

**FINAL PROJECT REPORT**

**“2003 HAWKSBILL TURTLE (*Eretmochelys imbricata*) RESEARCH AND POPULATION  
RECOVERY, AT CHIRIQUÍ BEACH AND ESCUDO DE VERAGUAS ISLAND,  
Ñö Kribo region, Ngöbe-Buglé Comarca,  
AND BASTIMENTOS ISLAND MARINE NATIONAL PARK”.**



Presented to:

Caribbean Conservation Corporation (CCC)  
National Environmental Authority (ANAM)  
Ngöbe-Buglé Comarca, Ñö Kribo Region  
And

Association for the Protection of the Ngöbe-Bugle Natural Resources (APRORENANB)

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## INTRODUCTION

Chiriquí Beach (08°56'N, 081°39'W), Bocas del Toro Province, Panama, was described by Archie Carr (1956) as one of the most important nesting beaches for the hawksbill turtle (*Eretmochelys imbricata*), a species included in the World Conservation Union's list of critically endangered animal species (IUCN 2003) and in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

At this beach during the 20<sup>th</sup> century, the hawksbill turtle was very important for the local economy. Roberts (1827) described the trade in shell in the region in 1815. Later, the beach was leased by the government to veladors or "stayers-awake". Veladors paid a tax for the rights to all female hawksbill turtles that nested on their section of beach (approximately one mile). Some of these "stayers-awake" interviewed in the 1980's reported that they managed to catch 35 to 50 hawksbill turtles per night in one mile of beach in the beginning of the 1950's (Meylan and Meylan, unpublished data). Meylan and Donnelly, in 1999 reported a population decline of hawksbill turtles at Chiriquí Beach of 98% from the level registered in 1950, based on information from ground and aerial surveys in 1980 and 1990. The decline is attributed to the extensive hunting that took place to supply the international trade in hawksbill shell. Concern for sea turtles on the Bocas coast was one of the factors that led to the establishment of the Bastimentos Island Marine National Park in 1988. Within its boundaries are three important hawksbill nesting beaches, Long Bay on Bastimentos Island, and the beaches of the two Zapatilla Cays.

Since 1995, local interest began in the Río Caña community to conserve the hawksbill turtles that nest on Chiriquí Beach. The Association for the Protection of the Ngöbe-Bugle Natural Resources (APRORENANB) was formed, undertaking protection one year and permitting turtle killing one year (information given by APRORENANB). From 1999 to 2002, short periods of field research provided a preliminary picture of the current problems for nesting females on Chiriquí Beach (Ordoñez 1999-2002, unpublished data). This work verified the continued importance of the beach for leatherback (*Dermochelys coriacea*) nesting and the decline in hawksbill nesting. In 2000, a project was established to study and protect turtles along the first 10 km of the beach, from the Río Caña rivermouth towards Río Chiriquí. In 2002, meetings were initiated with national and local authorities, local conservation groups and communities to assess their interest in establishing a long-term hawksbill conservation program on Chiriquí Beach, Escudo de Veraguas Island and the Zapatilla Cays. The long-term goal was to promote an increase in the small hawksbill populations that currently nest along the Bocas coast. In June 2003, the research and monitoring work began.

This report summarizes the results of the first year (2003) of research, monitoring and conservation work at Chiriquí Beach, Escudo de Veraguas Island and on the Zapatilla Cays within the Bastimentos Island Marine National Park. The report also provides some recommendations for conservation action along the coast of Bocas del Toro Province.

## OBJECTIVES

The objectives of the first year of work included:

- 1.- Implement standardized hawksbill nest monitoring surveys to assess nesting density and hatching success at Chiriquí Beach, Escudo de Veraguas Island and the Zapatilla Cays.
- 2.- Establish standardized nest monitoring surveys for leatherback turtles and other species that nest at Chiriquí Beach and Escudo de Veraguas island.
- 3.- Determine the genetic identity of hawksbill turtles nesting along the Bocas del Toro coastline.
- 4.- Determine migrations and movements of hawksbill turtles from along this coast.
- 5.- Conduct night patrols along Chiriquí Beach and the Zapatilla Cays to observe nesting females, tag and record re-nesting females, collect biometric data, and observe nesting behavior.
- 6.- Develop environmental education programs for the teachers of communities adjacent to Chiriquí Beach and other interested communities.

## **METHODS**

### **Preparations**

On May 24, the first visit to Río Caña was undertaken by Dr. Peter Meylan, Sebastian Troëng, Cristina Ordoñez and representatives of the National Environmental Authority (ANAM). A small meeting was held with the inhabitants of Río Caña and Río Chiriquí to begin the research and monitoring work of the 2003 season.

From June 1 to 2, a theoretical and practical course about turtle biology and management was conducted by Cristina Ordoñez, including an exam to select the monitors who would work in the project. Following the course, four selected monitors undertook a trip to the Zapatilla Cays for training by Drs. Peter and Anne Meylan in genetic sampling and tagging techniques, and to learn about the results of satellite tracking experiments conducted on the Zapatilla Cays in previous years.

During the month of June, sporadic night patrols were conducted on Chiriquí Beach and work began on constructing and improving the camp and stables. Also, the beach was marked every 500 meters using a 300 foot fiberglass measuring tape, and white posts were erected with the number of the zone painted in black in order to be visible during night work. The demarcation of zones began at the Río Caña river mouth and ended at the Río Chiriquí river mouth. At Zapatilla Cays, the beaches were divided into zones using natural landmarks; occasional nighttime patrols began on 1 June.

### **Track surveys**

At the Zapatilla Cays, track surveys were conducted from May 29 (Small Zapatilla Cay) and May 30 (Big Zapatilla Cay) until October 30.

At Chiriquí Beach, morning work began on June 12 with a general survey of each zone of the beach during which all tracks from the different species were recorded; hawksbill *Eretmochelys imbricata* (Ei), leatherback *Dermochelys coriacea* (Dc) and green turtle *Chelonia mydas* (Cm). For this, the different tracks were evaluated in the following way.

Nests: uptrack, removal of sand, obvious bodypit and return to the sea. In some cases, mainly with the leatherback turtle, it was not possible to verify the presence of eggs in the nest.

Half-moons (false crawls, non-nesting emergences): in these cases, the turtle's uptrack and return to the sea without significant sand removal was observed.

Also, the nest sector was determined (open, border, or vegetation).

Chiriquí beach was divided into two sections for the work and two work teams were organized, one at each end. During the morning, all turtle activities occurring the previous night were recorded; each team used horses to facilitate the daily work. From June to October surveys were conducted daily. When the number of activities decreased in November, surveys were conducted every three days and in mid-December, one survey per week was conducted. On Escudo de Veraguas Island, visits were conducted every two weeks to register nesting activity.

### **Night patrols**

Night patrols were conducted sporadically on the Zapatilla Cays and along all of Chiriquí Beach to observe females and attach metal tags. Tagging was conducted once the females finished laying. Hawksbill and green turtles were tagged through the second scale in the front flippers and the leatherbacks in the fold of the rear flippers. All turtles were double-tagged and the following information was recorded for each turtle; tag numbers, species, date, time and activity at first encounter, presence of tag scars or overgrown tags, mutilations or deformities, fibropapillomas and other important characteristics.

### **Biometric data**

If the turtle was encountered before egg laying, the number of normal and yolkless eggs was counted as the eggs fell into the nest. Measurements of the carapace length and width were also taken, using a flexible measuring tape. All measurements were taken in centimeters and millimeters for better precision.

The carapace length of leatherback turtles was measured from the notch in the shell behind the head to the end of the caudal projection along the central line and for hawksbill and green turtles, from the notch behind the head to the notch between the posterior-most marginal scales. The width was measured at the widest part of the carapace.

## **Genetic samples**

Tissue samples were collected from the hind flippers of hawksbill turtles using biopsy punches. Each sample was preserved in a tube of SED buffer solution and the tag number and collection date were recorded. The sample collection was done after egg laying was finished.

## **Transmitters**

With the help of Sebastian Troëng, two transmitters were attached to hawksbill turtles at Chiriquí Beach during the month of July to determine their migratory routes after nesting. The transmitters were attached to the carapace with fiberglass and resin. The antenna was located towards the posterior end and its base protected with a roll of fiberglass.

## **Determination of survivorship and hatching success**

At Chiriquí Beach, if the turtle was encountered before covering the eggs, the nest was marked by attaching three pieces of pink tape in the vegetation to allow triangulation. At Zapatilla, nests were examined during morning track surveys and clutch location was confirmed by careful excavation to the top eggs of the clutch (and reburial). The clutch site was marked either with four stakes or vegetation to allow later evaluation. The location of all observed hawksbill nests was recorded with a GPS. Every morning during track surveys, all nests were inspected so that the loss of nests could be determined. The loss of nests by depredation, poaching or erosion was registered during the inspection work.

At Chiriqui Beach and the Zapatilla Cays, if hatchling tracks were observed or if two months of incubation had passed, the nest was excavated to evaluate its contents. We made separate counts of empty shells, live or dead pipped eggs, live hatchlings, unhatched eggs (with and without development) and yolkless eggs. With this information the hatching success was calculated.

## **Dead turtles**

Information was collected on dead turtles observed on the beach and an attempt was made to determine a possible cause of death. Also, through informal interviews in other communities we tried to obtain information about illegal sea turtle hunting.

## **Environmental education activities**

Education activities were conducted when the schedule and project activities permitted. The emphasis of education activities was on transparency of the entire project, the importance of local participation in the conservation and research activities, and the importance of maintaining habitats protected and intact. These activities also involved teachers and university students in order to disseminate the project at a higher level.

## **RESULTS**

### **Preparations**

The sea turtle training course at Chiriquí Beach was given to 20 persons from Río Caña and four from Río Chiriquí. From these participants, four monitors were selected for each end of the beach. Four working groups of two persons each were formed and took turns on a weekly basis to conduct the daily work.

A kitchen dining area was built between the refuge houses at Río Caña, the houses were repaired, and a stable for three horses was built at the Río Caña station.

During the preparations, the project acquired the necessary equipment to run the program at Chiriqui Beach. This included a white fiberglass boat (26 feet long by five feet wide) with a Yamaha 40 hp outboard motor, a portable Compaq computer with a Canon printer, horses to facilitate monitoring work, a Yamaha generator, field equipment, and materials for the installations.

By dividing the beach into 500 m sections, it was determined that the beach is 24 km long; the beach was divided into two units (12 km each unit) so that the monitors at each end worked half the beach on a daily basis.

Monitoring of the beaches of the Zapatilla Cays was organized as an extension of the annual research netting project run from the small Zapatilla by the Meylans since the early 1990's. Equipment provided by WCS for the netting project is also available for use by the nesting beach monitoring efforts.

## Track surveys

Track surveys were conducted 169 days along the 24 km of Chiriquí Beach (June 12 - December 31). At Escudo de Veraguas Island, six days of surveys were conducted (August 5 - November 22). Regular surveys were conducted on 156 days on the Small Zapatilla Cay (May 29 – October 30) and on 155 days on the Big Zapatilla (May 30 – October 30). The results of the activities registered by species in each area are presented in Table 1.

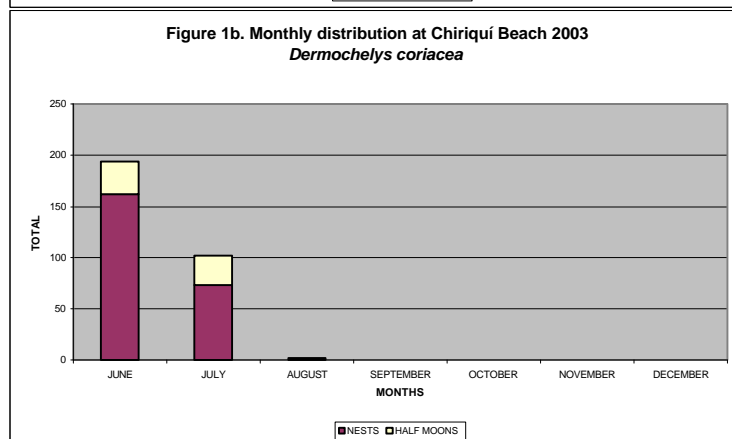
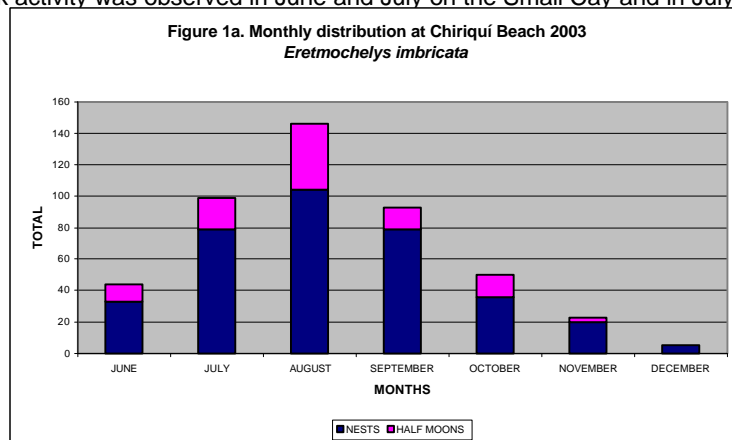
In addition to nests found during the daily surveys, nests were recorded on the Small Zapatilla Cay during April (one), May (eight) and November (one), and on the Big Zapatilla Cay during April (two) and May (six). A single leatherback nest hatched on the Big Zapatilla Cay on June 10; the date that this turtle nested is not known.

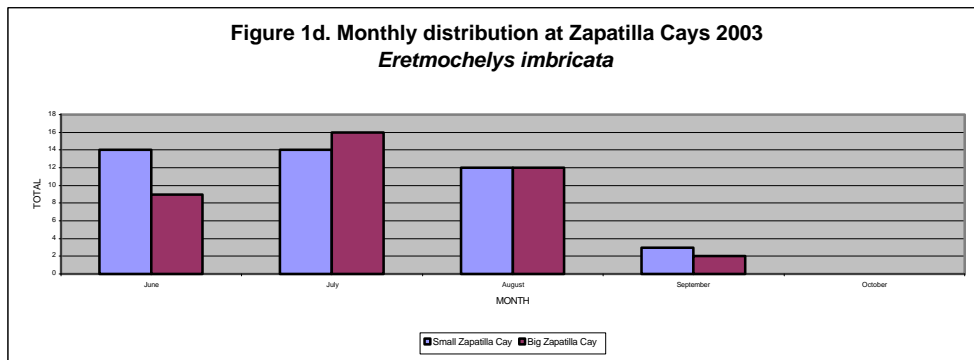
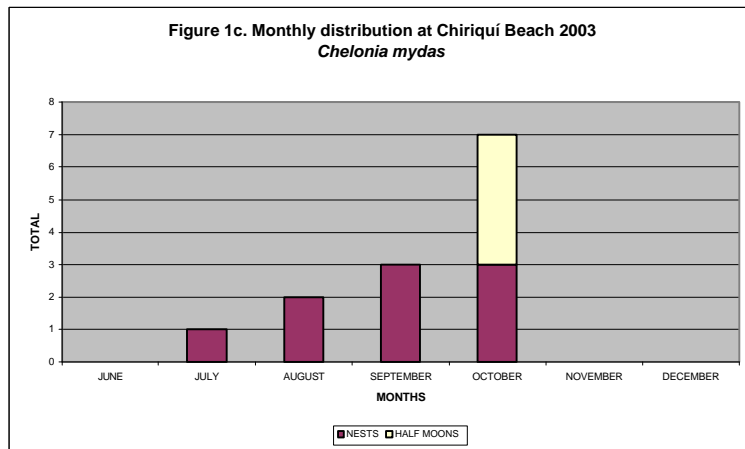
**Table 1. Activities registered by species in each area during the 2003 season.**

	Beach length (km)	Dates monitored	Nests Ei	Half moon Ei	Nests Dc	Half moon Dc	Nests Cm	Half moon Cm
Río Caña section	12	Jun 12 – Dec 31	270	69	560	89	3	0
Río Chiriquí section	12	Jun 12 – Dec 31	119	38	365	41	6	4
<b>Subtotal Chiriquí Beach</b>	<b>24</b>	<b>Jun 12 – Dec 31</b>	<b>389</b>	<b>107</b>	<b>925</b>	<b>130</b>	<b>9</b>	<b>4</b>
<b>Escudo de Veraguas</b>			<b>20</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>
Big Zapatilla Cay	2.36	May 30 – Oct 30	39	n. r.	1	0	0	0
Small Zapatilla Cay	2.10	May 29 – Oct 30	43	37	0	0	0	0
<b>Subtotal Bastimentos Park</b>	<b>4.46</b>		<b>82</b>		<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>PROJECT TOTAL</b>	<b>28.46</b>		<b>491</b>		<b>927</b>	<b>130</b>	<b>9</b>	<b>4</b>

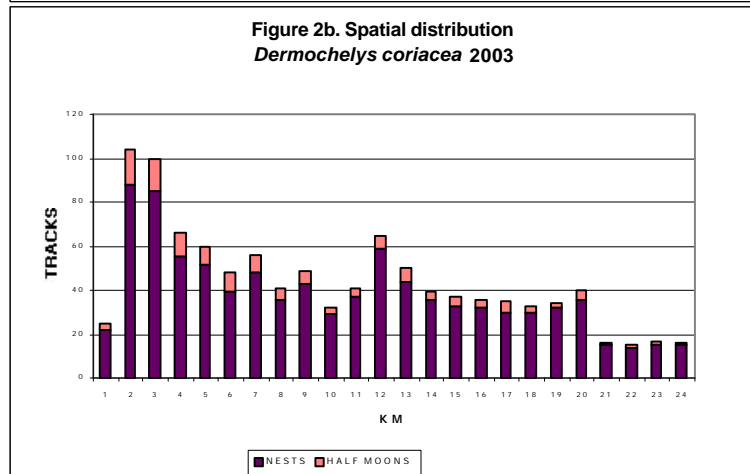
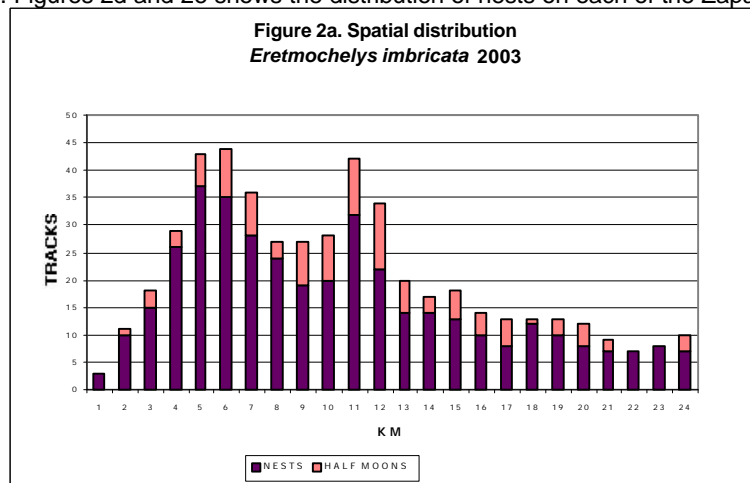
(Ei: *Eretmochelys imbricata*, Dc: *Dermochelys coriacea*, Cm: *Chelonia mydas* y n.r. not recorded)

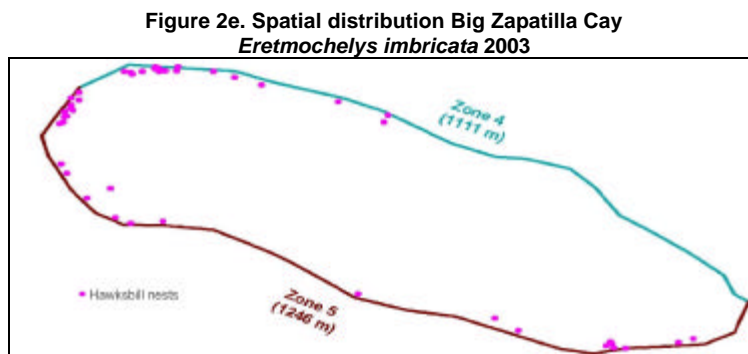
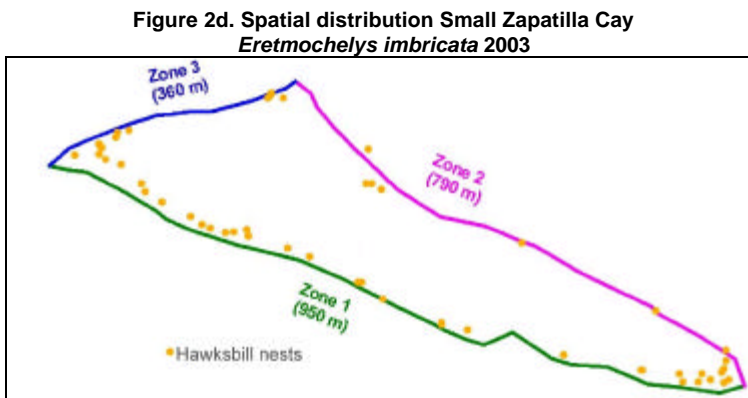
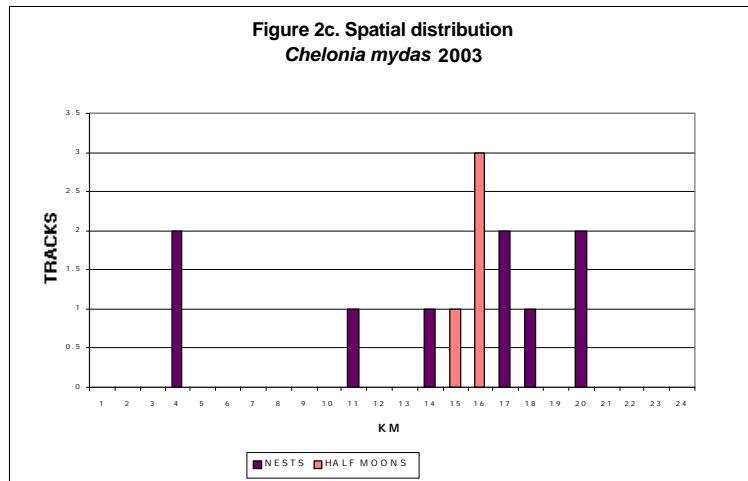
The monthly distributions of tracks throughout the 2003 season, by species, at Chiriquí Beach are presented in Figure 1a, 1b and 1c. The results are presented without results from the general track survey on June 12, in order to avoid overestimating the month of June. In Figure 1 a, the peak of the hawksbill nesting season can be seen in the month of August. Figure 1d summarizes the monthly distribution of nests recorded during daily surveys at the Zapatilla Cays. Peak activity was observed in June and July on the Small Cay and in July on the Big Cay.





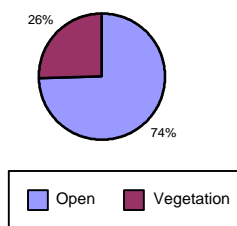
The spatial distribution of activities registered at Chiriquí Beach, by kilometer, during the 2003 season is shown in Figures 2a, 2b and 2c. Figures 2d and 2e shows the distribution of nests on each of the Zapatilla Cays.



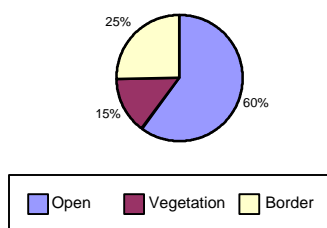


Sea turtles exhibit different nesting behaviors. For example, the hawksbill turtle prefers to nest in the vegetation, while the leatherback prefers open areas, principally in the middle part of the beach. Occasionally nests are laid too close to the sea (border) and are in danger of erosion or inundation. For this reason, the nest sector was registered during the surveys on Chiriqui Beach. This information was not registered on the Zapatilla Cays. In Figures 3a and 3b the percentages of hawksbill and leatherback nests occurring in the various nest sectors are presented.

**Figure 3a. Beach sector for nests of *Eretmochelys imbricata***



**Figure 3b. Beach sector for nests of *Dermochelys coriacea***



Visits of the different beaches on Escudo de Veraguas Island were conducted only every two weeks and all observed activities were recorded. A summary of the recorded tracks is presented in Table 2. Each nest was marked with pink tape and its position taken with GPS for monitoring and final evaluation. Nesting was recorded on six of the ten monitored beaches. In Table 2, the high index of nest loss by erosion can be seen. This is due to the majority of these beaches being very dynamic.

**Table 2. Records for Escudo de Veraguas 2003**

Date	SP	N/H	DESTINY	OBSERVATIONS	NORTH	WEST
05-Aug-03	ei	N	Eroded	nest 1	09° 05.555'	081° 33.982'
05-Aug-03	ei	N	Poached	nest 2	09° 05.541'	081° 34.001'
05-Aug-03	ei	N	Eroded	nest 3	09° 05.532'	081° 34.002'
05-Aug-03	ei	H		Half moon		
05-Aug-03	ei	H		Half moon		
05-Aug-03	ei	N	Eroded	nest 4	09° 05.446'	081° 34.277'
05-Aug-03	dc	N	Unknown	nest 1	09° 05.438'	081° 34.324'
31-Aug-03	ei	N	Eroded	nest 5	09° 05.437'	081° 34.306'
31-Aug-03	ei	N	Eroded	nest 6	09° 05.438'	081° 34.328'
31-Aug-03	ei	N	Did not lay	nest 7	09° 05.442'	081° 32.882'
16-Sep-03				Nothing new		
27-Sep-03	ei	N	Eroded	nest 8	09° 05.536'	081° 34.007'
27-Sep-03	ei	N	Depredated	nest 9	09° 05.444'	081° 34.263'
27-Sep-03	ei	N	Eroded	nest 10	09° 05.444'	081° 34.265'
27-Sep-03	ei	N	Eroded	nest 11	09° 05.439'	081° 34.294'
27-Sep-03	ei	N	Eroded	nest 12	09° 05.492'	081° 34.343'
27-Sep-03	ei	N	Eroded	nest 13	09° 05.535'	081° 34.343'
27-Sep-03	ei	N	Eroded	nest 14	09° 05.434'	081° 32.833'
27-Sep-03	ei	N	Eroded	nest 15	09° 05.417'	081° 32.843'
27-Sep-03	ei	N	Eroded	nest 16	09° 05.433'	081° 32.904'
27-Sep-03	ei	N	Eroded	nest 17	09° 05.471'	081° 33.344'
25-Oct-03	ei	N	Eroded	nest 18		
25-Oct-03	ei	N	Eroded	nest 19		
22-Nov-03	ei	N	Eroded	nest 20	09° 05.538'	081° 34.342'

(SP: Species, ei: *Eretmochelys imbricata*, N/H: Nest / Half moon)

## Night patrols

Work was conducted during a total of 90 nights on each end of the Chiriquí Beach between June 7 and November 3. During this time, a total of 96 different females of three species were encountered, including 28 hawksbills, 67 leatherbacks and one green turtle (Appendix 1). On the Small Zapatilla Cay, sporadic night patrols were conducted and ten hawksbill females were encountered. In Appendix 1 and 2 is a summary of the females encountered. The total turtle encounters, by species and area, in which data were collected are presented in Table 3.

**Table 3. Activities worked by species during the 2003 season**

	Ei	Dc	Cm
<b>Río Caña</b>	26	77	1
<b>Río Chiriquí</b>	11	17	0
<b>SUBTOTAL</b>	<b>37</b>	<b>94</b>	<b>1</b>
<b>Small Zapatilla Cay</b>	14	0	0
<b>SUBTOTAL</b>	<b>14</b>	<b>0</b>	<b>0</b>
<b>TOTAL DEL PROYECTO</b>	<b>51</b>	<b>94</b>	<b>1</b>

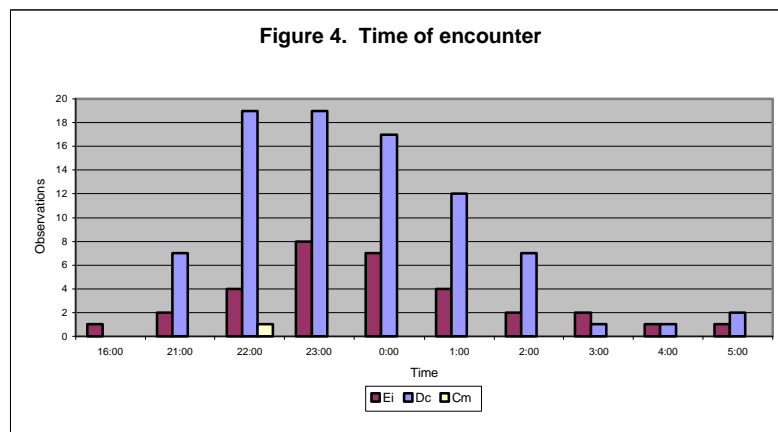
(Ei: *Eretmochelys imbricata*, Dc: *Dermochelys coriacea*, Cm: *Chelonia mydas*)

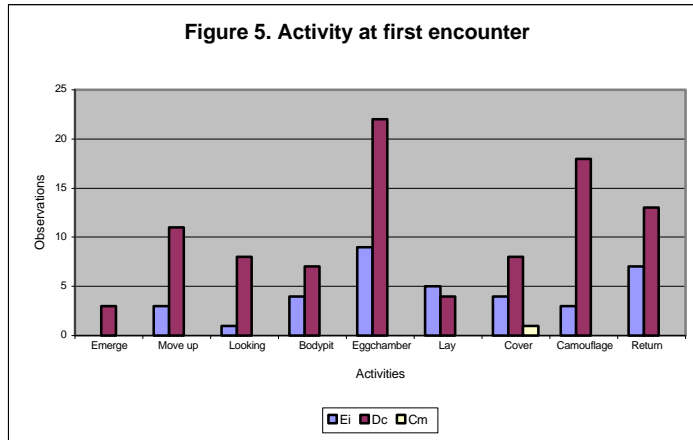
Of the 28 hawksbill turtles encountered on Chiriquí Beach, 27 were newly tagged (first time observed on the beach), and one had old tag scars on both front flippers. Of the leatherback turtles, 57 were newly tagged, nine were remigrants from other beaches or seasons (Appendix 1) and one had a scar from a previous tag in the right flipper. The encountered green turtle was tagged in the rear flippers (Appendix 1). Of the ten different hawksbill turtles encountered on the Small Zapatilla Cay, eight were newly tagged and two were tagged during the net capture work undertaken by the Meylans during the 2003 season (Appendix 2).

Also, on September 28, Mr. Jorge Stonestreet gave us a juvenile hawksbill turtle he had captured between the Fever Point reefs while looking for lobsters. The tags we attached are listed in Appendix 1.

During the night patrols at Chiriqui Beach, a total of 89.2% of the hawksbill females laid their eggs in the vegetation (n=33) and 10.8% did not lay eggs (n=4). Of the 94 leatherback activities worked, a total of 14.9% did not lay eggs (n=14), 2.1% made the nest close to the sea (n=2), 36.2% in the open beach section (n=34) and 46.8% in the vegetation (n=44).

The recorded times and activities at first encounter at Chiriquí Beach are summarized in Figure 4 and 5.





### Biometric data

Carapace size (length and width) and clutch size statistics for hawksbill turtles by area are summarized in Tables 4a and 4b. For the green turtle, the number of eggs deposited is unknown. Its curved carapace length was 100.4 cm and width 90 cm.

**Table 4a. Hawksbill turtle summary statistics at Chiriquí Beach**

	Curved length cm	Curved width cm	Eggs	Yolkless eggs
<b>n</b>	38	38	38	38
<b>Mean</b>	84.9	74.1	119.3	1.6
<b>Standard deviation</b>	3.9	4.5	71.5	2.7
<b>Maximum</b>	98.4	84	225	8
<b>Minimum</b>	75	64.7	0	0
<b>Median</b>	85	73.5	131	0

**Table 4a. Hawksbill turtle summary statistics at the Small Zapatilla Cay**

	Curved length cm	Eggs
<b>n</b>	9	3
<b>Mean</b>	87.9	147
<b>Standard deviation</b>	3.7	
<b>Maximum</b>	92.8	164
<b>Minimum</b>	82	120
<b>Median</b>	88	

Carapace size (length and width) and clutch size for leatherback turtles are summarized in Table 5, the results for leatherback turtles with complete and incomplete caudal projections are presented separately.

**Table 5. Leatherback turtle summary statistics**

	Complete caudal projection				Incomplete caudal projection			
	CL	CW	NE	YE	CL	CW	NE	YE
<b>n</b>	31	31	31	31	57	57	57	57
<b>Mean</b>	150.4	109.3	62.7	21.3	151	112	58.6	14.6
<b>ST.DEV.</b>	6.0	3.9	33.2	16.5	10.0	6.5	39.8	12.5
<b>Maximum</b>	160	118.5	105	55	168.8	126	104	45
<b>Minimum</b>	135.5	102.3	0	0	114.5	98	0	0
<b>Median</b>	151.5	108.9	77	25	153	111.2	78	18

(CL: Curved length, CW: Curved width, NE: Eggs, YE: Yolkless eggs)

The juvenile turtle reported by Mr. Jorge Stonestreet had a curved length of 41 cm and curved width of 36 cm.

**Genetic samples**

Seven genetic samples from hawksbill turtles were collected on Chiriquí Beach and eight on the Small Zapatilla Cay. These will be analyzed during 2004 in Florida, USA. A summary of collection dates and tag numbers for turtles providing the samples is presented in Table 6a and 6b.

**Table 6a. Hawksbill turtle genetic samples, Chiriquí Beach**

Sample	Date	Right Tag	Left Tag
1	11-Jul-03	CH0202	CH0201
2	16-Jul-03	CH0231	CH0230
3	18-Jul-03	CH0233	CH0232
4	19-Jul-03	CH0281	CH0282
5	19-Jul-03	CH0229	CH0234
6	22-Jul-03	CH0236	CH0235
7	11-Aug-03	CH0238	CH0237

**Table 6b. Hawksbill turtle genetic samples, Small Zapatilla**

Sample	Date	Right Tag	Left Tag
1	08-Jun-03	MY508	MM1065
2	09-Jun-03	MY511	MM1068
3	27-Jun-03	CH0001	CH0002
4	06-Jul-03	CH0003	CH0004
5	08-Jul-03	CH0005	CH0008
6	24-Jul-03	CH0009	CH0010
7	08-Sep-03	CH0016	CH0017
8	08-Sep-03	CH0018	CH0019

**Transmitters**

Two transmitters were attached to hawksbill turtles on Chiriquí Beach. The first was deployed on July 16 on a female with tags CH0231 and CH0230 (Tobü Señorita Caña). This turtle remained close to the Caribbean coast of Panama until August 17. It later swam to Jamaican waters (Figure 1). The second transmitter was attached on July 19 to a turtle with tags CH0281 and CH0282 (Señorita Beche). This turtle was observed on the beach nesting for a second time on August 20 and remained close to the Panamanian coast until September 22. Later it made a journey to the Nicaraguan coast (Figure 2).

**Figure 1. Post nesting movements of Tobü Señorita Caña**



**Figure 2. Post nesting movements of Señorita Beche**



### Determination of survivorship and hatching success

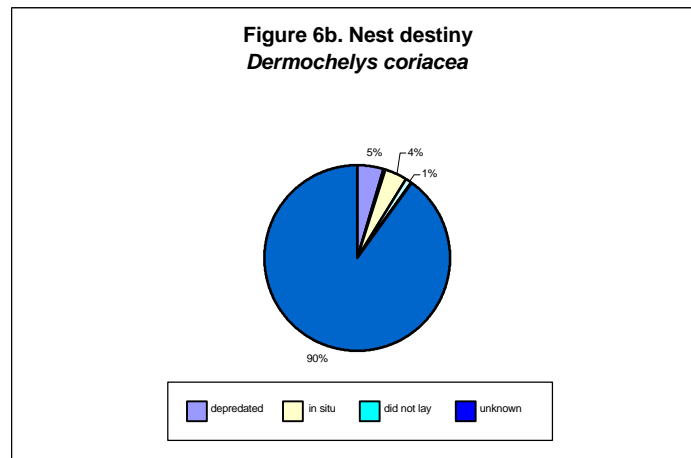
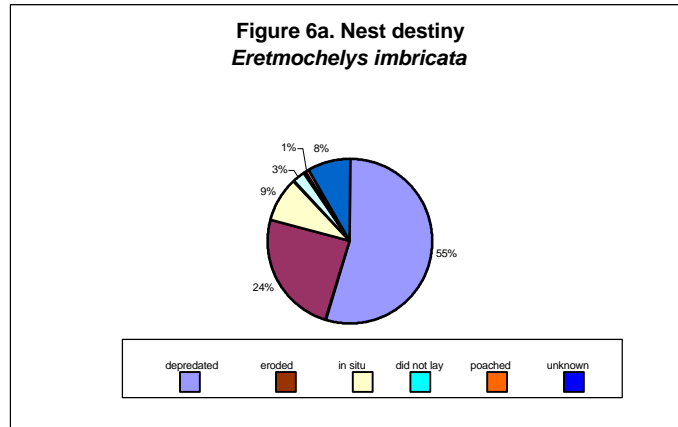
At Chiriquí Beach, between June 20 and August 28, 19 hawksbill nests were marked with pink tapes and the positions recorded with GPS. Six (31.6%) of those nests were observed to have been predated by dogs two months after being deposited which made evaluation difficult. One nest (5.3%) was eroded. Evaluation of the nest to determine hatching success was possible for twelve nests (63.1%). On the Zapatilla Cays, in the Bastimentos Island Marine National Park, 84 hawksbill nests were monitored. Of these, seven (8.3 %) could not be found, 76 (90.5 %) were excavated after hatching, and one nest (1.2 %) failed to hatch. Also, at Chiriquí Beach, six leatherback nests were evaluated and at the Big Zapatilla Cay, one leatherback nest was found from hatchling tracks and evaluated. The results and basic statistics on hatching success by species and area are presented in Table 7.

**Table 7. Summary of nest excavations and hatching success for Chiriquí Beach and the Zapatillas Cays.**

<b>Hawksbill nests at Chiriquí Beach</b>											
			<b>Excavations</b>								
<b>Treatment</b>	<b>Destiny</b>	<b>Nests</b>	<b>Excavated nests</b>	<b>Empty shells</b>	<b>Pipped live</b>	<b>Pipped dead</b>	<b>Eggs with development</b>	<b>Eggs without development</b>	<b>Depredated eggs</b>	<b>Total Eggs</b>	<b>% hatching</b>
Not moved	Intact	34	12	1393	255	9	194	18	0	1869	74.5
Not moved	Depredated	213	2	0	0	0	0	0	441	441	0
Not moved	Washed out	95	1	0	0	0	0	0	0	0	0
Not moved	Poached	4	0	0	0	0	0	0	0	0	0
Not moved	Unknown	33	0	0	0	0	0	0	0	0	0
		<b>TOTAL</b>	<b>19</b>	<b>1393</b>	<b>255</b>	<b>9</b>	<b>194</b>	<b>18</b>	<b>441</b>	<b>(estimated) 2777</b>	<b>(estimated) 50.2</b>
<b>Hawksbill nests at Zapatilla Cays</b>											
			<b>Excavations</b>								
<b>Treatment</b>	<b>Destiny</b>	<b>Nests</b>	<b>Excavated nests</b>	<b>Empty shells</b>	<b>Pipped live</b>	<b>Pipped dead</b>	<b>Unhatched eggs</b>		<b>Depredated eggs</b>	<b>Total Eggs</b>	<b>% hatching</b>
Not moved	Intact	77	77	10260	28	170	1750		0	12226	83.9
Not moved	Unknown	7	0	0	0	0	0		0	0	0
<b>Leatherback nests at Chiriquí Beach</b>											
			<b>Excavations</b>								
<b>Treatment</b>	<b>Destiny</b>	<b>Nests</b>	<b>Excavated nests</b>	<b>Empty shells</b>	<b>Pipped live</b>	<b>Pipped dead</b>	<b>Eggs with development</b>	<b>Eggs without development</b>	<b>Depredated eggs</b>	<b>Total Eggs</b>	<b>% hatching</b>
Not moved	Intact	36	6	311	1	8	150	22	0	492	63.2
Not moved	Depredated	44	0	0	0	0	0	0	0	0	0
Not moved	Washed out	1	0	0	0	0	0	0	0	0	0
Not moved	Poached	0	0	0	0	0	0	0	0	0	0
Not moved	Unknown	833	0	0	0	0	0	0	0	0	0
		<b>TOTAL</b>	<b>6</b>	<b>311</b>	<b>1</b>	<b>8</b>	<b>150</b>	<b>22</b>	<b>0</b>	<b>(estimated) 492</b>	<b>(estimated) 63.2</b>

The single leatherback nest recorded on the Big Zapatilla Cay was excavated and had 14 hatched eggs and 60 unhatched eggs with a hatching success of 18.9 %.

During all morning track surveys, all nests were inspected even if they had not been triangulated or recorded with GPS. Through this work it was observed that a high percentage of hawksbill nest lost on Chiriqui Beach was due to dog predation. For the leatherback nests, it was not possible to know the final destiny of all nests as the project began at the end of the season and it was difficult to follow-up on all nests. A summary of the nest destinies by species is shown in Figure 6a and 6b.



On the Zapatilla Cays, only one partly eroded nest with the loss of some eggs was observed. The remaining eggs were relocated. On these islands there is no problem with dog predation but some eggs and hatchlings may have been lost to crabs.

### Dead turtles

On July 17, two hawksbill turtles were illegally taken while nesting in the Río Chiriquí section and on July 29 another hawksbill turtle was taken but was recovered by the beach monitors and liberated the following day. Also, a hawksbill turtle was reportedly killed in the Río Caña section (date unknown) by local individuals who do not approve of the project. This turtle had its eyes removed and it was abandoned half dead on the beach. It was later buried by the beach monitors. Another local individual took the carapace for personal use (sale).

A dead green turtle was observed washed up on Chiriquí Beach on July 25. This turtle had propeller cuts in the carapace and we assume these were the cause of death. On August 1 in the Río Caña section, a green turtle was taken while nesting.

Through informal interviews, information on the take of marine turtles in other areas of the coast was obtained. On August 5 a visit was made to Kusapin and a school teacher informed us about the capture of five green turtles and twelve hawksbills. These turtles were captured by harpoon. He informed us that some of the hawksbill turtles had metal tags with the letters CH (our tag series) but he did not know the numbers.

In Río Caña, some representatives of APRORENANB informed us that in the areas of Tobobe and Playa Colorado turtles are captured by harpoon and occasionally on the beach while nesting. In Palo Blanco, San Pedro and San Pedrito, they use nets to capture green turtles and hawksbills. They mentioned that they have captured approximately ten or more turtles with CH tags.

## **Environmental education activities**

In August, Argelis Ruiz of STRI presented a two-day program about sea turtle biology and marine environmental conservation. Twenty teachers from the communities of Río Caña, Río Chiriquí, Río Diablo and San Pedro participated.

Two posters were presented at the National Environmental Authority (ANAM) stand at the Annual Sea Fair at Bocas Island from September 18 to 21, 2003. One poster gave the project description and preliminary results, the other showed results of the migratory routes of the two Chiriquí Beach hawksbill turtles with transmitters. Two beach monitors, the research coordinator from Chiriqui Beach, and Inocencio Castillo and Natalia Decastro from the Zapatilla Cays presented the project to the public and answered any questions that emerged. Sr. Castillo also provided live green turtles and acquired a hawksbill turtle from a local restaurant owner for exhibit at the fair (they were tagged and released at the close of the fair). The stand was one of the most visited during the fair. Afterwards, the posters were shown at the Río Caña primary school and the project was explained to eight teachers, 40 students and 20 community members. In November, the posters were put at the project installations in Río Caña. Twelve persons from the communities of Playa Colorado and Río Chiriquí visited and received an explanation about the work while they were visiting Río Caña for a football game.

On October 21, a talk was presented about Chiriquí Beach sea turtle research to five professors and 20 students at the Science Faculty of the University of Panama, Changuinola campus. During the talk, the students expressed great interest in getting involved and participating in the project.

## **DISCUSSION AND CONCLUSIONS**

### **Preparations**

Chiriquí Beach belongs to the Ngöbe-Buglé Comarca area and is the most important hawksbill (Carr 1956) and leatherback nesting beach in Caribbean Panama (Meylan, Meylan and Ruiz 1985). An important goal of the project at Chiriqui Beach is to generate conservation-oriented employment for local inhabitants and to teach them about the subject of conservation, as well as to build capacity for natural resource management. During the first year of work, we managed to learn about the interest of the locals of Río Caña in participating in the project. In the Río Chiriquí section, there are local individuals who support the project and others who do not. We hope that through environmental education we will be able to count on total support from both communities. The beach was divided into two sections to give participation to both communities adjacent to the study area.

At the Zapatilla Cays, limited beach monitoring has been ongoing since 1990 incidental to the Meylan's netting project sponsored by the Wildlife Conservation Society. Because these islands are uninhabited and enjoy some protection as part of the marine national park, the possibilities for protecting nesting females and their eggs are excellent.

### **Track surveys**

This first year, the work was extremely useful to determine the current importance of the beaches for nesting by sea turtles, for beach monitors to learn the tracks of different species that nest and to learn the local problems facing these species.

Through the daily monitoring, we determined that on Chiriquí Beach the leatherback turtle has the highest nest density (38.5 nests per km), followed by the hawksbill turtle (16.2 nests per km). The green turtle is the species that is least frequently seen nesting on these beaches (0.4 nests per km). The hawksbill turtle was the species most frequently observed during the months of monitoring (June-December) with a peak in nesting during the month of August (Figure 1a). For leatherback turtles, we only managed to obtain results for the end of the nesting season, with the last nesting of this species recorded in the month of August (Figure 1b). We hope that during the 2004 season we will obtain more information about the season for leatherback turtle nesting on this beach. The sporadic green turtle nesting recorded was from July to October (Figure 1c). It is well known that this species uses the waters of Caribbean Panama as a migration route and for feeding. Nesting occurs primarily at Tortuguero beach, Costa Rica.

At Chiriqui Beach, the majority of hawksbill and leatherback turtle nesting took place along the first 12 km of beach from the Río Caña river mouth to the middle of the beach. The other half of the beach has less nesting activity but is still an important part of the study area (Figure 2a and 2b). However, green turtle nests were observed with a greater frequency on the eastern end of the beach, from the middle of the beach to Río Chiriquí (Figure 2c).

On Escudo de Veraguas Island, few activities were recorded. However, it is possible that more nesting had taken place and was not recorded due to the interval between visits and the beach dynamics that may have erased some of the nests. We hope to establish weekly or daily monitoring during 2004, as is done at Chiriquí Beach (Table 2).

On the Zapatilla Cays beaches, hawksbill nesting density was greater (18.4 nests per km) than at Chiriqui Beach but there was only one leatherback nest, and no green turtle nests were recorded. It can be concluded from the results presented in Figure 1d that both cays are of great importance for hawksbill nesting.

### **Night patrols**

The number of turtles encountered at night would have been greater if the effort had been greater. As the priority of the project is to monitor the number of nests and identify the problems faced by nesting females and their nests, constant nightly monitoring was not conducted. But it will be important in the future to establish constant night work in order to estimate the number of females nesting at these beaches. Also, it will be valuable to consider the movements between nesting beaches (Appendix 1). Information on such movements can only be obtained through the observation of tagged females.

We cannot conclude anything about the time and activity at first encounter because observations depended on the interest of the volunteers who mainly worked between 9:00 PM and 12:00 AM (Figure 4). The most commonly observed activity was the digging of the egg chamber (Figure 5).

### **Biometric data**

Measurements of nesting females show that the smallest species is the hawksbill turtle, followed by the green turtle and the leatherback turtle. However, the clutch size is always greater for hawksbill turtles than for leatherback turtles.

For leatherback turtles, the determination of complete or incomplete caudal projection can vary depending on the criteria used by the observer and the different authors. It was observed that the statistics on carapace length and width are slightly smaller when the caudal projection was observed as complete and slightly larger when it was incomplete (Figure 5). Some authors suggest that the completeness of the caudal projection depends on the age of the turtle or wear of the projection when turtles are reproductively active. In relation to the clutch size no significant difference was observed between the different types of caudal projection.

### **Transmitters**

As can be seen in Figure 1 and 2, the post-nesting movements of these two hawksbills did not follow the same pattern. Given the extended amount of time spent at each of the turtle's respective destinations (they are still being monitored by satellite as of July 2004), these areas in Nicaragua and Jamaica can be presumed to be their home feeding grounds. These satellite tracking results, combined with a previous track of a hawksbill followed after nesting at the Zapatilla Cays suggest that it is important to join conservation efforts with different countries in the Caribbean in order to achieve the objective of recovering the hawksbill turtle population of Chiriqui Beach.

### **Determination of survivorship and hatching success**

Through the daily nest inspections we observed that at Chiriquí Beach the major loss of hawksbill nests is due to dogs. These predators, introduced by man, are very difficult to control but we hope that the environmental education work will help citizens to understand the importance of the control of this problem. At Zapatilla, where there are no dogs, and in fact, no terrestrial mammals, hatching success was very high (83.9%). All but one of the 77 nests followed to hatching produced hatchlings, and most produced more than 100 hatchlings. The only predators observed on these beaches were crabs which do not cause a complete loss of hatchlings. It was very difficult to know the fate of the monitored leatherback nests as work was initiated at the end of the nesting season.

Concerning the few nests that were evaluated to estimate the percentage of hatching success at Chiriquí Beach, we observed that the leatherback turtles had greater hatching success (mean estimated at 63.2%), than did hawksbill turtles (mean estimated at 50.2%). These results are not conclusive because the sample of nests that could be checked was very small.

### **Dead turtles**

The efforts this year at Chiriqui Beach greatly discouraged the capture of turtles on the beach. But it is important to realize that these efforts are counteracted by the fact that many nesting females appear to be taken from waters along the Bocas coast. To achieve the best conservation results, we require help from the traditional organizations, the government authorities and the communities that can help to better control the illegal fishing in areas adjacent to

these important nesting beaches. By joining forces and providing information we hope to achieve the primary objective of the project ,**"to recover the hawksbill turtle population"**.

#### **Environmental education activities**

These activities are of great importance to strengthen the efforts conducted at Chiriquí Beach. Also, another project interest is to build capacity in the Panamanian communities, mainly through university students, by involving them in the project.

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## RECOMMENDATIONS

- 1.- The horses are of great use at Chiriquí Beach, but there is a lack of interest in the welfare of these animals on behalf of the monitors and we should discontinue their use.
- 2.- More personnel is required to cover the beach at night to allow work with more nesting females.
- 3.- It is important to identify dog control methods for all of Chiriquí Beach in order to achieve greater hatching success.
- 4.- More training of beach monitors is required in finding nests using the triangulation technique and in evaluating hatching success before dog predation occurs.
- 5.- The visits and interventions of the Traditional Authorities of the Comarca and the National Environmental Authority of the Comarca at Chiriquí Beach are very important to strengthen the project. The authorities need to understand that turtle exploitation in neighboring areas will diminish the success of the efforts undertaken at Chiriquí Beach and in Bastimentos Island Marine National Park.
- 6.- The education work would have better success if conducted monthly and in different areas. It is also very important to have more activities in areas where fishing of these species is still practiced.
- 7.- It is important to achieve the involvement of Panamanian students to initiate training work at a higher level.

**Appendix 1 Tag numbers by species at Chiriquí Beach**

Date	Species	Right tag	Left tag	Eggs	Yolkless eggs	Length	Width	CP	Observations
13-Jun-03	ei	Ch0227	ch0226	204		88	77		
18-Jun-03	ei	Ch0502	ch0501			82	72.5		
27-Jun-03	ei	Ch0202	ch0201			89.5	73.5		
28-Jun-03	ei	Ch0204	ch0203	148		91	77		
30-Jun-03	ei	Ch0206	ch0205	185	8	90.3	69.6		
04-Jul-03	ei	Ch0229	ch0228	122	2	87	80		
04-Jul-03	ei	Ch0208	ch0207	195		89	72.7		
16-Jul-03	ei	Ch0231	ch0230	119		81.1	64.7		
17-Jul-03	ei	Ch0277	ch0276			84	74		
18-Jul-03	ei	Ch0233	ch0232			81.6	67		
18-Jul-03	ei	Ch0279	ch0278			87	76		
19-Jul-03	ei	Ch0281	ch0282	111		85.8	69.9		
21-Jul-03	ei	Ch0504	ch0503	225		98.4	79		
22-Jul-03	ei	Ch0236	ch0235	137		83	65.7		
22-Jul-03	ei	Ch0284	ch0283	125		85	73.5		
28-Jul-03	ei	Ch0286	ch0285			82.5	70.5		
29-Jul-03	ei	Ch0289	ch0288			85.5	73.5		
02-Aug-03	ei	Ch0506	ch0505	0	0	85	72.2		
03-Aug-03	ei	Ch0508	ch0507			80	75		
06-Aug-03	ei	Ch0510	ch0509	0	0	83.8	72.5		
11-Aug-03	ei	Ch0238	ch0237			85	80.5		
12-Aug-03	ei	Ch0512	ch0511	100		85	76		
29-Aug-03	ei	Ch0210	ch0209			86	76		
08-Sep-03	ei	Ch0514	ch0513	0	0	82	68		
10-Sep-03	ei	Ch0212	ch0211			84	80		
11-Sep-03	ei	Ch0214	ch0213			75	84		
06-Oct-03	ei	Ch0516	ch0515	0	0	82	80		
03-Nov-03	ei	Ch0520	ch0519			83.2	71.5		
28-Sep-03	ei	Ch0291	ch0290			41	36		Juvenile
07-Jun-03	dc	Ch1051	v4203	13	0	148.1	115.1	n	Chiriquí Beach 18-Jun-01
07-Jun-03	dc	Ch1002	ch1001			156.6	114.1	s	
07-Jun-03	dc	Ch1004	ch1003	0	0	146.9	108.9	s	
08-Jun-03	dc	Ch1006	ch1005	93		156.1	104.8	s	
08-Jun-03	dc	Ch1053	ch1052	78	28	148.9	104.1	s	
08-Jun-03	dc	Ch1008	ch1007	82		147.1	106.3	s	
08-Jun-03	dc		ch1026	0	0	114.5	98	n	
08-Jun-03	dc	Ch1010	ch1009	61		151.3	110	n	
08-Jun-03	dc	Ch1012	ch1011			135.5	102.6	s	
09-Jun-03	dc	Ch1014	ch1015	71	27	153.3	107.5	s	
09-Jun-03	dc	Ch1055	ch1054	52		143	111.3	s	
09-Jun-03	dc	Va3366	va1000	80		152.3	109.5	s	Long Beach 18-Aug-03
10-Jun-03	dc	Ch1029	ch1028	0	0	146.4	110	n	
10-Jun-03	dc	Ch1031	ch1030	0	0	131	103	n	
10-Jun-03	dc	Ch1033	ch1032	0	0	160	114	s	
11-Jun-03	dc	Ch1035	ch1034	92		155.1	114	n	
12-Jun-03	dc	Ch1017	ch1016	0	0	152	107.5	s	
12-Jun-03	dc	Ch1019	ch1018	67	29	153	105.6	s	
12-Jun-03	dc	Ch1021	ch1020			156.9	115	n	
12-Jun-03	dc	Ch1023	ch1022			132.9	101.8	n	
13-Jun-03	dc	Ch1025	ch1024			158.5	114.5	n	
13-Jun-03	dc	turtle046	turtle047			158	126	n	Canada
14-Jun-03	dc	Ch1057	ch1056	78		139	101	n	
14-Jun-03	dc	Ch1059	ch1058			158	112	n	
14-Jun-03	dc	Ch1327	ch1326						
15-Jun-03	dc	Ch1061	ch1060			142	106	s	
16-Jun-03	dc	Ch1037	ch1036			150.5	110.3	n	
16-Jun-03	dc	Ch1039	ch1038	94	30	151.6	109.2	n	
16-Jun-03	dc	Ch1302	ch1301			152.1	110	n	
17-Jun-03	dc	d10882	ch1040			168.8	122.5	n	No records
17-Jun-03	dc	Ch1304	ch1303	63		155	108.5	n	
17-Jun-03	dc		ch1305					s	
17-Jun-03	dc	Ch1042	ch1041	34	18	122.3	104.7	n	
17-Jun-03	dc	Ch1308	ch1307	78		151.5	114.4	s	
17-Jun-03	dc	Ch1063	ch1062			149	106	n	
18-Jun-03	dc	Ch1310	ch1309			144	104	n	
18-Jun-03	dc	Ch1065	ch1064	99	30	144.2	110.9	n	
18-Jun-03	dc	Ch1067	ch1066			141.9	107.3	n	
18-Jun-03	dc	Ch1068	v4210	0	0	148.4	110.8	n	Chiriquí Beach 25-Jun-01
18-Jun-03	dc	Ch1044	ch1043	101	25	157.7	114.7	n	
18-Jun-03	dc		v4213					n	Chiriquí Beach 28-Jun-01
19-Jun-03	dc	Ch1046	ch1045	94	10	135.5	100.2	N	
20-Jun-03	dc	Ch1077	ch1076			148	114	n	

Continue.....

Continuation.....

Date	Species	Right tag	Left tag	Eggs	Yolkless eggs	Length	Width	CP	Observations
21-Jun-03	dc	Ch1312	ch1311					n	
24-Jun-03	dc	Ch1079	ch1078			154	114	n	
24-Jun-03	dc	Ch1081	ch1080	90	24	162.9	122.3	n	
25-Jun-03	dc	Ch1315	ch1314			155	111.2	n	
26-Jun-03	dc	Ch1317	ch1316			158.3	116.2	s	
27-Jun-03	dc	Ch1319	ch1318			153.4	113	s	
27-Jun-03	dc	Ch1102	ch1101	91	10	146.1	102.1	n	
27-Jun-03	dc	Ch1104	ch1103			151.2	105.8	n	
27-Jun-03	dc	Ch1106	ch1105	90	45	152.8	109.1	s	
28-Jun-03	dc	Ch1322	ch1321	105		149.3	108.6	s	
28-Jun-03	dc	Ch1108	ch1107			151.5	118.5	s	
30-Jun-03	dc	Ch1075	v4219	93	15	160	120.9	n	Chiriquí Beach 27-Jun-01
01-Jul-03	dc	Ch1085	ch1084			160	123	n	
01-Jul-03	dc	Ch1083	ch1082			144	106	n	
03-Jul-03	dc	Ch1087	ch1086			144	108	n	
05-Jul-03	dc	Ch1325	ch1324			156	116	n	
05-Jul-03	dc	Ch1329	ch1328						
05-Jul-03	dc	Ch1111	ch1109	90	25	150	110	n	
08-Jul-03	dc	Ch1377	ch1323			153.9	109.5	s	
13-Jul-03	dc	Ch1331	ch1330	76	16	147	107.2	s	
17-Jul-03	dc	Ch1089	ch1088	64	25	135.6	102.3	s	
17-Jul-03	dc	Ch1091	ch1090	44	45	146.1	103.9	n	
17-Jul-03	dc	Va2532	76505	69	18	144	110	s	
23-Jul-03	dc	Va2087	va2088	91	21	163.5	121.4	n	Tortuguero Beach 17-May-03
06-Jul-03	cm	Ch0352	ch0351			100.4	90		

(CP: Caudal Projection, Ei: *Eretmochelys imbricata*, Dc: *Dermochelys coriacea*, Cm: *Chelonia mydas*)**Appendix 2 Tag list for Zapatilla Cays**

Date	Species	Right tag	Left tag	Eggs	Length	Observations
8-Jun-03	ei	MY508	MM1065	0	88	
9-Jun-03	ei	MY511	MM1068	0	82	
27-Jun-03	ei	CH0001	CH0002	157	85.5	
6-Jul-03	ei	CH0003	CH0004		92.5	
8-Jul-03	ei	CH0005	CH0008	0	90	
24-Jul-03	ei	CH0009	CH0010			
8-Aug-03	ei	CH0011	CH0012	0	88.2	
15-Aug-03	ei	CH0014	CH0015	6	83.5	
8-Sep-03	ei	CH0016	CH0017	0	88.4	
8-Sep-03	ei	CH0018	CH0019	0	92.8	