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HELMINTH FAUNA OF ROE DEER (*CAPREOLUS CAPREOLUS*) IN UKRAINE: BIODIVERSITY AND PARASITE COMMUNITY

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Helminth Fauna of Roe Deer (*Capreolus capreolus*) in Ukraine: Biodiversity and Parasite Community. Kuzmina T. A., Kharchenko V. A., Malega A. M. — The results of survey of helminth species diversity of roe deer (*Capreolus capreolus* Linnaeus, 1758) from nine regions of Ukraine are presented. Ninety-two roe deer from Chernigivska, Zhytomyrska, Kyivska, Vinnytska, Rivnenska, Ternopilska, Khmelnitska, Sumska and Cherkasska regions were examined by the partial helminthological dissection. Totally 30,753 helminth specimens were collected and identified by morphological criteria. Prevalence of roe deer infection with helminths was 92.4%. Sixteen helminth species (1 of the Class Trematoda, 2 — of Cestoda and 13 — of Nematoda) were found. *Setaria cervi* (prevalence — 10.9%) was found in visceral cavity. *Dictyocaulus eckerti* (6.9%) and *D. capreolus* (2.3%) was found in lungs. *Taenia hydatigena* larvae (2.3%) were found in mesentery. *Paramfistomum cervi* (10.9%), *Haemonchus contortus* (57.6%), *Ashworthius sidemi* (40.2%), *Marshallagia marshalli* (15.2%), *Nematodirus oiratinus* (1.1%), *Trichostrongylus axei* (3.3%) were found in stomach. *Moniesia expansa* (1.1%), *Bunostomum phlebotomum* (10.9%) were found in small intestine. *Trichocephalus ovis* (18.5%), *Oesophagostomum venulosum* (7.6%) and *O. dentatum* (1.1%) were found in caecum. *Chabertia ovina* (28.3%) was found in large intestine. Forty-four helminth associations were separated in the roe deer examined.

Key words: roe deer, *Capreolus capreolus*, helminth biodiversity, Ukraine.

Гельминтофауна косули (*Capreolus capreolus*) в Украине: видовой состав и паразитарное сообщество. Кузьмина Т. А., Харченко В. А., Малега А. М. — Представлены результаты исследования видового разнообразия гельминтов косули (*Capreolus capreolus* Linnaeus, 1758) из 9 регионов Украины. Методом частичного гельминтологического вскрытия были исследованы 92 косули из Черниговской, Житомирской, Киевской, Винницкой, Ровенской, Тернопольской, Хмельницкой, Сумской и Черкасской областей. Собрано и определено до вида по морфологическим критериям 30 753 экз. гельминтов. Экстенсивность инвазии (ЭИ) исследованных косуль гельминтами составила 92,4%. Обнаружено 16 видов гельминтов (1 вид трематод, 2 вида цестод и 13 нематод). *Setaria cervi* (ЭИ — 10,9%) обнаружены в полости тела косуль; *Dictyocaulus eckerti* (EI — 6,9%) и *D. capreolus* (2,3%) — в легких. Личиночные стадии *Taenia hydatigena* (2,3%) выявлены на брыжейке. *Paramfistomum cervi* (10,9%), *Haemonchus contortus* (57,6%), *Ashworthius sidemi* (40,2%), *Marshallagia marshalli* (15,2%), *Nematodirus oiratinus* (1,1%) и *Trichostrongylus axei* (3,3%) обнаружены в желудке. *Moniesia expansa* (1,1%), *Bunostomum phlebotomum* (10,9%) зарегистрированы в тонком кишечнике. *Trichocephalus ovis* (18,5%), *Oesophagostomum venulosum* (7,6%) и *O. dentatum* (1,1%) обнаружены в сычуге. *Chabertia ovina* (28,3%) выявлена в толстом кишечнике косуль. Выделено 44 ассоциаций гельминтов.

Ключевые слова: косули, *Capreolus capreolus*, гельминтофауна, Украина.

Introduction

Roe deer (*Capreolus capreolus* L., 1758) is one of the most popular game animals in Ukraine. Every year thousands of roe deer are bagged. The population of roe deer has shown a tendency to decrease during the last decade, due to increase of poaching (Mezhzherin, 2008) and decrease of game-preserve areas in Ukraine. According to official data of the Forestry State Department of Ukraine, now the total roe deer population in Ukraine is about 131.8 thousands individuals (Statistic..., 2008).

Roe deer are parasitized by a variety of helminths, particularly nematodes. Helminth biodiversity of roe deer in European countries with significant populations of these cervids was intensively studied (Nickel et al., 1978; Vetýška, 1980; Govorka et al., 1988; Zaffaroni et al., 1996, 2000; Rossi et al., 1997; Panadero et al., 2001). Fauna of roe deer parasites has been investigated in the neighboring countries: in Belorussia (Kochko, Yakubovski, 2000; Shimalov, Shimalov, 2003; Anisimova et al., 2008), Poland (Dróżdż et al., 1987, 1992; Demiaszkiewicz et al., 2001), Czech and Slovakia (Kotrlá, Kotrlý, 1980; Vetýška, 1980), western regions of Russia (Muromtsev, 2008). However, the helminth fauna of roe deer in Ukraine has not been studied yet. Fragmentary data on roe deer parasites in Ukraine have been published in 50–70th years of the previous century (Rukhliadev, 1964; Nazarova, 1967; Dvojnos, Pogrebniak, 1977). Modern state of helminth fauna was briefly investigated by V. A. Kharchenko (2004) and V. A. Kharchenko et al. (2004).

Mild and humid climatic conditions of the Forest and Forest-Steppe zones of Ukraine and abundance of wild ungulates promote development, circulation and spreading of a variety of helminth parasites in natural ecosystems. Keeping of a number of wild ungulates at restricted areas of natural and hunting reserves facilitates the rising level of animal infection. This state of parasitological situations at natural and hunting reserves in Ukraine requires detailed investigation, monitoring and control.

In this study, we present the results of a survey of species diversity of roe deer helminths from nine regions of Ukraine. Analysis of the helminth communities structure and distribution of various helminths in studied regions was also performed.

Material and methods

Ninety-two roe deer of various age from hunting areas of nine regions of Ukraine (fig. 1): Chernigivska (18 animals), Zhytomyrska (32), Kyivska (15), Vynnytska (5), Rivnenska (10), Ternopilska (3), Khmelnitska (2), Poltavska (3), Sumska (2) and Cherkasska (2) regions were examined (fig. 1).

Roe deer were collected at hunting grounds during hunting seasons (November — December) of years 2002–2008. The animals killed by hunters were examined *post mortem* by the partial helminthological dissection (Ivashkin et al., 1971). Helminths were collected from separate parts of intestine by successive washing of the intestine content in saline (Ivashkin et al., 1971), and fixed in 70° ethanol. Prior to identification helminths were cleared in 80% phenol-glycerin solution. Identification was performed by morphological criteria under light microscope (Boev et al., 1963; Govorka et al., 1988; Gibbons, Höglund, 2002). Totally 30,753 helminth specimens were collected and identified.

Data summaries and descriptive statistic analyses were calculated using the Microsoft™ Excel.

Fig. 1. Map of Ukraine showing the locality of the hunting areas studied.

Рис. 1. Карта Украины с обозначением исследованных охотничьих угодий.

Results

Prevalence of the roe deer infection with helminths in the present study was 92.4%. No helminths were found in lung and intestine of 7 animals.

Sixteen helminth species were found: 1 species of Trematoda, 2 — of the Cestoda and 13 — of Nematoda (tabl. 1).

In roe deer, the helmitnth species were found in associations of 1–2 up to 8 species per one host. Forty-four helminth associations were separated in the roe deer examined (tabl. 2)

Twenty roe deer (21.7% of the total number of studied animals) were found to be infected with one helminth species; 23 roe deer (25%) — with two species, 20 roe deer (21.7%) — with three species, 15 roe deer (16.3%) — with four species, 3 roe deer (3.3%) — with 5 species, and one roe deer was parasitized with 8 helminth species.

Bray-Curtic claster analysis shows the most common helminth associations in roe deer examined (fig. 2)

Biodiversity of helminth fauna significantly differed in separate regions of Ukraine (fig. 3). The results of the cluster analysis demonstrated the similarity of the helminth fauna in roe deer from northern regions of Ukraine (Chernigivska, Kyivska, Zhytomyrska and Rivnenska) and its significant difference from the helminth fauna of roe deer from regions of the central Ukraine.

Discussion

The results obtained in the present study revealed high prevalence of roe deer infection with helminths in Central and Northern parts of Ukraine — more than 90% of animals examined were found to be infected. Similar data were reported by researchers from neighboring countries, such as Belorussia (Anisimova et al., 2008; Shimalov, Shimalov, 2002; Kochko, Jakubovsky, 2000), Poland (Dróżdż et al., 1993, 1997), Czechoslovakia (Kotrlá, Kotrlý, 1980). However, the intensity of roe deer infection was rather low — in average from dozens to several hundreds of helminths per host. This can explain the absence of clinical signs of helminthoses in roe deer from most of hunting grounds in Ukraine. Likewise, we can observe that high prevalence and moderate intensity of helminth infection is typical for parasites of wild cervids in other European countries (Ambrosi et al.,

Table 1. Helminth species found in roe deer (*Capreolus capreolus*) in Ukraine
Таблица 1. Виды гельминтов, обнаруженных у косуль (*Capreolus capreolus*) в Украине

Helminth species	Localisation	Prevalence, %	Intensity
Paramfistomum cervi (Zeder, 1790)	stomach	10.9	1–53
Taenia hydatigena (Pallas, 1766)	mesentery	2.3	2–3
Moniezia expansa (Rud., 1810)	small intestine	1.1	2
Trichocephalus ovis Abidgaard, 1795	caecum	18.5	1–18
Bunostomum phlebotomum (Railliet, 1900)	small intestine	10.9	1–26
Chabertia ovina (Fabricius, 1788)	large intestine	28.3	1–243
Oesophagostomum dentatum (Rud., 1803)	large intestine	1.1	1
O. venulosum (Rud., 1809)	caecum	7.6	1–3
Dictyocaulus eckerti (Bloch, 1782)	lungs*	6.9	3–68
D. capreolus Gibbons & Hoglund, 2003	lungs*	2.3	14
Setaria cervi (Rud., 1819)	visceral cavity	10.9	1–14
Haemonchus contortus (Rud., 1803)	stomach	57.6	1–3,500
Ashworthius sidemi Schulz, 1933	stomach	40.2	3–7,000
Trichostrongylus axei (Cobbold, 1879)	stomach	3.3	4–16
Marshallagia marshalli (Ransom, 1907)	stomach	15.2	1–5
Nematodirus oiratinus Rajevskaja, 1929	stomach	1.1	3

* Lungs were missed in material from 48 of roe deer examined.

Table 2. Association of the helminth species found in roe deer in Ukraine

Таблица 2. Ассоциации видов гельминтов косуль Украины

Species	Helminth associations (number of members)																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
H. contortus	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X		X
A. sidemi	X									X	X	X	X	X	X	X	X				X	
S. cervi		X								X								X		X	X	X
P. cervi											X											
M. marshalli			X									X									X	X
C. ovina				X			X	X	X				X					X				
B.phlebotomum					X		X							X								
T. ovis															X				X	X		
O. venulosum																			X			
D. eckerti								X														
D. capreolus																X						
T. axei																	X					
N. oiratinus																						
T. hydatigena									X													
M. expansa																						
O. dentatum						X																

Species	Helminth associations (number of members)																					
	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
	(3)	(3)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(5)	(5)	(5)	(5)	(7)
H. contortus	X				X	X	X	X	X	X	X	X	X					X	X			X
A. sidemi			X	X	X	X	X	X		X	X	X		X	X	X		X		X		X
S. cervi	X	X	X	X			X	X	X				X	X	X	X	X	X	X	X	X	X
P. cervi					X							X		X								
M. marshalli					X	X							X	X					X	X		
C. ovina							X				X				X	X	X		X	X	X	
B.phlebotomum		X				X									X						X	
T. ovis	X	X	X					X	X				X			X	X	X	X		X	X
O. venulosum				X					X								X	X		X	X	X
D. eckerti										X												
D. capreolus																						
T. axei										X	X											
N. oiratinus																						X
T. hydatigena												X										
M. expansa																						X
O. dentatum																						

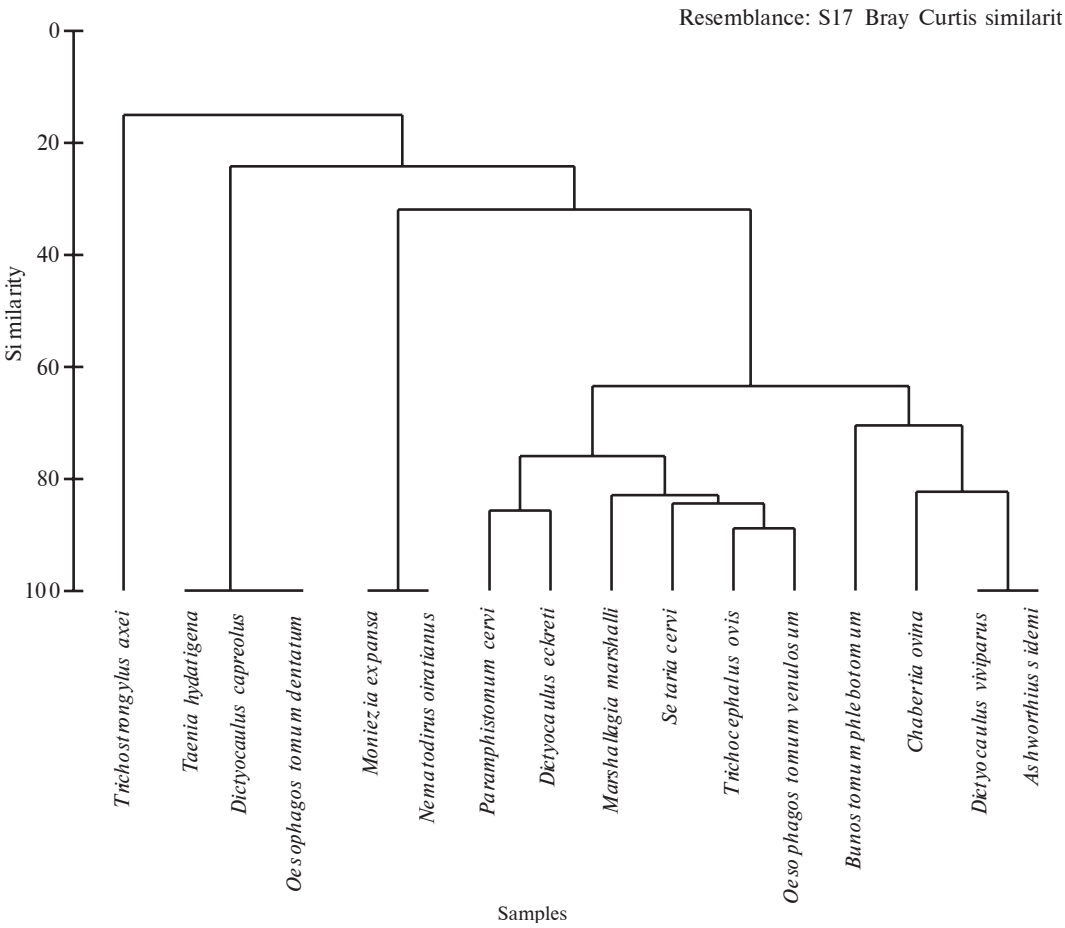

Fig. 2. Bray-Curtic claster analysis of helminth associations in roe deer.

Рис. 2. Ассоциации гельминтов косуль по результатам кластерного анализа.

1993; Dróżdż et al., 1987, 1993, 1997; Zaffaroni et al., 1996; Rossi et al., 1997; Garc a Romero et al., 2000; Sant in-Durán et al., 2004, 2008).

Most of helminths found in our study are parasites of wide range of hosts including various species of wild and domestic ungulates (Boev et al., 1963; Govorka et al., 1988). In our opinion, similarity of helminth fauna in wild and domestic ungulates can considerably effect spreading of helminthoses in game animals as well as in protected and domestic ungulates. It is worth to mention that in Ukraine the pasturelands are usually not fenced and can be grazed by both domestic and wild ungulates. This creates favorable conditions for parasite exchange between various wild and domestic animals. Occurrence of such parasites as *Trichostrongylus axei*, *Trichocephalus ovis* and *Haemonchus contortus* in wild roe deer confirm the possibility of helminth exchange between wild and domestic hosts (Dróżdż, 1989; Janèev, 1979; Kotrlá, Kotrlý, 1980; Zaffaroni et al., 1996, 2000; Rossi et al., 1997). Such an exchange influences the population abundance of roe deer and other wild ungulates' populations in Ukraine.

In the present study, the nematode *Ashworthius sidemi* was found in roe deer in all hunting areas examined. This nematode was considered to be a typical parasite of Asiatic sika deer *Cervus nippon* (Dróżdż, 1998). In the second part of XX century *A. sidemi* had been introduced in Europe with its hosts and, thereafter, colonised other species of wild ungulates (roe deer, red deer, elks, moufflons) in many European countries — Slovakia, Czechia, Poland, France etc. (Ferté et al., 2000; Dróżdż et al., 1998, 2000 a, b; Dróżdż,

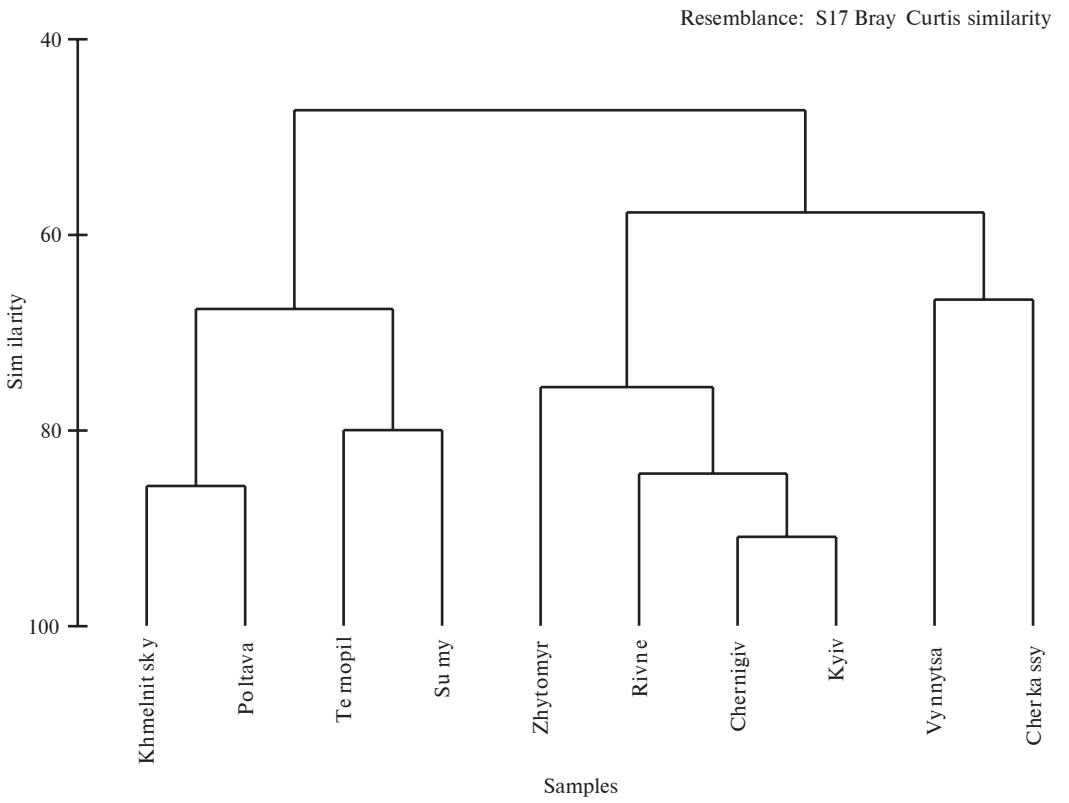

Fig. 3. Bray-Curtic claster analysis of similarity of helminth fauna in roe deer from various regions of Ukraine.
Рис. 3. Кластерный анализ сходства гельминтофауны косуль из разных регионов Украины.

2002). In Ukraine, *A. sidemi* was first registered in 1977 at the Dubno hunting ground whereto the parasite has been brought with sika deer from the Far East (Dvojnos, Pogrebniak, 1977). In the present study, *A. sidemi* was one of the main stomach parasites of the roe deer. Finding of *A. sidemi* in hunting grounds of all regions examined confirms successive spreading of this parasite in Ukraine.

Haemonchus contortus was one of the most prevalent parasites of roe deer found in the present study. The intensity of animal infection reached 5,000–7,000 specimens per host that can cause clinical signs of severe haemonchiasis and leads to death of animals. High prevalence and intensity of *H. contortus* in roe deer was observed in Italy (Zaffaroni et al., 2000), Czechoslovakia (Vetýška, 1980), Slovenia (Bidovec, 1987). We observed the simultaneous presence of *H. contortus* and *A. sidemi* in the stomach of roe deer.

Low prevalence of cestodes in roe deer was observed in the present study; *Moniezia expansa* was found only in one roe deer (1.1%) from the Chernigivska region, and larvae of *Taenia hydatigena* were found twice in the Zhytomyr region. Low prevalence of cestodes has also been observed in the countries neighboring Ukraine — in Belorussia (Kochko, Yakubovski, 2000; Shimalov, Shimalov, 2003; Anisimova et al., 2008), Slovakia (Letková et al., 2008) and Poland (Tropilo, Kiszak, 1995); this can be related to similar climatic conditions in all these countries.

In the present study we found a specimen of the nematode *Oesophagostomum dentatum,* a typical parasite of wild boars, in the large intestine of a roe deer from Zhytomyr region. We exclude the possibility of occasional transfer of parasite from wild boars during collecting and the preliminary processing of helmintological material. In our opi-nion, it can be rather an accidental parasitizing of *O. dentatum* in roe deer with low immunity.

Low prevalence of *Dictyocaulus* species in roe deer observed in our study could be explained by lack of material (lungs) that was granted by private hunters — lungs were absent in helminthological material from 49 roe deer (53.3% from the total number of animals examined). We believe that prevalence of *Dictyocaulus* in Ukraine may reach 60%, as it has been found in other European countries (Govorka et al., 1971; Panadero et al., 2001; Demiaszkiewicz et al., 2001; Cisek et al., 2003 etc.).

Thus, the present study demonstrates the similarity between the roe deer parasite fauna in Ukraine and in other European countries (Bidovec, 1987; Dróżdż et al., 1992; Kochko, Yakubovski, 2001; Shimalov, Shimalov, 2003; Anisimova et al., 2008). Investigation of roe deer helminth fauna from other regions of Ukraine is planned.

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