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Assessment of the epizootic situation by invasive diseases in reindeer farms in the Murmansk Oblast

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SUMMARY
Reindeer invasive diseases cause significant damage to reindeer farms due to reduction in animal productivity and deterioration in quality of reindeer products. Helminthiases take a special place among them. Knowledge of the epizootic situation will contribute to the successful organization of a system of therapeutic and preventive measures to protect the domestic reindeer stock from helminthiases. The article presents assessment results for the invasive disease epizootic situation in reindeer farms in the Murmansk Oblast in 2018–2021. The research was carried out in two large reindeer farms – APC "Tundra" and APC HFE SEN "Olenevod" during the planned slaughter of reindeer. A total of 4,048 deer carcasses of all ages were examined and 199 samples of faeces were tested. A retrospective analysis of the veterinary service's data showed that, among helminthiases, mainly cysticercosis is recorded in reindeer herds of the Murmansk Oblast. The prevalence of cestodes infection varies from 0.16 to 0.83% depending on the year, however the extensiveness of cysticercosis invasion of reindeer is decreasing. The prevalence of oedemagenosis varied in different age and sex groups from 25 to 100%. It was found that reindeer of all ages were infested with paramphistomiasis (12.50–15.15%), setariasis (5.36–6.06%), nematodiasis (3.0–6.0%), dictyocaulosis (3.03–3.57%), protostrongylosis (3,0%) and, to the least extent, echinococcosis (0.04%). Helminths of the genus *Taenia*, class *Cestoda*, that cause cysticercosis, mainly infest young animals – extensiveness of invasion (EI) is 0.50–0.81%. Thus, oedemagenosis and paramphistomiasis prevail in the structure of helminth infections; they are recorded in all reindeer herds. It was established that invasive diseases occur in the form of mixed invasions. Mixed invasions most often occur in the following associations: oedemagenosis + protostrongylosis, oedemagenosis + paramphistomiasis + setariasis, oedemagenosis + paramphistomiasis + cysticercosis (finnosis), oedemagenosis + dictyocaulosis + protostrongylosis.

Keywords: domestic reindeer, epizootic situation, invasive diseases, helminthiases

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Оценка эпизоотической ситуации по инвазионным заболеваниям в оленеводческих хозяйствах Мурманской области

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РЕЗЮМЕ
Инвазионные заболевания наносят значительный ущерб оленеводческим хозяйствам за счет снижения продуктивности животных и ухудшения качества оленеводческой продукции. Особое место среди них занимают гельминтозы. Знание эпизоотической обстановки будет способствовать успешной организации системы терапевтических и профилактических мероприятий по защите поголовья домашних северных оленей от паразитарных заболеваний. В статье представлены результаты оценки эпизоотической ситуации по инвазионным заболеваниям в оленеводческих хозяйствах Мурманской области за период с 2018 по 2021 г. Исследования были проведены в двух крупных оленеводческих хозяйствах – СХПК «Тундра» и СХПК ОПХ МНС «Оленевод»

во время планового убоя северных оленей. Всего было исследовано 4048 туш оленей всех возрастов и 199 проб фекалий. Ретроспективный анализ данных ветеринарной службы показал, что из гельминтозов в оленеводческих стадах Мурманской области в основном регистрируется цистицеркоз (*Cysticercosis*). Процент зараженности животных цестодами варьирует по годам от 0,16 до 0,83%, при этом наблюдается уменьшение экстенсивности инвазии северного оленя. Распространенность эдемагеноза по разным половозрастным группам составляла от 25 до 100%. Показано, что олени всех возрастов болеют парамфистоматозом (12,50–15,15%), сетариозом (5,36–6,06%), нематодиреллезом (3,0–6,0%), диктиокаулезом (3,03–3,57%), протостронгилезом (3,0%) и в меньшей степени эхинококкозом (0,04%). Гельминтами рода *Taenia* класса *Cestoda*, вызывающими цистицеркоз, заражается преимущественно молодняк, экстенсивность инвазии составляет 0,50–0,81%. Таким образом, в структуре заболеваемости гельминтозами доминирующее положение занимают эдемагеноз и парамфистоматоз, регистрируемые во всех оленеводческих стадах. Установлено, что инвазионные болезни протекают в форме микст-инвазий, чаще всего в следующих ассоциациях: эдемагеноз + протостронгилез, эдемагеноз + парамфистоматоз + сетариоз, эдемагеноз + парамфистоматоз + цистицеркоз (финноз), эдемагеноз + диктиокаулез + протостронгилез.

Ключевые слова: домашний северный олень, эпизоотическая ситуация, инвазионные болезни, гельминтозы

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INTRODUCTION

Reindeer husbandry is a traditional ancient occupation of most peoples of the Far North. Deer is a major component of the ecosystem of the Northern regions and the welfare, level of economic and social development of indigenous peoples largely depend on its rational use. Preservation and further development of domestic reindeer husbandry, increasing its productivity and profitability are impossible without proper organization and implementation of effective measures against infectious and invasive animal diseases that can cause significant damage to reindeer farms.

The main diseases causing significant economic damage to reindeer husbandry are necrobacteriosis, oedemagenosis, cefenomyosis and helminthiases. These infections are often registered in reindeer herds, reduce the animals' productive qualities [1–8] and often cause mortality [9–11]. Helminthiases should be particularly noted.

Reindeer are ruminants, but due to scarce food supply in their habitats, they developed food preferences untypical of ruminants. They can eat fallen horns of their relatives and moose, brackish soil, chicks, bird eggs and droppings, as well as lemmings. Cases of deer drinking from puddles and simultaneously urinating and defecating were also recorded. These and other factors increase the likelihood of helminth invasion of deer [12].

Currently, there is only general information on diversity of parasites in reindeer [10, 13–21], and detailed information on parasitic infections is limited. Complete data on parasitic prevalence and diversity will contribute to a more targeted fight against infestations.

Reindeer diseases caused by helminths are widespread in reindeer herds both in the Russian Federation [15–17, 22, 23] and in the Scandinavian countries (Norway, Finland) [24, 25].

Thus, in the Republic of Sakha (Yakutia) the infection rate of deer with *Setaria cervi* was 32.8% [15], with *Cysticercus tarandi* – 13.3%, *Cysticercus parenchimatosa* – 10%, *Paramphistomum cervi* – 10%, *Echinococcus granulosus* – 10% among all tested animals. Larvae of nasopharyngeal gadflies (*Cephenomyia trompe*) affected 36.6% of the deer population, infection with larvae of hyperdermic gadfly was established at 100% (*Oedemagena tarandi*, oedemagenosis) [16].

The invasiveness of *Dictyocaulus eckerti* (dictyocaulosis) in wild reindeer was 100%, in domestic reindeer it was 45.5% for adult animals and 100% for calves of the current year of birth [22]. For comparison: in Norway, the prevalence of dictyocaulosis in wild reindeer varied from 28 to 80% depending on the period [24].

The level of prevalence of *Oedemagena tarandi* in deer grazing on the territory of the Khanty-Mansi Autonomous Okrug – Yugra, is much lower than in the Republic of Sakha (Yakutia). The extensiveness of oedemagenosis invasion varied from 0.71% in 2012 to 10.37% in 2015 [17].

The helminthiasis epizootic situation with regard to animal husbandry in the Murmansk Oblast remains practically unstudied. To date, there is little data and research works in the field of epizootology, epizootic process studies, as well as scarce information on clinical signs, treatment and prevention of reindeer invasive diseases in the region.

Timely epizootological monitoring, development and implementation of preventive, quarantine and health improvement measures in reindeer breeding farms are necessary conditions for the control of diseases caused by helminths [14].

For successful organization of a system of therapeutic and preventive measures to protect domestic reindeer population from parasitic diseases, knowledge of the biology of pathogens and their pathogenic effect on the host

organism, as well as information on the epizootic situation are necessary [26].

Therefore, the task was set to assess the epizootic situation of invasive diseases in reindeer breeding farms of the Murmansk Oblast in order to develop an effective strategy and tactics for the control, prevention and eradication of helminthiases.

MATERIALS AND METHODS

Studies on the spread of invasive diseases and helminth infestation of reindeer were conducted in 2018–2021 in two large reindeer breeding farms of the Murmansk Oblast ("Tundra" and "Olenevod" farms) during the planned slaughter of animals at the slaughter sites in the Lovozero settlement. In total, 4,048 carcasses from deer of all ages (2,812 from the "Tundra" farm and 1,236 from the "Olenevod" farm), as well as 199 fecal samples were examined.

Meat inspection included examination of animal's rumen, reticulum and abomasum. The helminthiases distribution was studied based on antemortem and postmortem diagnosis and taking into account the epizootological data. At the same time, coproscopic (ovoscopy, larvoscopy, helminthoscopy), flotation (according to Fulleborn) and sedimentation (sequential washing) tests were performed, incomplete helminthological autopsy was carried out and individual organs were examined according to K. I. Scriabin's method [27].

The species diversity of helminth fauna was determined morphologically by microscopy of macro- and micro-preparations using deer helminth identification guide [28].

Table 1
Extensiveness of helminthiasis infestation of domestic reindeer in reindeer farms of the Murmansk Oblast

Holding	Number of tested carcasses	Helminthiasis	Number of infested carcasses	Extensiveness of invasion, %
"Tundra" farm	2,812	cysticercosis	14	0.50
		echinococcosis	1	0.04
	56	paramphistomiasis	7	12.50
		setariasis	3	5.36
		dictyocaulosis	2	3.57
"Olenevod" farm	1,236	cysticercosis	10	0.81
		echinococcosis	–	–
	33	paramphistomiasis	5	15.15
		setariasis	2	6.06
		dictyocaulosis	1	3.03

Table 2
Extensiveness and intensity of helminthic invasion in reindeer of different sex and age groups

Holding	Sex and age group	Number of samples	II, eggs/g faeces	EI, %		
				Nematodiasis	Protostrongylosis	Paramphistomiasis
"Tundra" farm	button bucks under 1 year old	14	3–4	3	–	–
	bucks	2	4–5	3	–	–
	does	11	3–4	6	–	–
	females under 1 year old	104	–	–	–	–
"Olenevod" farm	button bucks under 1 year old	50	3–5	–	3	–
	does	6	–	–	–	–
	females under 1 year old	5	–	–	–	–

RESULTS AND DISCUSSION

Based on meat inspection results of parenchymal organs and gastrointestinal tract of 2,812 deer carcasses belonging to the "Tundra" farm, and 1,236 carcasses submitted to the slaughtering site from the "Olenevod" farm, infection with helminths of the genus *Taenia* (*Taenia hydatigena*), class *Cestoda* (mainly young animals) was detected, the extensiveness of invasion (EI) was 0.5 and 0.81%, respectively. Infection with echinococcosis agent (*Echinococcus canadensis*) was detected only in the "Tundra" farm, while the EI was insignificant and amounted to 0.04% (Table 1).

Of the total number of deer carcasses tested, 56 carcasses from the "Tundra" farm and 33 carcasses from the "Olenevod" farm demonstrated helminths of the genus *Paramphistomum* (*Paramphistomum cervi*) belonging to the digenetic trematodes (deer of all ages were infested) – with EI 12.50 and 15.15%, respectively, causative agents of setariasis (*Setaria tundra* of a genus of parasitic roundworms phylum *Nematoda*) – EI 5.36 and 6.06%, and dictyocaulosis (*Dictyocaulus eckerti*, phylum *Nematoda*) – EI 3.57 and 3.03%, respectively.

Thus, in the study of slaughter products, it was found that the extensiveness of domestic reindeer invasion in reindeer farms in the Murmansk Oblast varies from 0.04 to 15.15%. The most common parasitic diseases are paramphistomiasis (15.15%), setariasis (6.06%), dictyocaulosis (3.57%); less common are cysticercosis (0.81%) and echinococcosis (0.04%).

Based on results of coproscopy (ovoscopy, larvoscopy, helminthoscopy), combined sedimentation-flotation studies and sequential washings, the extensiveness (EI) and intensity (II) of helminthic invasion in reindeer of different age and sex groups were determined (Table 2). It was revealed that the EI of domestic reindeer with nematodiasis was from 3 to 6%, with protostrongylosis – 3%, the intensity of invasion was from 3 to 5 eggs/g of feces.

Retrospective analysis conducted based on reports of the veterinary service of the Lovozersk Animal Disease Control Station for 2018–2021 showed that of all helminthiases predominantly cysticercosis (or finnosis) is registered in reindeer of the Murmansk Oblast (Table 3).

Analyzing the results of meat inspection on farms, it can be noted that in 2018 the highest EI for finnosis (0.39%) was in the "Tundra" farm. In the "Olenevod" farm the maximum invasion rate (1.79%) was observed in 2020. In

Table 3
Retrospective analysis of cysticercosis distribution in reindeer in the Murmansk Oblast

Year	"Tundra" farm			"Olenevod" farm			Average, by farms		
	Total number of slaughtered animals	Animals with finnosis detected	EI, %	Total number of slaughtered animals	Finnosis detected	EI, %	Total number of slaughtered animals	Animals with finnosis detected	EI, %
2018	3,883	15	0.39	1,520	1	0.07	5,403	16	0.30
2019	2,995	7	0.23	1,902	1	0.05	4,897	8	0.16
2020	2,816	7	0.25	1,735	31	1.79	4,551	38	0.83
2021	3,381	5	0.15	1,338	8	0.60	4,719	13	0.28

2018–2021, the percentage of cestodes infestation for all farms, on average, was relatively low and varied from 0.16 to 0.83%. In 2021, there was a decrease in EI, which is associated with the use of ivermectin-based drugs and increased effectiveness of reindeer anti-parasitic treatment and animal health control measures.

At the next stage, the prevalence of hypodermic gadfly larvae infestation in reindeer of the Murmansk Oblast was studied by sex and age groups (Table 4).

Analysis of the obtained data shows that the highest invasiveness of domestic reindeer is observed in the "Olenevod" farm, where the EI was 100% for all sex and age groups. In the "Tundra" farm, the EI was significantly lower, but nevertheless quite high, especially in the groups of breeding bucks (71.4%) and calves (50.7%). On average, the extensiveness of edemagenous invasion in the entire studied reindeer population of both farms was 70.3%.

Such a high level of invasion with *Oedemagena tarandi* larvae is due to the fact that not all livestock (under 50%) of domestic reindeer are subjected to treatment against hypodermic gadfly, and the treatment terms are incompliant.

Analysis of the meat inspection results and studies conducted using a combined method showed that the invasions identified in reindeer of the Murmansk Oblast, as a rule, occur in the form of mixed invasions in various associations, the most frequent being: oedemagenosis + protostrongylosis, oedemagenosis + paramphistomiasis + setariasis, oedemagenosis + paramphistomiasis + cysticercosis (finnosis), oedemagenosis + dictyocaulosis + protostrongylosis. Similar data were obtained by researchers from Finland – more than half (53.3%) of the surveyed deer population had mixed parasitic infections [25].

Table 4
Infestation of reindeer by hypodermic gadfly larvae in reindeer farms in the Murmansk Oblast

Sex and age group	"Olenevod" farm					"Tundra" farm				
	Hides examined, pcs.	Infested by larvae, pcs.	Larvae recorded, pcs.	Medium II per animal, pcs.	EI, %	Hides examined, pcs.	Infested by larvae, pcs.	Larvae recorded, pcs.	Medium II per animal, pcs.	EI, %
Bucks	43	43	3,736	86.9	100	7	5	451	90.2	71.4
Does	6	6	475	79.2	100	4	1	87	87.0	25.0
Deer calves	5	5	397	79.4	100	73	37	3,005	81.2	50.7
Total	54	54	4,608	85.3	100	84	43	3,543	82.4	51.2

CONCLUSION

The results of the conducted studies have shown that invasive diseases of reindeer caused by helminths – representatives of three classes: trematodes, nematodes and cestodes – are registered in all surveyed farms of the Murmansk Oblast.

The most common parasitic diseases are paramphistomiasis (12.50–15.15%), setariasis (5.36–6.06%), nematodiasis (3.0–6.0%), dictyocaulosis (3.03–3.57%), protostrongylosis (3.0%), echinococcosis (0.04%) is less common. Helminths of the genus *Taenia,* class *Cestoda*, causing cysticercosis, infect mainly young animals, EI is 0.50–0.81%. The prevalence of oedemagenosis varied by different age and sex groups of animals from 25 to 100%. Oedemagenosis and paramphistomiasis occupy a dominant position and are recorded in all herds.

A retrospective analysis carried out during the meat inspection of venison on the basis of veterinary reporting documents within planned animal slaughter showed that among all helminthiases, mainly cysticercosis (finnosis) is registered in reindeer herds of the Murmansk Oblast.

It was established that invasive diseases occur in the form of mixed invasions. The following associations are most often registered: oedemagenosis + protostrongylosis, oedemagenosis + paramphistomiasis + setariasis, oedemagenosis + paramphistomiasis + cysticercosis (finnosis), oedemagenosis + dictyocaulosis + protostrongylosis.

The conducted studies made it possible to assess the epizootic situation of invasive diseases in reindeer breeding farms of the Murmansk Oblast. The data obtained will contribute to the successful organization of a system of therapeutic and preventive measures to ensure protection of domestic reindeer population from helminthiases.

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