

COSEWIC
Assessment and Update Status Report

on the

Burrowing Owl
Athene cunicularia

in Canada



ENDANGERED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
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DES ESPÈCES EN PÉRIL
AU CANADA

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Wellicome, T.I. and E.A. Haug. 1995. Second updated COSEWIC status report on the Burrowing Owl *Speotyto cunicularia* in Canada. Committee on the Status of Endangered Wildlife in Canada. 1-37 pp.

Haug, E.A. and A.B. Didiuk. 1991. Updated COSEWIC status report on the Burrowing Owl *Speotyto cunicularia* in Canada. Committee on the Status of Endangered Wildlife in Canada. 1-35 pp.

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COSEWIC Assessment Summary

Assessment Summary – April 2006

Common name

Burrowing Owl

Scientific name

Athene cunicularia

Status

Endangered

Reason for designation

This grassland owl has suffered significant declines across its North American range; Canadian populations declined 90% in the 1990s and the species is essentially extirpated from British Columbia and Manitoba. This population decline slowed somewhat between 1994 and 2004, but remained at approximately 57%. The true cause or causes of this widespread decline remain unknown.

Occurrence

British Columbia, Alberta, Saskatchewan and Manitoba

Status history

Designated Threatened in April 1979. Status re-examined and confirmed in April 1991. Status re-examined and designated Endangered in April 1995. Status re-examined and confirmed in May 2000 and in April 2006. Last assessment based on an update status report.



COSEWIC
Executive Summary

Burrowing Owl
Athene cunicularia

Species information

Burrowing Owls are small, long-legged predators of the open prairie with a close association with burrowing mammals such as ground squirrels (*Spermophilus* spp.), badgers (*Taxidea taxus*), and prairie dogs (*Cynomys* spp.). Adults are drably coloured with a mix of brown, white, and beige spotting. Juveniles are more richly coloured in dark brown and cream. Adults and young are relatively conspicuous because of their tendency to be active during the day, foraging from elevated mounds or fenceposts in open, prairie habitats.

Distribution

Burrowing Owls have a disjunct breeding distribution within Canada. A few (reintroduced) pairs breed in the Thompson-Nicola valley of southcentral British Columbia, while the main prairie population breeds from southcentral Alberta east through southern Saskatchewan. Available evidence suggests that the species is now essentially extirpated as a breeding species in Manitoba. In the United States, Burrowing Owls (*A. c. hypugaea*) breed from the Great Plains westward, with a disjunct subspecies resident in Florida (*A. c. floridana*). Burrowing Owls winter primarily in Mexico, with some birds overwintering in the southwestern United States (e.g., Texas, New Mexico, Arizona, California). The breeding range of Burrowing Owls in Canada has shrunk in recent years to less than half of the range occupied in the 1970s, and to only one-third of the range occupied in the early-1900s.

Habitat

Preferred habitat is open, sparsely vegetated grasslands with burrows excavated by badgers, ground squirrels, or other mammals. Foraging habitat is generally in and around nesting sites during the day, but at night, owls may forage further afield and in areas with denser grasses and forbs. On the wintering grounds, habitat includes open grasslands, agricultural fields, and scrubland.

Biology

Burrowing Owls return to Canadian breeding areas during April and May and nest in existing mammal burrows. In Canada, clutches are initiated in May with an average of 9

eggs (range = 5–14). Typically, a single brood is raised, although pairs that fail may lay a second (smaller) clutch. Family groups remain together until late August, then disperse to individual burrows before migrating southward in September and October.

Population sizes and trends

In Canada, the current (2004) minimum (known) population size is 795 individuals: 498 in Saskatchewan, 288 in Alberta, and 9 in British Columbia; this may underestimate the actual population by as much as 50%, so the population is likely between 800 and 1600 individuals. Only one pair has been confirmed breeding in Manitoba since 1999, and no nests were documented in Manitoba in 2004. Data from intensive and extensive Burrowing Owl surveys, as well as the Breeding Bird Survey, suggest a significant decrease in density in all areas of prairie Canada over the past 30 years, resulting in a 90% population decline from 1990 to 2000, slowing to a 57% decline from 1994 to 2004. In the U.S. portion of the range, populations of Burrowing Owls are thought to be stable in the core of the species' range (e.g., Colorado, Idaho, New Mexico), but declining rapidly in California, in states along the eastern edge of the species' range, and in the northern states that border Canada. Though population trends in Mexico are unknown, wintering owl populations have declined in Texas and California, where some of Canada's population spends the winter.

Limiting factors and threats

Historically, the ultimate factor responsible for the decline in population viability of Burrowing Owls in Canada is thought to have been conversion of grassland to cropland, as well as the fragmentation and degradation of remaining grasslands. Other factors thought to have contributed to the recent population declines include: 1) higher emigration of owls from Canada to the U.S.A. than immigration to Canada from the U.S.A.; 2) loss of burrows (used for nesting and roosting) due to declines in the populations of burrowing mammals; 3) increased predation on the nesting grounds and in wintering areas resulting from increasing habitat fragmentation and changes in the predator community and grassland ecosystem; and 4) declines in prey abundance as a result of habitat changes and possibly changing weather patterns; 5) negative effects of toxins (from pesticide/herbicide applications); 6) mortality due to collisions with vehicles;

Special significance of the species

Burrowing Owls were once a common element of the prairie and southern interior (B.C.) landscapes. They are now rare throughout their Canadian range, and declining everywhere except in the core of their range in the U.S.A.

Existing protection or other status designations

Burrowing Owls are classified as G4 (apparently secure globally because of wide distribution, but some cause for concern due to declines) by NatureServe. Provincial NatureServe rankings are S1B in British Columbia and Manitoba, and S2B in

Saskatchewan and Alberta. Burrowing Owls are listed as *Endangered* in Manitoba, Saskatchewan, Alberta, and British Columbia; it is listed as *Endangered*, *Threatened* or a *Species of Concern* in several U.S. states. The last COSEWIC designation classified Burrowing Owls as Endangered in Canada.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2006)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

**Update
COSEWIC Status Report**

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2006

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SPECIES INFORMATION

Name and classification

English name: Burrowing Owl
French name: Chevêche des terriers
Scientific name: *Athene cunicularia* (Molina)

Description

The Burrowing Owl is a small, terrestrial owl that inhabits open habitats and typically occurs in close association with burrowing mammals. Adults are drably coloured with a blend of brown, and white, with cream spotting. They typically perch on the ground on mounds, or on short perches (e.g., fenceposts), and fly low to the ground with rapid wingbeats.

Nationally significant populations

Currently there are no nationally significant populations recognized. However, current research in Alberta and Saskatchewan is attempting to identify both critical habitats and centres of population abundance (T. Wellicome, pers. comm., October 2005).

DISTRIBUTION

Global range

Burrowing Owls have an extensive breeding range in western North America (Figure 1), with a disjunct (resident) subspecies (*A. c. floridana*) in Florida. There are also a number of subspecies on various Caribbean islands, as well as in South America (Clark 1997). The wintering distribution of western North American populations is poorly understood. In the northern portions of the range (including Canada), the species is migratory, while many individuals in the southern part of the range (e.g., Mexico, Texas, Oklahoma, California, Arizona, New Mexico) may remain on their breeding sites through the winter. Adult and juvenile owls banded in Alberta, Saskatchewan, and Manitoba appear to migrate south through the central Great Plains to winter from southern Texas to central Mexico (James 1992, Hjertaas *et al.* 1995, G. Holroyd pers. comm., October 2004).



Figure 1. Current and 1970s breeding range of Burrowing Owls (*hypugaea* subspecies) in western North America (modified from Wellicome and Holroyd 2001). No information is available for the historical (early-1900s) range of the owl across North America, and no information is available for the distribution of the owls in Mexico in the 1970s.

Canadian range

In Canada, Burrowing Owls currently breed in Saskatchewan, Alberta, and the southern interior of British Columbia, occupying only about half the area occupied in the 1970s, and less than one-third of the area they occupied from 1880-1950 (Figure 2). In British Columbia, Burrowing Owls were extirpated as a breeding species in the early 1980s and the few breeding pairs that still occur there are likely the result of continued reintroductions (Dyer 1991, Leupin and Low 2001).

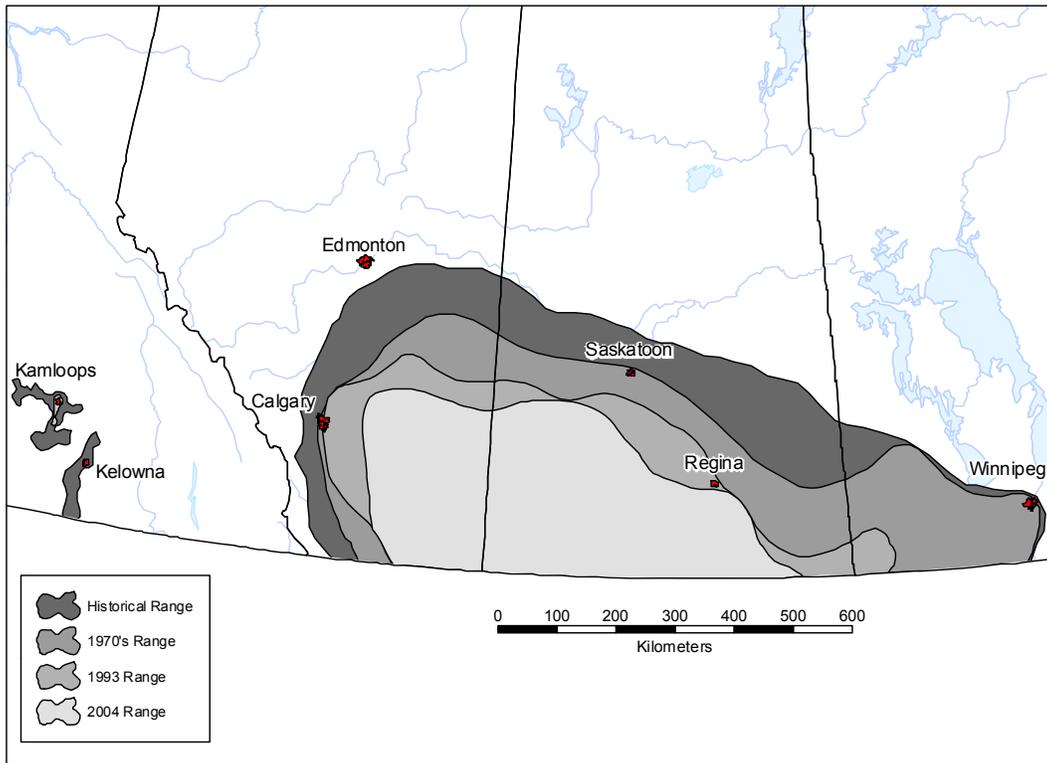


Figure 2. Change in the Canadian breeding distribution of the Burrowing Owl. The 2004 distribution was based on intensive search effort. The owls' 1970–1977 breeding range is based on Wedgwood (1978), and the 1993 range is from Wellicome and Haug (1995). The owls' historical range (1880–1950) is based on a comprehensive literature review of written records from early explorers and naturalists (Wapple 2005), with B.C. portions updated by J. Surgenor (pers. comm. 2005).

In Alberta, the species was found historically throughout the Prairie regions (Figure 2; Salt and Wilk 1958). In recent decades, the species' range in Alberta has contracted, especially along the western and northern peripheries (Wellicome and Holroyd 2001).

The breeding range in Saskatchewan has also contracted towards the south and west (Figure 2). Burrowing Owls are still widely (but sparsely) distributed in the southern prairie areas, but they no longer breed in many former nesting areas of central (e.g. Saskatoon area; Smith 1996) and southeastern Saskatchewan (Wellicome and Holroyd 2001, unpublished data from Operation Burrowing Owl). Average colony size has also declined over the past few decades (Skeel *et al.* 2001).

Only one pair has been confirmed breeding in Manitoba since 1999, and no nests were documented in Manitoba in 2004 (K. De Smet, pers. comm., September 2004). Burrowing Owls are officially considered Endangered in Manitoba (www.gov.mb.ca/natres/wildlife/index.htm).

Although Aboriginal lands are located within the current range of the Burrowing Owl (see Appendix 1), no breeding owls were found during survey work in 2003 on the Blood, Nekaneet, Piapot, and Siksika reserves (although an old nest site was located on Siksika; T. Wellicome, unpublished data). However, in 2005, one nest was found on the Blood Reserve, and one or two were reported from Siksika.

HABITAT

Habitat requirements

Burrowing Owls nest in open country, such as grazed pastures, prairie grasslands, sometimes with small amounts of sagebrush, and the edges of agricultural fields (Poulin *et al.* 2005). In all of these habitats, owls prefer to nest in areas with sparse vegetation and flat, open terrain. In Canada, Burrowing Owl habitat in Alberta and Saskatchewan is typically flat, treeless prairie, while in British Columbia preferred habitat is plateau and valley grassland (Wellicome and Haug 1995). Another important habitat component for Burrowing Owls is proximity to land with medium to tall grass for (largely nocturnal) foraging. While owls typically restrict their diurnal foraging to the area in the immediate nest vicinity, they appear to range more widely at night, feeding over nearby fields in denser vegetation (Haug and Oliphant 1990, Plumpton 1992, Sissons *et al.* 2001, Sissons 2003.).

In Canada, nests are always in abandoned burrows of various mammals, including ground squirrels, prairie dogs, badgers, foxes, skunks, coyotes, and marmots (Wellicome and Haug 1995, Wellicome 1997, Poulin *et al.* 2005), or in artificial nest burrows (De Smet 1997, Wellicome *et al.* 1997, Leupin and Low 2001). Burrowing Owls typically nest in whichever burrow type is most common locally. On the Great Plains, owls appear to show a preference for nesting in active prairie dog towns (e.g., Butts and Lewis 1982), and owl abundance may be linked to the local abundance of prairie dogs (Desmond *et al.* 2000). In Canada, most populations of Burrowing Owls now nest in abandoned badger and Richardson's ground squirrel (*Spermophilus richardsonii*) burrows, but show a preference for burrows with entrances that are 'badger-sized' (Poulin *et al.* 2005).

Burrowing Owls typically spend the day close to their nest burrow and fly further from the burrow area at night to forage (Haug & Oliphant 1990). Reported mean home-range sizes for Burrowing Owls are 2.41 km² in Saskatchewan (Haug and Oliphant 1990) and 3.73 km² in Alberta (Sissons 2003). Sissons (2003) showed that Burrowing Owls spend considerable time foraging at night in nearby grassland areas. Home-range size shows a positive correlation to the percentage of surrounding habitat that is under agricultural cultivation, suggesting that larger home-ranges are required when higher proportions of land are under cultivation (Haug 1985, Wellicome and Haug 1995).

Habitat trends

Suitable breeding, migration, and wintering habitat (primarily open grassland) continues to decline (see Telfer 1992, Hjertaas 1997, Warnock and Skeel 2004). Telfer

(1992) estimated a loss of 39% of the native grasslands in prairie Canada between 1949 and 1986. Hjertaas and Lyon (1987) estimated a 21% loss of native prairie in Saskatchewan over a 7-year period in the late 1970s and early 1980s. In Manitoba, at least 20% of historic nest sites recorded over a five-year period were destroyed during land cultivation or urban development (Haug and Churchward 1988). Warnock and Skeel (2004) reported that grassland loss, specifically from owl sites in southern Saskatchewan, averaged 6% per year from 1987 to 1993. All of these studies suggest that the primary loss of habitat occurs through conversion of native grasslands to agricultural crops.

In Canada, the rate of loss of grassland habitat has been accompanied by a decline in the number of ground squirrels and an even more rapid decline in the abundance of Burrowing Owls. In British Columbia, Howie (1980) identified a reduction in badger (*Taxidea taxus jeffersonii*) populations as the main factor responsible for the provincial Burrowing Owl decline. On the prairies, there are indications that Richardson's ground squirrels have decreased in some parts of Alberta (Kirk and Banasch 1996), Saskatchewan (Schmutz *et al.* 2001), and Manitoba (K. De Smet, pers. comm.), but population data are not available at larger scales (Michener and Schmutz 2002). The population of Burrowing Owls in the four western provinces is now so low that areas of potentially suitable habitat are not currently occupied (Skeel *et al.* 2001, Burrowing Owl Recovery Team Meeting, 2004).

Habitat protection/ownership

The majority of suitable Burrowing Owl habitat in Canada is under private ownership. As a consequence, habitat protection programs have been initiated with voluntary land stewardship programs including Operation Grassland Community (<http://www.afga.org/Conservation/ogc.htm>) in Alberta and Operation Burrowing Owl (<http://www.naturesask.com/OBO/obo.htm>) in Saskatchewan. These programs encourage landowners to report the number of Burrowing Owls on their land each year, to protect nesting areas from cultivation and pesticide use, and to consider planting native grasses in place of introduced grass species. Both programs have been successful in raising the profile of native species, have helped efforts to retain native grasslands (e.g., Warnock and Skeel 2004), and have also contributed valuable long-term data to Burrowing Owl monitoring efforts.

There are currently efforts underway in Alberta and Saskatchewan (T. Wellicome, pers. comm., September 2004) to first identify and then to protect (with stewardship and conservation easements) critical habitats for breeding Burrowing Owls. Habitat protection on the migration routes (U.S.A.) and on the wintering grounds (Mexico) is also critical because recovery of the Canadian population may also be dependent on habitat conservation measures in these areas.

BIOLOGY

Reproduction

Burrowing Owls are summer residents in the northern half of their breeding range, including the Canadian Prairie Provinces. Some individuals released in British Columbia in captive-breeding reintroduction programs do not migrate, but this is likely an artifact of captive-breeding. Burrowing Owls arrive on their prairie breeding grounds in April and May, lay an average of 9 eggs, typically fledge 3-5 young, and then begin fall migration sometime in late August or September (Wellicome 1997, Wellicome 2000, Todd *et al.* 2003). Most pairs are monogamous (Wellicome 2005), although polygyny is occasionally reported (Haug 1985).

Male owls typically defend a nest site and display for prospecting females (Haug *et al.* 1993). Both sexes may renovate and maintain the nest burrow, but only females incubate eggs and brood young. Males provision the female with food during the 28-30 day incubation period and while nestlings are brooded (Haug *et al.* 1993, Poulin 2003). The nestling period lasts approximately 44 days (Landry 1979), after which time juveniles disperse to nearby satellite burrows (Green 1983; Todd 2001b). Normally only a single brood is raised but a pair will re-nest if the first clutch is lost early in the season (Haug *et al.* 1993).

Survival

Estimates of adult survival have ranged from 37% to 51% over six years in Saskatchewan (James *et al.* 1997), 47% to 58% in Alberta (unpublished data cited in Haug *et al.* 1993), and 24% to 40% during a population decline in Manitoba (De Smet 1997). Dyer (cited in Haug *et al.* 1993) reported a 37% return rate for adults in British Columbia. Juvenile survival rates are lower, but are more difficult to estimate due to the lower site-fidelity of juvenile owls (De Smet 1997, Wellicome *et al.* 1997). Dyer (*loc. cit.*) found a 14% return rate for juvenile owls in B.C., while Hoyt *et al.* (2001) found a 6% return rate in Saskatchewan, and De Smet (1997) measured 3.5% return rate in Manitoba. Johnson (1997) found a minimum juvenile survival rate of 23% in California, but lower juvenile survival rates were noted in Colorado, where only 5% of fledglings were seen the following year (Lutz and Plumpton 1999). Clearly, these return rates underestimate survival rates, given that many adults and juveniles typically disperse from breeding and natal areas (see Movements/dispersal below). The lack of an accurate measure of adult and juvenile survival rates hampers attempts to accurately predict local population viability (McDonald *et al.* 2004).

Juvenile mortality after fledging apparently varies with predation pressure and local food availability. In Saskatchewan, a study involving radio-tagged juveniles found that mortality during the period between fledging and migration averaged 42% during normal years, but that no tagged juveniles died in a year of high food availability (Todd *et al.* 2003). In Alberta, post-fledging juvenile survival ranged from 45% during 1995–1996 ($n = 21$; Clayton and Schmutz 1999) to 61% during 1999–2000 ($n = 52$; Shyry 2005). In

addition, juvenile mortality tended to be higher in relatively fragmented habitat patches (Todd 2001a), suggesting that habitat fragmentation may be negatively affecting juvenile survival in Great Plains habitats (see also Clayton and Schmutz 1999).

Movements/dispersal

The degree to which adult and juvenile Burrowing Owls show fidelity to breeding (and natal) sites is difficult to assess as resightings of banded birds within finite study areas may underestimate dispersal. However, information from stable isotope studies suggests significant dispersal and genetic exchange among neighbouring populations (Duxbury 2004).

In Alberta, observations of individually-marked returning juveniles showed that nests were established 300 m to 30 km from their natal sites, with females moving farther than males (J. Schmutz, cited in Haug *et al.* 1993). Natal dispersal on the Regina Plain ranged from 0 to 295 km (Wellicome *et al.* 1997). De Smet (1997) reported that returning juveniles nested 1 to 77 km from their natal sites in Manitoba.

Between-year movements of adults were significantly lower. On the Regina Plain, movements ranged between 0–45 km for females, with no dispersal (i.e., 100% site-fidelity) shown by males (Wellicome *et al.* 1997). Adult males in Manitoba moved an average of 3.0 km among years and females moved an average 10.9 km.

Recovery of Burrowing Owls banded in Canada suggests that most of the prairie population migrates directly south through the Great Plains and winters in central Mexico (James 1992, Hertaas 1995, Duxbury 2004).

Interspecific interactions

Aside from anecdotal observations of Burrowing Owls being harassed by songbirds (e.g., Martell 1990), there are few observations of interspecific interactions aside from predation events.

Adult and juvenile Burrowing Owls are taken by a wide range of predators, with raptors and badgers (*Taxidea taxus*) being the most common (Wellicome *et al.* 1997, Todd *et al.* 2003, McDonald *et al.* 2004). Predation has been cited as a significant source of mortality in local populations. For example, an entire wintering population on Santa Barbara Island, California was eliminated due to predation by Barn Owls (*Tyto alba*; Drost and McCluskey 1992). Reintroduction efforts in British Columbia have been hampered by heavy predation from Northern Harriers (*Circus cyaneus*), Great Horned Owls (*Bubo virginianus*), Red-tailed Hawks (*Buteo jamaicensis*), and coyotes (*Canis latrans*; Leupin and Low 2001). In Alberta and Saskatchewan, avian predation accounted for almost half of all mortality of juvenile owls between the fledging and migration periods (Clayton 1997, Todd 2001). Badgers have been noted as serious predators of Burrowing Owls in Saskatchewan (Wellicome *et al.* 1997), in Oregon (Green 1983), and in Nebraska (Desmond 1991). Finally, near human habitations,

domestic cats and dogs are known to prey heavily on eggs and young (Haug 1985, Millsap and Bear 1988, Sleno 2000).

Behaviour/adaptability

Burrowing Owls are generally tolerant of minor human disturbance around nest sites. In many areas of their range, Burrowing Owls are often victims of shooting programs aimed at prairie dogs (James and Espie 1997). Even when such shooting is not directed at owls, it typically results in reduced owl reproductive success (Woodard 2002).

Most studies of Burrowing Owl foraging behaviour have noted the flexibility in the species' diet, depending on time of day, season, and local fluctuations in different prey species (McDonald *et al.* 2004). On the Canadian prairies, voles (*Microtus* spp.), mice, (*Peromyscus* spp.), grasshoppers (Acrididae), and beetles are common prey items (Haug *et al.* 1993). During the summer, Burrowing Owls typically forage during the day around their nest sites for insects, but feed on small mammals in nearby grasslands at night (Schmutz *et al.* 1991, Haug *et al.* 1993, Sissons *et al.* 2001). During the breeding season in Saskatchewan, over 90% of the prey biomass is composed of small mammals and such prey is typically captured at night (Poulin 2003). A similar ratio of insects to mammals is consumed during the winter in Mexico (Valdez Gomez *et al.* 2002).

POPULATION SIZES AND TRENDS

Estimates of Burrowing Owl population trends come from a variety of sources including: 1) large-scale breeding bird surveys carried out by volunteers on designated routes in Canada and the United States; 2) dedicated Burrowing Owl counts carried out by the Provinces (AB, SK, MB) in support of provincial conservation programs; 3) surveys of landowners participating in Operation Grassland Community (AB) and Operation Burrowing Owl (SK); and 4) surveys carried out by Burrowing Owl researchers on the Regina Plain, Grasslands National Park, and other research sites in the Prairie Provinces. Given the differences in methodology, scale, and observer effort among these surveys, the four survey types have different strengths and weaknesses. While the BBS and landowner surveys give results on the broadest scales, they are also more prone to observer/sampling error. Dedicated Burrowing Owl surveys carried out by provincial and federal biologists may give more accurate results, but are necessarily restricted to much smaller areas. Taken together, however, the four survey methods likely provide a relatively robust representation of the long-term population size and trends of Burrowing Owls in Canada.

Canada

In Canada, previous COSEWIC status reports on Burrowing Owls reported population sizes of 2000 pairs in 1977 (Wedgwood 1978), 2540 pairs in 1991 (Haug and

Didiuk 1991), and 1010-1685 pairs in 1995 (Wellicome and Haug 1995). Data from 2004 suggest a total minimum population size of 795 individuals in Canada: 498 individuals in Saskatchewan, 288 individuals in Alberta and 9 individuals in British Columbia (National Burrowing Owl Recovery Team 2004). This number almost certainly underestimates the total Canadian population as relatively large areas of potentially suitable habitat in Alberta and Saskatchewan remain unsurveyed; the actual population may be as high as 1600 individuals (National Burrowing Owl Recovery Team 2006). However, this number comes from a year (2004) in which some local populations appeared to have increased from the previous year by as much as 73% (D. Todd, pers. comm., December 2004). It should be stressed that each of the COSEWIC status reports used different methods to estimate population sizes, thereby complicating long-term trend analysis.

Burrowing Owls are seen on too few Canadian Breeding Bird Survey routes to generate meaningful population trends. Recent trend data from dedicated Burrowing Owl surveys in Canada, however, show a clear decline in the number of owls since the late 1980s.

Manitoba

Data from Manitoba show a decline from 76 nests in 1982 to 0 nests in 1997 (Figure 3), and only 1 nest in 1999. Since 1999, only one pair has been confirmed breeding in Manitoba (2001), and no nests were documented in Manitoba in 2004 (De Smet 1997; updates from K. De Smet, September 2004). While it may be too early to consider the Burrowing Owl extirpated in Manitoba, it is almost certainly only an irregular breeder now in the province (probably <10).

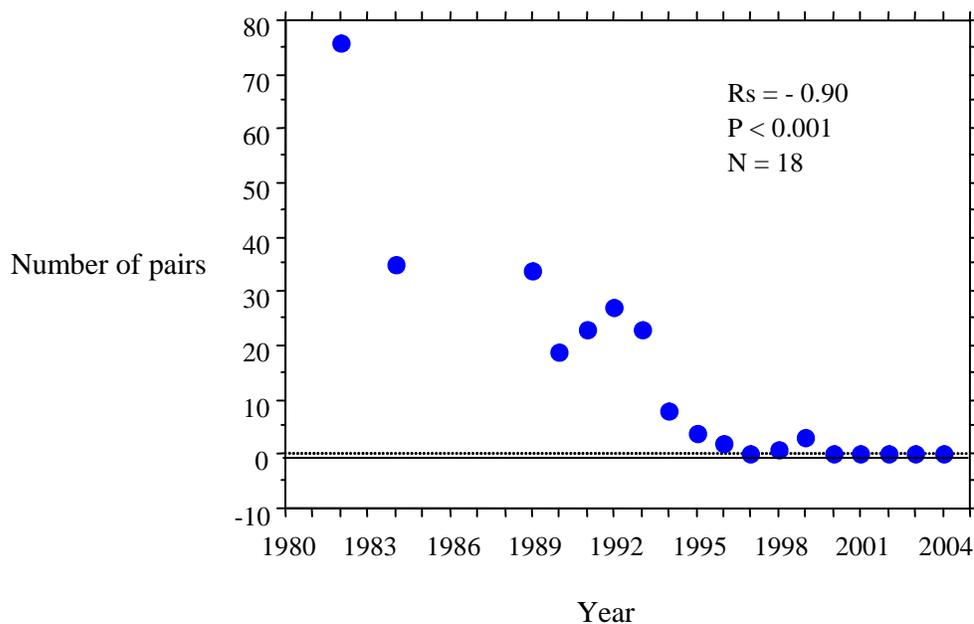


Figure 3. Trend in the number of pairs of Burrowing Owls found nesting in Manitoba since 1982 (updated from De Smet 1997; K. De Smet, pers. comm., September 2004).

Alberta

In Alberta, standardized surveys have been carried out near Hanna (104 quarter sections) and Brooks (128 quarter sections), sites that contain large blocks of suitable habitat and have been surveyed since the late 1980s and early 1990s, respectively (Wellicome 1997). In the Hanna blocks area, the number of Burrowing Owl nests has decreased from a high of over 30 in 1991 to 2 nests or less since 2001 (Figure 4). Similar surveys near Brooks (Figure 5) show a less dramatic decline, but only five nests/100 km² in 2002 and 2004. On a larger scale, data from Operation Grassland Community in Alberta also show a long-term negative trend (Figure 6). Taken together, the standardized survey and OGC data from Alberta suggest significant declines in the density of breeding Burrowing Owls in the province. The OGC data in particular indicate a decline from about 240 nests in 1991 to about 25 in 2001.

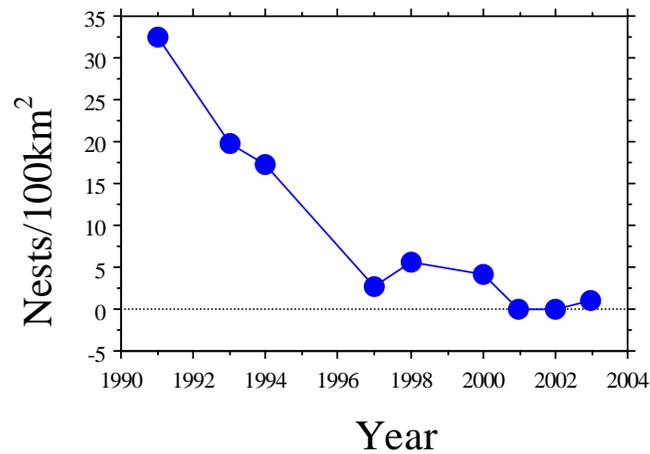


Figure 4. Trend in the number of nests/100 km² on survey blocks near Hanna, Alberta. The negative trend is statistically significant ($R_s = -0.89$, $P = 0.01$, $n = 9$).

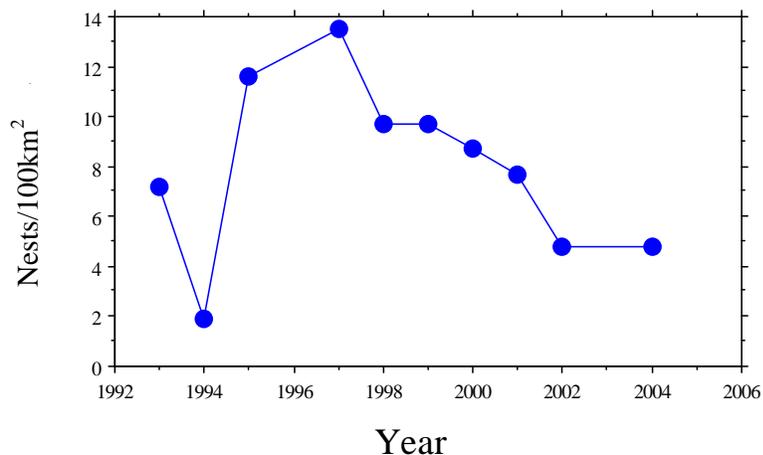


Figure 5. Trend in the number of nests/100 km² on survey blocks near Brooks, Alberta. Note that surveys were not performed in 1996 and 2003, and that an incomplete survey was carried out in 1993. Data are from Russell (2002) and the Burrowing Owl Recovery Team meeting (2004).

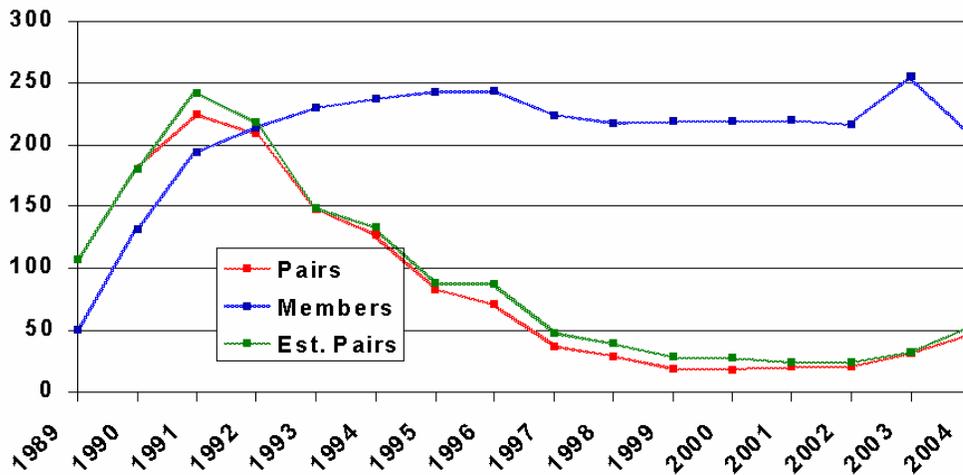


Figure 6. Trend in the number of Burrowing Owls reported by Operation Grassland Community landholders in Alberta between 1989 and 2004. Unpublished data provided by L. Tomy, Operation Grassland Community.

Saskatchewan

In Saskatchewan, surveys carried out by Operation Burrowing Owl cover a large proportion of the historical range of the species in the province. However, the survey includes only data from participating landowners and should consequently be viewed as a rough approximation of actual population trend in the province.

Figure 7 displays the trend in the number of Burrowing Owls reported by private landowners enrolled in Operation Burrowing Owl in Saskatchewan. The data show a significant decline in the estimated number of breeding pairs from around 1000 in the late 1980s, to less than 100 pairs since 2000.

Studies carried out on the Regina Plain have monitored the population status and breeding success of Burrowing Owls since 1987. Figure 8 shows the long-term population trend on the Regina Plain, with a significant decline in numbers from 1987 to 1999, and low numbers of breeding pairs since that time.

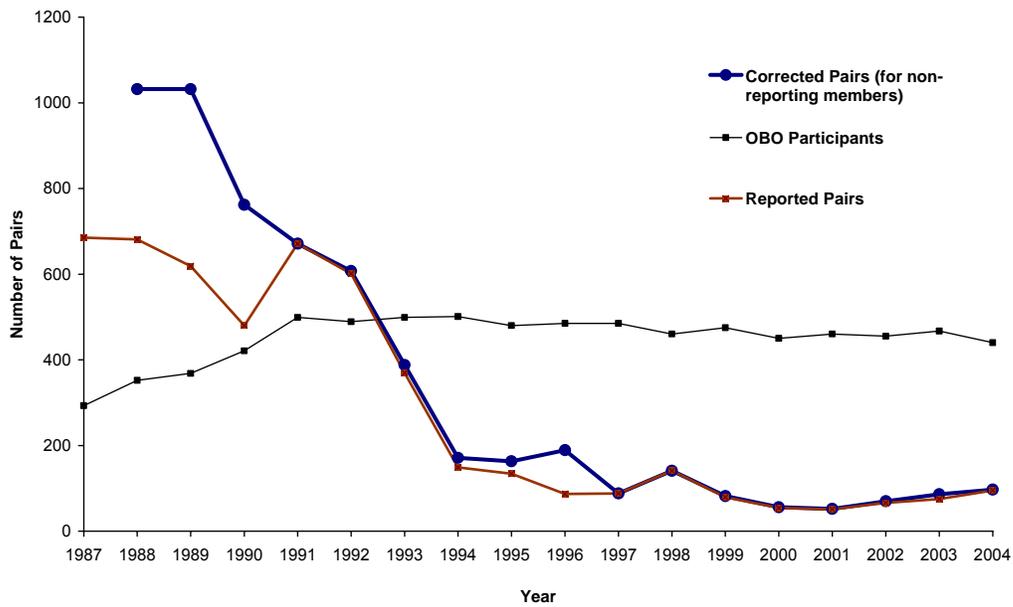


Figure 7. Burrowing Owl population trend at Operation Burrowing Owl sites in Saskatchewan between 1987 and 2004. Unpublished data provided by K. Dohms, Operation Burrowing Owl.

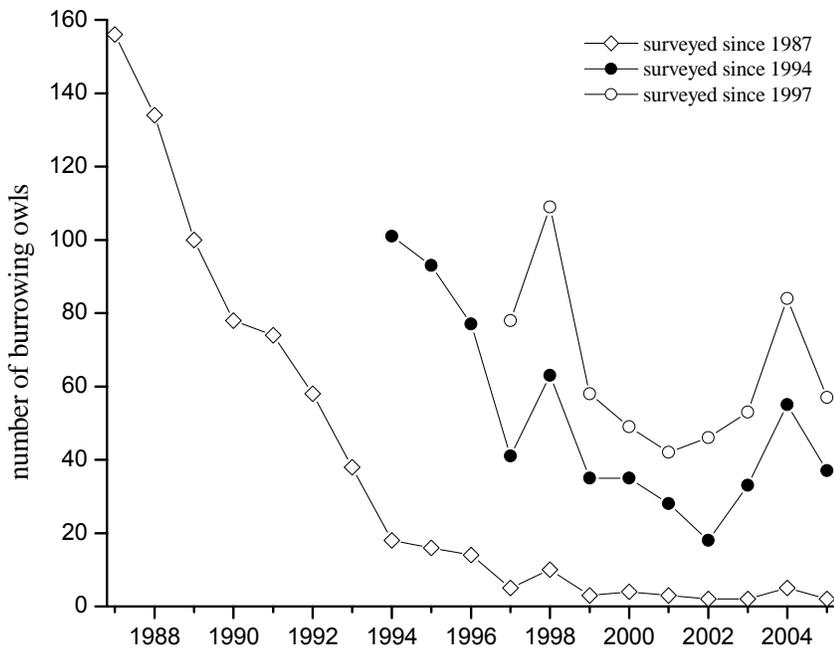


Figure 8. Trends in the number of Burrowing Owls found during surveys on the Regina Plain area in southcentral Saskatchewan. The study areas originally surveyed since 1987 (P.C. James) and since 1994 (T.I. Wellicome) are geographic subsets, wholly contained within the larger study area surveyed since 1997 (R.G. Poulin and L.D. Todd).

Finally, at Grasslands National Park and the adjoining Dixon ranch, the number of nesting pairs has increased since 1998 (Figure 9). However, the extent to which this increase may be due to improved surveying techniques and increased survey coverage is not clear (G. Holroyd, pers. comm., October 2004). Breeding success in the Grasslands Park area has varied strongly among years, with between 1 and 4 young produced per nesting attempt (Figure 9). Such annual variation is typical, and the overall reproductive success of Burrowing Owls appears to be comparable or even slightly higher than that recorded in Great Plains states in the U.S (McDonald *et al.* 2004).

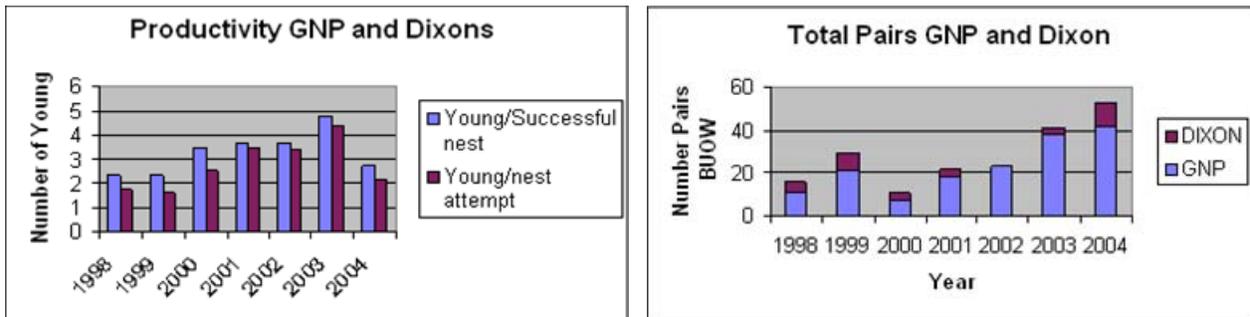


Figure 9. Breeding success (left panel) and number of breeding pairs at Grasslands National Park and Dixon's ranch, Saskatchewan. Unpublished data provided by G. Holroyd, Canadian Wildlife Service.

In summary, the various data sets from Saskatchewan suggest a significant long-term decline in the number of Burrowing Owls at the provincial level, with evidence of a small, stable population at Grasslands National Park in the extreme south of the province. Modest population increases within the last few years are interpreted to be the result of good productivity; however, 2005 data from the Regina Plain show another downward trend following poor productivity in 2004 (Figure 8).

British Columbia

Burrowing Owls were extirpated in British Columbia sometime in the 1980s (J. Surgenor, pers. comm., 2004). Efforts aimed at re-establishing a viable population in the province started with the release of captive-raised birds in the Thompson-Nicola region in 1983 and the release of families transplanted from Washington to the south Okanagan Valley from 1983 to 1988 (Dyer 1990). Although the program has succeeded in establishing small numbers of captive-raised birds that breed and migrate, as of 2004, only 9 individual owls were found in surveys in southern British Columbia. Of these, 4 were raised in the wild, 2 were returning captive-reared birds, and 3 were of unknown origin (J. Surgenor, pers. comm., October 2004). Apparently, larger numbers (i.e., > 50 birds/year) of releases will be necessary to re-establish a self-sustaining breeding population in British Columbia.

Summary of breeding season surveys

Survey data from the Prairie Provinces discussed above suggest a population decline from about 1315 pairs (AB, 240; SK, 1000; MB, 75) to 125 (25, 100, 0) through the 1990s. This represents a decadal decline of about 91%. This trend has decreased in the last 10 years (1994-2004) to approximately 57% based on the same data sources (ca. 325 pairs to ca. 140 pairs; Figures 3, 6 and 7).

Wintering range

Burrowing Owls from the Canadian prairies are known to migrate through the southern Great Plains states (James 1992) and are thought to winter largely in Mexico (G. Holroyd, unpubl. data). In the northern portion of their wintering range, Burrowing Owls occur within some Christmas Bird Counts (hereafter, CBCs). CBCs are carried out throughout North America and are one-day, fixed-radius surveys conducted each year in late December or early January. Analysis of the long-term trend in the number of Burrowing Owls seen on CBCs in Texas (where a few Canadian owls may winter) shows a statistically significant decline since 1960 (see Figure 10; Spearman Rank Correlation $R_s = -0.42$, $n = 43$, $P < 0.01$). However, these data must be interpreted with caution as wintering Burrowing Owls in Texas are largely of unknown origin (i.e., it is unclear to what extent owls from the Canadian prairies winter in Texas). Similar analysis of CBC data from California, where B.C. owls are thought to winter, shows a strong, significant decline from 1960 to 2003 (Figure 10; $R_s = -0.66$, $n = 43$, $P < 0.001$).

In summary, since 1995, Burrowing Owl populations have continued to decline in all areas of Canada and the species is no longer a confirmed breeder in Manitoba and portions of southeastern Saskatchewan.

LIMITING FACTORS AND THREATS

Historically, the ultimate threat to viable populations of Burrowing Owls is thought to have been the conversion and degradation of habitat (Haug *et al.* 1993, Wellicome and Haug 1995, Clayton and Schmutz 1999). Telfer (1992) reported a 39% decline in unimproved pastureland between 1946 and 1986 in areas of the Prairie Provinces, while dramatic losses of native grasslands have been reported in Alberta (61% of mixed grass prairie), Saskatchewan (81% of mixed grass prairie), Manitoba (99% of both tall and mixed grass prairie), and the western and central U.S. Great Plains (Samson and Knopf 1994).

Mortality of young and adults also affects Burrowing Owl population viability (De Smet 1997, Clayton and Schmutz 1999, King and Belthoff 2001). In Saskatchewan, following years with relatively poor juvenile survival, the local breeding population decreased by 11-48%, while years of high juvenile survival were followed by a population increase as well as relatively strong juvenile recruitment into the breeding population (Todd *et al.* 2003). The close correlation between nesting productivity in a

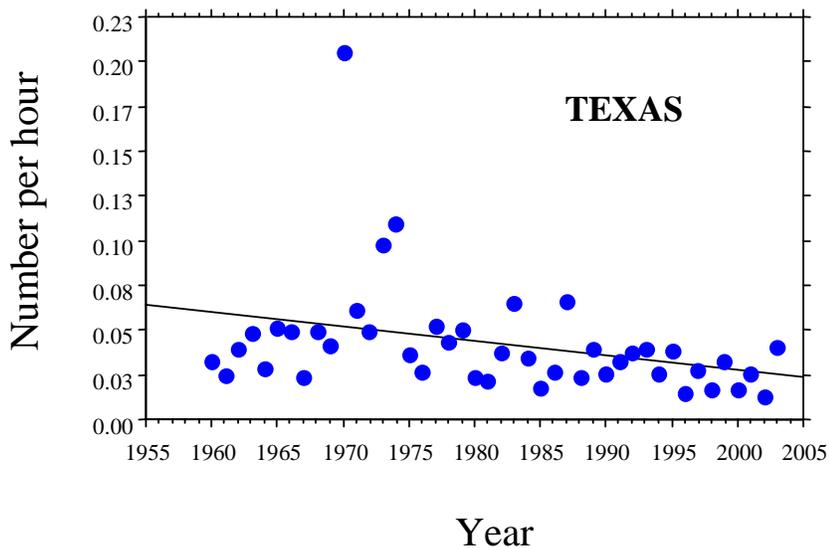
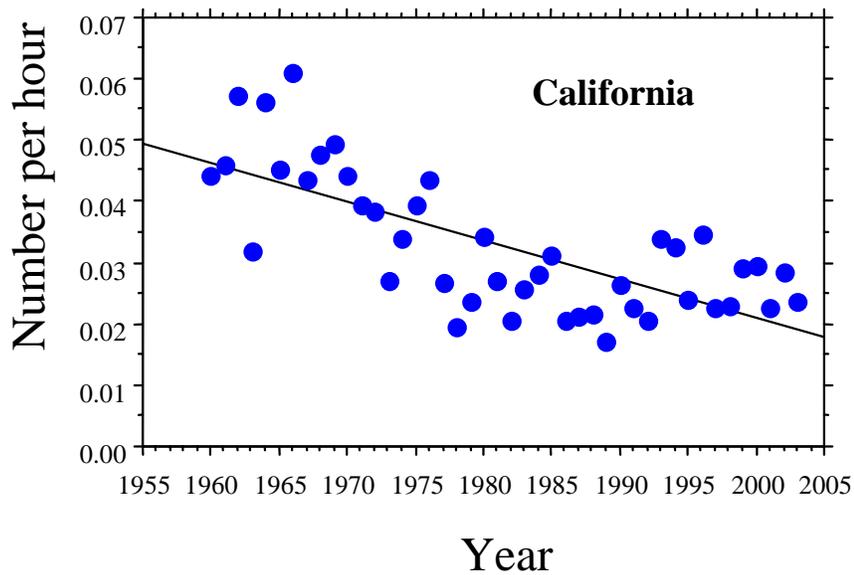


Figure 10. Pattern of abundance (number seen per survey hour) of Burrowing Owls seen on Christmas Bird Counts in Texas (lower figure) and California (upper figure).

given year and the size of the population in the following year suggests an important relationship (Franken and Wellicome 2003, R. Poulin, D. Todd, T. Wellicome, unpublished data). De Smet (1997) showed that successful nests in Manitoba were more than three times as likely to be reoccupied the following year than failed nests, and percentages that returned to the same territory were four times greater for successful than for unsuccessful sites.

Pesticides may also have direct and indirect effects on Burrowing Owls (Fox *et al.* 1989, Gervais and Anthony 2003, Gervais *et al.* 2003). Applications of rodenticides (e.g., strychnine) may cause direct mortality of adult and juvenile owls, as well as significantly decreasing breeding success (Butts 1973, James *et al.* 1990, Sheffield 1997). Insecticides (e.g., carbaryl and carbofuran) have been shown to significantly reduce owl fledging success in Saskatchewan (James and Fox 1987). Heavy use of insecticides and herbicides near Burrowing Owl foraging and roosting areas has been observed (but not quantified) on the wintering grounds in Mexico (G. Holroyd and H. Trefry, pers. comm., October 2004). In California, samples of Burrowing Owl eggs show varying levels of DDE contamination among years, with significant negative effects on reproductive success apparent during years of poor food availability (Gervais and Anthony 2003).

Although the evidence is thus far only correlative, it appears that pesticides may affect reproductive success and survival by significantly decreasing prey abundance. For example, offspring production decreased by up to 83 percent following the application of carbaryl and carbofuran around Burrowing Owl nest burrows (James and Fox 1987). Strychnine-treated grains (used for rodent control) and carbofuran-based insecticides remain widely used in the United States and Mexico and may pose a threat to the Canadian population of Burrowing Owls during migration and on the wintering grounds (McDonald *et al.* 2004, G. Holroyd, pers. comm., October 2004).

Although poorly quantified, collisions with vehicles are thought to be a significant source of mortality for adult and juvenile Burrowing Owls. Owls often forage near roads where grass conditions are optimal for small rodents and insects, and are thus susceptible to collision with vehicles. Clayton and Schmutz (1999) found that approximately 31% of all known Burrowing Owl fatalities on the Regina Plain, Saskatchewan, were due to collisions with vehicles. In Saskatchewan, 15% of known juvenile mortalities, during the post-fledging/pre-migration period, were attributed to collisions with vehicles (Todd *et al.* 2003). The author of this report found two dead adult Burrowing Owls on a single morning on small, secondary roads in the Oklahoma panhandle in May 2005, suggesting that vehicle collisions may be a significant mortality factor on the Great Plains.

Predation on Burrowing Owls, especially on recently fledged young, can represent a significant source of mortality in some populations. Todd (2001) found that in one year of a two-year study, 15 of 33 radio-tagged fledglings in Saskatchewan died prior to migration, with the primary cause being predation by avian predators. The high losses to predators were attributed to a combination of habitat fragmentation and reduced availability of mammalian prey (principally *Microtus voles*; Todd 2001).

Juvenile survival (from fledging to migration), which is largely mediated by local prey availability during the fledging stage, has been shown to have strong effects on subsequent population densities in Saskatchewan (Todd *et al.* 2003).

In summary, although habitat loss appears to have been the primary historical factor triggering population declines, suitable habitat is currently unoccupied, and lowered demographic factors (adult and juvenile mortality rates, productivity, immigration/emigration) now appear to be the key variables hampering the recovery of Burrowing Owls in the prairie provinces.

SPECIAL SIGNIFICANCE OF THE SPECIES

Burrowing Owls were formerly common inhabitants of open habitats throughout most of the western U.S.A and the southern parts of western Canada. Burrowing Owls are now rare throughout their Canadian range, which is one-third the size it was in the early 1990s, and are declining everywhere except the core of the species' range in the mid-western United States. Despite considerable attention from researchers and government agencies, it is still unclear which factors are ultimately responsible for the declines (see discussions in Holroyd *et al.* 2001, Wellicome and Holroyd 2001, McDonald *et al.* 2004). The population decline likely cannot be explained by a single factor; instead, it appears to result from the cumulative impacts of several threats, many of which may be interacting. Conservation actions have successfully engaged landowners on the Canadian prairies in helping to preserve Burrowing Owl habitat. The extent to which potential threats (habitat loss, pesticides) during migration and on the wintering grounds are contributing to ongoing declines is not yet clear.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Burrowing Owls are currently classified as G4 (apparently secure globally, although they may be quite rare in parts of their range) by the Nature Conservancy, with provincial Natural Heritage designations of S1B in British Columbia and Manitoba, and S2B in Saskatchewan and Alberta. S2B refers to a species that is either very rare or local throughout its range, or found locally in a restricted range. S1B is defined as species that are critically imperiled because of rarity, or because of some factor of its biology making it especially vulnerable to extinction. Summaries of the existing protection and legal status of Burrowing Owls in the United States and Canada can be found in Klute *et al.* (2003), McDonald *et al.* (2004), and on the NatureServe website (www.natureserve.org/explorer).

In Canada, the Burrowing Owl is nationally assessed as *Endangered* (COSEWIC 2001, 2006). Provincially, the species is listed as *Endangered* in Manitoba (www.gov.mb.ca/natres/wildlife/index.html), *Endangered* in Alberta (Alberta Fish and Wildlife 2006). In Saskatchewan, it is *Endangered* (<http://www.se.gov.sk.ca/ecosystem/speciesatrisk/>). It is also listed as *Endangered* in nearby Minnesota (<http://www.dnr.state.mn.us/ets/birds.html>), as a *Species of Concern* in Montana (<http://nhp.nris.state.mt.us/animal/index.html>), and as a *Candidate Species* (for listing as *Endangered*, *Threatened*, or *Sensitive*) in Washington (<http://www.wdfw.wa.gov/wlm/diversty/soc/candidat.htm>).

The primary, on-the-ground protection efforts in Alberta and Saskatchewan are to engage private landowners in taking an interest in preserving remaining Burrowing Owls and their habitat (e.g., Operation Burrowing Owl, Operation Grassland Community), enhancing foraging habitat, and monitoring reproductive success in areas where owls remain relatively common. Such efforts are typically oriented towards private stewardship, whereby landowners are encouraged to protect areas that are identified as important nesting and foraging sites. In Saskatchewan, Operation Burrowing Owl has succeeded in slowing the rate at which grasslands are converted to cropland (Warnock and Skeel 2004).

TECHNICAL SUMMARY

Athene cunicularia

Burrowing Owl

Chevêche des terriers

Range of Occurrence in Canada: AB, BC, SK, MB (essentially extirpated in BC and MB)

Extent and Area information	
• <i>extent of occurrence (EO)(km²)</i>	ca 160,000 km ²
• <i>specify trend (decline, stable, increasing, unknown)</i>	Decline
• <i>are there extreme fluctuations in EO (> 1 order of magnitude)?</i>	No
• <i>area of occupancy (AO) (km²)</i>	ca. 5000 to 10,000 km ²
• <i>specify trend (decline, stable, increasing, unknown)</i>	Decline
• <i>are there extreme fluctuations in AO (> 1 order magnitude)?</i>	No
• <i>number of extant locations</i>	Not applicable
• <i>specify trend in # locations (decline, stable, increasing, unknown)</i>	
• <i>are there extreme fluctuations in # locations (>1 order of magnitude)?</i>	
• <i>habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat</i>	Declining
Population information	
• <i>generation time (average age of parents in the population) (indicate years, months, days, etc.)</i>	2-3 years
• <i>number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)</i>	ca. 800-1600
• <i>total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals</i>	Declining
• <i>if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)</i>	Ca. 90% through 1990s; ca. 57% 1994-2004
• <i>combined data from Alberta, Saskatchewan and Manitoba.</i>	
• <i>are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?</i>	No
• <i>is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?</i>	No
• <i>list each population and the number of mature individuals in each</i>	
• <i>specify trend in number of populations (decline, stable, increasing, unknown)</i>	
• <i>are there extreme fluctuations in number of populations (>1 order of magnitude)?</i>	
Threats (actual or imminent threats to populations or habitats) [add rows as needed]	
<ul style="list-style-type: none"> - Loss, fragmentation, and degradation of breeding, migration and wintering habitat - Reduced immigration from neighbouring U.S. populations - Increased predation on adults and young - Poor reproductive success in most years, preceding population decreases in the next year 	

Rescue Effect (immigration from an outside source)	Very low; habitat loss is major source of decline
• <i>does species exist elsewhere (in Canada or outside)?</i>	Yes
• <i>status of the outside population(s)?</i>	Declining
• <i>is immigration known or possible?</i>	Yes
• <i>would immigrants be adapted to survive here?</i>	Yes
• <i>is there sufficient habitat for immigrants here?</i>	Declining
Quantitative Analysis	
Current Status	COSEWIC: Endangered (2001, 2006)

Status and Reasons for Designation

Status: Endangered	Alpha-numeric code: A2bc: C1
<p>Reasons for Designation: This grassland owl has suffered significant declines across its North America range; Canadian populations declined 90% in the 1990s and the species is essentially extirpated from British Columbia and Manitoba. This population decline slowed somewhat between 1994 and 2004, but remained at approximately 57%. The true cause or causes of this widespread decline remain unknown.</p>	
<p>Applicability of Criteria</p>	
<p>Criterion A: (Declining Total Population): Endangered A2bc; population has declined by about 57% in last three generations.</p> <p>Criterion B: (Small Distribution, and Decline or Fluctuation): population not fragmented or fluctuating</p> <p>Criterion C: (Small Total Population Size and Decline): Met Endangered C1; population less than 2000 and decline likely to continue.</p> <p>Criterion D: (Very Small Population or Restricted Distribution): Not applicable; population and AO/EO too large</p> <p>Criterion E: (Quantitative Analysis): Not done.</p>	

ACKNOWLEDGEMENTS

We owe particular thanks to Troy Wellicome, Geoff Holroyd, Ray Poulin, and Danielle Todd for providing us with extensive unpublished information on the status and biology of Burrowing Owls in Canada. This report was written with a heavy reliance on earlier COSEWIC reports by Wellicome and Haug (1995), Haug and Didiuk (1991), and Wedgwood (1979). We also thank the Burrowing Owl Recovery Team for allowing me to attend their 2004 meeting and to report their unpublished data. Troy Wellicome, Geoff Holroyd, and Danielle Todd read the entire report and provided extensive suggestions that greatly improved its quality. Funding, provided by the Canadian Wildlife Service, Environment Canada.

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David Wiggins is an ornithologist working in Sweden and North America. He completed an undergraduate degree at the University of Oklahoma, a Master's degree at Brock University (on parental care in Common Terns, under Ralph Morris), a Ph.D. at Simon Fraser University (on quantitative genetics in Tree Swallows, under Nico Verbeek), and a post-doctoral fellowship at Uppsala University in Sweden (on life-history evolution in Collared Flycatchers). David has since worked as a Research Ecologist within the Danish Environment Ministry, and is currently a consultant to the U.S. Forest Service, working with avian conservation projects in the western U.S.

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Appendix 1. Potential Aboriginal lands where Burrowing Owls may occur as of October 2004. Owl nests have been confirmed on the Blood Reserve and reported on Siksika.

Indian Reserve Lands	Province
Blood Reserve	AB
Cowessess IR #73	SK
Last Mountain Lake IR #80A	SK
Nekaneet Cree Nation IR #160A	SK
Piapot IR #75	SK
Piapot IR #75I	SK
Piapot IR #75J	SK
Piapot Cree First Nation IR#75E	SK
Piapot Cree First Nation IR#75F	SK
Piapot Cree First Nation IR#75G	SK
Piapot Cree First Nation IR#75H	SK
Siksika 146	AB
Wood Mountain IR #160	SK