

**PARASITE FAUNA OF MINNOW (*PHOXINUS LUMAIREUL*
LINNAEUS, 1758) FROM BELČIŠTA WETLAND,
REPUBLIC OF NORTH MACEDONIA**

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ABSTRACT

During parasitological investigations on minnows (*Phoxinus lumaireul*) from the Belčišta wetland (Republic of North Macedonia), four parasite species were identified: *Pseudochetosoma salmonicola*, *Nematoda gen. sp.*, *Acanthocephalus lucii*, and *Pomphorhynchus bosniacus*. The overall prevalence of infestation was 90.48%, with the highest prevalence observed in *Pomphorhynchus bosniacus* (found in 90.48% of minnows). *Nematoda gen. sp.* and *Acanthocephalus lucii* were each found in 9.52% of the fish, while *Pseudochetosoma salmonicola* had the lowest prevalence at 4.76%. The average intensity of infestation was 5.52, with the highest level recorded for *Pomphorhynchus bosniacus* (5.68). These findings represent the first recorded occurrence of all these parasite species in *Phoxinus lumaireul* from the Belčišta wetland and Republic of North Macedonia. Among the parasite species found in minnows from the Belčišta wetland, *Pomphorhynchus bosniacus* was associated with the greatest pathological impact.

Keywords: parasite fauna, minnow, Belčišta wetland

1. INTRODUCTION

The Belčišta wetland (also called Sini Viroj) is located in the municipality of Debrca, below Ilinska Mountain, at an altitude of about 767 meters. The wetland is fed by 11 karstic springs, known as Sini Viroj, which originate

from springs north and northeast of the village of Novo Selo, in the direction of the village of Belčišta. The surface of the wetland covers approximately 400 hectares. There are also several lakes within the wetland, three of which are larger: Belčiški Sin Vir, Novoselski Sin Vir 1, Novoselski Sin Vir 2, and Sino Duvlo. With the retreat of Desaret Lake along the Sateska River, numerous endemic species of plant and animal life have continued to exist in the waters of the wetland. The Belčišta wetland is the largest and one of the most important wetlands in N. Macedonia. It features flooded forests and wet pastures and is well-preserved. It is notable for its diverse types of wetland habitats, particularly flooded alder forests. The wetland boasts a great diversity of flora and fauna. According to research, a total of 55 different plant species and seven different fish species have been recorded in this water ecosystem. There are also nine species of birds, nine mammals, nine amphibians and reptiles, as well as 14 invertebrate species. The Belčišta wetland is part of the Emerald National Network of the Republic of North Macedonia and has been proposed for nomination as a Natura 2000 location (Zoroski 2022).



Fig. 1: Map of North Macedonia - the red square indicates the area of Belčišta wetland.



Fig. 2: Belčišta wetland – landscape – original photos.

The Belčišta wetland is a remnant of the former Desaret Lake, which flooded the Debrca valley in the Pliocene epoch. According to (Cvijic 1911), Lakes Ohrid, Prespa, and Malič are part of the so-called "Desaret" lakes. This group of lakes, as part of the lake region of South Macedonia and Thessaly, belongs to the basin of the Adriatic Sea and developed independently.

Neighboring Lake Ohrid and Lake Prespa are also inhabited by *Phoxinus lumaireul*. Initial investigations of the parasite fauna of fishes from the Belčišta wetland were carried out by [3], who found *Pomphorhynchus bosniacus* in *Squalius squalus*, *Phoxinus lumaireul*, and *Pelagus minutus*.

Blazhekovikj-Dimovska *et al.*, (1969) reported *Acanthocephalus lucii* in *Phoxinus lumaireul* from the Belčišta wetland.

Hristovski (1983), during parasitological research on fishes from N. Macedonia, found *Ligula intestinalis* (larva) in *Phoxinus lumaireul* from Lake Ohrid, but did not find any parasite species in *Phoxinus lumaireul* from Lake Prespa. In his PhD thesis, (Stojanovski 2003) reported finding *Dactylogyrus borealis* in *Phoxinus lumaireul* from Lake Ohrid.

2. MATERIALS AND METHODS

Fish material from a total of 21 specimens of minnow (*Phoxinus lumaireul* Linnaeus, 1758) from the Belčišta wetland (southwest of Republic of North Macedonia) were subjected to a parasitological investigation, conducted seasonally from 2021 to 2023. The localities in the Belčišta wetland where the investigations were carried out included: Djošev Kladenec, Novoselski Vir, and Matica near the bridge where it flows into the Sateska River. Only fresh fish were subjected to routine identification, dissection, and observation methods. Cleaned parasites were separated and placed in specific fixatives, prepared for determination using established techniques of staining and clearing (Gussev 1983; Vasiljkov 1983). For the collection of acanthocephalan species, the intestines of the fish were examined using the stereomicroscope "Zeiss Stemi 305" and the microscope "Zeiss Primovert", and parasites were removed. For morphological examination, permanent slides of whole individual parasites were prepared by staining with acetocarmine, dehydrating with ascending grades of alcohol, and mounting in Canada balsam. Identification was made based on the morphology of the neck, bulb, proboscis with hooks, and the reproductive system, using reference keys for determination (Chankovic *et al.*, 1968; Bauer 1987). We calculated the prevalence of infestation (the mean percentage of fish infected with a particular parasite) and the intensity of infestation (or parasite richness, as the mean number of parasites per fish).

3. RESULTS

During the parasitological investigations on minnows (*Phoxinus phoxinus*) from the Belčišta wetland (N. Macedonia), four parasite species were found: *Pseudochetosoma salmonicola* (Fig. 3), *Nematoda gen. sp.* (Fig. 4), *Acanthocephalus lucii* (Fig. 5), and *Pomphorhynchus bosniacus* (Fig. 6).



Fig. 3: *Pseudochetosoma salmonicola* from Belčišta wetland – whole parasite – original photo.

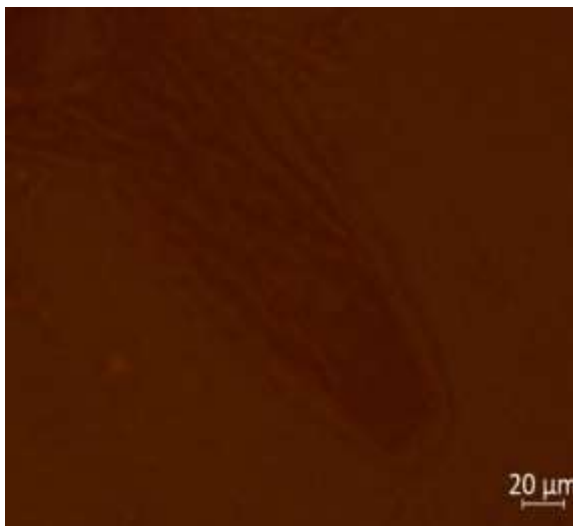


Fig. 4: *Nematoda gen. sp.* from Belčišta wetland – anterior part – original photo.

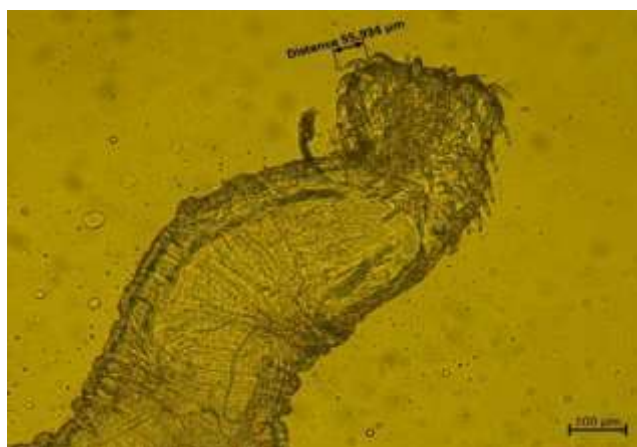


Fig. 5: *Acanthocephalus lucii* from Belčišta wetland - proboscis of a female worm with hooks – original photo.

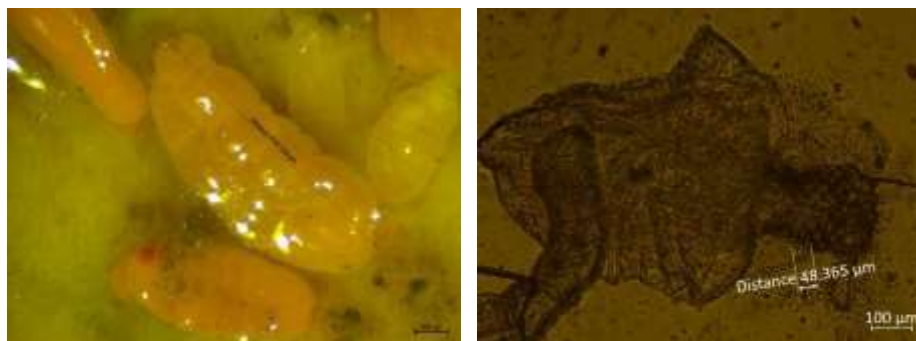


Fig. 6: *Pomphorhynchus bosniacus* from Belčišta wetland: left – attached on intestines; right proboscis (original photos)

The total prevalence of infestation was 90.48%, with 19 out of 21 examined fish being infested. The highest prevalence was observed for *Pomphorhynchus bosniacus* (found in 90.48% of minnows), while *Nematoda gen. sp.* and *Acanthocephalus lucii* were found in 9.52% of the fish. The lowest prevalence was observed for *Pseudochetosoma salmonicola* (4.76%) (Table 1, Figure 7).

The average intensity of infestation was 5.52, with the highest level recorded for *Pomphorhynchus bosniacus* (5.68) and the lowest for *Acanthocephalus lucii* (1.0) (Table 1, Figure 7).

We found three fish specimens infested with two different parasite species and two fish specimens infested with three different parasite species.

Table 1. Parasite fauna of the minnow (*Phoxinus lumaireul*) from Belčišta wetland

Parasite species	Prevalence			Intensity of infection
	No. of examined fishes	No. of infected fishes	% of infected fishes	
<i>Pseudochetosoma salmonicola</i> (<i>Digenea</i>)	21	2	9.52	1.50
<i>Nematoda gen.sp.</i> (<i>Nematoda</i>)		2	9.52	1.50
<i>Acanthocephalus lucii</i> (<i>Acanthocephala</i>)		3	14.29	1.0
<i>Pomphorhynchus bosniacus</i> (<i>Acanthocephala</i>)		19	90.48	5.68
Total infection	21	19	90.48	5.52

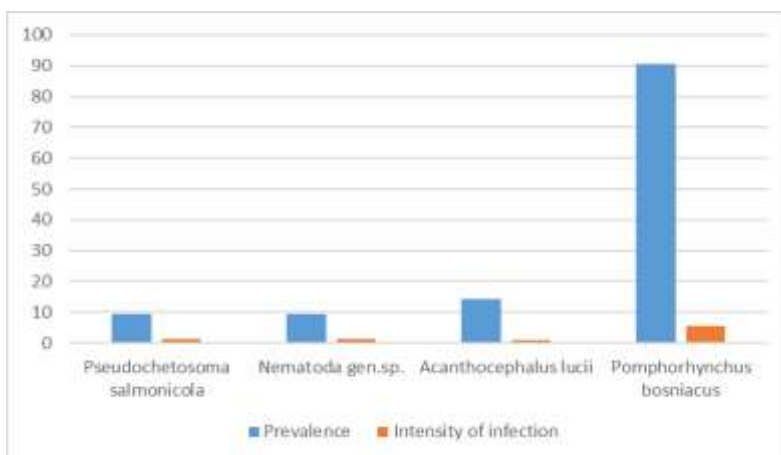


Fig. 7: Parasite fauna of the minnow (*Phoxinus lumaireul*) from Belčišta wetland.

4. DISCUSSION

The parasite fauna of minnows (*Phoxinus lumaireul*) from the Belčišta wetland is similar to that of fish from the family Cyprinidae found throughout the Balkan Peninsula and beyond (Ergens 1960; Chankovic 1968; Ergens 1970; Gussev 1983; Hristovski 1983; Kakacheva-Avramova 1983; Vasiljkov 1983; Dupont and Lambert 1986; Bauer 1987; Nedeva-Lebenova 1991; Cacic 1992; Stojanovski 1997; Stojanovski 2003; Djikanovic *et al.*, 2012; Stojanovski *et al.*, 2012; Blazhekovikj-Dimovska *et al.*, 2022; 2023).

Some of the identified parasites have a wide distribution and a broad host range, such as *Acanthocephalus lucii*. Other identified parasites are stenoparasites or near the border of stenoparasitism, such as *Pseudochetosoma salmonicola* and *Pomphorhynchus bosniacus*.

The findings of all parasite species represent the first recorded occurrences for *Phoxinus lumaireul* in the Belčišta wetland and N. Macedonia. Among the parasite species found in minnows from the Belčišta wetland, the greatest pathological influence was associated with *Pomphorhynchus bosniacus*.

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