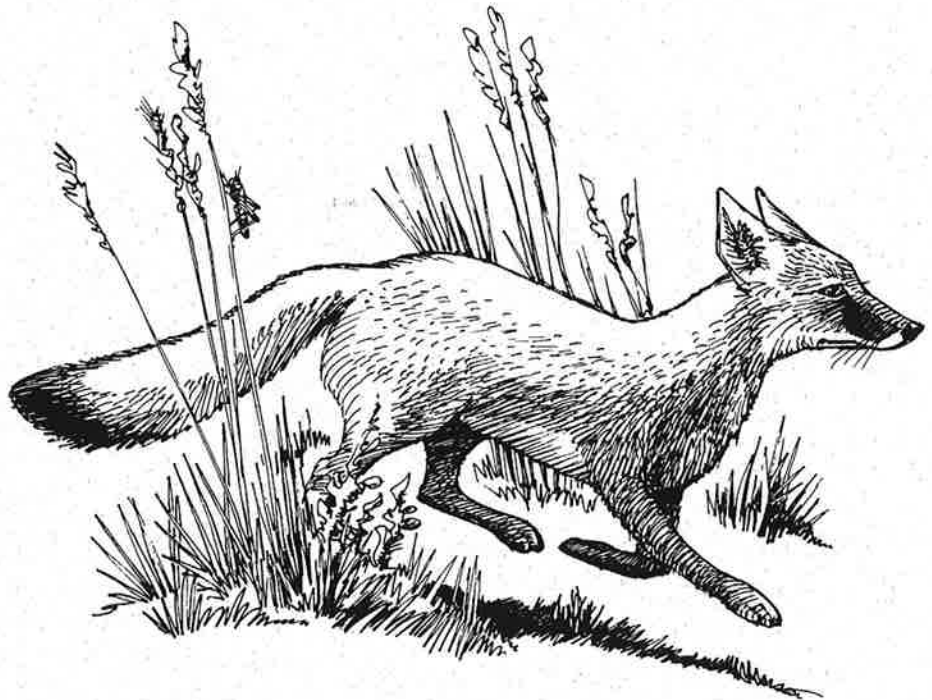


Status of the Swift Fox (*Vulpes velox*) in Alberta

Wildlife
Management
Division

Susan E. Cotterill

STATUS AND
SURVEYS BRANCH



Alberta Wildlife Status Report No. 7



Alberta
ENVIRONMENTAL PROTECTION

**Status of the Swift Fox
(Vulpes velox) in Alberta**

Susan E. Cotterill

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PREFACE

Every five years, the Wildlife Management Division of Alberta Natural Resources Service reviews the status of wildlife species in Alberta. These overviews, which have been conducted in 1991 and 1996, assign individual species to 'colour' lists which reflect the perceived level of risk to populations which occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily-available sources of population data. A primary objective of these reviews is to identify species which may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the 1996 *Status of Alberta Wildlife* review process, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are potentially at risk in the province (Red or Blue listed), that are of uncertain status (Status Undetermined), or which are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Wildlife Management Division of Alberta Environmental Protection, and are intended to provide detailed and up-to-date information which will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information which will assist the proposed Alberta Endangered Species Conservation Committee to identify species that may be formally designated as endangered or threatened under the Alberta Wildlife Act. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

The Swift Fox (*Vulpes velox*) is currently listed as an 'endangered' species in Alberta and is fully protected under the Wildlife Act. Nationally, the Swift Fox was listed as 'extirpated' by the Committee on the Status of Wildlife in Canada in 1978. Although abundance and range are also greatly reduced in the United States, the Swift Fox is not presently listed under the U.S. Endangered Species legislation.

Native to short and mixed-grass prairie regions, the Swift Fox began to decline as native grasslands were converted to agricultural lands in the late 1800s. Loss of habitat combined with interspecific competition, primarily from Coyotes (*Canis latrans*), vulnerability to trapping and poisoning programs, and severe climate conditions contributed to the extirpation of the Swift Fox from Canada by the late 1930s.

Captive breeding began in 1973 through a privately-run program. This initiative expanded into an intensive reintroduction project involving federal and provincial agencies, academia and non-government organizations. Swift Foxes were first released into Alberta in 1983 and by 1996, 478 foxes had been released in the Alberta/Saskatchewan border area. Across the Canadian prairies, a minimum of 855 Swift Foxes had been released by 1996.

Reintroduction efforts have been successful, and small populations have become established in the border area of southeastern Alberta and southwestern Saskatchewan and in the Wood Mountain/Grasslands National Park Reserve region in Saskatchewan. Reproduction is now occurring in these wild populations, and the majority of the current population are wild-born offspring of released animals. A census conducted during the winter of 1996-1997, estimated the Alberta/Saskatchewan border population as approximately 192 foxes, and the Canadian population as 289 foxes.

Despite the re-establishment of Swift Foxes in Alberta and Saskatchewan, several factors may limit the expansion of the species' range. Increasing abundance and predation by Coyotes, as well as habitat loss combined with small population size make the existing Swift Fox populations susceptible to collapse.

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INTRODUCTION

Once common throughout the short and mixed-grass prairie regions, North America's smallest canid, the Swift Fox (*Vulpes velox*), suffered dramatic range-wide declines in the late 1800s and early 1900s. In Canada, the species disappeared from historic range in the early twentieth century and has been listed as 'extirpated*' since 1978. Although severe declines have also occurred in the United States, the Swift Fox is not listed as endangered at the federal level in that country. Reintroduction efforts in the Canadian prairies over the past 14 years have resulted in the establishment of small populations in southern Alberta and Saskatchewan. Currently the Swift Fox is designated as 'endangered' under the Alberta Wildlife Act.

As the focus of intense management and research programs, much has been learned about the biology of the Swift Fox. This report is a comprehensive review of the most recent available information on the Swift Fox and its status in Alberta.

HABITAT

Swift Foxes typically prefer short or mixed-grass prairie with flat to gently rolling terrain and sparse vegetation which allow for good mobility and visibility (Russell and Scotter 1984). Native grasses and bushes such as blue gramma (*Bouteloua gracilis*), spear grass (*Stipa comata*), fescue (*Festuca* spp.) and pasture sage (*Artemisia frigida*) are the dominant vegetation in these areas. In Wyoming, prairie/sagebrush habitat is also highly utilized by the Swift Fox (Lindberg 1986). Coulees, brushy areas and cultivated

lands are usually avoided (Mamo 1994a), although Swift Foxes have been observed near settlements and agricultural lands (Carbyn et al. 1994).

In addition to unfragmented prairie, several other habitat features are necessary to support Swift Fox populations. Unlike other canids, Swift Foxes use multiple den sites year round for shelter and rearing young, and as escape routes from predators (Carbyn et al. 1994). The presence of fossorial animals, such as Badgers (*Taxidea taxus*) and Richardson's Ground Squirrels (*Spermophilus richardsonii*), is crucial as Swift Foxes will modify existing burrows (Kilgore 1969). New dens may also be excavated (Cutter 1958a). Den location is variable, perhaps dependent on local topography. Dens have been located on hill tops in well-drained sites (Cutter 1958a, Pattimore 1985, Pruss 1994, Sharps 1984, Uresk and Sharps 1986), as well as in predominantly flat terrain (Fitzgerald et al. 1983). In Nebraska, Hines (1980) recorded den sites in both flat terrain and areas with gently rolling hills. Permanent water bodies and low predator abundance also enhance habitat suitability for Swift Fox (Brechtel et al. 1996, Mamo 1994a).

Within Canada, extensive fragmentation of native prairie has resulted in a limited number of sites with the landscape attributes necessary to support substantial Swift Fox populations. Most areas of suitable habitat which remain are located in southern Alberta and Saskatchewan and are privately owned, leased lands or community pastures (Brechtel et al. 1996).

CONSERVATION BIOLOGY

Primarily nocturnal, Swift Foxes are opportunistic predators that consume a variety of prey including mammals, carrion,

* See Appendix 1 for definitions of selected status designations

invertebrates (grasshoppers and beetles), vegetation and small birds (Carbyn et al. 1994, Hines and Case 1991, Sharps 1994, Uresk and Sharps 1986). Remains of fish, amphibians and reptiles have also been identified in Swift Fox scat (Cutter 1958b, Kilgore 1969). Analyses of scat collected in Alberta indicated that the mammalian component consisted primarily of small rodents (64.1 %), followed by ungulates (23.6 %; probably as carrion), lagomorphs (5.2 %) and ground squirrels (2.1 %; Reynolds et al. 1991).

Swift Foxes appear to be monogamous, however examples of possible polygamy or presence of a "helper" individual have been recorded (Carbyn et al. 1994, Hines 1980, Kilgore 1969). Breeding usually begins in the second year, although yearling females have been documented with pups (Brechtel et al. 1993). The breeding season starts in mid-February, and foxes reintroduced to Alberta and Saskatchewan have produced pups from late April to early May (Carbyn et al. 1994).

Litter size of reintroduced animals has ranged from one to seven pups, with an average litter size of 3.9 (Brechtel et al. 1993). In Colorado, Fitzgerald et al. (1983) documented the average litter size for wild Swift Foxes to be 3.6 young. Covell (1992) also recorded average litter size for wild foxes in Colorado as 2.4 for fox pairs and 4.2 for fox pairs with a helper fox.

In Alberta alone, 66 natal dens were located, with a minimum of 209 young, between 1982 and 1993 (Canadian Wildlife Service, unpubl. data). These dens were established both in native prairie (Table 1) and in pens used during the early stages of the release program. The majority of dens were located in the Alberta/Saskatchewan border area (Figure 1). For dens where the number of young could be

Table 1. Number of natal dens, with a confirmed number of young, located in native prairie in Alberta from 1984 to 1993.

Year	Number of Dens	Number of Young	Average Litter Size
1984	2	9	4.5
1986	1	2	2.0
1987	1	1	1.0
1988	5	9	3.8
1989	4	18	4.6
1990	13	47	3.6
1991	11	46	4.2
1993	5	16	3.2
Total	43	158	3.7

confirmed, litter size averaged 2.6 young for 19 dens established in release pens and 3.7 young for 43 natural dens. Between 1984 and 1992, an additional 13 dens with a minimum of 45 young were found in Saskatchewan (Figure 1). The majority of these dens were also located in the Alberta/Saskatchewan border area.

Juveniles typically disperse in the late summer and autumn, when they are four or five months old (Egoscue 1979, U. S. Fish and Wildlife Service 1990). In Colorado, Covell (1992) found that the majority (79 %) of juvenile dispersal occurred during September and October, while Rongstad et al. (1989) documented juvenile dispersal beginning in November. Dispersal distances are poorly known for wild-born juveniles. However, Covell (1992) documented dispersal distances

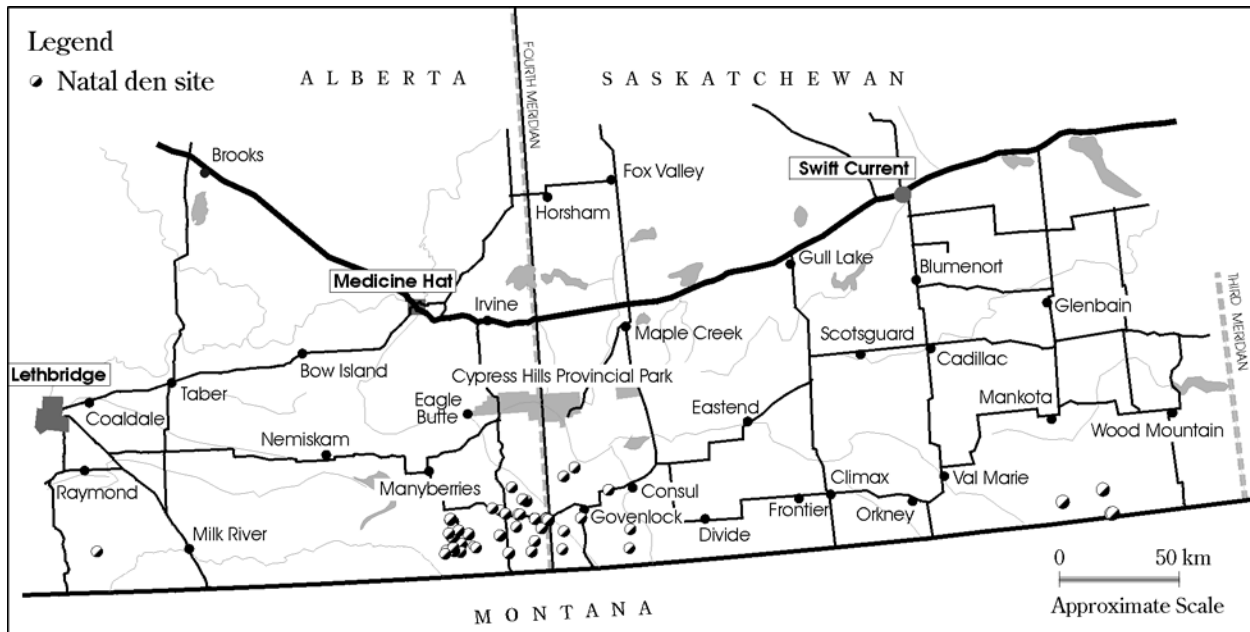


Figure 1. Swift Fox natal den sites located in Alberta and Saskatchewan from 1982 to 1993. Data provided by the Canadian Wildlife Service to the Swift Fox National Recovery Team.

of 9.4 ± 1.7 km for juvenile males and 2.1 ± 0.2 km for juvenile females.

The mean dispersal distance, from release site to last known location or site of death, was 12.8 km for reintroduced adult foxes in Canada from 1987 to 1991 (Brechtel et al. 1993, Carbyn et al. 1994). Long-distance dispersals of 70 to 190 km have been recorded for the species (Carbyn et al. 1994).

Swift Foxes do not appear to be territorial and home ranges may overlap in high-quality habitat (Carbyn et al. 1994, Hines et al. 1981).

Preliminary analyses of home range data collected on 16 Swift Foxes in the Alberta/Saskatchewan border area indicate an average home range size of approximately 34.1 km^2 (A. Moehrensclager, pers. comm.).

This estimate is similar in size to a 32.3 km^2 average home range calculated for seven Swift Foxes in Nebraska (Hines and Case

1991), and home ranges of 20 to 30 km^2 documented in Colorado (Rongstad et al. 1990).

Swift Fox populations appear to have a balanced sex ratio, are generally dominated by the juvenile age class and are characterized by high annual mortality rates (FaunaWest 1991).

Brechtel et al. (1993) estimated the minimum annual survival rates for wild-born Canadian foxes as 46 % for adults, and 36 % for juveniles during their first year. Annual survival rates of 56 % overall, 67 % for adults and yearlings and 38 % for pups were recorded in Colorado (Covell and Rongstad 1989).

Predation was the principal cause of mortality and accounted for 58 % of known deaths for 89 of the Swift Foxes released between 1987 and 1991 on the Canadian prairies (Table 2; Carbyn et al. 1994). Coyotes (*Canis latrans*)

are the main predators (Brechtel et al. 1993, Carbyn et al. 1994, Rongstad et al. 1989, Scott-Brown et al. 1986) and will often kill, but not consume the much smaller Swift Fox in what appears to be interspecific competition between the two species. Other predators include the Badger, Golden Eagle (*Aquila chrysaetos*) and Bobcat (*Lynx rufus*; Brechtel et al. 1993, Carbyn et al. 1994, Fitzgerald et al. 1983, Rongstad et al. 1989). Human-induced mortality, due to road kills, hunting or trapping, also occur to a lesser extent.

Despite the high rate of annual mortality, Brechtel et al. (1996) estimated that an average litter size of 3.9 was sufficient to support slow growth of the Canadian Swift Fox population

DISTRIBUTION

1. Alberta. - Historically, Swift Foxes were found throughout southern Alberta, ranging north to the 53rd parallel, west to the foothills and Rocky Mountains, and east to the Saskatchewan border (Soper 1964; Figure 2). A rapid decline in abundance occurred during the late nineteenth and early twentieth centuries, with the last verified sighting of a Swift Fox in Alberta reported in 1938 near Manyberries (Scott-Brown et al. 1986). Beginning in 1983, Swift Foxes have been released in the Alberta/Saskatchewan border area as part of an intensive reintroduction program. In 1989, Swift Foxes were also released into the Milk River Ridge area in Alberta.

Swift Fox populations have established in the area bounded in the west by Manyberries, Alberta (48 km from the Alberta/Saskatchewan border) and in the east by Consul, Saskatchewan (35 km west of the Alberta/Saskatchewan border; Figure 3). The

Milk River area has not been surveyed recently and it unlikely that a Swift Fox population continues to survive in the area.

Table 2. Causes of mortality for 89 Swift Foxes released during the reintroduction program from 1987 to 1991 (from Carbyn et al. 1994).

Cause of Death	Percentage
Coyote Predation	31
Suspected Coyote	7
Avian Predation	6
Suspected Avian	2
Badger Predation	3
Suspected Badger	3
Unknown Predation	6
Road Kills	6
Accidental Death	2
Unknown Cause	34

2. Other Areas. - The largest historical portion of the Swift Fox range in Canada occurred in Saskatchewan, as far north as the Saskatchewan River (Carbyn et al. 1994). Swift Foxes may also have occurred west into southeastern British Columbia and east into the Pembina Hills and Souris River area of Manitoba (Soper 1964, Pattimore 1985 Figure 2). The last confirmed specimen was taken in 1928 in southern Saskatchewan, near Govenlock, 14 km east of the Alberta/Saskatchewan border.

Reintroduction of Swift Foxes into Saskatchewan in the Alberta/Saskatchewan border area and the Wood Mountain and Grasslands National Park Reserve region have resulted in newly-established populations in

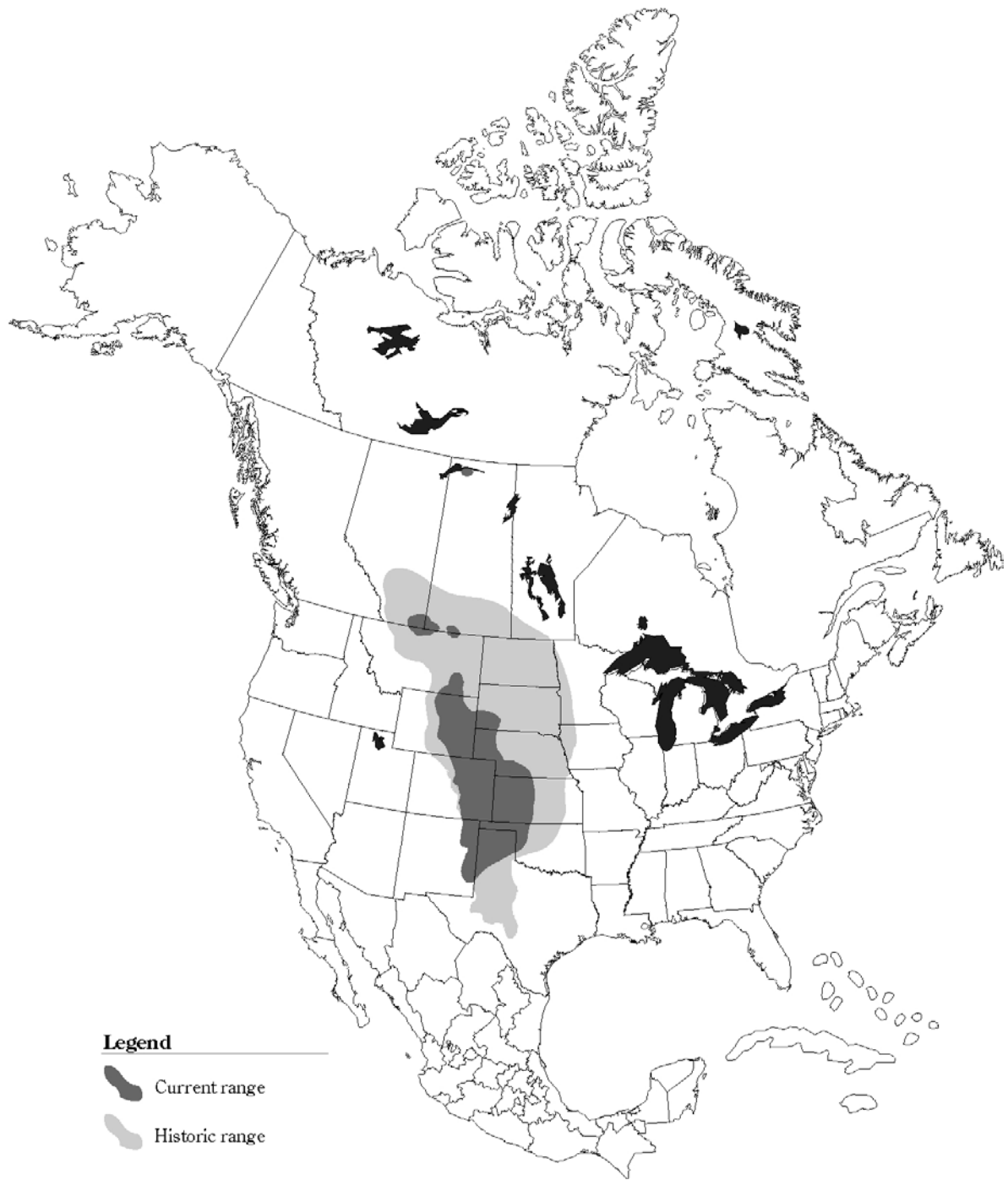


Figure 2. Present and historic ranges of the Swift Fox in North America (modified from Kahn et al. 1996).



Figure 3. Present range of Swift Fox in Alberta and Saskatchewan. Release sites used during the Canadian reintroduction program are represented by triangles and numbered. (Site 1 = Milk River Ridge Area; Site 2 = Alberta/Saskatchewan Border Area; Site 3 = Wood Mountain Area).

these areas (Figure 3). During the 1996-1997 Swift Fox census, individuals were live-trapped in the area south and east of Val Marie and west of Killdeer, Saskatchewan (Cotterill 1997).

Swift Foxes once occupied an extensive range in the United States, stretching south from the Canada/United States border to northern Texas, southeastern New Mexico and the Oklahoma panhandle (Kahn et al. 1996; Figure 2). The range extended west to the Rocky Mountains in Colorado, Wyoming and Montana and east through Kansas, Nebraska, North and South Dakota into Minnesota and Iowa (Carbyn et al. 1994). This range was drastically reduced by intensive predator control programs, poisoning, trapping and habitat loss through agricultural practices in the late 1800s and early 1900s. Range

expansion has slowly occurred over the past 40 years, and Swift Foxes currently occur in low abundances in Montana, Nebraska and South Dakota (Allen et al. 1995). The species is abundant in Colorado, Kansas, Wyoming and is locally common in parts of Texas, New Mexico and Oklahoma (Allen et al. 1995, Carbyn et al. 1994). Kahn et al. (1996) estimated that 30 % of the historical range in the United States is currently occupied by Swift Fox.

POPULATION SIZE AND TRENDS

1. Alberta/Saskatchewan Border Area. - Several independent estimates of population size have been obtained since 1990 for the Swift Fox. Brechtel et al. (1993) arrived at two estimates: one based on saturation trapping within a township (92.16 km²) and

extrapolation to the core area (13 townships); and the second based on capture-recapture information within the same core area. The saturation trapping method resulted in an estimated average density of eight animals per township in the core area, whereas the recapture method yielded a density of 8.5 foxes per township. Based on these two estimates, Brechtel et al. (1993) estimated the 1990-1991 border area population to be between 150 and 250 animals.

The size of the Alberta/Saskatchewan border population was assessed again in 1994 using a combination of live trapping, track counts, night lighting and scat count surveys, and resulted in an estimate of 110 to 150 foxes (Mamo 1994b). Mamo (1994b) attributed the smaller border population size in 1994, compared to the 1990-1991 estimate, to severe conditions during the two previous winters and to elevated predation rates by Coyotes.

During the winter of 1996-1997, a census of the Canadian Swift Fox population was conducted as part of the Swift Fox national recovery plan. Portions of 58 townships within the suspected range of Swift Fox (108 townships) in Canada were surveyed. The results suggested a population size of 192 foxes (95 % confidence interval: 93 to 346 individuals) in the Alberta/Saskatchewan border area (Cotterill 1997).

The Alberta/Saskatchewan border is a political boundary, with no biological significance to Swift Foxes that may move across it. However, for management purposes, there may be an interest in reporting the proportion of Swift Foxes occurring in each of these provinces. Based on density estimates obtained from the 1996-1997 Canadian Swift Fox census (Cotterill 1997), and total area of the suspected Swift Fox range in the border area, Alberta and

Saskatchewan appear to each support approximately 50 % of the border population.

2. Wood Mountain Area, Saskatchewan. - Brechtel et al. (1993) estimated that the Swift Fox population in the Wood Mountain region numbered less than 50 animals in 1991. Hjertaas (1994) estimated the Wood Mountain population as 25 foxes (range of 15 to 50 foxes) in 1993. This area was also surveyed during the winter of 1996-1997, and the survey indicated that the current population size is approximately 87 foxes (Cotterill 1997). There is evidence, however, that some of the Swift Foxes reintroduced to the Wood Mountain region have dispersed into Montana (Carbyn et al. 1994). If these animals are reproducing and movement is still occurring across the Canada/U.S. border, the population in this area may be larger than indicated by the Canadian census.

3. North America. - Although historical population levels of Swift Fox are unknown, fur trading records give an indication of population size. The Hudson's Bay Company traded an average of 4,876 Swift Fox pelts annually between 1853 and 1877 (Rand 1948). The American Fur Company traded a total of 10,614 Swift Fox pelts between 1835 and 1838 (Johnson 1969).

Brechtel et al. (1993) estimated the winter 1991-1992 Canadian Swift Fox population to be 225 foxes (range of 150-300) animals. Results of the 1996-1997 winter census suggest a population of 289 foxes in Canada (95 % confidence interval: 179 to 412 individuals; Cotterill 1997).

Current estimates of the size of the Swift Fox population in the United States range from 16,400 to 27,500 animals (Kahn et al. 1996). Brechtel et al. (1996) estimated that the Canadian Swift Fox population represents less

than one percent of the North American population.

After suffering a drastic range-wide decline in the late 1800s and early 1900s, Swift Fox populations appear to be slowly increasing in Canada, primarily as the result of intensive reintroduction efforts. In the United States, increasing population levels are accompanying range expansion.

LIMITING FACTORS

Once widely distributed across the Great Plains of North America, from southern Canada to Texas, the Swift Fox range began to decline in the late 1800s. This decline has been attributed primarily to human-related factors, such as habitat fragmentation, Coyote abundance and range management. These factors continue to play a role in the survival of Swift Fox populations and will be the focus of this section.

Despite the predominance of human-induced limiting factors, one natural limiting factor, climatic conditions, deserves mention. Due to its small size, the Canadian Swift Fox population may be extremely vulnerable to stochastic climatic conditions which may affect prey abundance and availability. Swift Foxes suffered lower survival and reproduction rates following a dry summer and a moderate to severe winter in 1988 (Carbyn et al. 1994). A severe drought in the 1930s has also been implicated in the demise of the Swift Fox in Canada (Brechtel et al. 1996).

1. *Habitat Fragmentation.* - Conversion of native prairie to agricultural lands was one of the major factors contributing to the decline of the Swift Fox in Canada (Carbyn et al. 1994, Macdonald and Handoca 1995). Within

Canada, approximately 24 % of the mixed-grass prairie region remains uncultivated (World Wildlife Fund Canada 1988). Despite severe fragmentation of this ecosystem, several large expanses of native grassland suitable for Swift Fox habitation exist in southern Alberta. Additional conversion of grassland to cropland would threaten this remnant habitat and the survival of resident Swift Foxes. Currently, range improvement on public land is marginal (K. Lyseng, pers. comm.). However, conversion of private rangeland to cultivated land is often financially driven. Should the financial incentive for cultivating cropland increase, conversion of native grasslands would again threaten Swift Fox habitat and populations in the Canadian prairies.

Oil and natural gas exploration also fragment existing grasslands and increase road traffic and access by humans. Impacts of this type of disturbance on Swift Foxes are unknown, but both positive and negative effects may be expected. On the positive side, prey abundance for Swift Foxes may increase in the vicinity of roads. However, loss of local habitat, increased mortality due to road kills, trapping and accidental shooting may also result (Carbyn et al. 1994).

2. *Coyote Abundance.* - Coyotes are the primary predator of Swift Foxes, and are perhaps the most important factor limiting successful establishment of the species in Canada. With the extirpation of the Wolf (*Canis lupus*) on the Canadian prairies, Coyote densities have increased despite ongoing fur harvest and persecution by landowners. In southeastern Alberta, aerial surveys indicate that Coyote abundance increased 135 % from the 1977-1989 survey period to the 1995-1996 survey period (L. Gudmundson, pers. comm.). As direct competitors and predators, Coyotes may

restrict range expansion by Swift Foxes, particularly in the few grassland expanses which are suitable for fox colonization.

3. Range Management. - Little is known of the effects of range management on Swift Foxes, however several management practices may adversely affect the species. Use of pesticides may reduce prey availability (insects, rodents), or result in the accumulation of toxins in prey species. Consumption of contaminated prey may then affect Swift Fox reproductive success and survival (Brechtel et al. 1996, Carbyn and Killaby 1989, Martin et al. 1996). Overgrazing may also affect habitat quality and prey abundance. O'Farrell (1983) documented diminished prey abundance and concomitant population declines of the closely-related Kit Fox (Vulpes macrotis), due to overgrazing.

Habitat quality, availability and Swift Fox survival are affected by a variety of factors, the majority of which are human-induced. Change of native prairie to agricultural land has had the greatest negative influence on Swift Fox populations, causing habitat loss and increased Coyote abundance.

STATUS DESIGNATIONS

1. Alberta. - Reintroduction efforts have resulted in the establishment of Swift Fox populations within the province. Although apparently increasing, these populations are small and vulnerable to decline. Due to these conditions, the species has been designated as 'endangered' in Alberta and is fully protected under the Alberta Wildlife Act. Swift Fox dens are also protected under this legislation.

In 1991, the species was 'Red-listed' by Alberta Fish and Wildlife. This status was reconfirmed during a 1996 status review for

all non-fish vertebrates in Alberta (Alberta Wildlife Management Division 1996). As a 'Red-listed' species, its populations are considered non-viable or at risk of declining to non-viable levels within the province. This status listing was based on several factors which included the species' low abundance, restricted breeding distribution and populations considered below minimum viable size. Additionally, Swift Fox populations in other parts of Canada and the United States were considered rare or at risk (Alberta Fish and Wildlife 1991). Habitat currently occupied by the Swift Fox was not considered to be at risk and was therefore not a major factor contributing to the 'Red-listed' status.

2. Other Areas. - The Committee on the Status of Endangered Wildlife in Canada officially designated the Swift Fox as 'extirpated' in Canada in 1978 (Committee on the Status of Endangered Wildlife in Canada 1978). A National Recovery Plan was developed with the mandate to increase Swift Fox populations to self-sustaining levels by the year 2000 (Brechtel et al. 1996). Although the Swift Fox does not have legal designation as 'endangered' in Saskatchewan, it is fully protected by the Wildlife Act (E. Wiltse, pers. comm.). In Manitoba, the Swift Fox is not protected under the Wildlife Act, however limited protection does exist through other legislation (Brechtel et al. 1996).

Northern populations of the Swift Fox in Canada and the United States were originally described as subspecies, Vulpes velox hebes (Merriam 1902). This subspecies was listed as 'endangered' by the U. S. Fish and Wildlife Service in 1979 but subsequently delisted when the subspecies designation was removed (Stromberg and Boyce 1986). In 1992, a petition was submitted to the U. S. Fish and Wildlife Service to have the Swift Fox again

listed as 'endangered' (Allen et al. 1995, Carbyn et al. 1994). This petition was considered warranted but precluded in June 1995 (Allen et al. 1995). As an alternative to endangered species listing, a Swift Fox Conservation Team consisting of federal and state agencies was formed in 1994. This committee drafted a Habitat Conservation Assessment and Strategy for the Swift Fox, similar in scope to a recovery plan for threatened or endangered species (Allen et al. 1995).

RECENT MANAGEMENT IN ALBERTA

1. Overview. - Swift Fox recovery efforts were privately initiated by Miles and Beryl Smeeton, owners of the Wildlife Reserve of Western Canada (now Cochrane Ecological Institute - Cochrane Wildlife Reserve) near Cochrane, Alberta. In 1973, the Smeetons imported two pairs of Swift Foxes from Colorado, and established a captive breeding program for the species. These initial efforts stimulated involvement of university researchers in 1976 and resulted in several thesis-based reintroduction feasibility studies (Carlington 1980, Reynolds 1983, Schroeder 1985).

By 1984, the project had expanded into an intensive reintroduction project involving four government agencies and six non-government organizations. From 1984 to 1989, the recovery program was directed by a Technical Committee which was replaced in 1989 by the National Swift Fox Recovery Team established by RENEW (Recovery of Nationally Endangered Wildlife). The first major task for the Recovery Team was a three-year (1989-1992) study to determine if a niche still existed in the Canadian prairies for the Swift Fox and if so, what the most suitable methods of reintroduction were (Brechtel et

al. 1993). Following this study, a National Recovery Plan for the Swift Fox was devised (Brechtel et al. 1996). The primary goal of the National Recovery Plan is to remove the Swift Fox from the endangered species list by increasing populations to stable, self-sustaining levels by the year 2000 (Brechtel et al. 1996). The target population size by the year 2000 is 420 adult animals during the spring, in the Alberta/Saskatchewan border area and Wood Mountain region (Brechtel et al. 1996). The main strategies employed to attain this goal are the release of sufficient foxes and the management and protection of key habitats (Brechtel et al. 1996). Swift Fox releases are scheduled to terminate in September 1997.

2. Reintroduction Program. - The first captive-reared Swift Foxes were released in Alberta in September, 1983. By 1996, 539 Swift Foxes had been released in the Alberta/Saskatchewan border area and the Milk River Ridge in south-central Alberta (Appendix 2), two of the largest blocks of native mixed-grass prairie remaining in the province (Mamo 1994a). However, due to high predator abundance and intensive predator and rabies control programs, the Milk River Ridge area is no longer considered suitable for Swift Fox releases (Brechtel et al. 1993, Mamo 1994a). Swift Foxes have also been released in the Wood Mountain/Grasslands National Park Reserve region in Saskatchewan. Across the Canadian prairies, a minimum of 855 Swift Foxes had been released between 1983 and 1996.

In Alberta, large uncultivated areas potentially suitable for Swift Foxes, also occur in the Tide and Scots Lakes areas as well as at the Suffield Military Base (Mamo 1994a). Although the Tide and Scots Lakes areas, east and southeast of Brooks, respectively, contain high prey abundance and burrow distribution,

they are currently not being considered as Swift Fox release sites because of elevated recreational and agricultural use, presence of major transportation corridors, extensive natural resource extraction activities and poor long-term habitat protection (Mamo 1994a). The Suffield Military Base has not been evaluated thoroughly enough to determine suitability for Swift Fox habitation (Mamo 1994a).

Three release methods have been used in the reintroduction program over the years (Carbyn and Killaby 1989). From 1983 to 1987, 'soft' and 'semi-hard' release methods were employed. A 'soft' release involves placing paired foxes in holding pens over winter and then releasing the foxes during the spring or fall. These animals are then supplementally fed after release. 'Semi-hard' releases are similar to soft releases; the main difference is that food is not provided after the foxes are released. 'Hard' releases were implemented in 1987 and involve releasing the foxes directly into the wild with minimal holding time. This method has proved to be more cost efficient and as successful as the other two methods (Brechtel et al. 1993).

Both captive-raised and wild-born foxes have been used during the reintroduction program for breeding and release purposes. Captive-reared animals have been supplied by the Cochrane Ecological Institute - Cochrane Wildlife Reserve, Calgary Zoo, Edmonton Valley Zoo and the Moose Jaw Wild Animal Park (Saskatchewan). One of the main objectives of the captive breeding program was to maximize the adaptive capabilities of the reintroduced Swift Fox population by increasing the genetic heterozygosity of the breeding population (Herrero et al. 1986). Additionally, due to the possibility of locally-adapted populations of Swift Fox, wild-born animals were obtained from the northern part

of the Swift Fox range in the United States (Colorado, South Dakota and Wyoming; see Carbyn et al. 1994, Stromberg and Boyce 1986).

Since 1992, the emphasis of the reintroduction program has been to release wild-born animals, which survive and reproduce more successfully and cost less than captive-reared animals (Brechtel et al. 1993, Carbyn et al. 1994). Translocated foxes appear to experience a two-fold greater survival rate in the 12 months following release and approximately 85 % of wild-born foxes versus 25 % of captive-released foxes reproduce in the first year after introduction into the wild (Brechtel et al. 1993).

Establishment of wild Swift Fox populations and reproduction by these populations indicate that it is possible for Swift Foxes to survive again on the Canadian prairies. The reintroduction efforts have been successful to date, however current populations remain extremely vulnerable due to their small size and isolation from other wild populations.

3. Land-Use Management. - Knowledge of Swift Fox biology and habitat requirements is now being integrated into land use management decisions at an operational level. Guidelines for development and activity restrictions near Swift Fox natal den sites are currently being developed by the Alberta Natural Resources Service (J. Taggart, pers. comm.). These guidelines include recommendations for a 200 m buffer around a natal den site to exclude passive leisure activities (e.g., walking, driving, photography) during the breeding and pup-rearing period (February 15 - July 31). A 500 m buffer around a natal den site, excluding all industrial and natural resource development activity year-round, has also been recommended (J. Taggart, pers. comm.).

Although incorporation of this information is in its infancy, it has been used during the review and construction of land-use developments such as pipelines.

SYNTHESIS

The Swift Fox is listed as 'endangered' in Alberta, while nationally it is still considered 'extirpated'. An intensive reintroduction program has resulted in the establishment of small populations in southeastern Alberta and southwestern Saskatchewan. Preliminary

results from a Swift Fox census conducted during the winter of 1996-1997 indicate that the size of the fox population in the Alberta/Saskatchewan border area is approximately 192 animals. The Canadian population is estimated to be 289 foxes. Reproduction is occurring in these wild populations, however both adult and juvenile annual mortality rates are high. The potential for continued habitat fragmentation of the mixed-grass prairie region, combined with increasing Coyote abundance, may threaten the survival of the small Swift Fox populations within Alberta and Canada.

LITERATURE CITED

- Alberta Fish and Wildlife. 1991. The status of Alberta wildlife. Alberta Fish and Wildlife, Edmonton, AB. 49 pp.
- Alberta Wildlife Management Division. 1996. The status of Alberta wildlife. Alberta Natural Resources Service, Edmonton, AB. 44 pp.
- Allen, S. H., J. W. Hoagland, and E. D. Stukel (eds.). 1995. Report of the Swift Fox conservation team 1995. No Location. 170 pp.
- Brechtel, S., L. Carbyn, G. Erickson, D. Hjertaas, C. Mamo, and P. McDougall. 1996. National recovery plan for the Swift Fox. Report No. 15. Recovery of Nationally Endangered Wildlife Committee, Ottawa, ON. 29 pp.
- Brechtel, S. H., L. N. Carbyn, D. Hjertaas, and C. Mamo. 1993. Canadian Swift Fox reintroduction feasibility study: 1989-1992; report and recommendations of the National Recovery Team. Unpubl. report, Alberta Fish and Wildlife Services, Edmonton, AB. 95 pp. + appendices.
- Carbyn, L. N. 1996. The return of the Swift Fox to the Canadian prairies. Pp. 273-280 in Proceedings of the fourth prairie conservation and endangered species workshop (W. D. Willms and J. F. Dormaar, eds.). Prov. Mus. Alberta Nat. Hist. Occ. Paper No. 23, Edmonton, AB. 337 pp.
- Carbyn, L. N., H. J. Armbruster, and C. Mamo. 1994. The Swift Fox reintroduction program in Canada from 1983 to 1992. Pp. 247-271 in Restoration of endangered species: conceptual issues, planning and implementation. (M. L. Bowles and C. J. Whelan, eds.). Cambridge University Press, Cambridge, UK.
- Carbyn, L. N., and M. Killaby. 1989. Status of Swift Fox in Saskatchewan. Blue Jay 47: 41-52.
- Carlington, B. G. 1980. Reintroduction of the Swift Fox (Vulpes velox) to the Canadian prairie. Unpubl. M.Sc. thesis, University of Calgary, Calgary, AB. 180 pp.
- Committee on the Status of Wildlife in Canada. 1978. The status of the Swift Fox (Vulpes velox) in Canada. COSEWIC, Ottawa, ON. 5 pp.
- Cotterill, S. E. 1997. Population census of Swift Fox (Vulpes velox) in Canada: winter 1996-1997. Unpubl. report for the Swift Fox National Recovery Team by Alberta Environmental Protection (Natural Resources Service), Edmonton, AB. 50 pp.
- Covell, D. F. 1992. Ecology of the Swift Fox (Vulpes velox) in southeastern Colorado. Unpubl. M.Sc. thesis,. University of Wisconsin, Madison, WI. 110 pp.
- Covell, D. F., and O. J. Rongstad. 1990. 1989 annual report - ecology of Swift Fox on the Pinyon Canyon Maneuver site. Unpubl. report for Environmental, Energy and Natural Resources Division, Fort Carson, CO. 7 pp.
- Cutter, W. L. 1958a. Denning of the Swift Fox in northern Texas. J. Mammal. 39: 70-74.
- Cutter, W. L. 1958b. Food habits of the Swift Fox in northern Texas. J. Mammal. 39: 527-532.
- Egoscue, H. J. 1979. Vulpes velox. Mammalian Species 122: 1-5.

- FaunaWest Wildlife Consultants. 1991. An ecological and taxonomic review of the Swift Fox (*Vulpes velox*) with a special reference to Montana. Unpubl. report for Montana Department for Fish, Wildlife and Parks, Bozeman, MT. 49 pp.
- Fitzgerald, J. P., R. R. Loy, and M. Cameron 1983. Status of Swift Fox on the Pawnee National Grassland, Colorado. Unpubl. manuscript. 21 pp.
- Herrero, S., C. Schroeder, and M. Scott-Brown. 1986. Are Canadian foxes swift enough? *Biol. Conserv.* 36: 159-167.
- Hines, T. D. 1980. An ecological study of *Vulpes velox* in Nebraska. Unpubl. M.Sc. thesis, University of Nebraska, Lincoln, NE. 103 pp.
- Hines, T. D., and R. M. Case 1991. Diet, home range, movements, and activity periods of Swift Fox in Nebraska. *Prairie Nat.* 23: 131-138.
- Hines, T., R. Case, and R. Lock. 1981. The swiftest fox. *Nebraskaland* June 1981: 22-27.
- Hjertaas, D. 1994. Reintroduction of the Swift Fox on the Wood Mountain Plateau. Unpubl. report for Saskatchewan Environment and Resource Management. 14 pp.
- Johnson, D. R. 1969. Returns of the American Fur Company, 1835-1839. *J. Mammal.* 50: 836-839.
- Kahn, R., L. Fox, P. Horner, and B. Giddings (eds.). 1996. Conservation assessment and conservation strategy for Swift Fox in the United States. Unpubl. draft report for the Swift Fox Conservation Team. No location. 54 pp.
- Kilgore, D. L., Jr. 1969. An ecological study of the Swift Fox (*Vulpes velox*) in the Oklahoma panhandle. *Amer. Midl. Nat.* 81: 512-534.
- Lindberg, M. 1986. Swift Fox distribution in Wyoming: a biogeographical study. Unpubl. M.Sc. Thesis, University of Wyoming, Laramie, WY. 64 pp.
- Macdonald, D. and L. Handoca (eds 1995. *The Swift Fox: a disappearing species.* *Canid News* 3: 41-45.
- Mamo, C. 1994a. 1994. Swift Fox habitat survey. Unpubl. report for Alberta Fish and Wildlife, Edmonton, AB. 25 pp.
- Mamo, C.. 1994b. Swift Fox (*Vulpes velox*) population assessment (1994). Unpubl. report for Alberta Fish and Wildlife and The Swift Fox Conservation Society, Edmonton, AB. 28 pp.
- Martin, P. A., D. L. Johnson, D. J. Forsyth, and B. D. Hill. 1996. Indirect effects of insecticides on wildlife. Pp. 116-119 in *Proceedings of the fourth prairie conservation and endangered species workshop* (W. D. Willms and J. F. Dormaar, eds.). *Prov. Mus. Alberta Nat. Hist. Occ. Paper No. 23*, Edmonton, AB. 337 pp.
- Merriam, C. H. 1902. Three new foxes of the kit and desert fox groups. *Proc. Biol. Soc. Washington* 15: 73-74.
- O'Farrell, T. P. 1983. The San Joaquin Kit Fox recovery plan. United States Fish and Wildlife Service, Portland, OR. 84 pp.
- Pattimore, G. 1985. The feasibility of reintroducing the Swift Fox to southern Manitoba. Unpubl. M.Sc. Thesis,

- University of Manitoba, Winnipeg, MB. 102 pp.
- Pruss, S. D. 1994. An observational natal den study of wild Swift Fox (Vulpes velox) on the Canadian prairie. Unpubl. M.Sc. Thesis, University of Calgary, Calgary, AB. 214 pp.
- Rand, A. L. 1948. Mammals of the eastern Rockies and western plains of Canada. Nat. Mus. Canada Bull. 108: 1-327.
- Reynolds, J. 1983. A plan for reintroduction of the Swift Fox to the Canadian prairie. Unpubl. M.Sc. thesis, University of Calgary, Calgary, AB. 112 pp.
- Reynolds, J., L. N. Carbyn, M. Nietfeld, H. Armbruster, S. Herrero, and C. Mamo. 1991. Food habits of Swift Foxes (Vulpes velox) in release programs in Alberta and Saskatchewan. Unpubl. manuscript. 26 pp.
- Rongstad, O. J., T. R. Laurion, and D. E. Anderson. 1989. Ecology of Swift Fox on the Pinyon Canyon Maneuver site, Colorado. Draft final report for Directorate of Engineering and Housing, Fort Carson, CO. 53 pp.
- Russell, R. H. and G. W. Scotter. 1984. Return of the native. Nat. Canada 13: 7-13.
- Schroeder, C. 1985. A preliminary management plan for securing Swift Fox, for reintroduction into Canada. Unpubl. M.Sc. Thesis, University of Calgary, Calgary, AB. 203 pp.
- Scott-Brown, J. M., Herrero, S., and C. Mamo. 1986. Monitoring of released Swift Fox in Alberta and Saskatchewan - Final report 1986. Unpubl. report for Canadian Wildlife Service, Edmonton, AB. 97 pp.
- Sharps, J. C. 1984. Game Report. Northern Swift Fox investigations 1977-1981. Completion Report No. 85-11. Unpubl. report for Department of Game, Fish and Parks, Pierre, SD. 26 pp.
- Soper, J. D. 1964. The mammals of Alberta. Hamley Press Ltd., Edmonton, AB. 402 pp.
- Stromberg, M. R., and M. S. Boyce. 1986. Systematics and conservation of the Swift Fox, Vulpes velox, in North America. Biol. Conserv. 35: 97-110.
- U. S. Fish and Wildlife Service. 1990. Report of the status of the Swift Fox, (Vulpes velox), a category 2 taxon in North Dakota. U.S. Fish and Wildlife Service, Bismarck, ND. 18 pp.
- Uresk, D. W., and J. C. Sharps. 1986. Denning habitat and diet of the Swift Fox in western South Dakota. Great Basin Nat. 46: 249-253.
- World Wildlife Fund Canada. 1988. Prairie conservation action plan: 1989-1994. World Wildlife Fund, Toronto, ON. 38 pp.

APPENDIX 1. Definitions of selected legal and protective designations.

A. Status of Alberta Wildlife colour lists (after Alberta Wildlife Management Division 1996)

Red	Current knowledge suggests that these species <u>are</u> at risk. These species have declined, or are in immediate danger of declining, to nonviable population size
Blue	Current knowledge suggests that these species <u>may be</u> at risk. These species have undergone non-cyclical declines in population or habitat, or reductions in provincial distribution
Yellow	Species that are not currently at risk, but may require special management to address concerns related to naturally low populations, limited provincial distributions, or demographic/life history features that make them vulnerable to <u>human-related</u> changes in the environment
Green	Species not considered to be at risk. Populations are stable and key habitats are generally secure
Undetermined	Species not known to be at risk, but insufficient information is available to determine status

B. Alberta Wildlife Act

Species designated as ‘endangered’ under the Alberta Wildlife Act include those defined as ‘endangered’ or ‘threatened’ by *A Policy for the Management of Threatened Wildlife in Alberta* (Alberta Fish and Wildlife 1985):

Endangered	A species whose present existence in Alberta is in danger of extinction within the next decade
Threatened	A species that is likely to become endangered if the factors causing its vulnerability are not reversed

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 1996)

Extirpated	A species no longer existing in the wild in Canada, but occurring elsewhere
Endangered	A species facing imminent extirpation or extinction
Threatened	A species likely to become endangered if limiting factors are not reversed
Vulnerable	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
Not at Risk	A species that has been evaluated and found to be not at risk
Indeterminate	A species for which there is insufficient scientific information to support status designation

D. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range

APPENDIX 2. Type of release and number of Swift Foxes released from 1983 to 1996 in the three main release areas, during the Canadian reintroduction program¹.

Year	Release Type	AB/SK Border	Wood Mountain	Milk River Ridge
1983 - Spring 1987	Soft	136	---	---
Fall 1987	Hard	57	---	---
1988	Hard	53	---	---
1989	Hard	35	---	61
1990	Hard	66	51	---
1991	Hard	35	75	---
1992	Hard	---	65	---
1993	Hard	15	35	---
1994	Hard	43	19	---
1995	Hard	21	34	---
1996	Hard	17	37 (39?) ²	---
Site Total		478	316 (318)	61

¹ Sources: Brechtel et al. 1993, Carbyn et al. 1996, Hjertaas 1994, L. Carbyn pers. comm., E. Wiltse pers. comm.

² Exact number unknown (E. Wiltse, pers. comm.)