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Original research paper

The metazoa parasites of gobiids in the Dniester Estuary (Black Sea) depending on water salinity

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Abstract

A list is presented of metazoan parasites that infect seven gobiid fishes (the toad goby *Mesogobius batrachocephalus*, monkey goby *Neogobius fluviatilis*, racer goby *N. gymnotrachelus*, bighead goby *N. kessleri*, round goby *N. melanostomus*, ratan goby *N. ratan*, and syrman goby *N. syrman*) from the Dniester Estuary (Black Sea). Infections by thirteen species of metazoa parasites, including four trematodes, three cestodes, five nematodes, and one crustacean species, were observed in the gobies sampled from the estuary. The data complements the existing list of parasite species that inhabit the fishes of this aquatic basin. Water salinity varies in the estuary, which impacts parasite distribution. Brackish-water parasites prevailed in the Dniester Estuary, while the marine trematode *C. lingua* occurred only in the southern part.

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INTRODUCTION

The Dniester Estuary, which is highly significant to both fisheries and recreation, is a brackish-water area of the northwestern Black Sea region. The Karolino-Bugaz Sandbar separates the estuary from the sea. The estuary is connected to the sea through the Tsaregradske gyrlo, a deep natural canal 10 m deep and 80 m wide (Starushenko & Bushuyev 2001).

Gobies (Pisces: Gobiidae) are commercial fish species found in the northwestern Black Sea. Although the parasite fauna of these fishes in the Dniester Estuary was reported previously by Chernyshenko (1957, 1960), no current data are available.

MATERIALS AND METHODS

The study was carried out in difference seasons from 2000 to 2003. The fishes were sampled by anglers and with trawls at different sites in the southern, central, and northern parts of the Dniester Estuary (Fig. 1). Water probes were used at these sites to collect samples for salinity analyses. The salinity was measured at the Laboratory of Water Environment (Odessa Branch of the Institute of Biology of the Southern Seas, Odessa) using a GM-65.

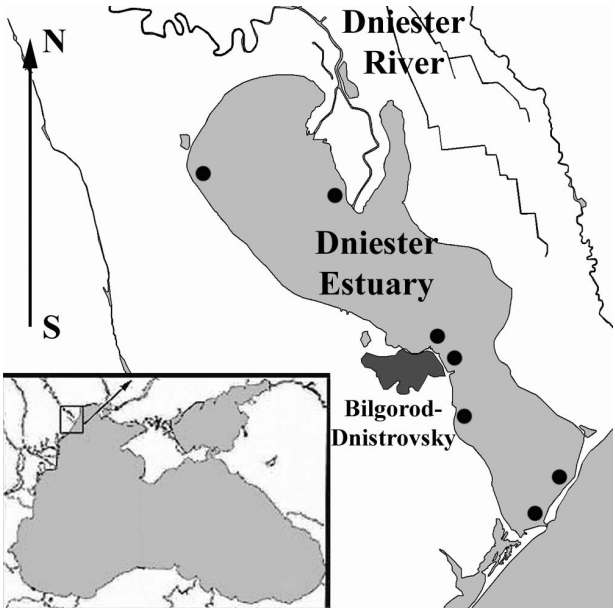

Fig. 1. Map of the investigated area.

In total, 377 gobies representing seven species were autopsied; the species included the toad goby *Mesogobius batrachocephalus* (Pallas), monkey goby *Neogobius fluviatilis* (Pallas), racer goby *N. gymnotrachelus* (Kessler), bighead goby *N. kessleri* (Günter), round goby *N. melanostomus* (Pallas), ratan goby *N. ratan* (Nordmann), and syrman goby *N. syrman* (Nordmann). The numbers of the fish examined are given in Table 1. Fresh fish were examined for parasites (skin, fins, gut, internal organs, cavities, muscles, brain, gills, and eyes). Metacercariae were isolated from cysts and stained with acetic carmine. Adult trematodes and cestodes were fixed in 70% alcohol and later stained in alum carmine. The stained helminths were dehydrated in ethanol and mounted in Canada balsam. Nematodes and crustaceans were fixed in 70% ethanol and mounted in glycerin for identification.

The prevalence (p, %), intensity range (ir), mean intensity (mi), and abundance (a) (Bush et al. 1997) were defined. The standard deviation of the mean intensity was calculated. The faunae were compared using the Czekanowski-Sørensen index. The significance of the various parasite species noted on the fauna was determined by using an abundance index according to the scale presented in Holms & Price (1986), as follows: >2 – core species; 0.6-2 – secondary species; 0.2-0.6 – satellite species; <0.2 – rare species.

Comparative analysis was not applied with the goby species that occurred rarely in the samples (i.e., toad, racer, bighead). The prevalence of infection in these species is presented in Table 1 as the number of infected specimens in relation to the number of examined fishes, but the mean intensity is given without the standard deviation.

RESULTS

Thirteen species of metazoa parasites, including four trematode, three cestode, five nematode, and one crustacean species, infected the gobies that were sampled from the Dniester Estuary (Table 1). Monogeneans and acanthocephalans were not found in the gobies from this aquatic basin. The parasites found are from the ecological groups listed below.

Marine species

The parasites from this group were only represented by the metacercariae of the trematode *Cryptocotyle lingua*, which is typical for European coastal marine waters. In the northwestern Black Sea the metacercariae of *C. lingua* is usually found along with *C. concavum* (Kvach 2002a, b); however, the Dniester Estuary is an exception. In this basin *C. lingua* was found in the fins of syrman and toad gobies (Table 1) from the Tsaregradske gyrlo. The water here has a salinity of

Table 1

Metazoa parasites infecting gobies in the Dniester Estuary.

Parasite species		*Mesogobius batrachocephalus* (n=7)	*Neogobiu fluviatilis* (n=217)	*N. gymnotrachelus* (n=5)	*N. kessleri* (n=6)	*N. melanostomus* (n=93)	*N. ratan* (n=23)	*N. syrman* (n=26)
1		2	3	4	5	6	7	8
TREMATODEA								
Bucephalus polymorphus Baer MET	p	-	-	-	-	14	4.3	-
	mi	-	-	-	-	8.2 ±8.9	7	-
	ir	-	-	-	-	1-32	7	-
	a	-	-	-	-	1.2	0.3	-
Nicolla skrjabini (Ivanitzky)	p	-	0.5	-	3 / 6 sp.	-	8.7	-
	mi	-	4	-	2.3	-	3.5 ±3.5	-
	ir	-	4	-	1-3	-	1-6	-
	a	-	0.02	-	1.2	-	0.3	-
Cryptocotyle concavum (Creplin) MET	p	4 / 7 sp.	6.5	2 / 5 sp.	-	11.8	87	-
	mi	28.5	334.6 ±507.0	7.5	-	3.5 ±7.5	49.7 ±62.5	-
	ir	1-100	16-1500	1-14	-	1-26	2-200	-
	a	19.0	21.6	3.0	-	0.4	43.2	-
C. lingua (Creplin) MET	p	1 / 7 sp.	-	-	-	-	-	3.8
	mi	20	-	-	-	-	-	1
	ir	20	-	-	-	-	-	1
	a	3.3	-	-	-	-	-	0.04
CESTODEA								
Ligula pavlovskii Dubinina PL	p	-	3.2	-	-	-	-	-
	mi	-	1.0 ±0.0	-	-	-	-	-
	ir	-	1	-	-	-	-	-
	a	-	0.03	-	-	-	-	-
Proteocephalus gobiorum Dogiel et Bychowsky L	p	-	-	-	-	1.1	-	-
	mi	-	-	-	-	1	-	-
	ir	-	-	-	-	1	-	-
	a	-	-	-	-	0.01	-	-
Proteocephalus sp. L	p	-	-	1 / 5 sp.	-	-	-	3.8
	mi	-	-	2	-	-	-	1
	ir	-	-	2	-	-	-	1
	a	-	-	0.4	-	-	-	0.04
NEMATODA								
Eustrongylides excisus Jägerskiöld L	p	1 / 7 sp.	2.8	-	3 / 6 sp.	4.3	4.3	38.5
	mi	1	1.2 ±0.4	-	1	1.0 ±0.0	1	1.7 ±1.3
	ir	1	1-2	-	1	1	1	1-5
	a	0.2	0.03	-	0.5	0.04	0.04	0.7
Raphidascaris sp. L	p	-	0.5	-	-	-	-	-
	mi	-	1	-	-	-	-	-
	ir	-	1	-	-	-	-	-
	a	-	0.005	-	-	-	-	-
Contracaecum rudolphii Hartwich L	p	1 / 7 sp.	-	-	-	-	-	-
	mi	1	-	-	-	-	-	-
	ir	1	-	-	-	-	-	-
	a	0.2	-	-	-	-	-	-
Dichelyne minutus (Rudolphi)	p	-	3.7	-	-	1.1	-	-
	mi	-	3.0 ±2.1	-	-	1	-	-
	ir	-	1-6	-	-	1	-	-
	a	-	0.1	-	-	0.01	-	-
Streptocara crassicauda (Creplin) L	p	-	-	-	-	1.1	17.4	-
	mi	-	-	-	-	1	1.0 ±0.0	-
	ir	-	-	-	-	1	1	-
	a	-	-	-	-	0.01	0.2	-
COPEPODA								
Ergasilus sieboldi Nordmann	p	-	-	-	-	-	4.3	-
	mi	-	-	-	-	-	14	-
	ir	-	-	-	-	-	14	-
	a	-	-	-	-	-	0.6	-

n – number of fish examined; p – prevalence, %; mi – mean intensity; ir – intensity range; a – abundance; MET – metacercariae; PL – plerocercoid; L – larva.

2-3 PSU, which is slightly higher than that in the other part of this aquatic basin where it ranges from 0.3-0.7 PSU.

This species was categorized as rare in the syrman goby (Table 1).

Brackish-water species

This group includes the Holarctic trematode *Cryptocotyle concavum* MET, the Boreo-Atlantic nematode *Dichelyne minutus*, and the Cosmopolitan nematodes *Contracaecum rudolphii* L and *Streptocara crassicauda* L In addition, the group includes two relict species of the brackish-water Ponto-Caspian basin (*Ligula pavlovskii* PL, *Proteocephalus gobiorum* L). The endemic fauna is typical for gobies, most of which are endemic to the Ponto-Caspian area.

The metacercariae *C. concavum*, which causes swelling in the skin and fins of gobies, was distributed throughout the sampling sites in the estuary, including the most desalinated northern part. This species was categorized as core for the monkey and ratan goby (Table 1). Only the bighead and syrman goby were uninfected. The remaining brackish-water species were categorized as rare.

Limnetic species

The group includes four species: *Bucephalus polymorphus* MET; *Nicolla skrjabini*; *Eustrongylides excisus* L; *Ergasilus sieboldi*. All these species are native to Euro-Siberian freshwaters.

The trematode *B. polymorphus* is connected to limnetic bivalves, therefore it occurred in the central and northern parts of the Dniester Estuary. The metacercariae of this trematode are secondary species in the parasitofauna of the round goby and satellite in the ratan goby (Table 1). Marites of *Nicolla skrjabini* were found in three goby species caught off the coast of the city of Bilgorod-Dnistrovsky in the central part of the estuary. This trematode was not found at other sites in the estuary. This trematode was categorized as rare for all gobiids (Table 1). These two species are connected to the more desalinated regions of the basin. The salinity in the northern part of the estuary was 0.3 PSU, but in the central part it ranged from 0.6 to 0.7 PSU.

The nematode *E. excisus* occurred at all the sampling sites in the estuary and infected all the goby species studied except the racer goby, in which it was rare as it presented in only five specimens from the samples (Table 1). This is a secondary species in the parasitofauna of the syrman goby, but it was a rare species in one of the other gobiids studied. The larvae were located in the body cavity and the muscles of the fishes. A larva was found in the intestine of a toad

goby; this might have been caused by consumption of other fishes that were infected with the nematode.

The copepod *E. sieboldi* was located on the gills of a ratan goby. This crustacean is a secondary species in the parasitofauna of the ratan goby (Table 1).

DISCUSSION

The Dniester Estuary is one of the most desalinated areas of the northwestern Black Sea, and freshwater benthos and ichthyofauna occur here (Starushenko & Bushuyev 2001). Until 1926 another canal known as the Ochakivske gyrlo functioned through the sandbar. The destruction of this canal might have caused a decrease in marine water inflow into this basin. However, the Dniester River flow was decreased by the construction of the Dubăsari (1956) and Novodnestrovsk (1981) hydroelectric stations in Moldova, and also by the construction of a navigation canal through the Tsaregradske gyrlo (Sirenko et al. 1992). Therefore, the hydrochemical regimen of the estuary has not changed significantly.

Ciurea (1933) published the first data on the parasites of fishes from the Dniester Estuary. He noted the metacercariae of *C. concavum* in the tadpole *Benthophillus stellatus* (Sauvage), toad, mushroom *Neogobius eurycephalus* (Kessler), monkey, and racer gobies. Chernyshenko (1957, 1960) also conducted investigations of the fish parasites of the Dniester Estuary. According to the Czekanowski-Sørensen index, the helminth fauna of the monkey goby is the most stable (Ics = 42.9%). The Ics for the round goby helminth fauna is 25%. The parasite fauna of the syrman goby has changed fully (Ics = 0%). In general, the helminthofauna of gobiids in the Dniester Estuary has changed significantly (Ics = 25%). Parasites such as the trematodes *Diplostomum spathaceum* MET, *Asymphylodora imitans*, *Acanthostomum imbutiformis* MET, *Pygidiopsis genata* MET, cestodes *Tetrarhynchus* sp., *Scolex pleuronectis*, *Proteocephalus torulosus* L, the nematode *Goezia tricirrata*, and the acanthocephalan *Acanthocephaloides propinquus* (noted as *A. incrassatus*) were detected in gobies of the Dniester Estuary at the time of the studies by Chernyshenko (1957, 1960), but they have now disappeared (Table 2). In addition, *C. lingua* MET, *L. pavlovskii* PL, *P. gobiorum* L, *C. rudolphii* L, *S. crassicauda* L, and *E. sieboldi* were noted for the first time in the reservoir. Chernyshenko (1957, 1960) noted parasites such as *B. polymorphus* and *E. excisus* L in many fish species, but not in the gobiids.

Unfortunately, the studies of Chernyshenko (1957, 1960) mention neither sampling sites nor the water salinity of these places. The author only gives the general location in which fishing was conducted (i.e., the northern and southern

Table 2

Metazoa parasites occurring in the Dniester Estuary according the current study and published data (Chernyshenko 1957, 1960; Ciurea 1933).

Parasite species	*Benthophilus stellatus*	*Mesogobius batrachocephalus*	*Neogobius eurycephalus*	*N. fluviatilis*	*N. gymnotrachelus*	*N. kessleri*	*N. melanostomus*	*N. ratan*	*N. syrman*	*Zosterisessor ophiocephalus*
Bucephalus polymorphus Baer MET								K		
Diplostomum spathaceum (Rudolphi) MET				Ch						
Asymphylodora imitans (Mühling)				Ch						
Nicolla skrjabini (Ivanitzky)		Ch		ChK		K		K		
Acanthostomum imbutiformis (Molin) MET			Ch	Ch		Ch			Ch	Ch
Cryptocotyle concavum (Crep.) MET	C	CChK	C	CK	CK		K	K		
C. lingua (Crep.) MET		K							K	
Pygidiopsis genata Looss MET			Ch	Ch			Ch		Ch	
Ligula pavlovskii Dubinina PL				K						
Tetrarhynchus sp. L		Ch							Ch	Ch
Scolex pleuronectis Rudolphi									Ch	
Proteocephalus torulosus (Batsch) L		Ch		Ch						
P. gobiorum Dogiel et Bychowsky L							K			
Proteocephalus sp. L					K				K	
Eustrongylides excisus Jägerskiöld L		K		K		K	K	K	K	
Raphidascaris sp. L				K						
Contracaecum rudolphii Hartwich L		K								
Goezia tricirrata Osmanov		Ch								
Dichelyne minutus Rud.			Ch	ChK		Ch	ChK		Ch	Ch
Streptocara crassicauda (Crep.) L							K	K		
Acanthocephaloides propinquus (Duj.)										Ch
Ergasilus sieboldi Nord.								K		

C – Ciurea (1933), Ch – Chernyshenko (1957, 1960), K – Kvach (current data).

parts of the Dniester Estuary). The marine species such as *A. imbutiformis* MET and *A. propinquus*, were found in the southern part of the basin. This is possibly an indication that previously the estuary salinity was higher than now. However, due to the lack of hydrochemical data in the Chernyshenko papers, it is impossible to discuss the factors which contributed to changes in the gobiids helminthofauna.

Most of the larvae that were noted during the current study (*C. concavum, C. lingua, E. excisus, C. rudolphii*, *S. crassicauda*) are distributed by birds which inhabit the wetlands of the Dniester River delta (Rusev 2000). *B. polymorphus* and *Raphidascaris* sp. are distributed by predatory fishes. Marites of *B. polymorphus* were found in the guts of the merlang *Odontogadus merlangus euxinus* (Nordmann) and pikeperch *Sander lucioperca* (L.) from the Dniester Estuary (Kvach, unpublished data). The round goby had higher infection rates of metacercariae than the ratan goby did (Table 1). This was due to the fact that the round goby, unlike the ratan goby, is typically malacophageous (Smirnov 1986). The first intermediate hosts of *B. polymorphus* are bivalves such as unionids and dreissenids (Wallet & Lambert 1986, Yamaguti 1958). Although the ratan goby inhabits the periphyton, bivalves are of little significance in its diet (Smirnov 1986). During the current study, no *Raphidascaris* sp. adults were noted, but the nematode *Raphidascaris acus* (Block) was noted by Chernyshenko (1960) in pike *Esox lucius* (L.) from the northern part of the Dniester Estuary.

The marine trematode *C. lingua* met inhabits the Dniester Estuary because of the seawater that flows into the reservoir though the deep part of the canal (Sirenko et al. 1992). Thus, the salinity of the deep water of the canal is similar to that of the seawater near the sandbar (12–13 PSU). This is higher than the water salinity in the surface of the southern part of the estuary (2-3 PSU). Partenites of both *C. lingua* and *C. concavum* develop in the snails of the *Hydrobia* genus. Contrary to the fact that *C. lingua* met is noted only in the canal, *C. concavum* met was found in gobies from all the estuary sampling sites, including the most desalinated northern part near the Dniester River mouth).

Migrations are not typical of most gobiids (Smirnov 1986); therefore, the infected fishes could not have come from the sea, which means that *C. concavum* continuously inhabits the northern part of the Dniester Estuary. It is the opinion of the author that metacercariae distribution does not depend on molluscs tolerance of salinity as previously mentioned (Zander 1998), but rather on the tolerance of the trematode larvae.

The nematode *D. minutus* was found in the southern part of the Dniester Estuary near the sandbar. This species inhabits the region of the estuary that has higher salinity and has a stronger connection to seawater than do other brackish-water species noted in the reservoir.

This paper is comprised of current data regarding the metazoa parasite fauna of gobiids in the Dniester Estuary (Black Sea). The data presented in this paper contributes to the list of parasite species which inhabit this basin. The estuary is comprised of waters with varied salinity, and this impacts the distribution of parasites in various sites of it. The brackish-water parasites are prevalent in this basin, but the marine trematode *C. lingua* occurred only in its southern part.

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