Preliminary study: cost of parental care in free-ranging Arctic foxes (*Alopex lagopus*)

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Fig. 1: Arctic fox at Hornvik

In Canidae, monogamy is the most prevalent rearing system. It has been suggested that this obligatory monogamy may be a consequence of the levels of post-partum care. Estimated postnatal growth rates from captive canids are higher than in any other carnivore and milk energy output estimated during peak lactation is surpassed only by hyenas. High energy demands, and the widespread phenomena of biparental care within Canidae support the premise that monogamy may be a consequence of high reproductive costs. Previous field studies suggest that significant male parental care (e.g., food provision to the female and pups) occurs within Arctic foxes. The goal of our study is to determine the parental investment in free-ranging male and female Arctic foxes during the breeding period. We anticipate, that if monogamy is associated with significant paternal investment, then we will be able to demonstrate that Arctic fox males with pups invest equally as females, and that females compensate by increasing activity when paternal investment is reduced. This premise was tested by comparison of FMR (double-labeled water) and activity patterns (GPS data-loggers) in reproductively successful males and females during the breeding period using field manipulations. We handicapped half the mated males by fitting them with a bell for the duration of activity measurements. Here we report preliminary data on parental activity at Hornvik.

Fig.2: Darting an arctic fox (Photo: E.R. Unnsteinsdottir)

Hypotheses

Monogamous rearing systems are typically associated with significant biparental care. Observations suggest that significant male parental care (e. g. food provision to the female and pups) occurs in foxes. Our aim is to evaluate the hypothesis that paternal investment in the Arctic fox is considerable during the breeding season. This hypothesis implies that paternal care is significant, and therefore females are dependent on male investment to breed. We intend to use the Arctic fox as a model to test this hypothesis (Fig.1). We predict that activity duration and distance travelled in males with pups during the post-lactation period are as high as in females, and females compensate by increasing activity when paternal investment is reduced. We will test these predictions by sex comparisons of activity pattern in paired foxes and by a series of field manipulations.

Study design

We have selected fox pairs with home ranges situated at Hornvik along the coastline, and their dens located nearby bird cliffs. For the first group of fox pairs no manipulations were conducted, and these served as the control. In the second group, the males were fitted with 2 little bells attached to their collar. The bells serve as a handicap as their sound warns the prey from the approaching fox. Data on prey items harvested by foxes at Hornvik indicated more than 90% of live captured adult sea birds, mainly fulmar (*Fulmarus glacialis*), kittiwake (*Rissa tridactyla*), razorbill (*Alca torda*) and black guillemot (*Cepphus grylle*). Previous observations have shown that foxes equipped with bells, although handicapped, were capable of capturing sea birds and, thus, not subjected to starvation. The primary hypothesis underlining our design is that in monogamous mammals both sexes invest equally in the rearing of the pups (e.g., baby-sitting, food provisioning, etc.). Hence, paternal investment should be high during the post-lactation period, and reduction in paternal investment is expected to be compensated by increase in maternal activity. Assuming the social system of Arctic foxes is in fit with the general monogamy model, we predict that our design will show that compared to the control group, bell-fitted males will bring less food to the den and expend more energy per day, and their female mates will travel more and bring food to the den at a higher rate.

Results

Arctic foxes in Hornvik were socially organized as pairs, which shared the same home range (Fig. 3). No sexual dimorphism was observed (mean mass for males = 3.9 kg and for females = 3.2 kg). Foxes were active at all hours of the day, with peak activity during evening and early morning hours. Rise in ambient temperature reduced activity (Fig. 4). Home range of males was smaller than that of females (Fig. 3 & 5). Daily activity duration (Fig.6) and distance from the den (Fig. 8) were similar between sexes, but distance traveled (Fig. 7) was lower in males. Males fitted with bells (i.e., handicapped) reduced distance from the den and were more active, while home range, activity and distance traveled by their mates was similar to that of control.

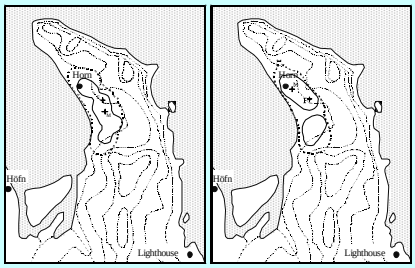
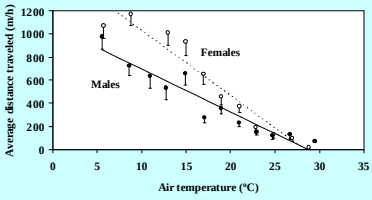


Fig. 3: Home range of a mated Arctic fox pair at Hornvik study site (Hornstrandir Nature Reserve, north-east Iceland). Female range is indicated by dotted and male by solid lines. The home range is based on 95% adaptive kernel from approximately 700 fix positions measured over 7 consecutive days. The black crosses represent center of activity of the adults. Presented are home ranges of pair #7 before (Control; left) and during the experiment (right). See text for further explanation.

Fig. 4: Average distance traveled by female (open circles and dotted regression line) and male (dark circles, solid regression line) Arctic foxes during peak provisioning period as a function of air temperature.



Conclusions

The preliminary results do not support our hypothesis that males invest in parental care equally to females. Instead, males invested less than females, and their handicap does not generate an increase in female activity but only a reduction in their own investment. Although home range of handicapped males somewhat increase compare with control, they travel less and maintain at a closer distance from the den indicating less time invested in foraging. These interesting conclusions resulted from limited number of experiments, and require several more field seasons to allow solid statistical support.

Methods

Trapping

Arctic foxes were captured using a dart gun (Dan-Inject; Fig. 2). Because the lack of hunting experience and the presence of tourists that occasionally feed foxes, most individuals are tame and approached people. Our three years experience in Hornvik indicates that several breeding pairs can be darted within a week after a short prebaiting and habituation period. We captured, collected tissue samples from the ear using biopsy punch, weighed, and took body measurements of all adults and pups. Pups were collected by hand near the den after calling them out.

Distance measurements

The foxes were individually marked by GPS collars (GPS3300L; Lotek Wireless, USA) and their movements and ambient temperature were continuously monitored for one week. Each unit is a GPS receiver that stores on board the fixes and temperature taken (700 data points per week). After one week, the collar drops off the animal and transmits a VHF signal that enables us to find it. The data was downloaded in the field to a laptop computer, and the unit refurbished by replacing the drop-off mechanism. The refurbished unit was fitted on another individual. The system makes it possible to get very accurate 3D positions of any tagged fox.

Fixes obtained via telemetry were used to determine daily movement distances. Distances reflect foraging effort of the foxes. Greater dispersion of food patches and larger litters are expected to generate larger distances (and greater energy expenditure) by both parents, as food for the pups has to be carried into the den at this stage. The altitude component makes it possible to correct for the effort of climbing by a proportional increase of the calculated distances relative to the angle of the terrain covered. Location of all foxes, taken at 15 min interval, generated sufficiently accurate estimates of the total distance traveled per day.

Rate of food provisioning

We used video cameras to observe dens without the disturbance caused by human presence. An active infrared monitor connected to a video camera enables to record any movement of foxes at a den. This small system was housed in a shoe-size box and hidden 20 m away from the den entrance (TrailMaster Monitors, Goodson & Associates, Inc.). A video camera was placed at each den for 2 days every week in order to verify litter size and rate of food provisioning by both parents.

Fig. 5: Average home range size in controlled (light blue bars) and treated (dark blue bars) female and male Arctic foxes during peak provisioning period.

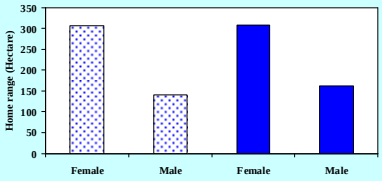


Fig. 6: Average daily activity time in controlled and treated female and male Arctic foxes during peak provisioning period.

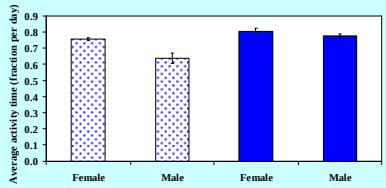


Fig. 7: Average daily travel distance in controlled and treated female and male Arctic foxes during peak provisioning period.

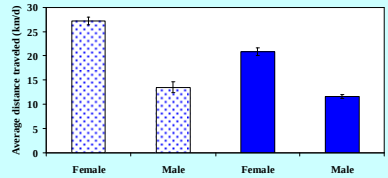
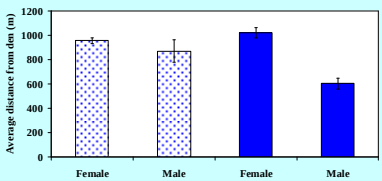


Fig. 8: Average daily distance from the den in controlled and treated female and male Arctic foxes during peak provisioning period.



Acknowledgements

We thank Reuven Hepner, Dror Pevzner , Ester-Rut Unnsteinsdottir and Shiri Biran for indispensable assistance at the field site. Special thanks to Thorleifur Eriksson and the staff at the Hornstrandir Natural History Museum at Bolungarvik for their utmost support and hospitality throughout the whole study. This study was supported by the Norwegian Polar Institute, the Hornstrandir Natural History Museum at Bolungarvik, and the United States Israel Binational Science Foundation.