

The reintroduction of the swift fox *Vulpes velox* to South Central Saskatchewan, Canada

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Abstract The Canadian Swift Fox Reintroduction Programme lasted from 1972 to 1997. From 1983 to 1997, a total of 841 captive-raised swift foxes and 91 translocated swift foxes were released in the Canadian Prairies. In South Central Saskatchewan, 406 captive-raised animals and 14 translocated animals were released from 1990 to 1997. This area was used to develop new release methods (in particular, portable protective shelters (PPS)) and saw the co-operation of a non-governmental organization (NGO) (Cochrane Ecological

Institute (CEI)) with two levels of government (Heritage Canada (Grasslands National Park) and the Government of Saskatchewan). A 1996–97 survey of swift foxes in South Central Saskatchewan estimated the population to be 87 animals. No attempt has been made to establish if this population level is sustainable.

Keywords Canada, Saskatchewan, swift fox, *Vulpes velox*, reintroduction.

Introduction

Two species of fox, the kit fox *Vulpes macrotis* and the swift fox *Vulpes velox*, are native to the Great Plains of North America. Historically, the swift fox range coincided with that of the North American bison *Bison bison*. The range extended from the Texas panhandle and New Mexico, USA, in the south, to the Aspen parkland of Saskatchewan and Alberta, Canada, in the north, and eastward from the foothills of the Rocky Mountain chain to Manitoba, Canada and to the Mississippi River in the USA.

Swift foxes are North America's smallest canid, weighing between 2.3 and 3.2 kg. They are opportunistic feeders, eating seeds, berries, grass, insects, amphibians, reptiles, and small animals and birds (Uresk & Sharps, 1986; Bremner, 1997). If water is available, they require 210 g of food per day; in the absence of water, the foxes absorb their necessary liquid from their food and require 330 g of food per day (Flaherty & Plaake, 1986). Swift foxes are preyed upon by both terrestrial and avian predators and are extremely den-dependent. Swift foxes are sedentary, social and largely monogamous. They rely on the burrows of other species for survival, using them as escape terrain and den sites. Swift foxes are, in general, more active at night than

during the day, but this activity pattern varies with the season (Pruss, 1994; Teeling, 1996).

A subspecies of the swift fox, the northern swift fox *Vulpes velox hebes*, described by Merriam (1902), was briefly listed by the US Department of the Interior in 1974 as endangered in the USA. The species was delisted on the basis that a valid subspecific variation did not exist, supported by Hall's statement that *Vulpes velox* was conspecific with *Vulpes macrotis* (Hall, 1981). By 1980, the northern swift fox had vanished throughout its Canadian range and from much of its northern range in the USA, reducing the possibility of subspecies verification. Definitive research, combining morphological and molecular systematic data (Stromberg & Boyce, 1986; Wayne, 1998), has resulted in the acceptance of distinct taxonomic descriptions for the kit fox *Vulpes macrotis* and the swift fox *Vulpes velox*.

The swift fox was classified as extirpated in Canada in 1978 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 1978) and, in 1995, was described as extirpated over 90 per cent of its historic range in the USA (*United States Federal Register* 60(116), 1995). The causes of the extirpation of this species were attributed to the rapid and radical change of the Great Plains ecosystem from native grasslands to cultivated farmland, and the inevitable hunting, trapping and poisoning programmes which accompany such habitat transformation (Carlington, 1980; Weagle & Smeeton, 1995).

History of the swift fox captive-breeding programme in Canada

Captive-breeding of the swift fox for reintroduction into its original Canadian range was initiated in 1972, at

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the Wildlife Reserve of Western Canada (now the Cochrane Ecological Institute (CEI)), using four founder foxes from the USA. The captive-breeding programme was initiated solely to provide swift foxes for reintroduction and not for exhibition purposes. Over the period of the programme, the CEI has continued to acquire swift foxes to add to the captive colony from the USA. No Canadian animals were available for addition to the swift fox captive-breeding programme as the species had been extirpated from that country.

By 1997, the CEI held 25 pairs of swift foxes and the captive-breeding programme had provided 841 swift foxes for the Canadian reintroduction programme. These were the progeny of 187 animals, of which 34 (17 males, 17 females) came directly from wild stock from Colorado, Wyoming and South Dakota. A swift fox studbook was started by M. R. Smeeton in 1972 and was transferred to International Species Information System (ISIS) software in 1986. This software is used to ensure maximum genetic heterozygosity in new breeding pairs (inbreeding coefficient < 0.05) and that animals of the same blood lines are not repeatedly reintroduced into the same geographic area (ISIS, 1989).

The Canadian Swift Fox Reintroduction Programme

After founding the CEI's captive-breeding colony in 1972, Miles and Beryl Smeeton signed a co-operative agreement with Dr Steven Herrero, Dean of the Faculty of Environmental Design, University of Calgary in 1977. This agreement outlined a series of research projects to be conducted as MSc theses (Carlington, 1980; Reynolds, 1983; Schroeder, 1987) on potential release sites and methodology. The Smeetons agreed to provide swift foxes for reintroduction and opened their facility to University of Calgary researchers. In mid-1980, on the advice of the newly formed Swift Fox Propagation Committee, swift foxes from the CEI captive-breeding colony were sent to three zoos (Calgary, Edmonton, and Moose Jaw) as breeding and educational exhibit animals. By 1997, none of the zoos participating in the breeding programme had swift foxes, having either returned their swift fox stock to the CEI, or released or euthanized the animals.

The Canadian Wildlife Service (CWS), a branch of the Federal Government of Canada, became involved for the first time in the programme in 1978, when the COSEWIC designated the swift fox as 'extirpated' in Canada. The federal government's jurisdictional involvement in the swift fox reintroduction programme was joined by provincial government involvement when the provinces of Alberta (1983) and Saskatchewan (1985) permitted swift fox releases within their jurisdic-

tion. In 1986, the ownership of the captive-breeding colony was transferred to the CWS, although the colony was still housed at CEI and maintained by CEI staff. From 1986 to 1997, the colony was managed under a research permit (0336GP) issued by the Alberta Government to the CWS. In 1997, the province of Alberta issued a Zoo Permit to the CEI, which resulted in ownership of the captive colony reverting to the CEI from the federal government (CWS). The CEI currently holds 16 pairs of swift foxes within single-pair enclosures and five individuals within a 9-ha enclosure.

In addition to the 841 captive-bred swift foxes released in Canada (1983–97), the Canadian Government authorities also undertook a trapping and translocation programme, taking wild swift foxes from the USA for release at Canadian sites. Supplementing the captive-bred releases, a total of 91 wild swift foxes were taken from Colorado and Wyoming. In an attempt to determine the most suitable time in the year for the release of swift foxes in the wild, the Swift Fox Recovery Team undertook a multi-year feasibility study. Of the 91 wild swift foxes imported from the USA, 33 were used in a spring release experiment.

The spring release experiment (1989–91) required that wild adult swift foxes were trapped in January in the USA and taken to Canada, where they were quarantined over the breeding season until April. They were then released with a comparable number of captive-bred juveniles born the previous year and retained for this purpose. The experiment involved the tracking of 122 captive-bred and 33 wild translocated animals over this period.

The results showed that the survival of the 41 captive-raised juveniles used in the spring release experiment (7.4 per cent) was significantly lower than that of the 33 adult, wild, translocated swift foxes from the USA (58.9 per cent) (Brechtel *et al.*, 1993). The survival of 81 radio-collared captive-raised juvenile animals released in the autumn was significantly higher at 39.7 per cent. Unfortunately, no data were provided for the survival of adult, wild, translocated animals from the USA that were released in the autumn, because none of them were radio-collared (Brechtel *et al.*, 1993). Hjertaas (1994) also analysed the data for the Wood Mountain area of Saskatchewan. His estimates of 12-month survival based on daily mortality rates were as follows: spring released, captive-raised swift fox (3.5 per cent); autumn released, captive-raised juvenile swift fox (37 per cent); and adult, wild, translocated swift fox from the USA (31 per cent). The reasons for these differences in 12-month survival rates calculated from the same data were not investigated.

Two conclusions were drawn from this spring versus autumn/captive-bred versus wild experiment. (1) The

government authorities concluded that captive-bred animals were less suitable for reintroduction than adult, wild, translocated swift foxes (Brechtel *et al.*, 1993). (2) The CEI concluded that captive-bred animals were effective in conservation terms, provided releases were conducted in the autumn. Of the two options, translocation and captive-bred reintroduction, the latter is generally accepted to be more effective provided there is a viable breeding population of captive animals. Captive-breeding supplements the remaining wild population, if such a population exists, whereas translocation only serves to move it around, often resulting in greater fragmentation of an already threatened species (Tudge, 1991).

Following this experiment, the reintroduction of captive-bred swift foxes continued at various release sites. From 1981 to 1984, the University of Calgary and the CWS were responsible for swift fox release

site selection (Carlington, 1980; Reynolds, 1983). On the other hand, government agencies were only responsible for releasing swift foxes onto the Canadian Prairies from 1985 to 1992. Their scatter-shot methods of site selection resulted in the distribution of small numbers of animals over large areas (Fig. 1). The aim of the National Recovery Plan for the Swift Fox in Canada was 'to establish a viable self-sustaining population, well distributed across suitable habitats on the Canadian Prairies which would result in the removal of the species from the endangered category by the year 2000' (Brechtel *et al.*, 1994; authors' italics). The hope was that a wide distribution of foxes would populate a larger area more quickly in compliance with the goals of the National Recovery Plan.

The release site selection was intended to result in swift fox occupancy of two large areas, one on the Alberta–Saskatchewan–Montana border and the other

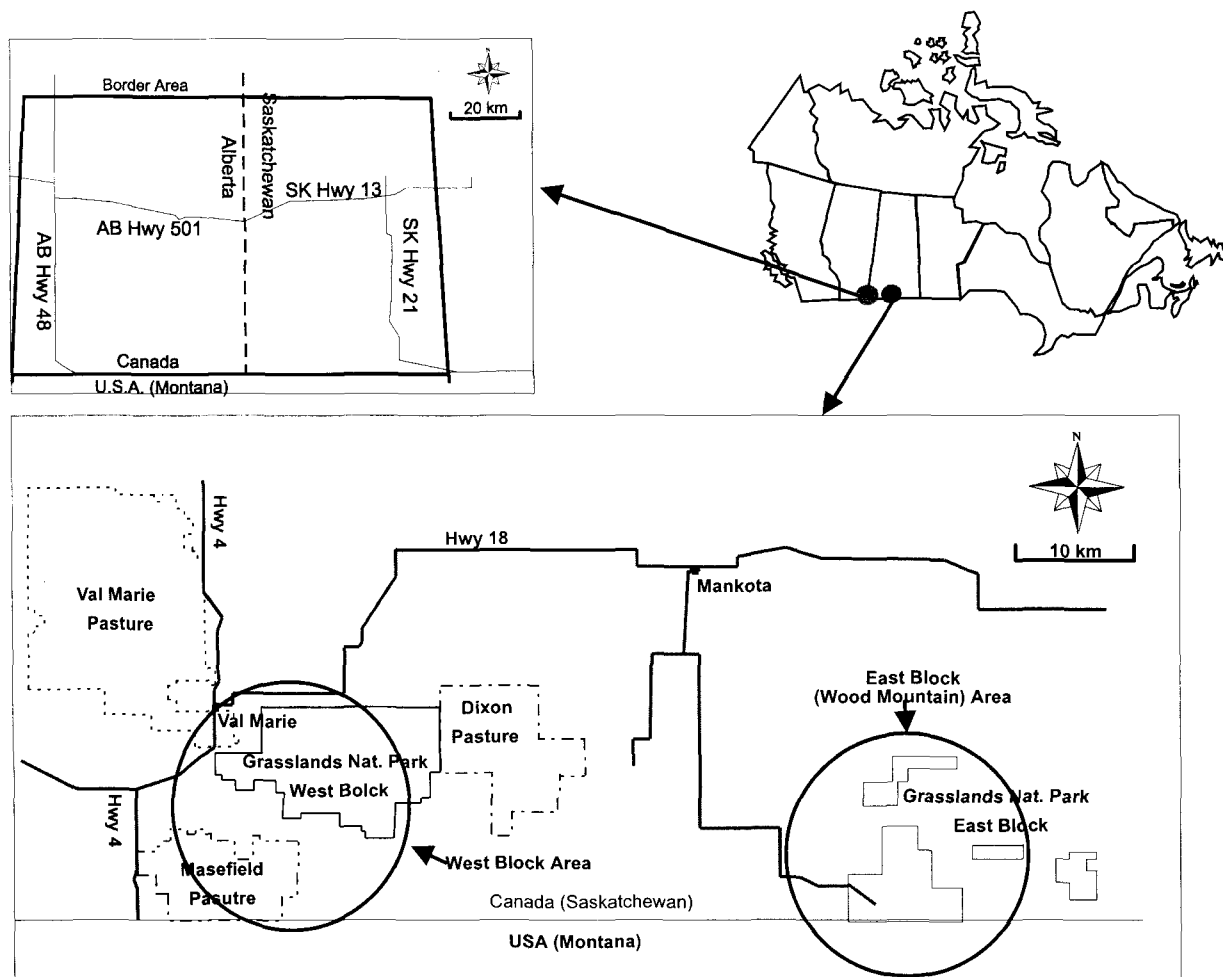


Fig. 1 The location of the primary release sites for the Canadian Swift Fox Reintroduction Programme.

in South Central Saskatchewan (Fig. 1). Prior study of both these populations was limited and of mixed success. From 1989 to 1991, the governments of Canada, Alberta and Saskatchewan released a total of 520 swift foxes in Canada. Of these, 122 captive-bred and 33 wild, translocated animals (29.8 per cent) were radio-collared and tracked for up to 2 years (Brechtel *et al.*, 1993). In addition, some winter scat and scent post surveys and spring (breeding season) trapping of swift foxes in the reintroduction sites were conducted (Carbyn, 1995). The western population established itself and appeared to increase slightly, but the eastern population did not appear to establish itself but shrunk from its original area. Speculation regarding the reasons for the lack of success in the eastern population varied from poor habitat to the lower survival rates of captive-bred animals (Hjertaas, 1994).

Release methods

Three specific release methods were used in the reintroduction programme:

1. University of Calgary—At the start of the programme (1983–85), swift foxes were released using the ‘soft release’ method. This consisted of constructing 3.7 × 7.3 m enclosures in the release site where pairs of swift foxes were over-wintered and kept until the following summer when the captive animals and their young, if any, were released. The animals in the enclosures had to be fed and watered. To reduce the travel time of the keeper, large amounts of meat were deposited in the enclosures. This method worked well for the swift fox because known recruitment outweighed known loss, but it was expensive in terms of equipment and staff time. Moreover, the feed provided to the swift foxes was considered to attract predators (Reynolds, 1983; Brechtel *et al.*, 1993).
2. Federal and Provincial Government—In 1985, the soft release method was changed to the ‘hard release’ method. Hard release consisted of transporting swift foxes, contained in small plastic kennels, to designated release sites and releasing them from the kennel onto the prairie. All sites were within 0.5 km of a road. No post-release monitoring was undertaken. The hard release method was cheap in terms of equipment and staff time; its rapidity meant that more animals could be released in a shorter period. The hard release method became the method of choice of the Swift Fox Recovery Team.

Using the hard release method, swift foxes were taken up at the breeding colony and placed in plastic transport kennels at least 2 days prior to

release. One day was spent trapping and kennelling captive-bred swift foxes intended for release. Swift foxes were captured either by a round-up method using many volunteers or were live-trapped. Once in their kennels, swift foxes were stacked in a holding area overnight. The following day, after receiving prophylactic inoculations and health checks by a veterinarian, they were transported to the release sites (a journey of between 8 and 10 h). On arrival at the release area, the kennelled animals remained stacked in the truck as it drove from site to site. This procedure could add a further 10 h to the time the animals spent in their kennels (up to 58 h in total) (Brechtel *et al.*, 1993).

3. CEI—In 1992, the CEI became involved with the field releases for the first time. The CEI considered that there were many questions of animal welfare associated with the hard release method, and that it was of vital importance that reintroduced swift foxes be encouraged to stay in the release sites during their initial period of acclimatization to the area. CEI involvement resulted in the development of the third release method using portable protective shelters (PPS). The CEI method had four components and was shown to reduce the stress on the transported swift foxes and to increase their initial survival in the field.
 - (A) Release site criteria—One week prior to the releases, sites were selected based on the following criteria: (a) evidence of swift fox activity (old den sites); (b) escape terrain (numerous burrowing animals’ holes); (c) proximity to water; and (d) a varied prey base. Predator activity was also noted. These criteria were developed from a survey of swift fox habitat in South Dakota (Smeeton, 1994).
 - (B) PPS—No more than 2 days prior to the actual release, a PPS was placed at each site. PPS design was based on the existing fox shelters at the CEI. The PPS A-frame is designed so it can be assembled *in situ* and the three-chambered fox box can be folded up and transported on a packboard. PPS are left at the release sites for a minimum of 4 days after the release.
 - (C) Release method—Swift foxes at the captive-breeding colony were tattooed and inoculated in their enclosures at least 1 week prior to the date set for release. The tattoos were applied with a Ketchum Tattoo Kit; males were tattooed in the right ear and females in the left ear. Numbering was sequential, beginning with 1 in 1972 and preceded with the letter ‘S’ (e.g. S122). All animals to be released were inoculated using Duramune DA2LP + P v (Canine

Table 1 Summary of the number of swift fox released in the East Block (Wood Mountain) and West Block areas of Grasslands National Park, Saskatchewan, Canada from 1990 to 1997

Year	Releases	
	West Block	East Block
1990		51
1991		75 (14)
1992	38	87
1993	24	11
1994	10	9
1995	16	9
1996	7	6
1997	26	51
Total	121	299

Number in parentheses indicates wild-caught, translocated animals.

Distemper—Adenovirus Type 2—Parainfluenza—Parvovirus vaccine (modified live virus) Leptospira Bacterin), and Imrab (rabies). The kits born in the captive-breeding colony were inoculated using Duramune at 4 weeks, then at 8 weeks, and immediately prior to release at 5 months. In addition, all kits were inoculated with Imrab immediately prior to release.

On the release date, the animals were trapped in the enclosures, loaded into individual plastic transport kennels and placed in the trucks intended for each release site. The loaded trucks left immediately for the release sites. On arrival at the designated sites, the kennels were set in a semicircle around the already situated PPS. After 20 min, the kennel gates were opened and the swift foxes allowed to come out in their own time. After the animals ceased to show any interest in the kennels, the kennels were removed.

- (D) Post-release monitoring—Volunteers monitored the swift foxes at the release sites on a continuous basis for the first 24 h. After the first 24 h, swift foxes were monitored on a daily patrol basis. Activities noted included movement, den preparation and hunting; fresh scat was collected in order to monitor initial hunting activity.

Reintroduction in South Central Saskatchewan

The reintroduction of swift foxes in South Central Saskatchewan began in 1990. The initial releases in 1990–91 were conducted as part of a government feasibility study (Brechtel *et al.*, 1993). During this period,

126 animals were released in the Wood Mountain area (Fig. 2). Of these, 14 were adult, wild, translocated swift foxes from the USA and 112 were captive-bred animals. All swift foxes were released using the hard release method. The government agencies continued to release swift foxes into the Wood Mountain area until 1997 (Table 1 and Fig. 2).

In 1991, the Canadian Federal Government (Heritage Canada) intensified the acquisition of land in Saskatchewan for the Grasslands National Park. When complete, the park will be the last and largest representation of the short and mixed grass prairie biome in North America. In other words, swift fox habitat will be preserved in perpetuity. At present, the Grasslands National Park is divided into East and West Blocks, bordered by government-owned grazing land and privately-owned ranches. The park shares its southern border with the state of Montana, USA, where most of the adjoining lands are owned by the Bureau of Land Management (BLM) Federal Grazing Land. The East Block encompasses some of the areas where the Wood Mountain releases took place. Until 1991, no releases had taken place in the West Block of the park.

In 1992, in an attempt to advance the reintroduction programme and to both answer some of the questions regarding the suitability of captive-raised animals for reintroduction as well as to explore more effective release techniques, the CEI began a co-operation programme with the Grasslands National Park. The West Block was chosen as a site where captive-bred animals only would be released. From 1992 to 1997, the CEI released captive-bred swift foxes into the West Block area using the PPS method only (Table 1 and Fig. 2).

In addition to the development and use of new release methods, the CEI in partnership with the Government of Saskatchewan began a series of monitoring studies of the southern Saskatchewan populations of swift foxes. These studies were intended to be non-intrusive, causing as little disturbance to the population as possible (CEI, 1994; Harris & McAdam, 1994; Longmuir, 1994; Michie, 1994a,b,c; Moehrensclager, 1994; CEI, 1995). The level of effort and type of monitoring used in these studies are presented in Table 2 and the results are summarized in Fig. 3.

Several problems were associated with the monitoring data, including variations in methods between studies, sampling during different periods of the year, and lack of co-ordination between government and non-governmental organizations (NGOs) in data collection. The data did, however, highlight some differences in animal distribution in the two release areas. Swift fox releases were more scattered in the East than the West Block. In the East Block, up to 1995, 242 swift foxes were released into 1187 sq km, resulting in a

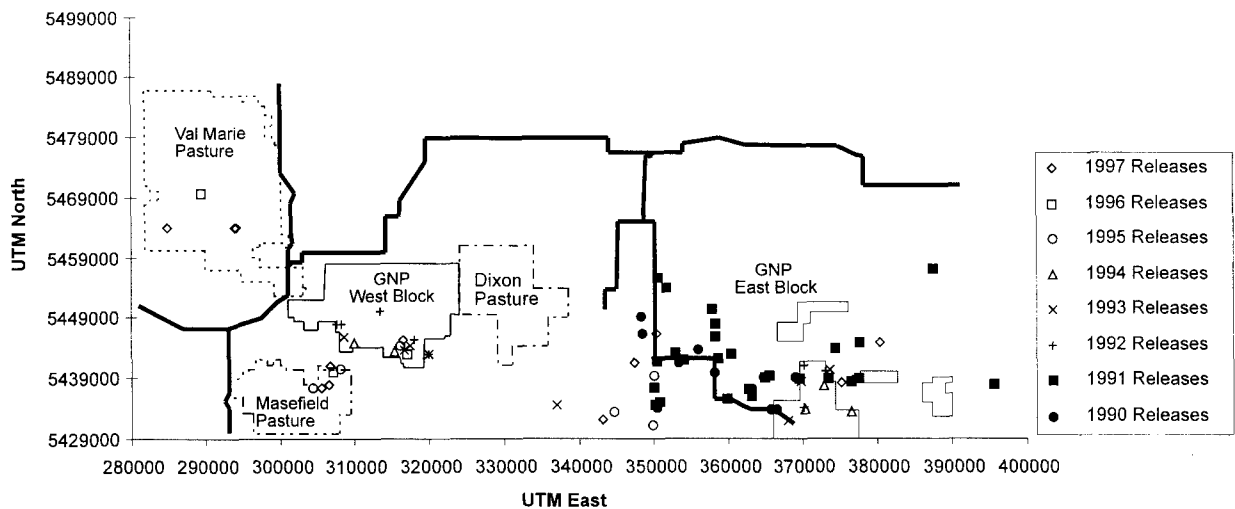


Fig. 2 Release sites locations for swift foxes in South Central Saskatchewan from 1990 to 1997 (locator system shown is the Universal Transverse Mercator Grid, Zone 12, North American Datum 1983).

release density of 0.204 fox per sq km. Meanwhile, over the same period in the West Block, 88 swift foxes were released into an area of 89 sq km, resulting in a release density of 0.989 fox per sq km. The monitoring data showed that by 1995 the population in the East Block occupied an area much smaller than the original release area. In contrast, the swift fox population in the West Block area expanded into new areas and maintained a population in the original release area as well. It was assumed that the swift foxes in the West Block were moving into areas of suitable habitat. The releases in the West Block from 1995 to 1997 showed similar movements as new releases were made into habitat that had been chosen by previously released swift foxes. Unfortunately, only one follow-up study to monitor populations has been conducted since 1995 (Cotterill, 1997).

The effectiveness of the PPS release method was still under review at the time of writing. Initial results are summarized in Table 3. Further evaluation of the methodology is necessary and is being carried out in conjunction with a new reintroduction project at the Blackfeet Reservation, Montana, USA. This study has the advantage of radio-collared swift foxes being released using the PPS method, with extensive post-release monitoring by graduate students.

In 1997, the governments of Canada, Saskatchewan and Alberta jointly planned and funded a winter trapping survey over what was perceived to be potential swift fox habitat in southern Saskatchewan and Alberta (Cotterill, 1997). In his analysis of the data, Cotterill combined the East and West Blocks of Grasslands National Park into one unit (Wood Mountain). The swift

fox density for this area was calculated to be 2.2 foxes per sq km, with a population of 87 individuals. These estimates were not particularly robust because of the methodologies and the number of captures. The main problem resulted from the assumption that the number of animals trapped from random sites could be extrapolated over a much wider area of unknown swift fox habitat potential. The assumption, that utilization of all habitat in the study is the same, could significantly over-estimate the population. It is interesting to note that two of the eight swift foxes trapped in the Wood Mountain area were captive-born, reintroduced animals and six were born in the wild. Population estimates for all the Canadian release areas were 289 individuals with a 95 per cent confidence limit of 179–412 individuals.

It has been demonstrated that the swift fox population in South Central Saskatchewan has been re-established, but the numbers in the wild are low making the survival of this newly established population uncertain. The reintroduction of swift foxes to the Canadian Prairie ended in 1997 because of a lack of financial support from the government. The target number of 420 individuals in the wild, as designated in the National Recovery Plan for the Swift Fox, has not been reached. The future of this unique project is, therefore, doubtful.

Conclusion

A century of habitat fragmentation and transformation has changed the status of the North American swift fox population from common, widespread and abundant,

to rare in the USA and extirpated from its range in Canada. The Canadian Swift Fox Reintroduction Programme attempted to re-establish the species in fewer than 14 years (1983–97). Over this period, the release of 841 captive-raised and 91 translocated swift foxes resulted in a change in classification by the COSEWIC (1998) from extirpated to endangered in Canada. Although the reintroduced swift foxes have shown—by

surviving, breeding and successfully raising their young in the wild—that their ecological niche still exists, it has not been established conclusively that the present swift fox population in Canada is now at a sustainable level.

The reintroduction of the swift fox into South Central Saskatchewan was accomplished over an 8-year period (1990–97). In this region, the release of 406 captive-

Table 2 Summary of the monitoring effort and methods in South Central Saskatchewan in 1994 and 1995

Source	Location		Night lighting (h)*	Scent post nights†	Days in field‡	Trap nights§
	West	East				
CEI (1994)	X				23	
Harris & McAdam (1994)		X		18	12	
Longmuir (1994)		X			7	108
Michie (1994a,c)	X		26	127	14	
Michie (1994b)	X				8	
Moehrenschlager (1994)		X	23.5	180	14	
CEI (1995)	X		31.75	390	64	
McAdam (1995)		X	52	242	37	
Stephens (1995)	X	X	18		13	
Effort	East Block		97.5	322	76	108
Summary	West Block		71.75	517	116	

* Represents the hours spent in the field, during this survey, examining systematically the roadsides for swift foxes with a 500,000 candle power spotlight.

† Total number of scent posts that were placed in the field, for a maximum of 3 nights at the same location, during this survey. Scent posts were baited with sardines and tracks were recorded with either smooth sand or smoked sheet metal.

‡ Total number of days spent in the field during the survey, used as an indicator of the level of effort.

§ Total number of nights that live traps were placed in the field during the survey.

East – East Block of Grasslands National Park and Wood Mountain; West – West Block of Grasslands National Park and surrounding area.

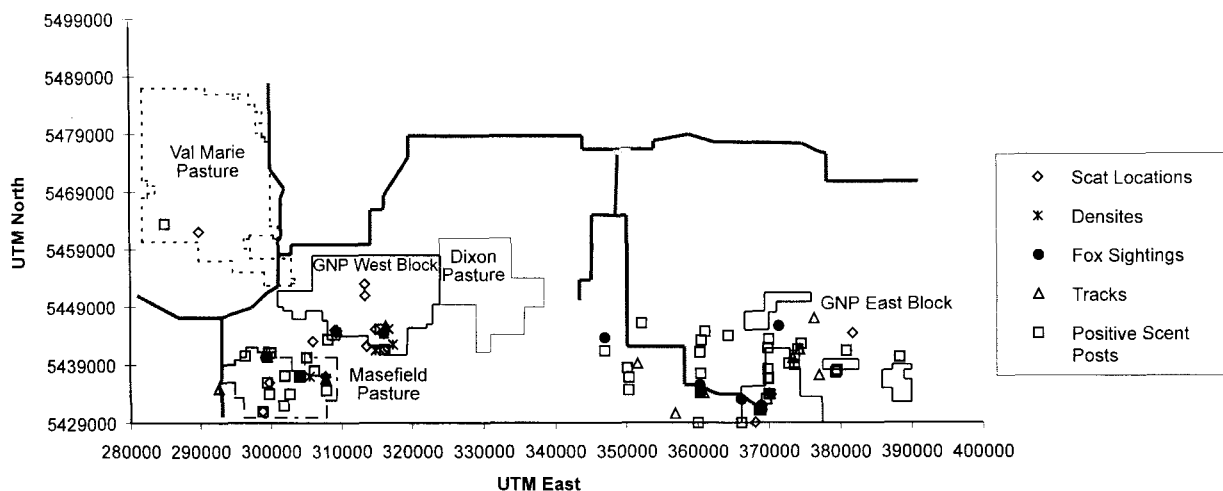


Fig. 3 The location of swift fox signs in South Central Saskatchewan. Data from the monitoring programmes in 1994 and 1995 are outlined in Table 2. The locations represent the distribution of swift fox as a result of the reintroduction programme from 1991 to 1995 (locator system shown is the Universal Transverse Mercator Grid, Zone 12, North American Datum 1983).

Table 3 Summary of the post-release observations for swift foxes released in the Grasslands National Park using the PPS method from 1993 to 1995

Year	No. foxes released	Initial reaction			Use of A-frame			Swift foxes observed at 7 days
		Bolted	Entered PPS	Investigated area	24 h	48 h	72 h	
1993	16	12	4	0	11 (69)	4 (25)	No data	No data
1994	19	8	0	11	4 (21)	3 (16)	3 (16)	6 (31)
1995	23	2	17	0	21 (91)	13 (56)	8 (35)	9 (32)

Percentage values are given in parentheses.

raised and 14 translocated swift foxes resulted in an estimated population of 87 individuals by 1997. Associated with these releases were the development of new release methods (notably PPS) and the inclusion of releases in the newly created Grasslands National Park. Although results indicate that the swift fox population has established in this area, more monitoring is necessary to determine whether it is at sustainable levels.

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Biographical sketches

Clio Smeeton has worked with animals and conservation issues since 1964 when she became Curator of the Children's Zoo at Calgary Zoo, Canada. In 1971, she jointly established, with Miles and Beryl Smeeton, the Wildlife Reserve of Western Canada (now the Cochrane Ecological Institute (CEI)). At the CEI, she has been involved in a wide range of activities, including the breeding of endangered species for reintroduction, the rehabilitation and release of orphaned wildlife, and environmental research and education. The CEI has contributed to the protection and reintroduction of North American bison, trumpeter swans and the swift fox. Clio Smeeton is currently working on a swift fox reintroduction project in the Blackfeet Indian Reserve, Montana, USA.

Ken Weagle began his career in environmental science and management as a student in New Brunswick, Canada, where he worked on the impacts of DDT on aquatic organisms and fish. Since then, he has worked extensively in Canada, the USA and internationally on the management of water-related environmental issues. In 1993, Ken Weagle became the Director of Scientific Programs at the Cochrane Ecological Institute. He is also the Executive Director of the Mackenzie Valley Land and Water Board, which is currently implementing a new system of community-based environmental and resource management in Canada's Northwest Territories.