

THE FEASIBILITY OF REINTRODUCING  
THE SWIFT FOX  
TO SOUTHWESTERN MANITOBA

By

John H. Pattimore

A Practicum Submitted  
In Partial Fulfillment of the  
Requirements for the Degree,  
Master of Natural Resources Management

Natural Resources Institute  
The University of Manitoba  
Winnipeg, Manitoba, Canada  
R3T 2N2

August, 1985

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## ABSTRACT

The primary objectives of the study were to determine the feasibility of reintroducing the swift fox to southwestern Manitoba and to determine how to carry out a reintroduction. The research included a literature search, a visit to the southeastern Alberta swift fox reintroduction site, a habitat survey in southwestern Manitoba and a public attitude survey. Two study areas, the Shilo Military Reserve (Shilo) and the Ellice-Archie Community Pasture (EACP) were examined and compared. The habitat quality of the two study areas, including prey base, den-site availability and security against human disturbances, was compared using release-area selection criteria developed from the literature. As a result of this comparison reintroduction was deemed to be feasible. Shilo Military Reserve was chosen as the release area based on the selection criteria. Public attitude in both study areas was in favour of swift fox reintroduction. A reintroduction process, release strategy and an action plan were recommended.

## ACKNOWLEDGEMENTS

The following people and organizations deserve recognition and thanks for their contributions to this project. Dr. Merlin Shoemith, Chief of Biological Services, Wildlife Branch, Manitoba Department of Natural Resources secured funding and provided equipment and logistical support during the project. Dr. Robert Wrigley, Museum Director and Curator of Mammals and Birds and Jack Dubois, Assistant Curator of Mammals, both of the Manitoba Museum of Man and Nature, advised on the method and provided equipment for the small mammal trapping program. Dr. J.I. Romanowski, Department of Geography, University of Manitoba gave support and advice to me during my graduate studies. The practicum committee comprised of Dr. Shoemith, Dr. Wrigley, Dr. Romanowski and Professor Henley reviewed practicum drafts and gave valuable critical comment toward its improvement and completion.

The faculty and staff of the Natural Resources Institute provided funding, guidance and support services throughout my graduate program. Hal Reynolds and Joanne Reynolds, Canadian Wildlife Service, Edmonton, were a great help during the Alberta field trip.

Thanks are also due to the Canada Department of National Defence, Shilo and the Prairie Farm Rehabilitation Administration, Regina for permission to conduct the research on the Military Reserve and EACP respectively.

I was honored to receive funding from the World Wildlife Fund and the Manitoba Naturalists Society. Their participation alongside government and the university made this project an example of cooperative research which is particularly important in regard to endangered species.

A very special thanks is due Nellie Dale, my wife, for her support, tolerance and advice. Her excellent typing skills are also acknowledged.

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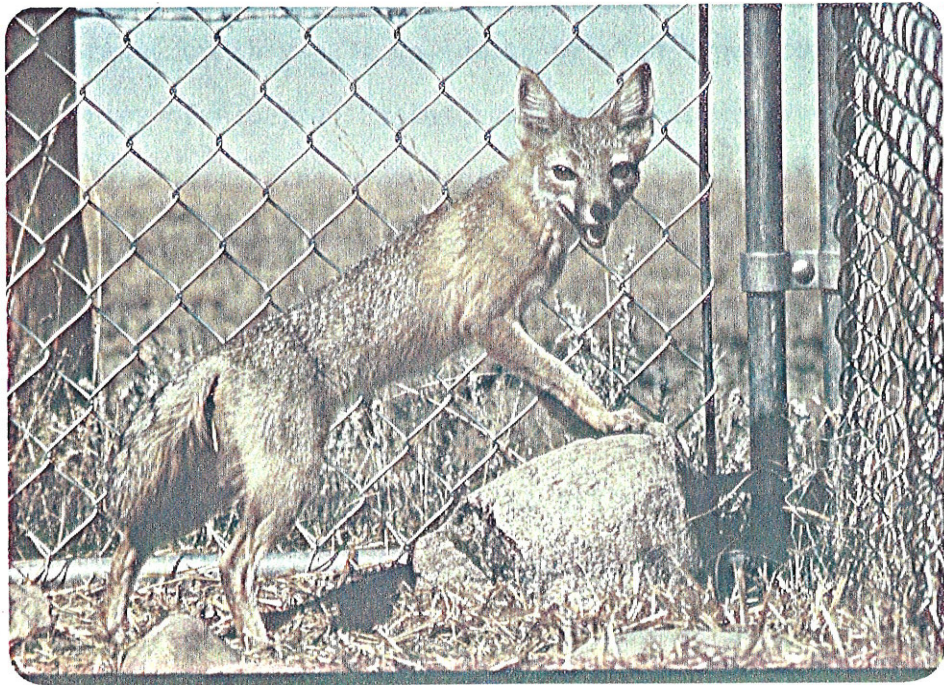
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Figure 1. A swift fox in a holding pen awaiting release to the wild at Lost River Ranch, Alberta (Credit: Miles Scott-Brown).



CHAPTER 1.0  
INTRODUCTION

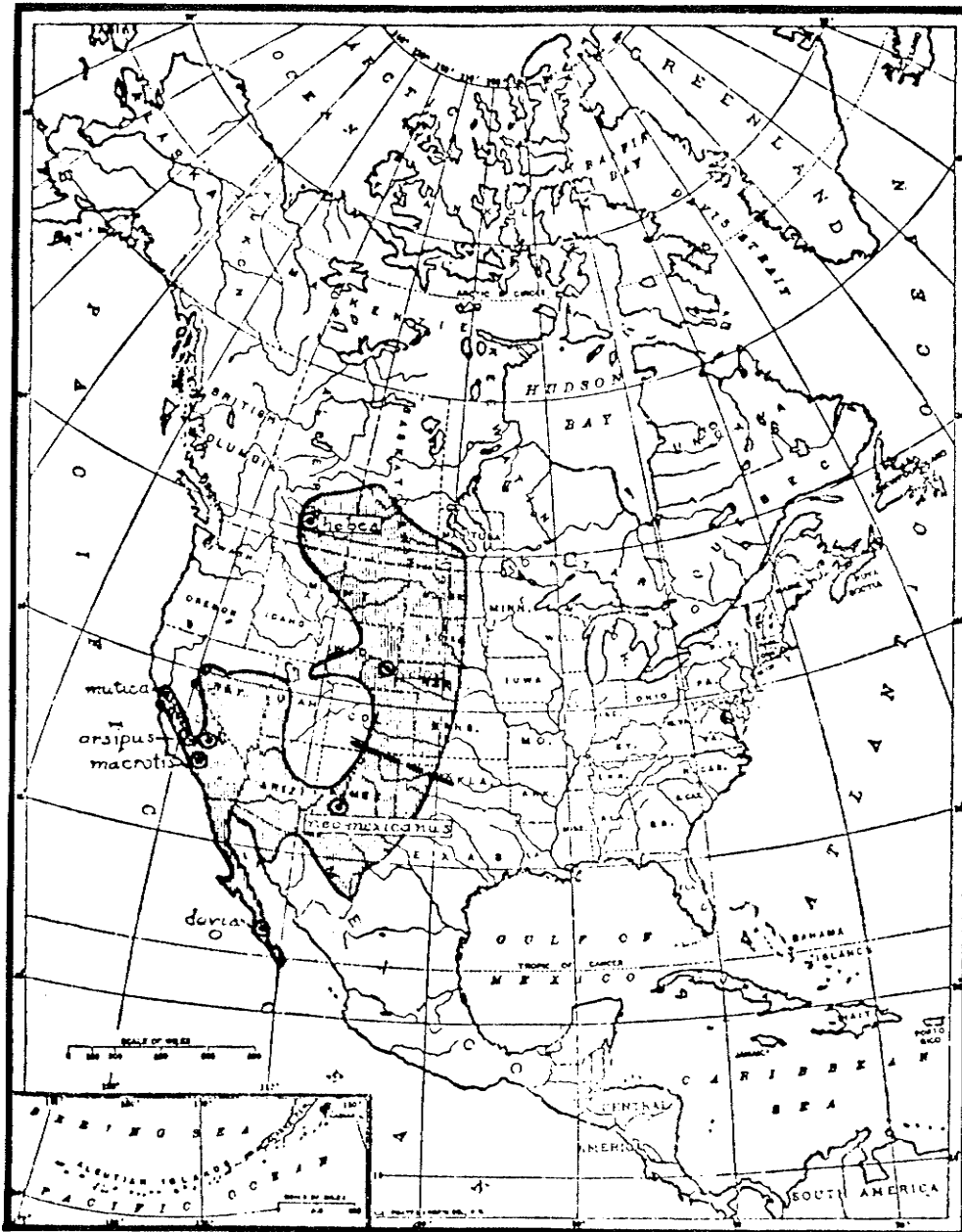
1.1 Preamble

The swift fox (Vulpes velox) is a diminutive species of fox native to the North American plains as shown on Map 1 (Seton, 1925). The Canadian range of this pale yellow to greyish brown fox included the southern prairies of Alberta, Saskatchewan and southwestern Manitoba. The swift fox was extirpated from Manitoba around the turn of the century and later in Alberta and Saskatchewan (Seton, 1925). Wild populations remained in North Dakota, South Dakota, Montana, Nebraska, Colorado, Wyoming and Kansas (Hillman and Sharps, 1978; C.W.S., 1982).

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated the swift fox as extirpated (C.W.S., 1982; Russell, 1982). In the United States, within its geographical range, it is not classified in some states while in others it is listed only as rare. Despite an apparent comeback in some states, land-use changes resulting in habitat loss may yet reduce its numbers to the point where the swift fox's survival may be threatened.

The demise of the swift fox on the Canadian Prairies has been attributed to agricultural practices which reduced or destroyed the fox's habitat, as well as to indiscriminate poisoning directed at coyotes (Canis latrans) and gophers. Trapping and hunting may have been factors

Map 1. The historical ranges of the Swift Fox (*Vulpes velox hebes* and *velox*) and the Desert (Kit) Fox (*Vulpes velox macrotis*).



Source: Seton, 1925

See also Maps 2 and 3.

in reducing swift fox populations but probably to a lesser degree (D.T.R.R., 1978; Russell, 1982). Now various government agencies and private groups are working to reverse the historic process. Russell op. cit. states: "The ultimate aim of all parties involved is that the swift fox will become well enough established within several regions of the prairie provinces to permit its removal from the endangered species list."

In Alberta work toward this end began in 1973. In that year a local couple, the Smeetons, started a captive swift fox breeding program near Cochrane, Alberta to help ensure survival of the species. Since then the Faculty of Environmental Design, University of Calgary and the Canadian Wildlife Service have attempted to use progeny from the breeding stock for reintroduction to the wild at release sites in southern Alberta. The World Wildlife Fund (Canada) has provided funds for reintroduction. The Canadian Wildlife Service encouraged expansion of the program to Saskatchewan and Manitoba (Russell, 1982). The swift fox remained classified as extirpated in Canada until September 1983, when several pairs of captive-bred animals were released to the wild in southeastern Alberta.

As of June 28, 1985 (Carbyn, 1985) this release was considered a qualified success. Three individuals are still being monitored by radio telemetry. Of the three, two formed a breeding pair which have been observed to have built their own den. The other is a single female. Although some mortality was observed some released foxes are unaccounted for and may have bred and successfully raised litters. More reintroductions are planned for this summer (Carbyn, op. cit.).

The summer 1984 release in southwestern Saskatchewan was deemed less successful. Less contact has been maintained with any of the released foxes. It is thought that the "harder" release strategy used in Saskatchewan (ie. no feeding of live prey during holding) coupled with a drought may have caused problems for the swift foxes in finding adequate prey (Carbyn, op. cit). CPRC (1985) reported that additional releases of male swift foxes were made in late 1984 when an initially released pair failed to form a breeding relationship. It was hoped that one of the newly released males would breed with the unattached female to produce a spring 1985 litter (CPRC op. cit.). More reintroductions are planned for Saskatchewan this summer (Carbyn, op. cit.).

### 1.2 Problem Statement

A fundamental ecological problem exists when man's activities have caused the extirpation or extinction of any other species of animal or plant. Such was the case for the swift fox in Canada. Extirpation is, however, sometimes reversible. The swift fox reintroductions in Alberta and Saskatchewan were attempts at such a reversal and at solving an ecological problem.

The feasibility of reintroducing the swift fox to southwestern Manitoba was the focus of this research. The research problems to be solved are outlined below as objectives.

### 1.3 Research Objectives

The following research objectives were pursued to address the

two problems:

### 1.3.1 Ecological Feasibility

- a. To review the ecology of the swift fox where it still exists in the wild and to determine its habitat requirements and relationships.
- b. To survey several Manitoba areas and to determine habitat availability and quality for a potential reintroduction.
- c. To identify present and potential land uses in or near the study areas and to determine possible inter-relationships between swift foxes and land uses.
- d. To determine the ecological feasibility of a reintroduction by comparing Manitoba research findings to the known ecology of the swift fox elsewhere.

### 1.3.2 Social Feasibility

- a. To survey the attitudes of local residents in the study areas toward the reintroduction of the fox.
- b. To inform the public about the swift fox project.

### 1.3.3 Reintroduction Process

- a. To select potential release sites.
- b. To develop an appropriate reintroduction process and release strategy.
- c. To determine the most appropriate techniques for releasing, monitoring and managing the swift foxes.



- d. To develop a format for an education program to support the reintroduction.

CHAPTER 2.0  
LITERATURE REVIEW

2.1 Introduction

. . . a plea for diversity--for the preservation of natural diversity and for the creation of man-made diversity in the hope that the prevailing trend toward uniformity can be arrested and the world kept a fit place for the greatest possible human variety.

(Dasmann, 1968)

The swift fox is the least known of the plains carnivores (Kilgore, 1969). This fact became evident during the early stages of research for the Manitoba Swift Fox Project. Many people were not familiar with the species and were not aware it had once inhabited parts of the province. Furthermore, the idea of reintroducing the swift fox to parts of its former range in Canada raises the important question . . . Why attempt it? Part of the answer centers around the concept of protecting the stock of endangered species and of natural diversity (Pimlott, 1974; Jenkins, 1976). Another part has to do with benefits to landowners if the swift fox population survives in the release area.

The most important reason for a reintroduction is that the swift fox is rare even in its present range in the United States and may become endangered there if steps are not taken to protect habitat and to establish new populations. Jenkins (1976) stated more emphatically; "Reduction in ecological diversity is detrimental to our

own long and short range interest." He discussed in some detail the importance of diversity, summarized as follows:

- a. Each biological species has unduplicated attributes which may cause it to play a unique role . . . as an ingredient in the food chain or participant in other relationships. The role is often unclear so that in case we need these attributes we would be prudent to retain as many of the species as possible.
- b. Each species is a unique biochemical factory which may at some time prove to be a renewable resource of practical significance in scientific research and pest control.
- c. Associations of species (plant and animal communities) are important resources. As interacting, coexisting entities communities are examples of healthy, local ecosystem function. They may serve as experimental controls, design models or material reservoirs and in this regard could improve our management of resources in contrived ecosystems or help us restore ecosystems we have previously destroyed (ie. a forest containing harvestable timber is such a community).
- d. There is almost certainly a human psychological need for recreational benefits as found in natural landscapes. Diversity in natural recreation areas is therefore a desirable characteristic for human enjoyment.

These ideas may be thought of as a description of the uses man can make of diversity. The view of diversity as useful is supported if we consider the role that the swift fox might play in our environment.

For example, as part of the food chain the swift fox is a useful predator in controlling agricultural pests such as mice and gophers. As a renewable resource the swift fox could be trapped for its fur. Seton (1925) reported low prices and suggested that the pelts were of low commercial value. However Moore and Martin (1980) reported 300 swift fox pelts taken from Colorado in 1978-79 indicating that at least some value is now attached to this fur. Of course this activity would only be possible if the swift fox population thrived and

increased significantly in numbers. A third example is that, in relation to recreational benefits on natural landscapes, most people enjoy wildlife sightings, especially those involving predators. Adding another predator to the fauna of a natural area would increase the potential for sightings by visitors to these places.

However there is another view of why diversity should be maintained by saving or reintroducing endangered or extirpated species. Quite apart from the potential usefulness of the swift fox we must also consider valuing the worth of animal species, besides man, in other terms. The evolutionary history of many animal species on earth is as long or far longer in many cases than that of man. Whether one has strong spiritual convictions, attributes rights to non-human animals or simply believes that existence is a value, clearly animals must continue to occupy their natural place on this earth.

These answers to the question "why reintroduce the swift fox" are the conceptual framework for a swift fox reintroduction. However, maintaining diversity is also the basis for government and private conservation programs. As both federal and provincial legislators have acknowledged this, there is a legislative framework within which a reintroduction would occur. Both the federal and provincial governments have an interest in endangered species. The Canada Wildlife Act, 1973 includes a section which refers to endangered wildlife:

9. The minister may in cooperation with one or more provincial governments having an interest therein, take such measures as he deems necessary for the protection of any species of non-domestic animal in danger of extinction. (21-22, p. 376).

The Manitoba Wildlife Act, 1980 also includes a section on endangered species:

Preservation of endangered species.

7. The Minister may, by regulation, declare any species or type of wildlife or any aggregation of a species or type of wildlife to be an endangered species or an endangered aggregation, as the case may be, and may, by regulation,

- (a) prohibit or restrict the hunting, taking, killing or possession of the species or aggregation or any member thereof by any person;
- (b) prohibit or restrict the entry by any person into an area of the province specified in the regulation where, in the opinion of the minister, any habitat of the species or aggregation is or is likely to be located;
- (c) prescribe other prohibitions or restrictions or measures, to be observed or implemented, for the preservation of the habitat of the species or aggregation and for the survival thereof.

S.M. 1980 c. 73, s. 7.

Both pieces of legislation make provision for the acquisition of lands for wildlife conservation and for the restriction of entry into the lands generally or according to the purpose and duration of certain land uses.

While the conceptual and legislative frameworks facilitate reintroducing the swift fox from the socio-economic point of view, environmental factors, the ecology of the swift fox and of the study areas, must also be considered.

## 2.2 Swift Fox Ecology

A review of the literature on the ecology of the swift fox forms the basis on which to assess the quality of the study area habitats and the interspecific relationships.

### 2.2.1 Taxonomy

Carlington (1980) presented the following discussion of swift fox taxonomy:

"The American Society of Mammalogists' Committee on Vernacular Names for North American Mammals has recommended that the name "kit fox" should be reserved for Vulpes macrotis, and its subspecies, whereas the common name "swift fox" should apply only to Vulpes velox, and its subspecies (Hall, Anderson and Packard, 1957; Jones, Carter and Genoways, 1975). Some of the common names that have been applied to the swift fox, V. velox, are as follows:

the prairie kit fox (Soper, 1964), the swift fox (Kilgore, 1969), the northern kit fox (IUCN Red Data Book, 1969), prairie fox (Rand, 1948), and the swift kit fox (Thornton and Creel, 1975). The fox that occurred in Canada was the northern subspecies of the swift fox, V. velox hebes (Merriam, 1902); type locality: Calgary, Alberta (U.S. National Museum Bull. #205).

There has been some doubt in the past as to whether the swift and kit foxes are in fact separate species, or conspecifics (Blair et al, 1968). Rohwer and Kilgore, in a 1973 study, maintain that while some hybridization occurs between V. velox and V. macrotis in an area of sympatry in west Texas and eastern New Mexico, the evidence indicated that since only occasional interbreeding occurred, specific status for both forms was justified. Thornton and Creel (1975) compared the two forms on the basis of pelage colouration, serum proteins, hemoglobins, karyo-types, ear size and position, eye, and head shapes. No difficulty was encountered in differentiating V. velox from V. macrotis. They further main-

tain that there was no evidence to indicate any gene exchange between the two taxa, and they suggested that the two taxa might be parapatric, rather than allopatric, in their Texas distribution. While a great deal of further study was called for, they recommended that both taxa be afforded specific status.

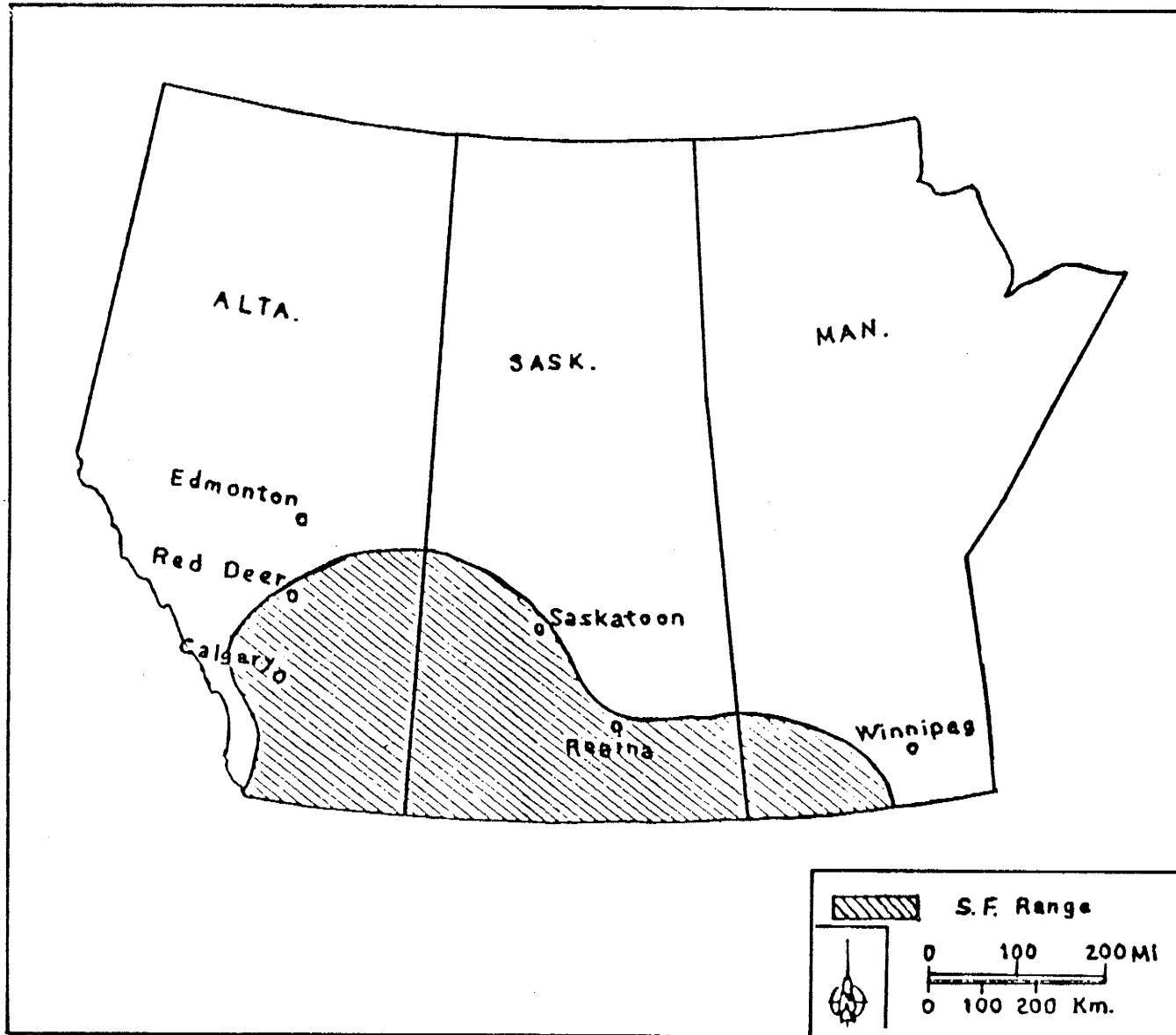
The northern race or subspecies, V. v. hebes, which occupied the Canadian portion of the species' range, is distinguished as being larger and slightly greyer than the southern race, V. v. velox, "... with the dark patches on either side of the snout being darker, the skull larger and heavier, the under-jaw longer, heavier, and more bellied under the sectorial tooth..." (Merriam, 1902).

While the southern race, V. v. velox, is not considered to be in any danger, the northern race, V. v. hebes, is considered extinct in Canada, and endangered in the United States (Endangered Species Act Regulations, FSF/LE ENF 4-REG-17)."

### 2.2.2 Occurrence and Status

Historically the swift fox inhabited most of the Great Plains of North America. Map 2 and Map 3 show the former North American range of the swift fox, which now has extirpated status in Canada. Most researchers agree that the present United States range is much smaller. They also suggest that numbers dropped in the early and middle 1900's (Bailey, 1926; Hoffman et al, 1969; Moore and Martin, 1980). For North Dakota Bailey (1926) reported that swift foxes formerly covered all of the prairie areas of the state. At the time of his writing the species was restricted to only the western part of the state. Subsequently Pfeifer and Hibbard (1970) provided a record of the species in southwestern North Dakota, the first in 50 years. There were no recent records from South Dakota (Pfeifer and Hibbard, 1970). However, Van Ballenberghe (1975) suggested there was a

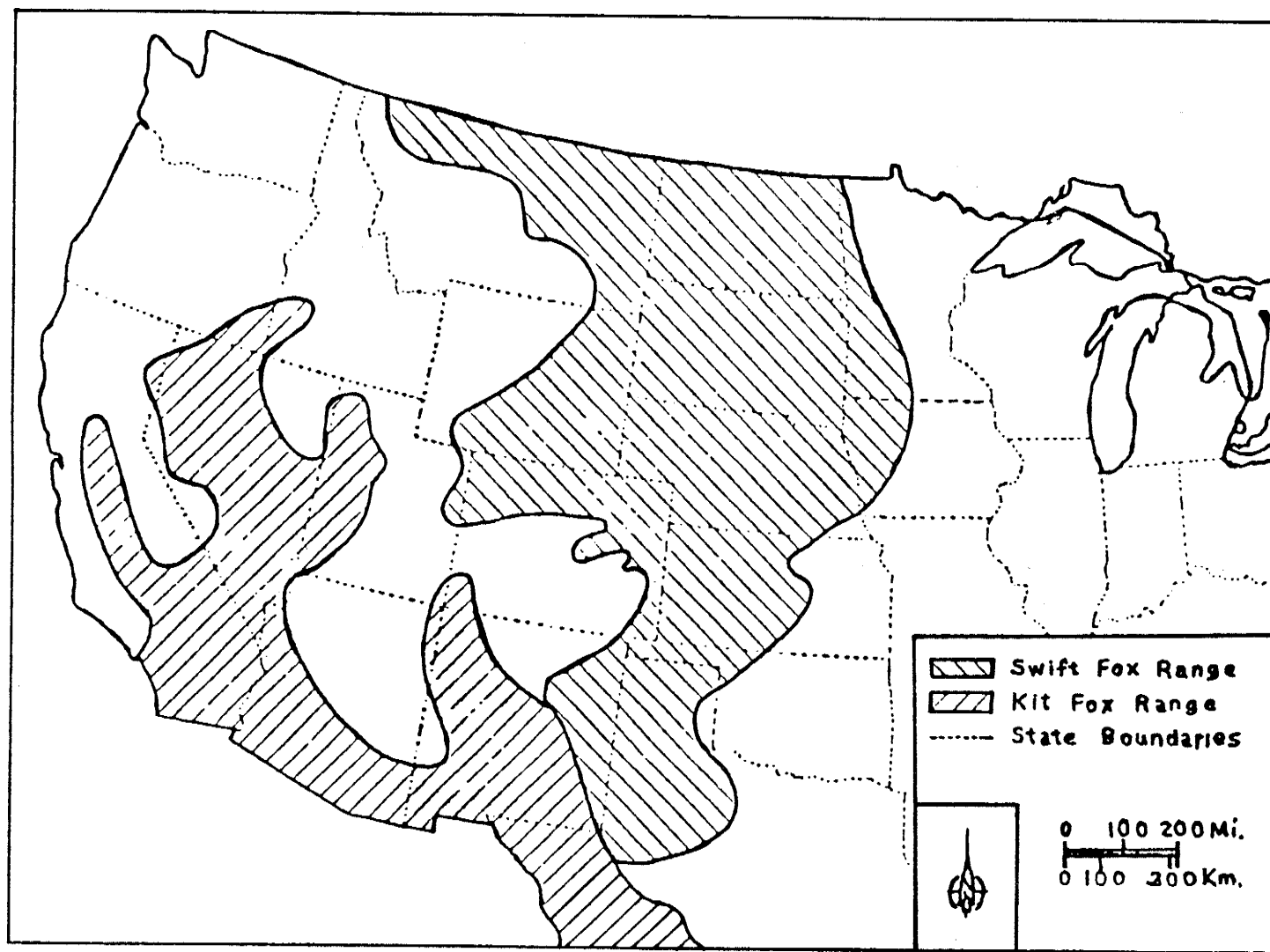
Map 2. Historical range of the swift fox in Canada (pre 1900).



Source: Carlington, 1980



Map 3. Historical ranges of swift and kit foxes in the United States (pre 1900).



Source: Carlington, 1980

small but expanding population starting with a record from east of the Missouri River. He theorized that the fox's absence for the last 60 years and then new records indicated an influx from the Nebraska Sand Hills.

Pfeifer and Hibbard (1970) maintained that swift foxes were increasing in the southern part of their range. There is evidence to support this view. In the five years previous to Pfeifer's and Hibbard's record the swift fox was reported for Nebraska (Blus, et. al., 1967), for Colorado (Robinson, 1961; Miller and McCoy, 1965), and Wyoming (Long, 1965). For Montana, Hoffman, et. al. (1969) reported the species extinct. A more recent record from Montana (Moore and Martin, 1980) changed the Montana status from extirpated to threatened. In Wyoming, numbers may have increased since 1965. Floyd and Stromberg (1981) reported that since November, 1970, 21 swift foxes were trapped in Laramie County, Wyoming. These reports document the present United States distribution of the species. There are few data on the abundance of the animal except that the reports of recent occurrences may indicate an increase in fox numbers. Kilgore (1969) and Floyd and Stromberg (1981) contended that population increases may be due to less intense and different methods of predator control and declining numbers of small farms and ranches.

Seton (1909, 1925) documented the historical abundance of swift foxes in Manitoba. He noted the observations of Alexander Henry who traded along the Red River in 1800-08. Henry received 57 swift fox pelts in the 1804-05 trapping seasons. The swift fox was formerly found in the Pembina Hills and west to the Souris River (Seton, 1909).

Seton (1925) quotes from Dr. E. Coues's 1873 observation that swift foxes were common along the Souris at the Boundary Trail. The Canadian Government Fur Lists included the swift fox as "Fox, other" and recorded about 600 pelts taken chiefly from Alberta from 1919-1922. Seton (1925) concluded that the species was extinct by this time in Saskatchewan and Manitoba. Admittedly, Seton only wrote about the records and observations of others not having seen the swift fox himself. It is possible that the observations along the Red and Souris Rivers and in the Pembina Hills may not have actually been in Manitoba. It is also possible that the furs collected by traders may have been from elsewhere. There are no museum specimens of the swift fox collected in Manitoba that would support the historical records and absolutely place this fox in Manitoba. However, given the existence of the prairie habitat in Manitoba and populations of the swift fox in North Dakota (Map 3) it is highly probable that healthy populations of swift foxes did indeed occur historically in southwestern Manitoba. It is even possible that occasionally swift foxes have extended their range north from North Dakota and Montana into Manitoba and Saskatchewan and that this has not been absolutely documented either.

### 2.2.3 Habitat Requirements

Habitat must provide species' requirements for both sexes, all ages, all seasons and all activities (King, 1938). King further groups habitat requirements into two categories:

- a. essentials -- food, water, coverts, juxtaposition and interspersion.

- b. extraeities -- occur on every range; poaching/hunting, predation, disease, parasitism, hazards.

These concepts are very much applicable today (Bailey et. al., 1974). The best wildlife range has all species requirements within the species' cruising range (ie., juxtaposition) and food, water and cover are interspersed throughout the range so that each unit of range can produce its share of the total maximum population (ie., species saturation point) (King, 1938). Minimum home ranges of swift foxes were reported by Reynolds (1983) to be 175 ha for males and 85 ha for females.

Kilgore (1969) and Wrigley (1974) both discussed the prairie range that is preferred by the swift fox. Short-grass and mixed-grass plains of a relatively dry, rolling nature are ideal habitats. However due to agricultural activities in most of its present range, the swift fox inhabits cultivated fields and short-grass pastures (Kilgore, 1969). Kilgore also stated that unlike red foxes (Vulpes vulpes) and coyotes (Canis latrans) the swift fox uses underground dens all year round. Seton (1925) suggested "the swift fox is strictly a prairie animal, harbouring in burrows and never venturing far from them."

Wrigley (1974) described the plant associations of the Carberry Sandhills and categorized the mammalian species according to the various habitats. Table 1 is derived from these data and correlates the plants and mammals thus describing the habitat formerly occupied by the swift fox in Manitoba.

Table 1. Prairie plant and mammal associations in swift fox habitat.

Xeric Mixed-grass Prairie	Species List
<u>Stipa spartea</u> - spear grass <u>S. comata</u> - spear grass	<u>Clethrionomys gapperi</u> -redbacked vole <u>Microsorex hoyi</u> - pigmy shrew <u>Lepus townsendii</u> - white tailed jack rabbit
<u>Bouteloua gracilis</u> -blue grama grass <u>Koeleria cristata</u> - june grass	<u>Eutamias minimus</u> - least chipmunk <u>Spermophilus tridecemlineatus</u> - 13 lined ground squirrel
<u>Andropogon scoparius</u> -little blue stem <u>Juniperus horizontalis</u> - ground juniper	<u>Thomomys talpoides</u> - northern pocket gopher
<u>Astragalus caryocarpus</u> -buffalo bean <u>Artemisia spp.</u> - sage	<u>Microtus pennsylvanicus</u> -meadow vole <u>Peromyscus maniculatus</u> -deer mouse <u>Onychomys leucogaster</u> - northern grasshopper mouse
<u>Arctostaphylos uva-ursi</u> -bear berry	<u>Microtus ochrogaster</u> -prairie vole <u>Mus musculus</u> - house mouse <u>Zapus princeps</u> - western jumping mouse <u>Perognathus fasciatus</u> - olive-backed pocket mouse
Mesic Mixed-grass Prairie	Species List
All plant species from Xeric Prairie and: <u>Solidago spp.</u> - goldenrod <u>Anemone cylindrica</u> - thimbleweed <u>Anemone patens</u> - prairie crocus <u>Rosa spp.</u> - prairie rose	<u>Sorex cinereus</u> - masked shrew <u>Spermophilus tridecemlineatus</u> - 13 lined ground squirrel <u>Thomomys talpoides</u> - northern pocket gopher <u>Peromyscus maniculatus</u> - deer mouse <u>Clethrionomys gapperi</u> -redbacked vole <u>Zapus hudsonius</u> -meadow jumping mouse <u>Microtus pennsylvanicus</u> -meadow vole <u>Microtus ochrogaster</u> -prairie vole <u>Zapus princeps</u> - western jumping mouse
	<u>Spermophilus richardsonii</u> -Richardson's ground squirrel <u>Perognathus fasciatus</u> - olive-backed pocket mouse

Adapted from: Wrigley, 1974

#### 2.2.4 Food Habits

Seton (1925) mentioned that swift foxes in Alberta preyed largely on mice and that they were adept at catching prairie chickens (Tympanuchus cupido). Kilgore (1969) analysed the contents of swift fox scats and stomachs and found that mammals, birds, amphibians, reptiles, invertebrates and plant material all form part of the swift fox's diet. Table 2 indicates the relative proportions of food items.

Although insects are a frequent food source they do not constitute the bulk of the diet. Mammals, however, do make up a large proportion of the biomass consumed, especially in spring and autumn (Kilgore, 1969). Cutter (1958b) and Kilgore (1969) both found jack rabbit (Lepus townsendii) making up the largest proportion of mammalian food. These authors suggested that some carrion is taken as well. Rodent remains in the scats of swift foxes correlated with their occurrence measured by a trapping program, suggesting that swift foxes prey on species in proportion to their availability and are not selective. Birds were the second largest food item (in biomass) consumed. The meadow lark (Starnella neglecta) and horned lark (Eromophila alpestris) were most common. Plant material in scats may be accidental but possibly it is used under special circumstances (Kilgore, 1969).

#### 2.2.5 Denning

Seton (1925) suggested that the swift fox was the most subterranean of foxes. Cutter (1958a) found 26 dens, 2 of which were in ploughed fields. Kilgore (1969) found 35 dens of which 16 were

Table 2. Contents of swift fox scats.

ITEM	number of occurrences	% of occurrences
Mammals		
- <u>Lepus</u> sp.	33	6.8
- Rabbit (unidentified)	104	21.1
- <u>Perognathus</u> sp.	38	7.7
- <u>Peromyscus maniculatus</u>	47	9.6
- Rodents (unidentified)	39	8.0
Birds total (Horned lark, meadowlark)	190	38.9
Reptiles total	38	7.7
Invertebrates		
- Orthoptera	393	80.5
- Coleoptera	331	67.8
Plant Material		
- Grasses	151	30.9
- Seeds	17	3.4

Adapted from: Kilgore, 1969

located in cultivated fields, 15 in short-grass pastures and the remainder in other man-made habitats. Generally dens are located in open, sparsely vegetated habitats on sloping plains and well-drained locations with a 5-30 cm-high mound of earth extending from the entrances (Cutter, 1958a).

Dens of swift foxes are excavated by the foxes themselves and are not renovated badger (Taxidea taxus) or coyote dens. Dens in short-grass pastures tended to have more entrances, generally with a diameter of 20 cm. The branched tunnels lead to one or more den chambers from 60 to 100 cm below the ground surface (Cutter, 1958a; Kilgore, 1969).

#### 2.2.6 Breeding

Swift foxes have only one litter annually, with 4 to 6 young being most common (Seton, 1925; Cutter, 1958a). Mating probably takes place in late December or early January, with young born in March or early April. However, Kilgore (1969) also suggested that exact mating periods and length of gestation are not well known. The whelps may stay with the family group until August and breed the following winter.

#### 2.2.7 Interspecific Relationships

As a predator primarily on small mammals, birds and insects, the swift fox likely plays a role in population control. Some of these prey species are crop pests. Although the swift fox preys on some ground-nesting birds (Cutter, 1958b; Kilgore, 1969), it is



noteworthy that no evidence of gallinaceous (game birds) was found in scats or stomachs examined. Seton (1925) does, however, mention that the swift fox was skilled in taking prairie chickens. Insect remains comprised a high percentage in scats analysed by Cutter (1958b) and Kilgore (1969), therefore, predation on insects by swift foxes may contribute to pest control. Except for one incident mentioned by Seton (1925) and one by Grinnell et. al. (1937) of domestic chicken thievery, it can be concluded that the swift fox has few habits injurious to human interests. Taking the predatory activities of the swift fox in total its positive values more than counterbalance its faults (Grinnell, et. al., 1937).

Egoscue (1962) suggested that a difference in preferred habitat and denning areas allows kit foxes to live successfully with other canids. This habitat relationship is similar for kit foxes and swift foxes because coyotes live in both species' range (Schitoskey, 1975). With the swift fox's preference for the open plains and its use of the den to escape predators, it may achieve the same success as kit foxes in coexistence with other canids. Carbyn (1985) reported that coyote and bobcat (Lynx rufus) predation may have caused mortality in the Alberta and Saskatchewan reintroduction projects. He offered no solution to the problem but agreed that these other predators are integral parts of the prairie ecosystem and that ultimately reintroduced swift foxes would have to survive, as they did historically and do elsewhere today, in spite of such predation. Continuing annual reintroductions into the same release areas have been recommended as an attempt to give the new fox populations every chance of success (Sharps and Witcher, 1981; Reynolds, 1983).

Other mortality factors for the swift fox include automobile and farm-implement kills, shooting and trapping (Kilgore, 1969). In addition, accidental mortality from coyote control and rodenticide programs has been documented (Robinson, 1961; Shitoskey, 1975). Unfortunately the swift fox readily takes bait either in traps or poisoned bait meant for coyotes (Cutter, 1958b).

### 2.3 Land Use/Wildlife Interactions

Human uses of land often affect the well being of wildlife species. Two fundamental factors are involved in determining the degree to which such impacts are manifested. The first factor is land-use change. All organisms possess in some measure an ability to adapt to changing environmental conditions. Human modification of habitat leads to disturbed ecological conditions (Leopold, 1966). Specialized animals with narrow limits of adaptability have become scarce and in some cases extinct. The swift fox is narrowly adapted to prairie habitat, but is apparently not adaptable to certain human activities there, such as predator and pest-control measures (Cutter, 1958b; Schitoskey, 1975). Leopold (1966) suggested that all endangered species are non-adaptive in some way or other.

The second factor in determining land use impacts on wildlife species is landowner attitudes to wildlife. Kellert (1981) stated, "Any attempt to examine the problems and promise of managing wildlife on private lands must therefore start with landowner attitudes towards wildlife." Landowner attitudes to wildlife and methods of determining them are more fully discussed in Section 2.5.

## 2.4 Habitat Evaluation

Gysel and Lyon (1980) described two categories of habitat evaluation. One is capability ratings which are based on the value of the environment for wildlife. The other is impact evaluation which measures the effect of environmental modifications on habitats and wildlife. The discussion of these two categories deals primarily with aspects of vegetative cover and availability of forage for ungulates. Gysel and Lyon (1980) do not discuss evaluating habitat for den-site and prey-species availability.

The literature contained many references to the building of models for habitat evaluation. Seitz and Kling (1982) concluded that models must be constructed for a particular habitat area or land use development using the following criteria:

- a. habitat models must contain habitat attributes that are likely to limit populations.
- b. the model must be structured to be sensitive to changes in habitat attributes.

They further concluded that a more complete understanding of the constraints and limitations of building, verifying and using habitat evaluation models may arise from ecological knowledge gained from well-designed quantitative studies of species-habitat relationships. Such relationships were documented in Egoscue (1962), Kilgore (1969) and Wrigley (1974).

## 2.5 Wildlife Attitude Survey Research

"Survey research is a method of obtaining feedback representative of a constituency's sentiment on a wildlife issue or agency program," (Witter and Sheriff, 1983). Kellert (1981) used survey research in the form of a mail questionnaire to solicit landowner attitudes to wildlife. He identified two categories of wildlife values and described the attitudes upon which the values are based. Table 3 illustrates commodity and non-commodity values and their ten sub-categories. Kellert op. cit. also found that negative attitudes toward wildlife varied directly with size of private property and economic dependence on the land. Sheriff et. al. (1981) used self-administered questionnaires to survey the Missouri landowners' perceptions of the importance of wildlife. The survey indicated that landowners perceived wildlife to be most important for recreation, but that crop damage often resulted from populations on their land. Groves et. al. (1973) used a semi-structured interview to measure personal wildlife values. This information was used to assess the land use decisions. They found that the survey allowed decisions on land use to be made with a more complete understanding of blocks of support of and opposition to land use change. The strengths and weaknesses of survey questionnaires of the interview and mail types are compared in Fillion (1980). Table 4 outlines this comparison. The Institute for Social and Economic Research (1983) also made similar comparisons.

In regard to the feasibility of reintroducing swift foxes, positive landowner and local attitudes and support are important, especially if the swift fox population should expand and disperse onto

Table 3. Attitudes toward animals.

COMMODITY VALUES:	
ATTITUDE	CHARACTERISTIC
Naturalistic:	Primary interest and affection for wildlife and the outdoors.
Dominionistic:	Primary interest in the mastery and control of animals typically in sporting situations.
Utilitarian:	Primary concern for the practical and material value of animals or the animal's habitat.
NON-COMMODITY VALUES:	
ATTITUDE	CHARACTERISTIC
Ecologicistic:	Primary concern for the environment as a system, for interrelationships between wildlife species and natural habitats.
Humanistic:	Primary interest and strong affection for individual animals, principally pets.
Moralistic:	Primary concern for the right and wrong treatment of animals, with strong opposition to exploitation or cruelty towards animals.
Scientistic:	Primary interest in the physical attributes and biological functioning of animals.
Aesthetic:	Primary interest in the artistic and symbolic characteristics of animals.
Negativistic:	Primary orientation an active avoidance of animals due to dislike or fear.
Neutralistic:	Primary orientation a passive avoidance of animals due to indifference and lack of interest.

Adapted from: Kellert, 1981

Table 4. Selected strengths and weaknesses of interview and mail questionnaire methods.

STUDY CONCERN	METHOD	
	INTERVIEW	MAIL QUESTIONNAIRE
Population types	<ul style="list-style-type: none"> <li>- suitable for most types of human populations</li> </ul>	<ul style="list-style-type: none"> <li>- best suited for literate individuals and persons or groups that can be addressed by name</li> </ul>
Sampling	<ul style="list-style-type: none"> <li>- difficulty and cost of contacting greatly increases with size and dispersion of sample</li> <li>- potentially high control over who responds and possible consultation or any substitution</li> <li>- surveys conducted during the day may overrepresent people outside labour force</li> </ul>	<ul style="list-style-type: none"> <li>- large dispersed samples can be used easily to increase accuracy</li> <li>- reaches people who are protected from solicitors and investigators and those temporarily away from home</li> <li>- requires addresses of individuals or households selected</li> <li>- may be difficult to verify that respondent is addressed</li> </ul>
Complexity of topic	<ul style="list-style-type: none"> <li>- suited for various question types including lengthy, complex and open-ended ones</li> <li>- filter questions and question sequence are more effective</li> <li>- suited for various types of data including complex nonfactual information</li> </ul>	<ul style="list-style-type: none"> <li>- most effective for short, simple and structured questions on factual data</li> <li>- open-ended and complex questions must be restricted to avoid overtaxing</li> </ul>
Response rate and validity	<ul style="list-style-type: none"> <li>- generally high response rate with callbacks</li> <li>- generally high item response</li> <li>- may be sensitive to socially desirable or threatening questions</li> <li>- sensitive to interviewer effects (tone of voice, language, sex, appearance, social class, etc.)</li> <li>- potential for probing and observing respondents in specific settings</li> <li>- high potential for variability among interviewers</li> </ul>	<ul style="list-style-type: none"> <li>- variable response rates. Generally highest for homogeneous or specialized populations. Response rate dependent on survey procedures used</li> <li>- some item nonresponse for boring or complex questions</li> <li>- greater potential for nonresponse bias</li> <li>- sensitive to questionnaire design</li> <li>- uniformity in wording, instructions and questions order</li> </ul>
Administrative constraints	<ul style="list-style-type: none"> <li>- stringent personnel needs (skilled interviewers, interviewer training and supervision)</li> <li>- complex organization for selecting, training and supervising interviewers</li> <li>- costs increase rapidly as size and dispersion of sample increase</li> <li>- completion time is variable and depends on sample size and number of field staff available</li> </ul>	<ul style="list-style-type: none"> <li>- requires fewer skilled personnel with some clerical support</li> <li>- insensitive to increasing geographical dispersion. Potentially least expensive method</li> <li>- requires at least 4-8 weeks from first mailing</li> </ul>

Adapted from: Filion, 1980

private lands. For example, landowners and local residents might be required to forego hunting and trapping of coyotes and foxes so that accidental mortality of swift foxes can be held to a minimum for some years.

## 2.6 Reintroduction Techniques

A swift fox reintroduction is a three-phased project (Hillman and Sharps, 1978; Carlington, 1980; Reynolds, 1983). Phase I is the feasibility study. Phase II involves the holding of breeding pairs at release sites to acclimate them to their new habitat. Phase III is the actual release and includes ongoing monitoring and management of the new population of swift foxes. More detailed components of a reintroduction were reported by Hillman and Sharps (1978), Sharps and Uresk (1980), Sharps and Whitcher (1981) and Russell (1982). These are as follows:

- a. feasibility study
- b. holding of breeding pairs in pens for approximately 8 months at release sites including feeding live native prey species.
- c. veterinary care, marking and radio-collaring followed by slow release which involves some continued feeding at the open release pen.
- d. monitoring of movements, collection of scats, carcass pick up and autopsy and collection of other observed data on new population.
- e. management of the habitat and of human activity in the release area.
- f. further reintroductions.

Sharps and Whitcher (1981) and Reynolds (1983) provided substantial detail on facilities and equipment used for holding and monitoring

the released foxes (Appendices D and E). Follman and Buitt (1978) described the use of a durable, light and adjustable radio-collar for gray and red foxes which may be adaptable for use on swift foxes (Appendix F).

## 2.7 Management Techniques

Management techniques for the released swift fox population include management of its habitat and of the human activities likely to affect the new population. Tester and Marshall (1962) reported on the wildlife management aspects of four treatments of prairie habitat in Minnesota. They studied the effects of spring and fall burning, grazing and mowing. In general changes in litter resulting from the treatments showed the following relationships (Tester and Marshall, 1962):

- a. increasing litter -- increasing populations of the meadow vole (Microtus pennsylvanicus)
- b. increasing litter -- decreasing populations of deer mouse (Peromyscus maniculatus)
- c. masked shrew (Sorex cinereus) populations independent of vegetative characteristics
- d. grasshoppers (Orthoptera) most abundant in light to moderate litter
- e. beetles (Coleoptera) associated with sparse litter.

These species changes as a result of prairie management techniques have significant implications for swift fox because all species discussed are among its preferred prey. If optimum habitat is to be maintained for prairie wildlife, Tester and Marshall op. cit. recommended a four-year rotation of spring burn, no treatment, graze and



no treatment on areas of the range.

Management of human activities on the swift fox range was discussed by Sharps and Witcher (1981) and Sharps and Uresk (1980). They contended that cooperation from landowners and locals or regulation of certain activities would be required to allow the swift fox population to get a start. Predator poisoning, furbearer or predator trapping and hunting would have to be curtailed or tightly controlled in a reintroduction area so that accidental swift fox mortality could be held to a minimum.

One wildlife management technique that is often overlooked is wildlife education. Smith and Berryman (1962) summarized the information activities of wildlife extension specialists into five categories.

- a. factual
- b. recreational, aesthetic, economic
- c. ecological
- d. land and water use
- e. public involvement in issues

In other words the public should be informed about wildlife management through programming that includes these various types of information.

Public support for wildlife management can be brought about by a combination of bringing the ideas and aspirations of the wildlife manager down to the level of the public's grasp and bringing the sentiments of the public up to the plane of wildlife management's possibilities.

(Schoenfeld, 1957)

The literature of conservation or wildlife education is vast but a common thread has emerged in the program directions being taken today. The concept of interdependence of all resources with particular emphasis on people's place in the environment is the most basic education program concept. A second thread common to many conservation education approaches is that of emphasis on programming for children (Swift, 1916).

## CHAPTER 3.0

### STUDY AREAS AND METHODS

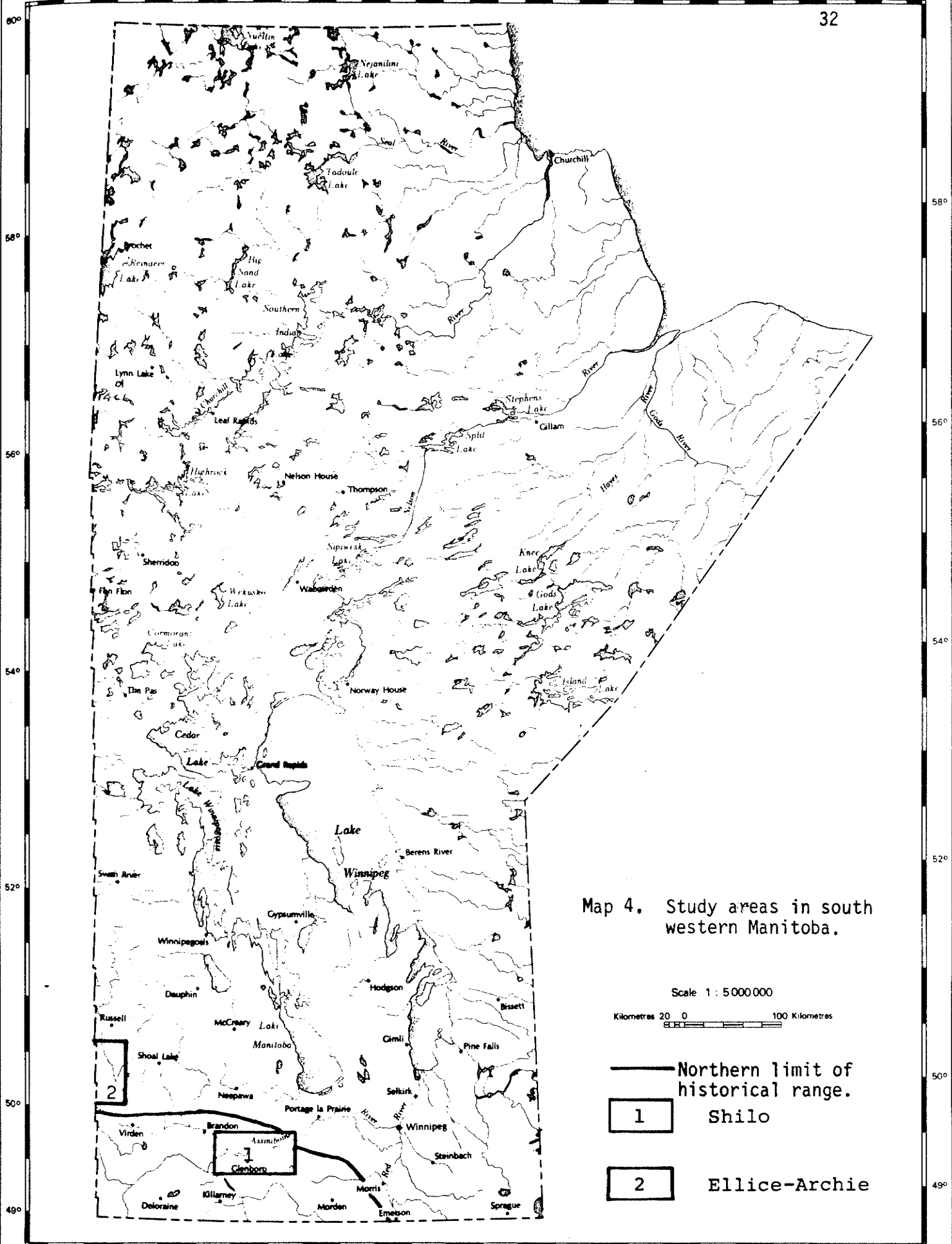
#### 3.1 Study Areas

Originally four areas were identified as having potential swift fox habitat. They were: Shilo Military Reserve; Ellice-Archie Community Pasture; South Block, Spruce Woods Provincial Park, and a private property near Oak Lake. On the basis of information about swift fox habitat requirements obtained from the literature review and the Alberta trip, and based on air and ground reconnaissance, Shilo Military Reserve (Shilo) and Ellice-Archie Community Pasture (E.A.C.P.) were chosen as the study areas (Map 4). Canadian Wildlife Service and Manitoba Wildlife Branch biologists concurred with this decision. The primary reason for rejecting the other two areas was that they were too small. Also there was not the visual expanse preferred by swift foxes. The South Block of Spruce Woods Provincial Park was frequently punctuated with groups of spruce trees and aspen stands.

##### 3.1.1 Shilo Military Reserve (Shilo) Study Area (Figure 2) (Map 5)

###### a. Topography (1:50,000 Map, 62G11 Glenboro)

The Shilo study area is rolling grassland terrain with widely spaced and generally small aspen stands. The main grassland portion of



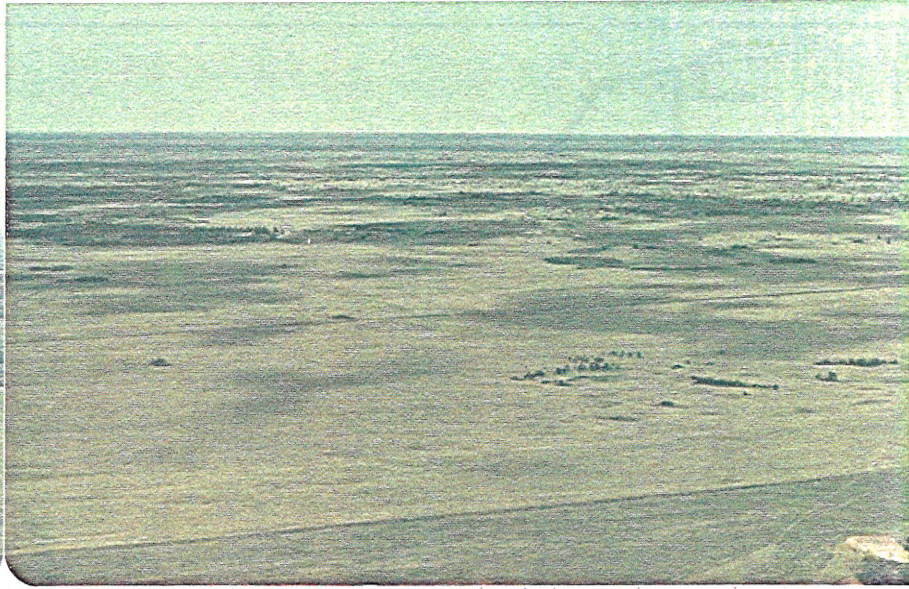
Map 4. Study areas in south western Manitoba.

Scale 1 : 5 000 000

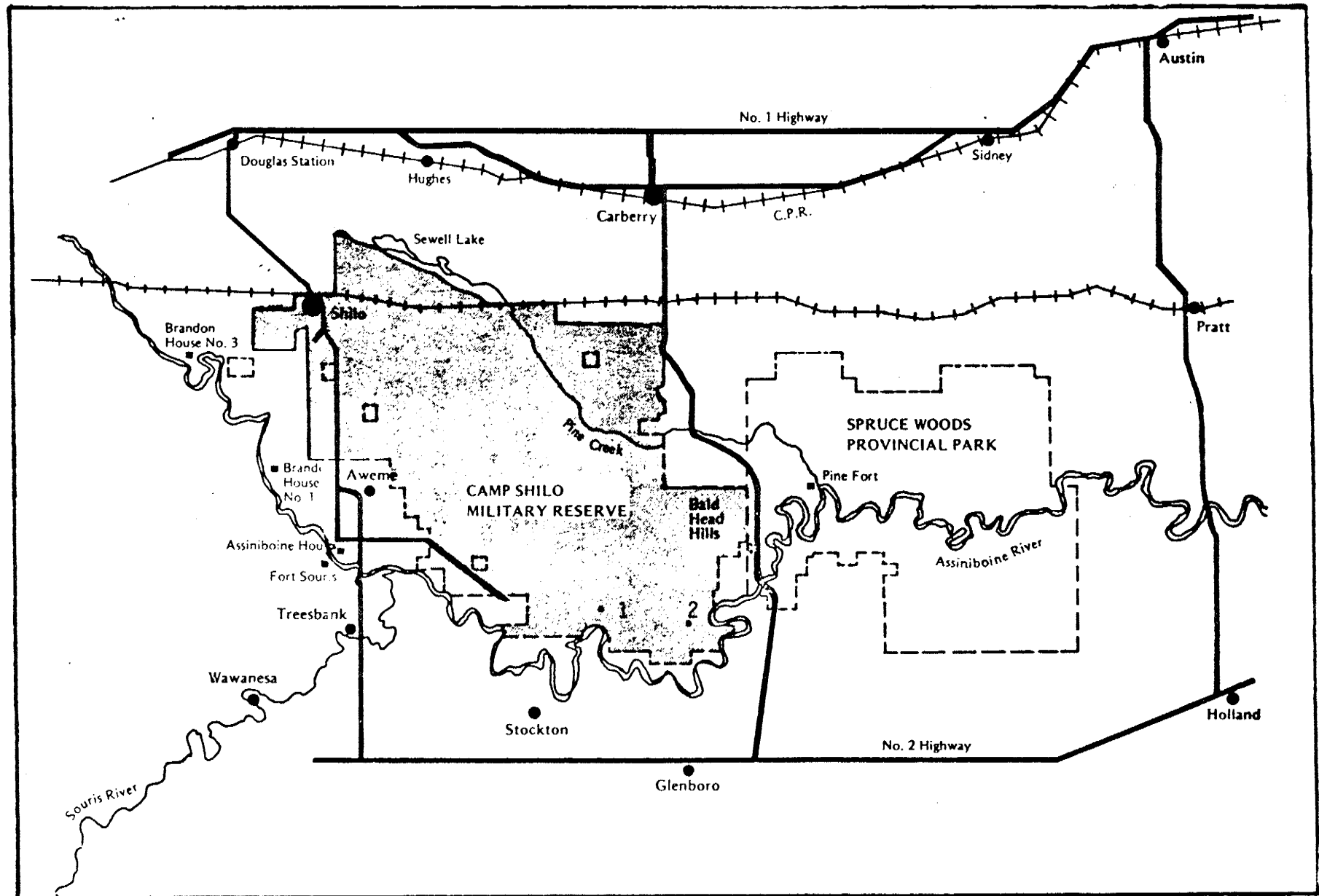
Kilometres 20 0 100 Kilometres

- Northern limit of historical range.
- 1 Shilo
- 2 Ellice-Archie

Figure 2. Typical habitat of the Shilo study area.



Map 5. The Shilo study area.



NOTES: 1. Study Site 1  
2. Study Site 2  
Source: Nero, 1976

the Military Reserve is bounded on the east by aspen-oak woods and the Baldhead Hills, on the south by the Assiniboine River, on the west by agricultural land and on the north by quite hilly terrain interspersed with aspen-oak stands.

#### b. Vegetation

Wrigley (1974) described both xeric and mesic mixed-grass prairie in the area. Grassland species found to be dominant on the study area were speargrass (Stipa comata), blue grama grass (Bouteloua gracilis), June grass (Koeleria cristata). Various herbs and shrubs were also found, such as: sage (Artemisia frigida), prairie crocus (Anemone patens), prairie rose (Rosa spp.) and ground juniper (Juniperus horizontalis). On the periphery of the prairie areas mixed forests of aspen (Populus tremuloides), oak (Quercus macrocarpa), elm (Ulmus americana), birch (Betula papyrifera) and maple (Acer negundo) occurred, especially along the Assiniboine River. Spruce (Picea glauca), aspen associations were found dotted throughout the prairie areas. Jack pine (Pinus banksiana) stands were common in the area.

#### c. Soil Characteristics

The soil of the Shilo study area is very sandy but has a shallow surface layer of partly decomposed organic matter. The subsurface as could be seen in gopher holes and badger dens showed no sign of coarse gravel in any abundance.

#### d. Access

Public access to the military range is restricted at all times. A range patrol regularly cruises the military range to enforce the restrictions. Access for researchers can be authorized and is coordinated by the Range Control Officer in Shilo. At times military activity may restrict daily access to the study area. Certain parts of the range may be reached anytime of day. For the most part the above-mentioned restriction still accommodates early morning or evening trips to the area.

Adequate road access from the south to study sites on the area is available via the Stockton Ferry in the open-water season and across the river ice after freeze-up. Access from the west through Shilo base via the PTH is also good.

#### e. Land Uses

The major land use on the Shilo study area is military activity. This includes tank manoeuvres, artillery practice and related vehicular traffic.

The two rural municipalities, North Cypress and South Cypress, surround the Shilo study area. The land uses in these adjacent areas are primarily agricultural. Grain, mixed farm and livestock operations are predominant.

#### f. Study Sites

Two study sites were chosen on the Shilo study area as being representative of the general character described above. Area 7 north of

the Stockton Ferry, just inside the Military Reserve boundary, was Shilo Study Site 1. The Dielinghofen no vehicle area (An International Biological Program Site) was Shilo Study Site 2.

### 3.1.2 Ellice-Archie Community Pasture (E.A.C.P.) Study Area (Figure 3) (Map 6)

#### a. Topography (1:50,000 Map, 62K/6 Birtle)

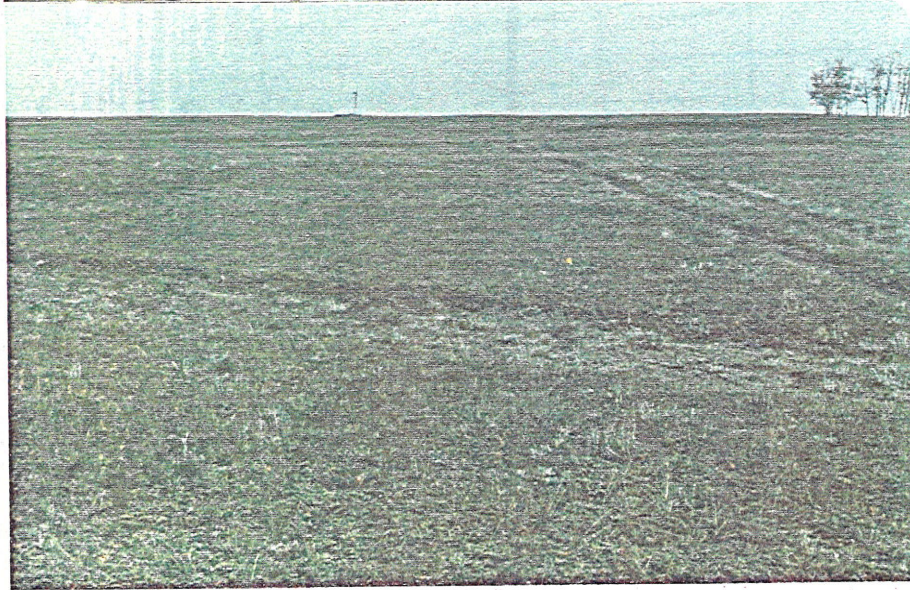
The E.A.C.P. study area is a gently rolling prairie plateau, bare of trees or shrubs over most of its area. There are peripheral aspen clumps and in places the edges of the pasture are lined with aspen woods. The main grassland portion of the community pasture is bounded on the east by the Assiniboine River, on the south by rolling cultivated fields and aspen parkland, on the west by the Saskatchewan-Manitoba border and agricultural land with pothole lakes, and on the north by the Qu'Appelle River.

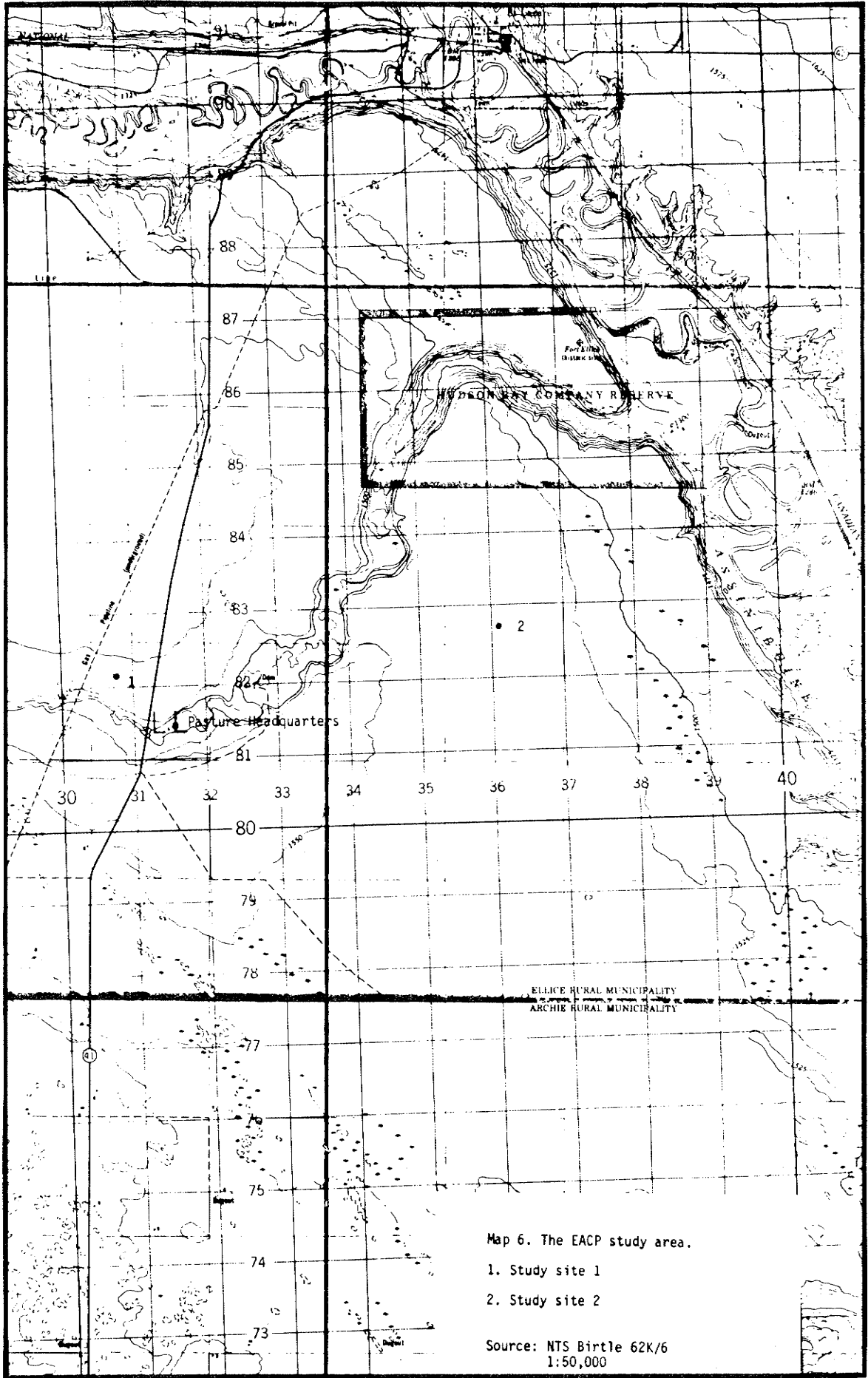
#### b. Vegetation

The dominant plant species included blue grama grass (Bouteloua gracilis), speargrass (Stipa comata), and sage (Artemisia frigida) which were also common on the Shilo study area. Two major differences between the vegetation at Shilo and at E.A.C.P. were that at E.A.C.P. the overall height of plants and the density of plant cover was less. Forest communities including white spruce, aspen, birch, oak and maple trees were found on the periphery of the prairie area especially along the Qu'Appelle and Assiniboine Rivers and creek valleys.



Figure 3. Typical habitat of the EACP study area.





Map 6. The EACP study area.

1. Study site 1

2. Study site 2

Source: NTS Birtle 62K/6  
1:50,000

### c. Soil Characteristics

The soil of the E.A.C.P. study area is sandy with a poorly developed organic layer. There is subsurface gravel as evidenced by the diggings at gopher and badger holes. There are golf ball and baseball-sized stones lying on the surface throughout the pasture.

### d. Access

Public access to the E.A.C.P. study area is restricted by barbed wire fencing and the "No Trespassing" signs. A cooperative surveillance program between the R.C.M.P., the pasture manager and the local public to reduce unauthorized entry to the pasture is in operation. However in practice the many unlocked pasture gates along Highway 41 allow relatively easy access to the community pasture. A licence to do research on the pasture must be obtained from the Regina Prairie Farm Rehabilitation Administration (P.F.R.A.) office. It is signed by the pasture manager and the researcher and is filed with the Regina office. Adequate road access to study sites on the area is available from Highway 41 between McAuley and St. Lazare. A system of pasture roads provides good access to most parts of the study area.

### e. Land Uses

The major land use on the E.A.C.P. is cattle grazing. The herds are transferred from pasture to pasture throughout the summer and early fall seasons. Therefore no cattle are overwintered on E.A.C.P. An oil exploration rig operated near Study Site 1 during the summer of 1983 with an associated increase in use of vehicles on that part of the pasture.

There is potential for potash exploration by the International Minerals and Chemicals Corporation in the future (Jurick, 1982).

The two rural municipalities, Ellice and Archie, surround the E.A.C.P. study area. Agricultural uses mostly of the mixed grain/livestock type are predominant in these adjacent areas.

#### f. Study Sites

Two study sites were chosen on the E.A.C.P. study area as being representative of the general character of the community pasture, described above. E.A.C.P. Study Site 1 was a pasture on the west side of Highway 41 just north of the creek at the community pasture manager's headquarters. E.A.C.P. Study Site 2 was a hay field to the east and north of the community pasture headquarters. Site 1 was characteristic of most of the grassland parts of E.A.C.P. Site 2 however was in an annually cropped hay field. The dominant plant species included clover, alfalfa and a hay grass species.

### 3.2 Methods

The research methods for this study fall into four categories: literature search, discussions and correspondence, field work and the attitude survey.

#### 3.2.1 Literature Search

A literature search was made of three Winnipeg libraries: Science Library, University of Manitoba; Manitoba Museum of Man and Nature Library; Manitoba Department of Natural Resources Library. A computer search of

Biological Abstracts was made by the University of Manitoba Science Library.

### 3.2.2 Discussions and Correspondence

Personal interviews and/or correspondence were carried out with biologists from Canadian Wildlife Service and the Manitoba and Saskatchewan wildlife branches. Researchers from University of Calgary and from the U.S. Fish and Wildlife Service and plains state universities were contacted. Telephone contact was maintained with the Alberta biologists involved in the swift fox reintroduction there.

### 3.2.3 Field Work

Field work was carried out in three categories: Alberta trip, habitat survey, and prey base survey.

#### a. Alberta Trip

From June 28 to June 30, 1983 I travelled in Alberta to the Lost River Ranch release site, the Calgary Zoo breeding facility and the Wildlife Range of Western Canada breeding facility.

#### b. Habitat Survey

A general habitat survey was made from air and land of each study area in Manitoba. Information on each area about topography, dominant vegetation, soil characteristics, access and surrounding land uses was collected. Two study sites were chosen for each study area to be

representative of the range of potential swift fox habitats available.

#### c. Prey Base Survey

The two-hectare quadrat and 100-metre line transect methods of small mammal trapping were combined for this survey. Quadrat sampling was chosen to give presence/absence data for potential small mammal prey species. One two-hectare quadrat was located in the most typical of potential swift fox habitats available on each study area. The line transects were located in selected edge habitats to further establish what species were present on the study areas. Quadrat and line-transect data from the two study areas would also allow comparison of relative abundance of prey between the two areas. Table 5 summarizes the trapping program format and schedule. Observations of other mammals, birds and large insects were made during each day of field work on each study site.

#### 3.2.4 Attitude Survey

On the basis of the literature search and the work of Filion (1980) and I.S.E.R. (1983/84) I chose the mail questionnaire for the attitude survey.

The specific objectives of the survey were:

- a. To determine whether the attitude of study area residents and landowners is positive or negative toward swift fox reintroduction.
- b. To determine which segments of the population in the study areas have negative attitudes toward swift fox reintroduction and what the characteristics of the negative attitudes are.
- c. To educate the public about the project.

Fifty questionnaire recipients were randomly chosen from the voters'

Table 5. Trapping program prey base survey.

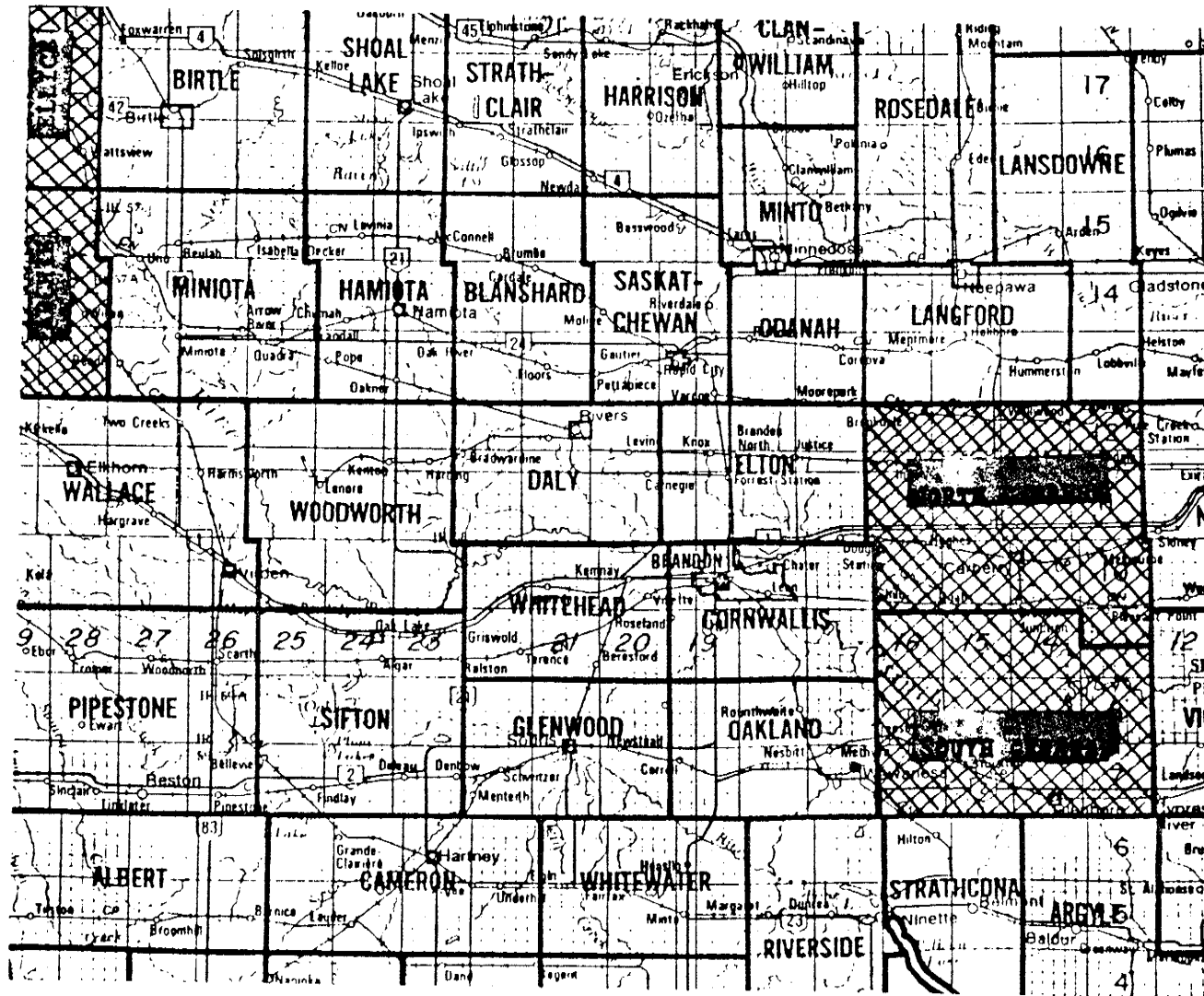
DATE	STUDY AREA	METHOD	TRAPNIGHTS
July 12-15, 1983	Shilo Site 1 (Area 7)	Quadrat	64 x 3 = 192
July 26-29, 1983	EACP Site 1	Quadrat	64 x 3 = 192
Aug. 11-14, 1983	Shilo Site 1 (Area 7)	Line transects	30 x 3 = 90
Aug. 31-Sept. 2, 1983	Shilo Site 2 (IBP)	Line transects	53 x 2 = 106
Sept. 2-5, 1983	EACP Site 1	Line transects	20 x 2 = 40
Sept. 2-5, 1983	EACP Site 2	Line transects	38 x 2 = 76

lists of each of the four Rural Municipalities. The Shilo study area is in the Rural Municipalities of North and South Cypress, while the Ellice-Archie Community Pasture study area is in the Rural Municipalities of Ellice and Archie (Map 7). The mailing to each of the 200 people chosen included a questionnaire, a swift fox information sheet and a covering letter. One reminder letter was sent to recipients from whom no response had yet been received. The covering letter, information sheet, questionnaire and reminder letter are included in Appendix A.

The returned questionnaires were coded and the data were entered into a computer file. The data were analysed by the SAS program for frequency and cross-tabulation results.



Map 7. Attitude survey study areas showing Rural Municipalities



## CHAPTER 4.0

### RESULTS AND DISCUSSION

The research objectives and the methods developed to achieve them, were divided into two categories: those that addressed the problem of determining the feasibility of reintroduction of the swift fox and those that addressed developing a swift fox reintroduction process. To determine the feasibility of reintroduction the results of the literature search, discussions and correspondence were compared to the results of the field work. The reintroduction process was developed primarily from the literature which included information on swift fox reintroduction projects in South Dakota and Alberta.

#### 4.1 Feasibility

The habitat requirements and interspecific relationships of the swift fox were documented in Chapter 2.0. These results of the literature search were mostly from ecological studies of the swift fox in Oklahoma and northern Texas. However researchers in South Dakota and Alberta studying reintroduction of swift foxes further developed habitat requirements and relationships for these areas which are similar to southwestern Manitoba (Carlington, 1980; Sharps and Uresk, 1980 and Reynolds, 1983). Their findings about the potential swift fox habitat in other similar areas compare closely with the results of my field work in southwestern Manitoba.

#### 4.1.1 Field Work

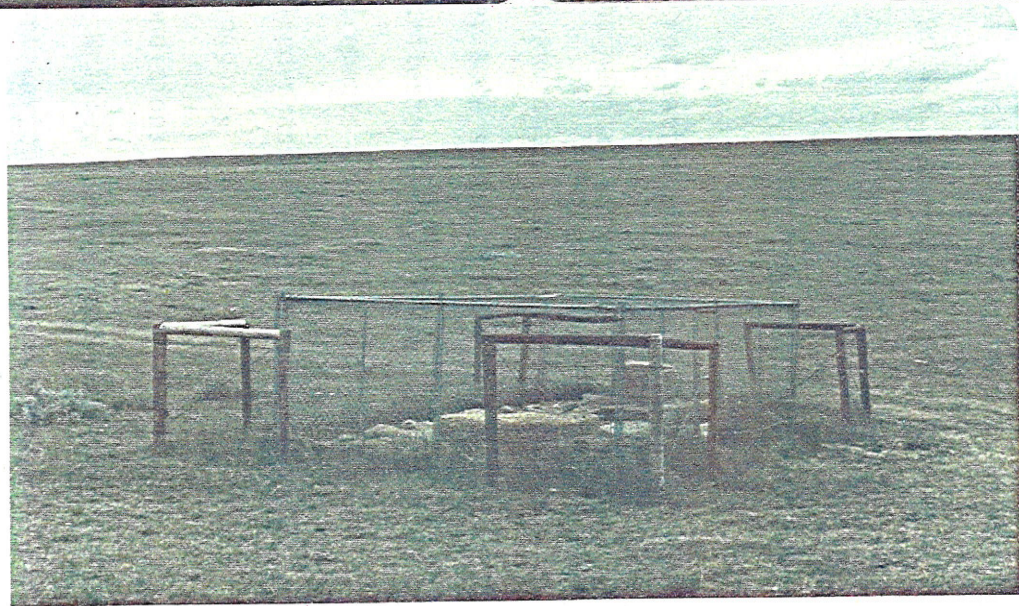
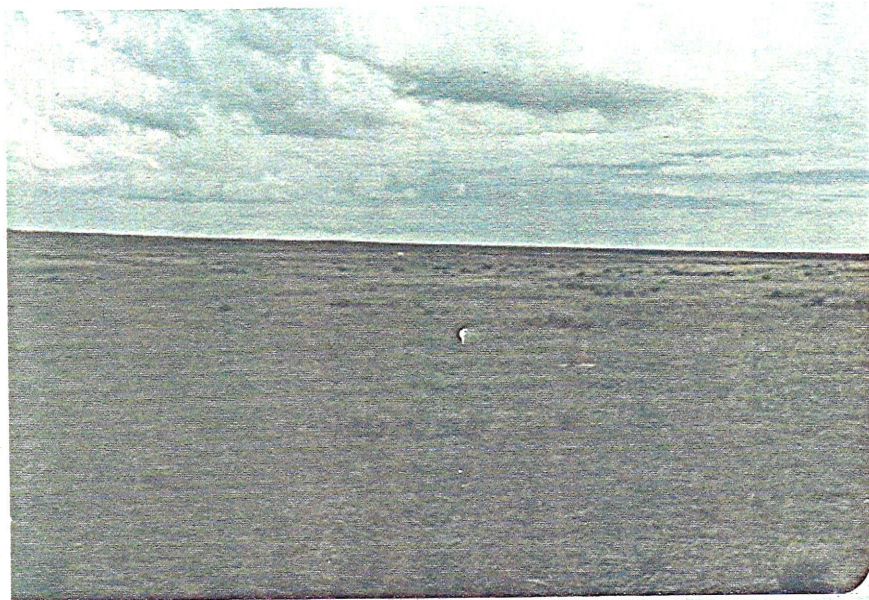
##### a. Alberta Trip

A trip was made starting June 28, 1983 to the Alberta release site at Lost River Ranch (L.R.R.) near Manyberries and to the swift fox captive breeding facilities at Calgary Zoo and the Wildlife Range of Western Canada (W.R.W.C.). I was accompanied by Hal Reynolds of the Canadian Wildlife Service and Joanne Reynolds of the University of Calgary, Faculty of Environmental Design.

At L.R.R. the Alberta Swift Fox Reintroduction Project was in the holding phase which involved 6 pens each containing a breeding pair of foxes. A tour of the ranch to each of these pens enabled me to observe the siting, construction method and materials used for the holding pens as illustrated in Appendices D and E. Also a few foxes came above ground during feeding. Otherwise the foxes remained in the underground dens much as the literature had suggested. The foxes would become active at dusk and become inactive at dawn as observed by their keeper. The fox food consisted of road killed mule deer, domestic chicks from a local hatchery and commercial dog food pellets. Water was also made available in the pens. The landscape on the Lost River Ranch was rolling short mixed-grass prairie punctuated by the deep canyons of the Lost and Milk Rivers (Figure 4). It was similar in appearance to what I had already seen at the Shilo Military Reserve and the Ellice-Archie Community Pasture except for two features. Habitat areas in Manitoba are far smaller than in Alberta and more trees are in evidence in the Manitoba study areas.

At Calgary Zoo I viewed the captive breeding facility and met

Figure 4. The Alberta release site habitat and holding pen.



the zoo director. These facilities used artificial dens similar to those at Lost River Ranch but the pens were much larger. Feeding at Calgary Zoo was essentially the same as that at Lost River Ranch.

At W.R.W.C. near Cochrane, Alberta northwest of Calgary I met with Miles Smeeton who guided us around his captive breeding facilities and discussed the upcoming reintroductions in the three prairie provinces. I was able to see much more of the foxes at W.R.W.C. as they were somewhat tamer there.

#### b. Habitat Survey

The results of the habitat survey for each study area are reported in Section 3.1, Study Areas. The habitat survey resulted in my being able to describe the study areas and choose study sites in each. These results along with those of the prey base survey are compared to habitat requirements and site selection criteria below.

In general swift fox habitat requirements are met by both the Shilo and EACP study areas. The short mixed-grass plains of a relatively dry rolling nature reported by Kilgore (1969) as ideal habitats are evident especially in the Shilo area. Similar conditions exist in the EACP area, except that heavy cattle grazing occurs. Wrigley (1974) reported that xeric and mesic mixed-grass prairie support various and abundant small mammal species (Table 1). The EACP area had several other plant species that were planted to enhance grazing. The terrain and soil of the study areas also compared favourably with the denning-site requirements of the swift fox.

### c. Prey Base Survey

The results of the prey base survey document the presence and relative abundance of swift fox prey species on the study sites. Table 6a shows the numbers of animals trapped according to the trapping method used. In Table 6b the total number of each species trapped is shown. Table 6 also allows a comparison of abundance of prey species between the Shilo and EACP study areas and study sites. Table 7 contains the results of visual observations of other species. The table includes animal sign observations as an indication of presence of the particular species in the area. As a check on the prey base survey results for the Shilo study area, some trapping results were obtained for similar habitats in other years. Appendix C includes trapping results from Dr. R. Wrigley of the Manitoba Museum of Man and Nature. Dr. Wrigley's results confirm the abundance and variety of small mammals in the Shilo area. Deer mice (Peromyscus maniculatus), meadow voles (Microtus pennsylvanicus), red-backed voles (Clethrionomys gapperi), and pocket gophers (Thomomys talpoides) are commonly caught in the area. Unfortunately no similar comparative trapping results are available for the EACP study area.

Kilgore (1969) suggests that swift foxes prey on species in proportion to their availability and are not selective. This being the case, a comparison of Table 2 to Tables 6 and 7 indicates that the trapped and observed species would form an adequate prey base for reintroduced swift foxes. For example Kilgore (1969) reports (Table 2) that small mammal species such as pocket mice (Perognathus spp.), deer mice and unidentified rodents occurred in 28% of swift fox scat samples. Also,

Table 6a. Results of the prey base survey using quadrat and line transect small mammal trapping methods.

6b. Combined totals of small mammal trapping methods used in the prey base survey.

a.

STUDY AREA METHOD	SHILO		EACP	
	SITE 1	SITE 2	SITE 1	SITE 2
Quadrat	DM: 3 PV: 1 13 L: 2		DM: 1	
Sub-total	6	0	1	0
Line Transects	DM: 8 RBV: 2 13 L: 1	DM: 7 RBV: 1 13 L: 1 SH: 1	DM: 5 RBV: 3 CHIP: 1	DM: 10 MV: 1
Sub-total	11	10	9	11
Total	17	10	10	11

DM - Deer mouse - Peromyscus maniculatus

PV - Prairie vole - Microtus ochrogaster

CHIP - Least chipmunk - Eutamias minimus

MV - Meadow vole - Microtus pennsylvanicus

13 L - 13-lined ground squirrel - Citellus tridecemlineatus

RBV - Red-backed vole - Clethrionomys gapperi

SH - Masked shrew - Sorex cinereus

b.

STUDY AREA SPECIES	SHILO		EACP	
	SITE 1	SITE 2	SITE 1	SITE 2
Deer mouse	11	7	6	10
Red-backed vole	3	1	3	0
13 lined ground squirrel	2	1	0	0
Prairie vole	1	0	0	0
Masked shrew	0	1	0	0
Chipmunk	0	0	1	0
Meadow vole	0	0	0	1
Totals	17	10	10	11

Table 7. Results of the prey base survey from field observations.

SPECIES OR SIGN	SHILO		EACP	
	SITE 1	SITE 2	SITE 1	SITE 2
<u>Mammals</u>				
Hare or rabbit droppings	X1			
Red fox tracks	X1			
Coyote tracks/droppings	X1	X1		
Pocket gopher mounds	X2	X1		X1
Richardson's ground squirrel <sup>10</sup>			XA	XA
Badger hole	X1		X1	
Jack rabbit <i>Lepus townsendii</i>			X1	
<u>Birds</u>				
Warblers/sparrows	XA			
Upland plover <sup>1</sup>	XC			
Meadowlark <sup>2</sup>	XA		XC	
Horned lark <sup>3</sup>	XA		XC	XC
Mourning dove <sup>4</sup>	XA		XC	
Chesnut collared longspur <sup>5</sup>	XC	XC	XC	XC
Sharp tailed grouse <sup>6</sup>	XC	XC	X1	
Grouse droppings	XC	XC		
Kildeer <sup>7</sup>			X1	
Flicker <sup>8</sup>	X1			
American Kestrel <sup>9</sup>		X1		
<u>Insects/Invertebrates</u>				
Carrion beetles	XC	XC		
Crickets	XA	XA		
Grasshoppers	XA		XA	XA
Dragonflies	XC			

Legend

- X - present  
A - abundant  
C - common  
1 - number of sightings  
or locations

Scientific namesBirds

- Bartramia longicauda*
- Sturnella neglecta*
- Eremophila alpestris*
- Zenaidura macroura*
- Calcarius ornatus*
- Tympanuchus phasianellus*
- Charadrius vociferous*
- Colaptes sp.*
- Falco sparverius*

Mammals

- Spermophilus richardsonii*



ground-nesting birds such as horned (Eremophila alpestris) and meadow (Zenaidura macroura) larks occurred in 38% of scat samples. The prey base survey showed that both of these groups of animals are relatively abundant on both study areas.

Winter survival of the swift fox has been questioned by those involved in studying their reintroduction to the Canadian prairies. It has been suggested that in particular Manitoba winters may prove too harsh for a successful swift fox reintroduction. The critical factor for winter survival would be prey availability. No research on winter prey base was conducted in this study and the literature does not address the question in any direct way. However, there was indirect evidence to suggest that the swift fox would survive in Manitoba as it is expected to elsewhere on the Canadian prairies. A major consideration in this regard is that the animal was native to Manitoba as documented earlier in this report.

The swift fox was reportedly extirpated by accidental poisoning and trapping by pioneer farmers not by natural environmental or habitat factors. Given the availability of suitable habitat and prey indicated by this study one could assume that the swift fox would survive in Manitoba as well now as in the past. Turning to prey availability specifically there was discussion in the literature of seasonal differences in the diet regime of swift foxes. Kilgore (1969) reported that the spring and fall diet included more mammalian prey than at other times of the year. Birds and insects may make up the most important food items in summer. What these points suggest is that the swift fox may be a very opportunistic hunter as an adaptation to seasonal energy requirements as well as to seasonal prey availability. Not only do most small mammals increase

activity in fall and spring but they are also of greater nutrient value and biomass than bird and insect prey. It is possible that the swift fox can, because of more easily caught and higher energy food items, build up energy reserves in the fall and recover quickly from lower winter food intake in spring. Therefore the annual diet regime for swift foxes in Manitoba could be as follows:

- Summer -- less biomass required
  - small birds, some mammals and insects
- Fall and Spring -- high biomass
  - small mammals including mice and ground squirrels (before and after hibernation), sharp tailed grouse, hare or rabbit.
- Winter -- less biomass required
  - small mammals and insects active under snow, occasional hare, rabbit or sharp tailed grouse.

This suggestion is based on the premise that in our Manitoba winter the swift fox would become very much less active and remain in its den for long periods of time during severe weather thus saving energy and requiring less food. The use of a den all year long is reported frequently in the literature (Seton, 1925; Cutter, 1958a; Kilgore, 1969). The swift fox would be expected to survive in winter through a combination of its flexible utilization of the prey base and its denning behavioural adaptation.

Smeeton (1984) lends credence to the view that swift foxes would survive Canadian prairie winters in his passages about escaped swift foxes from his Alberta captive breeding population:

"He was in good shape having survived six months and the first half of a severe winter on his own."

"She had been away for two and half years, for two breeding seasons . . ."

"There is no reason why he should not have survived the winter as we have since had a fox leave us in the late fall and then return in the spring."

#### 4.1.2 Release Area/Site Selection Criteria

The release area/sites should be selected using the following criteria (Carlington, 1980):

- a. A release area should be within the recognized former range of the swift fox and be within the mixed-grass prairie region of the Grassland Biome.
- b. Only those areas still maintaining native mixed-grass prairie communities in the least-disturbed state should be considered.
- c. A release area should meet the following primary biological needs:
  - i) Food availability (especially critical in winter)
  - ii) Denning habitat including well drained, easily excavated slopes with good visibility of surrounding area
  - iii) Water source (within approximately 2 km)
  - iv) Sufficient size to minimize chances of expanding population moving immediately out of the protected area
- d. Security must be provided for an adequate length of time from:
  - i) poisoning/predator control
  - ii) unrestricted hunting and trapping
  - iii) road kills on country roads/highways
  - iv) harassment by recreational vehicles
  - v) disturbance by other human activities

- e. Management access for care (feeding and watering) and monitoring the swift foxes during the holding and release phases must be possible.

#### 4.1.3 Site-selection Criteria Applied

Table 8 shows the release-area/site-selection criteria applied to the Shilo and Ellice-Archie Community Pasture study areas.

The EACP study area appears to be outside the former range of the swift fox. Although no accurate written or mapped information is available to confirm this one way or another, the existence of doubt as to the historic range boundary is sufficient to warrant favouring Shilo as the release area. It is known to be within the historic range (Seton, 1909).

The modification of vegetation and impact on native prairie habitat by grazing on the EACP may be the cause of the low species abundance and variety when compared to the more natural Shilo study area. As a result the Shilo study area seems more favourable as a release area.

In regard to prey numbers and variety, even though the numbers on the Shilo study area are not much higher than those on the EACP study area, the fact that trapped and observed species variety is greater, is significant. This factor is most important for winter food availability. There was a greater variety of small mammals on the Shilo area that would be active above and under snow. As discussed previously the swift fox may be quite flexible in its prey utilization and winter behaviour in order to survive.

Table 8. Comparison of the Shilo and EACP Study Areas using the site selection criteria.

CRITERIA CATEGORY	RELEASE AREA/SITE SELECTION CRITERIA	SHILO MILITARY RESERVE STUDY AREA	EACP STUDY AREA
Location	Within former swift fox range	Yes	Undetermined due to lack of accurate historic range boundary
Habitat	Native prairie vegetation	Yes (somewhat disturbed by military activity)	No (grazing and haying have modified it)
	Adequate numbers and variety of prey species	Yes	Less variety and lower numbers (possible winter scarcity)
	Adequate den sites	Yes	Yes (but larger rocks and coarse gravel)
	Permanent waterbodies	Yes	Yes
Security	Protection from human activity	Yes by military patrol	No present security inadequate
	Sufficient size	Yes (for limited number of foxes)	Yes (for limited number of foxes)
	Protected over long term	Yes (use for next 10 years by military)	Enforcement would need to be implemented
Management Access	Fairly accessible year round	Yes	Yes

Water availability is comparable for both the Shilo and EACP study areas. However there is some question as to whether the coarse, somewhat rocky soil of the EACP study area is ideal for swift fox denning. Reynolds (1983) described den-site soils as including clay, loam, clay-loam and sandy-clay-loam types. The Shilo study area soils more closely approximate this description with more sand than clay.

Protection from human activity is also an important criteria not met by the EACP study area. Continued military use and patrolling of the Shilo ranges for the duration of the recently signed federal/provincial lease (approximately 10 years) ensures restricted unauthorized access. The EACP study area would require a new surveillance program to be implemented and maintained until a swift fox population could establish itself. The community pasture manager Milton Henry suggested that snowmobile activity on EACP is presently an uncontrollable disturbance to wildlife. On the other hand one might view the existence of military activity at Shilo as a disadvantage rather than as a protective advantage to the release of swift foxes. Tank manouvres and artillery firings are noisy there. However many species of wildlife including coyotes and red foxes as well as elk, deer and sharp-tailed grouse are common and even abundant at Shilo in spite of the apparent disturbances. Also the "soft release" technique used in such reintroductions is intended to acclimatize the foxes during the holding phase to all aspects of the release site environment.

One aspect of human activity that cannot easily be protected against is vehicle-wildlife collisions. The EACP study area has an important regional highway running through it which divides the available swift fox habitat. It is likely that, because road kills frequently occur

at night and because swift foxes are primarily nocturnal, this road would be a significant hazard to reintroduced animals.

Both study areas are accessible year round to swift fox project managers conducting maintenance and monitoring activities.

There is one aspect of the release area selection process that is not included as a criteria but that may have some bearing on the success of a successful swift fox reintroduction. It is the characteristics of the coexistence of swift foxes and other canids. Egoscue (1962) and Schitoskey (1975) both reported that swift foxes live successfully in close proximity to coyotes and red foxes. Although this means that all three species may use some of the same prey species, competition seems not to affect any of them adversely. That red foxes and coyotes exist in habitat areas thought to be suitable for swift foxes may in fact be an indicator that the habitat is indeed suitable for swift foxes. In other words if other canids survive over the years in an area so should swift foxes. To support this hypothesis information on the trends in canid population numbers was sought from fur records on red foxes and coyotes for southwestern Manitoba where the study areas are located. Table 9 provides a 9 year record of canid furbearer harvests of which Coulson (1985) estimates 50% was taken from the most southerly portion of the open trapping area known as Zone I and which includes Shilo Military Reserve. He also suggested that although fox-coyote populations are evenly distributed over Zone I certain areas have better habitat than others. One such area is adjacent to Spruce Woods Provincial Park and Forest which of course corresponds to the Shilo release area. The numbers of foxes and coyotes harvested for furs certainly fluctuated from year to year (Table 9) probably due more to factors of the

Table 9. Harvests of red fox and coyote as furbearers in southwestern Manitoba

YEAR	RED FOX <sup>a</sup>	COYOTE <sup>a</sup>
1975-76	4776	5330
76-77	5050	4620
77-78	3729	3827
78-79	4159	4649
79-80	3612	3566
80-81	2649	2889
81-82	5139	4708
82-83	4570	5854
83-84	3607	5159
Average	4143	4511

Note:

- a. These figures do not include canids taken in predator control efforts or for pelts used in handicrafts or personal items.

Source: Coulson, 1985



trapping business such as markets and travel conditions in the field, than to population numbers. However the fact that the canid populations did sustain a harvest at the level indicated over the 9 year period indicates something about fox-coyote survival probabilities in the habitat area.

#### 4.1.4 Attitude Survey

##### a. Roles of the Survey

The formal attitude survey had two functions. Firstly the mailing, which included a covering letter, a swift fox information sheet and the questionnaire, served an education role. Secondly the questionnaire itself had the more obvious role of soliciting attitude and comments from the respondents.

The education role was also served by an informal attitude survey. An informal information program using presentation/discussions, mailings and community bulletin boards was carried on during research work in each study area. Rural Municipal Councils, the Manitoba Wildlife Federation, the Manitoba Naturalists Society, Agriculture Representatives and individuals were contacted in this way. The result of this activity was a higher level of awareness about the swift fox project.

##### b. Survey Questionnaire

The three most important attitude areas surveyed by the questionnaire were:

- a. level of support or opposition to the reintroduction,
- b. level of support or opposition to restrictions on hunting and trapping,
- c. level of support or opposition categorized to reflect

residency status near the study areas (ie. landowner non-farmer, farmer, town resident).

Eighty-three out of 195 questionnaires were returned giving a 43% response rate. Five questionnaires were returned, address unknown. The data on these attitudes are summarized in Table 10 and discussed below.

For the question about general attitude toward reintroduction to the Shilo area 78% of all respondents answered. Twenty-two (22) percent did not answer the question. With 60% of respondents supporting and the proportion of people against at only 5% it is clear that a strong supportive attitude toward reintroduction exists. In regard to the question about general attitude to reintroduction to the EACP area 86% of all respondents answered. Thirteen (13) percent did not answer the question. Seventy (70) percent of respondents supported reintroduction in the EACP area. Therefore like the results for the Shilo area a supportive attitude toward reintroduction exists.

Respondents showed support for hunting and trapping restrictions (80% for Shilo, 80% for EACP).

The data on the basis of residency status categories show the same support for the reintroduction. In each category the proportion of respondents supporting the reintroduction is significantly larger than the proportion of respondents against it. For example 38% of all respondents who were mixed and livestock farmers and lived in the Shilo area supported the reintroduction compared to only 4% of mixed or livestock farming respondents who were against it. The results are similar for the EACP area meaning that livestock farmers do not fear depredations by this animal.

Table 10. Results of the attitude survey shown as the percentage of all respondents having a certain attitude.

ATTITUDE AREA	SHILO	EACP
<u>GENERAL ATTITUDE<sup>1</sup></u>		
Support	60%	70%
Against	5	4
Neutral	13	12
<u>ATTITUDE TO RESTRICTIONS<sup>1</sup></u>		
Support	80	80
Against	10	13
Neutral	7	5
<u>ATTITUDE BY RESIDENT STATUS<sup>2</sup></u>		
Landowner Non Farmer		
Support	17	17
Against	2	1
Neutral	4	2
Farmer		
Grain Only Farm		
Support	4	8
Against	0	0
Neutral	1	1
Mixed Farm		
Support	31	35
Against	4	5
Neutral	10	7
Livestock		
Support	7	6
Against	0	0
Neutral	1	1
Town Resident		
Support	7	6
Against	1	1
Neutral	2	1

- 1 Where percentages do not total 100 the non-responses make up the difference.
- 2 Where percentages do not total 100 in the categories (ie. Landowner Non Farmer, Farmer, Town Resident) the difference is made up by respondents resident elsewhere and non-responses to the question.

The questionnaire contained some open-ended questions designed to allow written comment on certain aspects of the project. Questions 2 and 3 asked respectively for advantages and disadvantages of the reintroduction. Forty percent of respondents offered opinions about the Shilo study area compared to 50 percent for the EACP study area. Of the people that offered an opinion on advantages, the majority saw the pest-control potential of the swift fox as the greatest advantage. As for disadvantages, 95% could see none for the Shilo study area while 92% could see none for the EACP study area.

Question 4 asked for written further comment about restrictions on trapping and hunting in the release area. Of the 19 respondents that commented on trapping, 13 agreed that trapping should be restricted. Comments included; "want to see all predator numbers increase", "trapping is not selective", "too many hunters using ski-doo's", "if coyotes and red foxes compete for food with swift foxes, do not restrict trapping", "I have noticed some decline in coyotes and foxes in areas where I hunt and trap".

Of the 26 respondents that commented on hunting, 16 were in favour of restrictions. Comments included; "have had land abused by hunters", "hunting small animals and deer should be reduced anyway", "not for too long so coyotes don't become a nuisance", "restrict outside hunters".

At a presentation given to the Manitoba Wildlife Federation executives in Morden, the Wild Gobblers Unlimited group expressed some concern about swift fox predation on wild turkey chicks and eggs from a reintroduced population in the Shilo area. Information on swift fox habitat preference and food habits was provided and discussed at that meeting and during a subsequent telephone conversation with Jack Dunlop,

the group's president. Of course there is no guarantee that a predator like the swift fox will be anything but an opportunistic hunter. However its preference for open prairie habitats as opposed to the forest habitat of the wild turkey would likely keep encounters between the two species to a minimum. Perhaps a bird the size of the turkey would be able to defend itself, its eggs or its chicks against the swift fox which is only one half the size of a red fox.

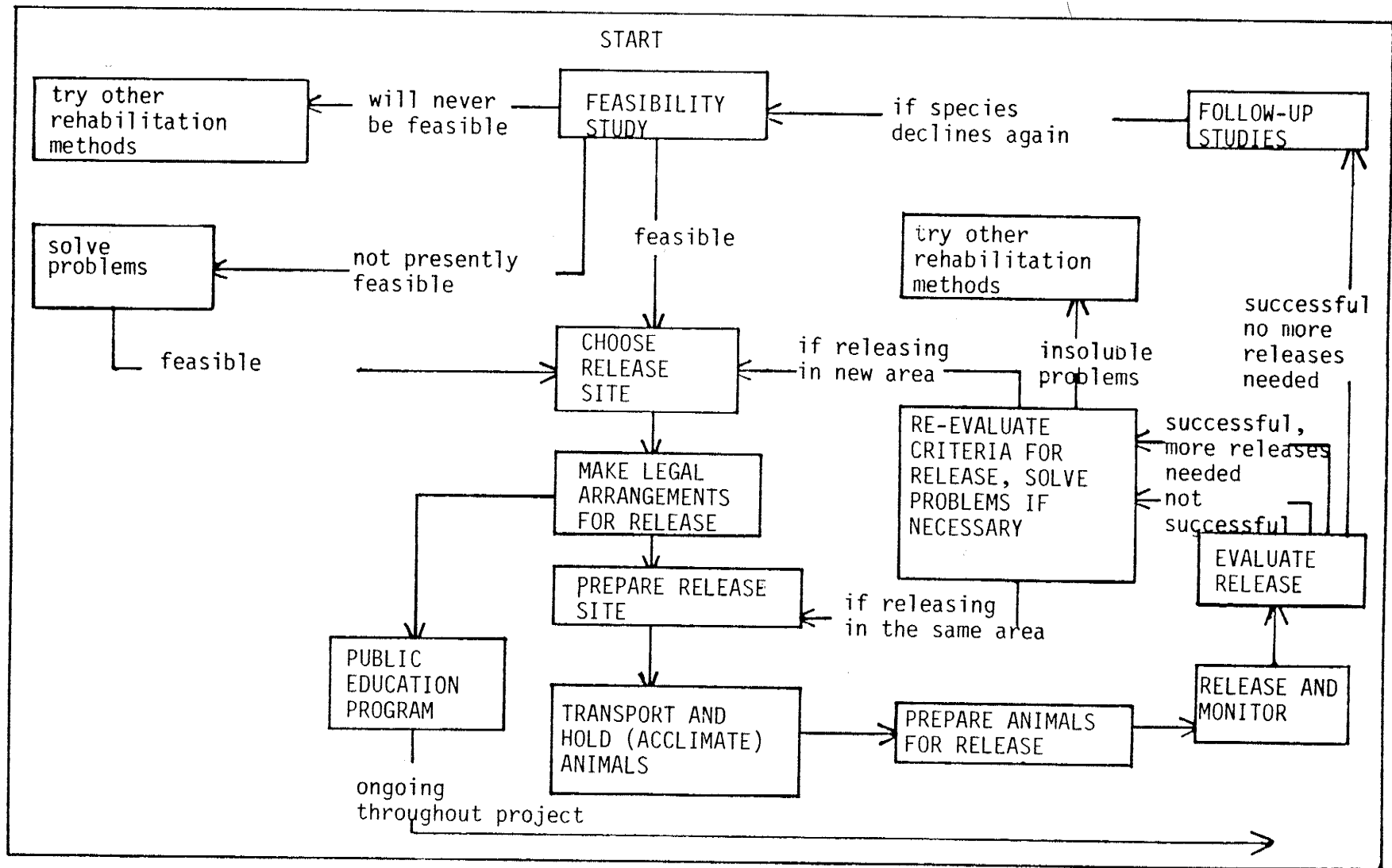
Sharp-tailed grouse are also important to game bird hunters in Manitoba, and some concern about predation of the birds by swift foxes was expressed during the informal attitude survey with various groups and individuals. It was pointed out that the sharp-tailed grouse population of the Shilo area in particular is stable and perhaps remains higher, even in low years, than elsewhere in Manitoba. This population level occurs in spite of predation by reportedly high populations of coyote and red fox in the same area. Additional predation on sharp-tailed grouse by swift foxes would not be a major mortality factor. Furthermore the swift fox population will not likely increase to a point where over predation would occur because not enough preferred habitat is available and coyote predation on swift foxes has been documented as a population control (Kilgore, 1969; Carbyn, 1985).

## 4.2 Reintroduction

### 4.2.1 Reintroduction Process

Figure 5 illustrates the general reintroduction process which includes three major phases, the feasibility study, the holding phase

Figure 5. Reintroduction process flow chart.



Source: Reynolds, 1983

and the release/monitoring phase. The feasibility study is now complete for the Manitoba Swift Fox Project. The holding phase, which includes logistical and legal arrangements for the release, release-site preparation, and the transportation and acclimatization of the foxes at the site, should now begin.

Logistical and legal arrangements include a Canada/Manitoba cooperative funding agreement, site-protection regulations, and acquisition of the swift fox breeding pairs from the Alberta captive stock. The release site will be prepared by building adequate fencing and artificial den boxes as illustrated in Appendix D and E, respectively. Transportation to the site and care of the foxes would then follow. In Alberta the foxes in holding were fed at least every second day in summer and winter. Careful monitoring of the food consumed or left untouched will help guide the keeper as to quantities to feed. A commercial dog food, dead chicks from a hatchery, and road-kill deer and antelope were fed in the Alberta project. Water was always available in summer in pails in the holding pens. The holding phase is essential to the success of the release in order that the pair of swift foxes in each holding pen acclimate to the new surroundings. They would further bond to their new home territory by breeding in late winter, in the final months of the holding phase.

The release and monitoring phase of the swift fox reintroduction will follow. Release involves preparing the foxes (ear-tagging, vaccinating against rabies and distemper and radio-collaring) and then making an opening in the holding pen. For a month prior to the release, a live-prey familiarization program should be conducted. This involves live-trapping and releasing local prey species into the pens. Feeding in the pen is continued until the foxes seem to be hunting in the wild and move away and/

or build a new den. Monitoring involves radio-telemetry tracking, (Appendix F), perhaps recapture, collection of any fox carcasses found, collection and analysis of scat samples, observation of fox activity using night scopes, and observation at den sites.

#### 4.2.2 Release Strategy

Figure 6 shows a comparison of release strategies all of which are "slow" or "soft" release techniques, meaning that the foxes are not released abruptly into the wild. Strategy 5 is favoured for the following reasons:

- a. Foxes already pair-bonded may stand a better chance of establishing in the release area (Sharps and Witcher, 1981). Therefore established breeding pairs over-wintered in holding pens will acclimate, produce a litter of pups, and when released will likely stay in the release area.
- b. The young of the year will naturally disperse in late August or early September (Kilgore, 1969; Hillman and Sharps, 1978). Therefore dispersal into other parts of the release area by young born in the holding pens, a desirable event, will occur shortly after the pens are opened to the wild.

#### 4.2.3 Public Education Program

A public education program is required in the swift fox release area concurrent with the holding phase and to be carried on throughout the release and monitoring phase. The surveyed residents of the study areas showed their support for a swift fox release and by their answers to survey questions showed that they had acquired some knowledge of the swift fox's



Figure 6. Comparison of release strategies.

Types of Foxes	Season of Transport	Season of Release	Time on Site Before Release	Strategy Number
Young of the year, paired	early fall	late fall	1-2 months	1
	late fall to early winter	early summer	6-8 months, thru pupping season	2
Yearlings, paired	early spring	early summer	3-5 months, thru pupping season	3
Established breeding pairs	early fall	late fall	1-2 months	4
	late fall to early winter	early summer	6-8 months, thru pupping season	5
	early spring	early summer	3-5 months, thru pupping season	6
Family groups	late spring or early summer	late summer to early fall	1-2 months	7

Adapted from: Reynolds, 1983

biology. The public education program should reach many more of the Shilo release area residents. Figure 7 shows education-program elements and a general schedule for their implementation. The information content of each element of the program is outlined below:

a. Brochure

- i) Emphasis on what the fox looks like (photographs) in comparison to red foxes and coyotes.
- ii) Briefly describe swift fox history and status in Canada and United States.
- iii) Swift fox biology (life history) should be discussed focusing on its preferred habitat, food habits and denning behaviour.
- iv) Discuss the reasons for such a reintroduction, how likely it is to succeed, and what is likely to hinder success (ie. harassment, hunting, trapping, natural mortality).
- v) Discuss the reintroduction process (feasibility, holding, release) and strategy. Give names and addresses and describe the activities of anyone working on the project. Sightings and fox carcasses can then be reported to the worker.
- vi) Discuss any protective regulations that will be in force for part or all of the project.

b. Media - The media will receive the brochure and hopefully will seek more information on the project. When the release date is set, then media should be contacted again with information focusing on the release of swift foxes to the wild from the holding phase.

c. Slide Presentations - School children, service groups, Spruce Woods Park visitors and naturalists groups can be reached effectively using slide talk presentations. The direct personal contact allows the public to ask questions of project staff.

Figure 7. General schedule for the elements of the public education program and the locations where the program should be conducted.

ELEMENT	PROJECT PHASE	
	HOLDING	RELEASE/MONITORING
BROCHURE	Schools, stores, ag. reps., rec. centre, S.W.P.P., hunter-trapper lisencc attach- ment, etc.	Continuing
MEDIA - newspaper radio t.v.	Local, reg., Brandon, Wpg. Brandon, Winnipeg Brandon, Winnipeg	New focus on release
SLIDE PRESENTATIONS	Schools, local wildlife service groups, other groups, S.W.P.P. visitor program	Continuing and new focus
POSTER		Schools, grocery stores, gas stations rec. centres, ag. reps., and govt. offices, etc.
UPDATE FLYERS		Mail, schools, offices, stores, etc.

- d. Poster - The Alberta swift fox project developed a poster to support the actual release of foxes. Its theme was DON'T SHOOT OR TRAP and it used photographs and silhouette drawings to help people identify the swift fox and distinguish it from red foxes and coyotes.
- e. Update Flyers - The public, especially those in the Shilo release area, must be kept informed of the success of the project. They should know how they can help by reporting sightings and carcasses of swift foxes and where they can continue to get information about the release and monitoring phase. Only in this way will the level of support found in the feasibility study and nurtured in the holding and release/monitoring phases be maintained. It is most important to maintain this support so that subsequent reintroductions into the same area can be done.

## CHAPTER 5.0

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

The conclusions fall into two categories as did the results in Chapter 4.0.

##### 5.1.1 Feasibility

- a. Although no absolute historical record of the swift fox in Manitoba exists (ie. museum specimens), the historical observations of explorers and traders and the documented historical presence of the fox in North Dakota leaves little doubt that the swift fox occupied its natural habitat on the Manitoba prairie as it did elsewhere on the Canadian prairies.
- b. The reintroduction of swift foxes to southwestern Manitoba is feasible ecologically and socially.
- c. There is habitat available in both study areas of sufficient quality and quantity to accommodate reintroduction of swift foxes.
- d. From the comparison of the study areas in Table 9, I concluded that Shilo satisfies the site-selection criteria more fully than EACP.

- e. The reintroduction of the swift fox will cause no major impacts on land use in the area surrounding a release site in Shilo Military Reserve.
- f. The low level opportunistic predation on wild turkeys and sharp-tailed grouse by swift foxes reported in Section 2.2.7 and discussed in Section 4.1.4 is unlikely to be a major game bird mortality problem.
- g. Coyote predation on swift foxes as reported in Section 2.2.7 may be a problem in release areas. The only viable possible solution to this problem is continued annual releases to increase the population numbers and to increase the chances of breeding success.
- h. The land uses in the area surrounding the release sites will have minimal impact on the released swift foxes given adequate regulatory protection of the animal and if a public education program is carried out.
- i. The attitude survey showed that there is support for swift fox reintroduction to southwestern Manitoba.
- j. The attitude survey showed that among non-farm and farm landowners in both study areas, the same attitudes exist toward a reintroduction.
- k. A strong attitude favouring trapping and hunting restrictions in a release area is indicated by the attitude survey results.

### 5.1.2 Reintroduction

- a. The reintroduction process developed in Alberta is a workable technique. During the research for this report swift foxes were successfully released to the wild there.
- b. The release strategy number 5 from Figure 6 will work in the Manitoba setting with strategy 2 being the best alternate.
- c. A public education program to keep release area residents informed about the reintroduction before, during the holding phase and after the actual release will help gain or maintain their support.

### 5.2 Recommendations

I have concluded that the reintroduction of swift foxes to southwestern Manitoba is feasible. The following recommendations provide a schedule of events as well as a set of guidelines to follow to ensure project success.

- 5.2.1 The reintroduction of swift foxes should proceed.
- 5.2.2 The first reintroductions should take place using release sites on the Shilo Military Reserve in Area 7 and Area C (see the Shilo Military Reserve Map).
- 5.2.3 Release strategy 5 (Figure 6) should be implemented.

- 5.2.4 Holding facilities should be constructed for 3 breeding pairs by the end of August and the pairs of swift foxes should be brought to and placed in the pens by the end of September (2 pairs for Area 7, one pair for Dielinghofen). The holding pens should be placed approximately 3 kilometers from each other.
- 5.2.5 The holding phase, in which care and observation of the foxes is required, should last until the beginning of June the next year (8 months) and should include feeding of live native prey to the captive animals for one month prior to release.
- 5.2.6 The release to the wild (preceded by radio collaring, marking and preventive veterinary care) should take place before the end of June and should include continued feeding by a keeper for 2 months to ensure that the foxes are more slowly required to feed themselves.
- 5.2.7 Radio tracking and field observation of the released animals should continue to the end of June the next year (12 months).
- 5.2.8 The managers of the swift fox reintroductions in Alberta and Saskatchewan should be contacted to get information on the success or the problems encountered in those releases.
- 5.2.9 If the swift fox release is deemed successful as a result of monitoring in 5.2.7 then holding facilities should be



constructed and breeding pairs placed on other release sites on the Shilo Military Reserve. The release strategy and schedule above would again be used.

- 5.2.10 If the released swift fox population undergoes severe predation by coyotes two possible solutions could be attempted. These are:
- a. annual releases to previously used release sites in the Shilo area
  - b. a reintroduction project implemented at the Ellice-Archie Community Pasture.
- 5.2.11 If released swift foxes are lost due to controllable human activity mortality factors at any release area, then replacement breeding pairs should be brought and put through holding and release phases as outlined.
- 5.2.12 Throughout the holding and release/monitoring phases, frequent reference should be made to Figure 5 so that the process, with its feed-back mechanisms, can provide project guidance.
- 5.2.13 A public-education program as outlined in the results section should be conducted during both the holding phase and the release phase of any reintroduction.
- 5.2.14 Contact should be maintained with the agencies, groups and individuals listed in Appendix B.

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APPENDIX A  
ATTITUDE SURVEY MAILINGS



THE UNIVERSITY OF MANITOBA

NATURAL RESOURCES INSTITUTE

Winnipeg, Manitoba  
Canada R3T 2N2  
(204) 474-8375COVERING LETTER

December 9, 1983

Dear Sir or Ms.

ATTITUDE SURVEY - MANITOBA SWIFT FOX PROJECT

I am conducting a study of the feasibility of reintroducing the swift fox to south-western Manitoba. One component of my research is to determine the attitudes of residents and/or landowners in the study area toward the planned reintroduction.

I have enclosed a swift fox information sheet and a questionnaire. Would you take a moment to read about the swift fox and then answer the questionnaire?

I look forward to your response and thank you for your help. The results of the survey will be sent to you in early January, 1984. Please feel free to contact me if you have any questions about my research.

Yours sincerely,

*John H. Pattimore*

Graduate Student



## SWIFT FOX INFORMATION SHEET

### DESCRIPTION

The swift fox which is closely related to the kit fox of the American desert areas is about the size of a cat. At an average weight of 2.5 kg the swift fox is only one half the size of a red fox and one quarter the size of a coyote. Its fur is yellow-brown tinged with grey on the back, lighter on the sides and a pale yellowish brown on the underside.

### BIOLOGY

Swift foxes prefer open prairie habitats where they prey on small mammals such as mice, voles, and gophers as well as birds, insects and reptiles. The swift fox is a nocturnal hunter and sometimes uses the dusk and dawn hours. Breeding is usually in late January or February and litters of 4 - 6 pups are born in April. The swift fox uses a den for whelping as do the red fox and coyote but displays a distinct behavioural difference. Unlike red foxes or coyotes, swift foxes use specific dens year round for sleeping and avoiding predators and extremes of heat and cold. The den is built on the open plains often on a south facing slope and becomes roughly the center of a 1.5 - 3 square kilometer hunting territory or home range.

### STATUS

Unfortunately the swift fox was totally eliminated from the Canadian Prairies by the late 1920's. In Manitoba the last records of the animal suggest it disappeared between 1900-1910. Although the swift fox was not an agricultural pest or an important furbearer, it was the accidental victim of poisoning and trapping campaigns directed at gophers, coyotes and wolves.

Recently, swift foxes were released to the wild in south-eastern Alberta and by late 1984 will be wild in Saskatchewan.

### PLANNED MANITOBA SWIFT FOX REINTRODUCTION

The governments of Canada and Manitoba are planning to reintroduce the swift fox to its historic range in south-western Manitoba. A study to determine the feasibility of the reintroduction is now underway.

This research began in May of 1983 at two study areas: Shilo Military Reserve and Ellice-Archie Community Pasture. Funding was provided by:

Wildlife Branch, Manitoba Department of Natural Resources  
Natural Resources Institute, University of Manitoba  
World Wildlife Fund (Canada)  
Manitoba Naturalists Society

There are two major components of the study. The biological feasibility of swift fox reintroduction will be determined by surveying the quality of the habitat available at the study areas. The attitudes of residents and landowners in the study areas will be determined through a survey questionnaire.

#### WHY REINTRODUCE THE SWIFT FOX

There are two reasons for reintroducing the swift fox to southwestern Manitoba. This animal was historically a part of the prairie ecosystem and was eliminated by human activity in spite of its harmlessness to human interests. It is exciting to those interested in wildlife to think that we could re-establish the swift fox and move toward a prairie environment with its complete endowment of wild animals. The more diverse the flora and fauna of an ecosystem the more stable or healthy it will be.

The predatory habits of the swift fox have been recognized as a useful biological pest control measure. The quantities of small mammals and insects it consumes, thereby reducing crop damage, is substantial.

If you wish further information, please call or write:

John H. Pattimore  
Graduate Student  
Natural Resources Institute  
University of Manitoba  
177 Dysart Road  
Winnipeg, Manitoba  
R3T 2N2

Ph. 474-8373

QUESTIONNAIRE

MANITOBA SWIFT FOX PROJECT

Please mark your answers with a ✓ and feel free to provide further written comment for any question. In some cases more than one answer may be chosen.

1. If swift fox reintroduction is found to be feasible how would you feel about its reintroduction to:

a. SHILO MILITARY RESERVE?

- STRONGLY SUPPORT \_\_\_\_\_
- SUPPORT \_\_\_\_\_
- NEUTRAL \_\_\_\_\_
- AGAINST \_\_\_\_\_
- STRONGLY AGAINST \_\_\_\_\_

b. ELLICE-ARCHIE COMMUNITY PASTURE?

- STRONGLY SUPPORT \_\_\_\_\_
- SUPPORT \_\_\_\_\_
- NEUTRAL \_\_\_\_\_
- AGAINST \_\_\_\_\_
- STRONGLY AGAINST \_\_\_\_\_

2. In your opinion are there any advantages to reintroducing swift foxes to:

a. SHILO MILITARY RESERVE \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

b. ELLICE-ARCHIE COMMUNITY PASTURE \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. What disadvantages do you think would be involved in a swift fox reintroduction to:

a. SHILO MILITARY RESERVE \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. ELLICE-ARCHIE COMMUNITY PASTURE \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. If reintroduction of swift foxes proceeds, trapping and hunting of foxes and coyotes may be temporarily restricted in the release area until the swift fox population becomes established.

a. Would you agree with restrictions on trapping?

YES \_\_\_\_\_

NO \_\_\_\_\_

DON'T KNOW \_\_\_\_\_

FURTHER COMMENT \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. Would you agree with restrictions on hunting?

YES \_\_\_\_\_

NO \_\_\_\_\_

DON'T KNOW \_\_\_\_\_

FURTHER COMMENT \_\_\_\_\_

4.b. cont.

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In order to establish a demographic profile of respondents, some personal information is required. Such information is useful in analysing which segments of the population hold certain attitudes. All information will be kept confidential.

5. a. If you are a voter in the R.M. of North Cyprus, are you a

- RESIDENT IN R.M. \_\_\_\_\_
- RESIDENT ELSEWHERE \_\_\_\_\_
- FARMER \_\_\_\_\_
- LANDOWNER (NON-FARMER) \_\_\_\_\_
- TOWN RESIDENT \_\_\_\_\_

b. If a farmer, what type of operation do you run?

- GRAIN ONLY \_\_\_\_\_
- MIXED \_\_\_\_\_
- LIVESTOCK  
BEEF \_\_\_\_\_
- HOGS \_\_\_\_\_
- POULTRY \_\_\_\_\_

6. a. If you are a voter in the R.M. of South Cyprus, are you a

- RESIDENT IN R.M. \_\_\_\_\_
- RESIDENT ELSEWHERE \_\_\_\_\_
- FARMER \_\_\_\_\_
- LANDOWNER (NON-FARMER) \_\_\_\_\_
- TOWN RESIDENT \_\_\_\_\_

b. If a farmer, what type of operation do you run?

- GRAIN ONLY \_\_\_\_\_
- MIXED \_\_\_\_\_
- LIVESTOCK \_\_\_\_\_
- BEEF \_\_\_\_\_
- HOGS \_\_\_\_\_
- POULTRY \_\_\_\_\_

7. a. If you are a voter in the R.M. of Archie, are you a

- RESIDENT IN R.M. \_\_\_\_\_
- RESIDENT ELSEWHERE \_\_\_\_\_
- FARMER \_\_\_\_\_
- LANDOWNER (NON-FARMER) \_\_\_\_\_
- TOWN RESIDENT \_\_\_\_\_

b. If a farmer, what type of operation do you run?

- GRAIN ONLY \_\_\_\_\_
- MIXED \_\_\_\_\_
- LIVESTOCK \_\_\_\_\_
- BEEF \_\_\_\_\_
- HOGS \_\_\_\_\_
- POULTRY \_\_\_\_\_

8. a. If you are a voter in the R.M. of Ellice, are you a

- RESIDENT IN R.M. \_\_\_\_\_
- RESIDENT ELSEWHERE \_\_\_\_\_
- FARMER \_\_\_\_\_
- LANDOWNER (NON-FARMER) \_\_\_\_\_
- TOWN RESIDENT \_\_\_\_\_

b. If a farmer, what type of operation do you run?

- GRAIN ONLY \_\_\_\_\_
- MIXED \_\_\_\_\_
- LIVESTOCK \_\_\_\_\_
- BEEF \_\_\_\_\_
- HOGS \_\_\_\_\_
- POULTRY \_\_\_\_\_

9. Which of the following outdoor activities do you participate in?

- CROSSCOUNTRY SKIING \_\_\_\_\_
- CAMPING \_\_\_\_\_
- DIRT BIKING \_\_\_\_\_
- HIKING \_\_\_\_\_
- HUNTING \_\_\_\_\_
- NATURE STUDY \_\_\_\_\_
- PHOTOGRAPHY \_\_\_\_\_
- SNOWMOBILING \_\_\_\_\_
- TRAPPING \_\_\_\_\_

OTHER \_\_\_\_\_

10. In your outdoor pursuits how important is the presence of wildlife to your enjoyment of the above activities?

- VERY IMPORTANT \_\_\_\_\_
- FAIRLY IMPORTANT \_\_\_\_\_
- NEUTRAL \_\_\_\_\_
- LITTLE IMPORTANCE \_\_\_\_\_
- NO IMPORTANCE \_\_\_\_\_

FURTHER COMMENT \_\_\_\_\_  
\_\_\_\_\_

11. Do you belong to a wildlife related organization?

YES \_\_\_\_\_

NO \_\_\_\_\_

IF YES, NAME \_\_\_\_\_

12. What is your age?

15-19 \_\_\_\_\_

20-24 \_\_\_\_\_

25-34 \_\_\_\_\_

35-44 \_\_\_\_\_

45-54 \_\_\_\_\_

55-64 \_\_\_\_\_

65 PLUS \_\_\_\_\_

13. What education level do you hold?

0-8 YEARS \_\_\_\_\_

SOME SECONDARY \_\_\_\_\_

NO POST SECONDARY \_\_\_\_\_

SOME POST SECONDARY \_\_\_\_\_

POST SECONDARY \_\_\_\_\_

CERTIFICATE OR DIPLOMA \_\_\_\_\_

UNIVERSITY DEGREE \_\_\_\_\_

14. Are you:

MALE? \_\_\_\_\_

FEMALE? \_\_\_\_\_





THE UNIVERSITY OF MANITOBA

NATURAL RESOURCES INSTITUTE

Winnipeg, Manitoba  
Canada R3T 2N1  
(204) 474-8373

January 25, 1984

REMINDER LETTER

Dear Sir or Ms.:

Attitude Survey - Manitoba Swift Fox Project

In early December, 1983 an information sheet, a survey questionnaire and a self-addressed stamped envelope were mailed to you. I have not yet received a response from you. The replies already received from other study area residents are greatly appreciated but more responses are required to help make the survey a success.

Please take a moment to read the information sheet on the swift fox and answer the questionnaire. If you have misplaced the previous mailing another will be sent on about February 16, 1984. If you have already replied please ignore this letter.

I look forward to and thank you for your participation in the Swift Fox Project.

Yours truly,

  
John H. Pattimore,  
Graduate Student

JHP:ncd

APPENDIX B  
CONTACTS IN  
AGENCIES AND ORGANIZATIONS  
WITH AN INTEREST IN THE REINTRODUCTION

FEDERAL GOVERNMENT

Lou Carbyn  
Canadian Wildlife Service  
1000-9942-108 Street  
Edmonton, Alberta  
T5K 2J5

George S. Brown  
Director  
Soil and Water Conservation Branch, P.F.R.A.  
Motherwell Building  
1901 Victoria Avenue  
Regina, Saskatchewan  
S4P 0R5

PROVINCIAL GOVERNMENTS

Marlon Killaby  
Wildlife Ecologist  
Wildlife Branch  
Department of Tourism and Renewable Resources  
E.I. Wood Building  
350 Cheadle Street W.  
Swift Current, Saskatchewan  
S9H 4G3

Merlin Shoesmith  
Chief, Biological Services  
Wildlife Branch  
Department of Natural Resources  
1495 St. James Street  
Winnipeg, Manitoba  
R3H 0W9

MANITOBA GROUPS AND MUNICIPALITIES

Manitoba Wildlife Federation  
1770 Notre Dame Avenue  
Winnipeg, Manitoba  
R3E 3K2

Manitoba Naturalists Society  
 214 - 190 Rupert Avenue  
 Winnipeg, Manitoba  
 R3B 0N9

Ernest McCallum (Secretary/Treasurer)  
 Rural Municipality of North Cyprus  
 Box 130  
 Carberry, Manitoba  
 R0K 0H0

Eric Plaetinck (Secretary/Treasurer)  
 Rural Municipality of South Cyprus  
 Box 219  
 Glenboro, Manitoba  
 R0K 0Y0

Claude Chartier (Secretary/Treasurer)  
 Rural Municipality of Ellice  
 Box 100  
 St. Lazare, Manitoba  
 R0M 0Y0

Allen Cole  
 Rural Municipality of Archie  
 McCauley, Manitoba  
 R0M 1H0

#### NATIONAL GROUPS AND UNIVERSITIES

Monte Hummel (Executive Director)  
 World Wildlife Fund  
 60 St. Claire Street E.  
 Suite 201  
 Toronto, Ontario  
 M4T 1N5

Dr. Stephen Herrero  
 Faculty of Environmental Design  
 University of Calgary  
 Calgary, Alberta  
 T2N 1N4

#### UNITED STATES (Key contacts)

Jon C. Sharps  
 Endangered Species Biologist  
 Department of Game, Fish and Parks  
 Rapid City, South Dakota  
 57701

Dr. Mark Boyce  
Department of Zoology and Physiology  
University of Wyoming  
Laramie, Wyoming  
82071

INTERNATIONAL

David MacDonald  
Vulpophile  
Department of Zoology  
Oxford University  
South Parks Road  
Oxford, England  
OX1 3PS

I.U.C.N.  
Species Survival Commission  
Specialist Group on Canids

## APPENDIX C

TRAPPING RESULTS: MANITOBA MUSEUM  
OF MAN AND NATURE7 MILES NORTH OF GLENBORO

- Near Spruce Woods Provincial Park, Manitoba
- October 22, 1970
- 400 traps, one night, 203 small mammals caught
- roadside weeds and grass, dune areas with some trees and sparse grasses
- species and numbers as follows:

- 82 Peromyscus maniculatus bairdii - Deer mouse
- 48 Clethrionomys gapperi - Red-backed vole
- 27 Microtus ochrogaster - Prairie vole
- 26 Microtus pennsylvanicus - Meadow vole
- 1 Onychomys leucogaster - Northern grasshopper mouse
- 1 Perognathus fasciatus - Olive-backed pocket mouse
- 1 Thomomys talpoides - Northern pocket gopher
- 9 Sorex cinereus - Masked shrew
- 3 Tamiasciurus hudsonicus - American red squirrel
- 5 Eutamias minimus - Least Chipmunk

4.5 MILES SOUTH, 2.6 MILES EAST OF PRATT

- September 13, 1972
- 60 traps, 18 small mammals caught
- mixed grass prairie on sandy hill (big and little bluestem, rose, skeleton weed, sage and ground juniper)
- species and numbers as follows:

- 6 Microtus ochrogaster - Prairie vole
- 9 Peromyscus maniculatus - Deer mouse
- 1 Clethrionomys gapperi - Red-backed vole
- 1 Sorex cinereus - Masked shrew
- 1 Thomomys talpoides - Northern pocket gopher

8.1 MILES SOUTH, 4 MILES WEST OF PRATT

- September 13, 1972
- 55 traps, 15 small mammals caught
- dry grass area (little bluestem, rose, skeleton weed and sage)
- species and numbers as follows:

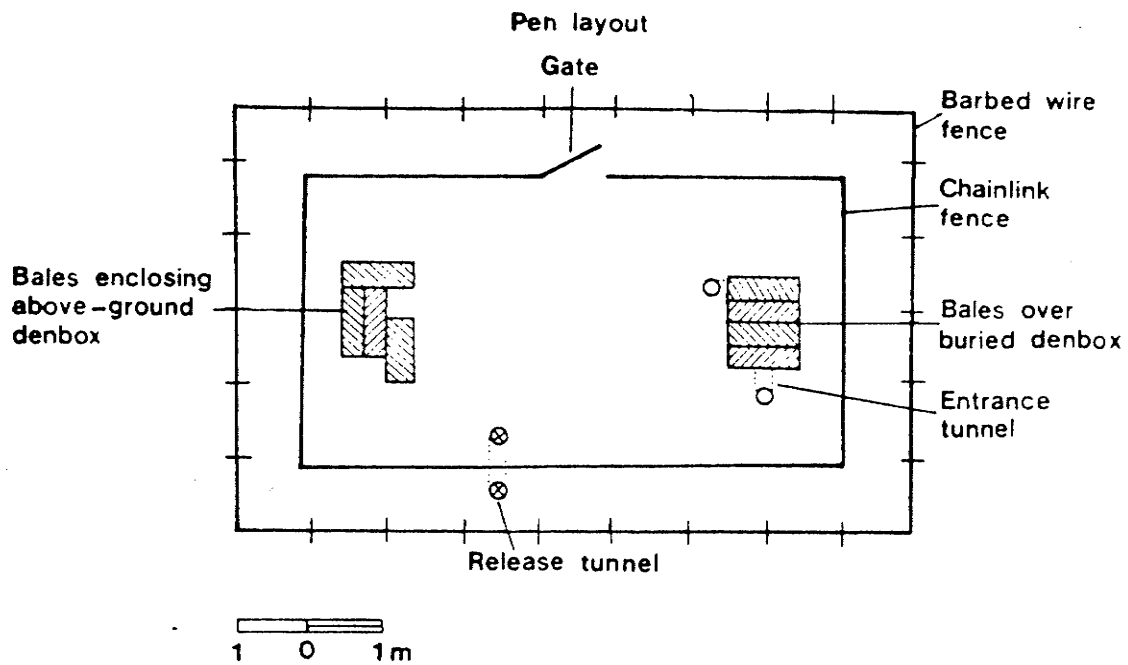
- 5 Microtus ochrogaster - Prairie vole
- 8 Peromyscus maniculatus - Deer mouse
- 1 Clethrionomys gapperi - Red-backed vole
- 1 Sorex cinereus - Masked shrew

6 MILES NORTH, 6 MILES WEST OF GLENBORO

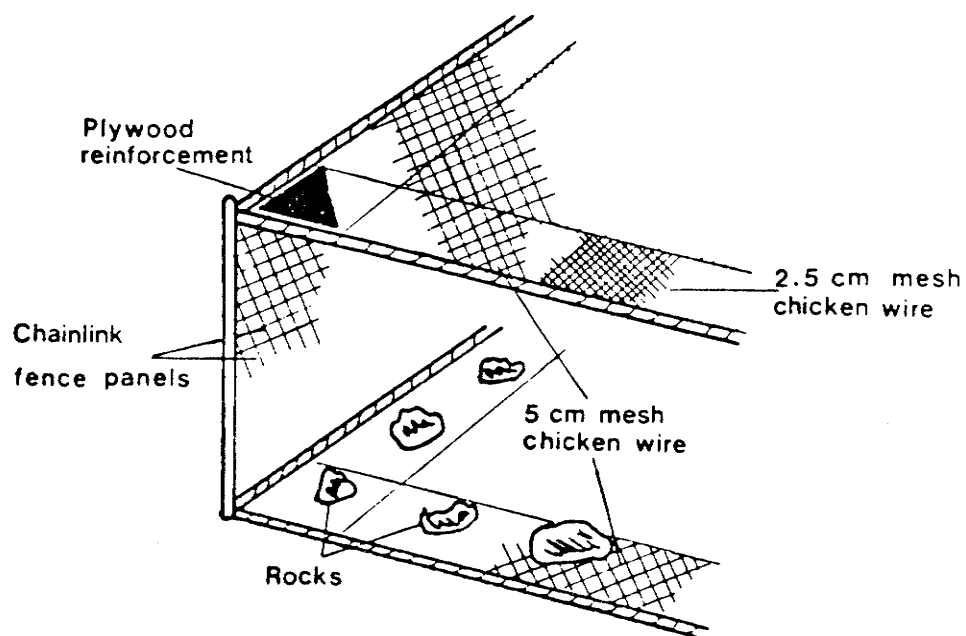
- September 14 and 15, 1972
- 60 traps (120 trap nights), 40 small mammals caught
- dune vegetation (sparse grass, Boutetoua, little bluestem)
- species and numbers as follows:

- 34 Peromyscus maniculatus - Deer mouse
- 2 Clethrionomys gapperi - Red-backed vole
- 4 Microtus ochrogaster - Prairie vole

APPENDIX D  
RELEASE SITE FACILITY



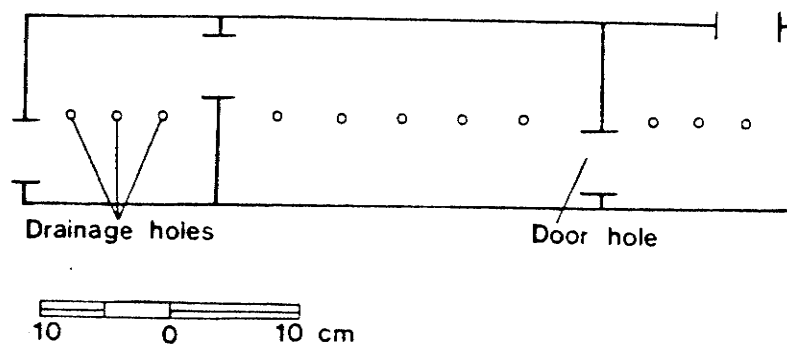
Pen construction



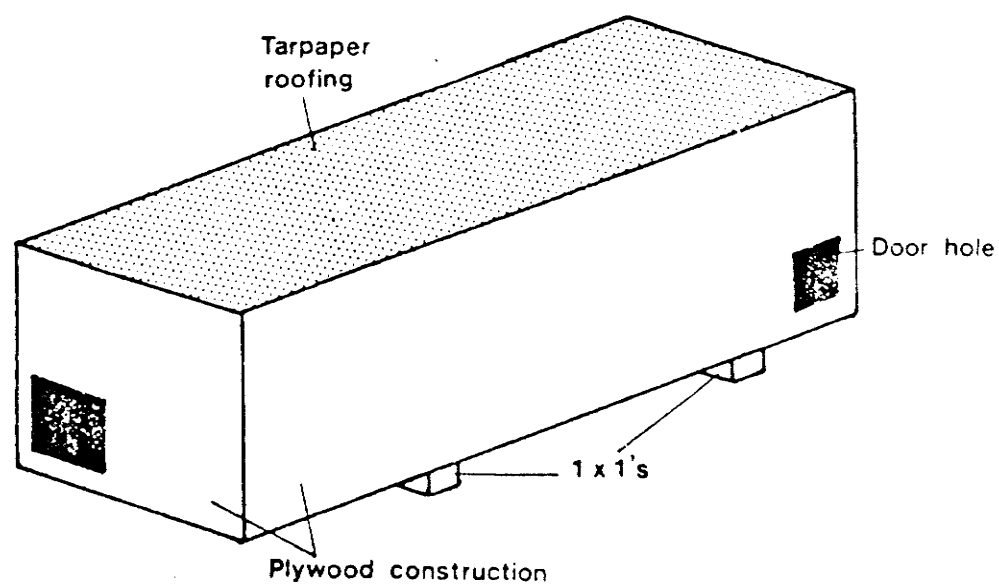
From: Reynolds, 1983

APPENDIX E  
ARTIFICIAL DEN BOX

Plan view of denbox



Side view of denbox



From: Reynolds, 1983



APPENDIX F  
SPECIFICATIONS OF TELEMETRY EQUIPMENT

All equipment is made by the Telonics Company, 1300  
West University Drive, Mesa, Arizona, 85201.

Transmitters

- All components plus battery hermetically sealed in a non-corrosive metal housing.
- Pulse rate: 50 pulses per min., 0.5 ppm.
- Frequency tolerance: 1 KHz over the range -50°C to 60°C.
- Operating frequency: 171.0 to 172.0 MHz.
- Range: Ground to air range of 5 to 80 km; ground to ground range of 2 to 25 km.

Collars

- Adjustment range: 14 to 30 cm circumference.
- Antenna type: External 25 cm stainless steel whip.
- Weight: 80 g maximum, including transmitter.

Receiver

- Frequency coverage: Full coverage, 171 to 172 MHz inclusive.
- Channel selection: 2,000 1 KHz channels, digitally selected with direct frequency reading controls.
- Fine tuning: Crystal controlled, covering 11 KHz; center frequency variation less than 0.3 KHz.
- Frequency stability over internal voltage range: Less than 1.01 KHz variation.
- Long Term frequency drift (after 1 min. stabilization): Less than 1.01 KHz.
- Operational battery life: At least 15 hours per charge.
- External charging source: Capable of recharging from any DC voltage source from 12 to 20 VDC, which is capable of supplying up to 70 milliamperes for 16 hours.

Scanner

- Memory capacity: 2,000 frequencies.
- Scanning sequence: Numerically ascending or descending (Selectable by front panel switch).
- Programming resolution: 1 KHz.
- Frequency accuracy: 0.1 KHz.
- Memory and Program retention: Non-volatile (when mated to receiver).
- Power source: No batteries required; plugs directly into receiver.