

Acta Veterinaria (Beograd), Vol. 54. No. 1, 73-82, 2004.

UDK 619:639.312:616.995.122.22

FAUNA OF MONOGENEAN TREMATODES – PARASITES OF SOME CYPRINID FISHES FROM LAKE PRESPA (MACEDONIA)

STOJANOVSKI S*, KULIŠIĆ Z**, BAKER RA***, HRISTOVSKI N****, CAKIĆ P***** and HRISTOVSKI M*****

*Hydrobiological Institute, Ohrid, Macedonia, **Faculty of Veterinary Medicine, Belgrade
School of Biology, University of Leeds, UK; *Faculty of Biotechnical Sciences, Bitola, Macedonia, *****Institute for Biological Research "Siniša Stanković", Belgrade, *****Faculty of Veterinary Medicine, Skopje, Macedonia

(Received 17.November 2003)

During parasitological investigations six species of monogenean trematodes were found on the gills of three cyprinid fish species from Lake Prespa (Macedonia), as follows: *Dactylogyrus prostrae* and *Dactylogyrus sphyrna* in *Leuciscus cephalus albus*, *Dactylogyrus erhardovae*, *Dactylogyrus sphyrna* and *Paradiplozoon zeller* in *Rutilus rubilio prespensis* and *Dactylogyrus elegantis* and *Dactylogyrus vistulae* in *Chondrostoma nasus prespensis*.

The prevalence in *Leuciscus cephalus albus* was 62.22%, in *Rutilus rubilio prespensis* 59.87%, while in *Chondrostoma nasus prespensis* it was the lowest and amounted to 41.59%. The overall prevalence of monogeneans in the investigated cyprinid fishes from Lake Prespa was 53.65%, and the mean intensity of infestation was 6.08. Among the monogenean species the highest prevalence occurred with *Dactylogyrus sphyrna* (25.08%), and the greatest intensity of infestation was evident in the cases of infestation with *Dactylogyrus erhardovae* (12.87). The greatest pathological effect was associated with the monogeneans *Dactylogyrus vistulae* and *Paradiplozoon zeller*.

All monogenean species found represented the first record for such parasite fauna of fishes in Macedonia.

Key words: Monogenean trematode, cyprinid fish, Lake Prespa

INTRODUCTION

Lake Prespa is situated in the south-western part of Macedonia. It is divided into two parts: Macro and Micro Prespa. It has an average depth of 18.74 m and the greatest is 54.2 m. The lake has several small rivers as tributaries. According to its trophic state, it is on the boundary between an oligotrophic and mesotrophic condition (Naumovski *et al.*, 1997). The surface level of the lake has significantly decreased in the last decade, because of long dry periods that led to eutrophication. The lake, which was formed in the pliocene age is as old as Lake Ohrid and is inhabited with a considerable composition of fish fauna.

Hristovski (1975) found nine species of helminths in fishes from Lake Prespa, during preliminary investigations on the parasite fauna of the fishes. Fur-

ther investigations were carried out by Hristovski (1983, 1984), Hristovski and Stojanovski (1997) and Hristovski *et al.* (2000, 2001).

Dupont and Lambert (1986), observed the following dactylogyrid species in fishes from Lake Mikro Prespa (Greece): *Dactylogyrus alatus*, *D. anchoratus*, *D. balkanicus n.sp.*, *D. caucasicus*, *D. chondrostomi*, *D. crivellius n.sp.*, *D. dyki*, *D. elegantis*, *D. erhardovae*, *D. ergensi*, *D. extensus*, *D. folkmanovae*, *D. minor*, *D. prespensis n.sp.*, *D. prostae*, *D. sphyrna* and *D. vistulae D. vistulae*. Three species of dactylogyrids: *D. balkanicus n.sp.*, *D. crivellius n.sp.* and *D. prespensis n.sp. dyki* in *Barbus cyclolepis prespensis* were new to science generally.

Monogenean trematodes are of major importance in the pathology of fishes. As ectoparasites, they are present in vast numbers in the environment and express a very clear specificity for their required host – fish. Monogeneans are one of the most specific parasites, in general. Also, monogeneans are regarded as a sensitive indicator of the state of health of the habitat.

MATERIALS AND METHODS

Fish material was sampled during 3 years, from summer 1998 to summer 2001. In this period 315 specimens of fishes from three species were examined: *Leuciscus cephalus albus*, *Rutilus rubilio prespensis* and *Chondrostoma nasus prespensis*.

Fishes were subjected to the routine methods of identification, dissection and observation. They were first examined carefully on the external side with a binocular lens. Cleaned parasites were separated, put in certain fixatives and then prepared for examination with appropriate techniques of staining and clearing.

For identification of the parasite species we used the following keys: Bauer, (1985) and Hotenovskiy (1985). The most successful preparations of each parasite species were photographed and displayed. SEM photographs were prepared in the Biological Faculty at Leeds University.

RESULTS AND DISCUSSION

The presence of six monogenean species was established: *Dactylogyrus elegantis*, *D. erhardovae*, *D. prostae*, *D. sphyrna*, *D. vistulae* and *Paradiplozoon zeller* (Figures 1-16).

All monogenean species found represented the first record for the parasite fauna of fishes in Macedonia.

A total of 315 specimens of three fish species were examined of which 169 (53.65%) were infested with monogeneans. The mean intensity of infestation was 6.08 (Table 1).

Chub (*Leuciscus cephalus albus*): 45 specimens were examined, of which 28 (62.22%) were infested with monogeneans. The mean intensity of infestation was 7.90. Two monogenean species were found: *Dactylogyrus prostae* in 18 fishes (40.0%) with a mean intensity of infestation of 8.0, and *Dactylogyrus sphyrna* in 10 chubs (22.22%) with an intensity of infestation of 5.75.



Figure 1. *Dactylogyryrus elegantis* (adhesive disc) - original, x 300

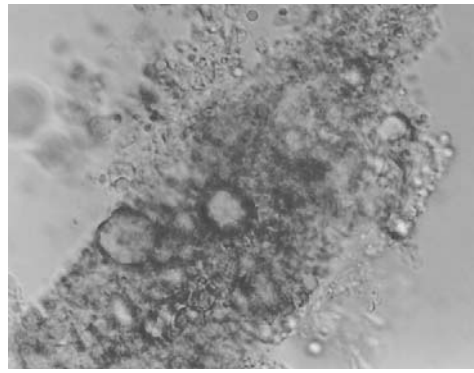


Figure 2. *Dactylogyryrus elegantis* (copulatory organ) - original, x 300

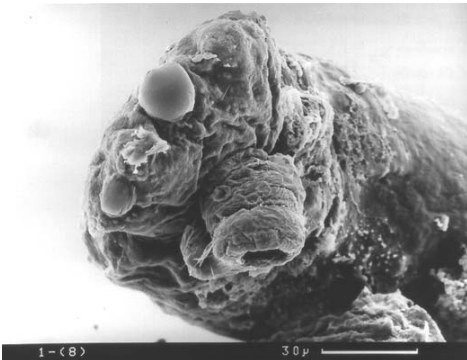


Figure 3. *Dactylogyryrus elegantis* - anterior part (original SEM photography)

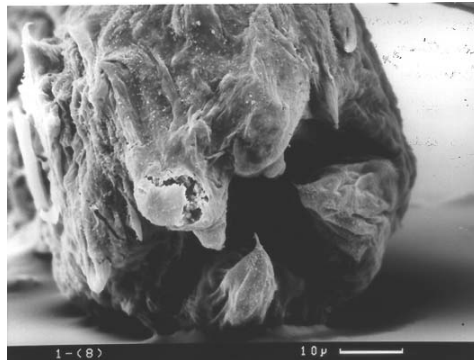


Figure 4. *Dactylogyryrus elegantis* - adhesive disc (original SEM photography)

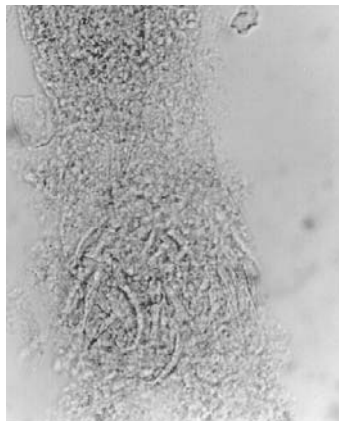


Figure 5. *Dactylogyryrus erhardovae* (adhesive disc) - original, x 300

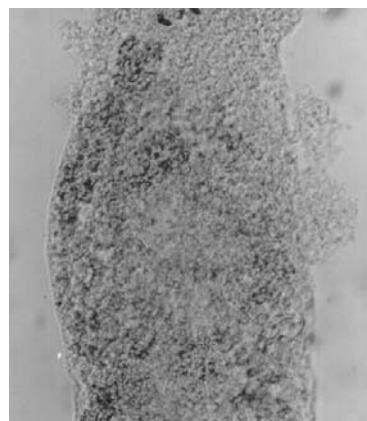


Figure 6. *Dactylogyryrus erhardovae* (copulatory organ) - original, x 252

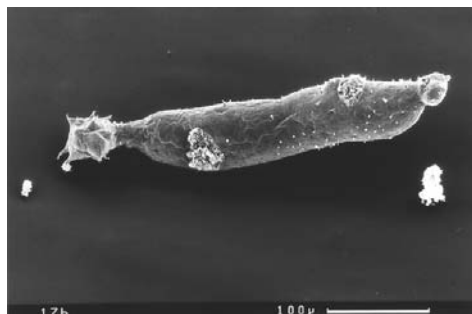


Figure 7. *Dactylogyus erhardovae* - whole parasite (original SEM photography)



Figure 8. *Dactylogyus erhardovae* - adhesive disc (original SEM photography)

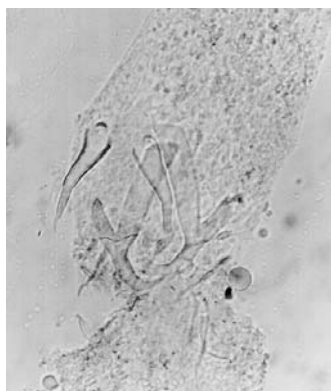


Figure 9. *Dactylogyus sphyrna* (adhesive disc) - original, x 320

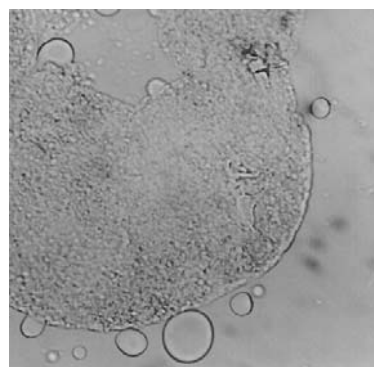


Figure 10. *Dactylogyus sphyrna* (copulatory organ) - original, x 320



Figure 11. *Dactylogyus sphyrna* - anterior part (original SEM photography)

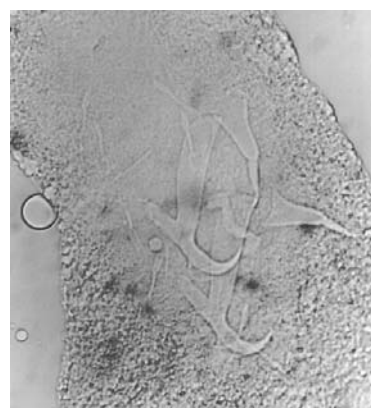


Figure 12. *Dactylogyus vistulae* (adhesive disc) - original, x 320

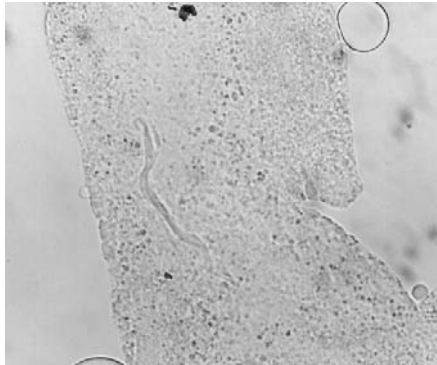


Figure 13. *Dactylogyrus vistulae* (copulatory organ) - original, x 320



Figure 14. *Paradiplozoon zeller* (clamps) - original, x 180

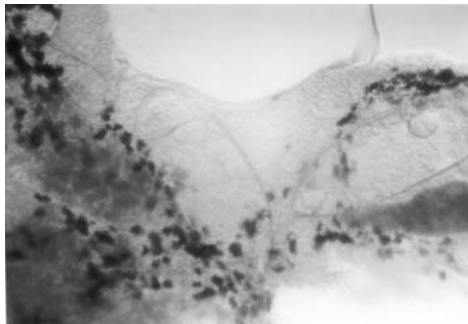


Figure 15. *Paradiplozoon zeller* (egg) - original, x 200



Figure 16. *Paradiplozoon zeller* - whole parasite (original SEM photography)

Roach (*Rutilus rubilio prespensis*): 157 specimens were examined, of which 94 (59.87%) were infested with monogeneans. The mean intensity of infestation was 7.53. Three monogenean species were found: *Dactylogyrus erhardovae* in 24 fishes (15.29%) with an intensity of infestation of 12.87; *Dactylogyrus sphyrna* in 69 fishes (43.95%) with an intensity of infestation of 5.96 and *Paradiplozoon zeller* in 3 roaches (1.91%) with an intensity of infestation of 1.0.

Undermouth (*Chondrostoma nasus prespensis*): 113 specimens were examined, of which 47 (41.59%) were infested with monogeneans. The mean intensity of infestation was 2.11. Two monogenean species were found: *Dactylogyrus elegantis* in 36 fishes (31.86%) with an intensity of infestation of 2.25, and *Dactylogyrus vistulae* in 12 undermouths (10.62%) with an intensity of infestation of 1.50.

Table 1. Prevalence and intensity of infestation with Monogenea among some fishes from Lake Prespa

Fish species	Parasite species	Season	Prevalence			Average intensity of infestation by seasons (depending of the No. of infested fishes)
			No. of examin. fishes	No. of infested fishes	% of infested fishes	
<i>Leuciscus cephalus albus</i>	<i>Dactylogyrus sphyrna</i>	Winter	4	0	0	0
		Spring	22	6	27.27	7.50
		Summer	11	4	36.36	4.0
		Autumn	8	0	0	0
	In total – <i>Dactylogyrus sphyrna</i>		45	10	22.22	5.75
	<i>Dactylogyrus prostaе</i>	Winter	4	0	0	0
		Spring	22	12	54.55	5.75
		Summer	11	6	54.55	11.0
		Autumn	8	0	0	0
	In total – <i>Dactylogyrus prostaе</i>		45	18	40.0	8.0
Overall infestation			45	28	62.22	7.90
<i>Rutilus rubilio prespensis</i>	<i>Dactylogyrus sphyrna</i>	Winter	26	0	0	0
		Spring	74	54	72.97	6.44
		Summer	34	12	35.29	6.75
		Autumn	23	3	13.04	4.0
	In total – <i>Dactylogyrus sphyrna</i>		157	69	43.95	5.96
	<i>Dactylogyrus erhardovae</i>	Winter	26	0	0	0
		Spring	74	15	20.27	8.60
		Summer	34	9	26.47	20.0
		Autumn	23	0	0	0
	In total - <i>Dactylogyrus erhardovae</i>		157	24	15.29	12.87
	<i>Paradiplozoon zeller</i>	Winter	26	0	0	0
		Spring	74	0	0	0
		Summer	34	3	8.82	1.0
Autumn		23	0	0	0	
In total – <i>Paradiplozoon zeller</i>		157	3	1.91	1.0	
Overall infestation			157	94	59.87	7.53

Continuation of Table 1 - 1.

Fish species	Parasite species	Season	Prevalence			Average intensity of infestation by seasons (depending of the No. of infested fishes)
			No. of examin. fishes	No. of infested fishes	% of infested fishes	
<i>Chondrostoma nasus prespensis</i>	<i>Dactylogyrus elegantis</i>	Winter	46	6	13.04	1.50
		Spring	27	6	22.22	1.50
		Summer	32	21	65.62	2.86
		Autumn	8	3	37.50	1.0
	In total – <i>Dactylogyrus elegantis</i>		113	36	31.86	2.25
	<i>Dactylogyrus vistulae</i>	Winter	46	0	0	0
		Spring	27	0	0	0
		Summer	32	12	37.50	1.50
		Autumn	8	0	0	0
	In total - <i>Dactylogyrus vistulae</i>		113	12	10.62	1.50
Overall infestation			113	47	41.59	2.11
Overall infestation - WINTER			76	6	7.89	3.0
Overall infestation - SPRING			123	91	73.98	6.32
Overall infestation - SUMMER			77	66	85.71	6.29
Overall infestation - AUTUMN			39	6	15.38	3.33
Overall infestation			315	169	53.65	6.08

Among the monogenean species individually, the highest prevalence occurred with *Dactylogyrus sphyrna* (25.08%) and *Dactylogyrus elegantis* (11.61%), and the greatest intensity of infestation was observed in the cases of infestation with *Dactylogyrus erhardovae* (12.87) and *Dactylogyrus prostae* (8.0). The greatest number of parasite specimens was found in cases of infection with *Dactylogyrus erhardovae* and *Dactylogyrus prostae* (30).

The monogenean trematodes detected in cyprinid fishes from Lake Prespa, are also present in other cyprinids from the Balkan Peninsula and wider (Bauer, 1985; Vasiljkov, 1983; Dupont and Lambert, 1986; Kakačeva-Avramova, 1983; Nedeva-Menkova, 1991; Nedeva and Babacheva, 1999; Kiškaroly, 1982, 1987; Kiškaroly and Tafro, 1988; Stojanovski, 1997, 2003).

The data obtained indicate that a relatively large number of monogeneans (6) are present, probably due to the existence of many biotopes in Lake Prespa,

where a great number of different fish species can find favorable conditions for development and survival. Many monogeneans have very expressed specificity towards certain species of host – fish or a narrow circle of related hosts. According to Whittington *et al.* (2000), monogeneans (flatworms) are among the most host-specific of parasites in general and may be the most host-specific of all fish parasites. The host epidermis is of critical importance to *Monogenea*. Monogeneans live on fish epidermis, they live in its products (e.g. mucus), monopisthocotyleans feed on it, some of its products are “attractants” but it may be an inhospitable surface because of its immunological activity. The structure of gill leaves has an important influence on the specificity as well as the specific chemical composition of fish skin and epithelium and secretions of certain fish species, together with anterior adhesive areas and sensitive organs of monogeneans. Also, because monogenean trematodes are ectoparasites of fish, they are much more exposed to changes in the physico-chemical features of the environment, i.e. water, to which they have to adapt.

We found in Lake Prespa a relatively large number of monogenean species (6), a high intensity of infestation (6.08), but not so high prevalence (53.65%), compared with neighboring Lake Ohrid, which shows a lower level of eutrophication.

These findings about the occurrence of monogenean species confirm those of Dušek *et al.* (1998), Koskivaara *et al.* (1991), Cakić (1992) and Overstreet (1997). According to them, the number of parasite species, particularly species of monogeneans - specialists is decreasing in polluted waters, compared with unpolluted habitats, exist significantly. However, in lakes with different trophic states and extents of pollution, the prevalence is approx. the same, but there are differences in the intensity of infestation, which is significantly higher in polluted lakes.

The greatest prevalence and intensity of infestation with monogeneans in Lake Prespa fishes occurs during the summer (prevalence 73.98% and intensity 6.32) and spring (prevalence 85.71%, and intensity 6.29), because of spawning, particularly of the cyprinid fishes. This conclusion complies with the findings of Thomas (1964), who emphasizes three factors why female trout are physiologically less resistant to parasites during the spawning period: weaker condition, stress and disruption in the production of estrogen. Also, after winter, which is a latent period, the vernal period provides better conditions for development and reproduction of the parasites, enabling them to increase in number.

The Fulton's condition coefficient among infested fishes was lower and amounted to 1.08 (average), while among uninfested fishes it was 1.22. These data confirm the detrimental influence of parasites on the health and condition of fish.

The greatest pathological effect was associated with the monogeneans *Dactylogyrus vistulae* and *Paradiplozoon zelleri*. However, other monogenean trematodes can also act negatively on the health and condition of fish when they are met in sufficient numbers.

Address for correspondence:
 Dr Stojanovski S
 Hydrobiological Institute,
 Naum Ohridski 50, Ohrid,
 Macedonia

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FAUNA MONOGENIH TREMATODA - PARAZITA NEKIH RIBA RODA CYPRINIDAE IZ PRESPANSKOG JEZERA (MAKEDONIJA)

STOJANOVSKI S, KULIŠIĆ Z, BAKER RA, HRISTOVSKI N, ČAKIĆ P i HRISTOVSKI M

SADRŽAJ

U toku parazitoloških istraživanja ciprinidnih riba iz Prespanskog jezera (Makedonija), kod 3 vrste riba na škrgamma pronađeno je 6 vrsta monogenih trematoda, i to: kod *Leuciscus cephalus albus* su nađeni *Dactylogyrus prostaе* i *Dactylogyrus sphyrna*, kod *Rutilus rubilio prespensis* su pronađeni *Dactylogyrus erhardovae*, *Dactylogyrus sphyrna* i *Paradiplozoon zeller*, kod *Chondrostoma nasus prespensis* su pronađeni *Dactylogyrus elegantis* i *Dactylogyrus vistulae*.

Ekstenzitet infestacije kod *Leuciscus cephalus albus* iznosio je 62,22%, kod *Rutilus rubilio prespensis* 59,87%, a kod *Chondrostoma nasus prespensis* je bio najniži i iznosio je 41,59%. Ukupno, ekstenzitet infestacije sa monogeneama kod ispitivanih ciprinidnih riba Prespanskog jezera iznosio je 53,65%, a intenzitet infestacije 6,08. Pojedinačno, po vrstama monogenea, najviši ekstenzitet infestacije je bio sa *Dactylogyrus sphyrna* (25,08%), a najviši intenzitet infestacije je utvrđen u slučajevima infestacije sa *Dactylogyrus erhardovae* (12,87).

Najveći patogeni uticaj su imale monogene trematode *Dactylogyrus vistulae* i *Paradiplozoon zeller*.

Sve pronađene vrste monogenea predstavljaju prvi nalaz za parazitofaunu riba Makedonije.