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WINTER DESTINATIONS AND HABITATS OF CANADIAN BURROWING OWLS

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ABSTRACT.—The winter destination of Burrowing Owls (*Athene cunicularia*) that breed in Canada is poorly understood. We flew 166.7 hr in a fixed-wing CESSNA 172, searching southern Texas and the Gulf Coast lowlands and central Mexico for signals from 125 VHF transmitters that were attached to Burrowing Owls in Canada in 1997, 1998, and 2000. Nine owls were located between Houston, Texas, and Michoacán, Mexico. The diurnal roosts used by the owls included vegetation, natural burrows, and a woodpile. Land-cover types around roosts were highly variable and less open than breeding habitat in Canada, but always included at least 35% low vegetation within 1 km of roosts.

KEY WORDS: *Burrowing Owl*; Athene cunicularia; *roost habitat*; *winter habitat*; *winter range*.

DESTINOS Y HÁBITATS INVERNALES DE POBLACIONES CANADIENSES DE *ATHENE CUNICULARIA*

RESUMEN.—El destino invernal de los individuos de la especie *Athene cunicularia* que crían en Canadá es pobremente conocido. Volamos durante 166.7 horas sobre el sur de Texas y las tierras bajas del golfo en un CESSNA 172 de ala alta buscando detectar señales de 125 transmisores VHF que habían sido acoplados a individuos de esta especie en Canadá en 1997, 1998 y 2000. Nueve individuos fueron ubicados entre Houston, Texas y Michoacán, Mexico. Los sitios de descanso utilizados por las aves durante el día incluyeron áreas con vegetación, madrigueras naturales y una pila de madera. Los tipos de cobertura del suelo alrededor de los sitios de descanso fueron bastante variables y menos abiertos en comparación con el hábitat de cría de Canadá, pero siempre incluyeron al menos un 35% de vegetación baja en un radio de 1 km alrededor de los sitios.

[Traducción del equipo editorial]

In Canada, the Burrowing Owl (*Athene cunicularia hypugaea*) declined at 20% per year through the 1990s (Holroyd et al. 2001) and an estimated 900 pairs remained in 2004 (Wiggins 2006), occupying only 40% of their former range (G. Holroyd unpubl. data). Effective conservation of Burrowing Owls, which were designated an endangered species in Canada in 1995 (Wellicome and Haug 1995), requires knowledge of the factors affecting annual survival, including migration and winter survival, and management of the habitats they occupy. Numerous studies have examined different aspects of Burrowing Owl breeding biology and possible causes of their decline (Haug et al. 1993, Wiggins 2006), whereas limited information is available about the winter phase of their life cycle (Butts 1973, Holroyd et al. 2001). Burrowing Owls in the Canadian Great Plains are at the northern limits of their range and are migratory, spending about half the year away from the breeding grounds (Haug 1985, Haug et al. 1993). The wintering grounds of these owls were unknown because of the low rate of band returns (James 1992).

According to Bird Banding Laboratory records, about 3100 owls were banded in Canada up to 1997 but none were encountered during the winter period of November to February. Encounters during migration indicated some owls from Saskatchewan and Manitoba migrated in a south-southeast direction toward Texas (Fig. 1). Because Burrowing Owls no longer breed on the coastal plain of southern Texas (Rappole and Blacklock 1994, Woodin et al. 2008), owls seen in southern Texas in winter are likely migrants (Rappole and Blacklock 1994), while

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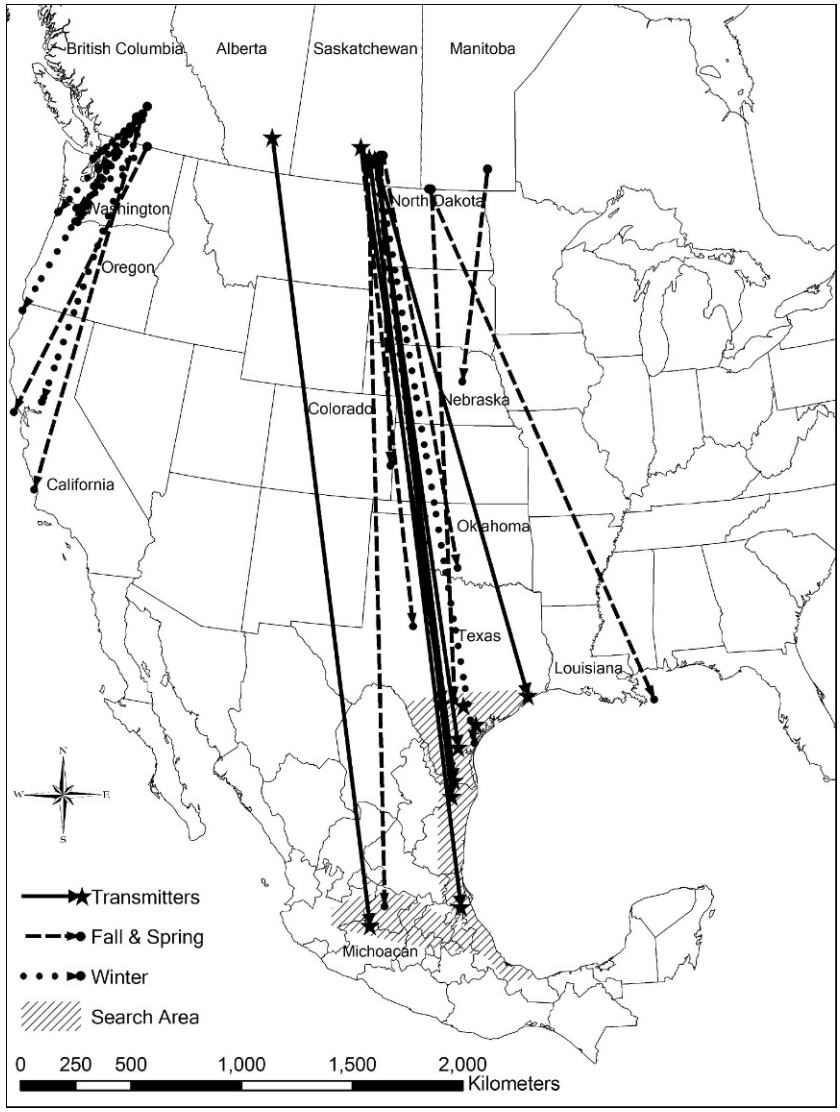

Figure 1. Canadian Burrowing Owl band encounters outside the breeding season prior to this study (dash and dotted lines) and transmitters located during this study. The migration of owls from British Columbia was not investigated with telemetry as part of this study.

those in northern Texas may be permanent residents or migrants (McIntyre 2004). Although encounters of Burrowing Owls banded in the U.S.A. have been reported in winter in Texas, the lack of winter band encounters of Canadian owls was attributed to leapfrog migration of more northerly owls to more southern winter grounds in Mexico (James 1992). A review of museum specimens indicated that Burrowing Owls are widespread in Mexico during winter (Enriquez-Rocha 1997).

Satellite transmitters have been used on many bird species to track long-distance movements. However, such transmitters were not an option for Burrowing Owls, as even the smallest satellite transmitters available in 1998 (20–30 g) would have exceeded the generally accepted weight guidelines of ≤3–5% body weight (Caccamise and Hedin 1985, Murray and Fuller 2000). Researchers have successfully used aircraft to follow other bird species wearing VHF transmitters during the day (Iverson et al.

1996, Boyd et al. 2000, McClelland et al. 1996, Chavez-Ramirez et al. 1994), including Burrowing Owls that moved in a southeasterly direction from southern Saskatchewan (Clayton 1997a). We are not aware of any telemetry study designed to find wintering Burrowing Owls with VHF transmitters. In this report, we document our efforts to locate Canadian Burrowing Owls on potential wintering grounds from southern Texas to central Mexico using aerial telemetry in three winters between 1998 and 2001.

METHODS

Researchers captured Burrowing Owls with noose carpets, bow nets and one-way door traps for breeding-season studies in Alberta and Saskatchewan. Necklace-style and backpack VHF radio-transmitters weighing 6 grams (Holohil Systems Ltd., Newmarket, ON) with 6-12-mo batteries were placed on juvenile and adult owls in May–July. In 1997, 12 transmitters were placed on owls in Saskatchewan (Clayton 1997a, 1997b). In 1998, 46 transmitters were still operating in the fall prior to migration in September and early October: 39 juveniles in Saskatchewan (Todd 2001, G. Holroyd unpubl. data) and 7 adults in Alberta (Sissons 2003). In 2000, 67 transmitters (34 in Alberta, 33 in Saskatchewan; 48 juveniles and 19 adults) on 16 frequencies were believed to be functioning on live owls before the owls migrated in September and early October (Shyry 2005, Todd 2001, G. Holroyd unpubl. data). Some transmitters had identical frequencies in the 172 mHZ range to reduce the number of scanning frequencies during surveys. All owls were banded with lock-on U.S. Geological Survey aluminum bands and butt-end anodized aluminum bands with two alphanumeric characters, color-specific for each province (Acraft Sign and Nameplate Co., Edmonton, AB).

Aerial searches for owls in southern Texas were conducted using three- (1997, 1998) or four- (2000-01) element Yagi receiving antennae attached to the wing struts of a four-passenger Cessna 172. From a height of 1800–2400 m aboveground level (agl) we could detect the transmitters at a maximum distance of 30 km off each wing tip, 12 km ahead of the plane, and 9 km behind the plane. We flew transects at 2400 m about 50 km apart, allowing some overlap of search paths. At times, due to weather conditions or flight restrictions, the flight elevations varied between extremes of 1400–3800 m agl. Using the switch box and circling in descending circles over the signal location allowed us to isolate most signals to an area of about 100 × 100 m.

Flight transects covered most of coastal Texas (generally south of Austin, Houston, San Antonio, and Del Rio) in 1997, 1998, and 2000–01. The transect flight times were 38.8, 54.3, and 44.4 hr, respectively. In Mexico we flew in northern Tamaulipas for 3.0 hr in 1998 and extended our effort to 26.2 hr in 2000–01 to include a 100-km strip of the Gulf coast plain south to Veracruz City and then west to include Lago Chapala and Guadalajara (Fig. 1). Flights in 1997 and 1998 occurred after dark from 17:30 to 24:00 H. All flights in 2000–01 were during daylight hours (08:00–17:00 H) due to safety concerns and after determination that most owls were likely aboveground during the day based on winter observations in New Mexico and Texas (G. Holroyd and H. Trefry unpubl. data). In Las Cruces, New Mexico, GLH observed 50% of resident owls were at the entrance of their burrows at any given time until about 3 hr before sunset when 90% were visible at the entrance to their burrows. GLH and HET observed migrant owls at the entrance to culverts in southern Texas every time they were visited if they were there, except when raining or if a predator was near.

Each location where Burrowing Owl signals were detected was subsequently visited on the ground by two observers with handheld VHF receivers and three-element yagi antennae in an attempt to locate the source of the signal and identify the owl. For those owls with transmitters that were located on the ground, roosts were described and the percent of habitat types within a 1-km radius (foraging distance based on G. Holroyd unpubl. data) of the owls' locations were estimated using our aerial photos, ground searches, and Google maps that showed the same habitats as the aerial photos (when available).

RESULTS

Nine of 125 transmitters were detected during the 3-yr search effort in Texas (137.5 hr) and Mexico (29.2 hr). In Texas, six owls' signals were detected from the air; of these birds, we read color bands on two of the three that were located on the ground (Table 1, Fig. 1). In Mexico, three owls' signals were detected from the air and two owls were found on the ground, one alive and one dead (Table 1, Fig. 1). The detection of transmitters from the air was low each year (8.3%, 4.5%, and 8.9%).

Table 1. Winter locations of Canadian Burrowing Owls detected in Texas and Mexico during aerial surveys.

DATE DETECTED	GENERAL LOCATION OF DETECTION	YEAR BANDED	AGE AT BANDING/ SEX	ORIGIN OF OWL	BAND CONFIRMED
November 25 1997	SE of Pearsall, TX	1997	Juv.	Moose Jaw, SK	No
December 7 1998	W of Kingsville, TX	1998	Juv.	Milestone, SK	No[a]
December 14 1998	180 km W of Monterrey, MX	1998	Adult	Lang, SK	No[a]
December 3 2000	Smith Point, TX	2000	Juv. Female	Milestone, SK	Yes
December 8 2000	McAllen, TX	2000	Juv. Male	Lang, SK	Yes
December 11 2000	Karnes City, TX	2000	Unknown	AB/SK[b]	No[a]
December 11 2000	Refugio, TX	2000	Unknown	AB/SK[b]	No[a]
January 23 2001	Angamacutiro, Michoacán, MX	2000	Adult Male	Brooks, AB	Yes
January 31 2001	Naranjo, Veracruz, Mexico	2000	Juv.[c]	Rouleau, SK	Yes

[a] Not able to obtain permission to access land.
[b] Frequency was used in both provinces and owl signal not found on ground.
[c] Bird was found dead.

Three of four owls located in Texas in December 2000 had moved when we tried to find them on the ground and during subsequent aerial searches. Only the Burrowing Owl in McAllen stayed in the general area for the winter and it was relocated by ground telemetry in a variety of roost sites until 10 February 2001. The two owls in Mexico in January 2000 were still there in February when we located them on the ground.

We identified eight specific roosts of the four owls that were located alive on the ground ('Yes' in Table 1). One roost was in a mammal burrow, one was in an erosion hole, one was in a woodpile and five were under vegetation. The specific roosts of the remaining five owls were not determined because we did not see the owls on the ground, but we were able to describe the habitats around their roosts ('No' in Table 1).

The immediate habitats around 11 roost areas (including all 9 original areas [Table 1] plus two that moved) were pasture: cultivated land at seven sites and mesquite-cactus shrubland at four. The land-cover types within 1 km surrounding the roost sites varied considerably. The extremes were one site surrounded by shrubland to a radius of over 1 km and three with 80–100% pasture. The sites had between 35–100% low vegetation with no shrubs or trees. Thus, although some owls roosted in shrubland, they had a considerable area of low vegetation within 1 km.

During this work we incidentally found a winter recovery of a Canadian Burrowing Owl while viewing a photograph taken at a badger (*Taxidea taxus*) burrow on a cattle ranch north of Edinburg, Texas, in December 1997. The band was of Saskatchewan origin but a search on 14 January 1998 revealed the owl had been killed by a raptor.

DISCUSSION

Our study provided the first documentation of wintering locations for Canadian Burrowing Owls, confirming migration from the northern Great Plains to southern Texas and Mexico, as was suggested by the southeastern pattern of spring and fall band returns from Saskatchewan and Manitoba. In the period since our study, another Burrowing Owl from Saskatchewan was located in the Corpus Christi area (Woodin et al. 2007). A subsequent band recovery of a nestling from Texas in Michoacán (C. Boal pers. comm.) and a fall recovery of a nestling from Oklahoma in Michoacán (Butts 1973) show there is a mixing of owls on the wintering grounds in Mexico. The distribution of winter records indicated that owls banded in Canada were found in both Texas and Mexico.

We were able to collect qualitative information on roosts and habitats used by Burrowing Owls using aerial photographs. In contrast to the open prairie grassland that the owls use in Canada (Haug et al. 1993), half of the wintering owls were roosting in vegetation surrounded by thick shrubland or similar vegetation. All 11 habitat plots included trees and shrubs, although there were also ample open pastures within 1 km where owls could forage. We ob-

served a number of raptors in those shrubby areas and two owls were believed to have been killed by raptors. We noted that owls found during our ground searches were reluctant to fly to open areas (which would have facilitated band-reading), and quickly returned to cover. The use of habitat in or near dense cover, in addition to the behavior we noted, may be a strategy to avoid detection by diurnal raptors.

The types of roosts utilized were highly variable and often did not involve a burrow as they do in the breeding season (Haug et al. 1993). Individual owls used alternate roosts, and at least two owls used alternate roosts that included vegetation when burrows or holes, including culverts, were readily available. During the search for the Michoacán owl, we flushed unbanded Burrowing Owls nine times. None of them were found at a burrow and, when first encountered, one was seen roosting at the base of a tall shrub in sparse 20-cm grass. The majority of Burrowing Owl roost sites in southern Texas were in culverts or metal pipes (Williford et al. 2005, Woodin et al. 2007; G. Holroyd and H. Trefry unpubl. data) near cultivated fields, but these findings may be biased by the relative ease with which these owls can be seen compared to those roosting in more dense cover types, and to the search effort that focused in open agricultural fields.

The low detection rate of transmitters is likely explained by several factors: radio failure, undetected transmitters, and air-space restrictions to part of the search area. Owls sometimes remove or bend their antennae, thus rendering the radios ineffective. In 1998, some of the 6-mo transmitters may have been failing, as our searches were at the end of the effective battery life. We may have missed some owls because they were in burrows, or because our scan time was 3.1 sec per frequency, time for only 2–3 ''chirp'' signals. Some owls likely died on migration north of our search area. Lastly, Burrowing Owls may spend the winter in other parts of Texas or Mexico that we did not cover with our surveys. The low detection rate is a limitation on the efficiency of this type of study.

Confirmation of all owls on the ground was not possible due to the short ground range of the transmitters, the secretive nature of the owls during the day and the difficulty of securing access to the land. A separate ground crew in communication with the flight crew would have been an asset, as we now know that some of the owls were not stationary. Although we did show this technique could be used to locate wintering owls, the expense and manpower were considerable. Stable isotope analysis, small satellite transmitters, and other new technologies may prove to be more efficient ways to locate migratory birds in winter.

Lacking winter band recoveries, this project was an exploratory attempt to locate wintering Burrowing Owls that had migrated from Canada. The area searched was extensive but did not include the entire potential winter range of the species. Our findings showed that Burrowing Owls from Great Plains populations are mixed across a relatively large area and use cover types that are more diverse than those used in the summer. The results illustrated the need for international cooperation in conserving such highly migratory species that spend part of their life cycle in multiple countries (Holroyd et al. 2001, Holroyd 2005). Our project also illustrated the difficulty of this task given the extent of the winter range and the variation in habitats used. Given the endangered status of this species in Canada and the uncertain risks it faces during the winter period, additional research is needed to adequately understand the winter ecology and behavior of Burrowing Owls that migrate from the Canadian Great Plains to wintering areas in southern Texas and Mexico.

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