

## The spread of equine parascariasis in the Tyumen region

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Received: 08.09.2021. Accepted: 11.10.2021.

The article provides information on the spread of parascariasis equids in the Tyumen region. According to the studies conducted, the incidence rate among horses with *P. equorum* in Tyumen region farms in the period from 2012 to 2016 ranged from 4.8% in 2015 to 7.55% in 2013. In areas with periodic findings of parascariasis equids, the minimum infection of animals was observed in the Armizonsky district with a prevalence of 2.49% (2014), and the maximum in the Sorokinsky district with a prevalence of 25.76% (2015). The extent of invasion of parascariasis in permanently troubled areas varied from 1.08% (2015) in Berdyuzhsky to 61.67% (2016) in the Isetsy districts. The analysis of the possible relationship between the extensiveness of parascariasis invasion among horses and the location of the research areas in a certain natural and climatic subzone is carried out. The highest infection rate among horses with *P. equorum* was observed in the subzone (prevalence 10.67%) and the lowest in the southern taiga subzone (prevalence 0.18%). There was an increase in the invasion index of *P. equorum* extension invasion when moving from north to south, respectively, from the southern taiga subzone with the prevalence of 0.18%, to the subtaiga-8.94%, in the northern forest-steppe-10.67%, and a significant decrease in the southern forest-steppe to 3.97%. These indicators confirm the presence of more favourable conditions for the invasion of horses by *P. equorum* in the subzones of taiga and northern forest-steppe. During the study period (2012-2016), no definitive dependence of the change in the extent of the invasion was revealed, except for an obvious decrease in the indicator with its previous increase, which is obviously associated with a more careful implementation of antiparasitic measures.

**Keywords:** Horses, *Parascaris equorum*, Extensiveness of invasion, Tyumen region, Russia.

### Introduction

Horse breeding for the manufacture of marketable products manufacturing in Russia is undergoing significant changes, in particular, the use of horses as draft animals has decreased. Nevertheless, breeding of this type of mammals for the purpose of obtaining meat, milk, and skins is widespread in various regions of Russia. Horse health is largely influenced by the spread of infectious agents (glanders, myxomatosis, anthrax, etc.) and invasive diseases (parascariasis, gastrofiliasis, strongylatosis, etc.) among the mammal population. Thus, the parasitism of *Parascaris equorum* in the horse's body leads to a decrease in productivity, which is confirmed by the reduction in less meat and milk output. With high intensity of invasion, severe intestinal damage develops, which in some cases leads to perforation and death of the mammal. Horses struggle with *P. equorum* on all continents. Thus, in the territory of South and Central America, namely in some regions of Brazil, the extent of parascariasis invasion of horses reaches 12.21% (Martins et al., 2019), in Colombia-8% (Chaparro-Gutiérrez et al., 2018), Mexico-5.7% (Villa-Mancera et al., 2021). In Europe, parascariasis equids have been reported in the UK (Relf et al., 2013), Poland (Studzińska et al., 2017), Turkey (Uslu et al., 2018), Belarus (Sinyakov et al., 2019), Ukraine (Nikiforova et al., 2020). At the same time, the extent of invasion (prevalence) varies from 2.07% in Ukraine to 12% in Turkey. In Asian countries, parascariasis equids was reported in Tajikistan records up to 90% EI (Shodmonov., 2019), Uzbekistan is 33.6% (Shakarboev et al., 2017), Pakistan-20.3% (Ali et al., 2018), Iran 20.0-20.8% (Shahbazi et al., 2018; Imani-Baran et al., 2019), India-14.59% (Valibasha et al., 2019), Indonesia (Tirtasari et al., 2021), Malaysia (Premaalatha et al., 2018), Tibet (Li D. F. et al., 2018) and in Sri Lanka up to 47.7% in the free population (Dissanayake et al., 2017). In Africa, the epizootology of horse helminthiasis is more studied in Ethiopia, with horse parascaris infestation of horses reaching 32.5% (Zerihun, 2008). On the territory of Russia, parascariasis equids are recorded in all regions of mammal breeding, in particular, on the territory of the Leningrad region, the extent of invasion was 8.8% (Gavrilova et al., 2019), and in Tatarstan it varied from 6.7 to 21.9% (Timerbaeva et al., 2017; Timerbalaev et al., 2019). On the territory of the Tyumen region, according to data of a complete helminthological autopsy, the prevalence was 66.6% (Siben et al., 2015).

Thus, the purpose of our study was to study the characteristics of the distribution of *Parascaris equorum* in different areas of the Tyumen region.

### Materials and Methods

The research work was carried out based on the results of coproscopic examination of horse feces samples performed in the laboratory of animal entomoses and helminthiasis of VNIIVEA—a branch of the Tyumen Scientific Center of the Siberian Branch of RAS (Tyumen) and regional state veterinary laboratories of the Tyumen region in the period from 2012 to 2016. (Table 1). The materials for the study were the fecal samples from horses by the Fülleborn method (Kotelnikov, Hrenov, 1975).

**Table 1.** The number of samples studied, breakdown by districts (2012-2016).

Study Area	Years of Research				
	2012	2013	2014	2015	2016
1. Abbatical	60	58	42	566	105
2. Armizonsky	204	218	201	200	205
3. Aromashevsky	13	10	10	10	10
4. Berdyuzhsky	443	397	345	279	296
5. Vagaysky	140	140	140	140	140
6. Vikulovsky	54	53	50	0	0

7. Golyshmanovsky	50	41	40	40	40
8. Z-Ukovsky	29	54	57	50	50
9. Isetsky	50	54	427	40	60
10. Ishim	46	77	13	39	47
11. Kazan	134	122	132	99	136
12. N-Tavdinsky	87	65	124	117	106
13. Omutinsky	38	63	81	31	45
14. Sladkovsky	103	104	100	100	110
15. Sorokinsky	80	61	60	66	60
16. Tobolsk	78	32	70	70	70
17. Tyumen	65	50	50	59	51
18. Uvat	20	20	35	20	10
19. Uporovsky	77	82	76	76	80
20. Yurga	20	23	20	22	20
21. Yalutorovsk	95	77	76	80	70
22. Yarkovsky	104	120	107	104	105
<b>Total</b>	<b>1990</b>	<b>1921</b>	<b>2354</b>	<b>2208</b>	<b>1816</b>

The spread of parascariasis equids was assessed in terms of the extent of invasion. The determination of species of eggs and larvae of helminths was carried out using the determinants of horse parasites by Ivashkin and Dvoynos (1984). To study the distribution of parascariasis equids in the context of natural zones, the principles of regionalization of the Tyumen region, suggested by Karetin (1990), were used.

## Results and Discussion

According to the studies carried out, the incidence of horses with *P. equorum* was found in the farms of the Tyumen region farms in the period from 2012 to 2016 ranged from 4.8% in 2015 to 7.55% in 2013 (Table 2).

As can be seen from the data presented in Table 2, on the territory of Aromashevskii, Golyshmanovskii and Tobolskii districts in the period from 2012 to 2016 invasion of *P. equorum* among horses has not been identified. Horsescariasis invasion was registered only once on the farms of Abatsky, Vikulovsky, Vagaysky, Kazanskiy and Uvatsky districts. In Armizonsky, Ishimsky, Sladkovsky, Sorokinsky, Tyumensky, Yurginsky and Yalutorovskiy, parasitism of *P. equorum* among horses was occasionally observed. The farms of Berdyuzhsky, Zavodoukovsky, Isetsky, Nizhnetavdinsky, Omutinsky, Uporovsky, and Yarkovsky districts were continuously troubled with parascariasis equids. It should be noted that in areas where the disease was detected once, the minimum extensiveness of the invasion was 1.67% (2012) in Abatskiy district, and the maximum was 16.16% (2015) in Kazanskiy district. In areas with periodic finding of parascariasis equids, the minimum animal morbidity was observed in the Armizonsky district with a prevalence of 2.49% (2014), and the maximum in the Sorokinsky district with a prevalence of 25.76% (2015). The extent of invasion of parascariasis in permanently troubled areas varied from 1.08% (2015) in Berdyuzhsky to 61.67% (2016) in the Isetsky districts.

Thus, parascariasis equids are recorded in most districts of the Tyumen region, with the exception of Aromashevsky, Golyshmanovsky, and Tobolsky. During the study period (2012-2016), no definitive dependence of the change in the extent of the invasion was revealed, except for an obvious decrease in the indicator with its previous increase, which is obviously associated with a more careful implementation of antiparasitic measures.

Due to the fact that the eggs of the causative agent of parascariasis equids reach the invasive stage in the environment, this process is influenced by climatic factors. We have performed an analysis of the possible relationship between the extent of the invasion of parascariasis among horses and the location of the research areas in a certain natural and climatic subzone.

**Table 2.** Extensiveness of horse parascariasis invasion of horses in the Tyumen region, in the context of districts (2012-2016).

Study Area	Year of the study. EI%				
	2012	2013	2014	2015	2016
1. Abbatical	1.67	-	-	-	-
2. Armizonsky	-	8.72	2.49	-	-
3. Aromashevsky	2.70	1.76	8.41	1.08	15.20
4. Berdyuzhsky	-	0.71	-	-	-
5. Vagaysky	-	-	2.0	0	0
6. Vikulovsky	-	-	-	-	-
7. Golyshmanovsky	17.24	7.41	8.77	8.0	18.0
8. Z-Ukovsky	32.00	35.19	5.61	30	61.67
9. Isetsky	-	6.49	-	10.26	-
10. Ishim	-	-	-	16.16	-
11. Kazan	26.43	3.08	4.84	3.42	6.60
12. N-Tavdinsky	13.16	6.35	18.52	25.81	13.33
13. Omutinsky	-	1.92	18.0	-	-
14. Sladkovsky	-	11.48	3.33	25.76	-
15. Sorokinsky	-	-	-	-	-
16. Tobolsk	-	10	24.0	13.56	9.80
17. Tyumen	5.00	-	-	-	-
18. Uvat	45.45	46.34	23.68	6.58	10.0
19. Uporovsky	20.00	13.04	-	4.55	10.0
20. Yurga	12.63	11.69	22.37	17.5	-
21. Yalutorovsk	19.23	16.67	7.48	9.62	12.38
22. Yarkovsky	6.73	7.55	7.09	4.80	7.27

According to Karetin (1990), two zones can be distinguished in the south of the Tyumen region: the taiga forest and forest-steppe zone. In turn, the forest taiga zone is divided into subzones of the southern taiga and subtaiga, and the forest steppe zone is divided into subzones of the northern forest steppe and southern forest steppe (Table 3).

**Table 3.** Extensiveness of the invasion of parascariasis amongst horses (2012-2016) in the natural and climatic zones of the Tyumen region (according to Karetin, 1990).

Year of the study	The extensiveness of horse parascariasis infestation of horses (EI. %)			
	Taiga-forest zone		Forest-steppe zone	
	Subzone of the southern taiga	Podzona Subzone	Subzone of the northern forest-steppe	Subzone of the southern forest-steppe
2012	0.42	13.13	14.51	1.36
2013	0.52	9.64	15.11	3.33
2014	-	4.62	10.56	6.68
2015	-	10.03	5.61	2.80
2016	-	7.31	11.86	6.02
Total	0.18	8.94	10.67	3.97

The highest horse infection rate of horses by *P. equorum* during the research period of research was noted in the northern forest steppe subzone of the northern forest-steppe (prevalence 10.67%), and the lowest was recorded in the southern taiga subzone (prevalence 0.18%). There is an increase in the index of invasion of *P. equorum* extension invasion when moving from north to south, respectively, from the southern taiga subzone with the prevalence of 0.18%, to the subtaiga – 8.94%, in the northern forest-steppe – 10.67%, and a significant decrease in the southern forest-steppe – 3.97%. These indicators confirm the presence of more favourable conditions for the invasion of horses by *P. equorum* in the subzones of taiga and northern forest-steppe.

Analysis of the distribution of parascariasis equids in the Tyumen region showed that according to coproscopic examination carried out from 2012 to 2016, the extensiveness of *P. equorum* invasion of animals varied on average from 4.80% in 2015 to 7.55% in 2013. These indicators are significantly lower than those presented in a previously published work by Siben et al. (2015). This is explained, first, by different diagnostic methods and, second, by a small sampling (n15) of previous studies. In the context of the natural and climatic subzones, we observed an increase in the invasion among horses by parascaris when moving from north to south, that is, respectively, from 0.18% in the subzone of the southern taiga, to 10.67% in the subzone of the northern forest-steppe, and then a significant decrease to 3.97% in the subzone of the southern forest-steppe. These observations can be explained by significant climatic differences in areas when moving from north to south, which is indirectly confirmed by previous studies on helminthiasis in cattle in this area (Siben et al., 2018a; 2018b). In addition, the territory of the northern forest-steppe subzone is considered the most economically valuable and used (Karetin, 1990).

As the results of studies carried out on the territory of the Tyumen region show, parascariasis equids is a common disease with its own epizootic characteristics, which should be taken into account when developing antiparasitic actions. One of the reasons for the high invasion of domestic horses by causative agents of nematodosis of the gastrointestinal tract is the formation of populations of parasites of this group resistant to the action of anthelmintic drugs (Zharkikh et al. 2019), in this regard, further studies of the parasite fauna of horses should include the solution of this problem.

To solve this problem, it is necessary to carry out the following activities:

1. Parasitological examinations (coproscopic examination and pathological autopsies);
2. Selection of anthelmintic drugs according to the results;
3. Study of the stability of the nematodosis population against anthelmintics, to prevent the formation of resistance to them.

## Conclusions

Parascariasis equids are recorded in most districts of the Tyumen region, with the exception of Aromashevsky, Golyshmanovsky and Tobolsky. During the study period (2012-2016), no definitive dependence of the change in the extent of the invasion was revealed, except for an obvious decrease in the indicator with its previous increase, which can obviously be associated with a more careful implementation of antiparasitic measures.

The highest infection rate among horses with *P. equorum* was observed in the subzone (prevalence 10.67%) and the lowest in the southern taiga subzone (prevalence 0.18%). There is an increase in the index of invasion of *P. equorum* extension invasion when moving from north to south, respectively, from the southern taiga subzone with the prevalence of 0.18%, to the subtaiga-8.94%, in the northern forest-steppe-10.67%, and a significant decrease in the southern forest-steppe down to 3, 97%. These indicators confirm the presence of more favourable conditions for the invasion of horses by *P. equorum* in the subzones of taiga and northern forest-steppe.

## Funding

The article was prepared with the financial support of FNI 296-2021-0018 'Study and analysis of the epizootic state of diseases of invasive etiology of agricultural and unproductive animals, bees, and birds, changes in the species composition and bioecological patterns of the parasite development cycle of parasites under conditions of displacement of the boundaries of their ranges'.

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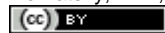
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**Citation:**

Domatsky, V.N., Siben, A.N. (2021). The spread of equine parascariasis in the Tyumen region. *Ukrainian Journal of Ecology* 11 (8), 67-70.

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