

**KRATAK SADRŽAJ** - Jedan od glavnih problema u kontrolisanom uzgoju divljači su parazitske bolesti. Paraziti, osim mehaničkog, toksičnog i alergijskog djelovanja, mogu biti prenosoci različitih vrsta patogenumikroorganizama. Teže infestacije divljih životinja, praćene slabom ishranom, posebno tokom zimskog perioda, mogu dovesti do pada tjelesne kondicije, nastanku uzgojnih bolesti i smrti. U radu su prikazana dosadašnja istraživanja parazitofaune kod divljih životinja na području Bosne i Hercegovine.

Ključne riječi: divljač, parazitofauna, Bosna i Hercegovina

**Abstract** - In controlled breeding, parasitic diseases represent one of the major problems of wildlife. Apart from having mechanical, toxic and allergic effects, parasites can transmit other pathogenic microorganisms. Together with poor nutrition, on winter conditions in particular, severe infestations result in worsening of the body condition, sickness and death.

The paper presents previous investigations of parasitofauna of wild animals in the area of Bosnia and Herzegovina.

Key words: wildlife, parasitofauna, Bosnia and Herzegovina

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According to data of the Office for Statistics of the Federation of Bosnia and Herzegovina (21), the country of Bosnia and Herzegovina (B&H) is located in southeastern Europe, in the western part of the Balkan Peninsula. It covers the area of 51,209.2 km\(^2\), of which the land includes 51,197 km\(^2\) and the sea 12.2 km\(^2\). Air distance by geographic latitude and longitude is: north-south 2\(^\circ\)43'30'' (314 km), and east-west 3\(^\circ\)53'41'' (309 km). There are three basic climatic zones recognized in B&H: mediterranean zone, mountain zone and area of moderate climatic zone.

B&H is a mountainous country in the mountain system of Dinarides (Dinaric Alps). Altitude up to 500 m covers 20,930 km\(^2\) (41%) of the territory, 17,400 km\(^2\) (34%) of the altitude of 500-1,000 m, and the altitude above 1,000 m covers approximately 12,900 km\(^2\) (25%) of the territory. The predominant altitude is above 200 m and covers the area of 44,450 km\(^2\) (87%). The country represents a mosaic of different types of soil and vegetation. Forests and forest land cover 2,709,769 ha (53%) territory of B&H, of which forests cover 2,209,732 ha (about 43%), and barren land 500,037 ha (about 10%). Percentage of forests in the past 30 years has decreased by 11-12%. Some reasons for shrinkage of areas under forests and forest soil were the expansion of urban areas, exploitation of minerals, expansion of agricultural areas, creation of hydroaccumulation lakes and building of the winter sport facilities (16).

The war in B&H (1992-1995) further accelerated the degradation of forests causing the forced migration of indigenous wild. Based on previous and incomplete analysis, damages in the forests are enormous, and are of the direct and indirect character. The direct damages are caused by fires, uncontrolled cutting and stealing of wood. Much more complex indirect damages are caused by the absence of preventive protection of forests during the war, which contributed to the destabilization of the forest ecosystem, making the prevention more difficult today. The emergence of diseases and pests that threaten the survival of some forests today is a natural sequence in the concatenation of biotic harmful agents.

There is a real danger of such biotic harmful agents be out of control and further spread causing even greater damage on a larger scale, since agents have no boundaries of administrative type. Despite the degradation of the forests and wild animals caused by poor industrialization, B&H remains an extraordinarily favorable area for wildlife. In recent years, wildlife has become of an economic importance worldwide, also playing a significant role in tourism. B&H has slowly been trying to join such trends. By importing animals in recent years, the efforts have been made toward the conservation of existing indigenous species. In the recent wartime, wild animals in our hunting areas significantly suffered and their number has been largely reduced so that some species such as lynx, bears and wolves has faced the extinction. In addition to the Conservation Acts, breeding measures have become an increasingly important factor in the health care of wild animals.

In the world, in controlled breeding parasitic diseases represent one of the major problems in wildlife. Apart from having mechanical, toxic and allergic effects, parasites can transmit other pathogenic microorganisms. Together with poor nutrition, on winter
conditions in particular, severe infestations result in worsening of the body condition, sickness and death (10, 13, 19). Despite being of a great importance and carried out in economically more developed countries, the study of wild animal parasites has not been conducted yet as a systematic research in B&H. The research results were confined to sporadic findings of some species, their morphology and dynamics of seasonal occurrence. In the area of B&H, there have been several studies of parasitosis of wild animals, or parasitosis is described in animals that had been shot or found dead.

Vuković and Varenika (22) in pine marten (Mustela martes) from the vicinity of Sarajevo found more specimens of Tetrathyridium bailleti, larval form of Mesocestoides lineatus. Larvae were localized in the abdominal and thoracic cavity.

Delić and Badnjević (4) describe a case of finding cysts of Coenurus cerebralis in chamois (Rupicapra rupicapra) from the hunting area "Zelengora", Foča (Eastern B&H). Before death, the chamois clinically showed signs of cenurosis manifested as movement and nervous system disorders. Other chamois having similar symptoms had died earlier, too.

Rukavina et al. (17) presented the findings of atypical form and morphology of larvae of Multiceps serialis (syn. Coenurus serialis), a developmental form of Taenia serialis, in the hare (Lepus europaeus).

Delić and Čanković (5) describe the finding of Gongylonema pulchrum in foxes (Vulpes vulpes). The authors state that G. pulchrum was discovered in several species of domestic animals, without the available literature ever quoting the foxes. Parasites were discovered in the mucosa on the lateral parts of the corpus linguae, and in the junction of the corpus and the radix linguae. Comparing the sexually mature female of G. pulchrum from the lingua with that from the esophagus of cattle and sheep, they observed no morphological differences in shape and structure of the parasite.

Delić and Ćanković (6) present the data about parasitofauna of chamois (Rupicapra rupicapra) from the area of the Treskavica mountain, in 2 males researched in 1959. On the mountain Treskavica, the chamoises live in wooded glades of 1.000-2.000 meters above the sea level, and often use water from the same sources as the domestic animals (sheep, cattle). In the brain of one male chamois, the authors reported a cyst of Coenurus cerebralis (3 cm in diameter), a larveal form of Taenia multiceps, and in the intestinal serosa a greater number of Cysticercus tenuicollis, a larveal form of Taenia hydatigena. In the content of abomasum, the authors reported Ostertagia circumcincta and Marshallagia marshalli, and in 1-2 meters of the proximal small bowel Trichostrongylus vitrinus and Trichostrongylus colubriformis. Parasitologic examination of the lungs, liver and large intestines revealed no parasites. The method of feces flotation confirmed weak to moderately strong invasion with oocysts of Eimeria arloingi and E. ninakohlyakimovae.

In another male chamois reported were two bladder Cysticercus tenuicollis, and significantly more severe infestation with gastrointestinal Strongylidae. In the abomasum, the authors reported Ostertagia circumcincta, Trichostrongylus vitrinus, Marshallagia marshalli, Haemonchus contortus, and the adult forms of Spiculopteragia sp. In the small
intestines reported were *Nematodirus spathiger*, *N. filicollis*, *Trichostrongylus vitrinus*, *T. colubriformis* and *Moniezia expansa*. The feces was investigated confirming the eggs of *Trichuris sp.*, larvae of *Protostrongylus sp.*, and oocysts of *Eimeria arloingi*.

Presented data suggest the same species of parasites exist in domestic animals, arguing they could be on a receiving end of the infestation chain.

Čanković et al. (2) find the information on parasitofauna of roe deer (*Capreolus capreolus*) gathered prior to 1962 in B&H inconclusive. The authors carried out postmortem examination of 10 deers from different hunting areas in B&H. All examined deers tested positive, and a total of 30 species of parasites were found: *Dicrocoelium dendriticum*, *Fasciola hepatica*, *Moniezia expansa*, *Cysticercus tenuicollis*, *Trichostrongylus axei*, *T. capricola*, *T. vitrinus*, *T. colubriformis*, *Ostertagia capreoli*, *O. circumcincta*, *O. ostertagi*, *O. leptospicularis*, *Teladorsagia davtiani*, *Haemonchus contortus*, *Skrjabinagia podjapolskyi*, *Spiculopteragia spiculoptera*, *Nematodirus filicollis*, *N. spathiger*, *Bunostomum trigonocephalum*, *Strongyloides papillosus*, *Capilaria bovis*, *Chabertia ovina*, *Trichocephalus ovis*, *Dictyocaulus viviparus*, *D. eckerti*, *Capreocaulus capreoli*, *Linquatula serrata* (nymphs), *Ixodes ricinus*, and *Melophagus ovinus*. The authors found the following parasites in all examined deers: *Dicrocoelium dendriticum*, *Cysticercus tenuicollis*, *Trichostrongylus axei*, *T. vitrinus*, *T. colubriformis*, *O. circumcincta*, *O. ostertagi*, *Haemonchus contortus*, *Nematodirus filicollis*, *N. spathiger*, and *Dictyocaulus filaria*. The authors gave a detailed description of the species rare in domestic ruminants: *Ostertagia capreoli*, *O. leptospicularis*, *Skrjabinagia podjapolskyi*, *Spiculopteragia spiculoptera*, *Dictyocaulus eckerti*, *Capreocaulus capreoli*.

Batistić (1) found the cysts of *Sarcocystis spp.* in the heart, tongue and skeletal muscle in high percentage (78%) in roe deer (*Capreolus capreolus*).


Delić et al. (8) examined the lungs in 35 roe deer (*Capreolus capreolus*) on 8 hunting areas in B&H from 1962 to 1965, and found the adult forms of *Capreocaulus capreoli* in 13 (37.14%), and larvae in 16 (45.7%) samples. Original drawings and photographs in the paper form give a detailed description of the extracted specimens of *C. capreoli*.
Delić et al. (9) found *Filaroides osleri* on the mucosa of the trachea and bronchi in wolf and one fox on hunting areas of "Igman", Sarajevo. The authors note that until 1965, no *F. osleri* had been registered in dogs on B&H territory.

Levi (12) examined deer from different areas of B&H. Out of 35 examined deers, one was found to have 140,000 oocysts per gram of feces. Further examination by sporulation discovered that oocysts belonged to the species of *Eimeria ponderosa*.

Rukavina et al. (18) describe two cases of cysticercosis in roe deer from hunting area "Gostovići", Zavidovići. The authors found the larvae of *Cysticercus cervi*, developing forms of *Taenia cervi*, parasites of dogs, wolves and foxes.

Čanković et al. (3) reviewed 3,634 samples of different animals between 1986-1996, and diagnosed *Trichinella spiralis* in 2,4% samples; 3,0% in wild boar, 4,5% in bear, and 0,6% in domestic pigs.

Jažić et al. (11) in 1997 noticed a higher incidence of trichinellosis in domestic and wild pigs, and the high prevalence of human trichinellosis in certain areas of B&H. According to available data in 1997, infestation of domestic pigs with *Trichinella spiralis* was 5,26% and 3,7% in wild boar. In 2007, 722 people were registered with trichinellosis in B&H. The causes of the human trichinellosis epidemic in B&H was a diet rich in meat and meat products of domestic and wild pigs, bears and badgers, not tested for trichinellosis due to unsafe methods at the time; unconnected veterinary services; and unregulated veterinary-sanitary measures on the borders of Bosnia and Herzegovina.

Omeragić et al. (14) adduce they coprologically examined 23 species of animals and birds from the ZOO "Pionirska dolina", Sarajevo between 1999-2002. In 1999, out of 13 examined species of animals and birds, 10 (76,92%) tested positive. In 2000, out of 16 researched species, 12 (68,75%) tested positive. In 2001, 4 out of 14 tested positive (28,57%). Out of 20 species of animals and birds examined in 2002, 7 tested positive (35,00%).

Ruminants (eland antelopes, mini goats, deers, scottish ox, mouflons) tested positive for the developmental forms of gastrointestinal *Strongylidae*, *Nematodirus sp.*, *Strongyloides sp.*, larvae of *Dictyocaulus sp.*, and *Protostrongylus sp.* Hoofed animals (zebras, ponies) tested positive for the developmental forms of *Anoplocephalidae*, *Strongylus sp.*, and *Triodontophorus sp.* Poultry (pheasants, peacocks, ducks, chicken) tested positive for the eggs of *Ascaridia sp.*, *Heterakis gallinarum*, *Capillaria sp.*, and oocysts of *Eimeria sp.* Porcupines tested positive for the eggs of *Trichurus sp.*, and rabbits for the eggs of *Trichostrongylus reto* and *Passalurus ambiguus*, and oocysts of *Eimeria irresidua*, *E. Perforans*, and *E. stiedae*.

Sinanović (20) did postmortem parasitological examination of 59 fallow deers (*Dama dama*) originating from two different locations (Rakovica and Donji Vakuf) between 2006-2008, and found the following species and larveal forms of endo- and ectoparasites: *Eimeria sp.* (39,30%), *Dicrocoelium dendriticum* (20,33%), *Paramphistomum sp.* (5,12 %), *Moniezia expanza* (6,78%), *Cysticercus tenuicolis* (3,39%), *Coenerus cerebralis* (1,69%), *Strongyloides papillosus* (20,33%), *Chabertia ovina* (18,64%), *Oesophagostomum radiatum* (18,64%), *O. venulosum* (8,47%),
Bunostomum phlebotomum (11.86%), Trichostrongylus colubriformis (74.58%), T. capricola (62.71%), T. axei (47.64%), T. vitrinus (11.86%), Ostertagia ostertagi (45.76%), O. circumcincta (18.64%), O. leptospicularis (11.86%), O. lyrata (6.78%), O. trifurcata (3.39%), Spiculopteragia asymmetrica (10.17%), Teladorsagia davtiani (10.17%), Marshallagia marshalli (25.42%), Cooperia punctata (37.29%), C. oncophora (11.86%), C. zurnabada (3.39%), Nematodirus filicolis (25.42%), N. spathiger (10.17%), N. helvetianus (6.78%), Haemonchus contortus (23.73%), Dictyocaulus viviparus (30.51%), Trichuris ovis (28.81%), T. globulosa (10.17%), and Ixodes ricinus (52.71%).

Omeragić et al. (15) present data on the health care of fallow deer (Dama dama linne) in the Sarajevo ZOO and hunting area "Rakovica", Sarajevo. In addition to the parasitic invasion with gastrointestinal Strongylidae, no significant problems were reported.

Presented data suggest that species found in related domestic animals, especially sheep, could be a source of infestation of wildlife. The war prevented any significant research on parasitic diseases in hunting areas, so there is a need for further and comprehensive research. It is necessary to establish a closer cooperation between the national and international research institutions, with the hunting, forestry and hunting and commercial organizations assisting in investigations in order to collect as much information about the health of wild animals as possible. In this way, we want to draw the public attention to the organizations who work on the healthcare and breeding of wildlife, and to promote their cooperation.

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