

Red fox takeover of arctic fox breeding den: an observation from Yamal Peninsula, Russia

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Abstract Here, we report from the first direct observation of a red fox (*Vulpes vulpes*) intrusion on an arctic fox (*Vulpes lagopus*) breeding den from the southern Arctic tundra of Yamal Peninsula, Russia in 2007. At the same time, as a current range retraction of the original inhabitant of the circumpolar tundra zone the arctic fox is going on, the red fox is expanding their range from the south into arctic habitats. Thus, within large parts of the northern tundra areas the two species are sympatric which gives opportunities for direct interactions including interference competition. However, direct first-hand observations of such interactions are rare, especially in the Russian Arctic. In the present study, we observed one red fox taking over an arctic fox breeding den which resulted in den abandonment by

the arctic fox. On July 19, eight arctic fox pups were observed on the den before the red fox was observed on the same den July 22. The pups were never seen at the den or elsewhere after the red fox was observed on the den for as long as we stayed in the area (until August 10). Our observation supports the view that direct interference with red fox on breeding dens may contribute to the range retraction of arctic foxes from the southern limits of the Arctic tundra in Russia.

Keywords Arctic fox · *Vulpes lagopus* · Red fox · Yamal peninsula · Russia · Intraguild competition

Introduction

The most widely published changes in the geographic distribution of mammalian species in the Arctic is the expansion of the red fox (*Vulpes vulpes*) and the retraction of the arctic fox (*Vulpes lagopus*) (Post et al. 2009). The arctic fox has a circumpolar distribution in arctic tundra that overlaps with the red fox in its southern part (Hersteinsson and Macdonald 1992). The recent retraction of the arctic fox from the former part of its range is both reported from the wide tracts of southern Arctic tundra (e.g. Skrobov 1960; Chirkova 1968; Novikov 1983; Hersteinsson and Macdonald 1992) and from low altitudes in the sub-arctic alpine tundra in Fennoscandia (e.g. Angerbjorn et al. 1995; Kaikusalo and Angerbjorn 1995; Linnell et al. 1999; Elmhagen et al. 2002; Frafjord 2003; Dalen et al. 2004; Killengreen et al. 2007). At the same time, the red fox has increased its distribution range northward into Arctic tundra (Marsh 1938; Skrobov 1960; MacPherson 1964; Hersteinsson and Macdonald 1992) and to higher altitudes in alpine tundra (Hersteinsson and Macdonald 1992; Frafjord 2003; Dalen et al. 2004). Although these range changes are widely

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Table 1 A summary of published observations of encounters between arctic fox (AF) and red fox (RF) interactions at arctic fox breeding dens in the alpine tundra of Fennoscandia

Date	Location	References	Interaction between AF and RF
1982, 1985	Sylane (Trondelag, Norway), Vindelfjällén (Västerbotten, Sweden)	Frafjord et al. (1989)	<ol style="list-style-type: none"> 1. RF♀ chased by unusually big AF♂ (near AF den) 2. AF♂ chased two times by RF♂ from AF den. AF♀ sat silently 100 m from den. AF returned to den after 2 min very upset, barked and screamed. 3. RF♀ killed AF cub on the den 4. AF♀ evaded from RF♂ inside the den 5.3 AF cubs hide from RF♂ inside the den 6. RF♀ on AF den, cubs inside In none of these cases abandonment of AF breeding den was reported
1994, 1998	Vindelfjällén, Sweden	Tannerfeldt et al. (2002)	<ol style="list-style-type: none"> 1. RF killed 2 AF cubs on den, and AF moved their cubs to another den. 2. AF ♀ moved her cubs to another den after the intrusion of RF on den, but 1 cub died later of bite from RF

acknowledged (Ims and Fuglei 2005; Post et al. 2009), the underlying mechanisms are not. Many mammalogists, especially those from Fennoscandia and northern America, argue that these changes in geographic range may be due to interference competition between the dominant red fox and the subordinate arctic fox (e.g. Hersteinsson et al. 1989; Hersteinsson and Macdonald 1992; Kaikusalo and Angerbjorn 1995; Elmhagen et al. 2002; Frafjord 2003; Killengreen et al. 2007). Due to few direct observations there has been some skepticism to this view (Linnell et al. 1999), especially among Russian mammalogists (Chirkova 1968; Novikov 1983). This skepticism is likely to result from the lack of published observations of interactions between the two species in the wild in Russia. Indeed, the nature of interactions between potentially competing species could be region-specific because of factors such as differences in productivity and other features of the ecosystem (Pianka 1999). This stresses the need for reporting observations from different geographic regions of the arctic tundra.

Direct interactions between the two species may be short-term and infrequent, and therefore difficult to discover or study systematically. However, there are two published reports providing detailed observations of direct interactions between arctic fox and red fox at den sites in alpine tundra in Fennoscandia (Table 1). Similar authoritative observations from the vast Russian section of the Arctic tundra, harboring the main proportion of the world population of arctic fox, are lacking. While Russian authors sometimes mention cases of direct interactions between arctic foxes and red foxes (Skrobov 1960; Chirkova 1968; Novikov 1983), there are no first-hand descriptions of such interactions at arctic fox breeding dens.

Here, we provide a detailed documentation of a red fox intruding on an arctic fox breeding den leading to arctic fox

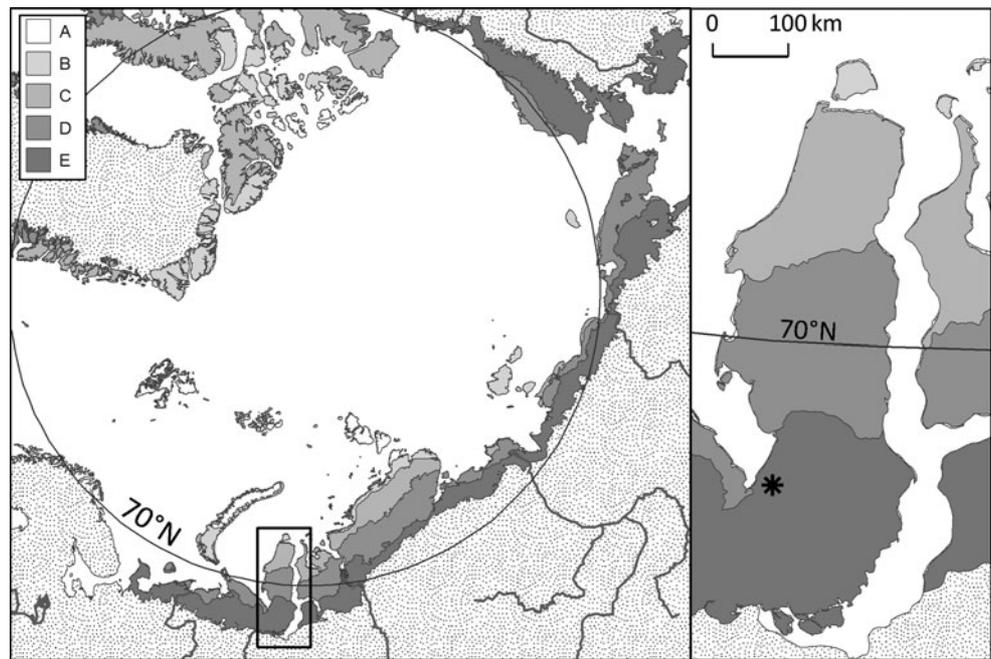
den abandonment in the southern Arctic tundra of Yamal Peninsula, Russian Arctic.

Materials and methods

The observations were made during field work for the International Polar Year (IPY) project “Arctic Predators as Indicators of Tundra Ecosystem State” along the Erkutayakha River, Yamal Peninsula, Russia (68°13'N, 69°09'E) (Fig. 1) during July 15–August 10, 2007. The study site is located within the erect shrub tundra subzone (Walker et al. 2005). Mean air temperature is −25.7°C in January and +8.6°C in July (Shiyatov and Mazepa 1995, World Meteorological Organisation for point Yaron). There were 12 known arctic fox breeding dens within the focal study area of 100 km² and of these 7 (58%) contained arctic fox litters (minimum numbers 3–8 pups) in summer 2007. In spite of a high proportion of inhabited dens, rodents were not abundant in the area that season. Based on rodent trapping in July, there were 1.16 individuals per 100 trap-nights ($n = 864$ trap-nights; unpublished data Arctic Predators, <http://www.arctic-predators.uit.no/>). The arctic fox breeding den, on which the observations reported in this note were made, is located at the bank of a large tundra lake 800 m from our field camp. The den is dug out in sandy soils and covers an area of approximately 110 m². It had 8 entrances and distance to the nearest lake was 5 m. The den was described for the first time in 1989 (V. Shtro, personal observations).

Red foxes were never been observed in the study area during summer field work in the period 1999–2006, 2008–2010 (Sokolov and Sokolov unpublished). However, red foxes are sometimes observed in winter by local people up

Fig. 1 Maps showing the position of the Yamal Peninsula in the Russian Arctic (*left map*) and the study site along the Erkutayakha River (denoted by a *star* in the *right map*) in the southern part of the Peninsula. *Different shadings* in both maps show the different Arctic bioclimatic subzones (modified from Walker et al. 2005)



to Tambey river in arctic tundra subzone of Yamal peninsula ($71^{\circ}, 3'N$) (Zhitkov 1913). Four red foxes were shot in our study area in winter 2006/2007 by one family of local people, which is an unusually high number (T. Laptander, personal communication). Viktor Shtro collected more than 2000 fox carcasses from the whole of Yamal Peninsula during 1974–1986. He collected carcasses at fur trade centers–factories (trappers have been paid for each carcass during Soviet time) of which only 3 were red fox carcasses. Two red foxes were observed by us in the study area during the summer season 2007. One of them was involved in the encounter at the arctic fox den described below, while the other was observed on July 15.6 km from the location of the encounter. Distinct differences in pelage characteristics and general condition testified for the fact that the two observations represented two different red fox individuals.

Results

The focal arctic fox den was first visited on June 26, 2007, by personnel from another expedition in which two of the authors participated. At that occasion, 3 small arctic fox pups were observed at the den. Next visit to the den was conducted by our IPY project on July 15 when several pups were observed from a distance of approximately 150 m. The pups were vigorous and clearly aware of the observer as indicated by “warning barks”. On July 19, the den was observed more closely for a longer time period and a minimum of 8 pups were registered and photographed (Fig. 2a).

On July 22, 1800 h one red fox was observed approximately 400 m from the den (Fig. 2b). It was passing the observer who was standing at a distance of approximately 100 m and moved in the direction of the arctic fox den. The red fox was peculiarly little shy (although obviously aware of the observer) and appeared to be in a poor condition walking slowly with stiff legs and taking frequent stops while panting. Owing to the observer’s position behind a hill, the red fox’s first encounter with the arctic fox den was not observed. As it could be disclosed later, the red fox was already inside the den when the observer reached the top of the hill 150 m from the den. The subsequent observations, beginning at 1815 h, were made from this hill top which gave an excellent overview of the den and its surroundings.

For the next 30 min, there were no signs of any foxes. Then an adult arctic fox (probably female according to its mode of urination) was observed while it approached the den against the wind. The arctic fox’s general body posture (Fig. 2c) and its slow and apparently hesitating walk indicated that it was aware of the presence of the red fox. The arctic fox stopped at a distance of approximately 50 meters from the den. It then retreated and laid down at the same hill as the observer sat (30 m from the observer). The arctic fox was constantly watching the den for 20 min until the red fox eventually emerged from one of the den entrances (Fig. 2d). The arctic fox then approached the den, stopped at a 50-m distance from the den, sat down and started to bark (Fig. 2e). For the next 10 min, the arctic fox continued barking, while the red fox remained lying on the den motionless. Next, the arctic fox again retreated back to her previous position at the hill. The observer now walked



Fig. 2 **a** The arctic fox breeding den with 8 pups observed on July 19, 2007. **b** The red fox was first observed approximately 400 m from the arctic fox den on July 22, 2007. **c** The arctic fox female is approaching the den with the intruding red fox. **d** The red fox is emerging from an

entrance of the arctic fox den. **e** The arctic fox barking at a 50 m distance from the den. **f** The red fox lying on the arctic fox den photographed from a distance of approximately 15 m

down to the den. The red fox entered one of the entrances first when the distance to the observer was 15 m. The appearance of the red fox at this close distance supported the initial impression that this individual was indeed in a poor condition (Fig. 2f). There were no signs of arctic fox pups at the den (i.e. warning sounds or remains) or even prey remains. After inspecting the den, the observer resumed his position at the hill. The red fox soon re-emerged and laid down while the arctic fox approached the den barking once more. This situation was status quo when the observer left the area at 2100 h. When the den was revisited 3 h later, the red fox was observed some hundred meters from the den moving slowly away. No arctic fox was observed.

The focal arctic fox den was revisited many times in course of the remaining period we stayed at the field site. No observations of foxes of either species were made at

these visits. The surroundings of the den area and neighboring dens were also searched for live and dead arctic fox pups without any findings.

Discussion

Our observation from Yamal Peninsula, Russia in summer 2007 adds to the few previous observations from Fennoscandia of red fox intruding on arctic fox breeding den (Frafjord et al. 1989; Tannerfeldt et al. 2002). Also in the cases reported in Tannerfeldt et al. (2002), this led to den abandonment of breeding arctic fox. Our observation is, as far as we know, the first documentation of direct interference competition between these two species as far north as in the erect shrub tundra of the Russian Arctic. In the present case, there was no indication of red fox killing arctic

fox pups. The red fox appeared to be in a bad shape (probably ill) and it is not likely that it was able to pursue and catch healthy arctic fox pups in a complex den system with many entrances and burrows. The arctic fox pups were most likely hiding in the burrow system while the red fox was present and abandoned the den area after the encounter. Although the red fox was in a bad condition, the arctic fox, which most likely was the mother of the previously observed litter, did not attempt to contest the intruder. This is likely to reflect the strong dominance-subordination relations between the two species.

Arctic and red foxes have been claimed to coexist without antagonistic interactions when there is enough food (Ovsjanikov and Menjushina 1987; Smits and Slough 1993), but in some cases arctic foxes may be chased or even killed by red foxes (Ashbrook and Walker 1925; Schamel and Tracy 1986; Frafjord et al. 1989; Pamperin et al. 2006). This has also been documented in penned or farmed animals (Rudzinski et al. 1982; Korhonen et al. 1997). Cases of arctic fox dominance over red fox are extremely rare, but some observations exist (Frafjord et al. 1989). The outcome of a direct contest may depend on the size, sex, and social rank of the individuals involved (Frafjord et al. 1989) and the red fox, which is usually about 25% larger in head-body length, has an advantage. One could, however, think that prior possession of a den could shift the dominance in direction of the den owner. This was, however, not the case in neither the present case nor in those observations previously recorded from Fennoscandia. The previous observation of intruding red foxes on arctic fox breeding dens in Fennoscandia did not always, however, lead to arctic fox den abandonment (Table 1).

In conclusion, our detailed observations from an arctic fox breeding den on Yamal Peninsula in Russia adds further weight to the view that the red fox is expelling the arctic fox in the southern parts of tundra and that direct interactions between the two species in the breeding season may contribute to this phenomenon.

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