



COTERC and GVI Costa Rica

Marine Turtle Monitoring Program on the
North Beach Of Tortuguero, Costa Rica

Final Report

Green Turtle Nesting Season 2006

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Produced by

Lidia Chaparro - Project Biologist (GVI)
Jana Daigle - Project Coordinator (COTERC)
Ulla Kail - Expedition Staff (GVI)

GVI Costa Rica

Address: Estación Biológica Caño Palma, Tortuguero, Costa Rica
Tel: (+506) 709 8052

Email: Costa_rica@gvi.co.uk & Tortuguero@gvi.co.uk

Web page: <http://www.gvi.co.uk>



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1. INTRODUCTION

Over the past 20 years there has been a huge decline in both Leatherback turtles (*Dermochelys coriacea*) (Troëng *et al.*, 2004) and green turtles (*Chelonia mydas*) (Troëng & Ranking, 2005) due to overexploitation such as illegal harvesting of their meat and eggs, as well as fishing, contamination and habitat alteration. Green turtles are classified as globally endangered on the IUCN Red List (IUCN, 2003). In addition to the general decline in sea turtles, Tortuguero and the surrounding areas are continuously developing and thus the need for protection and conservation of sea turtles and their habitat is growing.

Tortuguero National Park (TNP) was established in 1975 with the main purpose of protecting sea turtles and the nearby areas of humid lowland forest and beach (A. Castro, *pers. comm.*) While its protection is contributing to the stability of sea turtle populations, many beaches surrounding the park are supposedly affected by a high level of poaching (J. Daigle, *pers. comm.*). In response to this, COTERC (Canadian Organization for Tropical Education and Rainforest Conservation) started a five-year feasibility study in 2004 with the aim of determining nesting populations and poaching rates of green turtles and Leatherback turtles on North Beach (the beach just north of Laguna Tortuguero) and the occasional Hawksbill (*Eretmochelys imbricata*) and Loggerhead turtles (*Caretta caretta*).

In July 2005 GVI joined COTERC in collecting data on the unprotected North Beach. As well as collaborating with data collection and analysis, GVI and COTERC share data with the CCC (Caribbean Conservation Corporation) in order to gain more knowledge about tagged turtles and to compare poaching rates with turtles nesting on the protected National Park beaches.

In March 2006 GVI and COTERC started a tagging program of all four sea turtle species nesting on North Beach. The tagging provides data about how many individual sea turtles of the different species visit the beach on how many occasions. This information is crucial for the development of a sea turtle conservation program on North Beach.



2. SEA TURTLE MONITORING PROGRAMME

2.1. Aim

Based on previous studies conducted by COTERC there is a great amount of illegal harvest of turtle eggs and to a lesser extent of turtle meat on the North Beach.

By monitoring sea turtle nesting activity on the North Beach we gain information about the spatial and seasonal distribution of nesting females, the total number of mature females, the extent of illegal harvest of turtle meat and eggs, as well as natural predation of nests.

The collected data are intended to be used as a basis for the development of a conservation project on North Beach aimed to protect both adult females and nests of all sea turtle species during future nesting seasons.

All data will be compared with other important nesting sites like the TNP beach.

2.2. Methodology

The methodology used for the marine turtle monitoring program follows the COTERC and GVI protocol which is adapted from and approved by the CCC.

2.2.1. Study site

The North Beach, which encompasses the study area, is 3 1/8 miles long, about 5 kilometers, and extends from the Tortuguero river mouth (10°36'36,9"N - 83°31'52,1"W) at the southernmost point until Laguna Cuatro (10°37'56,3"N – 83°32'25,7"W) in the north. Although this beach is not located within the TNP boundaries, it is situated within the Barra Colorado Wildlife Refuge, which, like the TNP, is managed by ACTo (Area de Conservación Tortuguero) under MINAE – the Costa Rican Ministry of Environment and Energy.

The limits of the study area are Mile 0 at the Tortuguero river mouth (10°35'51"N – 83°31'40"W), and Mile 3 1/8 at Laguna Cuatro. The entire study area is divided and marked with mile markers at each 1/8 of a mile (200 meters) from the south to the north



with ascending numbers. This allows for the documentation of spatial distribution and density of nests along the beach.

The nearest village to the study beach is San Francisco, situated south of mile 0, a constantly growing community of about 100 residents. Two hotels, Cabinas Vista al Mar and Turtle Beach Lodge and a few ranchos and houses are located along the study beach. On the southern side of the Tortuguero river mouth is Tortuguero beach which the CCC monitors from mile 0 (10°35'51"N – 83°31'40"W) to mile 18 (10°21'46"N – 83°23'41"W) at Jalova lagoon.

The sand of the study beach is black and fine, typical for a high energy-beach. The width of the nesting beach platform or berm varies from 2 to 38 meters, but the configuration of the shape and size of the berm changes constantly in response to long shore drift and exposure levels.

The dominant plants on the nesting beach are members of the morning glory family (*Ipomoea Pes-Caprae*), Rea-purslane (*Sesuvium portulacastrum*) and Rush grass (*Sporobolus virginicus*). The berm is bordered by a hedgerow of Cocoplum (*Chrysobalanus icaco*) and Sea grapes (*Coccoloba uvifera*) with a mixture of Coconut palms (*Cocos nucifera*) and various tropical hardwoods behind.

The beach is littered with a variety of debris including logs, coconut husks and a large amount of plastics, trash, beer bottles etc.

2.2.2. *Weather Data*

Rainfall was measured twice daily at 6am and 6pm at the rain gauge at the entrance to North Beach.

2.2.3. *Daily track census and nest surveys*

The green turtle nesting season on the Caribbean coast of Costa Rica lasts from June until November (Troëng *et al.*, 2004). Night and morning patrols on North Beach are carried out from March 1st until October 31st, whereas this year night patrols were conducted until October 25th.



The daily track surveys start at 6:00 am and last until 8:30 am consisting of walking the beach between mile 0 and 3 1/8, recording and monitoring tracks and nests from the night before. The day team identifies tracks as full tracks (turtle nested) or half moons (non-nesting emergences in which the track takes the form of a parabolic curve), or a lifted turtle (no tracks going back into the sea). The vertical position of the nest on the beach is identified either as Open (O – area of beach which receives 100% sunlight), Border (B - area where nest is partially shaded by vegetation) or Vegetation (V - area where nest is constantly shaded by vegetation). Nests are then identified as natural (if remained in its original state), poached (with at least 2 of the following signs: stick marks, exposed egg chamber, flies, eggs shells on the sand or human foot prints) or predated by an animal.

Data is also recorded when encountering dead turtles on the beach. The size, sex, state of the turtle, and an estimated time of death are recorded. Any obvious sign of an unnatural death is also recorded such as harpoon marks, machete cuts or blows to the head and/or limbs and photographs taken. If the turtle had been tagged, the ID number is recorded and checked against CCC tagging data.

2.2.4. *Night surveys*

Each night a minimum of one survey team walks the beach between mile 0 and mile 3 1/8 during approximately 5 hours (21:00 to 02:00).

Since June 5th the survey period was extended by division into 2 shifts (20:30 to 00:30 and 00:00 to 04:00) whenever the number of expedition members made this possible.

The purpose of the night patrols is to collect data from as many turtles as possible. However, considering that the beach is 3 1/8 miles long and only covered by one night team at any time, except when 2 teams meet between 00:00 and 00:30, there is a high possibility that not all turtles are encountered. In this case their tracks are documented confirming that there are two sets of tracks, one ascending and one descending the beach, following the same methodology as used for the day protocol.

When encountering a turtle on the beach, the following data is collected: the date, the time when the track is found, the species, the activity corresponding with a sequence



from 1-8 (1-emerging from the sea, 2-selecting nest site, 3-digging body pit, 4-digging egg chamber, 5-oviposition, 6-covering egg chamber, 7-camouflaging, 8-returning to the sea) the initials of each member of the team, the mile marker number and the GPS position of each nest, the orientation of the nesting turtle (turtle facing North, South, East or West) and the vertical position of the nest on the beach (Open, Border or Vegetation). When the nesting process is observed the number of laid eggs including yolkless eggs is recorded. Any other comments or anomalies observed are noted.

2.2.5. *Tagging*

Green turtle females are tagged in the front flippers just before the primary scale using Inconel #681 tags. Females are only tagged if they lay eggs and then the tagging takes place while they are covering the egg chamber, camouflaging the nest or returning to the sea. Evidence of old tags in the flippers like old tag notches (OTN) or old tag holes (OTH), are recorded, as well as evidence of trauma or parasites due to old tags.

2.2.6. *Biometric Data*

During the oviposition process the clutch size (number of eggs) is recorded by hand using a plastic glove and a manual counter (clicker). In some cases green turtles lay both normal and yolkless eggs.

For all turtles found after the oviposition process, the Minimum Curved Carapace Length and the Maximum Curved Carapace Width are recorded by two people using a 300 cm fibreglass measuring tape. The measurement is taken three times to allow for precision and the average of the three measurements is calculated.

- Minimum Curved Carapace Length (CCLmin): CCLmin is measured from the beginning of the carapace on the neck along the center of the carapace.
- Maximum Curved Carapace Width (CCW max): CCW is measured at the widest part of the carapace from one side to the other.



2.2.7. *Nest Fate, Nest Survivorship and Hatching success*

Samples of nests are marked using triangulation in order to locate the nests 5 days after the estimated hatching time or 70 days after the nest was laid for excavation. Triangulation is conducted during oviposition using three pieces of flagging tape (tags) which are attached to the vegetation behind the nest. The distance from the center of the egg chamber to each of these tags is measured to the nearest cm whilst the turtle is laying eggs. The distance to the most recent high tide line is also recorded. Triangulation allows finding the location of the egg chamber where the three tag lines cross when the nest is due to be excavated. Three tags are used to compensate for the loss of any points of reference. If one tag is lost it is still possible to locate the nest using the other two tags.

Marked nests are excavated 5 days after hatching, whereas if there are no sign of hatching, excavation is carried out 5 days after the average incubation period for each of the species. Green turtle nests are excavated 70 days after the date they had been laid. This report includes all nest fate and excavation data collected until the 11th of December 2006.

In addition, all nests found hatching on the beach during morning or night surveys are excavated 5 days after the first hatchling tracks are encountered.

For all excavations the number of live and dead hatchlings, egg shells accounting for more than 50% of an egg, unhatched eggs with no sign of development, unhatched eggs with embryos and depredated eggs by crabs or other animals are counted and recorded.

For all accurately marked and measured nests a nest fate is determined. Nests which are not marked or measured correctly, or for which more than one reference is lost are excluded from analysis. The following nest fate categories are applied: hatched, poached, predated, eroded and flooded. Empty egg chambers are classified as poached nests. If there is any doubt about the fate of a nest it is categorized as unknown.

During all excavations the bottom depth of nests, which is the depth measured from the surface to the bottom of the nest after all eggs have been removed, is measured using a stick and a 1,50 m fiber glass measuring tape.



2.3. Results

Night data for the 2006 nesting season was collected from March 1st until October 25th whereas morning surveys were carried out from March 1st until October 31st 2006.

The total numbers of morning and night surveys undertaken were 243 and 257, respectively.

Note: Not all data collected throughout the green turtle season are included in this report, like encounter time, orientation and vertical nest position, due to fact that these data had been analyzed in conjunction for all four species nesting on North Beach in the GVI phase reports. The latter data could not be split up in time to finish this report.

2.3.1. Weather Data

The highest precipitation was measured in August with 503.65mm, followed by July with 263.9mm. Figure 2-1 shows the monthly rainfall recorded on North Beach from May 1st until October 31st 2006.

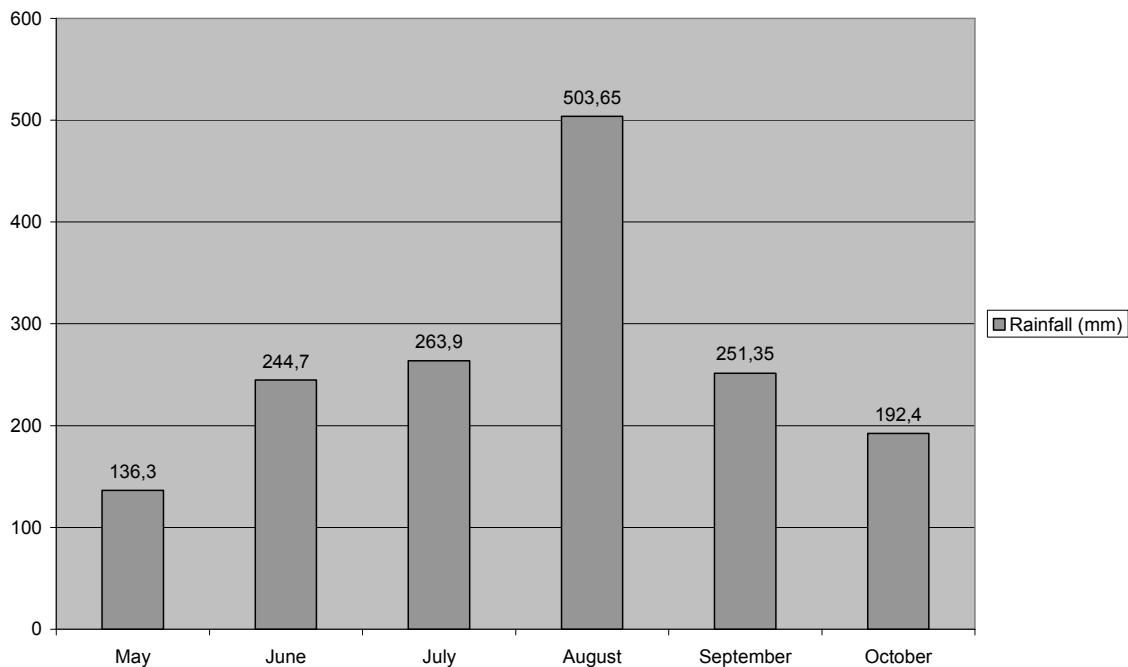


Figure 2-1 Monthly rainfall recorded on North Beach from May 1st until October 31st 2006.



2.3.2. Daily track census and nest surveys

A total of 914 green turtle tracks were recorded on North Beach from March 1st until October 31st 2006, divided into 347 nests and 567 half moons.

The seasonal distribution of nests and half moons of green turtles is shown in Figure 2-2.

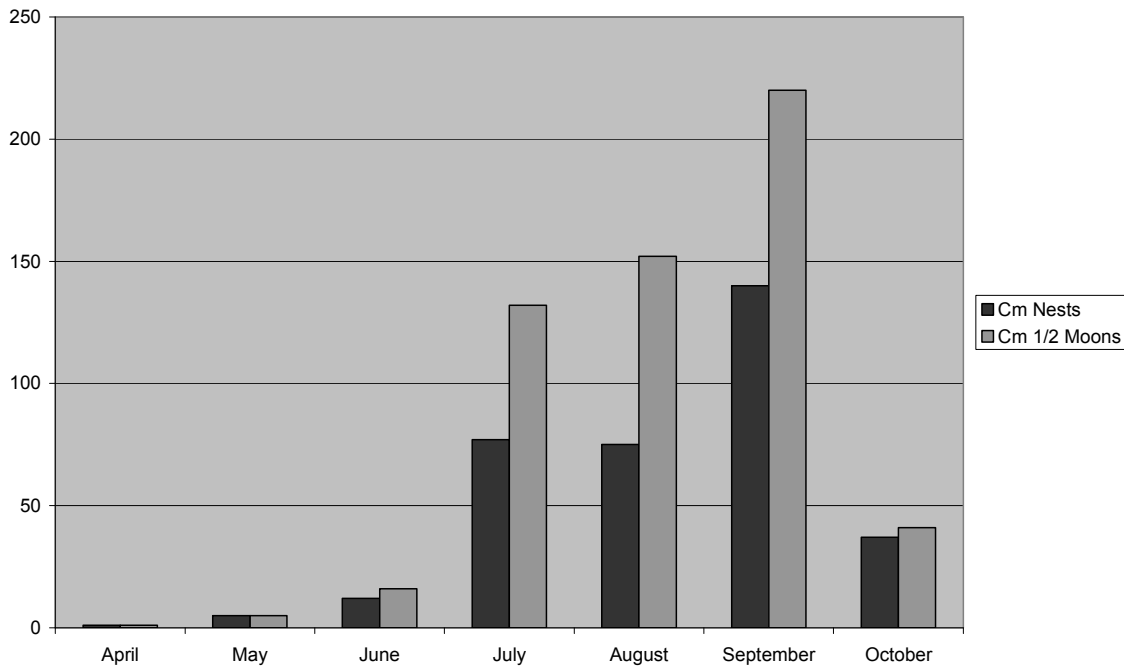


Figure 2-2 Seasonal distribution of nests and half moons of green turtles between March 1st and October 31st 2006.

The highest number of green turtle nests were recorded in September (n=140) followed by July and August with 77 and 75 nests respectively. September also accounted for the highest number of half moons (n=220) whereas in August 152 half moons were found and July accounted for 132 half moons on North Beach.

Figure 2-3 demonstrates the spatial distribution of nests and half moons of green turtles.

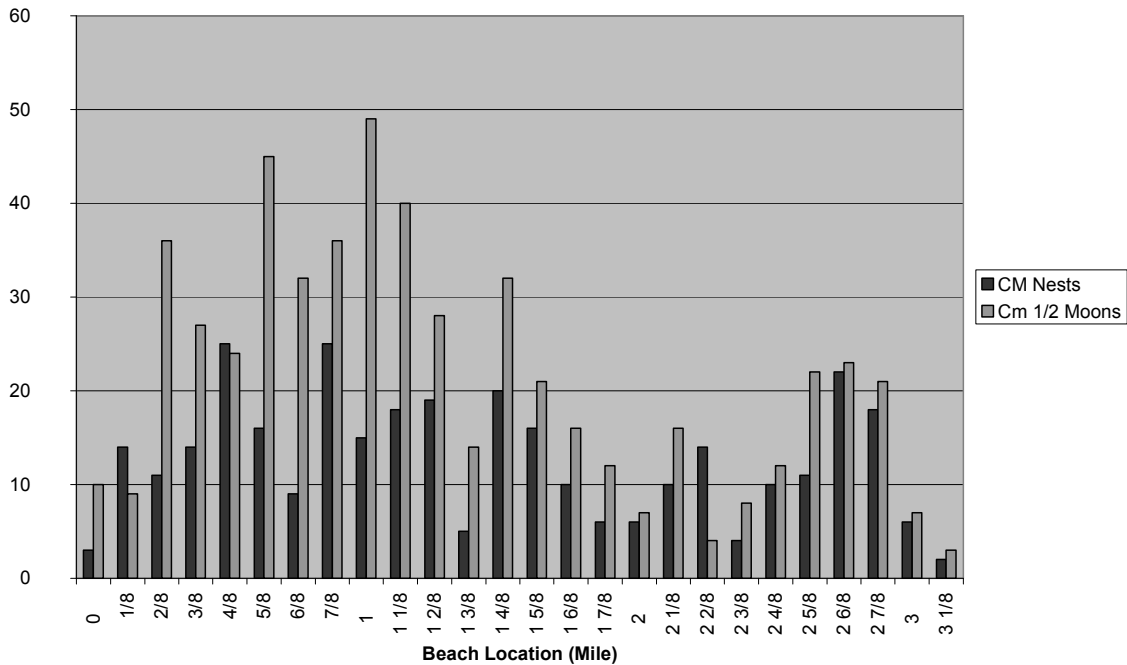


Figure 2-3 Spatial distribution of nests and half moons of green turtles on North Beach between March 1st and October 31st 2006. Note: There was no information regarding the location for 18 nests and 13 half moons.

Regarding the spatial distribution of green turtle nests on North Beach Mile 4/8 and Mile 7/8 accounted for the highest number of nests (n=25 each). Green half moons peaked at Mile 1 (n=49), followed by Mile 1 1/8 (n=40).

2.3.3. *Monitoring of female turtles*

Three dead green turtles were found on North Beach between June 20th and July 30th 2006 during this nesting season, one of which was identified as a male.

2.3.4. *Tagging*

The green turtle tags applied by the Caño Palma Sea Turtle Monitoring Program from March 1st until October 25th are shown in table 1-1. Numbers of removed or destroyed tags are listed in table 2-2.



CP0001-CP0006	CP099-CP0112	CP0167
CP0008	CP0114-CP0118	CP0169-CP0170
CP0010-CP0026	CP0122-CP0123	CP0172
CP0029-CP0033	CP0125-CP0133	CP0175-CP0184
CP0035	CP0137-CP0143	CP0186-CP0189
CP0037-CP0041	CP0145-CP0146	CP0191-CP0192
CP0043-CP0044	CP0149	CP0194-CP0195
CP0046-CP0048	CP0152-CP0153	CP0199-CP0202
CP0050-CP0090	CP0156-CP0161	CP0205-CP0208
CP0092-CP0097	CP0162-CP0165	CP0210-CP0213

Table 2-1 Tags applied by the Caño Palma Sea Turtle Monitoring Program from 1st of March until 25th of October 2006.

88231 removed + recovered	CP0196 destroyed - not recovered
CP0185 removed + recovered	CP0197 destroyed + recovered
CP0193 destroyed + recovered	CP0209 destroyed + recovered

Table 2-2 Tags removed or destroyed by the Caño Palma Sea Turtle Monitoring Program from 1st of March until 25th of October 2006.

Four green turtle tags with the numbers 96968, 96969, 104480 and 105163 were given to the station in October from turtles which had been killed in San Francisco.

A total of 15 green turtles nested twice and three turtles were encountered three times on North beach from 1st of March until 25th of October 2006. For 13 turtles the inter-nesting interval was an average of 9.8 days, while six turtles nested an average of 21.8 days apart, for two turtles the average nesting interval was 33,5 days (n=21).

2.3.5. *Biometric data*

Mean carapace length, carapace width and clutch size of green turtles for which this information could be collected is shown in table 1-3. The mean carapace length of newly tagged individuals with no evidence of previous tags (OTH or OTN) was 103.95 cm (n=73), whereas the mean carapace width was 92.95 cm (n=73). Newly tagged greens with old tag holes or old tag notches had a mean carapace length of 105.64 cm (n=7)



and a mean carapace width of 95.15 cm (n=7). Previously tagged green turtles averaged at a carapace length of 104.25 cm (n=50) and a carapace width of 94.73 cm (n=47). The average number of fertile eggs was 115.37 for newly tagged green females (n=41) with no signs of previous tagging and 107.5 for newly tagged green turtles with old tag holes or old tag notches (n=7). Previously tagged green turtles laid an average number of 107.42 eggs per clutch (n=24).

Green turtles	CCL min (cm)		CCW max (cm)		Number of Eggs	
	n	$x \pm \Sigma T. \Delta.$	n	$x \pm \Sigma T. \Delta.$	n	$x \pm \Sigma T. \Delta.$
Newly tagged with no OTH/OTN	73	103.95 \pm 5.34	73	93.95 \pm 4.91	41	115.37 \pm 23.25
Newly tagged with OTH/OTN	7	105.64 \pm 1.46	7	95.15 \pm 3.23	4	107.5 \pm 23.98
Previously tagged	50	104.25 \pm 4.84	47	94.73 \pm 4.82	24	107.42 \pm 21.09

Note: One egg count of a previously tagged turtle was excluded, as it was a partial nest with 5 eggs only.

Table 2-3 Green turtle mean carapace length, carapace width and clutch size on North Beach from 1st of March until 25th of October 2006.

2.3.6. *Monitoring of nests*

Out of 307 green turtle nests, for which a nest fate was determined during night and morning surveys 47.71% seemed to be left in their natural state without any signs of poaching, erosion or predation (n=146). Based on at least two evidences such as human foot prints, stick marks, flies, egg shells and/or an exposed egg chamber, the remaining 51.96% (n=159) of nests were classified as poached. One nest was classified as unknown (0.33%). See figure 1-4.

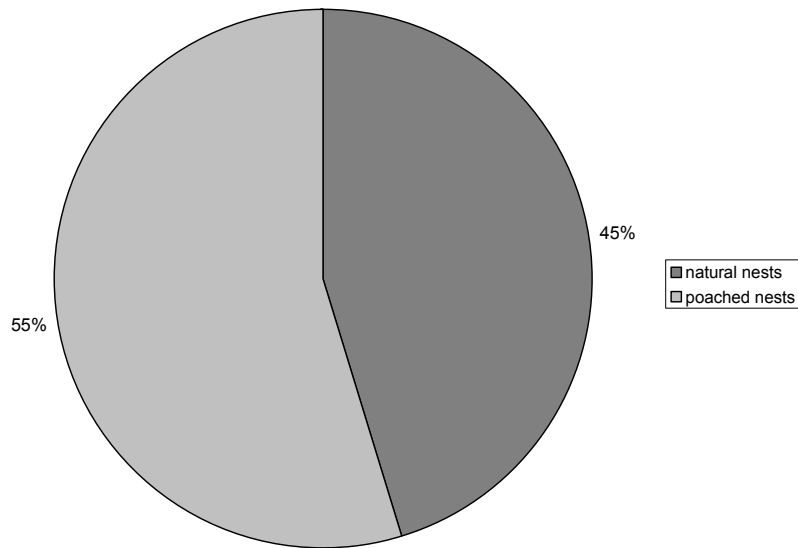


Table 2-4 Nest fate recorded during morning and night surveys on North Beach from 1st of March until 31st of October 2006.

2.3.7. Nest Fate of nests marked by triangulation

A total of 62 triangulated and marked green turtle nests were dug up within the time frame analyzed in this report from the 1st of March until the 11th of December 2006. After December 11th eight triangulated green turtle nests remain to be excavated on North Beach, the last on December 31st 2006.

Regarding the 62 above nests, which were checked for their nest fate, nine nests could not be found because of inaccurate measurements (n=2) or lost tags (n=7) and were excluded from analysis. 53 nests were located using the measurements taken, out of which 64.15% (n=34) of nests were “empty” (some nests contained one to a few eggs or eggshells) and therefore classified as poached. 32.08% of nests (n=17) had hatched while 3.77% (n=2) of nests contained the full clutch of eggs but did not hatch, both of the latter were excavated. See table 1-4 for a summary of excavation results and figure 1-5 for nest fate of marked nests.

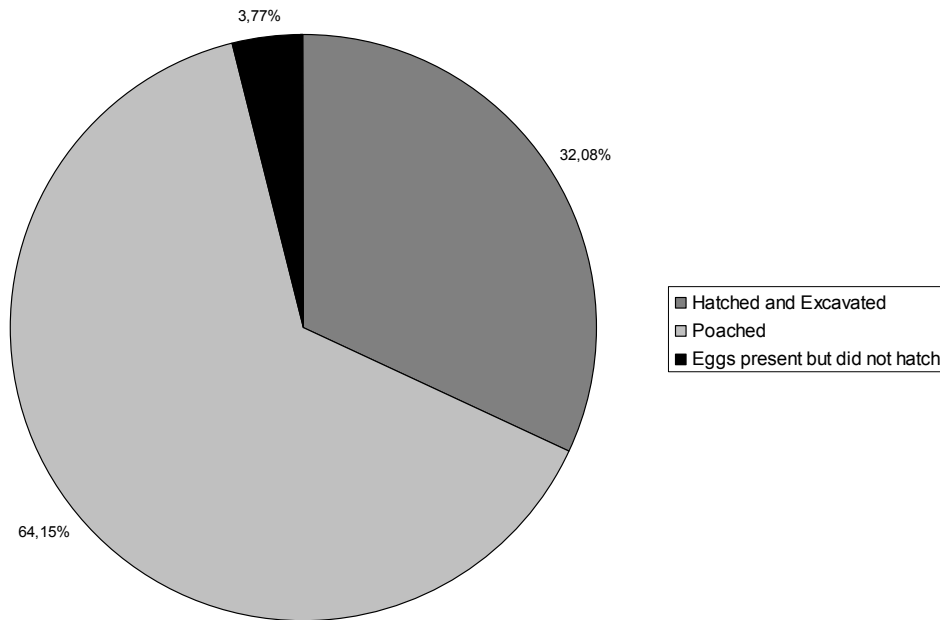


Figure 2-4 Nest fate results of marked green turtle nests on North Beach from March 1st until December 11th 2006.

2.3.8. *Excavation Results, Hatching and Emerging success*

During morning patrols from March 1st until October 31st 2006 a total of 13 sets of hatchling tracks were found on North Beach for 12 of which the position of the nest could be located. These 12 green turtle nests, all of which had not been triangulated, were excavated a minimum of five days after the tracks had been encountered and the data collected is summarized in Table 1-5.

Out of 62 nests marked by triangulation, 53 could be located using the measurements and reference points taken. 19 of these nests contained a full clutch of eggs and their content was excavated and analyzed. See Table 2-5 for a summary of the data recorded during excavations of all nests, unmarked and marked.



# of nests	Alive Hatchlings	Dead Hatchlings	Shells >50%	Yolkless Eggs	Unhatched without Embryo	Unhatched with Embryo	Depredated	Unknown	Total Eggs
31	6	3	2975	9	113	130	373	76	3667

Table 2-5 Summary of excavation results for 31 green turtle nests on North Beach from March 1st until December 11th 2006.

For 23 nests the bottom depth of the egg chamber was measured during the nest excavations. The calculated average nest depth accounted for 67.57 cm (n=23).

The incubation period could not be calculated as none of the marked nests was observed hatching.

See table 2-6 for hatching and emergence success of the 55 marked nests excavated on North Beach.

n	Fate	eggs total	shells total	hatching success (%)	emerging success (%)
17	hatched	2006	1823	90.89	90.58
34	poached	3712	0	0	0
2	unhatched	283	0	0	0
53	total	6001	1823	30.38	30.28

Table 2-6 Hatching and emerging success for 53 marked green turtle nests excavated from March 1st until December 11th 2006 on North Beach. Note: For nests of which the number of eggs laid was unknown, the average number of eggs per clutch (x = 120) was used to calculate hatching and emergence success.

Hatching and emerging success for marked hatched nests were almost equal at 90.89% and 90.58% (n=17) respectively. Overall, triangulated nests accounted for 30.38% hatching and 30.28% (n=53) emerging success.



Table 2-7 shows hatching and emerging success for 12 nests which were observed hatching during morning and night patrols. As the number of eggs is unknown for those nests, the average clutch size of 120 eggs was used for analysis.

n	Fate	eggs total	shells total	hatching success (%)	emerging success (%)
12	hatched	1440	1152	80	79.79

Table 2-7 Hatching and emerging success for 12 unmarked green turtle nests excavated from March 1st until December 11th 2006 on North Beach.

For the 12 nests found hatching a hatching success of 80% and an emerging success of 79.79% was calculated.

2.4. Discussion

2.4.1. *Daily track census and nest surveys*

The study period from March 1st until October 31st 2006 covers the peak nesting period of green turtles, which on the Caribbean coast of Costa Rica ranges from June to November.

The seasonal distribution of green turtle tracks shows September as the peak of the nesting season with 140 nests and 220 half moons followed by July and August with 77 and 75 nests respectively. While more nests were recorded in July than in August, the latter month accounted for more half moons (n=152) compared to July with 132 half moons.

Regarding the spatial distribution of green turtle tracks on North beach during the 2006 nesting season, the preferred section of North Beach was within the first Mile and a half (Mile 2/8 to Mile 1 4/8), where both half moons and nests had their highest peaks.

2.4.2. *Monitoring of female turtles*

The four dead green turtles found on North Beach during this nesting season together with four tags of turtles killed in San Francisco brought to the station show that adult sea turtles are still being killed for their meat on North Beach.



The killing of adult sea turtles causes a major impact on nesting populations by reducing the number of adult females who can live for about 19 years beyond maturity until 45-59 years. It is estimated that an adult green turtle produces 1900-2300 eggs and 1000-1900 hatchlings in her lifetime (*Sea Turtles, Spotila J.R., 2004*). It should be of highest priority to stop the killing of sea turtles in the Tortuguero area by involving the local authorities when such events occur. Collaboration with both the CCC (Caribbean Conservation Corporation) and MINAE should be aimed for to reduce the killing.

2.4.3. *Biometric data*

The overall biometric data collected during the 2006 green turtle nesting season matches with the expected pattern of an ongoing tagging program. Newly tagged turtles without signs of previous tags accounted for smaller carapace length and width measurements (n=73 for CCL and CCW) than both previously tagged turtles (n=50 for CCL and n=47 for CCW) and newly tagged turtles with signs of previous tagging (n=7 for CCL and CCW).

These results reflect the continuous tagging effort throughout the green turtle nesting season. The smallest size of newly tagged turtles without OTN or OTH indicates that these turtles might be neophytes in their first year of nesting.

2.4.4. *Monitoring of nests*

Illegal poaching of sea turtle nests was recorded throughout the entire study period. During morning and night patrols a minimum of 51.96% of nests (n=159) were classified as poached. Compared to 64.15% of poaching of marked nests by triangulation (n=34), the above numbers underestimate the actual poaching rate.

Only two triangulated nests could not be found because of inaccurate measurements, whereas seven nests could not be located due to removal or loss of triangulation tags. The latter happens when vegetation is cleared, but there also seems to be a certain degree of tag removal by locals. Possibly raising awareness among the people living in the area could reduce this loss of information.



Although North Beach receives less than 1 % of the Tortuguero green turtle population of nesting females, every possible effort should be made to better protect this nesting beach of globally endangered green turtles, endangered Loggerhead and critically endangered Leatherback and Hawksbill turtles.

Green turtle nest protection should be aimed for, but the situation of the local community regarding their dependence on sea turtle eggs together with the lack of control by the local authorities make this approach a highly sensitive one. Finding sources of alternative income as well as raising awareness within the local community should hopefully help to decrease poaching of adult turtles and sea turtle eggs in the near future. The implementation of a sustainable sea turtle conservation program on North Beach should be aimed for as soon as possible.

2.4.5. Excavation results, hatching and emerging success

The hatching and emerging success of hatched, marked nests recorded on North Beach is high at 90.89% and 90.58% (n=17) respectively. These numbers are higher than those recorded for undisturbed, marked nests excavated on Tortuguero Beach by the CCC (Unpublished Report on the 2005 green turtle program by the Caribbean Conservation Corporation) with 82.8% hatching and 80.5% emerging success (n=151).

Regarding hatching and emerging success of 12 unmarked nests observed hatching, the obtained numbers of 80% and 79.79% respectively are closer to the success rates of undisturbed nests on Tortuguero Beach than to the success rates of marked, hatched nests on North Beach.

The overall hatching and emerging success on North Beach with 30.38% and 30.28% respectively (n=53) is very low due to a high percentage of poached nests (64.15%). Compared to an overall hatching success of 70.7% and an overall emerging success of 68.1% recorded on Tortuguero Beach by the CCC, the success rates of sea turtle nests on North Beach are preoccupying. These results should be a strong enough reason to all for protective measures, e.g. patrolling of North Beach, by the local authorities during future sea turtle nesting seasons.



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