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Source: Journal of Wildlife Diseases, 27(1) : 105-109

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-27.1.105>

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## PREVALENCE AND GEOGRAPHICAL DISTRIBUTION OF THE EAR CANKER MITE (*OTODECTES CYNOTIS*) AMONG ARCTIC FOXES (*ALOPEX LAGOPUS*) IN ICELAND

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**ABSTRACT:** Three hundred forty five adult arctic foxes (*Alopex lagopus*) from all counties in Iceland were examined for excess cerumen and ear canker mites (*Otodectes cynotis*). Only 13 foxes (4%) from a single county in northwestern Iceland were infested, where the prevalence of otodectiasis was 38%. Whether or not this parasite is new to the arctic fox in Iceland is unknown. If it is recently introduced, possible sources of infestation are farmed silver foxes (*Vulpes vulpes*), domestic dogs, domestic or feral cats, and arctic foxes from Greenland. It appears that the rate of transmission between adult foxes is low; a more common route of transmission is probably from the mother to her offspring or between vixens breeding in the same dens in subsequent years by contamination of the dens. No correlation was found between the prevalence of mites in foxes and Samson character.

**Key words:** Ear canker mite, *Otodectes cynotis*, Arctic fox, *Alopex lagopus*, geographical distribution, prevalence, route of transmission, Samson character, survey.

### INTRODUCTION

Ear canker mites (*Otodectes cynotis*) are parasites of many carnivores, including domestic cats, domestic dogs, red foxes (*Vulpes vulpes*), arctic foxes (*Alopex lagopus*), wolverines (*Gulo gulo*) and ferrets (*Mustela putorius furo*) (Ismail et al., 1982; Preisler, 1985; Wilson and Zarnke, 1985; Molina, 1986; Scheidt, 1987; Moriello, 1987; Shustrova, 1987). In arctic foxes bred on fur-farms the problem of ear canker mites is wide-spread and can be of significant economic importance. If not controlled with medication, damage by scratching and rubbing may occur in affected animals (Kangas, 1982). Extensive infestation by ear canker mites of arctic foxes in the Commander Islands (U.S.S.R.) has been reported (Danilina, 1987).

The first record of ear canker mites in Iceland was in silver foxes (*Vulpes vulpes*) imported from Norway in the 1930's (Hersteinsson et al., 1986). The farming of silver foxes ended about 1950 but was again initiated in the autumn of 1983 with the importation of new stock from Norway. These foxes also were infested with ear canker mites (Hersteinsson et al., 1986; E.

Gunnarsson, unpublished data). Ear canker mites occur in both domestic cats and dogs in Iceland (S. H. Richter, pers. comm.), but the prevalence is unknown.

In this report we present the first recorded cases of *O. cynotis* in wild arctic foxes in Iceland. The geographical distribution of the parasite is described and the possible routes of transmission are discussed.

### MATERIALS AND METHODS

Arctic fox carcasses were sent to the Institute of Experimental Pathology (Reykjavik, Iceland) by fox hunters from all counties of Iceland as part of a larger study on various aspects of arctic fox biology during 1986 to 1989. Their locality at death was usually known to within 5 km; in all samples the county where they were killed was known. Since fox hunting usually occurs at breeding dens during early summer (Hersteinsson et al., 1989), often both members of breeding pairs could be examined.

Three hundred forty five carcasses of adult foxes were examined for excessive cerumen after cutting down and forward from the anterior edge of the ear canal to the depth of the ear drum. Most foxes had clean ear canals and were not infested with ear canker mites. From some foxes, samples of cerumen were removed by scraping with a scalpel and observed microscopically. Cerumen was dissolved in a 4% NaOH

solution, placed on a microscope slide and viewed at 100 $\times$  magnification. The search was discontinued after an adult *O. cynottis* was identified. Immature mites were never found in the absence of adults.

If breeding foxes invariably infect their mate with ear canker mites, then both members of a breeding pair would or would not be expected to have the infestation. Conversely, with random mating and no transmission of mites from one member of a pair to the other, the following equation would apply:  $p^2 + 2pq + q^2 = 1$ ; where  $p$  is the proportion of foxes free of ear canker mites and  $q$  is the proportion of foxes with ear canker mites; and thus  $p^2$  is the frequency of pairs with both members free of mites,  $2pq$  is the frequency of pairs with one member infested with ear-mites, and  $q^2$  is the frequency of pairs with both members infested with ear-mites. In 10 instances both members of breeding pairs were available for examination and within-pair infestation patterns were compared. Fox hunters generally gave information about the names of the breeding dens where individual foxes had been killed. Thus, it was possible to compare the pattern of infestation with den occupancy.

### RESULTS

Excessive cerumen was found in 36 of the 345 foxes examined. The presence of ear canker mites was confirmed in 13 (36%) of these, or 4% of the 345 foxes examined.

Geographical distribution of the prevalence of ear canker mites was confined to only one county, Strandasylla, in north-western Iceland (Fig. 1; 65 $^{\circ}$ 00' to 66 $^{\circ}$ 15'N, 21 $^{\circ}$ 00' to 22 $^{\circ}$ 10'W).

Of the 23 foxes free of ear canker mites but having excess cerumen, eight apparently had Samson character (Lampio, 1948, 1949; Voipio, 1950; Hersteinsson et al., 1988). This is a condition in which a lack of the guard hairs covering the ears predisposes to a considerable amount of soil and sand inside the ears, which may precipitate copious production of cerumen. An additional seven foxes with Samson character examined had clean ears. One fox with Samson character had ear canker mites. The cause of excessive cerumen in seven foxes was not determined. There was no correlation between the presence of ear canker mites and Samson character.

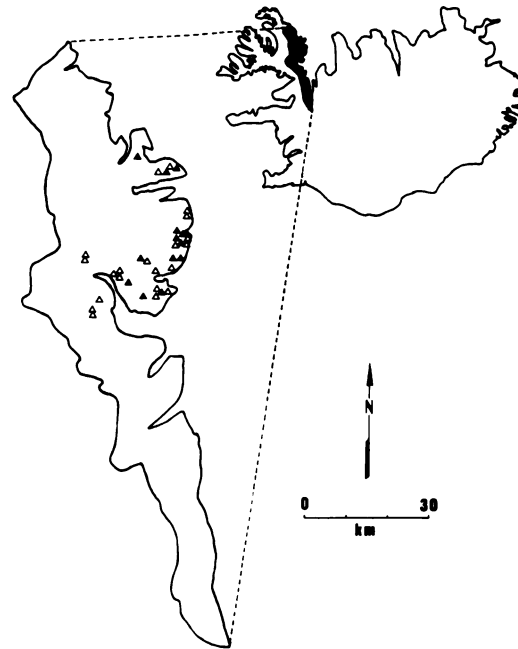


FIGURE 1. A map of Strandasylla county, Iceland, showing the location where individual foxes, later examined for the presence of ear canker mites, were killed.  $\Delta$  denotes absence of ear canker mite infestation,  $\blacktriangle$  denotes an ear canker mite infestation.

Since ear canker mites were found only in Strandasylla county, foxes from other counties were excluded from the analysis to determine routes of transmission. In the total sample from Strandasylla county the frequency of occurrence of ear canker mites was 0.382. In the case of random mating and no transmission between adults, frequencies of pair combinations would be (1) 0.382 ( $p^2$ ) pairs with neither member infested, (2) 0.472 ( $2pq$ ) for pairs of which one member is infested, and (3) 0.146 ( $q^2$ ) for pairs with both members infested.

Both members of 10 pairs from Strandasylla county were available for examination. In three pairs neither member was infested, in five pairs one member of the pair was infested and in two pairs both members of the pair were infested with ear canker mites. The frequencies of 0.3, 0.5 and 0.2 respectively (30, 50 and 20% prevalence, respectively) were almost identical to those expected through ran-

dom mating with no transmission of ear canker mites from one member of a pair to the other. Because of the small sample size a test of significance was not performed. However, our results suggest that there was insignificant transmission between free-living adult foxes, even within breeding pairs.

Many breeding dens are consistently reoccupied by arctic foxes and may persist for several centuries (MacPherson, 1969; Hersteinsson, 1980; Garrott and Eberhardt, 1987). There were four instances from Strandasysla county of foxes examined which had been killed at the same den in different years. None of the four foxes killed at two of the dens had ear canker mites. At the third den the male fox killed in 1987 was infested with ear canker mites but his mate was free of mites and a vixen killed there 2 yr later was also free of mites. At the fourth den, the vixen killed in 1988 had ear canker mites but the male fox did not. However, in 1989, both breeding foxes at that site had ear canker mites.

#### DISCUSSION

*Otodectes cynotis* is very rare in arctic foxes in Iceland and apparently it is limited to one northwestern county of the island. Because arctic foxes have not been previously examined for ear canker mites it is not possible to determine if the fox population has only recently become infested or whether the geographical distribution of the parasite is expanding, contracting or remains stable. However, silver foxes (*Vulpes vulpes*) imported into Iceland for fur-farming in the 1930's had ear canker mites, and some of these escaped (Gudmundsson, 1945). Both the captive or escaped silver foxes could have contacted either wild or escaped domestic arctic foxes and have provided the initial source of infestation for wild arctic foxes.

While silver foxes imported in 1983 had ear canker mites, it seems less likely that this was the origin of the infestation among wild arctic foxes. The silver foxes imported

in 1983 were quarantined for 16 mo and all animals treated systemically with subcutaneous ivermectin (Ivomec®, 10 mg/ml; Merck, Sharp and Dohme, B. V., Haarlem, The Netherlands) and locally with antiparasitic drugs in an effort to contain and eventually eradicate the parasite. None of these escaped from captivity and by 1987 ear canker mites were considered to have been eradicated (E. Gunnarsson, unpubl. data). Furthermore, the farm where they were quarantined is located about 160 km away from the area where wild arctic foxes were found infested with *O. cynotis*.

Arctic foxes could have been infested by contact with domestic dogs or cats. While transfer of mites between species has been successfully performed under laboratory conditions (Sweatman, 1958; Tonn, 1961), there is no evidence in support of transmission between species in the wild.

Finally, it is possible that ear canker mites were carried by arctic foxes from Greenland to Iceland on drift-ice. Although it has never been demonstrated that arctic foxes from Greenland have entered Iceland, it seems highly likely that this occasionally occurs. It is well established that arctic foxes sometimes trail polar bears (*Ursus maritimus*) hundreds of km on the pack-ice (Freuchen, 1935; Braestrup, 1941) and arctic foxes have been seen on drift-ice mid-way between Greenland and Iceland (Saemundsson, 1932). Polar-bear tracks and scats were seen in Strandasysla county in the spring of 1979 (G. Kristinsson, pers. comm.) and a yearling polar bear was killed elsewhere in northern Iceland in February 1988 (Hersteinsson, 1988). However, it has not been established whether or not arctic foxes in Greenland are infested with *O. cynotis*.

The cause of Samson character is unknown. However, it has been shown here that it is not due to an ear canker mite infestation.

The means for transmission of ear canker mites between hosts has not been determined. Tonn (1961) found that adult cats housed together with mite-infested cats

could remain free of mites for over a 1 yr period while kittens readily became infested. Similarly, the rate of direct transmission from one free-living adult fox to another appears to be low, as determined from the present analysis of frequencies of infestation between breeding pairs.

There are conflicting accounts on the survival of mites and eggs in the environment (Tonn, 1961; Catcott, 1968; Kangas, 1982; Moriello, 1987). Although our evidence is based on a very small sample size, we hypothesize that transmission mostly occurs between mother and offspring and by contamination of breeding dens such that vixens breeding in dens used in previous years by infested vixens, eventually will become infested by ear-mites. Male foxes rarely enter breeding dens (Hersteinsson, 1984), and would be less likely to contaminate the den or become infested from this source. This may explain why the vixen using a particular den in 1989 did not have ear canker mites although the male fox at that den 2 yr previously had ear canker mites. Alternatively, ear canker mites may not survive in a den, if it stays vacant for one or more breeding seasons. The pattern of infestation in Strandasysla county is being monitored to clarify this matter.

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*Received for publication 21 February 1990.*