

THE OCCURRENCE OF THE HELMINTH FAUNA IN SAND GOBY (*Gobius fluviatilis* PALLAS, 1811) FROM LAKE ULUABAT, TURKEY

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Helminth parasites of sand goby (Gobius fluviatilis Pallas, 1811) from Lake Uluabat were investigated on a monthly or bimonthly basis between April 1998 and November 1999. Four species of helminth parasites were recorded in 98 out of 134 fish: Gyrodactylus gobii Shul'man, 1953; Bothriocephalus acheilognathi Yamaguti, 1934; Ligula pavlovskii Dubinina, 1959; Eustrongylides excisus Jagerskiöld, 1909. They were evaluated with respect to seasons and host size. While G. gobii appeared to infect the gills and the skin of host fish, B. acheilognathi established itself in the intestines, and E. excisus and L. pavlovskii in the body cavity. A total of 789 specimens of G. gobii were detected especially on smaller host fish during the spring period (prevalence 25.3%, mean intensity 23.21 ± 9.17 specimens/fish). Although 184 B. acheilognathi appeared on host fish of various sizes and in all seasons, the mean intensity of infection was relatively low (prevalence 34.3%, mean intensity 3.98 ± 3.15 specimens/fish). Concerning L. pavlovskii, the second cestode species, only 9 parasites were found in medium-sized host fish during the summer, autumn and winter (prevalence 3.7%, mean intensity 1.60 ± 0.89 specimens/fish). A total of 108 parasite specimens of E. excisus was found on 40 host fish in the summer and autumn (prevalence 29.8%, mean intensity 2.70 ± 2.29 specimens/fish). The present study gives the occurrence, density, seasonal changes, and parasite-host size relationship for a new locality - Lake Uluabat - as a contribution to the geographical distribution of G. gobii and E. excisus in sand goby.

Keywords: Bothriocephalus acheilognathi, Eustrongylides excisus, Gobius fluviatilis, Gyrodactylus gobii, Ligula pavlovskii, seasonal patterns, size-dependence

INTRODUCTION

There have been few detailed studies relevant to the description of parasite species of helminth fauna in Turkey and only several helminth species have been identified. Major investigations have been conducted by such researchers as

Ekingen (1976), Oguz (1991) and Ozturk *et al.*, (2001). Our study area, Lake Uluabat, has one of the largest bodies of water in the Marmara Region and is also significant in terms of fishing. The helminth fauna of some fish species in the lake was investigated by Oguz (1991), Akinci (2001) and Ozturk *et al.*, (2000). However, no investigation has been conducted for *G. fluviatilis*, a species which exhibits a significant population density in the lake. As for other localities in Turkey, two studies have been made on the helminth fauna of this host fish (Oguz, 1996; Ozturk *et al.*, 2001). The first researcher noted two helminth species in *Gobius* varieties in Mudanya gulf: *Gaidropsarus mediterraneus* (L.) and *Pleuronectes flesus luscus* (Slastanenko 1939). The latter researcher detected two species of helminth in sand goby fish of Lake Manyas: *Ligula pavlovskii*, cestoda and *Eustrongylides excisus*, nematoda (Ozturk *et al.*, 2001).

During the surveys, even though the parasites of monogenea, digenea, acanthocephala, crustacea and leech were sampled on the above mentioned host fish, not single specimen from the other helminth groups, cestoda and nematoda, was identified. Basic criteria for the assessment of the parasite species of host fish were the general parameters related to parasite populations, which are prevalence, mean intensity, seasonal variation and relationship between host size and infection. This study aimed to reveal the parasite fauna of the fish Lake Uluabat sustains, as well as the geographical properties of the lake. Naturally, it would be valuable to determine the current parasite fauna of the fish for future evaluations.

MATERIALS AND METHODS

Located in North-western Anatolia, Lake Uluabat, geographically falls on the co-ordinates 41°11' N, 29°04' E. A shallow lake (mean depth approximately 4 m), Uluabat has a surface area of 150 km² at an altitude of 8 m (Aksoy *et al.*, 1997). It is a natural eutrophic lake. This ichthyohelminthological study was carried out between April 1998 and November 1999. Fish were collected by local fishermen with bow-nets. The specimens were placed in plastic containers with the lake water added and then transferred to the research laboratory. They were kept in the tanks until examination and were subject to inspection within 24 hours of collection. During the examination, the methods adopted and utilised for the helminthological necropsy, and later for the ichthyohelminthological analysis, were routine techniques (Pritchard & Kruse, 1982). All possible sites of infection were examined for the occurrence of parasites with the aid of a stereo microscope with x12 and x50 magnification. The identified parasites were fixed with formaldehyde or Bouin's fluid, and then stained with Mayer's haematoxylin. Other species were killed, fixed in glacial acetic acid and stored in 70% ethanol. The specimens were identified according to Markevich (1951) Bychovskaya-Pavlovskaya (1962), Yamaguti (1963), Anderson (1992) and Khalil *et al.*, (1994).

Data for the population intensity of parasite species, percentage of infection, mean, together with minimum and maximum number of parasites, were assessed monthly and with reference to the size of host fish. Maturity aspects of a helminth species (*B. acheilognathi*) were assessed on a seasonal basis and were categorised into different groups. Each group was evaluated in terms of infection rate, mean parasite number, and other values according to the criteria of Wootten

(1974): groups 1-immature worms, body unsegmented, gonad absent (juvenile specimens); groups 2-mature worms, body segmented, developing gonad (young specimens); groups 3- mature worms, gonad fully developed (hermaphroditic specimens); groups 4- mature worms with eggs in uterus (gravid specimens).

The data on the parasite population were divided into four subunits (spring, summer, autumn and winter periods) on the basis of the seasons in which they were collected. Similarly on the basis of the host fish length, the data were divided into six groups: I. group (5-6 cm), II. group (7-8 cm), III. group (9-10 cm), IV. group (11-12 cm), V. group (13-14 cm), VI. group (>15 cm). The average length of all samples in each period was 7.25 ± 1.63 in spring, 9.21 ± 2.37 in summer, 12.03 ± 2.36 in autumn and 7.34 ± 1.20 in winter.

In addition, to characterise the structure of the parasite species populations, several measures were used. The total number of parasites was determined directly by numerical count. To measure variety between each parasite species and fish size, Spearman's rho test was applied. Kruskal-Wallis analysis of variance was applied to the data to demonstrate the significance of differences in parasite mean intensities. The minimum and maximum values are given in the tables, showing the arithmetic mean and standard deviation in parenthesis. Means were compared using the Tukey HSD test at the 0.05 error level. Statistical analyses were performed using a statistical program (SPSS 10.0).

RESULTS

Of the 134 host fish inspected, 98 were infected with one or more parasites (73.1%). Four species of parasites were identified: *Gyrodactylus gobii* Pallas, 1811 (Monogenea: Gyrodactylidae); *Bothriocephalus acheilognathi* Yamaguti, 1934 (Cestoda: Pseudophyllidae); *Ligula pavlovskii* (Bloch, 1782) (Cestoda: Diphyllbothriidae) and *Eustrongylides excisus* Jagerskiöld, 1909 (Nematoda: Dioctophymatidae). While the first species, *Gyrodactylus gobii*, appeared in the gills and skin of host fish, *Bothriocephalus acheilognathi* occurred in the intestines and the others in the body cavity (Table 1).

Table 1. The occurrence of parasites of sand goby (*Gobius fluviatilis*) in Ulubat lake. Examined fish number (N), Infected fish number (In), minimum-maximum (M) and mean parasite number ($\bar{X} \pm S.D.$), total parasite number (Σ)

N	In & (%)	Identified parasites groups	M	& ($\bar{X} \pm S.D.$)	Σ
134	34 (25.3)	<i>Gyrodactylus gobii</i>	10-58	(23.21 \pm 9,17)	789
	46 (34.3)	<i>Bothriocephalus acheilognathi</i>	1-18	(3.98 \pm 3,15)	184
	5 (3.7)	<i>Ligula pavlovskii</i>	1-3	(1.60 \pm 0,89)	9
	40 (29.8)	<i>Eustrongylides excisus</i>	1-10	(2.70 \pm 2,29)	108

Parameters of parasite invasion and mean, minimum-maximum and total number of parasites were established in relation to seasonal patterns and fish

size. Thus, 789 specimens of *Gyrodactylus gobii*, were sampled during the spring. During this period, *G. gobii* had a higher prevalence and mean intensity than did all the other parasite species (prevalence 25.3%, mean intensity 23.2 ± 9.17 specimens) (Table 1). Found on the host fish for the first time in April 1998, *G. gobii* appeared in a higher number the next April. The parasite infection reached the maximum level on smaller fish in April 1999 (81%). Likewise, the mean parasite number per fish attained the highest prevalence at 34 specimens (Table 2). However, in May, the density of this parasite gradually decreased to an infection rate of 46% and the mean parasite number per fish to 21.0 ± 3.31 specimens. In later months it vanished entirely. The relationship between the size of host fish and the variance-to-mean ratio for intensity of *G. gobii* appeared in this manner: parasites were more common in smaller host fish, there being a significant difference in prevalence and intensity between small and larger fish (45.4% and 4.3% respectively). Infection and mean intensity per fish peaked on the big fish sampled (58.0 ± 0.00 specimens per fish). The parasite intensity, both with respect to the rate of infection and the mean parasite number per fish, declined steadily, affected by the increase in fish size. Infection by this parasite never occurred in fish larger than 13 cm (Table 3).

Bothriocephalus acheilognathi infected the intestines of host fish with a prevalence of 34.3% and mean intensity of 3.9 ± 3.15 specimens/fish. Although noticed in all surveys, this species generally had a lower prevalence and mean intensity in infected fish (Table 2,3). When seasonally viewed, it was observed that the rate of infection increased steadily from spring towards autumn. In line with this result, maximum density of this parasite occurred in November, with 4.6 ± 0.68 specimens per fish. During spring and autumn, the difference between the rate of parasite infection and the number of parasites collected from host fish was more dramatic than the mean number of parasites (Table 2). It was apparent from the data that the percentage occurrence of *B. acheilognathi*, which occurred in all the host fish sampled, varied in relation to the size of host fish, but it neither exceeded 69.5% nor went under 11.7% (Table 3). Although the rate of infection was maximum in medium size host fish, maximum parasite number (18 specimens) and the highest mean intensity (6.8 per fish) on a single fish was recorded on small fish. Few parasites occurred on the largest fish (Table 3).

Fortunately, it was possible to keep track of annual maturity phases of *B. acheilognathi* on host fish. In this context, the parasites detected were categorised into four groups: juvenile, young, hermaphroditic and gravid. The rate and number of each group on host fish varied seasonally (Table 4). Juvenile populations of parasites, which newly infected the host fish, were seen throughout the year, primarily in summer and autumn. Hermaphroditic specimens mostly appeared in the summer months. However, their infection rates exhibited seasonal fluctuations. For instance, during summer and autumn, the ratio of juvenile and young populations in host fish was higher than in mature adults, both with respect to the rate of infection and the mean parasite number per fish. Gravid parasites were more prevalent in the latter half of the year, that is, in the autumn. However, this variation was not significant statistically (chi-square= $\chi^2=0.619$, $p=0.961$).

Table 2. Monthly changes and species composition (Gg: *Gyrodactylus goli*, Ba: *Bolothrocephalus achelognathus*, Lp: *Ligula pavorosa*, Ee: *Eustrongylides excrucians*) of the parasites of the sand goby (*Gobius fluviatilis* L.) in Lake Ulubat. Examined fish number (n), seasons (S), infected fish number (in) and rate (%), minimum-maximum (M) and mean (X±S.D.) parasite number, total parasite number (Σ)

N	S	In & (%)						M & (X±S.D.)						Σ					
		Gg	Ba	Lp	Ee	Gg	Ba	Lp	Ee	Gg	Ba	Lp	Ee	Gg	Ba	Lp	Ee		
54	Spring	34 (62.9)	10 (18.5)	0 (0.00)	10 (18.5)	10-58 (23.2±1.57)*	2-4 (2.8±0.40)*	0 (0.00)*	1-5 (1.8±0.57)	789	28	0	18						
21	Summer	0 (0.00)	7 (33.3)	2 (9.5)	2 (9.5)	0 (0.00)*	1-6 (2.8±0.59)*	1-3 (2.0±1.00)*	1-9 (5.0±4.00)*	0	20	4	10						
52	Autumn	0 (0.00)	29 (55.7)	2 (3.8)	28 (53.8)	0 (0.00)*	1-18 (4.6±0.59)*	1-2 (1.5±0.50)*	1-10 (2.8±0.41)*	0	136	3	80						
7	Winter	0 (0.00)	0 (0.00)	1 (14.2)	0 (0.00)	0 (0.00)*	0 (0.00)*	2 (2.00)*	0 (0.00)*	0	0	0	2						

Table 3. Relationships between the parasite species (Gg: *Gyrodactylus goli*, Ba: *Bolothrocephalus achelognathus*, Lp: *Ligula pavorosa*, Ee: *Eustrongylides excrucians*) and host fish size groups in Lake Ulubat. Examined fish number (N), fish size (L, cm), infected fish number (in) and rate (%), minimum-maximum (M) and mean parasite number (X±S.D.), total parasite number (Σ)

N	(L)	In & (%)						M & (X±S.D.)						Σ					
		Gg	Ba	Lp	Ee	Gg	Ba	Lp	Ee	Gg	Ba	Lp	Ee	Gg	Ba	Lp	Ee		
34	(5-6)	12 (35.2)	4 (11.7)	0 (0.00)	1 (2.9)	10-26 (18.17±5.64)*	2-4 (3.00±1.15)*	0 (0.00)*	4 (4.00)*	218	12	0	4						
41	(7-8)	15 (36.5)	8 (19.5)	1 (2.4)	13 (31.7)	10-30 (22.80±5.34)*	2-18 (5.62±5.19)*	2 (2.00)*	1-6 (2.38±1.50)*	342	45	2	30						
11	(9-10)	5 (45.4)	3 (27.2)	3 (27.2)	7 (63.9)	24-28 (25.40±1.67)*	1-6 (4.39±2.89)*	1-3 (1.67±1.15)*	1-2 (1.14±0.39)*	126	13	5	8						
23	(11-12)	1 (4.3)	16 (69.5)	1 (4.3)	5 (21.7)	45 (45±0.00)*	1-6 (2.44±1.15)*	2 (2.00)*	1-4 (1.80±1.30)*	45	40	2	10						
22	(13-14)	1 (4.5)	13 (59.1)	0 (0.00)	13 (59.1)	58 (58±0.00)*	1-12 (5.8±3.49)*	0 (0.00)*	1-10 (4.38±2.99)*	58	64	0	54						
3	(15>)	0 (0.00)	2 (66.5)	0 (0.00)	1 (33)	0 (0.00)*	4-6 (2.00)*	0 (0.00)*	2 (4.00)*	0	10	0	2						

Table 4. Distribution of maturity of *Bothriocephalus achellognathi* in *Gobius fluviatilis* in particular seasons during the study period. S: season, N: parasite number, proportion of parasite and rate (%); J: juvenile, Y: young, H: hermaphroditic, G: gravid specimens

S	N	J	Y	H	G
Spring	20	10 (50,0)	6 (30,0)	2 (10,0)	2 (10,0)
Summer 27	12	7 (44,4)	5 (25,9)	3 (18,5)	(11,1)
Autumn 137	65	39 (47,4)	18 (28,4)	15 (13,1)	(10,9)
Total	184	87 (47,2)	52 (28,2)	25 (13,5)	20 (10,8)

Plerosercoids of *Ligula pavlovskii*, another cestode species, were represented by only 9 specimens in the body cavity of 5 sand goby in summer, autumn and winter (prevalence 3.7%, mean intensity 1.6 ± 0.89 specimens per fish) (Table 1). The density rate of this parasite changed from 1 to 3, reaching the maximum level in summer. During the other two seasons 1 or 2 specimens occurred and in spring, it did not appear (Table 2). The intensity of infection by this parasite was also evaluated according to the variance in fish size. This species was acquired by medium size host fish. It was also in medium size fish that this parasite had both the highest rate of infection and the highest mean number. As fish became larger, infection by this parasite decreased steadily. Infection never occurred in fish larger than 11 cm (Table 3).

Out of 136 sand goby specimens, 40 were infected in their body cavity by *Eustrogyldes excisus*, the fourth parasite species (prevalence 29.8%, mean intensity 2.7 ± 2.29 specimens/fish). The number of specimens of this parasite in infected fish varied between 1-10. They were not observed in seasons other than spring, summer and autumn (Table 2). Infection increased from July until October, to a degree of 53.8%. The highest mean number of parasites per fish was observed in the summer period (5.0 ± 4.00). Towards the end of autumn, however, the infection rate started to decline and the parasites disappeared. If the relationship between the intensity of infection by this parasite and the size of host fish is assessed, it can be seen that these nematodes occurred on all host fish, except for the first group. The rate of infection varied with host size, neither exceeding 59.1% nor decreasing below 2.9%. Infection occurred more on larger fish than on smaller ones and it peaked on the last groups (Table 3).

The number of parasites and their diversities on the basis of host fish size and season showed significant variation. It was most significant in terms of the number of parasites on the basis of both fish size and seasons. *Ligula pavlovskii* was an exception on the basis of season (Kruskal-Wallis, $P < 0.05$). Details of the correlation coefficient and its significance between each parasite species and fish size are given in Table 5. These values varied between (r) - 0,229 and 0,440.

Table 5. Correlation between the parasite species (Gg: *Gyrodactylus gobil*, Ba: *Bothriocephalus achelognathi*, Lp: *Ligula pavlovskii*, Ee: *Eustrongylides excisus*) and fish size (Fs). r: correlation coefficient, p: significant (2-tailed)

	Fs	Gg	Ba	Lp	Ee
Fs r	1,000	-,229**	,440	,049	,360**
p	,	,008	,000	,570	,000
Gg r	-,229**	1,000	-,059	-,113	-,078
p	,008	,	,501	,193	,373
Ba r	,440**	-,059	1,000	-,041	,220*
p	,000	,501	,	,641	,011
Lp r	,049	-,113	-,041	1,000	,059
p	,570	,193	,641	,	,495
Ee r	,360**	-,078	,220*	,059	1,000
p	,000	,373	,011	,495	,

*: $P < 0.05$, **: $p < 0.01$

DISCUSSION

The four parasite species identified on host fish were subject to qualitative and quantitative comparisons and changes in their population patterns were evaluated in terms of fish size and seasons. Firstly, all the parasites detected in host fish were helminths. Of these parasites, *Gyrodactylus gobil* was acquired by younger fish and as fish size became larger, its intensity had a decreasing trend. In other words, there exists a negative correlation between the increase in intensity and rate of infection by *G. gobil* and the size of host fish. Therefore, it can be suggested that factors such as seasonal conditions and size of fish play a significant role in the increase, decrease, or disappearance of infection by *G. gobil*. This agrees with the range reported by Žitnan & Hanzelova (1982). They studied the seasonal and ecological events of another species of *Gyrodactylus* and proposed that it attained a maximum level of infection in early July, maintained its optimum phase of reproduction in the following hot summer months, and therefore should be classified as a thermophilic species. Since *G. gobil*, too, exhibits such a pattern of infection in similar periods of the year, it can also be considered a thermophilic species of *Gyrodactylus*. Parallel to this argument, Žitnan (1978) concluded that for the increase or decrease of infection rate by *Gyrodactylus*, besides ecological factors, size of host fish is also an important factor, because, as a result of increase in fish maturity, an immune system develops against parasites. Another point is that *G. gobil* was not identified in previous parasitological studies in Turkey (Ozturk et al., 2001; Oguz, 1996). Therefore, *G. gobil*, found on sand goby of Lake Uluabat, is a new record for the helminth fauna of Turkey and a new locality -Lake Uluabat- has been added to its global geographical distribution.

Some parasitic helminths have complex life cycles and to sustain their life, they need one, two or more intermediate hosts (Khalil et al., 1994). Several studies have been conducted (Boomker et al., 1980; Andrews et al., 1981; Clarkson et al.,

1997) to describe the development and maturation of *Bothriocephalus acheilognathi*, a cosmopolitan parasite species. It was pointed out that the majority of larvae of this species could be present on host fish unsegmented for some time. As seen in table 4, juvenile and young individuals made up a large majority of *B. acheilognathi* specimens sampled in the study area. This was particularly true in autumn and winter, when circumstances were not warm enough to foster maturation. In winter, accordingly, general parasitic infection on host fish either appeared in lower quantities or entirely vanished (Table 2). Granath & Esch (1983), reported similar results to the present study. They showed that mature individuals of the same species with lots of segments came into being on *Gambusia affinis* at 25 °C. In a similar way, Marcogliese & Esch (1989) pointed out that intensity of infection by this species increased in May-June, decreased in August-September and again increased in September-October.

Plerocercoids of *Ligula*, another species of cestode, had the lowest number among all parasite species (Table 2, 3). Unquestionably, the main factors affecting the density of *Ligula* on fish are the amount of *Cyclops* in the diet and water quality (Bauer, 1965). Hartley (1947) examined the intensity of *Ligula* infection and attributed the high density of *Ligula* on younger fish to the fact that copepods comprised a great proportion of the diet. It was also demonstrated that the lower rate of infection on older fish was attributable to the decrease in their intake of copepods. In the present study, too, fish infected with *Ligula* were identified on small and medium size host fish during the summer and autumn. Likewise, Dence (1957) reported that rate of infection by *Ligula* had a decreasing trend in age 3+ in *A. brama*.

Ligula had a considerable pathogenic effect on host fish. Cantoray and Özcan (1975), recorded infection by *Ligula* in *L. cephalus*, *C. capoeta* and *B. plebejus* in Lake Cip and the dam Lake of Keban. During necropsy of fish, found dead at the study site, they noticed that infection with *Ligula* was seriously high and suggested that mortality of fish could be attributed to this parasite. Kelle (1978) found a 19% decrease in size-weight ratio for infected fish compared to those remaining unaffected. Taylor and Hoole (1989) reported that, in *Ligula*-infected fish, some organs such as gonads and liver were deformed by shrinking. Also, a thinning of the tissue of the body cavity occurred. Stomachs were swollen and the surface of the liver was reddish. Despite this, since the study site was a natural lake, no event of death due to *Ligula* infection was recorded. However, it is known that, as indicated by Bauer (1965), death of *Ligula*-infected host fish may occur.

The geographical distribution of *Eustrongylides excisus* includes Romania, Bulgaria, Hungary, Russia, Central Asia, China and Australia (Moravec, 1994). With the present study, Turkey appears to be a new site for its distribution in Europe. Anderson (1992) named the primary fish, amphibian and reptile species which served as paratenic hosts for this parasite: e.g. *Perca fluviatilis*, *Gymnocephalus cernuus*, *Stizostedion lucioperca*, *S. volgensis*, *Esox lucius*, *Silurus glanis*, *Chalcalburnus chalcoides*, *Phoxinus phoxinus*, *Leuciscus idus*, *Barbus brachycephalus*, *Acipenser ruthenus*, *A. gueldenstaedti* and the amphibian: *Rana ridibunda* and reptile: *Natrix tessellata*. After the sand goby of Lake Manyas (Öztürk et al., 2001), the same fish species appeared to serve as a secondary host for *E. excisus* in Lake Uluabat.

Larvae of *E. excisus*, were either free in the body cavity, or encapsulated with a thin fibrous serosal membrane on the surface of inner organs, or attached to the mesenteries (Moravec, 1994). When it reaches a ratio of 10-20 parasites/fish, infestation of *E. excisus* may be dangerous and cause pathogenic conditions (Moravec, 1994). The data cited above proved to be valid in the present study, too. There were distinctive accounts of rashes, or even lesions, on the intestines, inner surface of body cavity, mesentery or liver surface of host fish infected with 10-14 parasites.

In conclusion, a new locality for the distribution of some parasite species (e.g. *G. gobii*, *B. acheilognathi*, *E. excisus*) on sand goby of Lake Uluabat has been determined. Variance of infection rates has been assessed in terms of seasons and size of host fish. Abiotic factors (e.g. temperature) affecting growth and maturation of some parasite species have been discussed. It is beyond the scope of this paper to postulate on how useful parasites may be in the future in helping to understand the fish and fisheries in the study area. However, some comments can be made on the ecological issues of the lake.

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ZASTUPLJENOST HELMINTSKIH PARAZITSKIH VRSTA KOD RIBE GOBIUS FLUVIATILIS IZ JEZERA ULUBAT U TURSKOJ

OZTURK OM, AYDOGDU A I DOGAN I

SADRŽAJ

U ovoj studiji su prikazani rezultati ispitivanja zastupljenosti helmintskih parazita kod riba vrste *Gobius fluviatilis* (Pallas, 1811) iz jezera Uluabat u Turskoj. Uzorci su prikupljeni mesečno ili dvomesečno od aprila 1998 do novembra 1999. godine. Ukupno je ispitano 134 primerka a paraziti su pronađeni kod 98 riba i to: *Gyrodactylus gobii* (Shulman, 1953), *Bothriocephalus acheilognathi* (Yamaguti, 1934), *Ligula pavlovskii* (Dubinina, 1959) i *Eustrongylides excisus* (Jagerskild, 1909). *G. gobii* je naseljavao škrge i kožu, *B. acheilognathi* creva a *E. excisus* i *L. pavlovskii* telesne šupljine. *G. gobii* je posebno bio prisutan kod manjih primeraka i u proletnjem periodu (zastupljenost 25.3% i prosečno 23.21 ± 9.17 parazita po primerku). *B. acheilognathi* se pojavljivao kod riba različite veličine ali je intenzitet

infestacije bio nizak (zastupljenost 34.3% i prosečno 3.98 ± 3.15 parazita po primerku). *L. pavlovskii* je dokazan samo kod riba srednje veličine (zastupljenost 3.7% sa prosečno 1.60 ± 0.89 parazita po primerku). Ukupno je otkriveno 108 parazita *E. excisus* na 40 riba domaćina i to samo u leto i jesen (zastupljenost 29.8% sa prosečno 2.70 ± 2.29 parazita po primerku).

