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## PREVALENCE OF ECHINOCOCCOSIS IN REINDEER (*RANGIFER TARANDUS*) IN SWEDEN

By  
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RONÉUS, OTTO: *Prevalence of echinococcosis in reindeer (Rangifer tarandus) in Sweden.* Acta vet. scand. 1974, 15, 170—178. — In Sweden echinococcosis is uncommon in domestic animals. In reindeer in the most northern part of the country echinococcosis was found. Of 1453 pairs of lungs, 23 pairs (1.6 %) were infected with hydatid cysts. These were of two types: typical well-developed hydatid cysts, which were found in nine of the 23 infected lungs, and collapsed hydatid cysts, which were found in 13 of the lungs. In only one lung pair both types of cysts were seen.

echinococcosis; hydatidosis; *Echinococcus granulosus*; reindeer; lungs; prevalence.

Echinococcosis or hydatidosis is a serious disease occurring in man and animals. Most commonly it is caused by the hydatid cysts of the tapeworm *Echinococcus granulosus* for which the dog is the definitive host. Intermediate hosts in which the hydatid cyst develops include sheep, goats, cattle, pigs, horses, reindeer, elk, and man. Another type of echinococcosis is caused by the hydatid cysts of *Echinococcus multilocularis* for which the fox is the definitive host, and small rodents and man are intermediate hosts. Echinococcosis is prevalent all over the world and occurs in arctic, temperate, and tropical regions (*Gemmell 1960, Rausch 1967*).

It is known that echinococcosis has occurred in Sweden, where it seems to be caused by *E. granulosus*. Recently new cases in man have been diagnosed in the most northern part of the country and some of these have undergone surgery (*Lindholm & Lantto 1968*). Further cases in man have been detected through serological tests (*Huldt, personal commun. 1973*). The occurrence

of human echinococcosis has made it a matter of urgency to investigate the extent to which other intermediate hosts are infected with hydatid cysts. Because of the geographical location of the human cases the reindeer attracted special interest. Therefore, lungs from reindeer from the most northern part of Sweden have been examined for hydatidosis. In addition, data on the frequency of hydatidosis observed during meat inspection and necropsies of domesticated animals are included in the present report.

## MATERIAL AND METHODS

### *Animals examined during meat inspection*

Data on the number of slaughtered domesticated animals and on cases of hydatidosis were collected for the years 1960—1972 from the yearly reports of the Food Hygiene Department of the National Swedish Food Administration.

In Sweden there are about 210,000 reindeer, and every year some 40,000 of these are slaughtered. During 1960—1968 a varying but small number — 100 to 2000 — were examined each year during meat inspection, but after 1968 some 20,000 per year were inspected. However, in the most northern part of the country only a few of the reindeer are inspected after slaughter.

In 1970 a total number of 4,268,303 animals excluding reindeer, i.e. 823,566 cattle, 210,709 sheep and goats, 3,223,137 pigs, and 10,891 horses were slaughtered and examined during meat inspection. During 1960—1972 the yearly number of carcasses was of this order, which means that a total of about 50 million animals of these species were inspected.

### *Examination of reindeer lungs*

From the northern area where human echinococcosis was reported only few of the reindeer are inspected after slaughter. To determine the frequency of echinococcosis in reindeer in this area 1453 pairs of lungs collected at slaughter were examined. The area from which the reindeer originated includes the most northern part of Sweden, situated north of latitude 67°N and bounded by Norway and Finland (Fig. 1). The reindeer belonged to different Lapp areas and were slaughtered at different places as listed in Table 1. The age of these animals varied between two and five years.

The slaughter of reindeer occurred out of doors, and it was very cold at the time of slaughtering. To be able to carry out this investigation, the lungs were transported in a frozen state to the laboratory. The restriction of examination to the lungs was due to the fact that in reindeer the hydatid cysts occur exclusively in the lungs.

The lungs were visually examined and carefully palpated to detect small or deeply located cysts. The hydatid cysts and suspected lesions of the lung tissue were examined histologically.

## RESULTS

### *Prevalence in reindeer examined during meat inspection*

Since 1960 only one case of echinococcosis in meat-inspected reindeer has been reported. This was in 1968, in the Jokkmokk district, where a typical hydatid cyst was found in the lung of an animal. Some cysts from reindeer livers, suspected of being hydatids, have also been examined. However, these cysts were either *Cysticercus tenuicollis* or congenital bile duct cysts.

### *Prevalence in other animal species*

During 1960—1972 about 50 million slaughtered animals excluding reindeer were examined during meat inspection and only one certain case of echinococcosis was found. It was in a 21-year old horse from the area of Gävle (*Hässler* 1962). Four additional cases of hydatidosis have been found, at necropsies of two thoroughbred horses imported from England and in a monkey imported from southern Europe. The fourth case was found in a deep-frozen cattle liver imported from New Zealand.

### *Prevalence and gross morphology of hydatid cysts in examined reindeer lungs*

The results of the examination of reindeer lungs are summarized in Table 1. In reindeer from the most northern part of Sweden, hydatid cysts were found in 23 out of 1453 pairs of lungs examined, i.e. 1.6 %.

The frequency of echinococcosis varied within each area. From the two Lapp areas Lainiovuoma and Könkämä, in the northern part of the area, 2.1 % of 1092 examined cases had hydatid cysts. This area mostly consists of mountains and tundra. The reindeer sometimes also move into the neighbouring

Table 1. Findings of hydatid cysts in lungs from 1453 reindeer slaughtered at different places in four Lapp areas situated north of latitude 67°N.

Lapp area	Slaughter place	Number of lungs examined	Lungs with hydatid cysts number (per cent)
Lainiovuoma	Pulsujärvi Järrämä Kenkiskero	664	14 (2.1)
Könkämä	Kuttainen Mertajärvi Sudjavaara	428	8 (1.9)
Tärendö Vittangi	Kero Fällträsk	361	1 (<1)
Total number		1453	23 1.6

Norwegian and Finnish districts. From the two Lapp areas Tärendö and Vittangi, in the southern part of the area, hydatid cysts were found in only one of 361 examined pairs of lungs. This area mostly consists of coniferous forests. Reindeer from this area usually graze only in Swedish territory (Fig. 1).

The hydatid cysts were of two different types: well-developed cysts and collapsed cysts.

Well-developed hydatid cysts were found in nine of the 23 infected pairs of lungs (Fig. 2). All these cysts were unilocular, almost spherical and without daughter cysts. The diameter ranged from 35 to 60 mm. Most of these cysts could be seen on the surface of the lungs but some were quite hidden in the tissue and were detected only after palpation.

Collapsed hydatid cysts were found in 13 of the 23 infected lungs (Figs. 3 and 4). They were relatively small with a diameter of 5 to 10 mm; only one was larger with a diameter of 30 mm. On the cut surface of the lung they look like knots in a board. The cut surface of the cysts was usually dark brown and was distinctly striated. This striation was caused by the collapsed and deeply wrinkled laminated membrane which often filled the cyst (Fig. 3). As a rule, these collapsed hydatid cysts were located deeply in the tissue of the lungs and were detected only after careful palpation. Only the largest one reached the surface of the lung.

Both types of cysts were found in one of the lungs.

A morphological analysis of the two types of cysts will be presented separately.

### DISCUSSION

Echinococcosis in the Swedish livestock, excluding reindeer, was first described in the beginning of this century. *Hallenborg* (1910) found echinococcosis in a horse imported from Ireland. *Simon* (1911) reported that echinococcosis occurred in 0.012 to

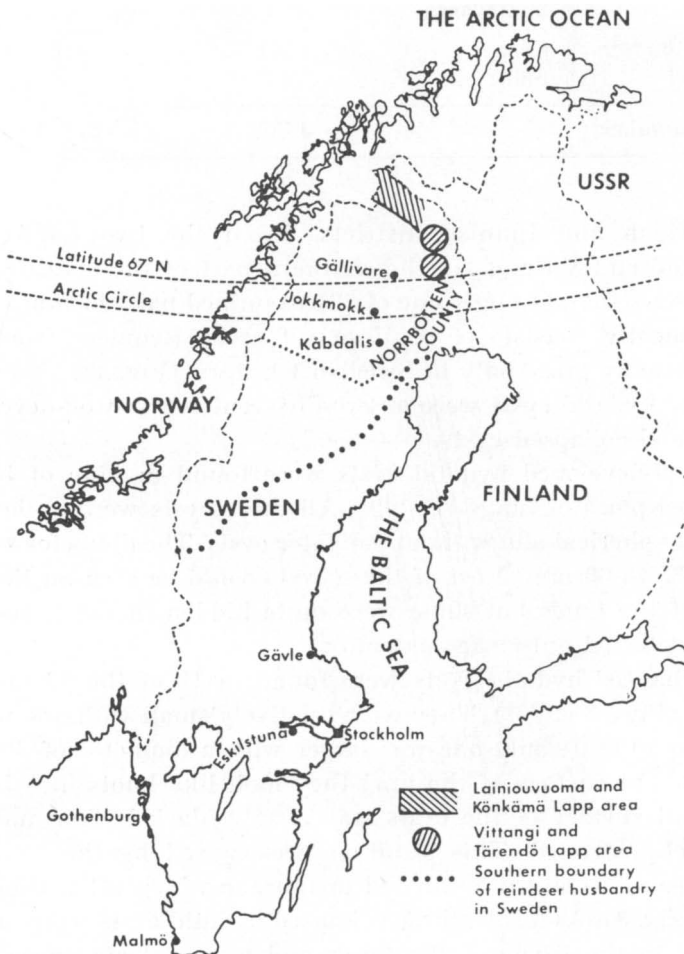
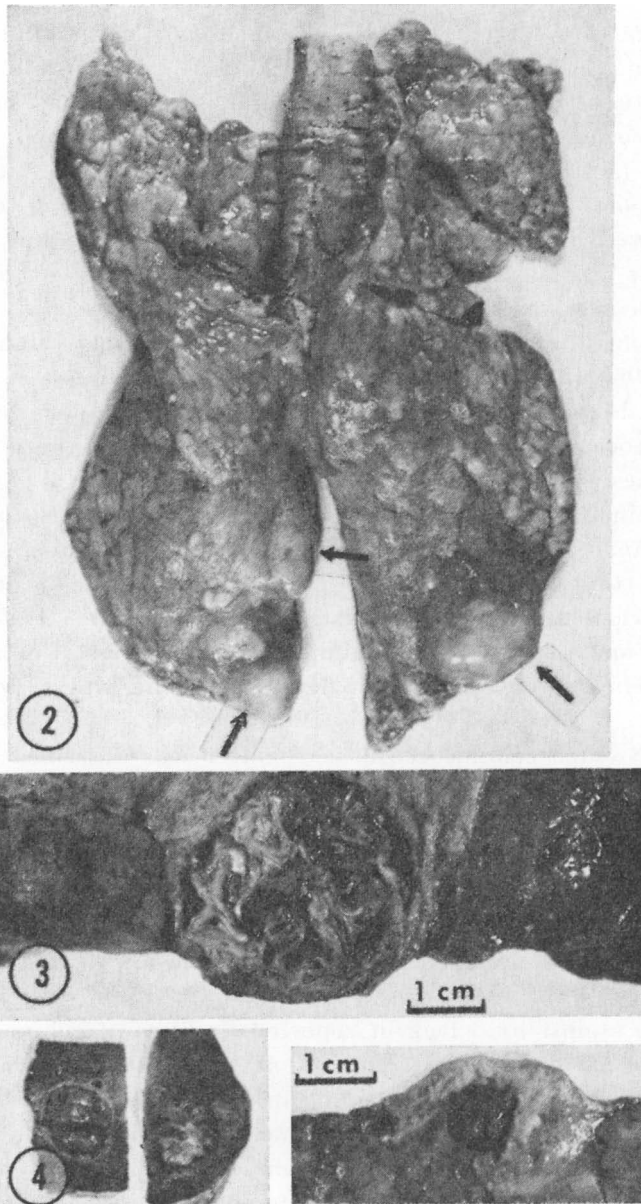


Figure 1. Map of Scandinavia with places and areas in Sweden where echinococcosis has been detected.



**Figure 2.** Lungs from reindeer with three well-developed typical hydatid cysts. Two are seen on the surface of the lungs, the third is only faintly outlined (upper arrow).

**Figure 3.** Section of a collapsed hydatid cyst in a reindeer lung. The collapsed and deeply wrinkled laminated membrane causes the striation of the cut surface of the cyst.

**Figure 4.** Section of small collapsed hydatid cysts in reindeer lungs. The cysts are located within the tissue of the lungs.

1.5 % of slaughtered animals in Gothenburg, Malmö and Eskilstuna and, occasionally, also in Stockholm and Norrbotten. *Låftman* (1911) showed that at the Malmö slaughter-house, in 1905, echinococcosis occurred in 336 of 13,465 cattle, in one of 678 horses, in 43 of 17,044 pigs, and in three of 7222 sheep. Certainly, the reports do not record by what morphological criteria the cysts were diagnosed, but the reports do indicate that echinococcosis was not rare in the livestock at that time. Now, however, the livestock is apparently free from echinococcosis. This is shown by the fact that among 50 million animals slaughtered after 1960 only one case of echinococcosis was found — that in an old horse (*Hässler* 1962). In the additional four cases, the echinococcosis was in all probability acquired in the exporting countries.

Echinococcosis in reindeer is observed in various countries. In a Canadian district 9.5 % of the reindeer are shown to be infected (*Choquette et al.* 1957), in Alaska the rate of infection in the caribou seems to be relatively low (*Rausch & Williamson* 1959), and in the area of Iakutskoi in the Soviet Union 34 of 2212 reindeer (1.5 %) had hydatidosis in the lungs (*Safronow* 1963).

In Sweden echinococcosis in reindeer was described by *Carstensen* (1939). According to observations of slaughtered reindeer, he considered the frequency of echinococcosis in reindeer in Norrbotten county at that time to be at least 10 %. Later *Söderhjelm* (1946) reported that in 1941, 1944 and 1945, 8 % of 130 slaughtered reindeer from Kåbdalis were infected with echinococcosis, but none of 300 reindeer from the forest area south of Gällivare.

The almost total lack of reported findings of echinococcosis in reindeer during meat inspection since 1960 indicates that echinococcosis is now uncommon in reindeer as well, at least in the southern reindeer districts where meat inspection is usual. Meat inspection of slaughtered reindeer is often carried out in low atmosphere temperatures, thereby causing the lungs to quickly become frozen hard, so that palpation of the lung tissue becomes impossible. Cases of echinococcosis might have escaped observation for this reason.

The 23 cases of echinococcosis found among 1453 animals from the area north of latitude 67°N show that echinococcosis occurs in reindeer in Sweden. The infection in reindeer must

have occurred recently since these animals were only two to five years old.

Some of the reindeer in these northern areas might have been infected when they extended the search for food to the adjacent Norwegian and Finnish districts. In these areas echinococcosis also occurs. In the adjacent Norwegian districts 9.6 % of 2204 reindeer slaughtered in 1956—1958 had echinococcosis (*Skjenneberg* 1959), and about 5 % of those slaughtered in 1968 (*Skjenneberg*, personal commun. 1968). In the adjacent Finnish districts 1.2 % of 1254 slaughtered reindeer were infected (*Pöysti & Pöysti* 1969).

The detected cases in reindeer as well as the human cases from the same area indicate the presence of an endemic focus of *Echinococcus* infection in the extreme northern part of Sweden. Obviously, there are still dogs infected with *E. granulosus* present in the area and new cases in animals and man may be expected.

#### ACKNOWLEDGEMENTS

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## SAMMANFATTNING

*Utbredningen av echinococcus hos renar (Rangifer tarandus) i Sverige.*

I Sverige är *echinococcus* ovanlig hos husdjur. Hos renar i nordligaste delen av landet påvisades *echinococcus*. Av 1453 undersökta lungpar var 23 lungpar (1,6 %) infekterade med hydatid cystor. Dessa var av två typer, dels typiska välutvecklade hydatid cystor, vilka fanns i 9 av de 23 infekterade lungorna, dels kollaberade hydatid cystor, vilka fanns i 13 av lungorna. I endast ett av lungparen påvisades båda typerna av cystor.

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