

STATUS OF THE LEAST TERN IN THE GULF OF CALIFORNIA

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Abstract.—Between 1985 and 1994 all known and potential nesting sites of the Least Tern (*Sterna antillarum*) along the Gulf coasts of Baja California, Baja California Sur and Sonora, Mexico, were surveyed, with especially intensive field work in 1992. Twenty-nine nesting sites were found; of which some might constitute clusters of alternative sites. On the basis of the numbers of nesting pairs at each colony in 1992-1994, the breeding population of the Least Tern in the part of the Gulf of California that was surveyed was estimated to be about 400 breeding pairs. Disturbance by off-road vehicles is the main problem for the Least Tern in the Gulf of California.

ESTADO DE *STERNA ANTILLARUM* EN EL GOLFO DE CALIFORNIA

Sinopsis.—Entre 1985 y 1994 se revisaron todos los sitios de anidación conocidos y potenciales del gallito marino *Sterna antillarum*, a lo largo de las costas de Baja California, Baja California Sur y Sonora, en el Golfo de California, México. Se registraron 29 sitios de anidación, algunos de los cuales podrían constituir grupos de sitios alternos. Con base en el número máximo de parejas anidantes entre 1992 y 1994, se estimó que existían alrededor de 400 parejas, en la parte del Golfo de California muestreada. El disturbio humano, por medio de vehículos para todo terreno es el principal problema para estos gallitos, en las costas del Golfo de California.

The Least Tern (*Sterna antillarum*) faces conservation problems both in the United States and in Mexico, where it has been given the legal status of endangered (Secretaría de Desarrollo Social 1994). Although the populations that nest in the United States have been researched intensely during the last 20 yr, those in Mexico have not. In particular, the abundance and distribution of Least Terns in the Gulf of California remain largely unknown.

On the Pacific coast of North America this species nests close to estuaries and coastal lagoons, and on sandy beaches and playas, from San Francisco Bay south to southern Mexico. Current data suggest a breeding population of about 2000 pairs in approximately 30 widely distributed colonies along the Pacific coast of the United States (B. W. Massey, pers. comm.). The Least Tern winters along the coasts of central and northern South America, but details of the winter range are still poorly known. Massey (1981) observed a group of banded California Least Terns (*S. a. browni*) wintering in Colima, Mexico; one banded bird, from a California colony, was recovered from Guatemala (C. T. Collins, pers. comm.).

The first record of a Least Tern in the Gulf of California was that of Brewster (1902) from San José del Cabo, Baja California Sur, but it was not until 1923 that a nesting colony was recorded at the same locality (Lamb 1927). The next breeding record in the Gulf of California was from Bahía Tóbari, Sonora, in 1930 (Van Rossem and Hachisuka 1937).

It was almost 50 yr later that additional breeding colonies were reported from the Gulf. Russell and Lamm (1978) reported a small colony near Puerto Peñasco, Sonora. In 1983 and 1984 two colonies in Laguna Percebú, Baja California (Carvacho et al. 1989) and one colony in the Ensenada de La Paz, Baja California Sur (E. Amador, pers. comm.) were found. From 1985 to 1987, four additional nesting sites for the Ensenada de La Paz were recorded (Palacios 1988), and in 1988 a colony was discovered in Punta Arena de La Ventana, Baja California Sur (E. Palacios, unpubl. data). In 1990 a third nesting site within Laguna Percebú was found (Palacios 1992). Several potential breeding colonies remain to be investigated (Everett and Anderson 1991).

The taxonomic status of the Least Terns in the Gulf of California is unclear. The colonies of southern California and the Pacific coast of Baja California are *S. a. browni*, whereas *Sterna a. mexicana* occurs from Guaymas south (Van Rossem and Hachisuka 1937). The colonies of Laguna Percebú and La Paz were reported as *S. a. browni* (Carvacho et al. 1989, Palacios 1988, Wilbur 1987), although this seems to have been based on improper subspecific identification. However, without formal taxonomic work it cannot be said that they are *S. a. mexicana*. Moreover, due to the restricted sample (seven specimens from one locality) on which *S. a. mexicana* was described, its validity should be reassessed.

In California, disturbance and degradation of nesting sites has led to its population decline (Massey 1974, J. L. Atwood, pers. comm.). In the Gulf of California, problems potentially affecting Least Terns include: (1) use of all-terrain vehicles (ATVs) and tourism development, (2) pesticide contamination from agriculture expansion in the Valle de Mexicali as well as the Gulf of California coast of Sonora and Sinaloa, and (3) and the discovery of "commercial quantities" of natural gas near the head of the Gulf of California (Los Angeles Times, 7 May 1981) that could lead to extraction-related developments (Wilbur 1987, Alcock 1992).

In this paper we summarize all available information on the Least Tern breeding populations along the Gulf of California shores of the states of Baja California, Baja California Sur and Sonora in order to give an overview of its population and conservation status in this area.

STUDY AREA AND METHODS

The Gulf of California (Fig. 1) is a subtropical sea with exceptionally high rates of primary production (Zeitzschel 1969). Topographically it is divided into a series of basins and trenches, deepening to the south, separated from each other by transverse ridges (Shepard 1950). The northern section (above the large islands between Baja California and Sonora; Fig. 1) is relatively shallow with the exception of its central basin. Coasts on the peninsular side of the Gulf are mainly rocky and steep, whereas those of the continental side are of alluvial origin and form extensive sandy beaches. The coasts of southern Sonora, Sinaloa and Nayarit, near the mouth of the Gulf, have many lagoons. Alvarez-Borrego (1983) and Alvarez-Borrego and Lara-Lara (1991) describe the oceanography of the

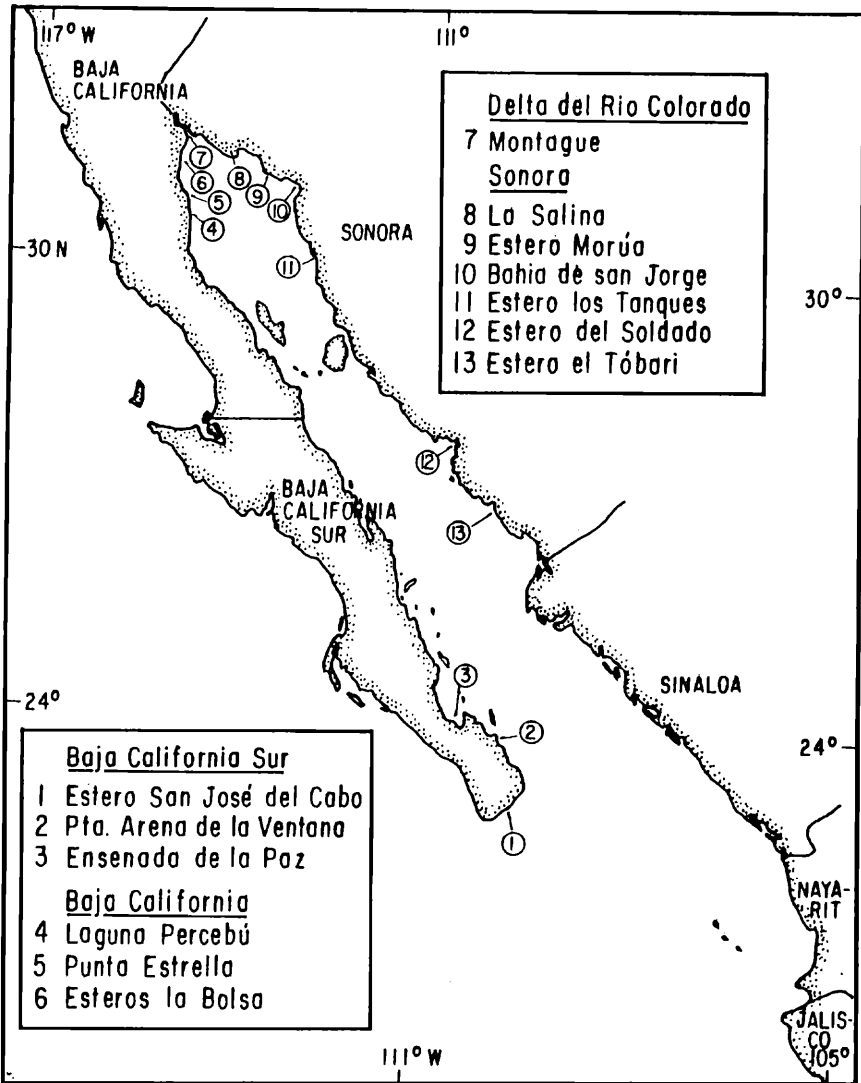


FIGURE 1. The Gulf of California and its known Least Tern breeding colonies.

Gulf of California in detail. The area covered by this paper includes the Gulf coasts of Baja California and Baja California Sur, and the coast of Sonora, but not the coasts of Sinaloa and Nayarit (Fig. 1).

We began detailed prospecting in several places in the Upper Gulf that seemed adequate for Least Tern nesting during the breeding season of 1991. In 1992, we overflew this area at low altitude, and between this

flight and 1994 we visited all the sites that we had selected from the air. We also surveyed known Least Tern breeding colonies on the peninsular side of the mouth of the Gulf of California, and in the Bahía Tóbari area (Fig. 1). Sites were reached by car, boat or on foot. At each site where Least Terns were found, we searched for evidence of nesting (eggs or chicks). Bibliographic sources of data were: Mellink and Palacios (1993), Mendoza (1994), Palacios (1988, 1992), Palacios and Guzmán (1987), Palacios and Mellink (1992a,b, 1993), Russell and Lamm (1978), and Tordecillas-Barnard and Soberon-Chavez (1993). We also used unpublished field notes from Edgar Amador, Daniel Anderson, Renato Mendoza, Gale Monson, Stephen M. Russell, as well as our own field notes.

RESULTS AND DISCUSSION

We documented 24 confirmed and five potential nesting sites that are active or were active sometime in the last 10 yr along the coasts of the Gulf of California (Table 1, Appendix 1). On the basis of the numbers of nesting pairs tallied 1992–1994, we estimate that the breeding population of the Least Tern along the Baja California (both states, north and south) and Sonoran coasts of the Gulf of California is at least 400 pairs (Table 1). There is a chance that additional, undetected breeding colonies exist in the Canal del Infiernillo area, between Isla Tiburón and the Sonoran coast. Also, our survey of southern Sonora was incomplete, and we believe that a closer look would locate several more breeding colonies of Least Terns. Some small colonies might exist elsewhere in the northern Gulf as well.

In addition, the coastal lagoons of Sinaloa and Nayarit also have extensive and apparently suitable nesting habitat for Least Terns, and it is very likely that they harbor important breeding colonies: Carmona and Danemann (1994) reported four individuals courting in Bahía de Santa María, and D. W. Anderson (pers. comm.) saw “a few” courting on a sandbar near Canal Los Puentes, Ensenada del Pabellón, 8 May 1974; both sites are in northern Sinaloa. As most field data on coastal bird life in Sinaloa and Nayarit are as yet unpublished or lacking (Anderson 1988), we are unable to provide an estimate of the size of the Least Tern population nesting there.

Our data (Fig. 1) indicate that the species is a common summer resident throughout the Gulf, not just in its northern section as reported by Wilbur (1987), and breeds in many more sites than was previously suspected. We confirmed previous suspicions (Eddleman 1989) that Least Terns could be nesting near Ciénega de Santa Clara, Sonora, as it does at El Doctor.

On the other hand, on the basis of field notes concerning putative (lost) specimens collected by others, Van Rossem (1945) stated that Least Terns wintered in the northern part of the Gulf. Despite intensive field work along the shores of the northern Gulf and some work throughout the Peninsula during the winter, we have failed to find any Least Terns

TABLE 1. Number of pairs of Least Terns and type of habitat at each known nesting site, in the Gulf of California. Before 1985, the number in parenthesis indicates the year of observation. A dash indicates that no information is available and an asterisk indicates that adults were present but no breeding evidence was found. The names of the colonies have been shortened for convenience; see Appendix 1 for complete names. Substrate: BB = barrier beach, SB = sandy beach, DS = dredge spoil, MF = mudflat, SM = sand bars with shell fragments or shell mounds on extensive mudflat and SF = saltflat.

Colony	Year											Substrate
	<85	85	86	87	88	89	90	91	92	93	94	
Baja California Sur												
San José del Cabo												
San José	15(23)	—	—	3	—	—	10	—	7	—	—	BB
Punta Arena de la Ventana												
Ventana	—	—	—	20	4	—	—	2	—	—	—	SB
Ensenada de La Paz												
Afegua	—	163	147	122	25	19	—	4	0	—	—	DS
Fidepaz	—	12	5	1	3	67	9	3	0	—	—	DS
Chametla	—	20	—	—	—	2	44	15	4	—	—	SM
Centenario	—	2	0	0	0	0	0	0	0	—	—	SM
Zacatecas	10(84)	—	1	—	—	8	—	3	0	—	—	SM
Baja California												
Laguna Percebú												
LP Sur	+ (83),17(84)	31	—	—	—	20	12	31	12	30	8	BB
LP Oeste	—	—	—	—	—	—	8	4	37	0	0	MF
LP Norte	—	15	—	—	—	15	4	18	27	30	7	BB
Punta Estrella												
Estrella	—	—	—	—	—	—	—	—	6	5	11	BB
Esteros La Bolsa												
La Bolsa	—	—	—	—	—	—	—	—	11	—	—	BB
Delta del Río Colorado												
Isla Montague												
Montague	—	—	—	—	—	—	—	5	20	6	10	SM
El Doctor	—	—	—	—	—	—	—	—	—	—	4	SF
La Flor*	—	—	—	—	—	—	—	—	—	—	2	SF
Sonora												
La Salina												
Salina N	—	—	—	—	—	—	—	—	1	—	—	SF
Salina S	—	—	—	—	—	—	—	2	—	—	—	SF
Estero Morúa												
???	+ (78)	—	—	—	—	—	—	—	16	+	—	BB
Morúa P	—	—	—	—	—	—	—	—	15	—	1	BB
Morúa D	—	—	—	—	—	—	—	—	—	—	—	BB
Bahía de San Jorge												
La Pinta	—	—	—	—	—	—	—	—	—	—	+	BB
Purinera	—	—	—	—	—	—	—	60	110	174	83	BB
Francisquito	—	—	—	—	—	—	+	16	36	3	4	BB
Estero Los Tanques												
Tanques*	—	—	—	—	—	—	—	—	4	—	—	BB
Lobos	—	—	4	—	—	—	—	—	—	—	—	SB
Estero del Soldado												
Soldado	25(79)	—	—	—	—	—	—	—	15	(79)	—	MF

TABLE 1. Continued.

Colony	Year										Substrate	
	<85	85	86	87	88	89	90	91	92	93		94
Estero El Tóbari												
Estero SJ	—	—	—	—	—	—	—	—	—	—	—	15 MF
Salitral SJ	—	—	—	—	—	—	—	—	—	—	—	15 SF
Tóbari I*	—	—	—	—	—	—	—	—	—	—	—	14 BB
Tóbari N*	—	—	—	—	—	—	—	—	—	—	—	17 BB
Tóbari S*	—	—	—	—	—	—	—	—	—	—	—	41 BB

in the area at this time and support the general impression that Least Terns move south and out of the Gulf during the winter.

Massey and Fancher (1989) found that, in California, some sites were actually clusters of alternative nesting sites, and that the selection and use of a particular site of the cluster depends on its suitability during that particular breeding season. In the Gulf of California, the 29 known breeding sites of Least Terns are in 13 different locations (Fig. 1), and some of them, such as Percebú and Morúa, seem to form clusters. The existence of multiple sites at a given locality has at least two important implications: (1) the cluster is the fundamental cell of Least Tern breeding and should be considered as such in any management scheme, and (2) population fluctuation might easily be overestimated, and population size underestimated.

The habitat used by Least Terns in the area that we surveyed is similar to that used by the species elsewhere. Fourteen out of 29 nesting sites were on barrier beaches, seven on dry mudflats, four on saltflats, two on dredge spoil sites, and two on open beaches. Nesting in four of the mudflat sites was restricted to small sand bars with abundant shell fragments or to shell mounds within the extensive mudflats.

Most of the colonies were small (74% were 1–20 pairs), and only two colonies (Afeagua and Purinera) had more than 100 nesting pairs in one breeding season. Colony size ($\bar{x} = 23.3 \pm 35.7$ SD; $n = 77$ colony/year) varied widely, not only in space, but also in time. On Afeagua islets, in Bahía de la Paz, after having a breeding colony of 163 pairs in 1985, Least Terns did not breed at all in 1992. Carmona et al. (1994) used this case as an example of the general decline of nesting waterbirds in Bahía de La Paz. However, the Least Tern population increased artificially after the creation of the dredge Afeagua islets, a by-product of the construction of a marina in 1982. Its decline paralleled the encroachment of vegetation on the islets, and their reduction in size because of erosion by tidal currents. Therefore, the lower populations that currently exist might be much closer to the historical populations in the area. In any case, the habitat provided by these islets was of low value, as the silt content of the dredge spoil caused the eggs to stick to the ground and led to reproductive failure.

The main conservation problem of the Least Tern in northwestern Mexico is that associated with the uncontrolled use of the beaches. Barrier beaches and open sandy beaches are heavily used for recreation with all-terrain vehicles (ATVs), forcing nesting birds into less favorable sites, such as mud and saltflats. Palacios (1992) found a significant negative relationship between percentage of vehicle tracks in the nesting sites and the size of different colonies on both coasts of northern Baja California. In some years, the Laguna Percebú colonies have experienced complete reproductive failures due to trampling by ATVs on the nesting sites. The Estero Morúa colony, was severely impacted as a result of ATV-based recreation during the weekend that included the 1992 Memorial Day celebration (a U.S. holiday that brings tourists to the area). Renesting took place on the steep slope of the large sand bar, a less favorable habitat, that was not free of use by ATVs. Impacts from tourism should be expected to increase as tourism developments are in progress or are planned for in many parts of the area.

In general, the Least Tern population in the Gulf of California should be considered threatened. The effective population is small, human disturbance of their breeding colonies is frequent and some habitat is scheduled for modification. Current conservation efforts should focus on the reduction of impacts from recreational activities and on the preservation of the coastal habitats (including all alternative sites of clusters) on which the species depends.

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APPENDIX 1

Gazeteer of Least Tern nesting sites in the Gulf of California

San José del Cabo

Estero de San José del Cabo (23°2'N; 109°53'W). Located immediately S of the city of San José del Cabo, on the tip of the peninsula. Barrier beach.

Punta Arena de la Ventana

Punta Arena de la Ventana (24°3'N; 109°51'W). This site is located at the tip of the sandy point with that name. Sandy beach.

Ensenada de La Paz

Islotes Afegua (24°8'N; 110°21'W). These islets were made with dredge spoil from the navigation channel, located in the southeastern part of the Ensenada de La Paz.

Marina de Fidepaz (24°7'N; 110°21'W). Mudflat formed by dredge material from the same navigation channel as the previous site.

Chametla (24°6'N; 110°23'W). A series of sand bars with shell fragments on a mudflat at the south end of Ensenada de la Paz. It is surrounded by *Salicornia* and mangroves.

El Centenario (24°6'N; 110°23'W). A small sand bar with shell fragments on a mudflat near the south shore of the Ensenada de la Paz.

Estero Zacatecas (24°11'N; 110°26'W). A small sandy area with shell fragments on a mudflat northeast of the tidal channel fringed by sandgroves in northwest Ensenada de la Paz. It often becomes flooded by high tides.

Laguna de Percebú

Laguna Percebú Sur (30°45'N; 114°42'W). Located on the south side of the southern mouth of Laguna Percebú, about 25 km S of San Felipe. This mouth is open only during spring tides. Barrier beach.

Laguna Percebú Oeste (30°47'N; 114°43'W). Inundation mudflat at least 5 km long, west of Laguna Percebú.

Laguna Percebú Norte (30°49'N; 114°42'W). On the barrier beach that forms the south side of the north mouth of Laguna Percebú.

Punta Estrella

Punta Estrella (30°55'N; 114°43'W). Barrier beach about 15 km S of San Felipe.

Estero La Bolsa

Estero La Bolsa (31°15'N; 114°53'W). At the mouth of one of several esteros that form this complex, about 25 km N of San Felipe. Barrier beach.

Isla Montague

Isla Montague (31°41'N; 114°42'W). Located on shell mounds surrounded by extensive mudflats just north of the lighthouse.

El Doctor (31°57'N; 114°45'W). This site is on the large saltflat that forms the southern two thirds of the Ciénega de Santa Clara. It is about 2 km SW from El Doctor, on the road from San Luis Río Colorado to Golfo de Santa Clara.

La Flor del Desierto (32°02'N; 114°52'W). This site has the same characteristics as the former location, from which it is 14 km NW. The site lies about 3.5 km SW of La Flor del Desierto.

La Salina

La salina Norte (31°31'N; 114°8'W). The colony was a few hundred m N of the houses of the workers of the salt company, in the large saltflat - oasis complex on the western mouth of Bahía Adair.

La salina Sur (31°30'N; 114°9'W). This locality was in a small saltflat between the former and the coast.

Estero Morúa

Estero Morúa–Dunas (31°17'N; 113°27'W). San Dunes on the seaside of the barrier beach that forms the western side of the mouth of Estero Morúa, about 1 km from its tip. About 10 km E of Puerto Peñasco.

Estero Morúa–Punta (31°17'N; 113°27'W). Located at the tip of the same barrier beach as the previous site.

Bahía de San Jorge

Estero La Pinta (31°14'N; 113°13'W). Tip of the barrier beach of Estero La Pinta, about 30 km E of Puerto Peñasco.

La Purinera (31°3'N; 113°7'W). A fractured shell-covered flat about 1.5 km from the tip of the southern barrier beach of Bahía de San Jorge. About 45 km SE of Puerto Peñasco.

Estero San Francisquito (30°59'N; 113°6'W). Colony at the tip of the barrier beach that forms the Estero de San Francisquito, about 10 km S of the previous site.

Estero Los Tanques

Estero Los Tanques (30°26'N; 112°53'W). At the tip of the barrier beach at the southern side of the mouth of Estero Los Tanques. 75 km ESE of Caborca, between El Desemboque and Puerto Lobos.

Puerto Lobos (30°16'N; 112°52'W). Puerto Lobos is a rocky tip 80 km SE of Caborca. The locality was about 1 km north of the lighthouse (Russell and Monson Pers. Comm.). Sandy beach.

Estero del Soldado

Estero del Soldado (27°57'N; 110°59'W). Located a few km S of San Carlos, and about 20 km NW of Guaymas (Tordecillas-Barnard and Soberón-Chávez 1993). Mudflat.

Estero El Tóbari

Estero San José (27°7'N; 110°8'W). The nesting area was on a small mudflat the north side of the estero that is immediately north of San José, about 45 km SW of Cd. Obregón, and 8 km NW of Estero el Tóbari.

Salitral del Estero San José (27°7'N; 110°6'W). A large saltflat 500 m E of San José.

Estero El Tóbari–Isla (27°9'N; 110°4'W). Islet immediately outside the north mouth of Estero El Tóbari, about 48 km SSW of Cd. Obregón. Barrier beach.

Estero El Tóbari Norte (27°9'N; 110°3'W). North tip of the barrier beach of Estero El Tóbari.

Estero El Tóbari Sur (27°2'N; 109°57'W). South side of the south mouth of Estero El Tóbari. Barrier beach.