

Ecological Peculiarities of Waterfowl Parasitocenosis Distribution

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Abstract

BACKGROUND: Invasive diseases cause severe illnesses in birds, which become extensive and threatening under conditions of extensive breeding of waterfowl.

OBJECTIVES: The aim of the study is to investigate the ecological peculiarities of distribution of parasitocenoses of waterfowl.

METHODS: Helminthoscopic method (Fülleborn method) was used in the research method (Fülleborn's method) and the method of incomplete helminthologic autopsy according to K.I. Skryabin.

RESULTS: It was found that the prevalence of parasitocenosis of waterfowl in the forest-steppe zone was 76,7%, in the steppe zone – 54,5%, and in the mountain-forest zone - 36,7%. The relationship between the prevalence of infestation and the intensity. At low intensity of infestation the reproductive capacity of the of echinostomes increases.

CONCLUSIONS: Parasitocenoses in waterfowl are represented by several species including *Echinostomes* waterfowl are represented by several species, including *Echinostoma revolutum*, *Hypodereum conoideum* and *Echinoparyphium recurvatum*. These parasites can cause a variety of diseases in waterfowl diseases, including intestinal disorders, loss of appetite and weight, and decreased productivity. Mixed infestation, in which waterfowl are simultaneously infected with two or more species of intestinal parasites, is quite common. In our study, the intensity of mixed infestation in geese with a combination of *Echinostoma revolutum* and *Hypodereum conoideum* species amounted to 36%.

Key words: ecology, infestation, infestation extents, infestation intensity, parasitocenosis, waterfowl.

Introduction

Waterfowl breeding is currently a developed area of poultry farming and an extremely necessary industry for the growth and development of certain countries and regions. The Republic of Bashkortostan is a region of the Russian Federation, part of the Volga Federal District and the Ural Economic Region. Bashkortostan has a long tradition of poultry farming. There are many poultry farms in the republic, including small farms and large industrial complexes. Currently, the Republic of Bashkortostan is a leader among the regions of the Russian Federation in terms of the number of waterfowl and meat production. To further increase the production of poultry products, the increase of productivity and viability is of decisive importance, which should be due to the prevention of infectious and invasive diseases of poultry (Abtin *et al.* 2022; Bashashati *et al.*, 2023; Razmarai Iranagh *et al.*, 2023; Rusli *et al.*, 2023).

Echinostomatidoses are widespread among waterfowl and cause significant economic damage. *Echinostomatidae* cause severe infestations in birds, which have become expansive and threatening in conditions of extensive breeding of geese and ducks. Echinostomatidoses of birds represent a group of poorly studied diseases affecting birds. The main manifestations of echinostomatidoses are oppressed state, emaciation, diarrhea, as well as lesion of different parts

of the intestine by trematodes from the family *Echinostomatidae*. The most common species of trematodes causing echinostomatidosis in birds are *Echinostoma revolutum*, *Hypodereum conoideum* and *Echinoparyphium recurvatum* (Chai *et al.*, 2020; Fried *et al.*, 2004).

Echinostomatidae parasitizing in the intestine traumatizes the mucosa, causing hyperemia, focal hemorrhages and loosening, as well as desquamation of the villous epithelium. Mixed infestations caused by trematodes of the genera *Echinostoma*, *Echinoparyphium*, *Hypoderaeum*, *Echinochasmus*, *Notocotilus* and *Catatropis* are also recorded, significantly reducing slaughter quality, fatness, body weight gain and productivity of geese (Mohanta *et al.*, 2018). Sick geese and ducks are the source of echinostomatidosis pathogens. The transmission factors of pathogens are aquatic plants (cassava), as well as silt sediments from the bottom of water bodies containing echinostomatidae adolescariiae. To date, different researchers have not fully reflected seasonal changes and peculiarities of formation of foci of different intensity of development of trematodes of the genus *Echinostomatidae* Dietz, 1909 in domestic waterfowl.

In connection with the above, **the aim of our research** was to study the ecological peculiarities of echinostomatidosis distribution in waterfowl.

Materials and Methods

The study was conducted in accordance with the ethical principles approved by the Ethics Committee for Animal Experiments of the Federal State Budgetary Educational Institution of Higher Professional Education «Bashkir State Agrarian University» (protocol No. 8 of 28.03.2019).

The prevalence of trematodes of *Echinostoma revolutum*, *Hypodereum conoideum* and *Echinoparyphium recurvatum* species in waterfowl (geese) was studied in 2016-2022 in the Republic of Bashkortostan, Russian Federation. Five natural zones - forest, forest-steppe, steppe, as well as mountain-forest and mountain-forest-steppe - are distinguished on the territory of the Republic of Bashkortostan. Forests occupy more than 40% of the territory of the Republic.

The degree of poultry infestation was determined by the results of helminthoscopic studies of geese droppings by flotation method (Fulleborn's method). A saturated solution of table salt was prepared (400-420 g of salt per 1 liter of water). A sample of feces weighing 3-5 g was placed in a glass, poured a small amount of flotation liquid, stirred thoroughly, then added 50-100 ml of this solution and filtered through a metal sieve into a dry, clean glass. The suspension was allowed to stand for 40-60 minutes, then the surface film was removed by touching the loop and transferred to a slide for microscopy.

Intensity and extensiveness of invasion (AI, EI) were determined by collecting helminths from the intestines of birds during incomplete helminthologic autopsy of the gastrointestinal tract according to K.I. Skryabin. For this purpose, the intestines of birds were opened, the co-substance was extracted and studied in small portions first in black and then in white cuvettes. Large helminths were selected visually, and small helminths - with the help of a hand-held magnifying glass with 8-10x magnification. Intensity of infestation (AI) is the number of helminths detected in the examined poultry, expressed in copies. Intensity of infestation (EI) is the ratio of the number of infected birds to the total number of examined birds, expressed as a percentage.

The obtained digital material was processed statistically with determination of the average number of trematode eggs in 1 g of feces and the number of detected imaginal echinostomes from each bird individually. The obtained digital material was processed statistically with determination of the average number of trematode eggs in 1 g of feces and the number of detected imaginal echinostomes from each bird individually.

Results

According to helminthoscopic studies of waterfowl feces, echinostomatidosis is widespread in the territory of the Republic of Bashkortostan. EI in adult waterfowl population

fluctuates with a wide range from 24,0% to 88,0%, averaging 56,0%. Peak values of echinostomatidosis invasion extensiveness in waterfowl were established in the forest-steppe zone (65,5% - 88,0%). In the steppe zone EI of waterfowl echinostomatidosis decreases (46,5% - 61,0%). In the mountainous forest zone, echinostomatidosis was observed much less frequently, the EI amounted to 28,5% - 44,0% of infected birds.

The intensity of invasion according to helminthoscopic studies varied in different species of trematodes. Thus, the AI in *Echinostoma revolutum* was $74,2 \pm 11,3 - 206,3 \pm 38,1$ specimens/head, *Hypodereum conoideum* - $75,4 \pm 13,2 - 221,4 \pm 41,2$ specimens/head and *Echinoparyphium recurvatum* - $52,1 \pm 7,2 - 124,5 \pm 12,3$ specimens/head.

The results of incomplete helminthologic autopsy of geese intestines also confirmed the wide distribution of poultry echinostomatidosis. The intensity of infestation ranged from 48,0 - 63,0%. The number of trematodes *Echinostoma revolutum* isolated from poultry raised in the steppe zone was lower and amounted to $52,1 \pm 10,2 - 177,3 \pm 26,1$ specimens/head, *Hypodereum conoideum* - $63,2 \pm 12,3 - 182,5 \pm 38,1$ specimens/head and *Echinoparyphium recurvatum* $42,3 \pm 5,1 - 108,3 \pm 9,1$ specimens/head. In the mountain forest zone of the republic the lowest percentage of echinostomatidosis infestation was observed - 34,0 - 65,0%.

The intensity of invasion according to the results of incomplete helminthological autopsy was maximum high in *Echinostoma revolutum* ($43,2 \pm 6,3$ - $132,1 \pm 11,2$ specimens/head), in *Hypodereum conoideum* it was $33,3 \pm 8,5$ - $141,0 \pm 26,1$ specimens/head and in *Echinoparyphium recurvatum* $28,3 \pm 6,7$ - $96,1 \pm 1,21$ specimens/head.

With the onset of fall (October-November), most of the trematodes of *Hypodereum conoideum* and *Echinostoma revolutum* reached the sexually mature stage (73,0%). Microscopy revealed a highly developed sexual apparatus in the maritimes, and the eggs contained a formed miracidium.

Discussion

Waterfowl are a widespread, species-rich group of animals that play a huge role in human life and economic activity. One of the factors reducing the productivity of waterfowl is helminths, which under certain conditions cause mass death of young birds and reduction of fatness of adult birds. Proper organization and timely implementation of diagnostic and therapeutic measures to improve the health of waterfowl from helminthosis are possible only on the basis of knowledge of the basic biology of pathogens, epizootology and pathogenesis of helminths.

Echinostomatid infestation is known to be widespread among waterfowl. At intensive echinostomatidosis lesions of the small intestine the body weight gain of geese decreases by 30-40%, egg production - by 15-25%. Therefore, echinostomatidosis of waterfowl represents a serious ecological and economic problem.

As a result of conducted researches on studying ecological distribution of echinostomatidosis of waterfowl in the conditions of the Republic of Bashkortostan we have established significant differences in invasiveness of birds. The high spread of echinostomatidosis in the forest-steppe zone of the Republic of Bashkortostan we attribute to the extensive type of goose breeding and the presence of a large number of artificially created small water bodies as a source of drinking water.

Our data are consistent with the results of many helminthologists. Thus, Zhemukhova *et al.* (2020) showed that in the conditions of the Central Caucasus trematodes of the genus *Echinoparyphium* Dietz, 1909 of the family Echinostomatidae in domestic and zoned breeds of waterfowl are characterized by significant species diversity and wide distribution. In the territory of the Kabardino-Balkar Republic. Kozhokov *et al.* (2007) studied etiological factors of waterfowl parasitocenoses. It was found that the prevalence of echinostomatidosis of geese differed depending on the zones. *Echinostoma revolutum*, *Echinoparyphium aconiatum*,

Hypoderaeum conoideum, *Echinochasmus baleocephalus* were predominant in geese. Ignatkin *et al.* (2019) drew attention to the ecological role of hydro- and amphibionts in the circulation of trematodoses of domestic birds in the Ulyanovsk region. They established the circulation of the pathogen of echinostomatidosis in mollusks in order to assess the level of danger of infection of waterfowl. A similar study was conducted by Assis *et al.* (2022) in an urban area of Brazil.

According to Labony *et al.* (2022), one of the key factors that affects the development of eggs and larvae of echinostomes is the average water temperature, which in turn adversely affects the development of intermediate hosts - freshwater mollusks of the genera *Radix*, *Lymnaea*, *Physa*, *Planorbis* and *Anisus*, and as a consequence, their numbers decrease. Consequently, in the forest-steppe zone of the Republic of Bashkortostan we observe a tendency to increase the intensity of invasion in the gram of litter with the maximum intensity of echinostomatidosis.

Thus, the possibility of formation of echinostomatidosis parasite fauna in waterfowl in the form of monoinvasion and widespread helminthosis is most favorably influenced by the close relationship of parasites between themselves and the environment, as well as the influence of environmental temperature, air humidity, terrain, wind rose, etc. of the forest-steppe zone. These

factors allow the trematode of the *Echinostomatidae* family to develop cyclically from the egg stage to sexual maturity.

It should be noted that the intensity of invasion of echinostomatidosis of all species in the mountain forest zone is 2 - 2.2 times less compared to the forest-steppe and steppe zones of the republic. These data are in favor of the data obtained by helminthoscopy, i.e., the biological activity of the parasitofauna and confinement to certain ecological zones of waterfowl echinostomatidosis directly depend on the ecological conditions of the republic (Gu *et al.*, 2020).

Conclusion. As a result of our research we found that in the conditions of the Republic of Bashkortostan an active process of infection of waterfowl with echinostomatidosis is registered due to the presence of favorable conditions for the biological cycle of development at the egg, larval and adult stages of trematodes of *Echinostoma revolutum*, *Hypodereum conoideum* and *Echinoparyphium recurvatum*. According to the results of intestinal autopsies and helminthoscopic studies of droppings, the intensity of infestation in waterfowl in the forest-steppe zone of the Republic amounted to 76,75%, in the steppe zone – 54,5%, and in the mountain-forest zone – 36,7%. Extensity of infestation in the form of mixed infestation in combination of *Echinostoma revolutum* and *Hypodereum conoideum* species in waterfowl amounted to 36,0%.

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