

Epidemic situation of cestodiasis in domestic reindeer on reindeer farms in the Murmansk Oblast

R. A. Pochepko¹, A. P. Kartashova², A. Lavikainen³, S. Malkamäki⁴

^{1,2} FSBSI "Murmansk State Agricultural Experimental Station", Molochny, Murmansk Region, Russia

^{3,4} University of Helsinki, Helsinki, Finland

¹ ORCID 0000-0001-6684-8192, AuthorID 646194, e-mail: research-station@yandex.ru

² ORCID 0000-0003-3144-2816, AuthorID 560003, Web of Science ResearcherID M-5495-2014, e-mail: research-station@yandex.ru

³ e-mail: antti.lavikainen@helsinki.fi

⁴ ORCID 0000-0001-6707-1581, e-mail: sanna.malkamaki@helsinki.fi

SUMMARY

The paper presents the results of the cestodiasis epidemic situation in domestic reindeer in the farms of the Murmansk Oblast. The studies were performed in 2018–2019 during the routine slaughter of reindeer at slaughter houses APC "Tundra" and APC HFE SEN "Olenevod" located in settlements Lovozero, Krasnoschelye, and Sosnovka. Totally 4,048 carcasses of domestic reindeer were tested, 2,812 out of them – in Lovozero, 396 – in Sosnovka, and 840 – in Krasnoschelye. During the meat inspection the parenchymal organs were examined for cestode cysts. When detected they were sampled and gross specimens were prepared using standard parasitological methods. 56 samples of internal organs of deer suspected in tapeworm infestation were collected from the inspected carcasses, in 25 of them tapeworms were detected and in the rest of the samples parasites were not detected. The tapeworm species were determined at the Department of Veterinary Biosciences, Faculty of Veterinary Medicine, University of Helsinki. The test performed revealed echinococcosis (*Echinococcus canadensis*) and cysticercosis (*Taenia hydatigena*). Most lesions were detected in liver where the agent's larvae cysts are observed. It was established that the level of domestic reindeer infestation with the agents of cysticercosis in APC "Tundra" was 0.5%, echinococcosis – 0.04%, in APC HFE SEN "Olenevod" cysticercosis was diagnosed in 0.81% cases, echinococcosis was not detected. On the whole 0.62% of reindeer on reindeer farms were infested with cestodes. Measures taken for prevention of helminth infestation in domestic and farm animals bear good results.

Keywords: Epidemic situation, cestodiasis, helminth infestation, reindeer, *Taenia hydatigena*, *Echinococcus canadensis*.

Acknowledgements: We would like to express our deep gratitude to the staff of the Murmansk Regional Station for Animal Disease Control and its head N. A. Kostyuk, as well as the Chairman of the Veterinary Committee of the Murmansk Oblast A. E. Kasatkin for providing comprehensive assistance in conducting the research.

For citation: Pochepko R. A., Kartashova A. P., Lavikainen A., Malkamäki S. Epidemic situation of cestodiasis in domestic reindeer on reindeer farms in Murmansk Oblast. *Veterinary Science Today*. 2021; 1 (36): 52–58. DOI: 10.29326/2304-196X-2021-1-36-52-58.

Conflict of interest: The authors declare no conflict of interest.

For correspondence: Anastasia P. Kartashova, Candidate of Agricultural Science, Interim Director, FSBSI "Murmansk State Agricultural Experimental Station", 184365, Russia, Murmansk region, Kola district, Molochny, Sovkhoznyaya str., 1, e-mail: research-station@yandex.ru.

УДК 636.294:616.995.121:576.895.121.56

Эпизоотическая ситуация по цестодовой инвазии домашних северных оленей в оленеводческих хозяйствах Мурманской области

Р. А. Почепко¹, А. П. Карташова², А. Лавикайнен³, С. Малкамяки⁴

^{1,2} Федеральное государственное бюджетное научное учреждение «Мурманская государственная сельскохозяйственная опытная станция» (ФГБНУ Мурманская ГСХОС), пос. Молочный, Мурманская обл., Россия

^{3,4} Хельсинкский университет, Хельсинки, Финляндия

¹ ORCID 0000-0001-6684-8192, AuthorID 646194, e-mail: research-station@yandex.ru

² ORCID 0000-0003-3144-2816, AuthorID 560003, Web of Science ResearcherID M-5495-2014, e-mail: research-station@yandex.ru

³ e-mail: antti.lavikainen@helsinki.fi

⁴ ORCID 0000-0001-6707-1581, e-mail: sanna.malkamaki@helsinki.fi

РЕЗЮМЕ

В статье представлены результаты анализа эпизоотической ситуации по цестодам домашних северных оленей в хозяйствах Мурманской области. Исследования проводили в период с 2018 по 2019 г. во время планового убоя северных оленей на убойных пунктах СХПК «Тундра» и СХПК ОПХ МНС «Оленевод», расположенных в поселениях Ловозеро, Краснощелье, Сосновка. Всего было обследовано 4048 туш домашних северных оленей, из них 2812 – в Ловозеро, 396 – в Сосновке, 840 – в Краснощелье. При ветеринарно-санитарной экспертизе проводили внешний осмотр паренхиматозных органов на предмет наличия на них цестодовых пузырей. При их обнаружении производили отбор проб и готовили макропрепараты по общепринятым в паразитологии методикам. Из числа обследованных туш было отобрано 56 проб внутренних органов оленей с подозрением на наличие цестод, в 25 из них обнаружены гельминты, в остальных образцах паразиты не выделены. Видовую принадлежность гельминтов определяли на кафедре ветеринарно-биологических наук факультета ветеринарной медицины Хельсинкского университета. В результате проведенных исследований из гельминтозных заболеваний были выявлены эхинококкоз (*Echinococcus canadensis*) и цистицеркоз (*Taenia hydatigena*). Преимущественно была поражена печень, где в пузырчатой форме паразитируют личинки возбудителя. Установлено, что инвазированность домашних северных оленей возбудителями цистицеркоза в СХПК «Тундра» составила 0,5%, эхинококкоза – 0,04%, в СХПК ОПХ МНС «Оленевод» цистицеркоз диагностировали в 0,81% случаев, эхинококки не выделены. В целом по оленеводческим хозяйствам цестодами поражено 0,62% оленей. Мероприятия по предупреждению распространения гельминтозов среди домашних и сельскохозяйственных животных проводятся достаточно эффективно.

Ключевые слова: Эпизоотическая ситуация, цестодоз, гельминтоз, северный олень, *Taenia hydatigena*, *Echinococcus canadensis*.

Благодарность: Выражаем глубокую благодарность сотрудникам ГОБВУ «Мурманская областная станция по борьбе с болезнями животных» и его руководителю Н. А. Костюк, а также председателю Комитета по ветеринарии Мурманской области А. Е. Касаткину за оказание всесторонней помощи при проведении исследований.

Для цитирования: Почепко Р. А., Карташова А. П., Лавикайнен А., Малкамяки С. Эпизоотическая ситуация по цестодовой инвазии домашних северных оленей в оленеводческих хозяйствах Мурманской области. *Ветеринария сегодня*. 2021; 1 (36): 52–58. DOI: 10.29326/2304-196X-2021-1-36-52-58.

Конфликт интересов: Авторы заявляют об отсутствии конфликта интересов.

Для корреспонденции: Карташова Анастасия Петровна, кандидат сельскохозяйственных наук, временно исполняющий обязанности директора ФГБНУ Мурманская ГСХОС, 184365, Россия, Мурманская обл., Кольский р-н, п. Молочный, ул. Совхозная, д. 1, e-mail: research-station@yandex.ru.

INTRODUCTION

Necrobacteriosis, oedemagenosis, cephenomyosis and helminthiasis should be singled out among the most frequently registered diseases in reindeer herds, which cause significant economic damage to reindeer husbandry. They reduce the animal performance and often cause their death [1–3].

Helminthiasis occupy a special place among the diseases of domestic reindeer. They reduce weight gain during feeding of animals, often cause their emaciation, and also worsen the quality of meat and leather, and fur products [4]. Deer infected with helminths at 5 months of age weigh 6.2 kg less [5] than the healthy ones, and adults – 16.4 kg less [6], the difference in meat yield is on average 3.8 and 10.9 kg respectively. Due to helminthiasis during the autumn slaughter of deer, 0.3–2% of carcasses, 25–40% of liver, 10–20% of hearts and lungs are discarded, which in some northern regions amounts to direct economic damage, measured in hundreds of tons. Worm infestations not only reduce the productivity of deer, but also increase their susceptibility to other diseases, such as necrobacteriosis, bronchopneumonia [7, 8]. It is known that 74 species of helminths can infect reindeer, 35 of which are found only in this animal and are specific for it [9].

Echinococcosis and cysticercosis are widespread among helminthic diseases in reindeer husbandry. In this case, mainly the liver and lungs are affected, where the pathogen larvae cysts are observed. In the tape stage, helminths parasitize in the intestines of carnivores (dogs, wolves, polar foxes) and humans. At this stage, parasites

persist for up to 18 months in the external environment and enter the deer's body with food. Effective measures to combat the worm cysts have not been developed. Affected parenchymal organs and tissues are discarded and destroyed. Control measures are aimed at de-worming treatments of dogs and destruction of faeces [10].

Compliance with modern requirements of veterinary and sanitary rules when working in the livestock industry has significantly improved the epidemiological situation in the country. However, there are regions with a high incidence of cysticercosis and echinococcosis in animals.

In Yakutia, the *Taenia parenchimatosa* infection rate of reindeer reaches 84.6%, and *Echinococcus granulosus* – up to 17.2% [3, 10]. According to the V. A. Bolshakov and I. I. Grigoriev's observations [5, 7], in the mountain-taiga zone of Yakutia cysticercosis infects 23.6–84.6% of young animals at the age of 6–8 months and 7.3–46.7% of adult deer, and echinococcosis – up to 7.5% of individual animals.

In Western Taimyr, the incidence of cysticercosis in reindeer is 61.5% [11].

In the Kabardino-Balkarian Republic, the incidence of echinococcosis in wild ungulates (chamois, deer, roe deer) was registered at the level of 18.5–50%, and cysticercosis – 7.4–11.8% [12].

In the conditions of the Central Chernozem Region (Voronezh Reserve) in the 70s–80s of the last century, the prevalence of echinococcosis in wild ungulates was less than 1%, but by 2017 it increased to 10% among elks. This has been associated with an increase in echinococcosis

infections in stray dogs. The average long-term infection with cysticercosis (*Taenia hydatigena*) was 19.9–86.2% in various ungulates (deer, roe deer, elk) [13, 14].

Thus, in some regions of the country, foci of the pathogens of helminthiasis of farm animals are maintained. At the same time, the natural chain of disease transmission between the definitive (wolf, dog) and intermediate (deer, roe deer) hosts is preserved.

Timely detection of echinococcosis and cysticercosis infested farm animals and their protection from pathogens are directly related to human health. So, in 2019, 451 cases of echinococcosis (0.31 per 100 thousand population) and 65 cases of alveococcosis (0.04 per 100 thousand population) infestations were detected in humans in the Russian Federation. Teniarinhoses (causative agent – *Taenia saginata*) and teniasis (causative agent – *Taenia solium*) account for up to 0.31% of all cases of helminthiasis in humans [15].

Analysis of the long-term incidence of echinococcosis in the constituent entities of the Russian Federation showed that the incidence of this helminthiasis exceeds the national average in Yamalo-Nenets (7.3 times), Chukotka (4.8 times), Khanty-Mansiysk (1.6 times) autonomous okrugs, Stavropol (1.8 times), Perm (1.1 times), Altai (1.6 times) territories, Kabardino-Balkarian (2.0 times), Karachay-Cherkess Republics (9.7 times), Republics of Bashkortostan (3.6 times), Altai (3.5 times), Sakha (Yakutia) (2.8 times), Kalmykia (2.5 times), Dagestan (1.8 times), Orenburg (6.9 times), Saratov (4.5 times), Astrakhan (4.1 times), Kurgan (2.4 times), and Kirov (1.1 times) Oblasts [16].

The main reasons for the disease spread remain violations of the rules for farm animal slaughter, the ineffectiveness of de-worming treatment of dogs and disinfection of natural environments. The main victims are workers who are in direct contact with farm animals, dogs, hunters, workers at slaughterhouses. In addition, there are still risks of the population infestation posed by eating raw meat dishes or contacting with the faeces of an animal infected with helminths through untreated berries, leaves, etc. For example, in February 2019, an outbreak of alveococcosis was observed in the Ulyanovsk region among students of the Suvorov school (26 affected people).

The purpose of this research is to study the distribution and extent of cestodiasis affecting domestic reindeer on reindeer herding farms in the Murmansk Oblast, as well as to determine the extent of echinococcosis affecting definitive hosts (domestic and wild carnivores).

MATERIALS AND METHODS

Scientific research was carried out in the reindeer breeding laboratory of the Murmansk State Agricultural Research Station together with the University of Helsinki and the Evira Food Safety Agency (Finland). We studied the morphological and genetic diversity of cestodes in the reindeer meat and internal organs on reindeer farms in the Murmansk Oblast.

The tests were performed in 2018–2019 during the routine slaughter of reindeer at slaughter houses located in the settlements Lovozero, Krasnoschelye, Sosnovka. A total of 4,048 carcasses of domesticated reindeer were examined: Lovozero – 2,812, Sosnovka – 396, Krasnoschelye – 840. During the meat inspection, the parenchymal organs were examined for cestode cysts, upon detection of which the samples were collected, and gross preparations were prepared from them according to the methods generally

accepted in parasitology. The helminth species were determined at the Department of Veterinary and Biosciences, Faculty of Veterinary Medicine, University of Helsinki (Finland).

Sampling of stray and reindeer herding dog faeces was carried out during the routine slaughter of reindeer on the territory of the slaughterhouses of the APC “Tundra” and the APC HRE SEN “Olenevod”, and the samples were also collected from pastures and at campsites. A total of 83 samples of dog faeces were collected. One wolverine was subjected to a complete helminthological dissection of some organs according to the Academician K. I. Skryabin's method (1928).

The collected faeces samples were placed in a plastic container and during the working day were delivered to the Murmansk Regional Veterinary Laboratory for microscopic examinations using Fyulleborn and Kotelnikov – Khrenov methods.

RESULTS AND DISCUSSION

During the meat inspection, the parenchymal organs were examined and cestode cysts were sampled. Totally 56 cyst samples were collected, 99% of which were found in the liver tissue. Only one sample was collected in the lung. The results are shown in Table 1.

In APC HRE SEN “Olenevod” at the slaughter house in s. Krasnoschelye 25 cyst samples were collected. In ten samples, *Taenia hydatigena* scolexes were detected, indicative of cysticercosis. At the slaughter house in s. Sosnovka 11 cyst samples were collected. No cestodes were detected.

In the APC “Tundra”: at the slaughter facility in s. Lovozero in herds No. 1, No. 2, and No. 8 twenty cyst samples were collected. *Echinococcus canadensis*, causing echinococcosis, was detected in one sample, and *Taenia hydatigena* scolexes, which cause cysticercosis, in fourteen samples.

When assessing the research results presented in Table 1, it can be noted that *Taenia hydatigena* mainly affected the liver, and pulmonary echinococcosis was diagnosed only in one case.

Up to 50% of the samples collected were not helminth cysts. These were liver tissues with fibrosis, scarring and cystic lesions. Most likely, such tissue lesions indicate earlier liver damage caused by different helminth species as well.

Besides, microscopic *Setaria tundra* larvae were found on the surface of a number of cysts. It can be assumed that damages on the surface of the deer's liver, in the form of various types of lesions and scarring, are caused by the migration of *Setaria tundra* larvae from the liver blood flow into the abdominal cavity. In addition, when examining carcasses and collecting samples from internal organs, mesentery, body cavities of some killed deer, adult helminths at pubertal stage were found (Fig.). These nematodes are transmitted by blood-sucking insects – mosquitoes. Considering that the summer of 2018 was very hot for the Murmansk Oblast (in July, on some days, the daytime temperature reached 29–31 °C), the spread of this helminth among reindeer may have accelerated.

As a result of examination of domestic reindeer on reindeer farms in the Murmansk oblast, such helminthic diseases as echinococcosis and cysticercosis were detected. It was determined that only the liver was affected, where the larvae cysts parasitize. In the APC “Tundra” echinococcosis was detected in 0.04% of reindeer, cysticercosis – in 0.5%. In the APC HRE SEN “Olenevod” cysticercosis infested 0.81% of reindeer, and echinococcosis was not detected. In general,

Table 1
Results of assessing the epidemic situation of cestodiasis in domestic reindeer on reindeer farms in the Murmansk Oblast

Таблица 1
 Результаты оценки эпизоотической ситуации по цестодовой инвазии домашних северных оленей в оленеводческих хозяйствах Мурманской области

Date of testing	Sex and age group	Infested organ	Number of samples	Cyst diameter, mm	Helminth presence	Helminth species
S. Krasnoschelye						
18.02.2019	adult (2–4 y. o.)	liver	2	14–20	Yes	<i>Taenia hydatigena</i>
			1	30	Yes	<i>Setaria tundra</i>
			2	5	No	–
22.02.2019	adult (2–4 y. o.)	liver	4	5–10	No	–
23.02.2019	adult (2–4 y. o.)	liver	1	5	Yes	<i>Taenia hydatigena</i>
			4	5–8	No	–
04.03.2019	calves (males)	liver	3	12–22	Yes	<i>Taenia hydatigena</i>
26.03.2019	adult (2–4 y. o.)	liver	4	13–30	Yes	<i>Taenia hydatigena</i>
			2	7–15	Yes	<i>Setaria tundra</i>
			2	5–15	No	–
s. Sosnovka						
13.01.2019	calves	liver	2	3	No	–
14.01.2019	calves	liver	4	4–10	No	–
16.01.2019	calves	liver	3	4–21	No	–
17.01.2019	calves	liver	2	3–4	No	–
s. Lovozero						
19.12.2018	calves	lung	1	25	Yes	<i>Echinococcus canadensis</i>
27.12.2018	calves	liver	1	15	No	–
09.01.2019	calves	liver	1	30	Yes	<i>Taenia hydatigena</i>
			2	4	No	–
10.01.2019	calves	liver	2	15–20	Yes	<i>Taenia hydatigena</i>
			1	3	No	–
14.01.2019	calves	liver	1	12	Yes	<i>Taenia hydatigena</i>
			1	13	No	–
22.01.2019	calves	liver	2	13–15	Yes	<i>Taenia hydatigena</i>
23.01.2019	calves	liver	1	10	Yes	<i>Taenia hydatigena</i>
12.02.2019	calves	liver	2	10–12	Yes	<i>Taenia hydatigena</i>
14.02.2019	calves	liver	5	10–22	Yes	<i>Taenia hydatigena</i>

25 animals were infested with cestodes on reindeer herding farms, which amounted to 0.62% of the tested domestic reindeer, of which echinococcosis was diagnosed in 0.02% of cases, and cysticercosis – in 0.59% (Table 2).

According to the information of the Rospotrebnadzor Administration for the Murmansk Oblast, only three cases of echinococcosis in humans were registered in the region from 2010 to 2017. At the same time, the last time this

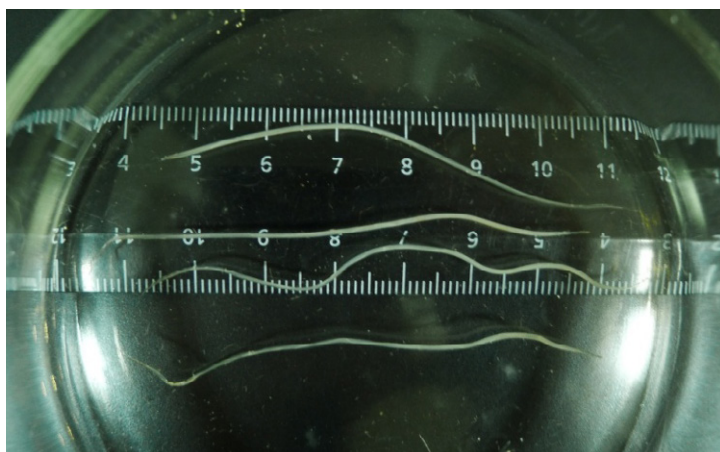


Fig. (Puc.) *Setaria tundra*

disease was observed twice in 2015. No cases of cysticercosis were reported in humans.

A similar situation with echinococcosis is observed in Finland. Every year, when examining the meat of wild reindeer, the country's Veterinary Service (Evira) detects isolated cases of echinococcus infestation. In 2015, one case of a child infested with echinococcosis was reported [17, 18].

According to the results of the microscopic examination of the faeces from carnivores of the APC "Tundra" *Echinococcus* (*Echinococcus granulosus*) eggs were not found. Nematode eggs were found in dogs of various types of keeping. The extensiveness of invasion in dogs was 28%, in case of helminthological dissection of a wolverine – 100% (Table 3).

As a result of microscopic examination no *Echinococcus* (*Echinococcus granulosus*) eggs were found in carnivores in the APC HRE SEN "Olenevod". Nematode eggs were found in dogs of various types of keeping. The extensiveness of infestation was 49% (Table 4).

Table 2
Indicators of the extensiveness of invasions caused by the cestodes *Taenia hydatigena* and *Echinococcus canadensis* in domestic reindeer at the APC HRE SEN "Olenevod" and APC "Tundra"

Таблица 2

Показатели экстенсивности инвазий, вызываемых цестодами *Taenia hydatigena* и *Echinococcus canadensis*, у домашних северных оленей в СХПК ОПХ МНС «Оленевод» и СХПК «Тундра»

Farm	Testing date	Slaughter facility, herd number	Number of tested carcasses	Number of infested carcasses		Extensiveness of infestation %	
				cysticercosis	echinococcosis	cysticercosis	echinococcosis
APC HRE SEN "Olenevod"	January, 2019	s. Sosnovka, No. 3	396	–	–	–	–
	February, 2019	s. Krasnoschelye, No. 2	364	3	–	0.82	–
	March, 2019	s. Krasnoschelye, No. 2–3	476	7	–	1.47	–
Total			1,236	10	–	0.81	–
APC "Tundra"	December, 2018	s. Lovozero, No. 1	617	–	1	–	0.16
	January, 2019	s. Lovozero, No. 2, 8	1,207	7	–	0.58	–
	February, 2019	s. Lovozero, No. 1, 8	988	7	–	0.71	–
Total			2,812	14	1	0.50	0.04
TOTAL			4,048	24	1	0.59	0.02

CONCLUSION

According to the results of testing of internal organs (liver and lungs) from 4,048 domestic reindeer for cestode cysts, the extensiveness of echinococcal and cysticercosis infestation was determined. On deer farms of the Murmansk Oblast cysticercosis was mainly detected in the liver of domestic reindeer. Extensiveness of echinococcal invasion was 0.02% in the entire tested deer population, cysticercosis – 0.59%. It is generally known that the degree of infestation of deer with echinococcus larvae primarily depends on the quality and frequency of de-worming treatment of reindeer herding dogs. Examination of dogs in direct contact with reindeer and slaughter products showed the presence of nematodes. No cases of cestodosis were observed in the examined animals.

Currently, no effective measures have been developed in reindeer husbandry to combat the helminth cysts. Therefore, the main preventive measures should be aimed at de-worming treatment of dogs with the subsequent destruction of faeces, as well as condemnation and destruction of the affected parenchymal organs and tissues of deer during slaughter. Considering that, in general, the situation in the oblast in terms of the incidence of cestodosis among people, including those directly employed in the field of reindeer husbandry, is quite favorable compared to other regions of the Russian Federation, for example, the Yamalo-Nenets Autonomous Okrug [19], it can be stated that measures to prevent the spread of helminthiasis among domestic and farm animals are performed quite effectively. Our closest neighbors in the Arctic region also have a great influence on the helminthiasis situation.

REFERENCES

1. Isakov S. I. Helminths and helminthiasis of Yakutia reindeer and measures to combat them [Gel'minty i gel'mintozы severnyh oleney Yakutii i mery bor'by s nimi]. Yakutsk; 1992. 36 p. (in Russian)

2. Pochevko R. A. Distribution and level of reindeer infestation with paramphistomatosis in the Murmansk Oblast [Rasprostraneniye i stepen' porazheniya severnykh oleney paramphistomatozom v Murmanskoy oblasti]. *Current state and prospects of food supply for the population of the North of the Russian Federation and its scientific support* [Sovremennoye sostoyaniye i perspektivy proizvodstva i razvitiya proizvodstva v Severnoy RF i ego nauchnogo supporta]. *Materials of the Joint Meeting of the SZRNTs and the Agro-Industrial Complex Committee of the Murmansk Oblast*. Murmansk; 2014; 92–95. eLIBRARY ID: 25412926. (in Russian)

3. Kokolova L. M., Safronov V. M., Platonov T. A., Zakharov E. S., Verkhovtseva L. A., Gavriyeva L. Yu. Epizootological situation on zoonosis and parasitic diseases of animals and fish in Yakutia. *Vestnik of NEFU*. 2012; 9 (3): 86–90. eLIBRARY ID: 20340425. (in Russian)

4. Belyaev V. I., Nazarova P. S. Reindeer helminths of the Nenets Autonomous Okrug [Gel'minty severnykh oleney Neneckogo avtonomnogo okruga]. In: *Diagnostics, prevention and therapy of animal diseases in the Far North* [Diagnostika, profilaktika i terapiya bolezney zhivotnykh na Krajnem Severe]. *Collection of Research Papers*. Novosibirsk: SO VASHNIL; 1983; 95–98. (in Russian)

5. Bolshakova V., Grigoriev I. Helminthiasis of calves of domestic reindeer in the mountain taiga zone of Yakutia. *Hippology and Veterinary*. 2019; 1 (31): 87–90. DOI: 10.13140/RG.2.2.36002.48328. (in Russian)

6. Saveliev V. D. Parasitic worms of commercial mammals and their circulation in tundra biocenoses of the Taimyr Peninsula [Paraziticheskie chervi promyslovyyh mlekopitayushchih i ih cirkulyaciya v tundrovyyh biocenozah poluostrova Tajmyr]: Author's Abstract, thesis Candidate of Science (Biology). Leningrad; 1975. 22 p. (in Russian)

7. Grigoriev I. I. Helminths and helminthosis of the domestic deer in the Yakutia mountain and taiga zone. *Bulletin of KSAU*. 2015; 1 (100): 162–166. eLIBRARY ID: 23143146. (in Russian)

8. Layshev K. A., Zabrodin V. A., Prokudin A. V., Samandas A. M. The evaluation of the epizootic situation in the populations of wild reindeer of the Arctic zone of the Russian Federation (literature review). *Actual Questions of Veterinary Biology*. 2015; 4 (28): 38–44. eLIBRARY ID: 25005102. (in Russian)

9. Kazanovsky E. S., Karabanov V. P., Klebenson K. A. Veterinary problems of reindeer husbandry in the European North of Russia. *Russian Journal of Parasitology*. 2016; 37 (3): 332–336. DOI: 10.12737/21657. (in Russian)

10. Kokolova L. M., Isakov S. I., Platonov T. A., Gavriyeva L. J., Grigoryev I. I., Ivanova Z. K., Stepanova S. M. Infectious diseases in farm animals of Yakutia. *Russian Journal of Parasitology*. 2015; 1: 46–52. Available at: <https://vniigis.elpub.ru/jour/article/view/133/136>. (in Russian)

11. Shalaeva N. M. Ecological peculiarities of helminth fauna of wild reindeer (*Rangifer tarandus* L.) in the Western Taimyr. *Theory and Practice of Combating Parasitic Diseases* [Teoriya i praktika bor'by s parazitarnymi boleznyami]: Materials of Reports of the International Scientific Conference. 2017; 18: 533–534. eLIBRARY ID: 30283788. (in Russian)

12. Shikhaliyeva M. A., Golubev A. A., Sarbasheva M. M., Bittirov A. M. Epizootological assessment of helminthiasis in chamois, red deer and roe deer in the Kabardino-Balkarian Republic. *Actual Questions of Veterinary Biology*. 2012; 4 (16): 36–38. eLIBRARY ID: 18152837. (in Russian)

Table 3
Indicators of the extensiveness of helminth-associated invasions in deer-herding, hunting and stray dogs in APC "Tundra", Lovozersky Raion, Murmansk Oblast

Таблица 3

Показатели экстенсивности инвазий, вызываемых гельминтами, у оленегонных, охотничьих и бродячих собак в СХПК «Тундра» Ловозерского района Мурманской области

Carnivore species	Number of tested faeces	Number of detected helminth eggs		Extensiveness of infestation, %	
		cestodes	nematodes	cestodes	nematodes
Deer-herding dogs	19	–	3	–	15.8
Hunting dogs	11	–	2	–	18.2
Stray dogs	6	–	5	–	83.3
Wolverine	1	–	1	–	100.0
Total	37	–	11	–	29.7

Table 4
Indicators of the extensiveness of helminth-associated invasions in deer-herding, hunting and stray dogs in APC HRE SEN "Olenevod", Lovozersky Raion, Murmansk Oblast

Таблица 4

Показатели экстенсивности инвазий, вызываемых гельминтами, у оленегонных, охотничьих и бродячих собак в СХПК ОПХ МНС «Оленевод» Ловозерского района Мурманской области

Carnivore species	Number of tested faeces	Number of detected helminth eggs		Extensiveness of infestation, %	
		cestodes	nematodes	cestodes	nematodes
Deer-herding dogs	27	–	9	–	33.3
Hunting dogs	5	–	1	–	20.0
Stray dogs	15	–	13	–	86.7
Total	47	–	23	–	48.9

13. Breslavtchev S. A., Romashov B. V. Role of wild animal in circulation of echinococcosis in natural conditions of Blacksoil Region. *Modern problems of general and applied parasitology* [Sovremennyye problemy obshchey i prikladnoy parazitologii]: Materials of the XII Scientific-Practical Conference in Memory of Professor V. A. Romashov. Voronezh: Scientific book; 2018; 5–10. eLIBRARY ID: 36474802. (in Russian)

14. Breslavtchev S. A., Romashov B. V. The role of wild ungulates in the circulation of zoonotic helminthiasis in the Voronezh Oblast [Rol' dikih kopytnykh v cirkulyacii zoonoznykh gel'mintozov v usloviyakh Voronezhskoy oblasti]. *Materials of the International Scientific and Practical Conference dedicated to the 90th Anniversary of the Faculty of Veterinary Medicine and Livestock Technology, hosted by the Voronezh State Agrarian University named after Emperor Peter I*. Voronezh: FGBOU VO Voronezh GAU; 2016; 49–51. eLIBRARY ID: 29374309. (in Russian)

15. Public health situation in the Russian Federation in 2019 [O sostoyanii sanitarno-epidemiologicheskogo blagopoluchiya naseleniya v Rossijskoj Federacii v 2019 godu]: Official Report. M.: Federal Service for Consumer Rights Protection and Human Welfare; 2020. 299 p. Available

at: https://www.rospotrebnadzor.ru/documents/details.php?ELEMENT_ID=14933 (date of access: 25.11.2020). (in Russian)

16. On the incidence of echinococcosis and alveococcosis in the Russian Federation [O zaboлеваemosti ekhinokokkozom i al'veokokkozom v Rossijskoj Federacii]: Letter No. 01/14780-13-32 dated 12.24.2013. M.: Federal Service for Consumer Rights Protection and Human Welfare. Available at: https://www.rospotrebnadzor.ru/documents/details.php?ELEMENT_ID=1097 (date of access: 25.11.2020). (in Russian)

17. Malkamäki S. *Echinococcus Canadensis* in reindeer in Northern Europe and Northwestern Siberia. One Arctic – One Health Conference 2019. (Oulu, Finland, February 7–9, 2019). Available at: <https://www oulu.fi/sites/default/>

files/56/Malkamaki2019_OneArcticOneHealth_Ec.pdf (date of access: 20.06.2020).

18. Hämäläinen S., Kantele A., Arvonen M., Hakala T., Karhukorpi J., Heikkinen J., et al. An autochthonous case of cystic echinococcosis in Finland, 2015. *Euro Surveill.* 2015; 20 (42):30043. DOI: 10.2807/1560-7917.ES.2015.20.42.30043.

19. Leshchev M. V., Boykova T. G., Korniyenko A. P. Spread of cestodiasis of reindeers in the Yamal-Nenets autonomous district. *Siberian Herald of Agricultural Science [Sibirskii vestnik sel'skokhoziaistvennoï nauki]*. 2007; 6 (174): 121–122. eLIBRARY ID: 9497395. (in Russian)

Received on 03.12.2020

Approved for publication on 12.01.2021

INFORMATION ABOUT THE AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

Rostislav A. Pochepko, Senior Researcher, Laboratory for Scientific Support of Agricultural Production, FSBSI "Murmansk State Agricultural Experimental Station", Molochny, Murmansk Region, Russia.

Anastasia P. Kartashova, Candidate of Agricultural Science, Interim Director, FSBSI "Murmansk State Agricultural Experimental Station", Molochny, Murmansk Region, Russia.

Antti Lavikainen, Doctor of Science (Veterinary Medicine), Associate Professor, Department of Veterinary Biosciences, Faculty of Veterinary Medicine, University of Helsinki, Helsinki, Finland.

Sanna Malkamäki, Lecturer, Department of Veterinary Biosciences, Faculty of Veterinary Medicine, University of Helsinki, Helsinki, Finland.

Почепко Ростислав Арсеньевич, старший научный сотрудник лаборатории научного обеспечения сельскохозяйственного производства, ФГБНУ Мурманская ГСХОС, пос. Молочный, Мурманская обл., Россия.

Карташова Анастасия Петровна, кандидат сельскохозяйственных наук, временно исполняющий обязанности директора ФГБНУ Мурманская ГСХОС, пос. Молочный, Мурманская обл., Россия.

Лавикайнен Антти, доктор ветеринарных наук, доцент кафедры ветеринарных биологических наук факультета ветеринарной медицины Хельсинкского университета, Хельсинки, Финляндия.

Малкамьяки Санна, преподаватель кафедры ветеринарных биологических наук факультета ветеринарной медицины Хельсинкского университета, Хельсинки, Финляндия.