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Marine Turtle Nesting, Nest Predation, Hatch Frequency, and Nesting Seasonality on the Osa Peninsula, Costa Rica

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Most of the eight species of marine turtles in the world are considered threatened or in danger of extinction (Groombridge, 1982). One of the greatest threats to marine turtles is human activity on and adjacent to marine turtle nesting beaches (Carr, 1967; Mortimer, 1979; Ehrhart, 1979; Cornelius, 1986; Waldichuck, 1987; Cheng, 1995). Human activity includes direct depredation of nests, introduction of domesticated animals that also depredate nests, and development along nesting beaches. The beaches on the Pacific coast south of Corcovado National Park on the Osa Peninsula in Costa Rica are experiencing nest predation and facing the threat of development.

Prior to a preliminary study in 1992 (Drake, 1993), no quantitative studies had been conducted on marine turtle nesting on the Osa Peninsula. This is in contrast with other marine turtle nesting beaches in Costa Rica, such as Tortuguero, Ostional, Nancite, and Playa Grande, several of which have been studied for over 30 years.

This study, conducted on four beaches on the Osa Peninsula over a 14 month period between September 1993 and October 1994, reports baseline data on: 1) spatial distribution of marine turtle nests, 2) nest predation frequency, 3) hatch frequency, and 4) seasonality of nesting activity. These data should serve as a baseline for future work and support conservation endeavors on the Osa Peninsula.

Materials and Methods. — Beach monitoring on the Osa Peninsula began at Playa Piro in September 1993, on Playa Río Oro in December 1993, on Playa Pejeperro in April 1994, and on Playa Carate in July 1994 (Fig. 1) and extended through July 1994 at Playa Piro and October 1994 at the other three beaches.

I conducted daily beach monitoring with the assistance of two hired residents. Each morning, we recorded the previous night's nesting, predation, and hatch activity in the following manner. Each of the four beaches was divided into 100 m subsections. Nests were assigned a three-part identification code which consisted of the number of the subsection, the number of meters from the subsection marker, and the number of meters from the treeline to the nest. We classified each nest as new (from the previous night) or old (from a prior night). Nests were subsequently categorized as intact, depredated, or hatched. Previous observations (Drake, 1993) showed that nest predators were limited to dogs, man, and coatis (*Nasua narica*). The predators of excavated nests were identified according to their tracks and the manner in which they excavated the nests (Cornelius, 1986). Excavated nests in which the predator was indeterminable were recorded as such.

Figure 1. Map of the Osa Peninsula, Costa Rica, indicating the four marine turtle nesting beaches monitored from September 1993 to October 1994. National Park boundaries are approximate.

To identify nesting species, the width and symmetry of the crawl was recorded (Pritchard et al., 1983; Cornelius, 1986). Symmetrical crawls up to 0.9 m wide were considered to be the black turtle *Chelonia agassizi* (= *Chelonia mydas*), and over 1 m wide to be the leatherback, *Dermochelys coriacea* (Pritchard et al., 1983; Cornelius, 1986). Asymmetrical crawls with a width less than 0.9 m were considered to be the olive ridley, *Lepidochelys olivacea*. The hawksbill, *Eretmochelys imbricata*, which also makes asymmetrical crawls, is known as an infrequent nester on these beaches (*pers. obs.*).

On occasion, it was not possible to determine the nesting species because the crawl had been washed by the tide or disturbed by other means such as wind or heavy rains. These crawls were recorded as indeterminable.

In addition to the daytime censuses, I conducted night walks along Playa Piro at

infrequent intervals throughout the study to identify nesting species and nest predators. Beaches were walked daily by at least one observer, except during the month of July at Playa Pejeperro, which was only monitored for 4 days that month.

Results

A total of 4119 nests was recorded between September 1993 and October 1994 on the 4 beaches. Of this total, 7% (n = 271) hatched. Allowing for a 60 day incubation period (Pritchard et al., 1983; Robinson and Redford, 1991), 31% (n = 1294) of the recorded nests were still incubating at the end of the study. Thirty percent (n = 1256) of the nests were depredated, and 32% (n = 1299) failed to hatch within the study period for unknown reasons.

Species. — A total of 3268 new nests was identified to species according to the width and symmetry of the crawl. Of these, 3155 (97%) were due to *Lepidochelys olivacea*, 78 were from *Chelonia agassizi*, 34 were made by *Dermochelys coriacea*, and at least 1 crawl was made by *Eretmochelys imbricata* (turtle seen). The remaining 851 nests were unidentifiable.

Turtles actually observed nesting during this survey included 12 *L. olivacea* and 1 *E. imbricata*. Hatchlings were observed emerging from 20 nests of *L. olivacea*, but none of any other species.

Nesting Seasonality. — Nesting and nest predation were greatest in September and October at all beaches, and lowest between February and May (Figs. 2 and 3). Hatching was highest in September and October, and minimal to nonexistent at other times (Fig. 4). Nests laid at the beginning of the rainy season (June) had a greater hatch frequency (103 of 1530, 7%) than those laid at the beginning of the dry season (January) (0 of 380, 0%).

Nesting, Nest Predation, and Hatch Frequency. — Playa Río Oro had the greatest concentration of nesting, nest predation, and hatched nests of the four beaches studied (Table 1). Playa Río Oro had almost 6 times the number of nests (n = 2968) than that of Playa Piro (n = 497), which was studied for the same number of months. Playas Piro, Pejeperro, and Río Oro had similar nest predation rates (30, 31, and 28%, respectively) while Playa Carate experienced a 54% predation rate. Hatch percentages ranged from 2% at Playa Pejeperro to 8% at Playa Río Oro.

Dogs were responsible for 49% of the depredated nests (16% of the total nests recorded), man for 42% (12% of total), and coatis for 2% (less than 1% of total) on all 4 beaches. Four percent of all depredated nests were excavated by wave action, and three percent of nest predators were indeterminable. Most of the excavations by coatis and wave action on these beaches occurred on Playa Piro, 97% and 89%, respectively. Human predation of nests was greater than that of dogs on Playas Pejeperro and Carate, and almost equal to nest predation by dogs on Playa Río Oro (Table 2).

Discussion

Nesting Seasonality. — Nesting seasonality of *Lepidochelys olivacea* followed the pattern known elsewhere for this species, with an increase in June and a peak during September and October, the height of the rainy season. This species is the primary nester on these beaches. There were no obvious seasonal trends in *Dermochelys coriacea*, whose nesting season peaks in December and January on beaches north of the Osa Peninsula. The nesting season of *Chelonia agassizi* was similar to that of *L. olivacea*. Because the crawls of *Eretmochelys imbricata* could not be distinguished from the more common *L. olivacea*, it was not possible to determine its nesting seasonality.

Nesting and Hatch Frequency. — Characteristics of a good nesting beach are accessibility from the sea, ample nesting area above the spring high tide line, and a substrate that facilitates gas diffusion within the nest and prevents slippage during nest construction (Ackerman, 1977; Mortimer, 1982). These factors have probably contributed to the high rates of nesting concentrated in the 6 km stretch of Playa Río Oro, between Laguna Pejeperro and Laguna Pejeperrito. Approximately 72% of all the nests were recorded there (Table 1).

The sand beach at Río Oro is neither silty nor gravelly, allowing successful excavation of nest cavities, and it has ample nesting area above the high tide line. The steep beach at Playa Pejeperro may not receive as many nests as Playa Río Oro (Table 1), despite the similar sand type and lack of major offshore rock formations, which facilitates the approach of potential nesters, due to the lack of nesting area caused by the encroachment of forest a few meters above the high tide line.

Playas Piro and Carate may have the lowest nesting activity of the four beaches due to their limited area above the high tide line for nesting, gravel shores, and offshore rocks (Table 1). Playa Piro has limited nesting area above the

Table 1. Nesting, nest predation, and hatch frequency data collected on four beaches on the Osa Peninsula, Costa Rica. Beach length in km; peak nesting season September–October.

Beach	Months Studied	No. Months	Beach Length	Total # Nests	Nests/Mo./ km	Peak Season Nests/Mo.	Total Depredated	Total Hatched
Piro	09/93–07/94	11	4.5	497 (12%)	10	62	199 (40%)	29 (6%)
Pejeperro	04–10/94	7	4.5	550 (13%)	17	190	170 (31%)	13 (2%)
Río Oro	12/93–10/94	11	6.0	2968 (72%)	45	515	830 (28%)	225 (8%)
Carate	07–10/94	4	3.5	104 (3%)	7	15	57 (55%)	4 (4%)
Total	09/93–10/94	14	18.5	4119 (100%)	16	782	1256 (30%)	271 (7%)

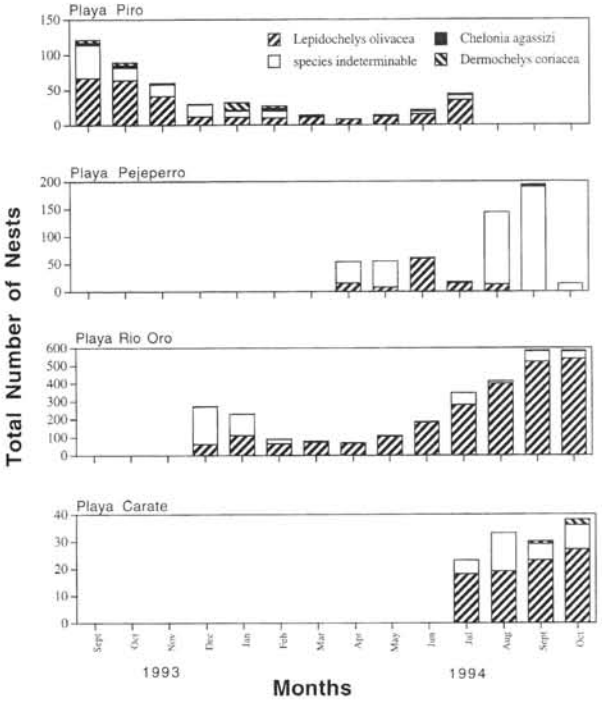

Figure 2. Monthly nesting activity per beach on the Osa Peninsula, Costa Rica. Months without bars indicate no censuses during that time.

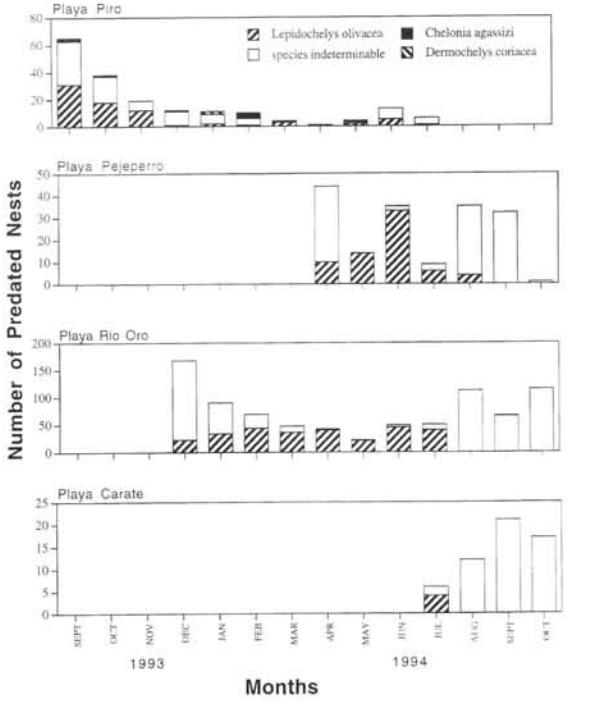

Figure 3. Monthly nest predation activity per beach on the Osa Peninsula, Costa Rica. Months without bars indicate no censuses during that time.

high tide line except at the 200 m area around the Piro River. As one moves southward on Playa Piro to Cabo Matapalo, nesting space becomes non-existent as the high tides wash up to the forestline.

In addition to high nesting frequency, Playa Río Oro has the greatest hatch frequency of all beaches inclusive, 83% of all hatched nests in the study. This may be partially a result of the ample nesting area above the high tide line. The other beaches may have a lower rate due to repeated tidal inundations, which kill developing embryos (Waldichuk, 1982).

There is a chance that some of the nests which should have hatched during this study, but did not appear to, may have hatched on days when censusing was not possible. This, however, is unlikely to explain the fate of all nests which should have hatched. There is a possibility that some nests may have been completely destroyed by tidal inundation, but this also is unlikely to explain all the unhatched nests. Infertile nests and the possibility that some false nests were recorded may explain the remainder of the unhatched nests.

Nest Predation. — Illegal local consumption of marine turtle eggs occurs in the communities along the Pacific coast of the Osa Peninsula, as does illegal commercial harvesting for retail sale outside of the communities (*pers. obs.*). Proximity of people and accessibility of the nesting beaches to man appear to be important factors in nest predation.

Playa Río Oro is the only beach with direct public road access to the beach between Carbonera and Carate, where the only road on the Osa ends (Fig. 1). Public road access to Playa Río Oro makes it easy for residents and outsiders to illegally take eggs. The rate of nest predation at Playa Río Oro is comparable to that of Playas Pejeperro and Piro, which are less accessible to man, but the total number of nests lost to predation on Playa Río Oro is greater than that of all other beaches combined. The loss of a larger number of nests at Playa Río Oro may be explained by the fact that there is a concentration of people living in Río Oro. Both humans and their dogs excavate marine turtle nests on the beach. The human population in Río Oro is small, with

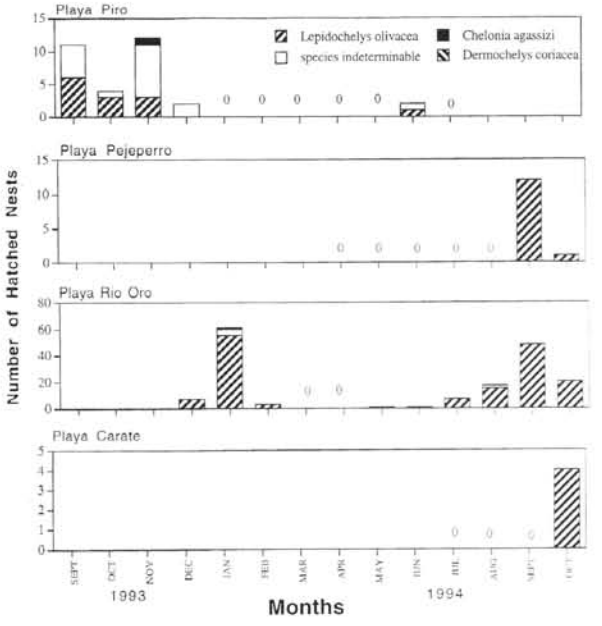

Figure 4. Monthly hatch frequency per beach on the Osa Peninsula, Costa Rica. Zeros indicate no hatched nests. Months without bars or zeros indicate no censuses during that time.

Table 2. Number of nests and percentages lost per cause per beach on the Osa Peninsula, Costa Rica.

Beach	Dog	Man	Coati	Inundation	Unknown
Piro	91 (47%)	25 (12%)	26 (12%)	45 (23%)	12 (6%)
Pejeperro	61 (36%)	104 (61%)	1 (1%)	0 (0%)	4 (2%)
Río Oro	489 (59%)	327 (39%)	0 (0%)	3 (<1%)	11 (1%)
Carate	21 (38%)	34 (59%)	0 (0%)	0 (0%)	2 (3%)
Total	662 (53%)	490 (39%)	27 (2%)	48 (4%)	29 (2%)

approximately 10 or 12 families near the beach, but the population of free-roaming dogs is large.

Nest predation by man and dogs is lowest at Playa Piro, which is the least accessible and has the least human population of all four beaches studied. To the contrary, Playa Carate is easily accessible to people, as the road to Carate is adjacent to Playa Carate much of the way from Río Oro. Carate is the last stop on the way to Corcovado National Park and is the location of the only store within 25 miles; many people gather there daily to socialize, and often go to the beach in search of turtle eggs. Like Playa Piro, there is little human activity on Playa Pejeperro, and only a single family living along the coast. The resident of Playa Pejeperro is a self-proclaimed egg poacher, and a total of 104 nests were excavated by humans on Playa Pejeperro over the course of the 4 months this beach was monitored. Although a portion of the nests excavated by human predators on Playa Pejeperro could be linked to the single resident, it is unlikely that this family took an average of a nest per day for their own consumption.

Conservation. — The results of this study indicate that Playa Río Oro is the most important in terms of marine turtle nesting activity of the beaches studied on the Osa Peninsula. No official studies have been conducted on marine turtle nesting in Corcovado National Park, but park rangers report limited marine turtle nesting activity on the park beaches (*pers. comm.*). Nesting reports on the beaches in Golfo Dulce are minimal.

Costa Rica has set a precedent among developing countries of serious intent to conserve its natural resources, as can be seen by the preserves and parks throughout the country. Concern for marine turtle conservation is evident in the Tortuguero, Las Baulas, and Santa Rosa National Parks, all encompassing major marine turtle nesting beaches. In keeping with its conservation precedent, the protection of the Osa Peninsula's primary nesting beach at Playa Río Oro ought to be considered. Its protection could be accomplished by expanding two adjoining wildlife refuges, Laguna Pejeperro and Laguna Pejeperrito, one on each side of Playa Río Oro, to include the nesting beach for the conservation and future of the endangered marine turtle species which nest there. Local people who participated in this study showed eagerness to conserve and protect this natural resource, and would be prime candidates for rangers to protect the refuge.

Playa Río Oro appears to be the most important olive ridley nesting beach on the Osa Peninsula, and is comparable to other solitary nesting beaches in Nicaragua and Mexico and beaches on the Nicoya Peninsula, Costa Rica, which do not experience mass arribadas. As the trend on the Osa Peninsula leans towards foreign ownership of the land, it is sociologically desirable to retain areas under local ownership and management. By making Playa Río Oro a wildlife refuge, protected by local concerned citizens, it would not only conserve a marine turtle nesting area, but help prevent development of the area and foster local responsibility and pride, which is an essential part of any conservation endeavor.

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