SHORT COMMUNICATIONS

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NEST-SITE CHARACTERISTICS OF THE SOCORRO GREEN PARAKEET[1]

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The Socorro Green Parakeet (*Aratinga holochlora brevipes*) has been previously considered a threatened species (CIPAMEX 1988, Collar and Juniper 1992, Collar et al. 1992). Rodríguez-Estrella et al. (1992) recently studied the status of this species and found that although its distribution on the island has decreased during recent decades, it is still common. However, increasing habitat degradation produced by sheep overgrazing may severely affect this endemic parakeet in the near future, as well as most of the endemic avifauna of the island (Rodríguez-Estrella et al., in press). Thus, information on the ecology of the species will be valuable for management plans to protect the biodiversity of the island. As there is no published information on the nesting habits of the Socorro Green Parakeet and little is known of its biology (Friedmann et al. 1950, Alderton 1991), we present information on its nesting habits and nest-site characteristics.

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STUDY AREA AND METHODS

Isla Socorro, the largest and most diverse of the four islands comprising the Revillagigedo Archipelago, is located in the Pacific Ocean approximately 450 km southwest of the tip of Baja California. Detailed descriptions of the island may be found in Miranda (1960) and Levin and Moran (1989). Socorro has an estimated area of 140–170 km^2 of remaining tropical vegetation. The Green Parakeet was found commonly in forest habitat (Rodríguez-Estrella et al. 1992). A search for nests was made from 19 to 24 November 1990 and from 1 to 5 December 1992. Nests were found by following groups of parakeets and observing their behavior. Areas that consistently contained groups of parakeets were closely examined for nests, and all nest trees found were climbed to check nest contents. Nest-site characteristics that were measured included plant species, crown cover and height of the nest-tree, height of the nest entrance, dimensions of the cavity entrance, depth of nest cavity, hole orientation, and elevation.

We also measured the vegetation structure of the forested areas where parakeets were frequently observed foraging and where nests were found. Two plots of 0.1 ha each were measured; only individuals taller than 0.5 m were counted for each plant species. Density

TABLE 1. Nest-tree characteristics of the Socorro Green Parakeet. All the nests were in *Bumelia* trees. Measurements are given in meters.

Nest	Height of tree	Height of nest entrance	Diameter of nest entrance	Depth of nest cavity	Cover tree-nest[1]	Hole orientation	Elevation
1	8.0	3.0	0.16 × 0.14	0.95	10.0 × 9.5	S	565
2	11.5	3.2	0.15 × 0.10	1.00	14.5 × 8.9	SW	575
3	6.5	2.3	0.18 × 0.15	1.00	11.3 × 5.3	SW	570
4	9.0	3.8	0.17 × 0.13	0.90	12.6 × 11.7	SW	550
5	6.3	2.5	—	1.50	16.3 × 9.4	SW	645
6	12.0	3.8	—	1.00	14.0 × 11.0	SW	625
7	15.0	2.6	0.15 × 0.15	1.00	18.5 × 16.9	S	620
Range	6.3–15.0	2.3–3.8	0.15–0.18 × 0.10–0.15	0.9–1.0	47.0–245.5	S-SW	550–645
$\bar{x} \pm$ SD	9.7 ± 3.2	3.1 ± 0.6	0.16 ± 0.01 × 0.13 ± 0.02	1.0 ± 0.2	117.9 ± 62.5		592.8 ± 36.4

[1] Calculated according to the formula of an ellipse: $C = \pi \cdot 2.5 \cdot d_1 \cdot d_2$; where d_1 is the largest crown diameter and d_2 the diameter perpendicular to d_1.

TABLE 2. Structural features of the forests where Socorro Green Parakeets were present (modified from Rodríguez-Estrella et al., in press).

Tree species	Mean height (m)	Crown cover (m^2/ha)	Crown cover (%)	Abundance	Density (plant/ha)	Density (%)
Site 1 (540 m elevation)						
Bumelia socorrensis	9.41 ± 2.15	4,420.38	32.40	7	70	5.51
Dodonaea viscosa	2.74 ± 0.87	2,408.42	17.65	56	560	44.09
Ficus cotinifolia	6.00	1,554.15	11.39	1	10	0.79
Guettarda insularis	5.14 ± 1.91	1,747.23	12.81	11	110	8.66
Ilex socorroensis	4.50 ± 0.61	610.25	4.47	4	40	3.15
Psidium aff. *sartorianum*	3.50	428.83	3.14	1	10	0.79
Psidium socorrense	2.66 ± 1.94	2,472.73	18.13	47	470	37.01
Site 2 (740 m elevation)						
Bumelia socorrensis	3.49 ± 3.17	1,525.10	5.25	7	106	6.03
Forestiera rhamnifolia	3.50	223.72	0.77	1	15	0.86
Guettarda insularis	4.24 ± 1.86	5,367.13	18.46	41	621	35.34
Ilex socorroensis	6.75 ± 1.89	7,666.32	26.37	26	394	22.41
Meliosma nesites	5.83 ± 3.17	3,457.18	11.89	12	182	10.34
Oreopanax xalapense	6.86 ± 1.92	9,884.83	34.00	25	379	21.55
Rhamnus sharpii	8.00	842.52	2.90	1	15	0.86
Unknown 1	2.27 ± 0.53	104.84	0.36	3	45	2.59

of dominant plant species, height of the trees and crown cover were calculated for a 1,000 m^2 area. Size of the areas was calculated by the Minimal Sample Area method (Mueller-Dombois and Ellenberg 1974).

RESULTS AND DISCUSSION

All parakeet nests found were in *Bumelia socorrensis* (Table 1). The nest-trees ranged from 6.3 to 15.0 m in height and exhibited wide crown covers. The parakeets used the natural holes in large branches as nest cavities. Most of the nest-holes showed a southwestern orientation. As we did not measure availability of natural cavities, we were unable to determine if any selection on cavity orientation was made by parakeets. Apparently the parakeets have a strong fidelity to nesting sites because three nests that were used in 1990 were reused in 1992. An examination of the structural features of the forests inhabited by Socorro parakeets indicated that the species was using areas with wide crown-cover trees 7–9 m tall, although some trees reached 15 m (site 1 and 2; Table 2). The forest where nests were found was dominated by *B. socorrensis, Psidium socorrensis, Guettarda insularis, Ilex socorrensis* and *Ficus cotinifolia* (site 1; Table 2). This forest type is located between 350 and 850 m elevation, and covers approximately 22% of the island. Nest-trees were located above 550 m elevation in the south-central area of the island (Table 1). Although groups of parakeets were also observed on the north side of the island at lower elevations, and they actively performed social interactions, we were unable to search for nests in this region because the extremely thick brush restricted the access.

Two nests were empty at the end of November 1990, although one adult was continuously observed inside the cavities, suggesting that incubation could begin soon (see Rodríguez-Estrella et al. 1992). On 4 December 1992, three nests contained one chick each, approximately 7–10 days old. Two other possible nests were empty at the time, but breeding was likely as adults flushed from the holes when we approached the nest-trees. Thus, breeding season of the Socorro Green Parakeet seems to begin in November, but the end of the breeding season remains unknown.

The Socorro Green Parakeet appears to be dependent on forest conditions for reproduction as nesting and feeding activities were mostly carried out in this vegetal association (see also Rodríguez-Estrella et al. 1992). Thus, the conservation of the Green Parakeet on Isla Socorro, as well as other species (see Castellanos and Rodríguez-Estrella 1993), depends on the conservation of forest vegetation.

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NEST SITE SELECTION BY EARED GREBES IN A FRANKLIN'S GULL COLONY: STRUCTURAL STABILITY PARASITES[1]

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The adaptive significance of birds nesting in colonies relates to predation and resource allocation. Birds that breed together may also provide social stimulation which increases reproductive synchrony and exposes eggs and young to predators for a shorter period of time (Burger 1981, Wittenberger and Hunt 1985). Further, nesting in colonies may allow individuals to forage more efficiently (Ward and Zahavi 1973, Waltz 1982).

Mixed-species nesting assemblages provide the same advantages, while possibly reducing competition for space and food (Krebs 1974). Species may also derive a protective advantage from nesting with more aggressive species (Koskimies 1957, Cullen 1960, Erwin 1979, Burger and Gochfeld 1990). Observing that Western Grebes (*Aechmophorus occidentalis*) derive early warning benefits from nesting with Forster's Terns (*Sterna forsteri*), Nuechterlein (1981) proposed that the grebes are information parasites, since they derive early warning from the anti-predator calls of the terns. Similarly, Silver (*Podiceps occipitalis*) and Rolland's (*Rollandia nigricollis*) Grebes derive anti-predator advantages from nesting with Brown-hooded Gulls (*Larus maculipennis*), and thereby have higher reproductive success than grebes that nest in monospecific colonies (Burger 1984).

Herein we examine nest site selection of Eared Grebes (*Podiceps nigricollis*) nesting in a Franklin's Gull (*Larus pipixcan*) colony in northwestern Minnesota. We suggest that the grebes not only derive early warning information and anti-predator behavior from the gulls, but that they also derive nest stability not otherwise available from the sparse vegetation in an open water marsh.

Eared Grebes assemble floating nests (Palmer 1962) and are known to associate with larids throughout their breeding range (Cramp 1977, Nuechterlein 1981, Boe 1993). Recently Boe (1992) examined wetland selection by Eared Grebes and compared 26 wetlands used by grebes with 26 wetlands not used. Colonies were generally in marshes with water less than 3 m deep, and they avoided marshes with public access and fishing. However, the selection of nest sites with respect to larid nests has not been examined in detail. Grebes could nest in a relatively monospecific clump within the larger gull colony, or their nests could be truly intermixed with the gull nests.

METHODS AND STUDY AREA

In May 1994 we examined nest site selection in one of two Eared Grebe colonies found nesting with Franklin's Gulls at Agassiz National Wildlife Refuge, Marshall County, Minnesota. We estimate that the mixed colony contained about 40,000 pairs of gulls. The birds nested in Agassiz Pool, where there was emergent veg-

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