Summer Food Habits of Sympatric Arctic Foxes, *Alopex lagopus*, and Red Foxes, *Vulpes vulpes*, in the Northern Yukon Territory

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Food habits of sympatric Arctic Foxes (*Alopex lagopus*) and Red Foxes (*Vulpes vulpes*) were determined from 31 Arctic Fox scats (from three active natal dens) and 39 Red Fox scats (from two active natal dens) collected in the northern Yukon Territory in summer 1985. Prey consumption was quantified in terms of percentages of fragments and percent frequency occurrence of taxa. Microtinae, primarily the Varying Lemming (Diacrostonyx groenlandicus) was the major prey for both fox species. The Brown Lemming (*Lemmus sibiricus*) and Tundra Vole (*Microtus oeconomus*) [Red Fox only], and Northern Bog Lemming (*Synaptomys borealis*) [Arctic Fox only] were consumed in lower quantities. Several bird species were consumed, primarily by Red Foxes. *D. groenlandicus* was consumed less frequently and birds more frequently by Red Foxes on the mainland (Yukon Coastal Plain) than by those on Herschel Island. The diets of sympatric Arctic Foxes and Red Foxes were similar; however, the Red Fox used more birds and less *D. groenlandicus* than did the Arctic Fox.

Key Words: Arctic Fox, *Alopex lagopus*, Red Fox, *Vulpes vulpes*, food habits, sympatry, competition, Yukon Territory

The diet of the Arctic Fox, *Alopex lagopus*, is restricted compared to that of the Red Fox, *Vulpes vulpes*, (Englund 1965; Chesemore 1968; Macpherson 1969; Stephenson 1970; Hersteinsson and MacDonald 1982; Garrott et al. 1983; Jones and Theberge 1983). This has been attributed to the dependence of Arctic Fox on a less diverse prey fauna (Hersteinsson and MacDonald 1982). The present study compares for the first time the summer food habits of sympatric Arctic Foxes and Red Foxes.

**Study Area**

The study area included the Yukon Coastal Plain (Bostock 1970) and Herschel Island in the northern Yukon Territory. The physiography and climate of the area have been described by Wiken et al. (1981).

Denning habitat on Herschel Island is characterized by moderately eroded, sloping, gullied terrain and sandy erosional mounds. The two dens sampled on the Yukon Coastal Plain were located in a streamside cutbank and a dune, both in fluvial landforms. Seat samples were collected from three Arctic Fox natal dens (two on Herschel Island at 69°36'N, 139°11'W, and 69°34'N, 139°08'W, one on Yukon Coastal Plain at 69°34'N, 139°40'W) and two Red Fox natal dens (one on Herschel Island at 69°37'N, 138°58'W, one on Yukon Coastal Plain at 69°37'N, 140°56'W). Distances between Arctic Fox and Red Fox dens varied from 8.0 km to 76.5 km.

Cottongrass tussocks (*Eriophorum vaginatum*), moss, ericaceous shrubs and willow shrub (*Salix* spp.) comprise the dominant 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, commonly interspersed with mud boils (Wiken et al. 1981).

Small mammal species included Brown Lemming (*Lemmus sibiricus*), Varying Lemming (*Diacrostonyx groenlandicus*), Northern Bog Lemming (*Synaptomys borealis*), Tundra Vole (*Microtus oeconomus*), Northern Red-backed Vole (*Clethrionomys rutilus*), and Arctic Ground Squirrel (*Spermophilus parryii*), the latter on Yukon Coastal Plain only.

The area supports a large and varied breeding avifauna and is important for migration, molting, and staging of the 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 hyemalis*), Semi-palmated Sandpiper (*Calidris pusilla*), Lapland Longspur (*Calidris 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.

Methods

Scat collections were made between 29 June and 7 July 1985. Only recent scats (identifiable by their dark and glossy appearance; Macpherson 1969) were collected. Each was labelled with the date, den number and fox species (from observation). The scats were soaked in water or a dephylatory, and fragments separated, dried and sorted. Only teeth and bone fragments were analyzed. These were compared with reference skeletons at the Zooarchaeological Identification Centre, National Museum of Natural Sciences (now Canadian Museum of Nature), Ottawa, some of which were obtained during this study. Prey consumption was quantified in terms of percentages of fragments and percent frequency occurrence of taxa. Differences in mean number of identified fragments per scat were tested using Student’s t-test. The number of scats containing a food item and the number not containing it were compared between fox species and between areas within species using 2 X 2 contingency table analysis with a Yates correction for continuity (Zar 1984).

Results

Scats found at the dens were of a relatively uniform size and could not be differentiated into those from juvenile or adult foxes using Speller’s (1972) classification.

Thirty-one Arctic Fox scats (27 from Herschel Island, four from Yukon Coastal Plain) and 39 Red Fox scats (22 from Herschel Island, 17 from Yukon Coastal Plain) were analyzed (Table 1). Most bones recovered from the scats were broken or damaged to the extent that many were unidentifiable, as gastro-intestinal erosion had modified bone fragment surface features. A large number of mammalian bones were only identifiable to subfamily, although a number of fairly complete elements occurred, e.g., vertebrae, carpals, tarsals, and phalanges. Diagnostic elements identifiable to the species level were primarily restricted to teeth and various long bone elements. Several samples contained avian bones, but the majority of these were unidentifiable fragments. The mean number of all identified fragments per Arctic Fox scat (78.5 ± 39.5 SD) was significantly greater than the mean for Red Fox scats (29.1 ± 26.5 SD; df = 68, t = 6.22, p < 0.001).

Microtinae were the most important prey class in both Arctic and Red Fox scats, comprising approximately half of all identified fragments. Dicrostonyx groenlandicus was the most frequently identified small mammal species in both Red Fox and Arctic Fox scats. The only other small mammals identified, Lemmus sibiricus (in both Arctic Fox and Red Fox scats), Synaptomys borealis (Arctic Fox) and Microtus oeconomus (Red Fox only) occurred at trace levels. Although mammalian hair was not analyzed, cursory examination of hair revealed no evidence of mammals larger than microtinae. Identified bird sub-families were Anatinae (Arctic Fox) and Merinae (Red Fox), and family Anatidae (Red Fox), each of which also occurred at trace levels.

Discussion

As adults of both the Arctic Fox and the Red Fox are reported to defecate infrequently at the den (Speller 1972; Scott 1943, respectively) the food habits reported here are likely primarily those of juveniles. These may not be representative of other age classes. Frank (1979) found that adult Red Fox scats contained a greater variety of bird remains than did juvenile scats. Kennedy (1980) reported that adult scats contained less caribou carrion than did juvenile Arctic Fox scats.

The greater number of identifiable fragments in Arctic Fox scats relative to those of Red Fox suggests that Red Fox foods are subject to more severe erosional factors during digestion. Comparisons between different food classes based on percentage of total numbers of identified fragments are complicated by differential digestibility and fragmentation between classes (Scott 1941; Lockie 1959). In feeding trials with Red Foxes, Lockie (1959) showed that birds are under-represented in faeces relative to their true dietary proportions. However, in our opinion comparisons among small mammals are valid, due to the similarity in size, weight, and the proportion of undigestible matter between species.

D. groenlandicus constituted 98% of all small mammal remains identified to species in Arctic Fox scats and 79% in Red Fox scats. The
Table 1. Arctic Fox and Red Fox food habits in the northern Yukon Territory expressed as % of total number of bone fragments and % frequency occurrence of food items in scats.

<table>
<thead>
<tr>
<th>Food Item</th>
<th>Arctic Fox</th>
<th>Red Fox</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Herschel Island 2 dens, n = 27</td>
<td>Yukon Coastal Plain 1 den, n = 4</td>
</tr>
<tr>
<td></td>
<td>Herschel Island 1 den, n = 22</td>
<td>Yukon Coastal Plain 1 den, n = 17</td>
</tr>
<tr>
<td>Mammals:</td>
<td>% of fragments</td>
<td>% freq. occurrence</td>
</tr>
<tr>
<td>Dicrostonyx groenlandicus</td>
<td>7.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Lemmus sibiricus</td>
<td>** t</td>
<td>3.7</td>
</tr>
<tr>
<td>Microtus oeconomus</td>
<td>t</td>
<td>3.7</td>
</tr>
<tr>
<td>Synaptomys borealis</td>
<td>51.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Microtinae, unidentified</td>
<td>58.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total Microtinae</td>
<td>25.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Small mammal, unidentified</td>
<td>83.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total Mammal</td>
<td>1.2</td>
<td>25.0</td>
</tr>
<tr>
<td>Birds:</td>
<td>0.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Anatinae</td>
<td>0.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Merginae</td>
<td>10.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Anatidae, unidentified</td>
<td>10.6</td>
<td>9.1</td>
</tr>
<tr>
<td>Total Anatidae</td>
<td>15.8</td>
<td>66.7</td>
</tr>
<tr>
<td>Bird, unidentified</td>
<td>8.0</td>
<td>31.8</td>
</tr>
<tr>
<td>Total Bird</td>
<td>2267</td>
<td>83</td>
</tr>
<tr>
<td>Vertebrate, class unidentified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fragments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* n = number of scats
** t = trace, or less than 0.1%
proportion of Microtinae among identified fragments was similar in Arctic Fox and Red Fox scats. If it is assumed that proportions of *D. groenlandicus* are similar in both identified and unidentified groups, then *D. groenlandicus* was the most common item in Arctic Fox scats (58% of total number of identified fragments), as well as in Red Fox scats (43%). These proportions are likely underestimated since unidentified small mammals is probably composed mainly, if not wholly, of Microtinae.

Other small mammal species occurred at much lower frequencies in scats of both fox species. The higher proportion of *D. groenlandicus* among small mammals in Arctic Fox scats suggests that they hunt more selectively for this species than does the Red Fox. Conversely, only Red Foxes appeared to take *M. oeconomus*, and they also took a greater proportion of birds. The dietary differences between Red Foxes of Herschel Island and the Yukon Coastal Plain may be attributable to differences in prey availability, to differences in individual preferences of the foxes involved, or to both.

The dietary overlap between Red and Arctic foxes was greater than that reported for Alaska (Eberhardt 1977), however, the Alaska study did not involve exclusively sympatric individuals. *Dicrostonyx* is a common food of the Arctic Fox on both island (Chesemore 1968; Kennedy 1980; Garrott et al. 1983) and mainland (Macpherson 1969; Speller 1972) locations in Alaska and the Northwest Territories. Birds also frequently predominate in the diet of the Arctic Fox (Chesemore 1968; Macpherson 1969; Speller 1972; Garrott et al. 1983) but apparently they do not when *Dicrostonyx* is abundant (Macpherson 1969; Kennedy 1980; Garrott et al. 1983). *Lemmus* (Speller 1972) and *Microtus* (Chesemore 1967; Burgess 1984) may also predominate where locally abundant. *Microtus oeconomus* inhabits primarily shrubby areas (Eberhardt 1977) which Arctic Foxes are known to avoid (Garrott et al. 1983). *Dicrostonyx*, the preferred food in the present study, inhabits tundra dominated by low shrubs and herbs, where Arctic Foxes prefer to hunt (Garrott et al. 1983).

The Red Fox diet is comparatively more diverse where its range does not overlap that of the Arctic Fox (Hersteinsson and MacDonald 1982) and this has been attributed to a comparatively less restricted prey base for Red Fox (*ibid*). The present study shows the summer diet of the Arctic Fox to be approximately similar to that of the Red Fox where their ranges overlap, with the Arctic Fox appearing to use slightly more *D. groenlandicus* and the Red Fox using more birds. Little is known of winter food habits of Red Foxes, however, they have been observed scavenging on Ringed Seals (*Phoca hispida*) killed by Polar Bears (*Ursus maritimus*) (Andriashek et al. 1985).

Competition between Arctic and Red Foxes extends beyond food habits to denning requirements (C.N.N.S., B.S.G. and R. H. Jessup, unpublished data). The behavioural dominance of the Red Fox over the Arctic Fox in an artificial pen enclosure led Rudzinski et al. (1982) to conclude that Red Foxes should be able to dominate in direct competition for den sites and other limited resources. Although there has been an influx of Red Foxes into Arctic Fox range since the early 1900s (Macpherson 1964; Chirkova 1967), the Red Fox is not known to have completely excluded the Arctic Fox in any sympatric situation.

Although the Red Fox should be able to exclude the Arctic Fox where resources are limited, other factors including a lower ability to withstand low ambient temperatures (Scholander et al. 1950; Irving et al. 1955) or to survive cyclic rabies epidemics could give the Arctic Fox a competitive advantage. The northward movement of Red Fox has been attributed to a warming trend (Chirkova 1967), which would favour the former hypothesis. The ability to acquire winter food may also be limiting the Red Fox's success.

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Literature Cited


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