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FOOT AND MOUTH DISEASE

EPIZOOTOLOGICAL SURVEILLANCE IN WILD ANIMAL POPULATION IN ZABAYKALSKY KRAI (RUSSIA) AS EXAMPLE

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SUMMARY

Wild animals can be a potential source of livestock infectious diseases. This problem is particularly relevant in the areas of distant-pasture cattle rearing where wild and domestic animals often contact on pastures and near watering places. Therefore, dzerens (or Mongolian gazelles) migrating from the border areas of Mongolia and China to the Russian Federation can be the source of infection in wildlife. In this connection, the determination of the role of wild dzeren gazelles in the spread of foot and mouth disease is an urgent task. The paper presents information collection and epizootological data analysis with regard to dzeren migration from Mongolia to the the Zabaykalsky Krai (the Russian Federation) for the period of 1992–2018. The FMD epidemic situation in the the Zabaykalsky Krai (the Russian Federation), Mongolia, and China in 2005–2018 is given. FMD virus serotypes that caused outbreaks in the the Zabaykalsky Krai of the Russian Federation from 2006 to 2018 were correlated with the serotypes identified in Mongolia. Biomaterial samples from 20 dzerens were tested in the FGBI "ARRIAH" Laboratory and Diagnosis Center. The laboratory testing results have confirmed FMD virus circulation in the population of dzerens migrating to the border areas of the Russian Federation from the adjacent areas of Mongolia. The potential threat of the FMD virus introduction into the territory of the Zabaykalsky Krai of the Russian Federation by wild animals is specified. The necessity of arranging FMD surveillance system in the population of susceptible wild migratory animals is also justified.

Key words: foot and mouth disease, surveillance, wild migrating animals, dzerens.

INTRODUCTION

Due to the growing threat in recent years of the introduction into the Russian Federation of pathogens of a number of transboundary infectious animal diseases, in particular foot and mouth disease (FMD) from adjacent territories of Mongolia and China, it has become necessary to study the FMD epidemic situation among susceptible wild animals that can serve as FMD natural reservoir and, therefore, be a source of infection posing a threat to domestic animal husbandry.

Foot and mouth disease is a particularly dangerous, quarantine, highly contagious viral disease of domestic and wild hoofed and tylopoda animals. The disease is characterized by an acute course and generalized infection process [9]. 105 species of domestic and wild cloven-hoofed animals belonging to 33 genuses and 14 orders are susceptible to foot and mouth disease [13].

There are many reports in foreign research papers and mass media on FMD cases among various species of wild cloven-hoofed animals and their significant role in the spread of FMD and other highly dangerous diseases among farm animals [10]. A number of research papers were devoted to the study of FMD susceptibility of wild animals [1–4, 8]. In the course of research FMD cases were identified in the wildlife (including zoos), that potentially proves that many wild animals can be susceptible to the virus and also be a source of infection [12].

Wild animals can pose a serious threat to livestock industry, as they present a closed ecological niche characterized by circulation of many pathogens of infectious and parasitic diseases, so the objective to clarify the role of wild dzeren antelopes in FMD spread is very important [11, 12].

Dzeren *(Procapra gutturosa)* is an ungulate of the genus *Procarpa*, family *Bovidae*. It inhabits steppes and semi-deserts of Mongolia, as well as Inner Mongolia and Gansu Provinces of China. It is very rare in the territory of Russia, it is listed in the Red Data Book, it can be found in Dauria, in the Chuiskaya steppe (Gornyi Altai) and on the territory of the "Ubsunurskaya hollow" reserve (Republic of Tyva) when entering from Mongolia. Until the end of the 1930s dzerens were numerous in Tyva, but later the population declined sharply. At present, in Russia dzeren is generally found only in the Daursky Reserve and its surroundings in the south of the Zabaykalsky Krai [5].

FMD occurs in dzerens latently, without pronounced clinical signs, and therefore these species can serve as a source of infection for a long time. In combination with the distant-pasture cattle rearing practiced in the border areas of a number of Subjects of the Russian Federation that share a common border with Mongolia and China, this exacerbates the risk of infection transmission from infected wild animals to livestock.

EPIDEMIC DATA ANALYSIS

As follows from the collected epidemic data, the dzeren population was completely exterminated in the Chita Oblast in the 70s of the last century, therefore this animal species is listed in the Red Data Book of the Russian Federation.

In 1992 a small group of gazelles was detected in the territory of the Daursky nature reserve in the Ononsky

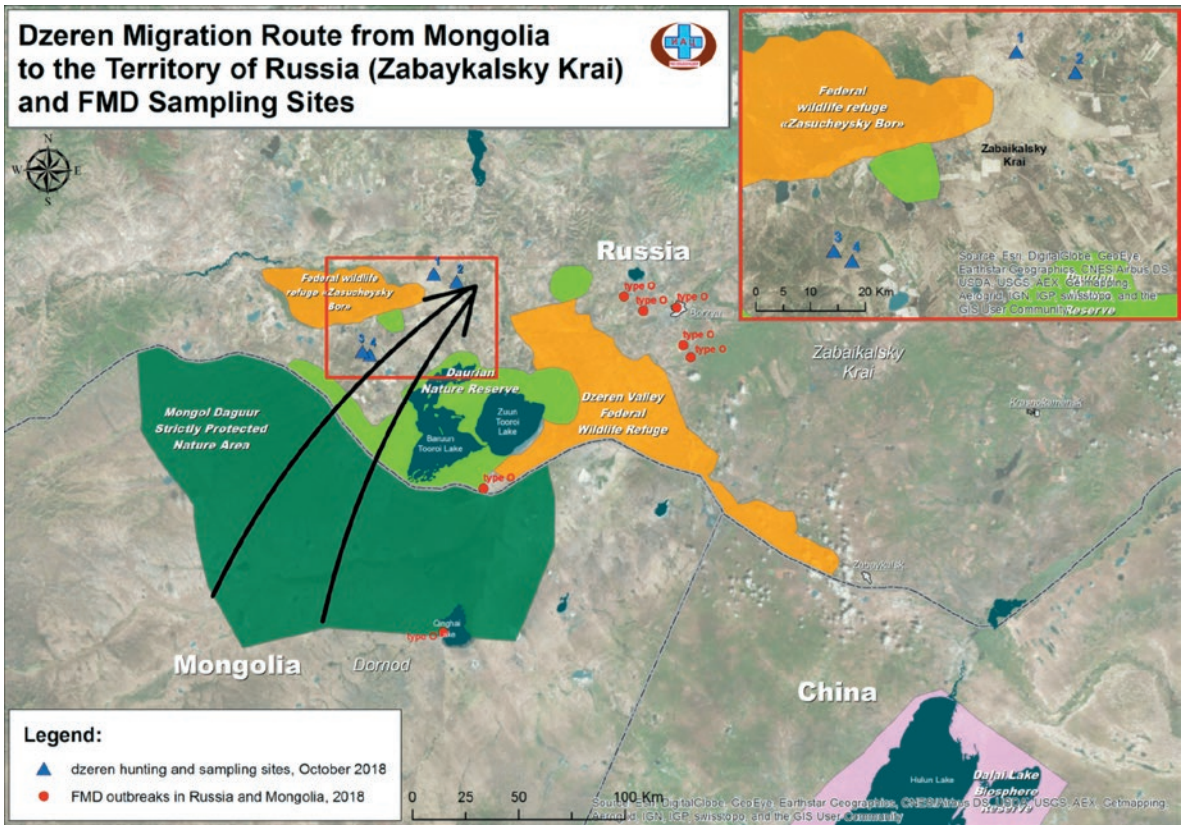


Fig. 1. Dzeren migration from Mongolia to the Zabaykalsky Krai (Russian Federation)

Raion of the Chita Oblast (later renamed the Zabaykalsky Krai), which slowly increased up to 80 animals by 2000. Herewith, the largest population of dzerens was found in the neighboring territories of Mongolia.

In January 2001 the first current mass migration of dzeren occurred from Mongolia to the territory of the Kirinsky Raion of the Zabaykalsky Krai due to very low temperatures (up to –47 °C) and thick snow cover. The herds of up to 500 animals were located near the state border with Mongolia till the beginning of April 2001.

In February 2003 herds of gazelles consisting of up to 200 animals reappeared in the Kirinsky Raion in the steppe areas near the state border.

In the harsh winter 2009–2010 there was the largest migration of dzerens from Mongolia to Zabaykalye. About 15 thousand animals moved to the southeastern part of the Kirinsky Raion in mid-December 2009, and in January – February 2010 about 5 thousand more animals came in.

In December 2015 the employees of the Onon-Baldzhinsky National Park of Mongolia reported that a cluster of dzerens totaling about 50 thousand animals was seen in its territory and about a thousand animals migrated to the territory of the Russian Federation.

In mid-January 2016 herds of dzerens of 1000–2000 animals, about 50 thousand individuals in total, migrated to the Akshinsky and Ononsky Raions of the Zabaykalsky Krai.

In the second half of October 2018, herds of dzerens entered the territory of the Ononsky and Borzinsky Raions (Fig. 1).

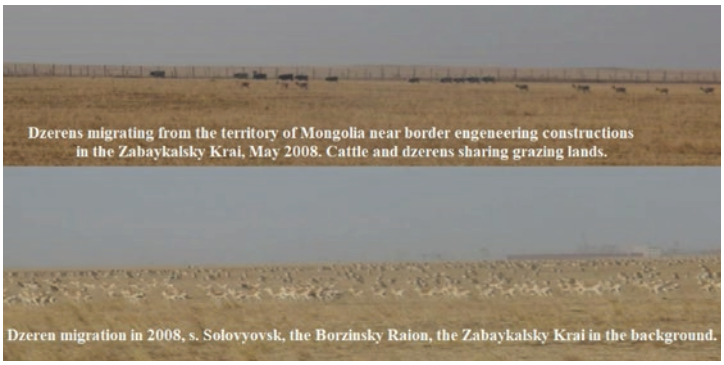
The dzerens migrating from Mongolia contact with the herds of those animals permanently inhabiting the Daursky Reserve (about 12,000 individuals). However, most animals move back to the territory of Mongolia from March to May.

According to the data provided by the employees of East Siberia NIIV – a branch of SFRCA RAS (Chita), the cattle were repeatedly observed sharing grazing lands with herds of dzerens migrating from Mongolia (Fig. 2).

Thus, dzeren migration from Mongolia to Russia in the period from 2001 to 2018 affected the territory of the Kirinsky, Akshinsky, Ononsky and Borzinsky Raions of the Zabaykalsky Krai (Fig. 3).

Table 1 presents data on FMD epidemic situation in the Zabaikialsky Krai of the Russian Federation, Mongolia and China in the period from 2005 to 2018, according to official data presented on the website of the World Organization for Animal Health (www.oie.int). The table shows the FMD virus serotypes reported in the three countries within approximately the same time period, taking into account the location of FMD outbreaks and identification of Mongolian

Fig. 2. Cattle share grazing lands with herds of dzerens migrating from Mongolia



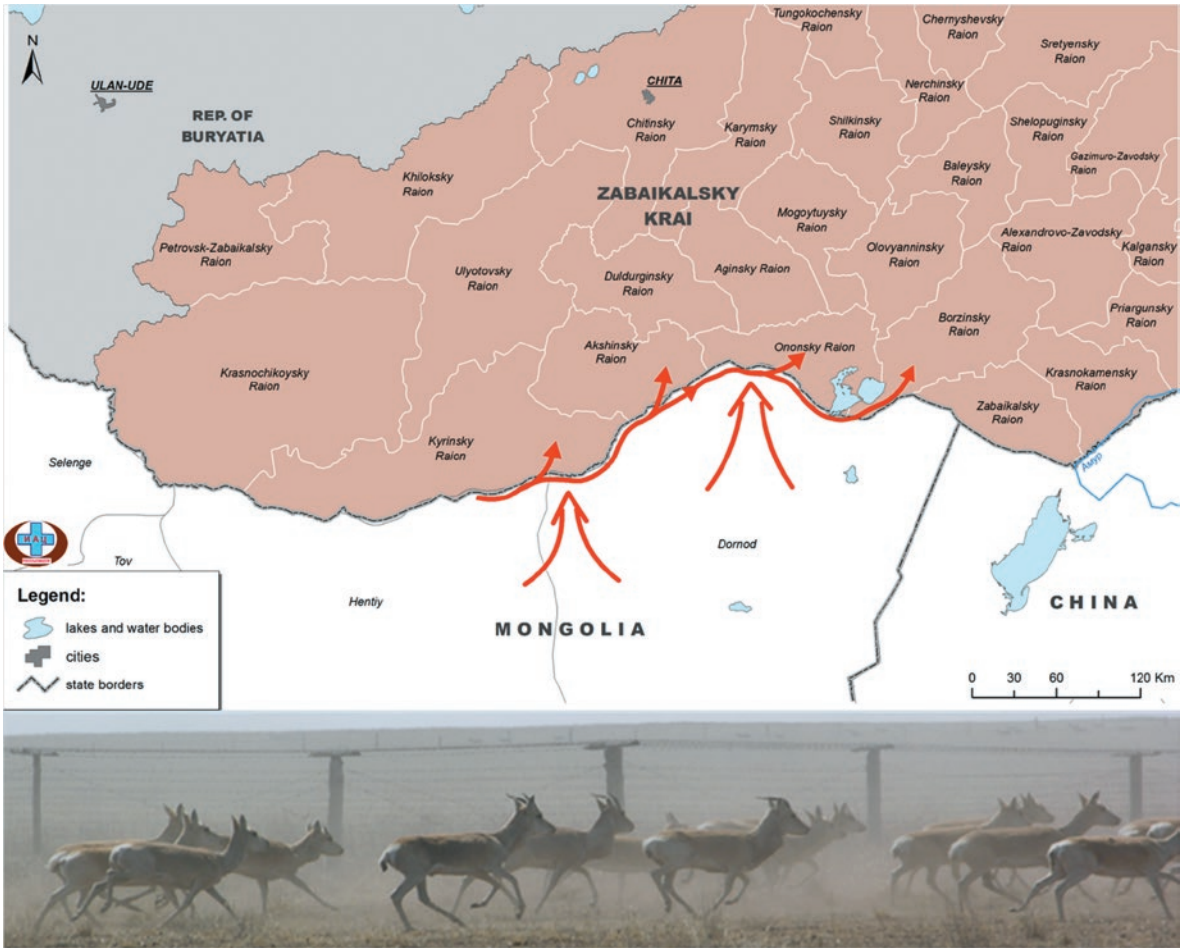


Fig. 3. Migration of dzerens from Mongolia to Russia in 2001–2018 in the territory of the Kirinsky, Akshinsky, Ononsky and Borzinsky Raions of the Zabaykalsky Krai

Table 1
Detection of FMD virus serotypes in Russia (the Zabaykalsky Krai), Mongolia and China in 2005–2018

Year	Russia (the Zabaykalsky Krai), virus serotype	Mongolia		China	
		Aimak	Virus serotype	Province	Virus serotype
2005	–	Dornod*	Asia -1	Beijing, Gansu, Hebei, Jiangsu, Qinghai, Shandong, Xinjiang	Asia -1
2006	Asia-1	–	–	Chongking, Gansu, Hubei, Jiangsu, Ningxia, Qinghai, Tibet	Asia -1
2007–2009	–	–	–	Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Inner Mongolia, Shaanxi, Shandong, Shanghai, Sichuan Xinjiang	Asia -1, A
2010	O	Dornod*, Govi-Sumber, Khentii*, Sukhbaatar, Tuv	O	Beijing, Gansu, Guangdong, Guizhou, Jiangxi, Ningxia, Qinghai, Shaanxi, Xinjiang, Tibet	A, O
2011	O	–	–	Guizhou, Hubei, Ningxia, Xinjiang, Tibet	O
2012	–	–	–	Jiangsu, Liaoning, Ningxia, Tibet	O
2013	A	Bayan-Ulgii, Dornod*	A	Guangdong, Jiangsu, Qinghai, Sichuan, Xinjiang, Tibet, Yunnan	A
2014	A, O	Dornogovi, Khentii*, Sukhbaatar	O	Jiangsu, Jiangxi, Tibet	A, O
2015	–	Bayan-Ulgii, Khovd, Sukhbaatar	O	Anhui, Hubei	A
2016	O	Govi-Sumber	A	Guizhou, Jiangxi, Sichuan, Xinjiang	O
2017	–	Dornod*, Dornogovi, Dundgovi, Khentii*, Sukhbaatar	O	Guangdong, Guizhou, Xinjiang, Tibet	A, O
2018	O	Arkhangai, Dornod*, Dornogovi, Dundgovi, Govi-Sumber, Khentii*, Sukhbaatar, Umnugovi	O	Anhui, Gansu, Guangdong, Guangxi, Guizhou, Henan, Hubei, Inner Mongolia, Ningxia, Shanxi, Xinjiang, Yunnan	A, O

* Mongolian aimaks adjacent to Russia.

aimaks bordering on Russia, which are the main habitats of dzerens.

The analysis of the data in Table 1 shows that FMDV serotypes that caused the outbreaks in the Zabaykalsky Krai of the Russian Federation in 2006–2018 match with the serotypes reported in Mongolia, except for 2016, when the disease didn't occur in a Mongolian aimak but in the central part of the country. However, in 2007, 2008, 2009 and 2012 no FMD outbreaks were registered either in Mongolia or in the Zabaykalsky Krai of the Russian Federation.

MATHERIALS AND METHODS

In October, 2018 samples were collected from dzerens which migrated from Mongolia to the territory of the state biosphere reserve "Daursky" situated in Ononsky Raion of the Zabaykalsky Krai.

Since the Mongolian dzeren is listed in the Red Data Book, the Rosselkhoznadzor Territorial Administration for the Zabaykalsky Krai obtained an authorization from the Rosprirodnadzor (Federal Service for Supervision of Natural Resources) for a commission shooting of 20 animals in the presence of the Rosprirodnadzor representatives and the staff of the reserve.

Shooting of animals was performed in 4 areas of the zone bordering on Mongolia at the distance of 20–80 km from utility facilities beyond the territory of the reserve 1–2 weeks after their migration from Mongolia to the Zabaykalsky Krai (according to the staff of the reserve) (Fig. 4). Sampling was carried out pursuant to "Methodical guidelines on sampling, preservation and transport of samples of pathological materials and products derived from slaughter for foot-and-mouth disease laboratory diagnostics" [7]. Immediately after sampling biomaterial samples were frozen and transported to the FGBI "ARRIAH" in liquid nitrogen in a Dewar.

Those measures resulted in the collection of 20 erum samples and 76 biomaterial samples from 20 dzerens aged from 2 to 7 years (Table 2).

Serum was analyzed at the FGBI "ARRIAH" Testing Centre by enzyme-linked immunosorbent assay (ELISA) to detect antibodies to structural and non-structural proteins of foot-and-mouth disease virus (NSP). Biomaterials (pharyngeal mucosa, lymph nodes, tonsils) were analysed for FMD virus RNA and virus isolation was carried out (S. N. Fomina, A. V. Shcherbakov).

RESULTS AND DISCUSSIONS

Observation of animals did not reveal diseased, emaciated or straggler animals. No pathoanatomical changes typical for FMD were found during examination of killed animal carcasses (foot lesions including erosions and pododermatitis signs) (Fig. 5).

The analysis of samples taken from animals (16 males and 4 females) showed that serum from 10 animals (Nos 1, 2, 6, 10, 13, 14, 15, 17, 19 and 20) were positive for antibodies to non-structural FMD virus polyproteins (table 3). Samples collected at three sampling sites– 1, 3 and 4 – were positive. Besides, specific antibodies to FMD virus, type O (No. 14 and 19) were detected in the samples from two females from Pad Temety. The results suggest that dzerens had FMD of the given type, however, the viral RNA was not detected in biomaterial samples. Specific antibodies to FMD virus, type O, A and Asia-1 were not detected in other positive samples collected from 8 male dzerens (Nos 1, 2, 6, 10, 13, 15, 17 and 20).

It should be noted that in 2018 FMD outbreaks caused by type O virus were registered in bordering aimaks of

Fig. 4. Sites of biomaterial sample collection from 20 dzerens

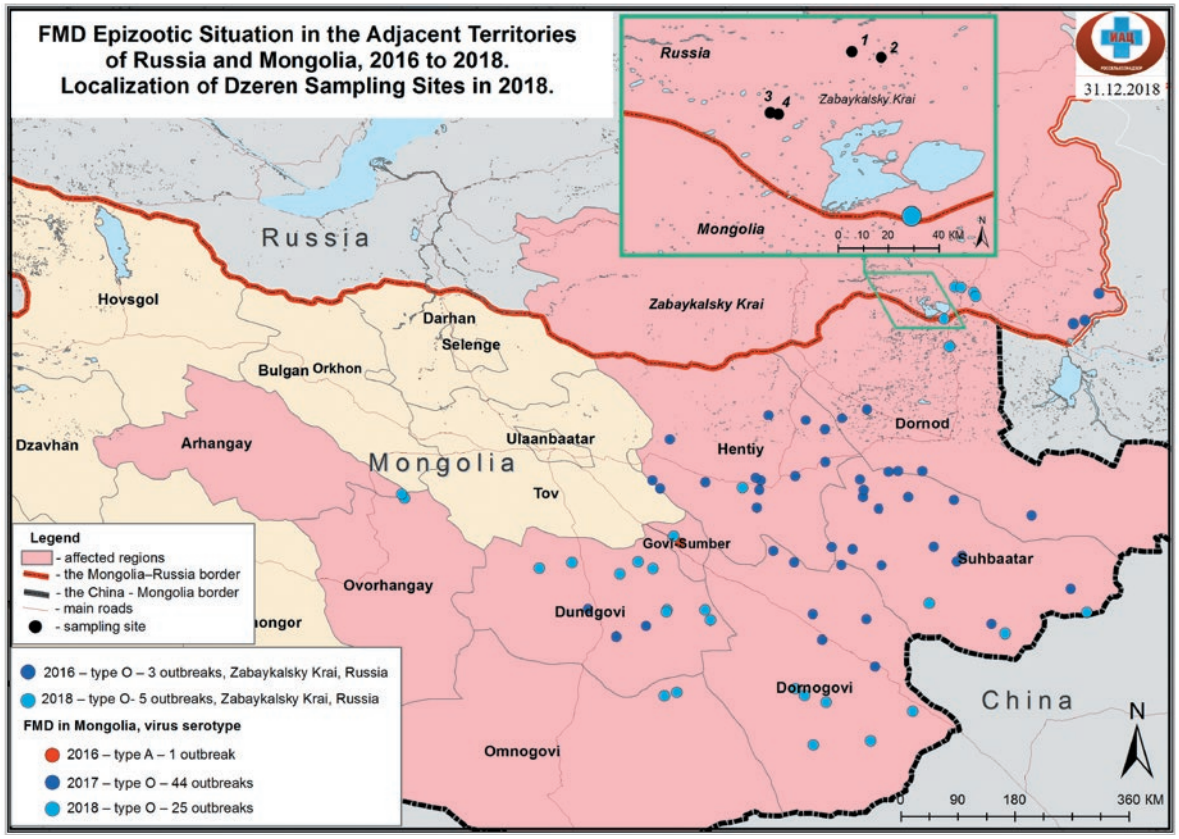


Table 2
Biomaterial samples collected from dzerens which migrated from Mongolia to Ononsky Raion of the Zabaykalsky Krai

Number of an animal	Sites of shooting and sampling, name of a sample	Age and gender of an animal	Date of sampling
1. Zasulan, near Novaya Zarya settlement			
1	serum, submandibular lymph nodes, pharyngeal mucosa	male 4–5 years	23.10.2018
2	serum, submandibular lymph nodes, pharyngeal mucosa, tonsils	male 4–5 years	
2. Zasulan, near Novaya Zarya settlement			
3	serum, submandibular lymph nodes, pharyngeal mucosa, tonsils, aortic lymph node, pancreas	male 6–7 years	23.10.2018
4	serum, submandibular lymph nodes, pharyngeal mucosa, tonsils	dam 3–4 years	23.10.2018
5	serum, submandibular and retropharyngeal lymph nodes, pharyngeal mucosa	male 2 years	23.10.2018
3. Krasnaya Imalka settlement			
6	serum, submandibular and retropharyngeal lymph nodes, pharyngeal mucosa	male 6–7 years	24.10.2018
7	serum, submandibular, retropharyngeal and mesenteric lymph nodes, pharyngeal mucosa	female 3–4 years	24.10.2018
8	serum, mandibular and mesenteric lymph nodes	male 6–7 years	24.10.2018
9	serum, mandibular and mesenteric lymph nodes	male 5–6 years	24.10.2018
10	serum, mandibular and mesenteric lymph nodes	male 5–6 years	24.10.2018
11	serum, mandibular and mesenteric lymph nodes	male 5–6 years	24.10.2018
12	serum, submandibular lymph nodes, pharyngeal mucosa	male 6–7 years	24.10.2018
4. Pad Temety, near Krasnaya Imalka settlement			
13	serum, submandibular lymph node, pharyngeal mucosa	male 5–6 years	25.10.2018
14	serum, submandibular lymph node, pharyngeal mucosa	female 4–5 years	25.10.2018
15	serum, submandibular lymph node, pharyngeal mucosa	male 5–6 years	25.10.2018
16	serum, submandibular lymph node, pharyngeal mucosa	male 6–7 years	25.10.2018
17	serum, submandibular lymph node, pharyngeal mucosa	male 5–6 years	25.10.2018
18	serum, submandibular lymph node, pharyngeal mucosa	male 4–5 years	25.10.2018
19	serum, submandibular lymph node, pharyngeal mucosa	female 3–4 years	25.10.2018
20	serum, submandibular lymph node, pharyngeal mucosa	male 6–7 years	25.10.2018
Total: 20 serum samples and 76 biomaterial samples			

Dornod and Khentii (Mongolia). In the same period five FMD outbreaks were registered in Borzinsky Raion of the Zabaykalsky Krai. Based upon the results of the phylogenetic analysis conducted at the FGBI "ARRIAH" FMD virus isolates recovered from diseased animals in the Zabaykalsky Krai in 2018 were assigned to the phylogenetic line O/PanAsia which became widespread in Mongolia in 2017–2018. [6].

Fig. 5. Cut in the angle of heel of a dzeren's hoof. No signs of pododermatitis

CONCLUSION

Upon the results of the work conducted in cooperation with the representatives of the East Siberia NIIV (branch of SFNCA RAS) and the Rosselkhoznadzor of the Zabaykalsky Krai it was established that each year starting from 2001 dzerens migrated from Dornod aimak (Mongolia) to the Zabaykalsky Krai. The analysis of samples taken from the above-mentioned animals detected antibodies to FMD virus which attests to their infection and consequently to a possible circulation of FMD virus in herds under observation. This could cause introduction and occurrence of FMD in domestic animals in the Zabaykalsky Krai.

Taking into account the analysis of the epidemiological data within the period of 1992–2018 the results of the performed research can be recognized as grounds for introducing an FMD surveillance system in the wild in the Russian Federation on the borders with FMD infected areas in Mongolia and China as well as for a need of inter-agency cooperation and better alert system.

Table 3
Results of laboratory analysis of serum for antibodies to non-structural polyproteins of FMD virus

Samples from dzerens	Antibodies to NSP of FMD virus	Antibodies to FMD virus, type O	Antibodies to FMD virus, type A	Antibodies to FMD virus, type Asia-1
1	**positive result**	not detected	not detected	not detected
2	**positive result**	not detected	not detected	not detected
3	negative result	not detected	not detected	not detected
4	negative result	not detected	not detected	not detected
5	negative result	not detected	not detected	not detected
6	**positive result**	not detected	not detected	not detected
7	negative result	not detected	not detected	not detected
8	negative result	not detected	not detected	not detected
9	negative result	not detected	not detected	not detected
10	**positive result**	not detected	not detected	not detected
11	negative result	not detected	not detected	not detected
12	negative result	not detected	not detected	not detected
13	**positive result**	not detected	not detected	not detected
14	**positive result**	**detected**	not detected	not detected
15	**positive result**	not detected	not detected	not detected
16	negative result	not detected	not detected	not detected
17	**positive result**	not detected	not detected	not detected
18	negative result	not detected	not detected	not detected
19	**positive result**	**detected**	not detected	not detected
20	**positive result**	not detected	not detected	not detected

To determine the role of dzerens in propagation of the FMD virus, a permanent monitoring of wild animal migration is to be organized with their health state record, obligatory sampling and laboratory research of samples from dead dzerens, careful examination of virus isolates recovered from them in order to determine their genetic affinity with isolates recovered from wild and domestic animals in Mongolia and China (passive surveillance). Besides, a double random sampling of biological material samples should be carried out in dzeren populations (active surveillance for FMD and other highly dangerous animal infections).

The elements of the FMD surveillance system described above should be applied for elaboration of methodical recommendations and relevant action plans for surveillance of highly dangerous animal infections in the wild.

Conflict of interests. The authors claim no conflict of interests.

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