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Occurrence of parasitic ciliates (Protozoa) on perch (*Perca fluviatilis*) in Lake Vlasinsko

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In the sample of 83 specimens of the perch (*Perca fluviatilis* L., 1758), caught on eight different sampling sites at the Vlasinsko Lake reservoir, in April–October 1993, 25 infested specimens were found. They were infested with the following species of parasitic ciliates: *Trichodinella epizootica, Apiosoma robustum, Apiosoma piscicolum* ssp. *perci, Ichthyophthirius multifiliis, Chilodonella cyprini* and *Chilodonella hexasticha*. The most intensive infestation with all quoted parasitic ciliates was registered in April. Only *Ichthyophthirius multifiliis* infested the perch intensively in July. *Trichodinella epizootica* and *Apiosoma robustum* revealed both the highest prevalence and intensity of infestation. Regarding the localization of the parasitic species, *Trichodinella epizootica* and *Apiosoma robustum* had a much stronger affinity for the gills than for the skin of the perch.

1. Introduction

The fauna of the parasitic ciliates of fresh-water fish of Yugoslavia has not been investigated in greater details to date. That was the main reason why we tried to analyze the quantity and quality of this fauna and study ecological traits of certain parasitic species. Investigations on ectoparasitic ciliates have also been carried out in Bulgaria (Grupcheva & Golemanski 1986), Czech Republic (Lom & Dykova 1989), and states of the former USSR (Bauer *et al*. 1973, Stein 1984, Allamuratov 1986, Tlenbekova & Dzevickaja 1986). From the ichtyoparasitological point of view the representatives of the phylum Ciliophora have been least studied in Yugoslavia, although they are the commonest parasites of the fresh-water fish. In Vlasinsko Lake reservoir l6 fish species have been registered to date, the most numerous of which are *Perca fluviatilis* and *Carassius auratus gibelio*.

2. Material and methods

2.1. Locality description

The Lake Vlasinsko is a reservoir, 12 km in length and of average width of 1 km (maximal width of 2.5 km). It is situated in the South-eastern Serbia, near the Bulgarian border, at 1 200 m above the sea level (42˚40′–42˚45′N, 22˚19′–22˚21′E). It consists of two morphologically different parts:

the jagged, narrow and deep northern part, of maximal depth up to 24 m, and mainly 7–16 m deep, and the broad, shallow, opened southern part, of depth up to 6 m, but mainly from 1–4 m. The reservoir was formed in 1950s, on the former Vlasinsko Peat Bog, for the electric power-plant system supply. The water level in it is very variable, and fluctuate greatly through the year. Every winter (i.e. from mid November to late March), the Lake Vlasinsko is under the heavy (up to 0.3 m) ice cover and surrounded by thick snow on the high mountains (up to 2 000 m) around it. The water in reservoir is mainly acid (pH = 5.59–6.99), although the surface layers could be slightly alkaline (i.e. pH = 8.07) after the snow thawing or greater rainfalls.

The ichthyofauna of the Lake Vlasinsko consists of 16 species, of which only two, the brown trout *Salmo trutta* and the brook (Mediterranean — eastern) barbel *Barbus peloponnesius* are autochthonous. The most frequent fish species is the Eurasian perch *Perca fluviatilis*, and the Prussian carp *Carassius auratus gibelio* is a common species, too. Other details on the Lake Vlasinsko morphology (i.e. sampling sites) and on fish community are available in Simonovic and Nikolic (1995).

Material was collected with the same set of gillnets (mesh size 2.5–4 cm) from same eight sampling sites in 1993 over the period from April, via July, to October. From the live samples, taken in the plastic barrel (60 dm^3) fulfilled with the water from the locality on which the sampling was done, squash slides were taken from the skin and gills and observed under light microscope (400 × magnitude) within two hours. The slides were impregnated with silver according to Klein-Foissner method (Hausmann 1985). The species were identified according to Bykhovskaya-Pavlovskaya (1964), Stein (1984), Banina (1984) and Shulman and Jankovsky (1984). The prevalence of infestation is presented as a percentage of infested fish in the total sample and as a percentage of infested fish for each season. The prevalence of infestation was also analyzed according to the localization of infestation. The intensity of infestation is presented with the total number of individuals on ten visual fields of a microscope (ITVF). The statistical significance of parasites' affinity for skin and gills was estimated by χ^2 test.

3. Results

3.1. Occurrence of ciliates

Trichodinella epizootica (Raabe 1950) occurs in the perch in the largest percentage, *Apiosoma robustum* (Zhukov 1962) occurs in somewhat smaller percentage while the species *Apiosoma piscicolum* ssp. *perci* (Chernyshewa 1976), *Ichthyophthirius multifiliis* Fouquet 1876, *Chilodonella cyprini* (Moroff 1902) and *Chilodonella hexasticha* (Kiernik 1909) are much less common (Table 1). Also, it should be noticed that the highest percentage of infestation by parasitic ciliates occurs in spring, in April, while in other months the infestation is very weak or absent.

The highest maximal intensity of infestation was achieved by the species *Trichodinella epizootica*, while the highest mean intensity of infestation was achieved by the species *Apiosoma robustum* (Table 1).

3.2. Localization of ciliate species

χ^2 test showed statistically significant differences in localization of infestation for the parasites *Trichodinella epizootica* ($\chi^2 = 13.00$; $df = 1$; $p < 0.001$) and *Apiosoma robustum* ($\chi^2 = 5.00$; $df = 1$, $p < 0.05$). These two species occur more frequently on the gills than on the skin of the perch. No statistically significant differences in localization for other ciliate species were found.

4. Discussion

The analysis of ciliates of perch revealed six species, out of which two species, *Apiosoma*

Table 1. The prevalence of seasonal infestation (in %) and intensity of infestation in April (in total number of individuals in ten visual fields – ITVF) of perch.

Parasitic Ciliata	April ($n = 32$)			July ($n = 31$)	Oct. ($n = 20$)
	% ITVF	average ITVF	min./max.	%	%
Trichodinella epizootica	43.75	13.83	1/142	0.00	0.00
Apiosoma robustum	40.63	27.50	4/123	0.00	5.00
Apiosoma piscicolum ssp. *perci*	15.63	3.80	1/10	0.00	0.00
Ichthyophthirius multifiliis	0.00			6.45	0.00
Chilodonella cyprini	3.13	3.00	3/3	0.00	0.00
Chilodonella hexasticha	3.13	2.00	2/2	0.00	0.00

robustum and *Apiosoma piscicolum* ssp. *perci*, were new for the Yugoslav fauna.

The analysis of the occurrence of ciliates in perch of the Lake Vlasinsko showed that all parasitic species were present in April. In July only *Ichthyophthirius multifiliis* and in October only *Apiosoma robustum* were found. Spring is the period when fish is the most sensitive to various infestations, not only by parasites, but also by virus and bacteria. The reason is both their weakened general condition after overwintering and, in the same time, the exhaustsness due to the spawning. This is especially true for the perch, which spawned shortly (two weeks) after the ice thawing, i.e. in the April 23–28. 1993, the spawning was just occurring. Thus exhausted perch represents the ideal medium for parasitic species. The possible cause of high infestation percentage of ciliates on perch in April also could be its high densities due to the spawning on each locality (personal observation), which favor the infestation. The low water temperature (5.6–6.0°C in April 1993) is also favored by trichodinids (Halmetoja *et al.* 1992) and the reason of their absence in July 1993 could be the remarkable heating of the upper water layers (up to 21.8°C), although the temperature at the thermocline, at depth of 5.6 m, was 15.3°C.

The highest prevalence of infestation (43.75%) was achieved by the species *Trichodinella epizootica*, which was found in April only. This is rather unusual for this species which in other fish species, e.g. fish-pond carp, occurs during the whole year with the similar prevalence (about 40%) (Nikolic 1994). On the other side, this is in agreement with the report of Halmetoja *et al.* (1992) who found the higher prevalence of trichodinids at lower temperatures. It may be assumed that *T. epizootica* in summer and autumn disappears from certain reasons, e.g. due to the increased immunological response of the host (Aaltonen *et al.* 1994), or its better condition at higher temperatures (Halmetoja *et al.* 1992).

The species *Apiosoma robustum* was also found in high percentage (40.63%), but the presence of this species was observed also in autumn, in October, although less frequently. Its absence in July could be caused by the high water temperature, but also by some other factors. The other species were found in relatively low percentages making it difficult to speak of their effect on the host. Some literature sources (Roberts 1978) reported on the just carrying role of fish on the *Apiosoma* spp., since these ciliate species filtrate their food from the surrounding water, but other sources (e.g. Kabata 1985) reported that *Apiosoma* spp. are obligate parasites, that damage skin (irritation, hyperaemia), as well as gills (mucus exudation) in heavy infections. The species *Trichodinella epizootica* damages the gills and cause epithelium erosion when it occurs in great intensities (Bauer *et al.* 1973). These parasites are not specialized and they may adapt to new hosts and cause mixed infestations with specialized parasites, so that virulence may be much increased (Golemansky & Gruptsheva 1975).

These two species of ectoparasites which have the greatest prevalence, i.e. *Trichodinella epizootica* and *Apiosoma robustum*, also show the highest intensity of infestation, both maximal and average. The mean intensity of the species *Apiosoma robustum* is twice the mean value of the intensity of the species *Trichodinella epizootica*. It may be explained by the fact that *Apiosoma robustum* belongs to the suborder Sessilina (Petrichia), which means that it is attached to the host and aggregates more densely on particular sites on it, while the species *Trichodinella epizootica* belongs to the suborder Mobilina (Peritrichia) and has the ability to move from the host temporarily or permanently**.** The maximal and mean intensities of infestation of the other species are low in comparison to the former two parasitic species of ciliates.

Although the strong pathogenic effect of *Ichthyophthirius multifiliis* and *Chilodonella cyprini* (e.g. Roberts 1978, Kabata 1985) is well known, none of such effect was observed on the Lake Vlasinsko perch, the most probably due to their low prevalences, insufficient to produce that effect, as reported in Radojcevic *et al.* (1978). The seasonal occurrence of these two species corresponds to the reported affinities to the respective water temperatures optimal for their living e.g. Kabata (1985).

The analysis of the localization of the studied species of the parasitic ciliates by χ^2 test showed that there existed certain differences concerning localization of these species. *Trichodinella epizootica* occurred significantly more often on the gills than on the skin of the perch. The same goes for the species *Apiosoma robustum*, while no significant difference was observed for the other species. It is known that the species *Trichodinella epizootica* and *Apiosoma robustum* prefer gills (Bykhovskaya-Pavlovskaya 1964),

whereas there are no literature data about preference of other species to one or to the other organ.

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