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Parasitology

HELMINTH FAUNA OF FLOUNDER *PLATICHTHYS FLESUS* (L.) AND TURBOT *SCOPHTHALMUS MAXIMUS* (L.) FROM THE GULF OF GDAŃSK

HELMINTOFAUNA STORNI *PLATICHTHYS FLESUS* (L.) I TURBOTA *SCOPHTHALMUS MAXIMUS* (L.) Z ZATOKI GDAŃSKIEJ

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The present investigation covered 400 specimens of *Platichthys flesus* and 22 of *Scophthalmus maximus* caught in the period of October 1993 – December 1994 in the Gulf of Gdańsk (the South-east Baltic). The following parasite species were found: *Bothriocephalus scorpii*, *Hysterothylacium auctum*, *Cucullanus heterochrous*, *Cuculanellus minutus*, *Anisakis simplex*, *Raphidascaris* sp. (probably *R. acus*), *Echinorhynchus gadi*, and *Pomphorhynchus laevis*. The occurrence of parasites was studied in relation to the season of fishing and the length of the fish body.

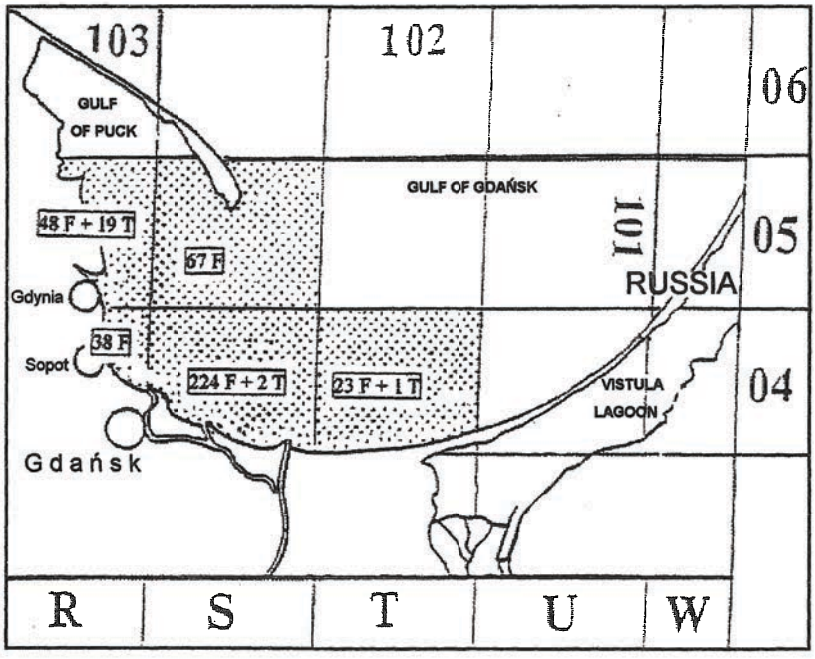
INTRODUCTION

Parasitological analysis was carried out for two flatfish species: *Platichthys flesus* (L.) and *Scophthalmus maximus* (L.) caught in the Gulf of Gdańsk (the Southeast Baltic). The aim of the present study was to determine the current infection of these species and to compare the results obtained with those from the period of 1982–1984 (Sulgostowska et al. 1987; Sulgostowska and Styczyńska-Jurewicz 1996).

MATERIAL AND METHODS

In the period from October 1993 to December 1994, a total of 400 specimens of *Platichthys flesus* and 22 of *Scophthalmus maximus* caught in the Gulf of Gdańsk was examined (Fig. 1). In January and February the study was temporarily suspended due to the closed season for the flatfishes. Most of the fish samples were taken during commercial

fishing, some were caught during research voyages on R/V "Baltica" belonging to the Sea Fisheries Institute and the Institute of Meteorology and Water Management, both from Gdynia. The fish samples examined consisted of 16–31 specimens each, 24 on the average, and only one comprised 9 fishes. For practical reasons, most of the samples were frozen and successively examined later. Parasitological investigations were carried out for all internal organs except the excretory system. Before the examination, each fish was weighed, measured, and its sex was determined. Subsequently the body cavity was cut-open to allow its contents, the surface of internal organs and the peritoneum. Then, after cutting the alimentary duct, the intestinal contents were poured into Petri dishes and examined under a low magnification of a dissecting microscope.



F—flounder, T—turbot

Fig. 1. Flatfish fisheries with numbers of fish examined and parasites species recorded in particular fishing areas.

R-4: *H. auctum*, *C. heterochrous*, *A. simplex*, *E. gadi*, *P. laevis*

R-5: *B. scorpii*, *H. auctum*, *A. simplex*, *P. laevis*

S-4: *B. scorpii*, *H. auctum*, *C. heterochrous*, *C. minutus*, *A. simplex*, *Raphidascaris* sp., *E. gadi*, *P. laevis*

S-5: *H. auctum*, *C. heterochrous*, *C. minutus*, *E. gadi*, *P. laevis*

T-4: *B. scorpii*, *H. auctum*, *C. heterochrous*, *P. laevis*

Cestodes were fixed and stained in lactocarmine dehydrated in graded series of ethanol, cleared in creosote, and mounted on microscope slides in Canada balsam. Nematodes were fixed in 80% ethanol and transferred to a mixture of 70% ethanol and glycerol (9:1). The alcohol was evaporated from the mixture before the determination. Acantocephalans fixed in 70% ethanol were dehydrated in 96% methanol and cleared in creosote.

Although the sample material was predominately from frozen fish, it was well preserved. Only in *Hysterothylacium auctum* different stages of degradation were observed upon defrosting. In addition, in this species the differentiation between larvae L_4 and preadult individuals is difficult in practice, which has already been noted by Fagerholm (1982). It was mostly for these two reasons that the stage of development of this species could not always be determined correctly, and the data reported should therefore be treated as approximate.

RESULTS

Parasites of flounder, *Platichthys flesus* (L.)

Cestoda

Bothriocephalus scorpii (Müller, 1776)

Only one larva of this tapeworm was found in a flounder caught in the S-4 fishing area (Fig. 1). It was detected in November in a 27-cm-long fish (Tabs. 1, 2).

Nematoda

Hysterothylacium auctum (Rudolphi, 1802)

It was a common species in the present study. Outside the lumen of the alimentary duct there were few nematodes of these. They occurred on the surface of the liver and along the intestine. The majority of them represented L_3 larval forms, few—L_4. Adult specimens were recorded only twice: on the liver of one fish in July and on the intestine surface of another fish in November. Inside the alimentary duct larval forms (L_3, L_4) were found in most cases, while the adult specimens occurred less frequently.

Both larvae and adult forms were observed in all months analysed in about a half of the fish examined. The prevalence of infection was the lowest in August and September, gradually increasing from October, to achieve its maximum between May and June. The mean intensity of infection was also the lowest in August and September, and the highest in the spring season (Tab. 1).

To prevalence related to the fish body length, demonstrated no significant differences, whereas its intensity was greater in bigger fish specimens, above 16 cm (Tab. 2).

Table 1

Occurrence of helminth fauna of flounder *Platichthys flesus* (L.) and turbot *Scophthalmus maximus* (L.) in particular months (seasons)

Month/ Season/Year		Winter (Dec)	Mar	Apr	May	Spring	Jun	Jul	Aug	Summer	Sep	Oct	Nov	Autumn	YEAR
No of fish examined		67 (1)	81 (2)	21 (ne.)	16 (ne.)	118 (2)	24 (18)	29 (ne.)	30 (ne.)	83 (18)	25 (ne.)	40 (ne.)	67 (1)	132 (1)	400 (22)
B. scorpii	a	0 (1)	0 (2)	0 (-)	0 (-)	0 (2)	0 (18)	0 (-)	0 (-)	0 (18)	0 (-)	0 (-)	1.5 (1)	0.8 (1)	0.25 (22)
	b	0	0	0	0	0	0	0	0	0	0	0	1.0	1.0	1.0
	c	0 (126)	0 (40;40)	0 (-)	0 (-)	0 (40;40)	0 (mass)	0 (-)	0 (-)	0 (mass)	0 (-)	0 (-)	1 (70)	1 (70)	1 (mass)
H. auctum (inside the alimentary tract)	a	55.2 (1)	53.1 (0)	52.4 (-)	81.2 (-)	56.8 (0)	100 (2)	89.6(-)	20.0 (-)	67.5 (2)	20.0 (-)	42.5 (-)	44.8 (0)	39.4 (0)	53.0 (3)
	b	6.03	17.63	9.45	12.23	15.24	17.17	7.0	1.17	10.73	3.4	10.65	10.83	10.06	11.17
	c	1-27 (1)	1-144 (0)	1-42 (-)	1-70 (-)	1-144 (0)	1-102 (1;1)	1-24 (-)	1-2 (-)	1-102(1;1)	1-10 (-)	1-34 (-)	1-62 (0)	1-62 (0)	1-144 (1;1)
H. auctum (outside the alimentary tract)	a	11.9 (0)	1.2 (0)	28.6 (-)	12.5 (-)	7.6 (0)	4.2 (1)	13.8 (-)	3.3 (-)	7.2 (1)	4.0 (-)	10.0 (-)	8.9 (0)	8.3 (0)	8.5 (1)
	b	1.37	1.0	2.67	1.0	2.11	1.0	2.75	1.0	2.17	1.0	1.0	2.17	1.64	1.79
	c	1-2 (0)	1 (0)	1-9 (-)	1-1 (-)	1-9 (0)	1 (1)	1-4 (-)	1 (-)	1-4 (1)	1 (-)	1-1 (-)	1-5 (0)	1-5 (0)	1-9 (1)
C. heterochrous	a	0	4.9	33.3	6.2	10.2	4.2	13.8	3.3	7.2	4.0	5.0	1.5	3.0	13.2
	b	0	1.0	3.29	1.0	2.33	1.0	3.25	2.0	2.67	1.0	3.5	1.0	2.25	2.41
	c	0	1-1	1-12	1	1-12	1	1-10	2	1-10	1	1-6	1	1-6	1-12
C. minutus	a	23.9	0	0	0	0	0	51.7	86.7	49.4	92.0	37.5	31.3	44.7	29.0
	b	2.87	0	0	0	0	0	9.8	19.35	15.85	12.96	4.13	4.71	7.80	9.96
	c	1-15	0	0	0	0	0	1-70	3-37	1-70	2-58	1-11	1-15	1-58	1-70
A. simplex	a	0	0	0	0	0	4.2	0	3.3	2.4	0	2.5	0	0.8	0.75
	b	0	0	0	0	0	2.0	0	6.0	4.0	0	2.0	0	2.0	3.33
	c	0	0	0	0	0	2	0	6	2-6	0	2	0	2	2-6
Raphidascaris sp.	a	0	1.2	0	0	0.85	0	0	0	0	0	0	0	0	0.25
	b	0	1.0	0	0	1.0	0	0	0	0	0	0	0	0	1.0
	c	0	1	0	0	1	0	0	0	0	0	0	0	0	1
E. gadi	a	0	1.2	23.8	12.5	6.8	8.3	27.6	3.3	13.2	4.0	2.5	0	1.5	5.2
	b	0	1.0	2.0	2.0	1.87	3.0	1.62	3.0	2.0	1.0	2.0	0	1.5	1.9
	c	0	1	1-5	1-3	1-5	1-5	1-3	1-3	1-5	1	2	0	1-2	1-5
P. laevis	a	40.3	38.3	28.6	25.0	34.7	37.5	69.0	56.7	55.4	48.0	55.0	41.8	47.0	44.0
	b	7.11	8.23	11.0	3.0	8.12	7.22	5.1	8.29	6.70	5.25	20.68	12.71	14.10	9.7
	c	1-10	1-108	1-50	1-5	1-108	1-23	1-21	1-30	1-30	1-15	1-80	1-65	1-80	1-108

a—prevalence of infection (%); b—mean intensity of infection; c—intensity of infection (range); ne.—not examined;
in brackets—data on turbots given in absolute numbers

Table 2

Occurrence of intestinal parasites of flounder *Platichthys flesus* (L.) depending on fish body length

Fish body length		< 11	11–15	16–20	21–25	26–30	31–35	> 35
No of fish examined		14	17	35	181	124	21	8
B. scorpii	a	—	—	—	—	0.8	—	—
	b	—	—	—	—	1.0	—	—
	c	—	—	—	—	1	—	—
H. auctum	a	50.0	47.1	42.9	58.6	50.8	47.6	37.5
	b	1.7	4.1	13.7	13.6	8.0	15.0	5.0
	c	1–5	1–10	1–144	1–62	1–42	1–3	1–13
C. heterochrous	a	—	—	—	3.3	8.9	23.8	—
	b	—	—	—	1.0	2.0	5.0	—
	c	—	—	—	1	1–6	1–12	—
C. minutus	a	—	—	17.1	34.2	36.3	14.3	—
	b	—	—	1.8	10.8	9.9	9.0	—
	c	—	—	1–3	1–97	1–70	3–19	—
A. simplex	a	—	—	—	0.5	0.8	4.8	—
	b	—	—	—	2.0	6.0	2.0	—
	c	—	—	—	2	6	2	—
Raphidascaris sp.	a	—	—	2.9	—	—	—	—
	b	—	—	1.0	—	—	—	—
	c	—	—	1	—	—	—	—
E. gadi	a	0	0	0	2.2	9.7	19.0	12.5
	b	—	—	—	1.3	1.8	3.0	2.0
	c	—	—	—	1–2	1–3	1–5	2
P. laevis	a	0	17.6	45.7	44.7	51.7	48.9	37.5
	b	—	6.0	5.7	8.0	8.8	23.1	59.3
	c	—	2–11	1–15	1–108	1–60	1–90	25–80

a—prevalence of infection (%); b—mean intensity of infection; c—intensity of infection (range)

Cucullanus heterochrous (Rudolphi, 1802)

It was least frequent among nematodes. The only adult forms were found. The ratio of the number of females to males was 1:1.5.

The nematode occurred in all months except December. In general, the prevalence of infection did not exceed 7%, being higher only in April and July. Mean prevalence of infection was almost at the same level during the whole time of investigation (Tab. 1).

This species was found exclusively in bigger fish (21–35 cm). Within this class of body length, both prevalence and intensity of infection increased together with the length of the fish (Tab. 2).

Cuculanellus minutus (Rudolphi, 1819)

This species was relatively frequent. It was represented mostly by adult individuals and, to a lesser extent, by L_4 larvae, which occurred in July and August and, less frequently, in September. The ratio of the number of females to males was about 1:1.

The prevalence and intensity of infection were the highest from July to September, decreasing gradually towards December. The nematodes were not found in the period from March to June (Tab. 1). Neither were they observed in fishes up to 15 cm in length and in bigger specimens above 35 cm. The infection parameters were the highest for fish body lengths from 21 to 30 cm (Tab. 2).

Anisakis simplex (Rudolphi, 1809) – larvae L_3

This species in exceptional cases occurred in the intestines of flounders: 10 individuals were found in 3 fish. The larvae were found on the surface of the liver and the intestine.

This nematode was observed in the period from June to October (Tab. 1). It occurred for fish body lengths 24, 28 and 34 cm (Tab. 2).

Raphidascaris sp. – larva

One individual only was found, possibly L_4 larva (length 8 mm). The nematode was seriously damaged. It was probably *R. acus* (Bloch, 1779). The nematode was identified based on the presence of the ventricular appendix, with lacking intestinal caecum, and on the morphology of the terminal fragment of the body.

The nematode was found in March in the intestine of a 20-cm-long fish (Tabs. 1, 2).

Acathocephala

Echinorhynchus gadi (Zoega in Müller, 1776)

It was a relatively rare species. Adult individuals only were found. The ratio of the number of females to males was 2:1.

These parasites were found in the period from March to October. None were observed in November and December. The prevalence of infection from April to July was the highest, dramatically decreasing in the autumn. The intensity of infection was low (1–3 on

the average) and did not vary essentially during the whole period of the occurrence of the acanthocephalan (Tab. 1).

They were only found in bigger fish exceeding 20 cm in length. The prevalence and intensity of infection increased with the body length in this fish group (Tab. 2).

Pomphorhynchus laevis (Zoega in Müller, 1776)

It was a common species. Adult forms were predominant. The ratio of the number of females to males was about 1:1.

The prevalence of infection was high during all seasons of the year, in particular from July to October. Mean intensity of infection was irregular, varying from 3.0 in May to 20.6 in October (Tab. 1).

This acanthocephalan was not found only in very young flounder, not exceeding 11 cm in length. The infection parameters, intensity in particular, increased with the length of the fish (Tab. 2).

Parasites of turbot, *Scophthalmus maximus* (L.)

Cestoda

Bothriocephalus scorpii (Müller, 1776)

It was a common species. In all turbot examined, mass occurrence of adult forms of this species was noted irrespective of the season of the year (Tab. 1) and of the fish body length.

Nematoda

Hysterothylacium auctum (Rudolphi, 1802)

Only four individuals were found: one L_4 larva and two preadult individuals in the intestines of three fish and one L_3 larva on the surface of the liver of fish.

Parasites inside the intestine were found in December and June, whereas on the surface of the liver in June (Tab. 1).

DISCUSSION

Within the studied time-period a total of 8 species of parasites identified as nematodes, acanthocephalans, and tapeworms, were detected in the flatfishes examined. As found by comparing the present results of investigations on parasite fauna with those from the previous years (Sulgostowska et al. 1987; Sulgostowska and Styczyńska-Jurewicz 1996), the number of nematode species occurring in flatfishes in the Gulf of Gdańsk increased. It concerned the species occurring in low numbers (*C. heterochrous*, *Raphidascaris* sp., and *A. simplex*). In the case of the remaining species of parasites, differences occurred in the infection rate of the fish. In the case of *H. auctum*, markedly higher preva-

lence and intensity of infection was observed compared to the previous observations in all seasons of the year analysed. In the previous investigations (Sulgostowska et. al. 1987) *C. heterochrous* was recorded only in the open sea. Recently, it has been found in the Gulf of Gdańsk. The level of infection with this nematode was similar, while the period of its occurrence throughout the year was prolonged. The infection with *C. minutus* markedly dropped compared to the previous period (Sulgostowska and Styczyńska-Jurewicz 1996). We concluded that it did not pose an epizootic threat to the flounder any more. The infection rate with *E. gadi* was slightly higher. In the case of *P. laevis* both the prevalence and intensity of infection significantly increased.

Generally, the infection level of the flounder with internal helminths increased with the fish body length, althought *H. auctum* occurred numerously also in the smallest ones. Lack of *C. heterochrous* and *C. minutus* in fish above 35 cm could have been a result of insufficient number of the fish specimens studied.

The systematic position of *H. auctum* was assumed after Fagerholm (1987, 1989) who claimed that only that species occurred in the fish of the Baltic. Many authors identified it as *H. aduncum*, previously assigned to other genera, i.e. *Ascaris*, *Contracaecum*, and *Thynnascaris* (c.f. Punt 1941).

Nematodes *C. heterochorus* and *C. minutus* are specific to the flounder, which is their proper final host (Fagerholm 1982).

A. simplex in flounder of the East Baltic were for the first time observed in the 1990s (Myjak et al. 1996). In the Baltic Sea, due to its low salinity, no primary intermediate hosts (euphausiids) of this nematode occur. Neither do, or are sporadically noted, the sea mammals which can be the final hosts. A know species infected with this species of nematode is herring of the spring shore spawning, migrating from the North Sea to the coastal waters of the South Baltic Sea. This type of nematode is rarely identified in the Baltic cod which, being a predatory fish, becomes infected from the herring. The flounder, a non-migrating species, can be infected with larvae L_3 after eating the remains of an infected herring. The larvae found occurred outside the intestine and were alive.

Raphidascaris acus is a nematode of fresh and brackish waters. It is a common parasite of fish in the Bay of Bothnia (Fagerholm 1982). In the flounder caught in the Gulf of Gdańsk *Raphidascaris* sp. was noted in the 1930s (Janiszewska 1938). Our finding of this nematode may indicate the improvement in the purity of the Gulf of Gdańsk waters.

Worthy of notice is the finding of larva *Contracaecum* sp. in the flounder[1] (Myjak et al. 1996). The larva was found in the region close to the Gulf of Gdańsk, i.e. outside the area considered in the present paper (fishing ground no. 102, fishing area S-7). The larva

[1] later named *C. osculatum* (Myjak et al.—paper in preparation)

was harboured on the liver of the fish. This species has not been observed before in the Baltic flounder, occurring mostly in the liver of the cod of the South Baltic. The cod caught by fishermen are usually gutted already at sea, their viscera being thrown outboard, thus being the possible source of infection of the flounder with this parasite.

Acanthocephalans *E. gadi* and *P. laevis* commonly occur in numerous fish species. As can be inferred from our investigations, the flounder is one of the main hosts for *P. laevis* (which is indicated by high intensity of infection), being an adventitious host for *E. gadi* (Grabda 1971).

Such an essential difference in the infection of flatfishes with tapeworm *B. scorpii* is striking. Turbot is always mass-infected with adult individuals, whereas in the flounder this tapeworm occurs in the larval form only, and this also very rarely. Identical results were obtained in previous investigations (Sulgostowska et al. 1987, Sulgostowska 1988). In the studies of Mulicki (1947) on nourishment of flounder and other flatfishes, no essential differences in the contents of the nutritive material were found which might account for such a degree of infection.

CONCLUSION

1. A slight increase of diversity of helminths parasiting flounder as well as a significant decrease of the infection level with *C. minutus* and, at the same time, the increase of the infection with *P. laevis* suggest the improvement in the purity of the waters of the Gulf of Gdańsk compared with those recorded in the 1980s. Similar conclusions can be drawn from other reports (Szumilas and Sobol 1996).
2. The infection rates of the flounder with internal helminths (except for *H. auctum*) increased with the fish body length.

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HELMINTOFAUNA STORNI *PLATICHTHYS FLESUS* (L.) I TURBOTA *SCOPHTHALMUS MAXIMUS* (L.) Z ZATOKI GDAŃSKIEJ

STRESZCZENIE

Badaniom w kierunku obecności helmintofauny wewnętrznej poddano 400 storni (*Platichthys flesus*) i 22 turboty (*Scophthalmus maximus*). Ryby były odławiane w Zatoce Gdańskiej w okresie od października 1993r. do grudnia 1994r. Badano występowanie pasożytów w zależności od pory roku oraz długości ciała ryb. Niniejsza praca jest kontynuacją badań podjętych w latach 80. i ma na celu porównanie obecnego stanu zarażenia płastug w Zatoce Gdańskiej z danymi z lat ubiegłych. Znaleziono następujące gatunki pasożytów: *Bothriocephalus scorpii*, *Hysterothylacium auctum*, *Cucullanus heterochrous*, *Cuculanellus minutus*, *Anisakis simplex*, *Raphidascaris* sp. (prawdopodobnie *R. acus*), *Echinorhynchus gadi* i *Pomphorhynchus laevis*. Otrzymane wyniki sugerują, że w porównaniu z okresem poprzednim poprawiła się czystość wód w Zatoce Gdańskiej.

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