Project for the Conservation of sea turtles, Playa Gandoca
Hawksbill Turtle and Green Turtle Season
REPORT 2009

Monitoring of the nesting activities of the Hawksbill turtle (*Eretmochelys imbricata*) and the Green turtle (*Chelonia mydas*) at Playa Gandoca, Gandoca-Manzanillo Wildlife Refuge, Costa Rica from August until October 2009

By

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Red para la Conservación de las Tortugas Marinas en el Gran Caribe

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Acknowledgements

Sponsors, MINAET, volunteers and volunteers agencies, Also the support of the central office at Tibás.

Table 1: Summary of Data recorded

	Variable	HS			LS	
	Period of Monitoring	***August 16th- October 15th, 2009***			***February 15th-August 15th, 2009***	
	Total # of Records	***36***			***41***	
		E. i.	***C. m.***		***E. i.***	***C. m.***
	# of false crawls recorded	***8***	***0***		***0***	***0***
	# of nests	***17***	***9***		***40***	***1***
	Total # of nests	***26***			***41***	
	# of females tagged	***3***	***0***			
Biometrics	Mean curved carapace length (CCL) – *E. imbricata* [cm]	***86,0***			***85,2***	
Biometrics	Mean curved carapace width (CCW) – *E. imbricata* [cm]	***77,3***			***76,0***	
Nests	Mean # of eggs laid per nest	***161,27***	***111,17***		***144,32***	
Nest Destination	Nests left natural	***9***			***10***	
Nest Destination	Nests relocated	***17***			***17***	
Nest Destination	Nests in hatchery	***0***			***8***	
Nest Destination	Nests poached	***1***			***6***	
Nest Destination	Mean hatching success [%]	***68,18***			***51,30***	
Nest Destination	Mean emergence success [%]-TOTAL	***61,35***			***45,90***	
Nest Destination	Mean emergence success [%]	***E.i.***	***C.m.***	***D.c.***		
Nest Destination		***73,2***	***98,2***	***56,1***		
Nest Destination	Mean percentage of unhatched eggs infested w/ bacteria/fungus within nests [%]-TOTAL	***26,30***				
Nest Destination	Mean percentage of unhatched eggs infested w/ bacteria/fungus within nests [%]	**E.i.**	**C.m.**	**D.c.**		
Nest Destination		16,7	21,4	41,0		
Nest Destination	Mean percentage of larvae infestation within nest [%]-TOTAL	4,87				
Nest Destination	Mean percentage of larvae infestation within nest [%]	**E.i.**	**C.m.**	**D.c.**		
Nest Destination		4,36	0	6,36		

Resumen

Este informe recoge los datos de la anidación de la Tortuga carey y la Tortuga verde para el periodo entre el 16 de Agosto y 15 de Octubre del 2009. El monitoreo no solo incluyó la playa principal Playa Gandoca, sino una extensión de 800 m de arena coralina al norte de Punta Mona llamada La Playita. Los monitoreos totales registraron una anidación final de 57 nidos de Tortuga carey y 10 nidos de Tortuga verde, este registro incluye lo documentado en el periodo previo de Marzo a Agosto 15. La longitud curva del caparazón de las hembras de Carey fue de 86,0 cm y su ancho curvo de 77,3 ambos registros se encuentran dentro de los ámbitos normales previamente registrados, mientras que el tamaño de nidada 161 huevos para el Segundo periodo de monitoreo. El éxito de emergencia para nidos de carey fue de 73,2 neonatos por cada 100 huevos. Los altos niveles de agua que incluso alcanzaron la vegetación, los altos valores de la temperatura, la erosion costera y la recolecta illegal de huevos, hembras y su pesca dirigida con redes de enmalle son los problemas principales documentados.

Introduction

The sea turtle is a reptile, which evolved millions of years ago and which roams our oceans ever since (Hickman *et al.* 1990). Seven species of sea turtles are known to have survived to date, and these extent species are subdivided into two families, the hard-shelled family Cheloniidae (six species) and the family Dermochelyidae (one species) (Hickman *et al.* 1990). Each of the seven species has established its own unique ecological niche, which holds the key to their co-existence. Now-a-day these last seven species are all threatened with extinction, mainly due to anthropogenic causes (Musick 1999, Tuck *et al.* 2003), like ocean pollution and incidental capture by long-line fishery, which have advanced to the main extinction menace a few decades ago. Almost all sea turtle species have experienced a decrease in their population size during the past 10 years, up to 80%, as a result all marine species are listed as endangered or critically endangered by the IUCN. In order to be listed as critically endangered by the IUCN a species needs to have faced a reduction in population size of 80% during the past three generations, and is thought to further decrease in future.

Human threats to sea turtles in general include over harvesting of eggs, hunting for the commercial use of oil and meat, commercial fishing as well as marine debris entanglement and ingestion. 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 armoring such as sea walls and sandbags present a physical barrier to females reaching nesting habitats as well as accelerate erosion down the beach thus diminishing the nesting area. Pollution such as oil spills, urban runoff of chemicals, fertilizers and petroleum impact the overall health of the sea turtle population as well as the food they eat. Sea turtles are also like so many other species threatened by global warming, since ocean currents are changing, and food resources are disappearing due to a rise in water temperatures.

Marine turtles are known for a slow growth rate and reach sexual maturity merely after 15-50 years (Eckert *et al.* 2000). These long generation times are an aspect that needs to be considered in sea turtle conservation. Some researches believe that sea turtles are also long lively species, but these assumptions are based on observations of terrestrial turtles kept in captivity (Hickman *et al.* 1990).

The most vulnerable stage of a sea turtles' lives are the first years, here they face their highest mortality rate (Chacón 2004). With increase in size the mortality probability diminishes as individuals that reached a certain size are not as prone to i.e. predation and other natural causes for an early death.

The Hawksbill turtle (*Eretmochelys imbricata*) is one of the extent species of sea turtles, and part of the family Cheloniidae. It is one of the smallest sea turtle species, growing to a curved carapace length (CCL) of approximately 75-88 cm and weighs 40-60 kg (Spotila 2004). A distinguishing feature of this turtle is its narrow, sharp beak which is used for feeding on sponges in the coral reefs (the main diet of hawksbill turtles), and the saw-like edge of its carapace.

.Hawksbill turtles are found in tropical and subtropical waters, in close proximity to coral reefs. Important nesting beaches are the Seychelles, Yucatán (Mexico), the islands Mona and Monito (Puerto Rico), and beaches associated with the Great Barrier Reef (Australia) (Chacón 2009).

The Populations size of hawksbills is difficult to evaluate since aggregation of hawksbill turtles do not necessarily need to belong to one distinct population as it was revealed in genetic studies, furthermore in-water studies are expensive and difficult to conduct, and therefore the most reliable information of abundance derives from nesting-beach monitoring, which exclusively concentrates on nesting females, since males do not come on shore. Females come in so cold cohorts to nest, which varies in size from nesting season to nesting season (Chacón 2009). Females and males meet in water adjacent to nesting beaches to reproduce. Hawksbills travel up and down the coasts to forage, and migrate to nesting beaches to deposit their eggs, which further makes it difficult to estimate abundance and to even define a population (Chacón 2009).

To reach adulthood and to fulfilll a life cycle the hawksbill needs suitable beaches, open ocean, coastal waters, and estuaries (Chacón 2009). During one normal life cycle this turtle disperses and migrates over great distances, up to several thousand kilometers, passing open waters, and different countries (Chacón 2009).

The growth rate varies between life stages and regions, but is all in all so slow that hawksbills tend to reach sexual maturity quite late with 20-40 years, after they have left their nesting beach as a hatchling (Chacón 2009). Hawksbills are known to reproduce for 10 or more years after they have reached sexual maturity (Chacón 2009). The mean fecundity in females is high, with a female laying a mean of 140 eggs per clutch, and several clutches per nesting season (Chacón 2009).

This high fecundity is compensated by a high mortality of hatchlings, and juveniles during the early phases of the life cycle. Many eggs do not survive the incubation period, hatchlings do not reach the ocean, or do not survive their first month in open waters (Chacón 2009).

Females leave the water to lay their eggs close to or in the beach vegetation. To deposit the eggs they dig an egg-chamber approximately 55 centimeters deep.

Females skip nesting seasons in order to build up enough energy reserves, and re-nest in average every two to three years and up to every one to six years, as it was observed in Barbados (Chacón 2009). Every female lays an average of 4.5 clutches per season, in intervals of 14-16 days, in between which she spends time off the coast foraging. Hawksbill eggs need around 50-70 days to incubate, depending on nest location (shade or broad sun light), and on weather conditions and temperatures (Chacón 2009).

As in all sea turtle species the sex of the hatchlings is determined by the incubation temperatures during the second third of the incubation period (week three to five). The pivotal temperature in which a sex ratio of 1:1 among hatchlings is achieved lies at 29.32°C for hawksbills (Chacón 2009). Below this temperature more males develop, and above this temperature the sex ratio shifts towards a bias in females. A healthy population has a sex ratio close to 1:1, which promotes genetic diversity, the material necessary to adapt to environmental changes. Global warming and beach development (removal of beach vegetation) creates a huge bias towards females in populations, such as a sex ratio of 1:2.5 (males to females) was found in Palm Beach, Florida (Chacón 2009).

Natural threats to Hawksbills consist of depredation of eggs and hatchlings by insects, birds, crabs and smaller mammals like raccoons or coati mundis (Chacón 2009). On developed beaches straying dogs have become an increasing problem, since the dig out turtle nests, and feed on eggs and hatchlings. Once in the water the hatchlings are facing big predatory fish, like groupers and sharks, and sea birds, while floating close to the surface (Chacón 2009). Adult hawksbills do barely have a natural predator, since they are a well protected by a hard carapace and to big to be swallowed whole.

Hawksbill turtles face many different threats which can be categorized into threats that menace their habitat, and into direct threats that affect the individual (Chacón 2009).

The coastal development is destroying nesting habitats, as beach vegetation is cut down, houses in close proximity to the beach pollute the beaches with white lights, debris are increasing, and beach erosion increases (Chacón 2009).

Hawksbill turtles are food specialists and feet on different sponges in reefs, but reefs now-a-days change dramatically due to global warming and sponges become rare.

The unsustainable egg harvesting is one of the direct threats which hawksbills face, and constitutes up to day a great threat, especially in the Caribbean where eating turtle eggs has a long cultural history (Chacón 2009). In some regions hawksbills are hunted for their meat as well (Chacón 2009).

For centuries the Hawksbill turtle has also been exploited by many cultures for its beautifully patterned shell. The long time demand for this shell has had a profound effect on the population status and survival of this species (Eckert 1995).

Incidental capture by industrial fisheries is one of the greatest menaces to all sea turtle species, where individuals get caught in long lines, gill nets, shrimp nets etc. and drown (Chacón 2009). Hawksbill turtles have been listed as endangered by the IUCN since 1982, and after a reevalution in 1996 the status was changed to critically endangered (Chacón 2009).

In the Caribbean, the 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.

In 1989 Meylan estimated that the hawksbill turtle in almost all countries of the Greater Caribbean host less than 100 nesting females annually, with an exception of a main rookery in Mexico (Peninsula Yucatán), where annually up to a 1,000 females nest (Chacón 2009). Groombridge and Luxmoore (1989) calculated the total number of nesting females in the Greater Caribbean at a maximum of 4,975. (Chacón 2009). In a reassessment of population status Meylan (2001) determined that a maximum of 5,000 females nest annually in the whole Caribbean region, Guyana, French Guyana, Suriname and Brazil not included (Chacón 2009). In these four latter mentioned countries no more than 600 females are thought to nest (Chacón 2009).

The nesting population in Mexico, and the smaller nesting populations in Jumbay Bay (Antigua), and Buck Island (US Virgin Islands), are now-a-days stable, and other rookeries started to recover, but only after years of protection (Chacón 2009).

Hawksbill sea turtles are facing an extremely high risk of extinction in the immediate future.

The Green turtle (*Chelonia mydas*), another member of the family Cheloniidae, is named after the green color of the fatty tissue. It can be easily distinguished from the other species by the single pair of prefrontal scales between its eyes. Adults measure generally 76-91 cm in carapace length and weigh approximately 136-180 kg. Green turtles nest in intervals of two to three or more years, with wide year-to-year fluctuations in numbers of nesting females. A single female lays between three to five clutches per season with an average of 115 eggs in each nest. The greatest threat for *C. mydas* arrives from the commercial harvest of eggs and meat. Other threats are the use of green turtle parts for leather as well as their 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. The number of nesting females worldwide was estimated to be 88,520 individuals in 2004 by the CCC.

The main objective of the WIDECAST Gandoca Sea Turtle Conservation Project is the protection and conservation of the critically endangered *D. coriacea* sea turtle.

But due to a fair amount of records of nestings of *E. imbricata* and *C. mydas* at Gandoca beach and the Playita after the end of the leatherback nesting season, it was decided that it is necessary to continue monitoring the beach after August 15th.

The principal aim of this report, and the activities conducted on Gandoca Beach during the period of August 16th to October 15th, 2009 is to documented existence and status of hawksbill and green turtles in the study area.

The participation of the community in these endeavors is intrinsic to its function. The information gathered throughout the season helps estimate population dynamics. The data collected, such as biometrics, nesting activities, nest success and hatchling releases helps predict future population tendencies as well as establishing and ameliorating of monitorial, conservational and research protocols.

Material and Methods

1. Monitoring Period

The monitoring of the nesting activities of *E. imbricata* and *C. mydas* at Playa Gandoca and Playita took place from the 16th of August until the 15th of October, 2009. During the monitoring period of the nesting activities of *D. coriacea* from February 15th to August 15th, 2009, nesting events of *E. imbricata* and *C. mydas* were also recorded, and data from this period is partly included in the results.

2. Project Site: Playa Gandoca

Playa Gandoca is in the jurisdiction of the Gandoca/ Manzanillo Wildlife Refuge (REGAMA), in the Talamanca region of Limon province, on the South Caribbean Coast of Costa Rica. This refuge covers 4436 hectares of marine area and 5000 hectares of protected land and includes a variety of ecosystems such as sea grass beds, mangrove swamps and primary forest. REGAMA was established in 1985 to protect both the fauna and flora present in this area, as well as the nesting beaches used by 3 species of marine turtles. Playa Gandoca is a 8.75 km long, stretch of sandy beach, geographically situated at 9°35'N, 82°34'W, which extents from Punta Mona in the north up to the natural border to Panama - Rio Sixaola in the south (**Figure 1**) (Chacón and Eckert 2007).

The Gandoca shore is characterized by a fine grained black sand, and a continental platform and deep waters as border along the coastline. Strong currents and high energy waters due to continental shift compose the dynamic character of Playa Gandoca (Chacon 1999). Beach erosion and significant quantities of marine debris as well as non-organic debris originating from Rio Sixaola, which are periodically washed up on-shore, constitute the main problems of Playa Gandoca now a day.

Off the main beach, past Punta Mona, a small stretch of beach called the Playita (north of Gandoca see figure 1), belongs to the monitored area. The shore at Playita is characterized by thicker-grained, white sand, typically for a beach that is found next to a coral reef.

The Sea Turtle Conservation Program in Playa Gandoca was established in 1990 to monitor the nesting activities of the leatherback turtle (*Dermochelys coriacea)* and to a lesser extent the nesting activities of the hawksbill turtle (*Eretmochelys imbricata*) and green turtle (*Chelonia mydas*), which can still be found in small numbers nesting at Playa Gandoca.

Figure 1: Satellite image of study area Gandoca beach.

1.1 Preparation of the Beach

The study site is marked by wooden markers every 50 meters, from north to south, with painted numbers ranging from 1 (Punta Mona) to 166 (Rio Sixaola). The area consists of 8.3 km of nesting habitat that is separated in 3 sectors: Sector A includes marker 1 to 36, sector B marker 37-87 and sector C marker 88-166.

The Playita, a small beach, which lies behind Punta Mona, is marked with wooden markers from 1-19, with a distance of 800 m each other marker.

3. Nightly Patrols

Nightly patrols were scheduled for the days when females were expected to re-nest, and were conducted between 10 p.m. – 2 a.m, or from 8pm to 5 am if required. Individual patrols covered the Playita or sector A/B.

Night patrols consisted of a qualified leader accompanied by trained volunteers. All participants were dressed in dark clothes and carried a flash light with red LEDs or a red filter for working on the beach. Use of light was always kept to a minimum, and was only used while working with the turtles, for emergency communication between patrols, or out of safety purposes (i.e. walk through areas with lots of debris).

When a nesting female was encountered during patrol, external identification tags were noted or applied if necessary. Nesting activity was recorded, and eggs were relocated on the beach or camouflaged and left natural. The use of latex gloves while handling turtles was strictly mandatory.

3.1 Beach Protocol

When a female was found on the beach her state of progress towards a nesting attempt was identified (making a body pit, digging the nest/egg chamber, laying the eggs, covering the eggs, camouflaging the nest). When turtle was almost done digging the nest, the leader approached the turtle from behind to measure the depth of the nest, and later on to insert an unrolled measurement tape into the egg-chamber to mark the position of the eggs for later relocation. During the laying process turtle was only approached to check for external tags in her front flippers, and to measure her hint flipper to estimate nest width. After she was done laying her eggs, and started to cover up, the patrol approached the turtle from behind and if already tagged took her biometrics, if female was not tagged she got tagged by a trained patrol leader, and measured afterwards.

3.2 Tagging

For *E. imbricata* and *C. mydas* only external tags, type metal tags MONEL N° 49, were used. Front flippers were checked for previous applied tags, or evidence of lost tags (holes, scar tissue, tears), and turtle ID was recorded. When no external tags were present the application area was thoroughly cleaned and disinfected with Vanodine® and metal tags were applied using metal pliers (Balazs 1999). Tags were applied either between the second and the third scale or into the third scale (Balazs 1999). External tagging was carried out only when the turtle finished laying and was covering the nest. Tags were applied consecutively with the higher number on the right side, and the lower number on the left side. Turtles encountered that were tagged or showing signs of previous tagging were considered re-migrants.

Figure 2: Position of external tags in front flippers of *E. imbricata and C. mydas*.

3.3 Biometrics

Biometric information was recorded, after the laying process, for every nesting female located during nightly patrols. Sand was systematically brushed off the carapace to avoid inaccurate measurements. For *C. mydas* and *E. imbricata* measurements of the curved carapace length (CCL) were taken along the center of the carapace to the tip of the carapace. Curved carapace width (CCW) was taken along the widest area of the carapace along the central scutes. Measurements were carried out three times on all individuals to keep measuring errors to a minimum.

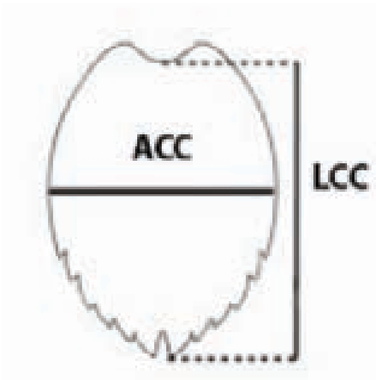


Figure 3: Biometrical measurements of CCW and CCL in *E. imbricata* and *C. mydas*.

4. Nest treatments

Nests were left natural if laid in a safe area as the objective is to keep the nests as natural as possible. If a laid nest was deemed to be at risk, or obviously doomed, the nest was transported to a predetermined safe stretch on the beach and was relocated there. Due to the large distance between the sectors in Gandoca, nests remained in their respective sectors, thus controlling the distance the eggs were transported and the amount of time they were outside the nest environment. The relocation was carried out as follows: A measurement tape was inserted into egg chamber while female laid her eggs. After she was done, and started to cover the eggs, female got measured. Eggs were dug out after female left back to the water or while she camouflaged the nest area to keep disturbance as low as possible. The bag was immediately transferred to a safe area where it was covered with wet sand to help preserve nest temperature while awaiting relocation.

The recorded nest depth and width as constructed by the female were used for nest replication. After artificial nest was dug eggs were inserted carefully one by one, and afterwards covered with humid sand, in imitation of natural process. All nests were camouflaged thoroughly to disguise eggs from the eyes of poachers and thus preventing them from becoming poached. The new location was recorded in the data. All Nests were marked with metal tags indicating the nests date, egg number and nesting female's ID, which were placed approx. 10-15 cm from the surface for accurate nest identification during later exhumations.

5. Daily Surveys

The morning walks had the purpose to ensure that the nests that were laid after the night patrol left the beach were detected, and to relocate these nests in order to protect them from poaching, and to identify hatched nests, counting hatchling tracks and hatchlings. Morning surveys were conducted daily at 5 a.m. covering sector A and B and the Playita, a small beach north of Punta Mona.

6. Exhumation

Exhumations were carried out on every hatched nest found and were performed no later than 2 days after a nest hatched, and the main bulk of hatchlings had emerged, to increase chances of survival for living hatchlings within the nest.

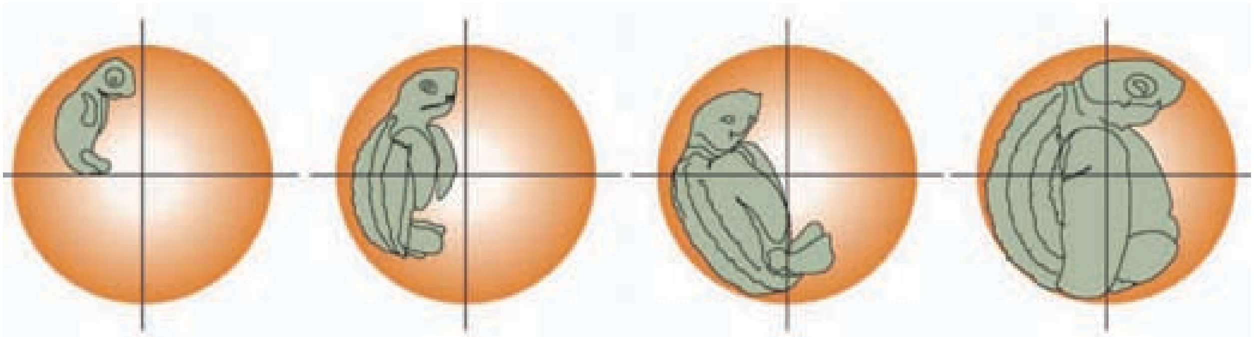
For the exhumation procedure, nests were opened and nest content was removed completely. The depth to the first egg was recorded as well as the overall depth of the nest after removal of eggs and shells. Empty egg shells were counted and unhatched eggs with intact shell were carefully opened to study content. It was distinguished if an embryo had started to develop within the egg and the developmental stage of the embryo inside was recorded, or if no development had taken place. The different stages of development were distinguished as follows:

Stage I: turtle embryo fills 0 to 25% of the amniotic cavity of the egg.

Stage II: turtle embryo fills 26 to 50% of the amniotic cavity of the egg.

Stage III: turtle embryo fills 51 to 75% of the amniotic cavity of the egg.

Stage IV: turtle embryo fills 76 to 100% of the amniotic cavity of the egg.



Furthermore information about pipped eggs (eggs that contained a fully developed embryo which started to hatch) and specific observation of egg content such as the presence of larva, fungus, crab holes, insect etc, was collected.

From the data collected the hatching success rate in % (how many hatchlings were able to leave the egg) as well as the emergence success rate in % (how many hatchlings were able to leave the nest) was calculated for the exhumated nests with following formula:

$$\text{Hatching Success} = \frac{\#\ \text{Shells}}{\#\ \text{Shells} + UH + UHT + P}.$$

$$\text{Emergence Success} = \frac{\#\ \text{Shells} - (\#L + \#D)}{\#\ \text{Shells} + UH + UHT + P}$$

Shells=Number of empty egg shells found in nest

UH=Unhatched eggs: including stage 1, 2 and 3 development.

UHT=Unhatched at term: including stage 4 development and pipped eggs.

P=Predated: including larva, bacteria and crabs

#L=Number of living hatchlings found during exhumation

#D=Number of dead hatchlings found during exhumation.

RESULTS

1. General

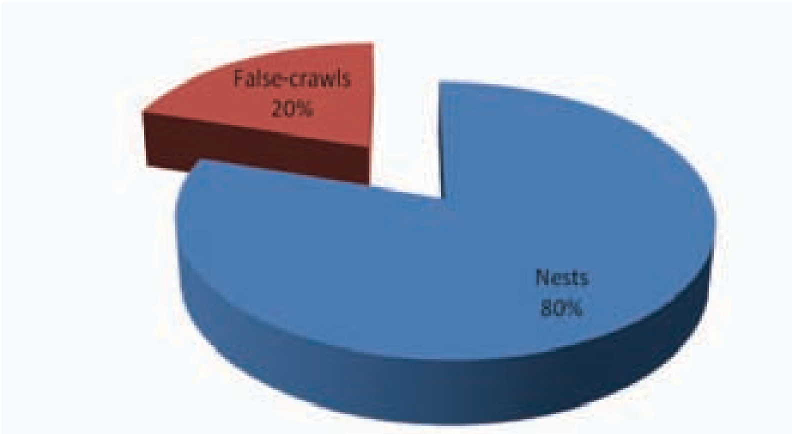


Figure 4: Percentage of recorded false crawls and nesting events at Gandoca beach and the Playita.

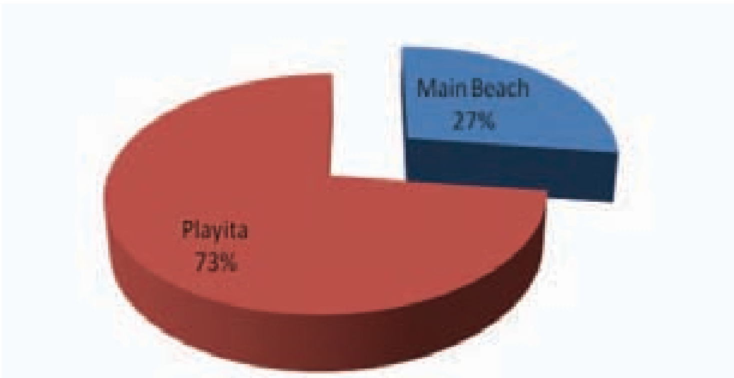


Figure 5: Percentage of nests of *E. imbricata* laid in Gandoca main beach and the Playita.

1.1 Females tagged

Three females of *E. imbricata* were tagged with external Monel N°49 tags, during the monitoring period (**Tab. 2**)

Table 2: Number, dates and ID number of Females tagged during monitoring period August 16th- October 15th, 2009

Date	Right Tag	Left Tag
21.08.2009	VA5654	VA5653
26.08.2009	VA5664	VA5663
07.09.2009	VA5668	VA5667

2. Distributions of Nests

2.1 Temporal Distribution

The temporal distribution of nests laid by *E. imbricata and C. mydas* throughout June until October 2009 shows a peak in the 30th week of the year which equals mid July.

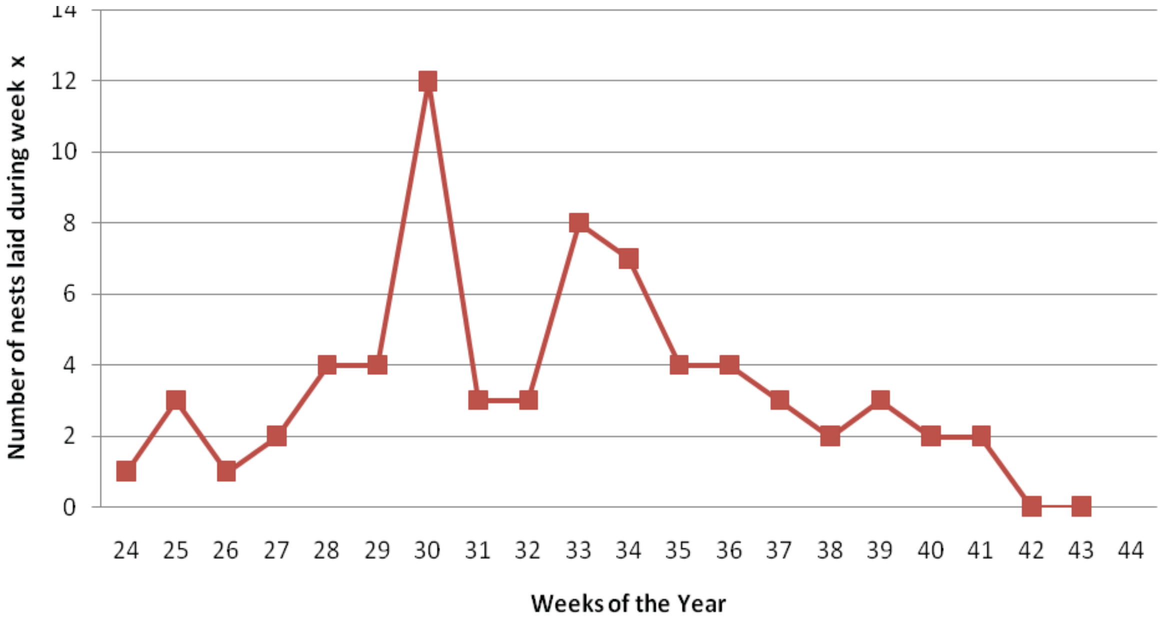


Figure 6: Temporal distribution of nests laid by *E. imbricata* and *C. mydas* during the monitoring periods from February 15th to August 15th and August 16th to October 15th, 2009 in Playa Gandoca main beach and the Playita. Nesting activity given by calender weeks.

2.2 Spatial Distribution

The spatial distribution of nests along Gandoca main beach does not show a peak for a certain area on the beach, probably due to small sample size. An obvious peak exists for the

Playita as preferred nesting site, with a peak for the area around wooden marker 19 in the Playita, and smaller peaks for the areas around wooden markers 2 and 15.

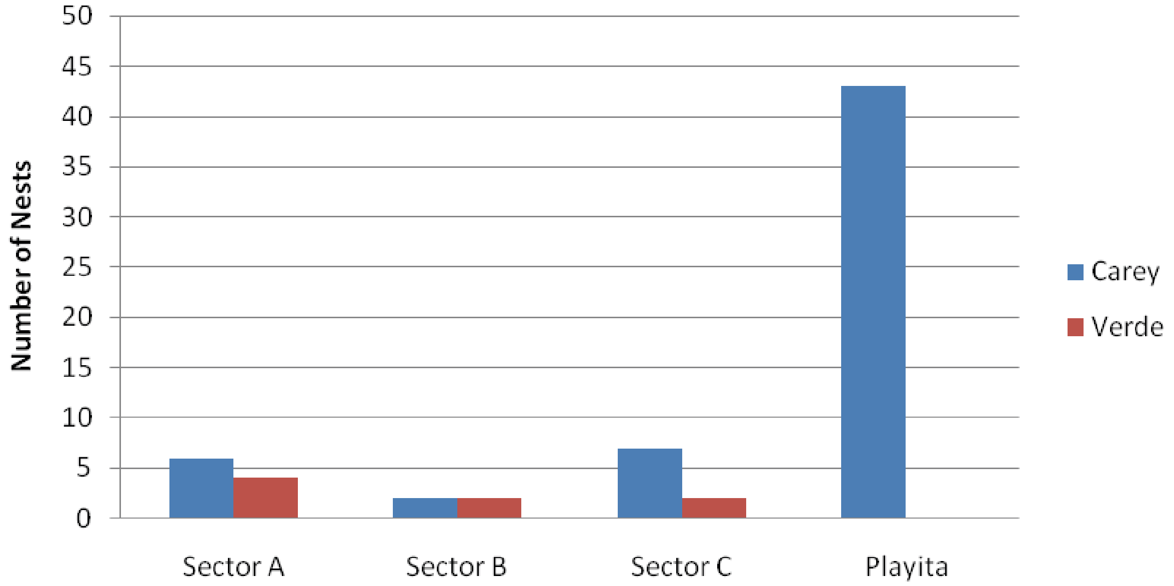


Figure 7 : Number of nests recorded per sector for *E. imbricata* and *C. mydas* for the monitoring period August 16th-October 15th, 2009.

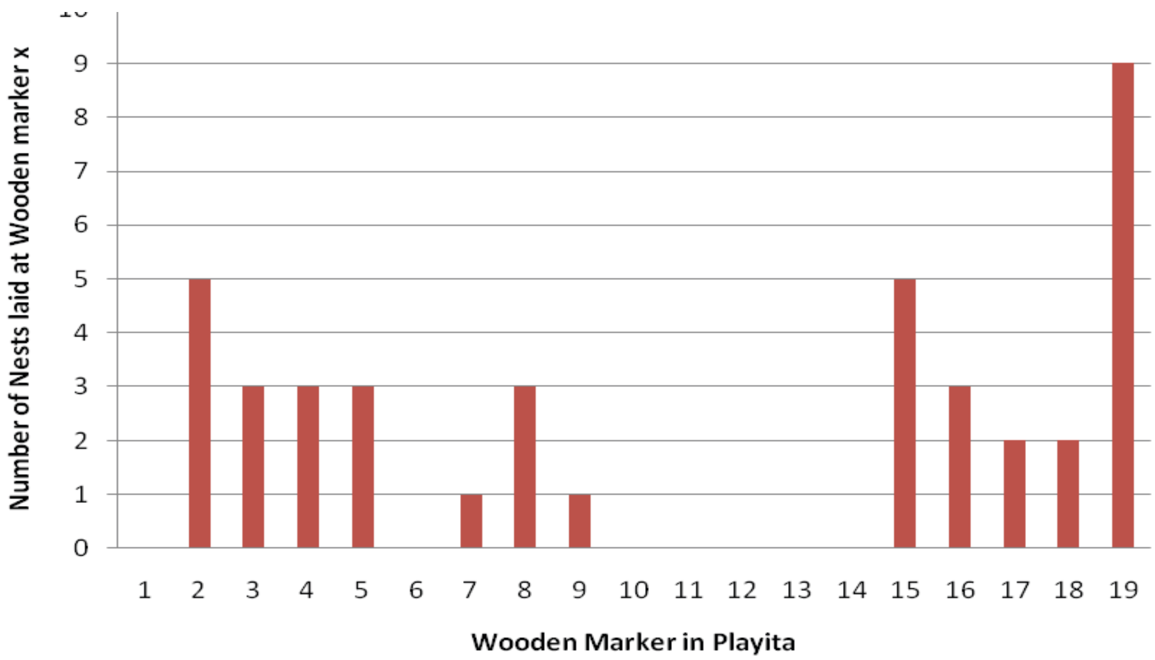


Figure 8: Spatial distribution of nests at the Playita.

3. Biometrics of females

Eight females of *E. imbricata* were measured in the first monitoring period, and three females of *E. imbricata* were measured during the second monitoring period. The mean value for the curved carapace length (CCL) varied from 86 cm to 85.25 cm between these two periods, and between 77.33 cm and 76.06 cm for the mean value of curved carapace width (CCW). No biometric data was taken for females of *C. mydas*.

Table 3: Mean measurements of CCW and CCL for *E. imbricata*.

Period	August 16th-October 15th	*February 15th-August 15th*
Sample size (n)	3	*8*
Mean Curved Carapace Length [cm] – CCL	86.00	*85.25*
Mean Curved Carapace Width [cm] – CCW	77,33	*76,06*

4. Nests

4.1 Final Destination

During the monitoring period from August 16th to October 15th around two third of the nests were relocated and one third was left natural. No nests were relocated to a hatchery, because the existing hatchery was located in Sector B and the distance to transport eggs from Sector A or even the Playita was to great. Furthermore it is prohibited by MINAET Resolution to remove clutches from the sector in which they have been originally laid. From all nests laid during this period only one hawksbill nest in Sector A (close to Punta Mona) got poached.

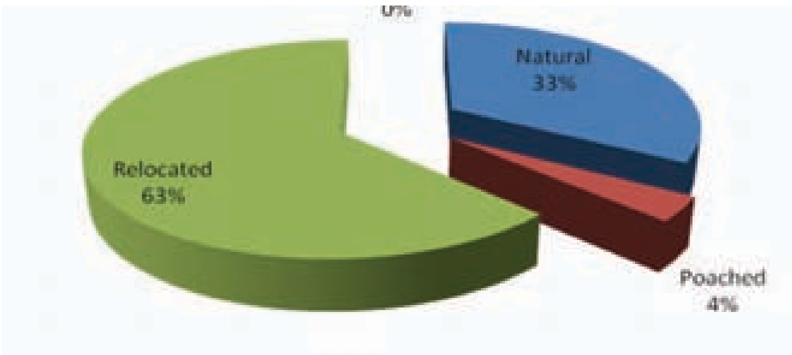


Figure 9: Nests final destination from August 16th–October 15th, 2009 in Gandoca main beach and the Playita.

In the first monitoring period from February 15th to August 15th also a third of hawksbill and green turtle nests were relocated, either into a hatchery or else where on the beach. 15 % (six nests) of the nests laid during this time were poached.

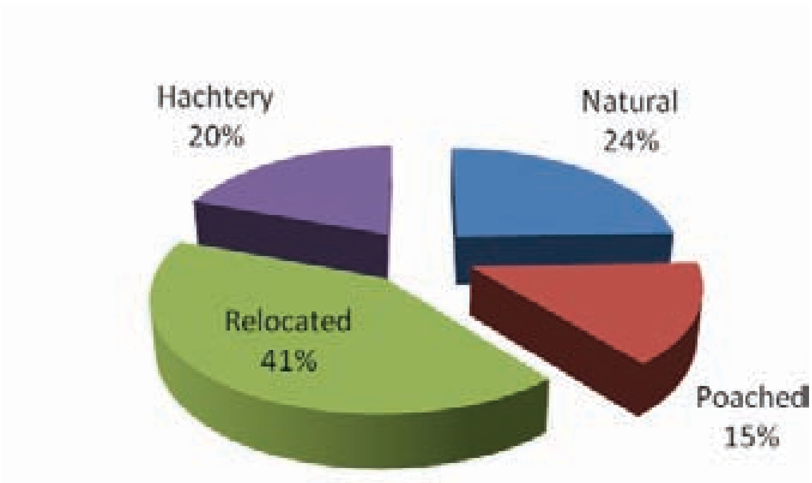


Figure 10: Hawksbill and green turtle nests final destination from February 15th-August 15th, 2009 in Gandoca main beach and the Playita.

4.2 Nests position on the beach

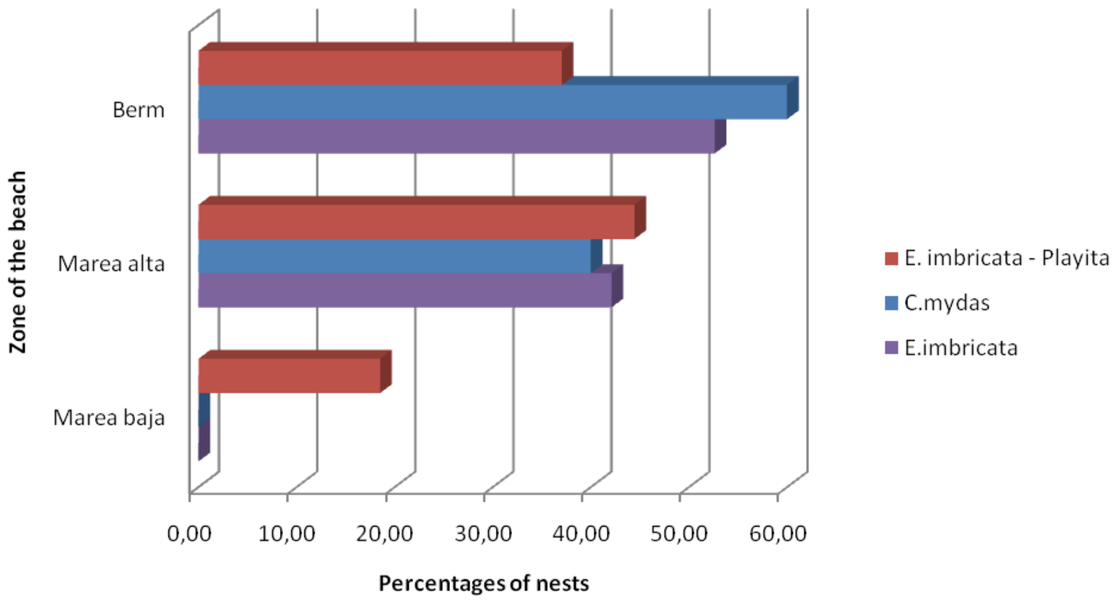


Figure 11: Nests position on the main beach in Gandoca in regard to the zones defined over the position of the ocean.

4.3 Nest Destination

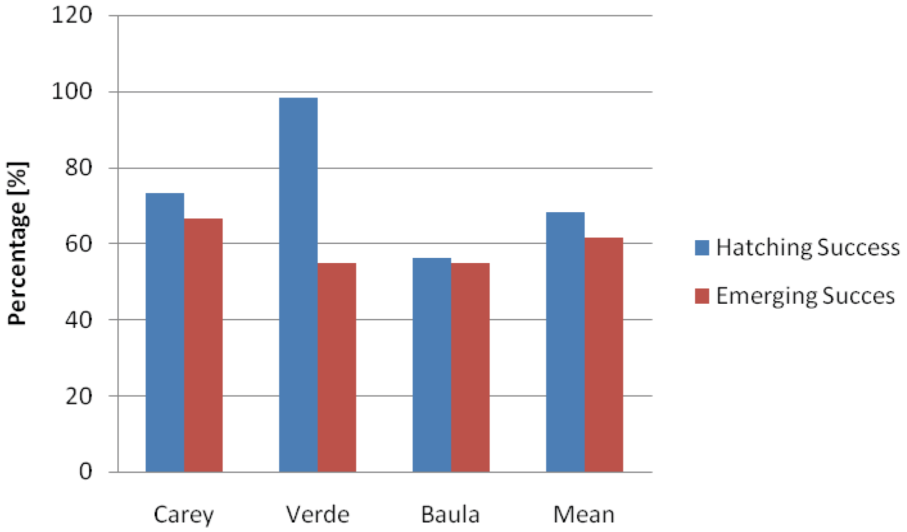


Figure 12: Over-all hatching and emerging success of clutches of *E. imbricata, C. mydas* and *D. coriacea* at Gandoca Beach and the Playita.

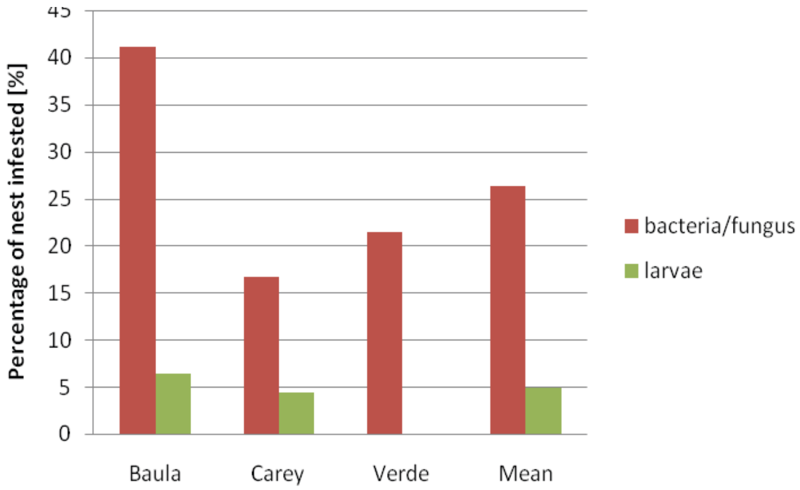


Figure 13: Mean percentages of unhatched eggs - within nest- infested with bacteria/fungus and mean percentage of larvae infestation in nests at Gandoca beach and Playita.

5. Beach Waste

In order to monitor the pollution by beach waste at Gandoca beach, beach waste collected on the beach was recorded and categorized. The biggest problem seems to be non-disposable plastic waste.

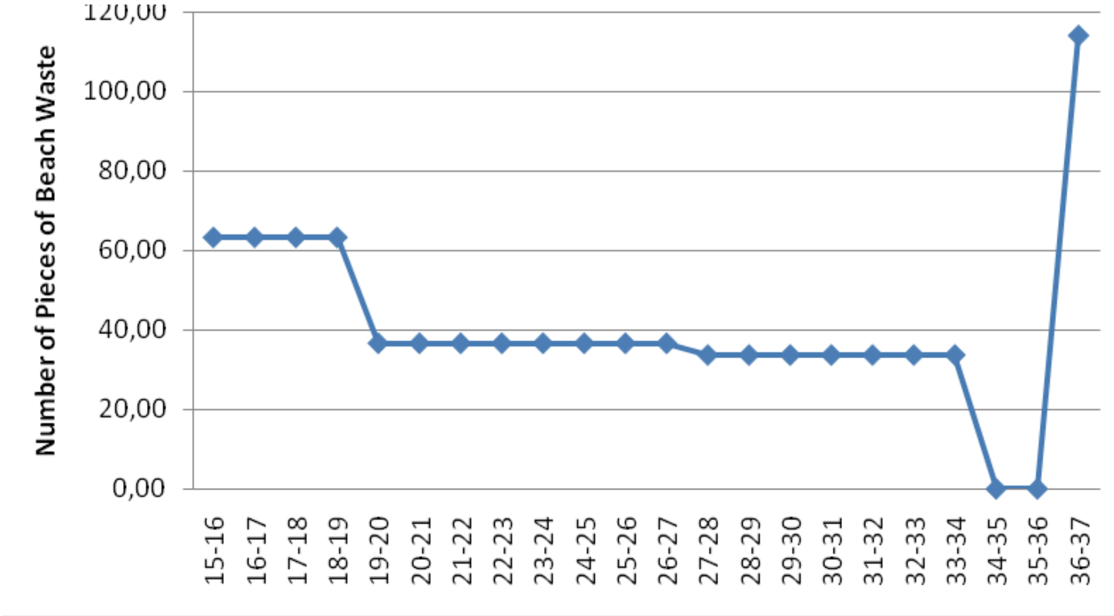


Figure 14: Spatial distribution of beach waste, from wooden marker 15 to 37 at Gandoca beach.

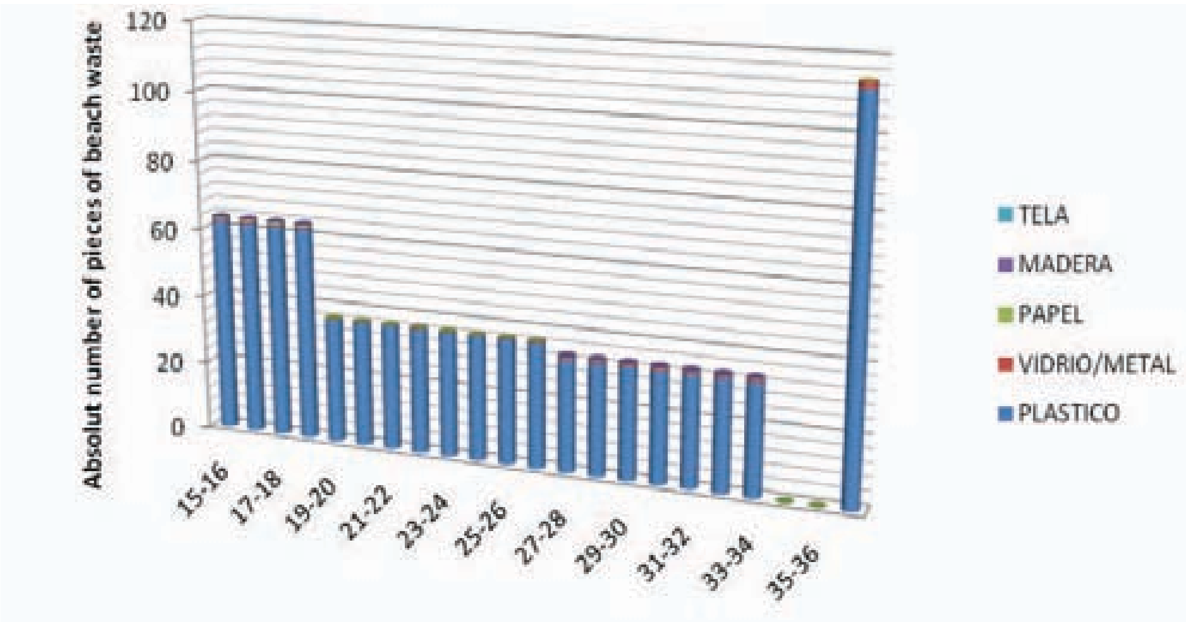


Figure 15: Spatial distribution and portion of different types of beach waste at Playa Gandoca from wooden marker 15-37.

RECOMMENDATIONS

The work at Playa Gandoca after the leatherback season seems necessary to provide a proficient protection of nests laid after the 15th of August each year. People in Gandoca (not necessarily from the community) are used to an un-surveyed beach after the usual season, and therefore a higher percentage of attempted poaching was noticeable. In order to not only protect nests from being poached, but to also collect scientific data of nesting activities of females, a team of at least 4 patrol leaders would be necessary, to patrol main beach Gandoca from 20-4 o'clock every night and the Playita as well. Otherwise females will fall through the meshes.

The access to the Playita was partly a problem, especially when it had been raining, and since not all volunteers are in the best physical shape, sometimes even constituted a danger to their health. It should be thought about an easier access to the Playita, either in making the path user-friendly, or by providing access by horse or boat. Furthermore, because of the bad condition of the path, eggs were not transported to Sector A to relocate clutches there, which lead to a high density of nests in the Playita.

Throughout the season illegal fisher boats were waiting in front of the Playita for hawksbill females to either hunt them by harpoon or to trap them in nets. MINAET should be asked to drive frequent patrols by boat to enforce refuge laws.

It was also found during the season that the small beach behind the Playita hosts a fair number of hawksbill nests as well, and it should be taken into consideration to include this beach in the patrols and morning surveys.

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ANNEX I: Project Images

Hawksbill nesting female laying eggs on the vegetation of Gandoca Beach.

Hawksbill baby turtle ready to be released on Gandoca Beach.