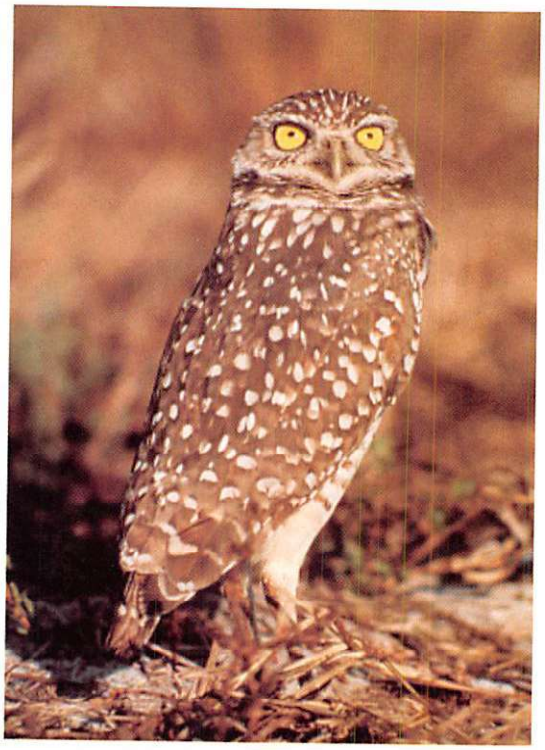
E. A. HAUG, B. A. MILLSAP, AND M. S. MARTELL

Speotyto cunicularia

Burrowing Owl

FRENCH:
Chevêche des terriers
SPANISH:
Lechuza llanera, Chicuate



People have long been fascinated with the Burrowing Owl, a ground-dwelling denizen of western grasslands and deserts and of the Florida Peninsula and adjacent Caribbean islands. The Zuni Indians called this owl the "priest of the prairie dogs" because it frequently nests and roosts in empty prairie dog burrows, and early European settlers were convinced that rattlesnakes often shared its nests. Unique among North American owls in many respects, this bird is active day and night and frequently nests in loose colonies in suburban and farmyard environments, making it a familiar owl and one generally appreciated by human residents. Such strong local interest in this species has been of great value where conservation efforts have been necessary to maintain or revive populations.

Small in body size and active both day and night, this owl is vulnerable to many different predators, both mammalian and avian. In addition, farming has taken a major toll on the bird and its habitat, destroying nesting burrows and exposing breeders and their young to the toxic effects of pesticides. Several introduction programs, combined with the use of artificial burrows, have helped to counter these threats.

The Birds of North America
Life Histories for the 21st Century

Although the Burrowing Owl is easy to find and watch during the summer breeding season, a fact that has encouraged numerous studies of its breeding biology, its life during migration and winter is essentially unknown.

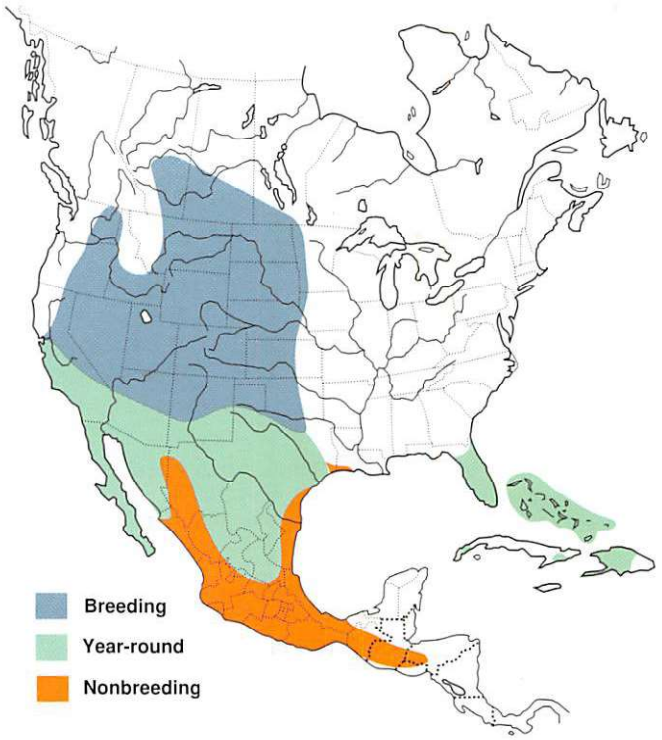


Figure 1.
Distribution of resident and migratory populations of the Burrowing Owl in North and Central America.

DISTINGUISHING CHARACTERISTICS

Small, ground-dwelling owl. Total length: males 19.5–25.0 cm, females 19.0–25.0 cm; mass about 150 g. Legs long and sparsely feathered below the tibiotarsal joint. Head round, lacking eartufts. Distinct oval facial ruff, framed by a broad, buffy-white eyebrow-to-malar stripe on the interior part. Iris usually bright lemon yellow. Wings relatively long and rounded, with 10 brown and buffy-white barred primaries (3 outermost with inner webs sinuated); tail short with 12 brown and buffy-white barred rectrices. Dorsum brown; back, scapulars, and crown profusely spotted with buffy white. Throat and undertail coverts white; remainder of underparts of adults buffy-white with broad brown barring on both sides. Females generally darker than males overall, particularly in worn plumage.

DISTRIBUTION

THE AMERICAS

Breeding range. Within the broad range limits in w. North America (Fig. 1), occurrence variable in open, well-drained grasslands, steppes, deserts, prairies, and agricultural lands. Also locally distributed throughout suitable habitat in Central and South America to Tierra del Fuego, and on Cuba, Hispaniola (including Gonave and Beata islands), the n. Lesser Antilles (St. Kitts, Nevis, Antigua, Redonda and Marie Galante), Bahama Islands, and in the Pacific Ocean off the west coast of Mexico (Isla Clarion, Revillagigedo, and Guadalupe; American Ornithologists' Union 1983).

Winter range. Much the same as breeding range, except that most apparently vacate northern areas of the Great Plains and Great Basin. Winter status in these areas not well understood. Even as far south as n. Arizona and New Mexico, present mainly in summer (Phillips et al. 1964, Hubbard 1978); but scattered winter records exist as far north as Montana (Skaar et al. 1985).

North of Florida and east of the Great Plains the species is accidental, but strays have appeared as far north and east as Ontario and New York. In Central America winters south through central Guatemala and central Honduras, but may breed locally in southern portion of winter range (Howell and Webb in press; Fig. 1).

RANGE OUTSIDE THE AMERICAS

None.

HISTORICAL CHANGES IN DISTRIBUTION

Extirpated from British Columbia in recent years; last confirmed sighting in 1979. Since 1983, >400 released in that province, 13 returned in 1992 (Haug et al. in press). Elsewhere in Canada and the n.-central U.S., range has contracted slightly southward, westward, and eastward (Haug et al. in press, Martell 1991). Reintroduction efforts being considered in Minnesota (Martell 1990). Reported as extirpated from the Caribbean islands of Antigua and Marie Galante (Am. Ornithol. Union 1957). In Florida, range has expanded northward, nearly to Georgia, since the 1950s (Courser 1979).

FOSSIL HISTORY

Speotyto (Athene) cunicularia has been reported from late Pleistocene (6.5 million years before present) and prehistoric sites in North, Central, and South America, and the West Indies (Brodkorb 1971: 226; Parmalee 1977: 197; Campbell 1979: 134; Olsen and Hilgartner 1982: 37).

The oldest and only fossil species related to the Burrowing Owl is *Speotyto megalopeza* (Ford 1966: 473) from the Blancan Canyon in Meade County, KS. This species has also been identified from about the same age deposits at Hagerman, ID (Ford and Murray 1967: 116). Ford (1967) concluded that *Speotyto* was distinct from *Athene* based on comparative osteology.

SYSTEMATICS

GEOGRAPHIC VARIATION

Not well studied. Measurements (Ridgway 1914) show largest birds from w. North America and s. South America; insular Caribbean populations (including Florida) intermediate; smallest nearest the equator. Plumage variable over year probably due to differential sun-bleaching in sexes (Martin 1973a, Millsap and Bear 1990); reports of geographic variation in color (e.g., darker color of Florida birds cited in Ridgway 1914) do not take this into account.

SUBSPECIES; RELATED SPECIES

Variously placed in the monotypic genus *Speotyto* or in *Athene*, where it has three congeners: *A. noctua*, *A. brama*, and *A. blewitti*. Placed in *Athene* by the American Ornithologists' Union in 1983 (Am. Ornithol. Union 1983), but currently placed in *Speotyto* based on karyotypic evidence (Am. Ornithol. Union 1991). Peters (1940) put it with other "typical" owls in the family Strigidae, subfamily Buboninae. *Athene* generally placed near *Ciccaba*, *Sceloglaux*, *Ninox*, *Micrathene*, *Surnia*, and

Glaucidium, based largely on external ear structure (Peters 1940, Burton 1973). From complete osteological review, Ford (1967) placed it in Tribe with *Surnia*, *Glaucidium*, and *Micrathene*. DNA-DNA hybridization data suggest closest affinity is with *Glaucidium* (Sibley and Ahlquist 1990).

Up to 18 subspecies currently recognized (Clark et al. 1978); 7 in North and Central America, including the Caribbean Basin (Ridgway 1914). None critically evaluated with modern systematic methods, but most are geographically distinct and presumably isolated. North and Central American subspecies from Ridgway (1914) and Peters (1940) are: (1) *A. c. hypugaea*, throughout North and Central America west of the eastern edge of the Great Plains south to Panama; (2) *A. c. rostrata* on Isla Clarion and presumably others in the Revillagigedo Islands group off the west coast of Mexico; (3) *A. c. brachyptera* on Isla de Margarita, Venezuela; (4) *A. c. floridana* in Florida and on the Bahama Islands; (5) *A. c. troglodytes* on Hispaniola (*A. c. dominicensis* in Ridgway [1914]); (6) *A. c. guadeloupensis* on Guadeloupe, Lesser Antilles; and (7) *A. c. amaura* on Nevis and Antigua, Lesser Antilles. Johnsgard (1988) recognized *hypugaea*, *floridana*, *troglodytes*, and *rostrata*. *A. c. floridana* and *troglodytes*, and *A. c. amaura* and *guadeloupensis*, were treated as specifically distinct from each other and *A. c. hypugaea* by Ridgway (1914) and others; the former were named *Athene floridana*, the latter *A. guadeloupensis*. Regarded as conspecific today (Am. Ornithol. Union 1983).

MIGRATION

NATURE OF MIGRATION IN THE SPECIES

Most of the North American population is migratory or disperses widely to some extent.

TIMING AND ROUTES OF MIGRATION

Little information on migration routes, times and wintering areas. The majority of owls that breed in Canada and the n. United States are believed to migrate south during Sep and Oct, north during Mar and Apr, and to the first week of May in Saskatchewan (see Fig. 3). Owls are predominately nonmigratory in Florida (Millsap in press) and s. California (Thomsen 1971), although owls in n. California are believed to migrate (Coulombe 1971).

Owls breeding in North and South Dakota are believed to winter in Texas (Brenkle 1936). The majority of owls that nest in the Oklahoma panhandle (Butts 1976), central and s. New Mexico (Best 1969, Martin 1973a), Texas panhandle (Ross 1974), and Colorado (Bailey and Niedrach 1965) migrate or disperse widely. Banding studies from Oklahoma and New Mexico documented 0.5%–3.0% of the summer breeding pairs remained as permanent residents (Martin 1973a, Butts 1976) and there were no migrants observed on these study areas.

The small number of banding recoveries (27 between 1 Nov and 28 Feb, 1927 to 1990 inclusive) provides little information regarding wintering areas. Owls banded in the west (British Columbia, Washington, Oregon, California) show a southern migration along the coast and, in one case, into Mexico. Owls banded on the n. plains (Alberta, Saskatchewan, Manitoba, Idaho, Montana, North Dakota) show a southern migration through Nebraska and Kansas into Oklahoma, Texas, Missouri, and farther south (one owl recovered in the Gulf of Mexico). Owls banded in the central states (Wyoming, South Dakota, Nebraska, Utah, Colorado, Kansas, Oklahoma) have been recovered in Arkansas, Oklahoma, Texas, and Mexico. Owls banded in the southern plains (Texas, New Mexico, Arizona, Nevada) were found in the same states in which they were banded. Banding recoveries suggest that Canadian owls migrate further south than those banded in the United States, suggesting a "leap-frog" migration (James 1992).

HABITAT

BREEDING RANGE

Dry, open, shortgrass, treeless plains, often associated with burrowing mammals. Also golf courses, cemeteries, road allowances within cities, airports, vacant lots in residential areas and university campuses, and fairgrounds. Presence of a nest burrow seems to be the critical requirement for the Western Burrowing Owl (Thomsen 1971, Martin 1973a, Zarn 1974, Wedgwood 1978, Haug 1985). Similar habitat in Florida, and perhaps elsewhere, but these owls usually excavate their own burrow (Millsap in press) so burrowing mammals unnecessary.

SPRING AND FALL MIGRATION

Information limited, similar to breeding range (Butts 1976).

WINTER RANGE

Information limited, absent from northern part of breeding range.

FOOD HABITS

FEEDING

Main foods taken. Opportunistic feeders; primarily arthropods, small mammals, and birds; amphibians and reptiles also reported and may be important in Florida (Wesemann and Rowe 1987).

Microhabitat for foraging. Typically short-grass, mowed, or overgrazed pastures; golf courses and airports also used (Thomsen 1971). Radio-telemetry suggests adult male owls in Saskatchewan forage during the summer in rights-of-way and uncultivated fields (Haug 1985).

Food capture and consumption. Primarily crepuscular in foraging habits but hunting observed over 24 h (Grant 1965, Thomsen 1971, Marti 1974). Insects often taken during daylight, small mammals taken more often after dark (Marti 1974, Plumpton 1992).

Hunt by walking, hopping, or running along the ground; flying from a perch; hovering, particularly over tall vegetation; and fly-catching in the air (Grant 1965, Thomsen 1971, Marti 1974). Hunting style varies with type and activity of prey pursued, time of day, and vegetative substrate (Thompson and Anderson 1988). Prey caught with the feet, but may be transferred to the beak for carrying or presentation to young.

DIET

Major food items/quantitative analysis. Invertebrates the major food item in Saskatchewan (93%; Haug 1985), Oregon (91.6%; Green 1983), Wyoming (88%; Thompson and Anderson 1988), and Colorado (92%; Marti 1974); low biomass, however, of total diet by weight (5% in Wyoming, 22% in Oregon). Small vertebrates (mostly mammals) 8.4% of the individuals and 78% of the biomass in Oregon and 12% of the items and 95% of the biomass in Wyoming. Scorpions, beetles, locusts, and small rodents (Heteromyidae) most frequent in pellets in Arizona between Jun and Aug (Glover 1953). *Coleoptera* sp., crickets, and meadow voles (*Microtus californicus*) most frequent in pellets in California (Thomsen 1971). Earwigs (Dermoptera) most common winter and early summer food in California (Coulombe 1971). Birds (particularly Horned Larks, *Eremophila alpestris*), frogs, toads, lizards, snakes, turtles, and crustaceans also recorded (Bent 1938, Hamilton 1941, Bond 1942, Konrad and Gilmer 1984, Haug 1985).

During the breeding season, significant declines in percentage of vertebrate prey and increases in invertebrate prey found in Saskatchewan (Haug 1985), Oregon (Green 1983), South Dakota (MacCracken et al. 1985), and Iowa (Errington and Bennett 1938). Seasonal variability in food habits found in Oklahoma (Butts 1973), with vertebrates occurring in less than 10% of the pellets collected in summer compared with 85% occurrence in winter. Arthropods found in almost 100% of the pellets collected in summer compared with 15% occurrence in winter. Similar results noted by Tyler (1983), also in Oklahoma. In California mammals make up the greatest volume in pellets collected except for the period Dec-Feb (Thomsen 1971).

In a 3 yr study, no differences in prey selection between years or habitats (farmland vs. short-grass prairie; Marti 1974). Mammals preyed upon in proportion to their availability (Green 1983). The owls appear to be generalists when preying upon insects (Plumpton 1992).

Quantitative analysis of prey remains not always reliable with Burrowing Owls. Pellets, used most often in food studies, can be poor indicators of food habits, owing to differences in the way prey is consumed or the rate at which remains decompose (Thomsen 1971, Haug 1985). Pellets with fur are preserved longer at the burrow than pellets containing chitin (Grant 1965, Coulombe 1971, Marti 1974). Grant (1965) observed owls catching at least as many amphibians as mammals, yet only mammalian remains were found in pellets he collected at burrows. Differences in foraging based on age or sex may also bias pellet collections. Vertebrates, not always totally consumed, bring overestimation of biomass.

NUTRITION AND ENERGETICS

Energy expenditure calculated as 15.5 ± 1.86 kcal/d (Coulombe 1970). Based on finding owls in burrows after many days of inclement weather, it has been suggested that Burrowing Owls may be capable of fasting for several days (Aggersborg 1885, Butts 1976).

METABOLISM AND TEMPERATURE REGULATION

Compared with other birds, Burrowing Owls show a significantly higher tolerance for carbon dioxide, apparently a response to nesting in burrows.

Daily lowering of body temperatures (at evening) controlled endogenously (demonstrated in the laboratory by Coulombe 1970, who also demonstrated increases in body weight and decreased metabolism in winter). Winter plumage has more extensive feather tracts, greater amounts of under-feathering, and higher emissivity resulting in greater insulation and less heat loss (Coulombe 1970). In summer, wing drooping, which provides a heat shield, body orientation

with respect to the sun, and gular flutter and panting are all used to thermoregulate (Coulombe 1971). Burrows also provide protection from weather extremes, as well as from water loss at high temperatures (Coulombe 1971). During hot weather, birds may use shade created by burrow mouths, rocks, or vegetation to escape high temperatures. Neither hibernation nor torpor verified in this species.

DRINKING, PELLET-CASTING, AND DEFECATION

Drinking observed in the wild (Coulombe 1971); in captivity, it increases with ambient temperature (Coulombe 1971, but see Grant 1965). Dust bathing observed in wild birds (Thomsen 1971). Pellets consisting of the inedible portions of prey are egested, presumably daily.

FOOD SELECTION AND STORAGE

Vertebrate and invertebrate prey found within nest burrows and tunnels during the breeding season (Haug 1985, MSM). Agersborg (1885) reported large food caches in winter burrows in South Dakota, although Butts (1976) reported no such activity in Oklahoma. Grant (1965) found food caches scattered throughout the hunting area, usually within 30 m of the nest burrow.

SOUNDS

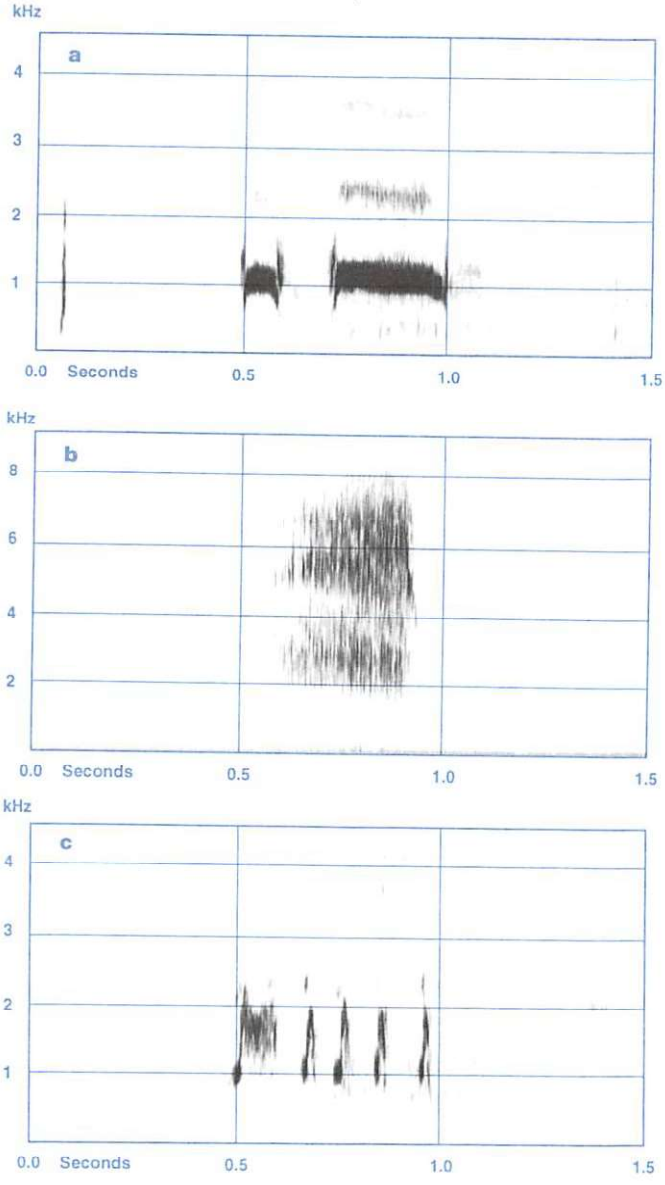
VOCALIZATIONS

Comprehensive vocal analysis based on field observations near Albuquerque, NM (Martin 1973b). Thomsen (1971) reported many of the same vocalizations from a population near Oakland, CA. Unknown if other populations have additional calls, or if some calls are missing in some populations.

Development. Martin (1973b) reported 3 distinct vocalizations from nestlings. The *Eep* Call is given by distressed young as a low-intensity alarm and hunger call from 2 to 4 wk of age. The Rasp Call is a hunger call given by the young; reportedly stimulates the male to begin foraging. In Florida, and perhaps elsewhere, hungry young utter this call repeatedly 3 to 4 s apart (BAM). A more intense and prolonged rasp (or scream) call, termed the Rattlesnake Rasp (Fig. 2b), is given when young are severely distressed. Experiments by Rowe et al. (1986) suggest the latter call functions as an acoustic mimic of a rattlesnake rattle, and deters potential predators from entering nest burrows. Sonograms of these calls can be found in Martin (1973b). Young males can give the adult Primary Song (see below) within 60 d of fledging (BAM).

Figure 2.

Sonograms of Burrowing Owl vocalizations: (a) male Primary or Courtship Song; (b) juvenal Alarm or "Rattle Snake Rasp" Call; and (c) adult Alarm Call (chatter). Recorded by D. J. Martin in New Mexico, 1971. Sonogram prepared by the Borror Laboratory of Bioacoustics.



Vocal array. Martin (1973b) identified 13 vocalizations of adult Burrowing Owls and 3 of young (see above) in New Mexico. Adult vocalizations include a Primary Song, 5 calls associated with copulation, and 7 calls associated with nest defense and/or food begging. The Primary Song, a 2–note call described as *coo coooo* (Fig. 2a), is given exclusively by the male. Haug and Didiuk (1993) have used recordings of this call to elicit responses from territorial pairs with good

success. The most common copulatory calls are the Smack Call, a series of down-slurred notes given by the female; the Tweeter Call, a multi-noted call by the male near the end of copulation; the *Coo* or *Coo coo* Song, a variation of the Primary Song given by the male during copulation; a Male Warble, or undulation, that is occasionally added to the end of the male's copulation song; and a Female Copulation Warble. Nest defense and food solicitation calls include the Rasp, given mainly by the female (and young, see above), but occasionally by the male when delivering food; the *Eep* Call, given mainly by the female (and young); the Defense Warble, given by the female when defending the nest from conspecific females; a Rattle Call, given by the female, which draws the male back to the burrow in a defensive mode; and a series of Clucks, Chatters (Fig. 2c), and Screams, given by both sexes when mobbing predators or defending the nest. Sonograms of all these calls can be found in Martin (1973b). Geographic variation in vocalizations not studied.

Phenology. Most reported vocalizations associated with breeding and nest defense. Much less vocal when not breeding.

Daily pattern of vocalizing. Little known.

Places of vocalizing. Most vocalizations given near the nest burrow.

Repertoire and delivery of songs. Little known.

Social context and presumed functions of vocalizations. See Development and Vocal array above.

NONVOCAL SOUNDS

Like other owls, capable of loud bill snaps when threatened; wing claps, a nonvocal sound of some owls, not reported. Young at first emergence from burrow (10 to 15 d) readily snap bill. Bill snaps usually given in series, accompanied by threat display and vocalizations. Martin (1973b) reported bill snaps produced by snapping the upper and lower mandibles together; others (e.g., Johnsgard 1988) report snaps made by clicking the tongue. Both actions may be involved, as owls often bite and injure the tongue when vigorously snapping. Most often heard in defense of nest site when breeding, but given whenever severely threatened. Bill snaps often given in conjunction with Chatter, Rattlesnake Rasp, or Scream vocalizations. Bill snap used primarily when closely approached or cornered by human or large predator; part of vigorous threat display.

BEHAVIOR

Walking, hopping, climbing, etc. Walks, hops, or runs along ground in pursuit of insects.

Flight. Brief undulating flights from ground to perch. Hunts by direct aerial flights, hovering over tall or dense vegetation, flycatching aerial pursuit of insects.

SELF-MAINTENANCE

Preening, head-scratching, stretching, bathing, etc. Typical self-preening. Mates seen preening each other's heads. Stretches wings over bowed head, or wing and leg extended laterally. Become excited in rain showers—both adults and young stretch out wings, flap, and run in burrow area, then shake and preen. Thomsen (1971) reports dust-bathing.

Sleeping and roosting. Sleeps and roosts in mouth of nest burrow, satellite burrow, or depression in ground. In Florida, roosts occasionally in shrubs and trees (BAM).

Daily time budget. Known to be diurnal, crepuscular, and nocturnal, depending on time of year. Breeding owls observed foraging for insects at all hours of the day. Radio-tagged males known to fly long distances (range 50–2700 m from the nest burrow) between 20:00 and 06:30 h (Haug and Oliphant 1990). Primarily nocturnal other times of the year, spending daylight hours in burrows or other roosts (Martin 1973a, Butts 1976).

AGONISTIC BEHAVIOR

Physical interactions. Intraspecific interactions include chasing and striking to displace intruder. Both male and female observed attacking intruders with outstretched talons (EAH, Martin 1973a). When harassed by song birds, react by escape to another perch or burrow mound.

Communicative interactions. Typical strigiform threat display: fluffing feathers to increase body size appearance, drooping wings and rotating them forward, crouching and weaving back and forth.

Spacing. Little known; both young and members of a pair roost together on or around the burrow mound (EAH).

Territoriality. A semi-colonial species; often forms loose colonies (see Fig. 4). Intraspecific territoriality around nest burrows does exist although distance is unknown and may vary with varying densities of nesting owls. Range of distances between nest burrows noted in the literature include 900 m in Idaho (Gleason 1978)

and < 14 m between nest burrows in a colony in Texas (Ross 1974). In the latter, 7.1 burrows/ha; aggression occurred when a disturbed owl attempted to enter another owl's burrow. In Oklahoma, Butts (1973) observed 10 nest burrows within 1.5 acres (16.4 burrows/ha). In some areas of Florida, densities are 17.6 pairs/km² (0.176 pairs/ha; Wesemann and Rowe 1987).

Pair formation and territories are established at approximately the same time, although some authors report that owls arrive on the breeding grounds already paired (Haug 1985). Males maintain territories using 3 methods: use of the primary call, resident male "presents" himself to intruder, and physical contact (Thomsen 1971). Owls display territoriality only to other Burrowing Owls, although the nest is defended against other species. Feeding areas are not defended, only nest burrows. No information available on winter territoriality or dominance hierarchies.

SEXUAL BEHAVIOR

Mating system. Predominately monogamous although occasional polygyny in Saskatchewan (D. Hjertaas pers. comm., Haug 1985).

Pair bond; courtship displays. Grant (1965) observed a display flight characterized by rapid ascent of approximately 30 m, hovering for 5–10 s, rapid descent of 15 m and repeat of this sequence. Thomsen (1971) observed circular flights of approximately 40 m in diameter performed mainly by males. Other displays observed near the nest burrow include mutual billing and preening of head and facial areas, presentation of food to female, male singing Primary Song.

Copulation; pre- and post copulatory displays. Both sexes display the "White and Tall" stance to each other: male stands erect looking down at female with white facial patches exposed and body feathers raised, female has white facial patches exposed but does not raise body feathers or stand as tall. Male flies to female and mounts. Male gives Song During Copulation and occasionally Male Warble and Tweeter Call. Female may give Smack Call and Copulation Warble. They may engage in billing or male may scratch female's head (Martin 1973a). After copulation male usually exposes white facial patches while looking down at female.

Duration and maintenance of pair bonds. Pair bonds not permanent in the Western Burrowing Owl. Martin (1973a) observed that marked birds changed partners in years following marking. In non-migratory populations of California, both pair retention and pair splitting observed (Thomsen 1971). The Florida Burrowing Owl exhibits strong pair fidelity, 92% of pairs where both adults survived remained together (Millsap and Bear 1990).

Extra-pair copulations. In a declining California population, Johnson (1992) determined that 5%–10% of offspring resulted from extra-pair fertilization.

SOCIAL AND INTERSPECIFIC BEHAVIOR

Degree of sociality. Migrants solitary during winter (Butts 1973); residents remain paired year-round in s. California and Florida (Columbe 1971, BAM). See Agonistic Behavior: territoriality, above.

Play. Young owls jump on siblings, on dead and crippled insects, and on dung around the burrow. Believed to be practice hunting.

Interactions with members of other species. Various species of songbirds harass owls by diving at them; e.g., Red-winged Blackbirds (*Agelaius phoeniceus*) mobbed 2 owls forcing them into a burrow (Martell 1990). Rabbits and cottontails elicit the threat posture. As owls use only abandoned burrows, few interactions between prairie dogs (*Cynomys* spp.) and ground squirrels (*Spermophilis* spp.). And contrary to myth, owls do not share burrows with rattlesnakes (*Sistrurus catenatus, Crotalus* spp.).

PREDATION

Mammals, particularly badgers (*Taxidea taxus*), are major predators of Burrowing Owls. Badgers accounted for 90% of the nest predation recorded by Green (1983) in Oregon; 15 broods (7.7% of total) were lost to badgers during a 2 yr study in Nebraska (Desmond 1991). Domestic cats accounted for 6 (30%) of the known deaths in a Florida study (Millsap and Bear 1988). Opossums (*Didelphis virginiana*), weasels (*Mustela* spp.), skunks (*Mephitis* spp.), and dogs feed on eggs and young (Bent 1938, Butts 1973, Haug 1985).

Burrowing Owls found as prey remains in Swainson's Hawk (*Buteo swainsoni*) and Ferruginous Hawk (*B. regalis*) nests. Merlins (*Falco columbarius*), Prairie Falcons (*F. mexicanus*), Peregrine Falcons (*F. peregrinus*), Great Horned Owls (*Bubo virginianus*), Red-tailed Hawks (*B. jamaicensis*), Cooper's Hawks (*Accipiter cooperii*), and American Crows (*Corvus brachrhynchos*) have all been seen or suspected as predators of adult and young Burrowing Owls (BAM, Wedgwood 1978, Konrad and Gilmer 1984, Millsap and Bear 1988, Martell 1990).

Cannibalism reported (Bent 1938, Coulombe 1971, Green 1983), but may only be scavenging; the only observed case of intraspecific predation

occurred after the mixing of two broods, the older group killing and eating the younger (Green 1983).

Mammalian predators elicit aerial attacks during the nesting season. Avian predators elicit escape behavior, often into burrows.

BREEDING

PHENOLOGY

Pair formation. Where migratory, arrive on the breeding areas either singly or paired. On arrival males occupy burrows, prepare them for use, and begin courtship and territorial behavior. Non-migratory owls retain pair bonds throughout the year.

First brood per season. Egg laying begins 3rd week of Mar in New Mexico (Martin 1973a), early to late Apr in Oregon (Henny and Blus 1981), late Apr in California (Thomsen 1971), and 15–30 May in central Saskatchewan (Fig. 3). In Florida, 95% of laying from Feb through late May (peak = mid-Mar), but can occur as early as Oct (Millsap and Bear 1990). Not known what factors stimulate egg laying.

Second brood per season. No known record of Western Burrowing Owls producing a second brood; renesting may occur if the first nest is destroyed early in the breeding season (Thomsen 1971, Butts 1973, Wedgwood 1976). In Florida, 5 instances of producing 2 broods in one year (1% of occupied nests over 2 yr; Millsap and Bear 1990).

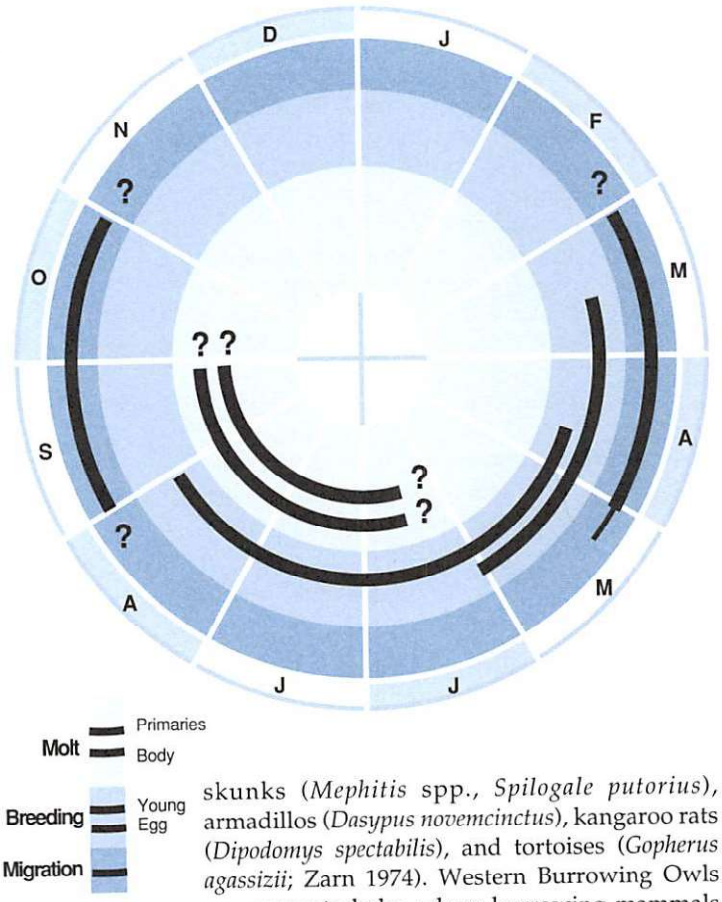


Figure 3.
Annual cycle of breeding, migration, and molt of Burrowing Owls that nest in northern states and the Canadian prairies. Thick lines show peak activity, thin lines off peak.

NEST SITE

Selection process. Not clear which member of pair selects burrow. Burrow hunting observed at dusk and assumed to occur at night (Thomsen 1971).

Site characteristics. In Colorado, owls tend to select their burrows in areas with other burrows, close to roads, surrounded by bare ground or short grass (Plumpton 1992). High perches nearby may also be a factor (Green 1983). In Saskatchewan they prefer grazed, level pastures with high density of burrows (Todd and James 1989).

In Florida, the birds concentrate in residential and industrial areas where development occupies 25%–75% of the landscape (Millsap and Bear 1988). Sites selected for burrow excavation are typically elevated (slightly), presumably to protect from flooding (BAM).

NEST

Construction process. Most often use burrows dug by mammals such as ground squirrels, badgers, prairie dogs, marmots (*Marmota* spp.), skunks (*Mephitis* spp., *Spilogale putorius*), armadillos (*Dasypus novemcinctus*), kangaroo rats (*Dipodomys spectabilis*), and tortoises (*Gopherus agassizii*; Zarn 1974). Western Burrowing Owls can excavate holes where burrowing mammals are absent (Thomsen 1971) but rarely do so; close association with burrowing mammals suggests dependence on them (Fig. 4).

Both adults renovate and maintain burrows by digging. They kick backward with feet and dig with beak (Thomsen 1971). Florida Burrowing Owls usually excavate their own burrows and can complete a 3 m burrow in 2 d (Millsap in press). Mealey (1992) observed a higher fledging success rate in old burrows than in newly excavated ones (63% vs. 19%). Burrow excavation probably common in Caribbean populations as burrowing mammals absent.

Structure and composition matter. Depth, size, and convolutions of a burrow depend on the animal that originally excavated it. All nest burrows have one or more turns and a mound of soil at the entrance. May line the burrow entrance and nest cavity with dried cow or horse manure, believed to mask the owl's scent (Green 1983); also with feathers, grass, and divots from a golf course (Thomsen 1971). In Florida, burrows excavated < 1 m deep, often extending 2–3 m in length, with frequent turns to avoid roots and other obstructions (BAM); nest burrow entrances often adorned with

Figure 4. Burrowing Owls usually nest in loose colonies, taking advantage of burrows dug by mammals such as prairie dogs. Drawing by J. Zickefoose.

highly visible objects—shells, shredded paper, tin foil, cigarette butts, plastic (Millsap in press).

Dimensions. Burrow dimensions vary; in Saskatchewan internal dimensions average 13 x 18 cm, cavities 17 x 25 cm (Haug 1985). In New Mexico, approximately 10 x 13 cm to 50 x 12 cm, mean = 11 x 20 cm (Martin 1973a). Tunnel slants approximately 15° downward from the entrance, with an enlarged cavity at the end of the tunnel (Zarn 1974). Nest cavity is roughly circular, approximately 25 cm wide and 10–12 cm high (Butts 1973).

Microclimate. No observed preference for orientation of burrow mouth (Todd and James 1989, Plumpton 1992). No significant difference between temperatures measured at the entrance of the burrow and 30 cm into it (Coulombe 1971). Relative humidity increases to almost saturation at 30 cm. No information available for microclimate throughout a burrow system.

Barn Owls (*Tyto alba*) in Colorado excavate burrows into vertical soil walls; on average, their burrow temperatures range only 2.8°C while outside (ambient) temperatures range 20.9°C (Millsap and Millsap 1987). Similar gradients may apply to burrows of Burrowing Owls.

Maintenance and reuse of nests. Continue to maintain their burrow by digging and lining it with dung throughout most of the breeding season. Will reuse same burrow the following year. In non-migratory populations, use and maintain burrows year-round; in winter, burrows provide protection from avian predators (Millsap in press).

Nonbreeding nests. Prefer nesting areas with high density of burrows available; this may provide extra escape burrows for young owls before independence (Todd and James 1989, Plumpton 1992).

EGGS

Shape. Round-ovate in shape (Landry 1979).

Length and breadth. Florida: n = 114; length 32.46 mm (31.37–34.04); breadth 26.72 mm (25.11–29.96). California: n = 144; length 31.63 mm (29.27–34.45); breadth 25.83 mm (24.44–27.49). Midwest (Kansas and Dakotas): n = 172; length 32.06 mm (30.62–34.36); breadth 26.17 mm (24.37–27.65) (L. Kiff pers. comm.).

Mass. Saskatchewan: n = 9; mean 10.5 g (8.4–11.3; EAH); 7% weight of adult female (EAH, Plumpton 1992).

Surface texture. Smooth, white in color but often soiled by droppings (Landry 1979).

Egg laying. Probably begins after pair formation and burrow renovations. In Idaho, eggs first observed in nest 2–3 wk after owls arrive on study area (Olenick 1990). Females typically lay only one clutch, but may renest if first clutch is destroyed early in the breeding season (Wedgwood 1976). Eggs laid at a rate of > 1/d (Henny and Blus 1981). In Idaho, average egg laying interval 36 h; 1/morning for 2 consecutive days, followed by a day with no egg laying (Olenick 1990).

INCUBATION

Onset of incubation. Incubation by female only; in California and New Mexico, begins with first egg laid (Thomsen 1971, Martin 1973a). In Saskatchewan and Oregon, cold, full clutches found, indicating incubation may not begin until clutch complete (Haug 1985, Henny and Blus 1981).

Incubation patch. Female only; one large vascularized patch. Florida males drop feathers and have a patch, but it does not become vascularized as in the female (BAM).

Incubation period. 28–30 d (Zarn 1974, Henny and Blus 1981, Olenick 1990). 12 eggs artificially incubated 21–23 d (Haug 1985).

Parental behavior. Male feeds female in early morning and evening (Zarn 1974). Female comes out only briefly at these times.

HATCHING

Success of 88.0% and 90.3% in Idaho (Olenick 1990); 64% and approximately 55% in California, for owls using artificial burrows (Landry 1979).

YOUNG BIRDS

Condition at hatching. Altricial (eyes closed, unable to leave nest, wholly dependent on parents for food and care); ptilopaedic (partially covered with down, usually over back and lower parts), and nidicolous (remain at nest and cared for by parents). Weight at hatching for Western Burrowing Owl: mean 8.9 g (range 6–12 g); tarsus length: mean 9.7 mm (range 6–13 mm); wing length: mean 11.2 mm (range 9–13 mm). Eyes open and evasive behavior observed on 5th d, respond to nest disturbance with Rattlesnake Buzzing vocalization. Eggtooth sloughs off around 9th day (Landry 1979, EAH).

Growth and development. Alar, femoral, crural, and spinal feather tracts begin to emerge on 6th d after hatching; capital, ventral, and humeral tracts on day 7. Full erect stance when 12 d old. Primary sheaths emerge about day 15. Able to thermoregulate on 16th d. Rapid growth up to around 25th d and then levels off. Tarsus grows to 33rd d, wing grows rapidly to 40–45th d (Landry 1979). Young known to move among nest burrows when 10 d old (Henny and Blus 1981); emerge from burrows at about 2 wk of age, where they wait for adults to bring food. Running, hopping, preening, flapping wings at 3 wk of age. Short flights at 4 wk, fly well by 6 wk but remain near burrow (Zarn 1974). Fledging at 44 d (Landry 1979).

Causes of death. On breeding areas: avian and mammalian predation (see Behavior: predation), human disturbance through agricultural and construction activities and shooting, collisions with vehicles, toxic chemicals (see Conservation and Management: pesticides), severe weather. On wintering grounds: unknown.

PARENTAL CARE

Brooding. Female does all brooding from hatching until an unknown time, presumably when young are capable of thermoregulation.

Feeding. Male does all hunting while young require brooding. Male carries prey in mouth, occasionally in feet (MSM), gives to female who tears prey for small chicks and feeds young. Young eat both small mammals and insects which are brought to nest burrow one at a time. In Florida, adult males never observed feeding young; if female dies, young will starve as male brings food but does not feed begging young (BAM). Elsewhere, males may feed young.

Female begins hunting as young become less dependent. At about 2 wk, young begin waiting at burrow entrance for adults to return with prey. Food caching observed in nest burrows (Landry 1979, Henny and Blus 1981, Haug 1985) and satellite burrows—nearby burrows used by adults and young for protection from predators and inclement weather (Gleason 1978, Rich and Trentlage 1983).

Nest sanitation. Feathers, prey remains, mammalian dung accumulate; owl feces also ignored.

Parental carrying of young. Never observed.

COOPERATIVE BREEDING

Never observed.

BROOD PARASITISM

Never observed.

FLEDGLING STAGE

Departure from nest. About day 44 (Landry 1979). Olenick observed departure at day 25, but probably early departure owing to human disturbance.

Condition of development at departure. Wing length (flight feathers) not completely grown.

Association with parents. Stay in area of nest burrow and join adults on foraging flights at dusk (Haug 1985).

Table 1. Burrowing Owl clutch size as a percentage of total clutches sampled in each of three different populations. Data from egg collections, L. Kiff, Western Foundation of Vertebrate Zoology, Camarillo, CA.

	Percent of total sampled in		
Clutch Size	California $n = 17$	Kansas $n = 32$	Florida $n = 74$
3	–	–	1.4
4	2.9	–	20.3
5	8.0	9.4	21.6
6	10.3	6.3	39.2
7	25.7	18.8	5.4
8	24.0	31.3	8.1
9	16.0	12.5	1.4
10	12.0	12.5	2.7
11	1.1	3.1	–
12	–	6.3	–

Ability to get around, feed and care for self. Practice prey capture by jumping on dead and dying insects brought in by parents. Begin chasing living insects and begin to use satellite burrows at 7–8 wk (Green 1983).

IMMATURE STAGE

Little known.

DEMOGRAPHY AND POPULATIONS

MEASURES OF BREEDING ACTIVITY

Age at first breeding; intervals between breeding. Western and Florida owls: both males and females can breed at 1 yr of age, with intervals of 1 yr between subsequent breeding. One Florida male possibly bred at about 10 wk, but this was not confirmed. Five instances of second brood in one calendar year (Millsap and Bear 1990).

Clutch. See Table 1. Western Burrowing Owl (area not specified): Bent (1938) reports clutch size of 6 to 11 eggs, with usual number 7 to 9. California: mean 7.0, range 1–11, $n = 32$ (Landry 1979). Idaho: mean 9.9, range not specified, $n = 30$ (Olenick 1990). Florida: median 4, range 2–6, $n = 14$ (Millsap in press).

Annual and lifetime reproductive success. Annual success has varied from 100% of nest attempts in New Mexico (Martin 1973a) to 33% in California (Thomsen 1971). Number of young fledged per nest attempt has ranged from 4.9 to 1.6; number of young fledged per successful nest: 4.9 to 2.9 ((Martin 1973, James in press).

In Florida, 77% of 406 nesting attempts produced at least one fledged young; median brood size at fledging: 3 (Millsap in press). Less than 1% of pairs raised 2 broods in the same year (Millsap and Bear 1990).

Food supplemented females lay more and larger eggs and hatch more young than those not supplemented, which may explain poor reproductive success in areas where human activity reduces quality of prey habitat (Wellicome 1992). Reproductive success also decreased by weather. In Florida, many burrows collapse with sudden spring cloudbursts; young and adults can be trapped inside and drown. In some years, a large percentage (27% in 1987) of nests with eggs and young chicks fail for this reason (Millsap and Bear 1988). Nest failure due to mammalian predation can be locally significant (see Behavior: predation). Factors influencing reproductive success need more study.

No information on lifetime reproductive success, although in California Johnson (1992) observed reproductive extinction in a population in half the time predicted by population models. Likewise not known if age of the breeding pair has a signigicant affect on reproductive success.

LIFE SPAN AND SURVIVORSHIP

In Saskatchewan, return rates of banded adults: 37%–51% over 4 breeding seasons (P. James unpub. data); in Alberta, 47%–58% (J. Schmutz unpub. data); in Manitoba, 29%–33% (1989 to 1992; K. De Smet unpub. data). In British Columbia, 37% return rates for banded adults and 14% return rates of fledglings (O. Dyer unpub. data). Considered minimum survival rates as owls that migrate have been known to change breeding pastures between years.

In nonmigratory populations, return rates are a better indication of survival. Minimum annual survival rates in Florida averaged 68% for adult males, 59% for adult females, 19% for 1- yr-old owls, based on 245 reencounters of 601 banded owls (Millsap and Bear 1992). In s. California, apparent survival rates of 30% for juveniles, 81% for adults based on banded birds (Thomsen 1971). One banded wild bird survived to 8 yr 8 mo (Kennard 1975).

MORTALITY AND DISEASE

Causes of death. Collisions with vehicles often a serious cause of mortality; the owls habitually sit

and hunt on roads at night (Bent 1938, Ratcliff 1987). Konrad and Gilmer (1984) reported that 3 of 5 known deaths in their study were caused by vehicle collisions, while Millsap and Bear (1988) reported 25% of their known mortality caused by automobile collisions. Thirty-seven percent of the owl remains found in a Saskatchewan study were attributed to vehicle collisions (Haug and Oliphant 1987).

Exposure. Haug (1985) reported 4 deaths due to a severe hailstorm in Saskatchewan.

Human/research impacts. Digging up of burrows to study nesting and incubation causes destruction and abandonment of these sites. Use of nest boxes makes such studies possible without causing destruction (Henny and Blus 1981). Little known of how more general disturbance affects reproductive success (but see Conservation and Management, below); in general the birds seem to be tolerant of human presence. Olenick (1990), however, suggests egg laying and incubation may be the periods most susceptible to disturbance.

Diseases and body parasites. Thirty-nine species of nest arthropods found in burrows, including 15 species of fleas, although many come from previous rodent inhabitants (Phillips and Dindal 1977). Lice (*Colpocephalum pectinatum*), sticktight fleas (*Echidnophaga gallinacea*), and human fleas (*Pulex irritans*) found on owls examined in California (Thomsen 1971). Gapeworm (*Cyathostoma americana*) identified as the cause of mortality in captive owls (Hunter and McKeever 1988). Newcastle disease reported in a dead Florida Burrowing Owl (Millsap and Bear 1988).

RANGE

Initial dispersal from natal site. Individual owls or family groups begin dispersing from breeding areas as young owls become less dependent, late Jul to early Aug in Saskatchewan (Fig. 3; Haug 1985).

Few owls that are banded as young return to natal areas to breed, although most settle nearby. In s. Saskatchewan, 37% of reencountered owl chicks moved to a different pasture in the following year (n = 24; P. James unpub. data). In Manitoba, 6 owls banded as young returned to nest 2.4–26.4 km (mean 14.4 km) from their natal areas (K. De Smet pers. comm.). In Alberta, owls moved 300 m to 30 km from natal sites in the following year, with males dispersing shorter distances than females (J. Schmutz unpub. data). In Florida, natal dispersal distances averaged 1,116 m for 31 females and 414 m for 28 males. In this same sample, 3% of females and 36% of males settled and bred on natal territory (Millsap and Bear 1992).

Fidelity to breeding site and winter range. Some fidelity to breeding sites in adult owls that migrate. In s. Saskatchewan, 26% of reencountered adults moved to different pastures (n = 50) between years (P. James unpub. data), 2 to 8 km for males and 0 to 9 km for females. In Oklahoma, 6 of 527 owls that overwintered stayed to breed the following year (Butts 1973).

In non-migratory populations, most birds are faithful to territories; an average of 68% of surviving adults remained on territory in Florida (Millsap and Bear 1992). In California, relocation projects suggested strong nest site fidelity in some cases, but more information is needed (Terrill and Delevoryas 1992).

Dispersal from breeding site or colony. Little information available for the Western Burrowing Owl. Reports of young dispersing alone or entire family groups leaving breeding sites. In Florida, most adults remain and young disperse an average of 1,116 m for females and 414 m for males (Millsap and Bear 1992).

Home range. In central Saskatchewan, for 6 male owls radio-marked, home range size varied from 0.14–4.81 km^2 (mean 2.41 km^2). Diurnal activities were restricted to within 250 m of nest burrow (Haug and Oliphant 1990). Other studies made only diurnal observations, e.g., Grant (1965) stated 2 pairs confined activities to 0.065 and 0.049 km^2; Butts (1973) observed young owls 1.6 and 2.4 km and an adult owl 1.1 km from the nest burrow; Hamilton (1941) observed owls 1.6 km from the nest burrow.

POPULATION STATUS

Estimates or counts of density. Species listed as Endangered in Minnesota and Iowa, and "of special concern" in Washington, Oregon, California, Montana, Wyoming, North Dakota, Florida, Idaho, Oklahoma, Oregon, South Dakota, and Utah (Martell 1990, James 1993). Designated Endangered in Manitoba and British Columbia, Threatened in Saskatchewan and Alberta. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated it as "threatened" in Canada (Haug and Didiuk 1991), with recommendations from the Burrowing Owl Recovery Team that it be uplisted to Endangered. A gross estimate of 2,000 pairs is extrapolated from smaller research areas across the Canadian prairies. More alarming are the monitoring data from these research areas which show declining populations in sw. Manitoba and s.-central Saskatchewan, plus the unstable reintroduced population in British Columbia (Haug et al. in press). Florida population size estimated 3,000 to 10,000 adults (Millsap, et al. 1990).

Of 24 jurisdictions in the western United States, 46% reported a population size between 1,000 and 10,000 pairs and 33% between 100 and 1,000 pairs. Fifty four percent reported their owl population was probably declining; no one reported an increase (James 1993).

Trends. Evidence of population decline due to habitat destruction, pesticides, predators, and vehicle collisions in states listed as endangered or "of special concern." Breeding Bird Survey (BBS) data from 1980 to 1989 show significant declines in w.- central Kansas and adjacent parts of Nebraska and Oklahoma, the w. Panhandle of Texas, the Trans Pecos region of Texas, and s. New Mexico. Same data set shows significant increases in the Lower Sonoran Deserts and Lower Colorado River Valley in w. Arizona and adjacent California, and in the Interior Valley of California. Analysis of Christmas Bird Counts (James and Ethier 1989) suggest a decline in numbers since the mid-1970s. Local populations are believed more prone to extinctions, as seen in California (Johnson 1992).

In Canada, a decrease in numbers and range in all western provinces. Historically, nesting pairs believed scarce, numbers increased during the early to mid-1900s. Then began a long term decline, greatest in the eastern and western edge,with density decreasing throughout Canadian range (Haug et al. in press).

Population regulation. Vehicle collisions a major source of mortality. Severe spring and summer weather known to kill both adults and young in burrows. Avian and mammalian predators can have severe local effects (see Behavior: predation). Food availability has a direct effect on clutch size (see annual and lifetime reproductive success, above). Insecticide use can result in direct mortality and indirect mortality due to loss of prey base (see Conservation and Management: pesticides and other contaminants). Western Burrowing Owl numbers may be adversely effected by lack of burrows; more information needed. Mortality factors on wintering grounds and migration routes unknown.

CONSERVATION AND MANAGEMENT

EFFECTS OF HUMAN ACTIVITY

Human activities have had a beneficial effect in Florida where mowing, grazing of cattle (Ligon 1963), and wetland drainage (Millsap in press) have increased the species' range. Residential and industrial areas currently support the largest Florida concentrations (Millsap in press).

Intensive cultivation of grasslands and native prairies has long been recognized as a cause of declining owl populations (Bent 1938); 21% loss of habitat over 7 yr reported in Saskatchewan (Hjertaas and Lyon 1987). Control of prairie dog towns also harmful; destroys nesting habitat (Butts 1973).

Sensitivity to disturbance at nest and roost sites. Thomsen (1971) estimated that 20% of the damaged burrows at her study site were caused by dogs, 65% by humans. Reproductive success at sites where home construction occurs is significantly less than at sites next to construction or where construction is not taking place (Millsap and Bear 1988).

Shooting and trapping. Wedgewood (1978) discusses 3 colonies completely destroyed by shooting. Butts (1973) documented that shooting caused 66% of the known mortality on his study sites in Oklahoma. Unknown if this is a local or widespread problem.

Pesticides and other contaminants/toxins. A significant negative impact on survival and reproductive success, believed to be due to direct toxicity, was observed when Carbofuran, a carbamate insecticide, was sprayed over nest burrows (James and Fox 1987). Indirect mortality due to contaminated prey may also be significant, but this is unknown to date. The weights of breeding owls on pastures where strychnine-coated grain is used to control ground squirrels are significantly lower than on control pastures, suggesting a sublethal effect or less food available (James et al. 1990). Organochlorine residues found in adult and juvenile owls in Saskatchewan, but with no effect on reproduction noted (Haug and Oliphant 1987).

Degradation of habitat: breeding and wintering. Intensive agriculture results in loss of burrows, loss of foraging habitat, creation of suboptimal nesting habitat, and increases in vulnerability to predation (Haug 1985); may also reduce the chance that unpaired owls will be able to find mates.

MANAGEMENT

Measures proposed and taken. The following have all been suggested as management strategies (Green 1983): protection of burrowing mammal populations; wood or plastic nest boxes and tunnels placed underground (Collins and Landry 1977, Henderson 1984); artificial perches which provide hunting and predator observation sites; and vegetation management through fire or grazing.

Agriculture Canada has changed Carbofuran insecticide instructions to prohibit Carbofuran within 250 m of occupied nest burrows; although

many landowners are aware of the Burrowing Owl, this labeling program appears to have been ineffective despite extensive promotion (Mutafov 1992). Manitoba, Saskatchewan, and Alberta have initiated habitat programs to protect private land from cultivation and reseeding practices through lease agreements, both voluntary and monetary. As of 1991, Operation Burrowing Owl in Saskatchewan had a membership of 499, with 647 pairs of owls protected on over 40,000 acres of habitat (James 1992). This has been an effective way of protecting habitat and educating landowners about this owl, but numbers are still decreasing at this time. Signs to alert people to the presence of nesting owls were placed near burrows in Florida. Survey techniques are being developed (Martell 1992, Haug and Didiuk 1993).

Reintroductions have been attempted in Manitoba, where 169 young and 18 adults have been released (DeSmet 1992); Minnesota where 105 young where released (Martell 1990, Martell et al. 1990); and British Columbia where 82 adults and 261 young were released (B. Lincoln pers. comm.).

Relocation of owls whose habitat was threatened with development has been attempted in California and Saskatchewan with some success. In Saskatchewan, road development has been delayed so owls could complete nesting (D. Hjertaas pers. comm.)

Effectiveness of measures: the species' response. Little quantitative information is available on the success of various management strategies. In British Columbia, 91 fledglings have been produced since 1986 from owls released in the reintroduction program. No returns of reintroduced young have been recorded in Manitoba or Minnesota. Mean number of young fledged and territory reoccupancy rate did not differ significantly where educational signs had been placed in Florida (Millsap and Bear 1988). Other management strategies including artificial nest boxes and perches, habitat management, and pesticide restrictions have not been tested for their effectiveness. However, Olenick (1990) used artificial burrows during a nesting study in Idaho and induced 100% of pairs to use them if he replaced the natural burrow chosen by the owls with an artificial burrow 4–7 d after the owls arrived on the study area.

APPEARANCE

MOLTS AND PLUMAGES

Hatchlings. Newly hatched young scantily covered, on feather tracts only, with grayish-white neossoptile down. Juvenal teleoptiles appear simultaneously on all feather tracts about 14 d. Prejuvenal molt nearly complete, and Juvenal plumage appears complete, by 30 to 35 d (Butts 1969), but remiges and rectrices not at full length until about 50 d (B. Mealey pers. comm.).

Juvenal plumage. Based on examination of 2 male and 1 female specimens from Cape Coral, Lee County, FL. Ground color of most dorsal surfaces brown. Forehead and crown marked with buffy-white streaks (mainly in center). Feathers of nape, back, median, greater, and posthumeral upper wing coverts (primary and secondary) broadly barred with buffy-white; some bars incomplete, appearing as spots. Often a band of unspotted brown feathers between nape and back. Marginal upper wing and lesser upper secondary coverts dark brown ground color with one small buffy-white spot per feather. Dorsal surface of remiges dark brown with about five visible opposite buffy spots on inner and outer margins. Dark brown ground color on anterior portion of the wing and on remiges contrasts sharply with lighter median upper secondary coverts; produces light band in upper surface of wing. Under wing and under secondary coverts beige; individual feathers with brown spots, bars, and mid-shaft streaks in Florida and Caribbean populations, but immaculate elsewhere (Ridgway 1914). Rump feathers downy; light brown. Upper surface of rectrices dark brown with three to four buffy-white bars (sometimes incomplete, forming opposite buffy spots). Distinct facial disc; light buff or white anterior portions and around eye, chest dark brown, some feathers barred with buff. Remainder of breast, sides, flanks, and abdomen light buff and unmarked, or very faintly barred with brown. Legs distal from tibiotarsal joint scantily feathered; feathers bristle-like.

Prebasic I molt. Juveniles undergo a rapid Prebasic molt at 45 (BAM) to 70 d (Butts 1973); this molt appears restricted to the contour plumage, scapulars, and wing coverts. Following completion, juveniles are indistinguishable from adults in coloration.

Basic I plumage. Based on 3 male and 4 female specimens from Cape Coral, Lee County, FL. Dorsal, same as Juvenal but white streaks on head not limited to center, without unmarked area between nape and back, and without light band in

Table 2. Measurements of Colorado (*Speotyto cunicularia hypugaea*) and Florida (*S. c. floridana*) Burrowing Owls. Measurements are from living owls in Basic plumage trapped at nest sites. Values are mean ± 1 SE, with *n* in parenthesis.

	Colorado[1]		Florida[2]	
	Male	Female	Male	Female
Wing cord (mm)	163.5 ± 1.1 (38)	159.4 ± 1.1 (39)	166.3 ± 0.5 (113)	163.6 ± 1.1 (167)
Tail (mm)	80.1 ± 0.7 (38)	77.4 ± 0.7 (39)	72.2 ± 1.0 (45)	67.9 ± 0.9 (75)
Mass (g)	146.3 ± 1.9 (38)	156.1 ± 3.6 (31)	148.8 ± 1.5 (111)	149.7 ± 1.7 (162)

[1]Plumpton 1992.
[2]B. A. Millsap and C. Bear unpubl. data, collected in Cape Coral, Lee Co., FL.

median upper secondary coverts. Ventrally much different. Chin, throat, and lower chest white; band of dark brown (mottled with white) between white throat and chest. Sides of chest, and entire breast, abdomen, and flanks broadly barred with brown on a white or light beige background. Underwing and under secondary coverts beige with fewer brown spots than Juvenal plumage in Florida and Caribbean populations; underwing coverts reportedly unmarked elsewhere (Ridgway 1914). Undertail coverts white. Elsewhere, same as Juvenal.

Butts (1973) reported a Prealternate molt of at least some contour feathers immediately prior to breeding; in Florida, Prealternate molt appears restricted to lower abdomen, possibly related to formation of brood patch (BAM).

Definitive Basic plumage. Adults undergo a complete Definitive Prebasic molt of remiges and rectricies, and perhaps most contours, starting about the time young fledge. The Prebasic molt is completed in Aug (Butts 1973) or Sep (Best 1969). Remiges and rectrices are normally molted in a sequential series, but simultaneous molt of all rectricies has been reported, in some populations frequently (Mayr and Mayr 1954, Courser 1972). Coloration same as Basic I.

BARE PARTS

Bill and gape. Bill cream, yellowish-white, or greenish-yellow. Gape pinkish.

Iris. Irides usually lemon. In some s. Florida populations (and perhaps elsewhere), < 5% of individuals have distinctly chocolate, brown, or olive irides; incidence of this eye color is increasing rapidly in some populations (B. A. Millsap and C. Bear unpubl. data).

Bare skin on head. Cere gray, light gray, or grayish-green; eyelids grayish.

Legs and feet. Bristle-like feathers on legs and feet white to beige. Skin dark gray, except undersides of feet sometimes yellowish in juveniles.

MEASUREMENTS

Data in Ridgway (1914) suggest w. North American forms are larger than Caribbean and tropical ones, but 2 large data sets from live birds from Florida and Colorado (*S. c floridana* and *S. c. hypugaea*, respectively) show little differences (Table 2). Reverse sexual size dimorphism, evident in most strigiforms, is not apparent in the Burrowing Owl (Snyder and Wiley 1976; Table 2).

ACKNOWLEDGMENTS

We wish to thank the members of the Canadian Burrowing Owl Recovery Team (D. Hjertaas, Saskatchewan Parks and Renewable Resources; S. Brechtel, Alberta Fish and Wildl. Div.; K. De Smet, Manitoba Dept. Nat. Res.; O. Dyer, British Columbia Dept. Env. and Parks; G. Holroyd, Can. Wildl. Serv.; P. James, Saskatchewan Mus. Nat. Hist.; J. K. Schmutz, Dept. Biol., Univ. Saskatchewan) for providing current information for inclusion in this manuscript. Thanks also to Lloyd F. Kiff, Western Foundation of Vertebrate Zoology, who supplied egg data. Cover photo © Arthur and Elaine Morris / VIREO.

REFERENCES

Agersborg, G. S. 1885 The birds of southeastern Dakota. Auk 2: 276–289.

American Ornithologists' Union. 1957. Check-list of North American birds. 5th ed. Am. Ornithol. Union, Washington, D.C.

American Ornithologists' Union. 1983. Check-list of North American birds. 6th ed. Am. Ornithol. Union, Washington, D.C.

American Ornithologists' Union. 1991. Thirty-eighth supplement to the American Ornithologists' Union check-list of North American birds. Auk 108: 750–754.

Bailey, A. M. and H. L. Niedrach. 1965. Birds of Colorado. Vol. I. Denver Mus. Nat. Hist., Denver, CO.

Bent, A. C. 1938. Life histories of North American birds of prey. U.S. Natl. Mus. Bull. No. 170.

Best, T. R. 1969. Habitat, annual cycle and food of Burrowing Owls in southcentral New Mexico. M.Sc. thesis, New Mexico State Univ., Los Cruces.

Bond, R. M. 1942. Food of the Burrowing Owl in western Nevada. Condor 44: 183.

Brenkle, J. F. 1936. The migration of the Western Burrowing Owl. Bird-Banding 7: 66–68.

Brodkorb, P. 1971. Catalogue of fossil birds: Part 4 (Columbiformes through Piciformes). Bull. Fla. State Mus. 15: 226.

Burton, J. A. (Ed.) 1973. Owls of the world. E. P. Dutton, New York.

Butts, K. O. 1973. Life history and habitat requirements of Burrowing Owls in western Oklahoma. M.Sc. thesis, Oklahoma State Univ., Stillwater.

Butts, K. O. 1976. Burrowing Owls wintering in the Oklahoma panhandle. Auk 93: 510–516.

Campbell, K. E. 1979. The non-passerine Pleistocene avifauna of the Talara Tar Seeps, northwestern Peru. Life Sci. Contrib., R. Ontario Mus. No. 118.

Clark, R. J., D. G. Smith, and L. H. Kelso. 1978. Working bibliography of owls of the world. Natl. Wildl. Fed. Sci. Tech. Ser. No. 1., Washington, D.C.

Collins, C. T. and R. E. Landry. 1977. Artificial nest burrows for Burrowing Owls. N. Am. Bird Bander 2: 151–154.

Coulombe, H. N. 1970. Physiological and physical aspects of temperature regulation in the Burrowing Owl *Speotyto cunicularia*. Comp. Biochem. Physiol. 35: 307–337.

Coulombe, H. N. 1971. Behavior and population ecology of the Burrowing Owl, *Speotyto cunicularia*, in the Imperial Valley of California. Condor 73: 162–176.

Courser, W. D. 1972. Variability of tail molt in the Burrowing Owl. Wilson Bull. 84: 93–95.

Courser, W. D. 1979. Continued breeding range expansion of the Burrowing Owl in Florida. Amer. Birds 33: 143–144.

DeSmet, K. D. 1992. Manitoba's threatened and endangered grassland birds: 1991 update and five-year summary. Rept. No. 92–93. Manitoba Dept. Nat. Res.

Desmond, M. J. 1991. Ecological aspects of Burrowing Owl nesting strategies in the Nebraska panhandle. M.Sc. thesis, Univ. Nebraska, Lincoln.

Errington, P. L. and L. J. Bennett. 1935. Food habits of Burrowing Owls in Northwestern Iowa. Wilson Bull. 47: 125–128.

Ford, N. L. 1966. Fossil owls from the Rexroad fauna of the Upper Pliocene of Kansas. Condor 68: 472–475.

Ford, N. L. 1967. A systematic study of the owls based on comparative osteology. Ph.D. diss., Univ. Michigan, Ann Arbor.

Ford, N. L. and B. G. Murray, Jr. 1967. Fossil owls from the Hagerman local fauna (Upper Pliocene) of Idaho. Auk: 115–117.

Gleason, R. S. 1978. Aspects of the breeding biology of Burrowing Owls in southeastern Idaho. M.Sc. thesis, Univ. Idaho, Moscow.

Glover, F. A. 1953. Summer foods of the Burrowing Owl. Condor 55: 275.

Grant, R. A. 1965. The Burrowing Owl in Minnesota. Loon 37: 2–17.

Green, G. A. 1983. Ecology of breeding Burrowing Owls in the Columbia basin, Oregon. M.Sc. thesis, Oregon State Univ., Corvallis.

Hamilton, W. J. 1941. A note on the food of the western Burrowing Owl. Condor 43: 74.

Haug, E. A. 1985. Observations on the breeding ecology of Burrowing Owls in Saskatchewan. M.Sc. thesis, Univ. Saskatchewan, Saskatoon.

Haug, E. A. and A. B. Didiuk. 1991. Updated status report on the Burrowing Owl in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.

Haug, E. A. and A. B. Didiuk. 1993. Use of recorded calls to detect Burrowing Owls. J. Field Ornithol. 64: 188–194.

Haug, E. A. and L. W. Oliphant. 1987. Breeding biology of Burrowing Owls in Saskatchewan. Pp. 269–271 *in* Endangered species in the Prairie Provinces. (G. L. Holroyd, W. B. McGillivray, P. H. R. Stepney, D. M. Ealey, G. C. Trottier, and K. E. Eberhart, Eds.). Provincial Museum of Alberta Occasional Paper, No. 9.

Haug, E. A. and L. W. Oliphant. 1990. Movements, activity patterns, and habitat use of Burrowing Owls in Saskatchewan. J. Wildl. Manage. 54: 27–35.

Haug, E. A., D. Hjertaas, S. Brechtel, K. De Smet, O. Dyer, G. Holroyd, P. James, and J. Schmutz. (In press). National recovery plan for the Burrowing Owl. A report prepared for the Committee for the Recovery of Nationally Endangered Wildlife. Canadian Wildlife Federation, Ottawa.

Henderson, C. L. 1984. Woodworking for wildlife: homes for birds and mammals. Minn. Dept Nat. Res., St. Paul, MN.

Henny, C. J. and L. J. Blus. 1981. Artificial burrows provide new insight into Burrowing Owl nesting biology. Raptor Res. 15: 82–85.

Howell, S. N. and S. Webb. (In press). A guide to the birds of Mexico and northern Central America. Oxford University Press, Oxford.

Hunter, D. B. and K. McKeever. 1988. *Cyanthostoma* infection in owls in Ontario. Abstract, Annual meeting of the Raptor Res. Found. Oct. 1988. Minneapols, MN.

James, P. C. 1992. Where do Canadian Burrowing Owls spend the winter? Blue Jay 50: 93–95.

James, P. C. 1992. Operation Burrowing Owl in Saskatchewan: The first five years. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

James, P. C. (In press). The current status of the Burrowing Owl in North America. J. Raptor Res.

James, P. C. and G. A. Fox. 1987. Effects of some insecticides on productivity of Burrowing Owls. Blue Jay 45: 65–71.

James, P. C., T. J. Ethier, and M. K. Toutloff. (In press). Parameters of a declining Burrowing Owl population in Saskatchewan. J. Raptor Res.

Johnsgard, P. A. 1988. North American owls. Biology and natural history. Smithson. Inst. Press, Washington, D.C.

Johnson, B. S. 1992. Demography and population dynamics of the Burrowing Owl. Abstract, Burrowing Owl Symposium, 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

Johnson, B. S. 1992. Reproductive success, relatedness, and mating patterns in a colonial bird, the Burrowing Owl. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

Johnson, B. S. 1992. Characterization of population and family genetics of the Burrowing Owl by DNA fingerprinting. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

Kennard, J. H. 1975. Longevity records of North American birds. Bird-Banding 46: 55–73.

Konrad, P. M. and D. S. Gilmer. 1984. Observations on the nesting ecology of Burrowing Owls in central North Dakota. Prairie Nat. 16: 129–30.

Landry, R. E. 1979. Growth and development of the Burrowing Owl. M.Sc. thesis, Calif. State Univ., Long Beach.

LeFranc, M. N. and B. A. Millsap. 1984. A summary of state and federal agency raptor management programs. Wildl. Soc. Bull. 12: 274–282.

Ligon, J. D. 1963. Breeding range expansion of the Burrowing Owl in Florida. Auk 80: 367–368.

MacCracken, J. G., D. W. Uresk, and R. M. Hansen. 1985. Burrowing Owl foods in Conata Basin, South Dakota. Great Basin Nat. 45: 287–290.

Martell, M. S. 1990. Reintroduction of Burrowing Owls into Minnesota: A feasibility study. M.Sc. thesis, Univ. Minnesota, Minneapolis.

Martell, M. S. 1991. Grassland owls. Pp. 96–104 *in* Proceedings of the Midwest raptor management symposium and workshop (B. G. Pendleton and D. L. Krahe, Eds.). Natl. Wildl. Fed. Sci. Tech. Series, No. 15, Washington, D.C.

Martell, M. S., J. Schladweiler, and J. Nibe. 1990. Minnesota Burrowing Owl conservation, 1990 Report. Unpubl. The Raptor Center, Univ. Minnesota, St. Paul.

Martell, M. S., J. Nibe, and P. T. Redig. 1992. A survey technique for Burrowing Owls in Badlands National Park, South Dakota. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, Washington.

Marti, C. D. 1974. Feeding ecology of four sympatric owls. Condor 76: 45–61.

Martin, D. J. 1973a. Selected aspects of Burrowing Owl ecology and behaviour in central New Mexico. Condor 75: 446–456.

Martin, D. J. 1973b. A spectrographic analysis of Burrowing Owl vocalizations. Auk 90: 564–578.

Mayr, E. and M. Mayr. 1954. The tail molt of small owls. Auk 71: 172–178.

Mealey, B. 1992. Reproductive ecology of the Burrowing Owl, *Athene cunicularia floridana*, in Dade and Broward counties, Florida. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann Meeting, Seattle, WA.

Mealey, B. (In prep.). Reproductive ecology of the Burrowing Owl, *Athene cunicularia*, in Dade and Broward counties, Florida. M.Sc. thesis, Fla. International Univ., Miami.

Millsap, B. A. (In press). Florida Burrowing Owl. *In* Rare and endangered biota of Florida Birds. (J. A. Rogers and H. W. Kale II, Eds.). Univ. Presses Florida, Gainesville.

Millsap, B. A. and P. A. Millsap. 1987. Burow nesting by common Barn Owls in north central Colorado. Condor 89: 668–670.

Millsap, B. A. and C. Bear. 1988. Cape Coral Burrowing Owl population monitoring. Ann. performance rept. Fla. Game, Freshwater Fish Comm., Tallahassee, FL.

Millsap, B. A. and C. Bear. 1990. Double-brooding by Florida Burrowing Owls. Wilson Bull. 102: 313–317.

Millsap, B. A. and C. Bear. 1992. Mate and territory fidelity and natal dispersal in an urban population of Florida Burrowing Owls (*Athene cunicularia floridana*). Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

Mutafov, D. T. 1992. Does the labelling restriction on Carbofuran containers help protect Burrowing Owls? Blue Jay 50: 201–203.

Olenick, B. E. 1990. Breeding biology of Burrowing Owls using artificial nest burrows in Southeastern Idaho. M.Sc. thesis, Idaho State Univ., Pocatello.

Olson, S. L. and W. R. Hilgartner. 1982. Fossil and subfossil birds from the Bahamas. Pp. 22–60 *in* Fossil vertebrates from the Bahamas. Smithson. Contrib. Paleobiol. No. 48.

Parmalee, P. W. 1977. The avifauna from prehistoric Arikara sites in South Dakota. Plains Anthropol. 22: 189–222.

Peters, J. L. 1940. Checklist of birds of the world. Vol. IV (Cuculiformes, Strigiformes, Apodiformes). Harvard Univ. Press, Cambridge, MA.

Phillips, J. R. and D. L. Dindal. 1977. Raptor nests as a habitat for invertebrates: A review. Raptor Research 11: 87–96.

Plumpton, D. L. 1992. Aspects of nest site selection and habitat use by Burrowing Owls at the Rocky Mountain Arsenal, Colorado. M.Sc. thesis, Texas Tech. Univ., Lubbock.

Ratcliff, B. D. 1987. Manitoba Burrowing Owl survey 1982–84. Rept. 87–15 Manitoba Nat. Res., Winnipeg.

Rich, T. and B. Trentlage. 1983. Caching of long-horned beetles by the Burrowing Owl. Murrelet 64: 25–26.

Ridgway, R. 1914. The birds of North and Middle America: a descriptive catalogue of the higher groups, genera, species, and subspecies of birds known to occur in North America. Vol. VI, U.S. Natl. Mus. Bull. No. 50.

Ross, P. V. 1974. Ecology and behavior of a dense colony of Burrowing Owls in the Texas Panhandle. M.Sc. thesis, West Texas State Univ., Canyon.

Rowe, M. P., R. C. Coss, and D. H. Owings. 1986. Rattlesnake rattles and Burrowing Owl hisses: a case of acoustic Batesian Mimicry. Ethol. 72: 53–71.

Schmutz, J. K., G. Wood, and D. Wood. 1991. Spring and summer prey of Burrowing Owls in Alberta. Blue Jay 49: 93–97.

Sibley, C. G. and J. E. Ahlquist. 1990. Phylogeny and classification of birds: a study in molecular evolution. Yale Univ. Press, New Haven, CT.

Snyder, N. F. R. and J. Wiley. 1976. Sexual size dimorphism in hawks and owls of North America. Ornithol. Monogr. No. 20.

Terrill, S. B. and P. Delevoryas. 1992. Relocation of Burrowing Owls during courtship period. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

Thompson, C. D. and S. H. Anderson. 1988. Foraging behavior and food habits of Burrowing Owls in Wyoming. Prairie Nat. 20: 23–28.

Thomsen, L. 1971. Behavior and ecology of Burrowing Owls on the Oakland municipal airport. Condor 73: 177–192.

Todd, M. W. and P. C. James. 1989. Habitat selection in Canadian Burrowing Owls. Abstract from Raptor Res. Found. Conference, Veracruz, Mexico.

Tyler, H. A. 1979. Pueblo birds and myths. Univ. Oklahoma Press, Norman.

Tyler, J. D. 1983. Notes on Burrowing Owl food habits in Oklahoma. Southwest. Nat. 28: 100–102.

Wedgwood, J. A. 1976. Burrowing Owls in south-central Saskatchewan. Blue Jay 34: 26–44.

Wedgwood, J. A. 1978. The status of the Burrowing Owl in Canada. A report prepared for the Committee on the Status of Endangered Wildlife in Canada. Can. Wildl. Serv., Ottawa.

Wellicome, T. I. 1992. Reproductive performance of Burrowing Owls: effects of supplementary food. Abstract, Burrowing Owl Symposium. 1992 Raptor Res. Found. Ann. Meeting, Seattle, WA.

Wesemann, T. and M. Rowe. 1987. Factors influencing the distribution and abundance of Burrowing Owls in Cape Coral, Florida. Pp. 129–137 *in* Integrating man and nature in the metropolitan environment (L. W. Adams and D. L. Leedy, Eds.). Natl. Inst. Urban Wildl., Columbia, MD.

Zarn, M. 1974. Burrowing Owl, Report No. 11. Habitat management series for unique or endangered species. Bureau Land Manage., Denver, CO.

ABOUT THE AUTHORS

Elizabeth Haug, a native of Wisconsin, received her B.Sc. in Wildlife Ecology from the University of Wisconsin-Madison in 1978 and her M.Sc. in Biology from the University of Saskatchewan in 1985. Her graduate thesis addressed the breeding biology and movements of the Burrowing Owl in Saskatchewan. She has been, and continues to be, involved in a variety of conservation programs, including captive breeding and reintroduction of Peregrine Falcons and Burrowing Owls. Current address: 314 Egbert Avenue, Saskatoon, Saskatchewan, Canada S7N 1X1.

Brian Millsap holds a B.Sc. degree in Wildlife Biology from Colorado State University, and a M.Sc. degree in Systematic and Evolutionary Biology from George Mason University where he studied the systematics of the Gray Hawk (*Asturina nitida*). He has been employed as a wildlife biologist for the Bureau of Land Management in Arizona and Wyoming, as a raptor biologist for the National Wildlife Federation in Washington, D.C., and as a nongame wildlife biologist with the Florida Game and Fresh Water Fish Commission's Nongame Wildlife Program. He is now Chief of the Bureau of Nongame Wildlife for the Florida Game and Fresh Water Fish Commission. Current address: Florida Game and Fresh Water Fish Commision, 620 South Meridian Street, Tallahassee, FL 32399–1600.

Mark Martell has a B.Sc. degree in Population Biology from the University of Wisconsin, Green Bay, and a M.Sc. degree in Wildlife Conservation from the University of Minnesota where he worked on the reintroduction of Burrowing Owls in Minnesota. He has been employed by the Raptor Center at the University of Minnesota since 1985. Current address: Raptor Center, University of Minnesota, 1920 Fitch Avenue, St. Paul, MN 55108.

The Birds of North America

The Birds of North America series provides comprehensive, authoritative summaries of current knowledge of the breeding bird species of North America. Each of these accounts includes a major bibliography of references as well as unpublished information. Their purpose is to enable informed conservation management of our native birds and to define directions for future research. Accounts are published separately to insure timely availability of their contents.

The Birds of North America accounts (ISSN 1061–5466) are published bimonthly by The American Ornithologists' Union and The Academy of Natural Sciences, Benjamin Franklin Parkway, Philadelphia, PA 19103–1195. Printed by Smith-Edwards-Dunlap Company, Philadelphia, PA.

The Birds of North America is supported by charitable and governmental organizations including: The Office of Migratory Bird Management (USFWS), National Fish and Wildlife Foundation, The McLean Contributionship, The Geraldine R. Dodge Foundation, The Richardson Foundation, and the American Birding Association. Benefactors of this program include Wallace C. Dayton and Joseph and Helen Taylor.

SUBSCRIPTIONS

To subscribe or request more information write:
The Birds of North America
1900 Benjamin Franklin Parkway
Philadelphia, PA 19103-1195
http://www.birdsofna.org

RECOMMENDED CITATION
Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Speotyto cunicularia*). *In* The Birds of North America, No. 61 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.