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First description of the nest and eggs of the Socorro Mockingbird.—The Socorro Mockingbird (*Mimodes graysoni*) represents a monotypic genus endemic to Isla Socorro, Mexico (Brattstrom and Howell 1956). Formerly abundant on Socorro, this species has declined since the middle of this century (Jehl and Parkes 1982) and now numbers between approximately 100 (Castellanos and Rodríguez-Estrella 1993) and 300 individuals. As a consequence of its restricted range and small population size, *Mimodes* is considered critically endangered (Collar et al. 1992). Possible causes of the species' decline include predation from feral cats, habitat destruction caused by feral sheep, and competition with recently arrived Northern Mockingbirds (*Mimus polyglottos*) (Jehl and Parkes 1982). Determining what action is needed to prevent the extinction of *Mimodes* will require understanding of the species' breeding biology. However, almost nothing of this bird's natural history is known. Here we present the first description of the nests and eggs of the Socorro Mockingbird, along with preliminary observations about breeding seasonality and behavior derived from our ongoing field study of the conservation status of *Mimodes graysoni*.

Isla Socorro lies 460 km SSW of Cabo San Lucas, Baja California Sur, and 580 km west of Cabo Corrientes, on the Mexican mainland. Socorro is the largest (110 km^2) and highest (1040m) of the four volcanic islands in the Revillagigedo Archipelago (Wehtje et al. 1993) (The archipelago was declared a Biosphere Reserve by the Mexican government in June, 1994). Socorro is probably early Pleistocene in age, based on evidence in the form of erosion shelves (Levin and Moran 1989, Brattstrom 1990). Descriptions of the different habitats on the island, which range from arid coastal scrub to moist montane forest, can be found in Miranda (1960) and Levin and Moran (1989).

We initiated field studies of the surviving population of *Mimodes* in January 1993. One of us (JEMG) subsequently made extended observations on Socorro in 1993 (6 June–5 August) and 1994 (18 February–4 June). Throughout these periods of study we have attempted to color-band and observe *Mimodes* over the entire island. By June, 1994, we had marked 215 Socorro Mockingbirds. We were able to identify the sex of many banded birds from observations of singing birds combined with measurements in the hand. Males average larger in wing and tarsus length (unpubl. data). We could also recognize paired females, regardless of whether they were nesting, because they gave distinctive calls when their mates were vocalizing. After a distant male sang, the females typically gave one or two short, guttural "chunk" calls, and then usually moved towards the vocalizing male. As soon as a female drew close to her mate, she gave a series of more nasal calls we describe as "nya, nya."

We were unable to locate any nests of *Mimodes* in 1993, but we found five in 1994. (We have deposited voucher photographs of nests and eggs with VIREO, accession numbers V06/19/001-003.) All five nests were in forested areas at elevations ranging from 850-950 m, just below the island's summit. All were placed in trees that included *Bumelia socorrensis* (N = 2), *Guettarda insularis* (N = 1), *Ilex socorroensis* (N = 1), and *Meliosma nesites* (N = 1). Dominant canopy trees in the vicinity of all nests were *Guettarda* and *Ilex; Oreopanax xalapense* was common in the subcanopy; and shrubs of *Triumfetta socorrensis* and *Eupatorium pacificum* were also present in the understory near the nests.

All five nests we found were open cups constructed of twigs, similar to those of many other Mimids, and lined with mosses and other epiphytes. Three nests were placed in foliage of outer branches, one in a forked bole of a large tree, and one in a shallow cavity in the side of the trunk of a large tree. The five nests averaged 16 ± 2.6 (SD) cm in outer diameter; the inner diameter was about 8 cm and the cup's depth about 4 cm. The nests were placed 3.7 ± 0.9 m high in trees that averaged 5.4 ± 0.7 m in height.

We observed eggs in three nests: all had bluish-green ground color with large brown spots concentrated at the widest end. The eggs therefore were similar to the eggs of most mockingbirds in the genus *Mimus,* and different from those of most *Toxostoma,* the eggs of which have small brown spots (Bent 1948). We measured three eggs from one nest. These averaged 26.8 ± 0.7 mm in length and 19.5 ± 1.8 mm in width.

The sparse evidence previously available suggested that nesting is concentrated in late winter and early spring. Strong territoriality and birds carrying nesting material had been observed in February (Castellanos and Rodríguez-Estrella 1993), and immatures had been seen in late April and early May (McLellan 1926, Santaella and Sada 1991).

Our observations confirm that many *Mimodes* pairs nest in early spring. Four of the five nests described above were active when discovered by JEMG between 29 March and 20 April 1994. Except for two breeding females, all parents at these nests had received color bands, which helped us to determine the identity of the birds involved in the different nesting activities. By following the banded adults, we found the empty fifth nest on 14 April, in a territory where on 28 March we banded one of two fledglings that may have fledged within the same territory. We also found two nests with three eggs on 7 and 20 April. At these nests, only females were seen incubating. Both nests failed after the females incubated the eggs for at least seven and twelve days respectively; in the latter, the unbanded female disappeared suddenly. The two other nests contained nestlings at the time of discovery. We found one of these on 29 March when the nestling period was fairly advanced; two chicks remained at the nest for at least six days. One chick was color banded on 3 April; on 2 June we saw this bird in a territory 1.6 km from its nest. Of the four nests observed with contents, only this nest is known to have successfully fledged young. The other nest with young contained two recently hatched nestlings and one egg on 11 April. We had seen the banded female from this nest carrying lining material (small, thin pieces of bryophyte) in this vicinity on 23 March; from this, and assuming that eggs are laid in successive days, we estimate an incubation period of no more then 15 days. On 14 April the nest contained three nestlings; the youngsters differed markedly in size. Five days later the youngest chick was absent, and the nest was empty by 23 April. We do not know if these young successfully fledged. If they did, it would indicate a nestling period of 14 days or less.

We also gathered additional evidence that may suggest that the population as a whole has a more extended breeding season. By examining the proportions of banded birds in juvenile, immature, and adult plumage, we conclude that some nesting may take place from November through July. We have found juveniles with spotted breasts from January through July, and immatures with clear breasts and brown irides from February through August. The existence of museum specimens in spotted juvenal plumage in December, January, and

March (K. Parkes, pers. comm.) further supports the possibility of an extended or variable breeding season. In order to reach a clearer understanding of the timing and duration of the complete nesting season, we need to determine the length time needed for the breasts spots characteristic of juvenile Socorro Mockingbirds to disappear.

We watched the foraging activities of the parents at least once for each nest for one hour. Parents perched on branches of *Oreopanax xalapense* and *Meliosma nesites* near their nests while hunting insects. The mockingbirds sat and visually inspected the nearby areas; when a suitable prey was located, the birds left the branch with a powerful flight toward the target. In some occasions the mockingbirds chased the insects flying through branches and bushes in a way that resembled the flight of *Accipiter* hawks. They also searched for insects on the ground. Mockingbirds also foraged in tree canopies when searching for fleshy fruits; they gleaned and probed their beaks on branches with epiphytes. Only putative parents, and no helpers, fed the broods we observed. Parents brought small insects, moths, small butterflies, which were abundant at the time, and caterpillars. We saw no parents carrying whole fruits to the nest in their beaks, but mockingbirds were feeding on the large fruits of *Bumelia* and *Ilex* at the time, and some may have regurgitated fruit pulp to the nestlings. On one occasion, a male arrived at the nest tree and gave a faint call, after which the brooding female left the nest and the male fed the chicks.

Of the four active nests where we found eggs or nestlings, three may have been lost to predators. Red-tailed Hawks (*Buteo jamaicensis soccoroensis*) are likely predators on nestlings and incubating females because some nests were placed near the crown edge. Furthermore, hawks frequently approached us, when we were moving through the vegetation searching for nests, and landed in the tree crowns in a manner that suggested they were hunting. Hawks also approached when mockingbirds we were banding gave distress calls. The endemic *Buteo* is known to prey on shearwaters and Northern Mockingbirds, as well as lizards and lambs (Whetje et al. 1993). Our observations confirm this hawk's potential for preying on nesting birds: on 12 January 1993, we saw a hawk emerge from dense vegetation carrying an adult Townsend's Shearwater. This occurred at high elevation on Socorro's north side, where many shearwater burrows are located (Whetje et al. 1993).

Feral introduced cats probably also prey on mockingbird fledglings, which perch on and near the groud, and are incapable of flight, for several days after leaving the nest. Because adults often forage on the ground, cats may take them as well. Rodríguez-Estrella et al. (1991) argued that predation on birds by cats on Socorro was not very important because only 22.6% of the 31 cat scats they examined had bird remains, including one with remains of *Mimodes* (the authors reported no details about the evidence from this scat). Rodríguez-Estrella et al. (1991) based their conclusion in part on data suggesting that cats were most abundant near the coastal naval base, though they also cited evidence that the distribution of cats was expanding. Our findings suggest that cats currently pose a more serious threat to the island avifauna. We found cat signs at all elevations. We examined stomach contents of 16 trapped cats and found two containing Rufous-sided Towhees (*Pipilo erythrophthalmus socorroensis*), although most remains were of arthropods and of the endemic lizard (*Urosaurus auriculatus*). We also examined 16 cat scats; in 14 (88%) we found bird remains, including Townsend's Shearwaters (*Puffinus auricularis*), Rufous-sided Towhees, Tropical Parulas (*Parula pitiayumi graysoni*), and Socorro Wrens (*Thryomanes sissonii*). We also found several Townsend's Shearwater carcasses on the ground torn apart in a manner that suggests cat predation (cf Veitch 1985); similar evidence of cat predation on shearwaters was found by Jehl and Parkes (1982).

The fact that we found arboreal nests of Socorro Mockingbirds argues against the idea that the decline of this species was caused by cats preying on ground nests, as conjectured—

without any knowledge of the nesting of *Mimodes*—by Jehl and Parkes (1983), or by trampling of nests by sheep. Predation by cats is more likely to occur on fledglings and, possibly, on adults. Nevertheless, it is necessary to determine other potential causes of nest failure, potential nest predators, and predation rates to evaluate the role of predation on the population structure of *Mimodes*. Because we found nests in montane forest areas where sheep impact has been moderate, our observations suggest that the decline of *Mimodes* was caused mainly by habitat destruction: suitable nesting habitat is lacking in highly overgrazed areas, because such habitat no longer provides the relatively unbroken shrubby ground cover and moderately dense trees that Socorro Mockingbirds appear to prefer for nesting. We advocate immediate implementation of a program to eradicate sheep and cat populations on Socorro; these actions may be required in order to avert the extinction of *Mimodes* and other native species such as Townsend's Shearwater considered at risk (Collar et al. 1992).

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Exceptional response by female Red Crossbills to dietary carotenoid supplementation.—Carotenoid-based pigmentation accounts for much of the yellow, orange, and red coloration of feathers (Brush 1978, Goodwin 1984). It has long been known that animals cannot synthesize carotenoid pigments *de novo* and must obtain such pigments from their diet (Giersberg and Stadie 1933, Brockmann and Völker 1935, Brush 1978, Goodwin 1984). However, the extent to which dietary access to carotenoid pigments can affect individual expression of plumage coloration and can generate variation in color expression within a populations has only recently been emphasized (Brush and Power 1976, Hill 1992, 1993a,b). While the brightness or hue of carotenoid-based plumage can be altered by diet, the distribution of pigmentation across the surface of a bird (i.e., the pattern of coloration) is not generally affected by diet (Hill 1993a). Similarly, in the few species that have been studied, differences between the sexes in expression of carotenoid-based integumentary coloration are not affected by dietary access to carotenoid pigments (Miskimen 1980, Burley et al. 1992, Hill 1993b). Here we report a dramatic change in the plumage coloration of female Red Crossbills (*Loxia curvirostra*) that were fed a diet rich in canthaxanthin during molt.

The Red Crossbill is a sexually dichromatic cardueline finch. Adult males have carotenoid-based ornamental coloration (Völker 1957) over their entire body plumage that varies in appearance from drab yellow to bright red (Tordoff 1952, Jollie 1953, Kemper 1959, Phillips 1977). Most males in definitive plumage are reddish-orange in coloration (Kemper 1959). Females are dull olive-gray to yellow-gray with faint streaking on their flanks and breast that is lacking in adult males (Jollie 1953, Phillips 1977). A few females show a wash of red coloration (Jollie 1953, Phillips 1977). In the wild, however, there is no overlap in the coloration of males and females: the most drably plumaged male is brighter and redder than the most brightly plumaged female (Tordoff 1952, Jollie 1953, Kemper 1959, Phillips 1977).

We used diet supplementation to test the effect on plumage coloration in male and female Red Crossbills. Diets were enhanced with red carotenoid pigments during pre-basic molt. Six male and three female Red Crossbills of call type 5 (Groth 1993) were captured 18-19 September 1993 near Aspen, Colorado, and four male and three female Red Crossbills of call type 2 (Groth 1993) were captured near Los Alamos, New Mexico 5-6 October 1993. Female crossbills of call type 5 were sexed by presence of a brood patch at the time of capture. Females of call type 2 were sexed by plumage. The birds were divided by call type and housed on the campus of New Mexico State University, Las Cruces, in an indoor room that was divided with 1.2 cm mesh screen into two 1.55 × 2.74 × 2.24 m aviaries. Birds were provided with grit and with water containing vitamins and calcium supplement. Fresh cones, usually ponderosa pine (*Pinus ponderosa* var. *scopulorum*), were provided daily, supplemented with sunflower seeds. Fresh pine branches were provided weekly. The red carotenoid pigment canthaxanthin was added to the drinking water of birds in the form of