COSEWIC
Assessment and Status Report

on the

Black-tailed Prairie Dog
Cynomys ludovicianus

in Canada

THREATENED
2011

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Gummer, D.L. 1999. Update COSEWIC status report on the black-tailed prairie dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-21 pp.

Laing, R.M.E. 1988. Update COSEWIC status report on the black-tailed prairie dog *Cynomys ludovicianus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 19 pp.

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NOTE: Population viability analysis for the Black-Tailed Prairie Dog (Stevens, T., and Lloyd, N.) is available by contacting the COSEWIC Secretariat (cosewic/cosepac@ec.gc.ca).

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COSEWIC
Assessment Summary

Assessment Summary – November 2011

Common name
Black-tailed Prairie Dog

Scientific name
Cynomys ludovicianus

Status
Threatened

Reason for designation
This small mammal is restricted to a relatively small population in southern Saskatchewan. The change in status from Special Concern to Threatened is based mainly on the threat of increased drought and sylvatic plague, both of which would be expected to cause significant population declines if they occur frequently. Drought events are predicted to increase in frequency due to a changing climate. Sylvatic plague was first recorded in 2010. Although the Canadian population is in a protected area, it exists within a small area and is isolated from other populations, all of which are located in the United States.

Occurrence
Saskatchewan

Status history
Designated Special Concern in April 1978. Status re-examined and confirmed in April 1988, April 1999 and November 2000. Status re-examined and designated Threatened in November 2011.

COSEWIC
Executive Summary

Black-tailed Prairie Dog
Cynomys ludovicianus

Wildlife species description and significance

The Black-tailed Prairie Dog is a diurnal, burrow-dwelling squirrel that lives in colonies. Individuals are 35-42 cm in body length, have short legs, tails with a black tip, small ears and brown to reddish-brown fur with an off-white underbelly.

Prairie dogs are an important component of native short and mixed-grass prairie ecosystems and provide breeding habitat for two endangered species, the Mountain Plover and Burrowing Owl, as well as being an important prey for several rare and endangered species such as the reintroduced Black-footed Ferret. The Canadian population of the Black-tailed Prairie Dog is considered a distinct local population because it is at the northernmost point of the species' range and is isolated from populations in the United States.

Distribution

The Black-tailed Prairie Dog occurs in the short- and mixed-grass prairies of North America from northern Mexico to Saskatchewan, Canada. The species is extirpated from east Texas north to eastern North Dakota, and where it remains the actual area occupied is small and colonies are mainly small and isolated. In Canada, the population is located in the lower Frenchman River valley and adjacent areas in southwestern Saskatchewan. The Canadian population exists as 18 colonies in close proximity ($12 km^2$); interchange between colonies is likely and the population is considered a single designatable unit. A second population, near Edmonton, Alberta, derived from escaped captives, is not discussed, as per COSEWIC guidelines.

Habitat

The Black-tailed Prairie Dog lives in grasslands with soils that support extensive burrow systems. The spatial extent of prairie dog colonies tends to be stable in the absence of sylvatic plague outbreaks, and can occupy the same area for many years. Colonies are characterized by short vegetation and numerous mounds of soil (often 30-60 cm high) heaped around each burrow entrance.

Biology

Black-tailed Prairie Dogs are herbivorous, predominantly eating grasses. They live in family groups (coteries) composed of one male and 2-4 females, often with 1-2 yearlings also present. Coteries are aggregated into colonies. Animals older than 2 years mate in March-April, with 2-6 young born in May. Maximum recorded age is 5yr (males) and 8yr (females). Most dispersal is by yearling males. Canadian Black-tailed Prairie Dogs hibernate for 4 months over winter.

Population sizes and trends

The size of the Canadian Black-tailed Prairie Dog population is not known. However, the minimum population size in 2010 is estimated at 6,165-9,360 mature individuals, using visual count data and the total area occupied by colonies.

Colony boundaries have been mapped periodically since 1970, and biennially since 1992. Colonies range in size from 0.6-172 ha, and total area occupied by Black-tailed Prairie Dogs in Canada has increased from a low of 828.8 ha (8km^2) in 1992/93 to a high of 1,235.4 ha (12km^2) in 2009. However, because colony area is not a good measure of prairie dog density, an increase in colony extent may not indicate an increase in population size.

It is difficult to estimate either a population estimate or trend because prairie dog density can vary greatly among colonies and between years. Visual counts have been conducted at several colonies in Grasslands National Park since 1992 and indicate that Black-tailed Prairie Dog populations undergo large (i.e. 4x average) short-term fluctuations in population size. Variations in growing conditions and/or interactions with other factors, including drought, presumably contribute to these substantial fluctuations. Different indicators suggest a decline has occurred in the last 10 years or, alternatively, that any decline is not statistically significant. Also, the population data include juveniles and COSEWIC assessments are based only on adults. Overall, the population size and trend is unknown but may be stable because decreases in density within colonies appear to be offset by stable or increasing size of the total population area.

Threats and limiting factors

The Canadian population exists as a single location because two threats, epizootic sylvatic plague and drought may impact the entire population in a short period. In 2010, a single Black-tailed Prairie Dog in Canada was found dead from sylvatic plague and plague was suspected in the loss of a small (4 ha) colony more than 10 km away. In 2011, pups were recorded where the plague had been found, suggesting the plague was not an epizootic event because numerous neighbouring colonies were not extirpated. Drought limits food production and likely explains fluctuating population levels. Drought is a natural event but frequency of drought is predicted to increase.

The recent (2009) reintroduction of Black-footed Ferrets has exposed prairie dogs to a predator they have not experienced in 70 years, and the resilience of the Canadian population to both sylvatic plague and ferret predation is unclear. The impact of Black-footed Ferrets on Black-tailed Prairie Dogs is being monitored but no results were available during the writing of this report.

Most other threats are minor, mainly because activities within the protected regulation zone containing the colonies are restricted. An expansion of the population beyond the current zone would be required for the species to recover to the point of not being listed by COSEWIC, but numerous threats outside the zone suggest expansion is unlikely.

Protection, status, and ranks

The Black-tailed Prairie Dog was previously assessed by COSEWIC in November 2000 and is currently listed as Special Concern on Schedule 1 of the federal *Species at Risk Act* (SARA). A management plan was completed in 2009. Fifty-nine percent of colony area occurs within Grasslands National Park and is protected under the *Canada National Parks Act*. In Saskatchewan, the Black-tailed Prairie Dog is protected under the Saskatchewan *Wildlife Act*, which protects them from being killed, harmed, or harassed without a permit. The Saskatchewan *Wildlife Habitat Protection Act* protects their habitat on Crown land. Black-tailed Prairie Dog colonies are protected within the 2007 regulation zone boundary as critical habitat for the Black-footed Ferret and Burrowing Owl. Permits to control Black-tailed Prairie Dogs may be issued by the Saskatchewan Ministry of Environment to control Black-tailed Prairie Dogs, if their colonies expand beyond their 2007 boundary. To date, one permit has been issued annually.

TECHNICAL SUMMARY

Cynomys ludovicianus
Black-tailed Prairie Dog — Chien de prairie
Range of occurrence in Canada: SK

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines (2008) is being used) *= Average age of females in population using method 3 (IUCN Standards and Petitions Subcommittee 2010) and cumulative life table from Hoogland (1995)*	3.03 years
Is there an observed continuing decline in number of mature individuals? *Data on mature animals do not exist. Fluctuations in relative abundance make conclusions difficult but an overall total population decline has possibly occurred. Colony area fluctuates, but appears to be stable.*	Unknown; colony boundaries appear stable while visual count indices suggest population decline.
Estimated percent of continuing decline in total number of mature individuals within 2 generations (6 years). *Data on mature animals do not exist. Mean visual count data fluctuates (4-fold increase and 4-fold decline) but a 22-33% decline in overall population has possibly occurred.*	Unknown; colony boundaries appear stable while visual count indices suggest population decline.
Inferred percent reduction in total number of mature individuals over the last 3 generations (9 years). *See previous.*	Unknown
Projected percent reduction in total number of mature individuals over the next 3 generations (9 years). *Projection difficult because reduction would be based on threats that may not occur (i.e. epizootic plague), will occur, but with unknown severity (i.e., drought), or are unconfirmed as a threat (i.e., recent Black-footed Ferret reintroduction)*	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future. *Data on mature animals does not exist though total population possibly declined 22-35%. Future declines dependant on threats occurring.*	Unknown
Are the causes of the decline clearly reversible and understood and ceased? *At present, drought and 1 case of enzootic plague occurred in last 10 years. Extirpated colony may have been due to epizootic plague but juveniles recorded in following spring suggests otherwise. Drought is expected to continue but at unknown intervals. Enzootic plague could be mitigated with dusting program, an epizootic event cannot necessarily be controlled.*	No

Are there extreme fluctuations in number of mature individuals? *A 10x fluctuation in mature individuals is considered 'extreme' in COSEWIC guidelines*	No; 4x population fluctuation occurred twice in 10 years but those data include non-mature animals and are below 10X threshold.

Extent and Occupancy Information

Estimated extent of occurrence. *Based on minimum convex polygon*	EO: 392 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value). *Total area of colonies (measured from outermost active burrows) in 2010 (calculated by D. Gummer, Parks Canada Agency)*	IAO: 160 km² Total colony area (mapped in 2010) = 12.3 km^2
Is the total population severely fragmented? *The Canadian population is likely isolated from the nearest US population. Colonies in Canada are connected by dispersal: >50% of the total area of occupancy in colonies separated by ≤ the average dispersal distance and all are within the estimated maximum dispersal distance of at least one other Canadian colony.*	The Canadian population is not severely fragmented
Number of locations∗ *As per COSEWIC Threats Calculator, 1 location exists, based on close proximity of colonies and encompassing nature of drought and sylvatic plague*	1
Is there an observed continuing decline in extent of occurrence? *Population extent fluctuates as colonies expand or when one extirpates (i.e., South Gillespie in 2010) but colony extent may be increasing.*	No
Is there an observed continuing decline in index of area of occupancy? *Index of area of occupancy on a 2km x 2km grid apparently constant since 1996*	No
Is there an observed continuing decline in number of populations? *There is only 1 population. The number of colonies has remained the same since 1992/93 - 2009; one small colony was extirpated in 2010.*	No
Is there an observed continuing decline in number of locations*? *The population exists as 1 location. The number of colonies has remained stable since at least 1992/93, with the exception of the loss of one small colony in 2010.*	No
Is there an observed continuing decline in area of habitat? *The area occupied has remained relatively stable over time, or increased.*	No

∗ See Definitions and Abbreviations on COSEWIC website, IUCN 2010 for more information on this term.

Are there extreme fluctuations in number of populations? *The Canadian population is 1 population and 1 location. The 1 location is based on threat of plague and drought, and has not changed. Number of colonies has remained stable since at least 1992/93, with the exception of the recent (2010) loss of 1 small colony, possibly lost from plague.*	No
Are there extreme fluctuations in number of locations∗? *There is only 1 location. The number of colonies and element occurrences has remained stable since at least 1992/93, with the exception of the loss of one small colony in 2010.*	No
Are there extreme fluctuations in extent of occurrence? *The EO was similar since 1992/93, increased in 2009, then decreased with extirpation of an outlying colony in 2010. The decline is not considered extreme or part of a declining trend.*	No
Are there extreme fluctuations in index of area of occupancy? *The index of area of occupancy, measured on a 2km x 2km grid, has remained constant since at least 1992/93.*	No

Number of Mature Individuals (in each population)

Population	**N Mature Individuals (estimated minimum)**
Population based on visual count methods and should be used with caution	
Total (estimated minimum in 2010)	6,165-9,360

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]. *Data on the population level effect of threats are not well understood, although simulations suggest that the effect on population size may be severe (up to 100% loss within 100 years depending on assumptions). The population can recover if the interval between catastrophic events is long enough.*	4% within 100 years, assuming no catastrophic disturbances. High probability (30-100%) if epizootic sylvatic plague or drought occurs at 15yr or smaller intervals.

Threats (actual or imminent, to populations or habitats)

Sylvatic plague, if it becomes epizootic, and drought, particularly if frequent, are considered a high threat. Winter severity, predation, tularemia are considered to be medium-low threats. Numerous threats apply if the population expands beyond its present zone of regulatory protection.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? *USA Apparently secure (NatureServe), nearest outside population in Montana ranked as Vulnerable (NatureServe)*	
Is immigration known or possible? *Not known but assumed to be unlikely because the nearest USA population in Montana is approximately 27km SE through rugged terrain, a distance beyond known maximum dispersal distance (9.6km).*	Not known and unlikely
Would immigrants be adapted to survive in Canada? *Environmental conditions assumed to be similar*.	Yes
Is there sufficient habitat for immigrants in Canada?	Unknown, but hypothesized to be present
Is rescue from outside populations likely?	No

Current Status

COSEWIC: Threatened (November 2011)

Status and Reasons for Designation

Status: Threatened	**Alpha-numeric Code:** D2
Reasons for Designation: This small mammal is restricted to a relatively small population in southern Saskatchewan. The change in status from Special Concern to Threatened is based mainly on the threat of increased drought and sylvatic plague, both of which would be expected to cause significant population declines if they occur frequently. Drought events are predicted to increase in frequency due to a changing climate. Sylvatic plague was first recorded in 2010. Although the Canadian population is in a protected area, it exists within a small area and is isolated from other populations, all of which are located in the United States.	

Applicability of Criteria

Criterion A: Not Applicable. Population is difficult to estimate and we lack data on mature individuals. Although a decline of 22-33% has possibly occurred, that data includes juvenile animals. Thus, evidence is lacking for a 30% threshold of decline by mature individuals. Also, increase in colony size may suggest population has not declined significantly.
Criterion B: Potentially applicable as Endangered under B1 and B2 with sub-criterion “a” and “b(v)”. B1 (EO=392km²) and B2 (IAO=160km²) are below the thresholds for Endangered (< 5,000 km² and < 500 km², respectively). Population is not severely fragmented but sub-criterion “a” is applicable as species is found in 1 location (no. of locations <= 5). An overall continuing decline in the population of 22-33% has possibly occurred but the data are difficult to interpret because of survey methodology, natural fluctuations, and lack of data specific to mature individuals needed for sub-criterion “b(v)”. A continuing decline may suggest mature animals have declined. Increased colony size may/may not indicate stability.
Criterion C: Potentially meets Threatened C1 or C2a(ii) (< 10,000 mature individuals), if a decline in mature individuals has occurred. May meet C1 with possible continuing decline in all animals of 22-33% in 10 years (threshold = 10% of mature animals) and possibly C2a(ii) with continuing decline and one population containing 100% of mature individuals. Applicability depends on interpretation of overall population decline of 22-33%.
Criterion D: Meets Threatened D2 because threats of increased drought and sylvatic plague would impact the entire population, indicating a single location (threshold =5).
Criterion E: Not Applicable. Population Viability Analysis suggested that the probability of extinction is high (>30%) if epizootic sylvatic plague and drought events occur with enough frequency. However, these threats are difficult to predict; an epizootic plague event may not occur and although drought will occur, the impact will be related to frequency and severity, which are not well known.

PREFACE

Since the publication of the 2000 COSEWIC status report, additional information on population trends and colony extent has become available, a population viability analysis for the Canadian population has been completed, and Black-footed Ferrets have been released into prairie dog colonies. In addition, sylvatic plague was detected in 2010 in the Black-tailed Prairie Dog population for the first time in Canada. The impacts of plague and the ferret are not well understood. The ferret re-introduction occurred in 2009-10 and monitoring is underway.

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 5, 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
(2011)

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 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

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

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Figure 1. Geographic range of Black-tailed Prairie Dog indicates a wide distribution but remaining colonies are generally small and isolated. Historic distribution included east Texas, north to eastern North Dakota. Since 1900, Black-tailed Prairie Dogs have been extirpated from 98% of their former area (Source: Tuckwell and Everest 2009a p. 3, based on Hall 1981 and Patterson *et al.* 2005). 8

Figure 2. Location of Black-tailed Prairie Dog colonies in Canada. Colonies occur on National Park or private property in the Frenchman River Valley of southwestern Saskatchewan. The bold line around the shaded blocks refers to a regulation zone boundary established in 2007 wherein prairie dogs are protected from various threats. (Source: Tuckwell and Everest 2009a p.15.) 9

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Figure 5. Estimated population size of adult and juvenile Black-tailed Prairie Dogs from 1996 to 2011 in Grasslands National Park, Canada. The trend in population represents a decline of 22%; however, the linear regression model is not statistically significant (weighted linear regression ($F_{1,9}=0.82$, $p = 0.39$). Annual population estimates are based on average and 95% confidence limits of visual counts x total area of prairie dog colonies. Labels indicate the number of visual count plots that were surveyed each year. SQRT stands for square root. (Source: D. Gummer, Parks Canada Agency.) 31

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Table 1. Cumulative life table for male and female prairie dogs that first emerged at Hoogland's study colony in South Dakota from 1975 to 1988 (Hoogland 1995: 396). Column headings: n_x, number of survivors at start of age level x; l_x, proportion of animals surviving to start of age interval x; q_X, rate of mortality during age interval x to $x + 1$; m_x the proportion of individuals that produce offspring at age x times the mean number of offspring when production occurs. 13

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and classification

Scientific name: *Cynomys ludovicianus* (Ord, 1815)

English name: Black-tailed Prairie Dog

French name: Chien de prairie

Classification: Class Mammalia, Order Rodentia, Family Sciuridae

Wilson and Reeder (2005) accept two subspecies of Black-tailed Prairie Dog, *C. l. ludovicianus* and *C. l. arizonensis*. The Black-tailed Prairie Dog in Canada belongs to the more widespread nominate subspecies, *C. l. ludovicianus* (Banfield 1974, Hoogland 1996). The Arizona Black-tailed Prairie Dog (*C. l. arizonensis*) occurs only in northern Mexico and the southwestern United States.

Morphological description

Black-tailed Prairie Dogs are large diurnal squirrels that spend most of their time underground in extensive burrow systems that they dig. Adult Black-tailed Prairie Dogs have a total body length of 35.5 to 41.5 cm. Males weigh 493 to 1390 g and average 15% heavier than females (Hoogland 1996, 2003). Black-tailed Prairie Dogs have short legs, small ears, brown to reddish-brown dorsal pelage and off-white ventral fur (Banfield 1974, Hoogland 1996). Their tails are 6 to 10 cm and form >20% of total body length (Hoogland 1995), with a distinct black tip. Their most distinctive behaviour is the territorial 'jump-yip' display in which they stretch out vertically, throwing their forefeet high in the air and emitting a barking sound (Hoogland 1995).

Black-tailed Prairie Dogs are a highly social species that live in structured colonies (towns), characterized by areas of intensively grazed grass, with numerous conspicuous bare mounds of soil (often 30 to 60 cm high) heaped around the burrow entrance. Colonies are subdivided into wards, about 2 ha in extent, that are generally separated physically by unsuitable habitat or natural or anthropogenic features (e.g., streams, roads, groups of trees). The smallest unit within the ward, often called the coterie (Hoogland 1995), is about 0.4 ha in extent and comprises the family unit of a male and two or three females and one or more young <2 years of age. All activities of the family unit are restricted to the coterie, which is defended against other prairie dogs.

Black-tailed Prairie Dogs are the only prairie dog species found in Canada. They are closely related to the ground squirrels. The Black-tailed Prairie Dog can be distinguished from Richardson's Ground Squirrel *Spermophilus richardsonii* by the prairie dog's larger size and stouter body (Banfield 1974).

Population spatial structure and variability

There is no information on genetic structure or variability within Canadian Black-tailed Prairie Dogs. However, all colonies in Canada are likely within dispersal distance of at least one other colony. A single colony is defined here as an aggregation of prairie dog tunnels not separated by more than approximately 100 m. In 2010, there were 18 colonies in Canada.

Studies in the United States have shown that genetic differentiation exists between prairie dog coteries, between wards, and between prairie dog colonies (Chesser 1983, Daley 1992, Dobson *et al.* 1998, Roach *et al.* 2001, Winterrowd *et al.* 2009, Magle *et al.* 2010). These differences sometimes correlate with the geographic distance between colonies, or the distance along potential dispersal corridors, such as drainage systems (Antolin *et al.* 2006, Roach *et al.* 2001, but see Daley 1992 and Trudeau *et al.* 2004). Dobson *et al.* (1998) found that as much as 15-20% of the genetic variation was found between coteries.

Levels of differentiation between colonies are often higher in highly fragmented habitats, such as urban landscapes, because of reduced dispersal rates (Antolin *et al.* 2006, Savage 2007, Magle *et al.* 2010), or in colonies infected by epizootic sylvatic plague (Roach *et al.* 2001). However, colonies that have been heavily reduced and isolated through intense population control measures may still retain heterozygosity levels similar to those in unmanaged colonies, if the colonies are able to rapidly increase and immigration is possible (Daley 1992).

Designatable units

One designatable unit is found in Canada because all colonies in Canada are in close proximity (within a $12km^2$ area) and are assumed to be linked through dispersal.

Special significance

Prairie dogs are an important component of native short and mixed-grass prairie ecosystems. Their activities disturb the soil and vegetation within their colonies, creating habitat for many species. Distinct vegetation communities can arise within prairie dog colonies that have been continuously occupied for many years (see Biology section). The Black-tailed Prairie Dog is important prey for the reintroduced Black-footed Ferret *Mustela nigripes.* Black-tailed Prairie Dog colonies provide breeding habitat for two endangered species, the Mountain Plover *Charadrius montanus* and Burrowing Owl *Athene cunicularis*. The success of the Black-footed Ferret reintroduction program in Canada is dependent on the continued viability of the Black-tailed Prairie Dog population.

The Canadian population of the Black-tailed Prairie Dog is at the northernmost point of the species' range and is likely isolated from populations in the United States. The Canadian population is therefore a distinct local population.

DISTRIBUTION

Global range

Cynomys ludovicianus historically ranged from Saskatchewan, Canada, south through parts of Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, Arizona, New Mexico, and Texas, to Chihuahua and Sonora states in Mexico. *Cynomys l. ludovicianus* was found through most of this range (from northeastern New Mexico and northeastern Texas, north to Saskatchewan) and *C. l. arizonensis* was restricted to Arizona, southwestern New Mexico, southwestern Texas, and Mexico.

Cynomys ludovicianus has been extirpated from Arizona, most of the easternmost portion of its historical range stretching from Texas to North Dakota (US Fish and Wildlife Service 2004), and from most of Montana north of the Milk River (Montana Prairie Dog Working Group 2002). The current range is shown in Figure 1. Black-tailed Prairie Dog colonies are distributed throughout this range, although remaining colonies are mostly small, isolated, and within protected areas (Hoogland 1996); Miller *et al.* (1990) estimate that only 2% of the historical range contains prairie dog colonies.

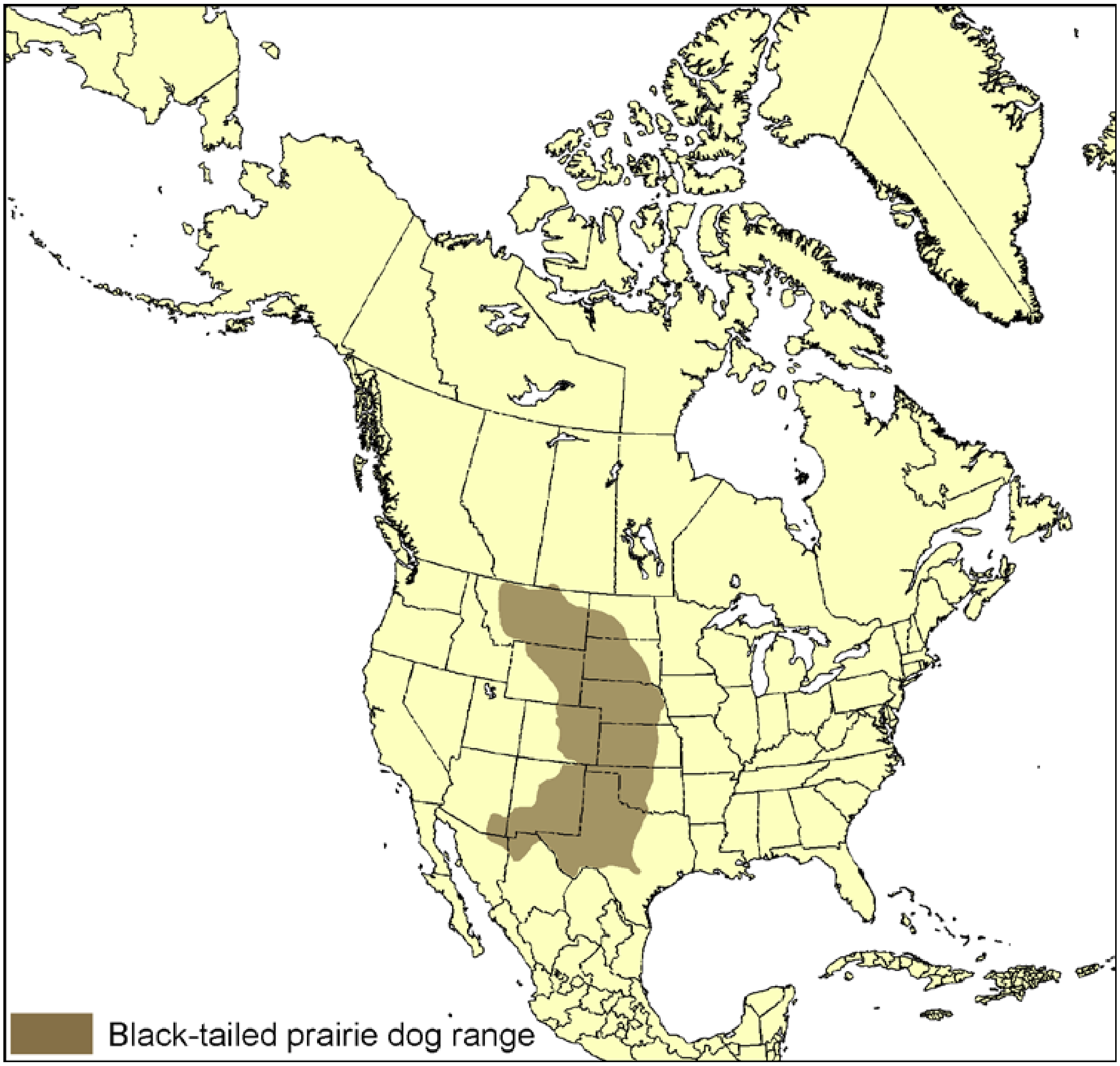

Figure 1. Geographic range of Black-tailed Prairie Dog indicates a wide distribution but remaining colonies are generally small and isolated. Historic distribution included east Texas, north to eastern North Dakota. Since 1900, Black-tailed Prairie Dogs have been extirpated from 98% of their former area (Source: Tuckwell and Everest 2009a p. 3, based on Hall 1981 and Patterson *et al.* 2005).

Canadian range

Black-tailed Prairie Dogs in Canada are restricted to the lower Frenchman River valley and adjacent areas in southwestern Saskatchewan (Figure 2). Their Canadian range appears to have remained relatively stable since they were first recorded in the Frenchman River Valley in 1938 (Soper 1938, 1944, Paynter 1962, Kerwin and Scheelhaase 1971, COSEWIC 2000).

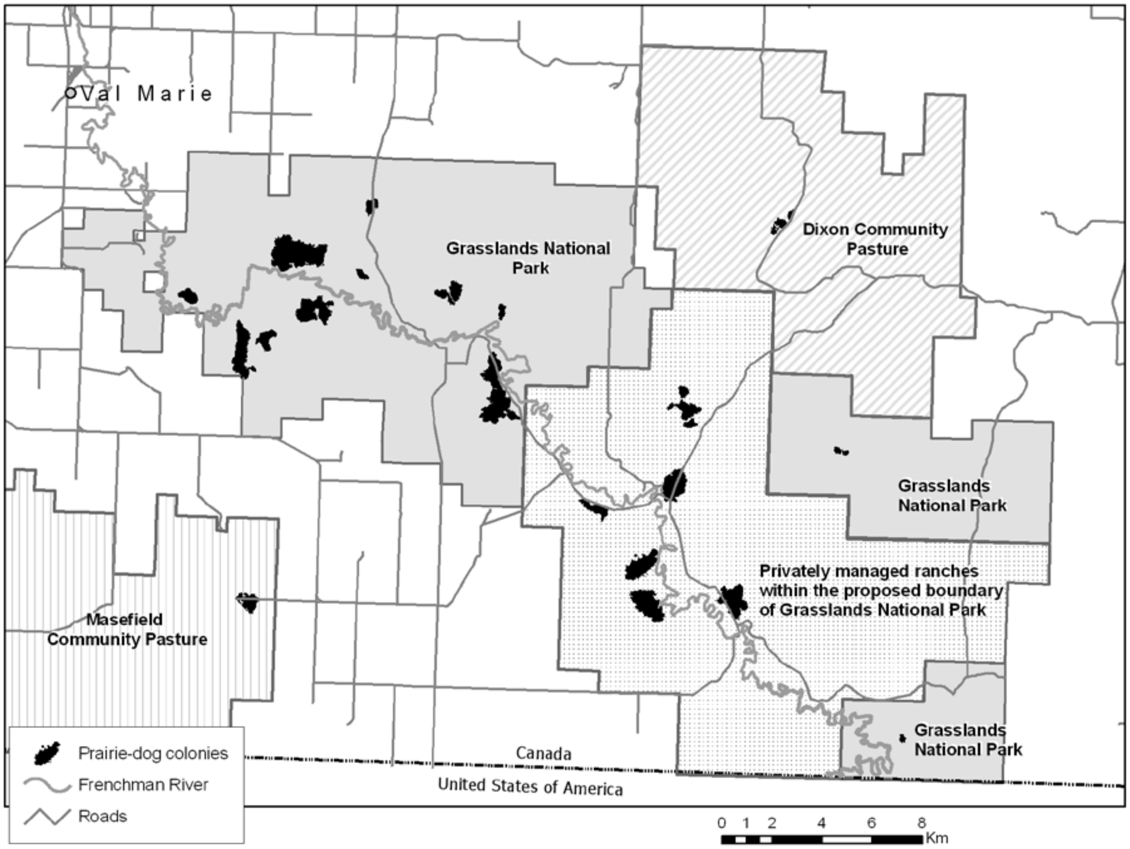

Figure 2. Location of Black-tailed Prairie Dog colonies in Canada. Colonies occur on National Park or private property in the Frenchman River Valley of southwestern Saskatchewan. The bold line around the shaded blocks refers to a regulation zone boundary established in 2007 wherein prairie dogs are protected from various threats. (Source: Tuckwell and Everest 2009a p.15.)

In 2010, the Canadian Black-tailed Prairie Dog population in Saskatchewan consisted of 18 colonies occupying approximately 12km^2 (1,230.8 ha). Total colony area has increased from a low of 829 ha in 1992/93 to a high of 1,235.4 ha in 2009 (see Population section). The minimum convex polygon method established an early 2010 estimated extent of occurrence (EO) as 472km^2, and the index of area of occupancy (IAO) as 160km^2, using the 2 km x 2 km grid occupancy. A small colony was extirpated in 2010 and this reduced the EO in late 2010 to 392km^2, a 16% reduction. However, the colony area fluctuates within the 10-year period and the 16% decline is not considered a trend, or evidence of an overall decline in EO.

An escaped population of the Black-tailed Prairie Dog exists near Edmonton, Alberta near the now-defunct Al Oeming's Alberta Game Farm. Individuals were introduced to the game farm, then escaped and established a population which may contain as many as 200 individuals (J. Nicholson, Alberta Fish and Game, pers. comm., June 2011; H. Trefry, Environment Canada, Edmonton, Alberta, pers. comm., July 2011). Some prairie dogs held at the game farm originated from the Saskatchewan population (G. Wilson, Canadian Wildlife Service, pers. comm., February 2011). The colony is situated in aspen-boreal parkland well beyond the historical or present natural range of the species. It is considered artificial and manipulated with no influence on the conservation of the species. It is not discussed further in the status report.

Search effort

Black-tailed Prairie Dogs were first documented in Canada by Soper (1938), when he reported the 1927 discovery of a small colony northwest of Val Marie, Saskatchewan. Additional surveys by Soper (1944), Paynter (1962), Kerwin and Scheelhaase (1971), and Millson (1976) confirmed other prairie dog colonies in the Val Marie region; all existing Black-tailed Prairie Dog colonies are assumed to have been identified during these studies. All colonies have been monitored since that time (see Population section). A significant difficulty in estimating population size and trends exists for this species: measurements of colony extent each year are approximate and prairie dog density within and between colonies can be highly variable. Consequently, changes in colony area over time may not reflect changes in population size.

HABITAT

Habitat requirements

Black-tailed Prairie Dogs live in large colonies in broad, flat river valleys and upland grasslands (Hoogland 1995). They require soils that support extensive burrow systems. The vegetation within prairie dog colonies is short compared to adjacent areas due to intensive grazing by prairie dogs and because they clip tall (>20 cm) plants that obstruct their view of the horizon (Hoogland 1995). Prairie dogs often colonize areas where the vegetation is already short, thereby gaining maximum visual predator detection with minimal landscape modification (Koford 1958, Snell 1985, Knowles 1986, Hoogland 1995).

In Grasslands National Park, 87% of the area occupied by Black-tailed Prairie Dog colonies occurs on deep colluvial clay soils and 13% on alluvial clay soils. Less than 1% of colony area occurs on glacial sediments (COSEWIC 2000, Tuckwell and Everest 2009a). Canadian prairie dog colonies occur at elevations between 750 and 875 m, with approximately 90% of colony area being on relatively flat terrain (COSEWIC 2000). Aboriginal Technical Knowledge was not available for this report.

The fine-scaled habitat requirements such as detailed understanding of soil characteristics, plant community structure, and elements that may pose a barrier to movement of prairie dogs are unknown in Canada (Tuckwell and Everest 2009a).

Prairie dog colonies tend to be relatively stable in their spatial extent through time. Colony extent is known to vary due to epizootic sylvatic plague (see Threats section). Sylvatic plague outbreaks appear to accelerate spatiotemporal movement of prairie dog colonies; boundaries occupied by infected colonies are unstable relative to uninfected colonies (Augustine *et al.* 2008). Sylvatic plague can occur in two states. The enzootic state is characterized by low levels of prevalence in the ecosystem, often within a host species that acts as a reservoir. The epizootic state is characterized by a dramatic increase in prevalence, rapid spread among the host population, and typically widespread decline in the population size and extent.

Habitat trends

Fifty-nine percent of the Canadian Black-tailed Prairie Dog population occurs within Grasslands National Park, where habitat is protected. Remaining prairie dog colonies occur on federal and provincial community pasture and on deeded land managed for cattle production. Habitat for prairie dogs is assumed to have remained stable within Grasslands National Park. Habitat loss or degradation through land management activities at current colony locations is unlikely to occur if current land management practices continue. Since 1992, the area occupied by Black-tailed Prairie Dogs has increased in most years, and the 2007 colony boundaries are protected by the Canadian *Species at Risk Act* and the Saskatchewan *Wildlife Act* (see Legal protection and Status).

BIOLOGY

Life cycle and reproduction

Activity

Prairie dogs are diurnal but their activity patterns are largely governed by weather (Hoogland 1995); in cold weather in northern areas, they may not emerge until 3 hours after sunrise (e.g., 11 am) and may be active only until 2-3 pm. However, in June they are likely to be active from sunrise until sunset. During this time they forage as much as possible, being diverted only by other activities (such as grooming, burrow maintenance, or aggressive behavioural interactions).

Timing of breeding

In the northern part of their range, Black-tailed Prairie Dogs breed in March or April (Saskatchewan: D. Gummer, unpub. data cited in COSEWIC 2000; Montana: Hoogland 1995), but further south breeding occurs earlier (e.g., January in Oklahoma, Hoogland 1995). Temperature appears to determine the precise timing of breeding. Breeding activity commences earlier during warm spring seasons. For example, in 1998, a warm spring in Saskatchewan allowed prairie dogs to start breeding in early March (Gummer, unpub. data cited in COSEWIC 2000). A single litter is born in April or May, following a gestation period of 28-32 days. The pups emerge from the natal burrow a few weeks after their birth and weaning occurs at 5-6 weeks of age, when they start grazing vegetation.

Age of breeding

Most juvenile prairie dogs become sexually mature within 21 to 23 months of their first emergence from natal burrows (Stockrahm and Seabloom 1988, Hoogland 1995). Thus, they usually mate in the second spring following their birth. Although approximately 35% of females and 6% of males mate in their first year, the probability of them breeding successfully (i.e., young to emergence) is low (9% for females, 6% for males). Some individuals (24% males, 5% females) do not become sexually mature until their third year (Hoogland 1995, 2006b).

Hoogland (1995) provides an estimate of fecundity for males and females at each year of life, based on his South Dakota study population (Table 1). From Hoogland (1995), Stephens and Lloyd (2011) calculated reproduction rates for adult male and female prairie dogs (Table 2). The generation time is 3.03 years, as determined using Method 3 (IUCN Standards and Petitions Subcommittee 2010) and the cumulative life table from Hoogland (1995).

Table 1. Cumulative life table for male and female prairie dogs that first emerged at Hoogland's study colony in South Dakota from 1975 to 1988 (Hoogland 1995: 396). Column headings: n_x, number of survivors at start of age level x; l_x, proportion of animals surviving to start of age interval x; q_x, rate of mortality during age interval x to $x + 1$; m_x the proportion of individuals that produce offspring at age x times the mean number of offspring when production occurs.

Sex	Age (years)	n_x	l_x	q_x	m_x[1]
Males	0[2]	587	1.000	0.532	0.000
	1	261	0.468	0.387	0.084
	2	140	0.287	0.529	2.926
	3	61	0.135	0.574	4.206
	4	23	0.058	0.652	4.920
	5	8	0.020	1.000	5.750
	≥6	0	0.000	-	-
Females	0[2]	523	1.000	0.457	0.000
	1	274	0.543	0.223	0.230
	2	190	0.422	0.232	1.657
	3	128	0.324	0.305	1.939
	4	80	0.225	0.413	1.966
	5	36	0.132	0.556	1.478
	6	16	0.059	0.750	1.000
	7	4	0.015	0.750	0.000
	8	1	0.004	1.000	0.000
	≥9	0	0.000	-	-

[1] Includes both male and female offspring.
[2] Because juveniles could not be captured until they appeared above ground, the starting point for the life table is first juvenile emergence rather than birth.

Table 2. Stages used in the construction of the Black-tailed Prairie Dog model in Stephens and Lloyd (2010). The parameter estimates are derived from Hoogland (1995).

Stage	Description	Survival and fecundity
Juvenile	Up to 12 months (non-breeding)	50% survival with 16% standard deviation
Yearling female	12 months to 2 years (non-breeding)	71% survival with 9% standard deviation
Yearling male	12 months to 2 years (non-breeding)	59% survival with 16% standard deviation
Adult female	2 years to 6 years; sexually mature, breeds every year	71% survival with 9% standard deviation; 3.08 juveniles produced per female with 1.06 standard deviation
Adult male	2 years to 5 years; sexually mature, breeds every year	59% survival with 16% standard deviation; 1.9 females per successful sire, 90% of adult males breed.

Breeding behaviour

Black-tailed Prairie Dogs have a polygynous mating system, with coteries typically consisting of one male, 2 to 4 females, and 1 to 2 yearlings. Territorial disputes between individuals of different coteries involve fights and chases. However, within the coterie usually the only aggressive behaviour is by pregnant or lactating females defending their nursery burrows. Mating usually occurs below ground but various courtship behaviours suggestive of copulation have been observed above ground (Hoogland 1995). Some females mate with only one male, while others may mate with as many as five males (Hoogland 2001, 2003). Mating with more males not only increases the chance of conception but it also leads to increased litter sizes, which provides insurance against predation or infanticide. Extreme inbreeding is prevented by four mechanisms (Hoogland 1982a): 1) young males leave their natal coterie before breeding, but female siblings remain; 2) adult males leave the breeding coterie before maturation of their daughters; 3) young females are less likely to be in oestrus if their fathers are in the colony; and 4) oestrous females avoid mating with relatives (fathers, sons, brothers). However, some breeding does occur between first and/or second cousins (Hoogland 1982a, Foltz and Hoogland 1983, Hoogland and Foltz 1982). There is no evidence of inbreeding depression in prairie dogs (Hoogland 1992, Dobson *et al.* 1997).

Litter size and characteristics of young

Because litters are born underground, estimating litter size at birth in the wild is difficult. However, *in utero* embryo counts from pregnant females and placental scars in lactating females, as well as laboratory studies, suggest that litter size varies from 1 to 8 young (Wade 1928, Anthony and Foreman 1951, Foreman 1962, Tileston and Leichleitner 1966, Knowles 1987, Foltz *et al.* 1988, Stockrahm and Seabloom 1988). In Saskatchewan, Millson (1976) reported average litter size at first emergence to be 2.3 to 3.5; COSEWIC (2000) reports litter size at first emergence ranging from 2 to 6 (n = 5, May 1998, Gummer unpublished data, cited in COSEWIC 2000). In South Dakota, average litter size (± standard deviation) at first emergence was 3.08 ± 1.06 (range of 1 to 6, n = 361; Hoogland 1995). Females do not apparently adjust the size of their litters, as in some other species (Hoogland 1995). Middle-aged individuals also produce more weanlings and yearlings (Hoogland 1995).

Survival rates

Average mortality rates during the first year are 53% and 46%, for males and females, respectively. Mortality rates are lower as prairie dogs reach middle age (1.5 to 4 or 5 yrs old). If males survive their first year they frequently live 2 to 3 years (5 yrs maximum). Survivorship is greater in females (Hoogland 1995). Females can live up to 8 years. Hoogland (1995) provides life tables for male and female prairie dogs at his study colony in South Dakota (Table 1). From Hoogland (1995), Stephens and Lloyd (2011) calculated mortality rates for juveniles, yearling females, yearling males, adult females and adult males (Table 2).

In South Dakota, infanticide and cannibalism are major causes of infant mortality, and this takes place prior to weaning and emergence. However, the significance of infanticide in the Canadian population is not known. Infanticide is carried out by neighbouring lactating females (22% of incidents in South Dakota), immigrant prairie dogs (8%), and the kin of abandoned litters (9%; Hoogland 1985, 1995, Hoogland *et al.* 1989). The most likely explanation for lactating females practising infanticide and cannibalism is because of their increased nutritional requirements during lactation (Hoogland 1985). The level of infanticide is highly variable and in some years infanticide is extensive, while in other years it is rare (Hoogland 1995). Communal nursing has also been recorded (Hoogland *et al.*1989).

Physiology and adaptability

Canadian prairie dogs enter hibernation for 4 months of the year because of adverse winter weather conditions (Gummer 2005). This winter behaviour is distinct from that of more southern populations, in that the Canadian population uses much more extensive, repetitive cycles of torpor whereas southern populations use shallow, short-term torpor. In Canada, Gummer (2005) shows that the probability of using torpor is related to daily air temperature and snow depth.

Dispersal and migration

Both male and female Black-tailed Prairie Dogs may disperse within or between colonies as yearlings, or as adults. While most females remain on their natal territories throughout their lives, those that disperse tend to move to another colony. In contrast, most males disperse; yearling males move within or between colonies, and adult males that move tend to stay within the same colony (Hoogland 1995). Eighty-three percent of adult inter-colony dispersers captured in South Dakota by Garrett and Franklin (1988) were female, whereas only 28% of yearling inter-colony dispersers were female. Ninety percent of within-colony dispersal was undertaken by males, 83% of which were yearlings.

Black-tailed Prairie Dogs disperse alone, rather than in groups. Genetic analysis of Black-tailed Prairie Dogs from 13 colonies in Colorado suggested that dispersal most likely occurred along low-lying dry creek drainages that joined colonies (Roach *et al.* 2001). In South Dakota, most inter-colony dispersers followed vegetated ravines, canyons and other protected areas, rather than traversing open grassland (Garret and Franklin 1988).

Black-tailed Prairie dogs have moved up to 5 to 6 km (Knowles 1985, Garrett and Franklin 1988, Hoogland 2006b); however, longer straight-line distances were inferred by the establishment of new colonies. Milne (2004) examined historical and recent maps of Black-tailed Prairie Dog colonies in North Dakota, South Dakota and Nebraska and found that the minimum distance between 120 newly formed colonies and the closest extant colony ranged from 0.18 to 9.6 km (mean 1.8 km). Roach *et al.* (2001) suggested a minimum dispersal distance from 1.4 - 5.7 km (mean 2.7 km) to re-establish 13 colonies extirpated by epizootic sylvatic plague. Based on this evidence, the maximum straight-line distance that Black-tailed Prairie Dog are known to disperse is 9.6km, although the typical distance to establish a new colony or re-establish an extirpated colony may be 1-3 km.

There is no information on dispersal within the Canadian population, and the establishment of new colonies is presumably a rare event. The establishment of new colonies in Canada has not been observed.

Interspecific interactions

The role of Black-tailed Prairie Dog on prairie ecosystems has been studied extensively in the United States (Stapp 1998, Miller *et al.* 2000, Cully *et al.* 2010). It is likely that general conclusions from work conducted in the adjacent populations would apply to the Canadian population. Black-tailed Prairie Dogs interact with the prairie ecosystem by influencing plant community and composition, providing habitat for vertebrates, and being an important prey item.

<u>Influence on plant community structure and composition</u>

Colonization by Black-tailed Prairie Dog can result in changes to the composition and structure of grasslands within their colony boundaries (Coppock *et al.* 1983, Brizuela *et al.* 1986, Cid *et al.* 1989, Cincotta *et al.* 1989, Weltzin *et al.* 1997a, b), with the magnitude of these changes dependent, in part, on the spatial turnover of colonies through time (Detling 1998, Augustine *et al.* 2008, Hartley *et al.* 2009). The most obvious effect of prairie dog grazing is a reduction in vegetation canopy height and biomass; vegetation biomass in their colonies can be reduced by 60 to 80% (Whicker and Detling 1988). Grazing decreases litter depth and above and below-ground vegetation biomass, and increases the ratio of live to dead standing biomass, and the cover of bare ground (Coppock *et al.* 1983, Archer *et al.* 1987, Weltzin *et al.* 1997a,b, Hartley *et al.* 2009). These effects become more pronounced the longer the colony is occupied.

In mixed-grass prairie, plant species richness and diversity are often higher within prairie dog colonies than outside colonies (Bonham and Lerwick 1976, Coppock *et al.* 1983, Fahnestock and Detling 2002). The number, cover and biomass of graminoid species in colonies generally decreases, while these parameters increase for forbs (Coppock *et al.* 1983, Archer *et al.* 1987). Some plant species, such as Fetid Marigold (also called Prairie Dog Weed) *Dyssodia papposa* and Scarlet Globemallow *Sphaeralcea coccinea* grow more abundantly, or occur only, in prairie dog colonies.

<u>Provision of habitat for vertebrates</u>

Over 200 vertebrate species are believed to be associated with prairie dog colonies (Campbell and Clark 1981, Clark *et al.* 1982, Reading *et al.* 1989, Sharps and Uresk 1990, Biodiversity Legal Foundation and Sharps 1994, Miller *et al.* 1990, 1994), and species richness, diversity and abundance of small mammals, passerine birds and predators is often reported to be higher on prairie dog colonies (Hansen and Gold 1977, O'Meilia *et al.* 1982, Agnew *et al.* 1986, Clark *et al.* 1982, Krueger 1986, Reading *et al.* 1989, Sharps and Uresk 1990, Miller *et al.* 1990, 1994). In their review of the evidence for prairie dogs playing a keystone role, Kotliar *et al.* (1999) found that prairie dog colonies did not, in fact, harbour consistently higher richness or abundance of mammals, birds and plants than areas without colonies.

Prairie Dogs perform key roles in creating the short-grass and burrow environments. Above ground, a 1-3 metre radius of bare earth surrounds burrows, which creates basking habitat for reptiles. Burrows are used by listed species such as the Burrowing Owl (Tyler 1968, Sharps and Uresk 1990), and the Black-footed Ferret (Biggins *et al.* 1985, Reading 1993). In Grasslands National Park each prairie dog colony has at least one pair of Burrowing Owls associated with it (R. Sissons, Parks Canada Agency, pers. comm., 2010). Burrowing Owls may be less vulnerable to American Badger *Taxidea taxus* predation in high-density prairie dog colonies (Desmond *et al.* 2000). Other species at risk that use prairie dog colonies are the Swift Fox *Vulpes velox*, Mountain Plover, Eastern Short-horned Lizard *Phrynosoma douglassii* and Prairie Rattlesnake *Crotalus viridis* (Agnew *et al.* 1986, Hoogland 1995). Long-billed Curlews *Numenius americanus* forage with their young in prairie dog colonies (Shackford 1987). In Oklahoma, Smith and Lomolino (2004) found a significant positive association between prairie dog colonies and Burrowing Owl, Killdeer *Charadrius vociferous*, Horned Lark *Eremophila alpestris* and meadowlark species *Sturnella spp.* during summer and Ferruginous Hawk *Buteo regalis* and Horned Lark during autumn.

Prairie dog grazing and burrowing activity can attract other grazing herbivores through the provision of nutritious forage (Coppock *et al.* 1983, Detling 1998, Holland and Detling 1990). Large native ungulate herbivores such as Bison *Bison bison*, Elk *Cervus elaphus*, and Pronghorn *Antilocapra americana* may graze preferentially in prairie dog colonies (Coppock *et al.* 1983, Wydeven and Dahlgren 1985, Krueger 1986), although this is contested by Vermeire *et al.* (2004).

Although it has been widely assumed that prairie dogs reduce the quantity and quality of forage for cattle, few empirical demonstrations of this exist. Detling (2006) determined that the actual influence of prairie dogs on livestock grazing is scale-dependent; at a broad extent, it is likely trivial given that prairie dogs occupy only 2% of the global range that they occupied 200 years ago (Detling 2006). In short-grass prairie, substantial overlap occurs between the diet of prairie dogs and livestock (Krysl *et al.* 1984, Detling 2006).

Black-tailed Prairie Dogs as prey

Black-tailed Prairie Dogs are prey for American Badger, Black-footed Ferret, Bobcat *Lynx rufus*, Coyote *Canis latrans*, Long-tailed Weasel *Mustela frenata*, Red Fox *Vulpes vulpes*, Swift Fox, Bull Snake *Pituophis melanoleucus*, Prairie Rattlesnake, Cooper's Hawk *Accipiter cooperii*, Ferruginous Hawk, Golden Eagle *Aquila chrysaetos*, Northern Harrier *Circus cyaneus*, Peregrine Falcon *Falco peregrinus*, Prairie Falcon *F. mexicanus*, Red-tailed Hawk *Buteo jamaicensis*, and Swainson's Hawk *B. swainsoni* (Sperry 1934, Olendorff 1976, Powell 1982, Halpin 1983, Campbell *et al.* 1987).

Black-footed Ferrets were reintroduced to Grasslands National Park in 2009 when 34 captive-bred individuals were released at several colonies. Fifteen captive-bred ferrets were released in fall 2010 (D. Gummer, pers. comm. November 2010). A minimum of 13 released ferrets and 3 wild-borne ferret kits were confirmed in August-September 2010 (Parks Canada 2011). Grasslands National Park may have a carrying capacity of about 30 ferrets (Tuckwell and Everest 2009b).

Diet

Black-tailed Prairie Dogs are primarily herbivorous, with plant material comprising 98% of their diet (Hoogland 1995). They occasionally eat invertebrates, including cutworms (Lepidoptera: Noctuidae), ground beetles (Coleoptera: Caribidae), and short-horn grasshoppers (Orthoptera: Acrididae; see Whitehead 1927, Kelso 1939, Costello 1970, O'Meilia *et al.* 1982). Because they may cannibalize their own young or young from other prairie dog families, they could also be considered omnivorous/carnivorous (Hoogland 1985, 1995). Fresh or old feces of Bison and domestic cattle are also eaten (Sheets *et al.* 1971, Hoogland 1995).

Prairie dogs selectively graze vegetation within their colonies. In northern mixed-grass prairie, the diet is composed principally of graminoids (at least 80%; Summers and Linder 1978, Fagerstone and Williams 1982, Uresk 1984). In the northern mixed-grass prairie of South Dakota, they preferred species such as Buffalograss *Buchloe dactyloides*, Scarlet Globemallow, Threadleaf Sedge *Carex filifolia*, Blue Grama *Bouteloua gracilis*, and Western Wheatgrass *Pascopyrum smithii* (Summers and Linder 1978) and avoided Tumblegrass *Schedonnardus paniculatus* and Slimspike (Red) Three-awn *Aristida longespica*, sagebrush *Artemisia* spp., Fetid Marigold and Canada Horseweed species *Conyza canadensis*.

Prairie dogs show seasonal changes in diet, with graminoids forming a higher component of the diet in spring and summer, and forbs, dwarf shrubs, and cacti in the winter (Summers and Linder 1978, Fagerstone *et al.* 1981, Fagerstone 1982, Fagerstone and Williams 1982, Uresk 1984).

Population viability

Stephens and Lloyd (2011) built a spatially explicit population model using Vortex for the Canadian Black-tailed Prairie Dog population to investigate relative probabilities of population persistence for Black-tailed Prairie Dogs in Canada. The model was primarily built using biological data from South Dakota (Hoogland 1995), although Canadian data were used where available (Table 2, 3). Both males and females were modelled.

Table 3. Parameters and assumptions used to develop the PVA model in Stephens and Lloyd (2010).

Parameter	Description
Reproductive system	Polygynous; one male mates with an average of 3-4 females
Density dependence	10% of adult females breed when N/K=1 and 90% adult females breed as N/K approaches 0; Allee effect = 0.01 so that the proportion of females breeding decreased at low population density; Standard deviation of 15% for the proportion of adult females that successfully produce a litter each year.
Initial population size	Average prairie dog density estimated from 2007 mark-recapture data in Canada as 18 individuals/ha multiplied by colony size in 2009.
Carrying capacity (K)	Assumed prairie dogs in Canada near carrying capacity; calculated using maximum prairie dog density estimated from 2007 mark-recapture data in Canada as 26 individuals/ha multiplied by colony size in 2007. Standard deviation set at 25% of K to allow for environmental variation.
Dispersal	Percentage of dispersers estimated as an inverse function of the linear distance between colonies. Dispersing individuals had an average mortality of 56%.
Number of colonies	20 colonies of various sizes.
Correlation	Vital rates among colonies correlated
Number of iterations	500

Using a single population model, a sensitivity analysis was undertaken to identify the sensitivity of the stochastic growth rate to 5 uncertain parameters: adult female mortality, adult male mortality, juvenile mortality, litter size, and percent breeding females. For each parameter, simulations were performed with that parameter set at baseline or 15% below, or above, while all remaining parameters remained unchanged. The stochastic growth rate was most sensitive to the percentage of adult females breeding, mean litter size, juvenile mortality and adult female mortality.

The single population model had a low (3%) probability of extinction within 100 years. Using a stochastic population model with all colonies functioning as a meta-population, the meta-population also had a low probability of extinction within 100 years (4%), even when it was assumed that there was no dispersal between colonies (3.6%). The results suggest that the size of colonies and the level of dispersal between colonies had minimal influence on the stochastic growth rate or probability of extinction of the meta-population, although dispersal increased the persistence of small, isolated colonies.

Sensitivity analysis was used to explore the relative risk to the Black-tailed Prairie Dog population of environmental conditions such as disease and extreme weather. Three scenarios were considered.

1. Simulation of decreased vital rates using available Canadian data. High variability in prairie dog mortality rates among years was observed in field research between 2007 and 2010. The direct cause of these fluctuations is unknown, but it was hypothesized that disease, severe weather conditions, intra- and inter-specific competition, and predation were causal factors. The effects of increased mortality and reduced reproductive success were modelled as catastrophes with a probability of occurring at 2-, 5-, 10- and 15-year intervals. The mortality rate of all age/sex classes was increased to 50% and reproduction decreased from 90% to 10% of adult females during catastrophe years. The probability of extinction under these scenarios was high (100%, 97%, 40% and 14% respectively), but suggested that the meta-population could rebound from increased mortality and decreased reproduction given sufficient time.

2. Simulation of drought. Drought was defined as lasting three years with a high probability of occurring every 15 years, and was modelled as a decrease in carrying capacity (K). Five scenarios were examined: When drought occurred, (1) K decreased by 75% every year for 3 years, (2) K decreased by 50% every year for 3 years, (3) K decreased by 25% every year for 3 years, (4) K decreased by 75% in the first year, 50% in the second year and 25% in the third year, and (5) K decreased by 25% in the first year, 50% in the second year, and 75% in the third year. The probability of extinction was low (2%) when carrying capacity was reduced by 25%. However, the probability of extinction (PE) under all other scenarios was high (decrease K by 50% = 40% PE, decrease K by 75% = 86% PE, decrease K each year = 33% PE, increase K each year = 35% PE).

3. Simulation of sylvatic plague. Epizootic sylvatic plague was conservatively modelled as a catastrophe affecting local colonies (but not spreading to other colonies) with frequencies every 2, 5, 10, or 15 years. The severity was modelled as an increase in mortality rates in affected colonies to 90%, 95% or 99% for all age and sex classes. The scenarios with 15-year frequency were also modelled with no dispersal between colonies. Enzootic plague was modelled as an increase in annual adult mortality rates by 30% (± 15%). When dispersal between colonies was possible, the Black-tailed Prairie Dog meta-population was able to rebound from epizootic plague that occurred at 15-year intervals, irrespective of the mortality rate (90-99% mortality, 11-31% PE). It was also able to rebound from enzootic plague when mortality rates were lower than those typically observed in affected colonies in the United States (25.5% mortality, 10% PE). In the absence of dispersal, the meta-population was able to rebound only when plague mortality was below 95% (90% mortality, 19% PE). More frequent epizootic events (or 15-year epizootic events with no dispersal possible) and higher adult mortality associated with enzootic plague resulted in extinction probabilities close to 100% (epizootic plague 2- to 10-year intervals with dispersal: 100% to 58% PE; epizootic plague 15-year interval, no dispersal, mortality 95-99%: 50% to 86% PE; enzootic plague mortality 30-34.5%: 49% to 100% PE).

Although the model was not built using Canadian demographic data and the true frequency and magnitude of risks from catastrophic events such as plague and drought are unknown, the model provides useful indications of likely sensitivity to perturbations. The results suggest that the Canadian meta-population (and most individual colonies) may be large enough to persist in isolation, but are highly susceptible to frequent catastrophic events that increase adult mortality. In general, high reproductive rates and high survival rates at low population densities enable the meta-population to rebound from severe but infrequent population losses.

POPULATION SIZES AND TRENDS

In 2010, the Canadian Black-tailed Prairie Dog population in Saskatchewan consisted of 18 colonies occupying approximately 12km^2 (1230.8 ha). Total colony area increased from 829 ha in 1992/93 to 1,235.4 ha in 2009. The minimum convex polygon method established the estimated extent of occurrence (EO) as 472km^2 in 2010 then declining by 16% to 392km^2 with the extirpation of the South Gillespie colony. The fluctuating size of the EO has been evident in the last 10 years and the recent 16% decline is not considered a declining trend. The index of area of occupancy (IAO) was 160km^2, using the 2x2 grid value. The methods to establish occurrence are described below:

Sampling effort and methods

Surveys of colony extent

Eleven surveys have mapped the extent of Black-tailed Prairie Dog colonies in Canada between 1970 and 2009 (Table 4). These surveys used different survey techniques. Kerwin and Scheelhaase (1971) mapped colony boundaries in 1970 but how colony boundaries were defined was not described. Millson (1976) identified colonies based on activity, mapped them using physiographic features and calculated area using planimetry and by overlaying a 1-centimetre grid and counting the squares (Gauthier and Boon 1994). These data are summarized in Table 4. Laing (1986, cited in Gauthier and Boon 1994) mapped colony boundaries in 1985 (Table 4) but no details were provided.

Table 4. The estimated extents (ha) of Black-tailed Prairie Dog colonies in Canada. A colony is defined as aggregations of Black-tailed Prairie Dog burrows that are within approximately 100m. A blank entry indicates that the prairie dog colony either did not exist, or was not visited during that period. Data in parentheses are coarse estimates. (Adapted from COSEWIC 2000 and Parks Canada Agency/Saskatchewan Environment, unpub. data).

Colony	Name	Ownership[1]	1970[2]	1975[3]	1985[4]	1992/93[5]	1995/96[6]	1997/98	2000	2002	2004	2007	2009
1	Laovenan (Ecotour)	GNPC				3.15	2.68	5.94	7.49	10.98	13.02	18.92	20.30
2	Snake Pit	GNPC	0.6	164.0	154.0	163.59	164.96	171.56	190.51	187.58	173.30	198.46	195.71
3	70 Mile Butte	GNPC	30.3	31.0	37.0	24.49	28.24	26.13	27.01	27.89	16.76	26.96	30.80
4	Monument	GNPC	103.3	254.0	57.0	85.96	89.72	97.92	109.21	120.71	110.3	133.89	141.41
5	Broken Hills	GNPC			78.0	95.23	81.60	94.07	94.10	85.58	77.62	96.01	96.65
6	Sage	GNPC				2.87	6.05	8.32	6.83	8.27	8.19	10.86	8.37
7	Police	GNPC				14.04	17.72	28.05	26.4	29.28	28.54	42.04	41.87
8	Timbergulch	GNPC				2.19	4.80	7.81	7.15	8.50	7.41	11.24	10.48
9	Larson	GNPC	0.4	4.4	77.0	110.35	132.89	157.04	147.09	146.68	147.23	168.11	163.63
10	North Gillespie	GNPC	18.2	4.0	(12.0)	15.50	19.10	9.73	1.66	3.35	4.14	8.21	8.80
11	South Gillespie	GNPC					0.21	0.55	0.77	1.17	1.68	4.66	4.62
12	Masefield	PFRA	2.0	8.0	12.0	27.62	31.38	34.25	38.76	37.09	39.65	38.06	39.17
13	Dixon Hill	Dixon	53.7	40.0	48.0		57.77	66.71	58.65	53.88	55.43	67.67	72.04
14	Dixon Main	Dixon	44.4	80.0	43.0	57.27	58.71	(58.7)	68.70	70.73	66.82	82.83	84.60
15	Dixon West	Dixon	34.3	17.6	19.0	20.67	23.3	26.35	26.58	27.26	22.98	33.33	37.86
16	Dixon Southwest	Dixon	92.9	120.0	63.0	75.79	64.13	72.24	67.14	65.94	61.82	77.50	67.74
17	Dixon South	Dixon				82.42	81.05	80.97	91.59	85.99	69.25	98.53	103.26
18	Walker	Walker	0.4	7.2	43.0	57.69	60.76	(60.8)	51.20	(51.2)	(51.2)	85.78	82.72

Colony	Name	Ownership[1]	1970[2]	1975[3]	1985[4]	1992/93[5]	1995/96[6]	1997/98	2000	2002	2004	2007	2009
19	Dixon Pasture	SKAF	122.6	32.8	(43.5)	6.64	(6.64)	23.78	26.96	22.56	9.15	21.40	25.33
Totals			503.1	763.0	686.5	828.8	931.9	1030.89	1047.80	1044.64	964.49	1225.42	1235.36

[1] GNPC, Grasslands National Park; PFRA, Prairie Farm Rehabilitation Administration; Dixon, Dixon Ranch; Walker, Walker ranch; SKAF, Saskatchewan Agriculture and Food.
[2] Kerwin and Scheelhaase 1971
[3] Millson 1976
[4] Laing 1986
[5] Gauthier and Boon 1994, and Saskatchewan Environment and Resource Management unpub. data
[6] Parks Canada Agency unpub. data, Saskatchewan Environment and Resource Management unpub. data

Gauthier and Boon (1994) used a global positioning system (GPS) to map the boundary of each Black-tailed Prairie Dog colony, using the outermost active burrows as the boundary (Table 4). Parks Canada Agency and the Saskatchewan Ministry of Environment have collaborated to map the boundary of colonies in and adjacent to Grasslands National Park using the same technique since 2000 (Table 4). Annual maps of prairie dog colony extent are assumed to be approximate boundaries only because of the difficulty of accurately distinguishing between active and inactive burrows (Tara Stephens, Calgary Zoo, pers. comm., November 2010).

Moore and Gauthier (1994) examined the potential to map Black-tailed Prairie Dog colony boundaries using historical aerial photographs. Poor temporal coverage and colony location limited the potential for aerial photography to locate and delineate historical prairie dog colony boundaries in Grasslands National Park.

<u>Burrow counts</u>

Kerwin and Scheelhaase (1971) estimated the number of burrows per colony in 1970 using an average of 20 burrows per acre (49.4 burrows/ha). Laing (1986, cited in Gauthier and Boon 1994) estimated burrow density by conducting plot surveys and did not distinguish between active or inactive burrows. He estimated a mean burrow density of 33.7 burrows per hectare (based on 48 plots over 4 colonies).

Gauthier and Boon (1994) counted burrows at colonies within Grasslands National Park. At each colony, they established 4-m wide transects, 40 m apart, so that approximately 10% of the area of each colony was sampled. All active, possibly active, and inactive burrows on each transect were counted. A burrow was counted if >50% of its opening was on the transect. Burrow density has been assessed at several colonies within Grasslands National Park periodically between 1995 and 2009 to inform the Black-footed Ferret reintroduction effort.

Visual counts

Visual counts may be correlated with Black-tailed Prairie Dog counts derived from mark-recapture studies (Severson and Plumb 1998), although Menkens *et al.* (1990) suggested that visual counts should only be used as a measure of relative density because of large standard errors around regression coefficients resulting in low precision. Preliminary analysis of Canadian mark-recapture data and visual count data supports the use of visual counts as an index of relative prairie dog abundance across years (D. Gummer, pers. comm., November 2010; T. Stephens, pers. comm., November 2010). However, these data may not be representative of the entire Canadian population as measurements are available only from the western part of Grasslands National Park.

Visual counts of Black-tailed Prairie Dogs have been conducted at several colony locations within Grasslands National Park. Kerwin (1972, cited in Gauthier and Boon 1994) estimated the density of prairie dogs on three colonies in the Frenchman River Valley (ranging from 34.4 to 120/ha) in May 1970 by counting the number of animals above ground in the early morning and late evening. Each colony was counted 2 to 5 times. Using the non-standardized counts, Black-tailed Prairie Dog density ranged between 2.25 and 6.25 adults/ha.

Several colonies within Grasslands National Park have been monitored between 1996 and 2010 using the method of Menkens and Anderson (1993) (Fargey and Marshall 1997, Miller *et al.* 2005, Parks Canada Agency and Calgary Zoological Society unpublished data, 2010). At each colony, prairie dogs were counted in a 4-ha plot every 10 to 15 minutes for 1-1.5 hours on three days in late August and early September, often by different observers (SKCDC 2010). The maximum count of prairie dogs within a 10-minute period over the 3 sample days in a given year was used as an index of the number of prairie dogs present. The number of prairie dogs recorded (adults and juveniles combined) was highly variable between counting periods (SKCDC 2010, data not shown), between plots within colonies, between colonies and between years (Table 5). The data were standardized to animals/ha for analysis, based on the physical size of visual count plots. The actual distances that prairie dogs may range during count periods, and therefore the effective sampling area, are not known (D. Gummer, Parks Canada Agency, pers. comm., November 2010).

Table 5. Number of prairie dogs recorded per plot during visual counts (adults and juveniles combined). (Source: Parks Canada Agency and Calgary Zoological Society, unpub. data, 2010).

Name	Plot_ID	Plot area (ha)	1996	1997	1998	1999	2004	2005	2006	2007	2008	2010
Dixon Main	DM-05	4										16
Dixon South	DS-01	4										27
Dixon Southwest	DSW-05	4										26
Ecotour	EC-01	4						73	110	115	29	54
Larson	LA-07	3.61										28
Larson	LA-08	3.61										39
Larson	LA-09	3.61										27
Larson	LA-10	3.61										31
Larson	LA-11	3.61										4
Larson	LA-12	3.61										35
Larson	LA-01	4						65	120	114	25	
Larson	LA-02	4		72	50	58	23	26	82	67	25	
Larson	LA-04	4						48	50	99	16	
Larson	LA-03	4					20	29	48	82	19	
Larson	LA-05	4		48	34	50		71	53	142	38	18
Larson	LA-06	4					43	33	91	127	35	
Monument A	MO-05	3.61										37
Monument A	MO-06	3.61										27
Monument A	MO-07	3.61										21
Monument A	MO-08	3.61										18
Monument A	MO-03	4						27	24	98	47	
Monument A	MO-04	4						28	39	44	36	
Monument A	MO-02	4						41	58	51	26	
Monument A	MO-01	4						67	48	72	28	
Monument B	MO-09	3.61										13
Monument B	MO-10	3.61										0
Police Coulee	PO-01	4	109	87	68	50		55	86	131	18	33
Police Coulee	PO-02	4						30	86	161	20	
Sage	SA-01	4										27
Snake Pit	SP-07	3.61										29
Snake Pit	SP-08	3.61										8
Snake Pit	SP-09	3.61										7
Snake Pit	SP-10	3.61										10
Snake Pit	SP-06	4	96	71	77	60		36	50	88	23	
Snake Pit	SP-05	4					20	36	45	84	27	
Snake Pit	SP-04	4	95	49	63	46		41	44	75	46	26
Snake Pit	SP-03	4					22	65	39	125	43	
Snake Pit	SP-02	4	41	22	28	24		31	52	77	41	

Name	Plot_ID	Plot area (ha)	1996	1997	1998	1999	2004	2005	2006	2007	2008	2010
Snake Pit	SP-01	4					19	56	52	38	29	
Mean (ln-transformed data)			3.05	2.67	2.61	2.53	1.93	2.46	2.73	3.14	2.10	1.84
± 95% confidence interval (ln-transformed data)			0.41	0.36	0.30	0.24	0.21	0.15	0.17	0.17	0.13	0.21

Data from 2009 were discarded because it was known that a large (but unknown) number of ground squirrels had been included in the counts due to observer error. Data from previous years may have also included an unknown number of ground squirrels. Ground squirrel numbers fluctuate between years within Black-tailed Prairie Dog colonies from none to very high numbers (2009 was a high population year). Data prior to 2009 were assumed to be acceptable for analysis, although it is anticipated that some level of contamination was present (D. Gummer, Parks Canada Agency, pers. comm., November 2010).

Mark-recapture

Mark-recapture data have been collected for 3 to 4 years during three studies in Grasslands National Park, between 1999 and 2010 (Gummer 2005, T. Stephens, unpub. data, and N. Lloyd, unpub. data). These data are currently being collated; however, the data from these studies are difficult to pool because the objectives and study designs differed substantially between studies (D. Gummer, Parks Canada Agency, pers. comm. November 2010). Work is ongoing to compile sufficient data to calculate mark-recapture estimates with confidence intervals but it is anticipated that only data from 2007 to the present will be directly comparable for this purpose. These data are restricted to the western part of Grasslands National Park and may not be representative of the entire Canadian population.

Abundance

Burrow density is not significantly correlated with Black-tailed Prairie Dog density (Campbell and Clark 1981, Hoogland 1995, Severson and Plumb 1998), and so cannot be used as a measure of Black-tailed Prairie Dog abundance.

As discussed in the previous section, reliance on visual counts is problematic and best used as a relative measure of density. Prairie dogs have been counted in, at most, 7.3% of the total colony area annually, and visual counts show large heterogeneity between counting periods, between plots, between colonies and between years. Consequently, although visual count data may provide an index of abundance over time, the data do not represent a direct measure of density and great care needs to be exercised in interpreting or extrapolating visual counts to estimate potential population size (D. Gummer, Parks Canada Agency, pers. comm. November 2010). Mark-recapture analysis of prairie dog study populations from 2007-2010 is not yet available (T. Stephens, Calgary Zoo, pers. comm., November 2010).

If it is assumed that the mean visual count in a given year represents a minimum estimate of prairie dog density, then we can calculate an approximate minimum population size using the 95% confidence limits (shown in Table 5) and the total colony area (shown in Table 4). Unpublished live-trapping data from Calgary Zoo indicate that juveniles represent 1-2% of the population trapped in poor years (2008 and 2010), and approximately 52% of the population trapped in high years (2007 and 2009). In 2010, the estimated minimum size of the mature Black-tailed Prairie Dog population in Canada is 6,165-9,360 individuals (assuming that the total colony area is the same as in 2009 minus South Gillespie colony, which was extirpated in 2010). In 2007, when the population may have been at a peak, estimated minimum mature population size is 11,463-16,116 individuals.

Fluctuations and trends

Colony area

The area of colonies is highly variable; Canadian colonies range from 0.09 ha to 198.5 ha (average 41.9 ha, Table 4). Although there is no evidence to suggest that colonies in Canada were larger or more extensive (at least since 1938 when first reported), colonies in the rest of the species' range were almost certainly much larger prior to European settlement in the prairies (200 years ago; Hoogland 2006a). For example, the largest prairie dog colony ever found is believed to be from Texas, in 1900, and was estimated to measure 161 km wide by 402 km long, and contained 400 million prairie dogs (Merriam 1901).

The total area inhabited by colonies in Canada has been monitored consistently since 1992/93. The total area occupied by prairie dogs has increased from a low of 828.8 ha in 1992/93 to a high of 1,235.4 ha in 2009 (Table 4, Figure 3). From 1969 to 2009, mean colony size may have remained stable. Between 1993/94 and 2009 when colony boundaries were measured using a consistent methodology, mean colony size increased slightly in 1996, and increased substantially in 2007, although these differences may not be significant due to large 95% confidence intervals. Measurements of colony extent each year are approximate and prairie dog density within and between colonies can be highly variable. Consequently, changes in colony area over time may not reflect changes in population size.

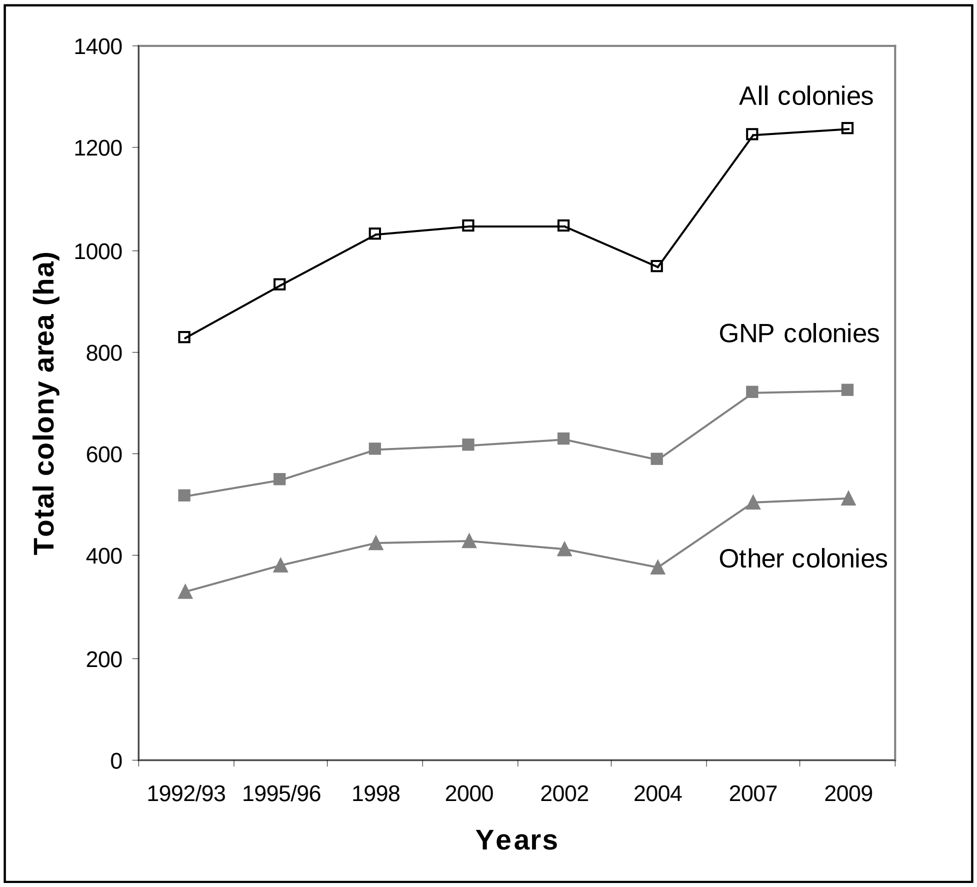

Figure 3. Total area (ha) of Black-tailed Prairie Dog colonies in Canada (All colonies) and within Grasslands National Park (GNP colonies) and other jurisdictions (Other colonies) separately, between 1992/93 and 2009. (Data source: Parks Canada Agency and Saskatchewan Environment.)

Population indices

The only index of abundance available over an extended time period in Canada are visual count data since 1996, or approximately 3 generations. These data, which include both juvenile and mature animals, suggest that the prairie dog population may have gone through three distinct phases: a population decline from 1996 to 1999 and a period of population growth from 2004 to 2007 (Figure 4). Based on the available data, the period 2007 to present shows a population decline (no data are available for 2009, Figure 4). Preliminary results from the mark-recapture study in 2009 indicate that prairie dog numbers increased substantially in 2009 before declining again in 2010 (D. Gummer, Parks Canada Agency, pers. comm., February 2011). Over the period 1994 to 2008, the mean visual count data showed a significant negative growth rate of 0.45, although sample size was very small (n = 7).[1]

[1] equation: $[\ln(A_{t+1})-\ln(A_t)] = 1.17\ (0.75, 2.15) - 0.45\ (-0.78, -0.26)A_t$, where A = abundance at time t, and bootstrapped 95% confidence intervals are shown in brackets

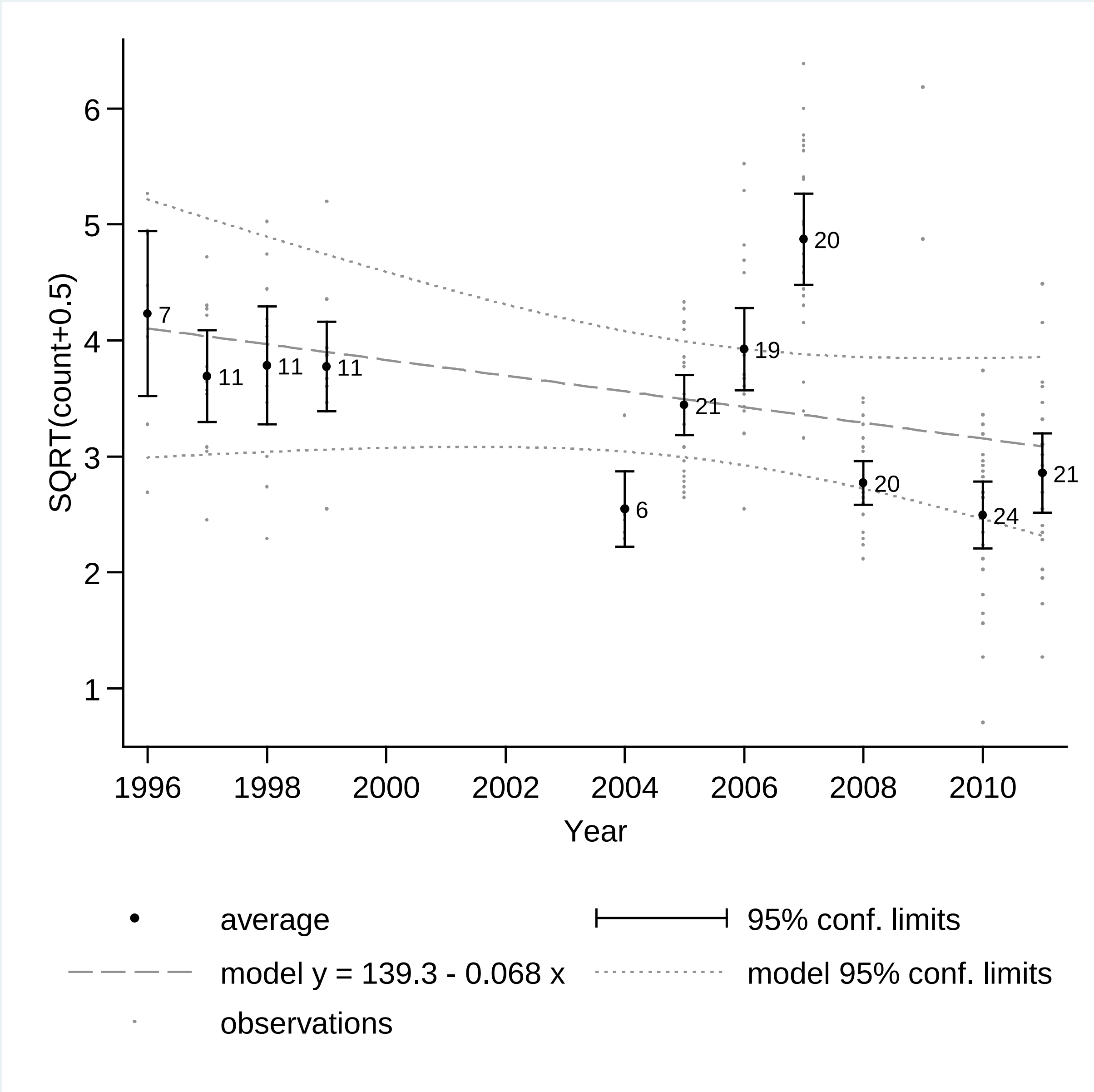

Figure 4. Visual counts as an index of relative abundance of adult and juvenile Black-tailed Prairie Dogs from 1996 to 2011 in Grasslands National Park, Canada. The linear regression with replication represents a statistically significant decline of 33% ($F_{1,161} = 34.0$, $p < 0.001$). Annual averages are labelled with the number of plots surveyed each year. SQRT stands for square root. (Source: D. Gummer, Parks Canada Agency.)

The cause of population declines such as those observed in 2004, 2008 and 2010 are unknown; however, poor growing conditions in spring and summer, combined with other factors such as enzootic plague and/or winter severity, are believed to be contributing (D. Gummer, Parks Canada Agency, pers. comm., November 2010). For example, anecdotal evidence[2] of extremely poor growing conditions in 2008 and 2009 may have resulted in females entering the winter hibernation period in poor body condition, resulting in lower survival over winter and very low reproductive success in the following spring (T. Stephens, Calgary Zoo, pers. comm., November 2010). In 2007, the ratio of pups:adults captured was high (approximately 50% pups), whereas in subsequent years less than 10% of captures were pups, and the proportion of lactating females was low (T. Stephens, Calgary Zoo, pers. comm., November 2010).

Overall, the population trend is difficult to evaluate due to substantial fluctuations in relative abundance. Also, COSEWIC criteria for assessment are based on mature animals but available data include juveniles. The ratio of juveniles changes dramatically over time. The following summary is provided by D. Gummer, Parks Canada Agency. Visual counts conducted on fixed plots, as a general index of relative abundance of prairie dogs in GNPC from 1996 to 2011, indicate substantial variability and fluctuations over time (Figure 4).Despite these fluctuations, there has been a significant overall decline in visual counts (linear regression with replication, F1,158 = 34.8, p <0.001), representing an estimated decline of 33% (14.2 to 9.5 per ha) over the last 10 years (2001-2011). If the trend was based on a simple difference in average number per ha on visual counts for the most recent 10-year period (1998-2008), then there has been a decline of 48% (13.8 to 7.2 per ha).

However, these data from fixed study plots do not account for simultaneous increases in the total area of the prairie dog colonies. If we estimate minimum total population size (all age-classes included) by multiplying relative abundance x area for the years for which there are sufficient data available, the trend in population size represents a decline of 22% from 2001 to 2011 (14,800 to 11,200) but is not statistically significant (weighted linear regression, F1,9=0.82, p = 0.39) (Figure 5). Alternatively, if we discount the fitted linear model and, rather, directly compare estimated population sizes from the most recent ~10-year period (1999 to 2010) this represents an estimated decline of 38% (14,300 to 8,800).

[2] Precipitation data for Grasslands National Park and area are not yet available for the period 2007 to 2010 (Environment Canada 2011). However, regional maps of precipitation as a function of the historical range are provided by Agriculture and Agri-Food Canada (http://www.agr.gc.ca/pfra/drought/pr_e.htm) for the years 2005-2010. These maps indicate that precipitation between 2007 and 2009 in the region around Grasslands National Park (near Coronach) was in the 20-40 percentile of the historical range, and that precipitation between 2009 and 2010 was close to the long-term average (40-60 percentile).

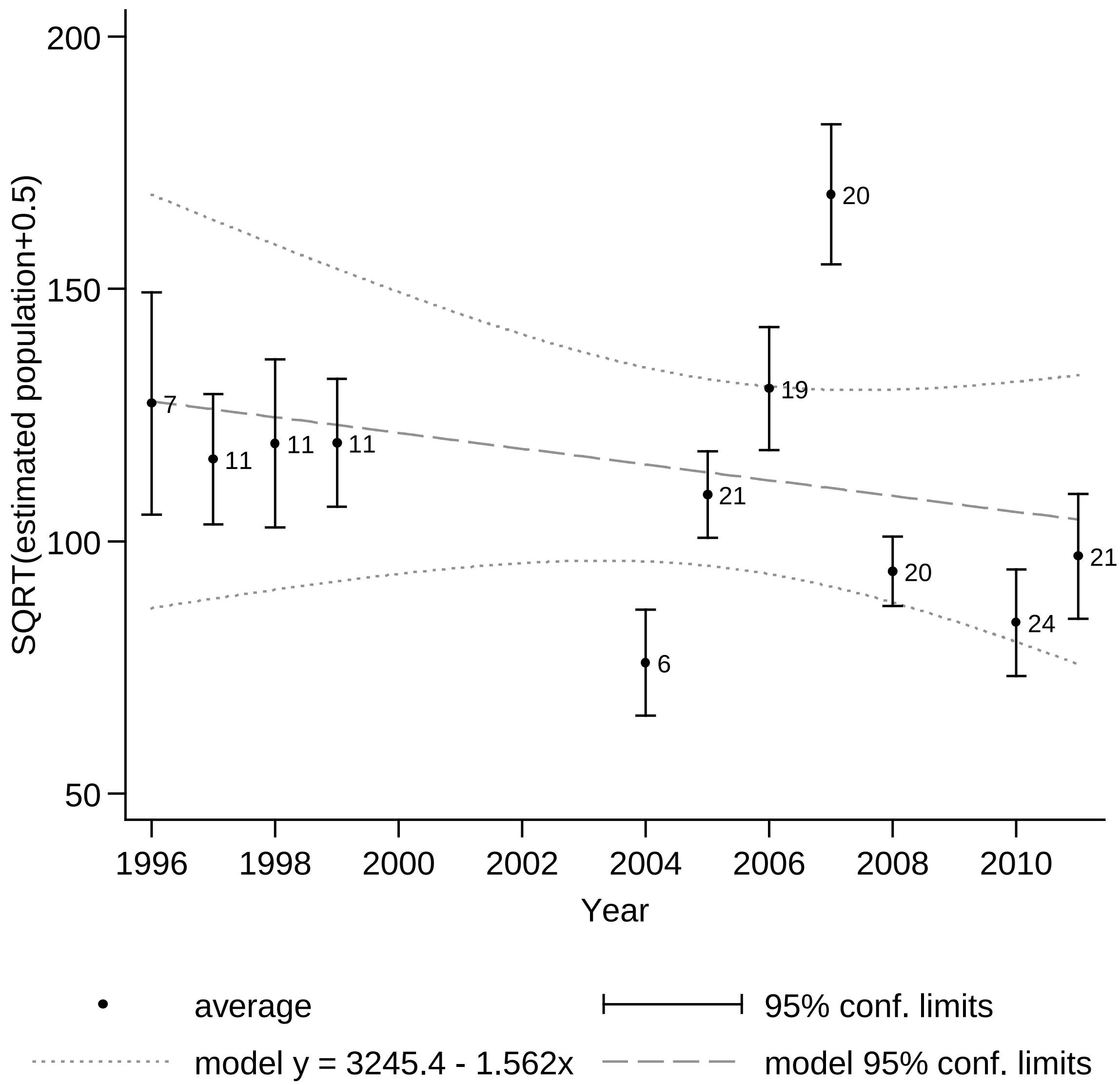

Figure 5. Estimated population size of adult and juvenile Black-tailed Prairie Dogs from 1996 to 2011 in Grasslands National Park, Canada. The trend in population represents a decline of 22%; however, the linear regression model is not statistically significant (weighted linear regression ($F_{1,9}$=0.82, p = 0.39). Annual population estimates are based on average and 95% confidence limits of visual counts x total area of prairie dog colonies. Labels indicate the number of visual count plots that were surveyed each year. SQRT stands for square root. (Source: D. Gummer, Parks Canada Agency.)

In conclusion, a decline in population size seems possible. The species is difficult to survey and fluctuations in population size estimates are a product of survey technique and response by prairie dogs to drought. Of the various measures available, each suggests a declining trend in population size. The results of the linear regression are the strongest of the four measures, and a decline of 22-33% is estimated from these measures. Application of these results to the COSEWIC process is difficult because: 1) COSEWIC focuses on mature individuals and the population size estimates for prairie dog include all age classes; and 2) fluctuations in the population size, due to both actual population change and (potentially) survey method, obscure the extent of decline.

Rescue effect

The Canadian Black-tailed Prairie Dog population is isolated from populations in the United States. The closest prairie dog colony in Montana is a small colony 27.1 km from the closest Canadian colony (D. Gummer, Parks Canada Agency, pers. comm., November 2010). The next closest colony in Montana is approximately 40km away, and the nearest complex of multiple colonies in Montana is 57-63 km away. These distances are well beyond the typical dispersal distance of Black-tailed Prairie Dogs (0.5-6.7 km Garrett and Franklin 1988) and further than the largest minimum (straight-line) recorded dispersal distance of 9.6 km (see Dispersal and Migration). Although the Canadian and nearest Montana colonies are both within the Frenchman River drainage system, and Black-tailed Prairie Dogs may preferentially follow low-lying creek drainages or other protected areas during dispersal, the two populations are not directly connected. The nearest Montana colony is not in the main river valley and is separated from it by rugged terrain. The distance and terrain characteristics make dispersal between the two Black-tailed Prairie Dog populations unlikely (D. Gummer, Parks Canada Agency, pers. comm., February 2011).

THREATS AND LIMITING FACTORS

The IUCN Threats Calculator was used in the following section. Information was mainly derived from the Black-tailed Prairie Dog management plan (Tuckwell and Everest 2009a).

Threats are presented in two parts: 1) threats to the existing population within the regulation zone, and 2) threats to the expansion of the population outside of the regulation zone. The Threats Calculator has been applied only to the population within the regulation zone.

Threats to existing population

Two threats, epizootic sylvatic plague and drought are considered very high-high impact threats to the population. Tularemia, predation by Black-footed Ferret, and severe winters are considered medium-low impact threats. Other threats are varied but considered as low impact threats.

Very high and high impact threats

Details of very high impact threats are discussed below, listed under the IUCN level 2 headings.

Invasive non-native species (IUCN 8.1)

Sylvatic plague is caused by the exotic bacterium *Yersinia pestis* and is primarily transmitted via the bites of infected fleas (Butler *et al.* 1982, Thomas *et al.* 1989, Rocke *et al.* 2004). The sociality of prairie dogs facilitates rapid spread of the disease between individuals and colonies (Miller *et al.* 1994, Biggins and Kosoy 2001, Cully and Williams 2001, Pauli *et al.* 2006). However, movement of the disease between areas is believed to occur through other flea hosts, such as rodents and Coyotes (Hanson *et al.* 2007, Jones and Britten 2010). Domestic dogs and cats may also be hosts. Disease modelling suggests that these other hosts drive a plague outbreak (epizootic plague; Webb *et al.* 2006), although recent evidence suggests that prairie dogs may also be enzootic hosts (Hanson *et al.* 2007). The environmental conditions that contribute to plague outbreaks are unknown.

In the United States, epizootic plague outbreaks typically result in 90-100% mortality in infected colonies (Cully and Williams 2001, Antolin *et al.* 2002, Stapp *et al.* 2004, Lorange *et al.* 2005). Epizootic plague typically appears in a limited number of colonies in a small area, then spreads in a regular pattern to additional colonies over 2 to 5 years (Augustine *et al.* 2008). Drainage systems likely facilitate spread of plague via dispersing prairie dogs (Roach *et al.* 2001). Roads, streams or lakes may serve as barriers to plague outbreaks (Collinge *et al.* 2005). In a 2002-2007 plague epizootic in the United States, plague reduced colonies by minimum 90% within a $12km^2$ area in year 1 and spread to >30 colonies over a $100km^2$ area in years 2-3 (Johnson *et al.* 2011). Colonies that were 2km way were infected within 3 years (Johnson *et al.* 2011) and in an earlier epizootic, all colonies <3km away were infected (Cully and Williams 2001). Of colonies not infected, most were >10km from an infected colony (Johnson *et al.* 2011). Generally, clustered colonies in close proximity facilitate the spread of the disease to adjacent colonies (Lomolino *et al.* 2004, Stapp *et al.* 2004).

An epizootic in the Canadian population would likely impact most, if not all, colonies within several years of initial infection; each colony in Canada is <10 km from another colony, and all colonies occur in a small area, within an approximately 30km section of the Frenchman River Valley (Figure 2). The river is narrow (<10m) and likely would not restrict the movement of disease.

Colonies can recover from epizootic events, presumably by immigration from un-infected colonies and increased productivity of survivors (Cully and Williams 2001). Recovery would be hindered if epizootic events occurred frequently or immigration was limited. In the United States, epizootics occurred in the same area approximately 10 years apart and populations recovered in several years (Cully and Williams 2001, Johnson *et al.* 2011). These areas contain 50-100 colonies, compared to the 18 colonies in Canada. The relative importance of inter-colony distance, colony density and density of prairie dog per colony on recovery rate is not known (Cully *et al.* 2010). However, the small number of colonies in Canada, and the apparent lack of rescue effect from populations in Montana, suggests recovery in Canada would be difficult if epizootics were frequent. The population viability analysis results suggest the persistence of the Canadian population may be highly susceptible to frequent (i.e. <15 years) epizootic plague (see Population Viability section).

In Canada, sylvatic plague was first confirmed in Black-tailed Prairie Dogs in 2010, when a single Black-tailed Prairie Dog from the Larson colony was found dead in early July 2010; necropsy confirmed cause of death as sylvatic plague. No additional infected prairie dogs were found in 2010. Plague was suspected in the loss of a small (4 ha) colony, South Gillespie, (likely in spring 2010) approximately 20 km away (P. Fargey, Parks Canada Agency, pers. comm., 8 November 2010) but the distance between colonies is fairly large and the events may not be connected. Observations in the United States suggest that finding one dead animal from plague is indicative of more widespread occurrence of plague at enzootic levels (D. Gummer, Parks Canada Agency, pers. comm., November 2010).

Plague does not appear to have spread in 2011. May-June observation surveys conducted at 18 colonies indicated Prairie Dogs at each site. The Larson colony (where plague was recorded in 2010) had pups present in 2011. The South Gillespie colony remained vacant (P. Fargey, Parks Canada, pers. comm., July 2011). The extirpation of the South Gillespie colony may have been from epizootic plague, but results on epizootic events elsewhere in the species' range would suggest it was not because the other colonies appeared healthy the following year. Further monitoring will document any future colony extirpation.

Low levels of plague (enzootic infection) may be difficult to detect in Black-tailed Prairie Dogs (Wimsatt and Biggins 2009, Matchett *et al.* 2010), and the presence of antibodies in canids and felids may be a more reliable indicator of its presence (Biggins *et al.* 2010, Brinkerhoff *et al.* 2009). Prior to 2010, sylvatic plague was known to be present in rural southern Saskatchewan, including Grasslands National Park, although no evidence of infection had been found in prairie dogs. Antibodies to sylvatic plague had been detected in domestic dogs and cats (Leighton *et al.* 2001) and in coyotes (Jardine and Cranshawe unpub.. data, cited in Tuckwell and Everest 2009a).

The probability of an epizootic occurring in Canada is not known because our understanding of vectors is poor and many factors are associated with transmission. If epizootic events arise from the vector species already located on site then the disease is already in situ. Alternatively, if it is carried long distances by wide-ranging species, then proximity to an infected colony is important. An epizootic with significant mortality and colony collapse occurred in the early 2000s in Phillips County, Montana (Dinsmore and Smith 2010), the nearest large colony to the Canadian population, approximately 70km away.

If plague did occur in Canada, there is evidence that dusting burrows with the insecticide deltamethrin during the early stages of epizootic plague can stop the spread of a plague outbreak, and the effects can last for up to 2 years (Karhu and Anderson 2000, Seery *et al.* 2003, Hoogland *et al*. 2004). In response to confirming an infected prairie dog in Canada in 2010, Parks Canada Agency applied DeltaDust® (deltamethrin) (Luk and Wruth 2010) to 32,400 burrows, or roughly one-third the total prairie dog colony area. A colony surveillance methodology was developed to confirm continued prairie dog occupancy at colonies, and colonies were monitored in 2011 for signs of plague. In addition, most prairie dog colonies were re-sampled in 2010 for active and inactive burrows using the same methodology as in 2009 (see Population Sizes and Trends section). Burrows were extensively swabbed for fleas, with few fleas detected. Parks Canada may spray the remaining colony area if new evidence of plague is found (P. Fargey, Parks Canada Agency, pers. comm., February 2011).

Droughts (IUCN 11.2)

Drought was calculated as a high impact threat. Drought may reduce prairie dog densities by up to 80% in Grasslands National Park (Parks Canada Agency unpub. data, cited in Tuckwell and Everest 2009a). Prairie dog reproductive success is positively correlated with body mass, a measure of body condition (Hoogland 1995). In semi-arid grassland systems the quality and quantity of food for prairie dogs is largely dependent on precipitation. In Montana, Knowles (1987) observed that prairie dog litter sizes correlated strongly with precipitation the previous summer.

Studies of climate change predict that the Northern Great Plains/southern Canadian prairies will experience increasing drought conditions and increased mean annual temperature (Rizzo and Wiken 1992, Lemmen *et al.* 1997, Sushama *et al.* 2010). Increased drought and higher temperatures are anticipated to reduce the quality and quantity of food available to prairie dogs, potentially leading to lower body condition. Female prairie dogs entering hibernation with low body condition may have lower reproductive success, with subsequent low population recruitment (see Fluctuations and Trends).

Modelling of threats in the PVA report (Stephens and Lloyd 2011) suggested that frequent droughts (i.e. every 15 years of 3-year duration) increased probability of extirpation to 40 and 86% if capacity (i.e. food supply) declined by 50 or 75%, respectively. Forecasting drought conditions at the resolution of the prairie dog population is not possible, but the drought parameters (3-year duration every 15 years) used in the PVA were derived from Environment Canada weather data for the Southern Saskatchewan region and appear to be plausible events (Bonsal and Regier 2006, Sushama *et al.* 2010)

Medium-low impact threats

Details of medium-low impact threats are discussed below, listed under the IUCN level 2 headings.

<u>Problematic native species (IUCN 8.2)</u>

A) Tularemia

Tularemia is an endemic disease in North America typically affecting rabbit and rodent species, including prairie dogs, although other animals, including humans, are also susceptible (Zeidner *et al.* 2004). It is caused by the bacterium *Francisella tularensis*. Ticks are typically considered the most efficient vectors but infection can occur through blood-feeding arthropods, animal bites and scratches, urine-contaminated water, and inhalation of infected aerosols (Hopla 1974, cited in Biggins *et al.* 2010).

Antibodies to tularemia have been found in 8.9% of domestic dogs and cats in the Grasslands National Park region (n = 120, Leighton *et al.* 2001). No cases of tularemia have been detected in Canadian prairie dogs; however, in one outbreak in a captive population in Texas, 7% of prairie dogs died within 30 days (n = 3600, Zeidner *et al.* 2004). It was hypothesized that the disease was spread by cannibalism of dead animals (Petersen *et al.* 2002). This threat is considered to be of medium-low concern because outbreaks in the wild are significant for a colony but are typically localized and do not greatly affect population levels.

B) Black-footed Ferret predation

Black-footed Ferrets were reintroduced to Grasslands National Park in 2009 and 2010. In 2009, 31 juveniles and 3 adults were released. An additional 15 juveniles were released in 2010. As of October 2010, 16 ferrets persisted in GNP; 13 were released animals and 3 were wild-borne kits. An additional 40 ferrets will be introduced in 2011, pending population rebound of Black-tailed Prairie Dogs after the drought-associated decline of 2010 (Parks Canada 2011).

Predation by native predators, including Black-footed Ferret, is a natural process in these ecosystems. Ferret reintroductions in Mexico and the United States did not cause declines in prairie dog populations (Tuckwell and Everest 2009a). The reintroduction of Black-footed Ferrets to Canada has exposed prairie dogs to a predator they have not experienced in 70 years, and the resilience of the Canadian population to both sylvatic plague and ferret predation is unclear. Canadian prairie dog populations may also be more susceptible to ferret predation than U.S. or Mexican populations because Black-tailed Prairie Dogs in Canada undergo lengthy periods of torpor in winter (Tuckwell and Everest 2009a). The impact of Black-footed Ferrets on Black-tailed Prairie Dogs is being monitored as indicated in the Black-footed Ferret Recovery Strategy (Tuckwell and Everest 2009b). No results were available during the writing of this status report.

C) Temperature Extremes (IUCN11.3)

Winter may be a difficult period for Black-tailed Prairie Dogs in Canada because the Canadian population relies on torpor during this period. Longer or colder winters than average may increase physiological demands on prairie dogs and affect their survival. In other hibernating rodent species, survival of juveniles in their first year is lower when winters are harsh (Armitage and Downhower 1974, Morton and Sherman 1978, Barash 1989). This threat has not been well studied for Prairie Dogs.

Low impact threats

Details of low impact threats are discussed below, listed under the IUCN level 2 headings.

<u>Tourism and recreation areas (IUCN 1.3)</u>

Short-term disturbance of colonies by tourists walking in the colony occurs within Grassland National Park but impact to the population is not considered significant. Five colonies are located near roads in GNP. Trespassing signs are posted on private land outside of GNP and these colonies likely are not impacted by people. Infrastructure is minimal within the regulation zone and no colonies are impacted by buildings.

Roads (IUCN 4.1)

Wide and heavily used roads (i.e. highways) are a barrier to prairie dog movement. In Canada, 7 of the 18 colonies abut roads but these roads are 2-lanes and traffic volume is low; the impact of the existing road network likely is slight. New road construction is limited by regulations within the 2007 boundary.

Storms and flooding (IUCN 11.4)

Black-tailed Prairie Dogs may be killed if their burrows are flooded. In Canada, most Black-tailed Prairie Dog colonies occur within the floodplain of the Frenchman River. A breached dam on the Frenchman River could be catastrophic but the probability of a breach is low. The more significant risk is from tributaries flooding or overland flow of water from rapid snow melts in significant snow-pack years. Park staff witnessed burrows that have collapsed due to flooding and there was at least one documented mortality of a prairie dog that dug itself out and expired on the surface with damaged lungs (necropsy done by the Canadian Cooperative Wildlife Health Centre; Pat Fargey; pers. comm., May 2011). The significance of such events is not known because animals likely would drown and remain underground. This type of flooding happens several times a decade and its scope is likely limited to <15% of the colony area (Pat Fargey; pers. comm., May 2011).

Threats to expansion of population

Application of the COSEWIC Threats Calculator is difficult because of the existing management of prairie dog in Canada. In 2007, the area containing prairie dog colonies was delineated to protect habitat and populations. Colonies within their 2007 boundary are legally protected from harmful activities by the *Species at Risk Act* (due to critical habitat designation for Black-footed Ferret and Burrowing Owl; see Legal Protection and Status). Critical habitat for these species is protected from cultivation, gravel extraction, industrial development, exploration or infrastructure, development (including roads and buildings), deliberate flooding or in-filling, and the construction of permanent fire breaks (Environment Canada 2010). This protection reduces many potential threats.

However, the species is likely to remain COSEWIC-listed because the regulation zone is too small. The population size, threats, and number of locations are below COSEWIC criteria thresholds. Expansion of the population would be necessary for a recommendation by COSEWIC to downlist the species. However, expansion would be limited by threats that would likely occur for animals beyond the regulation zone. These threats are associated with habitat loss or degradation from road construction, conversion of grassland to cropland or forage crops, commercial and industrial development primarily through oil and gas development, and human persecution.

Annual and perennial non-timber crops (IUCN 2.1)

Cultivated land represents a loss of habitat for prairie dog but cultivation is minor within the regulation zone; much of the land is marginal for crop production. New cultivation is not permitted within the 2007 regulation zone. Expansion by the prairie dog population beyond the regulation zone would likely be limited by cultivation because crop production is more common outside the regulation zone.

Livestock farming and ranching (IUCN 2.3)

Cattle grazing is permitted on 8 colonies located on private land within the 2007 regulation zone. Cattle grazing is not believed to impact Black-tailed Prairie Dogs. Cows and horses can be injured in prairie dog holes and this concern is the basis for removal programs (i.e., shooting, poisoning) across their range. It is unlikely that natural expansion of the Canadian population beyond the regulation zone can occur in areas with cattle ranching.

Oil and gas drilling (IUCN 3.1)

Road and infrastructure construction associated with gas production represents a loss of habitat for prairie dog. This activity is not permitted within the regulation zone. Gas drilling is predicted to increase in the region and could adversely affect expansion of the population beyond the regulation zone.

Renewable energy (IUCN 3.3)

Road and infrastructure construction associated with wind energy production represents a loss of habitat for prairie dog. This activity is not permitted within the regulation zone. Wind farms are predicted to increase in the region and could adversely affect expansion of the population beyond the regulation zone.

Roads (IUCN 4.1)

Wide and heavily used roads (i.e. highways) are a barrier to prairie dog movement. Expansion of population beyond the regulation zone would invoke a minor threat. Large road projects are not anticipated for the area.

Hunting and collecting terrestrial animals (IUCN 5.1)

Many land managers consider prairie dogs to be a nuisance because prairie dogs intensively graze their colony habitat to such an extent that grasses are no longer available for foraging cattle and horses. This potentially reduces the stocking rate of ranch land.

In Canada, persecution by humans is of low concern, primarily because 63.7% of the prairie dog population occurs on federally or provincially managed land, and the species and its habitat are protected within their 2007 colony boundaries (see Legal Protection and Status). A permit from the Saskatchewan Ministry of Environment is required to kill prairie dogs outside of Grasslands National Park, and permits are only issued to control their expansion beyond their 2007 boundaries. Permits have been issued to one landholder annually since 2007; in 2009, 45 prairie dogs were culled under this permit (P. Lalonde, Saskatchewan Ministry of Environment, pers. comm. 2010). Human persecution may become a more significant threat if the population expands beyond their 2007 boundaries on private land, or new colonies become established on private land.

Number of locations

The number of locations in COSEWIC is derived from threats to the population. Although the population exists in 18 colonies, the number of locations is 1. This number is based on the likelihood that a single threat event of sylvatic plague or drought will impact the entire population within a short time period. Sylvatic plague, once established as an epizootic, results in high mortality (potentially >90%) within affected colonies. Plague is generally restricted to only one or a few colonies within a population in the first year, then spreads in following years to adjacent colonies. In Canada, the population is vulnerable because the close proximity of colonies (EO; 392km^2, IAO; 160km^2) facilitates dispersal and interaction of individuals and disease within the population.

A second threat, drought, is recurrent, severe (possibly reducing population size by 25% to 75%, Stephens and Lloyd 2011), and pervasive, affecting all colonies within the Canadian range. It is anticipated that this threat may increase with climate change.

PROTECTION, STATUS, AND RANKS

Legal protection and status

The Black-tailed Prairie Dog was previously assessed by COSEWIC in November 2000 and is currently listed as Special Concern on Schedule 1 of the federal *Species at Risk Act (SARA)*. In Saskatchewan, Black-tailed Prairie Dogs are listed as Vulnerable under the Saskatchewan *Wildlife Act* (1998), which protects them from being killed, harmed, or harassed without a permit. The Saskatchewan *Wildlife Habitat Protection Act* (1992) protects their habitat on Crown land. The *Canada National Parks Act* protects Black-tailed Prairie Dogs and their habitat within Grasslands National Park.

A management plan (Tuckwell and Everest 2009a) has been prepared under *SARA* to prevent Black-tailed Prairie Dogs from becoming endangered or threatened in Canada. The management plan recommends that Black-tailed Prairie Dogs be protected from being killed, harmed, or harassed within the boundaries of their 2007 distribution. Also under *SARA*, Black-tailed Prairie Dog colonies within their 2007 boundary are protected as critical habitat for Black-footed Ferrets (Tuckwell and Everest 2009b) and Burrowing Owls (Environment Canada 2010). The Saskatchewan Ministry of Environment issues permits to control Black-tailed Prairie Dogs only if colonies expand beyond their 2007 boundaries (Tuckwell and Everest 2009a; P. Lalonde, Saskatchewan Ministry of Environment, pers. comm. November 2010).

Non-legal status and ranks

Globally, the Black-tailed Prairie Dog is ranked as Least Concern by the International Union for Conservation of Nature (IUCN) because it is widespread, there are estimated to be millions of individuals, and its populations are not declining fast enough to qualify for listing in a more threatened category (IUCN 2010). NatureServe ranks the species as Apparently Secure globally (G4) because 'it has a relatively large range, many occurrences and large population size (millions), although the extent of occupied habitat and abundance have been reduced from historical levels by about 98%; the long-term outlook is one of low decline' (NatureServe 2010).

In Canada (and Saskatchewan), NatureServe ranks the Black-tailed Prairie Dog as Imperiled (N2, S2). In 2010, the Wild Species Report ranked the species as At Risk (Rank 1) in Saskatchewan, and May Be At Risk (Rank 2) in Canada (CESCC 2006). In the United States, the Black-tailed Prairie Dog is nationally ranked by NatureServe as Apparently Secure (N4) but in Montana (the population closest to the Canadian population) it is ranked as Vulnerable (S3). Other state rankings are listed in Table 6.

Table 6. NatureServe ranks for the United States.

NatureServe rank	Description	U.S. state
SX	Presumed extirpated	Arizona
S2?	Imperiled	New Mexico
S2	Imperiled	Wyoming
S3	Vulnerable	Colorado, Kansas, Montana, Oklahoma, Texas
S3S4	Vulnerable-Apparently secure	Nebraska
S4	Apparently secure	South Dakota
SU	Under review	North Dakota

Habitat protection and ownership

Black-tailed Prairie Dog colonies occur within the current boundary of Grasslands National Park (58.5%), the Masefield Community Pasture (Agriculture and Agri-Food Canada, 2.1%), the Dixon Community Pasture (Saskatchewan Agriculture, 3.2%), and on provincially leased land and privately deeded land (36.3%). All Black-tailed Prairie Dog colonies are protected within their 2007 boundaries by SARA (see Legal Protection and Status).

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Dr. **Jennie L. Pearce** was born in Australia and immigrated to Canada in 1999. In both countries her research has focused on modelling the distribution, viability and habitat requirements of wildlife to inform and guide conservation efforts. Her company, *Pearce & Associates Ecological Research*, utilizes the latest statistical techniques and computerized technology in the design, implementation and presentation of environmental data and research. She has written or co-authored 8 COSEWIC reports and has published more than 35 scientific papers in the area of conservation biology.

Born in the United Kingdom, Dr. **David Anthony Kirk** has been working for over 20 years with the federal and provincial governments of Canada as well as non-government organizations (e.g., Bird Studies Canada, World Wildlife Fund, and the Yellowstone to Yukon Conservation Initiative) and First Nations. He has a wide range of ecological and land use experience in different ecosystems from tropical to boreal. His company (Aquila Conservation & Environment Consulting) specializes in the use of multi-species and single species distribution models for application to conservation planning (integrating human resource use and biodiversity conservation), as well as literature reviews and objective analysis of a variety of human disturbance influences on biodiversity in anthropogenic landscapes. David is particularly interested in the benefits of organic farming to wildlife and plants, and in the spatial mapping of biodiversity; he also works extensively on the status, recovery and management of species at risk. He has written or co-authored 22 COSEWIC status reports and updates, as well as drafted 23 recovery plans, action plans and management plans for species at risk. Aquila's emphasis is on peer-reviewed scientific articles in ecological and conservation journals as a forum for changing policy and management practices, and David has co-authored 30+ papers in peer-reviewed scientific journals and books in the last 19 years.

COLLECTIONS EXAMINED

No collections were examined as part of this status report.

THREATS ASSESSMENT WORKSHEET

Species or Ecosystem Scientific Name	Black-tailed Prairie Dog			
Element ID			**Elcode**	
			Level 1 Threat Impact Counts	
	Threat Impact		**high range**	**low range**
	A	Very High	1	1
	B	High	1	1
	C	Medium	0	0
	D	Low	3	3
	Calculated Overall Threat Impact:		Very High	Very High

Threat		Impact (calculated)		Scope	Severity	Timing	Comments	Number of Locations		
								Lowest	**Most Likely**	**Highest**
1	Residential & commercial development	D	Low	Small	Slight	High				
1.3	Tourism & recreation areas	D	Low	Small	Slight	High	Colonies visited by tourists within Grassland NP but impact likely minimal to populations. Impact can be mitigated by planning and regulations. 5 colonies are near roads and more likely visited by tourists in GNP.			
2	Agriculture & aquaculture	D	Low	Small	Slight	High				
2.3	Livestock farming & ranching	D	Low	Small	Slight	High	Cattle grazing on 8 colonies on private land within the 2007 boundary may compete with prairie dogs for food.	8	8	
4	Transportation & service corridors	D	Low	Restricted - Small	Slight	High - Low				
4.1	Roads & railroads	D	Low	Restricted - Small	Slight	High - Low	Roads are a barrier to movement; 7 of 18 colonies abut roads but they are narrow, rarely used roads and impact likely is slight. New road construction limited by regulations within the 2007 boundary.	7	7	
8	Invasive & other problematic species & genes	A	Very High	Pervasive	Extreme	Moderate				
8.1	Invasive non-native/alien species	A	Very High	Pervasive	Extreme	Moderate	Epizootic Plague. Has not been recorded but potential exists. High (>90%) mortality expected. Most colonies likely impacted because of close proximity. Recovery likely from increased productivity of survivors but low rescue effect will limit recovery. PVA suggests plague events<15 years apart will likely lead to extirpation. Probability of event unknown; enzootic plague recorded in 2010 for 1st time but factors causing epizootic plague not understood.	1	1	3

Threat		Impact (calculated)		Scope	Severity	Timing	Comments	Number of Locations		
8.2	Problematic native species	CD	Medium - Low	Pervasive - Restricted	Moderate - Slight	High - Moderate	Two threats: Tularemia (disease) Mortality likely would be < 10% and localized to specific colonies because spread is minimal. Probability is unknown because disease has been recorded in area but not in prairie dogs. Scope is restricted, severity is slight and timing is moderate; number of locations is 0,18,18. Black-footed Ferret (specialist predation). Reintroduction of this predator specialized on prairie dog occurred in 2009-10 but impacts are not known. Ferret predation is considered a non-issue to prairie dog populations elsewhere but Canadian population enters torpor and it is unknown if this difference creates a significant threat to the prairie dog population. Scope is pervasive, severity is moderate-slight (?), timing is high; number locations is 1,1,18.	1	18	18
11	Climate change & severe weather	B	High	Pervasive	Serious	High				
11.2	Droughts	B	High	Pervasive	Serious	High - Low	Prairie dog productivity is strongly reduced by drought; past drought events likely explain large variation in population levels for last 20 years. Close proximity of 18 colonies suggests all colonies would be affected in single event. Drought predicted to be probable and more frequent in area. PVA suggests a 3-year long drought every 15 years of >25% decrease in carrying capacity would result in probable extirpation. Timing is 'High-Low' because droughts are periodic (= 'high/ continuing' but sustainable at present levels) and are predicted to worsen only in the future (='low')	1	1	2
11.3	Temperature extremes	CD	Medium - Low	Large	Moderate - Slight	Moderate	Severe winters increase mortality because Canadian population 'hibernates' and late spring would cause starvation.	1	1	1
11.4	Storms & flooding	D	Low	Small	Slight	High	Periodic flood events kill burrowed animals and most colonies are in a floodplain. Individuals in 5 colonies near river impacted but >90% of colony is not. Severe flood events or breach of upstream dam would be catastrophic but is unlikely to occur.	1	1	5

Classification of Threats adopted from IUCN-CMP, Salafsky *et al*. (2008).