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BASELINE REPORT ON THE STATUS OF SEA TURTLE POPULATIONS IN BOCAS DEL TORO PROVINCE AND THE COMARCA NGÖBE-BUGLÉ, PANAMA

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CONTENTS

EXECUTIVE SUMMARY

The objective of this report is to provide a summary of existing data collected by the Sea Turtle Conservancy (Formerly Caribbean Conservation Corporation) and other conservation organizations on nesting populations of hawksbill (*Eretmochelys imbricata*) and leatherback (*Dermochelys coriacea*) sea turtles at key nesting beaches in Bocas del Toro Province and the Comarca Ngöbe-Buglé, Panama.

It will include an overview of existing sea turtle research and conservation projects in the region, methods used to collect data, and review the current status of hawksbill and leatherback populations. There will also be an evaluation of the major anthropogenic threats to sea turtles and their habitats in the region.

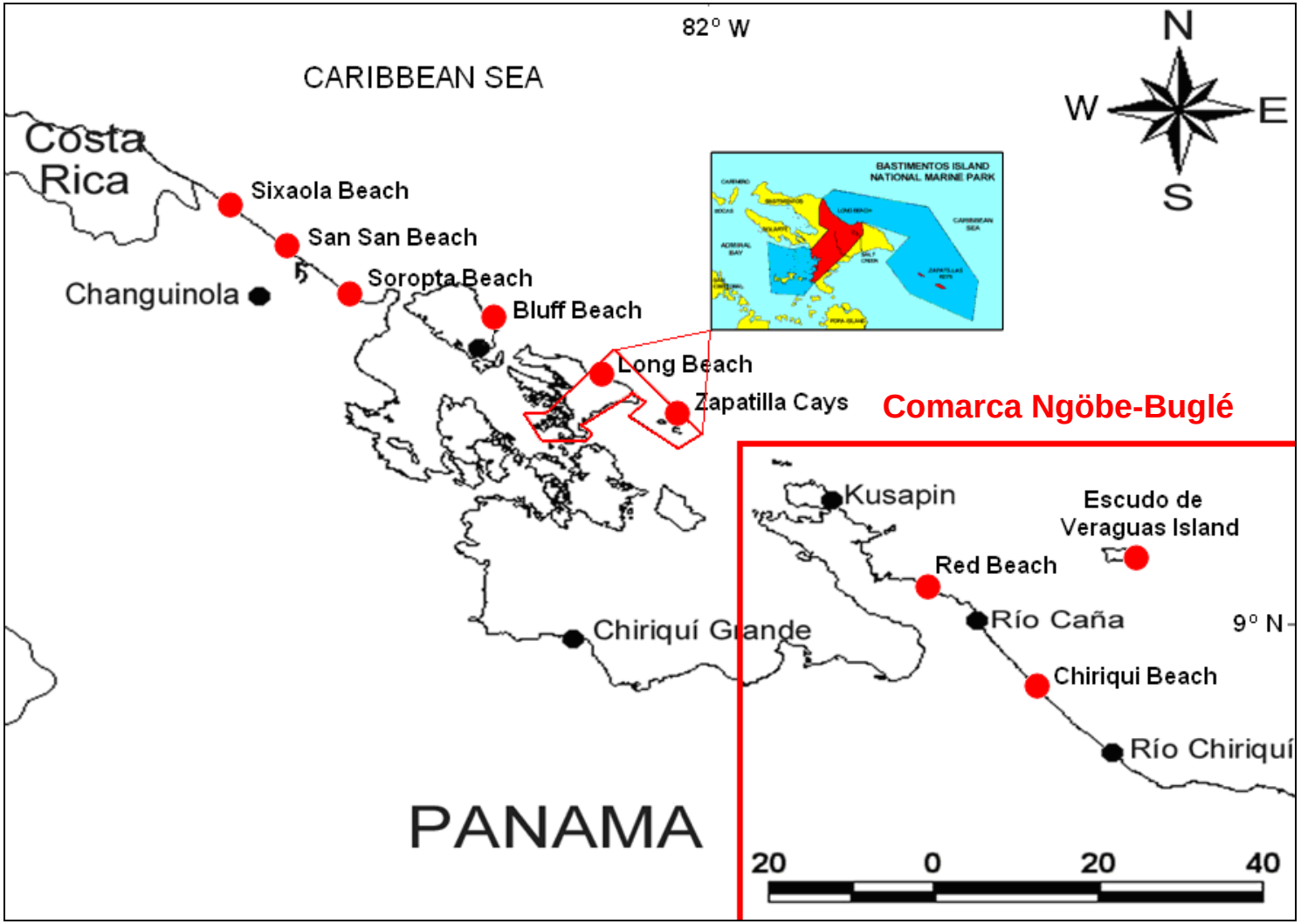
INTRODUCTION

The Bocas del Toro region, on the Caribbean coast of Panama, includes Bocas del Toro Province and the semi-autonomous indigenous Comarca Ngöbe-Buglé (See Figure 1). Four species of sea turtles have been recorded in the region; the green turtle (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*), and it contains important nesting, migration and foraging sites for various life stages of these different species.

For centuries the hawksbill turtle has been central to the economy of the coastal residents of Bocas del Toro and the Comarca—dating back to when they were hunted extensively to supply the international tortoiseshell market. In more recent times, Chiriquí Beach (Playa Chiriquí) was leased to '*veladors*' who paid for the exclusive rights to all hawksbill turtles nesting in their section of beach. This beach was once described by Dr. Archie Carr (1956) as one of the most important nesting beaches for the hawksbill turtle in the region, and '*veladors*' reportedly captured 35-50 females per night within a single mile of beach (Meylan and Donnelly, 1999). However, by the early 1980s and 1990s aerial and ground surveys had revealed a dramatic decline in the hawksbill population nesting at Chiriquí Beach (estimated at 98%) from levels reported by '*veladors*' in the 1950s—a decline attributed to decades of indiscriminant harvesting (Meylan, 1999; Meylan and Donnelly 1999).

Indigenous Ngöbe-Buglé communities have been actively involved in protecting sea turtles in the Comarca. In 1995, Río Caña residents formed a community group called the Association for the Protection of Ngöbe-Buglé Natural Resources (APRORENANB), and shortly afterwards initiated rudimentary turtle conservation efforts that only allowed the hunting of turtles at Chiriquí Beach every other year (information provided by APRORENANB).

Figure 1. Map of Bocas del Toro Province and Comarca Ngöbe-Buglé, showing location of sea turtle nesting beaches.



Intermittent periods of field work at Chiriquí Beach from 1999 to 2002, confirmed the previously observed decline in hawksbill nesting, and provided preliminary information on the threats they face (Ordoñez 1999-2002, unpublished data). Aerial and ground surveys conducted in the early 1980s had revealed Chiriquí Beach to be one of the most important nesting sites for leatherbacks in the Bocas area, and in the Caribbean region (Meylan *et al*., 1985). This site has subsequently been shown by STC to be the most important nesting beach for leatherbacks on the Caribbean coast of Central America (Ordoñez *et al*., 2007) and one of the top four remaining in the world.

In 2003, a long-term project entitled "Hawksbill and Leatherback Turtle Research and Population Recovery at Chiriquí Beach, Escudo de Veraguas Island and Bastimentos Island National Marine Park, Panama" was initiated under the coordination of the Sea Turtle Conservancy in collaboration with the Wildlife Conservation Society (WCS), APRORENANB, the Panama National Environment Authority (ANAM), Smithsonian Tropical Research Institute (STRI), Eckerd College and the Florida Fish and Wildlife Conservation Commission (FWC). Additional funding for the project has been provided by the Disney Wildlife Conservation Fund, International Fund for Animal Welfare, National Fish and Wildlife Foundation (NFWF), U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, World Wildlife Fund and others. The initial goal of the project was to increase the region's hawksbill population through research, monitoring and conservation efforts. As research determined the global importance of Chiriquí Beach as a leatherback nesting site, the project was expanded to encompass this species as well.

Sea turtle research and conservation efforts have been conducted at numerous nesting beaches in Bocas del Toro Province for many years, including Sixaola Beach (Playa Sixaola), Soropta Beach (Playa Soropta) and San San Beach (Playa San San), which are all in the San San Pond Sack Wetland; Bluff Beach (Playa Bluff), which has no official protected status at present; and Long Beach (Playa Larga) and the Zapatilla Cays within Bastimentos Island National Marine Park. Beaches that have been studied to date within the Comarca Ngöbe-Buglé include Red Beach (Playa Roja), Escudo de Veraguas Island and Chiriquí Beach (Playa Chiriquí) (See Figure 1). The frequency and duration of monitoring of nesting beaches has varied among beaches. These projects have been coordinated by a variety of local, national and international organizations including Caribaró Conservationist Association, National Association for the Conservation of Nature (ANCON), Association for the Conservation of Ngöbe-Buglé Natural Resources (ACORENANB), Association of Friends and Neighbors of the Coast and Nature (AAMVECONA), APRORENANB, ANAM, STC, WCS, Association ANAI, Endangered Wildlife Trust (EWT), Institute for Tropical Ecology and Conservation (ITEC), PROMAR Foundation and the Regional Environmental Program for Central America (PROARCA).

STC has worked extensively with indigenous community leaders of the Comarca Ngöbe-Buglé and government enforcement agencies such as ANAM and the Authority for Aquatic Resources of Panama (ARAP) to study the sea turtle populations in the region and ensure their protection. The Comarca Ngöbe-Buglé has been very supportive of sea turtle research and conservation efforts within the Comarca; the Ñö Kribo Regional Congress of the Comarca Ngöbe-Buglé issued a letter of support for the project in May 2003 and a formal Memorandum of Understanding (MoU) has been developed through discussions with the Ñö Kribo Regional Congress, ANAM and APRORENANB. This MoU was formally signed by all parties during a community celebration that took place on June 14, 2006.

METHODOLOGY

Since 2003, the STC-coordinated long-term hawksbill and leatherback project at Chiriquí Beach and associated nesting sites has involved a program of intensive monitoring of turtle nesting at five beaches. Activities have included track surveys to determine spatial and temporal distribution of nesting for each species; nest marking to assess nest survivorship; excavation of nest contents to calculate hatching and emerging success; and additional research to study migratory behavior and genetic diversity. Chiriquí Beach and the Zapatilla Cays were selected as index beaches for population trend evaluation at the CITES Wider Caribbean Hawksbill Turtle Dialogues in 2001 and 2002. To ensure consistency of data collection across the numerous sites where surveys are conducted, monitors were trained to follow a standard index nesting beach survey protocol (See Appendix 1). Other methodology is also standardized at these five sites, such as the protocol for nest evaluations. However, only a subset of nesting beaches that are currently being surveyed in the Bocas area (those being coordinated by STC and project partner, WCS) follow a standardized protocol; Chiriquí Beach, Escudo de Veraguas Island, Red Beach and the Zapatilla Cays. The standard protocol is adapted slightly for leatherback turtles; no verification of the presence of eggs is conducted for nests of this species during track surveys, due to the difficulty of locating the egg chamber within the nest site.

Study sites within the Comarca Ngöbe-Buglé are Chiriquí Beach, Escudo de Veraguas Island and Red Beach; monitoring at these locations is conducted by STC. Within Bastimentos Island National Marine Park are the two Zapatilla Cays and Long Beach. Monitoring at the Zapatilla Cays is conducted by Drs. Peter and Anne Meylan (Wildlife Conservation Society and the Smithsonian Tropical Research Institute); at Long Beach, EWT runs the program during the leatherback nesting season (March – July) and the Drs. Meylan direct the monitoring during the hawksbill season (July – November).

Track surveys of study sites are conducted on foot to record all sea turtle nesting activity. All tracks are identified by species, and recorded as either a successful nesting attempt or a false crawl emergence (when the female comes ashore but does not lay eggs). A record is also made of nest predation, illegal take of eggs and/or female turtles, or erosion by high tides. At Chiriquí Beach surveys of the entire 24km of beach are conducted weekly in December and January, every two days in February and November, and daily from March through October. Daily surveys of the Zapatilla Cays are conducted from May through November; surveys on Long Beach were initiated in 2006 and are conducted daily from May through October. From April to November, surveys of Escudo de Veraguas Island (from 2003) and Red Beach (from 2004) are also conducted. The frequency of surveys at these latter two localities is dependent on sea conditions and availability of personnel.

The position of all hawksbill nests observed during track surveys is marked using flagging tapes in the vegetation behind the nest; measurements are taken from the egg chamber to each tape, and triangulation is used to locate the nest for excavation. For leatherbacks, nests are also marked during night patrols using flagging tapes, if the turtle is encountered while laying. A GPS location is also recorded for each nest. All marked nests are monitored on subsequent surveys throughout the incubation period to record illegal take, predation or erosion events, and to record the date of hatching. Nest contents are excavated 2-3 days after hatching is observed, to determine hatching and emergence success.

STC conducts nightly patrols to encounter nesting females at Chiriquí Beach from March through October each year. Up until 2005, two teams patrolled a 5km section at each end of the beach, but in 2005 an additional station was constructed in the middle of the beach so three research teams are able to patrol a minimum of 12km of beach each night. Patrols are also conducted at Long Beach (April through October) and the Zapatilla Cays (May through October. All nesting females encountered are flipper tagged and biometric data collected. If females are encountered prior to laying eggs the nest is marked using the method described above. For a sample of females a tissue sample is also collected for inclusion in a study of the genetic diversity of the turtle populations in the region.

Monitoring and conservation at Sixaola Beach and Soropta Beach is coordinated by EWT in collaboration with local communities and the Integrated Development Association of Bocas del Toro (ADIB); at San San Beach research is conducted jointly by EWT and the local conservation non-governmental organization AAMVECONA. Monitoring activities began at Soropta Beach in 2002, at Sixaola Beach in 2006 and at San San Beach in 2007; daily track surveys are now conducted at all sites throughout the leatherback nesting season (March thru July), and night patrols are also conducted to encounter nesting females. Through an agreement between STC, EWT and WCS, STC staff provides assistance with the logistical coordination of these projects and the management

of data. Satellite telemetry is used to determine the migration routes and feeding grounds of hawksbill and leatherback turtles nesting within the Bocas del Toro region. Several individuals have been fitted with satellite transmitters to track their post-nesting migrations. These data are invaluable in helping to determine the threats faced by turtles during their migrations, and at their feeding grounds beyond Panamanian waters.

RESULTS

LEATHERBACK NESTING IN BOCAS DEL TORO

Table 1 summarizes leatherback nesting at beaches in Bocas del Toro Province and the Comarca Ngöbe-Buglé between 1999 and 2009; these data are taken from Meylan *et al*. (In Press) and show the number of nests that have been recorded each year at nine study sites, including Bluff Beach which has been studied intermittently by various organization over the years. As can be seen from the notes on monitoring status in Table 1, the intensity and timeframe of monitoring have varied among the beaches and thus these data are not of equivalent quality. Furthermore, monitoring on northern beaches has focused on the leatherback turtle.

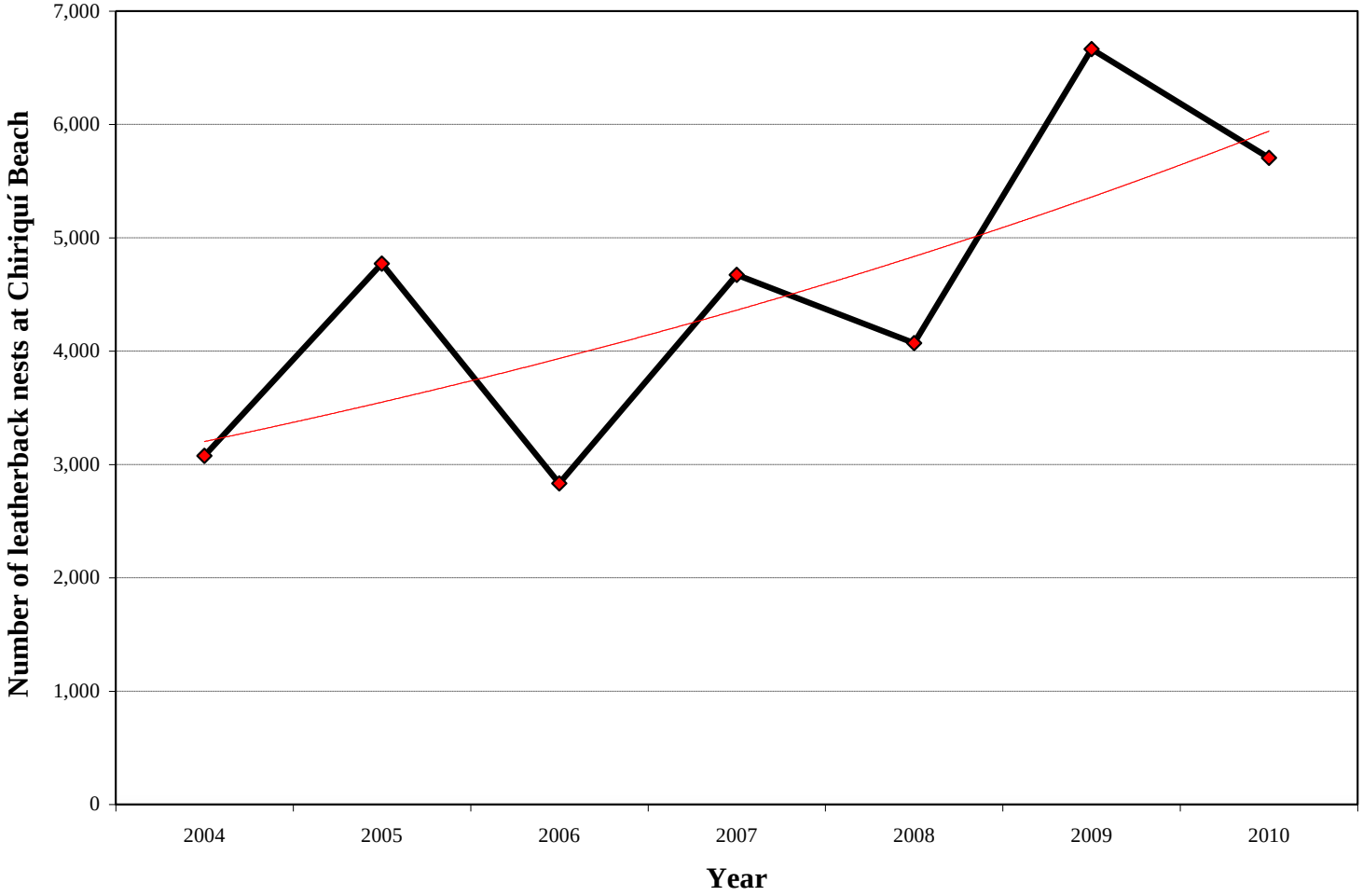
What is very obvious from Table 1 is that Chiriquí Beach is the principal leatherback nesting beach in the region, with between 1,000 – 4,999 nests per year until 2009. During the 2010 season, subsequent to the above study, nesting of leatherbacks at Chiriquí Beach reached 6,665 nests. Significant numbers of leatherback nests are also laid at Sixaola Beach, San San Beach and Soropta Beach; between 100 – 499 nests per season. Monitoring and conservation programs were initiated at these three beaches to reduce the number of females that were killed as they came ashore to nest, solely to extract their eggs. At all these sites an increase in the number of nests laid per year can be attributed to a large extent to the fact that the killing of female turtles has been eliminated.

There has been an increase in leatherback nesting observed in Bocas in the last few years; however, one factor that needs to be taken into consideration when assessing the population trend for this species in the region is that there has been a considerable increase in survey effort, either through incorporation of a new study site, or a change in frequency of surveys at an existing site. However, at Chiriquí Beach survey effort has been relatively constant since the start of the project; only in 2003 was monitoring not conducted year round. Figure 2 shows the number of leatherback nests recorded at Chiriquí Beach from 2004 – 2010; which are the years with monitoring throughout the entire leatherback nesting season. Despite annual fluctuations in the number of nests laid, the overall trend is positive; between 3,077 – 6,665 nests each year.

Table 1. Summary of leatherback nesting data from surveys conducted at nesting beaches in Bocas del Toro, Panama, 1999 – 2009. Monitoring status: 1 denotes beaches with irregular or short-term monitoring, 2 denotes beaches with regular but not daily monitoring since at least 2004, and 3 denotes beaches with daily monitoring during the nesting season since at least 2004 (Data from Meylan *et al*., In Press).

Site	Length of beach / km	Number of nests per year	Monitoring Status
Sixaola Beach	6.8	100 – 499	2
San San Beach	12.0	100 – 499	2
Soropta Beach	10.0	100 – 499	3
Bluff Beach	4.0	25 – 99	1
Long Beach	4.3	100 – 499	3
Zapatilla Cays	4.2	<5	3
Red Beach	2.5	5 – 24	2
Chiriquí Beach	24.0	1000 – 4999	3
Escudo de Veraguas Island	~5.6	5 – 24	2

Figure 2. Leatherback nesting trend at Chiriquí Beach from 2004 – 2010; data from 2003 are excluded as monitoring activities in that year did not cover the entire leatherback nesting season.



The results of tagging programs conducted in Bocas del Toro have indicated that individual leatherback females will frequently travel between different nesting beaches both within a single nesting season and between different seasons. Indeed, individuals tagged while nesting in Panama have been encountered by researchers working at beaches along the entire Caribbean coast of Costa Rica (including Gandoca, Parismina, Pacuare and Tortuguero) and at nesting sites on islands within the Caribbean; for example, Aruba (R. Van der Waal, pers. comm.). There is an initiative to establish a regional leatherback data base to incorporate information about individuals that move between nesting beaches in Panama and Costa Rica; to facilitate data exchange between projects in the two countries and further existing knowledge of leatherback reproductive behavior.

It has been determined that individuals from Bocas del Toro form part of a nesting population of leatherbacks that has been estimated to be the fourth largest worldwide, with between 1,152 – 2,579 females (Troëng, Chacon & Dick, 2004); only populations in Gabon, French Guiana/Suriname, and Trinidad and Tobago are larger. Recent increases in the number of nests recorded at beaches in Bocas del Toro suggest that the population of nesting females may have increased since that article was written.

HAWKSBILL NESTING IN BOCAS DEL TORO

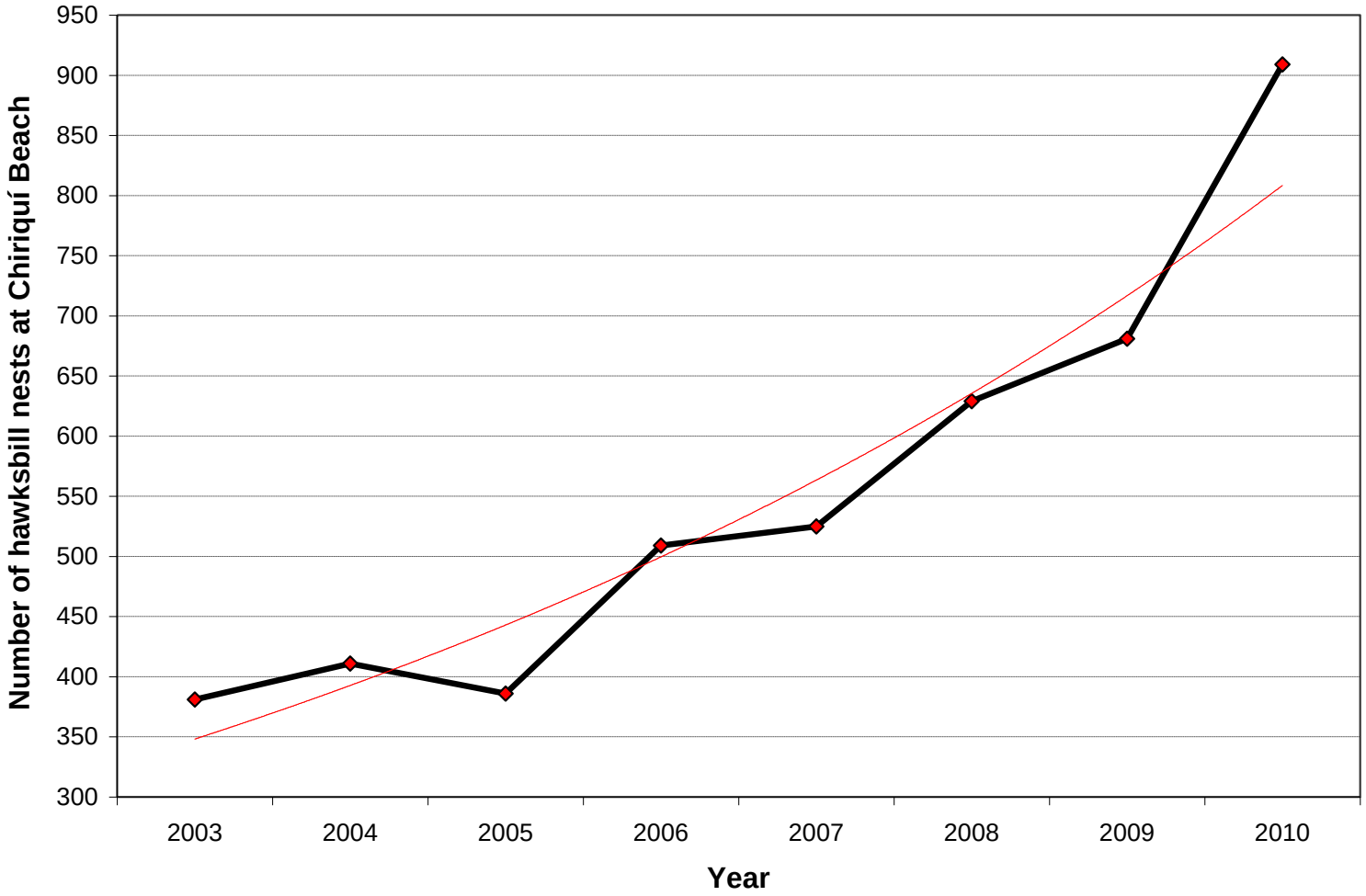
Table 2 summarizes hawksbill nesting at beaches in Bocas del Toro Province and the Comarca Ngöbe-Buglé between 1999 and 2009; these data are taken from Meylan *et al*. (In Press) and show the number of nests that have been recorded each year at nine study sites, including Bluff Beach which has been studied intermittently by various organization over the years. The intensity and timeframe of monitoring at different beaches varies, and monitoring efforts have focused on other species, so hawksbill nesting is probably underestimated. However, it is clear from Table 2 that Bocas del Toro hosts a considerable number of hawksbill females each year at various nesting beaches. Chiriquí Beach is the largest hawksbill nesting beach in the region, with 500 – 999 nests per year; however, the Zapatilla Cays and Escudo de Veraguas Island have also been shown to receive a substantial number of nests per season (100 – 499).

Figure 3 shows the number of hawksbill nests recorded at Chiriquí Beach since 2003. At this site survey effort has been relatively consistent since the start of the project, therefore as the principal nesting site for this species in the area the trend observed at this beach is a good indicator of the trend for the entire region. There has been a strong increase in the annual number of hawksbill nests laid since 2003; from 389 in 2003, to 909 in 2010 (to November only). These are preliminary data that will be the subject of further refinement and analysis. Using an estimate of 3 – 5 nests per female per nesting season, this represents approximately 303 – 182 females.

Table 2. Summary of hawksbill nesting data from surveys conducted at nesting beaches in Bocas del Toro, Panama, 1999 – 2009. See Table 1 for description of Monitoring status codes. (Data from Meylan *et al*., In Press).

Site	Length of beach / km	Number of nests per year	Monitoring status
Sixaola Beach	6.8	5 – 24	2
San San Beach	12.0	<5	2
Soropta Beach	10.0	5 – 24	2
Bluff Beach	4.0	<5	1
Long Beach	4.3	25 – 99	2
Zapatilla Cays	4.2	100 – 499	3
Red Beach	2.5	25 – 99	2
Chiriquí Beach	24.0	500 – 999	3
Escudo de Veraguas Island	~5.6	100 – 499	2

Figure 3. Hawksbill nesting trend at Chiriquí Beach, 2003 – 2010.



PRINCIPAL THREATS TO SEA TURTLES AT CHIRIQUÍ BEACH

During track surveys on Chiriquí Beach any disturbance of leatherback or hawksbill nests, whether natural or anthropogenic, is recorded to determine the different threats to nests at the nesting beach. Table 3 summarizes the information regarding the three primary causes of nest loss identified at Chiriquí Beach; tidal erosion, predation by domestic dogs and illegal take by humans.

Table 3. Summary of principal causes of nest loss at Chiriquí Beach, 2003 – 2010. N = Number of nests; [1] = Data from June - December only; [2] = Data from January - November only.

Year	Leatherback			Hawksbill		
	Erosion	Predation	Poached	Erosion	Predation	Poached
	N	N	N	N	N	N
2003[1]	<5	25 – 99	<5	25 – 99	100 – 250	<5
2004	<5	5 – 24	<5	5 – 24	100 – 250	25 – 99
2005	<5	5 – 24	<5	<5	5 – 24	<5
2006	<5	5 – 24	<5	<5	25 – 99	<5
2007	25 – 99	25 – 99	<5	25 – 99	100 – 250	5 – 24
2008	25 – 99	25 – 99	<5	25 – 99	25 – 99	5 – 24
2009	100 – 250	25 – 99	<5	5 – 24	100 – 250	5 – 24
2010[2]	100 – 250	25 – 99	<5	<5	100 – 250	<5

For leatherback turtles the biggest threat to nests is from erosion; since 2003, 1.4% of all leatherback nests have been washed out by high tides. Hawksbill nests are also subject to erosion; 5.4% of nests laid since 2003 were lost as a result of erosion. Leatherback nests are typically laid in the more open section of the beach, closer to the high tide line, and so are particularly prone to erosion. Even hawksbill nests, however, which are more often laid in the vegetation at the back of the beach, are not completely protected; at certain times of the year, especially at the end of the hawksbill nesting season, Chiriquí Beach is subject to very high tides that completely flood the entire beach, with waves often reaching the vegetation line and impacting hawksbill nests.

The biggest threat to nest survival for hawksbills at Chiriquí Beach is predation by domestic dogs from the two indigenous communities that are located at either end of the beach. When monitoring activities began in 2003 over 50% of hawksbill nests were predated by dogs; 19.8% (almost 900 nests) have been excavated by dogs in the last eight years. For leatherbacks the impact of dog predation is not as significant, due in part to the depth of leatherback nests and also to the large number of nests that are deposited on the beach each season. Nevertheless, over 300 leatherback nests have been predated by dogs since 2003.

As would be expected, the hatching success of nests that are depredated by dogs is significantly lower than that of the undisturbed nests, for both leatherback and hawksbill turtles. Hatching success of undisturbed leatherback nests at Chiriquí Beach ranges from 23.7% - 67.7%, with an average of 48.1%; for nests disturbed by predators hatching success ranges from 1.6% - 26.3%, with an average of 9.3%. This 38.8% decrease in success will obviously significantly reduce hatchling production if predation is allowed to continue unchecked.

For hawksbill nests the impact of dog predation is even more dramatic; undisturbed nests have a hatching success rate that ranged from 63.2% - 92.6%, with an average of 81.3%. Nests disturbed by predators, however, have a hatching success that ranges between 8.2% - 28.5%, with an average of just 17.7%; this is a decrease of 68.6% from undisturbed nests. Hawksbill nests at Chiriquí Beach are subject to more intensive dog predation pressures, possibly due to the fact that they are much shallower, and so are easier for the dogs to find than a leatherback nest. For both species, the majority of predation occurs not when the nests are recently laid, but rather when the hatchlings have hatched from the eggs and are within the egg chamber waiting to emerge.

At Chiriquí Beach illegal poaching of leatherback nests is negligible; only three nests have been taken by humans since 2003. Poaching of hawksbill nests has been variable throughout the course of the project, ranging between 0.1 – 8.2% of the annual number of nests laid. Innovative methods to reduce poaching (for example, contracting the wife of a known poacher on the project, with the agreement that he stops taking nests) have been relatively successful, though continued education campaigns are important to raise awareness among local community members of the negative impacts of poaching on the survival of the hawksbill population. The local indigenous people have no cultural history of eating hawksbill turtles, and so the killing of adult females on the nesting beach is rare; since 2003 eight individuals have been killed at Chiriquí Beach. In 2010, however, eight hawksbills were killed at Red Beach. Hawksbills, however, may be hunted to obtain shell for the tortoiseshell trade. Indigenous people do traditionally hunt green turtles at sea, and will opportunistically take hawksbills if encountered; one of the continuing threats to these species in the Bocas del Toro Province, and specifically within the Comarca Ngöbe-Buglé, is the uncontrolled take of individuals at sea. Collaborative initiatives with the government

environmental agencies (ANAM and ARAP), to increase vigilance and improve law enforcement, will hopefully provide a solution to this problem in the future. It is important to emphasize through education and outreach programs with local communities that while hawksbill populations are beginning to recover in Bocas this does not imply that turtles can be harvested again without negatively affecting the population.

It is possible to make an estimation of hatchling production at Chiriquí Beach since 2003 using data on the number of nests laid, the percentage of loss due to erosion, predation or poaching, the average clutch size and the average hatching success. For leatherbacks; 32,725 nests have been laid, of which 469 were lost to erosion and poaching and therefore produced no hatchlings. A further 329 nests were predated by dogs and consequently had a much lower hatching success than undisturbed nests. If the remaining number of nests (31,927) is multiplied by the average clutch size (77 eggs) a total of 2,458,379 eggs have been deposited. Given that the average hatching success is 48.1%, this equates to 1,182,480 hatchlings from undisturbed nests. For those nests predated by dogs a further 2,356 hatchlings have been produced, giving an overall estimate of 1,184,836 leatherback hatchlings leaving Chiriquí Beach; an average of 148,105 hatchlings per year since 2003.

For hawksbills; 4,517 nests have been laid at Chiriquí Beach, of which 322 were lost to either erosion or poaching. An additional 892 were depredated by dogs. The remaining 3,303 undisturbed nests had an average of 136 eggs; giving a total of 449,208 eggs. Average hatching success for hawksbills is 81.3%, so 365,206 hatchlings have been produced from undisturbed nests; for the 892 nests subject to predation hatching success was 17.7%, giving a further 21,472 hatchlings. This equates to an estimated production of 386,678 hawksbill hatchlings at Chiriquí Beach; approximately 48,335 hatchlings per season in the last eight years.

RECOMMENDATIONS and CONCLUSIONS

For both leatherback and hawksbill turtles monitoring efforts indicate that nesting populations are increasing in Bocas del Toro Province and the Comarca Ngöbe-Buglé and research to date has highlighted the regional and global significance of the area for both species. However, there are still significant threats to both species in the region, and so it is very important to continue the on-going monitoring programs that have been established. Several threats have already been determined, and sustained efforts are needed to ensure that they do not negatively impact the future survival of these critically endangered species. Furthermore, several other emerging threats are being recognized; including coastal development, which could result in the loss of important nesting beach habitat and damage to other critical habitats in the region. Within the Comarca Ngöbe-Buglé recent controversial plans by international developers to build a

huge resort complex within the Damani-Guariviara Wetland of International Importance, which lies directly behind Chiriquí Beach and is a listed RAMSAR site, have generated considerable concern among Comarca leaders and conservation organizations such as STC. Also, uncontrolled tourist activities, which if not properly managed could cause direct harm to nesting female turtles, eggs and hatchlings. Habitat damage is also another important factor that could negatively impact sea turtles in Bocas; for example, through extraction of sand for construction purposes, or increases in artificial lighting on nesting beaches that could deter nesting females and disorientate hatchlings. These three threats are obviously closely related, and so need to be addressed collectively.

There is, however, considerable potential for tourism to actually have a positive impact on sea turtle conservation within the Bocas del Toro region, with respect to providing alternative incomes and generating funds that could be used to support research initiatives or enforcement activities to improve protection of turtles and their vital habitats. In addition to establishing mechanisms to directly conserve sea turtle populations, it is necessary to ensure that both local community members and visitors to the Bocas del Toro region are provided with adequate information about the importance of the area for sea turtles. A targeted education and outreach program needs to be developed in collaboration with key stakeholder groups in the region, such as local government officials, indigenous community leaders, conservation organizations and tour operators, that highlights local and regional conservation initiatives and promotes participation in eco-tourist activities that benefit local communities, support government environment agencies and do not negatively impact turtles or their habitats. STC has been conducting environmental education and outreach in Bocas del Toro Province and the Comarca Ngöbe-Buglé for several years, striving to involve many of the important stakeholders; however, to date, these efforts have not been focused on trying to directly engage the private sector to support turtle conservation efforts in the region.

To improve protection and ensure adequate enforcement of environmental laws, there is an urgent need to build capacity within government agencies such as ANAM and ARAP. This could be achieved through training programs or workshops, such as those conducted by STC at its station in Tortuguero, Costa Rica. The development of public-private partnerships within Bocas del Toro will hopefully allow government enforcement agencies to improve their turtle protection efforts in the region by providing a sustainable funding source. For example, additional funds for enforcement activities would allow an increase in the level of protection for nesting, mating and foraging sea turtles in the Bastimentos Island National Marine Park (which was specifically established to protect them), which is a high priority. Furthermore, other important turtle nesting beaches in Bocas, such as Bluff Beach, need to be designated as protected areas. Such classification would obligate and empower ANAM and ARAP to ensure the protection of female turtles and nests.

Establishing strategic partnerships within the region, such as the proposed bi-national leatherback data base to facilitate information exchange between the two countries, and ensuring the involvement of coastal indigenous communities in the development of activities related to turtle protection, investigation, conservation and ecotourism, will hopefully ensure the continued survival of all sea turtle populations in Bocas del Toro Province and provide a sustainable source of resource-based income for the region.

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APPENDICES

APPENDIX 1. COPY OF STANDARD INDEX BEACH PROTOCOL USED AT HAWKSBILL NESTING BEACHES IN BOCAS DEL TORO PROVINCE AND THE COMARCA NGÖBE-BUGLÉ.

Index Nesting Beach Survey Protocol for Caribbean Hawksbills

Sea Turtles depend on a variety of coastal and marine environments during their life cycle and for different life stages. This in combination with other biological factors such as long time period to reach sexual maturity and nesting periodicity pose unique challenges in monitoring populations to determine long term trends. Monitoring nesting populations is logistically the most easily accomplished method of surveying populations and for that reason the most commonly practiced survey methodology. These special and complicated conditions require the particular development of protocols that permit the generation of precise and comparable information. The key element in ensuring data is suitable for trend analysis is the consistent and long term application of standardized techniques at the selected index sites. Long term here means at least 8 years due to the 2.7 average nesting remigration interval of the hawksbill (Bjorkland 2001).

The purpose of this protocol is to guide the collection of hawksbill nesting data to measure the tendency of the nesting as a change in relative abundance over time. The application of this protocol if implemented at the many recommended index sites will give a more complete assessment of the population status of hawksbills in the Caribbean. However, any analyses must also recognize the unique status of individual nesting colonies that may not reflect the general trend of the Caribbean meta-population.

Survey Boundaries

Survey boundaries of index nesting beaches must be specifically set and adhered to from year to year. Selection of survey boundaries (survey length) should take into consideration the long-term potential for survey continuation in accordance with the index survey protocols.

The survey area must be representative of local nesting, for example, in the case of cays, one or more cays may comprise a “single” index nesting beach.

Survey Zones

The establishment of survey zones within the broader index beach is recommended if finer scale nesting data are needed for addressing management questions at the local level.

Survey Frequency

Survey frequency (number of days per week the survey is conducted) must be specifically set and adhered to from year to year.

Ideally, nesting surveys should be conducted daily, however, logistical considerations may preclude daily surveys.

A survey frequency of every other day is considered a minimal requirement to reduce survey error. In the case of remote, isolated nesting beaches, where logistics preclude every other day surveys, a reduced survey schedule of 2-3 times evenly spaced across the week may be sufficient, provided all other criteria, including surveyor training are met.

Survey Period

The survey period should encompass the peak of the nesting season and should be designed to allow for shifts in the peak of the nesting season from year to year

Beaches that have not been previously surveyed, or for which the nesting season has not been defined, will require pilot studies to identify the peak of the nesting season prior to setting the survey period. Pilot studies should be conducted for a period of 3 years, during which time the complete nesting season will be surveyed.

Ideally, the complete nesting season should be encompassed, however, the minimal survey period is 8 weeks, shorter survey periods may be appropriate depending on local conditions and a complete understanding of variability in the nesting season

Survey Time

Ideally, index nesting beaches surveys should be conducted as early in the morning as possible, when conditions are optimal for discerning crawls.

Nest Verification

Ideally, surveyors will be sufficiently trained to confirm nests by evaluating track and nest site characteristics. If there is a question whether a crawl has resulted in a nest, the presence or absence of eggs should be verified by hand digging.

Surveyor Training

Training should include observations of nesting turtles to ensure that surveyors have a thorough understanding of the behaviors that result in crawl and nest characteristics, this is key to correctly identifying nests vs. non-nesting emergences.

Training should also include “hands-on” training evaluating crawls on the survey beach with experienced personnel.

New personnel should work side-by-side with experienced personnel until the project leader is sufficiently convinced that new personnel have the knowledge and skills

necessary to perform an accurate survey.

What data will be collected?

FOR EACH SURVEY SEASON:

- Physical Description of Boundaries (Survey Area)
- Start and Stop Dates of Survey
- # of Days per Week Surveyed
- Narrative describing significant changes at the nesting beach that may influence nesting, other metadata important to interpreting nesting information, including any deviations from the protocols

FOR EACH SURVEY:

- Survey Beach (if multiple beaches comprise the index site)
- Survey Day
- Survey Start and End Time
- Surveyor Name(s)
- Number of Nesting Emergences (includes poached and depredated nests) (by zone if the beach is sub-divided)
- Number of Non-nesting Emergences (by zone if the beach is subdivided)

Literature Cited

Kerr, R. 2001. Monitoring Population Trends, pp. 137-138. *In* K.L. Eckert and F. Alberto Abreu-Grobois (eds), Proceedings of the Regional Meeting: Marine Turtle conservation in the Wider Caribbean Region: A Dialogue for Effective Regional Management, Santo Domingo, 16-18 November 1999. WIDECAST, IUCN-MTSG, WWF, and UNEP-CEP. xx + 154 pp.

Table 1: Selection criteria of nesting beaches in the Caribbean Sea

Level I:

1. Some information of nesting activity
2. Evidence of important nesting colony (Size, abundance or number of turtles)
3. Some evidence that continuity in monitoring can be expected since a program is already in place (Persistent in the collection of data. Historical of the project)
4. Possibility of the development of a monitoring project in the site
5. Need to have an adequate spread across geographic area to have representative selection

Level II:

[Additional characteristics that would help assure representativity in the selected index sites - select sites so as to include all characteristics]

1. Level of protection: High level of protection / no protection / isolated
2. Availability of knowledge on trends: Information on trends is available / Trends are unknown
3. Degree of development in the area: Some development / no development
4. Historic status: Data suggesting important nesting colony in the past

Table 2. Caribbean area locations considered currently or historically important as hawksbill nesting beaches.

	Nesting Beach	Country
1	Isla Aguada	Mexico
2	Punta Xen	Mexico
3	San Lorenzo	Mexico
4	Las Colorados - El Cuyo	Mexico
5	Isla Holbox	Mexico
6	Celestun	Mexico
7	Isla Contoy	Mexico
8	Manatee Bar	Belize
9	Manabique Peninsula	Guatemala
10	Cayo Cochinos	Honduras
11	Utila Island	Honduras
12	Pearl Cays	Nicaragua
13	El Cocal Beach	Nicaragua
14	San Andres Islands	Colombia
15	Tortuguero	Costa Rica
16	Cahuita	Costa Rica
17	Chiriquí Beach	Panama
18	Bastimentos Island National Park	Panama
19	Isla del Rosario	Colombia
20	Islas los Roques	Venezuela
21	Los Garzos y Guinimita	Venezuela
22	Bonaire	Netherlands Antilles
23	Bahamas	Bahamas
24	Doce Leguas Cays	Cuba
25	Canarreos Archipelago	Cuba
26	Ambergris and Seal Keys	Turks & Caicos (UK)
27	Portland Bight Cays	Jamaica
28	Luana/Font Hill	Jamaica
29	Jaragua	Dominican Republic
30	Mona Island	Puerto Rico
31	Humacao	Puerto Rico
32	Sandy Point	USVI
33	East Beaches	USVI
34	Buck Island	USVI
35	Jumby Bay	Antigua
36	St. Eustatius	Netherlands
37	Dog Island	Anguilla (UK)
38	Guadeloupe	Guadeloupe
39	Hilton	Barbados
40	Ronde and Sandy Island (NE Coast)	Grenada