NOTES ON BREEDING COASTAL WATERBIRDS IN NORTHWESTERN SONORA

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Although several researchers have studied birds in the state of Sonora, Mexico, few published reports exist. Van Rossem (1945) published the only comprehensive summary, now outdated. Recently, Everett and Anderson (1991) addressed the status of the breeding seabirds of the Gulf of California.

The northernmost of Sonora's large lagoons is Bahía San Jorge, with its associated Estero San Francisquito and islands (Figure 1). Bahía San Jorge is a large bay separated from the open gulf by a long (10 km) sand bar on its southern side. Estero San Francisquito, a long, narrow tidal estuary, lies immediately to the south. Except for marshes inside the southern part of the bay, dunes are the principal terrestrial habitats around Bahía San Jorge. Certain areas are open flats with shell debris. Bahía San Jorge and Estero San Francisquito have not been investigated ornithologically in any detail, like the rest of the northern Sonora coast, with the exception of Puerto Peñasco, a popular destination for North American birdwatchers, reported on by Huey (1935) and Janes and Janes (1987).

The Islas San Jorge are several small rocky islands located just outside the bay. They lack vegetation (Felger and Lowe 1976) but are important for the nesting of several birds, including Red-billed Tropicbirds (*Phaethon aethereus*), Elegant Terns (*Sterna elegans*; Mailliard 1923), Royal Terns (*S. maxima*), Yellow-footed Gulls (*Larus livens*), Heermann's Gulls (*L. heermanni*; Bancroft 1927), Craveri's Murrelets (*Synthliboramphus craveri*; van Rossem 1926, Bancroft 1927), and Brown Boobies (*Sula leucogaster*; Everett and Anderson 1991). Felger and Lowe (1976) reported that guano was extracted from the Islas San Jorge, and Mailliard (1923) indicated that egging was carried out by local people. Formerly, there was a fish-meal factory at the tip of the sand bar of Bahía de San Jorge, and the place is now called La Purinera. The bay and estero are used mainly for oyster farming, especially at La Purinera, and low-intensity recreation. However, there is interest in increasing tourist use of the area, and recently palapas (shades) were set in to make the place more attractive to visitors.

Two other small coastal lagoons in this region are Los Tanques and Estero Morúa. Los Tanques lies about 18 km south of El Desemboque and is separated from the sea, on its southern side, by a sand bar and dunes. Estero Morúa, 10 km east of Puerto Peñasco, is limited, on its western side, by a high flattened sand bar, with steep slopes, that ends in a low flat tip.

The Gran Desierto of northwestern Sonora, although containing some small oases, has been overlooked by biologists. So far, there exists only a vegetation survey by Ezcurra et al. (1988). Van Rossem's (1945) work does not include any localities in this area. It is unclear from May's (1976) paper

whether he surveyed most oases in the Gran Desierto, but he seems not to have visited the largest oasis, La Salina.

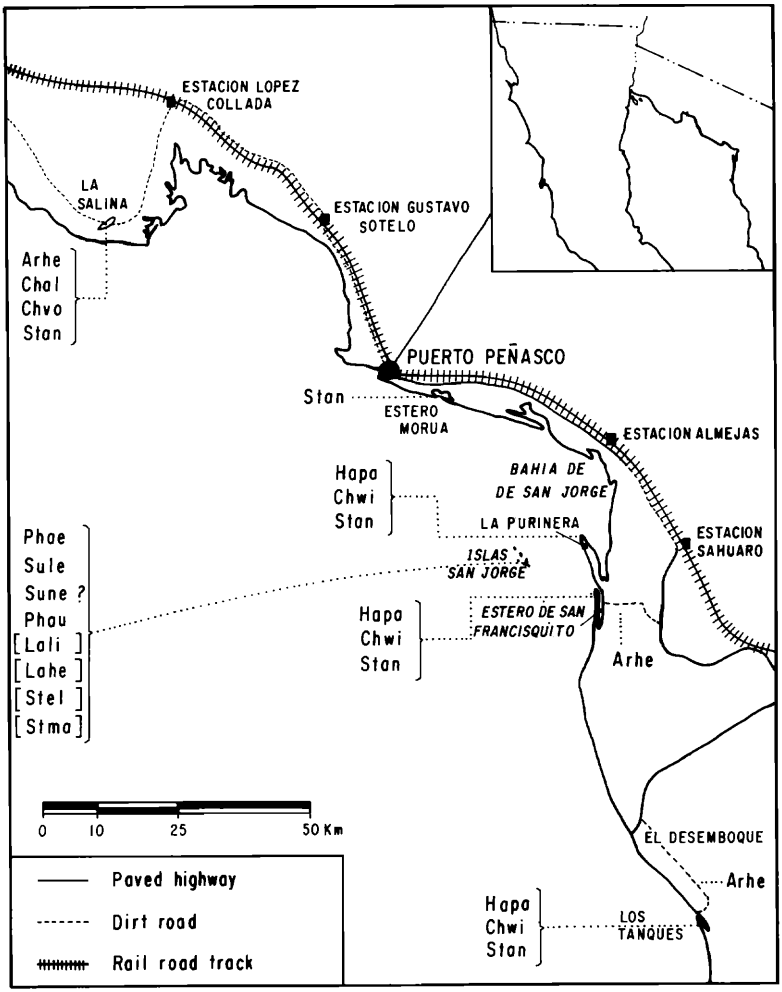

Figure 1. Coastal northern Sonora, showing localities visited and the distribution of the breeding birds recorded. Brackets indicate past but not current breeding. Arhe, *Ardea herodias*; Chal, *Charadrius alexandrinus*; Chvo, *Charadrius vociferus*; Chwi, *Charadrius wilsonia*; Hapa, *Haematopus palliatus*; Lahe, *Larus heermanni*; Lali, *Larus livens*; Phae, *Phaethon aethereus*; Phau, *Phalacrocorax auritus*; Stan, *Sterna antillarum*; Stel, *Sterna elegans*; Stma, *Sterna maxima*; Sule, *Sula leucogaster*; Sune, *Sula nebouxii*.

La Salina oasis (Figure 1) consists of a large salt flat stretching northeast to southwest for about 5 km. Its southwestern tip is separated from the sea by sand dunes. Near the northern end of the salt flat several artesian wells of fresh water feed patches of luxuriant vegetation, including the exotic salt cedar (*Tamarix chinensis*) and stands of screwbean or tornillo (*Prosopis pubescens*), tule (*Scirpus americanus*), saltgrass (*Distichlis spicata*), and ditchgrass (*Ruppia maritima*). At the eastern side there is a well and vegetation consisting mainly of tornillo, saltgrass, and spiny rush (*Juncus acutus*), with stands of arrowweed or cachanilla (*Pluchea sericea*). The hydrology and plant ecology of this and other oases of the Gran Desierto are described by Ezcurra et al. (1988). The salt flats are currently used for intensive salt production.

To study the birds of these areas, we visited the Islas San Jorge on 27 April 1991 and 25 April 1992, Bahía San Jorge on 3 December 1990, 26–27 April 1991, 20 and 22 July 1991, 24–29 April 1992, and 3–4 June 1992, and La Salina on 23–24 April 1991, 4–5 June 1991, 18–21 October 1991, and 1–2 May 1992. We visited Los Tanques on 17 July 1991 and 29 April 1992, and surveyed the sand bar of Estero Morúa on 4 June 1992. We visited the small oxidation basin next to the Centro de Estudios Tecnológicos del Mar (CETMAR), Las Conchas, Puerto Peñasco, on 30 April 1992. At Bahía San Jorge we surveyed the tip of the sand bar (La Purinera and vicinity) in December 1990, April 1991, July 1991, April 1992, and June 1992, and Estero San Francisquito in April 1991, July 1991, April 1992, and June 1992. We visited the marsh at the south end of Bahía San Jorge briefly in July 1991. At La Salina we surveyed the salt flats, some wells, especially the largest, and the tornillo grove at the eastern end of the salt flat. We checked the sandy beach at La Salina during the June 1991 visit.

SPECIES ACCOUNTS

Red-billed Tropicbird. In April 1991 we saw 12 flying over, and one incubating in a small cave about 4 m above sea level (Figure 2), at the Islas San Jorge. In April 1992 we saw only 5 flying over the islands and none nesting; the last year's nest was unoccupied.

Brown Booby. In April 1991 we estimated about 1000 nesting pairs on the Islas San Jorge. Approximately 10% had eggs and 90% had chicks three-quarters grown. On 25 April 1992 we counted, from a boat, 5800 boobies on the islands. We observed only two nests with one egg each, 60 chicks, and several juveniles, but Rubén Astorga informed us that on 28 March 1992 there were many eggs and chicks on the island. This species seems to have fluctuated greatly over time. Whereas Mailliard (1923) reported only a few and Bancroft (1927) none, D. Anderson (pers. comm.) thinks there were more than 1000 during the 1970s, and Mellink saw many in June 1982. Everett and Anderson (1991) reported that up to 5000 pairs breed there in some years. The irregularity of the Brown Booby's nesting was reported by Bancroft (1927), who found on Isla San Luis no Brown Boobies in 1925 yet a large breeding colony in 1926.

Blue-footed Booby (*Sula nebouxii*). We observed this species on all visits to the Islas San Jorge. Although we suspect that it nests there, we saw no definite evidence of this.

Double-crested Cormorant (*Phalacrocorax auritus*). In April 1991 we counted about 100 pairs with small and half-grown chicks (Figure 3) on the Islas San Jorge and a few hundred individuals, including many immatures, at La Purinera and in Estero San Francisquito. These numbers are much higher than those found by Mailliard (1923). The only cormorants that Bancroft (1927) saw in the Gulf of California were on Isla San Luis. In July 1991 there were a few hundred in two groups along Bahía San Jorge, 60 at La Purinera, and about 200 on the oyster boxes.

Osprey (*Pandion haliaetus*). We saw one at La Purinera in December 1990, four along Bahía San Jorge and one at La Purinera in July 1991, and three in June 1992. One was roosting on the La Salina radio antenna in October 1991. Henny and Anderson (1979) reported Ospreys breeding in coastal Sonora, although they didn't record any in the northernmost area, lacking cardón cacti (*Pachycereus pringlei*), in which the birds nest. Neither did Bancroft (1927) report the species in the area. In 1982 Mellink saw one nest, and in 1991 and 1992 we saw several nests along the railroad between estaciones López Collada and Sahuaro. All the Osprey nests we have seen in the area have been on powerline towers and railroad telephone poles, suggesting that these man-made structures have promoted the Osprey's colonizing the region. The railroad telephone system has existed for many decades, but the construction of the powerline towers started in early 1978, ended in mid 1979. Although the maintenance of the power system requires removal of nests, those of Ospreys are spared (J. Virgen pers. comm.).

Great Blue Heron (*Ardea herodias*). In April 1991 we saw at least 32 active nests at three wells at La Salina. In May 1992 we counted 45 active nests at the same wells. Nesting substrate was always tornillo. In June 1991 we saw many adults and juveniles. Brood size was two or three fledglings per nest. In June we saw also one adult at the fishing camp. When the young leave the nests, the birds apparently

Figure 2. Red-billed Tropicbird in nest, Islas San Jorge, 27 April 1991.

Photo by Eric Mellink and Eduardo Palacios

disperse along the coastline, as we saw no Great Blue Herons at La Salina in October 1991. We recorded them also at La Purinera in December 1990, three in Estero San Francisquito in April 1991, and one in the marsh of Bahia San Jorge, three along the shoreline of the bay, and three at La Purinera (one on the oyster boxes) in July 1991. There was one occupied nest in a saguaro (*Carnegiea gigantea*) next to the road leading to Estero San Francisquito, 1 km east of the beach, in April 1991. In June 1992, a nest in the same area had two chicks. In April 1992 we counted seven nests in cardones 6 km northeast of Los Tanques.

Cattle Egret (*Ardea ibis*). In May 1992 Cattle Egrets were nesting at the largest well of La Salina, among the Great Blue Herons. Twelve individuals flew from the site, where we saw at least three nests and found some broken eggs on the ground underneath.

Snowy Plover (*Charadrius alexandrinus*). We observed one male on the salt flats of La Salina in April 1991. In June 1991 there was one juvenile feeding on the salt flat, next to a well. Although May (1976) reported the Snowy Plover as only a migrant in the region, the presence of adults during the breeding season in suitable nesting habitat suggests that the species may breed on the site. The Snowy Plover has not yet been found nesting in Sonora. The species' breeding chronology in Baja California coincides with these observations (Palacios pers. obs.).

Wilson's Plover (*Charadrius wilsonia*). In July 1991 we counted 16 pairs at La Purinera and in Estero San Francisquito. One pair was nesting in the Least Tern (*Sterna antillarum*) nesting colony at La Purinera. When we located this nest, the male was incubating; later, the female took over. At this time we saw two females, one male, and two unsexed individuals at La Purinera and four pairs at Los Tanques.

Figure 3. Double-crested Cormorant family, Islas San Jorge, 27 April 1991. Note Brown Boobies at left behind rock and in flight.

Photo by Eric Mellink and Eduardo Palacios

Of the latter, one pair engaged in a distraction display and another bird sat down on an empty nest. In April 1992 we found several nests with eggs at Estero San Francisquito and La Purinera and five nests with no eggs at Los Tanques. These had probably been preyed upon by the dogs from the oyster farm, whose tracks were all over the area. In June 1992 we found eight nests with eggs at La Purinera.

Killdeer (*Charadrius vociferus*). This species was observed on all visits to the salt flats of La Salina: two individuals in April 1991, four in June 1991, and one (plus several heard) in October 1991 and May 1992. In June 1991 we noted a pair, one of which was performing the broken-wing distraction display and feigning incubation.

American Oystercatcher (*Haematopus palliatus*). In April 1991 we saw two pairs in Estero San Francisquito and two more pairs along the sand bar at La Purinera. One pair in Estero San Francisquito was incubating. In July 1991 we saw two individuals along Bahía San Jorge and one pair plus another individual at La Purinera. In April 1992 we saw two pairs nesting at Estero San Francisquito. At this time we did not record any at La Purinera, but in June we saw a pair with a full-grown chick. At Los Tanques, three pairs had nests in April 1992, on a sand bar separated by tidal channels at its ends. The nests had three, two, and zero eggs.

American Avocet (*Recurvirostra americana*). On 30 April 1992 we saw five individuals in breeding plumage at the oxidation basin near Puerto Peñasco. They attacked us and performed broken-wing distraction displays. We could not find any eggs but suspect that they might have been chicks hidden in nearby bushes.

Heermann's Gulls were seen on all visits. In April 1991, they were in Estero San Francisquito (4 adults, 8 immatures) and on the Islas San Jorge. On the latter, we saw about 20, stealing fish from nests of Double-crested Cormorants. In July 1991 about 150, mainly adults, were standing on the oyster boxes; there were about 120 elsewhere. Although this species has bred on the Islas San Jorge (Mailliard 1923), we found no evidence of its nesting there.

Royal Tern. We saw four individuals in Estero San Francisquito in April 1991 but no sign of them on the Islas San Jorge, where they were reported by Mailliard and Bancroft (1927).

Elegant Tern. We found only one in Estero San Francisquito in April 1991. This species was reported to breed by the thousands on the Islas San Jorge by Mailliard (1923), yet we saw none. Schaffner (1986) found that, in southern California, the populations of this species paralleled changes in the populations of the Northern Anchovy (*Engraulis mordax*). In the northern Gulf of California, the anchovy has appeared commonly in recent years, and Monterey Sardines have decreased (Hamman and Cisneros-Mata 1989, G. Hamman pers. comm.), yet Elegant Terns have evidently disappeared as breeding birds from the islands.

Least Tern. We found 16 pairs nesting and one in ground courtship at La Purinera in April 1991. Of these, one pair had its nest in the sand dunes, and the other 15 had theirs on a flat with shell debris. We marked three nests. One had one egg and two had two. The pair with one egg copulated while we were watching the colony. Another pair moved its eggs next to our marker, which we had placed about 50 cm away. In Estero San Francisquito we counted 38 individuals, forming at least 16 pairs. We observed two pairs in ground courtship, two copulations, and one pair building a nest. In July, we saw several dozen individuals in Estero San Francisquito and along Bahía San Jorge, and counted 58 at La Purinera. Some individuals were seen carrying fish, presumably to feed young.

In 1992 we found important colonies in this area. In April there were five pairs courting and one incubating at Estero San Francisquito and 60 nests with eggs at La Purinera (we marked 45). The members of the oyster-farming cooperative informed

us that nesting had started about 10 April. In early June we counted 120 juveniles and 5 adults in an evening concentration on the beach. We marked an additional 35 nests and estimated 40–50 nests total. We saw also birds courting on the ground and three small chicks. From the success of the birds nesting in April we suspect that this second wave was composed of adults arriving later, possibly including birds that were unsuccessful breeding at nearby sites.

In July 1991 we saw two adults and one juvenile at Los Tanques. One adult was feeding the juvenile. In April 1992, eight individuals were feeding along the beach and in the estero. There were no nests, but 80% of the area had vehicle tracks, allegedly of tourists, and there were dogs in the area. Thus the terns may have attempted to nest unsuccessfully at Los Tanques in 1992.

In June 1992 we found seven nests about 30 individual terns at Estero Morúa. Five nests on the south slope of the high sand bar had two eggs each. On the flat area at the tip, one nest had one newly hatched chick and one egg, and the other had one newly hatched chick and two eggs. The area was severely disturbed by off-road vehicles on the weekend that included Memorial Day (a U.S. holiday). The nests observed were probably second attempts.

Although the site is about 3 km from the sea, we saw two pairs on the salt flats of La Salina during the April and June 1991 visits. In April, one pair was building a nest, and in June, one pair had a nest with two eggs. The eggs were partially covered with salt crystals, but the chicks were pipping and picking the shell. One adult was seen fishing by the fishermen's camp. In May 1992 there was one pair with a nest and two eggs on the southernmost salt flat. These eggs had little salt on them.

Interestingly, egg-laying by Least Terns started approximately one month earlier in the upper Gulf of California than on the Pacific coast of Baja California.

DISCUSSION

The San Jorge areas seem to be of great biological importance; in addition to being a breeding site for several species of water birds, the Islas San Jorge are the northernmost locality for the rare Fishing Bat (*Myotis vivesi*; Hall 1981).

It is difficult to assess the conservation threats to the biota of the area. The egging reported by Mailliard (1923) does not seem to be practiced today. The intensification of tourism may present the most serious threat, if it includes driving of off-road vehicles and other destructive activities. We observed one off-road vehicle in the Least Tern colony of Estero San Francisquito and several on the dune at the base of the sand bar of Bahía San Jorge. Their impact on the nesting colonies of Least Terns and Wilson's Plovers at Los Tanques and Estero Morúa seems to have been strong.

La Salina may be an important stop for migratory shorebirds. In April 1991 we saw a flock of 425 Western Sandpipers (*Calidris mauri*) in breeding plumage and 80 Least Sandpipers (*Calidris minutilla*).

At La Salina the only modification of the vegetation has been the cutting of tornillos for fuel by fishermen. This has not been very intense, but already there are areas with dead stumps. An increase of fishermen, which are present only seasonally, might accelerate destruction of the habitat. This wood cutting has not extended to the wells used for nesting by Great Blue Herons. In addition, operation of the salt works results in vehicles being driven among the tornillos, another possible source of degradation.

The salt operation is based on inundating the flats with water locally pumped, letting the water evaporate, and scraping the area with bulldozers. These activities have not destroyed any vegetation, since they are carried out only on the salt flats, but they may affect the nesting habitat of Least Terns and Snowy Plovers and the habitats used by migrating shorebirds. If the pumping modifies the balance and presence of fresh water in the wells of the oasis, severe habitat changes could result.

Some people travel on off-road vehicles along the dirt road. As the beach is a preferred location, they do not camp in the tornillos. If an off-road race were held, the tornillos would be an attractive place for camps and fires. Only a few such events would be sufficient to affect the habitat severely. Owing to the solitude of the area, some drug smuggling apparently takes place. At least the army and narcotics agents patrol the area. The tornillos could be an attractive camping and roadblock point, also affecting the habitat.

Finally, on the Islas San Jorge, instead of a community of dippers (*sensu* Ashmole 1971, mainly Elegant Terns), recorded by Mailliard (1923) in 1921, we found a community of surface plungers and pursuit divers (Brown Boobies and Double-crested Cormorants) in 1991. This change might be in response to environmental changes, as surface water has warmed over the past 100 years (V. Ferreira pers. comm.)

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