Abundance and Summer Occupancy of Arctic Fox, *Alopex lagopus*, and Red Fox, *Vulpes vulpes*, Dens in the Northern Yukon Territory, 1984-1990

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Smits, Cor M. M., and Brian G. Slough. 1993. Abundance and summer occupancy of Arctic Fox, *Alopex lagopus*, and Red Fox, *Vulpes vulpes*, dens in the northern Yukon Territory, 1984-1990. Canadian Field-Naturalist 107(1): 13–18.

A total of 32 fox dens were known to exist on Herschel Island in 1990. Few dens were located before 1986. Dens located before 1986 were generally larger and, therefore, more likely to be natal than dens found in latter years. Thus a comparison of the proportion of natal fox dens between years was confounded. When proportions of natal dens are compared between years using dens sampled each year from 1986-1990 (n=32), proportions of natal Arctic Fox dens were substantially higher in 1988 (18.8%) and 1990 (18.8%) than in 1986 (6.3%), 1987 (6.3%), and in 1989 (3.1%). No substantial differences were apparent in proportions of natal Arctic Fox dens between all years during 1984-1990, comparing dens known in 1984 (n=14). On the Yukon Coastal Plain, 32 dens were identified during a preliminary survey in 1984, while an aerial stratified random block sampling census in 1987 yielded a total estimate of 50-63 dens (90% C.I.). One natal Arctic Fox den was found during each of 1985 and 1988, and one Red Fox natal den was observed in 1985, 1987, 1988, and 1989. There was no substantial difference in proportions of natal Arctic Fox, or natal Red Fox dens between years on the Yukon Coastal Plain. Herschel Island had one of the highest densities of Arctic Fox natal dens reported in the literature, whereas the Yukon Coastal Plain had one of the lowest densities.

Key Words: Arctic Fox, *Alopex lagopus*, Red Fox, *Vulpes vulpes*, den, productivity, Yukon Territory.

Arctic Foxes (*Alopex lagopus*) depend upon dens for rearing their young during spring and summer and use dens year-round for shelter (Macpherson 1969; Eberhardt et al. 1983). In the northern Yukon Territory, Arctic Foxes den on the Yukon Coastal Plain and on Herschel Island. Red Foxes (*Vulpes vulpes*) den in this area as well (Ruttan 1974; C.M.M.S., B.G.S., and R. H. Jessup, Yukon Department of Renewable Resources, unpublished data). The physical characteristics and terrain association of these den sites have been described to identify key Arctic Fox habitat and understand denning ecology (Smits et al. 1988; Smith et al. 1992). Prior to 1984 only cursory information on den distribution and occupancy in the Yukon Territory was available (Ruttan and Wooley 1974; Ruttan 1974). This study investigated the abundance and summer occupancy of fox dens in the northern Yukon Territory during 1984-1990 as baseline information for the management of Arctic Fox habitats and populations.

Study Area

The study area encompassed Herschel Island (101 km^2) and the Yukon Coastal Plain between the Babbage and Crow (Tulugaq) rivers to the east and the Canada/USA border to the west [2449 km^2] (Figure 1).

Herschel Island is composed of marine sediments that have been deformed and ice-thrusted into their present form (McKay 1959; Bouchard 1974). The sediments are predominantly fine-grained, with limited exposures of sand and gravel. Differential erosion has resulted in the development of coarse-textured ridges within a landscape of otherwise fine-grained materials. Most of the surface is rolling upland at elevations ranging from 60 - 180 m above sea level (Smits et al. 1988).

The Yukon Coastal Plain (Bostock 1970) is an eastward extension of the Arctic Coastal Plain (Wahrhaftig 1965) from Alaska. The plain encompasses an area of approximately 3700 km^2. It averages 20 km in width and slopes from a high point of 150 m above sea level northward to the Beaufort Sea. The surficial materials of the Yukon Coastal Plain originated from both glacial and non-glacial processes. Morainic, lacustrine, and fluvial deposits are most common. Active fluvial landforms (large deltas) predominate on the plain west of Herschel Island. East of Herschel Island, the plain consists of rolling moranic deposits interspersed with nearly flat areas of lacustrine material. Lakes and ponds of thermokarst origin dot the plain, and local relief rarely exceeds 30 m (Rampton 1982; Smits et al. 1988). The mean annual temperature at Komakuk is -12.1°C; the mean annual precipitation is 125 mm (Canadian Climate Program 1982).

Cottongrass tussocks (*Eriophorum vaginatum*), moss, ericaceous shrubs, and willows (*Salix* spp.) are the dominant vegetation on imperfectly drained upland sites. On well-drained sites Avens (*Dryas integrifolia*), vetch (*Astragalus* spp.) and Arctic Willow (*Salix arctica*) predominate (Wiken et al.

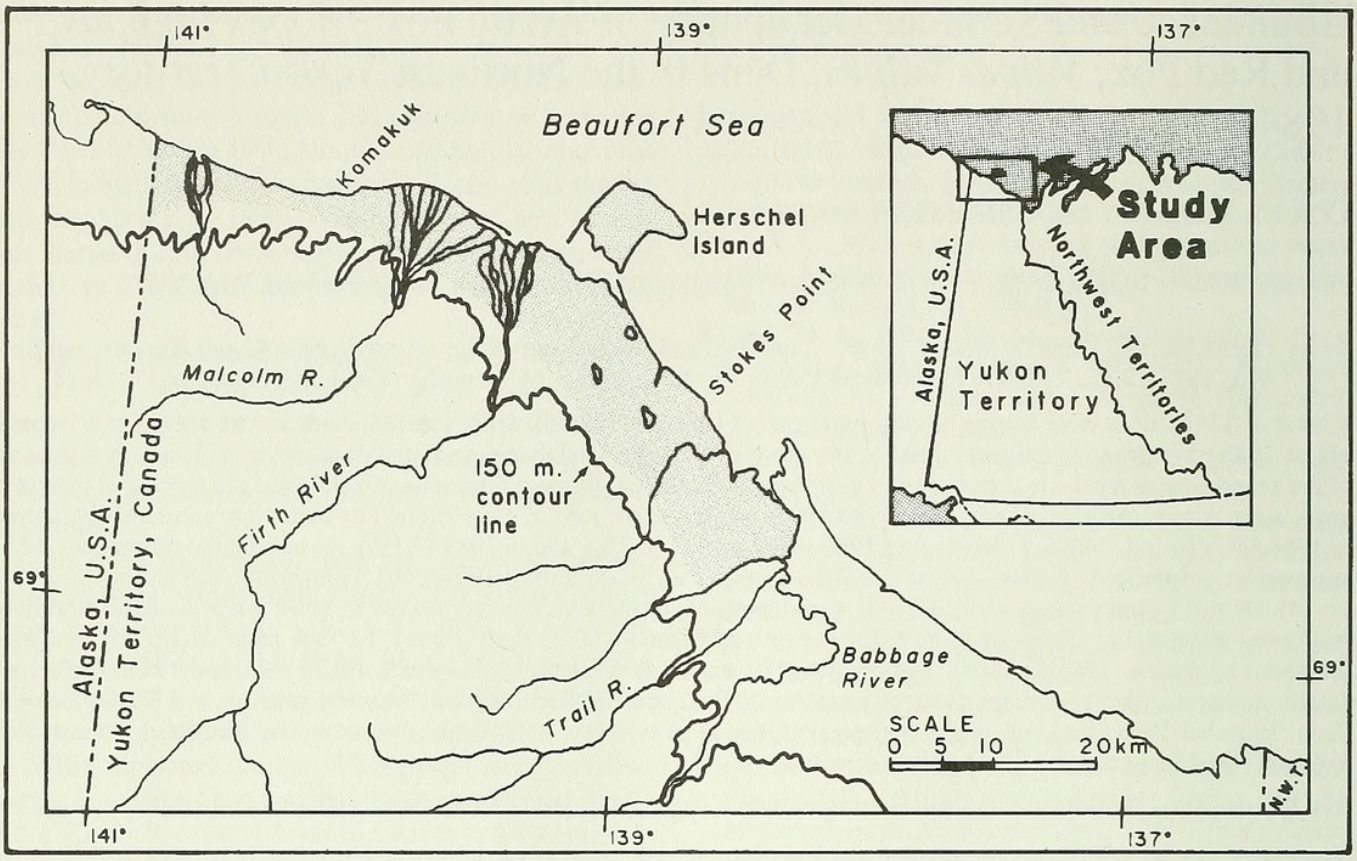

FIGURE 1. Location of the study area (shaded) in the northern Yukon Territory.

1981). Common small mammal species included Brown Lemming (*Lemmus sibiricus*), Varying Lemming (*Dicrostonyx groenlandicus*), Northern Bog Lemming (*Synaptomys borealis*), Tundra Vole (*Microtus oeconomus*), Northern Red-backed Vole (*Clethrionomys rutilus*), and Arctic Ground Squirrel (*Spermophilus parryii*, on Yukon Coastal Plain only). The area supports a large and varied nesting avifauna and is also important for migration, molting, and staging by several species (Salter et al. 1980; R. Ward and D. Mossop, Yukon Department of Renewable Resources, unpublished data). At least 50 bird species are summer residents of the study area, including Oldsquaw (*Clangula hyermalis*), Semi-palmated Sandpiper (*Calidris pusilla*), Lapland Longspur (*Calcarius lapponicus*), Baird's Sandpiper (*Calidris bairdii*), Arctic Tern (*Sterna paradisaea*), Northern Phalarope (*Lobipes lobatus*), Willow Ptarmigan (*Lagopus lagopus*), and American Golden Plover (*Pluvialis dominica*), all of which are abundant Microtine rodents and birds were the main summer food items of Arctic and Red foxes (Smits et al. 1989).

Methods

Dens were identified using a completed census (July 1984), incidental observations during monitoring flights (July 1985 and July 1986), an aerial stratified random block sampling census [Jolly 1969] (July 1987) and incidental observations (July 1985-1990). During aerial searches, den locations were plotted on 1:250 000 (Yukon Coastal Plain) or 1:50 000 (Herschel Island) topographical maps. Den searches were conducted from a Bell 206 Jet Ranger B helicopter by one or two observers. Each July during 1984-1990, all known dens were ground-checked for occupancy, with the exception of 1986 and 1990 when no dens were checked on the Yukon Coastal Plain. Occupancy status was determined by the presence of recent fox scats, hair, tracks, prey remains, and/or the presence of foxes. Dens were classified as natal if juvenile foxes were sighted, if juvenile tracks or faeces were present, or if characteristic juvenile barks were heard from within the den (Eberhardt et al. 1983). Red Fox and Arctic Fox dens were distinguished by sightings or hair identification at den entrances.

Differences in size (i.e., number of den entrances) of dens between years were evaluated using the TTEST procedure of SAS (SAS Institute Inc. 1985). Natal and non-natal dens were combined for Herschel Island and Yukon Coastal Plain to test for differences in size due to small sample size on the Yukon Coastal Plain.

Results

Herschel Island

The total number of dens identified on Herschel Island varied from 14-34 during 1984-1990 (Figure 2). Differences in the total number of dens between

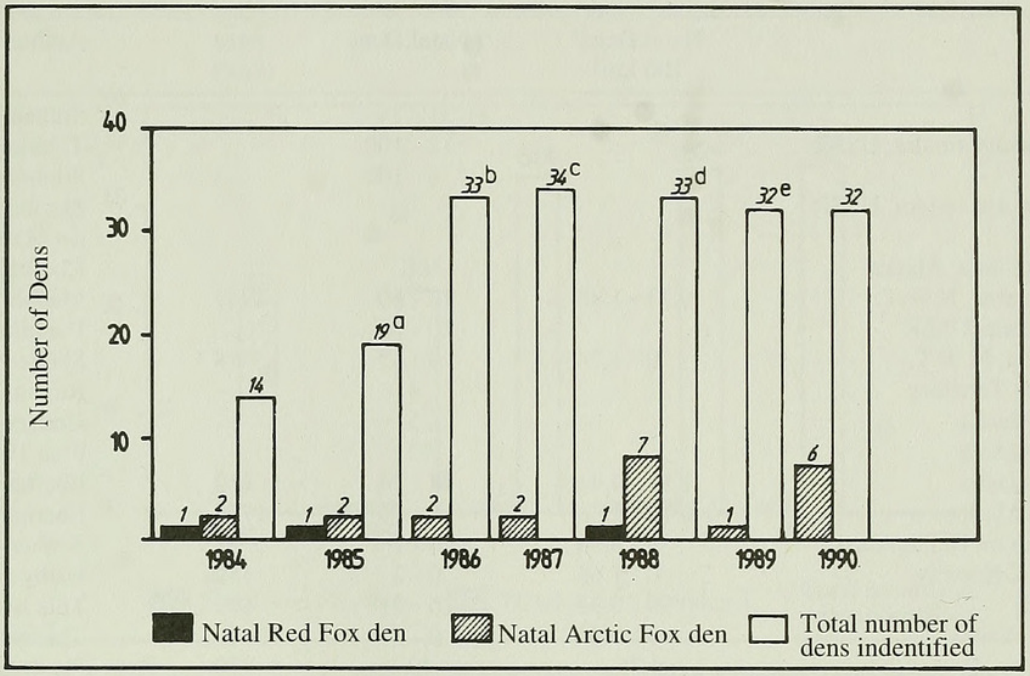

FIGURE 2. Breeding status and number of known fox dens on Herschel Island, 1984–1990: [a]additional dens found; [b]17 additional dens found while three known dens had collapsed since 1985; [c] one additional den found; [d], [e] one den collapsed each year.

years resulted from both the discovery of dens not previously found and from collapse of known dens. Dens detected in 1986 were significantly ($p = 0.0043$) smaller (number of den entrances) ($\bar{x} = 6.4 \pm 10.0$ [S.D.]) than dens located before 1986 ($\bar{x} = 20.8 \pm 13.4$). Non-natal dens (combined Herschel Island and Yukon Coastal Plain data) ($\bar{x} = 5.2 \pm 5.6$) were significantly ($p = 0.0001$) smaller than natal dens ($\bar{x} = 25.1 \pm 13.2$). The number of known natal Arctic Fox and Red Fox dens varied from 2-7, and from 0-1, respectively, during the study period (Figure 2). Substantial differences were apparent in the proportions of natal Arctic Fox dens between years when dens known in 1986 were compared ($n = 32$). These differences were less substantial when dens known in 1984 were compared ($n = 14$) (Table 1). Figure 3 shows the frequency with which known natal dens were used during the study period.

Yukon Coastal Plain

The total number of dens identified on the Yukon Coastal Plain increased from 32 in 1984 to 53 in 1989 (Figure 4). The mean number of entrances of dens identified in 1984 and 1985 ($\bar{x} = 18.2 \pm 8.7$) is significantly ($p = 0.0055$) greater than that of dens identified in 1987 ($\bar{x} = 9.2 \pm 9.6$). No substantial difference in proportions of natal dens between years for Arctic Fox or Red Fox was apparent on the Yukon Coastal Plain. This holds for both when dens

TABLE 1. Number of natal Arctic Fox dens located on Herschel Island, 1984–1990.

Year	Sub-Sample[1] (%)	Complete Sample[2](%)
1984	2(14.3)	
1985	2(14.3)	
1986	1(7.1)	2(6.3)
1987	2(14.3)	2(6.3)
1988	4(28.6)	6(18.8)
1989	1(7.1)	1(3.1)
1990	4(28.6)	6(18.8)

[1]Dens known in 1984 (for comparisons between 1984–1990).

[2]Dens known in 1986 (for comparisons between 1986–1990).

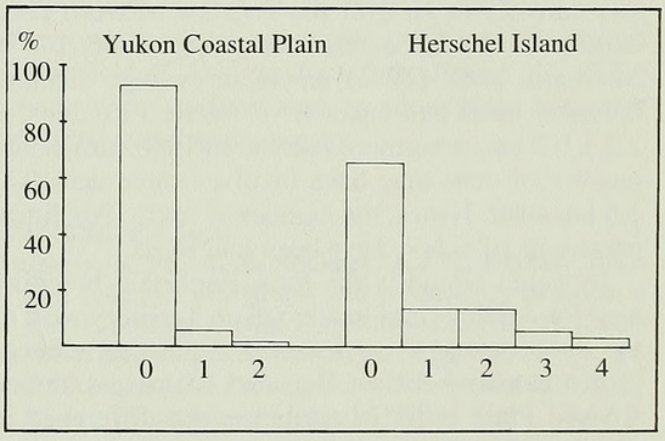

FIGURE 3. Frequency of natal den use per den. The number of years used was out of four years for the Yukon Coastal Plain and five years for Herschel Island.

Table 2. Crude density and percentage of natal dens reported for Arctic Fox den surveys.

Location	Natal Dens/ 100 km^2	%Natal Dens	Area (km^2)	Authority
USSR		31 - 74		Shibanoff 1951
Bol'shezemel'skaya tundra, USSR		12 - 100		Tchirkova 1951
Taimyr, USSR		6 - 100		Sdobnikov 1960
Bol'shezemel'skaya tundra, USSR		3		Skrobov 1961 (*in* Macpherson 1969)
Teshekpuk Lake area, Alaska		4		Chesemore 1969
Aberdeen Lake area, N.W.T.	0.33 - 1.38	12 - 50	4947	Macpherson 1969
Whole tundra zone, USSR		10 - 80		Bannikov 1970
Keewatin district, N.W.T.	0 - 1.74	0 - 43	518	Speller 1972
Northern Yukon Territory		4		Ruttan 1974
Prudhoe Bay, Alaska		25		Underwood 1975
Prudhoe Bay, Alaska		42		Fine 1980
Prudhoe Bay, Alaska	1.11 - 4.44	18 - 74	450	Eberhardt et al. 1983
Colville Delta, Alaska	0.12 - 1.35	6 - 55	1700	Eberhardt et al. 1983
Yukon-Kuskokwim Delta, Alaska	0 - 8.33	0 - 7	37	Anthony et al. 1985
Hardangervidda, Norway	0 - 1.65	0 - 3	182	Østbye et al. 1978
Herschel Island	0.99 - 6.93	6 - 21	101	This study
Yukon Coastal Plain	0 - 0.04	0 - 2	2449	This study
Svalbard	4.76	40	870	Prestrud 1992

known in 1984 were compared between years, and when dens known in 1987 (when many additional dens were located relative to 1984-1985) were compared between 1987, 1988, and 1989.

Discussion

Few dens of the larger size typical of natal dens were found during surveys after 1985 on both Herschel Island and the Yukon Coastal Plain, suggesting that few natal dens were missed during the later surveys. On Herschel Island two dens were used by the same Arctic Fox litter in 1988 (C.M.M.S, B.G.S., and A. Angerbjorn, University of Stockholm, unpublished data). Additional simultaneous use of dens by other litters may have occurred. In that case, fewer litters would have been present than suggested by the number of natal dens alone. However, with the exception of 1990, we consider this unlikely in view of the distance between natal dens (all > 2.7 km during 1984, 1985, 1986, 1987). Eberhardt et al. (1983) report an average distance between natal and successive Arctic Fox dens of 2.2 ± 0.7 km in northern Alaska. In 1990, simultaneous use of dens may have involved three dens 0.8-1.6 km apart. Hence, the number of Arctic Fox litters present in 1990 may have been four to six.

Herschel Island is the most important breeding area for Arctic Foxes in the Yukon Territory west of the Babbage and Crow rivers. The great differences in den density between Herschel Island and Yukon Coastal Plain is likely related to the difference in terrain between these areas. Arctic Foxes prefer well-drained soils, a prevalent terrain type on Herschel Island but much less common on the Yukon Coastal Plain (Smith et al. 1992). The limited available data do not support the occurence of a 3-4 year population cycle for both Herschel Island and Yukon Coastal Plain as reported for inland populations (Braestrup 1941; Elton 1942; Chitty 1950; Tchirkova 1951; Vibe 1967), nor of the magnitude of fluctuations reported by Tchirkova (1951), Sdobnikov (1960), or Bannikov (1970) in the coastal U.S.S.R. (Table 2). In inland Arctic Fox populations, the cycle closely follows changes in lemming populations and evidence has been presented that lemming abundance in the breeding season governs the survival of fox whelps (Macpherson 1969). Lemmings, primarily the Varying Lemming, were also the largest component in the summer diet of Arctic Foxes in northern Yukon during 1985 (Smits et al. 1989). However, coastal Arctic Foxes have access to a greater variety of food sources than inland Arctic Foxes (Braestrup 1941). As a result, coastal Arctic Foxes might not be regulated by lemming cycles to the same extent as inland Arctic Foxes. Alternatively, lemmings on the Yukon North Slope may not display a three to four-year population cycle. The annual harvest of Arctic Foxes on the Yukon North Slope has been extremely low since 1985 (K. Poole, N.W.T. Department of Renewable Resources, personal communication) and yearly variation in fox abundance was, therefore, undetectable in harvest statistics.

A low proportion of dens on Herschel Island and Yukon Coastal Plain are used for breeding, relative to other areas (Table 2). However, such a comparison may not be valid as it is not known in most cases if small dens (< 5 den entrances), unlikely to

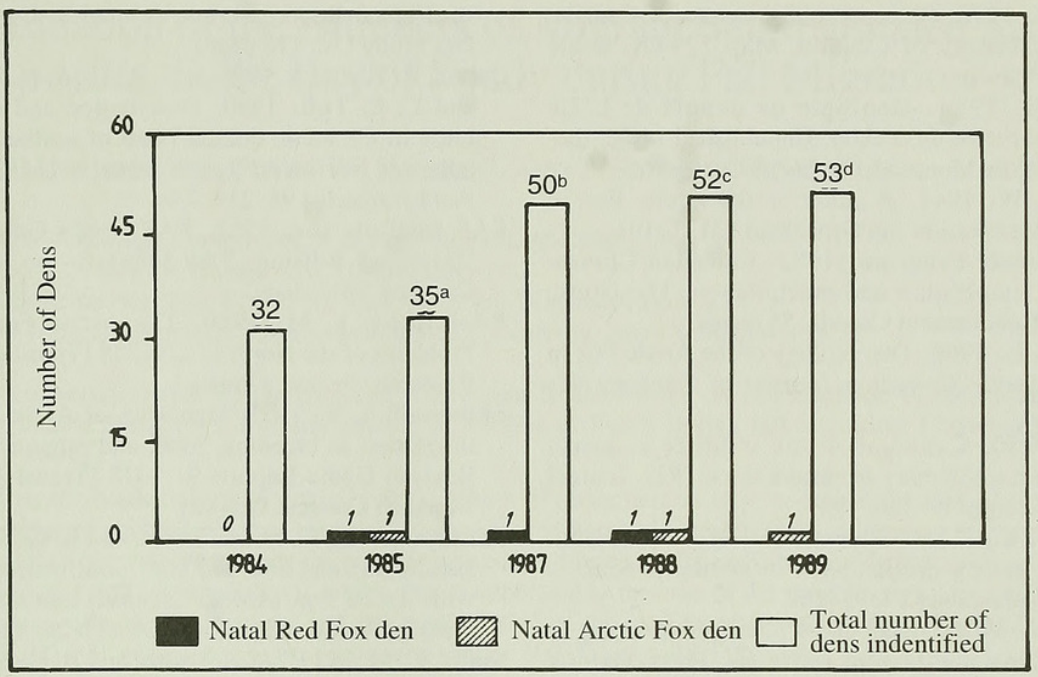

FIGURE 4. Breeding status and number of fox dens on Yukon Coastal Plain, 1984, 1985, 1987–1989. [a]three additional dens found; [b]50–63, 90% C.I., 50 natal dens were known, 15 of which were additional to those found in 1985; [c]two additional dens found in 1985; [d] one additional den found).

have been natal dens, were included in the sample of other studies. A more relevant comparison would involve the number of natal dens per unit area, which is also a more appropriate and direct index of habitat productivity. When this number is compared between areas (Table 2), Herschel Island is shown to possess one of the highest numbers of natal Arctic Fox dens per unit area, whereas the Yukon Coastal Plain possesses the lowest number reported. Similarly low proportions of natal dens were observed in the study area in 1972 (2 out of 50 identified dens, Ruttan 1974).

Many non-natal dens had been used by foxes in the recent past as evidenced by spoor of foxes at dens (i.e. scats, fur at den entrances). Such dens may have been occupied by pairs of foxes early in the breeding season whose litters subsequently failed (Macpherson 1969) or foxes may have used the dens for shelter from inclement weather at any time of year as has been reported by Eberhardt et al. (1983).

No Arctic Fox dens have been located on the Yukon Coastal Plain east of the Babbage and Crow Rivers despite systematic aerial surveys (Ruttan 1974; Ruttan and Wooley 1974; C.M.M.S. and R. H. Jessup, Yukon Department of Renewable Resources, unpublished data). However, the vegetation in that area is relatively dense and might obscure fox dens. There are no records of Arctic Foxes breeding in the Yukon Territory further inland than the Yukon Coastal Plain (D. Mossop, Yukon Department of Renewable Resources, and D. Russell, Canadian Wildlife Service, personal communication) although arctic tundra extends south to about 100 km from the Beaufort Sea. Information currently available, therefore, suggests that Herschel Island is the primary area producing Arctic Foxes in the Yukon Territory.

Acknowledgments

The study was funded by the Northern Oil and Gas Action Program (NOGAP)(1984 and 1985), the Yukon Wildlife Management Program of the Inuvialuit Final Agreement (IFA)(1987-1990), and the Yukon Department of Renewable Resources, with field support provided by Polar Continental Shelf Project (1987-1990). We thank the Canadian Parks Service for allowing us to work in Ivvavik National Park. Our gratitude is also expressed to A. Angerbjorn, H. Jessup, A. Baer, J. Snyder and M. Waterreus for their assistance in the aerial surveys and/or field. T. Rodger drafted the figures. D. Milne typed, while A. Baer and an anonymous reviewer critically read the manuscript.

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Received 6 April 1992
Accepted 23 August 1993