WESTERN BIRDS

Volume 24, Number 1, 1993

AN ANNOTATED CHECKLIST OF THE BIRDS OF ISLA SOCORRO, MEXICO

WALTER WEHTJE and HARTMUT S. WALTER, Department of Geography, University of California, Los Angeles, California 90024-1524 (present address of Wehtje: Western Foundation of Vertebrate Zoology, 439 Calle San Pablo, Camarillo, California 93010)

RICARDO RODRIGUEZ ESTRELLA, JORGE LLINAS and ARADIT CASTELLANOS VERA, Centro de Investigaciones Biológicas de Baja California Sur, Apartado Postal 128, La Paz, Baja California Sur 23000, Mexico

In recent years, ornithologists have devoted increased attention to insular avifaunas and the problems they face (Scott et al. 1986). Many island species are critically endangered and require human intervention in order to survive. Island species also provide the opportunity to test differing ecological and biogeographical theories (MacArthur and Wilson 1967, Jones and Diamond 1976). However, many remote islands are not visited frequently enough or for periods long enough to provide information on population trends and the loss and/or gain of breeding species. Such has been the case for the Islas Revillagigedo of Mexico (Figure 1).

The Islas Revillagigedo are a group of four islands lying off the Pacific coast of Mexico. In ascending order of size they are Roca Partida, Isla San Benedicto, Isla Clarión, and Isla Socorro. The last is located at 18° 47' N, 110° 57' W, about 460 km south of Baja California (Figure 2). In the absence of a good topographic map, we estimate the size of Isla Socorro as 110 km^2. The maximum elevation of the island, Cerro Evermann, is 1040 m. The flora of the island has been described by Levin and Moran (1989) and consists of at least 117 native species of plants, 30 of which are endemic. There are six principal plant associations (León de la Luz pers. comm.): mixed scrub, dominated by *Dodonaea viscosa* and *Pteridium caudatum* (0–700 m), deciduous scrub, dominated by *Croton masonii* (0–250 m), sheep-induced prairie, mainly with *Mitracarpus hirtus, Aristida* spp., and *Boerhavia* spp. (250–400 m), the shore habitats with *Conocarpus erecta,* woodlands dominated by *Bumelia socorrensis, Ficus cotonifolia, Ilex socorrensis, Guettarda insularis,* and *Psidium* sp. (350–850 m), and highland prairie, dominated by *Castilleja socorrensis, Gnaphalium attenuatum, Heterotoma cordifolia,* and *Linaria canadensis* (850–950 m).

The mixed scrub, up to 3 m high, covers much of the island below 700 m elevation. Where it is undamaged, this extremely thick brush effectively restricts access. The vegetation of the southern half of the island, however, has been severely damaged by feral sheep, introduced during the 1860s. We estimate the present sheep population at 2000 individuals. The damage caused by sheep ranges from inhibiting regrowth in forest at mid-elevations to the complete removal of vegetation on some slopes and hilltops. Soil erosion is a major problem in several areas.

In addition to sheep, feral domestic cats and house mice are also present on Isla Socorro. The latter two species are believed to have arrived on the

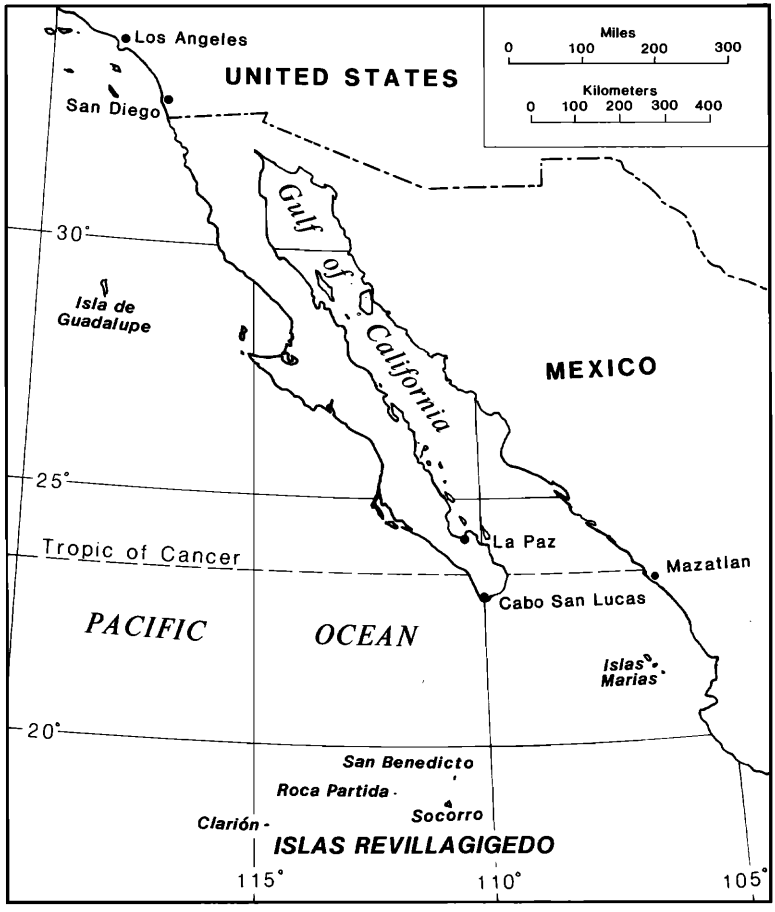

Figure 1. Location of Isla Socorro in the Pacific Ocean to the south of Baja California.

island when the Mexican navy established a base there in 1958 (Jehl and Parkes 1982). Miraculously, rats have not invaded Isla Socorro.

The navy base is located on the southernmost tip of the island and houses close to 200 military personnel and dependents. There is also a landing strip and radar station, constructed on the eastern side of the island in 1978. The only roads on the island are one connecting the airstrip to the navy base and another leading from this main road to the southern plateau region, terminating at approximately 500 m elevation on the southern slope of Cerro Evermann. Previous authors (Jehl and Parkes 1982, Brattstrom and Howell 1956) mentioned a temporary lake called Laguna Escondida on the southern side of the island. It has never been filled during our visits. There are a number of deep potholes in the canyons that contain limited quantities of fresh water after the rainy season (July–November). Apart from the navy base and a spring located in the tidal zone at Caleta Grayson, no known permanent sources of water exist on the island.

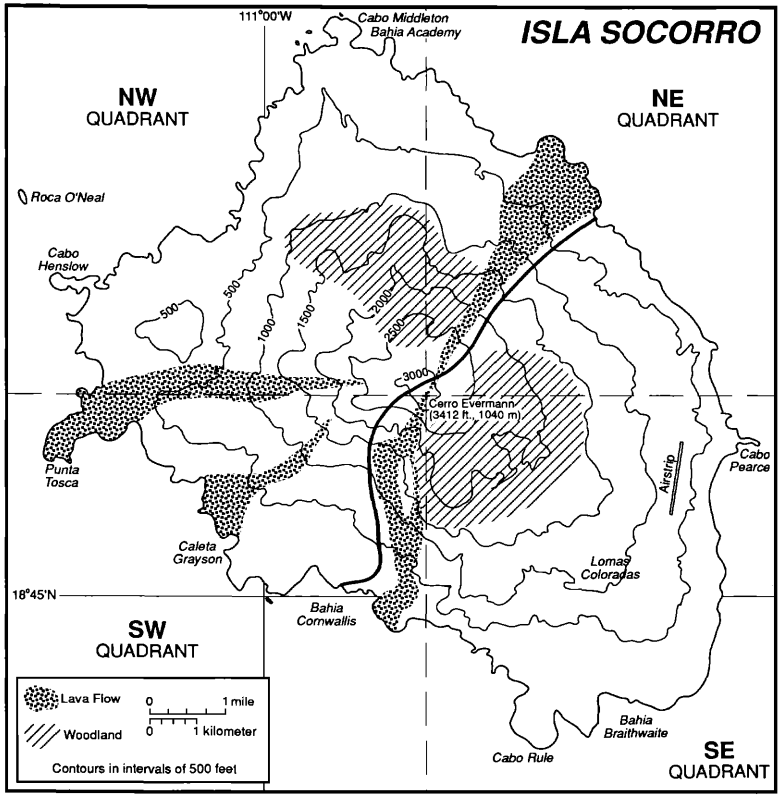

Figure 2. Socorro Island. The northeast–southwest line partitions the island into the sheep-free northern half and the sheep-degraded southern half.

The Revillagigedos belong to the federal government of Mexico and are currently administered by its navy. Access to Isla Socorro is severely restricted because of the lack of facilities for visitors. The absence of roads limits the area that can be easily visited. Two trails lead to the peak of the island from the end of the mountain road. Areas affected by sheep are also fairly easily traversed by humans. The rugged terrain, lava flows, and nearly impenetrable vegetation of the northern side of the island make much of the island difficult to survey. Because of these conditions, most earlier reports were based upon studies in severely altered habitat. Time constraints kept most researchers in the past from spending any length of time in undisturbed areas. We have been able to explore a larger portion of the island for a greater length of time, and over different seasons during the same year.

Although Isla Socorro was first discovered by the Spanish in 1533, the first natural history expeditions to the island were made by Andrew Jackson Grayson in 1865 and 1867. Shipwrecked there for 10 days (19–28 May 1867), he and his son discovered and collected specimens of all the island's endemic birds (Grayson 1872). Ornithological assessments of other early expeditions can be found in Anthony (1898), McLellan (1926), Brattstrom and Howell (1956), and Jehl and Parkes (1982).

Interest in the avifauna of the Islas Revillagigedo has increased during the past decade, and several articles dealing with these islands have recently been published (Jehl and Parkes 1982 and 1983, Jehl 1982, Brattstrom 1990, Howell and Webb 1990, Parkes 1990, Santaella and Sada 1991). The last comprehensive annotated bird list for the archipelago was that of Jehl and Parkes (1982).

Most visits to Isla Socorro have been ship-based, limiting the time observers can spend ashore. As members of a joint conservation project of the University of California, Los Angeles (UCLA), the Centro de Investigaciones Biológicas (CIB) in La Paz, and the World Wildlife Fund, we visited this rugged island repeatedly by airplane in April, July, September, November, and December 1988, February, May, and November 1990, and August 1991, spending a total of 62 days on the island. During these visits we improved our understanding of the population status of the resident species and other visitors, and observed 23 previously unrecorded bird species. Here we provide an updated annotated checklist for the avifauna of Isla Socorro.

An asterisk before a species name specifies a new record.

ANNOTATED SPECIES LIST

Pied-billed Grebe (*Podilymbus podiceps*). Brattstrom found a dead specimen on the beach at Cabo Henslow on 14 November 1971 (Jehl and Parkes 1982).

Laysan Albatross (*Diomedea immutabilis*). Howell and Webb (1990) observed an individual over Cabo Henslow on 16 February 1988. Two birds on 7 May 1990 (Walter) and one on the following day (Wehtje) were seen flying over the navy base. This species is extending its range, with breeding recorded on Isla Clarión and Isla Guadalupe and nesting behavior observed on Isla San Benedicto, 55 km north of Isla Socorro (Howell and Webb 1990).

Wedge-tailed Shearwaters (*Puffinus pacificus*) have been observed near Isla Socorro in moderate numbers (10–130) in March, April, May, and November (Anthony 1898, Brattstrom and Howell 1956, Jehl and Parkes 1982, Santaella and Sada 1991). The lack of sightings in other months is probably due to the absence of observers. This species breeds on Isla San Benedicto (Jehl and Parkes 1982).

Townsend's Shearwater (*Puffinus auricularis*). Jehl (1982) is the best source for information on this species, but here we add a few observations that confirm and elaborate on his findings. Jehl stated that breeding birds arrive in December and leave by June. We spent the night of 20 November 1990 in a forested canyon on the north side of the island at 750 m elevation and found ourselves in the midst of a very noisy shearwater colony. This suggests that the birds arrive at least by mid-November. We captured and photographed one individual at the mouth of a burrow under a large boulder. Other birds were heard inside their burrows during daylight hours. Most of the burrows were located on steep slopes that were difficult to reach. We also heard between one and five shearwaters calling over land on 25 August 1991, indicating that this species may visit its breeding colonies throughout the year. Shearwaters were commonly seen from shore in numbers of up to a dozen in August.

In the evening of 23 February 1990 we found another colony, northeast of Cerro Evermann at 500 m elevation, where we estimated hearing close to 100 birds calling simultaneously. Because of the impenetrability of the vegetation, we were unable to approach it. On 24 February Rodriguez heard a similar number of birds to the northwest of Cerro Evermann, indicating another colony in that area. The breeding colonies were concentrated at higher elevations in undisturbed forest and mixed scrub. We agree with Jehl's (1982) assessment of the current population size (approximately 1000 pairs) but do not believe that the population is in imminent danger from cat predation. We base this assessment on the fact that no obvious cat sign was found near the colonies discovered. Three carcasses located did not have bitten-off feathers consistent with cat predation, nor did we find any cat feces in these areas. The largest number of Townsend's Shearwaters recently observed was several hundred in mid-February 1990, a flock staging just south of the naval base at sunset (F. Gohier pers. comm.).

Audubon's Shearwater (*P. lherminieri*). Santaella and Sada (1991) observed 110 individuals between Isla San Benedicto and Isla Socorro on 30 April 1990.

Leach's Storm-Petrel (*Oceanodroma leucorhoa*). Anthony (1898) reported that in early May 1897 it was "common at sea near the island" and "apparently migrating." L. Baptista and Walter observed one less than 2 km off the west side of the island on 27 July 1988.

Galapagos Storm-Petrel (*O. tethys*). Reported as uncommon but regular in November 1974 in the vicinity of Isla Socorro by Jehl and Parkes (1982).

Red-billed Tropicbird (*Phaethon aethereus*). This species appears to be resident, with records from February, March, May and November (Anthony 1898, McLellan 1926, Brattstrom and Howell 1956, Jehl and Parkes 1982, Howell and Webb 1990, Santaella and Sada 1991). None, however, were seen by Wehtje and Walter along the east side of the island on 23 and 25 August 1991. This species may breed on Isla Socorro, as two to four pairs were courting over Roca O'Neal on 7 April 1981 (Jehl and Parkes 1982), but there is no other evidence.

Masked Boobies (*Sula dactylatra*) have regularly been observed in February, March, April, May, July, and November (Anthony 1898, Brattstrom and Howell 1956, Jehl and Parkes 1982). McLellan (1926) did not observe any in May 1925. We have seen this species on every visit, albeit in low numbers, never more than ten at a time. As with the other boobies at Isla Socorro, there is no evidence that they breed there, although they roost on coastal cliffs.

Brown Booby (*S. leucogaster*). This species has been recorded by all visitors, with Howell and Webb (1982) observing up to 120 birds roosting along the cliffs between Caleta Grayson and Cabo Henslow in February 1988.

Red-footed Booby (*S. sula*). Anthony (1898) noted "quite a colony . . . gathered about the cliffs on the southwest end of the island." He may have been referring to *S. sula, S. leucogaster* and *S. dactylatra* together, or only *S. sula*. One or two were seen daily in 1974, 1978, and 1981 by Jehl and Parkes (1982). Howell and Webb (1990) observed two immatures roosting with the Brown Boobies. Wehtje saw two brown-phase birds off the northeast side of the island on 22 February 1990.

Magnificent Frigatebird (*Fregata magnificens*). Another species observed by all visitors except McLellan (1926). We have observed Magnificent Frigatebirds during each visit, usually with no more than three birds seen at any one time. This species breeds on Isla San Benedicto (Howell and Webb 1990).

Great Frigatebird (*F. minor*). Brattstrom and Howell (1956) reported unidentified frigatebirds at Isla Socorro that may have been this species. Howell and Webb (1990) identified a female at Bahía Academy and recorded breeding on Isla San Benedicto.

Great Blue Heron (*Ardea herodias*). "Not uncommon" according to Anthony (1898). None were seen by McLellan (1926), nor did Jehl and Parkes (1982) report any sightings. One individual was fishing at Playa Blanca on 25 July 1988 (Walter). Two individuals were seen by Santaella and Sada (1991) at Bahía Braithwaite, 2–3 May 1990. A single bird was observed by Walter on 18 November 1990 in the orchard near the naval base. Baptista, Walter, and Wehtje saw one near the harbor on 24 November 1990. Another individual was seen on the north side of the island on 25 August 1991. This species appears to be an occasional nonbreeding visitor.

*Great Egret (*Casmerodius albus*). Walter saw one on 17 December 1988 near the navy base. On 25 November 1990, a single bird was observed at the landing strip by Baptista, Rodriguez, Castellanos, Walter, and Wehtje.

*Snowy Egret (*Egretta thula*). One individual was seen near the navy base by Llinas and Wehtje from 22 to 27 February 1990.

Cattle Egret (*Bubulcus ibis*). First sighted by Jehl and R. L. Pitman, who saw flocks of 11, 19, and 35 arrive at the south end of the island in the early morning between 21 and 24 November 1974 (Jehl and Parkes 1982). They also saw between six and eight at the navy base in 1981. Two were present there on 14 December 1988 (Walter). On 16 February 1990, one was seen near the garrison. On 22 February three were present at the same location. Up to 14 were seen on 25 November 1990 by Walter and Wehtje. None was observed in August 1991.

Yellow-crowned Night-Heron (*Nycticorax violaceus gravirostris*). This resident species is most commonly encountered at night. At the navy base, at least three birds, most often immature, can be counted every night. We have encountered this species throughout the island, up to 500 m elevation, but in low numbers (one to two individuals at a time). It feeds primarily on land crabs (*Cardisoma* sp.) and to a lesser extent on scorpions (Llinas pers. obs.). Because the crabs are so abundant, food cannot be limiting the herons, and predation by Red-tailed Hawks is probably a factor limiting the herons' numbers. On several occasions we encountered remains of herons that appeared to have been killed by hawks.

Osprey (*Pandion haliaetus*). Brattstrom and Howell (1956) reported one on 19 November 1953. Additionally, Brattstrom observed two in 1971. Jehl and Parkes (1982) saw two at Caleta Grayson on 10 April 1978 and one at Cabo Henslow the next day. One was seen hunting on the southwest shore on 7 May 1990 by Walter. Three birds were seen soaring over Cerro Evermann on 20 November 1990 (E.

Martínez, Walter, Wehtje), and two birds were stationed near Bahía Academy during our August 1991 visit (Wehtje, Walter). The species may remain on Isla Socorro year round.

*Northern Harrier (*Circus cyaneus*). Walter saw one immature on 15 November, a female on 14 December, and two individuals on 15 December 1988.

*Sharp-shinned Hawk (*Accipiter striatus*). J. Clements, R. Clements, and Walter observed a female on 15 December 1988. Baptista saw a female on 24 November 1990 on the south side of the island at 500 m elevation.

Cooper's Hawk (*A. cooperii*). One was seen on 15 November 1988 leaving the island, flying south at an altitude of a few hundred meters. Nearest land in that direction is Clipperton Island, over 900 km away. Additionally, one individual was observed in the orange grove southeast of Cerro Evermann on 20 November 1990. Both observations by Walter.

Red-tailed Hawk (*Buteo jamaicensis socorroensis*). This endemic subspecies is the main avian predator on the island. Prey remains found in active nests were of Northern Mockingbirds, Townsend's Shearwaters, lizards, and lambs. We have also observed them feeding on land crabs. We estimate the current population at 15–25 pairs. The hawks are found throughout the island but are most commonly seen in the open areas in the southern part of the island and near the peak. Walter (1990) discussed this species further.

American Kestrel (*Falco sparverius*). First observed on the island by J. Clements and A. Sada in early December 1986 (Clements pers. comm.). On 16 November 1988 Walter observed a single individual. On 14 December of the same year, he found two birds. Wehtje and Rodriguez observed an adult female on 18 February 1990, and a female and male on 21 February 1990. A female was present in late November 1990 at the terminus of the mountain road. All individuals have been seen on the southern side of the island in disturbed habitat. This species has not been recorded during the spring or summer months and cannot be considered a breeding species, as stated by Parkes (1990).

Peregrine Falcon (*F. peregrinus*). Brattstrom and Howell (1956) reported one from Caleta Binner on 18 November 1953. Walter observed one individual on 14 and 16 November 1988. Rodriguez saw another on 22 February 1990 near the navy base.

Black-bellied Plover (*Pluvialis squatarola*). Jehl and Parkes (1982) observed three birds near the airstrip on 13 April 1978. Baptista and Walter recorded one at Bahía Blanca on 27 July 1988.

Semipalmated Plover (*Charadrius semipalmatus*). One was collected by Brattstrom at Bahía Braithwaite on 3 May 1955; a second was collected by Jehl and Parkes (1982) on 11 April 1978.

Killdeer (*C. vociferus*). One was heard by K. C. Parkes near the temporary lake on 6 April 1981 (Jehl and Parkes 1982).

Willet (*Catoptrophorus semipalmatus*). Listed by Brattstrom and Howell (1956) as accidental without any specific reference.

Wandering Tattler (*Heteroscelus incanus*). This winter visitor arrives by August and has been seen as late as the middle of May (Anthony 1898, McLellan 1926, Santaella and Sada 1991). Three were observed near the navy base on 21 February 1990 (Wehtje), with others observed at the lava flow south of Bahía Cornwallis on 22 November 1990 (Baptista, Walter, Wehtje). Additionally, Wehtje observed four individuals at Bahía Academy on 25 August 1991.

Spotted Sandpiper (*Actitis macularia*). Anthony (1898) observed a single bird on the north side of the island on 14 May 1897. Also noted by McLellan (1926) on "the beach." Brattstrom and Howell (1956) reported seeing several at Caleta Binner and at Punta Henslow in March 1953, in addition to collecting a specimen on the north side of the island on 20 November 1953. One was observed at Cabo Henslow on 1 May 1990 (Santaella and Sada 1991).

Whimbrel (*Numenius phaeopus*). This is another species that appears to winter regularly. Most sightings have been between November and May (Brattstrom and Howell 1956, Jehl and Parkes 1982, Santaella and Sada 1991). Baptista, Walter, and Wehtje saw one individual on the lava flow at the south end of Bahía Cornwallis on 22 November 1990.

*Surfbird (*Aphiriza virgata*). Walter saw a single bird on 26 July 1988 at Playa Blanca.

Sanderling (*Calidris alba*). Listed by Brattstrom and Howell (1956) as accidental with no reference for its inclusion.

Western Sandpiper (*C. mauri*). One seen at Laguna Escondida on 6 April 1981 (Jehl and Parkes 1982).

Northern Phalarope (*Phalaropus fulicaria*). Jehl and Parkes (1982) saw a few small flocks between Isla Socorro and Isla San Benedicto in 1981.

Pomarine Jaeger (*Stercorarius pomarinus*). Jehl and Parkes (1982) noted two at Bahía Braithwaite on 18 November 1974.

Laughing Gull (*Larus atricilla*). One immature observed on 21 November 1974 (Jehl and Parkes 1982). A first-year bird was seen at the garrison by Wehtje on 21 February 1990.

Franklin's Gull (*L. pipixcan*). An adult was photographed on 7 June 1977 (Jehl and Parkes 1982).

Heermann's Gull (*L. heermanni*). Jehl and Parkes (1982) found a partial skeleton at Playa Blanca on 11 April 1978. Wehtje observed a first-year bird at the navy base on 16 February 1990.

*Ring-billed Gull (*L. delawarensis*). The most common gull at the garrison on 16 February 1990, with approximately 175 individuals present, 30% of them adults. By 27 February the same number of birds remained, but only 10% of them were adults (Wehtje). Identification was assisted by comparison with California Gulls.

California Gull (*L. californicus*). A first-winter bird was collected in November 1974 (Jehl and Parkes 1982). One adult and fewer than five immatures were observed at the garrison by Wehtje on 16 February 1990. By 27 February several adults and up to 20 immatures were present.

*Herring Gull (*L. argentatus*). Several were at the garrison on 22 February 1990 (Wehtje).

Western Gull (*L. occidentalis*). Anthony (1898) found on the southwest side of the island the remains of an immature gull that he tentatively identified as being of this species.

Glaucous-winged Gull (*L. glaucescens*). A first-year bird was collected at Bahía Braithwaite on 21 November 1974 (Jehl and Parkes 1982). A first year bird was seen by Wehtje at the navy base on 16 February 1990.

Sooty Tern (*Sterna fuscata*). Anthony (1898) reported a large colony nesting on a rock 1 mile southwest of Isla Socorro. Such a rock does not now exist. He may have

been referring to Roca O'Neal, which lies about 2 km to the northwest of Isla Socorro. McLellan (1926) observed some near Roca O'Neal in early May 1925. Howell and Webb (1990) saw up to 14 associated with Townsend's Shearwaters off Isla Socorro but none at Roca O'Neal. Over 100, many of them nesting, were observed there on 30 April 1990 by Santaella and Sada (1991).

Brown Noddy (*Anous stolidus*). This species was found by Anthony (1898) to be nesting with the Sooty Terns in equally large numbers. A few individuals were noted near Isla Socorro in early May 1925 (McLellan 1926). Twenty were seen along the east coast on 7 April 1981 (Jehl and Parkes 1982). Howell and Webb (1990) saw none in February 1988 but Baptista and Walter saw two birds on 27 July 1988 along the west coast. Over 100 were observed around and nesting on Roca O'Neal on 30 April 1990 by Santaella and Sada (1991). Single birds were seen feeding in Bahía Braithwaite by Walter and Wehtje in August 1991.

White Tern (*Gygis alba*). Gifford (1913) reported a single bird collected on Roca O'Neal in 1905 by R. H. Beck.

Rock Dove (*Columba livia*). Only a few domesticated pigeons were seen in 1982 (Jehl and Parkes 1982). Fourteen were counted by Clements and Walter in December 1988. The population had dramatically increased to slightly less than 100 in February 1990, and 80 were counted in November 1990 (Wehtje). So far, the birds are found only within the navy base where they feed, roost, and breed only in buildings. We have urged the navy commander on the island to eliminate this species, as it may carry diseases for which island birds may be highly susceptible.

Mourning Dove (*Zenaida macroura*). First observed by Jehl and Parkes (1982) in April 1978, with over 100 seen on or near the airstrip and many others seen on the southeast side of the island. In 1981, they were found to be abundant on the southeast part of of the island (Jehl and Parkes 1982). Hundreds of breeding birds were observed on the southern side of the island in 1988 (Walter). Two were seen near Playa Blanca on 26 July 1988 (Baptista, Castellanos, Walter). Flocks of up to 60 individuals were seen in February 1990 (Wehtje). Well over 100 individuals were seen near rainwater puddles in an otherwise dry riverbed on the southwest side of the island in November 1990. At least one pair was seen at Bahía Academy in August 1991 (Walter, Wehtje). This species appears to be well established on Isla Socorro.

Socorro Dove (*Z. graysoni*). Still extinct in the wild, but more than 100 pairs of this Isla Socorro endemic survive in captivity in California and Germany (Baptista pers. comm.). The Socorro Island Restoration Project intends to repatriate this population in the near future. This goal is supported by a unanimously approved resolution of the Commission of the Californias (Newport Beach, March 1988).

Common Ground Dove (*Columbina passerina socorrensis*). This endemic subspecies is found in small numbers at lower elevations throughout the island. It is most numerous between the airstrip and the garrison, particularly in the *Croton* matorral at the southern end of the island, where it is not uncommon to see a total of 20 birds along the length of the road.

Green Parakeet (*Aratinga holochlora brevipes*). Although the island population of this species (Figure 3) probably exceeds several hundreds, it can be missed during short visits. During much of the year it frequents the upper elevations. Here, troops of 10–30 parakeets fly noisily over the forest. Seasonally available food in coastal groves brings them to these habitats as well. On the morning of 26 August 1991, more than 100 parakeets flew over our camp near the end of the mountain road in less than 15 minutes. Flocks of up to 60 individuals were observed later that day feeding in the *Ficus* groves.

*Groove-billed Ani (*Crotophaga sulcirostris*). A single individual was found in the orchard near the garrison in February 1990 (Rodriguez). What appeared to be the same individual was relocated there on 7 May 1990 by Walter; no trace of it was found in November of the same year.

Barn Owl (*Tyto alba*). In November 1990, naval personnel reported that this species might be present at Punta Tosca. Llinas and Rodriguez observed one near the garrison in February 1990 and collected a pellet, which contained crab remains. Villa (1960) also reported signs at Bahía Braithwaite. This owl may breed on Isla Socorro.

Elf Owl (*Micrathene whitneyi graysoni*). The last record for this species was in 1931, when a specimen was collected (Jehl and Parkes 1982). We have visited most of the likely coastal habitat of this species without any luck. As it has not been recorded for 60 years and little unexplored habitat remains, we fear that the subspecies may be extinct.

Belted Kingfisher (*Ceryle alcyon*). Brattstrom and Howell (1956) reported seeing one flying near Cabo Henslow on 18 March 1953. Brattstrom saw three in 1971, while Jehl and Parked (1982) observed several in 1978.

*Red-naped Sapsucker (*Sphyrapicus nuchalis*). Walter observed a single individual feeding in *Bumelia* trees on 26 November 1990, 300 m beyond the end of the mountain road.

Northern Rough-winged Swallow (*Stelgidopteryx serripennis*). Jehl and Parkes (1982) saw two at Bahía Academy on 14 April 1978. A flock of more than ten birds, probably of this species, was seen near the garrison on 25 November 1990 (Wehtje).

*Barn Swallow (*Hirundo rustica*). A few individuals were seen at scattered locations on the south side of the island between 19 and 24 November 1990 by Baptista, Walter, and Wehtje.

Figure 3. The Green Parakeet (*Aratinga holochlora brevipes*).

Socorro Wren (*Thryomanes sissonii*). This habitat generalist is the second most abundant bird of the island. It is found everywhere, from coastal cliffs to dense matorral and open canyon forest (Figure 4).

*Swainson's Thrush (*Catharus ustulatus*). Rodriguez saw a single bird in a fig grove at approximately 500 m elevation on the south side of the island on 18 February 1990.

Northern Mockingbird (*Mimus polyglottos*). This species was first reported by Jehl and Parkes (1982). It appears to have invaded the island after 1971, and is now a common breeder in disturbed habitat on the southern side of the island. It is rare in undisturbed scrub, the preferred habitat of the endemic Socorro Mockingbird. However, two Northern Mockingbirds were observed near a pair of Socorro Mockingbirds in undisturbed vegetation on the northeastern part of the island in February 1990 (Wehtje, Castellanos). In November 1990, no Northern Mockingbirds were observed north of the peak, where more than 30 Socorro Mockingbirds were found.

Socorro Mockingbird (*Mimodes graysoni*). Though considered the island's most common bird in the 1950s and earlier, the Socorro Mockingbird (Figure 5) has since decreased dramatically. Isla Socorro's best differentiated endemic is now rare but fortunately not yet extinct, and there may be enough time and habitat left to prevent further decline. The birds are often inconspicuous and silent but respond well to playbacks of their song. We were not able to confirm the presence of the species in any coastal or lowland habitat. The woodland and matorral ecotones around Cerro Evermann contain the largest numbers of the remaining population, consisting of more than 30 confirmed territory holders and an estimated total of 80–200 pairs. The decline in numbers of this species coincided with the establishment of the navy base, leading us to believe that the feral cats are responsible for their present rarity.

Water Pipit (*Anthus spinoletta*). Listed by Brattstrom and Howell (1956) as accidental without any specific reference.

Figure 4. The Socorro Wren (*Thryomanes sissonii*).

*Cedar Waxwing (*Bombycilla cedrorum*). Rodriguez saw 30–35 north of Cerro Evermann on 25 February 1990. Two days later, Wehtje saw a flock of 50–60 at the end of the mountain road.

Tennessee Warbler (*Vermivora peregrina*). One was observed at Bahía Braithwaite on 12 April 1978 (Jehl and Parkes 1982). On 18 February 1990, Llinas observed one in the *Ficus* groves on the southern flank of Cerro Evermann.

Tropical Parula (*Parula pitiayumi graysoni*). This is the most abundant bird on Isla Socorro. We found this very active and unafraid bird in most habitats from the shore to the peak of the island (Figure 6).

Yellow Warbler (*Dendroica petechia*). Jehl and Parkes (1982) observed an immature male Mangrove Warbler (subspecies *castaneiceps* or *rhizophorae*) at Bahía Braithwaite on 10 April 1978. They saw another individual in the same area two days later. On 26 February 1990, Rodriguez saw one near the garrison.

Yellow-rumped Warbler (*D. coronata*). "Many" were observed by Villa (1960) in 1958. One seen at end of mountain road on 18 February 1990 (Wehtje). Two were seen in the orchard on 28 February 1990. On 18 November 1990, Walter saw six individuals in the orchard.

Townsend's Warbler (*D. townsendi*). A male was collected on Cerro Evermann on 13 April 1978 (Jehl and Parkes 1982). Walter observed one male in dense forest on the southern flank of Cerro Evermann on 9 May 1990.

Black-throated Green Warbler (*D. virens*). Two females were collected along with the Townsend's Warbler on 13 April 1978 (Jehl and Parkes 1982).

Figure 5. An adult Socorro Mockingbird (*Mimodes graysoni*).

*Blackpoll Warbler (*D. striata*). Walter observed one in the orchard with a group of Yellow-rumped Warblers on 18 November 1990.

*American Redstart (*Setophaga ruticilla*). A female was observed by Walter in April 1988 in the forest near the planted orange grove.

*Wilson's Warbler (*Wilsonia pusilla*). A female was observed in the orchard on 17 November 1990 by Baptista, Wehtje, and Walter.

*Summer Tanager (*Piranga rubra*). Rodriguez banded a female near the end of the mountain road on 22 November 1990.

*Rose-breasted Grosbeak (*Pheucticus ludovicianus*). A first-spring male was seen in the orange grove by S. Bailey and K. S. Anderson on 18 March 1988.

*Indigo Bunting (*Passerina cyanea*). An adult male was observed by Baptista and H. Horblit near the garrison on 29 July 1988.

Rufous-sided Towhee (*Pipilo erythrophthalmus socorroensis*). A resident endemic that is quite numerous in its shrub and woodland habitats from the coast to the upper limits of shrubby vegetation. This species is easily overlooked when inactive, as it remains hidden in thick brush. In contrast to Parkes (1990), we have found this species to be inquisitive and tame.

*Lark Sparrow (*Chondestes grammacus*). Walter observed one bird near the garrison on 7 May 1990.

*Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). Recorded in the deciduous scrub near the airstrip by Llinas on 24 February 1990.

Figure 6. A Tropical Parula (*Parula pitiayumi graysoni*), Isla Socorro's most abundant bird species.

*Brown-headed Cowbird (*Molothrus ater*). First observed in the garrison area in April 1988 (Walter and Castellanos). One individual was seen there by Baptista on 29 July 1988. Nine, three of them adult males, were seen at the garrison on 17 December 1988. In February 1990 two males and a female were present at the garrison. One bird was seen on 7 May 1990. In November 1990, five birds were present. None were found on the island in August 1991. The species appears to be a regular visitor.

*House Sparrow (*Passer domesticus*). An adult male and female were seen by Walter on 7 May 1990 at the garrison.

DISCUSSION

In terms of abundance, nonresident species make up a small portion of Isla Socorro's avifauna. The pelagic species are few in number, and most likely visitors from Isla San Benedicto. Of the eight species of gulls recorded, only the Ring-billed and the California Gulls have been seen in any great numbers. Shorebirds, with the exception of the Wandering Tattler and Whimbrel, appear to be accidentals. Isla Socorro possesses few sandy and muddy beaches that would attract them.

Perhaps the most interesting of our observations are of the raptors. The simultaneous presence of the American Kestrel, Northern Harrier, Cooper's Hawk, Sharp-shinned Hawk, Peregrine Falcon, and Barn Owl suggests increased bird predation on this remote island, where Red-tailed Hawks are the only resident birds of prey (Walter 1990). This may complicate the planned reintroduction of the Socorro Dove.

Except for the Yellow-rumped Warbler, the passerines usually occur as single individuals. Migrants frequently concentrate in the planted mango, lemon, and palm orchard near the navy base. Additional migrants are likely to be recorded.

Of considerable concern are the frequent sightings of the Brown-headed Cowbird. So far, we have not detected any attempted breeding of this brood parasite. The observation of the Groove-billed Ani is not a surprise because the species' population in Mexico is increasing. Cattle Egrets and House Sparrows have been confined to the immediate vicinity of the navy base.

The navy base has had a substantial impact upon the avifauna of Isla Socorro. The introduction of domestic cats was almost certainly the major factor in the extirpation of the Socorro Dove and drastic reduction in numbers of the Socorro Mockingbird (Jehl and Parkes 1982, 1983). On the other hand, some of the native bird species appear to have adjusted well to the permanent human presence on Isla Socorro. The Yellow-crowned Night-Heron is most commonly seen in the garrison area at night, while the Common Ground-Dove is attracted by the constant availability of fresh water. Indirectly, the introduction of the house mouse may have provided the Barn Owl with a prey source, enabling it to colonize the island.

The navy base also acts as a magnet for visiting birds. One reason that there have been so many new records of species on Isla Socorro may be that the area around the navy base is more attractive to vagrants than the rest of the island and they are more likely to be seen there. The orchard has

several fruit trees that attract insects, while the garbage produced by the navy personnel provides an ample food supply for visiting gulls. When observed, Brown-headed Cowbirds have been in the company of the few horses and cattle present. Both the Snowy Egret and the Cattle Egrets were seen in the vicinity of the navy base.

At present, the known avifauna on Isla Socorro consists of eleven endemic species and subspecies, of which one, possibly two, are extinct in the wild (Socorro Dove and Elf Owl), two or three newly established species (Mourning Dove, Northern Mockingbird, and possibly Barn Owl), two species of seabirds that nest on nearby islets (Sooty Tern and Brown Noddy), and 68 seasonal visitors and accidental species. The increase recorded in the past few years in the number of nonresident species is probably a result of more frequent visits to the island.

As noted, Isla Socorro's avifauna has undergone substantial changes within the past two decades (Jehl and Parkes 1982, 1983). We believe that Isla Socorro provides an excellent opportunity to document ongoing changes in species composition and relative abundance over time. In addition, if the feral sheep and cats can be successfully removed from the island, there is the prospect of observing how the recently established bird species adapt to a less disturbed habitat. We hope to be able to report on these changes in the future.

ACKNOWLEDGMENTS

We thank all participants of the recent Isla Socorro expeditions for their excellent stamina and enthusiasm: Luis F. Baptista, Stephen F. Bailey, Jim and Robert Clements, Helen Horblit, Enrique Martínez Ojeda, Filemon Manzano Hernández, and Andres Sada, who all contributed their unpublished data for this paper. We thank the Mexican armed forces for their invaluable assistance with transportation and logistics, the Secretaría de Desarrollo Urbano y Ecología for sponsoring our conservation efforts, Admiral Gordillo Rodriguez for his unfailing support and deep curiosity about anything on Isla Socorro, Manuel Marin for valuable comments on several drafts, UCLA and CIB for the establishment of a binational conservation project, and the Commission of the Californias for initiating the official quest for the return of the Socorro Dove.

LITERATURE CITED

Anthony, A. W. 1898. Avifauna of the Revillagigedo Islands. Auk 15:311–318.

Brattstrom, B. H. 1990. Biogeography of the Islas Revillagigedo, Mexico. J. Biogeogr. 17:177–183.

Brattstrom, B. H., and Howell, T. R. 1956. The Birds of the Revilla Gigedo Islands, Mexico. Condor 58:107–120.

Gifford, E. W. 1913. The birds of the Galapagos Islands, with observations on the birds of Cocos and Clipperton islands (Columbiformes to Pelecaniformes). Proc. Calif. Acad. Sci., Ser. 4, 2:1–132.

Grayson, A. J. 1872. On the physical geography and natural history of the islands of the Tres Marias and of Socorro, off the western coast of Mexico. Proc. Boston Nat. Hist. Soc. 14:261–302.

Howell, S. N. G., and Webb, S. 1990. The seabirds of las Islas Revillagidedo, Mexico. Wilson Bull. 102:140–146.

Jehl, J. R. Jr. 1982. The biology and taxonomy of Townsend's Shearwater. Gerfaut 72:121–135.

Jehl, J. R. Jr., and Parkes, K. C. 1982. The status of the avifauna of the Revillagigedo Islands, Mexico. Wilson Bull. 94:1–19.

Jehl, J. R. Jr., and Parkes, K. C. 1983. "Replacements" of landbird species on Isla Socorro, Mexico. Auk 100:551–559.

Jones, H. L., and Diamond, J. M. 1976. Short-time-base studies of turnover in breeding birds of the California Channel Islands. Condor 76:526–549.

Levin, G. A., and Moran. R. 1989. The vascular flora of Isla Socorro, Mexico. San Diego Soc. Nat. Hist. Memoir 16.

MacArthur, R. H., and Wilson, E. O. 1967. The Theory of Island Biogeography. Princeton Univ. Press, Princeton, N.J.

McLellan, M. E. 1926. Expedition to the Revillagigedo Islands, in 1925. VI. The birds and mammals. Proc. Calif. Acad. Sci., Ser. 4, 15:279–322.

Parkes, K. C. 1990. Was the Socorro Mockingbird (*Mimodes graysoni*) a predator on small birds? Wilson Bull. 102:317–320.

Santaella, L., and Sada, A. M. 1991. The avifauna of the Revillagigedo Islands, Mexico: Additional data and observations. Wilson Bull. 103: 668–675.

Scott, J. M., Mountainspring, S., Ramsey, F. L., and Kepler, C. B. 1986. Forest bird communities of the Hawaiian Islands: Their dynamics, ecology, and conservation. Studies Avian Biol. 9.

Villa, R. B. 1960. Vertebrados terrestres, in La Isla Socorro. Monogr. Inst. Geofis., Univ. Nacl. Autónoma Méx. 2: 203–216.

Walter, H. S. 1990. Small viable population: The Red-tailed Hawk of Socorro Island. Conserv. Biol. 4:441–443.

Accepted 28 March 1992