Parque Marino Las Baulas: Conservation lessons from a new national park and from 45 years of conservation of sea turtles in Costa Rica

English Original

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Abstract

Dry tropical forest beaches are an important ecotone between the forest and ocean. Sea turtles are the flagship species and development the greatest danger to this ecotone. Four species of sea turtles nest on the Pacific coast of Costa Rica. These are the leatherback, black, olive ridley and hawksbill. The leatherback is in danger of extinction in the Pacific, the hawksbill is rare and the other species are declining. The greatest threat to Pacific sea turtles is capture in fishing gear. Nets, trawls and longlines kill many turtles and are primarily responsible for the recent declines in these species. Taking of eggs also has had a great effect. Development of beaches now is an additional threat because this drives away nesting females and harms eggs and hatchlings. Most leatherbacks nest in Guanacaste Province at the beaches protected by Parque Nacional Marino Las Baulas and Parque Nacional Guanacaste. Most olive ridleys nest at Playa Nancite in Parque Nacional Guanacaste and at Play Ostional, which is a managed refuge. Forty five years of conservation by Archie Carr, other biologists and concerned Costa Ricans has protected many beaches for sea turtles. However, there is a fundamental problem that threatens all of the progress made to date. The power elite of Costa Rica sees economic development and profit as more important than conservation of natural resources, development of a modern park system and protection of wildlife. The diversion of tourist revenues to development instead of conservation, the lack of funding for parks, the priority of tourist access over protection, the weak enforcement of conservation laws and the lack of philanthropy on the part of wealthy Costa Ricans are leading to the demise of the Park system and, in this case, the sea turtles of Costa Rica. Radical change is needed to protect the natural resources of Costa Rica and nowhere is that

more apparent than at the edge of the dry forest on the most important nesting beaches for sea turtles in the world.

Introduction

The edge of the sea marks one boundary of the dry tropical forest in Costa Rica. Just as the ocean draws many Costa Ricans and foreigners to vacation spots along the Pacific coast in the summer, the beaches are a magnet for biologists, conservationists, developers, and politicians. This is because the beaches are critical habitat for all of these people and a focal point for one of the greatest dramas in conservation at the end of the 20th Century. Biologists come to study sea turtles and other exotic flora and fauna, conservationists come to save species from extinction, developers come with international financing to foster coastal development as an economic boom, and politicians chant the mantra of "sustainable development" to justify the uncontrolled spread of tourist and residential facilities along the coast. In one sense, all of these people interact in a play that will determine the future of this ecotone between the forest and the marine ecosystems. Local residents are on stage as minor characters and exotic species make occasional cameo appearances to attract the attention of tourists and potential buyers of land and houses, before disappearing from the scene.

The star of this play is the flagship species for this ecotone, the sea turtle. Unfortunately for both the star and its ecosystem, it is not at all clear whether in the future we will look back on this play as a high drama, a comedy of errors, or a tragedy. There is certainly plenty of drama to go around. There have also been plenty of errors made that would be funny if they were not so tragic. Ultimately if we fail in this conservation effort then it will be a tragedy. In a classic Greek tragedy the hero is ultimately doomed to failure due to an inherent flaw in his or her character. All of the characters in this drama have inherent flaws, as does the system of conservation in Costa Rica. Sea turtles have some inherent limitations in their life histories that make them

vulnerable as well. At the center of this mix is one of the newest parks in the Costa Rican system of natural areas, Parque Marino Las Baulas. This Park is situated along the Guanacaste coast and protects the largest surviving nesting population of leatherback sea turtles in the Pacific Ocean.

In this Chapter we will focus on the biology of sea turtles that nest on the dry tropical forest beaches of Costa Rica, give the history of conservation efforts for these species in Costa Rica, discuss the local, national, and international aspects of this conservation activity, present the status of Parque Marino Las Baulas, detail the process that led to its formation, consider the flaws and limitations of the human and turtle actors, and present lessons for the future. It is not at all clear that this play will have a happy ending.

Biology of sea turtles

Four species of sea turtles nest on the Pacific coast of Costa Rica. Leatherback turtles, *Dermochelys coriacea*, nest primarily in Guanacaste Province (Figure 1) especially on beaches of Parque Marino Las Baulas near Tamarindo. Olive ridley turtles, *Lepidochelys olivacea*, nest in large flotillas or arribadas at Playa Nancite in the Santa Rosa Sector of Parque Nacional Guanacaste and at Ostional on the Nicoya Peninsula, and singly on other beaches. Black turtles, *Chelonia mydas agassizii*, nest in small numbers at several beaches from Parque Nacional Guanacaste to the Osa Peninsula, including Playa Naranjo, Playa Cabuyal, and Playa Naranjo in Guanacaste and Playa Carate and Playa Río Oro in Osa. Hawksbill turtles, *Eretmochelys imbricata*, nest on Playa Carate and Playa Río Oro on the Osa Peninsula (Drake, 1996).

Leatherback Turtle

The leatherback turtle is the largest sea turtle reaching a length of 2.8 m from head to tail and a mass of 916 kg (Eckert and Luginbuhl, 1988). The carapace (upper shell) is 130 to 190 cm

long and elongate with 7 sharply peaked longitudinal ridges. It tapers to a point in the rear called the caudal peduncle The thin leathery skin is black with white spots and the head is large with an irregular pink spot above the pineal gland. On the Pacific coast leatherbacks nest primarily from October to February, while on the Caribbean coast they nest from March to June. This coincides with the dry season on each coast. Between 70 and 90 % of leatherbacks on the Pacific coast nest at Parque Marino Las Baulas. The Atlantic and Pacific populations may be isolated from one another. The biology of the leatherback turtle was reviewed in a series of articles in Chelonian Conservation and Biology edited by Behler, et al. (1996).

Olive Ridley Turtle

The olive ridley turtle is the smallest sea turtle with an adult size of 36 kg and length of 76 cm. It has a hard shell and is olive drab in color. It nests in large arribadas at Playa Nancite and Playa Ostional and as solitary individuals at these and other beaches on the Pacific coast of Costa Rica during most months of the year, but especially from August to February. It is distributed in the Pacific, Indian and Atlantic Oceans and nests on tropical beaches. Its close relative, the Kemp's ridley, *Lepidochelys kempi*, nests at only at Rancho Nuevo and nearby beaches, Tamaulipas, Mexico and is distributed in the Caribbean Sea and North Atlantic Ocean. There are no ridley turtles on the Caribbean coast of Costa Rica.

Black Turtle

The black turtle, *Chelonia mydas agassizii*, is a subspecies of the green turtle and is 100 cm long as compared to 120 cm for the green. Morphological and mtDNA and nDNA indicate that East Pacific Chelonia populations are distinct but do not support a taxonomic distinction at the species level (Kamezaki and Matsui, 1995; Karl and Bowen, 1999). On the Pacific coast

black turtles nest primarily from August to February although some nesting occurs throughout the year. On the Caribbean coast green turtles nest from June to September.

Hawksbill Turtle

Hawksbill turtles are rare on the Pacific coast of Costa Rica. They are 90 cm long and are distinguished by their bird like beak and beautiful "tortoise shell" covered carapace. In general, hawksbill populations are only a small fraction of their presettlement numbers throughout their range (Bjorndal, 1999). They are now seen primarily as solitary nesters, but in areas where they are protected, like Buck Island Reef National Monument in the US Virgin Islands and Jumby Bay Island off Antigua, they nest in groups just like green and black turtles (Meylan, 1999; Richardson, et al. 1999). They probably did so in the past before they were hunted to near extinction for their shells. There is little scientific information about their biology in Costa Rica but hawksbills are in the Golfo Dulce and nest on the beaches of the Osa Peninsula (Drake, 1996). Hawksbills also nest along the Caribbean coast of Costa Rica. The biology of the hawksbill turtle was reviewed in a series of articles in Chelonian Conservation and Biology edited by Rhodin and Pritchard (1999).

Regional and Global Context

Turtles and Fishing

Sea turtles are an excellent example of the need for conservation efforts to focus, not only on the local, but also on the national and international levels in order to establish effective protection plans and policies. Because these species travel great distances in the ocean they live in waters controlled by many nations and in international waters as well. For example, we attached satellite transmitters to eight leatherbacks at Las Baulas over a four year period and all eight traveled in a narrow 500 km wide corridor southwest along the Cocos Ridge, past Isla del

Coco towards the Galapagos Islands. Five swam past the Galapagos into the South Pacific as far as 2700 km (Morreale et al., 1996). One of these turtles slowed down and stayed among the Galapagos for nearly two weeks before continuing into deeper ocean water (Morreale, 1999).

Transmitters had a life of one year and were transmitting well with strong batteries when we last received a signal. Tracking durations lasted from 3 days to 87 days and distances covered were 67 to 2780 km (Morreale, 1999). It was not likely that transmitters failed during these periods. Two transmitters that detached from turtles in 1991 floated at the surface for months and gave current patterns in the ocean from El Salvador to the Gulf of Tehuantepec off Mexico. We believe the loss of transmission from our other turtles was due to the death of the turtles in the fishery and the subsequent loss of the transmitters when the turtles sank. Video records indicate that long line fishing boats from Costa Rica regularly catch leatherbacks and other sea turtles while fishing near the Galapagos (R. Arauz, Sea Turtle Institute, San José, Costa Rica). Normal procedure is to kill the animal or to cut off the flipper or other portion of the body in which the long line hook is impaled. Few turtles survive encounters with fishing gear. Thus only about 15 % of turtles tagged on Las Baulas beaches ever return to nest again (Spotila, et al., 2000). These data indicate the need to find international solutions to the threats to these animals.

Leatherbacks

On the Caribbean coast of Costa Rica and Panama leatherback turtles nest in the hundreds. Some protection is provided in Tortuguero National park where the Caribbean Conservation Corporation has an ongoing study. Park rangers do little active patrolling. Further south, John Denham's Pacuarae Reserve protects 6 km of beach where in some years one or two hundred leatherbacks nest. His rangers patrol the beach and face poachers (people who steal eggs) who are armed with weapons ranging from machetes to automatic weapons. The aggressive

program of patrolling and arrests deters poachers and keeps nest loss to a minimum. Denham's rangers also use hatcheries to protect nests from more remote portions of the beach. Some natural loss does occur. South of Limon, Didier Chacon and his volunteers of Associacion ANAI protect the beaches in the Refugio Nacional de Fauna Silvestre Gandoca-Manzanillo near the Panamanian border. In Panama leatherbacks are unprotected and poachers kill adults to get their eggs in addition to digging up nests in the Bocas del Torro region.

The other major nesting beaches in the East Pacific region for leatherbacks are in Mexico. Although a few leatherbacks nest in Nicaragua, there are no major beaches there or in other countries in Pacific Mesoamerica. The Mexican population was estimated to be 70,000 females in 1980 (Pritchard, 1982) but has declined to less than a few hundreds in 1999 (Spotila et al., 1996; Sarti and Dutton, personal communication). While biologists monitor many beaches and provide protection at Mexiquillo in Michoacan, there is no protection on beaches to the south such as Tierra Colorado in Guerrero and Bahía Chacahua and Barra de la Cruz in Oaxaca. Poachers take essentially all the eggs on these beaches and kill some adults (E. Possardt, U.S.F.W.S. Atlanta, personal communication). In 1998 and 1999 Georgita Ruiz's federal rangers in Oaxaca confiscated trailer truck loads of turtle eggs from middlemen who purchased the eggs from poachers. These included tens of thousands of eggs from olive ridley, black, and leatherback turtles. Satellite tracking of adult females from these beaches (Eckert and Sarti, 1997) confirmed the results of our studies in Costa Rica. Leatherbacks not only traveled in distinct corridors but also traveled over large portions of the North as well as into the South Pacific Ocean.

The leatherback turtle is declining in numbers at a catastrophic rate in the Pacific Ocean and if current trends continue it will disappear from these waters within the next few years

(Spotila et al., 1996; Spotila, et al., 2000). Considering that it numbered over 100,000 in the Pacific Ocean in the early 1980's this is almost unbelievable. It appears that the decline is due primarily to the incidental catch of turtles in longline, gill net and trawl fisheries. Harvesting of eggs from nesting beaches, and some killing of adults on nesting beaches and at sea by indigenous peoples for food, and medicinal oils and ointments all have an effect.

Olive Ridleys

Olive ridley turtles that nest in Costa Rica also traverse great distances in the East Pacific (Plotkin et al., 1995, 1996). In contrast to leatherbacks, olive ridleys did not follow migration corridors, but rather swam in diverse patterns in waters ranging from Mexico to Peru and the Galapagos. Some swam along the coast either north or south and others swam west into the Pacific and then moved around a large area before returning to nest again in one or two years. Some were lost to fishing and one transmitter was apparently on board a ship as it steamed in a straight line at several knots an hour for a week before being thrown overboard or destroyed. Again these turtles lived in waters under the jurisdiction of many countries and in international waters. Any successful conservation plan must address the problem of interactions of sea turtles with the fishing industry of numerous countries, not only those of the Americas, but those of Asia as well.

Nesting beaches

In addition to the two arribada beaches in Costa Rica, olive ridleys also nest at one arribada beach in Pacific Mexico and two arribada beaches in India. Other arribada beaches in Mexico were destroyed by the 1980s through extensive killing of adult females for the leather trade. A minor arribada beach in Surinam, the only one in the Atlantic, was decimated by a combination of heavy egg collection for several decades and ongoing trawler mortality

(Pritchard, 1997). There are some minor arribada beaches on the Pacific coast of Nicaragua and Guatemala and scattered nesting along Pacific Mesoamerica.

A few years ago the 350,000 olive ridleys nesting in the Orissa area of India comprised the largest sea turtle population in the world. The beaches of Orissa were placed into a protected park and there was an ongoing tagging and conservation program. However, at the same time the government of Orissa supported the construction of a new fishing port and jetty nearby and a large shrimp trawler fleet began to operate. Attempts to introduce turtle excluder devices (TEDS) were not successful. Thousands of dead olive ridleys washed ashore on Orissa beaches in the early to mid nineties and by 1999 the population was decimated. Olive ridleys there now number in the low thousands and arribadas have been greatly depleted. Uncontrolled fishing overwhelmed conservation efforts on the beach.

Therefore, the arribada beaches in Costa Rica take on an added significance. Costa Rica officially requires TEDS on shrimp trawls, although fishermen often do not use them or sew TEDS shut. The Nancite population declined during the 1980s and 1990s. The Ostional population is also smaller than in previous years. Accurate numbers are not available for that beach. Nevertheless, the fishing industry poses a very significant threat to Costa Rica populations of olive ridleys. Without protection of arribada beaches and populations at sea this species will suffer a catastrophic and perhaps irreversible decline.

Black Turtles

Black turtles nest in Nicaragua, El Salvador, Guatemala, and Mexico as well as Costa Rica. Conservation efforts take place at many beaches in these countries, but the poaching of eggs takes place on most beaches and is a serious problem for the survival of this species. In Nicaragua conservationists working with members of the local communities protect the main

beaches of Chococente and La Flor. Soldiers provide protection for the beaches and hatcheries protect some nests. Development threatens these beaches. In Guatemala the ARCAS foundation protects several small beaches and places eggs in hatcheries. Local people are paid in flour, corn and other foods in return for 10 eggs from every nest of eggs that they take. That means that only 10 % at most of the eggs are being saved. While this is a noble effort, it is doomed to failure since studies on freshwater turtles (Congdon et al., 1993; 1994) and modeling of life history characteristics of sea turtles (Spotila et al., 1996) demonstrate that this level of predation on nests cannot be sustained by a turtle population. Due to the high rate of mortality on the few turtle hatchlings released into the ocean insufficient animals are being produced to insure a return of adults when this cohort would be maturing and returning to nest.

In Mexico considerable effort is being made to monitor the black turtle beaches in Michoacan. In addition Mexican marines have provided protection for biologists, turtles, and their nests. However, poaching is still rampant and despite efforts with local communities these populations are still being heavily exploited.

Extinction of Leatherback Turtles?

In 1996 (Spotila et al., 1996) we estimated the number of leatherbacks nesting on 28 beaches around the world from the literature and from communications with investigators studying those beaches. In 1995 there were about 34,500 adult female leatherbacks as compared to about 115,000 in 1980 (Pritchard, 1982). The greatest declines occurred in Malaysia which in 1968 had about 3100 females and by 1994 had 2 and the Pacific coast of Mexico which in 1980 had 70,000 females and now had only a few hundred. Both of these colonies experienced an exponential decline. We are now seeing an exponential decline at the beaches of Las Baulas

National Park as well (Figure 2). Even since 1996 the estimate for the Mexican population has dropped from 700-1000 nesting females per year to less than 100 and the Costa Rica population has declined from 800-1250 in 1996 to 117 in 1999 (Spotila, et al., 2000). Thus, the East Pacific population is not 4,638 as we estimated in 1996 but 1,760! The world population is about 27,600 (Table 1).

Demographic modeling based on extensive research and modeling on freshwater turtles and data from leatherback populations in Costa Rica indicates that stable leatherback populations can not withstand an increase in adult mortality above natural background levels without decreasing. However, protection of eggs and hatchlings during the first day of life can have a significant effect on overall stability of leatherback populations in the face of a moderate increase in adult mortality (5 %). However, annual mortality on leatherbacks from Costa Rica is 35% (Spotila, et al. 2000). Leatherback populations in the Pacific and Indian Oceans cannot withstand even moderate levels of adult mortality from the fisheries in these oceans. Atlantic populations are being exploited at a rate that cannot be sustained. Thus, leatherbacks are on the verge of extinction (Spotila et al., 1996; 2000). They are certainly almost gone from the Pacific. The next 10 years will tell the tale there. An exponential decline in the Atlantic population only awaits the arrival of the fishing fleets there when the Pacific fisheries are finally depleted.

Pritchard (1996) objected to our use of population modeling to assess leatherback populations. He concluded that “the leatherback is a vigorous and dynamic species, more flexible than chelonid turtles....., and able to show quite rapid response to protection.” He also stated that “we do not yet have the necessary data on which to base a theoretical construct that has predictive value, and therefore we should look at those populations for which adequate population trend data exist, and look for common threads or stresses in those cases for which

serious population decline has occurred." We disagree with his conclusion and believe that we can use the principles of population biology and the lessons from long term studies of freshwater turtles (Congdon et al. 1993, 1994) to predict population dynamics of leatherbacks.

However, even if we use Pritchard's objection as a starting point, we see that for the six leatherback populations for which long term data exist, three of the largest are in catastrophic decline (Malaysia- 9000 in 1968- <10 in 1994, Mexico -100,000 in 1980- <600 in 1998, and Pacific Costa Rica- 1646 in 1989- <600 in 1998), the other is beginning to show signs of decline (French Guiana and Suriname- 15,000 in 1989- 5,000-10,000 in 1997, Girondot- personal communication and Reichart- personal communication), and two small populations (St. Croix- 60 in 1985-170 in 1993, and South Africa- 50 in 1968- 282 in 1996) are increasing.

If our models are right and protection of nests and hatchlings can offset moderate levels of adult mortality, and if Pritchard is right and the species is resilient and flexible in its life history characteristics (reproductive characteristics, growth rate, behavior, nest site selection, etc.), then perhaps an all out conservation effort in Costa Rica may save the leatherback in the Pacific Ocean. Certainly nesting beaches must be preserved and nests protected or there will be no "next generation". However, this effort will not be sufficient in the face of large-scale mortality in the fishery. Therefore, what takes place at the edge of the dry tropical forest in Costa Rica over the next 10 years may be not only critical to the survival of the leatherback in the Pacific, but also predictive of its future throughout the world's oceans.

Parque Marino Las Baulas

Parque Marino Las Baulas (Figure 3) is located on the coast of Guanacaste and includes the Bahía de Tamarindo, adjacent beaches and mangrove estuaries near). It protects the largest

population of leatherbacks in the Pacific Ocean and is critical for the survival of this species. The Park includes three beaches that are used by leatherbacks as nesting sites, Playa Ventanas, Playa Grande, and Playa Langosta.

Playa Grande is a crescent shaped white sand beach composed of finely broken shell rubble and sand. This beach is one of the world's finest surfing areas. There is increasing development along the beach just outside of the public 50 m zone. The Estero Tamarindo is the largest estuary in dry Pacific Central America and hosts many species of plants and animals. Flagship species include the red, white, black, buttonwood, and tea mangroves, the American crocodile, the roseate spoonbill, the white ibis, the boatbill heron, wood storks, great blue herons, egrets, howler monkeys, kinkajous, jaguars, and raccoons. More than 60 species of birds have been identified in the Park.

Tamarindo is built behind what once was a leatherback nesting beach. Only once every year or so does a leatherback come ashore to nest in Tamarindo now. This area is not in the Park. The lights of the town are a major problem for both adult and hatchling leatherback turtles because these animals are attracted to the lights. Adults get entangled in boat lines in the anchorage off the town and hatchlings wash ashore after swimming to the source of the lights. This points out one of the flaws in Costa Rican conservation laws. There is no law prohibiting lights from shining onto a turtle beach. Thus, unchecked development undermines the protection of the Park because of a simple thing like the lack of a lighting ordinance.

Just offshore from Tamarindo the Isla Capitan provides habitat for many marine birds. Tamarindo Bay is filled with fish and shellfish, but there has not been a scientific survey of the species living there. Although this is a protected zone of the Park, and in fact turtles are supposed

to be protected by law within Costa Rican waters, commercial trawlers ply the Bay at will since there is no means of enforcement for the park law at sea.

The Estero San Francisco is another large estuary with mangrove forests and abundant bird life. It isolates Playa Langosta from Tamarindo. The beach is set aside as a biological reserve and is not open to tourism or visitation of nesting leatherbacks. Behind the beach and the estuary is the Finca Pinilla, which at present provides protection from development. However, a plan approved by the Instituto Nacional de Vivienda y Urbanismo that would allow production of a large housing complex on the Finca. A new hotel complex on the rocky shore north of Playa Langosta and the estuary poses a threat to this nesting beach from its lights and activity. Workers filled in part of the estuary near the hotel site. Despite the filing of a legal action "Denuncio" against the hotel by the Park the estuary has not been restored as of 2000. The hotel now blocks access to Playa Langosta and uses the beach as a private location for guests despite its reserve status. Again another "Denuncio" has had no effect on this activity

In 1988-89 1367 leatherbacks nested on Playa Grande. In contrast, during the 1998-99 season only 117 leatherbacks nested there (Figure 2). Current threats on land include construction of houses and hotels behind Playas Grande and Ventanas, lights from these buildings and from Tamarindo, high levels of tourism on Playa Grande, and the threat of poaching of eggs. Little actual poaching occurs on these beaches due to protection from scientists, volunteers and rangers during the main nesting season. However, poaching does occur on all the beaches early in the season when rangers are not patrolling. Playa Langosta suffers poaching from October until December when student volunteers from the University of Costa Rica arrive to help tag turtles and patrol the beach. Rangers seldom visit this beach.

Leatherbacks at Las Baulas

There is a high rate of mortality at sea on adult leatherbacks from Las Baulas. Data from tagging since the 1993-94 season indicates that the average annual mortality at sea for these turtles is 34%. Thus, after 5 years only 12 % of these turtles will still be alive. It is not surprising that only 15% of these animals ever return to nest a second season. In a given year 75% of leatherbacks are first time nesters, and 25% are re-migrants. In a freshwater turtle population the reverse is true (Congdon et al., 1993, 1994). Most sea turtle populations have a smaller percentage of remigrants than in freshwater turtles due to some level of exploitation by humans. However, these percentages are especially low for the Las Baulas population.

It is instructive to look at two of the populations where leatherbacks are increasing in numbers. At St. Croix 48.5 % of nesting leatherbacks are remigrants (Boulon, et al. 1996) and 58.5 % of turtles tagged during 1987-91 returned to nest through 1995 (McDonald and Dutton, 1996). In South Africa 60 % of leatherbacks were remigrants between 1976-77 and 1985-86. From 1986-87 to 1994-95 45 % of leatherbacks were remigrants (Hughes, 1996; Boulon et al., 1996). Throughout this period the population was increasing due to the introduction of new turtles which showed up as first time nesters. This was probably due to the increased protection afforded this nesting population by George Hughes and the Natal Parks Board since 1963. The decline in remigrants probably reflects an increase in mortality at sea.

In any case, it is clear that even in leatherback turtles the normal percentage of remigrants should be from 45 to 60 % of nesters in a given year. The Las Baulas population is much below that percentage. Out of over 1100 leatherbacks PIT tagged at Playa Grande two have nested at Playa Naranjo and one has come ashore at Playa Ostional but did not nest. Only one of our tagged turtles has been recorded on another beach outside of Costa Rica. That was in Mexico

(Sarti, unpublished data). Since the turtles are not showing up at any other nesting beach we assume they are really dead. Thus five years after a cohort of leatherbacks nests at Las Baulas for the first time only 12 out of 100 females will still be alive.

Leatherbacks are long-lived like other large marine organisms. Populations of long-lived organisms cannot withstand heavy human exploitation (Congdon et al., 1993, 1994; Crouse, 1999; Heppell, et al., 1999; and Musick, 1999). The short lives of leatherbacks that we observe at Las Baulas today are not normal and reflect the intense fishing pressure imposed on these turtles. Thousands of leatherbacks died each year in oceanic longline and gill net fisheries in the 1980s and 1990s (Frazier and Brito, 1990; Nishimura and Nakahigashi, 1990; Weatherall et al., 1993; Eckert and Sarti, 1997; Lutcavage et al., 1997).

The Making of a Park: the long journey to an uncertain future

Parque Marino Las Baulas exists primarily due to the efforts of Maria Teresa Koberg, Mario Boza, Clara Padilla, and Peter Pritchard. Much has been written in the popular press, in magazines and books about this park, and much is incorrect. We worked at Las Baulas since 1990 and participated in or observed most of the activity surrounding the park. We were involved in research and conservation efforts at the Park and worked with officials of the Ministry of Natural Resources, Energy and Mines (MINAE) and its National Park Service (SPN) in efforts to consolidate the Park. Between 1990 and 1999 we raised over $788,000 in grants and donations to support these efforts from 10 organizations (including EARTHWATCH, the U.S. National Science Foundation, the National Geographic Society, Drexel University, World Wildlife Fund, Guinness, LTD., and the U. S. National Marine Fisheries Service) and many individuals. Here we relate the history of the Park as we participated in it.

In the late 1980s the Estero de Tamarindo and Playa Grande were designated as the Tamarindo Wildlife Refuge, a Refugio Nacional de Vida Silvestre, and the estuary was protected as a wetland under the RAMSAR Convention. The beach was protected up to 50 m above the high tide mark. However, the Refuge designation did not improve upon the nationwide legal protection given to mangroves, ocean beaches and turtles.

Under its refuge status Playa Grande was the scene of uncontrolled poaching, tourism and beachfront development. The beach was bright with camera flashes during the height of the nesting season and many people rode on the backs of leatherbacks as they crawled up and down the beach. Poachers stole almost every egg laid. One person built a hotel along the northern portion of the beach without any environmental assessment or permits. Another person built a hotel at the south end of the beach by cutting mangroves and filling in the Tamarindo estuary. Plans also existed for a major development of 250 houses behind Playa Grande and more than 50 behind Playa Ventanas. A major luxury resort for 5,000 with a casino, nightclub, hotel, condominiums, and a yacht club was planned for Playa Grande.

Maria Teresa Koberg led the early efforts to obtain protection for the leatherbacks and was a pioneer in converting poachers to guides and rangers. Her most famous convert was Esperanza Rodríguez, the matriarch of a family that was long the major source of poaching on Playa Grande. From 1988 to 1996 Doña Esperanza made daily nest counts on Playa Grande while riding the beach at sunrise on her horse. These data were critical to our understanding of the population trends of leatherbacks there. Koberg, not Wilson and Pastor (Honey, 1999), mounted a program of education and protection. She brought in Boy Scouts from Costa Rica and Boy Scouts from Minnesota. They patrolled the beach and protected nests and turtles by persuasion. She obtained national media attention and promoted the idea of a park.

In 1990 a report by Pritchard and members of the local community (Pritchard, et al. 1990) recommended formation of a park. In 1991 President Calderón issued a decree that established the park as Las Baulas de Guanacaste (Executive Decree No 20518, June 5, 1991). While the limit to the Park was only 125 m inland from the high tide, it did protect the ocean offshore to 19.2 km.

Koberg was the first Director of the Park and established a protection program involving leaders and members of the Playa Grande and Tamarindo communities. She brought in a young biologist, Randall Arauz, who began a program of education in the nearby villages. In 1992 he became the second Director of the Park and carried out a vigorous program of research and conservation on Playa Grande (Arauz and Naranjo, 1994). Gradually residents began to accept the Park as they became turtle guides and realized that their concerns were being heard (Naranjo and Arauz, 1994).

In 1991-1992 we raised funds for rural guards and obtained grant support for Anny Chaves, who with her students conducted a study of the nesting ecology on Playa Langosta and a program of environmental education in local villages (Chaves et al., 1996). On Playa Grande a 1300 m restricted zone where tourists could not enter provided a haven for nesting leatherbacks (Herzog, 1992). Significant progress was made with local residents through a cooperative program with the Fundación la Gran Chorotega, a local NGO that promoted the preservation of the local cultural and biological resources of Guanacaste.

During the 1992-93 nesting season we moved our research to Playa Grande to assist in conservation efforts, population data collection and other research in the main portion of the Park. EARTHWATCH volunteers and students and faculty from Drexel and Indiana-Purdue Universities tagged turtles and controlled ecotourists. Paladino taught guides in Spanish about

turtles and control of ecotourists. In addition, we helped Park rangers construct the first house for the Park that served as the headquarters and a home for the Director and his family. We also conducted botanical surveys and produced guidebooks for the estuary and dry forest.

In 1993-94 we began to permanently tag all leatherbacks on the beach and continued studying their nesting ecology and physiological ecology (Steyermark et al., 1996). A cooperative agreement between the Ministry and Drexel University provided English language training to several Ministry employees involved in developing the park. The Park, under Director José Quiros, continued to offer training courses for the local guides and we continued our meetings and education efforts as well. We also met with many of the delegates of the National Assembly to educate them about the turtles and the need for passage of a national law to formalize the park.

From 1994-95 to 1997-98 Sergio Obando was Director and did an excellent job in beginning the consolidation of the Park. Outreach in local villages increased and we established a program of conservation education in the Playa Grande community and Matapalo school. In 1995 the National Assembly finally passed the law making the Park a permanent entity. Unfortunately an apparent "clerical error" established the Park as 125 m under the sea instead of 125 m inland from the high tide. As of 2000 this was still not corrected.

During the Obando period more funds came to the park. With the help of EARTHWATCH England we obtained a grant from the Guinness Corporation's "Water of Life" Program to provide a building fund for the Park. That allowed the construction of a large dormitory building for Park volunteers. We also funded and mentored students from the Nacional University in Heredia who carried out tagging and nesting ecology studies on Playa Langosta. They controlled poaching and when necessary brought Park rangers to that beach to maintain order. The Park closed Playa Langosta to tourists so that it was a refuge for leatherbacks.

In 1998-99 one of our Nacional University students became Director of the Park after graduation. Rotney Piedra brought not only enthusiasm but also training in sea turtle biology to the position. He increased controls on the beach and worked with local landowners to improve protection of the turtles. This part of the play is still ongoing.

By 1999, residents generally accepted the Park. Tourists could only go on the beach with a guide, group size was officially limited to 10, and Park rangers were more diligent about their duties. There were still many problems. The Park Law still needed to be fixed to properly establish the boundaries along the land behind the beaches. Agreements were still needed with landowners behind Playa Grande to support the Park. A lighting law was needed to protect the adults and hatchlings from lights behind the beaches and from Tamarindo. The urbanization plan for the area still needed to be completed and park consolidation was still ongoing. Some rangers looked the other way when large tourist groups came over from Tamarindo and some guides still caused difficulty for researchers despite 5 years of education and clear rules from the park about non- interference with the turtle studies. Money, from ecotourists to guides or from development to business people, was the dominant factor controlling activity around the park. Completion of the hotel in Tamarindo overlooking Playa Langosta created a new threat to that beach. Conservation at Las Baulas is obviously still a work in progress.

Forty five years of sea turtle conservation in Costa Rica

The Caribbean

Archie Carr began sea turtle conservation in Costa Rica in 1954 when he visited Tortuguero with Guillermo “Billy” Cruz. In 1955 he started the green turtle tagging project that continues to this day (Bjorndal, et al., 1999). In 1959 Joshua Powers formed the Brotherhood of

the Turtle after reading The Windward Road (Carr, 1955). This later became the Caribbean Conservation Corporation (CCC), which ensured continued funding for the green turtle project at Tortuguero. The original goal of the CCC was "to save the green turtle from destruction, to give it a chance to renew its numbers, and to redistribute it to all those beaches where it was once common." The approach was one of scientific research, conservation, and restoration. In addition to the effort to protect the nesting beach at Tortuguero, from 1961 to 1966 the US Navy delivered thousands of green turtle eggs and hatchlings each year to old nesting beaches around the Caribbean as part of "Operation Green Turtle," an attempt to reestablish nesting colonies that had been wiped out by egg collection and killing of adults. Although additional scientific data later suggested that this project was overly optimistic, the international attention it brought to the green turtle was a major factor in the development of the sea turtle conservation movement worldwide.

Along the way Archie Carr worked with the leading citizens of Costa Rica to convince them to protect turtles. In 1963 the President signed the first executive decree regulating the hunting of sea turtles and the collection of their eggs. Also in 1963 the first guards came to Tortuguero to protect the turtles. In 1970 Costa Rica prohibited all turtle hunting and egg collection and established Tortuguero as a national park thus protecting the 48 km nesting beach. In 1973 Costa Rica signed CITES making international trade in sea turtles and other endangered species illegal. In 1975 the government expanded Tortuguero National Park to include the nearby hills and lowlands.

Throughout this time Carr continued his green turtle studies at Tortuguero and established an ethic in Tortuguero that respected and protected the turtles. By employing villagers at the Casa Verde field station and to do turtle nest counts in the Park, Carr had a significant impact on the

local economy and this formed an economic basis for development of the turtle conservation effort in the village. He linked economic progress of the local community with conservation long before anyone made up terms such as "grassroots community-based conservation, parks for people, sustainable development and use, and conservation for development" (Brandon, et al., 1998). This later laid the groundwork for ecotourism there. Local consumption of one turtle a week or month continued for local subsistence but biologists working with the villagers and Park guards controlled poaching on the northern part of Tortuguero beach and to a lesser extent on the main portion of the Park as well. Carr's students carried out numerous pioneering studies on hearing and orientation of hatchlings. Scientific research was always a key part of the conservation effort at Tortuguero (Spotila, 1988). There was little interest in the research and conservation at Tortuguero among the Costa Rican universities during this period. The Escuela de Biologia was just beginning at the University of Costa Rica. In addition, Limon Province was far removed from the Central Valley in travel time and mindset. The main form of transportation was a slow train that made 56 stops on the 50 mile trip from Limon to San José.

In 1978 a major scientific expedition sailed to Tortuguero on the Alpha Helix and several key physiological studies took place. It was here that Standora et al. (1982) accomplished the first successful radio and sonic telemetry of sea turtles. In 1980 Morreale et al. (1982) demonstrated the importance of temperature dependent sex determination to conservation of sea turtles. Throughout this period there was a continued harvest of 500 adult green turtles a year for the slaughter house in Limon. In 1982 local pressure led to an increase in the regulated harvest to 1800 green turtles per year. By the mid-1980s an ecotourism boom started in Tortuguero and the population of the village went from about 100 to 500 a night with the addition of several hotels and cabinas. The turtle ethic began to break down as more people came to Tortuguero from other

areas and money flowed into the community from the illegal arms traffic to Nicaragua during the Contra war. The paving of the runway, development of the area inland from Tortuguero and finally the construction of an illegal road to Tortuguero in 1996 ended its isolation.

Throughout this period the CCC increased its conservation efforts. It erected an information kiosk in 1985, initiated a comprehensive conservation and development plan in 1989 and obtained approval of a maritime terrestrial zone for Tortuguero in 1993. Despite the untimely death of Archie Carr in 1987, his family, students and the CCC staff, energized by Cindy Taft, redoubled their efforts to preserve green turtles and expand conservation efforts into Nicaragua and into the leatherback nesting season. We started physiological and nesting ecology studies on leatherbacks at Tortuguero in 1989 (Paladino, et al., 1990) and included education and conservation as a central part of our program. Initially local people did not regard leatherbacks as animals worthy of notice. Poaching of eggs was common. Guards were not on the beach. This was just what we had expected from conversations with Archie Carr before we began the project. He encouraged us to work on leatherbacks at Tortuguero because when scientists are on the beach the status of the turtles goes up and protection improves.

Talks in the school, visits with community leaders, employment of local residents, and encouragement of the park guards brought visibility to the leatherbacks and gave them a status and level of protection approaching those of green turtles. After waking guards up for a few nights in a row to chase poachers the poaching stopped and the turtles were unmolested, at least while we were present in the area. This scenario repeated each year. Our rule of thumb became "no scientists, no protection" and we expanded our project to the entire leatherback nesting season. That extended protection on the beach to include both the leatherback and green turtle seasons, March through September. This developed into an annual tagging program (Campbell et

al., 1996) and nicely complemented the CCC conservation efforts in Tortuguero and Nicaragua. In 1994 the CCC completed its new field station and visitor center in Tortuguero and in 1998 Costa Rica and Panama signed an agreement for the collaborative management of sea turtles in the Caribbean.

By 1998 banana plantations and cattle ranches replaced the vast forest between the volcanoes and Tortuguero. The only part of the rainforest left was that protected in Tortuguero National Park and the small corridor leading north to the large forests along the San Juan River in Nicaragua. Tortuguero was filled with tourists, who stayed in a dozen or so lodges. No one, including visiting biologists, could wander out to the beach after dark to look for turtles. Ecotourists walked single file down the beach behind local guides in silence. Times had changed.

You can never go back to the old days, and most of the natural world around Tortuguero has been changed, for centuries if not forever. However, more turtles arrived to lay eggs in 1998 than ever before. The nesting beach was protected. Thousands of people had their first mystical encounter with a green turtle in the dark and silence of the night. They did so under the watchful eye of a local conservationist/guide trained and certified by the CCC. The guides were well informed, friendly, and staunch defenders of the turtles. Protection of the beach was paying off.

Meanwhile on the Pacific Coast

Olive ridleys, along with the leatherbacks at Las Baulas, dominate the nesting beaches of Pacific Costa Rica. Richard and Hughes (1972) were the first to document the large number of sea turtles that nested on many beaches there and the mass nesting of olive ridleys at Playas Nancite and Ostional (Hughes and Richard, 1974). While a Peace Corps volunteer, Steve Cornelius documented the nesting of leatherbacks, black turtles and olive ridley turtles on Playa

Naranjo. Through the 1970s and 80s he and Douglas Robinson carried out a series of studies on the sea turtles along the Pacific coast (Cornelius, 1976; Cornelius, 1986). Robinson and his students at the University of Costa Rica began the serious study of sea turtles on most of these beaches.

Doug Robinson came to the University of Costa Rica in 1966 from Texas A&M University for a brief stay and spent the rest of his life there. With Steve Cornelius he did the first research on Pacific sea turtles in Costa Rica and through the 1970s and 80s they carried out a series of studies together. Robinson also started the Ostional Project to control the harvesting of olive ridley eggs at that beach. He established a Museum of Zoology at the University and the Programa de Tortugas Marinas, which served as a focal point for education of Costa Rican and foreign students in sea turtle biology and conservation. He directed the thesis studies of several students and established the first computer database for flipper tag returns from turtles along the Pacific coast of Central America. He also played a key advisory role in the development of conservation policies and laws in Costa Rica. The program continued at the University after his death in 1991 but, lacking a director with his mature leadership and scientific training, floundered by the mid-90s and was closed by the University. Fortunately a vigorous program directed by Claudette Mo remained at Universidad Nacional and several students a year participated in studies with David Owens on Playa Nancite and with us at Las Baulas. In addition, a cadre of former students remained from the Robinson group at UCR and Mario Alvarado, Randall Arauz, Jorge Ballestero, Juan Carlos Castro, Anny Chaves, and Isabel Naranjo continued to be active in sea turtle biology and conservation. Unfortunately only Roldan Valverde continued on to receive a Ph.D., so Costa Rica is still reliant on foreign scientists for leadership in this area.

Perhaps the most ambitious project started by Robinson was the experiment with a controlled harvest of olive ridley eggs at Ostional. In 1980 he saw that the little village situated on one of the most important sea turtle nesting beaches in the world would play a critical role in the future of sea turtle conservation. Even though the harvesting of sea turtle eggs had been illegal in Costa Rica since 1966 it still took place at night at Ostional and elsewhere. The problem was what to do with all those eggs from thousands of olive ridleys, especially when the turtles nesting over the nest 96 hours destroyed many nests from the first 24 hours of an arribada. Also, how could the local villagers control their local development and lifestyle with the coming of outside development money to the Pacific coast? Robinson established the Ostional turtle station of the University of Costa Rica to study the arribada phenomenon and began to involve villagers in the protection of the arribada. The concept evolved that villagers could take the eggs from the first 24 hours of the arribada since they would be destroyed anyway and protect the eggs from the later portion of the event. This led to the current controlled harvest (Alvarado, 1990). From 1977 when Robinson first proposed the idea until 1987 when the Costa Rican Congress reformed the Wildlife Conservation Law that prohibited egg harvesting to allow a controlled harvest at Ostional, a vigorous debate within Costa Rica and worldwide among sea turtle biologists considered all aspects of the plan. The final arrangement saw the Ostional community form an economic development association, Asociacion de Desarrollo Integral de Ostional (ADIO) to manage the harvest and the University of Costa Rica entrusted with the legal responsibility for carrying out the scientific studies needed to sustain the population. The University was to prepare an annual plan and review and provide scientific guidance to the community in its effort at sustainable development.

The Ostional experiment is a qualified success and has been the subject of numerous articles worldwide (i.e., Baker, 1994). The village has a new school, a new clinic, a new Guardia Rural office, and a new sense of civic pride in what the members of the community have accomplished. Local wardens patrol the beach, villagers help to count the turtles, and the egg harvest is conducted in a regular and fairly well managed way (Alvarado, 1990; Ballestero, et al., 1996). In the early 1990s ADIO collected up to three million eggs a year and sent them on to a distributor for the national market. About half the eggs went to bars and street vendors and half to bakeries, which use them to make fluffier cakes and cookies. ADIO divided the $95,000 per year between the community (80%) and Ministry of Agriculture. In the community 70% went to association members as payment for labor and 30% went to the sea turtle station and local community projects. Running water and turtle safe lights were especially prized by the villagers.

There are still many problems. The Ostional project has not diminished the illegal egg trade, which still occurs on both coasts of Costa Rica and invades the national parks whenever rangers or scientists let down their guard. That is because the Ostional project provides a cover for illegal harvest of other sea turtle eggs. It is not unusual to see other sea turtle eggs, even large leatherback eggs, offered for sale in San José bars along with the legal Ostional eggs. Thus once away from the beaches there is an enforcement nightmare, even if any officials attempted to enforce the turtle egg law. In addition, since the loss of Robinson the efforts of biologists have lacked the scientific guidance needed to maintain the scientific integrity of the project. The data available are not accurate enough to adequately assess the long-term viability of the turtle population. The arribadas have decreased in number of turtles in the late 1990s. It is not clear how much of this decline is due to the long-term egg harvest and how much is due to mortality of olive ridleys in the net and longline fisheries in the Pacific. There has been increased friction

between some biologists and the members of the local community and disputes have risen to the level of the Ministry of the Environment and the courts. Development in Nosara, 12 km south, has forced land values out of the reach of local people, just as at Las Baulas. Developers are buying land surrounding Ostional and planning to build tourist projects. It may be difficult for the community to maintain local control of the beach and arribadas. It would be premature to term this experiment a success and it would be a major mistake to take it as a model for sustainable development of other communities near sea turtle nesting beaches. Fortunately the University of Costa Rica is once again actively involved in the project at Ostional and since 1998 data collection has improved. More work is needed to insure that data are collected based on a good experimental design and that the egg harvest is controlled such that the turtle population is sustained. This is an unfinished experiment, one in great need of more vigorous management by MINAE, in concert with more vigorous enforcement of laws for sea turtle protection throughout Costa Rica.

Lessons for the Future

There are many lessons to learn from the story of sea turtles in Costa Rica. In 1964 Archie Carr wrote the following about conservation in Africa, “But the saving of wild beings from obliteration cannot be expected to pay for itself in more than a sprinkling of special cases. For most of the wild things on earth, the future must depend upon the conscience of mankind... The welfare of the wildlife will have to be reckoned against the rights of multiplying African man.” In 1993 Bonner echoed these sentiments when he stated that if Africa’s wildlife is to be saved it will require radical policies and changes in attitudes. Certainly both of these sentiments apply to the saving of sea turtles in Costa Rica. The central lesson of the last 45 years is that there

has to be a radical change in the approach of Costa Ricans and their government if they are to succeed in preserving sea turtles on their beaches and in the oceans.

Some things have worked

A dedicated cadre of conservationists has succeeded in establishing and maintaining a wonderful park system in Costa Rica. Mario Boza, Alvaro Ugalde, Pedro León, Sigfredo Marín and their colleagues have worked vigorously and effectively for the Parks. At the same time they have been helped by many North American biologists who have provided a scientific basis for management of the Parks. Of course, from the beginning foreigners have played an essential role in the National Park System (Wallace, 1992). In general, Parks have had the support of most of the people of Costa Rica. Sea turtles are viewed as charismatic creatures and certainly the people of the Central Valley believe that Costa Rica is vigorously defending these animals.

The fundamental problem

The consensus is that it is out on the beaches and among the local people where the problems arise. This is a convenient alibi that masks a more fundamental problem in the Costa Rican approach to sea turtle protection and wildlife conservation in general. The fundamental problem is that the power elite of Costa Rica sees economic development and profit as more important than conservation of natural resources, development of a modern Park system, and protection of wildlife, including sea turtles. This is a familiar problem in all countries. It is always a matter of balancing budget priorities in government and of raising private funds for conservation organizations. However, in Costa Rica conservation is losing and, whereas in the United States and Europe the "civil society" is committed to conservation, this is not true in Costa Rica. For example, there is a fundamental lack of philanthropy on the part of wealthy Costa Ricans. They expect foreigners and their conservation organizations to continue to provide

monetary support for the Park system. While many young Costa Ricans and middle class adults have volunteered their time and donated modest amounts of money ($5-10,000) to support sea turtle and other conservation projects, wealthy Costa Ricans, in general, have not provided substantive amounts to support the Park system. In addition, there is little support in the government for the Park system. This is most obvious in the lack of commitment of funds to the Parks. Despite ecotourism being the number one source of foreign revenue, inadequate funding hinders development of Park infrastructure, training of Park personnel, and protection. Even more damaging is the subservience of the Park System and environmental protection to development and tourism interests. When there is a choice to be made between the demands of protection of the turtles on the beach at Las Baulas and access to the turtles by guides and tourists, the latter win because of the power of the tourism agency, ICT, to overrule MINAE. If this does not exist in law, it certainly does in practice. There is a tax on tourists entering and leaving the country, but this money goes to support ICT not the Parks. While Costa Rica is seen as a leader in ecotourism and Parks (Terborgh, 1999), it is essentially mining its Parks for tourist dollars and putting very little resources back into the Parks to sustain them. Finally, laws to prevent poaching, protect beaches, regulate fishing, and defend wildlife are weakly enforced and laws critical to the protection of sea turtles still await passage by the National Assembly.

Questions

Where is the law to prevent lights from hotels and houses from shining on sea turtle beaches, disorienting adults and killing hatchlings? Where are the funds to complete urban plans for the area around Las Baulas Park? Private developers have completed urban plans to develop the area behind Playa Langosta despite theoretical protection of that nesting beach, but for the lack of $5000 the government has not competed its plan that would regulate development around

the most important leatherback nesting beaches on the Pacific Ocean. Why after years of recommendations by scientists and conservationists hasn't MINAE proposed, let alone the National Assembly pass, new legislation to correct the law establishing Las Baulas Park in order to give it boundaries on land instead of under the ocean? Why are there no effective laws to regulate development along the beaches? Why are no funds available to consolidate Las Baulas Park over 9 years since its establishment by decree and 5 years after it was codified in law? Why don't Park rangers patrol the beaches 8 hours a night, let alone 24 hours a day during the turtle nesting season at Las Baulas or Tortuguero?

Answers

The answer to these questions is a lack of leadership at the highest levels in MINAE and the government and an entrenched, inefficient bureaucracy in the Ministry and Park Service. The low priority the government gives to protection leads to institutional weakness. The political leadership fails to demand successful conservation and fails to provide adequate training and motivation to their staff. The founding generation of the Parks, Boza, Ugalde and others still have the fire of conservation in their hearts. However, they are placed in secondary positions and held in check by the Ministers of MINAE, ICT, and Agriculture who are more interested in prestige, friendships, and monetary development than in conservation. Meanwhile the personnel of the Park system and the Ministry have never been trained in how to develop a park, how to build infrastructure, how to interact with tourists, and how to defend their Parks. Instead they spend their time ensuring their own welfare in the bureaucracy rather than the welfare of the resources, the plants and animals, that they are supposed to protect. Rangers are poorly educated, poorly paid, and little motivated to do their jobs. In fact they do not know what it is exactly that a

park ranger is supposed to do. As in other countries (Terborgh, 1999), guards at Las Baulas are not empowered and so they occupy themselves with controlling tourists and scientists while closing their eyes to the more serious challenge of evicting squatters and controlling guides and developers. While it is true that Costa Rica has a much more organized Park system than most other tropical countries (Terborgh, 1999), it is also true that its Parks sustain a much greater number of ecotourists and a much greater rate of development along their borders than Parks in those countries. Unfortunately the institutional weakness of the Park system prevents it from dealing with these pressures.

Caught in a trap

Costa Rica is caught in the same trap as many other nations. With an expanding population, a declining resource base, and a large foreign debt there seems to be little hope for the resources needed to ensure protection of the established National Parks let alone the new ones like Las Baulas. Without sustainable development the future will be grim and our play about the sea turtles will indeed end as a tragicomedy. However, no nation has achieved or is near to reaching the golden egg of sustainable development and there is no guarantee that sustainable development will lead to harmony between humans and nature. The problems of sustainable development have been well documented by Frazier (1998).

Radical change is needed

Costa Ricans will have to outgrow their laisse faire attitude towards environmental protection and establish strong, clear laws to control development and to protect the Parks and the natural resources contained in them on land and at sea. Then they will have to reform the legal system to provide vigorous enforcement of those laws. We agree with Terborgh (1999) that there is no substitute for enforcement. Without it all is lost.

Next the Park system will have to be revitalized. It can no longer operate as a biodiversity welfare system reliant on donations from foreign governments and conservation organizations. There are plenty of resources available in the form of ecotourism dollars and biodiversity royalties. If Costa Ricans want to preserve their biodiversity, their Parks, and most importantly for this story, their sea turtles, then they will have to use some of those resources to adequately fund their conservation infrastructure. Personnel need to be adequately trained, led and paid in order for them to do their jobs effectively. Professionals with BA/BS, MA/MS and Ph.D. degrees need to be hired. Perhaps an exchange program with park systems in nations such as the United States and Canada, not based on a welfare program but on a work program, would be effective. Rangers from those nations could be given release time to come to Costa Rica to train rangers onsite and to learn about the biodiversity in Costa Rica first hand, while rangers from Costa Rica took their place in the home country and learned how an effective Park system functioned by working in it.

Finally, until Costa Ricans acquire the advanced training and education needed to carry out the research and conservation efforts needed to manage their sea turtles and other resources they are going to have to continue to accept help from foreign biologists who can carry out that work. While it may not yet be necessary to internationalize the Parks in order to save them (Boza, 1993), it is true that sea turtles, at least, are international resources. If the people in Costa Rica cannot protect them on their nesting beaches, then pressure will increase for the international community to step in and carry out that function.

International Interest

Certainly the precedent has been established that the international community has the right to intervene in a country to protect human rights as in Bosnia and Kosovo. It will not be too

long in the future before the international community establishes the precedent that it has the right to intervene in a country to protect nature and biodiversity vital to the future well being of the global community. This is one basis of the evolving theory of environmental security. This theory arose from the concept of preventive defense (Carter and Perry, 1999) which seeks to prevent wars before they occur. Environmental security goes a step further and states that environmental problems such as overpopulation, lack of resources and environmental degradation can be the causes of conflict and will become the predominant causes of conflict in the decades to come (Myers, 1996). Because Costa Rica has so much biodiversity and the most critical sea turtle nesting beaches in the Pacific, it has the obligation to protect them by making changes in its conservation strategy so that its Parks accomplish their stated purpose. If it does not then it can expect that other nations will become increasingly involved. Boza (1993) is right.

Finally

This play does not have to end as a tragedy. Costa Rica has the basis for success in sea turtle conservation and in reforming its Park system and environmental ministry. It has a democratically elected government that enjoys the support of the people. Most of its population appreciates the intrinsic value of nature and most of its people are well educated. There is already a large area of land set aside in Parks, there is a cadre of senior conservationists who can lead a revitalized park system, and the youth of the nation are committed to protection of plants and animals. There is no nation in the tropics better positioned to take the next step into real nature conservation. All that is needed is the political will on the part of the power elite to change their priorities and make conservation an ethical imperative (Oates, 1999) instead of an advertising initiative.

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Table 1. Regional population estimates for nesting leatherback turtles, Dermochelys coriacea. Numbers are based on data reported in Spotila et al. (1996) and recent information from nesting beaches.

Region	Estimated Number of Nesting Females
Western Atlantic	15,000
Caribbean	4,000
Eastern Atlantic	4,700
Indian Ocean	450
Western Pacific	1,700
Eastern Pacific	1,760
Total	27,610

Figure Captions

Figure 1. Sea turtle nesting beaches in Costa Rica. Leatherbacks nest from Tortuguero to the Panama border on the Caribbean coast. On the Pacific coast they nest primarily in Las Baulas Park, but also at Playa Naranjo and in scattered numbers at other beaches. Black turtles nest along the Pacific coast. Green turtles nest along the Caribbean coast. Hawksbills nest in very low numbers along the Caribbean coast and on the Pacific coast, particularly along the Osa Peninsula.

Figure 2. Numbers of leatherback turtles nesting on Playa Grande from the 1988-89 nesting season to the 1998-99 nesting season. Data from 1988 to 1992-93 are based on counts of the number of nests and assume a clutch frequency of 7. Numbers from 1993-94 to 1998-99 are based on PIT tag identification of individual nesting female turtles. The population has undergone an exponential decline during this period.

Figure 3. Parque Marino Las Baulas is located on the Pacific coast of Costa Rica in Guanacaste. The shaded areas indicate Park boundaries. The Park includes Playa Ventanas, Playa Grande, Playa Langosta, the Estero de Tamarindo, and the Estero San Francisco with their associated mangrove stands. Redrawn from Steyermark et al (1996) with permission.