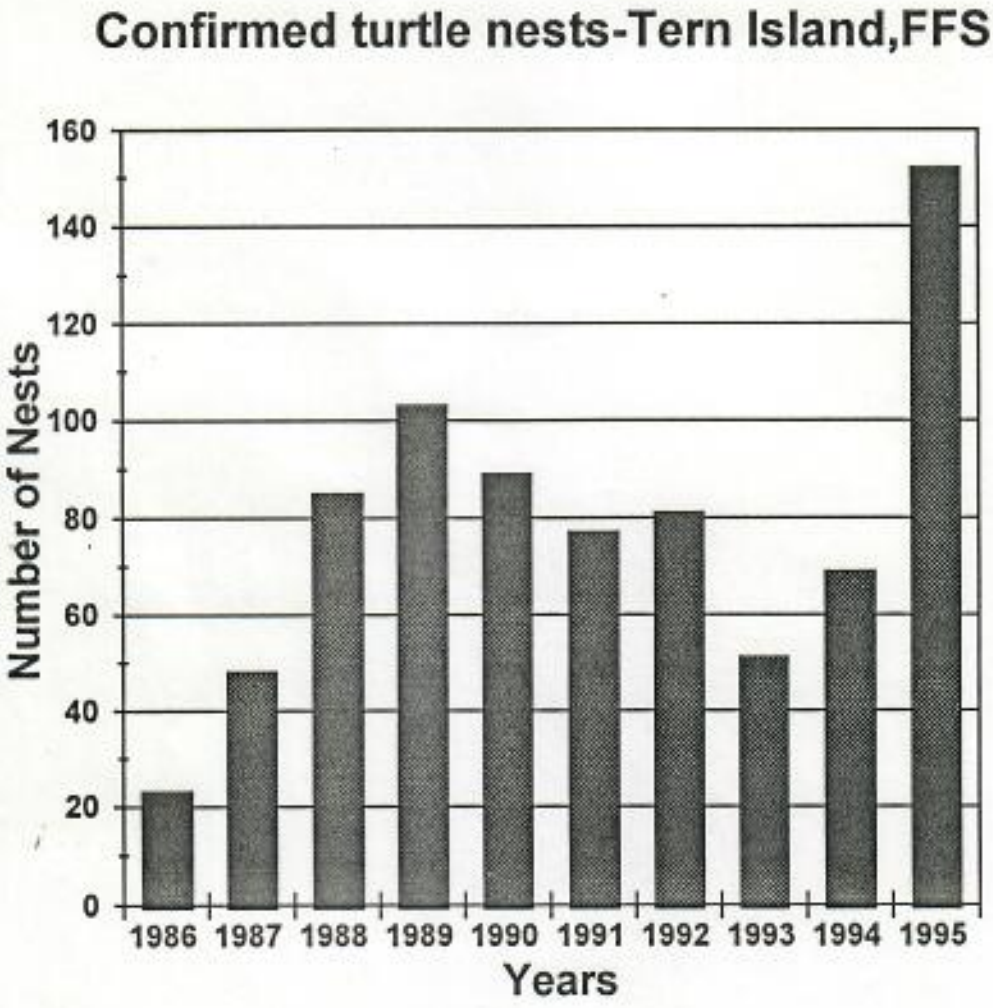

Figure 1: Comparison of confirmed hatched turtle nests from 1986-1995

GREEN TURTLE NEST/HATCHING SUCCESS FORM ed.II

Island________ YEAR________ PAGE #___ OF___

NEST #	LAY DATE	LOCATION		HATCH DATE	PRE PIT?	#TRAP TURTS	#DEAD-DEVELPD		#ROT EGGS	INCU TIME	COMMENTS
		EW	NS				FULL	<FULL			

1995

Green Turtle (Chelonia Mydas) Hatchling Carapace Measurements
Tern Island, French Frigate Shoals

Hatch Date	Hatchling Number	Nest Number	Straight Carapace Length (SCL) in mm	Curved Carapace Length (CCL) in mm	East-West Meter Mark	North-South Meter Mark
1995 12 NOV	1	243	54.85	58.	44	41
12 NOV	2	243	51.47	56.5	44	41
12 NOV	3	243	54.99	57.2	44	41
12 NOV	4	243	54.6	57.5	44	41
12 NOV	5	243	54.5	58.0	44	41
12 NOV	6	243	52.93	58.5	44	41
17 NOV	7	245	55.17	58.0	409	28
19 Dec	8	251	46.83	55.0	Shell Beach	Shell Beach
19 Dec	9	251	49.15	58.0	Shell Beach	Shell Beach

20 February, 1996

Hello George,

Here is a copy of our 1995 Tern Island turtle summary. I look forward to any feedback you or Jerry may have on our work. Perhaps a nice correlation between East and Tern Island nest numbers will become evident.

Also enclosed are additional turtle hatchling measurements that were taken following Kimberly's departure in mid November '95.

I'll be in Honolulu purchasing supplies for the East Is turtle camp in early April and look forward to catching up with you then. Any plans to personally come to Tern in June with the turtle techs to deploy more satellite transmitters or data loggers?

I hope all is well George.

Aloha, Steve