

UDC 576.89:599.723(438)

## OCCURRENCE OF GASTRO-ITESTINAL PARASITES IN POLISH PRIMITIVE HORSES FROM THE ROZTOCZE NATIONAL PARK, POLAND

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**Occurrence of Gastro-Intestinal Parasites in Polish Primitive Horses from the Roztocze National Park, Poland. Slivinska K., Wróblewski Z., Gawor J.** — The study was performed to investigate the gastro-intestinal parasite fauna using the method of diagnostic deworming in own modification in 29 Polish primitive horses (*Equus caballus*) from the Roztocze National Park, south-east of Poland. The parasite community was comprised of 35 species represented by three nematode families (Strongylidae, Ascaridae, Habronematidae), one cestode family (Anoplocephalidae) and larvae of insects from the family Gasterophilidae (Diptera). Strongylidae being 100 % prevalent was represented by 31 species from the subfamily Strongylinae (6 species) and Cyathostominae (25 species). *Parascaris equorum* was recorded in 48.3 %, *Habronema muscae* in 55.2 %, tapeworms (*Anoplocephala perfoliata*) in 24.1 % and *Gasterophilus intestinalis* larvae in 41.4 % of horses surveyed. The present results showed high prevalence of pathogenic intestinal parasites, which create the risk of health problems for horses living free in the reserve as well as stabled horses, when rarely treated.

Key words: Polish primitive horse; gastro-intestinal parasites; Roztocze National Park.

**Встречаемость желудочно-кишечных паразитов у польского коника в Розточанском национальном парке, Польша. Сливинская К., Врублевский З., Гавор Я.** — Обсуждаются результаты исследования желудочно-кишечной паразитофауны у 29 лошадей породы польский коник (*Equus caballus*), которые разводятся в условиях вольного и конюшенного содержания в Розточанском национальном парке, что на юго-востоке Польши. При этом был использован метод диагностической дегельминтизации в собственной модификации. Выявлено, что сообщество паразитов состояло из 35 видов, которые были представлены семействами Strongylidae, Ascaridae, Habronematidae (Nematoda), Anoplocephalidae (Cestoda) и личинками насекомых из семейства Gasterophilidae (Diptera). Стронгилиды были найдены у всех исследованных лошадей (100 %) и представлены 31 видом из подсемейства Strongylinae (6 видов) и Cyathostominae (25 видов). *Parascaris equorum* был зафиксирован в 48,3 %, *Habronema muscae* в 55,2 %, ленточные черви (*Anoplocephala perfoliata*) в 24,1 % и личинки *Gasterophilus intestinalis* в 41,4 % исследованных лошадей. Полученные результаты выявили высокую распространенность патогенных кишечных паразитов, которые представляют опасность для здоровья лошадей в условиях вольного и конюшенного содержания, а также в случае нерегулярных антигельминтных обработок поголовья.

Ключевые слова: коник польский, желудочно-кишечные паразиты, Розточанский национальный парк.

### Introduction

Wild Polish primitive horses (*Equus caballus*) have been living under natural conditions in the Roztocze National Park since 1982. The habitat of wild horses currently embraces 180 hectares of forest, grassland and lake. There is one harem of 16 animals: 1 stallion, 8 mares and 7 foals. Since 1996 in the National Park horses have been bred under the stabled conditions as well. Currently there are 13 females and their foals.

Two herds of Polish primitive horses (*Equus caballus*) are kept in the Roztocze National Park (south-east of Poland), one (n = 16) living free in the reserve, the other (n = 13) kept in the stable. No anthelmintic

treatment has been applied to the reserve herd to date. For the control of the population dynamics yearling offsprings are captured from the reserve every year in winter, then after taming they are bred under the stabled conditions. The stabled group consists currently of 13 females with their foals. Anthelmintic treatment is rarely applied to these horses.

Gastro-intestinal parasites are an important factor which may influence the health of horses, in severe intensity of infection can be a cause of mortality. Therefore, the evaluation of intestinal parasite occurrence (prevalence and intensity) in both, the reserve and the stabled group is important to prevent the risk of health hazard. To date, gastro-intestinal parasite fauna in wild Polish primitive horses in Poland was investigated only in free-living horses in the Popielno Forest Reserve, the north of Poland (Slivinska et al., 2009 a). There is limited knowledge of such parasite community in the Polish primitive horses living under natural and stabled conditions at the Roztocze National Park.

In the present study, using method of the diagnostic deworming in own modification we surveyed gastro-intestinal parasite community of the Polish primitive horses living in the natural reserve and stabled conditions in south-east of Poland. These results are the basis for the comparison of the ecological management and control of the parasitological situation under reserve and stabled breeding of the primitive horses.

### Material and methods

Examination of the gastrointestinal (GI) parasites of 16 wild horses (1 harem stallion 5 years old, 8 mares of age range from 5 to 25 years old (mean = 12.5; *S. D.* = 8.8), 7 offsprings 0.5 years old) and 13 stabled mares 3 to 17 ( $4.9 \pm 4.3$ ) was performed by the diagnostic deworming (Kuzmina et al., 2004) method in April 2008.

Wild horses were kept under natural conditions all seasons during the year. Stabled horses were kept in stable at night and returned to fenced pastures during a day.

No anthelmintic treatment has been applied to wild horses to date. Anthelmintic treatment to stabled mares has been applied rarely, not every year.

Mean egg output counted as egg per gramme (EPG) was carried out on a day before treatment using the McMaster method (Herd, 1992). EPG values counted individually from each horse and calculated in group of horses — wild harem (separately stallion, mares and foals) and stabled mares — are given in table 1.

All horses ( $n = 29$ ) were treated with 18.7 mg ivermectin + 140.3 mg praziquantel (Equimax paste, Virbac de Portugal Laboratorios LDA, Portugal) in dose 1.07 g of paste per 100 kg of body weight. The body weight of stallion was about 350 kg, each mare was 250–300 kg and the foal was 150 kg.

Faecal sampling for expelled parasites (200 g from each horse) was performed per rectum from each horse 24, 36 and 48 hours after treatment. In the laboratory, samples were washed with tap water and preserved in 40 % alcohol. Gastro-intestinal parasites were isolated from faeces, then fixed in 70 % alcohol, counted and identified to species level using the keys by Lichtenfels and Kharchenko (2008). A number of parasites found in each sample was defined as relative intensity.

Totally 24,254 parasite specimens in wild and stabled horses (12,219 and 12,035, respectively) were collected and identified.

### Results

#### GI parasite community in wild horses ( $n = 16$ )

All wild horses were infected with strongylids; the mean egg output was 320.3 EPG (75–900), 43.8 % of horses expelled *Parascaris* eggs (225.0 EPG) and 25 % expelled eggs of *Strongyloides westeri* (175.0 EPG). Harem stallion excreted only strongylids eggs (100 EPG). *Parascaris* eggs were found in 25 % of wild mares (50.0 EPG) and in 71.4 % of foals (295.0 EPG). 57 % of foals excreted *Strongyloides westeri* eggs (175 EPG) (table 1).

**Table 1. Results of faecal egg counts in wild Polish primitive horses (*Equus caballus*),  $n = 29$ , in the Roztocze National Park, Poland (April 2008)**

**Таблица 1. Результаты овоскопического исследования коника польского (*Equus caballus*),  $n = 29$ , Розточанский национальный парк, Польша (апрель 2008)**

Horse		Mean EPG									
		Strongylidae			<i>Parascaris equorum</i>			<i>Strongyloides westeri</i>			Cestoda
		EI, %	II	SD	EI, %	II	SD	EI, %	II	SD	
Wild harem, $n = 16$	Stallion $n = 1$	100	100.0	0	0	0	0	0	0	0	0
	Mares $n = 8$	100	237.5	128.2	25	50	26.7	0	0	0	0
	Foals $n = 7$	100	446.4	331.2	71.4	295.0	225.4	57.1	175	150	0
Stable mares $n = 13$		100	1821.2	1088.1	15.4	350.0	160.4	0	0	0	0

Note. EPG — eggs per gram; EI, % — prevalence; II — intensity in infected horses.

Thirty-five species of GI-parasites were found: 33 nematodes, 1 cestode and 1 larva of botfly. From 17 to 29 species ( $21.2 \pm 3.9$ ) were found per host (table 2). Ten Strongylidae species (*Cylicocyclus nassatus*, *Cyathostomum catinatus*, *Cylicostephanus longibursatus*, *C. minutus*, *Cylicocyclus ashworthi*, *Cylicostephanus calicatus*, *C. goldi*, *Cylicocyclus leptostomum*, *Coronocyclus labratus* and *Strongylus vulgaris*) dominated in the parasite community; they were found in 90–100 % of wild horses examined and composed 87.2 % of total parasite number. *Parascaris equorum* and *Habronema muscae* were of 56.3 % and 43.8 % prevalence, respectively. *Anoplocephala perfoliata* specimens and larvae of *Gasterophilus intestinalis* were found in 37.5 % and 56.3 % of horses, respectively. In general, the relative intensity of nematode infection was low. The mean number of specimens of *Strongylus vulgaris* and *S. edentatus* (subfamily Strongylinae) varied in different age

**Table 2.** Results of gastro-intestinal survey in wild Polish primitive horses (*Equus caballus*), n = 16, kept in nature conditions in the Roztocze National Park, Poland (April 2008)

**Таблица 2.** Результаты исследования желудочно-кишечной паразитофауны коников польских (*Equus caballus*), n = 16, вольного содержания в Розточанском национальном парке, Польша (апрель 2008)

Parasite species	Prevalence, %		Number of specimens								Total	
			Mean		Mini- mum		Maxi- mum		SD			
	1	2	1	2	1	2	1	2	1	2	1	2
<b>Strongylinae</b>												
<i>Strongylus vulgaris</i>	88.9	28.6	7.1	1	1	1	16	1	5.6	0	57	2
<i>S. edentatus</i>	77.8	0	7.9	0	3	0	12	0	4.1	0	55	0
<i>Triodontophorus serratus</i>	62.5		7.2		2		15		5.5		72	
<i>T. brevicauda</i>	62.5		4.1		1		10		4.8		41	
<i>T. tenuicollis</i>	50.0		3.5		2		9		2.5		28	
<i>Craterostomum acuticaudatum</i>	25.0		2.5		1		6		2.4		10	
<b>Cyathostominae</b>												
<i>Cyathostomum catinatum</i>	100		19.6		41		232		57.1		1913	
<i>C. pateratum</i>	75.0		20.9		2		37		10.8		251	
<i>Coronocyclus coronatus</i>	87.5		21.1		3		47		15.4		295	
<i>C. labiatus</i>	81.3		9.0		2		19		5.7		116	
<i>C. labratus</i>	93.8		7.8		1		16		5.6		117	
<i>Cylicostephanus calicatus</i>	100		29.3		2		64		19.1		468	
<i>C. minutus</i>	100		18.4		14		205		65.8		1895	
<i>C. hybridus</i>	25.0		1.3		1		2		0.6		5	
<i>C. longibursatus</i>	100		29.6		18		232		73.3		2073	
<i>C. goldi</i>	100		6.8		2		31		11.0		269	
<i>C. bidentatus</i>	37.5		1.5		1		3		0.9		9	
<i>Cylicocyclus radiatus</i>	6.3		1.0		1		1		0.6		1	
<i>C. elongatus</i>	68.8		12.1		3		26		8.9		133	
<i>C. insigne</i>	87.5		20.8		6		39		13.0		291	
<i>C. leptostomum</i>	100		15.8		2		32		8.9		252	
<i>C. nassatus</i>	100		59.1		15		282		78.3		2546	
<i>C. ashworthi</i>	100		57.8		2		104		32.8		925	
<i>C. ultrajectinus</i>	25.0		2.8		1		5		1.4		11	
<i>Cylicodontophorus bicoronatus</i>	18.8		2.0		1		2		0.7		6	
<i>Parapoteriostomum euproctus</i>	56.3		7.0		2		13		4.6		63	
<i>P. mettami</i>	50.0		2.3		1		5		1.5		18	
<i>Poteriostomum imparidentatum</i>	25.0		2.3		1		4		1.2		9	
<i>P. ratzii</i>	43.8		1.4		1		3		0.9		10	
<i>Petrovinema poculatum</i>	43.8		1.7		1		3		1.0		12	
<i>Gyalocephalus capitatus</i>	18.8		1.3		1		2		0.6		4	
<b>Ascaridae</b>												
<i>Parascaris equorum</i>	56.3		5.1		1		13		4.1		46	
<b>Habronematidae</b>												
<i>Habronema muscae</i>	43.8		11.1		1		65		16.1		78	
<b>Anoplocephalidae</b>												
<i>Anoplocephala perfoliata</i>	37.5		2.5		1		7		1.8		15	
<b>Gasterophilidae</b>												
<i>Gasterophilus intestinalis</i>	56.3		2.7		1		11		2.8		24	

Note. 1 — adults horses (n = 9); 2 — foals (n = 7).

groups. In adult wild horses 7.1 and 7.9 specimens of *Strongylus vulgaris* and *S. edentatus* were found, respectively. Only one specimen of *S. vulgaris* was recorded in foals group (table 2). In case of Cyathostominae, 1.0–159.1 specimens were found in all wild horses. The mean number of ascarids per horse was  $5.1 \pm 4.1$  and habronematids  $11.1 \pm 16.1$  (table 2). Eight most abundant cyathostome species (*C. nassatus*, *C. longibursatus*, *C. catinatum*, *C. minutus*, *C. ashworthi*, *C. calicatus*, *C. goldi*, *C. leptostomum*) made up 86.4 % of total strongylids in wild horses examined, with the mean number of specimens found from 15.8 (*C. leptostomum*) to 159.1 (*C. nassatus*) (table 2). Tapeworms (*A. perfoliata*) were recorded in 37.5 % of horses surveyed, with 1 to 7 specimens recovered (mean 2.5). One non-helminth gastro-intestinal parasite, namely larvae of *G. intestinalis* was also recorded with the prevalence of 56.3 % and intensity 1–11 specimens (mean 2.7).

GI parasite community in stabled mares (n = 13)

All mares were infected with strongylids, the mean egg output was 1328.0 EPG (range 400–3775) and 15.4 % of horses expelled *Parascaris* eggs (350.0 EPG) (table 1).

Twenty-eight species of GI-parasites were recorded, among them 26 nematodes, one cestode species and one larva of botfly. From 16 to 28 species ( $18.8 \pm 2.3$ ) were found per host. Twelve strongylid species (*C. nassatus*, *C. catinatum*, *C. longibursatus*, *C. minutus*, *C. ashworthi*, *C. calicatus*, *Coronocylus coronatus*, *Cylicocylus insigne*, *C. goldi*, *Cyathostomum pateratum*, *C. leptostomum* and *Strongylus edentatus*), which

**Table 3.** Results of gastro-intestinal survey in stabled mares of the Polish primitive horses (*Equus caballus*), n = 13, in the Roztocze National Park, Poland (April 2008)

**Таблица 3.** Результаты исследования желудочно-кишечной паразитофауны маточного поголовья коника польского (*Equus caballus*), n = 13, конюшенного содержания в Розточанском национальном парке, Польша (апрель 2008)

Parasite species	Prevalence, %	Number of specimens				Total
		Mean	Minimum	Maximum	SD	
<b>Strongylinae</b>						
<i>Strongylus vulgaris</i>	84.6	10.5	3	37	10.6	166
<i>S. edentatus</i>	92.3	7.4	1	23	5.8	89
<i>Triodontophorus serratus</i>	53.9	2.6	1	4	1.5	18
<i>T. brevicauda</i>	30.8	2.8	2	5	1.5	11
<i>T. tenuicollis</i>	38.5	1.8	1	3	1.1	9
<i>Craterostomum acuticaudatum</i>	7.7	2.0	2	2	2	0,6
<b>Cyathostominae</b>						
<i>Cyathostomum catinatum</i>	100	174.6	75	254	46.6	2270
<i>C. pateratum</i>	92.3	22.9	1	48	15.6	275
<i>Coronocylus coronatus</i>	100	36.5	9	73	18.2	475
<i>C. labiatus</i>	76.9	12.3	4	21	7.1	123
<i>C. labratus</i>	84.6	9.0	3	18	6.2	99
<i>Cylicostephanus calicatus</i>	100	69.0	22	109	23.5	897
<i>C. minutus</i>	100	120.8	49	241	50.4	1570
<i>C. longibursatus</i>	100	129.3	43	205	49.5	1681
<i>C. goldi</i>	100	24.2	2	58	10.6	315
<i>Cylicocylus elongatus</i>	76.9	14.1	1	36	12.7	141
<i>C. insigne</i>	100	26.8	2	57	15.0	348
<i>C. leptostomum</i>	100	18.3	1	38	12.6	238
<i>C. nassatus</i>	100	174.8	69	226	46.6	2272
<i>C. ashworthi</i>	100	71.0	16	149	35.3	923
<i>Parapoteriostomum euproctus</i>	30.8	5.8	4	8	2.9	23
<i>P. mettami</i>	30.8	1.5	1	2	0.8	6
<i>Poteriostomum imparidentatum</i>	23.1	1.3	1	2	0.6	4
<i>Petrovinema poculatum</i>	23.1	2.3	1	5	1.4	7
<b>Ascaridae</b>						
<i>Parascaris equorum</i>	38.5	1.8	1	3	1.0	9
<b>Habronematidae</b>						
<i>Habronema muscae</i>	69.2	6.3	1	19	5.4	57
<b>Anoplocephalidae</b>						
<i>Anoplocephala perfoliata</i>	7.7	3.0	3	3	1.0	3
<b>Gasterophilidae</b>						
<i>Gasterophilus intestinalis</i>	23.1	1.7	1	2	0.8	5

were found in 92.3–100 % of horses examined, dominated in the parasite community composing 94.3 % of all parasite specimens found. *P. equorum* and *H. muscae* were of 38.5 % and 69.2 % prevalence, respectively. *A. perfoliata* and larvae of *G. intestinalis* were recorded in 7.7 % and 23.1 % horses, respectively.

In general the relative intensity of nematode infection was high. The mean number of specimens of a given species from the subfamily Strongylinae varied from 1.8 to 10.5 (table 3), while that from Cyathostominae was 1.0–174.8. The mean number of ascarids per horse was  $1.8 \pm 1.0$ , while that of habronematids was  $6.3 \pm 5.4$  (table 3). Six strongylids species (*C. nassatus*, *C. catinatum*, *C. longibursatus*, *C. minutus*, *C. ashworthi*, *C. calicatus*) made up 80.4 % of total strongylids in stabled mares examined. The mean number of specimens per horse was from 69.0 (*C. calicatus*) to 174.8 (*C. nassatus*). The mean number of specimens of other strongylids species was less than 36.5. *A. perfoliata* was recorded in one horse (7.7 %), while the prevalence of *G. intestinalis* was 23.1 %, with 1–2 larvae found (mean 1.7).

Prevalence and intensity of the infection of parasites grouped by the family and the number of species of the GI-parasites in the wild and stabled Polish primitive horses are given in table 4.

**Table 4.** Prevalence and Intensity of GI-parasites infection of Polish primitive horses (*Equus caballus*), n = 29, in the Roztocze National Park, Poland, (April 2008)

**Таблица 4.** Экстенсивность и интенсивность инвазии желудочно-кишечными паразитами коника польского (*Equus caballus*), n = 29 в Розточанском национальном парке, Польша (апрель 2008)

Parasites	Wild horses (n = 16)			Stabled horses (n = 13)		
	EI, %	Specimens per infected horse	Total number of species	EI, %	Specimens per infected horse	Total number of species
Gasterophilidae	56.3	2.7	1	23.1	1.7	1
Anoplocephalidae	37.5	2.5	1	7.7	3.0	1
Ascarididae	56.3	5.1	1	38.5	1.8	1
Habronematidae	43.8	11.1	1	69.2	6.3	1
Strongylinae	100	19.3	6	100	22.7	6
Cyathostominae	100	734.3	25	100	897.5	18

## Discussion and conclusions

In wild mares, their foals and stabled mares the prevalence of *Parascaris* infection counted by EPG was 25 %, 71.4 % and 15.4 %, respectively. Four mares (two from the wild and two from the stabled group) and five wild foals had positive ascarid egg counts. These data were confirmed by worm counts — 56.3 % in the wild harem and 38.5 % in stabled horses. Similar prevalence of *Parascaris* infection in mares was revealed in helminth surveys in horses from small farms in Poland (Gawor, 1996).

*Strongyloides westeri* eggs were found exclusively in foals (57.1 %). Infection with this parasite in foals of 5 months old was recorded in other surveys (Lyons et al., 1973; Mirck, 1975).

In both groups of horses the prevalence of strongylids infection was 100 %. The number of specimens was from 1.0 to 159.1 in wild and 1.3 to 174.8 in stabled horses. In wild horses from 17 to 29 (mean  $21.2 \pm 3.9$ ) of GI-parasites species were found; in stabled horses 16–21 ( $18.8 \pm 2.3$ ). High worm counts of strongylids in stabled horses is a result of management conditions. When horses are kept in the fenced pasture strongylids infection is transmitted most efficiently (Kornas et al. 2006).

Six common species of Strongylinae were found in both groups (*S. vulgaris*, *S. edentatus*, *Triodontophorus serratus*, *T. brevicauda*, *T. tenuicollis*, *Craterostomum*

*acuticaudatum*). 10 species of the Cyathostominae formed the core of GI parasite community for both horse groups (*Cyathostomum catinatum*, *Coronocyclus coronatus*, *Cylicostephanus calicatus*, *C. minutus*, *C. longibursatus*, *C. goldi*, *Cylicocyclus insigne*, *C. leptostomum*, *C. nassatus*, *C. ashworthi*).

25 species of cyathostomes were revealed, with 18 species (*C. catinatum*, *C. pateratum*, *C. coronatus*, *C. labiatus*, *C. labratus*, *C. calicatus*, *C. minutus*, *C. longibursatus*, *C. goldi*, *C. elongatus*, *C. insigne*, *C. leptostomum*, *C. nassatus*, *C. ashworthi*, *C. euproctus*, *Parapoteriostomum mettami*, *Poteriostomum imparidentatum*, *Petrovinema poculatum*) common for both groups of horses (table 5).

The present results are comparable with the earlier studies of Polish primitive horses which breed under natural and stabled conditions similar to that in the Roztocze National Park.

A total of 35 gastro-intestinal parasite species were recorded from wild and stabled Polish primitive horses from the Roztocze National Park (this study) in comparison with 28 species found in the Popielno Forest Reserve (Slivinska et al., 2009 a). Such results could have been caused by similar conditions for wild horses in both reserves and the same season of year and method of parasite survey.

**Table 5. Species composition of the gastro-intestinal parasites in Polish primitive horses from the Roztocze National Park (this study) and the Popielno forest reserve (Slivinska et al., 2009)**

**Таблица 5. Видовой состав желудочно-кишечных паразитов коника польского из Розточанского национального парка (настоящее исследование) и лесного заповедника в Попельно (Сливинская и др., 2009)**

Species of parasite	Present study		Popielno, 2007 Wild horses (n = 11)
	Wild horses (n = 16)	Stabled horses (n = 13)	
<i>Strongylus vulgaris</i>	+	+	+
<i>S. edentatus</i>	+	+	-
<i>Triodontophorus serratus</i>	+	+	+
<i>T. brevicauda</i>	+	+	-
<i>T. tenuicollis</i>	+	+	-
<i>Craterostomum acuticaudatum</i>	+	+	-
<i>Cyathostomum catinatum</i>	+	+	+
<i>C. pateratum</i>	+	+	+
<i>Coronocyclus coronatus</i>	+	+	+
<i>C. labiatus</i>	+	+	+
<i>C. labratus</i>	+	+	+
<i>Cylicostephanus calicatus</i>	+	+	+
<i>C. minutus</i>	+	+	+
<i>C. hybridus</i>	+	-	-
<i>C. longibursatus</i>	+	+	+
<i>C. goldi</i>	+	+	+
<i>C. bidentatus</i>	+	-	+
<i>Cylicocyclus radiatus</i>	+	-	-
<i>C. elongatus</i>	+	+	+
<i>C. insigne</i>	+	+	+
<i>C. leptostomum</i>	+	+	+
<i>C. nassatus</i>	+	+	+
<i>C. ashworthi</i>	+	+	+
<i>C. ultrajectinus</i>	+	-	+
<i>Cylicodontophorus bicoronatus</i>	+	-	+
<i>Parapoteriostomum euproctus</i>	+	+	+
<i>P. mettami</i>	+	+	+
<i>Poteriostomum imparidentatum</i>	+	+	+
<i>P. ratzji</i>	+	-	-
<i>Petrovinema poculatum</i>	+	+	-
<i>Gyalocephalus capitatus</i>	+	-	+
<i>Parascaris equorum</i>	+	+	+
<i>Habronema muscae</i>	+	+	+
<i>Oxyuris equi</i>	-	-	+
<i>Anoplocephala perfoliata</i>	+	+	+
<i>Gasterophilus intestinalis</i>	+	+	+
Total number of species	35	28	28

Climatic conditions are different for both reserves in Poland. The Popielno Forest Reserve is situated in north-eastern part of Poland within the geographical region of Masuria. Masuria has a temperate climate with cold winters and warm summers. The weather there is cooler than in most parts of Poland, and area also has some snow during the winter. The area is usually frozen from December to the end of April. The Roztocze National Park is situated in the east-central Poland. The Roztocze area is characterized by the continental climate, with air temperature varying from  $-30^{\circ}\text{C}$  in the winter, to  $+30^{\circ}\text{C}$  in the summer (Kondracki, 2000; Kozuchowski, 2011). Differences in climate in both reserves are possibly a reason for different results obtained in both studies.

In horses from Roztocze and Popielno reserves, higher helminth diversity is connected with lower relative intensity of the parasite infection. The mean number of specimens of given strongylid species varied from 1.5 to 11.0 in this study and 1.9 to 2.5 in Polish primitive horses in Popielno, while cyathostome species from 1.0 to 134.7 and 1.3 to 166.1 in this study and in Popielno, respectively. However, the earlier studies of stabled Polish primitive horses (Gawor, 2000) reported similar prevalence of large strongyles to the present findings, with *Strongylus* spp. forming up to 5 % of Strongylidae population. Six species of Strongylinae in horses from Roztocze and two species in Popielno horses were representatives of strongylids populations. It is significant that studies in both reserves in Poland were performed during early spring. In a northern climate at this time of year strongylids parasites are emerging from arrested development (Cyathostominae) or completing their maturation (Strongylinae), and egg and worm counts are at their annual peak (Herd, 1986). Our findings are confirmed by the results of previous surveys on dynamics of Strongylidae in Poland (Betlejewska, 2000; Romaniuk et al., 2002; Kornas et al., 2006).

In horses from both reserves, the dominant gastro-intestinal group (in terms of prevalence and intensity of infection) was the family Strongylidae.

Infection by *Parascaris equorum*, *Anoplocephala perfoliata* and *Gasterophilus intestinalis* in horses from the Roztocze National Park was lower than in those from the Popielno Forest Reserve (48.3, 24.1, 41.4 % in Roztocze and 63.6, 72.2, 90.9 % in Popielno, respectively).

The lower prevalence of infection with *Anoplocephala perfoliata* in horses from the Roztocze National Park than in the Popielno Forest Reserve could be explained by the high dependence of *A. perfoliata* eggs to humidity in the environment (Meana, 2005). Present results are comparable with the earlier studies in Poland (Romaniuk et al., 2001; Kornas et al., 2006) and in other countries (Gasser et al., 2005). Disparity between results of fecal examination and worm count for cestodes in wild and stabled mares and foals in the Popielno Reserve was recorded (Slivinska et al., 2009 b). Authors concluded that there is no reliable method of tapeworm infection diagnostics in the living horses. The negative results of faecal examination cannot exclude the existence of infection with these parasites. Method of diagnostic deworming with per rectum gathering of faeces used in our study gives prospects for improved diagnosis of tapeworm infections in the living horses.

Infection by *Habronema muscae* of horses in Roztocze was higher than in Popielno (55.2 % and 18.2 %, respectively). Horses in the Roztocze National Park were not infected by *Oxyuris equi*, while in the Popielno Reserve 23.1 % were found infected.

Our findings that few strongylid cyathostome species constitute the core of the gastro-intestinal community in the wild Polish primitive horse are confirmed by results of helminth surveys conducted in other horse species in Poland (Romaniuk et al., 1983, 2001; Gawor, 2000), in France (Marchand et al., 2004), in Turkmen kulans *Equus hemionus* Pallas, 1775 in Ukraine and Turkmenia (Dvojnos et al., 1992) and in various breeds of domestic horses in different parts of the world (Mfitilodge, Hutchinson 1985, 1990; Reinemeyer et al., 1984; Lyons et al., 1997; Scialdo-Krecek et al., 1983; Ogbourne, 1976; Eysker, Mirck, 1986; Meana et al., 2004; Farkas, 2004).

It is important to point out that among 35 gastro-intestinal species recorded in this study, four species, i. e. *Strongylus vulgaris*, *S. edentatus*, *Anoplocephala perfoliata* and *Gasterophilus intestinalis* are of veterinary importance. It can be concluded that under the Roztocze National Park conditions anthelmintic treatment in stabled horses is necessary, however it should be performed after detailed faecal examination.

We would like to thank to Jan Słomiany from the Roztocze National Park for his great help during the study. The study was supported by Visegrad Fund, Slovakia.

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Received 16 October 2012

Accepted 1 October 2013