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SHORT COMMUNICATION

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The helminth fauna of wild and domestic ruminants in Mongolia—a review

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Abstract The helminth fauna of eight species of wild ruminants and five species of domestic ruminants sharing common grassland in Mongolia was reviewed. A total of 108 species of helminths, belonging to 40 genera, 23 families, 11 superfamilies, 6 orders and 3 classes were reported in wild and domestic ruminants in Mongolia. Several new host–helminth associations have been recorded. Twenty seven helminth species have been found in certain host species for the first time in Mongolia. These included 2 species of trematodes, 2 species of cestodes and 23 species of nematodes. Helminths that are specific for some of the examined ruminant species were determined. However, wild animals may serve as a reservoir of helminth infections for domestic animals when sharing grassland in Mongolia. The helminth fauna of the ruminants with respect to occurrence, distribution, prevalence and intensity of infection was considered for six geographic regions of Mongolia.

Keywords Parasites · Wildlife · Biodiversity · Artiodactyla

Introduction

For centuries, livestock was the most important factor contributing to the socio-economic status of the nomadic herdsmen in Mongolia. Approximately 30 million livestock such as goats, sheep, cattle, camels and horses, and 40 other mammalian species are present in Mongolia. Parasitism by helminths is of serious concern in either grazing animal husbandry or wildlife. Several studies have shown that wild-living animals may act as reservoirs of infectious agents (Simpson 2002) and parasites (Badanin 1940; Rodonaâ 1962; Asadov 1963; Petrov 1985; McManus 1996; Kjimtrup et al. 2000) of domesticated animals. Considering the difficulty of access to information on the helminth fauna of wild-living and domestic animals in Mongolia, the aim of this paper is to review the studies on cattle, sheep, goat, yak and camel, and wild ruminants including the maral (*Cervus elaphus sibiricus*), roe deer (*Capreolus pygargus*), argali (*Ovis ammon*), ibex (*Capra sibirica*), Mongolian gazelle (*Procapra gutturosa*), goitred gazelle (*Gazella subgutturosa*), Mongolian saiga (*Saiga tatarica mongolica*) and wild Bactrian camel (*Camelus bactrianus*).

Table 1 shows the helminth species found in our studies (Gongoryn 1978; Tazieva et al. 1981; Gongoriin and Kuznetzov 1986; Sharhuu 1986; Sharkhuu 2001). Considering in addition the studies of other authors on the helminth fauna of Mongolian domestic (Kopyrin 1937; Šumakovič 1937; Ivaškin 1955; Namjil 1967; Baatar 1970; Dashzeveg 1973; Sharhuu 1986) and wild ruminants (Baatar 1969; Danzhan 1978; Sharhuu 1986; Ganbold 2000), a total of 108 species of helminths belonging to 3 classes, 6 orders, 11 superfamilies, 23 families and 40 genera were registered. The following helminth species were first described in Mongolia: *Moniezia skrjabini* in sheep and goats (Baatar 1970); *Thelazia ivashkini* in cattle (Dashzeveg 1973); *Nematodirus changai* in the maral (Sharhuu 1986) and *Paradictyocaulus gutturosa* in the Mongolian gazelle (Danzhan and Ganbold 1999).

Trematode infections were mainly restricted to certain areas in Mongolia, namely, the area of the Depression of Great Lakes, and their biodiversity is very limited. For cestodes, species of the families Anoplocephalidae (39.5%) and Taeniidae (16.1%) were common. The most often recorded helminths were nematodes of the families Trichostrongylidae (55%), Protostrongylidae (7.5%), Setariidae, Habronematidae and Trichuridae (4.5%).

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Table 1 Helminth fauna of domestic and wild ruminants in Mongolia. + denote species found in the studies reviewed (Gongoryn 1978; Tazieva et al. 1981; Gongoriin and Kuznetzov 1986; Sharhuu 1986; Sharkhuu 2001)

Helminths	Domestic camel (*Camelus bactrianus*)	Cattle (*Bos taurus*)	Yak (*Poephagus grunniens*)	Sheep (*Ovis aries*)	Goat (*Capra hircus*)	Maral (*Cervus elaphus sibiricus*)	Roe deer (*Capreolus pygargus*)	Argali (*Ovis ammon*)	Ibex (*Capra sibirica*)	Mongolian gazelle (*Procapra gutturosa*)	Goitred gazelle (*Gazella subgutturosa*)	Mongolian saiga (*Saiga tatarica mongolica*)	Wild bacterian camel (*Camelus bactrianus*)
Class Trematoda													
Paramphistomum ichikawai		+[b]	+[a,b]	+[b]	+[b]								
Paramphistomum sp.					+[b]								
Liorchis scotiae		+[b]	+[a,b]	+[b]	+[b]								
Orientobilharzia turkestanica	+[b]	+		+	+[b]								
Class Cestoda													
Moniezia expansa				+	+	+[a,b]	+[b]	+[b]	+[b]	+[a,b]			
M. benedeni				+	+			+[b]	+[b]	+[a,b]			
M. skrjabini	+[a,b]			+	+								
M. alba		+[b]	+										
M. autumnalia		+[b]	+[a,b]		+								
Moniezia sp.					+[b]								
Avitellina centripunctata			+[a,b]	+	+[b]							+[b]	
Thysaniezia giardi		+	+	+	+								
Taenia hydatigena larva		+		+	+	+	+[b]	+[b]	+[b]				
T. ovis larva				+[b]									
T. saginata larva		+	+										
Multiceps multiceps larva		+	+	+	+			+[b]	+				
Echinococcus granulosus larva	+	+	+	+	+			+[b]	+[b]	+[a,b]			+[a,b]
Class Nematoda													
Trichuris skrjabini	+	+	+	+[b]	+		+[b]	+[b]	+			+[b]	
T. ovis		+		+	+			+[b]	+	+	+		
T. spiricollis					+[b]								
Trichuris sp.					+[b]								
Skrjabinema ovis			+[a,b]	+				+[b]		+	+[b]		
S. caprae					+[b]				+[a,b]				
S. chubuki							+[a,b]						
S. dserani											+[b]		
S. skrjabini												+[a,b]	
Parabronema skrjabini	+	+	+	+	+	+	+	+[b]	+[a,b]	+[a,b]	+[b]	+[b]	+[a,b]
Thelazia gulosa		+	+										
Th. skrjabini		+	+										
Bunostomum trigonocephalum		+		+	+								
B. phlebotomum		+[b]	+										
Chabertia ovina	+	+	+	+	+			+[b]	+[b]	+[a,b]		+[b]	
Oesophagostomum venulosum						+[b]		+[b]					
Oe. Radiatum		+	+										
Setaria capreola							+[b]						

Table 1 (Contd.)

Helminths	Domestic camel (*Camelus bactrianus*)	Cattle (*Bos taurus*)	Yak (*Poephagus grunniens*)	Sheep (*Ovis aries*)	Goat (*Capra hircus*)	Maral (*Cervus elaphus sibiricus*)	Roe deer (*Capreolus pygargus*)	Argali (*Ovis ammon*)	Ibex (*Capra sibirica*)	Mongolian gazelle (*Procapra gutturosa*)	Goitred gazelle (*Gazella subgutturosa*)	Mongolian saiga (*Saiga tatarica mongolica*)	Wild bacterian camel (*Camelus bactrianus*)
Se. altaica						+[b]							
Se. digitata		+[b]											
Setaria sp.											+[b]		
Haemonchus contortus		+	+	+	+			+[b]		+			
Marshallagia marshalli					+[b]			+	+	+[b]			
M. mongolica	+	+		+	+			+[b]	+[b]	+	+	+[b]	
M. dentispicularis					+			+[a,b]	+[a,b]	+[a,b]	+	+[b]	
M. skrjabini	+[a,b]			+[b]				+[a,b]	+[a,b]	+[a,b]			
M. shumakovichi											+[b]		
Ostertagia buriatica		+	+	+	+			+[a,b]	+[a,b]	+		+[a,b]	
O. circumcincta				+	+				+				
O. dahurica	+[a,b]	+	+	+	+		+[a,b]	+[b]	+[a,b]	+[b]	+	+[a,b]	
O. leptospicularis							+[b]						
O. occidentalis					+			+[b]	+[b]				
O. orloffi	+	+	+	+	+			+[b]	+[a,b]	+[b]			
O. ostertagi		+	+[b]										
O. trifurcata					+			+[b]					
Spiculopteragia dagestanica							+						
Teladorsagia kasachstanica	+[b]	+[b]	+[b]	+	+[a,b]			+[a,b]	+[a,b]	+[b]		+[a,b]	
Skrjabinagia kolchida							+[b]						
Skrjabinagia lyrata								+[b]	+[b]				
Trichostrongylus axei		+	+	+	+		+	+[b]					
Tr. colubriformis	+	+	+	+	+		+[b]	+[b]	+[b]	+[a,b]		+[b]	
Tr. probolurus	+	+		+	+		+[b]	+[b]	+[a,b]	+	+[b]	+[b]	
Tr. capricola							+[b]	+[a,b]					
Cooperia surnabada	+	+	+										
C. oncophora	+	+	+										
Nematodirus andreevi			+[b]		+[a,b]				+[a,b]				
N. archari					+[b]			+[b]					
N. dogieli				+	+[b]			+[b]	+[b]				
N. gazellae								+[b]		+[a,b]		+[b]	
N. helvetianus		+											
N. oiratianus	+	+	+	+	+		+	+[b]	+[b]	+	+[b]	+	
N. schulzi				+	+[a,b]			+[b]					
N. shumakovichi												+[a,b]	
N. spathiger								+[b]					
N. sugatini									+[b]			+[a,b]	
N. abnormalis								+					
N. changai						+[a,b]							
N. davtiani		+							+				
Nematodirus sp.					+[b]			+					
Nematodirella longissimespiculata		+	+[b]	+	+			+[b]		+[b]	+[b]		
Ne. cameli	+												
Ne. gazelli										+[b]		+[b]	
Dictyocaulus filaria				+	+[b]								

D. eckerti							+																	
D. viviparus		+							+															
Protostrongylus hobmaieri					+	+																		
P. raillieti					+																			
P. caprae																								
Skrjabinocaulus sofievi																								
Spiculocaulus leuckarti																								
S. orloffi																								
Elaphostrongylus panticola																								
Number of helminth species																								
Recorded in our own studies	17		37	30		36	45	8		17		38	31	20		12		17		2			
reviewed																								
Recorded in other studies	23		36	31		53	35	6		6		2	6	19		1		-		-			
Total registered in Mongolia	27		48	41		58	54	13		21		39	34	29		12		17		2			

[a]New host
[b]First record in Mongolia

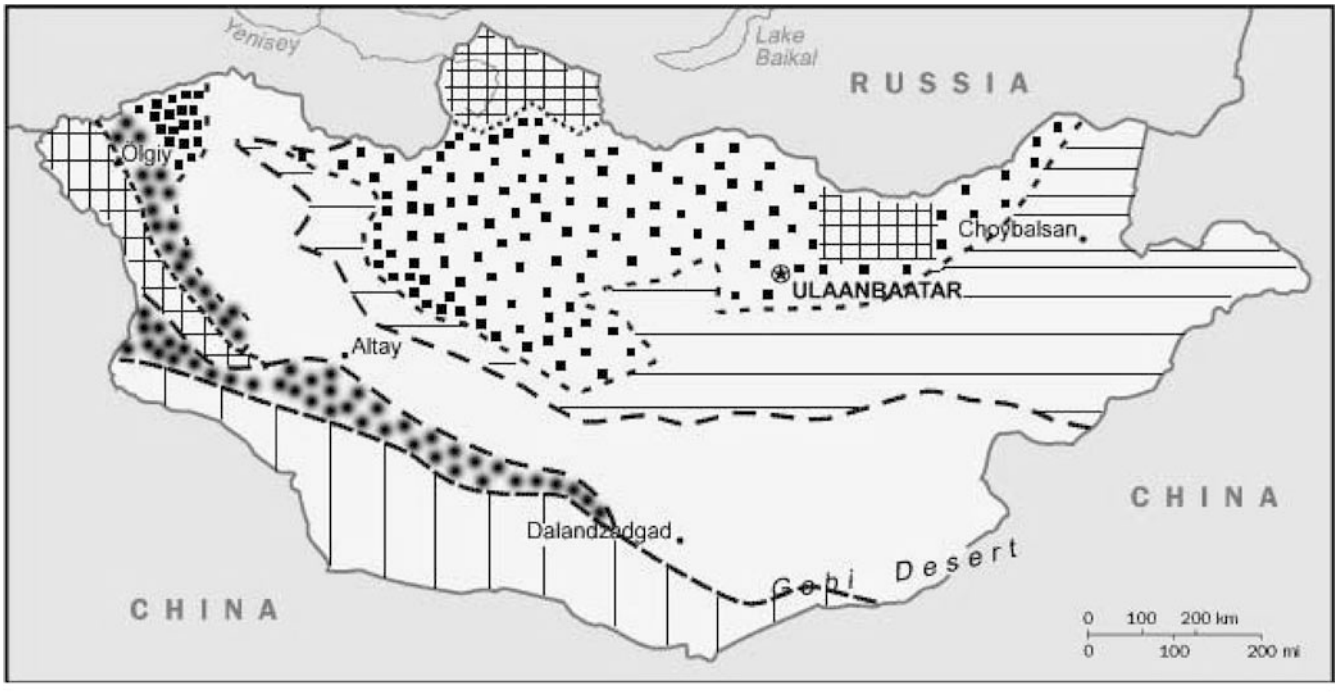
According to their location in the host, 80 species were recovered from the digestive tract, 10 from the lungs, 6 from the chest and abdominal cavities (*Setaria altaica, Se. capreola, Se. cervi, Se.digitata*, *Se. labiatopapillosa*, *Setaria* sp.), 2 from the skin (*Stephanofilaria stilesi*, *Onchocerca* sp.), 3 from the lacrymal glands (*Thelazia gulosa, Th. ivashkini, Th. skrjabini*), and 1 each from the liver (*Echinococcus granulosus* larva: *Echinococcus hydatidosus*), the heart (*Taenia ovis* larva: *Cysticercus ovis*), the brain and spinal cord (*Multiceps multiceps* larva: *Coenurus cerebralis*), the dura mater and pia mater of the brain (*Elaphostrongylus panticola*), the skeletal muscle (*Taenia saginata* larva: *Cysticercus bovis*) and the portal vein (*Orientobilharzia turkestanica*). Sixty-seven species are parasites of both wild and domesticated ruminants. These helminth species are named common helminths and were determined with similarity indexes of 55.5% in the argali, 33% in the ibex, 46.5% in cattle and the yak, 39.6% in the Mongolian gazelle, 56.5% in the goat and 36.5% in the camel. The higher the similarity index, the closer is the interrelation of helminths between domestic and wild ruminants.

The following species of helminths reported in Mongolia were considered specific to their hosts: *Dipetalonema evansi, Dictyocaulus cameli* and *Nematodirella cameli* to the Bactrian camel; *Taenia saginata* larvae, *Thelazia gulosa, Th. ivashkini, Th. skrjabini, Stephanofilaria stilesi, Onchocerca* sp. and *Dictyocaulus viviparus* to cattle and yak; *Setaria altaica, Elaphostrongylus panticola* and *Nematodirus changai* to the maral; *Setaria capreola, Skrjabinocaulus sofievi*, *Skrjabinagia kolchida*, *Ostertagia antipini* and *Spiculopteragia dagestanica* to the roe deer; *Spiculocaulus leuckarti and Nematodirus archari* to the argali; *Skrjabinema caprae, Protostrongylus caprae* and *Neostrongylus zvetkovi* to the ibex, *Setaria* sp., *Paradictyocaulus gutturosa, Skrjabinodera saiga, Nematodirus gazellae* and *Nematodirella gazelli* to the gazelle species.

Although prevalence and intensity of helminth infection were studied in each animal, here the genera of helminths are considered only on the average of the hosts with respect to their occurrence throughout the ecological regions of Mongolia. Information about geography and climatic conditions in each region were reported according to the data given by Gungaadash (1984) and the National Atlas (Anonym 1990). On the basis of our review of the helminth fauna, the existence, distribution, prevalence and intensity of infection in the various geographic regions of Mongolia are detailed below (see Fig. 1).

1. High mountains (Huvsgul and Altai)

Long, cold winter lasts in the area. Thirty helminth species, including 5 species of cestodes and 25 species of nematodes, were identified in this region. *Haemonchus* and *Bunostomum* spp. (prevalence: 5.4–45.5%; average intensity: 11–689), *Oesophagostomum* spp. (25–36%; 59–230) and *Dictyocaulus* spp. (0.8–31.6%; 6–116) were found. Trematodes with fresh-water molluscs as intermediate hosts were not reported.



Semi-Desert (semi arid) helminth fauna locality

Desert helminth fauna locality

High mountain helminth fauna locality

Steppe helminth fauna locality

Hangai-Hentii premountain chains helminth fauna locality

Altai premountain helminth fauna locality

Fig. 1 Helminth fauna localities of ruminants in Mongolia

2. Altai pre-mountains

This region includes the Mongol and Gobi-Altai mountain chains with an altitude of 2,000–3,000 m (absolute height 3,500–4,374 m) above sea level. Average annual precipitation is 100–300 mm, January temperature: −25 to −30 °C; July temperature: +17 to +18 °C. Fifty-six species of helminths were registered in this region, 11 species were cestodes, and 45 species were nematodes. *Haemonchus, Oesophagostomum* and *Bunostomum* spp. were absent in this region. There were also no trematodes that require fresh-water molluscs in their lifecycle.

3. Hangai-Hentii pre-mountain chains

The altitude of this region is 1,500–2,000 m above sea level. Annual precipitation is 200–300 mm on average; the temperatures in January are −25 to −30 °C and in July +15 to +20 °C. Sixty-two helminth species, including 2 trematode, 12 cestode and 48 nematode species, were registered. *Paramphistomatidae* trematodes and nematodes such as *Trichuris* (10.4–84%; 5–416), *Bunostomum, Chabertia* (5.2–83%; 18–390), *Oesophagostomum, Ostertagia* (50–91.1%; 105–60,000), *Marshallagia* (50.6–96%; 132–2,620), *Haemonchus* (28.2–100%; 120–5,660), *Cooperia* (5–79.1%; 115–21,763), *Nematodirus* (17–90%; 112–6,953), *Dictyocaulus* and *Protostrongylus* spp. were found.

4. Steppe

Steppe is found 800–1,200 m above sea level. Average annual precipitation is 120–250 mm; average temperatures are −15 to −20 °C in January and +20 to +25 °C in July. Fifty-five helminth species, including 12 species of cestodes and 43 species of nematodes, were registered

in this region. The most common infections were with *Chabertia, Ostertagia, Marshallagia* and *Nematodirus* spp. *Dictyocaulus* infections were rare, and trematodes were not found.

5. Semi-desert (semi-arid)

This region is about 1,000–1,500 m above sea level and experiences warmer and drier winters, and hotter and drier summers with, on average, 50–150 mm precipitation. Fifty-three species of helminths, including 3 species of trematodes, 12 species of cestodes and 38 species of nematodes including *Bunostomum, Chabertia, Haemonchus, Trichostrongylus* (8–60%; 12–50,000), *Oesophagostomum, Dictyocaulus* and *Ostertagia* spp. were registered here. The following nematode species were considered as indicators of this region: *Nematodirus oiratianus, Trichostrongylus probolurus, Nematodirella cameli* and *Parabronema skrjabini* (40–100%; 34–920). Animals originating from the Depression of Great Lakes in this region had a higher prevalence and intensity of helminth infections, and 42 helminth species were identified. Molluscs, which are the intermediate hosts of *Paramphistomum*, *Liorchis* and *Orientobilharzia* spp., are abundant here.

6. Desert

No trematode species, 2 species of cestodes and 25 species of nematodes were recorded in animals from this region. The high temperature and low humidity of air and soil in semi-arid and desert regions are the climatic conditions that are responsible for lower levels of some helminth infections in comparison with other localities (data not shown). The common helminth genus here is *Nematodirella* (2.6–30%; 90–3,400) in the camel and goats.

Conclusions

In conclusion, the helminth fauna of domestic and wild ruminants in Mongolia is rich, with varying diversity as to occurrence, distribution, prevalence and intensity of infection in the geographic regions. The knowledge of the helminth fauna in relation to hosts and geographical regions is very important, particularly with respect to control measures in domesticated animals.

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