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The role of wild and domestic ungulates in forming the helminth fauna of European bison in Belarus

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Abstract: Discussed is the role of wild and domestic ungulates in the formation of helminth fauna of the European bison in the Republic of Belarus. The current status of helminth infection of E. bison was determined and comparative analysis was conducted regarding the helminth fauna of other wild and domestic ungulates of the Republic of Belarus.

Key words: European bison, helminth infection, Belarus

Introduction

The European bison (*Bison bonasus*) is a rare terrestrial mammal inhabiting a number of countries including the territory of the Republic of Belarus. To facilitate further increase of its population, measures for conservation and sound management have been developed, aiming at preserving the already existing European bison population and enriching it with new individuals through an import of animals from other countries.

One of present urgent problems in maintenance of European bison are parasitic infestations, since breeding programs carried out in Belarus concern not only the European bison but also other species of large mammals. Therefore an access to complete information about the types of helminths that are capable to affect the health of the E. bison and about factors that influence the formation of helminthiases is very important. One of these aspects is the transfer of helminths from one organism to another. Hence it is necessary to know mechanisms of helminths' transmission among different mammal species. Moreover, a majority of ungulate parasites are pathogenic to humans.

So far 47 species of parasitic worms are registered in the E. bison, and 41 of them occur on the territory of Belarus. According to literature data, this species has only few specific helminths. In E. bison recorded were species mainly typical

for *Bovidae* and partially for *Cervidae*. Thus the composition of helminth fauna in E. bison depends mostly on other ungulates sharing the same habitat(Shestakova et al. 2014).

The purpose of this paper was to determine the current status of helminth infection of Belarusian European bison, and the species composition of parasites and compare it with helminth fauna of other wild and domestic animals from the same region.

There are following objectives of the study:

1) To characterize the helminth fauna of the European bison and other wild and domestic ungulates of the Republic of Belarus.
2) To identify common helminth species for the studied ungulate species of the Republic of Belarus.
3) To calculate the coefficient of generality of the species composition of helminths for European bison *Bison bonasus,* roe deer *Capreolus capreolus*, red deer *Cervus elaphus*, elk *Alces alces*, wild boar *Sus scrofa*, Sika deer *Cervus nippon*, fallow deer *Dama dama*, cattle *Bos taurus*, pig *Sus scrofa domesticus*, goat *Capra hircus* and sheep *Ovis aries* within the Republic of Belarus.

Material and methods

For the comparative analysis of helminth fauna, 7 species of wild ungulates that inhabit the territory of the Republic of Belarus were considered. Five of them (wild boar *Sus scrofa*, elk *Alces alces*, red deer *Cervus elaphus*, roe deer *Capreolus capreolus*, European bison *Bison bonasus*) are native or reintroduced species living in the wild, and two species (Sika deer *Cervus nippon* and fallow deer *Dama dama*) are bred in enclosures. Additionally, the domestic pig, sheep, goat and cattle were investigated.

Coprological studies (ovary and larvoscopia) as well as autopsy of selected or dead animals were conducted (Yatusevich *et al.* 1999).

Results and Discussion

The study of the helminth fauna of the European bison was carried out by many researchers (Kochko 2000; Merkusheva and Bobkova 1981; Pelgunov 2008; Anisimova 2016). In general, all the papers indicate a rich species composition of helminths and a high infestation level of these animals with parasitic worms. Among 41 species of helminth parasites recorded in the E. bison, 3 species occurring in Belarus are strictly specific for the E. bison: *Capillaria bilobata*, *Cooperia zurnabada*, and *Nematodirus oiratianus*. The remaining species are found in at least one of remaining ungulate species. The formation of the helminth fauna of the European bison was altered during the acclimatization period as the result deworming, but later on in new ecological conditions, helminth fauna began to form on the basis of

parasites of wild and domestic animals sharing the same territory (Anisimova and Penkevich 2016).

At present, the most frequently parasitizes identified in the European bison are *Paramphistomum sp.*, *Fasciola hepatica* and *Dicrocoelium dendriticum*, *Dictyocaulus viviparus*, as well as representatives of families of Trichostrongylidae and Dictyocaulidae (Penkevich and Kochko 1987). Among the parasites nematodes predominate. It has been found that the species composition of helminthiasis in the E. bison in different subpopulations has formed depending on the conditions of existence of the host, sometimes the differences in nutrition and veterinary treatments (Yatusevich 2013).

As much as 38 species of helminths are recorded for the elk. A majority of these parasites are the species occurring in livestock and other deer, but *Nematodirella alcidis*, *Nematodirella gazelle* were not found in other animals. The most dangerous to that animal are: *Parafasciolopsis fasciolaemorpha*, *Liorchis scotiae*, *Protostrongylidae g. sp.*, and *Nematodirus sp*. Species like *Ostertagia anlipini*, *Mazamostrongylus dagestanica*, *n. longissimespiculata* are common in elk (Pelgunov and Maklakova 2008).

The coefficient of generality of species composition of helminths in European bison and elk is 35,2%, and they have 20 common parasites species. Therefore, there is high possibility of mutual interchange of helminths. Often this happens in winter, as elks use E. bison trails for movement, and they are often attracted to salt licks made for E. bison. Resting sites of elks and E. bison are frequently situated close to each other, which may facilitate to conceal their tracks and the smell from predators and hunters.

The value of the coefficient of generality for the elk and other animals is 30,94 ± 5,1% on average. The most common is helminth fauna of the elk with roe deer (55,6%), while much less - with wild boar and Sika deer (9,2 ± 1,2%). Some cases of detecting the Moniezia, originating from domestic animals in the elk and the European bison have been also recorded in Belarus.

The fauna of worms in deer has been studied quite comprehensively. In the European part of the continent, 54 species of helminths were registered in the red deer, 40 of them at the territory of the Republic of Belarus. Two of them: *Elaphostrongylus panticola*, *Taenia krabbei (Cysticercus tarandi)* were recoded only in deer (Pelgunov and Maklakova 2008; Litvinov 2012a; 2012b) The remaining species of worms are widespread helminths and occur in the cervids, the hollow-horned ruminants, as well wild as domestic animals. In all red deer populations, nematodes dominate, ranging from 25,0 to 92,8%. The occurrence of the Trematoda class is 7,1%, Cestoda – 19,8%. Nematodes dominated not only regarding the occurrence but also in terms of species diversity. Among nematodes most frequent were Trichostrongylidae, Dictyocaulidae, Protostrongylidae, and other Strongylidae.

Red deer often attend feeding points in winter time, and simultaneously receive anthelmintic medicines mixed with the feed, so the level of helminthic infestation in this species is lower than that of other ungulates (Shestakov *et al*. 2014)

The value of the coefficient of generality of species composition of helminths in the European bison and the Red deer is 35%, i.e. slightly less than in the case of the elk. The largest number of common helminth species with Red deer was found with roe deer and fallow deer (29 and 26 species respectively), which may be due to the fact that those species prefer the same biotopes. As in the case of the elk, the lowest similarity of helminth fauna was with pigs (6,2 ± 0,9%).

Since the XIX century by 2016 at the territory of Belarus 44 species of helminths were recorded in roe deer, including 6 trematodes, 5 cestodes, and 23 species of nematodes (Anisimova and Penkevich 2016). Such a number of species can be explained by the fact that the roe deer is an ecologically flexible animal and is able to exist in a wide range of localities, as well as in places with a dense population of people and intensively developed agriculture, where helminth infection from domestic animals occurs. Complete data on the parasite fauna of this animal is not yet available, although the study of its helminth fauna and helminthiases was carried out by many researchers. Among parasites of the roe deer, nematodes predominate. Dominant in frequency and having epizootic significance are: *Oesophagostomum venulosum, O. ostertagi, O.ovina, Bunostomum trigonocephalum, Haemonchus contortus.* The remaining species are not recorded as often, their occurrence rarely exceeds 10%. Often, at high population intensity of the roe deer, *Dictyocaulus eckerti* and *Nematodirus filicollis* are recorded, which are closely related to habitats typical for roe deer. Two species: *Spiculopteragia kutkascheni and Spiculopteragia kolchida* were detected only in roe deer (Litvinov 2012a).

The value of the coefficient of generality of the species composition of the European bison and the roe deer is 50%. This is the largest value that was revealed when comparing the helminth composition of E. bison and other ungulates. The number of 29 common species can be explained by the fact that, although the roe deer is ecologically flexible animal, it most often prefers the same biocenoses as the European bison, and the large densities of ungulates increase the probability of a transmission of parasites.

The fallow deer, like in other cases of acclimatized and re-acclimatized animals, when appearing in new ecological conditions, it loses some of the parasite diversity. Such phenomenon may be connected to the absence of intermediate hosts of certain types of parasites, specific vectors, changes in climatic regimes, changes in the diet etc. On the other hand, animals in new environmental conditions can be invaded by completely new parasites because of a direct contact with native inhabitants of the new region. At present, 39 species of parasites are recorded in the fallow deer (Anisimova 2016). The most common are: *Oesophagostomum venulosum, Spiculopteragia asymmetrica, Ostertagia ostertagi,* and *O. leptospicularis.* Dominating are species of the family Trichostrongylidae (Penkevich 1983).

The value of the coefficient of generality of the species composition of the fallow deer and the European bison is 48,1%, they share 26 parasites, which originate from both wild and domestic ungulates.

Wild Sika deer are relatively only slightly infected with parasitic worms. In Europe, 11 species of parasitic helminths have been recorded in Sika deer, all belonging to nematodes (Anisimova 2016). Such low level of infestation could be due to the fact that until recently in Belarus the species was kept only in captivity and had limited contact with other animals. However, the helminth fauna of the Sika deer may change in a near future.

The value of the coefficient of generality calculated for the European bison and the Sika deer was 8,3%, and there were only 4 common species: *Ashworthius sidemi*, *Cooperia pectinata*, *Ostertagia gruhneri*, and *Setaria cervi*. It is believed that the species *Ashworthius sidemi* was imported into Belarus together with the Sika deer, which is its native host, and later adapted to parasitize the E. bison (Protasovitskaya 2013).

Cattle in Belarus are infested by 46 helminth species (Protasovitskaya 2013; Subbotin et al. 2015). Of those 4 belong to trematodes, 7 to cestodes and 35 to nematodes. Only 8 species do not occur in wild ungulates, but remaining parasites are widely represented in their helminth fauna. Only one species of *Thelazia skrjabini* is found only in a cow. The most pathogenic for cattle are: *Dictyocaulus fillaria and Dictyocaulus eckerti*, which attacks lungs of animals (Lipnitsky 1999).

The value of the coefficient of generality of the species composition calculated for cattle and the E. bison is 46,7%, what means that in the formation of the helminth fauna of the European bison, cattle is important, which in grazing grounds creates high concentration of invasive elements that provide intensive infection of wild and domestic ungulates with helminths. It has been established that the level of infestation with Fasciola sp. directly depends on the number of livestock grazing (Samoylovskaya 2008).

In the goat 32 species of helminthes are recorded such as trematode and cestode (4), nematodes (28) (Yatusevich *et al*. 2011; Gerasimchik and Baranovsky 2008). Specific species include *Protostrongylus rufencens and Skrjabinema ovis*, which are found only in goats and sheep.

Helminth fauna of the sheep is represented by 50 species of helminthes (Verbitskaya and Olekhnovich 2008; Dikov 1961). Of these, 4 species are specific for sheep: *Multiceps multiceps (Coenurus cerebralis)*, *Taeniarynchus saginatus larvae*, *Hystrongylus rubidus and Metastrongylus confuses*.

The value of the coefficient of generality for the European bison and goats is 41,5%, for the E. bison and sheep – 42,2%, which also indicates potential importance of these animals in the formation of helminth fauna in E. bison, only to a lesser extent than in the case of cattle.

High values of the coefficient of generality among studied animals prove that, with a long joint existence within a certain territory, a constant circulation of parasitic worms between animals occurs, which determines the formation of the helminth fauna of ungulates (Samoylovskaya 2008).

In the wild boar of Belarus, 20 species of helminthes were found including: Trematode - 3 species, cestode (larval forms) - 3, nematodes - 13 and acanthocephalus - 1 species (Anisimova 2016). Among all species of helminthes identified in the wild boar some were strongly dominant. From the class of nematodes there were the metastrongylid pulmonary helminths (80,4%) (Vlasov 2013). There were all kinds of metastrongylids found in mixed invasion, but predominating species was *Metastrongylus pudendotectus*. It is a dangerous parasite leading to the death of pigs (Yatusevich et al. 2013). From the class of cestodes, the species *Sparganum spiromenra erinacei* dominates, with the level of invasion reaching 50,6%. The most common are *Globocephalus urosubulatus and Trichuris suis*. Exclusive parasite for wild boar is *Macracanthorhynchus hirudinaceus*.

The helminth fauna of domestic pigs is richer than that of the wild boar and is represented on the territory of Belarus by 22 species (Vlasov 2013; Penkevich 1999). According to the results of the study, the total helminth fauna of these species is 53,8%. This is the percentage of helminth species that occur on the territory of the Republic of Belarus, both in wild boars and in domestic pigs The fauna of helminths of wild ungulates depends on their distribution, which is important in the formation of biocenoses (Samoylovskaya 2008). For example, species such as *Alaria alata larvae*, *Spirometra erinacei larve, Metastrongylus confuses* are found only in the wild boar.

The value of the coefficient of generality of the species composition calculated for the European bison, domestic and wild pigs is 10,9% and 5,2%, respectively. The presence of helminths, which are both in the bison, in wild and domestic ruminants and in wild and domestic pigs, shows the priority for such a factor as visiting agricultural land (Mozgovoy 1967).

Conclusions

On the basis of literature data and our own research we determined that wild and ungulate animals on the territory of the Republic of Belarus are affected by 103 species of helminths, the main part of which are nematodes.

The highest values of the generality coefficient were found for following pairs of species: the roe deer and the European bison (50%), European bison and fallow deer (48,1%), the E. bison and cattle (46,7%). In the case of wild boar and red deer, the number of common species is minimal. The least similarity was found between the Sika deer and remaining ungulates.

It has been also proved that cattle plays important role in the formation of the helminth fauna of the European bison, through high concentration of invasive forms in places of grazing which leads to intensive infestation of wild and domestic ungulates by helminths. Sharing of the high proportion of the same parasites is a result of long coexistence within jointly used area and a constant circulation of parasitic species among animals.

Additional factors in the formation of the species composition of helminth fauna include: age, sex, density of animals, the presence of intermediate hosts, a method of transmission of parasites etc.

We are convinced that a high value of the coefficient of the generality of helminth species is characteristic for phylogenetically close hosts. Thus, the phylogenetic factor plays a leading role in the formation of the helminth fauna of the European bison in the Republic of Belarus. Ecological, geographical and anthropological factors may only change the quantitative and qualitative aspects of the E. bison parasitic fauna.

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Rola dzikich i udomowionych parzystokopytnych w formowaniu helmintofauny żubra w Białorusi

Streszczenie: W pracy przedstawiono wyniki badań składu fauny pasożytniczej u kilku gatunków zwierząt. Oprócz podstawowego gatunku, do którego się odnoszono, czyli żubra *Bison bonasus*, przeanalizowano również dane o parazytofaunie sarny *Capreolus capreolus*, jelenia *Cervus elaphus*, łosia *Alces alces*, dzika *Sus scrofa*, jelenia sika *Cervus nippon*, daniela *Dama dama* oraz bydła *Bos taurus*, świni *Sus scrofa domesticus*, kozy *Capra hircus* i owcy *Ovis aries*. Analizowano podobieństwo składu fauny pasożytującej w organizmach różnych gatunków. Stwierdzono duże podobieństwo gatunków pasożytów bytujących u żubra i sarny, oraz u żubra i daniela i u żubra i bydła domowego. Generalnie stwierdzono 103 gatunki pasożytów u badanych gatunków na terenie Białorusi.