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Helminths of saiga antelope (*Saiga tatarica* L.) in the "Askania Nova" Biosphere Reserve, Ukraine

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Summary

Analysis of the species composition and community structure of helminths in saiga antelope (*Saiga tatarica*) was performed using multi-year (1979–2013) data collected from the "Askania Nova" Biosphere Reserve, Ukraine. During this period, 31 saiga antelopes of different ages (7 calves, 24 adults) were examined; totally, more then 63,900 helminth specimens were collected and identified by morphological criteria. Levels of saiga infection by nematodes were from 39 to 671 EPG (207±132 SD); seasonal fluctuations in saiga infections were insignificant (Mann-Whitney test; $p>0.05$).
Nineteen helminth species were found in saigas in the "Askania Nova": 3 species of Cestoda (*Avitellina centripunctata, Moniezia expansa* and *Taenia hydatigena*) and 16 species of Nematoda (*Chabertia ovina, Haemonchus contortus, Marshallagia marshalli, Cooperia oncophora, Camelostrongylus mentulatus, Aonchotheca bovis, Skrjabinema ovis, Oesophagostomum venulosum, Trichostrongylus axei, T. colubriformis, T. probolorus, Ostertagia ostertagi, O. circumcincta, O. trifurcata, Nematodirus spp., Trichurus ovis*). From 2 to 13 species per one host were observed. Nematodes dominated within the parasite community and composed more then 99 % of the total helminths found. Significant differences were found in helminth diversity between young and adult saigas ($p<0.05$). Prevalence–frequency distribution revealed multimodal structure of helminth community with dominant, subdominant, background and rare species. The highest number of helminthes (14 species and 50 % of the total amount) inhabited the small intestine; 11 species (45 %) were found in the abomasum and 9 species (5 %) in the large intestine. The Bray-Curtis cluster analysis revealed significant differences within the helminth communities in saigas from the "Askania Nova" Biosphere Reserve and saigas from Kazakhstan, Dagestan and Kalmykia.
Keywords: helminths; Cestoda; Nematoda; Saiga tatarica; prevalence–frequency distribution; Askania Nova; Ukraine

Introduction

The saiga antelope (*Saiga tatarica* Linnaeus, 1766) is a member of the family Bovidae and is an indigenous inhabitant of Eurasia. Originally saigas inhabited extensively large territories from the Carpathian Mountains to Dzhungaria and Mongolia. Currently saigas occur only in Kazakhstan and Uzbekistan; and low populations inhabit Turkmenistan and Russia (Kalmykia and the Astrakhan region) and western Mongolia (Bekenov *et al*., 1998; Sokolov, Zhyrnov, 1998). Over the last 100 years due to illegal hunting the saiga's population has been on the verge of extinction. In 2004, the International Union for Conservation of Nature (IUCN) assigned this species to the category of "Critically Endangered" (Mallon, 2008).
In Ukraine, the saigas is currently live only in the "Askania Nova" Biosphere Reserve (Gavrylenko, 2009). Saiga antelope were the first ungulates imported into the "Askania Nova" in 1887 by the founder of the Biosphere reserve F. E. Falz-Fein. However, in the 1920's the Askanian saiga population has ceased to exist (Falz-Fein, 1997). In 1979, 37 individuals were transportation from Ka-

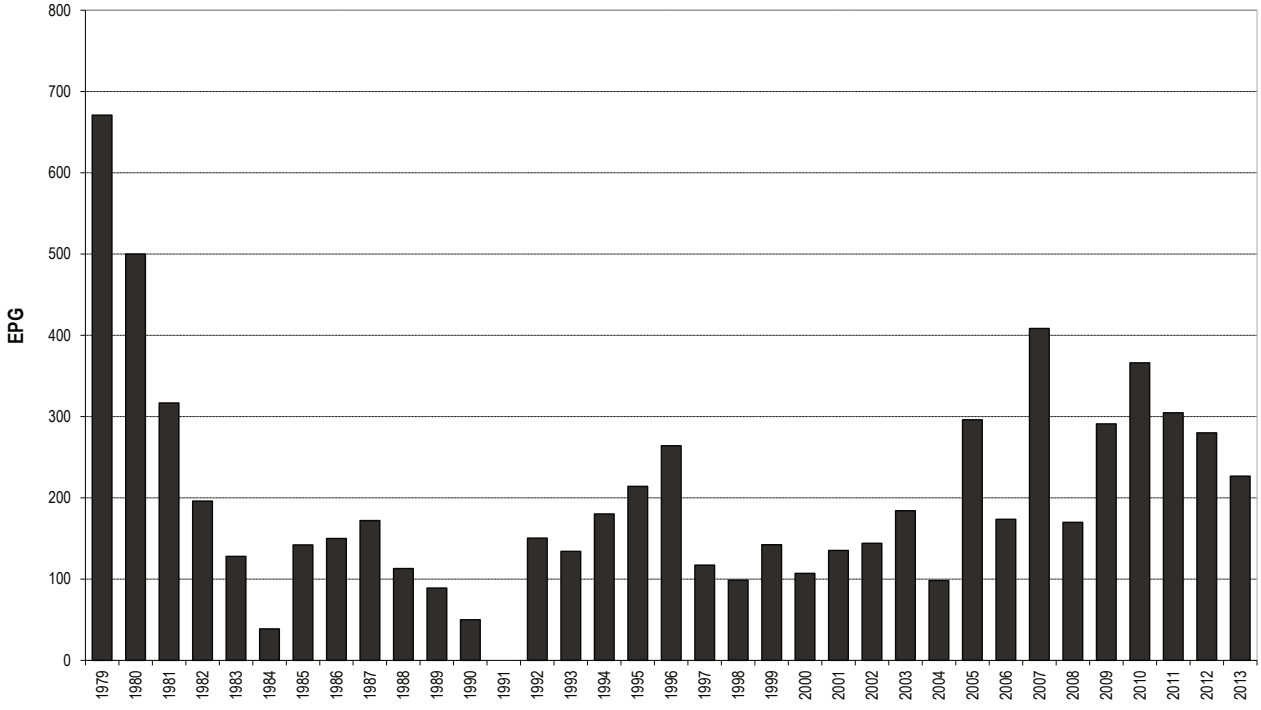

Fig. 1. Mean eggs/gram (EPG) values in saiga antelopes (*Saiga tatarica*) from the "Askania Nova" Biosphere Reserve during 1979 – 2013

zakhstan and were the founder animals that make up the current saiga population in the "Askania Nova" (Treus, 1993; Gavrylenko, 2009). Presently, the population of saigas in the biosphere reserve has increased to approximately more than 490 animals.

In the Reserve, saigas are kept under semi-free conditions in a large steppe enclosure named the Bolshoi Chapelski Pod (2376 ha), where they freely graze with different species of wild ungulates. Joint grazing of large numbers of herbivores from the families Equidae, Bovidae, Cervidae and Camelidae facilitates transmission of their gastro-intestinal parasites

Parasitological surveys of the saiga's population were performed regularly since their importation into the biosphere reserve in 1979. Basic monitoring studies of these animals were conducted *in vivo* using coprological methods, and by necropsy of all died animals (Kotelnikov, 1984). Considering the peculiarities of saiga behavior in nature, such as anxiety, fearfulness and running away when frightened (Minoransky, Tolcheeva, 2010), lifetime studies of these animals are particularly difficult. Therefore, the main studies on saiga's parasite fauna in nature were performed by *post mortem* methods (Matevossian *et al*., 1959; Boev *et al*., 1962; Petrov, 1983; Bekrkinbaev *et al*., 1994; Morgan *et al*., 2005, 2006).

The aims of our study were an analysis of multi-year (1979 – 2013) data on the species composition and community structure of helminths of saiga antelopes kept in the "Askania Nova" Biosphere Reserve, as well as a comparison of helminth fauna in saigas from Ukraine and from other parts of their range.

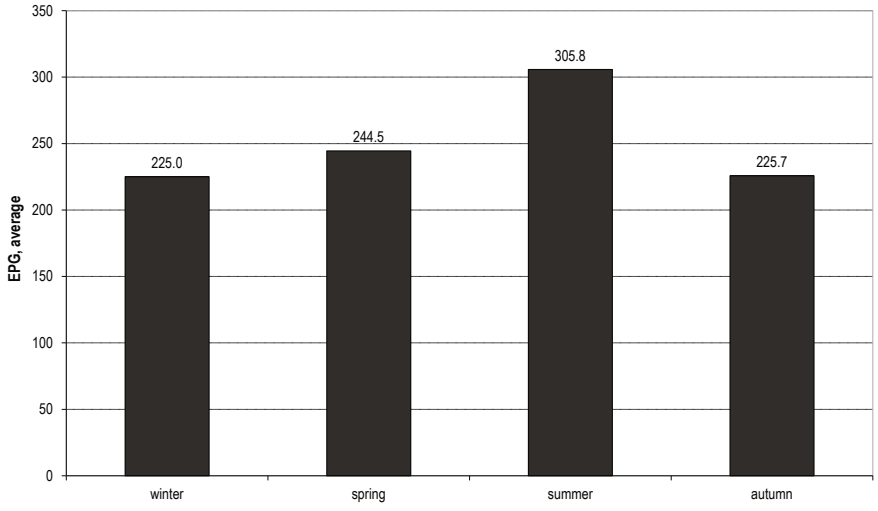

Fig. 2. Average levels of infection in saigas by intestinal strongylids in the "Askania Nova" Biosphere Reserve in different seasons

Material and methods

This investigation was carried out during 35 years (1979–2013) in the "Askania Nova" Biosphere Reserve (Kherson region, Ukraine; 46°29' North and 33°58' East). In 1979 the population of saiga was 37 animals and this grew to 492 by 2014. The saiga antelope were kept in a fenced area of the Bolshoi Chapelski Pod (2376 ha). Since 1984, 130 saiga calves have been raised in "Askania Nova" by artificial feeding. These young calves were kept in fenced plots of steppe of 3.3 ha.

From 1979 to 2013, 252 fresh fecal samples were collected from adult saigas (an average of 5.2 % of total saiga population) for coprological examinations. Level of infection of intestinal nematodes from the order Strongylida (number of eggs per 1 g of faeces – EPG) was determined by the coprological flotation Fulleborn's method (1979–2006) and McMaster method (2007–2013) (Kotelnikov, 1984; Nicholls, Obendorf, 1994).

Totally, 31 saigas (18 males and 13 females) of different ages (7 calves younger than 1 year old, 24 adults) died from different causes or killed after severe traumas were examined *post mortem* by the method of partial helminthological investigation (Kotelnikov, 1984). Helminths were collected from separate organs and from the gastrointestinal content; totally, 63,959 helminths were collected. Identification of helminths was performed under a light microscope based on the morphological characters (Trach, 1986; Ivashkin *et al*., 1989).

The results obtained were analyzed using the Microsoft™ Excel (Microsoft Excel, Redmond, Washington: Microsoft, 2003, Computer Software) and Paleontological Statistics Software (PAST) (Hammer *et al*., 2001). Nonparametric Mann–Whitney test (U) was used to compare differences in levels of saiga infection by helminths between seasons, sex and age groups. The shape of the prevalence frequency distribution was determined for all helminths found according to the description of Bucknell *et al*. (Bucknell *et al*., 1996). The proportion of each species in the community of each host was calculated as the number of specimens of the particular species in relation to the total number of helminths found. The Bray–Curtis cluster analysis was performed using the Biodiversity Professional v.2.04 (McAleece *et al*., 1997).

Results

During 1979 – 2013, all the saigas examined were found to be infected with intestinal nematodes from the order Strongylida (Fig. 1). The average level of infection was from 39 to 671 EPG (207±132 SD). The highest level of infection was observed in 1979 in saigas transported into Askania Nova from Kazakhstan.

Seasonal fluctuations in levels of saiga infections by parasites were rather low; average levels of infections varied from 200 to 300 EPG (Fig. 2). Differences in levels of saiga infections by nematodes between seasons were statistically insignificant ($p > 0.05$).

Nineteen helminth species (32 % of the total number of species

Table 1. Helminths species found in saigas (*Saiga tatarica*) from the "Askania Nova" Biosphere Reserve, Ukraine, and from others countries of Eastern Europe

	Helminth species	"Askania Nova", Ukraine (our data)	Kazakhstan* (Petrov, 1983; Berkinbaev *et al*., 1994)	Kalmykia (Matevosian *et al*., 1959)	Dagestan** (in Petrov, 1983)
	Cestoda				
1.	*Avitellina centripunctata* (rivolta, 1874)	+	+	—	+
2.	*Echinococcus granulosus* (Batsch, 1786), larvae	—	+	—	—
3.	*Moniezia expansa* (Rudolphi, 1810)	+	+	+	+
4.	*M. benedeni* (Monies, 1879)	—	+	—	—
5.	*Multiceps multiceps* (Leske, 1780), larvae	—	+	+	—
6.	*Taenia hydatigena* (pallas, 1766)= *Cysticercus tenuicollis*	+	+	+	+
7.	*Thyzaniezia giardi* (Monies, 1870)	—	+	+	+
	Nematoda				
8.	*Aonchotheca bovis* (Schnyder, 1906)	+	—	—	—
9.	*Bunostomum trigocaphalum* (Rudolphi, 1808)	—	—	—	+
10.	*Camelostrongylus mentulatus* (Railliet et Henry, 1909)	+	—	+	—
11.	*Chabertia ovina* (Fabricius, 1788)	+	+	+	+
12.	*Cooperia oncophora* (Railliet, 1898)	+	—	—	+
13.	*C. zurnabada* Antipin, 1931	—	—	—	+
14.	*Dictyocaulus filaria* (Rudolphi, 1809)	—	—	—	+
15.	*Haemonchus contortus* (Rudolphi, 1808)	+	+	+	+
16.	*Marshallagia marshalli* (Ransom, 1907)	+	+	+	+
17.	*M. mongolica* (Schumakovitsch, 1938)	—	+	—	+

18.	*M. dentispicularis* (Assadov, 1954)	—	+	+	+
19.	*M. skrjabini* (Assadov, 1952)	—	—	—	+
20.	*Nematodirella cameli* (Rajevskaja et Badanin, 1933)	—	+	+	+
21.	*N. longissimespiculata* (Romanowitsch, 1915)	—	+	—	+
22.	*N. gazelli* (Sokolova, 1948)	—	+	+	+
23.	*Nematodirus abnormalis* (May, 1920)	—	+	+	+
24.	*N. andreevi* (Satubaldin, 1954)	—	+	—	+
25.	*N. dogieli* (Sokolova, 1948)	—	+	—	+
26.	*N. gazellae* (Sokolova, 1948)	—	+	—	+
27.	*N. mauritanicus* (Maupas et Senrat, 1912)	—	+	—	—
28.	*N. oiratianus* (Rajevskaja, 1929)	+	+	+	+
29.	*N. spathiger* (Railliet, 1896)	—	+	+	+
30.	*N. helvetianus* May, 1920	—	—	—	+
31.	*N. junispiculatus* (Assadov, 1968)	—	—	—	+
	Nematodirus spp.	+			
32.	*Oesophagostomum columbianus* (Curticie, 1890)	—	—	+	+
33.	*O. venulosum* (Rudolphi, 1809)	+	—	+	+
34.	*Ostertagia ostertagi* (Stilles, 1892)	+	+	—	+
35.	*O. belockani* (Assadov, 1954)	—	—	—	+
36.	*O. orloffi* (Sankin, 1930)	—	+	—	—
37.	*O. circumcincta* (Stadelmann, 1894)	+	+	+	+
38.	*O. trifida* (Guille, Mmarotel et Panisset, 1914)	—	+	—	+
39.	*O. trifurcata* (Ransom, 1907)	+	+	—	—
40.	*O. kegeni* (Satualdin, 1954)	—	+	—	—
41.	*Ostertagiella occidentalis* (Ransom, 1907)	—	+	+	+
42.	*Parabronema skrjabini* (Rassowska, 1924)	—	+	—	—
43.	*Parafilaria antipini* (Ruchliadev, 1947)	—	+	—	—
44.	*Protostrongylus kochi* (Schulz, Orloff et Kutass, 1933)	—	—	—	+
45.	*Setaria digitata* (Linstov, 1906) Railliet et Henry, 1911	—	+	—	—
46.	*S. labiatopapillosa* Railliet et Henry, 1911	—	+	—	—
47.	*Skrjabinagia lyrata* (Sjöberg, 1926)	—	+	—	—
48.	*Skrjabinema ovis* (Skrjabin, 1915)	+	+	—	+
49.	*Skrjabinodera saiga* (Gnedina et Vsevolodov, 1947)	—	+	—	—
50.	*Strongyloides papillosus* (Wedl, 1856)	—	+	—	—
51.	*Thelazia rhodesi* (Desmarest, 1827)	—	+	—	—
52.	*Trichostrongylus axei* (Cobbold, 1879)	+	+	+	+
53.	*T. colubriformis* (Giles, 1892)	+	+	+	+
54.	*T. probolorus* Railliet, 1896)	+	+	+	+
55.	*T. skrjabini* Kalantarian, 1928	—	—	—	+
56.	*T. capricola* Ransom, 1907	—	—	—	+
57.	*T. vitrinus* (Lios, 1905)	—	—	+	+
58.	*Trichurus (Trichocephalus) ovis* (Abildgaard, 1795)	+	—	+	+
59.	*T. skrjabini* (Baskakov, 1924)	—	+	+	+
	Acanthocephala				
60.	*Moniliformis* sp. (Travassos, 1915)	—	+	—	—

* Data collected by Petrov(1983), Berkinbaev *et al*., (1994) and Morgan *et al.* (2005)

** Luguev, 1975 – cited by Petrov (1983)

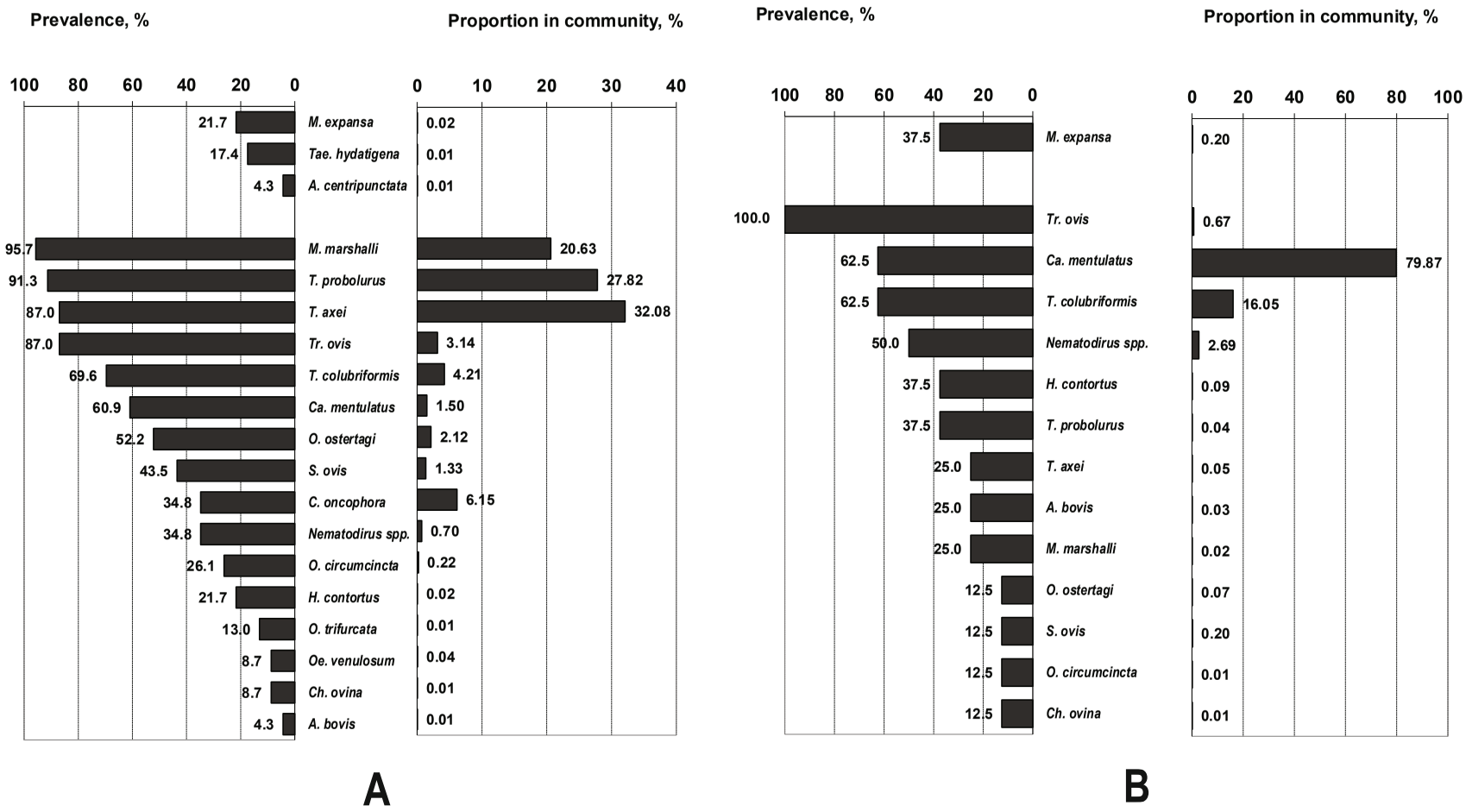

Fig. 3. Structure of helminth communities in adult (A) and young (B) saigas (*Saiga tatarica*) from the "Askania Nova" Biosphere Reserve, Ukraine

Table 2. Prevalence, intensity and proportion in community of helminth species found in adult (n=23) and juvenile (n=8) saigas from the "Askania Nova" Biosphere Reserve, Ukraine

	Helminth species	Adult (>1 year old)			Juvenile (< 1 year old)		
		Prevalence, %	Intensity, mean±SD	Proportion, %	Prevalence, %	Intensity, mean±SD	Proportion, %
	Cestoda						
1.	*Avitellina centripunctata*	4.3	2	0.01	—	—	—
2.	*Moniezia expansa*	21.7	2±1.2	0.02	37.5	13.3±12.1	0.2
3.	*Taenia hydatigena*	17.4	1	0.01	—	—	—
	Nematoda						
4.	*Chabertia ovina*	8.7	2.5±0.7	0.01	12.5	3.0	0.01
5.	*Haemonchus contortus*	21.7	1.6±0.9	0.02	37.5	6.0±4.0	0.1
6.	*Marshallagia marshalli*	95.7	456.1±608.8	20.6	25.0	2.0±1.4	0.02
7.	*Cooperia oncophora*	34.8	373,9±768,7	6.2	—	—	—
8.	*Camelostrongylus mentulatus*	60.9	52.1±61.9	1.5	62.5	3235.2±5721.0	79.9
9.	*Aonchotheca bovis*	4.3	3	0.01	25.0	3.5±0.7	0.03
10.	*Skrjabinema ovis*	43.5	64.9±88.0	1.3	12.5	40.0	0.2
11.	*Oesophagostomum venulosum*	8.7	9±1.4	0.04	—	—	—
12.	*Trichostrongylus axei*	87.0	780.2±1080.2	32.1	25.0	5.0±5.7	0.05
13.	*T. colubriformis*	69.6	127.9±221.9	4.2	62.5	650.2±1287.1	16.1
14.	*T. probolorus*	91.3	644.4±1132.7	27.8	37.5	2.7±1.5	0.04
15.	*Ostertagia ostertagi*	52.2	85.8±78.3	2.1	12.5	14.0	0.07
16.	*O. circumcincta*	26.1	17.7±23.5	0.2	12.5	3.0	0.01
17.	*O. trifurcata*	13.0	2.3±0.6	0.01	—	—	—
18.	*Nematodirus* spp.	34.8	42.4±69.8	0.7	50.0	136.3±238.5	2.7
19.	*Trichurus ovis*	87.0	76.3±77.3	3.1	100.0	16.9±13.5	0.7

registered in saigas were found in saiga antelope in Askania Nova – 3 species of tapeworms (class Cestoda) and 16 species of nematodes (class Nematoda) (Table 1).

Nematodes dominated the parasite community; together they composed more then 99 % of the total number of helminths (Table 2). Cestodes were found in 39 % of saigas with prevalence of separate species from 4.3 % to 21.7 %, and constituted less then 0.5 % of the total helminth number.

No significant differences in the species composition or in the levels of helminth infection were found between males and females, as well as between saigas that died from natural causes or killed due to severe injuries (p> 0.05).

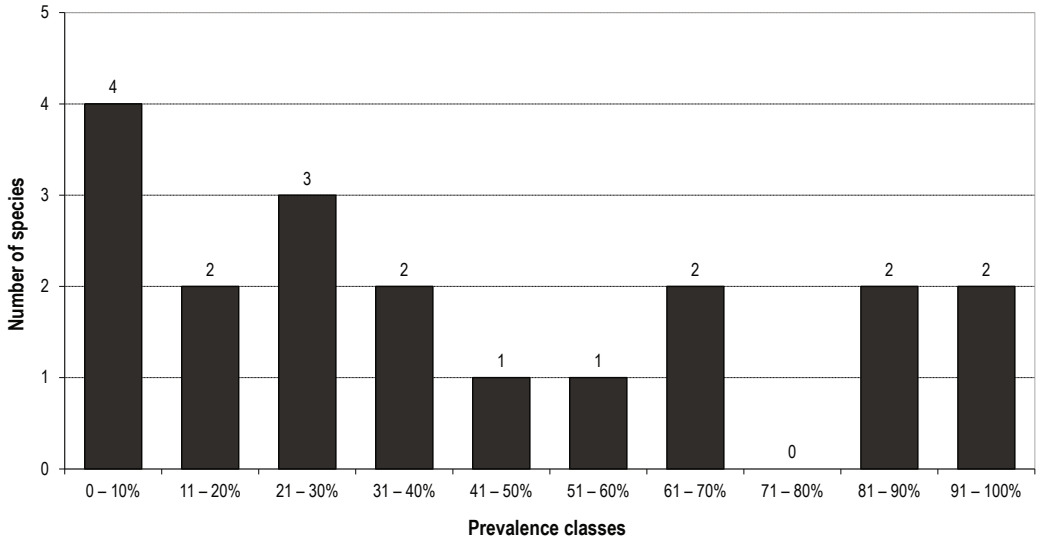

Fig. 4. Distribution of helminth species found in saigas from the "Askania Nova" Biosphere Reserve between the prevalence classes

Significant differences were found in helminth biodiversity between young and adult saigas (U = 106.5; z = –2.2; p = 0.03).

Besides an observed higher number of species in the helminth communities of adult hosts (19 helminth species) compared to calves (14 species), the most abundant species (*M. marshalli*, *T. probolorus* and *T. axei*) were found to infected adult saigas more uniformly, they constituted 22.6 %, 27.8 % and 32.1 % of helminth community, respectively (Fig. 3). In young saigas, the most abundant species, *Ca. mentulatus*, constituted almost 80 % of the total helminth number; in adult saigas this species was much less abundant (1.5 % of the total helminth number). The species predominating in the helminth community of adult saigas, such as *M. marshalli*, *T. probolorus* and *T. axei*, constituted less than 0.1 % of helminth community in calves.

Prevalence–frequency distribution of helminth species revealed the multimodal structure of helminth community with dominant (prevalence > 80 %), subdominant (prevalence = 50 – 80 %), background (prevalence = 10 – 50 %) and rare (prevalence <10 %) species (Fig. 4). In adult saigas, 4 species (*M. marshalli*, *T. probolurus*, *T. axei* and *Tr. ovis*) were dominant; 3 species (*T. colubriformis*, *Ca. mentulatus* and *O. ostertagi*) were subdominant; 6 species of nematodes (*S. ovis*, *C. oncophora*, *Nematodirus spp.*, *O. circumcincta*, *H. contortus*, *O. trifurcata*) and 2 species of cestodes (*M. expansa* and *Tae. hydatigena*) were background species, and 3 species of nematodes (*Oe. venulosum*, *Ch. ovina* and *A. bovis*) and one species of cestodes (*A. centripunctata*) were rare species.

In adult saigas, from 3 to 13 helminth species (mean 7.8 ± 2.6 SD) occurred simultaneously; in calves up to 1 year old, from 2 to 8 (mean 5.1 ± 2.2 SD) species were found.

Distribution of helminths in the saiga population was over dispersed, from 13 to 13,829 specimens (average 2115 ± 3008.7) were found per one host in adult saigas, and from 30 to 16,342 specimens (average 2532 ± 5691.1) in calves.

Examination of the distribution of helminths in separate parts of the gastrointestinal tract revealed that the highest number of helminths (14 species and 50 % of the total number) parasitized the small intestine; in the abomasum, 11 species and 45 % of the helminth number were found; the lowest number (9 species and 5 % of the total number) was registered in the large intestine (Fig. 5).

Cestodes *M. expansa* and *A. centripunctata* inhabited exclusively the small intestine; only larval forms of *Tae. hydatigena* (*Cysticercus tenuicollis*) were found outside the intestine on the omentum. Beside cestodes, 4 species of nematodes – *C. oncophora* (100 %), *Nematodirus spp.* (97.9 %), *T. colubriformis* (96.4 %) and *T. probolorus* (98.1 %) were observed primarily in the small intestine.

In the abomasum, 4 nematode species: *H. contortus* (100 %), *O. ostertagi* (98.6 %), *O. circumcincta* (94.3 %) and *O. trifurcata* (100 %) were found predominantly, as well as most of the *Ca. mentulatus* (75.5 %), *M. marshalli* (74.6 %) and *T. axei* (72.5 %). In the large intestine, 4 species: *Ch. ovina* (100 %), *Oe. venulosum* (100 %), *S. ovis* (99.9 %) and *T. ovis* (91.1 %) were found.

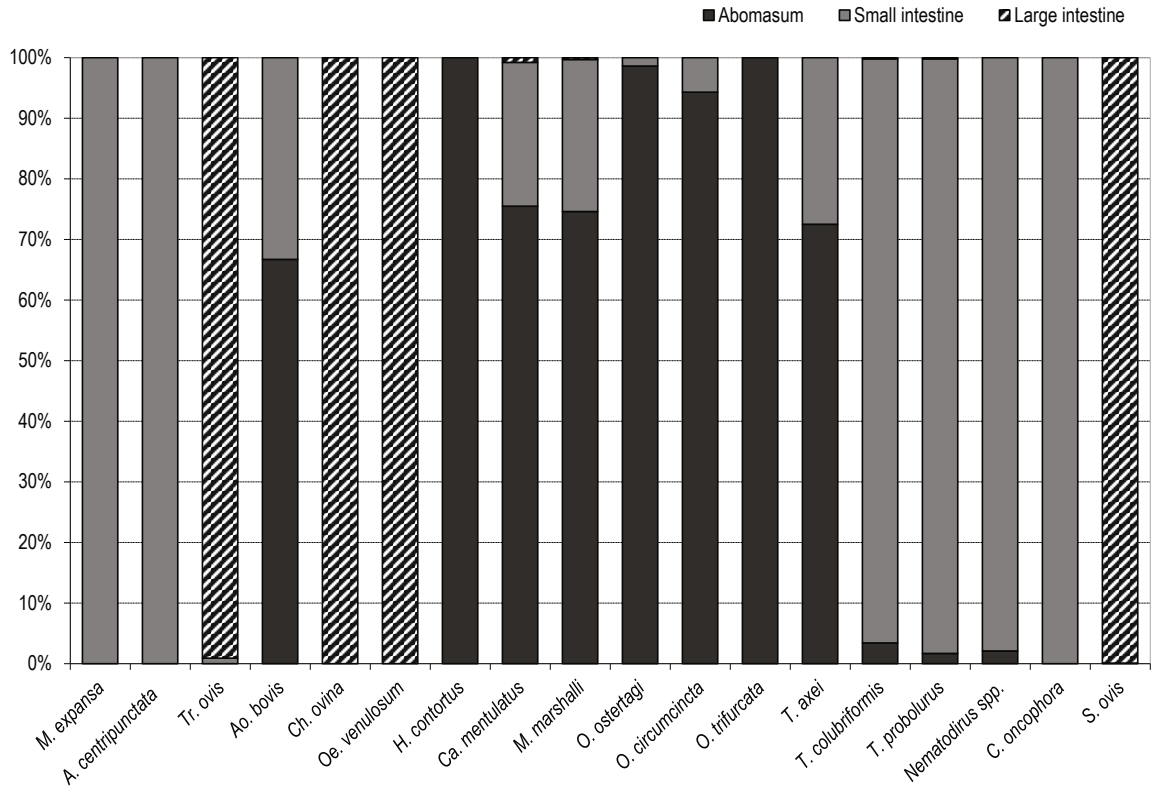

Fig. 5. Distribution of 18 helminth species between separate parts of intestine in saigas (*Saiga tatarica*) from the "Askania Nova" Biosphere Reserve

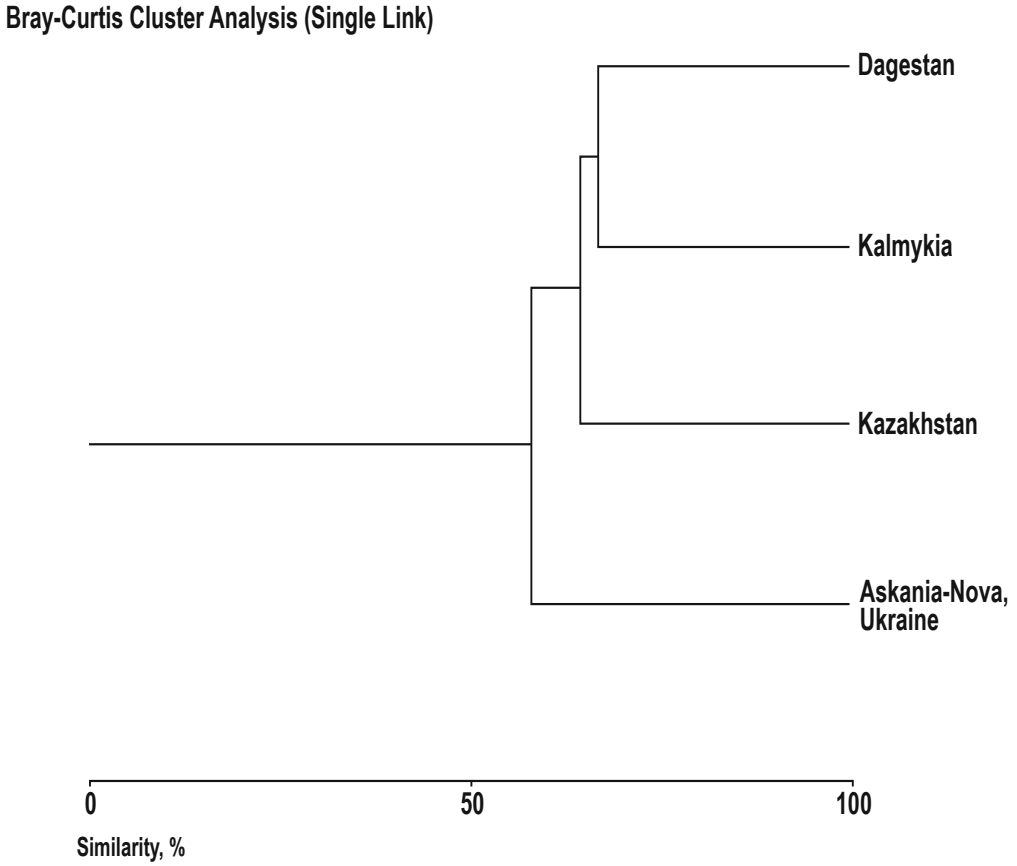

Fig 6. Bray-Curtis cluster analysis on similarity of the helminth communities in saigas (*Saiga tatarica*) from the "Askania Nova" Biosphere Reserve and from other regions of saigas inhabits

The Bray-Curtis cluster analysis revealed significant differences of helminth community in saigas from the "Askania Nova" Biosphere Reserve from those in saigas from Kazakhstan (Petrov, 1983; Berkinbaev *et al*, 1994; Morgan *et al*., 2005), Dagestan (Luguev, 1975 – cited in Petrov 1983) and Kalmykia (Matevosian *et al*., 1959) (Fig. 6).

Discussion

The results obtained in our study show that, despite the 100 % infection of saigas by helminths, the level of their infection was rather low and not harmful for animal health. The population of saigas in the Biosphere Reserve has increased; moreover parasites did not appear to be the cause of death in any of the animals, even without any anthelmintic treatments (Steklenev, Smagol, 2013). Saigas kept in steppe enclosures show various behavioral adaptations to regulate their infection with intestinal helminths, such as selective eating of plants with anthelmintic properties like tansy (*Tanacetum vulgaris*) and several species of wormwood from the family *Artemisia* (Treus, Zvegintsova, 1997; Minoranskij, Tolcheeva, 2010). This also could explain the absence of pronounced seasonal peaks of saiga infection with intestinal nematodes, which are obvious in other species of antelopes in the "Askania Nova" zoo (Treus *et al*., 1992; Zvegintsova, Treus, 2007; Zvegintsova, 2009, 2010).

Nineteen helminth species from 17 genera were recorded in adult saigas in the "Askania Nova" Reserve. This is the highest helminth biodiversity compared to those of other ruminants in the Reserve (Treus *et al*., 1992; Zvegintsova, Treus, 2007; Zvegintsova 2008, 2009, 2010, 2012, 2013a, 2013b). In our opinion, this is caused by an overlay of native and introduced helminth faunas, since the ancestors of the saiga population were imported directly from free-ranging herds from Kazakhstan. As saigas are indigenous species of antelope in southern Ukraine (Sokolov, Zhyrnov, 1998), the climatic conditions of Askanian steppes are favorable for survival and transmission of their parasites.

In Kazakhstan, from 15 to 23 helminth species were recorded in saigas by different authors (Matevossian *et al*., 1959; Petrov, 1983; Berkinbaev *et al*., 1994; Morgan *et al*., 2005, 2006). All of these species also were found in other ruminants, such as dzheirans (*Gazella subgutturosa*), argali/arkhars (*Ovis ammon*), camels (*Camelus bactrianus*), as well as in domestic cattle, goat and sheep (Boev *et al*., 1962; Morgan *et al*., 2005). In addition, several ungulates were grazing together in enclosures of the Bolshoi Chapelsky Pod for decades; this facilitates free exchanges of their parasites.

Nematodes were found to be the most abundant group of parasites (99 % of the parasite community) both in young and adults saigas. In adult saigas, 4 nematode species (*M. marshalli*, *T. probolurus*, *T. axei* and *Tr. ovis*) dominated the helminth community according to their prevalence (> 80 %) and intensity of infection. In young calves (<1 year old) the most prevalent species was *Tr. ovis* (prevalence 100 %) with rather low intensity (16.9±13.5).

Camelostrongylus mentulatus was the most abundant nematode species in calves; these nematodes constituted almost 80 % of the total helminth abundance. In the "Askania Nova" Biosphere Reserve this species was recorded first in saigas; later it was found in blackbuck antelopes and markhors (Zvegintsova, 2010, 2012). Moreover, it also was the first record of this species in Ukraine. We believe that *Ca. mentulatus* was imported to Ukraine from Kazakhstan, where it is common in sheep and other ruminants (Boev *et al*., 1962; Ivashkin *et al*., 1989).

The nematode *M. marshalli* also was found in the «Askania Nova» Reserve for the first time; even though this species is common in ruminants in Ukraine (Trach, 1986; Ivashkin *et al*., 1989). Among antelope it was observed only in saigas and in the representatives of the subfamily Caprinae (Zvegintsova, 2012, 2013a, 2013b).

Cestodes were found in 39.1 % of saigas examined, and composed less than 0.5 % of the total helminth number. *Moniezia expansa*, which apparently was imported with the saigas from Kazakhstan, was the most prevalent species (21.7 %). In the first years (1979 – 80), several cases of saiga death from hyper-infection by *M. expansa* were registered in the Askania Nova; however, during the following two years the level of infection by *Moniezia* decreased even without anthelmintic treatments, and saiga mortality due to moniesiosis stopped (Treus, 1993). Currently, the intensity of infection by this cestode in saigas is low, 2 ± 1.2 specimens in adult saigas, and 13.3 ± 12.1 in calves.

The cestode *Avitellina centripunctata* was found in the "Askania Nova" for the first time; this species is a common parasite in saigas in Kazakhstan (Matevossian *et al*., 1959; Petrov, Viebe, 1971; Petrov, 1983; Berkinbaev *et al*., 1994; Morgan *et al*., 2005), as well as in domestic ruminants in Ukraine (Ivashkin *et al*., 1989). Single bladders of *Cysticercus tenuicollis* (larval stage of *Taenia hydatigena*) were found on the mesentery only in adult saigas. Carnivores (dogs, foxes, etc.) are definitive hosts of *T. hydatigena;* they live in the "Askania Nova" and promote the circulation of this parasite between ungulates in the reserve. Cysticercosis has been detected in saigas throughout their distribution (Matevossian *et al*., 1959; Petrov, Viebe, 1971; Petrov, 1983; Berkinbaev *et al*., 1994; Morgan *et al*., 2005), even in the antelope kept in zoos (Sokolov, Zhyrnov, 1998; Minoransky, Tolcheeva, 2010).

The observed distribution of helminth species along different parts of saiga's intestine corresponds to earlier published data from Kazakhstan (Matevossian *et al*., 1959; Boev *et al*., 1962). As in these publications, in our study most helminths (95 %) were found almost equally in the abomasum and small intestine; the colon was inhabited by 9 nematode species constituting about 5 % of the total helminth number.

Analysis of the 19 helminth species distribution among prevalence classes revealed the multimodal structure of helminth community with dominant, subdominant, background and rare species. This type of structure is typical for parasite communities in wild or in semi-free ungulates from natural reserves that are not as affected by frequent anthelmintic treatments as are the ungulates from zoos (Kuzmina *et al*., 2007, 2013).

Comparison of the helminth fauna in saigas kept under semi-free conditions as in the «Askania Nova» Biosphere Reserve with those in saigas from steppes of Kazakhstan, Kalmykia and Dagestan showed a decrease of parasite diversity. Beside differences in climatic and natural conditions of steppes in the Askania Nova and others regions, we suspect these differences are primarily due to joint grazing of saigas with other species of ungulates, particularly equids, on the same pastures. It is known that joint grazing of different species of ungulates (ruminants and equids), leads to elimination of free-living stages of gastro-intestinal helminths on pastures (Eysker *et al*., 1983; Herd, 1986; Southcott, Barger, 1975). This also can explain the low level of saiga infection by strongylid nematodes in the Askania Nova, which has been maintained at 200 – 300 EPG even without anthelmintic treatment.

The results of our long-term study indicates that climatic conditions of the "Askania Nova" Biosphere Reserve are favorable for survival and successful circulation for the primary groups of parasites commonly found in the saigas inhabiting Central Asia. Despite the limited areas where saigas are kept, the level of their infection is consistently low, due to natural mechanisms of parasite control such as behavioral adaptations of saigas to regulate their infection by eating plants with anthelmintic properties, as well as due to elimination of infective larvae on pasture by joint grazing of different species of ungulates. However, it is necessary to continue the studies of helminth fauna in saigas in the "Askania Nova" Biosphere Reserve for monitoring their infection and forecasting the changes in ecological and parasitological situation in the reserve, as well as to explore various natural mechanisms of parasite control in limited areas of natural reserves.

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