

Parasitic Fauna of American Plaice (*Hippoglossoides platessoides*) from the Northwest Atlantic

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Abstract

American plaice (*Hippoglossoides platessoides* (Fabricius, 1780)) from six offshore areas of the Labrador-Newfoundland region (Hamilton Bank, Funk Island Bank, Flemish Cap, and the northern, southeastern and southwestern slopes of the Grand Bank) were examined for internal parasites. Twenty species of parasites belonging to six major taxonomic groups were found and identified: 4 Protozoa, 2 Cestoidea, 8 Trematoda, 4 Nematoda, 1 Acanthocephala, and 1 Crustacea. Differences in species composition and degree of infestation indicated that the different populations of American plaice were infested with parasite species which are peculiar to their geographic origin.

Introduction

Investigations of the parasitic fauna of fishes provide valuable information on the ecological aspects of the species being studied, particularly with respect to their feeding behaviour and their role in the "parasite-host" cycle. In the case of American plaice (*Hippoglossoides platessoides*) of the Northwest Atlantic, most aspects of the biology have been generally well-studied (e.g. Huntsman, 1918; Templeman, 1953; Pitt, 1963, 1966, 1969, 1973, 1976; Lux, 1970; Nevinsky and Serebryakov, 1973), and the parasitic fauna of this species in the Northwest Atlantic have been documented by many authors (Table 1). This list of 45 species of parasites of American plaice from various sources comprises 8 species of Protozoa, 2 of Cestoidea, 21 of Trematoda, 8 of Nematoda, 3 of Acanthocephala, and 3 of Crustacea.

Much of the existing information on parasites of American plaice deals mainly with systematics. In this paper, data on the parasitic fauna of the species from various parts of the Northwest Atlantic are presented and the ecological implications are considered.

Materials and Methods

Samples of American plaice were collected in June-July 1978 from six areas of the Labrador-Newfoundland region, i.e. Hamilton Bank, Funk Island Bank, northern, southeastern and southwestern slopes of Grand Bank, and Flemish Cap (Fig. 1). A total of 143 specimens were examined by the method of complete parasitological dissection (Dogel, 1933). Species identification of the parasites were made by scientists of the parasitological laboratories of the Polar Institute of

Marine Fisheries and Oceanography, Murmansk (PINRO), and the Atlantic Research Institute of Marine Fisheries and Oceanography, Kaliningrad (Atlant-NIRO). The data are presented in terms of rate of infestation (percentage of infested fish) and mean intensity of infestation (mean number of parasites per fish).

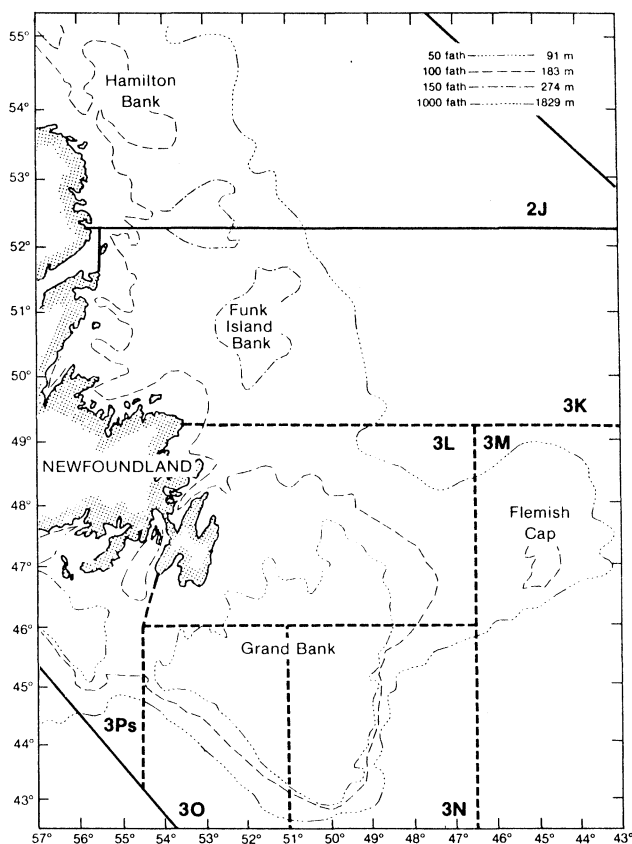


Fig. 1. Labrador-Newfoundland region showing the banks where the American plaice samples were obtained.

TABLE 1. Some reported parasites of American plaice in the Northwest Atlantic.

Species	Literature sources
Protozoa	
<i>Ceratomyxa drepanopsettae</i> Awerinzew, 1908	Zubchenko (1980)
<i>Cryptobia bullocki</i> Strout, 1965	Daily (1978)
<i>Haemohormidium terraenovae</i> So, 1972	So (1972)
<i>Haemohormidium</i> sp.	Laird and Bullock (1969)
<i>Myxidium sphaericum</i> Thelohan, 1895	Zubchenko (1980)
<i>Ortholinea divergens</i> (Thelohan, 1895)	Zubchenko (1980)
<i>Schulmania aenigmatosa</i> Kovaljova, Zubtschenko and Krasin, 1983	Zubchenko (1980) as <i>Myxoproteus</i> sp., Kovaljova et al. (1983)
<i>Trypanosoma murmanensis</i> Nikitin, 1927	Khan (1977)
Cestoidea	
<i>Bothrimonus sturionis</i> Duvernoy, 1842 Syn: <i>Diplocotyle olrikii</i> Krabbe, 1874	Ronald (1958b)
<i>Scolex pleuronectis</i> O. F. Muller, 1788	Ronald (1958b), Zubchenko (1980)
Trematoda	
<i>Anisoporus manteri</i> Humminen and Cable, 1940	Humminen and Cable (1940)
<i>Aporocotyle simplex</i> Odhner, 1900	Ronald (1960), Zubchenko (1980)
<i>Brachyphallus crenatus</i> (Rudolphi, 1802)	Zubchenko (1980)
<i>Cryptocotyle lingua</i> (Creplin, 1825)	Ronald (1960)
<i>Derogenes varicus</i> (O. F. Muller, 1784)	Stafford (1904, 1907), Ronald (1960), Scott (1975a, 1975b, 1982), Bray (1979), Zubchenko (1980)
<i>Diptherostomum microacetabulum</i> (Shulman-Alborva, 1952)	Bray (1979), Zubchenko (1980) as Trematoda gen sp., Scott (1982)
<i>Genolinea laticauda</i> Manter, 1925	Zubchenko (1980)
<i>Gonocerca macroformis</i> Wolfgang and Myers, 1954	Wolfgang and Myers (1954)
<i>Hemiurus levinseni</i> Odhner, 1905	Ronald (1960), Scott (1975a)
<i>Hemiurus</i> sp.	Ronald (1960)
<i>Lecithaster gibbosus</i> (Rudolphi, 1802)	Scott (1975a, 1975b, 1982), Bray (1979), Zubchenko (1980)
<i>Otodistomum veliporum</i> (Creplin, 1837)	Scott (1975a)
<i>Podocotyle atomon</i> (Rudolphi, 1802)	Ronald (1960), Scott (1975a)
<i>Progonus muelleri</i> (Levinsen, 1881) Syn: <i>Distoma muelleri</i> Levinsen, 1881 <i>Genarches muelleri</i> (Levinsen, 1881) <i>Genarchopsis muelleri</i> (Levinsen, 1881)	Bray (1979)
<i>Prosorhynchus squamatus</i> Odhner, 1905	Scott (1975a)
<i>Steganoderma formosum</i> Stafford, 1904 Syn: <i>Nordostrema messjatzevi</i> (Issaitschikov, 1928)	Manter (1947)
<i>Stenakron vetustum</i> Stafford, 1904 Syn: <i>Rhodotrema problematicum</i> Issaitschikov, 1928 <i>Stenakron problematicum</i> (Issaitschikov, 1928) <i>Rhodotrema quadrilobata</i> Bazikalova, 1932 <i>Steringotrema quadrilobatum</i> (Bazikalova, 1932) <i>Stenakron quadrilobatum</i> (Bazikalova, 1932)	Radulescu (1969), Scott (1975a, 1975b, 1982) Bray (1979), Zubchenko (1980)
<i>Stephanostomum baccatum</i> (Nicoll, 1907)	Huntsman (1918), Ronald (1960), Wolfgang (1954, 1955)
<i>Steringophorus furciger</i> (Olsson, 1867) Syn: <i>Distomum furcigerum</i> Olsson, 1867 <i>Leioderma furcigerum</i> (Olsson, 1867) <i>Fellodistomum furcigerum</i> (Olsson, 1867)	Stafford (1904, 1907), Scott (1975a, 1975b, 1982), Bray (1979), Zubchenko (1980)

TABLE 1. (continued).

Species	Literature sources
<i>Steringotrema ovacutum</i> (Lebour, 1908) Syn: <i>Steringophorus ovacutus</i> Lebour, 1908 <i>Rhodotrema ovacutum</i> (Lebour, 1908) <i>Stenakron ovacutus</i> (Lebour, 1908)	Scott (1975a, 1975b, 1982), Bray (1979), Zubchenko (1980)
<i>Zoogonides viviparus</i> (Olsson, 1868)	Scott (1975a, 1975b), Zubchenko (1980)
Nematoda	
Anisakinae gen. sp. (larva)	Ronald (1963)
<i>Anisakis</i> sp. (larvae)	Templeman <i>et al.</i> (1957), Zubchenko (1980)
<i>Capillaris kabatai</i> Inglis et Coles, 1963	Zubchenko (1980)
<i>Contraeaecum</i> sp.	Ronald (1963)
Nematoda gen. sp.	Huntsman (1918)
<i>Phocanema decipiens</i> (Krabbe, 1878) Syn: <i>Porrocaecum decipiens</i> (Krabbe, 1878) <i>Terranova decipiens</i> (Krabbe, 1878)	Scott (1950, 1953, 1954), Myers (1960), Scott and Black (1960), Zubchenko (1980)
<i>Phocanema</i> sp. Syn: <i>Porrocaecum</i> sp. <i>Terranova</i> sp.	Templeman <i>et al.</i> (1957), Ronald (1963)
<i>Thynnascaris adunca</i> (Rudolphi, 1802) Syn: <i>Contraeaecum aduncum</i> (Rudolphi, 1802) <i>Contraeaecum gadi</i> (O. F. Muller, 1777)	Ronald (1963), Zubchenko (1980)
Acanthocephala	
<i>Corynosoma</i> sp.	Ronald (1963)
<i>Echinorhynchus gadi</i> (O. F. Muller, 1776)	Ronald (1963)
<i>Echinorhynchus laurentianus</i> Ronald, 1957	Ronald (1957, 1963)
Crustacea	
<i>Acanthochondria cornuta</i> (O. F. Muller, 1776) Syn: <i>Acanthochondria flurae</i> (Kroyer, 1863)	Bere (1930), Wilson (1932), Leigh-Sharpe (1933), Ronald (1958a), Zubchenko (1980)
<i>Argulus megalops</i> Smith, 1874	Wilson (1905)
<i>Lernaecera branchialis</i> (Linnaeus, 1767)	Templeman <i>et al.</i> , (1976)

Results

The parasitological investigation of 143 American plaice yielded 20 species of parasites (Table 2) which belong to 6 major taxonomic groups: Protozoa (4), Cestoidea (2), Trematoda (8), Nematoda (4), Acanthocephala (1), and Crustacea (1).

Hamilton Bank

Sixteen species of parasites were found in the 24 specimens that were examined. *Ceratomyxa drepanopsettae* was the most significant of the parasites with a direct developmental cycle. Of the parasites with a complex developmental cycle, the fish were found to be rather heavily infested with *Aporocotyle simplex*, and moderately with *Steringotrema ovacutum* and *Echinorhynchus gadi*, which were probably acquired by the fish from feeding on infested gastropods, bottom copepods and amphipods, implying that these

animals form a significant part of the diet of American plaice. Infestation was much less significant for other parasites with complex developmental cycles, which are associated with benthic animals (*Diptherostomum microacetabulum*, *Genolinea laticauda*, *Stenakron vetustum*, *Steringophorus furciger*) and with plankton (*Anisakis simplex*, *Lecithaster gibbosus*, *Scolex pleuronectis*, *Thynnascaris adunca*).

Funk Island Bank

Eleven species of parasites were found in the 15 specimens that were examined. Infestation of the fish with *Ceratomyxa drepanopsettae* in this area was somewhat lower than on Hamilton Bank, whereas the incidence of *Aporocotyle simplex* and *Steringotrema ovacutum* was notably higher, indicating a close association of American plaice with the bottom and the important role of gastropods in the feeding regime. However, infestation with *Scolex pleuronectis* larvae

TABLE 2. Parasitic fauna of American plaice in six areas of the Northwest Atlantic from sampling in June-July 1978.

Parasite	Hamilton Bank		Funk Island Bank		N Grand Bank		SW Grand Bank		SE Grand Bank		Flemish Cap	
	Specimens infested %	Mean infestation	Specimens infested %	Mean infestation	Specimens infested %	Mean infestation	Specimens infested %	Mean infestation	Specimens infested %	Mean infestation	Specimens infested %	Mean infestation
Protozoa												
<i>Ceratomyxa drepanopsettae</i>	95.8	+	73.3	+	63.3	+	70.0	+	55.2	+	93.3	+
<i>Myxidium sphaericum</i>	29.2	+	33.3	+	10.0	+	13.3	+	10.3	+	53.3	+
<i>Ortholinea divergens</i>	—	—	—	—	—	—	—	—	—	—	20.0	+
<i>Schulmania aenigmatosa</i>	29.2	+	—	—	—	—	—	—	—	—	—	—
Cestoidea												
<i>Grillotia erinaceus</i> (larvae)	—	—	—	—	—	—	—	—	10.3	0.1	66.7	5.1
<i>Scolex pleuronectis</i> (larvae)	4.2	0.1	40.0	4.5	16.7	0.7	3.3	0.1	24.1	0.6	33.3	2.3
Trematoda												
<i>Aporocotyle simplex</i>	41.7	0.9	66.7	1.3	6.7	0.1	10.0	0.1	13.8	0.1	—	—
<i>Derogenes varicus</i>	—	—	—	—	6.7	0.1	—	—	6.9	0.1	20.0	0.3
<i>Diphlostomum microacetabulum</i>	4.2	0.7	—	—	—	—	—	—	—	—	—	—
<i>Genolinea laticauda</i>	12.5	0.3	26.7	0.4	—	—	—	—	6.9	0.1	—	—
<i>Lecithaster gibbosus</i>	8.4	0.1	—	—	—	—	—	—	—	—	26.7	0.3
<i>Stenakron vetustum</i>	4.2	0.0	6.7	0.2	—	—	36.7	0.8	10.3	9.9	—	—
<i>Steringophorus furciger</i>	4.2	0.6	20.0	2.3	26.7	1.0	23.3	1.3	34.5	2.5	86.7	18.7
<i>Steringotrema ovacutum</i>	37.5	2.1	73.3	3.0	56.7	7.0	46.7	14.0	44.8	9.2	60.0	8.6
Nematoda												
<i>Anisakis simplex</i> (larvae)	4.2	0.0	—	—	6.7	0.1	33.3	0.4	10.3	0.1	46.6	0.3
<i>Ascaropsis arctica</i>	—	—	—	—	3.3	0.2	10.0	0.1	—	—	—	—
<i>Phocanema decipiens</i> (larvae)	25.0	0.5	13.3	0.1	36.7	2.1	6.7	0.1	10.3	0.1	26.7	0.5
<i>Thynnascaris adunca</i> (larvae)	16.7	0.1	13.3	0.1	13.3	0.3	6.7	0.1	17.2	0.3	86.7	5.3
Acanthocephala												
<i>Echinorhynchus gadi</i>	54.2	3.5	6.7	0.1	—	—	6.7	0.1	20.7	0.3	53.3	3.5
Crustacea												
<i>Acanthochondria cornuta</i>	4.2	0.0	—	—	—	—	—	—	—	—	—	—
Number of fish examined	24		15		30		30		29		15	

indicates significant association with planktonic organisms.

Flemish Cap

Fourteen species of parasites were found in the 15 specimens that were examined. In addition to heavy infestation with *Ceratomyxa drepanopsettae*, which is characteristic of most flatfishes, the American plaice from this area were more heavily infested with *Myxidium sphaericum* than those from any other area. Moderate to heavy infestation with parasites whose developmental cycles involve planktonic organisms included *Anisakis simplex*, *Derogenes varicus*, *Grillotia erinaceus*, *Lecithaster gibbosus*, and *Thynnascaris adunca*. *Steringophorus furciger* and *Echinorhynchus gadi* are associated with benthic animals, and they are acquired by American plaice during feeding on bivalve molluscs and amphipods.

Northern slope of Grand Bank

Eleven species of parasites were found in the 30 specimens that were examined. These fish were rather heavily infested with *Ceratomyxa drepanopsettae* and *Steringotrema ovacutum*, whose developmental cycles are associated with benthic organisms. Gas-

tropods (intermediate hosts of these two parasites) and amphipods (intermediate hosts of *Phocanema decipiens*) are evidently the major prey of American plaice in this area.

Southwestern slope of Grand Bank

Twelve species of parasites were found in the 30 specimens that were examined. In addition to rather heavy infestation of American plaice with *Ceratomyxa drepanopsettae*, the fish were moderately infested with *Anisakis simplex*, *Stenakron vetustum*, and *Steringotrema ovacutum*, which have a complex developmental cycle. Gastropods, decapods and various pelagic animals are the intermediate hosts of these parasites.

Southeastern slope of Grand Bank

Fourteen species of parasites were found in the 29 specimens that were examined. Infestation with *Ceratomyxa drepanopsettae* in this area was lower than in any other area. Of the parasites with a complex developmental cycle, the most significant were *Steringotrema ovacutum* and *Steringophorus furciger*, whose intermediate hosts are gastropod and bivalve molluscs, which evidently are important to the feeding regime of American plaice.

Discussion

Comparison of the parasitic fauna of American plaice from the various areas showed notable differences in both the specific composition of parasites and the degree of infestation, due possibly to differences in the habitats and feeding preferences of the fish. Quantitative differences in infestation were most pronounced in fish from Hamilton Bank, Flemish Cap and Funk Island Bank. The comparatively high levels of infestation of fish from Hamilton Bank with *Aporocotyle simplex* and *Echinorhynchus gadi* were probably due to an abundance of intermediate hosts in the shallow depths and close association of American plaice with the bottom fauna. *Aporocotyle simplex* was not found on Flemish Cap where the fish inhabit greater depths. In contrast to the situation on Hamilton Bank, infestation of Flemish Cap fish with *Anisakis simplex*, *Grillotia erinaceus*, *Myxidium sphaericum*, *Scolex pleuronectis*, *Steringophorus furciger*, *Steringotrema ovacutum* and *Thynnascaris adunca* was much higher. Some of these parasites (*Anisakis simplex*, *Grillotia erinaceus* and *Thynnascaris adunca*) are probably acquired by American plaice through consumption of plankton and nektobenthos rather than from eating small fish. The fish specimens from Funk Island Bank were characterized by comparatively high infestation with *Scolex pleuronectis*, *Aporocotyle simplex* and *Steringotrema ovacutum*.

Differences in infestation of fish from the Grand Bank slopes were less pronounced than among other areas, except for the high infestation with *Stenakron vetustum* on the southwestern slope and with *Phocanema decipiens* on the northern slope. *Echinorhynchus gadi*, which occurred in other slope areas, was not found in fish from the northern slope, and *Ascarophis arctica*, which occurred on the other slopes of Grand Bank, was not found on the southeastern slope. In general, the infestation of American plaice from the Grand Bank with *Ceratomyxa drepanopsettae*, *Myxidium sphaericum* and *Aporocotyle simplex* was lower than in the other areas, apart from the absence of *Aporocotyle simplex* on Flemish Cap.

It is noteworthy that *Schulmania aenigmatosa*, *Diptherostomum microacetabulum* and *Acanthochondria cornuta* were found only in fish from Hamilton Bank. In an earlier paper (Zubchenko, 1980), the first two parasites were reported as *Myxoproteus* sp. and Trematoda gen. sp. respectively, and the American plaice in which they were found were from the Labrador area. Although Zubchenko (1980) reported *Ortholinea divergens* as a parasite of American plaice off Labrador, it was found only in fish from Flemish Cap during the present study. This parasite is commonly found in Greenland halibut (*Reinhardtius hippoglossoides*) which generally inhabit much greater depths than American plaice, although there may be slight

overlap in the distributions of the two flatfishes along the slopes of the continental Shelf. *Schulmania aenigmatosa*, and *Acanthochondria cornuta* are typical parasites of flatfish species, but *Diptherostomum microacetabulum* is characteristic of wolffishes (*Anarhichas* sp.). According to Chubrik (1966) and Zelikman (1966), possible intermediate hosts of these parasites are the gastropods *Cnoba aculeus*, *Buccinum finmarchianum* and *Sipho islandicus*, which live in littoral and epicontinental zones, indicating a possible link between American plaice of Hamilton Bank and coastal waters.

The foregoing aspects of American plaice parasitism and ecology lead to some conclusions about the intraspecific structure of populations in the surveyed areas. The populations of Hamilton Bank, Funk Island Bank, Flemish Cap and Grand Bank are geographically isolated, due to presence of deepwater channels which prevent significant movement of fish from one bank to the other. Thus, the parasitological data confirmed the conclusions of Pitt (1963, 1969, MS 1975), which were based on differences in meristic characters and the results of tagging experiments. The concept of ecological isolation is quite feasible, because spawning of American plaice occurs in virtually all parts of its distributional area (Pitt, 1966). Although the southern populations are not genetically isolated from the northern ones, because eggs and larvae from the northern areas are transported southward by the Labrador Current (Nevinsky and Serebryakov, 1973; Pitt, MS 1975), the intermixing of juveniles and adults among areas is low enough to consider the fish on Hamilton Bank, Funk Island Bank, Grand Bank and Flemish Cap as separate populations.

The parasitological studies showed no pronounced differences in infestation of American plaice from the three slopes of the Grand Bank, although Pitt (1969, MS 1975) noted insignificant migrations of fish within each area and suggested that there were several local populations throughout the Grand Bank region. Although some parasitological characteristics, such as the presence of certain parasites (usually low infestation) in fish from one or two slopes and their absence from the other slopes of the Grand Bank, indicated the possible existence of local groups, the lack of significant isolation is indicated by the almost equal representation of parasites (*Ceratomyxa drepanopsettae* and *Steringotrema furciger*) with the highest infestation rates. No parasites, which are uncommon to American plaice but are characteristic of a particular ecological niche (such as *Ortholina divergens* on Flemish Cap), were found in fish from the Grand Bank slopes. The apparent lack of significant ecological isolation of American plaice on different parts of the Grand Bank is due probably to the existence of adequate living conditions throughout the region and the lack of physical barriers.

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