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BURROW NESTING BY COMMON BARN-OWLS IN NORTH CENTRAL COLORADO[1]

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The Common Barn-Owl (*Tyto alba*) is flexible in its selection of nest sites. Such plasticity is adaptive because barn-owls generally show no tendency to construct nests of their own. In contrast to what was believed to be typical behavior, Martin (1973) watched barn-owls excavate a nest burrow in an arroyo wall in New Mexico. Everman (1882) and Dawson (1923) studied barn-owls nesting in arroyo cavities in California, and they surmised nest cavities were excavated by the owls but provided no substantiation. None of these authors commented on possible reasons barn-owls used cavities in arroyo walls, but Martin (1973) noted that no barns or large trees were present on his study area.

In north central Colorado barn-owls nest in cavities in arroyo walls even though buildings, cliffs, and trees with large cavities are available. In this note, we report observations on this Common Barn-Owl population that may help explain burrow nesting in this species.

STUDY AREA AND METHODS

Our study was conducted on a 1,740 km² area in eastern Larimer and western Weld counties, Colorado, in 1977 and 1978. The eastern two-thirds of the study area were dominated by short grass prairie interspersed with riparian communities of cottonwood (*Populus* spp.) and willow (*Salix* spp.), and cattail (*Typha latifolia*)-sedge (*Scirpus* spp. and *Eleocharis* spp.) marshes. The western one-third of the area consisted of hogbacks and foothills vegetated by mountain mahogany (*Cercocarpus montanus*), skunk bush (*Rhus trilobata*), and rabbitbrush (*Chryothamnus* spp.). During our study, summer daytime temperatures occasionally exceeded 38°C, and spring lows were often below −17°C. High solar radiation resulted in rapid diurnal heating and substantial nocturnal cooling.

We searched the study area for Common Barn-Owls beginning in early March 1977 and in late February 1978. Overall, we checked 74 barns, silos, and outbuildings; 12 km of gallery riparian forest; 9 km of cliff; and 25 km of arroyos. Some nest sites on cliffs were probably overlooked, but we believe most breeding Common Barn-Owls were found. At nests in arroyo walls we took several cavity measurements, and simultaneous ambient and cavity temperatures were recorded over 24 hr at three nests in July 1977, and at one nest in April 1978. Cavities sampled varied in several respects. Cavity A had a SSW aspect and contained no barn-owls when sampled; internal temperatures were obtained at the full depth of 90 cm on 14 to 15 July. Cavity B had an ENE aspect and contained six nestlings; internal temperatures were taken at the full depth of 132 cm on 15 to 16 July. Cavity C had a SSE aspect and contained three nestlings in July and none in April; internal temperatures were taken at full depth (160 cm) and one-half full depth (80 cm) on 16 to 18 July, and at the full depth on 25 to 26 April. All temperatures were obtained using a calibrated thermograph with remote probes. In January and February 1978, we placed barn-owl nest boxes (design by Prescott 1974) on arroyo walls within 35 m of seven cavities used in 1977. Boxes were placed at the same height and aspect as the cavity at each site.

All nests were inspected every 7 to 10 days. Nesting chronology and productivity were determined; all young and most adults were banded with U.S. Fish and Wildlife Service bands.

RESULTS AND DISCUSSION

Barn-owls were first observed on the study area on 15 March each year. Overall, we located 14 occupied nest sites (two or more owls at a suitable nest site) in 1977 and 10 in 1978. Number of young fledged per successful nest site (nest sites fledging young) ranged from two to six in 1977 and two to seven in 1978 (Table 1). Young fledged from July to early September. We found no barn-owls on the study area after 21 September. Three barn-owls we banded were recovered during au-

TABLE 1. Productivity statistics of Common Barn-Owls in north central Colorado, 1977 to 1978.

Year	n[a]	Mean (SE)/occupied nest site: Clutch size	Brood size	Fledglings	No. successful nest sites[b]
1977	14	4.6 (0.4)	3.0 (0.7)	2.3 (0.6)	8
1978	10	5.3 (0.8)	4.0 (0.7)	3.9 (0.8)	8

[a] Sample size is the number of occupied nest sites. Included are two sites (one in 1977 and one in 1978) where no eggs were laid.
[b] Occupied nest sites were suitable sites where two or more owls were present during the breeding season. Successful nest sites were occupied nest sites from which young fledged.

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TABLE 2. Mean dimensions of burrows used by Common Barn-Owls in north central Colorado, 1977 to 1978.

	Mean/SE			Mean/95% CI
		Entrance hole		
Burrow origin	Depth (cm)	Height (cm)	Width (cm)	Entrance height (%)[a]
Unknown	126.1	40.0	38.7	87.6
(n = 14)	16.0	2.8	5.0	81.7–92.4
Owl-excavated	96.9	31.6	33.2	89.5
(n = 2)	39.1	2.4	6.9	84.5–91.6

[a] Height of burrow entrance/total arroyo wall height. Means were calculated using the angular transformation (Sokal and Rohlf 1981). Dispersion statistics are 95% confidence intervals.

tumn and winter. All were south of the study area, including two females banded as breeders that were recovered in winter 700 km SE in southwest Texas. These observations suggest at least portions of our study population were migratory.

In 1977, 13 nests were located in cavities in arroyo walls and one in a cave in a cliff. In 1978 nine nests were located in cavities in arroyo walls and one in a cliff cave. Only one of the nest sites found in 1978 was not used in 1977. We found signs (feathers, egested pellets) that barn-owls occasionally roosted in seven (12.1%) of 58 barns and five (31.3%) of 16 silos checked, but none were used recently for nesting. We found no evidence that barn-owls used tree cavities for nesting. Seemingly suitable alternative nest sites (based upon previous experience with >25 barn-owl nests) were present within 1 km of 80% of the barn-owl nests in cavities in arroyo walls. No suitable arroyo walls were present within 1 km of the single barn-owl cliff nest.

None of the seven nest boxes put out for barn-owls before the 1978 breeding season were used for nesting. At two of these breeding areas barn-owls occasionally roosted in or on boxes. Two cavities used in 1977 collapsed overwinter; owls excavated and nested in new cavities at both locations in 1978 (see below) even though boxes were available.

Sixteen different arroyo-wall cavities were used for nesting by barn-owls. All cavities were similar, consisting of a round opening extending horizontally into the soil wall and ending in an enlarged chamber where eggs were laid. We observed barn-owls excavating two burrows in 1978 at sites where 1977 burrows had collapsed. One burrow was completed in four nights, the other in nine. Mean dimensions of these burrows did not differ substantially from those of the other 14 arroyo-wall cavities of uncertain origin (Table 2).

Directional exposure of arroyo walls with nest cavities appeared random ($\chi^2 = 2.50$, $0.25 < P < 0.50$, df = 3). There was no significant difference in mean depth among cavities that received full morning sun ($n = 5$), full afternoon sun ($n = 7$), and no direct sun ($n = 4$) (one-way ANOVA; $F = 1.78$; $0.20 < P < 0.50$; df = 2,14).

At the three nests where temperatures were sampled in July, daily mean cavity temperature averaged 3.0°C (SE = 1.0°C) cooler than ambient temperature (Fig. 1). Daily range in ambient temperature averaged 20.9°C

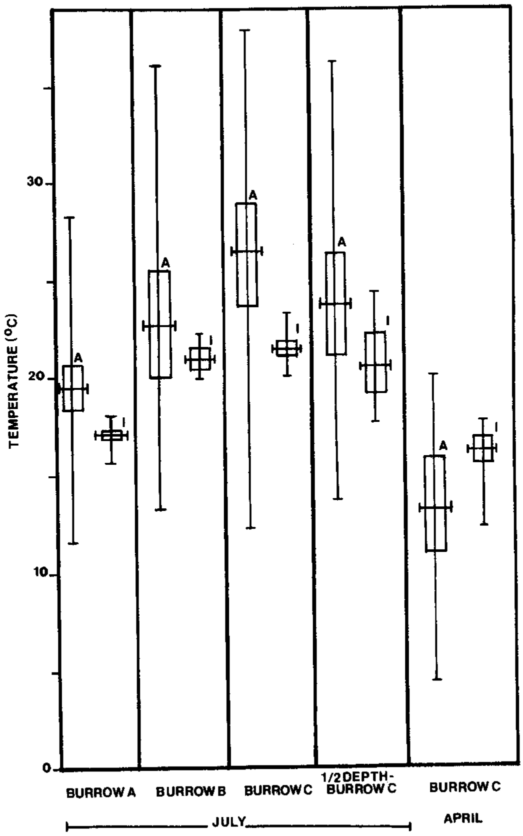

FIGURE 1. Comparisons of simultaneous within burrow (I) and ambient (A) temperatures over 24-hr sample periods. Horizontal bars are means, boxes are 95% confidence intervals, and vertical lines are ranges. For each comparison, n = 24 temperature readings taken hourly. All burrow temperatures were taken at the maximum burrow depth except as noted on the figure. Characteristics of each burrow are described in the text. Each burrow was sampled on a different day.

greater than daily cavity temperature range. July differences in temperature range and between ambient and cavity mean temperature were less at one-half full cavity depth at nest C. The single cavity sampled in April (C) averaged 2.8°C warmer than ambient temperature. Range in ambient temperature was 11.7°C greater than the range in cavity temperature.

Our observations suggest barn-owls chose to excavate burrows rather than use more typical nest sites on our study area. Although we only witnessed burrow excavation at two nest sites, we believe the practice was more widespread because the owl-excavated burrows were similar in mensural characteristics to burrows of unknown origin, and burrows of these dimensions were rarely found on our study area outside known barn-owl breeding areas. Two advantages burrows might offer over other nest sites are increased protection from predators (Wallace and Mahan 1975) and shelter from extreme temperature and weather conditions. Great Horned Owls (*Bubo virginianus*) are probably the chief predators of adult Common Barn-Owls on our study area (pers. observ.). Although burrows probably afford some protection, we found two adult Common Barn-Owls that were killed by Great Horned Owls in or at the mouths of their burrows. We do not believe protection from predators, at least Great Horned Owls, is greater at burrows than it would be at other potential nest sites.

Data presented suggest that burrows could provide a refuge from extreme ambient temperatures (−17°C to 38°C) characteristic of our study area during the breeding season. Barn-owls have a narrow thermoneutral zone, poor feather insulation qualities, and low fat reserves compared to other strigiforms (Piechocki 1960, Johnson 1974), and are particularly susceptible to low temperatures and heavy snow cover (Errington 1931, Smith and Marti 1976, Bunn et al. 1982, Marti and Wagner 1985). Both weather conditions are frequent on our study area in March and April. During periods of cold and food stress barn-owls roosting in burrows probably expend less energy on thermoregulation and are more likely to survive than owls in more poorly insulated shelters.

Burrows and cavities serve as climatic refuges for at least two other western North American strigiforms. Coulombe (1971) found that Burrowing Owl (*Athene cunicularia*) burrows sheltered the owls from heat stress and potentially desiccating aridity. Relative humidity in burrows was found to greatly exceed that in the ambient air due to effects of soil moisture (Coulombe 1971). Ligon (1968) postulated that cavities used by Elf Owls (*Micrathene whitneyi*) in saguaro cacti (*Carnegiea gigantiea*) protected them from ambient temperatures frequently in excess of the species' upper thermal maximum. Barn-owl burrows might function similarly in summer as refuges from high daytime temperatures and low relative humidities.

Barn-owls on our study area hatched a higher proportion of eggs than populations nesting in man-made structures for which comparable data are available (70% vs. a range of 42.3% to 62.3%; Otteni et al. 1972, Reese 1972, Smith et al. 1974, Bunn et al. 1982). Hatching success is partly dependant upon the physical and climatic environment of the nest site (Welty 1975), and the high egg hatchability of our study population might be attributable to the stable microclimate of burrows. However, reproductive parameters fluctuate greatly with prey availability in barn-owls (Otteni et al. 1972), and unknown differences in food availability between study areas could also account for observed differences in hatching success.

Our explanation for the selection of burrows by our study population rests on the assumption that burrows are better insulated than most alternative nest sites. We were unable to test this. We believe the assumption is valid given the high insulative properties of soils (Brady 1974), but additional studies comparing climatic parameters of burrow and other nest sites should be conducted.

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