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Epizootic situation on sheep pox and goat pox in Tajikistan in 2000–2021

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SUMMARY

Modeling of potential nosoareals of sheep pox and goat pox that was performed in 2016 revealed a possible trend for aggravation of epizootic situation intensity with regard to these diseases up to 2020, but taking into account the cyclical fluctuations of the situation, it was assumed that the intensity level might reduce in 2017–2020. The highest frequency of reporting these nosounits was characteristic of regions with a higher probability of sheep pox and goat pox occurrence. The retrospective analysis was used to determine the structure, dynamics and properties of the epizootic process of these infectious diseases in the Republic of Tajikistan in 2000–2021. The main causes of sheep pox and goat pox outbreaks in the country were identified. The obtained results confirming the methodological validity of the epizootic situation analysis carried out in 2016 and correctness of the developed models of potential sheep pox and goat pox nosoareals, can become the basis for epizootological prediction of infectious disease risk when the pathogen interacts with susceptible animal population in specific climatic, socio-economic, organizational and managemental conditions. Based on systemic epidemiological analysis of the structure and dynamics of nosoareals, as well as risk assessment of sheep pox and goat pox entry, emergence and distribution, monitoring and establishment of infected and endemic zones, the features and patterns of distribution and occurrence of these diseases' epizootic process were defined, which confirms the need for a systematic approach to epidemiological surveillance of highly dangerous and economically significant infectious diseases having a trend for transboundary spread, which will facilitate the solution of the problem regarding identification of possible threats and the implementation of veterinary and sanitary measures in case of disease occurrence in the territory of any country to ensure animal disease freedom.

Keywords: epizootic situation, sheep pox, goat pox, indicators of epizootic situation intensity, modeling of potential nosoareal

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Эпизоотическая ситуация по оспе овец и оспе коз в Таджикистане в 2000–2021 гг.

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РЕЗЮМЕ

Выполненное в 2016 г. моделирование потенциальных нозоареалов оспы овец и оспы коз до 2020 г. выявило возможность тренда на усугубление напряженности эпизоотической обстановки по этим болезням, но с учетом циклических колебаний ситуации допускалась возможность снижения напряженности в 2017–2020 гг. Наибольшая частота регистрации этих нозоединиц была характерна для регионов более высокой вероятности возникновения оспы овец и оспы коз. При ретроспективном анализе определены структура, динамика и особенности эпизоотического процесса данных инфекционных болезней в Республике Таджикистан в 2000–2021 гг. Выявлены основные причины возникновения вспышек оспы овец и оспы коз в стране. Полученные результаты, подтверждая методическую обоснованность осуществленного в 2016 г. анализа эпизоотической ситуации и верность разработанных моделей потенциальных нозоареалов оспы овец и оспы коз, могут стать основой для эпизоотологического прогнозирования риска возникновения инфекционных болезней при взаимодействии патогена с популяцией восприимчивых животных в конкретных климатогеографических, социально-экономических и организационно-хозяйственных условиях. При системном эпизоотологическом анализе структуры и динамики нозоареалов, результатов оценки риска заноса, возникновения и распространения, мониторинга и определения неблагополучных и эндемичных по оспе овец и оспе коз зон определены особен-

ности и закономерности распространения и проявления эпизоотического процесса при этих заболеваниях, что подтверждает необходимость системного подхода к эпизоотологическому надзору за особо опасными и экономически значимыми инфекционными болезнями, имеющими тенденцию к трансграничному распространению, который будет способствовать решению проблемы определения возможных угроз и реализации ветеринарно-санитарных мероприятий в случае возникновения заболеваний на территории любой страны для сохранения эпизоотологического благополучия.

Ключевые слова: эпизоотическая обстановка, оспа овец, оспа коз, показатели напряженности эпизоотической ситуации, моделирование потенциального нозоареала

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INTRODUCTION

Complex global epizootic situation on a number of highly dangerous small ruminant (ovine and caprine) diseases of viral etiology, including sheep pox (SP) and goat pox (GP), determines relevance of the epizootological monitoring for risk assessment of introduction, emergence and spread of these infections, causing significant economic losses in sheep and goat industry as a result of animal mortality and reduction in productivity and costs of veterinary, sanitary, preventive and quarantine measures.

To determine the structure, dynamics and features of the SP and GP epizootic process in Tajikistan in 2000–2021, a retrospective analysis was carried out taking into account the results obtained by A. V. Kneize et al. when modeling potential nosoareals of these diseases up to 2020 [1]. The development of effective anti-epidemic measures is based on epizootological forecasting, the purpose of which is to determine the risk of an infectious disease when a pathogen interacts with susceptible animal population in specific natural, socio-economic, organizational and managemental conditions [2, 3].

MATERIALS AND METHODS

The research was carried out in accordance with the "Methodical guidelines for conducting epizootological monitoring of exotic highly dangerous and little-known animal diseases" [4] and the provisions of the OIE Terrestrial Animal Health Code [5].

The analysis was based on the data available on the websites of the World Organization for Animal Health (OIE, http://www.oie.int), the Food and Agriculture Organization of the United Nations (FAO, http://www.fao.org), the Rosselkhoznadzor (https://fsvps.gov.ru /), the reports of the State Veterinary Surveillance Service of the Ministry of Agriculture of the Republic of Tajikistan, the Food Safety Committee under the Government of the Republic of Tajikistan and its structural divisions (the National Center for Food Safety Diagnosis (NCFSD) and the Republican Anti-Epizootic Center).

The epizootological method of SP and GP monitoring included: a) comparative descriptive techniques and methods; b) analytical techniques for the formulation and statistical verification of hypotheses, multidimensional statistical analysis and modeling, field and computational experiments; c) methods of synthesis and classification of the obtained knowledge on patterns of epizootic situation development, reasons and conditions of infectious disease emergence, substantiation of methods and means of the epizootic situation control [4].

To form samples characterizing the SP and GP reporting process and outbreaks in 2000–2021, the indicators of the epizootic situation intensity were calculated: the stationary rate (SR is the ratio of disease reporting period duration (years) in the country to duration of the period under investigation (years), measured in fractions of a unit from 0 to 1.0) and the incidence rate (IR is the frequency of reporting new outbreaks in livestock population in an affected country within a year). The SP and GP incidence rate and the stationary rate were evaluated in fractions relative to unity: 0–0.2 – low; 0.2–0.4 – below average; 0.4–0.6 – average; 0.6–0.8 – above average; 0.8–1.0 – high [4, 6].

RESULTS AND DISCUSSION

Small ruminant pox studied by T. Ya. Vannovskii [7], N. V. Likhachev et al. [8], U. G. Kadyrov and Yu. F. Borisovich [9], I. T. Sattorov et al. [10] and others [11, 12] was first officially reported in Tajikistan in 1949. Over one hundred of small ruminant pox-infected settlements were identified in 1951–1952 in Leninabad (now Sughd), Kulyab (now Khatlon) Regions and Regions of Republican Subordination (RRS). Notably goats (80–90%) were the most seriously affected, 18–28% of animals died [10].

Over a 35-year period under study from 1961 to 2000, excluding 1971–1972, 1987–1988 and 1991 (no data

available), the SP infection lasted 22 years in Tajikistan (66 outbreaks were recorded with SR of 0.63 – above average; the average number of outbreaks during the disease registration periods (MNODRP) – 3; the average number of outbreaks during the observation periods (MNOOP) – 1.89). The corresponding indicators in other Central Asian Republics were as follows: Kazakhstan – 25 years (186 outbreaks, SR 0.71 – above average; MNODRP – 7.44; MNOOP – 5.31), Kyrgyzstan – 19 years (129 outbreaks, SR 0.54 – average; MNODRP – 6.79; MNOOP – 3.69), Turkmenistan – 14 years (35 outbreaks, SR 0.4 – average; MNODRP – 2.5; MNOOP – 1) and Uzbekistan – 10 years (45 outbreaks, SR 0.29 – below average; MNODRP – 4.5; MNOOP – 1.29). In Western Asia there were also SP outbreaks being recorded in Azerbaijan for 15 years (45 outbreaks, SR 0.43 – average; MNODRP – 3; MNOOP – 1.29), Armenia – 10 years (64 outbreaks, SR 0.29 – below average; MNODRP – 6.4; MNOOP – 1.83). During this period 3 outbreaks (3-year infection period) were identified in Ukraine with SR 0.09 – low; MNODRP – 1; MNOOP – 0.09, and in Russia the period of infection lasted 16 years when 142 outbreaks were reported (SR 0.46 – average; MNODRP – 8.88; MNOOP – 4.06). From 1961 to 2000 SP was being detected for 34 years in the CIS countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Russia and Ukraine) (SR 0.97; MNODRP – 21.03; MNOOP – 20.43), when 715 outbreaks were registered (Table 1). It should be noted that Kyrgyzstan and Uzbekistan border on the Republic of Tajikistan (RT) and are its trading partners, as well as have partnership links with Kazakhstan, Turkmenistan, Ukraine and Russia, and the fact that Kazakhstan, Kyrgyzstan, Tajikistan and Russia are permanently SP and GP affected determines the severity of the problem.

The largest number of SP outbreaks in the RT was observed in 1964 and 1965 (9 for each year), the smallest – in 1967, 1978, 1983, 1986, 1993 and 1998 (1 for each year), and in 1970, 1973, 1977, 1980–1982, 1984, 1985, 1989, 1990, 1994, 1997 and 1999 the disease was not registered.

According to the OIE data [5], small ruminant pox was detected in all regions (Gorno-Badakhshan Autonomous Region, Sughd and Khatlon Regions, RRS) of Tajikistan in 1992, 1993, 1996–1998, 2000–2003, 2005–2010.

It was reported [10] that only SP was registered in the RT in the period of 1961–2000, and though there are no data on morbidity and mortality available, it is assumed that on average there were about 160 diseased animals per outbreak, and the epizootic cycle in the long-term dynamics was 5 and 8 years. There is also an opinion [13] that both SP and GP outbreaks occurred in Tajikistan (1992–1998) and in other CIS countries: Kyrgyzstan (1994–1997), Azerbaijan (1995), Turkmenistan (1995), Uzbekistan (1995), Kazakhstan (1995–1997).

Considering the risk of SP and GP entry, emergence and spread in the territories bordering on Afghanistan (Sh. Shokhin, M. S. A. Hamadoni, Farkhor, Panj, Jayhun, Shahrituz, Qubodiyon, Nosiri Khusrav) and adjacent to them (Mu'minobod, Vose', Danghara, Vakhsh, J. Balkhi, Kushoniyon, Khuroson) Districts, as well as in Kulyab city in the Khatlon Region, monitoring of morbidity and vaccine prophylaxis efficacy was carried out since 2003 (since 2011 – on the entire RT territory). The epizootic threat of SP and GP entry, emergence and spread in all regions of the country is posed by joint grazing on the pastures of flocks belonging to various farms located in these areas. It should be noted that five valley rivers including the Kofarnihon and the Vakhsh flow in the Khatlon Region and form the Amu Darya, which, as well as the upper source of the Panj River, is a boundary with permanently SP and GP-infected Afghanistan, determining the possibility of a sub-regional risk of these diseases' introduction, occurrence and spread.

The epizootological forecast for the Russian Federation and neighboring states for the period from 2016

Table 1
Data on sheep pox epizootic situation in CIS countries in 1961–2000

Part of the world	Subregion	Country	Total		SR	MNODRP	MNOOP
			outbreaks	infection period (years)			
Asia	Western Asia	Azerbaijan	45	15	0.429	3.000	1.286
		Armenia	64	10	0.286	6.400	1.829
	Central Asia	Kazakhstan	186	25	0.714	7.440	5.314
		Kyrgyzstan	129	19	0.543	6.789	3.686
		Tajikistan	66	22	0.629	3.000	1.886
		Turkmenistan	35	14	0.400	2.500	1.000
		Uzbekistan	45	10	0.286	4.500	1.286
Europe	Eastern Europe	Ukraine	3	3	0.086	1.000	0.086
		Russia	142	16	0.457	8.875	4.057
		Total	715	34			
		Average			0.971	21.030	20.430

to 2020 showed that the highest probability of SP and GP occurrence was determined for the North Caucasian, Southern and Crimean Districts, and the greatest hazard of the disease introduction came from the countries bordering on Russia or having close economic ties with it, such as Tajikistan, Kyrgyzstan, Kazakhstan, Uzbekistan, Turkmenistan, Armenia, Georgia, Azerbaijan, Mongolia and China. Hence, the epizootic situation on these diseases should be constantly monitored, controlled, adapted and extrapolated to specific periods of warning [14].

The trend for aggravation of SP and GP epizootic situation intensity had been dynamically predicted up to 2020 in potentially infected regions, however, taking into account cyclical fluctuations of the situation, it was assumed that the intensity level might reduce in 2017–2020. The maximum registration frequency of these nosounits was characteristic of regions with a higher probability of SP and GP emergence [1].

During the study period (2000–2021: 22 years) 114 outbreaks of SP (65) and GP (49) were detected in the RT: 14 – in the Sughd Region (only SP), 70 – in the Khatlon Region (SP – 44, GP – 26) and 30 – in the RRS (SP – 7, GP – 23) (Table 2). The largest number of outbreaks (35) in the Republic was registered in 2002 (SP – 7, GP – 28): in the Sughd Region, the same parameter was 4 (2008: SP), in the Khatlon Region – 27 (2002: SP – 7, GP – 20) and in the RRS – 8 (2002: GP) (Fig. 1).

While only SP outbreaks were identified in the Sughd Region, the outbreak number for SP exceeded the corresponding indicator for GP in the Khatlon Region and GP was much more frequent than SP in the RRS. Most SP outbreaks were detected in the Khatlon Region (67.69%), followed by the Sughd Region (21.54%) and the RRS (10.77%), and the corresponding indicators for GP in the Khatlon Region and the RRS were 53.06 and 46.94%, respectively. The distribution of both disease outbreaks was as follows: the Sughd Region (SP only) – 12.28%, the Khatlon Region – 61.4%, the RRS – 26.32%. In total 57.02% of outbreaks were associated with SP and 42.98% – with GP in Tajikistan (Fig. 2).

Sheep pox in the Sughd Region was registered for 9 years (SR 0.41 – average; MNODRP – 1.56; MNOOP – 0.64), in the Khatlon Region – 13 years (SR 0.59 – average; MNODRP – 3.38; MNOOP – 2) and in the RRS – 5 years (SR 0.23 – below average; MNODRP – 1.4; MNOOP – 0.23), and GP in the Khatlon Region was registered during 5 years (SR 0.23 – below average; MNODRP – 5.2; MNOOP – 1.18) and in the RRS – 9 years (SR 0.41 – average; MNODRP – 2.56; MNOOP – 1.05) (Fig. 3). The infection period with regard to these diseases in the RT from 2000 to 2021 was 14 years, respectively (SR 0.64 – above average; MNODRP – 4.64; MNOOP – 2.95) and 12 years (SR 0.55 – average; MNODRP – 4.08; MNOOP – 2.23), for both SP and GP – 16 years (SR 0.73 – above average; MNODRP – 7.13; MNOOP – 5.18). During 22 years of observation in the Khatlon Region the both diseases were registered for 14 years (SR 0.64 – above average; MNODRP – 5; MNOOP – 3.18) and 11 years in the RRS (SR 0.5 – average; MNODRP – 2.73; MNOOP – 1.36).

During the study period the peaks of SP incidence in the RT (Fig. 4) were registered in 2002 (7 outbreaks in the Khatlon Region), 2008 (10 outbreaks: 4 in the Sughd and 6 in the Khatlon Regions) and 2013 (5 outbreaks: 1 for each of the Sughd and Khatlon Regions, 3 in the RRS). However, the peaks of the disease outbreak detection in the regions do not always comply with the indicators for the Republic: in the Sughd Region these peaks were reported in 2004 (2 outbreaks) and 2008 (4 outbreaks – compliant data), in the Khatlon Region – in 2002 (7 outbreaks – compliant) and 2007 (8 outbreaks), in RRS – in 2013 (3 outbreaks – data compliant). Graphically, the morbidity periods are presented in ascending-descending or undulating lines: the Sughd Region – 2003–2006, the Khatlon Region – 2000–2004 and 2005–2009, the RRS – 2012–2014) and descending (the Sughd Region – 2008–2009) lines. In general, 3 waves of SP morbidity were identified in Tajikistan: 2000–2005, 2006–2009, and 2012–2014. One outbreak was identified in 2018 in the Khatlon Region.

To be described among the last ones [15] were the pox outbreaks (caused by the SP virus according to NCFSD data) that occurred in February 2018 in the Dangara Raion of the Khatlon Region in two mixed flocks among 1.5–2 month old lambs at an early lambing stage, that had been infected in winter pastures, and the source could not be identified (it was assumed that it could be the pathogen-infected sheep pen). The severity of clinical and pathomorphological changes was due to both the virulence of the circulating strain and the age of diseased animals (50% mortality), who lacked colostral immunity, and the animals' resistance level was low as a result of colostrum and milk underfeeding. Although these outbreaks occurred in flocks belonging to one holding at a distance of 10–12 km, however, no association was established between them.

In 2002 (28 outbreaks – undulating period), 2007 (3 outbreaks – ascending period), 2013 (4 outbreaks – undulating) and 2019 (2 outbreaks – ascending period) the GP incidence peaks were recorded in Tajikistan (Fig. 4), including the indicators for the Khatlon Region (peaks: in 2002 – 20; 2013 and 2019 – 2 outbreaks each) and the RRS (peaks: in 2002 – 8; 2007 – 3 and 2013 – 2 outbreaks). The undulating period of GP incidence in 2001–2004 was due to the situation in the RRS, and its peak was an outbreak in the Khatlon Region, where 2 GP outbreaks were also observed in 2019.

In 2000 several pox outbreaks were identified in the areas bordering on Afghanistan in the Khatlon Region of the RT [10], mainly among Angora goats with the morbidity and mortality rate of 90 and 26%, respectively. Typical lesions on a significant part of hairless skin areas were observed in animals. The disease which was most severe before and during lambing, caused anorexia, vision loss, udder lesions, decreased milk production, mass abortions and infertility, and the mortality rate among newborn goatlings was 85–90%. The following year (2001) GP was identified in 11 farms already. In 2002, mainly in the autumn-winter period, it spread in two regions of Tajikistan (the Khatlon Region and the RRS) among goats of local breeds, the disease had a mild form (mortality up to 3%) and the monopathogenic agent was not transmitted to sheep kept together.

When the pathogen was isolated in VNIIVViM (Pokrov, Russia) using electron microscopy, brick-shaped virions (180–320 nm) with rounded edges were detected in the pathological material, the virus antigen titer during solid-phase enzyme immunoassay was 1:32–1:64 [16–18]. Most capripoxvirus strains are species-specific, but some of them can cause disease in both sheep and goats. The GP

virus strain Dangarinsky isolated in the RT in 2002 was pathogenic for both goats and sheep, and the former died after they developed a full complex of disease symptoms, and the latter had a mild form of the disease (with no manifestation of characteristic clinical signs), indicating the possible circulation of the virus among non-immune sheep which could be the pathogen source in the inter-epizootic period [10, 16, 19]. However, despite the high degree of antigenic relation, SP and GP viruses are phylogenetically diverse, and the latter, often inducing a more severe form of the disease, causes high mortality in young animals and significant economic losses.

Table 2
Epizootic situation on sheep pox and goat pox in the Republic of Tajikistan (2000–2021)

Year			Region, area				RRS			Tajikistan		
			Sughd	Khatlon								
			SP	SP	GP	SP + GP	SP	GP	SP + GP	SP	GP	SP + GP
2000				2		2				2		2
2001			1	5		5		2	2	6	2	8
2002				7	20	27		8	8	7	28	35
2003			1	5		5		3	3	6	3	9
2004			2	1		1		2	2	3	2	5
2005			1	1		1				2		2
2006			1	3		3		1	1	4	1	5
2007				8		8	1	3	4	9	3	12
2008			4	6		6				10		10
2009			2	3		3	1		1	6		6
2010								1	1		1	1
2011												
2012							1	1	2	1	1	2
2013			1	1	2	3	3	2	5	5	4	9
2014			1	1	1	2	1		1	3	1	4
2015												
2016												
2017												
2018				1	1	2				1	1	2
2019					2	2					2	2
2020												
2021												
Total	outbreaks		14	44	26	70	7	23	30	65	49	114
	years	observation	22	22	22	22	22	22	22	22	22	22
		disease registration	9	13	5	14	5	9	11	14	12	16
SR			0.41	0.59	0.23	0.64	0.23	0.41	0.50	0.64	0.55	0.73
Average annual number of outbreaks per period		disease registration	1.56	3.38	5.20	5.00	1.40	2.56	2.73	4.64	4.08	7.13
		observation	0.64	2.00	1.18	3.18	0.32	1.05	1.36	2.95	2.23	5.18

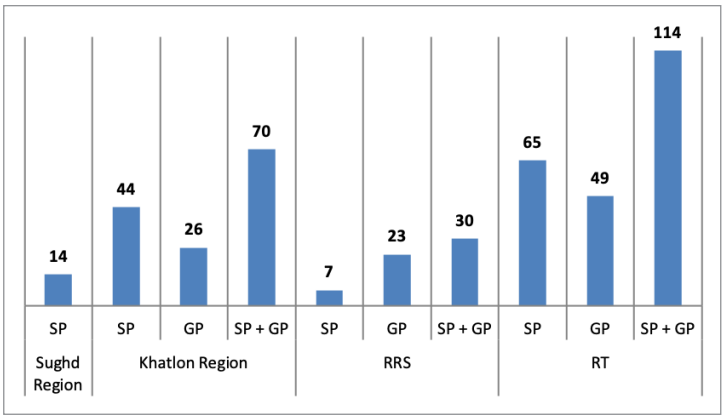


Fig. 1. Number of sheep pox and goat pox outbreaks reported in the Republic of Tajikistan in 2000–2021

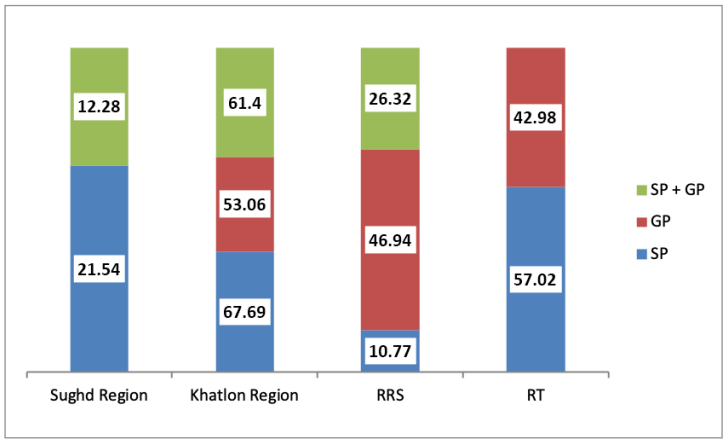


Fig. 2. Proportion of sheep pox and goat pox outbreaks in the Republic of Tajikistan in 2000–2021 (%)

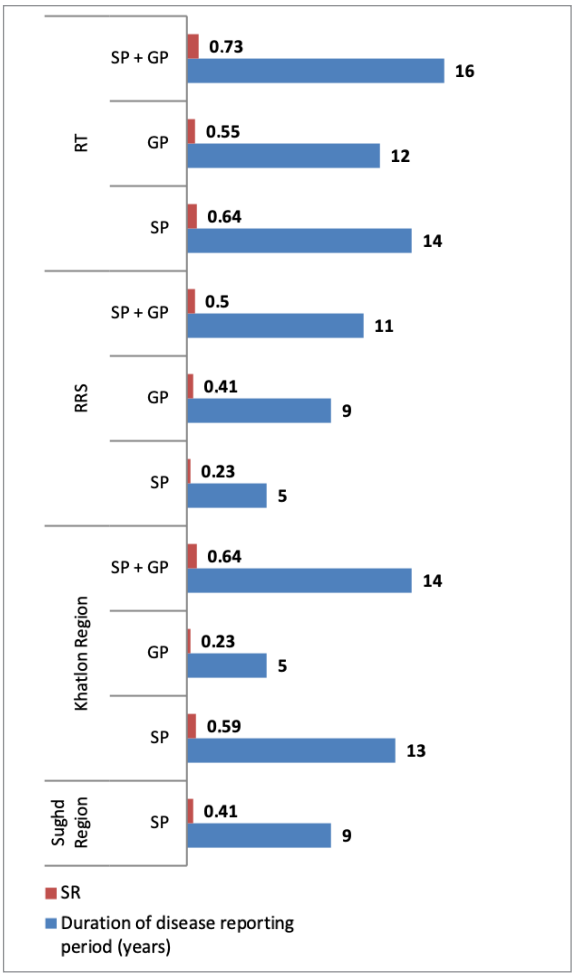


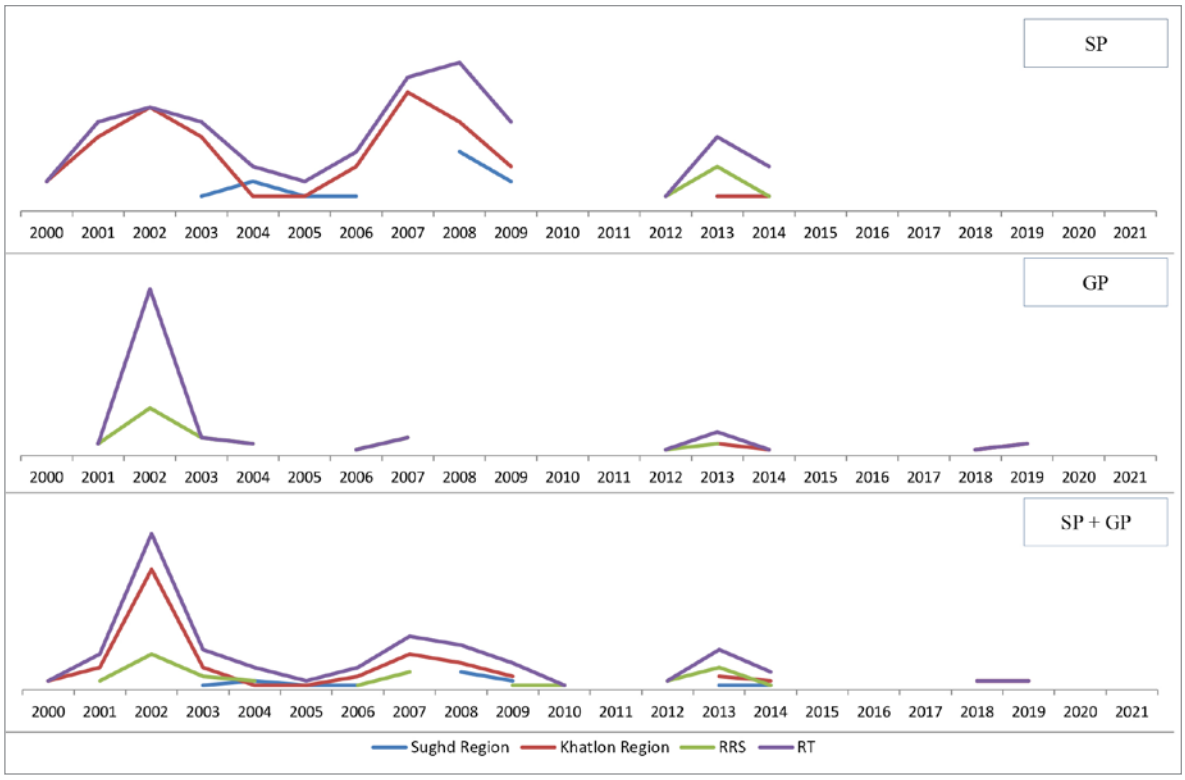
Fig. 3. Reporting period duration (years) and stationary rate for sheep pox and goat pox in the Republic of Tajikistan in 2000–2021

The specific sera obtained using SP and GP virulent viruses neutralized the SP virus strain B/5-96 and GP virus strain Dangarinsky adapted to the continuous sheep kidney cell culture in 1:32 and 1:64 titers, respectively [17, 20].

In total, the SP and GP outbreaks caused 3 waves (periods) of the disease incidence among small ruminants in Tajikistan (Fig. 4): 2000–2005 (peak in 2002 – 35 outbreaks), 2006–2010 (peak in 2007 – 12 outbreaks) and 2012–2014 (peak in 2013 – 9 outbreaks). One SP and one GP outbreaks were registered in 2018, 2 GP outbreaks – in 2019. In the Khatlon Region, 2 waves (periods) of morbidity were observed in 2000–2005 (peak in 2002 – 27 outbreaks), 2006–2009 (peak in 2007 – 8 outbreaks) and a descending period from 2013 (3 outbreaks) to 2014 (2 outbreaks). The incidence in the RRS was graphically expressed in 2 waves (periods) in 2001–2004 with a peak in 2002 (8 outbreaks) and in 2012–2014 with a peak in 2013 (5 outbreaks), as well as one ascending period in 2006–2007 (1 and 4 outbreaks, respectively). In addition, one SP and one GP outbreak were identified in this region in 2009 and 2010.

The analysis of the dynamics and structure of small ruminant pox nosoareal in the RT in 1991–2011 showed increased intensity of the epizootic situation, which was characterized by increased outbreak incidence, but the morbidity rate had a tendency to decrease. The temporal cycles of epizootic process intensity determined for Tajikistan were 6–8 and 14–16 years. When dynamic models were extrapolated to the period up to 2015, the incidence rate of outbreaks ranged from 0 to 10 per 1 million animals, the incidence coefficient was 1–10 cases per 100 thousand small ruminants ($P > 0.75$). Environmental and socio-economic factors significantly influenced the territorial distribution of intensity indicators of epizootic process: SR – 0.437, IR – 0.478 and the morbidity rate – 0.45 ($\alpha < 0.005 – 0.01$). Probability of SP and GP emergence on the RT territory for the Khatlon Region, south and southwest of the Gorno-Badakhshan Autonomous Region was 0.6–0.8 (above average), for the Sughd Region and the RRS – 0.4–0.6 (average) [13].

Analysis of the SP epizootic process dynamics in Tajikistan in 2000–2021 revealed that in 2000–2009 it was mainly determined by the situation in the Khatlon Region, while the situation in the Sughd Region had similar trends in 2003–2005, 2008 and 2009, and in the RRS – in 2012–2014. The development of the GP epizootic process in the RRS in 2001–2004, 2006, 2007, 2012, 2013 formed the corresponding situation in the RT, which was determined by the situation in the Khatlon Region in 2013, 2014, 2018



Puc. 4. Dynamics of sheep pox and goat pox epizootic process in the Republic of Tajikistan in 2000–2021 (outbreaks)

and 2019. It is unquestionable that the SP and GP epizootic process in Tajikistan depends on the situation in the Khatlon Region, but as regards SP, it is significantly affected by the situation in the Sughd Region , and as regards GP – by the situation in the RRS.

The SP and GP tensity decreased in 2017–2020 due to cyclical fluctuations of the epizootic situation: no outbreaks were registered in 2017, and in 2018 (SP – 1, GP – 1) and 2019 (GP) there were 2 outbreaks in the Khatlon Region, which confirms trueness of the previously developed model of potential nosoareal development [1].

Average annual number of SP and GP outbreaks within the disease reporting period in the RT (Fig. 5) was 7.13 (SP – 4.64; GP – 4.08). This indicator was the highest in the Khatlon Region (5.00: SP – 3.38; GP – 5.2), in descending order followed by the RRS (2.73: SP – 1.40; GP – 2.56) and the Sughd Region (SP – 1.56). It is characteristic that in the regions of GP distribution this indicator significantly exceeded the corresponding one (in the Khatlon Region by 1.5; in the RRS – by 1.8 times) for SP. Average annual number of SP and GP outbreaks within the observation period can be considered as preliminary prognostic:

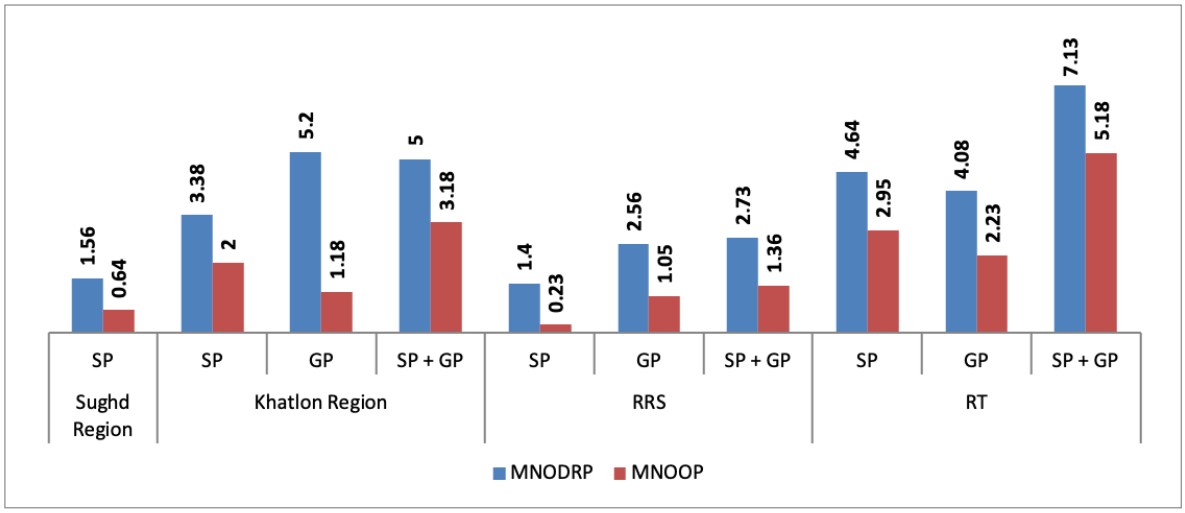


Fig. 5. Average number of sheep pox and goat pox outbreaks (annually) in the reporting and observation periods (2000–2021) in the Republic of Tajikistan

in general in Tajikistan – 5.18 (SP – 2.95; GP – 2.23), in the regions – from 0.64 (SP), in the Sughd Region to 3.18 (SP – 2.00; GP – 1.18) in the Khatlon Region, the corresponding values for the RRS – 1.36 (SP – 0.23; GP – 1.05).

Analysis of the SP and GP epizootic situation dynamics in Tajikistan in 2000–2021 identified the main causes of outbreaks of these diseases: 1) vaccination coverage of not all livestock population; 2) immunization without taking into account the colostral immunity; 3) contact of healthy animals with diseased ones when being driven to pastures (winter and summer) and grazing on high-altitude (summer) pastures; 4) grazing of small ruminants on permanently infected pastures bordering on Afghanistan; 5) vaccination of emaciated animals; 6) non-compliance with veterinary and sanitary and quarantine rules.

CONCLUSION

Characteristics and patterns of SP and GP epizootic process spread and manifestations identified based on systemic epizootological analysis of the structure and dynamics of nosoareals, as well as the results of the risk assessment of introduction, emergence and spread (taking into account climatic, socio-economic and organizational and managemental factors), monitoring and identification of SP and GP infected and endemic zones confirm the need for a systematic approach to epizootological surveillance of highly dangerous and economically significant infectious diseases that have a trend for transboundary spread. This approach will facilitate solving the issue of possible hazard analysis and implementation of veterinary and sanitary measures in case of disease emergence in any country to ensure epizootological well-being.

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