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Actinomycosis-like lesions in skulls of Finnish muskrats, Ondatra zibethica (L.)

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Bone lesions of unknown aetiology were detected in 3.2 % of Finnish muskrat skulls (n = 758). The disease was not sex-dependent, but was more common in older individuals. When severe, this condition may cause the death of the animal through malocclusion of the incisors.

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1. Introduction

There are several reasons for malocclusion of the incisors in rodents (Brander 1951, see also Alexander & Dozier 1949, Akkermann 1974). In the muskrat (Ondatra zibethica L.) one of these is actinomycosis, a disease which is caused by a bacterium of the genus *Actinomyces* (Dozier 1943, Bergey 1974). The bacterium attacks the bones of the skull and the roots of the teeth in the muskrat (Dozier 1943, Howe 1970, Doude van Troostwijk 1976). *Actinomyces* bacteria commonly occur in the oral cavities of healthy animals (Howe 1970), but the disease agent is usually able to penetrate into the tissues as the result of some form of trauma in the oral epithelium (Mohler 1916). In the muskrat this can take the form of slight wounds caused by eating coarse plant material or mussels, or perhaps by fighting.

Actinomycosis has been reported in muskrats both from North America (Dozier 1943) and Europe (Doude van Troostwijk 1976), although the disease is rare. In the present study the occurrence of a macroscopically similar disease was studied in Finnish muskrats, in which actinomycosis has not been detected.

2. Material and methods

The main material (644 individuals) was collected between 1978 and 1980 from four localities in Finland: *southern Finland* (1978—80): Lohja, lake Lohjanjärvi (60°15′ N, 24°00′ E), *eastern Finland* (1979—80): Kitee, lake Kiteenjärvi (62°10′ N, 30°10′ E) and Ilomantsi, rivers Koitajoki and Ilomantsinjoki (62°45′ N, 30°45′ E) and *northern Finland* (1979—80): Kemijärvi (66°30′ N, 24°45′ E), lake Kemijärvi and several smaller lakes. The muskrats were collected by local muskrat trappers, who skinned the animals and deepfroze the carcasses (see also Pankakoski 1980). Most of the animals were trapped between April 15 and May 15, or during the second half of May in Kemijärvi. In the laboratory the muskrats were sexed and the head of the animal was removed, boiled and cleaned. A further 114 muskrat skulls from the collections of the Zoological Museum, University of Helsinki, were included in the material. The museum animals had been trapped between 1946 and 1971 in several localities in central and southern Finland (Table 1). The ages of the muskrats were determined from the molar wear according to the method presented by Pankakoski (1980).

The skulls were carefully examined for bone lesions probably caused by actinomycosis. The severity of the lesions was classified into 9 ranks (1 = least severe, 9 = most severe). The precence of *Actinomyces* bacteria was not confirmed microbiologically in this study. Therefore, all the changes in bone due to infection were combined as "actinomycosis-like lesions".

3. Results and discussion

Twenty-four (3.2 %) of the 758 skulls were classified as altered (Table 1). Doude van Troostwijk (1976) reported 7 out of 454 skulls (1.5 %) to have been infected by *Actinomyces* sp. in Dutch muskrats. The difference between the percentages of infected animals in these two studies is not statistically significant ($P = 0.08$). The sporadicalness of actinomycosis has also described in other species of mammals (Mac Diarmid 1962).

Table 1. Numbers of muskrat skulls investigated and skulls with actinomycosis-like lesions in different trapping localities in Finland (A = author's sample, M = museum sample).

Trapping locality		Sample size	Infected muskrats
Lohja	(A,M)	422	15
Helsinki	(M)	42	3
Lokalahti	(M)	3	0
Kustavi	(M)	5	0
Riihimäki	(M)	10	0
Tyrvää	(M)	10	0
Kangasala	(M)	10	0
Sääksmäki	(M)	4	0
Kitee	(A)	36	1
Ilomantsi	(A)	176	5
Kemijärvi	(A)	40	0
Total		758	24

Bone lesions were found only in the mandibles, as is usually the case with actinomycosis (Howe 1970). At their least severe the bone lesions are seen in the mandible as a decrease in the height of the bone at the root of the tooth and/or in the widening of the biggest nerve foramen (Foramen mentale, Fig. 1). From this stage onwards, there was a continuous series with the bone becoming spongy and porous in appearance towards the most severe stages with considerable swelling of a mandible (Fig. 1, cf. the term "lumpy jaw" in e.g. Dozier 1943, Howe 1970).

The occurrence of actinomycosis-like lesions in muskrats from eight separate trapping points (dispersed over an area of c. 50 km^2) in lake Lohjanjärvi did not seem to be distributed in clusters, but was found in most places where sufficient samples had been obtained (Table 2). However, because the lesions are so rare, any clustering effect would have to be very strong to become apparent.

Twelve of the individuals with bone lesions in the skull were males (2.9 % of all males) and 12 were females (3.6 % of all females). The sex ratio of infected muskrats did not differ from that in healthy animals ($\chi^2 = 0.25$, $P = 0.617$).

Bone lesions are more common in older than in younger muskrats:

Table 2. The distribution of muskrats with actinomycosis-like lesions over the trapping area (c. 50 km^2) of lake Lohjanjärvi in 1978—80.

Trapping point	Sample size	Infected muskrats	Expected frequency
1	64	5	2.5
2	79	2	3.0
3	7	1	0.3
4	65	3	2.5
5	12	0	0.5
6	125	4	4.8
7	1	0	0.0
8	37	0[1]	1.4
Total	390	15	

[1] One infected muskrat was trapped in 1981.

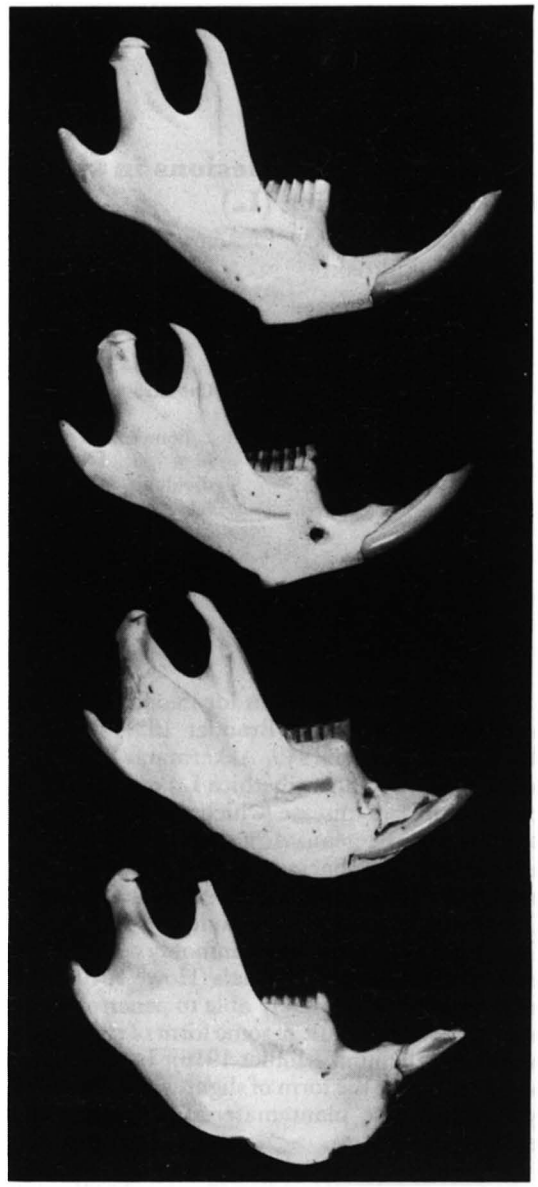

Fig. 1. Muskrat mandibles with different stages of actinomycosis-like bone lesions (healthy mandible uppermost). The two lowest mandibles are considerably swollen and the growth of the incisor is inhibited.

Age:	< 1 year	> 1 year	
% infected	2.5	10.6	$P = 0.0033$
sample size	676	66	(Fisher's exact test)

This observation is a general phenomenon in parasitology: older individuals are usually more infected by parasites and diseases than young animals (see e.g. Dogiel 1964, Andersson & Beaudoin 1966).

Spearman's rank correlation test showed low correlation between the age and stage of severity of the bone lesions in muskrats: $r_s = -0.04$ ($P = 0.858$). Even a young muskrat can therefore present serious lesions. This is also seen in the observation that the youngest infected muskrat (with serious bone alterations; the lowest mandible in Fig. 1) was only 6 months old (a male, trapped on Nov. 25, 1979).

The growth of either incisors or molars was

Fig. 2. Skull of a healthy muskrat (upper) and skull of a muskrat suffering from actinomycosis-like lesions and the beginning of a malocclusion (lower). The growth of the right lower incisor of the diseased muskrat was inhibited by the disease (notice the swelling of the right mandible). This resulted in a reduction in the wear of the upper incisors and their abnormal growth.

assessed to have been disrupted in 10 individuals (1.3 % of the whole material). If the disease inhibits the growth of an incisor, the corresponding upper incisor starts to grow abnormally (two cases, Fig. 2). Severe actinomycosis can thus lead to starvation and death of the muskrat trough malocclusion (Dozier 1943). This could be the explanation for the case with the muskrat described by Artimo (1952), which was found dead as a consequence of very bad malocclusion and lengthening of the incisors. Judging only from the photograph, it seems evident that the animal had suffered from actinomycosis-like lesions, as the right mandible is "porous" and swollen, much as in Fig. 1. If the disease attacks the upper jaw (as in plate 7 in Doude van Troostwijk 1976), it may affect the molar age determination of the muskrat (which is based on measurements of the roots and crown of the first upper molar, M^1). The present study included three muskrats in which the mandible molar roots had clearly degenerated as a result of infection.

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