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The avifauna of the Revillagigedo Islands, Mexico: additional data and observations.— The Revillagigedo Islands are an archipelago of four oceanic volcanic islands in the eastern Pacific Ocean about 650 km (400 nautical miles) west of the Mexican state of Colima. Clarión (3.5 × 8.5 km) is the westernmost and oldest island (early Pliocene). Roca Partida is a rocky islet and is the throat of an old volcano. It is younger than Clarión but older than Socorro, the largest island (16.5 × 11.5 km, early Pleistocene), and San Benedicto (4.5 × 0.9 km), the youngest and northernmost island (late Pleistocene). Seabirds are numerous and diverse, but include only one endemic species. The terrestrial avifauna is relatively depauperate, but its degree of endemism is very high. Socorro, the largest and most diverse island, has the largest number of endemic land birds, followed by Clarión, the second largest but oldest island. The smallest, Roca Partida, has none, and the second smallest and youngest island, San Benedicto, had only one, a Rock Wren (*Salpinctes obsoletus exsul*), that became extinct following the catastrophic volcanic eruption in 1952 (Brattstrom 1990).

Numerous visitors have discussed the status of birds of the Revillagigedos including Grayson (1872), Anthony (1898), Brattstrom and Howell (1956), Jehl and Parkes (1982), Everett (1988), and Howell and Webb (1990). We conducted a cruise in the area from 29 April to 8 May, 1990, visiting all four islands as follows: San Benedicto (19°18′N, 110°49′W) 29–30 April; Socorro (18°47′N, 110°58′W) 30 April–3 May; Roca Partida (19°00′N, 112°04′W) 4 May; and Clarión (18°22′N, 114°45′W) 5–7 May. While at sea, we maintained a continuous watch for seabirds. We here add recent data to the status of the known avifauna of the Revillagigedo Islands and include our observations of other species never observed before on or around the islands.

San Benedicto remains uninhabited, and we saw no land birds or introduced species. Because of rough seas, we could not land on the northern part of the island, which seabirds successfully recolonized after the devastating volcanic eruption of 1952 and where nesting was observed by Howell and Webb (1990). We circled the island, and seabirds were abundant over and all around it. We were able to land on the southeastern part, where lava and ash cover practically everything. Seabirds, except for roosting boobies and airborne frigatebirds, were few.

Socorro has a Mexican naval garrison that has grown to 250 people, including women and children. Introduced sheep are abundant (greater than 3000 animals) and are hunted by the garrison (only young males are taken). The resulting overpopulation of sheep has degraded the landscape, caused severe erosion in areas, and prevented regeneration of many of the forests. This further endangered the endemic avifauna, especially the highly endangered Socorro Mockingbird (*Mimodes graysoni*). Feral cats are seen infrequently (we saw none), and their population is unknown, but they may be responsible for the extirpation of the Socorro Dove (*Zenaida graysoni*), the near-extinction of the Socorro Mockingbird, and the disruption of the breeding colonies of Townsend's Shearwater (*Puffinus auricularis*) (Jehl and Parkes 1982, 1983; Parkes 1990). There is an effort underway to eliminate the cats. We spent 1½ days on Socorro, traveling by truck from the garrison via the landing strip to the base of Cerro Evermann. From there we proceeded on foot on 2 May to the wooded areas where the Socorro Mockingbird was found in 1990 by Mexican observers, and thence to the top of the volcano (1130 m) where we saw no evidence of nesting seabirds in areas where Townsend's Shearwater historically had nested. (McLellan 1926, Jehl and Parkes 1982).

Clarión has a naval garrison of nine men who live under rather difficult conditions. The introduced feral rabbits and pigs, a food source for the garrison, have damaged the ecology of the island. The rabbits appear to have occupied practically all seabird burrows, and the pigs virtually have destroyed all the prickly pear cactus (*Opuntia* sp.) on the island. They are now starting to root and destroy the small trees and large bushes on which the Red-footed Booby (*Sula sula*) nests. Goats have also been recently introduced. Sheep now number about twenty and are protected from hunting until their numbers increase further. Data gathered by our expedition have been forwarded to the proper officials in Mexico City, where there is genuine concern for the conservation of Clarión as well as Socorro.

The following list summarizes our observations; * indicates the species has not been recorded previously in the Revillagigedo Islands.

* Short-tailed Albatross (*Diomedea albatrus*).—We saw one adult on 29 April flying low over the water at 19°26′N, 110°44′W, 10 km (six nautical miles) north of San Benedicto (Santaella and Sada, in press). As far as we are aware, this is the first record for the Revillagigedo Islands and only the second this century for Mexico (L. Spear, pers. comm.).

Laysan Albatross (*D. immutabilis*).—We saw two on 29 April flying at 19°32′N, 110°43′W, about 10.5 km (6.5 nautical miles) north of San Benedicto and one on 4 May flying past Roca Partida. Four birds were present on the ground at Clarión, 5–6 May, near the naval station. These were remarkably tame, and one pair demonstrated courtship ritual, but we found no evidence of nesting. Members of the naval garrison assured us that there had been many more albatrosses earlier in the year. Since Howell and Webb (1990) reported much larger numbers in February, May is apparently late in the season for this species on Clarión.

* Juan Fernández Petrel (*Pterodroma externa*).—On 7–8 May we observed about 70 petrels 30–260 km (19 to 150 nautical miles) northeast of Clarión, both flying and rafting, the largest raft numbering approximately 40 birds. Previously only Pitman (1986) had reported this petrel from Mexican waters, but he believes that it is the commonest *Pterodroma* off western Mexico and that most individuals are non-breeders found nearly year-round (Pitman, pers. comm.).

* Tahiti Petrel (*P. rostrata*).—We saw one on 8 May gliding and banking over the water at 20°13′N, 112°41′W, 170 nautical miles northeast of Clarión. Again, only Pitman (1986) had reported this petrel from anywhere in Mexican waters.

* Cook's Petrel (*P. cookii*).—This petrel has been regularly recorded off Baja California (Wilbur 1987) and off western Mexico (Pitman 1986). We saw three on 29 April at 19°57′N, 110°37′W, north of San Benedicto, one at 19°00′N, 112°06′W on 4 May between Roca Partida and Clarión, and six on 7–8 May up to 170 nautical miles northeast of Clarión.

* Black-winged Petrel (*P. nigripennis*).—We observed one on 7 May at 18°34′N, 114°27′W, 19 nautical miles northeast of Clarión. Pitman (1986) has reported this petrel off Western Mexico.

* Flesh-footed Shearwater (*Puffinus carneipes*).—We observed two individuals: one on 4 May between Roca Partida and Clarión and the other on 7 May northeast of Clarión.

Wedge-tailed Shearwater (*P. pacificus*).—We observed several hundred around San Benedicto on 29 April, where they are known to breed (Brattstrom and Howell 1956, Jehl and Parkes 1982), the most northerly sighting being at 19°41′N, 110°39′W. The proportion of dark to light morph birds was approximately 60% to 40%. We saw these shearwaters flying at dusk and early evening, over the boat, directly to the northern part of the island, where presumably their nests were located. On 30 April, we observed 25 between San Benedicto and Socorro. From 1 to 7 May we saw another 10 around Socorro and Roca Partida, between the latter and Clarión, and all around Clarión. We found no evidence of nesting on either Socorro or Clarión. No shearwaters of this species were observed by Howell and Webb (1990) in February.

Townsend's Shearwater (*P. auricularis*).—Our first sighting was of two birds on 29 April at 20°28′N, 110°30′W, approximately 40 nautical miles north of San Benedicto, while still out of sight of land. From there until arrival at San Benedicto, we saw four more. Between 20:00 and 21:30 h that evening, we observed approximately 20 of these shearwaters flying over the boat directly to the northern part of the island, just as the Wedge-tailed Shearwaters were doing. This observation suggests possible recolonization by this shearwater at San Benedicto, the first evidence since the volcanic eruption of 1952. On 30 April, we saw three birds between San Benedicto and Socorro. We found no direct evidence of breeding by this highly endangered endemic species on Socorro, although very recently three nesting colonies have been found on the northern part of the island (A. Castellanos, pers. comm.). Jehl (1982) estimated the Socorro breeding population at 1000 pairs, but Howell and Webb (1990) did not report any breeding there. On 4 May, we saw only one bird between Roca Partida and Clarión. On Clarión, Everett (1988) found no occupied burrows in January, and Howell and Webb (1990) found all nesting sites marked by severe pig rooting, and numerous shearwater remains littered the destroyed burrows. They found no occupied burrows. Several members of our expedition spent the night of 5 May on Clarión, exploring the little-known eastern end and found no evidence of recent nesting or of shearwaters coming to land. We all explored on 5–6 May the western and central portions of the island. All burrows found were old and occupied by rabbits or destroyed by pigs. We found neither bones nor feathers and saw only five birds flying over the boat at night in the direction of land. Between 4 and 7 May we saw only six others in Clarión waters. It appears that this shearwater may have all but abandoned Clarión, its former stronghold (McLellan 1926).

* Audubon's Shearwater (*P. lherminieri*).—This shearwater has never been recorded as far north as the Revillagigedo Islands and usually is encountered only in the eastern Pacific from Acapulco south (R. Pitman pers. comm.). Six birds were seen on 29 April at 20°26′N, 110°29′W, about 60 km (35 nautical miles) north of San Benedicto, where the water had suddenly changed from 70° to 78°F. We saw ten on the same day en route to and around San Benedicto and 110 between San Benedicto and Socorro on 30 April. We found this

bird nowhere else in the Revillagigedos. The smaller size, brown extending below the eye and as a half moon on the sides of the neck, and lack of white flanks readily differentiated Audubon's Shearwaters from the Townsend's Shearwaters that often accompanied them.

* Wilson's Storm-Petrel (*Oceanites oceanicus*).—This species has been recorded only occasionally off western Mexico (Pitman 1986) and never in the Revillagigedo Islands. We saw two on 29 April at 20°07'N, 110°35'W, north of San Benedicto, two off Roca Partida on 4 May, and one off Clarión on 7 May.

Leach's Storm-Petrel (*Oceanodroma leucorhoa*).—The nearest known breeding colonies of this storm-petrel to the Revillagigedo Islands are on islands off the Pacific Coast of Baja California. Wintering birds are regularly found off western Mexico and among the Revillagigedos (Pitman 1986). We observed about 15 birds throughout the archipelago. All were white-rumped, except for one entirely dark-rumped and one other partially so.

* Band-rumped Storm-Petrel (*O. castro*).—This storm-petrel has been observed infrequently off western Mexico (Pitman 1986). On 29 April, we observed one at 20°20'N, 110°31'W and three at 19°57'N, 110°37'W, north of San Benedicto and on 7 May, two northeast of Clarión.

* Wedge-rumped Storm-Petrel (*O. tethys*).—This species is common off western Mexico (Pitman 1986) and although not reported previously, it is the most abundant storm-petrel in the Revillagigedo Islands, in our experience. We saw 230 birds throughout the archipelago, the most (150) on 4 May around Roca Partida.

Black Storm-Petrel (*O. melania*).—Three of these storm-petrels followed our boat from shortly after departure from Cabo San Lucas on 28 April until 29 April, when at 20°26'N, 110°29'W, north of San Benedicto, where the water temperature suddenly changed from 70° to 78°F, the birds abruptly departed. We saw no others anywhere in the archipelago.

Red-billed Tropicbird (*Phaethon aethereus*).—We saw 50 around San Benedicto, mostly about the northern cliffs; 12 along the cliffs at Cabo Pearce, Socorro, on 3 May; and another 24 around Clarión, mainly off the northwestern and eastern cliffs.

Red-tailed Tropicbird (*P. rubricauda*).—One flew over our boat on 29 April about 8 km (5 nautical miles) north of San Benedicto, and another landed on a ledge on a cliff on the northwestern side of the island. Rough seas prevented a close approach to detect whether the bird was nesting.

Masked Booby (*Sula dactylatra*).—We saw at least 300, including many juveniles, around San Benedicto on 29–30 April and 10 between San Benedicto and Socorro on 30 April. All were the yellow-billed form, *S. d. californica*. On 4 May, we saw 50 roosting adults on Roca Partida, among which were three pairs of *S. d. granti*, the distinctive orange-billed Galápagos form. Two of the pairs were displaying and could have been nesting on ledges of the south pinnacle. At most 100 pairs of *S. d. californica* were nesting on the ground at two sites on the western end of Clarión. All were on eggs or had very young chicks. This number is lower than that found by Howell and Webb (1990). Despite previous reports (McLellan 1926, Brattstrom and Howell 1956), no one has seen the Blue-footed Booby (*Sula nebouxii*) on or near the Revillagigedo Islands in recent years.

Brown booby (*S. leucogaster*).—We observed no more than ten, mostly adults, around San Benedicto. Since Howell and Webb (1990) observed many more and confirmed breeding in February, our low number suggests fledgling dispersal after breeding. On 1 May, we saw 30 birds roosting on the cliffs of Cabo Henslow, Socorro. Over 100 were present on Roca Partida on 4 May. On Clarión, we saw eight around the island but none on land. Howell and Webb (1990) also saw very few at Clarión.

Red-footed Booby (*S. sula*).—We found few (<15), mostly juveniles, around San Benedicto and Socorro. On 4 May between Roca Partida and Clarión, we observed several adults swooping for flying fish disturbed by our boat. We found 3000 pairs nesting on small trees

and large bushes at five sites, all on the eastern half of Clarión. Practically all nests had down-covered chicks. The birds were very tame and appeared to ignore our presence. Most (99%) adults were white morphs. Of the white morphs, 80% were black-tailed and 20% were white-tailed.

Magnificent Frigatebird (*Fregata magnificens*).—We saw six around San Benedicto, another six around Socorro, possibly one off Roca Partida, and none on Clarión. This frigatebird apparently does not reach Clarión (Everett and Anderson, in press).

Great Frigatebird (*F. minor*).—This frigatebird appears to greatly outnumber *F. magnificens* in the Revillagigedo Islands (Howell and Webb 1990). We saw at least 100, mostly females and juveniles about or around San Benedicto on 29–30 April; none on Socorro; two or three around Roca Partida on 4 May; and twelve around Clarión, including three or four daily at Sulphur Bay between 5 and 7 May. We found no evidence of nesting either on Roca Partida or Clarión.

Great Blue Heron (*Ardea herodias*).—We saw two at Bahia Braithwaite, Socorro, on 2–3 May and one on Clarión on 5 May.

Cattle Egret (*Bubulcus ibis*).—Although recorded from Socorro (Jehl and Parkes 1982), there appear to be no previous records from Clarión. We saw one in the twin canyon area, close to the Red-footed Booby colonies in the interior of Clarión.

Socorro Red-tailed Hawk (*Buteo jamaicensis socorroensis*).—We encountered four individuals of this endemic subspecies 2–3 May. Two were near the summit of Cerro Evermann. Unlike most of the endemic landbirds, this hawk was wary and did not permit close approach.

Pacific Golden Plover (*Pluvialis fulva*).—We saw two in basic plumage on 6 May on the grassy plateau in the center of Clarión. This species is considered accidental on Clarión (Brattstrom and Howell 1956) but may actually be regular on the islands (Howell and Webb 1988).

Wandering Tattler (*Heteroscelus incanus*).—We saw one on rocks at Caleta Trueno, northwest Socorro, on 1 May and three on rocks in Sulphur Bay, Clarión, on 7 May.

Spotted Sandpiper (*Actitis macularia*).—We saw one on rocks at Cabo Henslow, Socorro, on 1 May and another on rocks at Sulpher Bay, Clarión, on 7 May.

Whimbrel (*Numenius phaeopus*).—We saw one at Bahia Braithwaite, Socorro, on 2 May and two at Sulphur Bay, Clarión, on 5 May.

California Gull (*Larus californicus*).—We observed two juveniles on the southeastern beach of San Benedicto on 30 April. These were the only gulls seen in the archipelago.

* Arctic Tern (*Sterna paradisaea*).—We saw five terns fly past Roca Partida on 4 May and one northeast of Clarión on 7 May. All were in full adult breeding plumage with deep red bill, uniformly gray upperwings, and translucent flight feathers.

Sooty Tern (*S. fuscata*).—Over 100 terns were seen on or around O'Neal Rock, off Socorro, on 30 April, and many were nesting. At least another 100 were on Roca Partida on 4 May, some of which appeared to be nesting.

Brown Noddy (*Anous stolidus*).—Over 100 were seen on or around O'Neal Rock and another 50 on Roca Partida, nesting on both rocks.

Mourning Dove (*Zenaida macroura*).—This species is a recent colonizer of Socorro and appears to be *Z. m. marginella* from the Mexican mainland (Jehl and Parkes 1983). It was very common in open and lightly wooded country. The birds were very wary. On the contrary, the very distinct endemic dove of Clarión, *Z. m. clarionensis,* was very tame and allowed close approach. We found it common throughout the island and especially around the naval station where it came to drink. We observed at least 150 birds, in marked contrast to Everett (1988) who noted only 20 individuals.

Socorro Common Ground-Dove (*Columbina passerina socorroensis*).—This endemic subspecies was common in open country on Socorro but did not allow very close approach.

Socorro Green Parakeet (*Aratinga holochlora brevipes*).—We found this endemic subspe-

cies in wooded areas around the slopes of Cerro Evermann. We encountered three flocks of 15, 25, and 10 birds, respectively.

Clarión Burrowing Owl (*Athene cunicularia rostrata*).—We observed about 20 individuals of this endemic subspecies mostly in the higher parts of Clarión, a number greater than Everett's (1988). They were usually seen in daylight, standing beside their burrow, and were very tame. Often the burrows were underneath the small trees where Red-footed Boobies nested.

Chaetura sp.—We observed one small swift flying over the hill in back of the naval station on Clarión on 6 May. *Chaetura* swifts have not been reported previously in these islands.

Barn Swallow (*Hirundo rustica*).—We observed two flying about and perching on wires by the naval station on Clarión on 6 May.

Common Raven (*Corvus corax clarionensis*).—This wary Clarión resident was common all over the island. We also frequently observed ravens perched around the colonies of Red-footed Booby, probably waiting for opportunities to steal eggs and chicks.

Socorro Wren (*Thryomanes sissonii*).—This tame endemic wren was the second most common land bird and was found in both open and wooded areas of Socorro at all elevations.

Clarión Island Wren (*Troglodytes tanneri*).—This endemic wren was common throughout Clarión (at least 100 seen), ranging from the rocks on the beach to the shrubs at the highest elevations. Everett (1988) saw only 20 individuals. They were often observed near the shore in the vicinity of the endemic Clarión snake (*Masticophis anthonyi*), but we saw no interaction between the two species. The few derelict vehicles remaining on Clarión all had nests of this species in the radiator or glove compartment! We noted some plumage variation: some of the wrens found in beach areas were paler and buffier than those found in the vegetation of highland areas.

Northern Mockingbird (*Mimus polyglottos*).—A recent invader (Jehl and Parkes 1982, 1983) that was very common throughout both open and wooded areas of Socorro and behaved exactly like its congeners on the mainland.

Socorro Mockingbird (*Mimodes graysoni*).—This monotypic endemic genus is unique to Socorro. Its affinities with mainland genera are obscure (Gulledge 1975). The Socorro Mockingbird is tame, bold, omnivorous (we witnessed it feeding on young leaves, fruit, large insects, and dead land crabs), and aggressive. It likely is a predator of eggs and nestlings of small passerines (Parkes 1990). Both the endemic Socorro Wren and Tropical Parula Warbler appear to be much more common now that *Mimodes* is nearly extinct (Brattstrom and Howell 1956, Parkes 1990).

From being the most abundant and widespread species of land bird on Socorro (McLellan 1926), *Mimodes* has declined to near extinction, most likely due to the depredations of feral cats (Jehl and Parkes 1982, 1983). In 1978, Jehl and Parkes (1982) found only a few *Mimodes*, mainly in the vicinity of large fig groves (*Ficus cotonifolia*) near the coast. In 1981, the same observers declared the species virtually extirpated. However, in August 1987, 20 individuals were found in a relatively inaccessible part of the island by a party from the Univ. of Mexico (Parkes 1990), and in early 1990 16 were found by a group from the Centro de Investigaciones Biológicas (C.I.B.) of La Paz, B.C.S. (H. Walter, pers. comm.). Following their instructions, we found a family of four *Mimodes* at about 600 m elevation on the way to the summit of Cerro Evermann in mixed open woodland consisting of *Ficus cotonifolia* and the endemic trees: *Bumelia socorrensis, Ilex socorroensis, Guettarda insularis,* and *Psidium socorrensis.* The family consisted of two adults and two immatures; the latter were fully grown and identical to the adults in appearance, except for yellow at the rictus. They still begged for food and were seen to be fed both insects and the olive-like fruit of *Bumelia* by their parents, although they were capable of foraging by themselves (fresh green shoots and dead crabs). The male sang and called loudly and appeared to be territorial, since he chased away a Northern mockingbird on two occasions. The female was more subdued and occasionally

"dueted" with her mate. In the same area we observed two individuals of the endemic Socorro lizard (*Urosaurus auriculatus*), a species that has probably also decreased due to cat predation.

Since the nidification of *Mimodes* is unknown, we searched in vain for a likely nest both in trees and on the ground. The only nest anywhere in the area was an old one, a large open cup on a tree fork, at a height of 3 m from the ground, probably of the Northern Mockingbird. All four birds were photographed (Vireo 527/7), videotaped, and recorded. Two other *Mimodes* were also seen and heard singing in the vicinity. The woodland where all six were found showed absolutely no sign of regeneration from the constant foraging by the abundant feral sheep. Later in the day below the crater of the volcano, we traversed a nearly intact forest with a lush understory showing no evidence of damage by sheep. Unfortunately we neither heard nor saw any *Mimodes* here, perhaps due to the lateness of the day. *Mimodes* was very tame and curious and readily came to inspect our photographic equipment and backpacks lying on the ground. Most of the time, however, it was arboreal and thus appeared less terrestrial than previously described (McLellan 1926). Perhaps those birds that have eluded the feral cats have done so by adopting a more arboreal existence.

Socorro Tropical Parula (*Parula pitiayumi graysoni*).—This endemic subspecies was the commonest land bird on Socorro in both open and wooded areas at all elevations. It was very tame, confiding, and inquisitive.

Socorro Rufous-sided Towhee (*Pipilo erythrophthalmus socorroensis*).—We found this endemic subspecies to be common in brushy and lightly wooded areas of Socorro. It was very tame and inquisitive, coming to inspect our feet and shoes as we hiked through brush. This behavior matches that described by Anthony (1898) but is in marked contrast to the shyness described by Jehl and Parkes (1982).

We did not find any American Kestrels (*Falco sparverius*), a species which has been considered a possible colonizer of Socorro (Parkes 1990) and has also been recorded from Clarión (Everett 1988). We also failed to find the Socorro Yellow-crowned Night-Heron (*Nyctanassa violacea gravirostris*) and the Socorro Elf Owl (*Micrathene whitneyi grayoni*), both endemic subspecies. Although feral sheep are causing serious ecological problems on Socorro such as erosion and lack of woodland regeneration, they do not appear so far to have affected the tree-nesting resident avifauna in the way feral cats have devastated the ground-nesting and ground-foraging birds (Socorro Dove, Socorro Mockingbird, and Townsend's Shearwater). On Clarión, although pigs have nearly destroyed all the prickly pear cactus (*Opuntia* sp.), the loss of this plant does not appear to have affected the resident land birds, since they were found in higher numbers than when Everett (1988) visited, at which time there were still extensive stands of *Opuntia*. The pigs, however, appear to have severely disrupted the breeding of Townsend's Shearwater and could adversely affect the breeding of the Red-footed Booby if they continue to destroy their nesting trees.

Clearly, control of the introduced animals is the number one conservation priority for the Revillagigedo Islands, since there are no apparent human pressures. Fortunately, both the Mexican civil government and the Mexican navy are now committed to the conservation of the islands, and feral animal control will be carried out and coordinated by the Centro de Investigaciones Biológicas of La Paz.

Roca Partida and San Benedicto are secure, and barring a new volcanic eruption on the latter, the number of nesting seabirds (possibly including Townsend's Shearwater) should continue to increase. We found seabirds numerous throughout the islands and the number of nesting species and populations matched fairly closely those observed by Howell and Webb (1990).

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