



FAUNA OF MONOGENEAN TREMATODES - PARASITES OF CYPRINID FISH FROM LAKE DOJRAN (MACEDONIA)

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SYNOPSIS

A parasitological examination from Macedonian part of the Lake Dojran showed that 86 fish of 454 examined (18,94%) were infested with monogeneans. Of the 7 fish species examined, infestation with monogeneans was found in 7 of the species. In our study the presence of 8 monogenean species was found: *Dactylogyrus difformis*, *Dactylogyrus extensus*, *Dactylogyrus minutus*, *Dactylogyrus similis*, *Dactylogyrus suecicus*, *Dactylogyrus vastator*, *Ligophorus sp.* and *Eudiplozoon nipponicum*. Individually, by parasite species, the highest prevalence was with *Dactylogyrus suecicus* (6,39%) and *Dactylogyrus similis* (6,17%). The highest intensity of infestation was with *Dactylogyrus difformis* (18,0) and *Dactylogyrus suecicus* (8,50). The greatest pathological effect was associated with the following species: *Dactylogyrus extensus*, *Dactylogyrus minutus*, *Dactylogyrus vastator* and *Eudiplozoon nipponicum*. All the monogenean species are recorded for the first time in the ichthyoparasitofauna of Lake Dojran and Macedonia.

INTRODUCTION

Lake Dojran is situated in the south-eastern part of Macedonia. The surface of the lake is 42,5 km², of which 26,58 km² belongs to Macedonia, and 15,92 km² to Greece. The maximum depth was 10 m. In the last 20 years, the level of the water has tended to lower continuously, due to years of drought and the excessive use of water, particularly by the Greek side. In this, the depth was reduced to less than 5 m. Due to better hydrological conditions in the last few years and artificial filling of lake by springs from Gjavato, water level has been almost returned to normal. Because of this, a total destruction of habitats has taken place, particularly in the littoral region. The appearance of rare, but mainly ubiquitous species for the lake is seen, representatives of a swampy fauna, and characteristic of a polisaprobic level of pollution.

The lake is characteristically eutrophic, with a large amount of phyto- and zooplankton. It is very rich in fish, one of the richest in Europe. In recent years, a drop in annual fish catch has been observed. Of the previous 250 tons, less than 100 t now, as a consequence of the changed conditions for fish due also to excessive fishing. In the fish population cyprinid fish dominate, represented by 8 species, and other species are: perch, eel and wels catfish. Roach, bleak, carp, perch and wels catfish particularly have great market value.

Monogenean trematodes have great importance in fish pathology. Certain species cause very serious diseases of fish, particularly in the young. A large number of monogenean species have a very clear specificity to a respective host - fish or a narrow circle of related hosts. Monogenean trematodes are present in large numbers in the environment. Because of them being ectoparasites, they are even more subject to changes in the physical-chemical characteristics of the aquatic habitat, which they have to adjust to. Monogenean trematodes could be a sensitive indicator to the changes of lake ecosystems. Data about their prevalence and intensity of infestation, together with the knowledge of the biology of these parasites could reveal the state of their environment.

MATERIALS AND METHODS

Fish material was sampled over several years, from the Macedonian side of Lake Dojran. Fishing was carried out seasonally, in the period from spring 2000 to spring 2002.

Fish were subjected to routine methods of identification, dissection and observation (**Gusev**, 1983; **Hotenovsky**, 1985, **Stojanovski**, 2003). It is important that fish for investigations should be freshly caught and examined. Cleaned parasites were separated and put in fixatives, prepared for identification using techniques of staining and clearing.

For the identification of the parasite species we used the following keys: **Bauer**, (1985) and **Hotenovsky** (1985). The most successful preparations for each parasite were photographed and displayed.

RESULTS AND DISCUSSION

During parasitological investigations in Lake Dojran (Macedonia) 7 fish species were examined and infestation with monogenea was found in 5 fish species. The two fish species not infested with monogeneans were: *Silurus glanis* and *Perca fluviatilis*. Eight species of monogenean trematodes were found on the gills, as follows: *Dactylogyrus difformis* (Figures 1, 2), *Dactylogyrus extensus* (3, 4), *Dactylogyrus minutus* (5, 6), *Dactylogyrus similis* (7, 8), *Dactylogyrus suecicus* (9, 10), *Dactylogyrus vastator* (11, 12), *Ligophorus sp.* (13), *Eudiplozoon nipponicum* (14, 15).

In *Rutilus rutilus dojranensis* Karaman, 1928 we found *Dactylogyrus similis* (prevalence 21,37% of roaches) and *Dactylogyrus suecicus* (22,14%); in *Scardinius erythrophthalmus dojranensis* Karaman, 1924 we found *Dactylogyrus difformis* (55,56% of rudd); in *Alburnus alburnus macedonicus* Karaman, 1928 we found *Ligophorus sp.* (2,02% of bleak); in *Cyprinus carpio* Linnaeus, 1758 we found *Dactylogyrus minutus* (24,0%), *Dactylogyrus extensus* and *Eudiplozoon nipponicum* (both 32,0%); and in *Carassius auratus gibelio* (Bloch, 1783) we found *Dactylogyrus vastator* (6,0%). The total prevalence with monogenea is 18,94%, i.e. 86 infested fish of 454 examined (Table 1, Figure 1). Total mean intensity of infestation in relation to the number of infested fish is 6,76.

10 specimens of wels catfish - *Silurus glanis* Linnaeus, 1758 and 80 specimens of perch - *Perca fluviatilis* Karaman, 1924, also investigated were found not to have these parasites.

Prevalence in *Rutilus rutilus dojranensis* is 43,51%, while intensity is 8,05; in *Scardinius erythrophthalmus dojranensis* prevalence is 55,56%, while intensity is 18,0; in *Alburnus alburnus macedonicus* prevalence is 2,02%, while intensity is 1,0; in *Cyprinus carpio* prevalence is 64,0%, while intensity is 2,17; and in *Carassius auratus gibelio* prevalence is the lowest (6,0%), while intensity is 2,50 (Table 1, Figure 2).

On the whole, the carriers of most monogenean species are *Cyprinus carpio* (3), then *Rutilus rutilus dojranensis* (2), and *Scardinius erythrophthalmus dojranensis*, *Carassius auratus gibelio*, *Alburnus alburnus macedonicus* are each infested with 1 species of parasite.

Results of determining the Fulton's condition coefficient among infested and uninfested fish from Lake Dojran show that it is 1,12 in uninfested fishes, while in infested is 1,06. These data reveal the influence of monogenean trematodes, and parasites in general, on the health and condition of fish, and are confirmed by a great number of investigators.

The highest prevalence and intensity of infestation with monogeneans in Lake Dojran' fishes occur during the spring (29,32%) and summer (26,09%), because of spawning, especially of cyprinid fish. This observation agrees with the findings of **Thomas** (1964), who, likewise, has the same view, that maximum prevalence and intensity of parasites occur in the course of a vernal period. Along with this, he emphasizes 3 factors, which induce lower physiological resistance of the female trout to parasites during the spawning period: weaker condition, stress and disruption in the

production of estrogen. Also, after the winter period, which is a latent period, the vernal period provides better conditions for development and reproduction of the parasites, which is mainly why they increase in number (Table 1).

Table 1. Prevalence and intensity of infestation with monogenean trematodes in the fishes from the Lake Dojran.

Tabela 1. Ekstenzitet i intenzitet infestacije monogenim trematodama kod riba Dojranskog jezera.

Fish species	Monogenean species	Season	Prevalence			Mean intensity of infestations by seasons (in relation to the number of infested fishes)	
			No. of examined fishes	No. of infested fishes	% of infested fishes		
Rutilus rutilus dojranensis	Dactylogyrus similis	Winter	20	2	10.0	7.50	
		Spring	53	18	33.96	9.72	
		Summer	28	8	28.57	2.37	
		Autumn	30	0	0	0	
	In total - Dactylogyrus similis			131	28	21.37	7.46
	Dactylogyrus suecicus	Winter	20	12	60.0	9.40	
		Spring	53	10	18.86	11.30	
		Summer	28	7	25.0	3.43	
		Autumn	30	0	0	0	
	In total - Dactylogyrus suecicus			131	29	22.14	8.50
Totally infested			131	57	43.51	7.99	
Scardinius erythrophth. dojranensis	Dactylogyrus difformis	Winter	3	2	66.67	15.0	
		Spring	6	3	50.0	20.0	
Totally infested			9	5	55.56	18.0	
Alburnus alburnus macedonicus	Ligophorus sp.	Winter	33	2	6.06	1.0	
		Spring	22	0	0	0	
		Summer	12	0	0	0	
		Autumn	32	0	0	0	
Totally infested			99	2	2.02	1.0	
Cyprinus carpio	Dactylogyrus minutus	Spring	7	3	42.86	1.0	
		Summer	10	3	30.0	1.0	
		Autumn	8	0	0	0	

	In total - Dactylogyrus minutus		25	6	24.0	1.0
	Dactylogyrus extensus	Spring	7	3	42.86	5.0
		Summer	10	3	30.0	3.0
		Autumn	8	2	25.0	1.0
	In total - Dactylogyrus extensus		25	8	32.0	3.0
	Eudiplozoon nipponicum	Spring	7	5	71.43	1.50
		Summer	10	0	0	0
		Autumn	8	3	37.50	1.0
	In total - Dactylogyrus extensus		25	8	32.0	1.31
Totally Infested			25	16	64.0	2.17
Carassius auratus gibelio	Dactylogyrus vastator	Winter	20	0	0	0
		Spring	30	3	10.0	3.0
		Summer	20	3	15.0	2.0
		Autumn	30	0	0	0
Totally Infested			100	6	6.0	2.50
Silurus		Spring	5	0	0	0
glanis		Summer	5	0	0	0
Perca fluviatilis macedonica		Winter	13	0	0	0
		Spring	10	0	0	0
		Summer	17	0	0	0
		Autumn	40	0	0	0
Totally Infested			80	0	0	0
Totally infested - Winter			89	18	20.22	7.11
Totally infested - Spring			133	39	29.32	10.29
Totally infested - Summer			92	24	26.09	2.22
Totally infested - Autumn			140	5	3.57	1.0
IN TOTAL			454	86	18.94	6.76

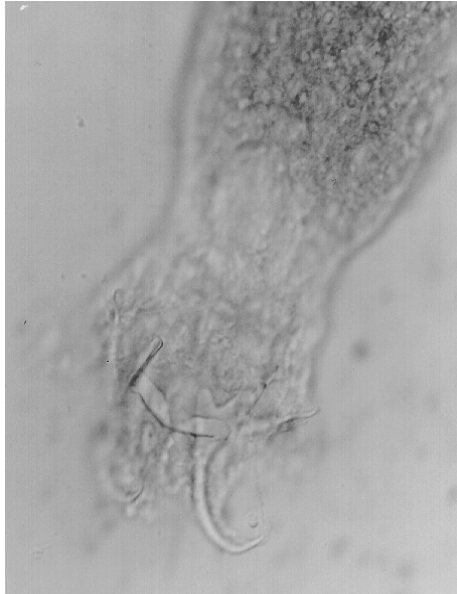


Figure 1. *Dactylogyrus difformis* - adhesive disk (original), x 332

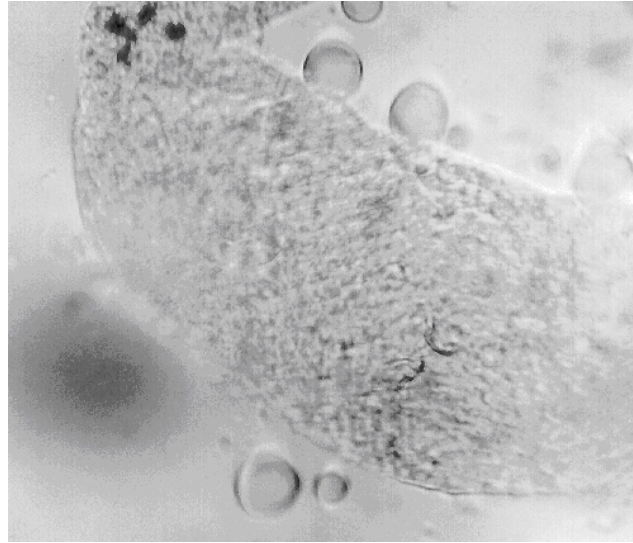


Figure 2. *Dactylogyrus difformis* - copulatory organ (original), x 300

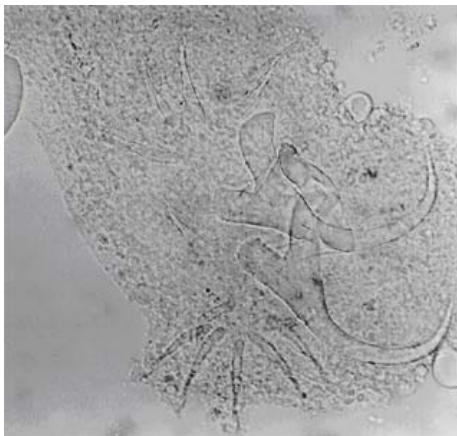


Figure 3. *Dactylogyrus extensus* - adhesive disk (original), x 252



Figure 4. *Dactylogyrus extensus* - copulatory organ (original), x 288

The greatest pathological effect was associated with the following species: *Dactylogyrus extensus*, *Dactylogyrus minutus*, *Dactylogyrus vastator* and *Eudiplozoon nipponicum*.

The monogenean fauna of fish from Lake Dojran is in common with that of the fish of corresponding families from the Balkan Peninsula and more widely, with the exception of *Ligophorus sp.*, which is found on the gills of marine fish from the family Mugilidae (Bauer, 1985; Cakic, 1992; Dupont & Lambert, 1986; Ergens, 1960; Ergens, 1970; Kakaceva-Avramova, 1983; Kiskaroly, 1982; Kiskaroly, 1987; Nedeva-Lebenova, 1991).

All monogenean species referred to in this paper represent the first record for fish from the natural lakes in Macedonia.

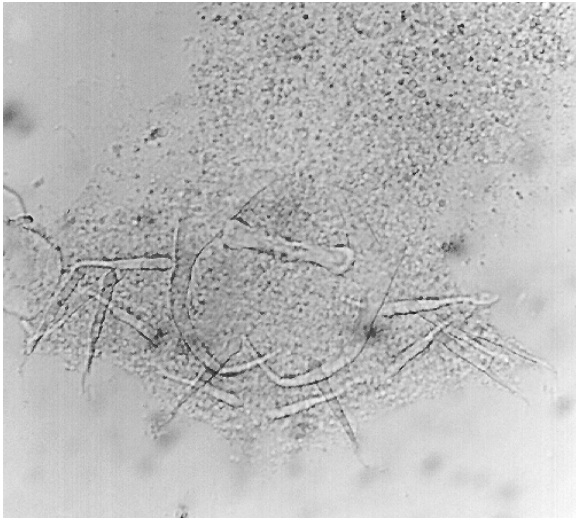


Figure 5. *Dactylogybus minutus* - adhesive disk (original), x 300

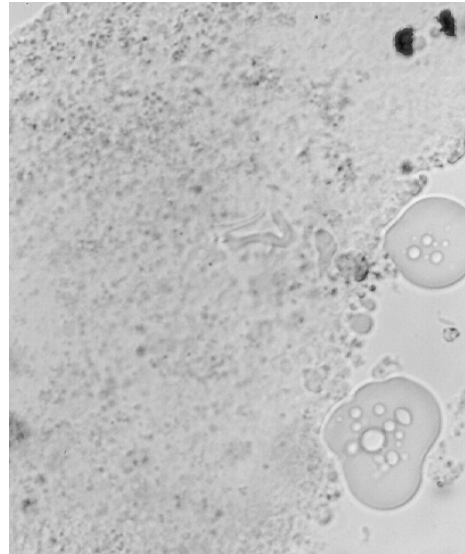


Figure 6. *Dactylogybus minutus* - copulatory organ (original), x 320

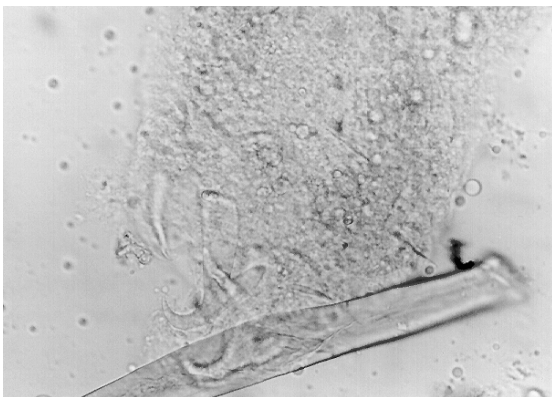


Figure 7. *Dactylogybus similis* - adhesive disk (original), x 252

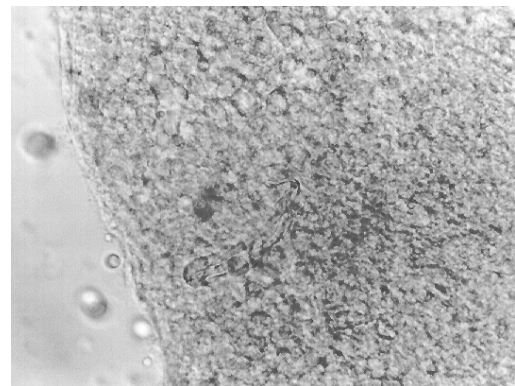


Figure 8. *Dactylogybus similis* - copulatory organ (original), x 252

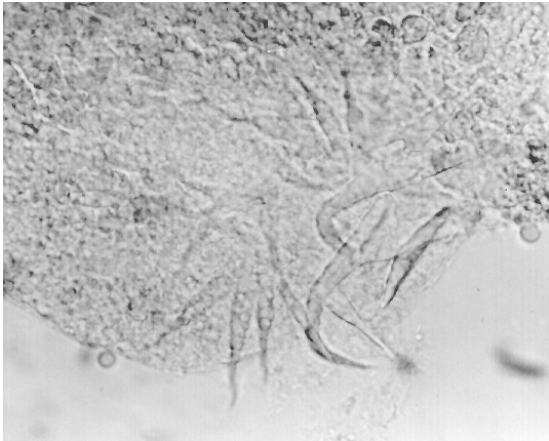


Figure 9. *Dactylogyrus suecicus* - adhesive disk (original), x 340



Figure 10. *Dactylogyrus suecicus* - copulatory organ (original), x 360

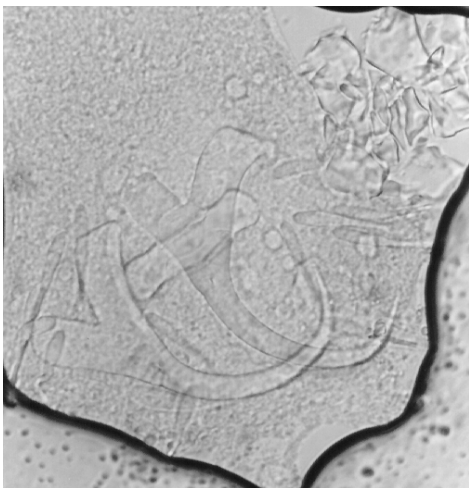


Figure 11. *Dactylogyrus vastator* - adhesive disk (original), x 360

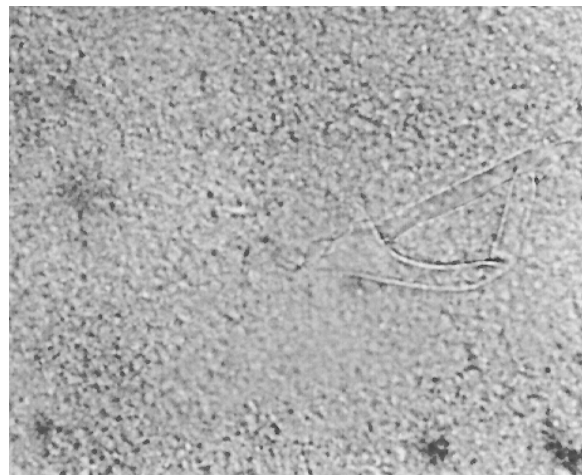


Figure 12. *Dactylogyrus vastator* - copulatory organ (original), x 360

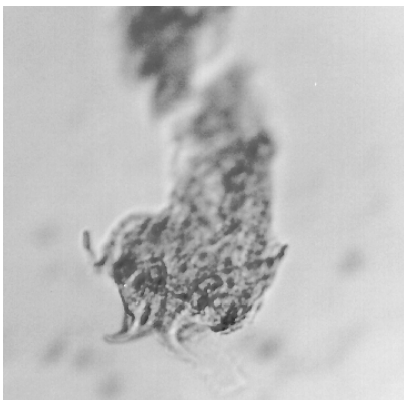


Figure 13. *Ligophorus* sp. - adhesive disk (original), x 400

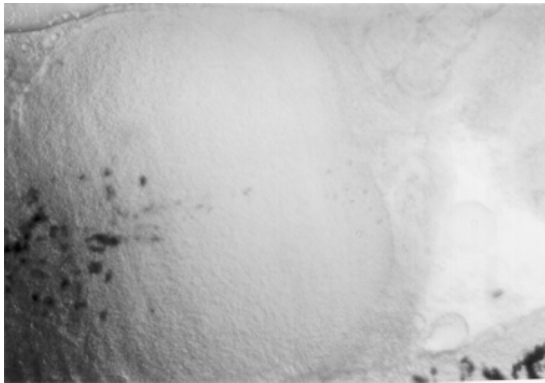


Figure 14. *Eudiplozoon nipponicum* - clams (original), x 126



Figure 15. *Eudiplozoon nipponicum* - dilatation of the middle part (original), x 63

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