

**PARASITES OF YOUNG BALTIC COD, *GADUS MORHUA CALLARIAS* L.
IN THE GULF OF PUCK, POLAND**

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Background. The hitherto published records of the parasite fauna of Baltic cod, *Gadus morhua callarias* cover commercially-caught adult fish. The aim of this study was to determine the composition of the parasite fauna of young Baltic cod, the relevant infection parameters and to relate those data to published records on the diet of cod.

Material and Methods. This survey was carried out on 154 young cod, caught in May and June 2002 in the Gulf of Puck, the Baltic Sea, Poland. The fish were examined using standard methods applied in parasitology.

Results. No external parasites were found. In the digestive tracts of 58 cod, 3 species of parasites belonging to 2 higher taxa (Nematoda and Acanthocephala) were found. The dominant parasite was *Echinorhynchus gadi* Zoega in Müller, 1776. The mean abundance ranged from 0.15 to 2.75. The prevalence ranged from 14.6%, in the smallest fish, to 66.7% in the larger ones. Only two acanthocephalan specimens of *Pomphorhynchus laevis* (Zoega in Müller, 1776) and five nematode larvae of *Hysterothylacium aduncum* (Rudolphi, 1802) were found.

Conclusion. The parasite fauna of young Baltic cod is significantly sparser than in larger fish examined by other authors. It is suggested that the occurrence of the species found, can be related to the composition of diet available.

Key words: fish, cod, *Gadus morhua callarias*, Gadidae, parasites, Gulf of Puck, Baltic Sea, Poland.

INTRODUCTION

Parasites of Baltic cod, *Gadus morhua callarias* L. were reported by Markowski (1933), Rutkowicz (1963), and Rokicki (1975). Those studies covered larger, commercially-caught fish, and mainly the internal parasites were described. Among the reported 22 metazoan species of parasites, the acanthocephalan *Echinorhynchus gadi* Zoega in Müller, 1776 was a predominant species (Studnicka 1965, Buchmann 1988, 1995, Reimer 1995).

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The aim of the present study was to examine which parasites can be found as early as in the young age groups of cod (which has not reached the market size), with particular reference to the issue of *E. gadi* dominance. Another objectives of this study were to compare the diversity of parasites with the available data on older-cod parasites and to relate the presence of parasites to the literature data on the diet composition of cod inhabiting the southern Baltic Sea.

MATERIAL AND METHODS

This parasitological survey was carried out on 154 young cod, caught with a fyke net as a by-catch during commercial fishing in the Gulf of Puck in May and June 2002. Fish were sampled three times, near Jastarnia (4 May, 58 individuals; 14 May, 51 ind., and 5 June, 44 ind.) at a depth of about 6 meters. The samples were iced and promptly delivered to a laboratory at the Division of General Zoology, University of Szczecin. There, after being measured and weighed cod underwent parasitological examination, focused on the skin, gills, fins, spleen, kidney, body cavity, and the digestive tract contents. The parasites found were preserved in 70% ethyl alcohol or glycerine-alcohol mixture and subsequently identified.

RESULTS

The cod examined were divided into eight length classes (Table 1). No external parasites were found. A total of 3 parasite species were recovered from the digestive tracts and digestive tract walls of 58 fish examined (5 nematodes *Hysterothylacium aduncum* L4; 150 adult acanthocephalans *Echinorhynchus gadi*; and 2 *Pomphorhynchus laevis*). The infection data are presented in Table 1.

Table 2 presents the infection parameters of *Echinorhynchus gadi* in cod. 35.7% of the cod population was infected with *E. gadi*. The mean abundance for each length class was low and ranged from 0.15 for the smallest fish up to 2.75 for the fish in the 21–22.9 cm length class. The mean intensity of infection was low; the highest was recorded in cod in the 21.0–22.9 cm length class.

DISCUSSION

Earlier studies on cod fished in the southern Baltic show relatively low abundance of nematode infections. The principal species recorded were *Contracaecum osculatatum* (Rudolphi, 1802), *Anisakis simplex* (Rudolphi, 1809, det. Krabbe, 1878), *Capillaria gracilis* (Bellingham, 1840), and *Hysterothylacium aduncum* (Rudolphi, 1802) (cf. Rokicki 1975, Myjak et al. 1994, Morozińska-Gogol 1995, Reimer 1995).

In the present study *H. aduncum* was found in low numbers. Experimental infections carried out by Køie (1993) demonstrate that that *H. aduncum* third-stage larvae developed in the haemocoel of calanoid and harpacticoid copepods, and as well in Mysidacea, Amphipoda, Isopoda, bristle worms, and molluscs. In the natural

Table 1
Parasites found in different length classes of young Baltic cod from the Gulf of Puck

Length class [cm]	N*	Number of fish infected	Number of fish infected with			
			<i>E. gadi</i>	<i>H. aduncum</i>	<i>E. gadi</i> <i>P. laevis</i>	<i>E. gadi</i> <i>H. aduncum</i>
13.0–14.9	41	8	6	2		
15.0–16.9	44	12	10		1	1
17.0–18.9	24	12	12			
19.0–20.9	11	7	7			
21.0–22.9	8	4	3		1	
23.0–24.9	15	8	8			
25.0–26.9	8	4	3			1
>27.0	3	2	1			1

* Number of fish examined.

Table 2
Infection parameters of *Echinorhynchus gadi* in cod

Fish length class [cm]	Number of fish infected	Number of parasites	Prevalence [%]	Intensity range	Abundance	Mean intensity of infection
13.0–14.9	6	6	14.6	1	0.2	1
15.0–16.9	12	36	27.3	1–12	0.8	3
17.0–18.9	12	26	50.0	1–5	1.1	2.2
19.0–20.9	7	19	63.3	1–8	1.7	2.7
21.0–22.9	4	22	50.0	1–15	2.8	5.5
23.0–24.9	8	25	53.3	1–11	1.7	3.1
25.0–26.9	4	12	50.0	1–8	1.5	3
>27.0	2	4	66.7	1–3	1.3	2

environment of the Baltic Sea the third-stage larvae of this species were recorded in many planktonic organisms (Fagerholm 1982, 1987).

It has been determined, the diet of 15-cm-long cod in the southern Baltic Sea consists mainly of representatives of Polychaeta, Mysidacea, and Amphipoda. *Mysis mixta* (Mysidacea) plays the main role in the diet of cod from 8 to 25 cm (Mańkowski 1959). Consequently, the fish feeding on zooplankton can get infected with nematode larvae. The percentage of zooplankton decreases with increased fish length (Table 3).

The predominant parasite in the fish of the present study was *E. gadi*. Abundance was low in fish shorter than 19 cm but reaching a peak in fish 21–22.9 cm long, and then, although based on a limited number of fish, apparently decreased again (Table 2). This tendency could be related to a change in the composition of the diet of the fish (Table 3). The daily diet of young fish constitutes 1% of their body weight, and its composition is very variable. The amphipods *Gammarus oceanicus*, *G. locusta*, and *Pontoporeia femorata* are often found in the diet contents of small cod (Załachowski 1977). These species are often intermediate hosts for *E. gadi* (cf. Valtonen et al. 1983). The daily diet composition of adult fish is less variable, and comprises up to 5% of the body weight. Therefore, cod get infected with larvae already as young fish, and their number consistently increases as time goes by. Acanthocephala species occur in cod from the southern Baltic usually in small numbers (Studnicka 1965, Rokicki 1975, Reimer and Walter 1993). In recent years a decrease of infection with *Gammarus* spp. by *Pomphorhynchus laevis* has been observed. Sulgostowska and Vojtková (1992) did not find a single *P. laevis* larva in 863 *Gammarus* spp. individuals. Similar observations were made by Voigt (1991) during his research carried out in the eastern Baltic. This probably explains why only two specimens of *P. laevis* were found in young Baltic cod in the present study.

Table 3

The mean percentage of different diet components in Baltic cod of various length according to Załachowski 1977 (amended)

Sustenance component	Length class [cm]				
	5–15	16–25	26–35	36–45	46–55
Priapulida	0.1	0.1	0.1		
Polychaeta	39.9	40.0	35.5	25.5	12.9
Bivalvia				0.1	
Entomostraca	0.1				
Mysidacea	23.9	19.2	8.6	5.0	3.4
Amphipoda	13.9	11.8	3.8	1.1	0.2
Cumacea	1.2	2.5	0.3	0.1	0.1
Isopoda	5.9	14.2	23.7	24.2	20.1
Decapoda	4.4	2.7	5.0	3.6	1.2
Clupeidae		1.0	13.4	31.7	50.9
Gadidae			0.2	1.0	3.8
Gasterosteidae				0.4	
Ammodytidae			0.1	0.7	2.6
Gobiidae	9.6	7.6	6.7	3.5	1.5
Cottidae	0.1				
Pleuronectidae					0.2
Others	0.9	0.9	2.7	3.3	3.1

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