Nesting Season in Cahuita 2007

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1. Sea Turtle Research Project

1.1 Introduction

Cahuita National Park is a small park of approximately 1067 hectares that extends along the Caribbean coast of Costa Rica. A survey conducted on this beach established it as an important nesting ground for Leatherback (*Dermochelys coriacea*) and Hawksbill (*Eretmochelys imbricata*) sea turtles, both of which are considered endangered species. A turtle conservation project was thus established in this area, by Asociación WIDECAST, in the year 2000.

Monitoring of turtle activity on this beach runs from the beginning of March to the end of October. Information presently collected by Asociación WIDECAST in this region consists of nest counts, track counts (where a nest is believed to have been deposited) as well as records of illegal egg collection. As in other nesting beaches along the coast of Costa Rica, it is assumed that before the start of this project over 99% of the eggs were taken from Cahuita National Park beach.

In 2007, Whole Foods Market Team Members participated in the sea turtle conservation project at Cahuita National Park from June through October. The Team Members were trained by both GVI and WIDECAST staff to patrol the length of the beach from the Puerto Vargas station to Río Carbón and to monitor the hatchery throughout the evening. In this way, Team Members provided valuable human resources to a local, long-term conservation project. The following is an introduction to the species of sea turtle nesting at Puerto Vargas, the threats to sea turtle survival and the techniques used in the conservation of sea turtles.

1.1.1 Leatherback Turtle (*Dermochelys coriacea*)

The leatherback turtle (*D. coriacea*) is the largest of the marine sea turtles and the only species of its family. It has a distinctive 4 cm thick rubbery textured carapace (Wood et al., 1996) and is the longest and deepest diver of the air breathing invertebrates. It is the most widely distributed of the marine turtles with a demographic extending from 71N to 47S (Pritchard and Trebbau, 1984).

A 70% decline has been reported in the Leatherback population from 1982 (115,000 individuals, Pritchard, 1982) to 1996 (less than 30 000 individuals, Spotila et al., 1996). The greatest threat to this sea turtle species is over harvesting of eggs, hunting for the commercial use of oil, incidental take in commercial fisheries and marine pollution such as balloons and plastic bags floating in the water, which are mistaken for jellyfish their common foodsource.

Population numbers for sea turtles do not exist; estimates are primarily based on beach monitoring reports of nesting turtles. The worldwide population of nesting Leatherback females, estimated by the Caribbean Conservation Corporation (CCC) in 2004, was projected to be in the range of 26,000 to 43,000 individuals. The leatherback turtle has been considered endangered by the World Conservation Union since 1996 and has been on IUCN's red list classified as a critically endangered species since 2003. Despite ongoing research and conservation efforts set up in many countries, the leatherback turtle is in serious danger of global extinction (Baillie, 1996).

1.1.2 Hawksbill turtle (*Eretmochelys imbricata*)

The Hawksbill turtle is one of the smallest sea turtle species, growing to a carapace length of about 1 m and weighing approximately 40-60 kg. A distinguishing feature of this turtle is its narrow, sharp beak used for feeding on coral reefs. For centuries the Hawksbill turtle has been hunted by many cultures for its beautifully ornate shell. The long time demand and exploitation for this shell has had a profound effect on the population status and survival of this species (Eckert, 1995).

Hawksbills have been on the IUCN's red list and considered endangered since 1982 and have been upgraded in status and classified as critically endangered since 1996. In the Caribbean, population status has been reported to be depleted or declining in 22 of the 26 geographical areas for which information is available (Meylan, 1999). The population was estimated in 2004, by the CCC, to be between 8,000 and 15,000 nesting females worldwide. Hawksbill sea turtles are facing an extremely high risk of extinction in the wild in the immediate future.

1.1.3 Green turtle (*Chelonia mydas*)

The Green sea turtle is named for the green colour of the fat under its shell. It can be easily distinguished from the other species by the single pair of prefrontal scales between its eyes. Adults are generally 76-91 cm in length and weigh approximately 136-180 kg. Green turtles nest at intervals of 2, 3, or more years, with wide year-to-year fluctuations in numbers of nesting females. This species nests between 3 to 5 times per season and lays an average of 115 eggs in each nest. The greatest threat to the Green turtle is from commercial harvest of eggs and meat. Other threats are the use of green turtle parts for leather as well as incidental by-catch in commercial shrimp trawling. The Green turtle has been considered an endangered species on the IUCN's red list of threatened species since 1982 and is in danger of extinction within the foreseeable future. The worldwide nesting female population in 2004 was estimated by the CCC to be 88,520 individuals.

1.1.4 Turtle Threats

It's estimated that only 1 in 1,000 to 10,000 sea turtle hatchlings will survive to adulthood. The natural obstacles faced by young and adult sea turtles are staggering, but it is the increasing threats caused by humans that are driving them to extinction. Some natural threats include nest and hatchling predation by racoons, crabs, birds and a host of predators in the ocean; adults are relatively immune to predators besides the occasional shark attack. Disease and infections as well as natural disasters are also a threat, however, data is rare on these occurrences and they are not believed to be critical. To understand the real threats to sea turtles, then human influence must be considered. Human threats include over-harvesting of eggs, hunting for the commercial use of oil and meat, commercial fishing as well as marine debris entanglement and ingestion (plastic bags are of particular concern as turtles can't distinguish them from floating jellyfish). Overdevelopment of nesting sites is an increasingly alarming problem; artificial lights discourage females from nesting and cause hatchlings to become disoriented and wander inland where they often die of dehydration or predation. Coastal armouring such as sea walls and sandbags block females from reaching nesting habitats and accelerate erosion down the beach. Oil spills, urban runoff of chemicals, fertilizers and petroleum impact the overall health of the sea turtle population as well as food they eat.

The extensive migration of sea turtles means that individuals from different rookeries may share foraging grounds. Human activities in those areas can therefore affect rookeries from geographically and politically separated areas. Mortality of juvenile and adults of highly migratory species can have widespread consequences (Tuck et al., 2003). In addition, the inherent characteristics of turtles as long lived, slow growing and late to mature species makes them particularly vulnerable to excessive mortalities and rapid population collapse (Musick, 1999).

Population dynamics of the species are still poorly understood due to the difficulty in obtaining reliable data. As a solitary, migratory sea living creature, marine turtles are inaccessible throughout most of their life phases. Data for population dynamics and survival probabilities to date are mainly comprised of beach studies on nesting females.

1.1.5 Natal Beach Homing

One theory suggests that female sea turtles, at their sexual maturity (13-14 years for Leatherbacks; Zug and Parham, 1996), return to the beach they emerged from as hatchlings to lay their eggs (Ackerman, 1997). Lohmann and Lohmann (1996) suggested that female sea turtles accomplish this through chemical imprinting; hatchlings imprinting chemical cues from their natal beach and retaining this information to later return to the same area to nest as adults. Another proposition is the magnetic map hypothesis. Turtles migrate great distances to return to their nesting site, implying they can efficiently determine their position relative to their goal when journeying (Lohmann and Lohmann, 1996). Possibly by using the earth's geomagnetic fields sea turtles can achieve precise migrations between long distances to return to their nesting site. Information concerning natal beach homing is particularly significant for sea turtle conservation as it has implications towards the protection of specific important nesting sites.

1.1.6 Tagging and Pitting

More information is required to determine a reliable estimate of the oceans sea turtle populations and to ameliorate turtle conservation techniques. Determining life cycle activities, migration patterns and the fate of sea turtles is of the utmost importance. Flipper tagging was introduced as a means of monitoring individuals, and cohorts for research purposes. Tagging provides information on movements, strandings, reproductive biology, residency and growth rates (Balazs, 1999). Over time the usefulness of this technique was demonstrated to be limited and unreliable with gross underestimations of survival due to loss of tags (McDonald and Dutton, 1996). In 1992, the use of Passive Integrated Transponders (PIT) was introduced. PIT tags are small inert microprocessors sealed in glass that transmit a unique identification number when activated by a low frequency radio signal sent by a hand held reader held at close range.

Although these tags are more costly, they are yielding more reliable information that provide better population dynamic trends (Dutton et al., 2005).

1.1.7 Nesting

Along the coast of the Caribbean in Central America, nesting for Leatherbacks occurs predominantly between the months of March and July (Chacon, 1999) and May to November for the Hawksbill. Once females reach sexual maturity, they return to nest on average every 2-3 years.

Leatherback turtles typically renest every 9-10 days for an expected total of 5-7 times a season (Eckert, 1999). The females, in this area, generally lay an average of 90 fertile eggs and 30 infertile eggs per clutch. The Hawksbill females in the Caribbean tend to re-nest at 15-21 day intervals and lay, on average, 130 eggs per clutch. However, they can lay up to 200 or more eggs in one nest.

Sea turtles require certain beach conditions to successfully nest. False crawls are a common occurrence on turtle nesting grounds and can be identified by tracks forming a half moon in the sand. False crawls can be provoked by disturbances or obstacles on the beach or occur naturally for undetermined reasons.

1.1.8 Hatchery

The hatchery is another means of collecting practical data that can be used to extrapolate population dynamic information as well as being a valuable conservation tool. A hatchery is an artificially constructed closed off area on the beach where eggs are relocated for protection from certain predators, poachers, erosion and various beach disturbances. This is of particular significance in areas where human activities are an important cause of mortality.

Hatcheries are also utilized for collecting information during the incubation period. Data is collected on the ambient environment of the nests such as temperature (to estimate sex ratios of hatchlings) and rainfall as well as on the overall success of the nests. Hatcheries are also surveyed throughout the night to allow for post emergence biometric information to be collected on the hatchlings.

1.1.9 Importance of Sea turtle conservation

Sea turtles are a part of two ecosystems: beach/dune system and the marine system. If turtles become extinct both these environments will be negatively affected. For example, *C. mydas* eats sea grass; this grazing maintains healthy grass beds on the marine floor that, in turn, provide breeding and development grounds for many species of fish, shellfish and crustaceans. Without sea grass beds, many marine species humans harvest would be lost as would the lower levels of the food chain. Moreover, undeveloped and underdeveloped sea turtle eggs in nests are an important provider of nutrients for dune vegetation which contribute to the health of the entire beach/dune ecosystem. Stronger vegetation and root systems help to protect the beach against erosion. With global warming and the rise of sea levels, dune vegetation is becoming increasingly important as a protection against land erosion.

Knowledge gathered from long-term sea turtle conservation projects is necessary to predict the effects of the preventive work currently underway and therefore improve management strategies in the future. Additional research programs are needed to determine the root causes of population declines and to set up pre-emptive measures that will halt long-term declines in sea turtle population size. Conservation on a global level is essential but requires consolidation of regional conservation strategies around the world. Team Member contribution to this project is therefore crucial in the long-term protection of these species of marine turtles nesting at the Puerto Vargas beach.

1.2 Aims

The aim of the project is to assist WIDECAST to meet their program objectives (see below), and document and monitor the nesting of female sea turtles (green, leatherback and hawksbill) and analyse the data at the end of the turtle season (July and October)

- A partial recovery and subsequent stabilization of the sea turtle nesting populations in the south Caribbean.
- The standardization of the programs on environmental education, conservation and research leading to the unification of criteria and efforts for the management of sea turtles at the level of the protected areas of Conservation Area of La Amistad- Caribe.

- More political incidence on a local and national level for decision making in the management, regulation and use of sea turtles.
- Economical alternatives for some groups of the community.
- Active participation by a high percentage of the members of the community in the conservation of sea turtles.
- Consolidation of the program as a key factor in the conservation of sea turtles in the region.
- Sharing of this pioneer experience, which integrates conservation with local socio-economical development, with the intention of supporting new projects for conservation of sea turtles, especially in areas where these represent a resource of local importance.
- Local team-workers installed, reducing the anthropogenic-consumptive use and promoting the non-consumptive uses, so that the conditions for the recovery of the biotic populations will be established, allowing continuity and sustainability.

1.3 Training

At the beginning of the phase Didiher Chacón (the director of turtle programs for WIDECAST) and his assistant Claudio Quesada gave presentations to the TMs on both the history of WIDECAST and its diverse array of projects in Talamanca and specifically on the Cahuita Marine Turtle project. After Claudio finished his talk, TMs received patrol and hatchery training from both the WIDECAST reserach assistants and GVI staff. GVI staff presented an in-depth PowerPoint presentation about Sea Turtle Conservation Methodologies which is accompanied by a handout that Team Members kept with them. During the presentation, the GVI staff discussed in detail the specifics of working on Puerto Vargas beach (length, markers, morning survey etc) and stressed the importance of patrolling guidelines (walking in a line, limited/quiet talking, red filters on headlamps, etc). After methodology training, the group was brought to the hatchery to discuss hatchery monitoring protocols. GVI staff or WIDECAST research assistants discussed every possible scenario TMs could encounter while at the hatchery and how to deal with it. The comprehensive training allowed the Team Members to provide quality data to GVI's program partner, WIDECAST and to advance knowledge of sea turtles on Puerto Vargas Beach in 2007.

1.4 Methods

1.4.1 Study Area

The study site for the WIDECAST Sea Turtle Conservation Project was carried out over a 14 km stretch of beach in Cahuita National Park located in the Talamanca region on the south-eastern coast of Costa Rica (09°45'27N 82°51'79 W to 09°39'33N 82°45'71 W). The beach extends from the town of Cahuita Playa Blanca to Puerto Vargas beach and ending in Playa Negra, Puerto Viejo. The study site is marked every 50 m with numbers starting at -99 to 180 that are painted on a palm tree or wooden stick implanted in the ground. This beach is a nesting site for *D. coriacea*, *C. mydas*, and *E. imbricata* species.

Satellite Photo of Puerto Vargas beach depicting the position of the markers. (www.googleearth.com)

When resources are available patrols are done from 20:00-4:00 in four hour shifts. Morning surveys are completed from 4-8am. The evening patrols started in front of the MINAE station (-27) and ended at Rio Carbon (110) for a total of 6.9 km. Morning survey started at marker -27 and ended near the town of Cahuita (-99) covering 3.6 km of beach. No nightly patrols were held from Rio Carbon to Playa Negra (makers 110-180) however, monthly morning surveys were done to record hatchling and turtle tracks and to perform excavations.

Due to the length of the beach patrolled, the turtles themselves were not always encountered during the evening surveys. In these circumstances, any available data was collected; such as area of the beach, nesting or non-nesting activity, and nest details if possible. When a nesting turtle was encountered during patrol, external and internal identification tags were noted or applied if necessary, nesting activity was recorded, and eggs relocated or camouflaged. After the incubation period, excavations were preformed on relocated nests and data collected on hatchling success rates.

The hatchery was monitored from 18:00-6:00 in six hour shifts. Data on nest temperatures (^{o}C) were collected every 6 hours, from nests containing thermocouples, using a Sperry® STK-3015T K Type thermometer. Rainfall was recorded (mm^3), using a plastic rain gauge, daily at 6:00 am. Incoming eggs from patrols were relocated into the next available hatchery quadrant (A1- M8) and expected nests monitored every 30 minutes for emergents. Latex gloves were worn for all turtle and egg manipulations.

1.4.2 Tagging

All *D. coriacea* species encountered were scanned on the right shoulder for Passive Integrated Transponder (PIT) using a Pocket▪Reader EX® microchip scanner. If a PIT was needed, the area was cleaned with a Vanodine solution and manually injected into the right shoulder using an AVID® pistol. External tags were checked and recorded on the rear flippers for *D. coriacea* and front flippers for *C. mydas* and *E. imbricata*. If external tags were needed the area was cleaned with a Vanodine solution and MONEL #49 metal tags were attached using metal pliers. The tagging area on *D. coriacea* is located on the thin membrane between the tail and rear flippers and on the posterior edge on the second scale of the front flippers for *C .mydas* and *E. imbricata*. Tissue samples were collected on all turtles receiving new tags or PIT. Tissue samples were collected using a scalpel blade (#10 or #15) from the posterior edge of the hind flipper and placed into a vial of alcohol solution labelled with identification tag numbers and date.

1.4.3 Biometrics

Biometric information was recorded on every turtle encountered during patrol. Sand was systematically brushed off the carapace to avoid inaccurate measurements. For *D. Coriacea*, the Curved Carapace Length (CCL) was measured the top of the carapace, where the skin touches the carapace, extending along the side of the central dorsal ridge to tip of the caudal projection. For *C. mydas* and *E. imbricate*, measurements were made along the centre of the carapace. Curved Carapace Width (CCW) was taken along the widest area of the carapace, perpendicular to the central ridge for *D. Coriacea*, and along the central scutes for the other two species. Measurements were conducted on all individuals as if the shell was undamaged and contained no malformations.

1.4.4 Relocation

Every encountered *C. mydas* and *E. imbricata* nest was relocated to the hatchery. *D. coriacea* nests found between -27 and 0 marker were relocated to the hatchery, those located between markers -27 to 110 were relocated to a safe area on the beach. Nest depth and width were recorded for nest replication, relocated nests were camouflaged and data was collected on new nest location. A metal tag was included in relocated nests with the date, egg count and nesting female's identification numbers for future use during excavation. Nests relocated to the hatchery quadrants were replicated using the nest measurements and protected with a mesh basket sunk 10 cm into the sand around the nest. A thermocouple, for temperature measurements, was placed in the centre of every second nest.

1.4.5 Reproductive Success

Hatchling Measurements

Biometrics and weights were collected from 15 hatchlings, chosen at random, using a 15cm calibrator and Pesola ® 100g scale. Hatchlings were placed into a plastic cup to be weighed and biometric methodologies followed the same protocol of nesting female turtles. Health conditions of emergents were recorded as well as the weather conditions at time of emergence. Hatchlings were released no less than 5 meters from the sea after 5pm or when conditions were optimal during the day i.e. cloud cover and lower temperatures. Hatchlings were released twenty at a time at different spots along the beach to increase their chance of survival.

Nest survival and success

Excavations were preformed five days after the first hatchling emerged from a nest. The entire nest content was removed and analyzed by separating them into living hatchlings, dead hatchlings, eggshells, eggshells without emergence evidence, and infertile eggs. First the eggs without evidence of emergence were opened and classified as eggs with embryos, egg without development, or eggs with fungus or bacterial infection. Embryos found were classified into developmental stages (I-IV). Dried eggshells were counted and identified as emerged hatchlings. The remaining pieces of eggshells were collected together to create the approximate size of an eggshell. Finally any pipped eggs (incomplete hatching), eggs affected by crabs or ants or larval infection, were identified and counted. Following excavations, contents of nests were placed in a hole, no less than two feet deep, in the forest away from the beach/hatchery. The hatchling success of a nest was then calculated using the following formula:

$$\text{Hatchery Hatchling success} = \frac{\text{Total number of hatchlings} \times 100}{\text{Number of fertile eggs}}$$

$$\text{Beach Hatchling success} = \frac{\text{Reconstructed egg shells + Live hatchlings found in nest X100}}{\text{Number of fertile of eggs}}$$

1.5 Results

1.5.1 Leatherback turtle

A time series of data collected on Puerto Vargas beach from 2001-2007 shows a decrease of nesting activity of *D. coriacea* through time (Fig. 1). The 2007 *D. coriacea* season started on February 27th and continued until the 25th of July. Percentage of nests documented on Puerto Vargas beach shows peak months for turtle activity from March through May with particularly high nesting activity in April and May (Fig. 2). A total of 226 different recordings were documented throughout the season where 67.7 % of the turtles nesting on Puerto Vargas beach (Table 1). Out of these nests, 40% were found on patrol and were relocated on the beach, 3.88% were relocated to the hatchery, 28.3% of nests were camouflaged and 2 nests (1.1%) were left natural. In total 26.7 % nests were poached with 29.1% from Puerto Vargas beach and 70.83% from Playa Negra. Overall, 32.3% false crawls were recorded. A turtle was identified (with PITand/or tags) for 62.8% of the nests documented. During the season, the majority of individual turtles were encountered by patrol only once. Re-nesting occurred to varying degrees, however, in general, the same turtle nested only once or twice in the patrolled area. No correlation could be established between curved carapace length and clutch size of D. coriacea (R^2=0.04; Fig. 4)

Table 1: Summary table of *D. coriacea* data collected on Puerto Vargas beach, Costa Rica, Feb. 15th to July 25th, 2007.

Category	**Number**
Total Number of Records	232
Total Number of Nests	180
Total Number of False Crawls	86
Total Number of Individuals Identified	113
Total Number of Re-Nesters	53
CCL Average	150.2
CCW Average	110.5
Number of Nests relocated on beach	72
Number of Camouflaged nests	51
Number of Nests relocated to hatchery	7
Number of Poached nests (+Playa Negra)	48
Number of Fertile eggs	12368
Number of Hatchery hatchlings	307

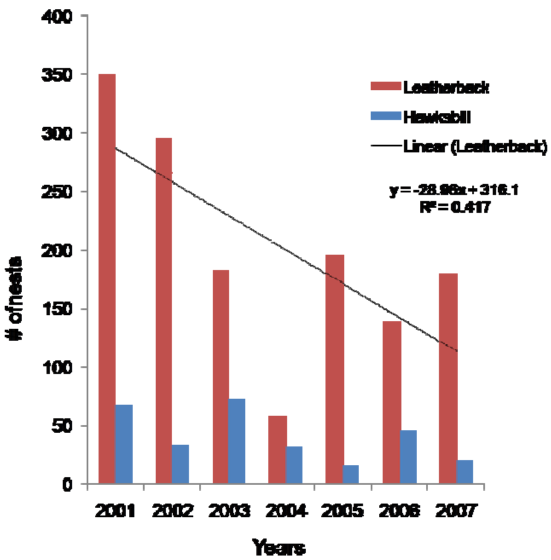


Figure 1: Time series for Leatherback (*Dermochelys coriacae*) and Hawksbill (*Eretmochelys imbricata*) nesting activity on Puerto Vargas beach, Costa Rica.

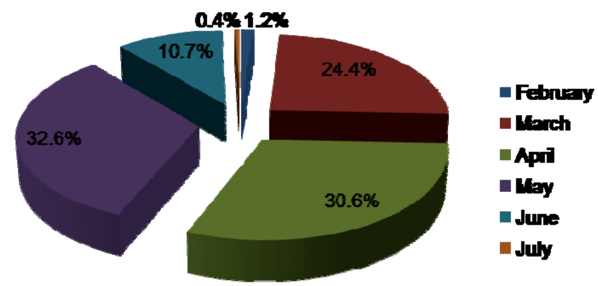


Figure 2: Percentage of individual Leatherback turtles (*Dermochelys coriacea*) nesting per month on Puerto Vargas beach, Costa Rica, Feb 27th–July 25th, 2007.

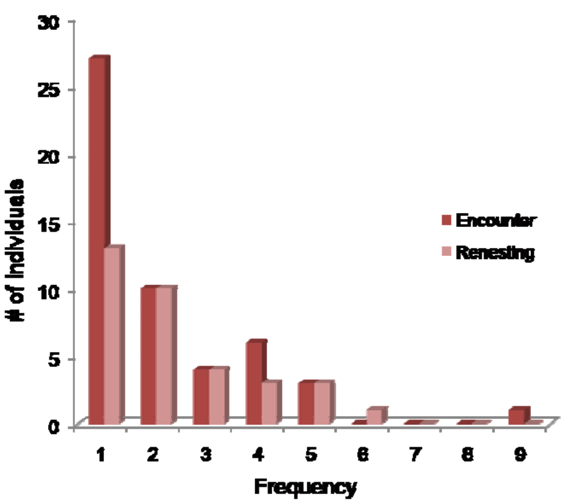


Figure 3: Encounters and re-nesting frequency recorded of individual Leatherback turtles (*Dermochelys coriacea*) on Puerto Vargas beach, Costa Rica, Feb 27th-July 25th, 2007.

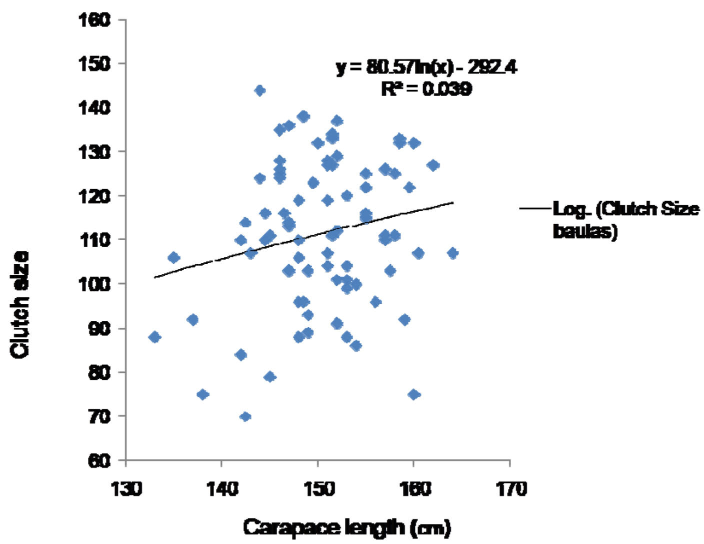


Figure 4: Scatter plot of clutch size (yolkless and fertile eggs) in relation to individual Leatherbacks (*Dermochelys coriacea*) curved carapace length, Puerto Vargas beach, Costa Rica, Feb. 27th-July 25th, 2007.

1.5.2 Green turtle

The 2007 *C. mydas* season started with the first nest laid on May 19th and continued until 6th of October when data was no longer collected. A total of 8 different recordings of turtle presence on the beach were documented throughout the season. Five nests were recorded for this species on Puerto Vargas and Playa Negra beaches; 1 of the nests was relocated on the beach, 3 were camouflaged, and 1 was poached from Playa Negra. Documentation of non nesting turtles resulted in one false crawl, one turtle was found deceased and decomposing from reasons unknown and one was placed approximately 10 meters in the vegetation by local fisherman towards Cahuita town, this turtle was identified and released.

1.5.3 Hawksbill turtle

The 2007 *E. imbricata* season started with the first nest laid on June 1st. Twenty-five different turtle recordings were documented and a total of 20 nests were laid (Table 2). From these nests, 10% were relocated on the beach and 75% were relocated to the hatchery. Only 1 nest was left natural and 2 were poached from Playa Negra. Only one false crawl was documented for this season. Out of the 20 nests compiled, 55% of the turtles were identified with tags. One time nesters were the majority with 36.4%, one turtle nested three times, and one nested four times.

Table 2. Summary Table of *E. Imbricate* data collected on Puerto Vargas beach, Costa Rica, February 15th to September 1st 2007

Category	**Number**
Total # of records	25
Total # of nests	20
Total # of False Crawls	5
Total # of individuals identified	11
Total # of re-nesters	2
CCL Average	98.5
CCW Average	82.2
# Natural nests	1
# Relocated nests	2
# Relocated to hatchery	15
# Poached nests (+Playa Negra)	2
# Fertile eggs	2340
# Hatchery hatchlings	807

1.5.4 Puerto Vargas Beach

Throughout the survey season, over 75% of the nests documented were *D. coriacea* nests (Fig. 5). Only a small amount of *E. imbricata* and *C. mydas* were recorded for this year's season. The majority of nesting turtle encounters on Puerto Vargas beach for this season, for all observed species, occurred between the hours of 22:00-01:00 (Fig. 6). A time series for poaching activity of *D. coriacea* eggs on this beach between 2001-2007 shows small variation in percentage save for a peak in the year 2004 (Fig. 7). Poaching activity on Puerto Vargas beach was considerably higher past marker 9 and showed marked increase in the direction of the Rio Carbon, towards maker 110 (Fig. 8).

1.5.5 Hatchlings

Throughout the 2007 nesting season 712 *D. coriacea* hatchlings were documented. Out of these hatchlings, 56.9 % emerged from nests from beach relocations and 43.1 % emerged and were released from the hatchery. A total of 807 *E. imbricata* hatchlings emerged and were released from the hatchery for the 2007 season. *E. imbricata* generally had better nest success in the hatchery than D. Coriacea. One *D. coriacea* and 8 *E. imbricata* nests that were relocated to the hatchery (for a total of 1148 fertile eggs) were still in development phase at the termination of the project. On the beach, 1 relocated nest (109 fertile eggs) and three camouflaged *C. mydas* nests were also still incubating, data on the success of these nests are thus unavailable. Excavations were not systematically conducted on the recorded nests. Only 12 out of 22 nests in the hatchery and 14 out of 125 relocated, camouflaged and natural nests on the beach were excavation, analysis could thus not be conducted on these data sets.

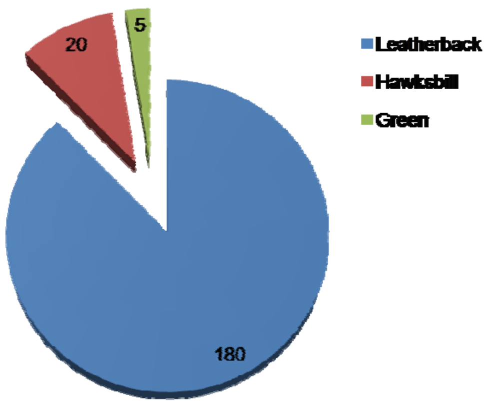


Figure 5: Pie chart of # of nests of Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricata)* and Green *(Chelonia mydas)* turtles on Puerto Vargas beach, Costa Rica, Feb. 27th-Sept. 1st, 2007.

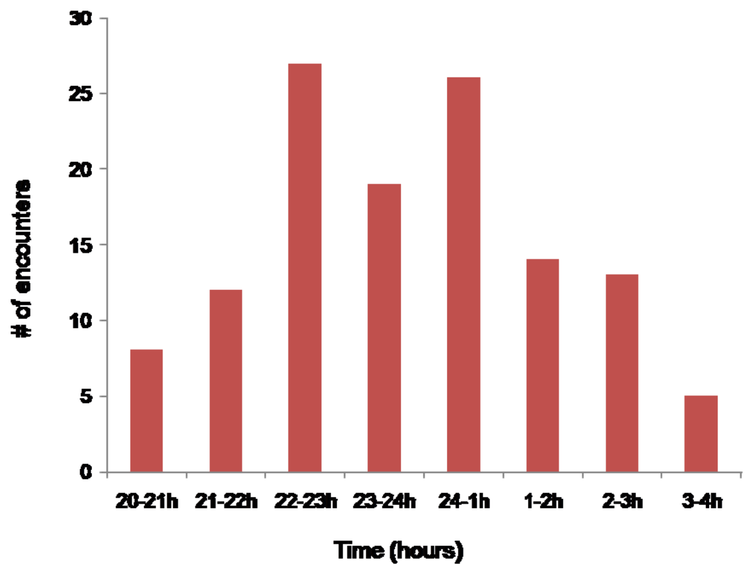


Figure 6: Frequency distribution of turtle encounters for Leatherback (*Dermochelys coriacea*), Hawksbill (*Eretmochelys imbricata)* and Green *(Chelonia mydas)* turtles in relation to time (hours) on Puerto Vargas beach, Costa Rica, Feb. 27th-Sept. 1st, 2007.

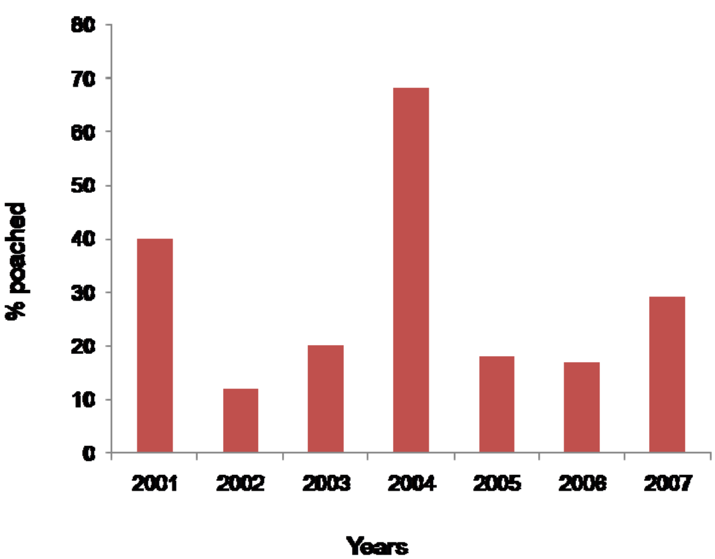
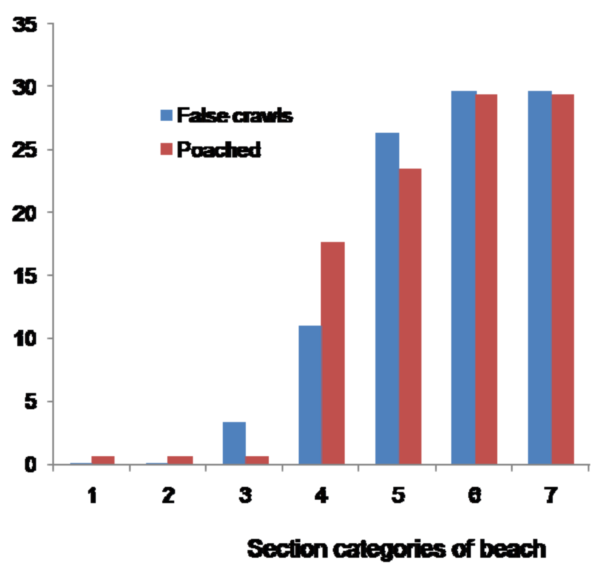


Figure 7: Times series for poaching of the Leatherback turtle (*Dermochelys coriacea*) through the years on Playa Negra and Puerto Vargas beach, Costa Rica.



Category	Markers
1	-99–70
2	-69–40
3	-39–10
4	-9-20
5	21-50
6	50-80
7	81-110

Figure 8: Number of false crawls and robbed nests recorded for different sections of Puerto Vargas beach, Costa Rica, Feb. 27th-Sept.1st, 2007.

1.6 Discussion

Through the years, a decrease in nesting activity of Leatherbacks turtles has been observed on Puerto Vargas beach. The significantly lower number of nests observed in 2004 may be an artifact of inter-annual nesting variation. Hence, the lower numbers observed that year do not necessarily signify a decline in the nesting population. As sea turtles are slow maturing and long lived, population dynamics cannot be properly established by this limited time series. Nevertheless, a noticeable 40% decrease of nests through the years of 2001-2007 is unsettling and may indicate an important and rapid declining trend in the Leatherback rookery of the Central American Caribbean. Added attention should be awarded to this particular rookery as it has been classified as one of the 4 largest Leatherback rookeries in the world. The underlying cause for this population's decline must be discovered and addressed as continuing threats to main rookeries would be disastrous to the worlds Leatherback population.

The majority of turtles were encountered only once on Puerto Vargas beach. The majority of encounters, for all studied species, were concentrated around the times of 22:00 to 1:00 in the morning. It is thus advised that, when resources are low and patrols are limited, surveys be conducted during this time range to increase the probability of encounters with nesting turtles.

Although Leatherbacks, Hawksbills and Greens have been recorded to nest on Puerto Vargas beach, the bulk of nesting turtles recorded in the area have been Leatherbacks. Despite the low Hawksbill encounters this season, conservation efforts should continue until the end of its predicted nesting season, as this species, with the exception of the Kemp's Ridley (*Lepidochelys kempii*), is considered to be the most endangered of all sea turtles. The low nesting activity recorded for Hawksbills on Puerto Vargas beach, a renowned nesting site for this species in the Caribbean, attests to its low population and threatened survival.

Leatherback illegal poaching activity on Playa Negra and Puerto Vargas beach has varied over the last 7 years with an increase apparent for the 2007 survey season. This increase can be explained by the simple fact that Playa Negra beach was not patrolled this year due to lack of resources and funding. During the monthly surveys on Playa Negra beach, 100% of nests encountered had been poached. These findings attest to the importance of finding funds to patrol not only Puerto Vargas beach but Playa Negra as well. Playa Negra, with it's proximity to

Puerto Viejo, is a convenient area for local turtle poachers and clearly requires active presence at night during the nesting season.

On Puerto Vargas beach, an increasing number of illegal poaching activities were recorded towards Rio Carbon. This area is further from the MINAE/WIDECAST base and presents a convenient area for fishermen from Hone Creek (village situated up the river) to poach at night. Lights were often observed in the vicinity of the river entrance during night patrols. Active MINAE presence on the beach would help diminish poaching in the area as well as provide security for the patrollers.

The higher quantity of turtle false crawls near Rio Carbon entrance could be attributed to the additional human activity on this section of the beach and/or to the higher quantity of washed up natural debris found there. It is recommended that MINAE and the local police of Cahuita and Puerto Viejo work more closely with the turtle conservation projects to ensure law enforcement. Poachers must be held accountable with correct court procedures and fines along with possible jail terms for repeat violators but of course is dependent on government resources. Walking on Puerto Viejo or Cahuita nesting sites at night, during or after patrol times, should be strictly prohibited and hold consequences for offenders.

Some immediate goals for protecting sea turtles include cracking down on illegal international trade of turtle products by enforcing laws and agreements as well as the mandatory use of Turtle Excluder Devices (TED's) by fishermen. Protection of nesting beaches is necessary and can be accomplished by establishing parks and refuges. When unattainable, elimination of disturbances by decreasing artificial lighting, halting beach armoring, regulating beach nourishment and limiting the impacts of people on the beach is necessary. Enforcement of national and international laws to minimize the dumping of pollutants and solid waste into the ocean and near shore waters is also needed. Another essential conservation strategy is to promote greater public awareness and support for sea turtle conservation worldwide. Public awareness can be achieved through community participation in sea turtle conservation by means of educational programs such as this one.

The continued research and monitoring of sea turtle activities is indispensable so that the population can be monitored and conservation efforts can be focused where they are most needed. For example: studying population status (population size), re-nesting and re-migration intervals, beach fidelity, hatch rates, threats to eggs and hatchlings and adult turtle sources of mortality. This information is essential for effectual management and future recovery of sea turtle populations.

1.7 Potential Work

This year's data compilation presented many discrepancies and problems due to inconsistencies in data collection. The lack of a biologist for this project has caused there to be an unorganized collection of raw data from the launch of the project in February. The project contains a program coordinator, highly experienced in turtle monitoring, and research assistants that change every three months. Due to this inconsistency in WIDECAST staff, the majority of complications derive from human error in data recording and transfer. Raw data sheets, transferred data, information in the data base, and excavation data were conflicting on many occurrences, thus creating unfeasible data resources and subsequently limited available data for analysis. In response to these human errors, it is advised that a biologist be hired as project coordinator and that the research assistants be properly trained in data collection methodology to assure that data, for the 2008 season, is collected in a consistent and practical manner. Also, GVI can significantly help in 2008 by being present for the whole season rather than for just part of it by making sure to help with data collection and entering right from the start, alleviating some of the work from WIDECAST.

Illegal poaching of eggs and turtles remains a problem on Playa Negra and Puerto Vargas beach. It is thus highly recommended that active presence on both these beaches during nesting season, and further involvement of MINAE and local authorities, be implemented to dissuade illegal activities in the area. Realization of community environmental education programs in Cahuita, Puerto Viejo, Hone Creek and other surrounding areas is essential for the future conservation of these species.