Epizootic Situation of Brucellosis of Domestic Northern Reindeer in the Republic of Sakha (Yakutia)

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Abstract. Brucellosis is a highly contagious zooanthroponotic disease. Epizootics of brucellosis etiology registered in the regions of Yakutia significantly reduce the efficiency of reindeer husbandry. In most cases, brucellosis in animals manifests itself chronically for several years, which makes it difficult to eliminate this infection in the conditions of reindeer farms and contributes to the formation of persistent, epizootic active foci. Brucellosis has not only social significance, but also serves as a potential barrier to trade (sale and exchange) of animals, products and products of animal origin, and prevents breeding. The article provides data on the epizootic situation of brucellosis in domestic reindeer in the Republic of Sakha (Yakutia). The data on the livestock and research on brucellosis of northern domestic reindeer in Yakutia are presented.

1. Introduction
The Even tribes, who lived in the upper reaches of the Lena River in the 4th-6th centuries, were engaged in reindeer breeding, using reindeer as transport animals [3, 9]. These data indicate that reindeer breeding is the oldest branch of agriculture. The domestic reindeer have adapted well to the peculiar conditions of the North, grazing on pastures all year round, feeding on lichen and snow-covered greens. Being all year round in the tundra and forest-tundra, reindeer practically never come into contact with other types of farm animals susceptible to brucellosis. Therefore, it is generally accepted that the sources of brucellosis infection in reindeer are domestic and wild reindeer sick with brucellosis. At the same time, the pathogen of brucellosis circulates among them independently, regardless of the main carriers of the pathogen of brucellosis - small and cattle, pigs [10, 11, 12, 17, 18]. The first studies to establish the susceptibility of domestic reindeer to brucellosis began in the 30s of the last century [2, 6, 13]. For this, an experimental infection of reindeer with virulent strains of B. abortus, B. melitensis, B. suis, as well as by direct contact with brucellosis of cattle, was carried out. For this, the possibility of infecting domestic reindeer with all three species of brucella was established. Subsequently, this information was confirmed by additional studies [5, 7].

2. Relevance
In Yakutia, brucellosis of domestic reindeer was first recorded in the Oymyakonsky district in 1955, and then in 1958 in Tomponsky and in 1961 in the Allaikhovsky districts [1]. In subsequent years, this disease was established in other reindeer herding farms in the republic.

In five districts of Yakutia, as of 01.01.2020, 35 points with an unfavorable situation for brucellosis of domestic reindeer were identified during the spring, spring-summer and autumn coralization in the
republic. In 2020, 117,877 animals were tested for brucellosis in the republic (more than 75% of the total livestock as a whole), while a positive reaction was detected in 0.1 percent of the studied individuals (109 animals).

3. The purpose and objectives of the study
The aim of the research was to study the epizootic situation of brucellosis in domestic reindeer in the Republic of Sakha (Yakutia).

At the same time, the task was set to study the epizootic situation of brucellosis in the Republic of Sakha (Yakutia).

4. Results of experimental studies
In Yakutia, brucellosis of domestic reindeer has become widespread and, in the conditions of market relations, interferes with the successful development of this industry in many reindeer breeding farms that are unfavorable for brucellosis. We carried out a comparative analysis of the epizootic situation of brucellosis in domestic reindeer during the Soviet period of research and in the period of the modern market economy (Fig. 1).

Figure 1. Dynamics of the studied for brucellosis and identified sick reindeer over a ten-year period.

The diagram presents information on the number of domestic reindeer studied and identified with brucellosis during the Soviet period (1983-1993). The trend line, with the value of the accuracy of the approximation \((R = 0.5)\), demonstrates a general tendency towards a decrease in the indicators of sick animals.
Figure 2. Dynamics of the studied for brucellosis and identified sick reindeer over a ten-year period

Judging by the linear trend with the accuracy of the approximation - R^2 = 0.5, despite the constant number of unfavorable points, the number of 51 sick animals decreases, without significant correlation with the dynamics of the number of studied animals. It should be noted that the number of unfavorable points practically did not decrease and throughout the entire research period remained at the same level (19 unfavorable points). However, the number of isolated sick animals dropped from more than 3% in 1983 to 0.5% in 1993. In 2007, work was carried out to clarify the number of unfavorable points in connection with changes in the forms of ownership, while out of 15 unfavorable points that were registered in the 60-90s, 47 unfavorable points were identified, the number of which decreased to 37 by 2018. The diagram (Fig. 2) shows the dynamics of the decrease in the number of sick animals for the period from 2008 to 2018.

Figure 3. Epizootic situation of brucellosis of domestic reindeer in the Republic of Sakha (Yakutia) for the period from 2010 to 2020.
As in the previous diagram, a trend line is marked, with an approximation confidence value \( R = 0.53 \), which demonstrates a general trend towards a decrease in the indicators of diseased animals. However, in this case, the percentage of decline in 2010 started from 0.7% and reached 0.1% in 2020, whereas from 1983 to 1993 similar indicators were 3.5 and 0.5%, respectively. In both cases, over the specified time periods, the indicators of identified sick animals decreased by more than 6 times. It should be noted that according to Sleptsov E.S., in the Soviet period, the coverage of livestock by diagnostic studies varied within 30% [14]. At the present stage, according to our data, the coverage of livestock by diagnostic studies reaches 70 percent or more. This fact can be explained not only by the improvement of veterinary and sanitary measures, but also by a significant decrease in the number of domestic reindeer associated with the restructuring of animal husbandry. The diagram (Fig. 4) shows the dynamics of the number of domestic reindeer from 1990 to 2020.

![Figure 4. Dynamics of the reindeer population in the Republic of Sakha (Yakutia).](image-url)

As can be seen from the diagram, as a result of the restructuring of animal husbandry, the number of domestic reindeer from 1990 to 2020 decreased by more than 2 times. A certain tendency to increase the number of livestock that has been emerging since the beginning of the new century has been replaced by stagnation after 2010. A small increase in livestock since the beginning of the new century can be explained by the fact that, according to the first subprogram of 2002-2007 of the Department of Traditional Industries of the North of Yakutia, a moratorium on industrial slaughter of reindeer was introduced and a subsidy was introduced for the increase in the number of livestock.

According to Vasilyeva A.A., in the nineties of the last century, brucellosis of domestic reindeer was most widespread in the farms of Ust-Yansky, Tomponsky, Oleneksky, Eveno-Bytantaysky, Bulunsky, Momsky and Nizhne Kolyma districts. The disease had an uneven spread. Thus, according to serological and clinical studies of reindeer from farms in 12 districts of the republic, a high incidence of brucellosis of reindeer was established in Bulunsky, Verkhoyansky, Allaikhovsky, Tomponsky and Oymyakonsky districts.

In the early nineties, there were only 240 herds of reindeer in reindeer farms, of which 109 or 45.4% were disadvantaged. Brucellosis of domestic reindeer is not registered in the Anabar, Abyisky and Srednekolymsky districts. In addition, it is also not installed in the farms of such livestock and industrial
areas as Allaikhovsky, Vilyuyisky, Gorny, Ust-Maysky, Olekminsky, Mirinsky, Neryunginsky, etc., where domestic reindeer are kept in small quantities mainly as transport animals. These districts are located in the south and south-east of the Sakha Republic; they are separated from the northern domestic areas, where mainly foci of brucellosis of domestic reindeer are located.

Some issues of epizootology of brucellosis of domestic reindeer in the mountainous taiga zone of the republic were studied by us on the example of farms in the Zhigansky district that were disadvantaged by this disease in the period from 1986 to 1990. There are 6 reindeer breeding districts in this zone, out of 54 of which 4 are unfavorable for brucellosis of domestic reindeer (Zhigansky, Tomponsky, Verkhoyansky, Momsky) [16].

These areas border each other and are located in similar ecological conditions, where the development of reindeer breeding farms occurs in accordance with the organizational scheme traditionally adopted in this region, which, to a certain extent, affects the formation and further development of epizootic processes; in farms with an unfavorable situation for brucellosis of domestic reindeer, this correlation can also be observed. Because of this, for the successful implementation of the prevention of brucellosis of domestic reindeer and the fight against it, measures aimed at investigating the situation of this disease in these regions are of great practical importance.

According to Iskandarov M.I. [8], the concentration of livestock on limited areas of agricultural land has a certain importance in the development of the epizootic process. Excessive livestock complicates the implementation of preventive and health-improving measures, and also has a negative impact on the dynamics of the values of intensive indicators for infectious diseases in general and, in particular, for brucellosis of domestic reindeer, since excessive numbers and high concentration of individuals susceptible to the disease in a limited area activates the mechanism of transmission of pathogens, which is why, although the scale of measures to prevent morbidity is very significant, the recovery of dysfunctional farms is slowing down. The concentration of livestock within a limited area leads to an increase in one of the key numerical coefficients of the intensity of epizootic processes, i.e. the coefficient of focality.

This opinion has a basis, which is confirmed by the results of the analysis of the situation of brucellosis of domestic reindeer in a comparative aspect in the Soviet and modern periods, the main characteristic of which is the market economy. As can be seen from the diagrams in Fig.1 and Fig.2, the indicators of detection of sick animals during diagnostic studies vary greatly in different periods of research.

In six districts of Yakutia, as of 01.01.2018, there are 37 farms with an unfavorable situation for brucellosis of domestic reindeer. During the spring, autumn, spring-summer coralization on the territory of the republic, 117,877 thousand heads of reindeer were examined for brucellosis (i.e. 75.4 percent of the total number). At the same time, a positive reaction was detected in 0.1 percent of the animals examined (109 heads). Compared to last year, the percentage of the research increased by 4%, the percentage of animals responding positively to brucellosis decreased by 0.02%. Animals from the following areas reacted positively to brucellosis: in Momsky district - 32 heads, in Nizhnekolymsky – 12 heads, and in Eveno-Bytantaysky district - 65 heads.

In Nizhnekolymsky and Oymyakonsky district, 3 points unfavorable for brucellosis of reindeer were rehabilitated in 2017, removed from the register of unfavorable points due to the liquidation of 2 reindeer herds of Allaikhovsky and Kobyai districts. The percentage of efficiency increased by 7.5% compared to last year.

Anti-brucellosis measures are carried out comprehensively and purposefully in the herds of Kobyai, Nizhnekolymsky, Zhigansky districts. The most tense situation regarding brucellosis of domestic reindeer in recent years has been created in herds, especially in the tribal communities of the Eveno-Bytantaysky district. So, during the autumn coralization, only 5.2% of the livestock were studied, 4.5% of the studied livestock were positive. Here, the heads of farms refused to carry out anti-epizootic veterinary measures, motivating the refusal by the lack of fuel, vehicles and the remoteness of the area of 56 coralization (Letter-notification of LLC RO "Sagah" dated 12.10.17 No.6, MUSP "Leninskoe" dated 06.10.17 b/n, GC (F) To Kapitonova N.Yu. dated 12.11.17 No.2, SPK "Turukan" dated 12.10.17
b/n). On the basis of which the head of the veterinary department of the Eveno-Bytantaysky district sent letters to the Veterinary Department. The result was the sending of a warning to the heads of reindeer herding farms. A warning was also sent about the inadmissibility of violating the mandatory requirements of veterinary legislation to the head of LLC "Bukchan" (reindeer herd of Momsky district), which has not been carrying out coralization and anti-epizootic measures for the past few years.

Also, coralization was not carried out in Abyisky, Vilyui and Mountainous regions due to the loss of deer. In the Gorny region, 33.3% of the livestock were examined during the year, while the livestock at the beginning of the year was only 153 heads.

In the Anabar district, 36.4% of the total number of reindeer were examined for brucellosis, but this is 21% higher than in the previous year. At the same time, 3 disadvantaged settlements with a total population of 4,573 reindeer were registered in this area, the percentage of the study was 54%.

Veterinary departments of Verkhoyansk (21.2%), Gorny (10.1%), Neryungrinsky (29.9%), Oymyakonsky (8.8%), Ust-Maysky (26.9%), Eveno-Bytantaysky (4.7%) indicated a low coverage of livestock vaccination against brucellosis of animals. The main reason for low anti-brucellosis work is the lack of labor and material resources, as well as special conditions due to climatic and geographical features and difficult logistics.

Fig. 5 shows data on the infection with brucellosis of domestic reindeer depending on the territorial and climatic zones of the Republic of Sakha (Yakutia).

![Figure 5. Infection with brucellosis of domesticated reindeer in different climatic zones of the Republic of Sakha (Yakutia).](image)

As can be seen from the histogram, domestic reindeer suffer the least from brucellosis in the mountain-taiga zone, whereas in the tundra zone, the incidence rates in different years are 2-4 times higher. The forest-tundra zone occupies an intermediate position between the tundra and mountain-taiga zones in terms of morbidity. To a certain extent, this is due to quantitative differences in the number of livestock, since, according to statistics, more than 40 percent of the total number of domestic reindeer is concentrated in the tundra zone [4].

No cases of brucellosis have been detected in domestic domestic reindeer kept in the taiga zone, in reindeer breeding farms of Gorny, Verkhnekolomsky, Aldansky, Ust-Maysky, Vilyujsky, Mirinsky, Neryungrinsky, Olekminsky and other districts; this is due to the fact that the listed areas are located in the south and south-east of the republic, where the main foci of the disease, concentrated mainly in the
northern home areas, in tundra, forest-tundra and mountain taiga zones, they are separated by natural obstacles.

The results of the work carried out give some idea of the antiepizootic process of brucellosis of northern domestic reindeer in the whole zone and can be useful in developing control measures in other areas with brucellosis problems; to achieve this goal, statistical data for a number of previous years were collected and analyzed. In addition, thirteen reindeer herds with more than 11 thousand heads (regardless of gender and age composition) that were disadvantaged by this disease were subjected to clinical and serological analyses.

RBP, RA, and RSC were used for serological diagnostics. Organs from reindeer forcibly killed with brucellosis were examined by the bacteriological method according to generally accepted tests [15].

Studies have been conducted on the possibility of the influence of external factors on the development of the epizootic process of brucellosis of domestic reindeer (conditions and schemes of keeping and feeding, rutting and calving, exchange, etc.).

5. Conclusions

Epizootic situation of reindeer brucellosis in the Republic Sakha (Yakutia) remains tense. Indicators of the problem of the tundra zone in different years are 2-4 times higher than similar indicators of the mountain-taiga zone. The implementation of the developed disease prevention and control measures allowed to reduce the incidence of animals in the farms of the district from 0.6% in 2010 to 0.1% in 2020.

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