

LONGITUDINAL ANALYSIS OF THE EPIDEMIOLOGICAL SITUATION OF ZOONOTIC INFECTIOUS DISEASES IN THE FLOOD-AFFECTED TERRITORIES OF SIBERIA

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The article presents the results of retrospective evaluation of the epizootological and epidemiological situation of zoonotic infectious diseases in the flood-affected territories of Altai Krai and Altai Republic in the result of the flooding of 2014. The conducted research revealed that in the postflood period there were formed the backgrounds for the epizootological and epidemiological complications in the territories of Altai Krai and Altai Republic. The authors proved, that the flood-affected territorial entities of the Russian Federation are anthrax (Siberian plague), tularemia, leptospirosis and yersiniosis endemic areas.

Key words: flooding, epidemiological situation, zoonotic infectious.

Introduction.

In the end of May 2014 in consequence of continuous rainfalls and glacier melting the foothills of Altai and Sayans evidenced a sharp rise of water level in the rivers and flooding of South-Western Siberian territory including Altai Krai and Altai Republic. According to the experts of the World Health Organization, the consequences of natural and various emergency situations can include epidemiological complications of 192 clinical entities of infectious pathology, and about 50% of population in the emergency zones are exposed to the direct threat of infectious diseases including zoonotic ones [4, 5, 7, 8, 9]. The improvement of the measures for the sanitary protection of particular administrative territories of the Russian Federation during the flooding period is one of the most significant problems [2, 3]. With regard to the above mentioned, special emphasis is laid on Altai Krai and Altai Republic in the epidemiological assessment. These regions hold key position at the shortest and economically advantageous Eurasian transport routes. The territories of Altai Krai and Altai Republic contain natural focuses of anthrax (Siberian plague), tularemia, leptospirosis and yersiniosis [1, 6].

Research objective: retrospective evaluation of the epizootological and epidemiological situation of zoonotic infectious diseases in the flood-affected territories of Altai Krai and Altai Republic.

Materials and methods

The data on the epizootological and epidemiological situation of zoonotic infectious diseases in the territories of Altai Krai and Altai Republic in the preflood period were used in the current work. There was analyzed the information on the zoonotic infections and the data of the epizootological monitoring obtained by the Irkutsk Antiplague Research Institute of Siberia and Far East of Rospotrebnadzor, Plague control station of Rospotrebnadzor, Federal Service on Surveillance

in the Sphere of Consumer Rights Protection and Human Welfare in Altai Krai, Federal Service on Surveillance in the Sphere of Consumer Rights Protection and Human Welfare in Altai Republic.

Results and discussion

Altai Krai is classified as the territory with expressed unfavorable epizootological and epidemiological situation of the anthrax (Tarshis epizootological index 0,0182) with 18,9% of registered permanent anthrax unfavorable locations (1261 rural settlements) of Siberian region (6688 rural settlements). Upon that the density of rural settlements constitutes 7,46 per 1 000 km which is 7,5 higher than Siberian average density (0,99) and 3,9 higher than in the West-Siberian region (1,9). Since 1985 anthrax has been registered in livestock animals (further – LSA) for 18 years in 29 rural settlements of 19 regional districts. Altai Krai holds the leading position in the incidence rate of livestock animals (0,456 per thousand animals) among Siberian regions which is 5,2 times higher than the average Siberian level (0,087 per thousand animals). The dynamics of anthrax unfavorable locations can be traced from 1927 to 2012, when in the whole period there were registered 2805 most unfavorable locations in 1933-1940, while from 2000 to 2012 there were registered 8 locations: 4 locations in 2000 and one each year - 2001, 2002, 2006 and 2012. The analysis of the rate of unfavorable locations of private sector and farm units of Altai Krai revealed their dynamic decrease in the farm units – from 30% to 25%, and increase in the private sector – from 70% to 75%. According to the Veterinary directorate of Altai Krai by 01.01.2014, there were registered 636 animal burials, 26 of which are anthracic. In the period from 1953 to 2013 in the territory of Altai Krai there were registered 99 cases of anthrax incidence among population, 5 out of which were lethal. In 1953-1963 annually there were registered from 3 to 10 patients with anthrax most unfavorable in 1958 and 1962.

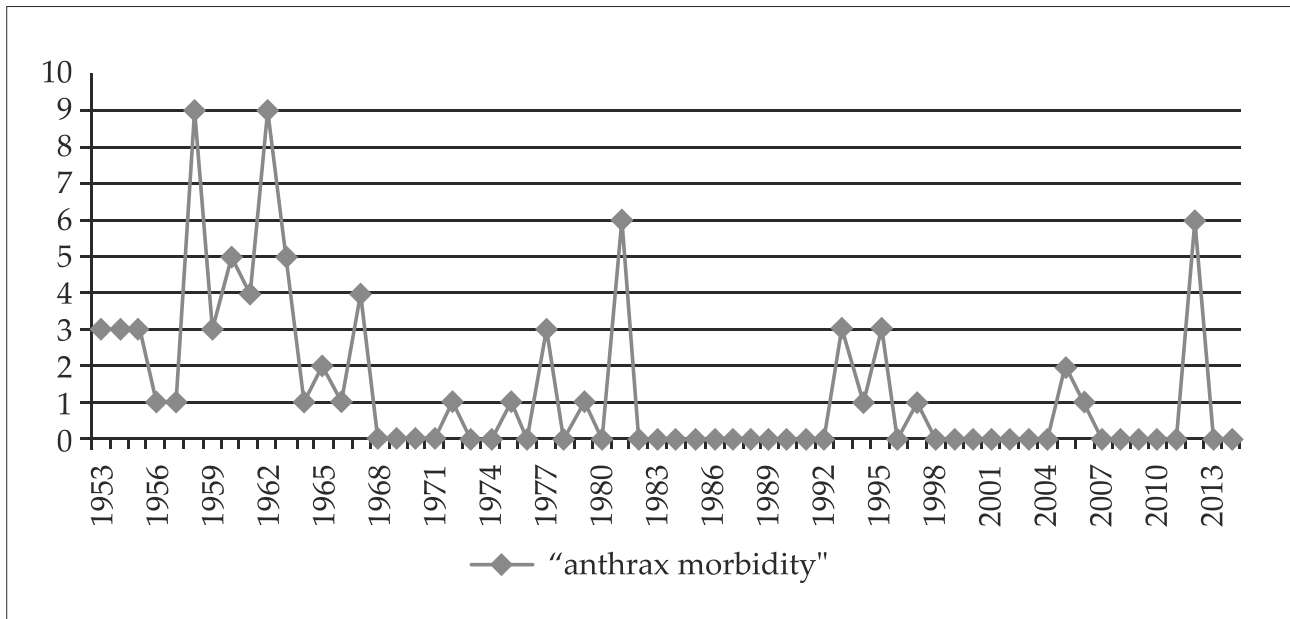


Figure 1.

The dynamics of anthrax morbidity in Altai Krai in the period from 1953 to 2013 (cases).

Source: Rospotrebnadzor administration of Altai Krai

In a subsequent period there were annually registered from 1 to 4 cases of anthrax incidence, the welfare periods constituted from 1 to 11 years. In 1968-1971, 1973-1974, 1976, 1978, 1980, 1982-1992, 1996, 1998-2004, 2007-2011, 2013-2014 the anthrax morbidity was not registered among the population of the region. In the steppe zone there were registered 16 cases of anthrax incidence among the population with maximum amount of diseased in 1957 – 4 people. In the forest-steppe zone there were registered 38 cases with maximum amount of diseased in 1955 – 6 people, in 1958 – 5 people, in 1962 – 6 people. In the foothill zone there were registered 39 cases with maximum amount of diseased in 1958 – 3 people, in 1960 – 3 people, in 1967 – 4 people, in 1977- 3 people, in 1981 – 4 people. In the Salair zone there were registered 6 cases of anthrax morbidity: in 1955 – 2 people, in 1965 – 3 people, in 1993 – 1 case (Figure 2). Anthrax of the Altai territory is characterized by summer-autumn seasonality with maximal registration of cases in July and August. In 22 cases (22,2%) there is stated

the pertaining of anthrax patients to the groups of occupational risks, 68,2% of them – livestock farm workers, 31,8% - veterinary specialists. The patients at the age of 15-17 constituted 1,0%; at the age of 20-29 – 27%; at the age of 30-39 – 30,5%; at the age of 40-49 – 19,5%; at the age of 50-59 – 13%; at the age of 60 and older – 9%. In 98,0% of cases in patients there was registered cutaneous anthrax. In 2012 anthrax was registered among the population in two districts of Altai Krai: Tselinny District (5 cases, incl. 1 lethal) and Bystroistoksky District (1 case). According to the Veterinary directorate of Altai Krai, from 1932 to 1986 in the territory of Tselinny District there were registered 79 cases of anthrax incidence in agricultural animals, 11 cases being registered near the disease hotbed emerged from 1934 to 1965.

The clinical diagnosis in 5 patients from Tselinny District is confirmed by polymerase chain reaction (PCR) and indirect hemagglutination test (IHT) with antibody diagnostic agent. Three patients

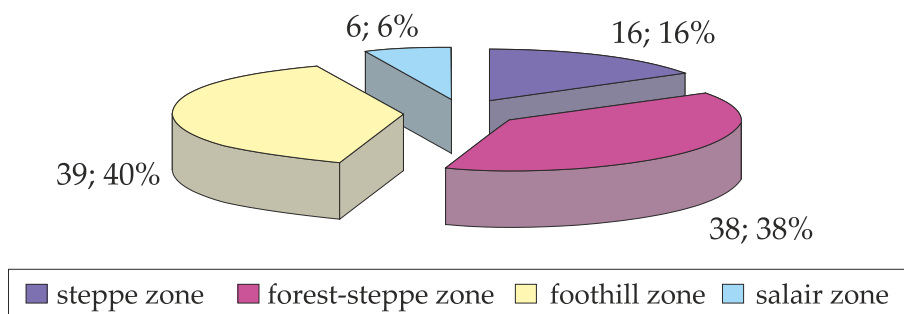


Figure 2.

Distribution of anthrax patients among the population of Altai Krai throughout natural zones. (The diagram is plotted according to Rospotrebnadzor administration of Altai Krai)

showed specific antibodies in paired sera within the titer from 1:40 to 1:320 in IHT. The total number of contact persons constituted 38 people, 15 out of whom (including 5 diseased), having various general and topical clinical manifestations, were admitted to hospital. The other contact persons received preventive treatment outpatiently. In Bystroistoksky District there were revealed 10 contact persons, including 6 persons in Bystry Istok village and 4 persons in the city of Biysk. All contact persons received preventive treatment. In Bystry Istok village there are registered Sanitary Norms and Rules, anthrax cases and cattle mortality were registered in 1933 and 1943. 58 municipal entities of Altai Krai are tularemia enzootic, 25 out of which refer to the tularemia hotbeds of high activity. 15 of them are situated in the foothill zone, 7 – in the flood land of the Ob River and 3 – in the forest-steppe regions. For the sake of monitoring of tularemia natural focuses the special danger infections laboratory Federal Budgetary Healthcare Institution “Hygienic and Epidemiological Center of Altai Krai” annually carries investigation of mammals and arthropods of various territories of the region. According to the existing data, in the period from 2011 to 2013 there were obtained 19 tularemia cultures in 10 territories of Altai Krai. According to the results of serological examinations of the materials of small mammals, excrements of carnivorous mammals, ixodic ticks and various objects of external environment, the traces of tularemia epizootics were revealed on the territories of 39 municipal entities. The circulation of tularemia agent is confirmed serologically in 201 samples in 2011, in 158 samples in 2012, in 218 samples in 2013. Serological examinations of the materials of external environment showed

high results of IHT confirming the existence of antibodies against tularemia in the blood of small mammals, which reflects high epizootic activity in the period from 2011 to 2013. In the territory of Altai Krai in 2012-2013 the circulation of bacterial agent is serologically confirmed in 91 (13,3%) cases out of 680 examined samples. In addition to the above said, the most part of positive results was obtained by the examination of the blood of small mammals for the existence of antibodies against tularemia agent (IHT) received in December 2012 in the floodplain-swamp type of hotbed of the Ust-Pristansky District. By the Federal Government Health Institution “Altai Plague Control Station” of Rospotrebnadzor there was revealed one tularemia culture out of water samples from the Kamenka River in Altai District (Altayskoye village). In 2013 there was registered the lowest number of small mammals for the period from 2008 to 2013. The number of positive serological results slightly exceeds the results of 2012 (out of 1134 samples examined by antibody neutralization reaction, the specific weight of positive samples constituted 10,2% out of 710 samples in antibody neutralization reaction, the specific weight of positive samples – 14,2%). At the same time, the high percent of seropositive results and wide scatter of areas with infected material (21 districts) indicates acute epizootic situation in the region. In the period from 2005 to 2013 among the population of Alai Krai there were registered 7 cases of bubonic and anginous-bubonic forms of tularemia (Figure 3).

In the territory of Altai Krai the breakouts of leptospirosis among the population were registered in 1967 (51 case), in 1973 (30 cases), in 1979 (21 case), in 1982 (16 cases), in 1996 (149 cases), in 1997 (35 cases) and in 1998 (22 cases). They were

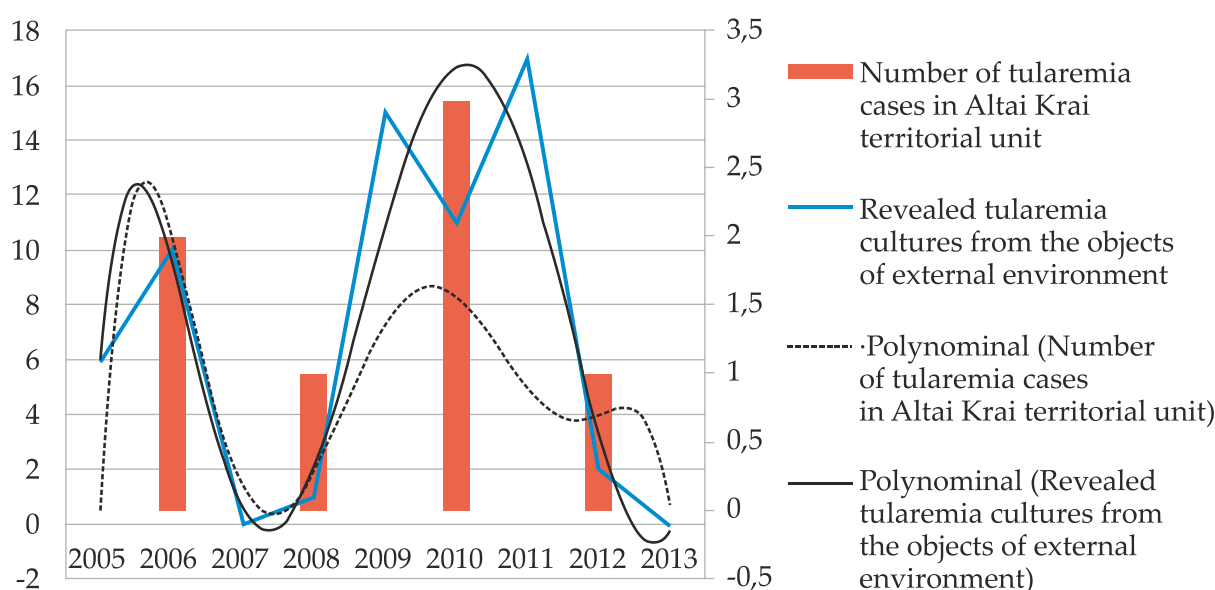


Figure 3.

Revealed tularemia cultures from the objects of external environment and Number of tularemia cases in Altai Krai territorial unit in the period from 2005 to 2013 (The diagram is plotted according to Rospotrebnadzor administration of Altai Krai)

caused by the decrease of natural focus activity and degradation of the epizootic situation. In the other years there were marked singled cases of leptospirosis incidence, at the same time from 1984 to 1991 there were no cases registered in the territory of Altai Krai. From the 25th of July till the 12th of August 1996 In Krasnoshchekovsky District there was registered the breakout of leptospirosis, 149 people fell ill, including 83 people (55,3%) at the age under 14. The intensive index per 100 000 of regional population constituted 5,6 by the average Russian index 0,97 per 100 000 people. Among the diseased – 111 (74,5%) men, 38 (25,5%) women. All patients had anicteric form of leptospirosis. The severe form of tularemia was registered in 9 (6,5%) people, moderate severity – in 90 (60%) people and mild form – in 50 (33,5%) people. In 107 (71,8%) patient the diagnosis was laboratorially confirmed by IHT and microagglutination test (MAT), including 63 (42,3%) patients with MAT confirmed diagnosis. In 42 diseased with the similar clinical picture laboratorial tests had been carried at the early stages of disease, which did not allow to determine the antibody titer.

In recent years the leptospirosis incidence among the population of Altai Krai has had a sporadic nature. In September 2013 there was registered one case of leptospirosis in an adult nonworker from Krutikha village. The circulation of leptospirosis is confirmed in rodents caught in the backyard of the patient and in the vicinity of Krutikha village. Annually, the Federal Budgetary Healthcare Institution "Hygienic and Epidemiological Center of Altai Krai" conducts epizootological investigation of the natural focuses of leptospirosis. The examinations of the Altai territory in 2011-2013 revealed 18 rural municipal districts and 2 cities with natural focuses of leptospirosis, which showed single occurrence of the carrier state among mouse-like rodents. The yersiniosis morbidity in the region in the period from 2004 to 2013 reduced from 1,70/0000 to 0,70/0000 by the average annual decrease constituting 9,2% ($R^2 > 0,5$). To study the circulation of yersiniosis causative agents in the nature the zoological group caught and examined main carriers of these bacteria – rodents. For the laboratorial tests there was taken the intestinal fragment with the contents. Totally there were examined 5 325 animals and 43 administrative entities of the region in the period from 2005 to 2014. According to the results of the laboratorial tests carried by the special danger infections laboratory Federal Budgetary Healthcare Institution "Hygienic and Epidemiological Center of Altai Krai" and according to the data of the federal Budgetary Institution of Science "Pasteur Institute of Epidemiology of Immunology" having conducted the identification of isolated cultures,

the natural focuses are the zone of circulation of strains of highly pathogenic and low pathogenic yersiniosis biotypes. The laboratorial yersiniosis and pseudotuberculosis tests of small mammals in the territory of Altai Krai in the period from 2011 to 2013 revealed 13 rural municipal districts and 1 city with natural focuses, which are characterized by carrier state among mouse-like rodents. The existence of natural focuses of yersiniosis were laboratorially confirmed in 25 municipal entities of Altai Krai. In the territory of the Altai Republic the natural and climatic factors (species composition of agents, carriers, peculiarities of landscape, water and temperature regimes) are favorable for long-term preservation of disease causative agents common for animals and human (including highly dangerous). Anthrax has been registered in the Altai Mountains since 1928. It can be assumed, that this infection took place also in the previous years. According to the archival data, in the period from 1928 to 1967 there were registered 630 cases of anthrax in animals. The highest number of cases of anthrax in animals was registered in the period from 1928 to 1940, which constituted 583 cases. For the period of 1946-1961 there were registered 7 cases of anthrax (6 men and 1 woman). Noncompliance with the elementary rules of decontamination of fallen animals, contamination of soil of the major part of the Altai Republic territory by the anthrax causative agent in previous years were one of the main causes of the infection preservation, formation of stationary unfavorable locations (further – SUL) and sustention of their activity. The biggest number of SUL – 12, is registered in Kosh-Agachsky District bordering on Mongolia, 11 – in Turochaksky and Mayminsky Districts, 6 – in Ongudaysky District, 3 – in Choysky, Ust-Kansky, Ust-Koksinsky and Shebalinsky Districts, 2 – in Chemalsky District and 1 – in Ulagansky District. The soil examination focused on toxicity and nutritional abilities in relation to anthrax microbe performed in the Altai Republic in 2002 showed, that 71,0% of soil samples are favorable environment for preservation and, in some cases, amplification of anthrax bacteria, and only 29,0% of soils are toxic for the causative agent. Climatic conditions: summer temperature of soils, amount of precipitation are also favorable for preservation and amplification of the microbe. Tularemia has been registered in the territory of the Altai Republic since 1941. Till 1955 there had been registered 234 cases among the population living in Gorno-Altaysk, in Mayminsky, Turochaksky and Choysky Districts. The highest epidemic rise of morbidity was marked in 1946 – 43 cases (the city of Gorno-Altaysk, Mayminsky District). Since the beginning of sixties of the previous century there has been marked the reduction of morbidity due to the performed mass vaccination. For the

period of thirty years (from 1960 to 1990) there were registered 14 cases of tularemia. From 1991 to 1997 the tularemia incidence among the population of the Altai Republic was not registered, but since 1998 single cases of tularemia have been registered almost annually on the background of lowering of the number of vaccinations. Clinically tularemia proceeded in anginous-bubonic, bubonic and intestinal forms with the tendency to moderate, and in separate cases – severe course (generalized form). In 2013 by the Altai Plague control station there was carried the tularemia examination of the material in the Altai Republic (small mammals, ticks, water and silt of the surface waters). There were revealed 5 cultures of tularemia causative agent, all from the ticks (from Mayminsky District – 2, from Choysky District – 2, from Turochaksky District – 1). The total contamination of ticks constituted 0,1%, the contamination of *H. concinna* ticks – 1,73%, of *D. silvarum* ticks – 0,05%. Epizootic manifestations in Mayminsky and Choysky Districts in the stated areas had been known either in previous years. The total contamination of ticks in the Altai Republic constituted 0,04%, including the contamination of *H. concinna* ticks – 0,95%, of *D. silvarum* ticks – 0,03%. The positive result of IHT in titers 1:80 was obtained (12.09.2013) in the valley of the Saydys River of Mayminsky District from common voles (one) and one from root-voles. The percent of seropositive common voles constituted 0,63%, of root-voles – 0,64%. Moreover, the serological examination by means of IHT revealed the antibodies of tularemia microbe in four cases: all from Pallas' pikas of Kosh-Agachsky District of the Altai Republic. Leptospirosis was firstly registered in the Altai Republic in 1947 in livestock animals from Shebalinsky and Mayminsky Districts. Since 1985 the examination of natural focuses of leptospirosis is carried by Altai Plague control station. The analysis of long-term observations shows, that natural focuses of leptospirosis has been diminishing since 2004 manifesting only in single cases. The epizootic process of the Altai Republic is influenced by a great variety of species of wild rodents and insect-eaters inhabiting humid biotopes (in the vicinity of livestock farms, along the shores of artificial and natural waterbodies, watering places, in the areas of management and pasture of livestock animals). The sources of the infection include the most dominant species of wild rodents – water rat *Arvicola terrestris*, root-vole *Microtus oeconomus*, common vole *Microtus arvalis*, narrow-skulled vole *Microtus gregalis*, wood mouse *Apodemus silvaticus*, field mouse *Apodemus agrarius*, red-toothed shrew *Sorex*, house mouse *Mus musculus* and brown Norway rat *Rattus norvegicus*. Since 1960 till the present time in the territory of the Altai Republic three species of livestock animals are

infected by leptospirosis: cattle, horses and sheep. There are registered the following serogroups: Pomona, Grippotyphosa, Ballum, Cynopteri, Javanica, Tarassovi, Hebdomadis, Icterohaemorrhagiae, Sejroe. On the ground of the data on the unfavorable locations, animal morbidity and epizootological examination results from 1960 to 2014 there was determined the nosoarea of leptospirosis in the territory of the Altai Republic, which included all municipal units. Till 1989 leptospirosis morbidity among the population was not officially registered. In the period from 1989 to 2013 there were registered 29 cases.

In the pre-flood period the epidemiological and epizootological situation on leptospirosis can be characterized as stably favorable, lacking officially registered leptospirosis morbidity in the Altai Republic for the past 14 years, on the background of low epizootic activity of natural and household focuses. Natural yersiniosis focuses are determined in 8 out of 10 districts of the Altai Republic. For the period of 32 years (1982-2014) in terms of the bacteriological control of yersiniosis contamination there were examined around 3,5 thousand samples of vegetables, fruit, other food products, appliances, packing materials, equipment in vegetable storehouses and dining places and from epidemiological focuses. Around 12,2 thousand small mammals were examined by various means (bacteriological, serological, PCR) on pseudotuberculosis and intestinal yersiniosis in terms of the epizootological investigation, annual census of synanthropic rodents and examination of epidemiological focuses for the mentioned period. The contamination by intestinal yersiniosis microbe was stated in 11 examined species out of 24. The most affected were wood mice – 2,7%, common and grey large-toothed red-backed voles – 1,6 and 1,4% respectively. The contamination of rodents of the semi-aquatic complex was lower: root-vole and water rat – 1,0%, Northern redbacked vole – 0,9%. The contamination of field mouse constituted 0,7%, common shrew – 0,5%. The causative agent of pseudotuberculosis was not registered in any of the above stated species.

Conclusion

The analysis of sanitary and epidemiological situation of zoonotic infectious diseases in the territories of Altai Krai and Altai Republic showed, that the territorial entities of the Russian federation are anthrax, tularemia, leptospirosis and yersiniosis endemic areas. Consequently, in the postflood period there were formed the backgrounds for the epizootological and epidemiological complications of the stated groups of infectious diseases in the territories of Altai Krai and Altai Republic.

References

1. Onishchenko G.G., Balakhonov S.V., eds. Sanitary and epidemiological welfare of the population at flood relief in the Far East. Novosibirsk: Science-Center; 2014.
2. Onishchenko G.G. The role of public sanitary epidemiologic service in the population health protection. Health service of the RF. 2013; 2: 3-10.
3. Onishchenko G.G., Krivulya S.D., Fedorov Yu.M., Subbotin V.G. Sanitary and anti-epidemic assistance of population in emergencies: regulations. Moscow; 2006.
4. Pavlovsky Ye.N. Natural nidity of transmissible diseases in relation to landscape epidemiology of zoonanthroponosis. Moscow-Saint-Petersburg: Medicine; 1964.
5. Pavlovsky Ye. N. Modern state of the doctrine of natural nidity of human diseases // Zoonotic human diseases. Moscow: Medgiz; 1960.
6. Saldan I.P., Dolgova I.V., Ushanova V.M. et al. Organization of preventive measures for infectious diseases in the emergency flood of 2014 in Altai Krai. Medical overview. Science and practice. 2014; 2 (2): 29-32.
7. Cherkassky B.L. Epidemiology and prevention of anthrax. Moscow; 2002.
8. Haumacher R., Hilss K.A., Lazak J., Eberle G., Kilian W., Ganz H. et al. Distribution and evolution of genotypes of *Bacillus anthracis* in wildlife of the Etosha National Park and their correlation with outbreaks in farm animals. Medical Biodefense Conference. 2011 (Munich, 25-28 October, 2011). Ref. BP100. 35.
9. Cheremnyh V.V., Medvedev B.F., Mefodyev V.V. The epidemiological situation of intestinal yersiniosis and pseudotuberculosis in the south of the Tyumen region. In: Proceedings of the regional scientific-practical conference dedicated to the 80th anniversary of the founding of the state sanitary and epidemiological service of the Russian Federation. Tyumen: Ltd. CPI Express; 2004; 150-154.

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