

Parasite fauna of the European eel (*Anguilla anguilla* L, 1758) from the Russian part of the Vistula Lagoon (Baltic Sea)*

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ABSTRACT. **Introduction**. The european eel is one of the major fishing objects of the Russian fishery zone of the Vistula Lagoon (Baltic Sea). This is the reason that its parasite fauna was studied within 1998-2005. **Material and methods**. Totally 142 individuals of 35-81 cm in length were examined. The parasites collected from various organs were fixed and processed according to commonly accepted methods. **Results**. Twenty two parasite species representing the following higher taxa: Coccidia (2), Oligohymenophorea (2), Myxosporea (5), Monogenea (1), Cestoda (2), Trematoda (2), Nematoda (4), Acanthocephala (2), and Crustacea (2) were recovered. The following main features of the eel parasitofauna were determined: high specificity, predominance of the parasites with simple life cycle, the presence of three invader species (*Anguillicola crassus*, *Pseudodactylogyrus anguillae*, and *Paratenuisentis ambiguus*). The latter species was found in the Vistula Lagoon for the first time.

Key words: eel, invader species, parasite fauna, Vistula Lagoon.

Introduction

European eel is one of the major fishing objects of the Russian fishery zone in the South Baltic Sea. Nowadays this species is also supposed to be an object for artificial cultivation here. There have been a number of publications on different systematic groups of eel parasites from other regions of the Baltic Sea [1–9]. However, information on the parasites of this fish in Russian part of the Baltic region is fragmentary. Recently, the problem of the eel infection of parasites invaders (*Anguillicola crassus* and *Pseudodactylogyrus anguillae*) was emphasized [10–13].

The present study was aimed at investigating the eel parasite fauna from the Russian part of the Vistula Lagoon.

Materials and methods

Within 1998-2005 a total of 142 eels were examined. The fish were caught in the north-east part of the Vistula Lagoon (Fig. 1) during May-August of these years. The weight and total length of the eels examined were: 70–1270 g and 35–81 cm, respectively. The parasites were fixed and processed using commonly accepted methods [14, 15]. Myxosporeans were fixed in glycerin-gelatin. Cestodes, trematodes, and acanthocephalans were fixed in 70% ethanol, stained with alum carmine. These helminths were mounted in Canada balsam after dehydration and clearing in lactic acid. Nematodes were preserved in 3% formaldehyde in saline and cleared in glycerin or lactic acid. Copepods were fixed with 70% ethanol. The ecological terms, such as prevalence (P), intensity (I.), and abundance (A), were used in accordance with the recommendations of Margolis et al. [16].

Results

Twenty-two parasite species of the following systematic groups: Coccidia (2), Oligohymenophorea (2), Myxosporea (5), Monogenea (1), Cesto-

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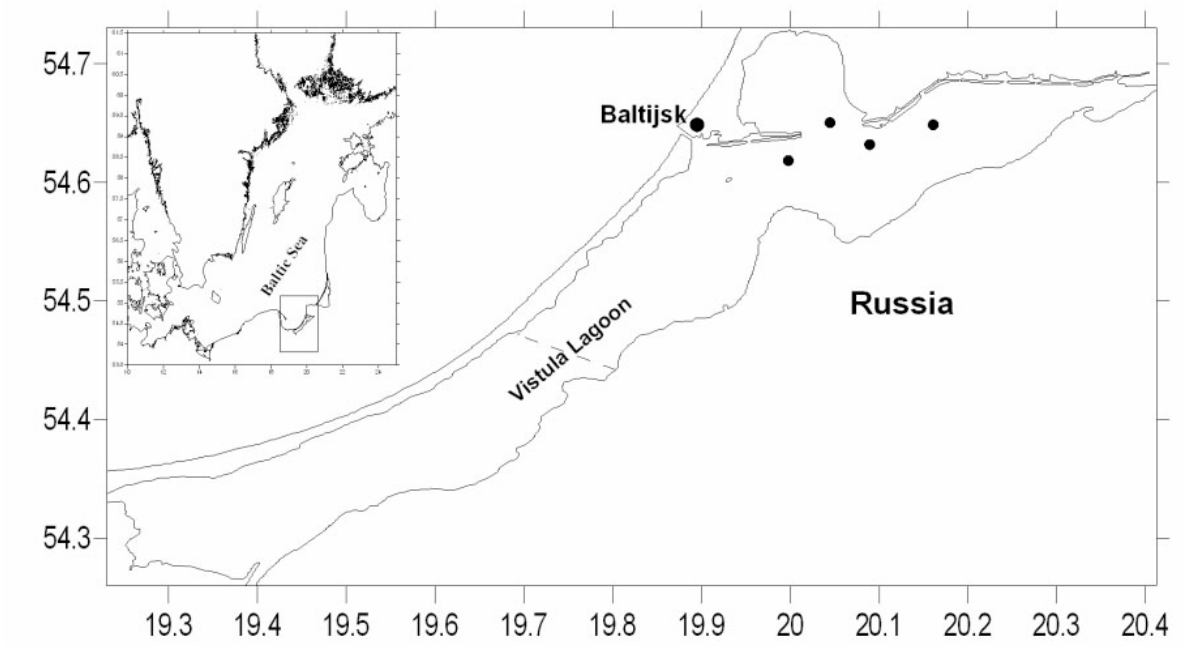

Fig. 1. Localization of fishing points in the Russian part of the Vistula Lagoon

da (2), Trematoda (2), Nematoda (4), Acanthocephala (2) and Crustacea (2) were recovered (Table 1). A total of 96.5% of the eels studied harboured parasites. The parasite species with the simple life cycles (54.5%) were most diversified. Among them two species of Myxosporea, namely *Myxidium giardi* and *M. rhodei* dominated. Their prevalence in eel have increased substantially within the recent years of this study (Table 2). Both species were found on the gills and on the skin, and in all internal organs. *M. giardi* preferred to colonize intestine, gills, and skin of the eel (Fig. 2), while *M. rhodei* was the most frequent in kidney, gills, intestine and spleen (Fig. 3).

Among the species with the complex life cycles nematodes were most diversified (4 species). Two of these species were found in fish at both larval and adult stages (Table 1).

Three invader species were found: monogenean *Pseudodactylogyrus anguillae*, nematode *Anguillicola crassus*, and acanthocephalan *Paratenuisentis ambiguus*. *A. crassus* were found in 1996 for the first time in this region (P = 40.2%, I = 1–28, A = 3.4). All three parameters (prevalence, intensity, and abundance) changed from year to year with the tendency to increase. In 1998 the prevalence of infection increased to 80.2% (A = 8). In recent years the eel infection were about 60–70% (A = 1.6–4.5) (Table 3). Two other invader species were found for the first time here: *P. anguillae* (in 2002) and *P. ambiguus* (in 2004). The infection with these helminthes was low during our researches (1.4% and 2.8% respectively).

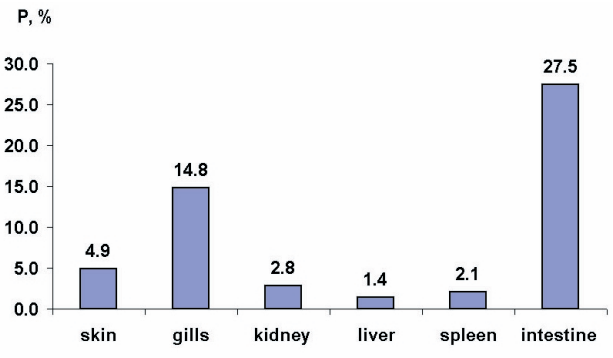

Fig. 2. The distribution of *Myxidium giardi* within various organs of European eel

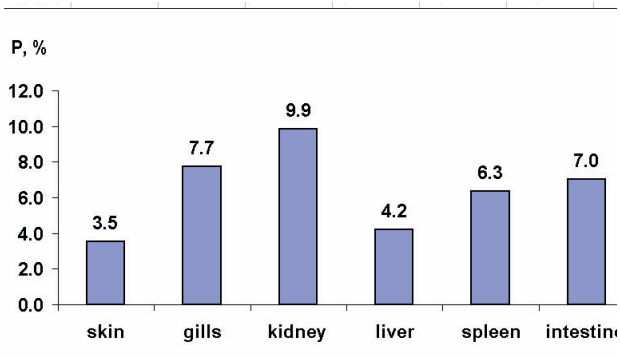

Fig. 3. The distribution of *M. rhodei* within various organs of European eel

Table 1. Eel parasite fauna in the Russian part of the Vistula Lagoon

Parasite species	Location	P (%)	I (Ind.)	A (Ind.)
Coccidia				
Eimeria sp.	gills	1.41		
*Epieimeria anguillae**	intestine, intestine wall	25.20	**	
Oligohymenophorea				
Trichodina jadranica	gills	24.30	**	
Trichodinella epizootica	gills, skin	9.50	**	
Myxosporea				
*Myxidium giardi**	skin, gills and all internal organs	30.14	**	
Myxidium rhodei	skin, gills and all internal organs	16.14	**	
*Zschokkella stettinensis**	urinary tubules	4.93	**	
*Sphaerospora anguillae**	urinary tubules	3.52	**	
Myxobolus sp.	urinary tubules, intestine	1.41	**	
Monogenea				
*Pseudodactylogyrus anguillae**	gills	1.41	1–2	0.014
Cestoda				
*Proteocephalus macrocephalus**	intestine	22.54	1–14	0.979
Bothriocephalus claviceps	intestine	0.70	2	0.014
Trematoda				
Diplostomum paracaudum m.	eyes	3.52	1	0.035
*Plagioporus angulatus**	intestine	1.41	1	0.014
Nematoda				
Camallanus lacustris l.	intestine	0.70	1	0.007
Cucullanus sp. l.	swim-bladder	0.70	4	0.028
Raphidascaris acus (adult, L_3, L_4)	intestine	52.11	1–53	5.063
*Anguillicola crassus** (adult, L_3, L_4)	swim-bladder, internal organs	64.60	1–28	4.029
Acanthocephala				
Echinorhynchus gadi	intestine	0.70	1	0.007
*Paratenuisentis ambiguus**	intestine	2.82	1–4	0.049
Crustacea				
Ergasilus sieboldi	gills	28.87	1–21	1.366
*Ergasilus gibbus**	gills	2.11	1	0.021

* — specific species; m. — metacercaria; l. — larva

Table 2. Long term differences in the prevalence of *Myxidium giardi* and *M. rhodei* in European eel

Year	*Myxidium giardi* (%)	*Myxidium rhodei* (%)
1996	6.0	0
1997	8.5	0
1998	0	0
2002	39.3	0
2003	44.6	12.0
2004	55.0	50.2
2005	59.2	51.0

Table 3. Long term differences in the infection levels of European eel with *Anguillicola crassus*

Year	P (%)	I (Ind.)	A (Ind.)
1996	40.2	1–28	3.4
1997	75.4	2–8	3.7
1998	80.2	5–19	8.0
2002	70.1	1–15	3.5
2003	60.1	1–31	3.5
2004	60.0	1–6	1.6
2005	66.0	1-25	4.5

Discussion

The European eel has some peculiarities of biology, such as diadromous migrations, near-button habitat, and polyphagia. These features are reflected in its parasite fauna. In the Baltic Sea, the eel parasites were so far the best recognized in the Szczecin Lagoon [3, 8], where 23 species representing various systematic groups were noted. In the Vistula Lagoon we have found 22 parasite species. But the species composition of the parasites in these two lagoons was not similar. Only 11 species occurred in both lagoons, 5 of them are host-specific species. In the Vistula Lagoon the richest groups were Myxosporea (5 species) and Nematoda (4 species). Out of 22 species recorded, as much as 10 (45.5%), namely *Epieimeria anguillae*, *Myxidium giardi*, *Zschokkella stettinensis*, *Sphaerospora anguillae*, *Pseudodactylogyrus anguillae*, *Proteocephalus macrocephalus*, *Plagioporus angulatus*, *Anguillicola crassus*, *Paratenuisentis ambiguus*, *and Ergasilus gibbus* are specific parasites of fish

belonging to the family of Angullidae.

Myxosporeans *Myxidium giardi* and *M. rhodei*, cestodes *Proteocephalus macrocephalus*, nematodes *Raphidascaris acus* and *Anguillicola crassus*, and copepods *Ergasilus sieboldi* occurred frequently (Table 1), *R. acus* and *A. crassus* showing the highest indices of fish infection. These two helmith species were found at adult and larval stages in the same fish specimens. It can prove that the eel actively fed on fishes, chironomids, and oligochaetes, (intermediate or paratenic hosts of *R. acus*), as well as on copepods and small cyprinid and percid fish (intermediate and paratenic hosts respectively for *A. crassus*) [17].

Twenty-one parasites were freshwater species. Only one species, *Echinorhynchus gadi*, was of the marine origin. This species was found very seldom (P = 0.7%).

Monogeneans *Pseudodactylogyrus anguillae*, nematodes *Anguillicola crassus*, and acanthocephalans *Paratenuisentis ambiguous* are recognized as invader species for the Vistula Lagoon. *P. anguillae* and *A. crassus* were introduced to Europe from the Far East with live Japanese eel in the 1980s. The former species was noted very rarely on the gills of eels from the Vistula Lagoon [12]. Nematodes *A. crassus* were recorded frequently. The acanthocephalan *P. ambiguus* was introduced to Europe with his high specific intermediate host — *Gammarus tigrinus* from the east coast of the USA [18, 19]. Recently this crustacean was recovered in the Vistula Lagoon too [20, 21], therefore the life cycle of *P. ambiguus* can be completed in this environment.

Our study revealed the main features of the eel parasite fauna in the Vistula Lagoon: high specificity, predominance of the parasites with simple life cycle, and the presence of three invader species.

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