

Subfossil Records of the Arctic Fox (*Alopex lagopus*) Compared to Its Present Distribution in Norway

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ABSTRACT. We studied the prehistoric and historic distributions of arctic foxes in Norway by examining material and reports from archaeological excavations. A total of 44 arctic fox bones were found in 15 excavations, all of which were younger than 5000 years before present (B.P.). The majority of these sites was located within or close to the present distribution of arctic foxes. Additionally, 44 naturally deposited arctic fox bones were found in two excavations dated 36 000–28 000 and 13 000 B.P. respectively, indicating that the arctic fox also lived along the Norwegian coast in the Pleistocene. No arctic fox bone was dated to the period 9000–5000 B.P., and the species may have been rare or absent during this comparatively warm period. Since most bones (61%) were from the distal part of the limbs, the foxes may have been skinned elsewhere and transported to the site of deposition. Bones from red foxes were found in three excavations within the present distribution of arctic foxes, indicating that the arctic fox was relatively more abundant than red foxes during the late prehistoric and the historic periods in south Norway, but less abundant in north Norway.

Key words: arctic fox, red fox, prehistoric and historic distributions, archaeological excavations, Norway

RÉSUMÉ. On a étudié les distributions préhistorique et historique du renard arctique en Norvège, en examinant du matériel et des rapports provenant de fouilles archéologiques. Au total, 44 os de renard arctique ont été trouvés dans des fouilles effectuées sur 15 sites, et tous les os dataient de moins de 5000 ans avant le présent. La majorité de ces emplacements était située à l'intérieur ou près de la distribution actuelle du renard arctique. On a en outre trouvé 44 os de renard arctique déposés naturellement dans deux fouilles datées respectivement de 36 000 à 28 000 ans avant le présent et de 13 000 ans avant le présent, ce qui révèle que le renard arctique vivait aussi le long du rivage norvégien au cours du pléistocène. Aucun os de renard arctique n'a été daté de la période allant de 9000 à 5000 avant le présent et il est possible que l'espèce ait été rare ou absente au cours de cette période comparativement tempérée. Étant donné que la plupart des os (61 p. cent) proviennent de la partie distale des membres, il se peut que les renards aient été dépouillés ailleurs et transportés à l'emplacement où ils ont été déposés. On a trouvé des os de renard roux dans trois fouilles à l'intérieur de la distribution actuelle du renard arctique, ce qui révèle que ce dernier était relativement plus abondant que le renard roux en Norvège méridionale, à la fin de la période préhistorique et au cours de la période historique, mais moins abondant en Norvège septentrionale.

Mots clés: renard arctique, renard roux, distributions préhistorique et historique, fouilles archéologiques, Norvège

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INTRODUCTION

The distribution of arctic foxes *Alopex lagopus* in Norway is now limited to the mountain range that extends through most of the country. In the northernmost part (Finnmark county) arctic foxes are also found in coastal tundra regions (Lilljeborg, 1874; Collett, 1912). In most parts of this range the arctic fox is found in small numbers (Johnsen, 1929; Frafjord, 1988). However, this may not always have been so, and it is generally believed that the arctic fox was much more common in earlier times than at present. In the 16th century arctic foxes were believed to be so common that "they are running in flocks" (Bernström, 1982:610). When the fur prices increased from about 1870 and reached a maximum in the 1920s, the intensity of fox hunting most likely increased proportionately (Collett, 1912; Zetterberg, 1953; Chesemore, 1972). A rapid decline in the population in Norway followed, and the species has been protected by law since 1930.

The lack of recovery of the population has been explained by competition with a recently increased population of red foxes *Vulpes vulpes* (Frafjord *et al.*, 1989; Hersteinsson *et al.*, 1989). The distribution and abundance of red foxes in alpine and arctic environments may be limited by the productivity of the habitat, while the red fox may limit the distribution of the smaller arctic fox (Hersteinsson and Macdonald, 1992).

Red foxes are presently distributed throughout Norway and may even in alpine regions outnumber the arctic fox.

Productivity of the habitat is largely governed by the climate, notably the summer temperature and the extent of the vegetational growth period (e.g., Thun and Vorren, 1992). The last glaciation in Norway, when most of the country was covered by ice, extended to about 10 000 B.P. (years before present). Since then the climate has fluctuated, with warmer periods succeeding cooler ones (Mangerud, 1990). Such climatic fluctuations may have had great impact on the distribution and abundance of arctic and red foxes in Norway. In this paper we study the prehistoric and historic distributions of arctic foxes in Norway by examining subfossil remains. We compare this with the present distribution of arctic and red foxes.

MATERIALS AND METHODS

The Museum of Zoology, University of Bergen, is the central institute for storing nonhuman bones uncovered at Norwegian archaeological sites. Records of more than 800 postglacial findings and a few glacial findings were analyzed by examining bones, lists, or available reports (Helskog, 1983; Larsen *et al.*, 1987; Gustafson, 1990). Most of these were from the coastal region, as only a few excavations have been made in the mountain region. We recorded

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the site of recovery, numbers and type of subfossil bones found, and the estimated age at the time of deposition. Bones of red foxes uncovered within the present distribution of arctic foxes were likewise examined, giving some information on the proportion of the two species. We also studied museum catalogues and reports on red foxes (Degerbøl, 1951; Olsen, 1976) from some major coastal archaeological findings to verify the extent to which this species was hunted by ancient "Norwegians." We checked the identity of most arctic fox bones and some red fox bones on their size and appearance, but the collection of arctic fox bones reported in Larsen *et al.* (1987) was not available. Dating of the material is discussed in the various reports, and some datings have been discussed by Hufthammer (1982).

RESULTS AND DISCUSSION

A total of 44 arctic fox bones has been found in 15 archaeological excavations (Table 1); 17 of the bones (36%) were found at one site. In addition, 43 naturally deposited bones have been found at one site dated to 36 000–28 000 B.P. (Larsen *et al.*, 1987), and 1 bone in deposits dated at 13 000 B.P. Both these samples were found in the cave Skjonghelleren, but being separated by about 17 000 years they are treated as two different sites (nos. 8a and b). Bones of red foxes (148 fragments) were found at only three sites located within the present distribution of arctic foxes (Table 1).

In south Norway, half of the 12 sites where bones of arctic foxes were recovered were located within the present distribution of arctic foxes (Fig. 1, Table 1). Four of the other 6 sites were located close to the present arctic fox distribution, indicating that the bones might have been brought down from the mountains. The last two sites were the natural deposits at Skjonghelleren from the Pleistocene and one postglacial site located close to Skjonghelleren (site no. 9, Fig. 1). Only this last finding may be surprising, indicating that arctic foxes

TABLE 1. Bone material recovered at Norwegian archaeological sites

Site	County	Dated (B.P.)	AF ¹	RF ²
1 Iversfjord	Finnmark	4300-3850		4
2 Kirkenes	Finnmark	≈ 700	1	
3 Nyelv	Finnmark	5000-4000	2	
4 Gressbakken	Finnmark	4300-3500	2	138
5 Kvaløy	Troms	350-150	1	
6 Innerdalen	Hedmark	5000-3500	1	
7 Vesle Hjerkin	Oppland	600-400	17	6
8a Skjonghelleren	Møre & Romsdal	≈ 30000	43 ³	
8b Skjonghelleren	Møre & Romsdal	≈ 13000	1	
9 Sauehelleren	Møre & Romsdal	4000-1500	3	
10 Skrivarhelleren	Sogn & Fjordane	3700-2500	5	
11 Nyset	Sogn & Fjordane	1500-1000	1	
12 Storhiller	Sogn & Fjordane	2500-1500	1	
13 Halnelegeret	Buskerud	350-150	1	
14 Andersbu	Hordaland	1200-700	5	
15 Heinslegeret	Buskerud	800-500	1	
16 Heisandtjønn	Hordaland	≈ 600	1	
17 Høre stavkirke	Oppland	800-600	2	

¹AF = Number of arctic fox fragments.

²RF = Number of red fox fragments.

³From Larsen *et al.*, 1987.

may have been transported longer distances by man, or indicating a wider distribution of the species during the period 4000–1500 B.P. The three items recovered at this site (one mandibula, one tooth, and one tibia; Table 2) may have originated from a single fox.

In north Norway, bones of arctic foxes were mainly found along the coast of Finnmark (Fig. 1). One fragment was excavated on an island in Troms (site no. 5) and may have been brought there by humans, or alternatively, the arctic fox may have had a wider distribution during 1600–1800 (350–150 B.P.). The fragments in Finnmark were found within the natural distribution of the arctic fox. The great distances between the recoveries in north Norway can be explained by the fact that few sites have been excavated in this region.

The few recoveries of red fox bones in the alpine range is surprising. They were only found at one site in south Norway (26.1% of a total of 23 fox bones recovered at this site) and at two sites in subarctic north Norway (Table 1). The very high proportion of red foxes at site no. 4 in Finnmark is interesting (98.6% of all fox bones). This site was dated to about 4000 B.P., a period most likely slightly warmer than the present (Vorren *et al.*, in press), which may have favoured red foxes. Larger scale agricultural activity in Finnmark started about 2900 B.P. (Vorren *et al.*, in press) and may also have favoured scavenging red foxes. Helskog (1983) reported 40 red fox bones and 6 arctic fox bones from site no. 1. However, we found only 4 red fox bones in the collections at the Museum of Zoology, University of Bergen, and these had erroneously been identified as bones from arctic foxes. Thus, the red fox probably greatly outnumbered the arctic fox at this site also. The red fox was hunted by man throughout the postglacial period and at some sites was recovered in large numbers (Table 3). For example, at Flatåsen-2, 30% of all bones identified were from red foxes and 19% were from otters, *Lutra lutra*, indicating that hunting for fur may have been an important activity of the people living there.

Most of the arctic fox bones recovered from postglacial sites were younger than 5000 years, dating from 5000 to 150 B.P. (Table 1). The latest Eurasian glacier reached a maximum 18 000 B.P., but melted rapidly from 14 000 B.P.

TABLE 2. Types of arctic fox bone fragments recovered at archaeological sites in Norway (excluding site 8a)

Bone	Fragments		Site no.
	n	%	
Cranium	1	2.4	15
Mandibula	4	9.8	4, 9, 14, 16
Dentes	2	4.9	9, 12
Costae	1	2.4	10
Humerus	1	2.4	11
Radius	2	4.9	3, 4
Ulna	1	2.4	3
Femur	3	7.3	5, 10, 13
Tibia	1	2.4	9
Metapodials	17	41.5	2, 7, 10
Phalanges	8	19.5	7, 14
No information	4	—	6, 8, 17

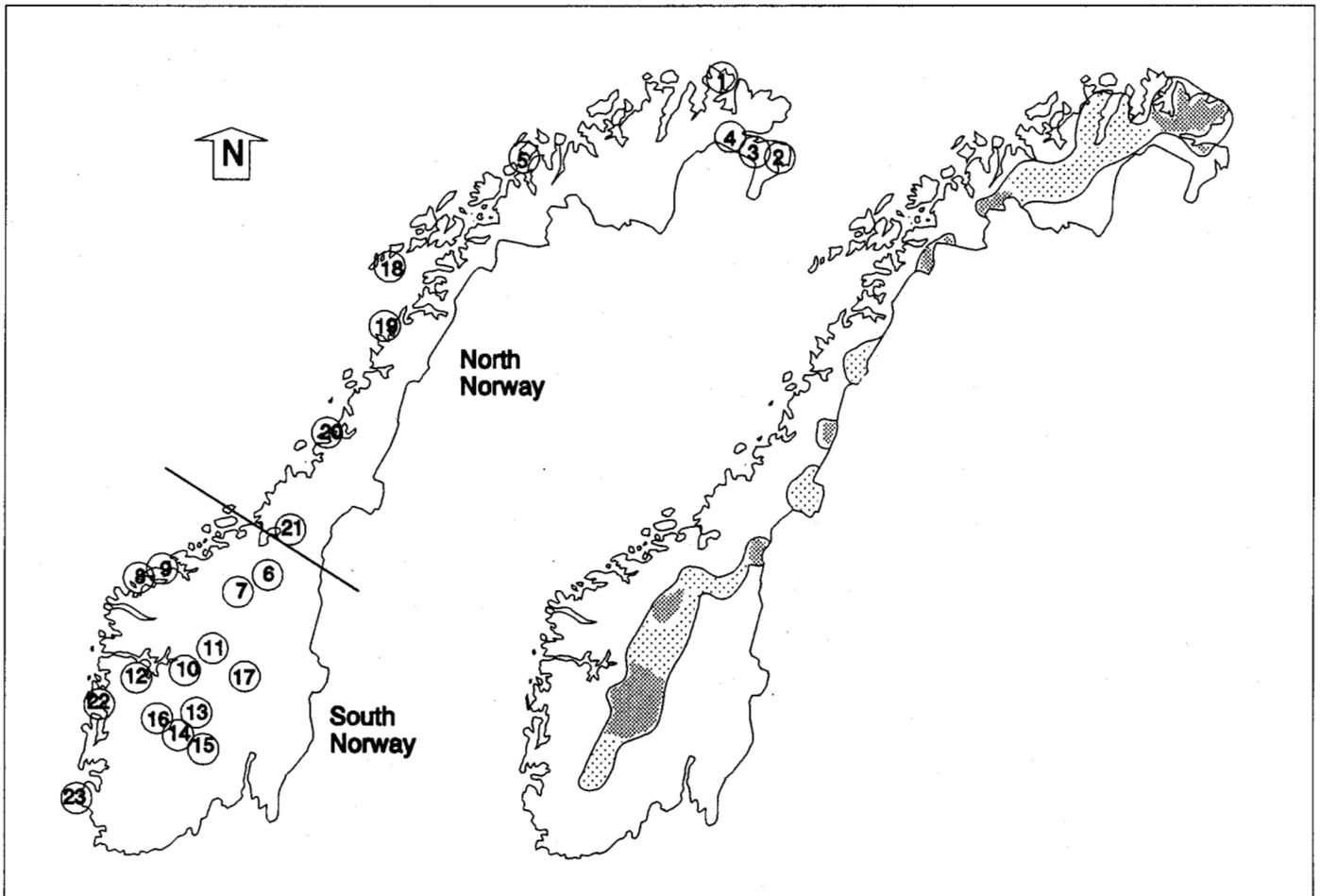


FIG. 1. Archaeological sites at which bones of arctic and red foxes have been recovered in Norway (left). Numbers refer to sites in Tables 1 and 3. The present distribution of the arctic fox in Norway (right). Most arctic foxes breed in the densely hatched regions (from Pedersen and Østbye, 1983; Frafjord, 1988, 1993).

TABLE 3. Bone material of red foxes recovered at some coastal archaeological sites

Site	County	Dated (B.P.)	n ¹	N ²
18 Lofoten	Nordland	5300-4600	62	1443
19 Gildeskål	Nordland	<3500	23	224
20 Flatåsen-2	Nordland	2500-1400	412	1375
21 Mære kirke	N-Trøndelag	≈ 1000	49	600
22 Skipshelleren	Hordaland	6000-4000	1	13057
23 Viste	Rogaland	8000-6000	11	913

¹n = Number of red fox fragments.

²N = Total number of fragments identified.

(Nesje and Kvamme, 1991). The period 9000–5000 B.P. was comparatively warm, and the presently largest glacier in south Norway disappeared completely during this period (Nesje and Kvamme, 1991). No arctic fox material has been recovered from this period; thus the species may actually have been very rare or absent during it. Red fox material from this period has been found (Table 3), indicating that foxes were hunted by man.

As the temperature decreased 2–3 °C from about 5000 B.P. until about 2000 B.P. (Nesje and Kvamme, 1991), arctic foxes may again have expanded their range. The Little Ice Age period during the 17th and 18th centuries was associated

with a great expansion of glaciers in south Norway (Nesje and Kvamme, 1991). The increased temperature since about 1700 (Nesje and Kvamme, 1991) may indirectly have caused the reduction of the arctic fox population during the early part of the 20th century through interaction with an increased population of red foxes. This decrease in the arctic fox population was most likely reinforced by human persecution.

The subfossil bone material of arctic foxes mostly consisted of distal parts of the feet (61 %, Table 2). These small bones are more persistent than the larger leg bones and are in higher numbers in the living animal. In fact, the proportion of feet bones is higher in a living animal than in our sample. However, the small feet bones are unlikely to be found without sieving of the material, which was done in only one of the excavations (site no. 10, 2 mm sieve). Thus, many of the carcasses may have been skinned before transportation and they may not have been used for food. One of the earliest records of arctic fox hunting in Scandinavia is from 1500, when their furs (both blue and white foxes) were valued at only one-quarter of a red fox fur (Lundmark, 1982). More valued red fox fur (apparently darker skins) was prized 2–5 times above that of an ordinary red fox and more than, for example, the skin of a cow (Vilkuna, 1982). Because red fox fur was more highly valued than that of arctic foxes,

red foxes were probably hunted more intensively. Thus, it is not likely that arctic foxes were selectively hunted in the mountains, although they may have been more easily caught than red foxes.

The proportion of red and arctic fox bones recovered probably at least to some extent reflects the relative abundance of the two species. Thus, arctic foxes were more common relative to red foxes in late prehistoric and early historic times than at present in south Norway but may have been less numerous in north Norway. Of 300 foxes killed in one region of Finnmark county during the winter 1880-81, 95% were arctic foxes (Brodtkorb, 1914). Arctic foxes may have been numerous in Finnmark during the late 19th century, but some of the foxes may have immigrated from Russia (Brodtkorb, 1914). No detailed information exists on the present abundance of this species in Finnmark.

Arctic foxes were likely common in Norway during the interstadials of the last glaciation, when the region was not entirely covered by ice. The present population may be a relict from that time or it may have immigrated later from the east. Both short- and long-term fluctuations in the abundance and distribution of arctic foxes are likely to occur, due to indirect effects of climatic fluctuations on their prey or on the abundance and distribution of red foxes.

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