

COSEWIC
Assessment and Update Status Report

on the

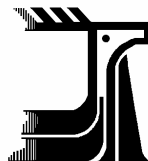
Grey Fox
Urocyon cinereoargenteus

in Canada



THREATENED
2002

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE IN
CANADA



COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

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COSEWIC Assessment Summary

Assessment Summary – May 2002

Common name

Grey fox

Scientific name

Urocyon cinereoargenteus

Status

Threatened

Reason for designation

The grey fox range in Canada is limited to small pockets in southern Ontario. It is accidental in Manitoba. Its woodland habitat has been reduced through human development. Some are caught accidentally in traps set for other species.

Occurrence

Manitoba, Ontario

Status history

Designated Special Concern in April 1979. Status re-examined and uplisted to Threatened in May 2002. Last assessment based on an update status report.



COSEWIC Executive Summary

Grey Fox *Urocyon cinereoargenteus*

Species information

The grey fox, *Urocyon cinereoargenteus*, is similar to the red fox, but with a number of unique characteristics. Most noticeably, the grey fox's fur is a grizzled grey colour, with cinnamon-coloured regions on its neck, sides and legs. There is a prominent black stripe running the length of the back down to the tip of the tail, which is also black, unlike the red fox's, which is white. The grey fox's prints closely resemble those of a domestic cat, but claws show in the fox's print.

Distribution

The grey fox is generally found from southern Canada to northern Colombia and Venezuela. Archeological evidence suggests that the grey fox was almost as common as the red fox in southern Ontario as far north as Midland just prior to European occupation. Currently, the grey fox is thought to be present in two regions in Canada, the Rainy River District of Ontario (west of Lake Superior) into southern Manitoba, and in southeastern Ontario. **Note to readers:** The range of the Grey Fox in Manitoba is restricted to the southeastern corner of the province, where it appears to be accidental.

Habitat

The grey fox's distribution is closely associated with deciduous forest, and in Canada it is also thought to inhabit marshland. Grey foxes den in many different kinds of substrate, usually located in dense brush close to a water source. In spite of these habitat preferences, *U. cinereoargenteus* is considered a habitat generalist and is quite tolerant of human disturbance. It is often found on the outskirts of cities.

Biology

U. cinereoargenteus is the most omnivorous of the North American canids. Vegetable matter, such as fruit, is an important year-round diet component. The grey fox has been observed to breed in Canada. The breeding season varies across their range, but Canadian grey foxes are thought to breed from mid-February to mid-March like populations in the northeastern U.S. Most female grey foxes breed in their first year and have one litter of about 3 or 4 kits per year. Grey foxes are typically nocturnal or

crepuscular. The basic social unit consists of an adult male and female and their offspring, and this group maintains a home range that is largely exclusive of other such groups. The adult sex ratio is usually 1:1 and grey foxes are generally assumed to be monogamous. It is unclear whether grey foxes are territorial, but they apparently use urine and faeces in communication.

Population sizes and trends

Although no quantitative population-level study of the grey fox in Canada has ever been published, it seems highly likely that the number of mature individuals present in Canada is fewer than 250.

Limiting factors and threats

The most important factor limiting grey fox populations in the U.S. is harvesting by humans, but the effect of the apparent weak harvest pressure in Canada on grey foxes is unknown. It is likely that grey foxes are able to avoid close competition with canids such as coyotes and red foxes since they are often found in sympatry. Diseases such as canine distemper and rabies could become significant limiting factors in an epizootic situation. Climate is another factor, which may be important to long-term trends in grey fox populations. Other factors, such as deforestation and road mortality may have adverse effects on grey fox populations in Canada.

Special significance of the species

The low rate of capture (i.e. under 20 per year in Ontario) indicates that the grey fox has little economic value as a furbearer in Canada. This species is of great interest to naturalists and scientists alike because the reasons for its substantial range decline in Canada compared to pre-European times are unclear.

Existing protection or other status designations

The Nature Conservancy has ranked the grey fox globally as very common (G5); however, no national (N) rank exists for Canada. In Ontario and Manitoba the provincial conservation data centres consider grey foxes found in their provinces to be migrants from the United States. It is illegal to kill grey foxes in Quebec. The grey fox is thought to be present, although rare, in St. Lawrence Islands National Park, it has been found in Fish Point Provincial Nature Reserve, Pelee Island, and it is thought to be present in the Whiteshell Provincial Park region in southeastern Manitoba.



COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.



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

**Update
COSEWIC Status Report**

on the

Grey Fox
Urocyon cinereoargenteus

in Canada

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2002

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SPECIES INFORMATION

Name and classification

Urocyon cinereoargenteus Schreber (grey fox; renard gris) is a member of the family Canidae, a group that includes dogs, wolves, foxes and jackals (DeBlase and Martin 1981). The generic name *Urocyon* means "tailed dog", and comes from the Greek *oura* meaning "tail" and *kyon* meaning "dog". The specific name *cinereoargenteus* translates as "silvery grey" (Baker 1983). Other common names for *U. cinereoargenteus* are tree fox, cat fox (Baker 1983), scrub fox (Peterson et al. 1953), zorra, zorra gris and gato de monte (Leopold 1959). Sixteen subspecies of *Urocyon cinereoargenteus* are recognized (Fritzell and Haroldson 1982), of which three are thought to be found in Canada, *U. c. borealis* Merriam, *U. c. cinereoargenteus* (Schreber) and *U. c. ocythous* Bangs (Banfield 1974).

Description

Urocyon cinereoargenteus (Fig. 1) is similar in appearance to the cross phase of the red fox (*Vulpes vulpes*); however, there are a number of characteristics that make it possible to reliably differentiate the two species. The grey fox has a dark longitudinal stripe, made up of coarse black-tipped hairs, running the length of its back and tail (Fritzell and Haroldson 1982). The sides and back of its pelage are grizzled grey, caused by individual guard hairs being banded with black, grey and white, and the underfur is buffy (Banfield 1974; Fritzell and Haroldson 1982). There is white fur on the ears, face, throat, chest, belly and hind legs (Fritzell and Haroldson 1982), but the tail is black-tipped, in contrast to the red fox's, which is white-tipped (Baker 1983). Parts of the grey fox's neck, sides and limbs are a cinnamon-rufous colour (Fritzell and Haroldson 1982). There is a distinctive black muzzle patch in front of each eye and on the lower jaw. The grey fox has shorter legs than the red fox, although it is of a similar mass. The grey fox has a shorter muzzle, rounder footprints, larger toe pads and more curved claws than the red fox (Banfield 1974). The grey fox has a tail gland that extends one-third to one-half the length of its tail, making it the largest of the North American Canidae (Seton 1923). Newborn grey foxes are blackish in colour whereas red fox kits resemble domestic pups with white-tipped tails (Peterson 1966). There are usually six mammae instead of eight as in the red fox (Piérard 1983). The grey fox is less vocal, and has a less intense and lower pitched call than the red fox (Peterson 1966).

The tracks of the grey fox are shorter and broader than those of the red fox. Spacing between grey fox prints is also slightly closer than between red fox prints. Grey fox tracks look very similar to domestic cat (*Felis catus*) tracks except that claw marks show in those of a grey fox (Fritzell 1987).



Figure 1. An adult grey fox, *Urocyon cinereoargenteus* (photo from the San Diego Zoological Society, from Nowak 1999).

Members of the genus *Urocyon* are distinguishable from other canids by having skulls with prominent, widely separated temporal ridges that run posteriorly from the postorbital processes to the occipital crest to form a U-shape (also found in *Otocyon*), and a dentary that has a unique step or notch near the posterior ventral border (also found in *Otocyon* and *Nyctereutes*) (Banfield 1974; Fritzell and Haroldson 1982). The dental formula of the grey fox is: incisors 3/3, canines 1/1, premolars 4/4, and molars 2/3 for a total of 42 teeth (Peterson 1966).

Grey fox average body measurements are as follows: total length 988 mm (range=800-1125 mm), tail length 372 mm (range=275-443 mm), hind foot length 142 mm (range=100-150 mm), ear 75 mm (Banfield 1974), condylobasal length of the skull 110-135 mm and skull width 65-74 mm (Peterson 1966). Males weigh 4.1 kg on average (range=3.6-5.9 kg), females weigh an average of 3.9 kg (range=3.4-5.4 kg) (Peterson 1966).

DISTRIBUTION

Global range

The grey fox is generally found in the southern half of North America, from southern Canada to northern Colombia and Venezuela (Fig. 2). Within that global range, the grey fox is absent from parts of mountainous northwestern United States, the Great Plains and eastern Central America (Fritzell and Haroldson 1982). However, the grey fox has expanded its range in the last 50 years, and is now found in 45 or more American states (Samuel and Nelson 1982, please see Fritzell and Haroldson 1982 for a list of references detailing the grey fox's range extension in the U.S.). In particular, grey foxes have expanded their range northward within several northeastern and Great Lakes states, including: Minnesota (B. Berg, pers. comm.), Wisconsin (J. Olson, pers. comm.), Michigan (T. Reis, pers. comm.) and New Hampshire (E. Orff, pers. comm.).



Figure 2. The global distribution of the grey fox, *Urocyon cinereoargenteus* (modified from Fritzell and Haroldson 1982).

Canadian range

Archeological evidence (Wintemberg 1921, 1928, 1936, 1939, 1948; Downing 1946) suggests that the grey fox was almost as common as the red fox in southern Ontario as far north as Midland prior to European occupation (Downing 1946). Grey foxes were extirpated from Canada around the time of the first European colonists (Downing 1946) over 350 years ago. However, Downing (1946) believed that the grey fox was extirpated by some factor other than the newly arrived Europeans because no author of the colonial period described seeing a grey fox in Ontario and, "If [grey foxes] were present in the numbers suggested by the remains in the Indian village sites, one

would hardly expect its tree-climbing habits to have escaped comment by some early writer” (Downing 1946, page 45). Grey foxes were absent from Ontario until the late 1930s or early 1940s (Downing 1946) when populations in the northeastern and Great Lakes U.S. states expanded northward (Hamilton 1943). The present apparent northward extension of the grey fox's range may be the result of climatic changes. Waters (1964) suggested that the grey fox's range expanded northward and eastward in the warm Hypsithermal Period (5000-2000 B.C., Dorf 1959) and then contracted southward when conditions cooled, and that this pattern repeated itself around 1000-1300 A.D. He speculated that the grey fox's recent expansion into New England was also related to a warming trend (Waters 1964, although see Waters 1967 for complicating evidence from Martha's Vineyard). The northward expansion of the grey fox in Wisconsin and Minnesota is thought to be at least partly attributable to warmer than average weather in the 1990s (J. Olson, pers. comm. for WI; B. Berg, pers. comm. for MN). Hersteinsson and Macdonald (1992) implicated climate change in the northward migration of the boundary between the geographic distribution of red foxes and arctic foxes (*Alopex lagopus*).

Banfield (1974) and earlier authors noted that the grey fox has been found in three regions in Canada: 1) the Rainy River District of Ontario (west of Lake Superior) and into southern Manitoba, 2) the north shore of Lake Erie from Windsor to Niagara Falls, and 3) the northeastern shore of Lake Ontario and into Quebec's eastern townships north of Maine (Banfield 1974). Each one of these three regions was thought to contain a separate subspecies of grey fox (Banfield 1974). These three subspecies are *U. c. ocythous* Bangs, *U. c. cinereoargenteus* (Schreber), and *U. c. borealis* Merriam respectively, and are found in the U.S. states directly south of the three Canadian regions (Hall 1981). With the exception of one recent record from Manitoba, however, all records of grey fox in the last 20 years have been from Ontario. The two regions of Canada with substantial numbers of grey fox records will henceforth be referred to by the abbreviations: WLS (West of Lake Superior) and SO (Southeastern Ontario) (Fig. 3a). The distribution of recent sightings, however, suggests that there may only be a breeding population on Pelee Island and records from elsewhere in Ontario may represent dispersing individuals from the United States.

To date, we have collected 74 records of grey fox sightings or captures in Canada (Appendix 1). Eight of these are from WLS and 65 are from SO, the latter including 1 record from Quebec from over 100 years ago (Appendix 1). Only one of these records is of an individual known to have been born in Canada (1 June 1998, Pelee I., Ontario; Appendix 1). The earliest post-Columbian record is from 1894 near Johnville, Quebec (Appendix 1) and the latest is from January 2001 on Pelee Island, Ontario (Appendix 1), although specimens were recovered from both regions in 2000 (see Appendix 1). A single grey fox individual was trapped near Lake Athabasca in Alberta (Fig. 3a, Moore 1952). However, Smith (1993) considers this specimen to be accidental and not representative of an established population.



Figure 3a. The Canadian distribution of the grey fox, *Urocyon cinereoargenteus* (modified from Banfield 1974). The grey shaded areas represent the two major regions of occurrence of grey fox in Canada: 1) the Rainy River District of Ontario (west of Lake Superior) and into southern Manitoba (WLS), and 2) southeastern Ontario (SO). Small black dots indicate grey fox records within these regions, and the large black dot in northern Alberta represents an extralimital grey fox record. A question mark in southeastern Manitoba represents a general report of grey foxes being trapped in the Whiteshell Provincial Park area, but no specific records (I. McKay, pers. comm.).

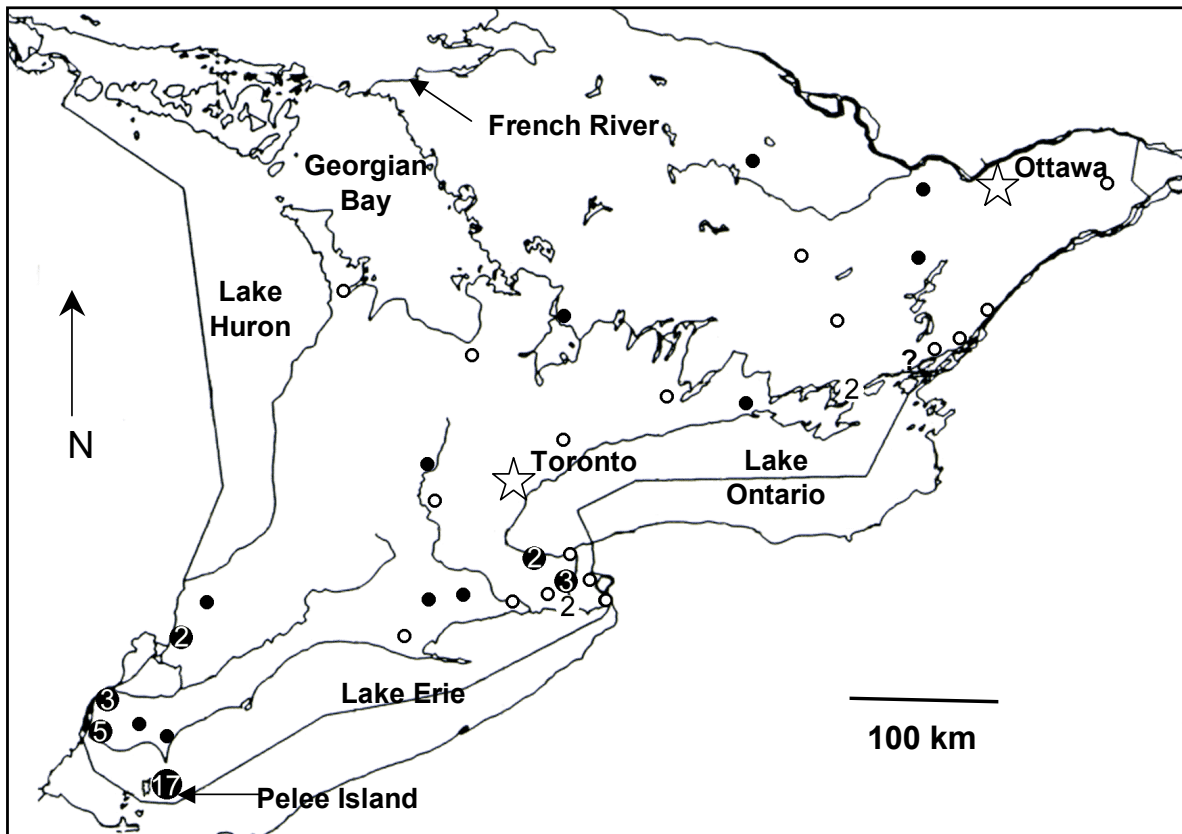


Figure 3b. Distribution of grey fox, *Urocyon cinereoargenteus*, records in southern Ontario (modified from Dobbyn 1994). Hollow circles indicate records prior to 1980. Solid circles indicate records from 1980 or later. Numbers are used when there is more than one record for a specific location (e.g. there are 17 grey fox records for Pelee Island). A question mark in southeastern Ontario represents an unverified report of grey foxes in St. Lawrence Islands National Park (J. Leggo, pers. comm.; Parks Canada 2000).

HABITAT

Habitat requirements

In eastern North America, the grey fox's distribution closely approximates that of the deciduous forest (Fritzell 1987). And in Canada, the grey fox prefers forests and marshes more than open habitats, relative to the red fox (Peterson 1966, Banfield 1974). During the course of a study into red fox behaviour, territoriality and movement, researchers with the Ontario Ministry of Natural Resources Rabies Research Unit had radio-tracked a single adult male grey fox (P. Bachmann, pers. comm.) from October 1980 to November 1981 in Lambton County, Ontario (Bachmann and Lintack 1982). The study area was typical of southwestern Ontario agricultural land: cultivated fields interspersed with deciduous woodlots dominated by sugar maple (*Acer saccharum*) and crisscrossed by a network of roads (Bachmann and Lintack 1982). Within this study area, the grey fox male was located most often within woodlots and moved most often within 100 m of the woodlot edge. However, the male did move into open, less wooded

areas and occasionally crossed roads (Bachmann and Lintack 1982). We believe that this is the only quantitative study of a grey fox in Canada.

In the United States, grey foxes prefer woodland habitat when it is interspersed with open areas or farmland (Samuel and Nelson 1982; Fritzell 1987 and references therein). The implication of this finding is that grey foxes use the many edges found in this type of landscape, where they can benefit from the shelter provided by the forest and the food resources present in the open areas (Richards and Hine 1953; Wood et al. 1958; Trapp and Hallberg 1975; Petersen et al. 1977; Bachmann and Lintack 1982). However, whether this apparent preference is a real phenomenon, or an artifact caused by the fact that most radiotelemetry studies have been carried out in a mosaic of forested and nonforested cover types (Fritzell 1987), is unclear. This point is highlighted by a study of grey fox habitat preference by Haroldson and Fritzell (1984), who studied grey foxes in an oak-hickory dominated landscape containing only about 5% open area, and found that grey foxes seldom used nonforested habitat.

Both daily and seasonal patterns of habitat use by grey foxes have been described. Grey foxes used woodlands more during daylight hours than at night (Follmann 1973, cited in Fritzell 1987; Haroldson and Fritzell 1984). In southern Illinois, wooded areas were used more than old fields in the winter and spring months, whereas the reverse was true for the summer and fall (Follmann 1973, cited in Fritzell 1987).

Grey foxes use a variety of locations for denning, including rock outcrops, hollow trees or logs, cavities under rocks, underground burrows dug by other animals, piles of brush, slab, wood or sawdust, and abandoned buildings (Trapp and Hallberg 1975; Fritzell 1987). However, grey fox dens are usually located in an area of dense brush and within 0.4 km of a water source (Layne and McKeon 1956; Sullivan 1956). Bachmann and Lintack (1982) found three den sites, all of which were within brush piles.

Apart from the general conclusion that grey foxes prefer wooded habitat, it should be noted that grey foxes are habitat generalists, as evidenced by: their ability to use reclaimed surface mines (Yearsley and Samuel 1980) and rural residential areas (Leopold 1959; Harrison 1997), and by their extensive geographic distribution (Fig. 2).

Trends

Due to pressure from development, it seems likely that the amount of wooded habitat along the Canada-U.S. border in Manitoba, Ontario and Quebec will continue to decline, although perhaps not as quickly as in previous years.

Protection/ownership

The grey fox is thought to occur in St. Lawrence Islands National Park (Parks Canada 2000) and has been found in Fish Point Provincial Nature Reserve, Pelee Island (Appendix 1). It is also thought to occur in the Whiteshell Provincial Park region in southeastern Manitoba (I. McKay, pers. comm.). Its occurrence in other parks and

reserves is unknown. It is likely that much of the habitat in Canada occupied by grey foxes is under private ownership.

BIOLOGY

General

U. cinereoargenteus is the most omnivorous of the North American canids. Vegetable matter, such as fruit, is an important year-round diet component. The grey fox has been observed to breed in Canada. The breeding season varies across their range, but Canadian grey foxes are thought to breed from mid-February to mid-March like populations in the northeastern U.S. Most female grey foxes become sexually mature and breed in their first year. Females have one litter of about 3 or 4 kits per year for their entire lives. Grey foxes are typically nocturnal or crepuscular. The basic social unit consists of an adult male and female and their offspring, and this group maintains a home range that is largely exclusive of other such groups. The adult sex ratio is usually 1:1 and grey foxes are generally assumed to be monogamous. It is unclear whether grey foxes are territorial, but they apparently use urine and faeces in communication.

Grey fox mortality in the wild is generally high and juveniles make up a large percentage of the population. The most important cause of mortality of grey foxes in the United States is human harvest by trapping and hunting, but fewer than 20 pelts are taken annually in Canada. Due to the lack of knowledge about numbers of grey foxes in Canada, the significance of this harvest pressure is unknown. Predation is not considered to be an important source of mortality for grey foxes. The diseases canine distemper and rabies, both prevalent in the wild and fatal to grey foxes, could severely affect populations, but likely only in cases of high grey fox density. The harsh Canadian climate may limit the northward spread of grey foxes (i.e. through the energy cost of locomotion in deep snow), but other factors, such as competition with other mid-sized carnivores, cannot be ruled out.

Reproduction

Little is known about grey fox reproduction in Canada. However, the grey fox breeding season is known to vary across its geographic distribution with more northern populations breeding later than more southern populations (Trapp and Hallberg 1975; Fritzell 1987). Therefore, Canadian populations of grey foxes should breed at a similar time, or later than populations in New York and Wisconsin whose peak breeding activity occurs from mid-February to mid-March (Layne and McKeon 1956; Jackson 1961). Most female grey foxes become sexually mature at around 10 months old (Fritzell 1987), breed in their first year (Wood 1958; Root and Payne 1985) and have one litter per year thereafter (Fritzell 1987). Litter sizes (based on counts of placental scars or embryos) range from 4.4 in New York (Layne and McKeon 1956) to 3.5 in Wisconsin (Root and Payne 1985). Fritzell (1987) calculated an average litter size of 3.8 from all published work on the subject. The grey fox gestation period has not been clearly determined, and is

usually cited as being either 53 days, as in the red fox (Sheldon 1949; Wood 1958), or 63 days, as in the domestic dog (Grinnell et al. 1937, cited in Trapp and Hallberg 1975). However, a study of grey foxes bred in captivity indicates a gestation period of approximately 59 days (Altiere et al. unpubl. data, cited in Fritzell 1987). Whelping occurs in the den and young are weaned at approximately 4 months of age but remain with the family unit until they are about 8 months old (Nicholson et al. 1985).

Two reports of grey fox reproduction in Canada exist. The first is from a news release from the office of the District Forester, Department of Lands and Forests, in Kemptonville, Ontario, dated 28 January 1952, which states, "It may be of interest to know that the gray fox is a fairly common visitor to this District. Since we have reports of litters being raised, it may be considered that this animal is a resident. One or two gray foxes are shot every year in the southern parts of Leeds, Grenville, Stormont, Dundas and Glengarry counties." (Peterson et al. 1953, page 126). The second is of a six-week old kit found on Pelee Island in western Lake Erie in the week of 1 June 1998 (London Free Press 1998). Norm Beattie, an experienced naturalist and hunter who lives on Pelee Island, has observed grey fox den sites and estimates that there are possibly 12 to 15 breeding pairs on the island (N. Beattie, pers. comm.). These reports correspond to one of the two regions in which grey foxes are found in Canada (SO; Fig. 3a). There are no reports of grey fox reproduction from the WLS region (Fig. 3a), and the Manitoba Conservation Data Centre considers grey foxes to be accidental, that is, migrants from the U.S. (MBCDC 2000).

Survival

Few estimates of grey fox mortality in the wild exist, but it is generally reported as high (Trapp and Hallberg 1975). Prenatal mortality of embryos (due to resorption by the female) was estimated at 32% for grey foxes in Illinois (Layne 1958). Wood (1958) found that grey fox kits had a 50% probability of dying in their first summer, 90% probability of dying in their first winter and a 50% annual mortality rate thereafter. These high mortality rates have been supported by data from a variety of studies, which show that juveniles (<1 year old) make up a large proportion of grey fox populations, e.g. 61.5% in New York (Tullar and Berchielli 1982) and 66% in Wisconsin (Root and Payne 1985). These studies also show that there are typically very few foxes in the older age classes, e.g. 4.8% >3 years old in New York (Tullar and Berchielli 1982) and 3% >4.5 years old in Wisconsin (Root and Payne 1985).

The most important cause of mortality of grey foxes in the United States is human harvest by trapping and hunting (Tullar and Berchielli 1982; Fritzell 1987). Grey foxes are harvested in all Great Lakes and northeastern U.S. states (Table 1). The harvest season ranges from Sept. 16 to Mar. 15 in Minnesota, to Nov. 10 to Jan. 31 in Ohio and there are no bag limits for grey fox in any of the U.S. states bordering the Great Lakes and southeastern Canada for which this information was found (Table 1). Harvest rates vary quite widely among those northeastern U.S. states that provided data (Table 1). However, raw harvest data is often biased because of its dependence on factors such as the number of trappers and hunters and pelt price, and therefore may be only roughly indicative of population trends.

Table 1. Harvest rates, season dates and bag limits for Ontario and the northeastern and Great Lakes U.S. states.

Season	Ontario	Minnesota*	Wisconsin	Michigan	Ohio	New York	Vermont	New Hampshire	Maine
1979/80	1								
1980/81	4								
1981/82	2								
1982/83	4								
1983/84	11								
1984/85	2								
1985/86	6								
1986/87	7								
1987/88	3								
1988/89	3	7000				13980			
1989/90	2	5000				7529		58	
1990/91	7	6000				4407		63	73
1991/92	0	5000				13816		76	74
1992/93	0	5000				4328		86	58
1993/94	0	3000				4438		76	46
1994/95	0	2000				5008		97	50
1995/96	1	4000				9246		75	104
1996/97	1	NA				15823		129	25
1997/98	7†	4000		4255		11276		104	92
1998/99	17†	2000				19944		120	75
1999/00		3000				32429		89	82
Hunting Season	Oct. 25 - Feb.28/29	Sept. 16 - Mar. 15	Oct. 14/28 - Feb. 15	Oct. 15 - Mar. 1	Nov. 10 - Jan. 31	Oct. 25 - Feb. 15†	Oct. 27 - Feb. 10	Oct. 1 - Mar. 31	Oct. 16 - Feb. 28
Trapping Season	Oct. 25 - Feb.28/29	Sept. 16 - Mar. 15	Oct. 14/28 - Feb. 15	Oct. 15 - Mar. 1	Nov. 10 - Jan. 31	Oct. 25 - Dec. 10‡	Oct. 27 - Dec. 31	?	Oct. 15 - Dec. 31
Bag Limit	?	No Limit	No Limit	?	No Limit	No Limit	?	No Limit	No Limit

Data for Ontario and the Great Lakes and northeastern U.S. states were taken from the following: Ontario (OMNR, unpubl. data), Minnesota (B. Berg, pers. comm.; MNDNR 2001), Wisconsin (WIDNR 2000), Michigan (T. Reis, pers. comm.; MIDNR 2001), Ohio (OHDNR 2001), New York (Goffe 2001; NYSDEC 2001a,b), Vermont (VTDFW 2001), New Hampshire (E. Orff, pers. comm.; NHFGD 2000a,b), Maine (W. Jakubas, pers. comm.; MEDIFW 2001).

*Harvest numbers for Minnesota are approximate (i.e. ±250 individuals) (B. Berg, pers. comm.).

†These numbers were unconfirmed by OMNR and are thought to be incorrect since auction houses in Ontario did not receive grey fox pelts from Ontario trappers for those years (C. Heydon, pers. comm.).

‡Season varies depending on location within the state.

Although the grey fox was declared a furbearer in Ontario in 1979 under an amendment to the Game and Fish Act (C. Heydon, pers. comm.), fewer than 20 pelts are traded annually in Ontario (Obbard et al. 1987; Table 1). From 1977 to 1989, biologists with the Ontario Ministry of Natural Resources attempted to verify every report of a grey fox trapped in Ontario; however, this is no longer being done (C. Heydon, pers. comm.). Approximately six to seven grey fox pelts are harvested each year from the Whiteshell Provincial Park region in southeastern Manitoba (I. McKay, pers. comm.). Quebec lists the grey fox as a furbearer so that managers can rapidly introduce regulations if necessary. However, it is currently illegal to harvest grey fox and although Quebec's regulations stipulate that accidental captures must be reported to a wildlife conservation officer (Société de la faune et des parcs du Québec 2000), there is no incentive to report accidental captures (R. Lafond, pers. comm.). Given the important role that trappers and hunters often play in other jurisdictions in gathering information about species' abundance and distribution, the absence of recent grey fox records in Quebec should be interpreted with caution.

Grey fox are hunted in Canada and there was a bounty on grey fox on Pelee Island until 15 years ago when it was removed because it did not comply with Ontario's Game and Fish Act (N. Beattie, pers. comm.). Hunters on Pelee Island currently shoot six to ten grey foxes every winter, although there is no indication that this practice is having a negative effect on the population (N. Beattie, pers. comm.).

Roadway mortality has been reported for grey foxes, both in the U.S. (Tullar and Berchielli 1982) and in Canada (Ontario Natural Heritage Information Centre (ONHIC) unpubl. data, D. Coulson, pers. comm., P. Pratt, pers. comm.), but its significance for fox populations is unknown. In one study, grey foxes were less likely than red foxes to be shot or hit by cars, and the authors suggested that this was the result of more cryptic behaviour and smaller home ranges on the part of grey foxes (Tullar and Berchielli 1982).

Several predators have been reported to prey on grey foxes, including: golden eagles, *Aquila chrysaetos* (Mollhagen et al. 1972), domestic dogs, *Canis familiaris* (Tullar and Berchielli 1982), bobcats, *Lynx rufus* (Progulske 1955), and possibly coyotes, *Canis latrans* (Grinnell et al. 1937, cited in Fritzell 1987), but the effect of predation on grey fox populations is not considered important (Fritzell 1987).

Grey foxes are resistant to sarcoptic mange mites (*Sarcoptes scabiei*) and heartworm (*Dirofilaria immitis*), parasites that are fatal or seriously debilitating to most other wild canids (Stone et al. 1972; Simmons et al. 1980). The only diseases reported with significant frequency in *U. cinereoargenteus* are canine distemper and rabies (Gier 1948; Davidson et al. 1992 and references cited therein). Canine distemper and rabies are almost always fatal to grey foxes (Fritzell 1987; Yuan Chung Zee 1999) and thus have the potential to limit fox populations under conditions of high grey fox density. In a study of 157 sick or dead grey foxes from 1972 through 1989, canine distemper was found to be a more significant source of mortality than all other diseases combined (Davidson et al. 1992).

Physiology

The northern edge of the grey fox's distribution may be limited by its ability to tolerate colder temperatures. *U. cinereoargenteus* is thought to be a southern, warm-adapted species (Waters 1964). Waters (1964) thought that historic fluctuations of the grey fox's range might be explained by temperature fluctuations and there is some evidence that the current northward expansion of the grey fox's range is due to a warming climate (see Distribution section above). At present, it is unknown how climate affects grey fox populations. Root and Payne (1985) suggested that the small average litter size (3.5) of a population in Wisconsin was due to a wider range of adverse environmental and nutritional conditions that exist on the northern periphery of the grey fox's range. Also, the northward expansion of the grey fox's range may be limited by the energy costs of locomotion in deep snow (M. Crête, pers. comm.).

Movements/dispersal

Grey foxes are most active at night (Follmann 1973, cited in Fritzell 1987; Yearsley and Samuel 1980; Haroldson and Fritzell 1984; Fritzell 1987; Harrison 1997). During its nightly activities, the adult male grey fox radiotracked in Ontario was often found making circuits of the woodlots within its home range (Bachmann and Lintack 1982).

Published estimates of grey fox home range sizes vary from 30 ha (Fuller 1978) to over 1000 ha (Haroldson and Fritzell 1984). However, home range estimates are known to increase with the length of time the animal is tracked (Haroldson and Fritzell 1984), indicating that care should be taken when interpreting results from these studies (Fritzell 1987). Home range size has been shown to increase during the breeding period (Follmann 1973, cited in Fuller 1978; Bachmann and Lintack 1982).

The extent of dispersal varies significantly among populations of *U. cinereoargenteus* (Fritzell 1987). Nicholson et al. (1985) found that, of 10 radio-collared juveniles in Alabama, only the males (N=3) dispersed from their natal areas. In contrast, 63% of female juveniles in New York dispersed from their natal areas, although male juveniles dispersed greater distances (Tullar and Berchielli 1982). Tullar and Berchielli (1982) also found that juveniles moved greater distances than adults. Sheldon (1953) recovered a marked vixen 84 km away from her natal area, 3 years after he had banded her as a juvenile.

Grey foxes have been dispersing into Canada from populations in the United States since the early decades of the 20th century (Downing 1946) and probably continue to do so. Given that the presence of the grey fox in Canada after a 350-year absence is due entirely to immigration from south of the border (Downing 1946), it seems likely that if the Canadian population were to disappear again, southern foxes would eventually repopulate the Canadian range.

Nutrition and interspecific interactions

U. cinereoargenteus is the most omnivorous of the North American canids, and their diet varies seasonally and geographically (Fritzell 1987). There have been a large number of studies that have catalogued the stomach contents of grey foxes (see references in Fritzell 1987 for detailed lists of organisms present in grey fox diet). Eastern cottontails (*Sylvilagus floridanus*) and small rodents (e.g. *Microtus* spp. and *Peromyscus* spp.) are the grey fox's principal prey (e.g. Hatfield 1939). Both Anderson (1946) and Palmer (1956) have suggested that the northward range extension of the grey fox is related to the northward spread of the cottontail rabbit (*Sylvilagus* spp.). However, the broad nature of the grey fox's diet means that the range of this carnivore is unlikely to be dependent on any single prey item. Mammal prey are most important in the grey fox's winter diet, possibly because other food sources such as insects and plants are less available. Plant material, such as persimmon (*Doispyros virginiana*), corn (*Zea mays*), apple (*Malus pumila*) and wild grape (*Vitis* spp.) can constitute up to 48% of the dry weight of fox stomach contents (e.g. Hockman and Chapman 1983). Vegetable matter is usually more prominent in the grey fox's diet in fall than in winter, but still makes up an important component of the diet in the latter season. The main conclusion to be taken from these studies is that grey foxes are more omnivorous than any other canid (Fritzell 1987), and are opportunistic feeders that prey on food items according to their availability (Carey 1982).

Several studies have compared grey fox diet with other canids, presumably to investigate possible competition for food resources. The diet of the grey fox has a large degree of overlap with those of other species, such as coyotes and red foxes, but is more diverse and more omnivorous than the diets of these potential competitors (Hockman and Chapman 1983; Cypher 1993). Grey foxes are more efficient at digesting fruit, and have a narrower gape and smaller carnassials than red foxes. These features may allow grey foxes to be more effective herbivores, but less effective carnivores, than red foxes (Jaslow 1987). Grey foxes may avoid competition for food with other canids by changing their habitat use patterns (Cypher 1993; see Habitat section above, and following paragraph) in addition to their diet.

There is some evidence that coyotes may have a negative impact on sympatric grey fox populations. Grey foxes and other similar sized carnivores increased in numbers when coyotes were removed from experimental plots in western Texas (Henke and Bryant 1999). In southeastern Minnesota grey fox numbers have decreased while coyote numbers have increased, and at the same time, grey foxes have increased their range into northwestern Minnesota right up to the Manitoba border (B. Berg, pers. comm.). Bowhunter sighting records of grey foxes, red foxes and coyotes for the past 10 years in Ohio seem to suggest an inverse relationship between foxes and coyotes (Fig. 4a). But there is no clear relationship between foxes and coyotes in New Hampshire when using a standardized metric of trapping effort (catch per 100 trap nights) (Fig. 4b). Also, the mechanism by which coyotes might regulate grey fox populations (e.g. competition for food or other resources, or predation) is unclear.

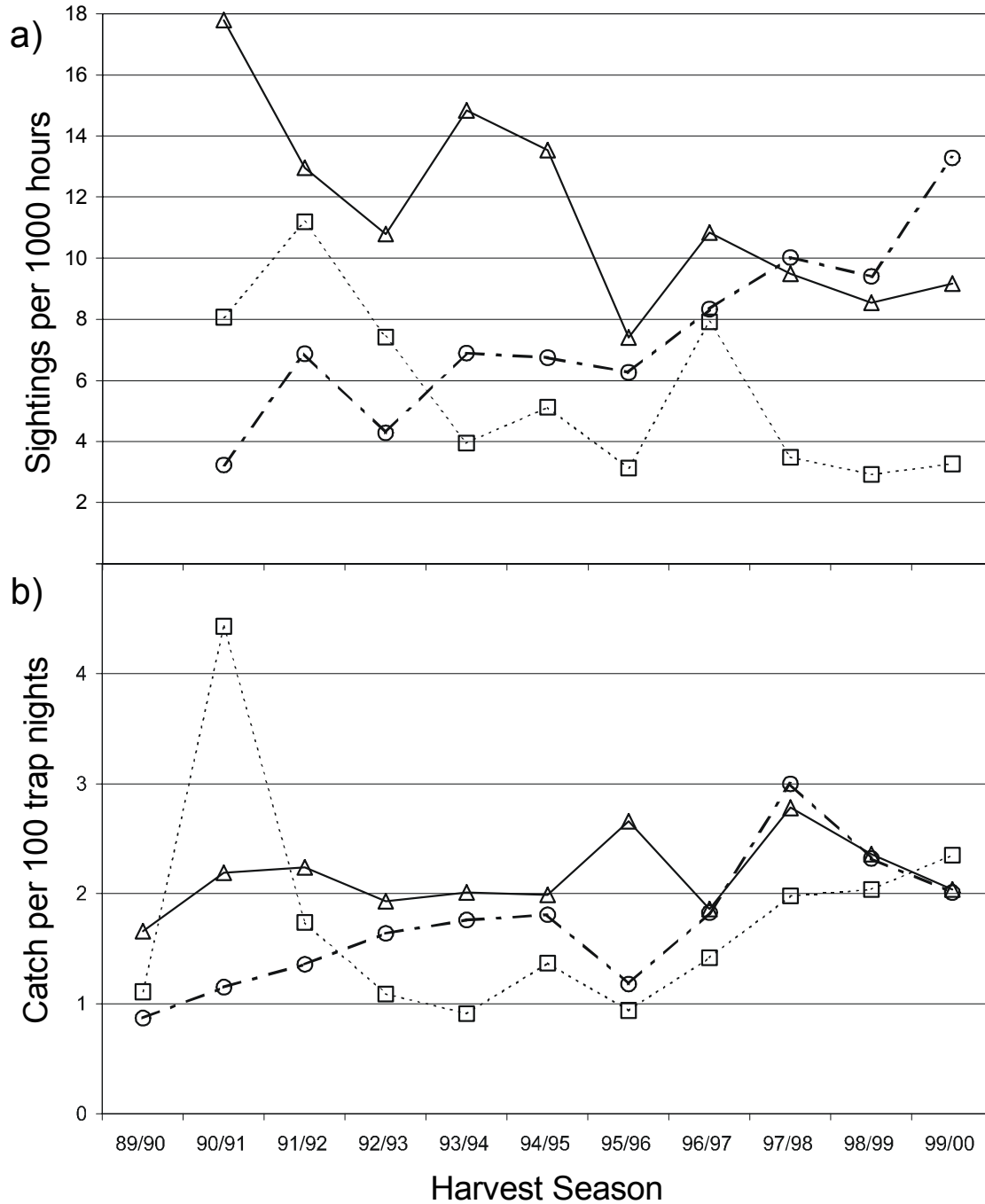


Figure 4. Relationships between coyote, grey fox and red fox abundances for: a) Ohio (data provided by C. Dwyer) and b) New Hampshire (data from NHFGD 2000b). Symbols and lines are as follows: grey fox (squares and dotted line), red fox (triangles and solid line), and coyote (circles and dash-dotted line).

Behaviour/adaptability

U. cinereoargenteus is typically nocturnal or crepuscular across its range (Fritzell 1987). The basic social unit consists of an adult male and female and their offspring,

and this group maintains a home range that is largely exclusive of other such groups (Lord 1961; Haroldson and Fritzell 1984). The adult sex ratio is usually 1:1 (Wood 1958) and grey foxes are generally assumed to be monogamous, although there is no definitive evidence to support this (Fritzell 1987). On several occasions two females with their litters have been observed occupying the same den, which suggests that polygamy may occur (Sheldon 1949; Gerhardt and McAnnis Gerhardt 1995). Young grey foxes leave the den at about 2.5-3 months old, accompany their mother until 4 months old when they start to forage on their own, and become completely independent at about 7 months old (Nicholson et al. 1985). It is unclear whether grey foxes are territorial, but they apparently use urine and faeces in communication (Trapp and Hallberg 1975). Grey foxes can climb trees (Terres 1939) and may use them as a diurnal resting place or as a means of escape (Yeager 1938).

POPULATION SIZES AND TRENDS

The grey fox has been found in two separate regions in Canada: 1) the Rainy River District of Ontario (west of Lake Superior) and into southern Manitoba (WLS), and 2) southeastern Ontario (SO) (Fig. 3a). However, grey fox reproduction has only been reported in southern Ontario.

Trapping effort for fox in southern Ontario is concentrated in the Algonquin Provincial Park (east of Georgian Bay) region (C. Heydon, pers. comm.). However, the boundary between northern and southern Ontario is the French River (H. Noseworthy, pers. comm.), which is considerably further north than the most northerly grey fox record from the SO region (Fig. 3b). Therefore, it is unknown whether the low number of grey fox captures (Table 1) represents an actual low abundance or simply a lack of trapping effort in the areas where they may be more abundant (i.e. north shore of Lake Erie from Windsor to the Niagara Peninsula).

The Pelee Island grey fox population is thought to number approximately 60 individuals, including possibly 12 to 15 breeding pairs (N. Beattie, pers. comm.). Although based on extensive field observations and not on any quantitative mark-recapture study, that population estimate yields a density of 1.4 individuals/km², which is very much within the range of measured densities from U.S. populations.

The 74 observation records presented in Appendix 1 are scattered across more than 100 years, making accurate determination of the grey fox's extent of occurrence in Canada difficult. In the absence of evidence of breeding outside Pelee Island in recent years, it seems likely that there are fewer than 250 mature grey foxes in Canada (M. Festa-Bianchet, pers. comm.). However, we echo Steers' (1979) call for quantitative research on the grey fox in Canada.

Archaeological evidence from pre-European Aboriginal village sites seems to indicate that the grey fox was once almost as common in southern Ontario as the red fox (Wintemberg 1921, 1928, 1936, 1939, 1948; Downing 1946). The grey fox was

extirpated from Canadian territory prior to European colonization over 350 years ago (Downing 1946). However, since 1900, the grey fox has reappeared in Canada, numbers of grey foxes have increased in Minnesota, Wisconsin, Michigan and New York, and the species has extended its range into previously unoccupied areas (Downing 1946; de Vos 1964; see Distribution section above).

LIMITING FACTORS AND THREATS

Undoubtedly, the most important factor limiting grey fox populations in the U.S. is harvesting by humans (Fritzell 1987). In the mid 1970s, it was estimated that almost one half of Wisconsin's grey fox population was harvested annually (Petersen et al. 1977). However, this harvest pressure has apparently been sustainable, because the grey fox continues to be harvested in large numbers in this state (WIDNR 2000). In addition, the grey fox has increased in number in Minnesota (B. Berg, pers. comm.), Wisconsin (J. Olson, pers. comm.), Michigan (T. Reis, pers. comm.) and New Hampshire (E. Orff, pers. comm.), despite there being no limits on the numbers harvested in those states (Table 1). The few grey foxes trapped each year in Canada are incidental captures by trappers targeting red fox. The effect of this grey fox by-catch on the grey fox population is unknown. Intraguild competition with other canids is widely cited but rarely demonstrated (see Nutrition section above), and it is likely that grey foxes are able to avoid close competition with canids such as coyotes and red foxes, since they are often found in sympatry (e.g. Cypher 1993; Layne and McKeon 1956). Predation on grey foxes by larger predators such as coyotes, bobcats or golden eagles is not thought to be important to population changes (Fritzell 1987). Palmer (1956) thought that the extension of the grey fox's range into the northeastern United States was associated with the range extension of one of its prey species, the eastern cottontail. However, the opportunistic nature of the grey fox's diet seems to argue against this hypothesis. Diseases such as canine distemper and rabies are fatal to grey foxes and have been reported in significant numbers of wild individuals (Davidson et al. 1992; Gier 1948). In an epizootic situation these diseases could represent significant limiting factors. Climate is another factor that may be important to long-term trends in grey fox populations. Waters (1964) suggested that past warming and cooling trends have caused the range of the grey fox to expand and contract. Adverse environmental and nutritional conditions at the northern periphery of the grey fox's range have been implicated in lower productivity (Root and Payne 1985). Also, the northward expansion of the grey fox's range may be limited by the energy costs of locomotion in deep snow (M. Crête, pers. comm.). Deforestation may limit grey fox populations by reducing the availability of dense cover and the variety of habitats that are preferred by *U. cinereoargenteus* (Fritzell 1987). Another factor, which may have adverse effects on grey fox populations in Canada, is road mortality. Grey foxes in central New York were slightly less likely than red foxes to be shot by hunters or hit by vehicles, possibly indicating that their more secretive lifestyle enabled them to avoid contact with humans better than red foxes (Tullar and Berchielli 1982).

SPECIAL SIGNIFICANCE OF THE SPECIES

In terms of economic interests, the low rate of capture indicates that the grey fox has little economic value as a furbearer in Canada. Also, prices for grey fox pelts are currently low (e.g. \$4.97/pelt in Ontario for the 1997-98 season, OMNR, unpubl. data), and therefore not likely to cause harvesting pressure to increase in the near future. However, the grey fox continues to be of some economic importance in the United States (e.g. the 1998/99 Wisconsin grey fox harvest was worth US \$124,444 to hunters and trappers, WIDNR 2000).

In the United States, where a significant amount of scientific work has been done, there are some very sophisticated questions that are starting to be asked (e.g. Henke and Bryant 1999, see Fritzell 1987 for a list of important biological and management questions). However, the situation in Canada is not as advanced. Simple questions about abundance and distribution have yet to be answered, which makes this species abundantly interesting to naturalists and scientists alike. The prospect of being the first to make a significant scientific contribution to the understanding of an organism's biology is very appealing, and highlights the scientific interest of the grey fox.

EXISTING PROTECTION OR OTHER STATUS DESIGNATION

At the international level, The Nature Conservancy (TNC) has ranked the grey fox as G5 or very common (G5 = demonstrably secure under present conditions); however, no national (N) rank exists for Canada (ONHIC 2000).

The Ontario Natural Heritage Information Centre actively gathers occurrence data on *U. cinereoargenteus* and has used TNC's ranking system to give a provincial (S) rank of SZB?, or accidental breeder (SZB = breeding migrants/vagrants, the ? indicates the level of uncertainty surrounding this species) to the grey fox (ONHIC 2000). The Ontario Ministry of Natural Resources lists the grey fox as a furbearer (C. Heydon, pers. comm.).

The Manitoba Conservation Data Centre (MBCDC) gives the grey fox the TNC provincial (S) rank of SH (SH = historically known, may be rediscovered) (MBCDC 2000), although biologists consider them to be accidental (W. Koonz, pers. comm.).

The grey fox is cited as present in Quebec under Quebec's list of vertebrate species (Desrosiers et al. 1993) and it is also listed as a furbearer, although it is illegal to hunt or trap them in the province (R. Lafond, pers. comm.). There have been no confirmed sightings of grey fox in Quebec for over 100 years.

U. cinereoargenteus is thought to be present, although rare, in St. Lawrence Islands National Park (Parks Canada 2000). It also occurs in Fish Point Provincial Nature Reserve on Pelee Island (Appendix 1) and is thought to be found in Whiteshell

Provincial Park in southeastern Manitoba (I. McKay, pers. comm.). Its occurrence in other parks and nature reserves is unknown.

SUMMARY OF STATUS REPORT

The grey fox, *Urocyon cinereoargenteus*, was once a relatively common species in southern Ontario in pre-European times. It disappeared from Canada just prior to the arrival of Europeans and only reappeared in the late 1930s or early 1940s. There are likely fewer than 250 mature grey foxes in Canada, but much uncertainty remains about their population size, trends and geographical distribution. Human harvest (trapping and hunting) is the most important factor limiting U.S. grey fox population; however, the importance of harvest on grey foxes in Canada is unknown. Climate change has been speculated to be an important factor determining the grey fox's range (i.e. warming trend causing a northward range expansion and vice versa). Disease, specifically canine distemper and rabies, which are both enzootic in North America, has the potential to limit grey fox populations. Another factor that could potentially pose a threat to grey foxes in Canada is road mortality, but until data on the frequency of occurrence of this factor is collected, its real effect remains unknown. Populations in the Great Lakes and northeastern regions of the United States have, in the past, repopulated Canadian territory and may do so again should the grey fox be extirpated from Canada.

The status designation of Vulnerable (now Special Concern) assigned in 1979, for reasons of: cold and dry climate, agricultural development, and predators (coyotes when numerous) (Steers 1979), does not appear justified. If current predictions about global warming are correct, the climate of Canada will become more attractive to the grey fox in coming decades. Given the lack of information on habitat selection of Canadian grey foxes and the knowledge that grey foxes apparently thrive across much of the U.S., including areas that are highly developed (e.g. suburban areas), the effect of increased agricultural development is unknown. Finally, predation by coyotes and other top carnivores is not considered important to grey fox population dynamics, although there is some circumstantial evidence that coyotes have a negative impact on grey foxes. The original status designation suggested these factors in the absence of any information on numbers of grey foxes in Canada.

Available information on the abundance and distribution of the grey fox in Canada is fragmentary and inadequate to allow an estimation of population trends. There is also considerable uncertainty about the current number of grey foxes in Canada, making it difficult to assess the risk of extinction for this species.

TECHNICAL SUMMARY

Urocyon cinereoargenteus

Grey Fox
Manitoba, Ontario

Renard gris

Extent and Area information	
• extent of occurrence (EO)(km ²)	Unknown
• specify trend (decline, stable, increasing, unknown)	Unknown
• are there extreme fluctuations in EO (> 1 order of magnitude)?	No
• area of occupancy (AO) (km ²)	Unknown
• specify trend (decline, stable, increasing, unknown)	Unknown
• are there extreme fluctuations in AO (> 1 order magnitude)?	No
• number of extant locations	1 known (Peelee Island)
• specify trend in # locations (decline, stable, increasing, unknown)	Stable
• are there extreme fluctuations in # locations (>1 order of magnitude)?	No
• habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat	Unknown
Population information	
• generation time (average age of parents in the population) (indicate years, months, days, etc.)	about 2 years
• number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)	30-250
• total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals	Unknown
• if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)	N/A
• are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?	Unknown
• is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?	Peelee Island may be the only breeding population in Canada
• list each population and the number of mature individuals in each	Peelee Island, unknown
• specify trend in number of populations (decline, stable, increasing, unknown)	Unknown
• are there extreme fluctuations in number of populations (>1 order of magnitude)?	No
Threats (actual or imminent threats to populations or habitats)	
- Stochastic events because of the very small number of individuals - Limited habitat availability	
Rescue Effect (immigration from an outside source)	
• does species exist elsewhere (in Canada or outside)?	U.S.
• status of the outside population(s)?	Not at Risk
• is immigration known or possible?	Probable
• would immigrants be adapted to survive here?	Probably
• is there sufficient habitat for immigrants here?	Unknown
Quantitative Analysis	N/A

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