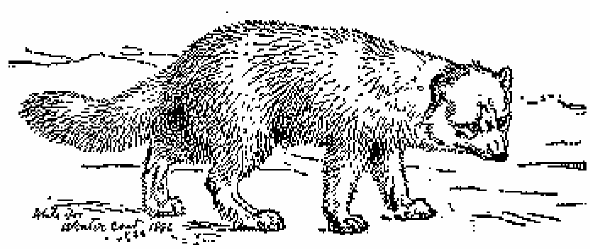
Foraging Behaviours and Population Dynamics of Arctic Foxes at Karrak Lake, Nunavut



Progress Report

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Summary: The abundance of mammals and birds fluctuates considerably among years in most northern environments. These fluctuations, in turn, are often related to variation in the abundance and distribution of foods. However, the influence of seasonally superabundant foods (such as large concentrations of nesting birds) on population dynamics of local consumers (e.g. arctic foxes) is poorly understood. The objectives of this study are to examine (*1*) how arctic foxes use seasonally superabundant foods such as geese and their eggs and (*2*) how access to these foods influence population dynamics of arctic foxes. This study will provide information on foraging behaviours and population dynamics of arctic foxes that can be used for management and conservation of both arctic foxes and arctic-nesting birds. Proper management of natural resources is important to residents in many northern communities where hunting and trapping are integral parts of the economy and culture. Fieldwork in 2011 will be limited to trapping and marking of adult foxes in spring as other field components of the project are completed.

1. INTRODUCTION

The abundance of mammals and birds often varies considerably among years in northern ecosystems (Sinclair and Gosline 1997, Krebs et al. 2001). These fluctuations, in turn, are often related to variation in the abundance and distribution of foods (Krebs et al. 1995). However, the influence of food caching and use of temporally superabundant foods (e.g. large concentrations of nesting birds) on population dynamics of local consumers is poorly understood (Vander Wall 1990, Willson and Womble 2006). In fact, the extent of food caching and its implications on population dynamics are poorly understood in most animals (Vander Wall 1990).

Arctic foxes (*Vulpes lagopus*) are opportunistic predators and scavengers that rely heavily on small mammals throughout most of their range (Audet 2002). However, other foods such as birds and their eggs and carrion from the marine system can be important in arctic fox diets when small mammals are scarce (Bantle and Alisauskas 1998, Samelius et al. 2007b). In fact, Prestrud (1992) suggested that the ability to learn new hunting skills and exploit local variation of foods is crucial factors for arctic fox survival.

Arctic foxes commonly cache foods when it is abundant and these foods can be important in arctic fox diets during periods of food shortage (Bantle and Alisauskas 1998, Samelius and Alisauskas 2000, Samelius et al. 2007b). Caching and use of stored foods appears to be especially frequent among arctic foxes at large bird colonies where food is often superabundant during the nesting season of birds (Bantle and Alisauskas 1998, Samelius and Alisauskas 2000). Large bird colonies therefore provide an ideal setting to study various aspects of food caching and the link between seasonally superabundant foods and population dynamics.

2. OBJECTIVES

The objective of this study is to examine how foraging behaviours and population dynamics of arctic foxes are influenced by large concentrations of geese. Specifically, we will examine (*1*) how abundance, survival, and recruitment of arctic foxes vary among areas with and without large concentrations of geese and (*2*) how foraging behaviours of arctic foxes vary among individuals and in relation to individual attributes of foxes (size, sex, and reproductive status) and nesting distribution by geese. Fieldwork in 2011 will be limited to trapping and marking of adult foxes as other field components of the project are completed.

3. STUDY AREA

This study is done at Karrak Lake (67^{o} 14' N, 100^{o} 15' W) and surrounding areas in the Queen Maud Gulf Bird Sanctuary, Nunavut (Figure 1). Karrak Lake is the largest Ross's (*Chen rossi*) and lesser snow geese (*Chen caerulescens*) colony in the Sanctuary, consisting of 1.2 million nesting geese in 2010(R. T. Alisauskas, unpublished data). This study is part of long-term research on factors affecting the nutritional and population ecology of Ross's and lesser snow geese by Dr. R. T. Alisauskas and Environment Canada.

4. TRAPPING AND MARKING OF FOXES

Trapping and marking of arctic foxes is vital for monitoring population dynamics and estimating vital rates (e.g. survival and recruitment rates) of foxes. Trapping and marking of foxes was also important for observing foraging behaviours of foxes – a part of this study that is now completed (see preliminary results below). Trapping procedures for this study are reviewed annually by the University of Saskatchewan Animal Care Committee (UCACS protocol number 19990029) and follow the Guidelines of the Canadian Council on Animal Care.

4.1. Trapping of adult foxes

Adult arctic foxes are captured in spring by using box-traps (plastic and wire traps) and padded leghold-traps (Softcatch No. 1) that are placed at locations with signs of fox activity (e.g. elevated knolls and large rocks). Foxes are trapped in a 5×14 km area of the original and central part of the goose colony (Figure 1) in May. Box-traps are checked at least twice daily whereas leghold-traps are kept under continuous observation to minimise stress on animals (Samelius et al. 2003). Adult foxes are anaesthetised to provide safe handling and to reduce stress on animals. We use 15 mg of Telazol (corresponding to 0.15 ml of the solution reconstituted to 100 mg/ml) that is injected intramuscularly in the upper part of the back leg (Samelius et al. 2003). We have not seen any ill-effects of the drug and immobilisation with Telazol is characterised by safe handling and predictable recovery (Samelius et al. 2003). Foxes are individually marked with collared ear-tags (plastic ear-tags by Dalton ID Systems Ltd. that are 1×3.5 cm in size – these tags are permanent and remain on foxes throughout their life), weighed, sexed, and we measure the right hind-foot. Fur and blood was collected for stable isotope analyses in 2000 to 2004; we clipped a small sample of fur and collected a small sample of blood (ca 0.5 ml) from the cephalic vein on the lower front leg. Blood samples will be collected in 2011 to examine parasite prevalence in arctic foxes. As before, blood will be collected from the cephalic vein.

A subsample of foxes were marked with radio-collars in 2001 to 2003 to help locating foxes for behavioural observations (MOD-105 Telonics Inc., weight = 70 g). Arctic foxes will not be radio-collared in 2011 as we have enough data for behavioural analyses (see preliminary results below).

4.2. Trapping of juvenile foxes

Juvenile arctic foxes (pups) were captured in wire traps in mid to late July in 2000 to 2007. Traps were kept under continuous observation when capturing pups. We placed traps on dens in early July to allow foxes to get used to traps (fieldwork in 2000 showed this to be critical for successful capture of pups). Pups were individually marked with collared ear-tags (same tags as used for adults above), weighed, sexed, and we measured the right hind-foot. We collected a small sample of fur from all fox pups for stable isotope analyses in 2000 to 2004. We did not anaesthetise pups, as they were calm during handling.

4.3. Summary of fox captures in 2000 to 2010

We have captured and marked 114 adult and 171 juvenile foxes at Karrak Lake in 2000-2010. Forty-nine of these foxes have been encountered at Karrak Lake one or more years after their initial capture (37 of which were marked as adults and 12 of which were marked as juveniles). In addition to foxes encountered at Karrak Lake, two foxes have been encountered in Resolute Bay on Cornwallis Island in 2001 (one subadult male and one subadult female that were both marked as pups at Karrak Lake in 2000), one fox (identity unknown) has been seen at Cambridge Bay in 2002, and one fox was encountered in Coppermine in 2004 (a subadult female that was marked as a pup at Karrak Lake in 2004).

4.4. Methods of travel to study area and within study area

We will travel to and from Karrak Lake by twin otter (Cambridge Bay-Karrak Lake return) and we will use a snowmobile to travel within the study area when trapping adults in May. We will stay at the Karrak Lake Research Station which was established for the long-term research on Ross' and lesser snow goose ecology at Karrak Lake by Dr. R. T. Alisauskas and Environment Canada.

5. POPULATION DYNAMICS OF ARCTIC FOXES

Abundance and reproduction of foxes were monitored through line-transects and den inventories (see Samelius 2006 for detail) whereas survival of foxes is monitored through a mark-recapture study following Pollock et al. (1990). The mark-recapture study will also allow us to estimate the relative contribution of adult survival and recruitment to population growth by foxes by using reverse-time mark-recapture following Nichols et al. (2000). All aspects of population dynamics will be evaluated in relation to nesting distribution by geese and variation in small mammal abundance.

Small mammal abundance was the main factor affecting population dynamics by arctic foxes; fox numbers were closely related to small mammal abundance in the previous year (i.e. there was a time-delay of about 1 year in fox numbers relative to small mammal abundance) and fox reproduction was closely related to small mammal abundance (e.g. foxes did not breed in years when small mammals were scarce). Nesting by geese did not appear to influence changes in fox numbers among years. Nesting geese and their eggs did, however, elevate fox abundance about 2-3 times above that outside of the goose colony at Karrak Lake. We have a manuscript that examines the influence of fluctuations in small mammals and geese on population dynamics of arctic foxes that is currently in review for publication in a scientific journal.

6. FORAGING BEHAVIOURS OF ARCTIC FOXES

Arctic fox diets were examined by stable isotope analyses where isotope signatures of fox blood and fur were compared to that of food items collected in the field (Kelly 2000, Samelius et al. 2007b). Stable isotope analyses showed that arctic foxes switched from small mammals to cached eggs in years when small mammals were scarce – cached eggs made up to about 50% of fox diets in years when small mammals were scarce whereas foxes rarely used cached eggs in years when small mammals were abundant (Samelius et al. 2007b). Caching of eggs may, thus, function as a buffer to unpredictable changes in small mammal abundance. This study also showed that cached eggs were important in arctic fox diets almost one year after caching.

We observed foraging behaviours of individually-marked foxes following Samelius and Alisauskas (2000). We are interested in how individual attributes of foxes (e.g. size, sex, and reproductive status), small mammal abundance, and nesting distribution by geese affect the rate at which foxes take eggs. We also plan to model how mobbing by geese influence the rate at which foxes take eggs to evaluate whether mobbing by geese acts as a cost of food acquisition for foxes. Preliminary analyses show that (1) arctic foxes take about 2,000-3,000 eggs per fox during the nesting season by geese and (2) individual attributes of foxes did not affect the rate at which foxes took eggs – i.e. there was no partitioning within the population in the rate at which they took eggs.

7. APPLICATIONS OF RESEARCH AND RELEVANCE TO NORTHERN RESIDENTS

This study will provide information on foraging behaviours and population ecology of arctic foxes that can be used for management and conservation of arctic foxes and arctic-nesting waterfowl. Proper management of natural resources is important to residents in many northern communities where hunting and trapping are integral parts of the economy and culture (Usher 1971, Bromley 1996). The fox study at Karrak Lake has resulted in eight publications to date (Samelius et al. 2002, Samelius et al. 2003, Samelius 2004, Hendrickson et al. 2005, Samelius et al. 2007a, Samelius et al. 2007b, Wiebe et al. 2009, Samelius and Alisauskas 2009) and we currently have another manuscript in review for publication in a scientific journal. We have also contributed to two studies on population genetics of arctic foxes (Dalén et al. 2005, Norén et al. 2011) which showed that there was little genetic separation of arctic foxes on a circumpolar scale (i.e. there is large exchange of foxes throughout its range). Our research has been noted in National Geographic for Kids (December 2002), National Geographic News (http://news.nationalgeographic.com/news/2007/10/071029-arctic-foxes.html), and Natural History Magazine (http://nhmag.com/new/1107/1107_samplings.html). More information about the project can be found at http://www.usask.ca/biology/fox which we hope will help to distribute information about the project.

8. ACKNOWLEDGEMENTS

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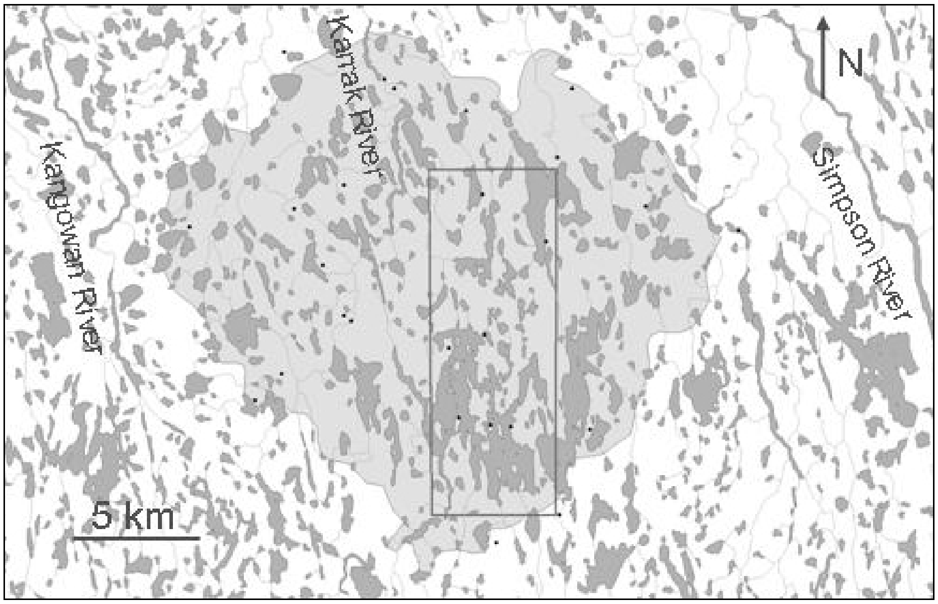

Figure 1. Extent of the goose colony (light grey) and location of the fox trapping area (grey square) at Karrak Lake goose colony (67° 14' N, 100° 15' W) in the Queen Maud Gulf Bird Sanctuary, Nunavut. Fox dens are symbolised by black dots.