Distribution and Summer Occupancy of

FOX DENS

in Northern Yukon Territory

1984 -1990

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Technical Report
January, 1992

Yukon
Renewable Resources
Fish and Wildlife Branch

TR-92-1

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ABSTRACT

We investigated the distribution and summer occupancy of fox (Alopex lagopus and Vulpes vulpes) dens in northern Yukon during 1984 - 1990. During a preliminary survey in 1984, 14 dens were identified on Herschel Island. Additional dens were found in subsequent years incidental to monitoring flights and a complete survey was conducted in 1986. A total of 32 dens were known to exist on Herschel Island in 1990. It is considered unlikely that any natal dens went undetected. There were two natal arctic fox dens annually from 1984 - 1987, seven in 1988, one in 1989 and six in 1990. There was one natal red fox den in both 1984 and 1985. A comparison of occupancy rates of dens by fox litters between years was complicated by the fact that dens located in earlier years were generally larger and, therefore, more likely to be natal. When occupancy rates are compared between years using dens sampled each year, 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%). A comparison of occupancy rates by arctic fox litters of dens known in 1984 between all years during 1984 - 1990 showed that the difference between those was not significant ($p>0.75$).

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 dens ($\pm$ 13, 90% C.I.) It is considered unlikely that any natal dens have been missed on the Yukon Coastal Plain within the study area. One natal arctic fox den was observed during each of 1985 and 1988, and one red fox natal den was observed in 1985, 1987, 1988, and 1989. There was no significant difference in occupancy rates between years for arctic foxes or red foxes on the Yukon Coastal Plain. Twenty arctic fox pups are known to have been produced on Herschel Island in 1980; litter size varied from

four to seven ($\bar{x}$ = 5.0 $\pm$ 1.2 [S.D.]). 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. Information currently available suggests that Herschel Island is the primary arctic fox producing area in Yukon Territory. The clumped distribution of the population's breeding component increases the vulnerability of the population as a whole to harvest and human disturbance. Arctic fox trapping may need to be restricted if wildlife viewing becomes a significant use of this natural resource.

ACKNOWLEDGEMENTS

The study was funded by the Northern Oil and Gas Action Program (NOGAP) (1984 and 1985) the Lands, Parks and Resources Branch, Yukon Department of Renewable Resources (1986) and the Yukon Wildlife Management Program of the Inuvialuit Final Agreement (IFA) (1987 - 1990), with field support provided by Polar Continental Shelf Project (1987 - 1990). We thank Parks Canada and the Yukon Lands, Parks, and Resources Branch for allowing us to work in Northern Yukon National and Herschel Island Territorial Parks, respectively. Our gratitude is also expressed to H. Jessup, A. Baer, J. Snyder, and M. Waterreus for their assistance in the aerial surveys and to a number of other people who provided field support; A. Angerbjörn, F. Mueller, D. Talarico, R. Ward, P. Lortie, C. Smith, C. Kennedy, K. McKenna, D. Murray, A. Hargrave, W. Nixon, J. Hunston, D. Ladret, and G. Baird. The cooperation of the Department of National Defense, Ottawa, and of Felec Services Inc., Winnipeg, are greatly appreciated. Kenn Borek Air, Associated Helicopters and Canadian Helicopters provided skillful pilots. N. Hulstein and T. Rodger drafted the figures. D. Milne and L. Dornian typed the manuscript and A. Baer critically read the manuscript.

INTRODUCTION

Arctic foxes (Alopex lagopus) are dependent upon dens for rearing their young during spring and summer and many are utilized year-round for shelter (Eberhardt et al. 1983). Den sites are limited to areas where the upper thaw layer of permafrost is sufficiently deep and where soil characteristics permit burrowing (Chesemore 1969, Smits et al. 1988). These areas are often rare and localized, resulting in arctic foxes reoccupying dens for many years. Macpherson (1969) calculated that some dens in the Canadian Arctic may be used for several centuries before the burrow system collapses. Although it is not yet known whether arctic fox populations are limited by the availability of suitable den sites (Macpherson, 1970), it seems obvious that the availability of suitable denning sites plays an important role in the reproductive success of the species.

In northern Yukon, arctic fox den sites occur on the Yukon Coastal Plain and on Herschel Island. Red foxes (Vulpes vulpes) breed in this area as well (Ruttan 1974, Smits and Jessup 1985). The physical characteristics and terrain association of these den sites have been described for the purpose of identifying key arctic fox habitat and understanding den ecology (Smits et al. 1988, Smith et al. in prep.). Information on den distribution and productivity prior to 1984 has only been described in a cursory manner (Ruttan and Wooley, 1974, Ruttan 1974). This report presents the results of an investigation into the distribution and summer occupancy of fox dens in northern Yukon Territory during 1984-1990. The aim of the investigation was to collect baseline information for the management of arctic fox from both habitat and population management perspectives.

STUDY AREA

The study area included Herschel Island (101 km^2) and the Yukon Coastal Plain between the Babbage and Crow (Tulugaq) rivers to the east and the Canada/U.S.A. border to the west (2,440 km^2)(Fig. 1).

Herschel Island is composed of marine sediments that have been deformed and ice-thrusted into their present form (McKay 1959, Bouchard 1974). While these deformed marine sediments are predominantly fine-grained, there are limited exposures of sand and gravel. Differential erosion has led to the development of coarse-textured ridges existing within a landscape of otherwise fine-grained materials. Most of the surface is rolling upland at elevations ranging from about 60 to 180 m above sea level.

The Yukon Coastal Plain (Bostock 1970) is an eastward extension of the Arctic Coastal Plain (Wahrhaftig 1965) from north coastal Alaska. Averaging 20 km in width, it slopes from a high point of 150 m above sea level northward to the Beaufort Sea coast and encompasses an area of approximately 3700 km^2. The surficial materials of the Yukon Coastal Plain have mixed origins, being derived from 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 morainic 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). 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.) constitute the dominate vegetation on imperfectly drained upland sites in the study area. On sites with better drainage avens (Dryas integrifolia), vetch (Astragalus spp.) and arctic willow (Salix arctica) predominate (Wiken et al. 1981).

Common small mammal species included Brown Lemming (Lemmus sibiricus), Varying Lemming (Dicrostonyx groenlandicus), Northern Bog Lemming (Synaptomys borealis), Tundra Vole (Microtus oeconomus), Northern Redbacked Vole (Clethrionomys rutilus), and Arctic Ground Squirrel (Spermophilus parryii). The Arctic Ground Squirrel occurs on the Yukon Coastal Plain only (pers. observ.).

The area supports a large and varied breeding avifauna and is important for migration, molting, and staging of various species (Salter et al. 1980; R. Ward and D. Mossop, 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 Ptrarmigan (Lagopus lagopus), and American Golden Plover (Pluvialis dominica), all of which are abundant.

Microtines and birds were the main summer food items of arctic and red foxes (Smits et al. 1989).

METHODS

Dens in the study area have been identified using a systematic transect census (July 1984), incidental observation during relocation flights (July 1985) (Smits and Jessup, 1985) and July 1986 (Slough and Ward 1987), an aerial stratified random block sampling census, July 1987 (Smits and Slough, 1987), and observations incidental to field activities on the ground (July 1985-1990). 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. During aerial searches, den locations were plotted on 1:250,000 (Yukon Coastal Plain) or 1:50,000 (Herschel Island) topographical maps. In 1988 aerial relocation of dens was facilitated by aerial colour photographs of den sites which were taken during previous surveys. Den searches were conducted from a Bell 206 Jet Ranger B helicopter by one or two observers. Dens located from the air were ground checked to determine their occupancy status 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 small tracks or faeces were present, or if characteristic juvenile barks was heard from within the den. Red fox and arctic fox dens were distinguished by sightings or hair identification at burrow entrances.

In July 1988, juvenile arctic foxes were live-trapped and ear-tagged at natal dens on Herschel Island. The purpose of this was to enable identification of harvested foxes and determine their seasonal distribution. These capture activities also allowed a more accurate estimate of litter size. Three to six traps (Tomahawk single-door collapsible live traps, National Live Trap Co., Tomahawk, WI, USA, size 23 x 23 x 43 cm) were baited with fish and placed in front of burrow entrances of natal dens. Captured foxes were run into a burlap sack, ear-tagged with numbered metal tags (style 1005 monel, size 1, National

Band and Tag Co., Newport KY, USA), sexed, weighed and released at the capture location. Differences in size between dens were evaluated using two-tailed Student's t-test (α=0.05), while differences in proportions of natal dens between years were tested using contingency table analysis (α=0.05).

RESULTS AND DISCUSSION

Den Abundance and Summer Occupancy

Herschel Island

Fourteen dens were identified during a systematic aerial transect survey by helicopter on Herschel Island in 1984 (Table 1). Five additional dens were found in 1985 while checking previously identified dens for occupancy. In 1986 an intensive aerial transect survey by helicopter yielded an additional 17 dens while three dens collapsed between the summers of 1985 and 1986 (Slough and Ward, 1987). From 1987 to 1990 only one previously unknown den was found. One den collapsed between 1987 and 1988 and one between 1988 and 1989. A total of 32 dens were known to exist on Herschel Island in 1990. When we compare the size of dens found in the 1986 survey with the size of those found in 1984 and 1985, dens detected in 1986 were significantly ($p<0.001$) smaller (mean no. of burrow entrances = 7.2 $\pm$ 10.0 [S.D.]) than dens located before 1986 (Mean number of burrow entrances = 20.8 $\pm$ 13.4). Since non-natal dens (Mean no. of burrow entrances = 5.2 $\pm$ 5.6) are also significantly ($p<0.01$) smaller than natal dens (Mean no. of burrow openings = 25.1 $\pm$ 12.9), this suggests that any dens remaining undetected are likely small and non-natal. Furthermore, since arctic foxes frequently use multiple dens simultaneously to raise their litter (Eberhardt et al. 1983), we consider it very unlikely that any litters were missed during the annual aerial surveys of 1986 to 1990.

During the years 1984 through 1987, two natal arctic fox dens were observed each year on Herschel Island, while one natal red fox den was observed in addition to this in both 1984 and 1985 (Table 1, Fig. 2). By contrast, seven dens were occupied by arctic fox litters and one by a red fox litter in 1988. In 1989, only one den was natal (arctic fox) while in 1990 six dens were identified as natal arctic fox dens.

A comparison of the proportion of natal dens between years has to take into account the type (size) of dens known in each year. To get a more realistic approach, we compared occupancy rates for the years 1986, 1987, 1988, 1989, and 1990 using dens sampled each year, excluding no. 58 (collapsed after summer of 1987), and no. 91 (not known in 1986). The proportions of natal dens for this adjusted number (n = 32) of dens are 6.3% (n = 2), 6.3% (n = 2), 18.8% (n = 6), 3.1% (n = 1), and 18.8% (n = 6) for 1986, 1987, 1988, 1989, and 1990, respectively, for arctic fox and 3.1% (n = 1) for red fox in 1988 (Table 2, Fig. 3). In 1988 den nos. 47 and 61 were used by the same arctic fox litter. Additional simultaneous use of dens by other litters may have occurred and would have caused apparent occupancy rates to be greater than the actual rates. However, with the exception of 1990 we consider this unlikely in view of the distance between natal dens (Figure 1). Eberhardt et al. (1983) report an average distance between natal and successive dens of 2.2 $\pm$ 0.7 km in northern Alaska. In 1990, simultaneous use of dens may have involved den no.'s 47, 50, and 61 given the distance between these dens (0.8 - 1.6 km). Hence, the number of arctic fox litters in 1990 may have varied from 4 to 6. One den produced fox litters during four seasons, two dens during three seasons, five dens during two seasons, five dens during one season, while 24 dens did not produce fox litters during the period of study (Fig. 4).

The comparison in occupancy rates between 1984-1990 by arctic fox litters took into account the relatively few dens known in 1984 and 1985 by comparing the occupancy rates of dens known in 1984 with those of the same dens sampled in subsequent years (Table 2). Occupancy rates of arctic foxes were highest during 1988 and lowest in 1989; however, the difference in the occupancy rates between those years wasn't significant ($p>0.75$).

A comparison between the years 1986-1990 when no natal dens were expected to be missed shows 1988 and 1990 to be 'high' years and 1986, 1987, and 1989 'low' years in annual variation in breeding success by arctic foxes on Herschel Island. However, 1990 may have been an 'intermediate' year if den nos. 47, 50, and 61 were used by the same litter.

Yukon Coastal Plain

Thirty-two dens were identified during a systematic aerial transect survey by helicopter on the Yukon Coastal Plain in 1984. Three additional dens were found in 1985 while checking previously identified dens for occupancy (Smits and Jessup 1985). In 1987, an aerial stratified random block sampling census (Smits and Slough 1987) yielded a total estimate of 50 dens ($\pm$13, 90% C.I.) Two more dens were located in 1988 while intensively surveying an additional 12 sample blocks (Smits and Slough unpubl. data). One additional den was found during 1989. Although the probability of finding more dens appeared fairly high, we suspect that few, if any, natal dens on the Yukon Coastal Plain were missed within the study area. The proportion of natal dens among any unobserved dens is likely lower than among the known dens as suggested by a comparison of the size of fox dens known previous to 1987 and those found during more intensive surveys in 1987 and 1988. The mean number of burrow openings of dens identified in 1984 and 1985 ($\bar{x}$ = 18.2 $\pm$ 8.7) is significantly greater than that of dens identified in 1987 ($\bar{x}$ = 9.2 $\pm$ 9.6)($t = 2.95$, d.f. = 38, $p<0.01$). No natal dens of either red or arctic fox were observed on the Yukon Coastal Plain during the 1984 survey (Fig. 5). One natal arctic fox den was observed during each of 1985 and 1988, while red fox natal dens were observed in 1985 (1), 1987 (1), and 1988 (1)(Table 3). One den produced fox litters during two seasons, three dens produced fox litters once, while 48 dens did not produce fox litters during the period of study (Fig. 4).

There was no significant difference in occupancy rates between years for arctic foxes or red foxes on the Yukon Coastal Plain. This holds for both when dens 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.

Fox Productivity

Between 1984-1987, observations of pups at natal dens were sporadic and probably not representative of the total numbers of pups present at dens. Observed numbers of pups in arctic fox litters varied from 1 to 4 and in red fox litters from 2-5, during this period (Smits and Jessup 1985, Slough and Ward 1987). Capture-recapture and ear-tagging activities in 1988 greatly aided the accurate estimation of litter sizes at natal dens. A total of 20 arctic fox pups (10 female, 10 male) were captured at five dens on Herschel Island during this year (Table 4). Litter size varied from 4 to 7 ($\bar{x} = 5.0 \pm 1.2$).

GENERAL DISCUSSION

Assuming that Herschel Island and mainland arctic foxes belong to one population, the higher proportion of natal arctic fox dens on Herschel Island relative to the Yukon Coastal Plain during 1988 and 1990 suggests that arctic foxes prefer habitat on Herschel Island over that of the Yukon Coastal Plain for breeding purposes. This phenomenon raises questions about habitat quality (e.g. prey availability and denning suitability) that can only be speculated on with the information currently available. In any event, it is clear that Herschel Island contains the most important segment of the arctic fox breeding range in Yukon Territory west of the Babbage and Crow rivers. The great difference 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 (Smith et al., in prep.), a prevalent terrain type on Herschel Island but much less common on the Yukon Coastal Plain. The higher proportion of dens used for breeding on Herschel Island as compared to the Yukon Coastal Plain probably reflects prey availability.

A striking phenomenon was the absence of an increase in red fox reproduction relative to arctic fox reproduction on Herschel Island during 1988 and 1990. Whatever factors allowed the breeding component of the arctic fox population to increase were not being capitalized on by red foxes. Alternatively, the red fox population may only consist of a low total number of reproductive and non-reproductive individuals. In the eastern Canadian Arctic, the red fox is a relatively recent (after 1900) immigrant (Macpherson 1969). On the Yukon Coastal Plain, on the other hand, the red fox has probably occurred since 1810 and possibly as early as 1435 as evidenced from analyses of archaeological remains at Trail River (Nagy 1990). Although occupancy of dens by arctic fox litters varied between years, there is no evidence of a 3-4 year cycle 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 5). In inland arctic fox populations, the cycle closely follow 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 3-4 year population cycle. The annual harvest of arctic foxes on the Yukon North Slope has been extremely low since 1985 as evidenced from Aklavik and Inuvik, N.W.T. harvest statistics (K. Poole, pers. commun.)[1] and yearly variation in fox abundance was, therefore, undetectable in harvest statistics. A comparison of proportions of natal dens reported elsewhere suggests that a low proportion of dens on Herschel Island and Yukon Coastal Plain are used for breeding, relative to other areas (Table 5). However, such a comparison may not be valid as it is not known if small dens (<5 burrows), unlikely to have been natal dens, were included in the sample of other studies. A more relevant comparison would involve the number and size of litters produced per unit area, which is also a more appropriate and direct index of habitat productivity. When this index is compared between areas (Table 5), Herschel Island is shown to possess one of the highest number of natal dens per unit area, whereas the Yukon Coastal Plain possesses the lowest number reported. Similarly low proportions

[1]The study area is trapped exclusively by Aklavik and Inuvik, N.W.T. trappers.

of natal dens were observed in the study area during 1972 (2 out of 50 identified dens, Ruttan 1974).

Many dens that were non-natal during the period of study have been used by foxes in the recent past as evidenced by old sign of foxes at dens (i.e. scats, fur at burrow 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. Dens are reportedly frequently used for the latter purpose (Eberhardt et al. 1983).

Since arctic fox pups first emerge from the dens when they are 3-4 weeks old (Garrott et al. 1984), it is not possible to readily obtain information of litter size at birth from arctic foxes in the wild. Weaned litter size estimates on the other hand are more a function of early whelp mortality, which in turn is controlled by food availability, than of the initial size of litters (Macpherson 1969). Our average weaned litter estimate of five falls within the range reported for coastal arctic foxes (Braestrup 1941, Østbye et al. 1978, Garrott and Eberhardt, 1987) which is less than the average reported for inland arctic foxes (8)(Braestrup 1941). The latter phenomenon has been suggested to be an adaptation to an unstable food supply.

No arctic fox dens have been located on the Yukon Coastal Plain east of the Babbage and Crow Rivers (Ruttan 1974, Ruttan and Wooley 1974, Smits and Jessup, 1985). However, the vegetation in that area is relatively dense and might obscure fox dens. There are no records of arctic foxes breeding in Yukon Territory further inland than the Yukon Coastal Plain (D. Mossop and D. Russell, pers. comm.). Information currently available therefore suggests that Herschel Island is the primary arctic fox producing area in Yukon Territory.

Indeed, all arctic fox litters located on the study area in July 1988 and July 1989 had been produced on Herschel Island. The total number of arctic fox breeders in Yukon Territory appears extremely low; the species may well be one of the rarest mammals breeding in the territory. The clumped distribution of the population's breeding component increases the vulnerability of the population as a whole to harvest and human disturbance.

MANAGEMENT IMPLICATIONS

Yearly den monitoring has provided important clues to the significance of certain areas and dens within those areas to produce arctic foxes. Conservation of arctic fox breeding habitat should be an important management aspect for the species. The absence of breeding dens over vast areas and the use of dens for hundreds of years attests to the importance of dens to arctic fox populations and indeed suggests that arctic fox populations may be limited by availability of suitable den sites. The results provide clear evidence of the value of conducting replicate den surveys during several successive summers. Surveys during years with few natal dens would not have indicated the relative importance of Herschel Island as an arctic fox producer, nor would they have highlighted certain dens as primary litter producers. The results also emphasize the significance of Herschel Island as a prime area for non-consumptive use potential of arctic fox. The projected increase of visitors to Herschel Island (D. Talarico, pers. comm.) will soon create a need to develop guidelines preventing human disturbance at den sites.

Trapping at breeding dens during late winter, a practice commonly used as evidenced by the presence of toggles (to which traps are attached) at many dens in northern Yukon Territory (Smits and Slough, pers. observ.), may have a deleterious influence on the number of fox litters subsequently produced. With many breeding pairs of arctic foxes located in a small area such as Herschel Island, it is cost/effort-effective for trappers to concentrate their operations there. This increases the likelihood that Herschel Island receives a more consistent and intensive trapping pressure than areas where breeders are more widely dispersed. The potential impact of intensive trapping on Herschel Island, as has occurred in the past (Smits and Jessup 1985), cannot be estimated but may be substantial (see Smirnov 1968). Arctic fox trapping may

need to be restricted if wildlife viewing becomes a signficant use of this natural resource.

Little is known of the effects of human disturbance on foxes at breeding dens other than that foxes may desert disturbed dens to occupy adjacent dens (Eberhardt et al. 1983, Anthony et al. 1985). Such behavior may conceivably result in increased mortality from predation, particularly when displacement from breeding dens occurs when fox whelps are young and more vulnerable to predation. Disturbance at breeding dens may also have a negative effect on whelp survival through effects of displacement from favorable to less favorable habitat.

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Table 1. Breeding status* of fox dens on Herschel Island, 1984-1990.

	Year						
Den I.D. Number	1984	1985	1986	1987	1988	1989	1990
37	-	AF	AF	-	AF	-	-
38	?	-	-	-	RF	-	-
40	-	-	-	-	AF	-	AF
41	RF	RF	-	-	-	-	-
44	-	-	-	-	AF	-	-
47	-	-	-	-	AF+	-	AF
48	AF	-	-	-	-	-	-
50	?	?	?	AF	-	AF	AF
53	AF	-	-	AF	-	-	AF
60	?	?	-	-	AF	-	AF
61	?	?	-	-	AF+	-	AF
67	?	?	-	-	AF	-	-
72	?	?	AF	-	-	-	-
TOTAL	3	2	2	2	8	1	6
(Percentage of total number of dens known)	21.4	10.5	6.1	5.9	24.2	3.1	18.8

*AF: natal arctic fox den
RF: natal red fox den
- : non-natal
+ : same litter
? : unknown

Table 2. Number of natal fox dens (arctic fox, except where noted) observed on Herschel Island, 1984-1990.

Year	Sub-Sample(%) n=14	Complete Sample(%) n=32
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)	7*(21.9)
1989	1(7.1)	1(3.1)
1990	4(28.6)	6(18.8)

For comparative purposes, two categories of den samples are described: 1) dens known in 1984 (sub-sample; for comparisons between 1984-1990), 2) dens known in 1986 (complete sample; for comparisons between 1986-1990).

* including one red fox natal den

Table 3. Breeding status* of fox dens on the Yukon Coastal Plain, 1984-1985, 1987-1989.

	Year				
Den I.D. Number	1984	1985	1987	1988	1989
3	-	RF	-	RF	RF
18	-	AF	-	-	-
75	?	?	RF	-	-
82	?	?	-	AF	-
TOTAL	?	2	1	2	1
(Percentage of total number of dens known)	0	5.7	2.0	3.9	2.1

*AF: natal arctic fox den
RF: natal red fox den
- : non-natal
+ : same litter
? : unknown

Table 4. Characteristics of arctic foxes captured on Herschel Island, July 1988.

Fox ID#	Den#	Date Captured	Time Captured	Sex	Weight (g)	Ear Tag #	
						Left	Right
1	44	21	23:20	F	1580	190	8071
2	44	21	23:20	F	1670	184	192
3	44	22	18:30	M	1745	8052	8051
4	44	22	18:30	M	1670	8053	8054
5	44	22	18:30	M	1860	8056	8055
6	44	22	18:30	M	1780	8057	8058
7	44	22	18:30	F	1640	8060	8059
8	47	24	22:00	M	1520	8062	8061
9	47	24	22:00	F	1370	8064	8063
12	47	25	00:20	F	1300	8069	8070
10	61	24	23:00	M	1640	8065	8066
11	61	24	23:00	M	1440	8067	8068
13	61	25	01:00	F	1350	A2653	A2652
14	61	25	03:05	F	1360	A2654	A2655
15	61	25	05:30	F	1440	A2657	A2656
16	36	26	02:00	F	1950	A2658	A2659
17	67	26	17:30	M	1830	A2661	A2660
18	67	26	21:20	M	1740	A2663	A2662
19	67	26	21:20	F	1740	A2665	A2664
20	67	26	21:20	M	1940	A2666	A2667

Table 5. Crude density and percentage of natal dens reported for arctic fox den surveys.

Location	Natal Dens Per 100 km^2	% Natal Dens of all dens	Area (km^2)	Authority	
U.S.S.R.		31 - 74		Shibanoff	1951
Bol'shezemel'skaya tundra, U.S.S.R.		12 - 100		Tchirkova	1951
Taimyr, U.S.S.R.		6 - 100		Sdobnikov	1961
Bol'shezemel'skaya tundra, U.S.S.R.		3		Skrobov (in Macpherson	1961 1969)
Teshekpuk Lake area, Alaska		4		Chesemore	1969
Aberdeen Lake area, N.W.T.	0.33 - 1.38	12 - 50	4,947	Macpherson	1969
Whole tundra zone, U.S.S.R.		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	1,700	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	Ostbye *et al.*	1978
Herschel Island	1.98 - 6.93	6 - 21	101	This study	
Yukon Coastal Plain	0 - 0.04	0 - 2	2,449	This study	