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## REPRODUCTION AND BREEDING SUCCESS OF CALIFORNIA LEAST TERNS IN JALISCO, MEXICO<sup>1</sup>

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The Least Tern (*Sterna antillarum*) is broadly distributed in the United States, with three well-defined subspecies: *browni* is found along the west coast, *athalassos* in the central U.S., and *antillarum* along the east coast and the West Indies (Massey 1981). The status of two subspecies described from Mexico, *mexicanus* from Sonora (Van Rossem and Hachisuka 1937) and *staebleri* from Chiapas (Brodkorb 1940) is uncertain.

Least Terns have disjunct summer and wintering ranges, breeding in northeast, central, and southwest United States south to Baja California and Sonora in Mexico, and on some Caribbean islands. The east coast population (*S. a. antillarum*) comprises more than 75% of all the individuals (Buckley and Buckley 1984; Clapp and Buckley 1984). The California Least Tern (*S. a. browni*) is less abundant; the largest concentration recently recorded is in San Diego, California (Massey 1981). It is considered endangered; its populations began to decline early this century, mainly because of habitat loss, disturbance of nesting sites, and predation by domestic and wild mammals (King 1981, Massey 1981, Jehl 1984, Vermeer and Ranking 1984).

California Least Terns breed from the San Francisco Bay in California southward to the tip of the Baja California Peninsula and Sonora, Mexico (Russell and Lamm 1978, Massey 1981, Mellink and Palacios 1993); early in the century a breeding colony was recorded in Oaxaca (Binford 1989). It winters along the coasts of western Mexico, south to northern South America (King 1981, AOU 1983). A group of seventy-five wintering Least Terns was found in Colima in 1979; additionally, some banded Least Terns were found in the same area in 1981, and this region is considered the northern limit of its wintering range (Massey 1981).

We report here the first recent tropical breeding record of Least Tern in Mexico, from the Cuixmala River in Jalisco, 150 km to the north of Boca de Pascuales, Colima, the northern limit of the wintering range (Massey 1981). Aside from extending the recent breeding records in Mexico more than 1,000 km to the south, we report the only clutch size data for this subspecies from the tropics, and raise questions about its summer and wintering distribution range.

### STUDY AREA

The study area is in southwestern Jalisco on the Mexican Pacific coast, 180 km south of Puerto Vallarta. A California Least Tern breeding colony was recorded at Cuixmala Beach (19°22'14" N and 104°59'31" W), on the northern bank of the Cuixmala River, one of the six most important rivers on the Jalisco coast (Fig. 1). Cuixmala Beach is 3 km long and its width varies from 30 to 70 m during the year, with larger fluctuations during the rainy season. The beach is free of vegetation, covered with small stones, and the sand is fine and brownish.

Both Cuixmala Beach and River belong to the Chamela-Cuixmala Biosphere Reserve (Fig. 1), which protects about 13,200 ha of tropical deciduous forest (Ceballos et al. 1994). The Cuixmala Ecological Foundation has ongoing research and conservation programs to protect five species of sea turtles (loggerhead *Caretta caretta*, Pacific hawksbill *Eretmochelys imbricata*, black turtle *Chelonia agassizi*, Pacific olive ridley *Lepidochelys olivacea*, and leatherback *Dermochelys coriacea*) and a population of American crocodiles (*Crocodylus acutus*) on Cuixmala Beach. With the addition of the California Least Tern there are seven endangered species protected on Cuixmala Beach, and more than 90 in the Reserve.

The physical and biotic characteristics of the region are described in detail elsewhere (Bullock 1986, Arizmendi et al. 1991, García and Ceballos 1994). The climate is tropical, hot and humid, characterized by a strong seasonality in rainfall and an annual mean temperature of 24.9°C. Rainfall is concentrated from July to October, followed by a dry season from November to June. Average annual precipitation varies from 748 to 1,000 mm (Bullock 1986), with Cuixmala averaging 1,251.3 mm during the 1992 and 1993.

Vertebrates include more than 428 species (Ceballos et al. 1994), with at least 110 species of birds associated with the beach and wetland habitats, including six *Sterna* species (Arizmendi et al. 1991).

### METHODS

California Least Tern nests were found from 1992 to 1995. Observations were made from April to September. The beach was surveyed daily for new nests. Nests were found near the Cuixmala River mouth in a sandy area between the sea and an estuary. All nests were

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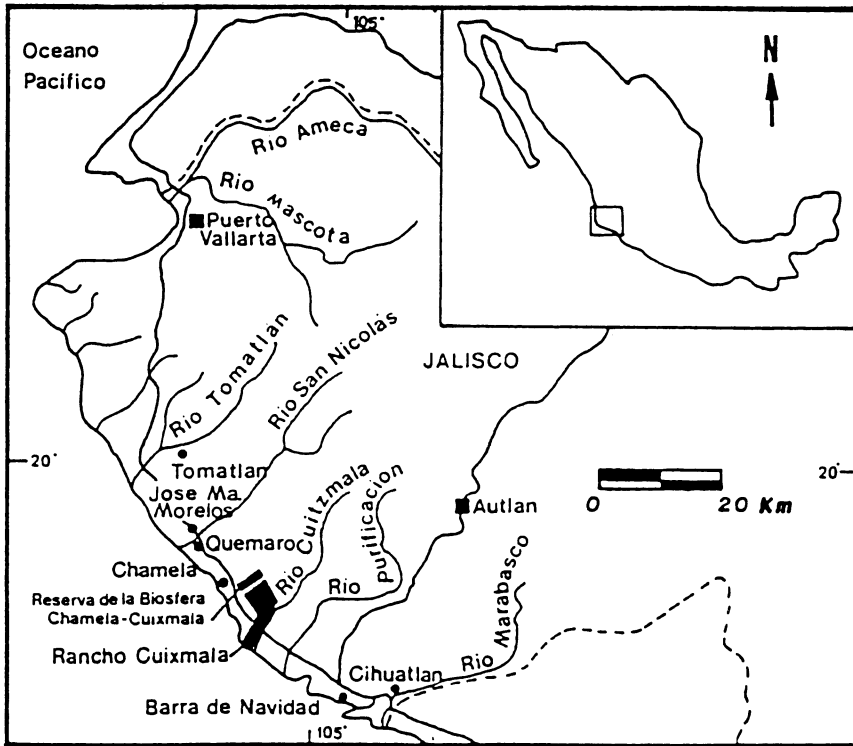


FIGURE 1. Location of the study site in the Chamela-Cuixmala Biosphere Reserve, in Western Mexico.

numbered with a stake to facilitate future inspections with binoculars without disturbing them. Least Terns are very sensitive to intruders and to handling of hatchlings (Massey 1981, Vermeer and Ranking 1984), so nests and hatchlings were disturbed as little as possible. Clutch size and hatching success were monitored for each nest during the 1992 and 1993 breeding seasons. Other beaches in the area were searched to locate other colonies, night roosts, and pre-nesting sites.

## RESULTS

A total of 122 nests were recoded from 1992 to 1995 (Table 1). Nests in the 1992 and 1993 breeding seasons produced 70 fledglings, but most fledglings were found in 1992 (Table 1). There were important differences in the two nesting seasons; in 1992 nesting began in mid-May and ended on August, and in 1993 nesting was in July (Table 1). Nesting activity occurred on the southern extreme of the Cuixmala beach. The beach presented a 1 m-high notch, that divided it in two adjacent areas (A and B), which differed in size and location. The size of the area A was approximately 1,400 m<sup>2</sup>; it was located on the lower part of the beach, below the notch, between the sea and the sand dunes that comprised area B. Area B was 300 m<sup>2</sup> in size, and was located between the estuary and area A, on the upper part of the beach.

In 1992, nests were found between 15 May and 19 June, and most (40) were located in area A. On average, two eggs per nest were laid on bare sand. Eggs were

sand-colored and averaged 30.7 × 22.8 mm ( $N = 42$ ). Hatching success was relatively moderate (Table 1) because a considerable proportion (41%) of the nests was abandoned or destroyed by natural causes. Of these, most never hatched and were deserted. The rest disappeared, either washed away by the sea or were destroyed, possibly by coatimundis (*Nasua nasua*). Hatching occurred from 5 June to 10 July (Fig. 2), and fledging from 29 July to 7 August.

In 1993, California Least Terns were first observed on 18 June on Negritos Beach, 2.8 km directly north of Cuixmala. However, there were no nests in Cuixmala until July 2 and 4, when all the nests were found in area B. Only seven hatchlings or fledglings were recorded. Other nests never hatched, were deserted or washed away by the sea. Average number of eggs per nest was lower than in the 1992 nesting period (Table 1). Hatching occurred from 23 to 27 July, chicks fledged from 15 August to 14 September, and the birds left Cuixmala on 15 September.

## DISCUSSION

The habitat used by California Least Terns on Cuixmala, sandy barrier beaches, is typical for the species (Massey 1981, Gochfeld 1983). California Least Terns usually return every year to the same beaches to reproduce (Massey 1981), as recorded at Cuixmala. In general, timing of breeding events in the Cuixmala colony such as nesting behavior, time to hatch, fledg-

TABLE 1. Summary of the breeding activity of California Least Tern in Cuixmala, Jalisco from 1992 to 1995. The number of nests was the only data recorded in the 1994 and 1995 breeding seasons.

	1992	1993	1994	1995
Number of nests	58	16	10	38
Number of eggs	125	22		
Average number of eggs per nest (range, SD)	2.1 (1-4, 0.64)	1.38 (1-2, 0.48)		
Average egg dimensions	22.8 × 30.7 mm	No available data		
Total number of fledgings	63	7		
Hatching success (%)	48.9	34.4		
Number of deserted nests	12 (21%)	1 (6%)		
Number of destroyed nests	11 (20%)	9 (56%)		

ing, and leaving the area, were similar to California colonies (Massey 1981).

Because of its timing, the nesting activity during 1993 probably was a second nesting wave after failure at an unknown location in the vicinity. Fledging success was moderate during 1992 and poor during 1993 (compared to data in Massey and Altwood 1981, Massey et al. 1992). Such differences between 1992 and 1993 were probably related to climate variation due to beach erosion caused by a hurricane. High tides were responsible for 5% and 56% nest disappearance during 1992 and 1993, respectively. At Cuixmala, annual average precipitation varies from 748 to 1,000 mm (Bullock 1986); however, the 1992 rainy season was atypical, with a great amount of rain during mid January (534 mm) and much less precipitation during the rest of the year (414 mm). In 1993, precipitation followed a typical pattern but was substantially higher than other years at Cuixmala and along the Jalisco coast. There was 1,554 mm of precipitation, with constant rains from June to October. In 1993 rainfall was 1.6 times higher than 1992.

Nesting probably occurs only because Cuixmala Beach is protected. All races of California Least Tern have evolved an ability to rapidly colonize new and appropriate nesting areas. The discovery of this additional nesting site adds new opportunities to the preservation of the most endangered of the Least Tern subspecies.

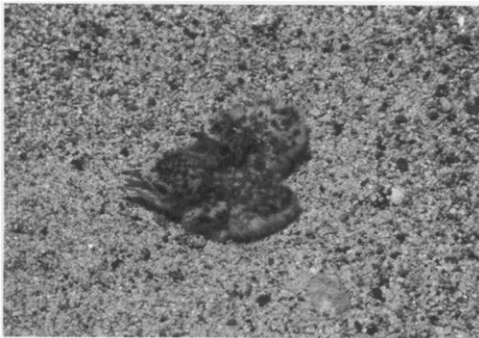


FIGURE 2. Chicks of Least Tern from the 1992 nesting season at Cuixmala beach.

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