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Biology and Conservation of Leatherback Turtles, *Dermochelys coriacea*, at Playa Langosta, Costa Rica

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ABSTRACT. – **Playa Langosta is a small (1.3 km), but very important nesting beach for leatherback turtles, *Dermochelys coriacea*, on the Pacific coast of Costa Rica. From the beginning of October 1991 through early March 1992 we tagged 229 leatherbacks nesting there. Nesting peaked in December and January with an average of 7–8 turtles per night. Internesting period was 9 days and observed clutch frequency was 3.3. These were among the smallest nesting leatherbacks in the world with a mean standard curved carapace length (SCCL) of 147.0 cm. The smallest individual had a SCCL of 128.0 cm. Mean clutch size was 65.3 yolked eggs and 39.4 yolkless eggs. Distance between nest sites of individual turtles for consecutive nestings was usually less than 300 m. However, 10% of leatherbacks tagged on Playa Langosta nested at least once on nearby Playa Grande and 20% of those tagged on Playa Grande did the reverse. Environmental education in the local schools, villages, and nationally, combined with law enforcement and research activities, helped to reduce poaching of eggs from a high of 91% in October to less than 2% in December.**

KEY WORDS. – **Reptilia; Testudines; Dermochelyidae; *Dermochelys coriacea*; sea turtle; nesting; population size; conservation; environmental education; Costa Rica**

Costa Rican beaches have played an important role in the survival of leatherback turtles, *Dermochelys coriacea*. Leatherbacks have been in decline in the Pacific and Indian Oceans and endangered from anthropogenic causes (Ross,1982; Pritchard,1982; Spotila et al., 1996). While for many years we knew that leatherbacks nested on the Caribbean coast of Costa Rica (Carr, 1967), and Cornelius (1976) reported on the nesting of leatherbacks on Playa Naranjo, until recently the extent of leatherback nesting on the Pacific coast was unknown.

Leatherbacks are an important symbol of the biodiversity of Guanacaste Province, Costa Rica. They serve to attract attention to the biological resources of this area and to focus the energy of many people on conservation. Historically leatherbacks nested on several Guanacaste beaches, including Playa Grande, Playa Langosta, Playa Naranjo, Playa Flamingo, Playa Tamarindo, and Playa Cabuyal (Fig. 1). Development has eliminated nesting from Playas Flamingo and Tamarindo, but nesting activity is still strong on Playas Grande, Langosta, and Naranjo. Of these beaches, Playa Grande is most important, but receives the attention of many tourists. Playa Langosta is much less disturbed and is also very important. Both are now protected as part of the new Las Baulas National Park. Playa Naranjo is not developed at all, is little visited, and is well protected because it is within Santa Rosa National Park.

For several years the Programa de Tortugas Marinas of University of Costa Rica has studied and preserved sea turtles in Costa Rica. Particular emphasis has been placed on the Pacific coast where a combination of scientific research, training of local para-biologists and guides, and environmental education has helped to improve the status of leatherbacks, olive ridleys (*Lepidochelys olivacea*) and black turtles (*Chelonia mydas agassizii*). The purpose of this study was to investigate the nesting biology and conservation of leatherbacks on Playa Langosta and to develop an education program to increase local involvement in conservation of the turtles and their eggs. A special effort was made to involve women, both from local villages and from the university, in conserving this biological resource. In the past women were not educated about or involved in conservation. Their social status outside the home was low and they had little influence on the preservation of their culture or their biological resources. We hoped that our project would help raise their stature in their local communities and expand their influence in moderating the exploitative behavior of uneducated egg poachers. By educating mothers and young women in the communities we sought to have them pass on an environmental ethic to their children and friends. It is well known that women in many countries can have a dramatic effect on the development of a "civil society," that is, a society dedicated to the personal well being and social development of all people. In this project we sought to improve turtle conservation by integrating this ethic.

MATERIALS AND METHODS

Study Site. — Playa Langosta is located in Guanacaste Province, south of Tamarindo, in the Tropical Dry Forest Life Zone (Holdridge, 1967). The rainy season usually lasts from May to early December and the dry season from mid-December to late April. The beach is 1.3 km long and we

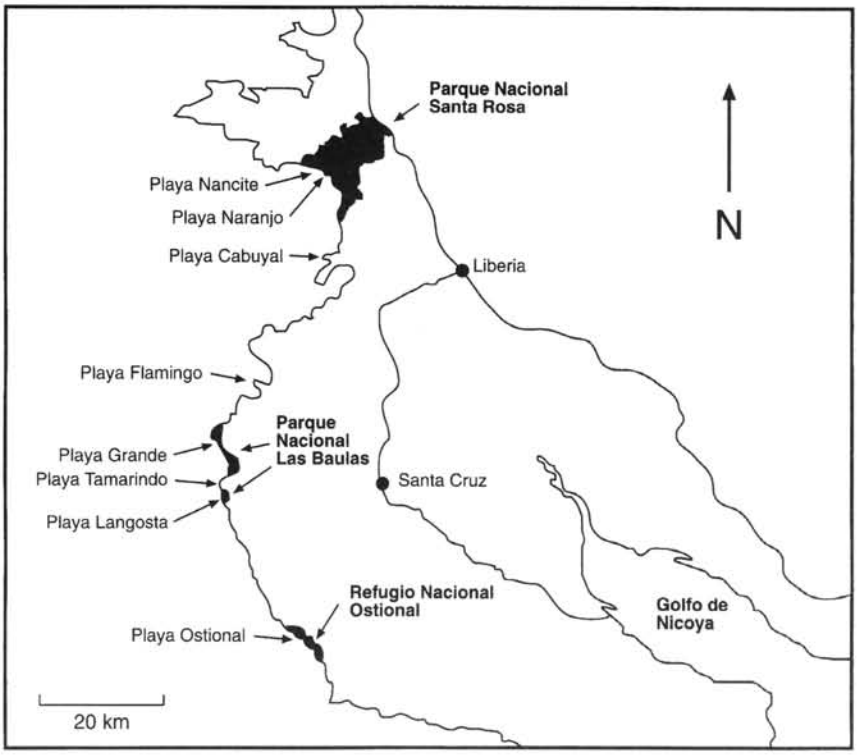

Figure 1. Historically important nesting beaches of leatherback turtles in Guanacaste Province on the Pacific coast of Costa Rica. Playa Grande, Playa Langosta, and Playa Naranjo are now protected in national parks. Playa Flamingo and Playa Tamarindo have been taken over by development. Playa Cabuyal has only a few nesters each season.

divided it into 14 sections of 100 m each, numbered from south to north. The undeveloped white sand beach is crescent shaped and located between two rocky points south of the Río San Francisco. At the south end there is only a slight slope leading to a clear open area bordered by beach vegetation, a thick line of brush, and then secondary forest. From sector 4 to 9 the beach has a steep slope with a wide, low dune at the top, backed by vegetation as in the south. In sectors 10 to 14 there is a steep slope with a wide dune at the top leading to the estuary on the other side. The brush behind the beach provides a wall-like obstacle for the turtles so that few nested beyond the low beach vegetation.

Tagging. — Since leatherbacks usually come ashore on Playa Langosta and Playa Grande with the high tide, we patrolled the beach at night continuously from 2 hrs before to 4 hrs after high tide from the beginning of October 1991 until early March 1992. While, or after, a turtle laid its eggs we tagged it on both rear flippers with inconel style 681 conservation tags (National Band and Tag). Tags had a University of Costa Rica return address in Spanish. We entered tagging data into the American Pacific Tag System, a data base for tag information coordinated by Programa Tortugas Marinas of the University of Costa Rica. We measured turtles with a flexible metric tape to obtain standard curved carapace length (SCCL), defined as the curved length from the center of the nuchal notch to the posterior carapace tip (alongside the central dorsal ridge), and standard curved carapace width (CCW), defined as the curved distance across the carapace at the widest point of the turtle from side ridge to side ridge. We counted the number of eggs (yolked and yolkless) as they were being deposited into 48 nests. We used volunteers to tag some leatherbacks at Playa Grande. Coverage on Playa Grande was incomplete because we did not have enough trained volunteers, there was extensive, uncontrolled tourism on the beach, and we had insufficient resources to patrol the beach at all times.

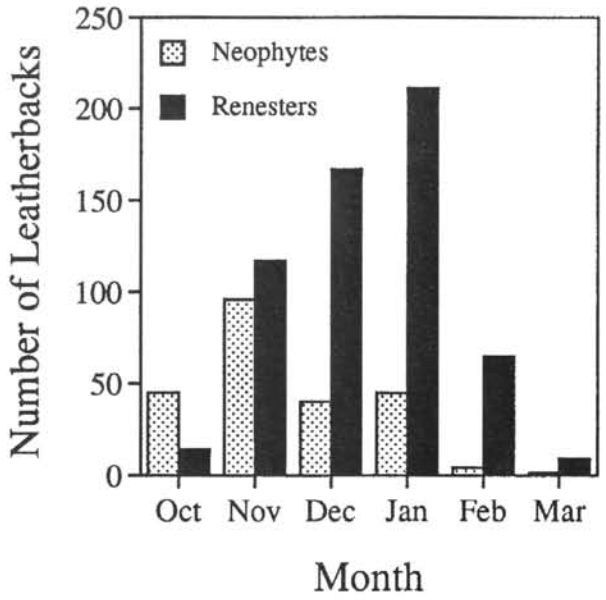

Figure 2. Nesting activity of leatherback turtles each month during the 1991–92 season at Playa Langosta, Costa Rica.

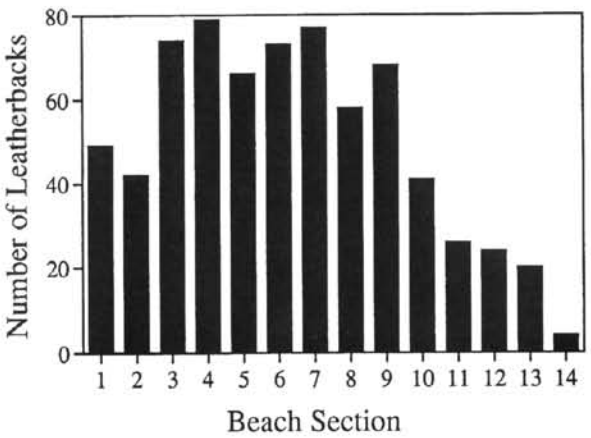

Figure 3. Distribution of leatherback turtles observed nesting on Playa Langosta during the 1991–92 nesting season. Sections 1–2 in the south are near a rocky point and 11–14 in the north are backed by an estuary near the mouth of the Río San Francisco.

Environmental Education. — Education was a major facet of this project. We brought children and their parents from the local communities to the beach to see the turtles. We also worked with groups from the National Museum of Costa Rica and the Costa Rican Scouts Association. Groups of ten people in family groups came to the beach on trips organized by the National Museum. Each group received a lecture on sea turtles and the rules for their behavior on the beach and then walked the beach with a trained biologist to see the turtles. Groups of five to ten boy scouts and girl scouts visited the project every weekend. During the day they participated in activities about biodiversity of coastal areas and at night they had lessons about sea turtles and helped with the research.

We visited local schools in nearby Pinilla and Hernandez every week during October and November. Special activities included lessons about biology, conservation, and sea turtles. Organized visits brought the children and their parents to the beach to see the leatherbacks. We presented slide shows and lectures in the villages of Pinilla, Hernandez, and Villarreal. We developed a brochure which we gave to local residents and other visitors to explain the biology of leatherbacks and the importance of protecting the nesting beach.

RESULTS

Nesting Ecology. — Although some leatherbacks arrived at Playa Langosta in late September and early October 1991, the nesting season started in earnest in late October. Leatherbacks arrived at Playa Langosta in October and new (non-tagged) turtles continued to arrive in December and January (Fig. 2). In February only a few new turtles appeared. We tagged 229 leatherbacks on Playa Langosta and made 522 reobservations of these animals for 751 total observations. Nesting activity increased in November (6–7 per night), remained high in December and January (7–8 per night) and dropped drastically in February (2 per night). Most nesting ended in early March. Between 1987 and 1991 volunteers from the Programa Tortugas Marinas tagged 62 leatherbacks at Playa Langosta. We observed two of these turtles nesting in the 1991–92 season, one from 1987–88 and one from 1988–89. We also tagged 27 olive ridley turtles, 2 black turtles, and observed the crawl of one hawksbill, *Eretmochelys imbricata*.

Leatherback nesting activity was concentrated on the open dune, above the high water mark, between sections 3 and 9 (Fig. 3) where the slope was high. Of 703 nests for which we recorded exact location, 660 nests were in the open area of the dune, 42 were on the border between the open area and the vegetation and 1 was in the vegetation. Nesting success was high with 91.7% of 819 nesting attempts resulting in completed nests (751 nests). Late in the season as the sand dried out, the surface sand often collapsed into nest holes causing some turtles to abort nest construction during the digging phase. Distance between re-nesting sites for individual turtles was usually less than 300 m and often within 100 m of the previous nest (Fig. 4). Observed internesting periods ranged from 5 to 57 days with a mode of 9 (Fig. 5). Mean observed clutch frequency (OCF) was 3.3 with a range of 1 to 9 (Fig. 6). Forty leatherbacks nested 4 times at Playa Langosta and 13 nested more than 6 times.

Mean SCCL of 150 leatherbacks was 147.0 cm and mean CCW (n = 149) was 136.1 (Table 1). The smallest leatherback had SCCL of 128.0 cm. Mean number of yolked

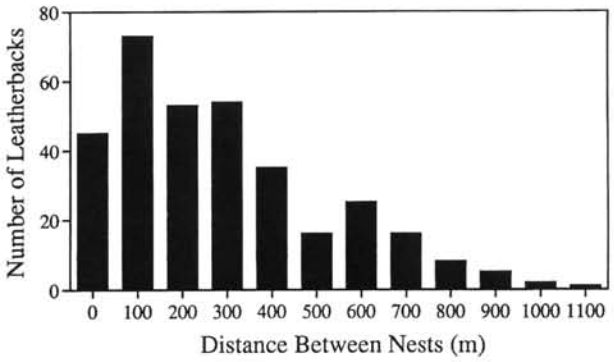

Figure 4. Nest site fidelity of leatherback turtles nesting on Playa Langosta during the 1991–92 season. Distance is the distance between current and prior nest for leatherbacks that laid two or more nests on Playa Grande. For example, this would be the distance between nests 2 and 1, 3 and 2, etc.

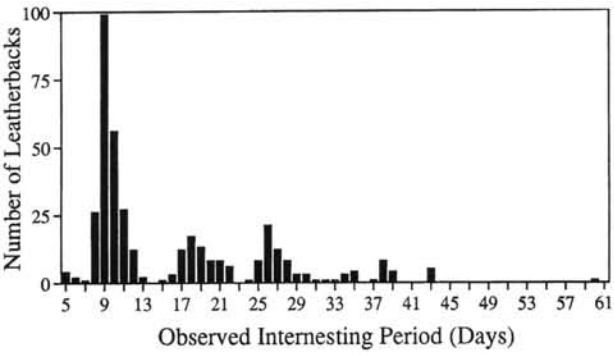

Figure 5. Observed internesting periods for leatherback turtles nesting on Playa Langosta during the 1991–92 season. Peaks of activity were at 9,18, and 27 day intervals.

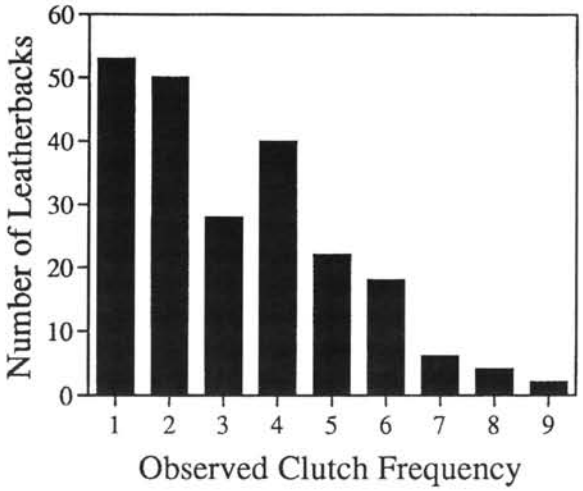

Figure 6. Observed clutch frequency (OCF) of leatherback turtles nesting at Playa Langosta during the 1991–92 season. Mean OCF was 3.3 nests.

eggs was 65.3 and the mean number of yolkless eggs was 39.4. There was no significant relationship (linear regression, $P > 0.05$) between SCCL and number of yolked eggs.

Poaching was high in October (49 of 54 nests, 90.7%) but dropped in November to 102 of 199 nests (51.2%) and was less than 2% (0–1.7%) for the rest of the season. Rural guards patrolled the beach nightly for three weeks in November and December. In January and February they only came to the beach periodically, but nightly research activity, environmental education in the villages, and the potential presence of guards deterred poachers from returning.

We tagged 215 leatherbacks on Playa Grande between November 1991 and the first week of February 1992. Poaching was almost completely controlled at night by the presence of Park guards, but some nests were dug up by poachers and dogs during the day. Extensive development was planned for Playa Grande at that time and tourists were uncontrolled. Activity on the beach was chaotic at night with visitors freely using lights and taking flash photographs.

We observed 23 leatherbacks (10%) that we tagged on Playa Langosta nesting in the same season on Playa Grande, and 44 leatherbacks (20%) that we tagged on Playa Grande nesting in the same season on Playa Langosta.

Environmental Education. — Special activities at local schools, coordinated with teachers, taught children about sea turtles and conservation. Children came to the beach with their parents to observe leatherbacks nesting. This activity, along with presentations in the local villages, helped to reduce poaching. Of the 751 nests laid during the season, poachers removed 20.6%. However, most of that activity occurred during October and early November. After we began our education campaign in the local schools and villages, started our research on the beach, and obtained some enforcement from rural guards, poaching dropped to zero in December and only 4 of 303 nests were poached during January to March. Some of the poachers lived in these villages and the education of their children and social pressures resulting from conservation activities encouraged them to stop taking eggs. Other poachers were from outside the local area and the presence of rural guards on the beach deterred their activities

Several groups of boy scouts and girl scouts came to Playa Langosta during December and January. This also helped to reduce poaching activity. Approximately 250 people participated in educational weekends at Playa Grande sponsored by the National Museum. These activities were open to families who responded to a newspaper advertisement. Before going on the beach participants attended a lecture on sea turtle biology. They accompanied a biologist onto Playa Grande where they observed leatherbacks nesting. This activity provided an example of beneficial tourism on this beach. We produced a brochure, *La Tortuga Baula*, which we distributed to local schools, hotels, and to the participants in our nesting beach activities. An article in the national newspaper, *La Nacion*, educated the country at large about leatherbacks.

Table 1. Morphometric data on leatherback turtles and their eggs on Playa Langosta during the 1991–92 nesting season. SCCL = standard curved carapace length, CCW = standard curved carapace width.

Measurement	Mean	SD	Min	Max	*n*
SCCL (cm)	147.0	6.9	128.0	167.0	150
CCW (cm)	136.1	7.4	117.0	154.0	149
Yolked eggs/clutch	65.3	15.9	26	106	48
Yolkless eggs/clutch	39.4	22.1	0	136	48

DISCUSSION

Playa Langosta is one of the most important nesting beaches for leatherback turtles on the Pacific coast of Costa Rica. In 1991–92, 229 leatherbacks nested there between October and the end of February. This beach supported fewer turtles than Playa Grande (Steyermark et al., 1996), but there was an exchange of leatherbacks between these beaches in this study. This indicated that these beaches shared the same overall nesting population. This was not surprising since they were within a few kilometers of each other and the nesting complex once included Playa Tamarindo, an area that is now occupied by a resort community with extensive lighting of buildings, grounds, and streets. Long term residents of Tamarindo reported to us that it was common for leatherbacks to nest there and that turtles came right up under their stilt houses when Tamarindo was a small village in the 1950s and had no lights.

Nest site fidelity on Playa Langosta was high. Leatherbacks generally placed nests within 100–300 m of their previous nest. This may have been due to the concentration of nests in the central portion of the beach. There were rocks at the north and south ends of the beach and the incoming tides may have funneled turtles onto the center of the crescent shaped beach.

Leatherbacks on Playa Langosta (mean SCCL = 147 cm) were similar in size to those on Playa Grande in 1993–95 (Steyermark et al., 1996), on Playa Naranjo in 1971–72 (Cornelius, 1976), and on Tierra Colorada, Mexico in 1977

(Pritchard, 1982), but smaller than those on the Caribbean coast of Costa Rica (156.2 cm and 152.8 cm) (Hirth and Ogren, 1987; Leslie et al., 1996). East Pacific leatherbacks are the smallest leatherbacks in the world. Deraniyagala (1939) reports the mean curved carapace length of 9 nesting leatherbacks in Sri Lanka as 151.4 cm (range = 125.0–165.0 cm). Leatherbacks at St. Croix (152.9 cm; Dutton et al., 1994), Culebra (154 cm; Tucker and Frazer, 1991), French Guiana (162 cm; Steyermark et al. [1996], calculated from Fretey and Girondot, 1989), Tongaland, South Africa (159.6 cm; Hughes, 1996), and Irian Jaya (162.2 cm; Starbird and Suarez, 1994) are all larger. It is possible that leatherbacks on Playa Langosta and Playa Grande grow at a slower rate or mature at a smaller size than elsewhere.

The internesting interval for leatherbacks at Playa Langosta was similar to that on other nesting beaches. Steyermark et al. (1996) reported a mode of 9 days for leatherbacks on Playa Grande, as have Tucker and Frazer (1991) on Culebra , Eckert (1987) and Boulon et al. (1996) on St. Croix, and Fretey and Girondot (1988) in French Guiana. Leatherbacks have the shortest internesting interval of all of the sea turtle species.

The mean OCF measured in this study (3.3) was lower than those reported for St. Croix (4.9–7.0, Eckert, 1987; 5.3, Boulon et al., 1996) and Culebra (5.2–7.0, Tucker and Frazer, 1991), but only slightly lower than those reported for Playa Grande (3.5 and 3.6, Steyermark et al., 1996). The lowest OCF is the 2.8 reported for French Guiana by Fretey and Girondot (1989). Steyermark et al. (1996) suggest that low OCF values for large colonies reflects incomplete coverage of the nesting beach because of the large nesting area. We had very complete coverage of the nesting beach at Playa Langosta during the period of time when leatherbacks normally come up to lay eggs, around the high tide. Therefore, it is likely that the low OCF for this beach was due to our inability to sample leatherbacks that nested before or after our study period at the beach, to the 10% of Playa Langosta leatherbacks that shifted part of their nesting to Playa Grande, and to the few leatherbacks that nested at times other than at high tide. Caution must be applied in comparing OCF from beaches with different amounts of investigator coverage.

The mean clutch size of leatherbacks on Playa Langosta in 1991–92 (65.4 yolked eggs) was greater than the clutch size of leatherbacks on Playa Grande in 1993–94 (59 yolked eggs, Schwandt, 1994), but similar to that of leatherbacks on Playa Naranjo (65.6 yolked eggs) in 1971–72 (Cornelius, 1971). Mean number of yolkless eggs (39.4) was similar to that for Playa Grande leatherbacks (42). Tortuguero leatherbacks lay more yolked (86) and yolkless (53) eggs than do Playa Langosta leatherbacks (Leslie et al., 1996). This is not surprising given their larger size. The larger leatherbacks at Culebra, St. Croix, and French Guiana also have larger clutches (Fretey and Girondot, 1989; Tucker and Frazer, 1994; Dutton et al., 1994; Boulon et al., 1996).

Environmental education played an important role in reducing poaching on Playa Langosta in 1991–92 and improving the status of the leatherback both locally and nationally. Our educational efforts with local children and adults, along with scientific activity on the beach and some active law enforcement, reduced poaching to essentially zero. Similar success occurred with Archie Carr's efforts on behalf of green turtles, *Chelonia mydas*, at Tortuguero (Fowler, 1979; Spotila, 1988) and with efforts for leatherbacks there in 1990–91 (Leslie et al., 1996). An article in the national newspaper and trips sponsored by the National Museum brought leatherbacks to the attention of many people in Costa Rica. Continued efforts by ourselves and others in the conservation community have raised public awareness of the leatherback in Guanacaste Province and resulted in an improvement in its nesting and hatching success on both Playa Langosta and Playa Grande. Active involvement of women from the University of Costa Rica and local communities in education and conservation activities was central in the education of children in local villages and in reducing egg poaching by people from the local communities.

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