COSEWIC
Assessment and Update Status Report

on the

Ord's kangaroo rat
Dipodomys ordii

in Canada

ENDANGERED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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Ord's kangaroo rat — Photograph by D.L. Gummer, courtesy of the Royal Alberta Museum.

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Ord's kangaroo rat

Scientific name
Dipodomys ordii

Status
Endangered

Reason for designation
The species requires sand dune habitat, which may disappear over the short term (10 years). The area of occupancy is only about 53 km² and only 1,000 or fewer individuals are alive at the end of most winters. There is strong evidence for local adaptations of the Canadian population and a rescue effect is extremely unlikely because the nearest population in the United States is 270 km away.

Occurrence
Alberta, Saskatchewan

Status history
Designated Special Concern in April 1995. Status re-examined and designated Endangered in April 2006. Last assessment based on an update status report.

COSEWIC
Executive Summary

Ord's kangaroo rat
Dipodomys ordii

Species information

Ord's kangaroo rat (*Dipodomys ordii* Woodhouse 1853), a small, nocturnal rodent, is the only species of *Dipodomys* that occurs in Canada. It has large hind legs and feet, and mainly orange-brown dorsal pelage with distinctive white markings, including lateral stripes on the tail. The tufted tail accounts for more than half of total length (260 mm). Mean adult body mass is 69 g.

Distribution

Ord's kangaroo rat is widely distributed in the interior arid grasslands and deserts of western North America, from southern prairie Canada to central Mexico. In Canada, the species occurs in a small area of sand hills in southwestern Saskatchewan and southeastern Alberta as a disjunct population at the northernmost periphery of the species' distribution.

Total extent of occurrence of kangaroo rats in Canada is 6,030 km², within which the area of occupancy is between 10 and 53 km². Both extent of occurrence and area of occupancy have likely declined in recent decades. The Canadian population of Ord's kangaroo rats functions as a metapopulation due to the highly dispersed and patchy nature of habitat and because patch turnover rates are high.

Habitat

Ord's kangaroo rat requires open, sparsely vegetated, sandy habitats to facilitate its hopping locomotion and extensive burrowing. Natural habitats consist of actively eroding sand dunes, sand flats, and sandy slopes of valleys in sand hill areas. Kangaroo rats also use sandy areas where the soil is disturbed by human land-uses (e.g., roads). These anthropogenic habitats may be low quality such that mortality exceeds recruitment.

Natural, sandy habitats are declining due to encroachment of vegetation. Climatic conditions contribute to dune stabilization, but land management such as fire suppression and altered grazing regimes presumably contribute to habitat loss. The extent of open sand in the Middle Sand Hills has declined by 40% per decade, on

average, since 1949. Over the same period, the number of exposed dunes has declined at a rate of 7 per decade, representing a 53% loss from 1995 to 2005. If this continues, there will be no active dunes remaining in the Middle Sand Hills by 2014. Coincident to the loss of natural habitat, there has been a dramatic increase in anthropogenic habitat created by human land-use (e.g., roads) which is apparently less suitable and possibly a population 'sink'. This rate of habitat loss and degradation appears representative of other areas within the species' range in Canada.

Most kangaroo rat habitat in Canada occurs on provincial land that is leased for grazing cattle. Approximately 12% is contained in provincial and federal protected areas. Canadian Forces Base Suffield contains approximately 13% of the Canadian range of the species.

Biology

Most kangaroo rats in Canada survive less than one year, with annual survival frequently ≤ 10 %. The population typically reaches its lowest point during early spring. Reproduction is constrained to the snow-free period, generally from early spring to early autumn. Average litter size is 3 and adult females may rear up to 4 litters per year. Average age at first reproduction for females is approximately 47 d. Generation length is < 1 year.

Canadian Ord's kangaroo rats exist in uncharacteristically cold and wet conditions for the genus. They are the only kangaroo rats known to use torpor to conserve energy during winter.

Kangaroo rats are territorial and defend burrows and underground food caches. Home range is generally ≤ 1 ha. Most dispersing individuals travel less than 500 m, though a maximum dispersal distance of 10 km has been recorded. Ord's kangaroo rats are primarily granivorous but also eat other plant parts and insects.

Population sizes and trends

Estimates of population size of Ord's kangaroo rats in Canada range between 545 and 1,040 during seasonal low-point (early spring). The population exhibits extreme seasonal fluctuations due to summer reproductive output and low over-winter survival. In addition to within-year fluctuations, inter-annual fluctuations likely occur but are difficult to quantify. There are no data to allow an evaluation of inter-annual variation or population trends. However, changes in available habitat strongly suggest long-term population declines.

Limiting factors and threats

The primary factor governing long-term persistence of Ord's kangaroo rats in Canada is likely loss and degradation of natural habitat. Additionally, the extreme seasonal fluctuation in population size puts the Canadian population at imminent risk of

extinction. The trend towards increasing use of anthropogenic habitats appears to be a threat to Canadian kangaroo rats and is currently being directly evaluated. Other anthropogenic factors that may limit the population include industrial (specifically oil and gas) development and agricultural practices.

Special significance of the species

Kangaroo rats in Canada possess unique life history and physiological characteristics, and the species is a potentially useful focal species for conservation of prairie sand dunes, a rare and declining habitat that many species depend on.

Existing protection

Ord's kangaroo rat was designated as special concern by COSEWIC in 1995 (then termed vulnerable). The global heritage status rank for the species is G5 (secure) and the provincial status rank is S2 (may be especially vulnerable to extirpation because of some factor of its biology) in Alberta and Saskatchewan. Kangaroo rats are considered endangered in Alberta under the Alberta Wildlife Act. In Saskatchewan, a portion of the species' range has recently been protected in the Great Sand Hills under the Representative Areas Ecological Reserves Act. Slightly less than half of the species range in CFB Suffield is protected as a National Wildlife Area (NWA) under the Canada Wildlife Act.

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.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune
Canada

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

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COSEWIC Status Report

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2006

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SPECIES INFORMATION

Name and classification

Ord's kangaroo rat (*Dipodomys ordii* Woodhouse 1853) is a small, nocturnal Heteromyid rodent endemic to the Americas. It is one of 21 species of kangaroo rats (*Dipodomys*) that occur exclusively in the arid grasslands and deserts of western North America and the only species of *Dipodomys* in Canada. *Dipodomys* is derived from Greek, meaning "two-footed mouse", referring to its bipedal locomotion. The common name reflects the characteristic hopping style of locomotion and the long tail. The French name is rat kangourou d'Ord.

Within the genus, Ord's kangaroo rat belongs to the *ordii*-group (Grinnell 1921, Stock 1974). Chromosomal evidence suggests that the species is more closely related to the Gulf Coast kangaroo rat (*D. compactus*) of southern Texas than to other congeners (Stock 1974, Patton and Rogers 1993).

There are 32 recognized subspecies of Ord's kangaroo rats (Williams *et al*. 1993). The Canadian population belongs to *D. o. terrosus* (Hoffmeister 1942, Anderson 1946, Setzer 1949, Hall 1981, Williams *et al*. 1993), which ranges from northern Wyoming and South Dakota into southern Alberta and Saskatchewan. The Canadian population is separated from the nearest populations of *D. o. terrosus* by approximately 270 km. Additionally, life history and physiological traits of the Canadian population are distinct (Gummer 1997a, Gummer 2005), indicating that the population is different from populations to the south. The original assignment of the Canadian population to *D. o. terrosus* appears to have been made based on an examination of only one specimen (Anderson 1946). Thus the taxonomic designation of the Canadian population likely requires reevaluation.

Morphological description

Ord's kangaroo rats have large hind legs and feet that facilitate bipedal locomotion (Figure 1). The dorsal pelage is mostly orange-brown but the ventral surface, dorsal surfaces of the feet, markings above the eye and below the ear, forelimbs, hip stripes, lateral stripes of the tail, and base of the tail are white. The species has fur-lined cheek pouches and five toes on each foot. The tail is tufted and long, accounting for more than half of total length (Table 1). Across most of the species' range, males tend to be slightly larger than females (Kennedy and Schnell 1978, Best 1993). However, the Canadian population does not exhibit sexual size dimorphism (Gummer unpubl. data). Adult kangaroo rats in Canada (Table 1) are consistently larger (up to 33 %) than conspecifics from more southern localities (Jones 1985, Best 1993). The skull is distinctive from other sympatric rodents in Canada due to its conspicuous, large auditory bullae and grooved upper incisors.

Figure 1. Photograph of Ord's kangaroo rat (photograph by D.L. Gummer, courtesy of the Royal Alberta Museum).

Table 1. Standard measurements of 49 adult Ord's kangaroo rats from the collections of the Royal Alberta Museum, Royal Saskatchewan Museum, and University of Alberta Museum of Zoology.

Measurement	Mean ± 1 standard error
Body mass (g)	69.2 ± 0.9
Total length (mm)	261.4 ± 1.7
Tail length (mm)	143.3 ± 1.2
Hind foot length (mm)	42.2 ± 0.2
Ear length (mm)	12.9 ± 0.2

Genetic description

The population genetics of northern Ord's kangaroo rats have not been studied. However, the Canadian population may have been isolated for approximately 6,000 years (Kenny 1989). Isolation, short generation time, and extreme annual population cycles are hypothesized to have favoured genetic drift and adaptations to prevailing regional environmental conditions (Gummer 1997a, Gummer 2005).

DISTRIBUTION

Global range

Ord's kangaroo rat is widely distributed in the interior arid grasslands and deserts of western North America (Figure 2; Hall 1981, Schmidly *et al*. 1993, Williams *et al*. 1993). Its geographic range extends across approximately 3,370,000 km² and 31º of latitude from the southern prairies in Canada to central Mexico. There have been no large-scale, historical changes in the overall geographic distribution.

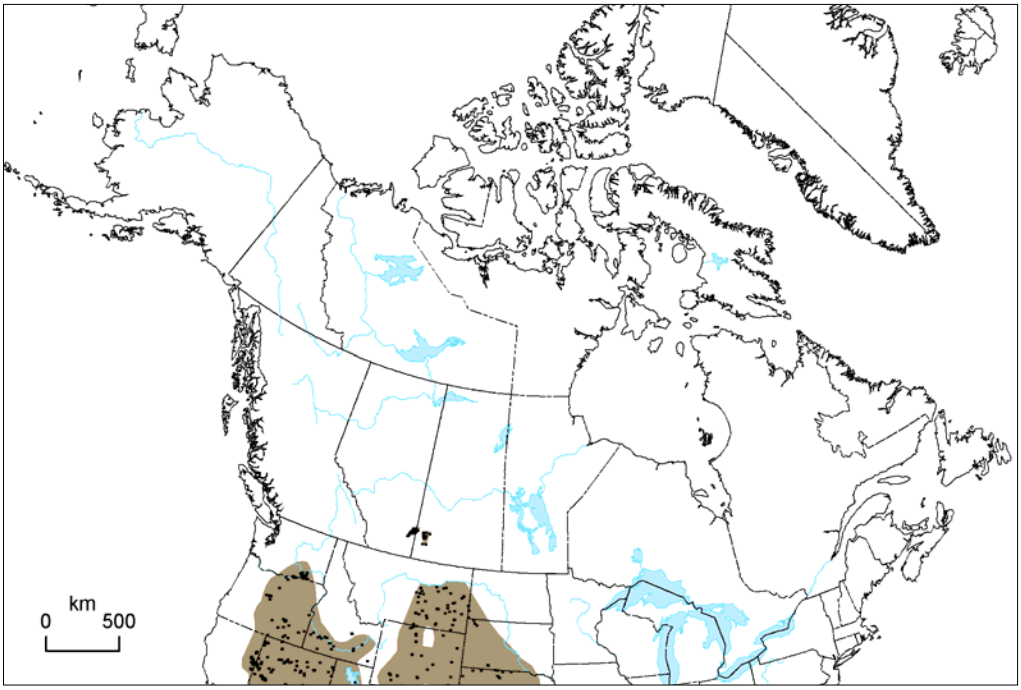

Figure 2. The distribution of Ord's kangaroo rats in Canada and the northern U.S. The species' distribution in the northwestern United States (revised to reflect the separation of the Canadian population) is also indicated for reference (after Hall 1981, Schmidly *et al*. 1993, Montana Natural Heritage Program 2005). Confirmed occurrences are indicated by black squares (▪). Confirmed occurrences in Canada are based on data provided by sources listed in Table 2, whereas occurrence records shown for the United States are based on a query of the Global Biodiversity Information Facility (2005) and the Montana Natural Heritage Program (2005).

Canadian range

The Canadian range of Ord's kangaroo rats is limited to a small area in southwestern Saskatchewan and southeastern Alberta (Figure 3), representing less than 1% of the species' global distribution. The Canadian range occurs in the mixed grassland ecoregion of the prairie ecozone (Marshall and Shutt 1999) in the vicinities of the Great Sand Hills, Saskatchewan (Nero 1956, Nero and Fyfe 1956, Kenagy 1976, Epp and Waker 1980, Kenny 1989), and the Middle Sand Hills, Alberta (Smith and Hampson 1969, Gummer *et al*. 1997, Gummer 1999, Gummer and Robertson 2003a, Gummer and Robertson 2003b). All confirmed records of kangaroo rats in Canada, including those from unpublished databases (Table 2), occur within or directly adjacent to sand hills (Figure 3), except for two records that are presumed to have been accidental or vagrant: (i) an anecdotal observation (Carleton 1956) near Ravenscrag, Saskatchewan (50 km south of the nearest sand hills); and (ii) a specimen held by the Royal Ontario Museum from near Val Marie, Saskatchewan (135 km south of the nearest sand hills).

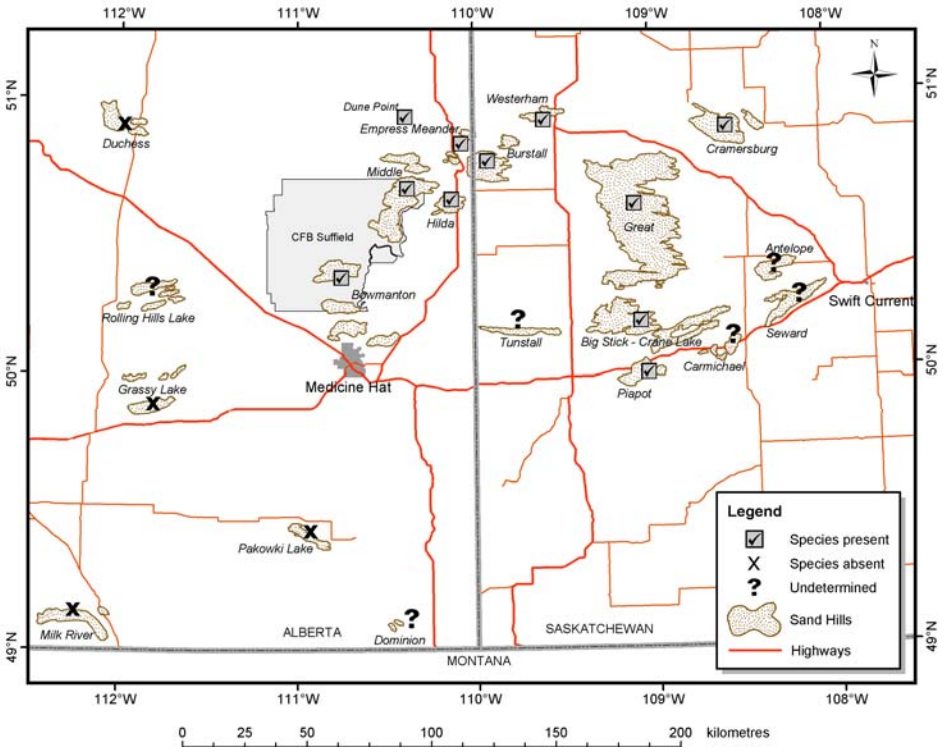

Figure 3. The distribution of Ord's kangaroo rats and the locations of surveys for the species in sand hills of southwestern Saskatchewan and southeastern Alberta. All recognized sand hill formations (following Wolfe 2001) within and adjacent to the Canadian range are shown. Also included is the status of kangaroo rats in each of the sand hill areas (i.e., species present, presumed to be absent based on surveys, or undetermined).

Table 2. Unpublished records of Ord's kangaroo rats in Canada used for mapping and analysis of the species' distribution (Figure 3). Confirmed occurrences were defined as direct observations of kangaroo rats or verifiable indirect observations (e.g., clear photograph of distinctive tracks and burrows) for which the precision of the geographic location was < 8 km. Data were excluded if they were redundant with original data sets or if consultation with original data sources revealed records to be suspect, unverifiable, or unmappable.

Sources	Total records	Confirmed occurrences
Museum collections:		
Canadian Museum of Nature	9	9
Royal Alberta Museum	94	94
Royal Ontario Museum	1	0
Royal Saskatchewan Museum	35	13
United States National Museum of Natural History (Smithsonian)	1	0
University of Alberta Museum of Zoology	14	14
Researchers:		
D.J. Bender *et al*., University of Calgary	1,615	1,612
D.L. Gummer, Royal Alberta Museum	4,596	4,524
Provincial databases*:		
Alberta Biodiversity Species Observation Database	1,511	0
Alberta Natural Heritage Information Centre	12	0
Saskatchewan Conservation Data Centre	14	2

*Provincial databases were consulted for confirmed occurrences that were not otherwise available from the original data sources.

Canadian Ord's kangaroo rats are a disjunct population at the northernmost periphery of the species' range (Figures 2 and 3; Kenny 1989, Gummer 1997a). The nearest occurrences of kangaroo rats in Montana (Montana Natural Heritage Program 2005), is approximately 270 km south. There is no evidence of kangaroo rats occurring in the Duchess, Grassy Lake, Milk River, or Pakowki Lake sand hills, despite intensive surveys for kangaroo rats in those areas of southeastern Alberta (Figure 3; Kenny 1989, Gummer and Gummer 1997, Gummer and Robertson 2003a). Systematic surveys for kangaroo rats have not been conducted in extreme southern Saskatchewan but there are no sand hills in that area (Figure 3).

The Canadian population of kangaroo rats occurs in two discrete areas: in the vicinity of the Great Sand Hills and centred around the Middle Sand Hills along the South Saskatchewan River (Figure 3). These two areas are fragmented by an intervening area of agricultural land that does not contain sand hills (Wolf 2001; Figure 4). Excluding this area, the total extent of occurrence of kangaroo rats in Canada is approximately 6,030 km^2 (Figure 4).

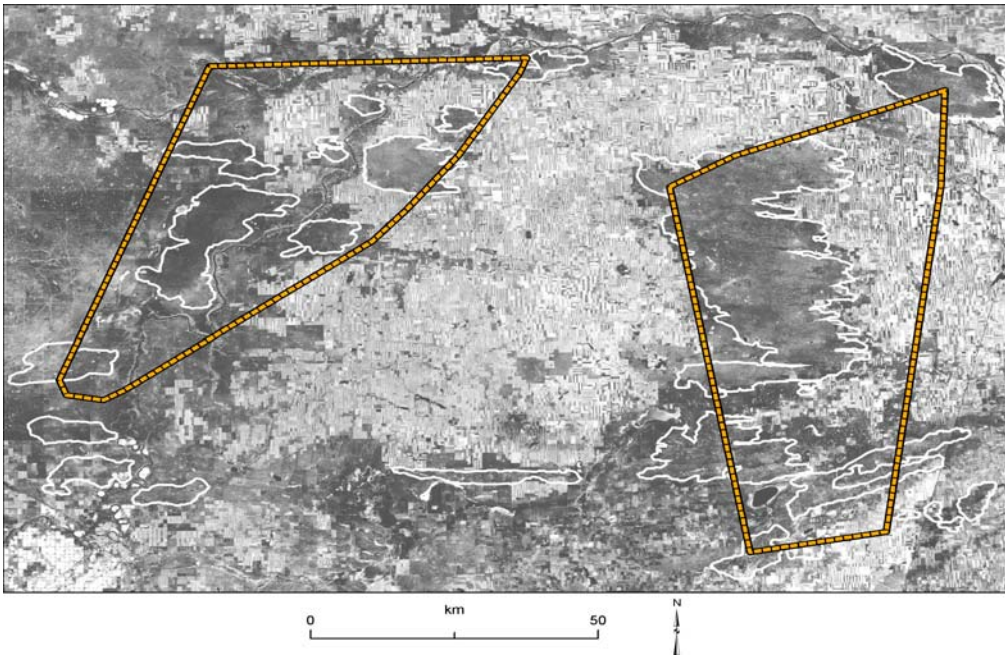

Figure 4. The distribution of sand hill habitat (depicted here as white polygons) and the estimated distribution of kangaroo rats in Canada (depicted using dashed borders). The range is fragmented by cultivated land evident in the satellite imagery (bright areas indicate cultivation and other intensive land-use; source: LandSat7 orthorectified imagery for 22 July 2000, GeoBase® 2005).

The area actually occupied by kangaroo rats is extremely small due to their specific habitat requirements. Kenny (1989) estimated the total area of open, sandy habitats available for kangaroo rats during a drought in the mid-1980s in the Great Sand Hills, Cramersburg Sand Hills, and Burstall Sand Hills (see Figure 3), representing more than 50% of the Canadian range, at approximately 6.8 km^2. The average amount of bare sand has been estimated at 0.10% for the Great Sand Hills (Vance and Wolfe

1996) and 0.011% for the Middle Sand Hills (Vance and Wolfe 1996, Bender *et al*. 2005). According to these estimates and the total area of sand hills in the Canadian range (Wolfe 2001), the maximum area of natural habitat occurring in the last decade was only 2.1 km^2. This estimate does not include anthropogenically created habitat such as sandy roads, trails, and fallow fields (see Habitat). Cumulatively, if all of the confirmed locations, including those in anthropogenic habitats, were each presumed to represent a quadrat of occupied habitat measuring 250 m in width (6.25 ha), then the area of occupancy in Canada would be 53 km^2. However, given that the majority of home ranges are < 100 m in width (< 1 ha; Gummer and Robertson 2003c), and the majority of patches of habitat are also < 100 m in width (Bender *et al*. unpubl. data), the area of occupancy is likely closer to 10 km².

Both the extent of occurrence and area of occupancy have apparently declined in recent decades. In 1970-1971, kangaroo rats occurred in an area of sand hills 15 km north of Hilda, Alberta, based on four museum specimens collected there (University of Alberta Museum of Zoology, Smith 1972). However, recent surveys in 1997 and 2001 found no evidence of kangaroo rats (Gummer and Gummer 1997, Gummer and Robertson 2003a).

There is some evidence that local distribution of kangaroo rats is dynamic. Kenny (1989) reported that 1 of 4 study populations was extirpated in the Great Sand Hills in 1985. Gummer and Robertson (2003b) found that 7 of 19 study populations in the Middle Sand Hills appeared to be extirpated in 2002. There is evidence of subsequent recolonization of 2 of these areas (Gummer and Bender unpubl. data).

HABITAT

Habitat requirements

Ord's kangaroo rat requires open, sparsely vegetated, sandy habitats for its hopping style of locomotion and extensive burrowing (Bartholomew and Caswell 1951, Armstrong 1979, Hallett 1982, Kenny 1989, Gummer 1999). Kangaroo rats cannot use their hopping locomotion to evade predators in dense vegetation or dig extensive burrows in fine textured soils. Natural habitats consist of actively eroding sand dunes, sand flats, and exposed sandy slopes of valleys in sand hill areas (Nero 1956, Nero and Fyfe 1956, Epp and Waker 1980, Kenny 1989, Gummer 1999, Reynolds *et al*. 1999, Gummer and Robertson 2003a, Gummer and Robertson 2003c).

Kangaroo rats also use sandy areas where the soil is disturbed by human activities (Nero and Fyfe 1956, Smith and Hampson 1969, Kaufman and Kaufman 1982, Stangl *et al*. 1992, Gummer 1997a, Gummer 1999, Bender *et al*. 2005). These anthropogenic habitats include roads, trails, fireguards, bare ground associated with oil and gas fixtures, heavily grazed pastures or trails, and the margins of cultivated agricultural lands. It appears that anthropogenic habitats are low quality, "sink" habitats in which mortality exceeds recruitment, and this is the subject of current research (Bender *et al*. 2005, Gummer unpubl. data).

Habitat trends

The primary natural habitat of kangaroo rats is active dunes, which are sensitive to both climatic change and human land-uses (Wolfe and Nickling 1997, Wolfe *et al*. 2001). Sand hills on the southern prairies are becoming increasingly stabilized by vegetation. Climatic factors, particularly moisture conditions, are cited as major drivers (David 1993, Wolfe *et al*. 1995, Wolfe *et al*. 2000). Whether human land-use practices increase stabilization has not been well studied, although humans have influenced the natural disturbance regimes, particularly fire and the effects of large grazers such as bison.

Wolfe *et al*. (1995) analyzed remote sensing imagery and land survey records dating to the late 1800s and found that sand dunes have been stabilizing since European settlement. Recently, Hugenholtz and Wolfe (2005) analyzed aerial photographs and demonstrated that the area of dunes in the Great Sand Hills and other regions has been decreasing since the mid-1900s. Vance and Wolfe (1996) and Muhs and Wolfe (1999) reported significantly less bare sand in the sand hills since the 1930s based on historical photos. Bender *et al*. (2005) quantified changes in the Middle Sand Hills from 1949 to 1998 using historical aerial photographs and multispectral satellite imagery. Exposed sandy areas have consistently declined at a average rate of 40% per decade (Figure 5). Analysis of individual dunes revealed that many were becoming completely stabilized by vegetation (no bare sand remaining) at a mean rate of loss of 7 dunes per decade (Figure 6), equating to 53% from 1995 to 2005. At this rate, all active sand dunes in the Middle Sand Hills will disappear by 2014.

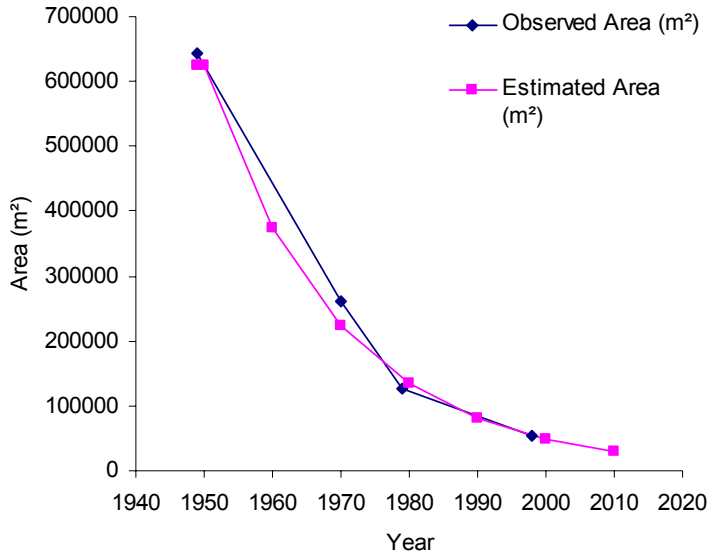

Figure 5. Observed rates of decline (diamonds) and estimated trend (squares) in the area of bare sand associated with active dunes in the Middle Sand Hills, Alberta, according to analysis of historical aerial photographs and satellite imagery (Bender *et al*. 2005).

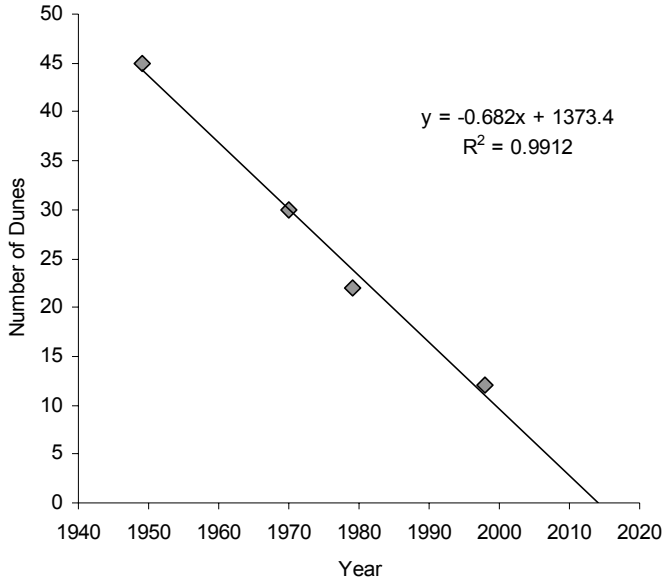

Figure 6. Decline in the number of active sand dunes in the Middle Sand Hills, Alberta, according to analysis of historical aerial photographs and satellite imagery (Bender *et al*. 2005). Trend line indicates the average rate of decline extrapolated to the year 2014 when no dunes are expected to occur on the landscape.

Land change analysis was also performed on a time series of multispectral satellite images (Landsat series) to evaluate changes in vegetation cover through time (Bender *et al*. 2005). This analysis demonstrated a 50% decrease in the proportion of bare sand from 1974 to 2001 and increasing shrub encroachment since 1974. Coincident with the marked decline in active sand dunes since 1949, there has been an increase in the area of anthropogenic habitats, specifically sandy roads, trails and fireguards (Figure 7). Much of this is associated with increasing numbers of oil and gas wells in the area (Figure 8).

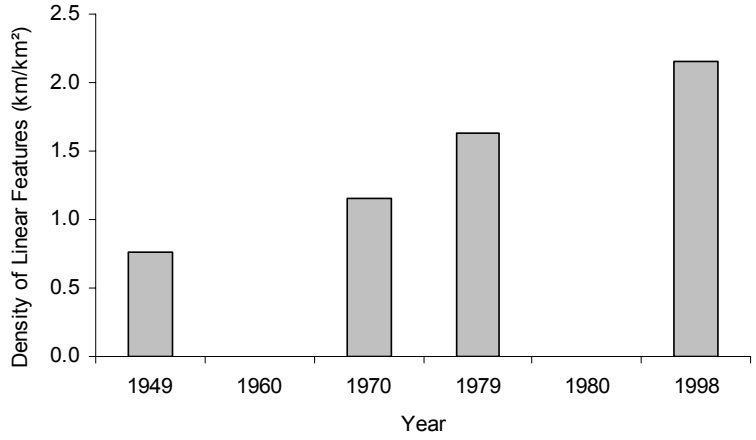

Figure 7. Density of linear features, e.g., roads, trails and fireguards, in the Middle Sand Hills based on analysis of historical aerial photographs and satellite imagery (Bender *et al*. 2005).

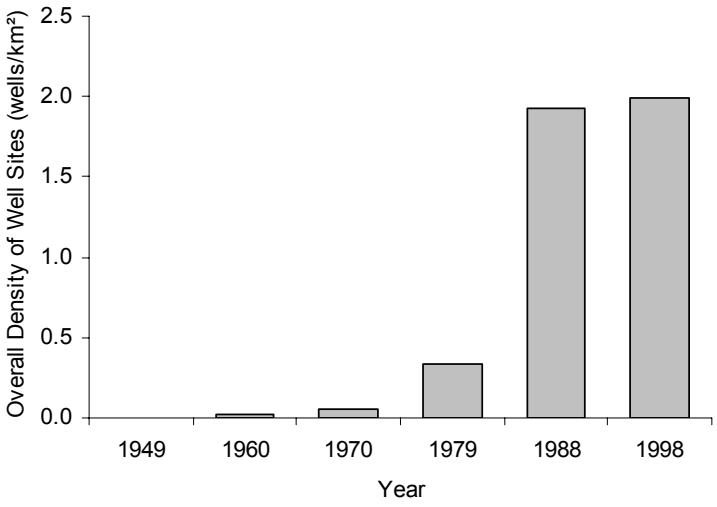

Figure 8. Density of oil and gas well sites in the Middle Sand Hills based on data from Ensight Corporation (Bender *et al*. 2005).

Habitat protection/ownership

The majority of kangaroo rat habitat in Canada occurs on provincial lands leased for grazing cattle. Approximately 62% (3,765 km²) of the Canadian range occurs in Saskatchewan (Figure 3), where at least 6% (of the Canadian range; 366 km²) is protected from cultivation and new industrial developments within the newly established Great Sand Hills Representative Area Ecological Reserve (Saskatchewan Environment 2005). The remaining 38% of the Canadian range is in Alberta, where the dens of kangaroo rats are protected under the Alberta Wildlife Act. Approximately 13% (811 km²) of the Canadian range occurs in Canadian Forces Base Suffield (Figure 3), which is owned by the federal Department of National Defence. CFB Suffield is managed primarily for live fire military training exercises, with secondary land-uses of oil and gas production and grazing managed by the Prairie Farm Rehabilitation Administration (PFRA). Within CFB Suffield, 6% of the Canadian range (376 km²) of the kangaroo rat is designated as a National Wildlife Area under the Canada Wildlife Act. Kangaroo rats are not known to occur on any Indian Reserves in Canada (Goulet pers. comm. 2005), nor any Parks Canada land (Achuff pers. comm. 2005).

BIOLOGY

Our knowledge of Ord's kangaroo rats in Canada is primarily based on research conducted in the Middle Sand Hills by Gummer and colleagues. Reference to other studies in more southern localities and other *Dipodomys* species is used where detailed data on the Canadian population of kangaroo rats are not available.

Life cycle and reproduction

Desert rodents tend to be relatively long lived and slow to reproduce for their body size (Stearns and Crandall 1981, Kenagy and Bartholomew 1985, Brown and Harney 1993) but Canadian kangaroo rats do not fit this trend (Gummer 1997a). Most individuals survive less than one year. Based on mark-recapture studies involving > 3,150 individuals over 11 years in the Middle Sand Hills, over-winter survival is frequently ≤ 10%, (range 5 to 34%) depending on winter severity (Kenny 1989, Gummer 1997a, Gummer and Robertson 2003b, Gummer and Bender unpubl. data) meaning that populations reach low levels during early spring. Factors contributing to mortality include predators (Gummer and Robertson 2003c), macroparasites (botfly larvae; Gummer *et al*. 1997), vehicle traffic, agricultural and industrial equipment crushing animals in their underground burrows, trampling by large grazers such as cattle and elk, and starvation (Gummer 1997a). Two individuals are known to have survived at least 4 years in the wild (Gummer and Robertson 2003b).

Kangaroo rats breed whenever conditions are favourable (Beatley 1969, Beatley 1976, Hoditschek and Best 1983, Best and Hoditschek 1986, Kenagy and Bartholomew 1985, Gummer 1997a). Mating occurs aboveground (Engstrom and Dowler 1981). For Canadian kangaroo rats, reproduction only occurs during the snow-free period, generally from early spring (March or April) to early autumn (September; Kenny 1989, Gummer 1997a). However, breeding attempts were observed during mild mid-winter conditions in one year (Gummer 2005).

Average litter size according to counts of embryos and placental scars from museum specimens is 3 (range 1 to 6, n = 16; Royal Alberta Museum) and is similar across the species' geographic range (Gummer 1997a). Gestation is approximately 29 d (Duke 1944, Day *et al*. 1956, Smith and Jorgensen 1975, Jones 1993) and lactation is 14 to 21 d (McCulloch and Inglis 1961). Lactating females appear capable of conceiving before their previous litter is weaned (Nielson 1941, Gummer 1997a). Number of juveniles weaned in 98 successful litters in the Middle Sand Hills ranged from 1 to 4 (Gummer 1997a).

Adult females in Canada may raise up to 4 litters per year (Gummer 1997a), considerably more than for other populations (1 to 2 litters per year; Gummer 1997a). Juvenile females attain sexual maturity when they reach approximately 73% of adult body mass, corresponding to an average age at first reproduction of approximately 47 d (Gummer 1997a). This is considerably earlier than elsewhere (60 to 90 d; Best and Hoditschek 1986, McCulloch and Inglis 1961, Smith and Jorgensen 1975, Jones 1985, Eisenberg 1993). Males become reproductive at approximately 79% of adult body mass and 61 d of age (Gummer 1997a). Given that most northern kangaroo rats fail to survive 1 year but produce up to 2 litters during their first year (Gummer 1997a), generation length for this population is < 1 year.

Predation

Known predators of Ord's kangaroo rats in Canada include Great Horned Owls (*Bubo virginianus*; Schowalter *et al*. 2002), Burrowing Owls (*Athene cunicularia*; Gummer unpubl. data, Poulin *et al*. pers. comm. 2005), prairie rattlesnakes (*Crotalus viridis*; Gummer and Robertson 2003c), and badgers (*Taxidea taxus*; Gummer unpubl. data). Domestic cats have been observed hunting in kangaroo rat habitat in the Middle Sand Hills (Gummer unpubl. data); both cats and dogs have brought dead kangaroo rats to their owners (Royal Saskatchewan Museum, Gummer unpubl. data). Although diurnal raptors are not generally considered predators of kangaroo rats, Gummer (unpubl. data) reported landowner accounts of (unidentified) diurnal raptors occasionally taking kangaroo rats in the daylight when burrows are disturbed by cultivation. Other likely predators of kangaroo rats in Canada are Short-eared Owls (*Asio flammeus*), Long-eared Owls (*A. otus*), red foxes (*Vulpes vulpes*), swift foxes (*V. velox*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), least weasels (*Mustela nivalis*), long-tailed weasels (*M. frenata*), striped skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), and bull snakes (*Pituophis melanoleucus*).

Kangaroo rats have many anti-predator strategies. Their erratic, bipedal locomotion likely evolved in response to selection for predator avoidance, primarily because this style of movement provides fast, energy efficient movements across open surfaces to the safety of burrows (Bartholomew and Caswell 1951, Yousef *et al*. 1970). The middle ear of Ord's kangaroo rat is sensitive to the sounds of owl wing beats and the movements of striking snakes, presumably allowing them to better avoid these predators (Webster and Webster 1971, Webster and Webster 1975). Banner-tailed kangaroo rats (*Dipodomys spectabilis*) perform foot-drumming as an alarm signal (Randall and Stevens 1987). Ord's kangaroo rats may also foot-drum (Brown 1989), which may alert predatory snakes to the fact that they have been detected and cause them to leave rather than investigate (Randall and Stevens 1987). Kangaroo rats are less active in open habitats under bright moonlight or northern lights (*aurora borealis*), presumably to minimize detection by visually orienting predators (O'Farrell 1974, Rosenzweig 1974, Kaufman and Kaufman 1982, Gummer unpubl. data).

Physiology

Kangaroo rats are adapted to hot and dry desert environments (MacMillen 1983, French 1993, Tracy and Walsberg 2002). Their nocturnal and fossorial nature facilitates heat avoidance and water conservation (Mullen 1971). Kangaroo rats can survive without exogenous water: their metabolic requirements met by eating seeds (Schmidt-Nielsen 1964, MacMillen and Hinds 1983). They select seeds with the highest water content in feeding tests (Frank 1988), and seeds cached in burrows undergo hygroscopic uptake of water (Reichman *et al*. 1986, Nagy and Gruchacz 1994). Kangaroo rat nasal passages are structured so that moisture condenses by counter-current heat exchange, minimizing water loss (Jackson and Schmidt-Nielsen 1964, Schmidt-Nielsen *et al*. 1970, Collins *et al*. 1971). On average, kangaroo rats have lower metabolism and water loss than other mammals of comparable size (Schmidt-Nielsen

1951, Fairbanks *et al*. 1983, Hinds and MacMillen 1985). Kenny (1989) considered these adaptations as evidence that northern Ord's kangaroo rats may be sensitive to drought, although this hypothesis may be inconsistent given that the species is adapted to dry desert conditions elsewhere in its range. Rather, cold and snow are likely to be limiting factors for northern Ord's kangaroo rats because these increase energetic requirements and restrict foraging (Gummer 1997a, Gummer 2005).

Canadian Ord's kangaroo rats use daily torpor to conserve energy during winter (Gummer 1997a, Gummer and Robertson 2003c, Gummer 2005). Individual kangaroo rats carrying or implanted with temperature data-loggers used torpor exclusively during the winter when the ground was snow covered (Gummer 1997a, Gummer and Robertson 2003c, Gummer 2005). Torpor was used primarily during daylight hours, with bouts extending up to 17 h and body temperatures falling to 13.5 ºC. Animals aroused from torpor during early evening and presumably fed from underground food caches during the night. Individuals generally did not emerge from burrows if there was snow on the ground. Kangaroo rats entered torpor on up to 70 d per winter (Gummer 2005), though some individuals did not exhibit torpor during mild winters (Gummer 2005).

The Canadian population of Ord's kangaroo rats is the only population of the genus known to use torpor in the wild. Laboratory studies of congeners reveal a drastic mass loss and death within several days if they are forced into torpor through starvation and exposure to low temperatures (Dawson 1955, Carpenter 1966, Yousef and Dill 1971, Breyen *et al*. 1973, MacMillen 1983). Likewise, there are reports of captures and observations of Ord's kangaroo rats aboveground in southern localities throughout the year (Reynolds 1958, Kenagy 1973, O'Farrell 1974, Nagy and Gruchacz 1994), even when air temperature approaches –19 ºC (Kenagy 1973, O'Farrell 1974) and there is up to 40% snow cover (Mullen 1971, Kenagy 1973, O'Farrell 1974).

Territoriality, home ranges and dispersal

Kangaroo rats are territorial and defend burrows and underground food caches (Eisenberg 1963). They are not colonial: individuals are solitary and exhibit little tolerance for conspecifics within the territory (Bartholomew and Caswell 1951, Garner 1974, Daly *et al*. 1984). Some species use foot-drumming as a territorial signal (Ward and Randall 1987).

Core home ranges of radio-collared kangaroo rats average 1750 ± 620 m² (± 1 standard error, n = 28; Gummer and Robertson 2003c). However, Ord's kangaroo rats occasionally move beyond this range at night, with overall home range size averaging 7,830 ± 2,930 m² (n = 38). The average maximum home range width is 130 ± 35 m (n = 38).

Juveniles are more likely to disperse than adults. Juvenile dispersal distances do not differ among the sexes, and are highly skewed with a median of 100 m; 75% of juveniles disperse < 500 m (Gummer 1997a). One juvenile male travelled approximately 10 km along a sandy fireguard (Gummer unpubl. data). The high connectivity of anthropogenic

habitats could facilitate greater dispersal and colonization of additional anthropogenic habitats. Kangaroo rats are unlikely to successfully disperse across densely vegetated sand hills because they cannot move inconspicuously through these areas.

Interspecific interactions

Ord's kangaroo rats are primarily granivorous. They collect food items in cheek pouches and store them in underground burrows. In addition to seeds, they collect green vegetation (Best and Hoditschek 1982) and other plant parts (silicles, pods, stems), insects (Johnson 1961, Alcoze and Zimmerman 1973, Flake 1973), bone fragments, and dry grasses for nest material. Canadian kangaroo rats collect seeds from at least 55 species of native plants (Beaudoin and Gummer unpubl. data) such as annual sunflower (*Helianthus couplandii*), cactus (*Opuntia* spp.), and scurph pea (*Psoralea lanceolata*). The diet also includes a high proportion of non-native, weedy plant species, such as common knotweed (*Polygonum aviculare*) and Russian thistle (*Salsola kali*), particularly in anthropogenic (disturbed) habitats.

Kangaroo rats are important in grassland and desert communities because they remove and eat seeds and grasses, and disturb soil (Brown and Heske 1990, Heske *et al*. 1993, Kerley *et al*. 1997, Curtin *et al*. 2000, Brock and Kelt 2004a). The low survival rate of northern Ord's kangaroo rats (Gummer 1997a), combined with their seed collection and caching behaviour, likely leads to a large number of abandoned seed caches for germination or for other granivores to exploit.

Other small rodents that are sympatric with Ord's kangaroo rats in Canada include the olive-backed pocket mouse (*Perognathus fasciatus*), bushy-tailed woodrat (*Neotoma cinereus*), deer mouse (*Peromyscus maniculatus*), northern grasshopper mouse, western harvest mouse (*Reithrodontomys megalotis*), house mouse (*Mus musculus*), meadow vole (*Microtus pennsylvanicus*), southern red-backed vole (*Clethrionomys gapperi*), sagebrush vole (*Lagurus curtatus*), northern pocket gopher (*Thomomys talpoides*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), and Richardson's ground squirrel (*S. richardsonii*; Epp and Waker 1980, Smith 1993, Reynolds *et al*. 1999). In a study of interspecific competition, Munger and Brown (1981) found that exclusion of *Dipodomys* resulted in increased abundance of smaller granivorous rodents and did not affect omnivorous species. In some cases, omnivorous northern grasshopper mice (*Onychomys leucogaster*) appear to displace Ord's kangaroo rats into microhabitats where there may be higher risk of predation (Rebar and Conley 1983).

Canadian Ord's kangaroo rats are the only population of the genus known to be parasitized by botfly larvae, *Cuterebra polita* (Gummer *et al*. 1997). The primary host of *C. polita* is likely the northern pocket gopher (Capelle 1970), but none of 86 northern pocket gophers caught in the Middle Sand Hills from 1994 to 2004 were parasitized (Reynolds *et al*. 1999, Gummer unpubl. data). *C. polita* could have shifted to kangaroo rats as the primary host, or alternatively the botfly may be a species not previously recognized. Parasitism by botfly larvae compromises survival, reproduction, and growth

of some small mammals (Boonstra *et al*. 1980, Burns *et al*. 2005). For Canadian Ord's kangaroo rats, botfly parasitism significantly reduces rates of reproduction and over-winter survival (Gummer unpubl. data). Kangaroo rats that inhabit anthropogenic habitats exhibit higher prevalence of botfly parasites (46%, n = 263) compared to those that occupy natural habitats (15%, n = 252; Bender *et al*. 2005).

Adaptability

The adaptability of Canadian kangaroo rats is highlighted by their opportunistic use of sandy areas produced by human activities (Nero and Fyfe 1956, Smith and Hampson 1969, Gummer 1999, Bender *et al*. 2005), similar to that reported for other kangaroo rats (Stangl *et al*. 1992, Price *et al*. 1994, Brock and Kelt 2004b). Although anthropogenic habitats superficially appear to represent additional habitat for kangaroo rats, a direct evaluation of the value of these habitats for the long-term persistence of the Canadian population is underway. Anthropogenic habitats are hypothesized to serve as population sinks (Gummer 1999, Bender *et al*. 2005).

Canadian kangaroo rats exhibit high rates of reproduction (Gummer 1997a) and breed opportunistically whenever favourable conditions arise (Gummer 1997a, Gummer 2005). This increases the potential for colonization of new habitats. Similarly, seasonal activity patterns and expression of torpor appear to vary according to the status of underground food caches and weather conditions (Gummer 2005). Cumulatively these strategies should facilitate rapid population responses to favourable weather, shifts in climate, or habitat management.

Distinct life history (e.g., age at first reproduction; Gummer 1997a) and physiological traits (e.g., torpor; Gummer 2005) of northern Ord's kangaroo rats may represent phenotypic plasticity and/or genetic differentiation (Gummer 1997a, Gummer 2005).

Kangaroo rats temporarily reduce home range size by as much as 50% when daytime industrial activities occur in the immediate vicinity (Gummer and Robertson 2003c). Contraction of home ranges likely decreases foraging opportunities, leading to depletion of underground food caches, and fewer reproductive opportunities, all of which could potentially have significant negative effects on the local population.

POPULATION SIZES AND TRENDS

Search effort

Since 1995, there has been considerable research on the life history, physiology, and landscape ecology of Ord's kangaroo rats in Canada. However, population monitoring has not been a priority. The high turnover rates of subpopulations confounds making opportunistic population estimates alongside other focused research (Kenny 1989, Gummer and Robertson 2003b). Therefore, estimation of general population

sizes and trends is difficult. Thus general trends in population size are probably best inferred from trends in the amount and quality of habitat.

These shortcomings aside, Kenny (1989) estimated the population size of kangaroo rats for the Great Sand Hills, Burstall Sand Hills, and Cramersburg Sand Hills in 1985 by combining live trapping results (densities) with interpretation of total potential habitat from aerial photographs. Kenny's estimates likely represent 50% of the total Canadian habitat at the time. Since it is unlikely that all patches were simultaneously occupied, Kenny's (1989) estimates should be viewed as liberal. Gummer (1997b) estimated the Middle Sand Hills population based on mark-recapture data in 1995. These estimates represent approximately 40% of the habitat at the time, but had broad confidence intervals owing to relatively low recapture success.

An important characteristic of the Canadian population of Ord's kangaroo rats is large fluctuations. These have been inferred from survival rates of animals in relatively small study areas (Kenny 1989, Gummer 1997a, Gummer and Robertson 2003b, Gummer and Robertson 2003c, Gummer unpubl. data) and assumes that population fluctuations documented in the Middle Sand Hills (e.g., Gummer 1997a) are representative of the Canadian range.

Abundance

Kenny (1989) estimated the maximum population size for the Great Sand Hills, Cramersburg Sand Hills, and Burstall Sand Hills to be 1,370, with 95% confidence limits of 1,120 and 1,690. If this represented 50% of the Canadian population then the total population estimate would have been 2,740 (2,240 to 3,380). Using Kenny's (1989) over-winter survival estimate (25%), the total population during the subsequent spring, the seasonal low-point, would have been approximately 685 (560 to 845). Kenny (1989) suggested that kangaroo rat abundance during his study was low due to ongoing drought.

Gummer (1997b) estimated the population in the Middle Sand Hills in 1995 to be 3,000 (2,180 to 4,160) at its seasonal peak. The corresponding total population estimate would be 7,500 (5,450 to 10,400). Based on Gummer's (1997a) over-winter survival estimate (10%), the total population during the subsequent spring was approximately 750 (545 to 1,040), similar to Kenny's (1989) estimate. Thus it is likely that at least in some years the Canadian population of Ord's kangaroo rat numbers less than 1,000 individuals during early spring.

Fluctuations and trends

The Canadian population of Ord's kangaroo rats experiences seasonal population fluctuations due to high summer reproductive output and low over-winter survival (Kenny 1989, Gummer 1997a, Gummer and Robertson 2003b). The population can decline by an order of magnitude (≤ 10% survival) during winter (Gummer 1997a). There is also a high frequency of local extinctions (i.e., sand dunes, road segments;

Kenny 1989, Gummer and Robertson 2003b), further evidence of the severity of population fluctuations. In addition to within-year, seasonal fluctuations, strong inter-annual fluctuations in population size are likely, albeit difficult to quantify. The current data are not sufficient to evaluate inter-annual variation, nor long-term trends in population size. The loss of the population near Hilda (see Distribution) may be indicative of an overall decline in the Canadian population.

There is strong evidence that the natural habitats of kangaroo rats have changed drastically in recent decades. It is reasonable to assume that there have been long-term population declines, concomitant with historical losses of natural sandy areas. Because kangaroo rats colonize anthropogenic habitats, rates of decline of natural habitats do not necessarily equate to declines in total population size, per se, but are strongly suggestive of declines in habitat quality.

Rescue effect

The likelihood of a rescue effect is negligible. The nearest conspecifics occur over 270 km to the south, beyond the dispersal capabilities of kangaroo rats. It is unlikely that translocations of animals from more southern localities would be effective or appropriate because the Canadian population may be endemic.

LIMITING FACTORS AND THREATS

The primary factor in the long-term persistence of Ord's kangaroo rats in Canada is loss and degradation of natural habitat. Additionally, the combination of a relatively small population that undergoes substantial seasonal fluctuations puts Canadian Ord's kangaroo rats at imminent risk of extinction. While population fluctuation has a natural component, there are anthropogenic factors that likely contribute to the amplitude of fluctuation.

Historical and ongoing declines of natural, sandy habitats in the Great Sand Hills and Middle Sand Hills are well documented (Wolfe *et al*. 1995, Vance and Wolfe 1996, Muhs and Wolfe 1999, Bender *et al*. 2005, Hugenholtz and Wolfe 2005). The prediction that 100% of dune patches in the Middle Sand Hills will disappear by 2014 if current trends continue (Bender *et al*. 2005) is alarming given that these types of habitat appear to be prerequisite for the species' persistence in Canada. Stabilization of open sand in the sand hills is generally driven by more humid conditions. However, land management, such as long-term suppression of fire, removal of large mammals that ranged widely and had heterogeneous effects on vegetation cover on the landscape (bison, *Bison bison*, and elk, *Cervus elaphus*), and practices which discourage erosion in sand hill areas, have obscured the natural trend. All of these factors have presumably contributed to stabilization of open sand. Noteworthy is the fact that the use of flax bales to discourage erosion in the Middle Sand Hills by CFB Suffield was discontinued in 1992 (Davies pers. comm. 2005), and in 1997 and 1998 elk were re-introduced in CFB Suffield in an effort to reestablish a large grazer. These steps may aid in slowing or

reversing losses of natural sandy habitats in that area. In addition, the Alberta Ord's kangaroo rat Recovery Team (2005) has proposed that experimental habitat management and development of a beneficial management plan (BMP) for maintaining active sand dune habitats is a high priority for 2005 to 2009. Fire and grazing management policies, shrub removal (Price *et al*. 1994), and physical reactivation of sand hills are possible.

Coincident to losses of natural habitat, human land-uses have rapidly overlaid a dense array of highly connected features on the landscape (e.g., access roads). Kangaroo rats' tendency to opportunistically colonize open sandy areas created by human disturbance may contribute to the severity of population fluctuations. Kangaroo rats that inhabit roads and fireguards: (i) have low survival rates and are prone to local (patch) extinctions (Gummer 1997a, Gummer and Robertson 2003b, Gummer unpubl. data); (ii) experience higher rates of botfly parasitism than kangaroo rats in more natural habitats (Bender *et al*. 2005, Gummer unpubl. data); (iii) have a significantly lower body mass index than kangaroo rats in more natural habitats (Bender *et al*. 2005). The long-term trend towards increasing anthropogenic habitats is a threat to Canadian Ord's kangaroo rats despite their apparent use of these areas. This hypothesis is currently being evaluated more rigorously (Bender *et al*. unpubl. data).

A large proportion of anthropogenic disturbances in the sand hills are associated with oil and gas development, so habitat degradation likely represents the principal effect of oil and gas development on kangaroo rats. There may be additional, direct effects of industrial activities such as seismic surveys, drilling wells, artificial lighting, auditory disturbances, and reclamation practices. Effects of pipeline construction on resident kangaroo rats have been studied intensively and several mitigation measures appear to effectively minimize direct mortalities of kangaroo rats (Gummer and Robertson 2003c).

Agricultural practices primarily affect kangaroo rats in three ways: (i) seasonal grazing of livestock in intact prairie that has not been cultivated; (ii) diligent management to discourage soil erosion, suppress fire, and generally increase vegetation cover; and (iii) conversion of natural, sandy habitats to anthropogenic habitats by cultivation. Livestock grazing is generally compatible with kangaroo rats and could potentially be managed to increase open, sandy habitats in some areas (Reynolds 1958). Although some kangaroo rats may be trampled by livestock or crushed in their underground burrows, this is likely outweighed by the benefits of reduced vegetation cover and increased amounts of open, sandy habitats. Conventional range management to reduce erosion and maintain or enhance vegetation cover may require innovative programs and incentives to favour sand dune conservation. Conversion of sandy habitats to cultivated lands is currently uncommon, but previously converted lands may contribute to the severity of population fluctuations by serving as population sinks.

Rural and industrial developments presumably limit kangaroo rat populations in some areas. The footprint and artificial lighting of buildings and other permanent

installations may inhibit kangaroo rats. Although the majority of kangaroo rat range is probably not subject to imminent development, large gas refineries and other industrial installations (e.g., gas compressor stations) continue to expand and increase in numbers. Additional expansion and additions of similar installations in other areas of kangaroo rat range may cause declines in local populations of kangaroo rats through habitat loss and interference with nighttime foraging behaviour and predator avoidance.

Approximately 13% of the Canadian range of Ord's kangaroo rat occurs in CFB Suffield, which is used intensively for military training. Military activities do not occur within the portion of the military lands designated as a National Wildlife Area and thus should not impact the population there. It is likely that the relatively small number of kangaroo rats that may be killed by vehicles or crushed in their underground burrows is outweighed by the fact that military exercises also generate frequent grass fires and create localized disturbance of the soil surface that may create habitat for kangaroo rats.

Botfly parasitism appears to be a limiting factor for the Canadian population of Ord's kangaroo rats because it compromises reproduction and over-winter survival of kangaroo rats (Gummer unpubl. data). Kangaroo rats are much more susceptible to botfly parasitism in anthropogenic habitats (Bender *et al*. 2005).

Like any small population that fluctuates in numbers, the Canadian population of Ord's kangaroo rats is highly susceptible to extinction from stochastic events including extreme weather events, unforeseen human disturbances, disease outbreaks, demographic stochasticity, genetic bottlenecks or in-breeding effects, and difficulty finding mates when populations are low. Winter severity, appears to be a critical, limiting factor for kangaroo rat survival (Gummer 1997a, Gummer and Robertson 2003c, Gummer 2005).

SPECIAL SIGNIFICANCE OF THE SPECIES

Ord's kangaroo rat is the only *Dipodomys* that occurs in Canada. Although the species is widely distributed and secure in the majority of its range in western North America, the Canadian population is geographically isolated and exhibits characteristics, e.g., torpor use, that appear unique among kangaroo rats (Gummer 1997a, Gummer and Robertson 2003c, Gummer 2005).

Ord's kangaroo rats may serve a keystone role in prairie sand hills, by exerting substantial effects on the plant communities, soils, and predators. Declines or extinction of Ord's kangaroo rats from this ecosystem would permanently alter many interspecific relationships. Ord's kangaroo rats are also a useful focal species for conservation of prairie sand dunes, which are rare and declining habitats upon which many other species at risk and a high proportion of endemic biodiversity depend (Finnamore and Buckle 1999).

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Ord's kangaroo rat was designated as a species of special concern by COSEWIC in 1995 (then termed vulnerable; Gummer 1995) due to its sparse distribution, disjunction from the nearest populations in Montana, and restricted sand dune habitats. The global heritage status rank for the species is G5 (demonstrably secure). The Alberta Natural Heritage Information Centre (ANHIC) and Saskatchewan Conservation Data Centre (SCDC) both list the provincial status rank of Ord's kangaroo rat as S2 (may be especially vulnerable to extirpation because of some factor of its biology). Nearest conspecifics to the south are listed by the Montana Natural Heritage Program as S4 (uncommon but not rare).

Ord's kangaroo rat has been listed as endangered in Alberta under the Alberta Wildlife Act since May 2002. A provincial recovery plan (Alberta Ord's kangaroo rat Recovery Team 2005) was accepted by a committee of stakeholders, and approved by the Minister of Sustainable Resource Development in 2005.

In Saskatchewan, the Wildlife Habitat Protection Act protects kangaroo rat habitat by preventing the clearing and breaking of Crown lands. Further protection, preventing cultivation and new industrial developments, has recently been provided to 366 km² of kangaroo rat range in the Great Sand Hills under the Representative Areas Ecological Reserves Act (Saskatchewan Environment 2005).

A large portion (811 km²) of the Canadian range of Ord's kangaroo rats occurs in CFB Suffield. There is no public access to this area and the Department of National Defence is committed to conducting military activities in an environmentally sustainable manner (DND 2003). Base Standing Orders currently do not permit activities within 250 m of kangaroo rat dens, based on the recommendations of Scobie and Faminow (2000). Slightly less than half of the distribution of kangaroo rats in CFB Suffield (376 km²) falls within lands designated as a National Wildlife Area (NWA) under the Canada Wildlife Act in 2003. All developments proposed to occur in the NWA require environmental assessments under the terms of the Canadian Environmental Assessment Act.

TECHNICAL SUMMARY

Dipodomys ordii
Ord's kangaroo rat rat kangourou d'Ord
Range of Occurrence in Canada: Alberta, Saskatchewan

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* EO was based on specimens, live captures, direct observations, and verifiable indirect observations for which the geographic precision was < 8 km. EO was estimated as the sum of the area of two polygons constructed separately in order to exclude a large, intervening area of unsuitable habitat (Figure 3 and Figure 4).	6,030 km²
• *Specify trend in EO*	Presumed declining, but at an unknown rate
• *Are there extreme fluctuations in EO?*	Unknown
• *Area of occupancy (AO) (km²)* AO was estimated according to 250-m wide quadrats (6.25 ha). However this is acknowledged to be a drastic overestimate for the Alberta records, which represent the majority of records. It also weights records in anthropogenic habitats as highly as natural sand dunes, but the majority of anthropogenic sites are not occupied in early spring. The sum of the potential habitats measured from aerial photos is much smaller, 6.8 km² for more than 50% of the range, and therefore 10 km² is considered a better reflection of occupied habitats.	≤ 53 km² including anthropogenic habitats (presumed to be *population sinks*); ca.10 km² if only natural habitats are considered
• *Specify trend in AO*	Unknown, but assumed to be declining because natural habitats are known to be rapidly declining
• *Are there extreme fluctuations in AO?*	Probably
• *Number of known or inferred current locations* Each discrete patch of sand hills (Figure 3 and Figure 4) may be considered a separate population and there are multiple locations within each, depending on how many patches of open sand or anthropogenic features there are within each.	>> 10
• *Specify trend in #*	Unknown but presumably declining since natural habitats are known to be declining
• *Are there extreme fluctuations in number of locations?*	Unknown
• *Specify trend in area, extent or quality of habitat* Area of open sand is declining at a rate of 40% per decade and number of sand dunes declined at 53% in the most recent decade. If this continues, all sand dunes in the Middle Sand Hills are predicted to disappear by 2014.	40 to 53% decline per decade depending on habitat metric
Population Information	
• *Generation time (average age of parents in the population)*	< 1 year
• *Number of mature individuals* Two similar estimates by independent data. Confidence intervals: (i) 560 to 845; and (ii) 545 to 1,040.	< 1,000 in early spring

• *Total population trend:*	Unknown but presumed declining due to known declines in habitat
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	Yes
• *Is the total population severely fragmented?*	Yes
• *Specify trend in number of populations*	Unknown, although assumed to be declining due to severe habitat loss
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each:	Unknown
Threats (actual or imminent threats to populations or habitats)	
- Loss of natural habitat and habitat degradation through increases in anthropogenic features - Small population size with severe fluctuations related to anthropogenic influence - Risks inherent to small populations (e.g., stochasticity, difficulty finding mates) - Intensive oil and gas development - Agricultural practices - Anthropogenic influences that increase botfly parasitism and predation, and interact with foraging behaviour, body condition, and winter severity	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* USA and Mexico: Stable—considered common and widely distributed	
• *Is immigration known or possible?*	Not likely
• *Would immigrants be adapted to survive in Canada?*	Not likely
• *Is there sufficient habitat for immigrants in Canada?*	No
• *Is rescue from outside populations likely?*	No
Quantitative Analysis	Not available
Current Status COSEWIC: Special Concern, April 1995 Endangered, April 2006	

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code**: A3c; B2ab(iii); C2a(i)

Reasons for Designation:
The species requires sand dune habitat, which may disappear over the short term (10 years). The area of occupancy is only about 53 km² and only 1,000 or fewer individuals are alive at the end of most winters. There is strong evidence for local adaptations of the Canadian population and a rescue effect is extremely unlikely because the nearest population in the United States is 270 km away.

Applicability of Criteria

Criterion A: Met Endangered, A3c. Inferred from loss of habitat.

Criterion B: Met Endangered, B2ab(iii). Based on an area of occupancy of < 53 km².

Criterion C: Met C2a(i). Total population size unknown but likely in the thousands. Populations are isolated based on dune habitat, which is declining. Further, high levels of mortality lead to very small numbers of adults in the spring.

Criterion D: Number of mature individuals is less than 1,000 in early spring. Total population size is unknown but likely in the thousands.

Criterion E: Not available.

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David Gummer is the Curator of Mammalogy at the Royal Alberta Museum. He acquired his Ph.D. from the University of Saskatchewan in 2005 and M.Sc. from the University of Calgary in 1997. His primary research interests and expertise are ecology and conservation biology of prairie mammals, seasonal activities and hibernation of small mammals, and biogeography. David prepared the original COSEWIC report on Ord's kangaroo rats in 1994-1995 and has conducted research on the population and its habitat ever since. He is a member of the Alberta Recovery Team for Ord's kangaroo rats.

Darren Bender is an Assistant Professor at the University of Calgary. He teaches in the Graduate Program of Geographic Information Science (MGIS) in the Department of Geography, and he holds an adjunct appointment in the Department of Biological Sciences. Darren received his Ph.D. in biology from Carleton University in 2000, and was a postdoctoral fellow in the Department of Fishery & Wildlife Biology at Colorado

State University prior to his appointment at the University of Calgary in 2001. He has research expertise in the fields of landscape ecology, population biology and geographic information systems. Much of his recent research has focused on landscape effects on small mammal populations, including Ord's kangaroo rats. Darren's earliest work on kangaroo rats began in 1995, and he is a member of the Alberta Recovery Team for Ord's kangaroo rats.

COLLECTIONS EXAMINED

Canadian Museum of Nature, Ottawa, Ontario, Canada [collections data]
Royal Alberta Museum, Edmonton, Alberta, Canada
Royal Ontario Museum, Toronto, Ontario, Canada [collections data]
Royal Saskatchewan Museum, Regina, Saskatchewan, Canada [collections data]
United States National Museum of Natural History (Smithsonian Institution), Washington D.C., USA [collections data]
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