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Parasitology

**AN ANALYSIS OF PARASITIC FAUNA OF GREENLAND HALIBUT,
REINHARDTIUS HIPPOGLOSSOIDES (WALBAUM, 1792)
IN DIFFERENT AGE GROUPS**

**ANALIZA PARAZYTOFAUNY HALIBUTA NIEBIESKIEGO,
REINHARDTIUS HIPPOGLOSSOIDES (WALBAUM, 1792)
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An analysis was made of infestation of the Greenland halibut in different age groups with parasitic Protozoa and Metazoa. The fishes originated from the Barents Sea and off the Labrador and aged from 3+ to 11+ (single specimens 12+, 13+). In order to verify the relationships under discussion, statistical methods were used, too.

INTRODUCTION

So far, parasitological studies of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) referred mainly to know a fauna of parasites of the host and a degree of infestation with particular parasites (Poljanskij 1955, Mamaev et al. 1963, Zubchenko 1980, Reimer 1981 and others). The aim of undertaken investigations is to complete the lack of data on parasitic fauna of the host under discussion, according age of fishes. For the present study was used relatively comprehensive material from off the Labrador (Wierzbicka 1991) and the Barents Sea (Wierzbicka, in press) and an analysis of infestation in different age groups was made.

MATERIAL AND METHODS

Data referred to the studied material are presented in Table 1. Age of specimens of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) determined

Table 1

List of data about the studied Greenland halibut specimens from the North Atlantic

Age	Number of fish studied		
	Off the Labrador	The Barents Sea	Total
3+	25	—	25
4+	57	3	60
5+	27	26	53
6+	27	27	54
7+	14	20	34
8+	3	9	12
9+	—	7	7
10+	2	3	5
11+	—	7	7
12+	—	2	2
13+	—	2	2
Total	155	106	261
Length of fishes (l.t.) in centimetres	24.2–73.3	36.5–77.5	24.2–77.5
Weight in grams	75–4030	350–5140	75–5140

from scales collected from the caudal part above the lateral line (Krzykawski 1976). It ranged from 3+ to 10+ from off the Labrador and from 4+ to 13+ from the Barents Sea. According to the Table 1, from the Barents Sea predominated specimens of age 5+, 6+ and 7+, so they made 68.9% of the studied population. Fishes originated from the Labrador bank, aged in the same range, made 43.9% whereas more numerous were presented the groups 3+ and 4+ (52.9%).

Data about methods of work are given in (Wierzbicka 1991).

Results of the investigations of the Greenland halibut from off the Labrador and the Barents Sea, excluding Protozoa, were processing mathematically. Numbers composition of particular parasite species of different age groups fishes, from the both fishing-grounds, was checked by Fmax test (Sokal, Rohlf 1981). Considering the compositions of almost every species were not similar the normal, for farther statistical studies used nonparametric tests. In order to state, if there is any significant difference of infestation between different age groups of Greenland halibut Kruskal-

-Wallis and Wilcoxon test for two trials (Sokal, Rohlf 1981) was used. For calculations were used all studied specimens (infected and uninfected) but for some parasitic species were analysed additionally only infected fishes. For every statistical calculation was assumed significance coefficient $\alpha = 0.05$.

RESULTS

Data on infestation (intensity and average intensity of infestation of the population) of different aged specimens of Greenland halibut, with Metazoa parasites, are presented in Table 2 (off the Labrador) and Table 3 (the Barents Sea). The average given were calculated for every Metazoa species, while data concerning parasitic Protozoa could be expressed only as extensity and intensity of infestation (Table 4).

The data from Table 2 and 3 show, that only for single species occurred some tendency of growing the number of parasites with host age. This correlation was most obviously observed when concerned the increase of a nematode *Anisakis simplex* infestation. In the Barents Sea average intensity of infestation of the population with this species was 8.67 specimens in fish group aged 4+ and gradually increased till to more than one thousand larvae in fish group aged 9+ and 11+ (Table 3). The infestation was similar from off the Labrador but average of the studied age groups was significantly lower (from 0.16 larvae in 3 year of life to 3.5 specimens in 10+ group (Table 2).

The other species which slight gradual growth of average intensity of infestation of the population, increasing together with the Greenland halibut age was observed, was a trematode *Derogenes varicus* from the Labrador fishing-ground (Table 2). Diametrically different was formed infestation of this parasite from the Barents Sea, where average intensity of infestation of the population of fishes from older groups was generally lower (Table 3). To return to the Labrador fishing-ground an addition is required that, the infestation with a trematode *Stenacron vetustum* was higher in fishes aged 6+, 7+ and 8+ comparing with younger groups; 3+ to 5+ (Table 2). From the Barents Sea this parasite was not noted in older Greenland halibut specimens (Table 3). Number of a cestode *Scolex pleuronectis* in fishes caught from the Barents Sea fishing-ground was generally higher in older age-groups (Table 3), but there was not observed such a tendency in intensification of infestation of the species from off the Labrador (Table 2).

The mentioned relationship was still slighter when other Metazoa parasites concerned or it didn't occur at all (Table 2 and 3).

Statistical analysis however showed that excluding *Anisakis simplex*, every others differences in a degree of fish infestation from different age groups appeared to be insignificant. Result of statistical analysis in case of *A. simplex* was as follows: from

Table 2

Infestation of the Greenland halibut with Metazoa parasites in different age groups.
Off the Labrador

Species of parasite		3+ n=25	4+ n=57	5+ n=27	6+ n=27	7+ n=14	8+ n=3	10+ n=2
<i>Entobdella</i> sp.	int.		1					
	\bar{x}	0	0,02	0	0	0	0	0
	s		0,13					
<i>Grillotia erinaceus</i> , pl.	int.		1					
	\bar{x}	0	0,02	0	0	0	0	0
	s		0,13					
<i>Scolex pleuronectis</i> , pl.	int.	2-34	1-37	1-47	1-57	1-23	2-11	26-45
	\bar{x}	6.68	5.23	6.04	9.00	4.50	4.33	35.50
	s	9.20	7.58	9.95	12.31	6.54	5.86	13.44
<i>Fellodistomum furcigerum</i>	int.		2	1	1-10	1-3	2	1-69
	\bar{x}	0	0.04	0.04	0.70	0.36	1.33	35.00
	s		0.26	0.19	2.20	0.84	1.15	48.08
<i>Stenacron vetustum</i>	int.	1-3	1-10	1-6	1-30	1-28	2-17	1-2
	\bar{x}	1.08	2.07	1.67	5.44	8.79	8.00	1.50
	s	0.91	2.19	1.59	6.53	9.72	7.93	0.71
<i>Steganoderma formosum</i>	int.	2	1	1-4	1-2	3-7	7-8	3
	\bar{x}	0.08	0.02	0.30	0.22	1.36	5.00	1.50
	s	0.40	0.13	0.82	0.51	2.37	4.36	2.12
<i>Hemiurus levinseni</i>	int.					1-25		
	\bar{x}	0	0	0	0	1.86	0	0
	s					6.67		
<i>Derogenes vericus</i>	int.	1-4	1-6	1-4	1-9	1-23	2-18	1-4
	\bar{x}	0.36	0.65	1.26	1.63	2.71	7.67	2.50
	s	0.91	1.04	1.26	2.00	5.94	8.96	2.12
<i>Genarehopsis mülleri</i>	int.				1			
	\bar{x}	0	0	0	0.04	0	0	0
	s				0.19			
<i>Lecithaster gibbosus</i>	int.	1-3	1-4	1-3	1-7	1-2	1-2	1
	\bar{x}	0.36	0.37	0.48	1.04	0.64	1.33	1.00
	s	0.76	0.77	0.75	1.63	0.74	0.58	0
<i>Anisakis simplex</i> , larva	int.	1	1-3	1-2	1-6	1-5	1-6	3-4
	\bar{x}	0.16	0.44	0.59	0.89	1.43	3.33	3.50
	s	0.37	0.76	0.75	1.50	1.45	2.52	0.71
<i>Thynnascaris adunca</i> , larva III st.	int.	1-9	1-15	1-13	1-42	1-16	1-9	2-5
	\bar{x}	2.16	3.56	4.19	5.22	3.93	3.67	3.50
	s	2.29	2.81	3.23	8.09	4.76	4.62	2.12
<i>Echinorhynchus gadi</i>	int.			1-5	1	1-9	6	7-48
	\bar{x}	0	0	0.22	0.11	1.07	2.00	27.50
	s			0.97	0.32	2.46	3.46	28.99
<i>Corynosoma strumosum</i> , larva	int.					1		
	\bar{x}	0	0	0	0	0.07	0	0
	s					0.27		
<i>Neobrachiella rostrata</i>	int.	1	1	1-3	1-4	1		1
	\bar{x}	0.12	0.18	0.44	0.48	0.21	0	0.50
	s	0.33	0.39	0.70	0.89	0.43		0.71

n — number of fish studied, int. — intensity of infestation, \bar{x} — average intensity of infestation of the population (number of parasites per one specimen of the studied population), s — standard deviation

Table 3

Infestation of the Greenland halibut with *Metazoa* parasites in different age groups.
The Barents Sea

Species of parasite		4+ n=3	5+ n=26	6+ n=27	7+ n=20	8+ n=9	9+ n=7	10+ n=3	11+ n=7	12+ n=2	13+ n=2
<i>Nybelinia surmenicola</i> , pl.	int.				1	1					
	\bar{x}	0	0	0	0.05	0.11	0	0	0	0	0
	s				0.22	0.33					
<i>Scolex pleuronectis</i> , pl.	int.	1	1	2-11	1-20	1-145	4-65	6-365	1-520	80	300
	\bar{x}	0.33	0.04	1.11	1.75	17.56	13.29	141.67	151.57	40.00	150.00
	s	0.58	0.20	2.78	4.51	47.86	23.61	194.90	250.04	56.57	212.13
<i>Felodistomum furcigerum</i>	int.		1-13	1-45	4-18	1	1-73	23	1-41	14	10
	\bar{x}	0	0.54	2.78	1.10	0.22	11.29	7.67	10.29	7.00	5.00
	s		2.54	9.23	4.08	0.44	27.27	13.28	16.98	9.90	7.07
<i>Stenacron vetustum</i>	int.	1	1	2-5	7		1				
	\bar{x}	0.33	0.04	0.26	0.35	0	0.14	0	0	0	0
	s	0.58	0.20	1.02	1.57		0.38				
<i>Hemiurus leviseni</i>	int.		1-2	1-8			16		1		
	\bar{x}	0	0.12	0.63	0	0	2.29	0	0.14	0	0
	s		0.43	1.90			6.05		0.38		
<i>Derogenes vericum</i>	int.	1-53	1-124	1-195	1-15	1-12	1-12		1-10	32	9
	\bar{x}	18.00	27.50	23.33	2.40	2.89	4.14	0	3.86	16.00	4.50
	s	30.32	31.78	43.51	3.60	4.94	4.02		3.53	22.63	6.36
<i>Lecithaster gibbosus</i>	int.		1	1	1						
	\bar{x}	0	0.08	0.04	0.05	0	0	0	0	0	0
	s		0.27	0.19	0.22						
<i>Anisakis simplex</i> , larva	int.	1-23	1-95	1-370	1-601	1-493	163-3713	322-3238	1-4168	235-867	1098-1101
	\bar{x}	8.67	13.08	35.48	108.10	156.00	1199.14	1311.33	1193.86	551.00	1099.50
	s	12.42	21.65	83.54	178.81	205.99	1366.84	1668.74	1387.57	446.89	2.12
<i>Phocanema decipiens</i> , larva	int.	2	1-9	1-18	3-10	1	2	1-2	2-14	3-12	14
	\bar{x}	0.67	3.12	3.11	1.05	0.11	0.29	1.33	3.43	7.50	7.00
	s	1.15	2.52	4.44	2.82	0.33	0.76	0.58	5.00	6.36	9.90
<i>Thynnascaris adunca</i> , larva III st.	int.	2-6	1-57	1-42	2-61	9-91	1-27	4-37	3-392	24-84	9-17
	\bar{x}	4.00	13.85	15.74	19.45	36.22	8.86	18.67	70.14	54.00	13.00
	s	2.00	15.02	12.38	15.18	31.01	9.08	16.80	142.47	42.42	5.66
<i>Echinorhynchus gadi</i>	int.			3						1	
	\bar{x}	0	0	0.11	0	0	0	0	0	0.50	0
	s			0.58						0.71	
<i>Corynosoma strumosum</i> , larva	int.	2-3	1-13	1-25	1-13	2-15	1-10	1	1-24	1-62	20
	\bar{x}	1.67	2.85	3.33	3.65	5.89	4.00	0.67	10.57	31.50	10.00
	s	1.53	3.26	5.05	3.33	4.68	3.21	0.58	8.38	43.13	14.14
<i>Corynosoma semerme</i> , larva	int.		1-2	1-2	1	1	2	1	1	1	
	\bar{x}	0	0.38	0.11	0.15	0.11	0.29	0.33	0.14	0.50	0
	s		0.75	0.42	0.37	0.33	0.76	0.58	0.38	0.71	
<i>Neobrachiella rostrata</i>	int.	1	1-4	1-2	1-6	1-15	1-3	2-4	1-4	2	
	\bar{x}	0.67	1.04	0.33	0.50	1.78	0.57	2.00	1.43	1.00	0
	s	0.58	1.31	0.55	1.40	4.97	1.13	2.00	1.62	1.41	

n - number of fish studied

int. - intensity of infestation

 \bar{x} - average intensity of infestation of the population

s - standard deviation

Table 4

Infestation of the Greenland halibut with Protozoa (*Myxosporidia*) in different age groups

Species of parasite		3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+
Off the Labrador												
<i>Ceratomyxa drepanopsettae</i>	ext. int.	100.0 single very numerous	100.0 single mass	100.0 not numerous very numerous	100.0 single mass	(3) ^x not numerous very numerous	(3) ^x not numerous mass		(2) not numerous numerous			
<i>Myxidium incurvatum</i>	ext. int.	60.0 single very numerous	50.9 single numerous	77.8 single very numerous	81.5 single very numerous	78.6 single numerous	(2) not numerous medium numerous		(2) single			
<i>Ortholinea divergens</i>	ext. int.	48.0 single mass	35.1 single mass	44.4 single very numerous	48.1 single mass	50.0 single medium numerous	(1) single		0			
<i>Paramyxoproteus reinhardti</i>	ext. int.	64.0 single very numerous	86.1 single mass	88.9 single mass	81.5 single mass	64.3 single mass	(2) single very numerous		(1) single			
The Barents Sea												
<i>Ceratomyxa drepanopsettae</i>	ext. int.	(3) medium numerous numerous	100.0 single very numerous	100.0 single very numerous	100.0 single mass	100.0 not numerous very numerous	100.00 single numerous	(3) single medium numerous	100.00 single medium numerous	(2) single not numerous	(2) not numerous medium numerous	
<i>Myxidium incurvatum</i>	ext. int.	0 0	26.9 single very numerous	33.0 single very numerous	20.0 single medium numerous	20.0 single	(1) single	0	42.9 single	(2) single not numerous	0	
<i>Ortholinea divergens</i>	ext. int.	0 0	3.8 very numerous	0	0	0	(1) single	0	0	0	0	
<i>Paramyxoproteus reinhardti</i>	ext. int.	(3) single mass	100.0 single mass	92.6 single mass	85.0 single very numerous	88.9 single numerous	100.00 single mass	(3) single medium numerous	71.4 single numerous	(2) single not numerous	(2) single	

ext. – extensity of infestation, int. – intensity of infestation, ^xin brackets given the number of fish infected without the calculation of percentage

the Berents Sea number of this nematode larvae was significantly greater in 8+ group comparing with 7+, and in 9+ group comparing with 8+. Treating together the whole population (infected and uninfected fishes) this relationship wasn't confirmed statistically on the Labrador fishing ground. The reason was relatively low infestation with this parasite. But, regarding only infected fishes showed importance of the differences in intensity of infestation with *A. simplex* on this area, too. Statistically important differences occurred between 3+ and 4+, 4+ and 5+, 5+ and 6+ age groups.

Data from Table 4 concerning parasitic Protozoa show the lack of any relationship of infestation of Greenland halibut specimens from their age. Extensity of infestation with protozoan *Ceratomyxa drepanopsettae* was 100% in every age group and both areas. In case the three other species (Table 4) extensity of infestation of fishes from particular age groups didn't differ important and didn't show distinct tendencies.

DISCUSSION

The investigations carried out on Greenland halibut aged from 3+ to 11+ (single specimens 12+ and 13+) showed, that the degree of infestation with parasites of Protozoa and Metazoa groups didn't depend on fish age. The only species, whose number increased with the host age, was *Anisakis simplex*. Statistically important differences of infestation with this parasite recorded in groups from 3+ to 6+ from the Labrador fishing ground and from 7+ to 9+ from the Berents Sea. The observed increase of infestation is tightly connected with biology of *A. simplex* and the way of Greenland halibut nourishment, whose feed changes together with the fish age and growth.

Life cycle of *Anisakis simplex*, according to numerous literature, was precisely described by Grabda (1973, 1981). First intermediate host of this nematode are planktonic crustaceans of the order Euphausiacea. So, infestation of young specimens of Greenland halibut occurred when they eat crustacea of this group, because they are one of the basic element of halibut nourishment in this period of life (Andrijašev 1954, Krzykowski 1975). Longer specimens of Greenland halibut infest eating mainly planktonophagous or predacious fish with III-rd stadium larvae inside. It's worth mentioning that, one of the most important element of the Greenland halibut nourishment from many geographical areas is capelin (*Mallotus villosus*, *Osmeridae*), which in turn feeds on crustacea of the order Euphausiacea, too (Andrijašev 1954). During dissections of Greenland halibut many times observed larvae penetrating from indigested still fishes, being halibut's prey, into the new host. It was possible to detect the phenomenon because, the studied fishes immediately after catching were frozen into 20°C below zero. The temperature killed larvae during their migration. After thawing when the preys were taking out from stomach of halibuts were seen nematodes, with one its end still into the preys' tissues and the other crushed in walls

of the Greenland halibut stomach. Larvae after migration to the body cavity or muscles state here and again encyst. This being so, into older Greenland halibut specimens, which are second intermediate host and paratenic host as well, together with its growth accumulate more and more *A. simplex* specimens.

Similar relationship was observed concerning infestation of snoek *Thyrstites atun* with *A. simplex* larvae off the New Zealand (Wierzbicka, Gajda 1984). The authors noted two times higher average intensity of infestation of the population of fishes more than 80 centimetres in length. Increase of infestation of cod, *Gadus morhua* and whiting, *Merlangius merlangus* from off Scotland with the nematode described Wootten and Waddell (1976–77). Grabda's (1976) studies showed, too that extensity of infestation of the Baltic cod with these larvae increase distinctly when fish measured 70–75 centimetres. Data showing the increase of infestation with *A. simplex* with age of herring, *Clupea harengus* give Khalil (1969) and Grabda J. (1974).

Identically as in case of *A. simplex* take place the development of a nematode *Phocanema decipiens*, founding in Greenland halibut from the Barents Sea, with one difference that first intermediate hosts of *Ph. decipiens* are *Nereis*, *Amphipoda*, *Iso-poda*, *Mysidacea* and others crustaceans (Myers 1960). III-rd stadium larvae eaten together with prey (second intermediate host) can also move into body cavity and musculature of predacious fish. So, like in the case of *A. simplex*, sometimes occurs an accumulation of *Ph. decipiens* larvae in older fishes. Wootten and Waddell's (1976–77) studies showed, the older cod the higher level of infestation with this nematode. They didn't noticed such tendency concern the studied Greenland halibut. This fact can be explain by other nourishment of this host. One of the dominant element of its nourishment is capelin, as mentioned above. Capelin in turn, feeds mainly on the *Euphausiacea* crustaceans, which are intermediate hosts of *A. simplex*. So, the older Greenland halibut the great number of nematodes of this species. Whereas infestation with *Ph. decipiens* larvae take place through others organisms as vectors, being less important as the fish nourishment, so infestation with this parasite is rather accidental. This explanation was confirmed by Palsson and Beverly-Burton (1984), who didn't find *Ph. decipiens* larvae in capelin from the North Atlantic, whereas noted an occurrence of *A. simplex* in this host. A little different life cycle has, found in Greenland halibut, a nematode *Thynnascaris adunca*. First intermediate hosts of this parasite are copepods *Acartia bifilosa* and *Eurytemora affinis* (Markowski, 1937). Adult parasites occurred in alimentary tract of predacious fish. From the literature result, that infestation with the larvae of planktonophagous and predacious fish, which are intermediate hosts, can arise together with their age. This was confirmed by Grabda J. (1976) in case of the Baltic cod and by Khalil (1969) in case of spratt, *Sprattus sprattus* aged 1–4 from the North Sea. This author however, observed also a decrease of infestation with these larvae with the growth of studied herrings from the North Sea. According to Grabda J. (1976), increase of the extensity of infestation of Baltic cod with

Th. adunca larvae results from growth of the number of fishes (vectors of larvea) being preys, in its nourishment. In present material wasn't observed any important difference of infestation of Greenland halibut with *Th. adunca* III-rd stadium larvae according the fish age, from the both fishing-grounds. Moreover, in the alimentary tract of this host from the Bering Sea (unpublished materials) were found numerous IV-th stadium larvea and adult specimens (females and males) and single IV-th stadium larvae and adult specimens in fishes from the Bering Sea. Sulgostowska and Jerzewska (1987) also reported in the alimentary tract of eelpout, *Zoarces viviparus* from off Hel (the Baltic) presence of IV-th stadium larvae and adult specimens of nematode *Th. adunca* in every seasons, and simultaneous presence of III-rd stadium larvae in the liver. Therefore, can be assumed, that III-rd stadium larvae of *Th. adunca* eaten by host, not always penetrate the body cavity, what suggest some authors, but stay in the alimentary tract and after twice cast off their cuticular layer develop into adult forms. Similar observations and conclusions gave Janiszewska (1937, 1938) studied flounder, *Platichthys flesus* from Puck Bay (the Baltic). Consequently, this is one of reason why don't occure an increase of infestation of Greenland halibut with III-rd stadium larvae according the fish age.

The observations on present studied material concern occurence of *Digenea* trematodes in Greenland halibut correspond to Kjøie (1983). The author studied dab, *Limanda limanda* ranged from 5 to 35 centimetres in lenght, originated mainly from off Denmark coasts. The author studied, among other parasites, infestation with trematodes *Fellodistomum furcigerum* and *Derogenes varicus* – species, which occured also in Greenland halibut. From her data result, that the infestation of dab with trematodes *F. furcigerum* and *D. varicus*, similar like the three other *Digenea* species, maintain on the same level or shows slight fluctuations (most probably not important statistically) in different length groups of the host. The only species whose extensity and intensity of infestation considerably decreased according the fish length was *Monascus filiformis* (Rudolphi, 1819).

Statistically ascertained the lack of ralationships between age of Greenland halibut and infestation of the host with other Metazoa parasites, as well as lack of significant differences concerning extensity of infestation with Protozoa parasites, is conected most probably, with nourishment of studied host and life cycles of parasites. More detailed interpretation of obtained results is very difficult, because of the lack of data concerning Greenland halibut nourishment composition and fauna of fishing-grounds, from which originated the studied fishes.

REFERENCES

Andrijašev A.P., 1954: Ryby severnyh morej SSSR. – Izd. AN SSSR, Moskva-Leningrad. (in Russian).

- Grabda J., 1973: Cykl rozwojowy *Anisakis simplex* (Rudolphi, 1809) w świetle ostatnich badań. [Developmental cycle of *Anisakis simplex* (Rudolphi, 1809) in the light of the recent investigations]. — *Wiad. Parazytol.*, **19**, 2: 149–154. (in Polish).
- Grabda J., 1974: The dynamics of the nematode larvae *Anisakis simplex* (Rud.) invasion in the South-Western Baltic herring (*Clupea harengus* L.). — *Acta Ichthyol. Piscat.*, **4**, 1: 3–21.
- Grabda J., 1976: The occurrence of Anisakid nematode larvae in Baltic cod (*Gadus morhua callarias* L.) and the dynamics of their invasion. — *Acta Ichthyol. Piscat.*, **6**, 1: 3–22.
- Grabda J., 1981: Zarys parazytologii ryb morskich. [Guideline to Parasitology of Marine Fishes]. — PNW, Warszawa. (in Polish).
- Janiszewska J., 1937: Das dritte und das vierte Larvalstadium von *Contracoecum aduncum* (Rud.) aus dem Darne der Flunder, *Pleuronectes flesus* L. — *Bull. int. Acad. pol., Cl. Math. Nat.*, B: 11–18.
- Janiszewska J., 1938: Studien über die Entwicklung und die Lebensweise der parasitischen Würmer in der Flunder (*Pleuronectes flesus* L.). — *Mem. Acad. pol., Cl. Math. Nat.*, B, Kraków, **14**: 1–68.
- Khalil L.F., 1969: Larval nematodes in the herring (*Clupea harengus*) from British coastal waters and adjacent territories. — *J. mar. biol. Ass. U.K.*, **49**: 641–659.
- Køie M., 1983: Digenetic trematodes from *Limanda limanda* (L.) (Osteichthyes, Pleuronectidae) from Danish and adjacent waters, with special reference to their life-histories. — *Ophelia*, **22**, 2: 201–228.
- Krzykawski S., 1975: Charakterystyka wzrostu halibuta niebieskiego *Reinhardtius hippoglossoides* (Walbaum) z północnego Atlantyku. [A characteristic of growth of Greenland halibut *Reinhardtius hippoglossoides* (Walbaum) from the North Atlantic]. (a doctor's thesis). (in Polish).
- Krzykawski S., 1976: A comparative analysis of some anatomical elements with regard to their relevance to the age and growth rate determination in Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum). — *Acta Ichthyol. Piscat.*, **6**, 2: 63–78.
- Mamaev Ju.L., A.M. Paruhin, O.M. Baeva, 1963: Paraziticheskie červi kambalovykh ryb dalnevostochnykh morej. In: Paraziticheskie červi životnykh primorja i Tihogo akeana. — *Izd. AN SSSR, Moskva*: 82–113. (in Russian).
- Markowski S., 1937: Über die Entwicklungsgeschichte und Biologie des Nematoden *Contracoecum aduncum* (Rudolphi, 1802). — *Bull. int. Acad. pol., Cl. Math. Nat.*, B: 227–247.
- Myers B.J., 1960: On the morphology and life cycle of *Phocanema decipiens* (Krabbe, 1878) Myers, 1959. — *Can. J. Zool.*, **38**: 331–344.
- Palsson J., M. Beverley-Burton, 1984: Helminth parasites of capelin, *Mallotus villosus*, (Pisces: Osmeridae) of the North Atlantic. — *Proc. Helminthol. Soc. Wash.*, **51**, 2: 248–254.
- Poljanskij Ju.I., 1955: Materiały po parazytologii ryb severnykh morej SSSR. Parazyty ryb Barentsowa morja. — *Trudy Zool. Inst. AN SSSR*, **19**: 5–170. (in Russian).
- Reimer L.W., 1981: Parasiten von *Reinhardtius hippoglossoides* (Walbaum), dem Schwarzen Heilbutt aus dem Nordatlantik. IV. Wissenschaftliche Konferenz zu Fragen der Physiologie, Biologie und Parasitologie von Nutzfischen vom 3. bis 6. September 1980 in Rostock. — *Wilhelm – Pieck – Univ. Rostock*: 121–123.
- Sokal R.R., F.J. Rohlf, 1981: Biometry. The principles and practice of statistics in biological research. — W.H. Freeman and Company, San Francisco.
- Sulgostowska T., B. Jerzewska, 1987: Helmintofauna węgorzycy — *Zoarces viviparus* (L.) z Helu. [Helminths fauna of eelpout, *Zoarces viviparus* (L.) from Hel]. — *Streszczenia materiałów zjazdowych, XV Zjazd Pol. Tow. Parazytol. Katowice, 24–26 września 1987*: 123–124. (in Polish).
- Wierzbicka J., 1991: Parasitic fauna of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) from off Labrador. — *Acta Ichth. et Pisc.*, **21**, 1: 17–25.
- Wierzbicka J.: Parasitic fauna of the Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum, 1792) from off Barents Sea. — *Acta Ichth. et Pisc.* (in press).
- Wierzbicka J., M. Gajda, 1984: Parasitic fauna of the barracouta, *Thyrssites atun* (Euphrasen, 1791) from off New Zealand. — *Acta Ichth. et Pisc.*, **14**, 1–2: 149–156.
- Wootton R., I.F. Waddell, 1976–1977: Studies on the biology of larval nematodes from the musculature of cod and whiting in Scottish waters. — *J. Cons. int. Explor. Mer.*, **37**, 3: 266–273.

Zubchenko A.V., 1980: Parasitic fauna of Anarhichadidae and Pleuronectidae families of fish in the Northwest Atlantic. — Int. Commis. Northwest Atlant. Fish., Selec. Pap., 6: 41–46.

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ANALIZA PARAZYTOFAUNY HALIBUTA NIEBIESKIEGO,
REINHARDTIUS HIPPOGLOSSOIDES (WALBAUM, 1792) W RÓŻNYCH GRUPACH WIEKU

STRESZCZENIE

Przeprowadzone badania halibuta niebieskiego w wieku od 3+ do 10+ z rejonu Labradoru i od 4+ do 13+ z Morza Barentsa wykazały, że stopień zarażenia pasożytami z grupy *Protozoa* i niemal wszystkimi pasożytami *Metazoa* nie jest uzależniony od wieku tej ryby. Jedynym gatunkiem, którego liczebność bardzo wyraźnie nasilała się z wiekiem żywiciela na obydwu łowiskach, był *Anisakis simplex* (tab. 2, 3). Statystycznie istotne różnice w zarażeniu tym pasożytem stwierdzono w grupach od 3+ do 6+ na łowisku Labradoru i od 7+ do 9+ w Morzu Barentsa. Obserwowany wzrost inwazji wiąże się ściśle z biologią *A. simplex* i odżywianiem halibuta niebieskiego, którego skład pokarmu zmienia się wraz z wiekiem i wzrostem.

Z dokonanej analizy statystycznej wynika, że z wyjątkiem *Anisakis simplex*, wszystkie inne różnice w stopniu zarażenia niektórymi pasożytami ryb należących do różnych grup wieku okazały się nieistotne.

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