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WESTERN SCRUB-JAY BREEDING BIOLOGY IN CENTRAL COLORADO

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ABSTRACT.—The breeding ecology of the Western Scrub-Jay (*Aphelocoma californica*) in the midwestern United States is relatively unknown compared with *Aphelocoma* species in other geographic regions. We examined Western Scrub-Jay breeding biology in Colorado between 1970 and 1992. Incubation was initiated in early April and lasted 16 days, while the nestling stage lasted approximately 17–18 days. Clutch size averaged 4.0 eggs per nest, reproductive success was 25%, and productivity averaged 0.66 fledglings per nest. The low reproductive success and productivity measures may be due to high predator densities in the surrounding suburban landscape. Western Scrub-Jays preferred nesting in eastern red cedar (*Juniperus virginianus*) with nests placed on southern exposures. Western Scrub-Jays bred monogamously and were more similar in their breeding biology to the Island Scrub-Jay (*Aphelocoma insularis*) than to the Florida Scrub-Jay (*Aphelocoma coerulescens*).

Key words: Western Scrub-Jay, Island Scrub-Jay, Florida Scrub-Jay, breeding phenology, territory sizes, reproductive success, productivity.

The Western Scrub-Jay (*Aphelocoma californica*) inhabits pinyon-juniper and scrub oak woodlands in western North America; however, Western Scrub-Jay populations have been declining in pinyon-juniper woodlands (Sauer et al. 2001). While breeding activities of the closely related, cooperatively breeding Florida Scrub-Jay (*Aphelocoma coerulescens*) and Island Scrub-Jay (*Aphelocoma insularis*) have been relatively well studied (Atwood 1980, Woolfenden and Fitzpatrick 1984, Atwood et al. 1990, Woolfenden and Fitzpatrick 1990, Breininger et al. 1996, Breininger 1999), there are few published data on breeding activities of Western Scrub-Jays in pinyon-juniper/scrub oak habitats. The primary objectives of this study were to gather basic breeding data concerning (1) breeding densities and territory sizes, (2) breeding phenology, (3) reproductive success, (4) nest productivity data, and (5) nest microsite characteristics for a Western Scrub-Jay population in central Colorado.

STUDY SITE

The Garden of the Gods, a city park owned by Colorado Springs (38°51′17″N, 104°52′39″W), consists of massive red sandstone hogbacks and outcrops that dominate the landscape. This region receives an average of 20.2 cm of precipitation annually, and summer temperatures range from 21°C to 28°C. We focused our observations on 33 ha in the south central portion of the park, which is directly adjacent to suburban housing. In general, slopes are south-facing, with alternating ridges and valleys that run north–south. The study site is dominated by clonal stands of scrub oak (*Quercus gambelii*) interspersed with meadow. Additionally, the study area is dotted with pinyon pine (*Pinus edulis*), eastern red cedar (*Juniperus virginianus*), one-seeded juniper (*J. mexicana*), and a few large ponderosa pine (*Pinus ponderosa*). Other shrubs commonly present are mountain mahogany (*Cercocarpus montanus*), three-leaved sumac (*Rhus aromatica*), and berry and currant bushes (*Ribes* and *Rubus* spp.).

Possible predators in the park include the coyote (*Canis latrans*), red fox (*Vulpes fulva*), domestic cat (*Felis domesticus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and fox squirrel (*Sciurus niger*). Common avian species include many corvid species: Black-billed Magpies (*Pica pica*), Pinon Jays (*Gymnorhinus cyanocephalus*), Common Ravens (*Corvus corax*), Common Crows (*Corvus brachyrhynchus*), and Blue Jays (*Cyanocitta*

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cristata). Finally, possible reptilian predators include garter snakes (*Thamnophis elegans* and *T. radix*), bull snakes (*Pituophis melanoleucas*), and prairie rattlesnakes (*Crotalus viridis*)

METHODS

Between 1974 and 1991, BLW banded 114 jays with an aluminum USFWS band and 2 colored plastic leg bands to help facilitate identification of individual birds. During 1990 and 1991 we mapped nests, recorded territorial interactions, and determined territory sizes based on these data. Although Western Scrub-Jays are very secretive during nest-building (Bent 1946), we monitored the study area intensively during these breeding seasons and are confident that we missed few active breeding pairs.

We observed Western Scrub-Jay breeding activities annually in the Garden of the Gods between late March and late July. We determined breeding phenologies by locating nests and then visiting them throughout the breeding cycle. The nests, which we did not flag, were relocated using detailed maps. We visited nests on approximately 3- to 5-day cycles and quantified the number of eggs, hatchlings, and fledglings for each nest. We determined productivity (the number of fledglings per nest) and reproductive success (the number of nests succeeding in fledging at least a single young) through observation of parental and fledgling activity. Because parents were most often banded, we were able to assess the success and/or failure of individual nests throughout the breeding cycle.

In addition to examining breeding parameters, we recorded nest microsite characteristics. In particular, we recorded the species of the nest tree as well as nest height and orientation. Using a chi-square test, we noted (1) whether Western Scrub-Jays selected particular tree species, and (2) whether nest-site orientation differed among trees. We were unable to perform a chi-square test on the relationship of tree species and nest orientation compared with nest success due to sample size issues that invalidate this test (Zar 1984). We used a 1-way ANOVA to examine the relationship between nest height and nest success as well as the relationship between nest height and tree species. We were unable to use the Mayfield method (Mayfield 1975) to analyze nest success data as the raw data necessary for this analysis were unavailable.

RESULTS

We monitored 61 nests between 1971 and 1992. Western Scrub-Jays in Colorado typically initiated nest-building activities in April, but some were noted beginning building nests as late as 23 May. Incubation typically lasted 16 days and hatchlings fledged after a 17- to 18-day period. The average clutch size for Western Scrub-Jays was 4.0 (±1.1); productivity averaged 2.8 (±1.5) fledglings per successful nest and 0.66 (±1.3) fledglings for all nests. Reproductive success was 25% and renesting was rare: only 9% of failed nest attempts were subsequently followed by a renesting attempt. Predation was a major cause of nest loss, causing almost equal losses during the egg (48%) and the hatchling stage (52%). Breeding territories, which averaged 1.87 ha in size, were determined for breeding Western Scrub-Jays in 1990 and 1991 ($n = 21$). Over the course of the 22-year study, we never observed cooperative breeding behavior.

Western Scrub-Jays used a variety of nesting substrates and orientations in our study site but preferred nesting in eastern red cedar ($\chi^2 = 17.2$, $P < 0.01$). Over half of all nests were located within cedars (54%), and scrub oak and pinyon pine were each used in 21% of nesting attempts. The few remaining pairs nested either in one-seeded junipers or ponderosa pine. Nest heights averaged 1.7 m (±0.67), and nest height did not differ significantly among tree species ($F = 1.1$, $P = 0.32$). Additionally, nest success did not vary with nest height ($F = 0.77$, $P = 0.39$). Nest orientation differed significantly from random ($\chi^2 = 9.8$, $P < 0.01$), with nests occurring more on the southern side of trees.

DISCUSSION

Western Scrub Jay breeding activities more closely resembled those of Island Scrub-Jays than Florida Scrub-Jays. For instance, the average territory size for Western Scrub-Jays in Colorado was similar to the 2-ha territories noted by Atwood (1980) for Island Scrub-Jays. Woolfenden and Fitzpatrick (1990) noted territory sizes averaging 9 ha for Florida Scrub-Jays, but differences in territory size when

comparing different *Aphelocoma* species are likely due to cooperative breeding activities of Florida Scrub-Jays. Territories for Western and Island Scrub-Jays are likely smaller because these *Aphelocoma* species do not support helpers (i.e., mature nonbreeders) at the nest (Atwood 1980, this study).

Breeding phenology for Western Scrub-Jays closely resembled that reported elsewhere. Atwood (1980) notes that the peak incubation period of Island Scrub-Jays occurs in late March and early April. Woolfenden and Fitzpatrick (1984) record a similar phenology for Florida Scrub-Jays. Schaub et al. (1992) report an 18-day incubation period and fledging after an additional 18 days for Florida Scrub-Jays, and Harrison (1979) noted a 16-day incubation period for all *Aphelocoma* species.

Clutch sizes for Western Scrub-Jays (4.0 ± 1.1) were similar to other reported values for mainland *Aphelocoma* species (e.g., clutch size = 4.47 for California mainland Scrub Jays; Atwood 1980); in general, mainland clutch sizes reported here and elsewhere (e.g., Atwood 1980) are higher than those reported for Island Scrub-Jays or for Florida Scrub-Jays (Woolfenden and Fitzpatrick 1984). However, reproductive success and productivity of Western Scrub-Jays in Colorado were relatively low compared to other *Aphelocoma* species. For instance, Florida Scrub-Jays with helpers fledged approximately 2.5 fledglings per pair while those without helpers fledged an average of 1.6 per pair (Woolfenden and Fitzpatrick 1990). Helpers can decrease predation rates (Schaub et al. 1992), predation being a major factor influencing nest success (Martin 1995). We did not observe cooperative breeding behavior, but nest failures in the Western Scrub-Jay population in Colorado resulted primarily from predation. The relatively low reproductive success and productivity in the Colorado site may have been influenced by the surrounding landscape. Predation rates on nests have been noted to be high in areas adjacent to suburban activities due to higher predator densities (Vierling 2000), and the Colorado study site was directly adjacent to a suburban housing development. While the influence of landscape on Western Scrub-Jay populations has yet to be examined, the influence of landscape on Florida Scrub-Jay demographics has recently received heightened attention (Breininger et al. 1996, Breininger 1999).

Nest-site orientation was not related to predation, but it may be associated with other factors. For instance, nest-site selection on southern exposures has been observed in both Pinon Jays (*Gymnorhinus cyanocephalus*) and Evening Grosbeaks (*Coccothraustes vespertinus*). Southern-exposure nest-site selection for these species was related to thermoregulation and protection from prevailing winds (Balda and Bateman 1972, Bekoff et al. 1987).

The applications of these data are limited due to small sample sizes and a single study site, but the study provides new information on basic demographic variables of Western Scrub-Jays that were previously unknown. Additional demographic information on Western Scrub-Jays breeding in different habitats and geographic locations will be important as landscapes continue undergoing change.

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