ACTA ICHTHYOLOGICA ET PISCATORIA
Vol. XXII, Fasc. 2 SZCZECIN 1992

Stanisław KRZYKAWSKI, Jadwiga WIERZBICKA

Fish systematics

AN ATTEMPT TO DETERMINE SYSTEMATIC POSITION OF GREENLAND HALIBUT, *REINHARDTIUS HIPPOGLOSSOIDES* (WALBAUM, 1792), FROM LABRADOR REGION AND BARENTS SEA ON THE BASIS OF MORPHOMETRIC, BIOLOGIC, AND PARASITOLOGICAL STUDIES

PRÓBA OKREŚLENIA PRZYNALEŻNOŚCI SYSTEMATYCZNEJ HALIBUTA NIEBIESKIEGO, *REINHARDTIUS HIPPOGLOSSOIDES* (WALBAUM, 1792) Z REJONÓW LABRADORU I MORZA BARENTSA NA PODSTAWIE BADAŃ MORFOMETRYCZNYCH, BIOLOGICZNYCH I PARAZYTOLOGICZNYCH

Department of Fish Systematics, Academy of Agriculture, Szczecin

The paper present comparative results on the variability of measurable and countable parameters, growth rate, length and weight as well as on the parasitologic studies of Greenland halibut from the region of Labrador and from the Barents Sea.

INTRODUCTION

The differences between two populations of the same species but originating from different geographic regions and different ecologic conditions are referred to as the geographic and ecologic variability. Both of them should be regarded as a reflection of species adaptation to the habitat. Particular populations of the same species are usually characterized by different adaptability. Studies on these differences may lead to the distinction of a subspecies.

Basic aim of the studies was to compare the results on the variability of measurable and countable parameters, growth in length and weight, and parasitic studies on Greenland halibut from the region of Labrador and from the Barents Sea. The results were taken from the papers by Krzykawski (1991, 1992) and Wierzbicka (1991a, 1992). In addition to this, an attempt was made to find out whether these differences were sufficient to distinguish taxons of this fish species.

MATERIALS AND METHODS

Materials were collected in 1976–1977 in two regions of North Atlantic, i.e. in Labrador fishing grounds (53°34' N; 52°20' W) and in the Barents Sea (72°34' N; 15°00' E).

In order to determine variability of the biometric parameters and of the growth rate 281 fish, from the region of Labrador 154 and 127 from the Barents Sea were examined.

Biometric analysis embraced 22 measurable parameters and 7 countable ones. Measurements of total length (l.t.), caudal length (l. caud.) and body length (l.c.) were made with a ruler, the other parameters were measured with a slide ruler up to 0.1 cm. Weight was determined up to 1 g. Methods as well as the results on morphometric parameters and growth rate in the two populations have been presented in the papers by Krzykawski (1991, 1992).

Student's t test was used to compare the results obtained for the two fish populations. This was possible due to the fact that the empirical data used to calculate the means were characterized by an almost normal distribution.

Studies on the parasitic fauna of Greenland halibut were carried out on 155 fish from Labrador and 106 from the Barents Sea. Information on the fish and the method of studies have been presented in the papers by Wierzbicka (1991a, 1992).

The results of parasitiologic studies, with the exception of Protozoa, were also analysed statistically. Significance of the differences in the infestation of the fish from Labrador and from the Barents Sea was established with Wilcox test for two samples (Sokal, Rohlf 1981). In comparing the two regions the whole fish samples were taken into consideration, but the effect of age had been excluded (Wierzbicka 1991 b). Statistical analyses on *Anisakis simplex* embraced only the fish in three age groups (5+, 6+ and 7+) as this material was suitable for quantitative comparisons. Moreover, this approach eliminated the effect of the host age on the degree of infestation with this parasite. In all statistical tests the significance level of $\alpha = 0.05$ was used.

RESULTS

Comparison of biometric parameters.

Table 1 presents the results of Student's t test on the significance of the differences between fish populations from Labrador and from the Barents Sea.

The table shows that as regards the measurable parameters (expressed in relation to body length), the two populations differed significantly with respect to total and caudal length, head length, head height, preorbital length, the smallest and the biggest body height, predorsal length, lenghth of the caudal part, height of the dorsal and anal fins, and length of the pectoral and ventral fins. Hence, from among 21 parameters under study, in as many as 13 the differences were statistically significant.

Table 1

Analysis of the significance of differences (Student's t test) in the biometric parameters of halibut populations from the region of Labrador and from the Barents Sea

Parameter symbol	Latin name	Labrador			Barents Sea			$t_{calc.}$
		n	$\bar{x}$	s	n	$\bar{x}$	s	
1	2	3	4	5	6	7	8	9
Measurable parameters — % longitudo corporis								
x_1	longitudo totalis	153	114.0	1.09	127	114.9	1.04	7.22*
x_2	longitudo caudalis	153	112.5	1.04	127	112.7	0.98	2.13*
x_7	longitudo capitis lateralis	148	24.2	0.87	127	23.8	1.02	3.50*
x_4	longitudo praeorbitale	150	5.3	0.49	127	5.0	0.34	6.31*
x_5	diameter oculi	153	4.0	0.41	127	4.0	0.31	0.00
x_6	longitudo postorbitale	151	14.0	0.64	127	13.8	0.80	1.96
x_8	altitudo capitis	153	14.7	0.72	127	14.2	1.16	4.22*
x_9	longitudo ossis maxillare	151	11.2	0.49	127	11.3	0.63	1.93
x_{10}	longitudo ossis dentale	150	14.1	0.63	127	14.0	0.68	0.38
x_{11}	altitudo corporis maxima	154	32.4	1.55	127	33.0	1.87	2.88*
x_{12}	altitudo corporis minima	154	8.2	0.53	127	7.8	0.52	7.32*
x_{13}	longitudo praedorsale	150	10.4	0.57	127	9.9	0.56	6.69*
x_{14}	longitudo praeventrale	148	26.3	1.36	127	26.0	1.58	1.52
x_{15}	longitudo praeanale	149	37.9	2.28	127	37.6	3.14	1.13
x_{16}	longitudo pedunculi caudae	153	11.6	0.84	127	11.0	0.97	5.23*
x_{17}	altitudo pinnae D	151	9.3	0.70	127	9.1	0.87	2.44*
x_{18}	altitudo pinnae A	151	10.3	0.91	127	10.0	0.86	2.98*
x_{19}	longitudo pinnae P	142	10.3	0.81	127	11.1	0.80	8.33*
x_{20}	longitudo pinnae V	149	6.6	0.68	127	6.8	0.67	2.45*
x_{21}	distantia V—A	151	13.4	1.44	127	13.3	2.45	0.55
x_{22}	longitudo mediale radiorum pinnae C	153	12.8	0.66	127	12.7	0.72	1.45

continued tab. 1

1	2	3	4	5	6	7	8	9
Measurable parameters — % lingitudo capitis lateralis								
x_4	longitudo praeorbitale	148	22.0	1.96	126	21.0	1.33	4.94*
x_5	diameter oculi	148	16.5	1.72	126	16.8	1.44	1.60
x_6	longitudo postorbitale	147	57.8	2.03	126	58.1	2.51	1.13
x_8	altitudo capitis	147	60.8	2.88	126	59.9	4.67	2.07*
x_9	longitudo ossis maxillare	147	46.4	1.52	126	47.7	2.12	5.88*
x_{10}	longitudo ossis dentale	146	58.2	1.85	126	59.1	2.30	3.45*
Countable parameters.								
D	numerus radiorum pinnae dorsalis	148	95.67	4.16	123	96.87	4.52	2.26*
A	numerus radiorum pinnae analis	149	71.39	3.29	127	72.15	3.55	1.84
C	numerus radiorum pinnae caudalis	149	19.02	0.14	107	19.11	0.37	2.70*
V	numerus radiorum pinnae ventralis	151	5.95	0.25	127	6.00	0.00	2.23*
P	numerus radiorum pinnae pectoralis	145	13.66	0.77	127	13.86	0.41	2.61*
sp.br.	numerus spinarum ad arcum branchiorum	154	15.89	1.35	127	15.00	1.16	5.83*
vt.	numerus vertebrarum	154	61.58	0.73	121	62.69	0.76	12.26*

* Statistically significant differences
n — number, $\bar{x}$ — arithmetic mean; s — standard deviation

Significant differences were found also in case of the measurable parameters expressed in relation to the lateral head length. From among six parameters, the differences were statistically significant in case of four of them, i.e. preorbital length, head height, and length of the upper and lower jaw.

These differences suggest that body shape of halibut from the two populations is quite different. Population from the Labrador region was characterized by longer and bigger head, longer snout, longer and higher caudal part, higher dorsal and anal fins, while the fish from the Barents Sea possessed higher body and longer pectoral and ventral fins.

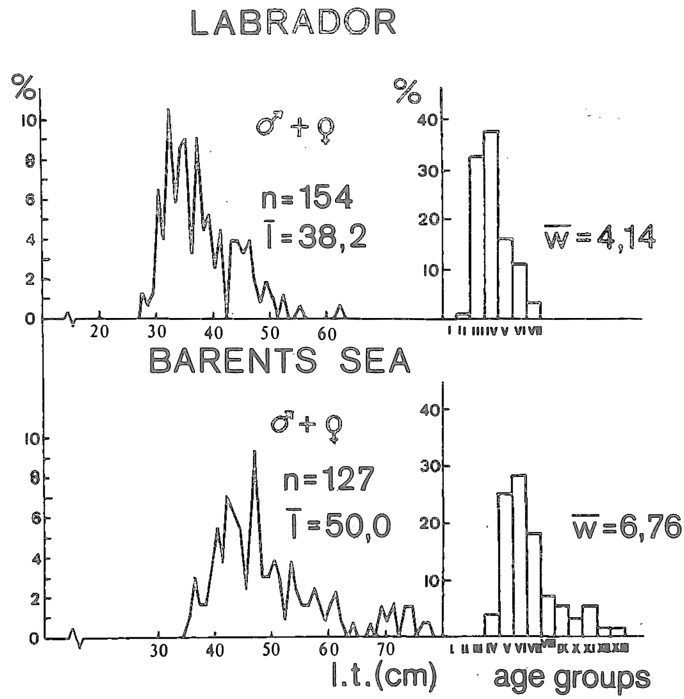

Fig. 1. Length distribution ana age composition in the fish populations under study

Significant differences were also found foe almost all countable parameters, number of rays in the anal fin being the only exception. Special attention should be given to the fact that the most pronounced differences were noted for the number of vertebrae and the number of gill rakers of the first branchial arch.

Comparison of length distribution and age composition.

As regards length and age of Greenland halibut from the Labrador region and from the Barents Sea (Fig. 1) it was found that the average length of the fish caught in the Barents Sea was considerably bigger (by almost 12 cm). These fish seemed also to live much longer than the fish from the region of Labrador.

Comparison of growth in length and weight.

Fig. 2 presents the curves of the growth in length, plotted using the von Bertalanffy's equation for fish from the two regions. It is readily seed that Greenland halibut from the Labrador region was characterized by more rapid growth, although length increments in the first year of life were almost identical in both regions. Higher value of "K" coefficient in v. Bertalanffy's equation for the Labrador stock also suggest that

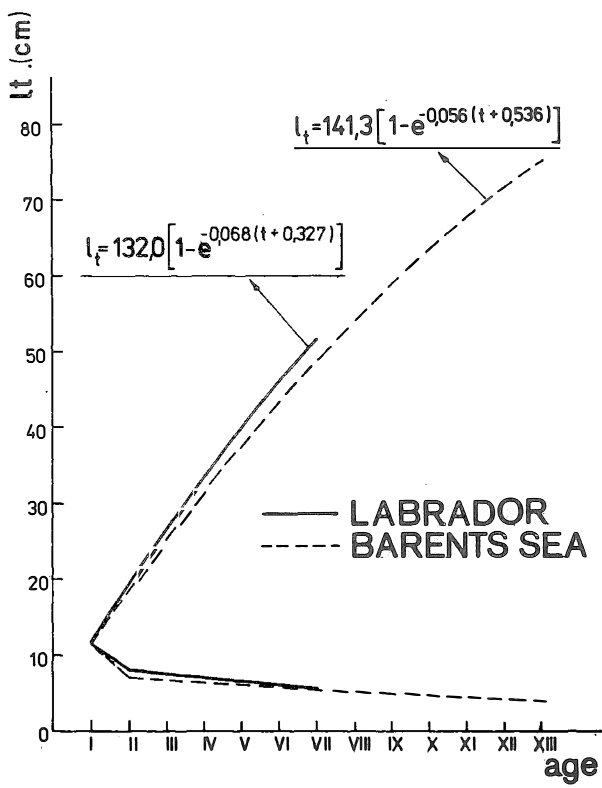

Fig. 2. Growth rate and annual length increments in the two regions, according to v. Bertalanffy's equation

these fish grew more rapidly. On the other hand, lower asymptotic value reflects slower growth rate in later years on the fish life. The comparisons, however, are limited only to this section of the two curves for which there were the empirical data representing the Labrador region, i.e. to the 7th year of life.

Fig. 3 presents graphic illustration of the relationship between length and weight of Greenland halibut from the Labrador region and the Barents Sea. This figure shows that up to the length of about 60 cm fish from the Labrador region were slightly heavier at the same length. Later the picture changes in favour of the fish from the Barents Sea. However, it should be mentioned that although the materials from the two regions were collected in the same season (spring), there was an almost 2-month gap between the samplings, and this might have affected the results. The other factor which might have caused the observed differences was different range of fish length in the samples used to calculate the parameters of power equations.

Rate of growth in weight in the two regions was presented using a modified equation of v. Bertalanffy (Fig. 4). The results confirmed the conclusions resulting from length comparisons halibuts originating from Labrador increased their weight more rapidly

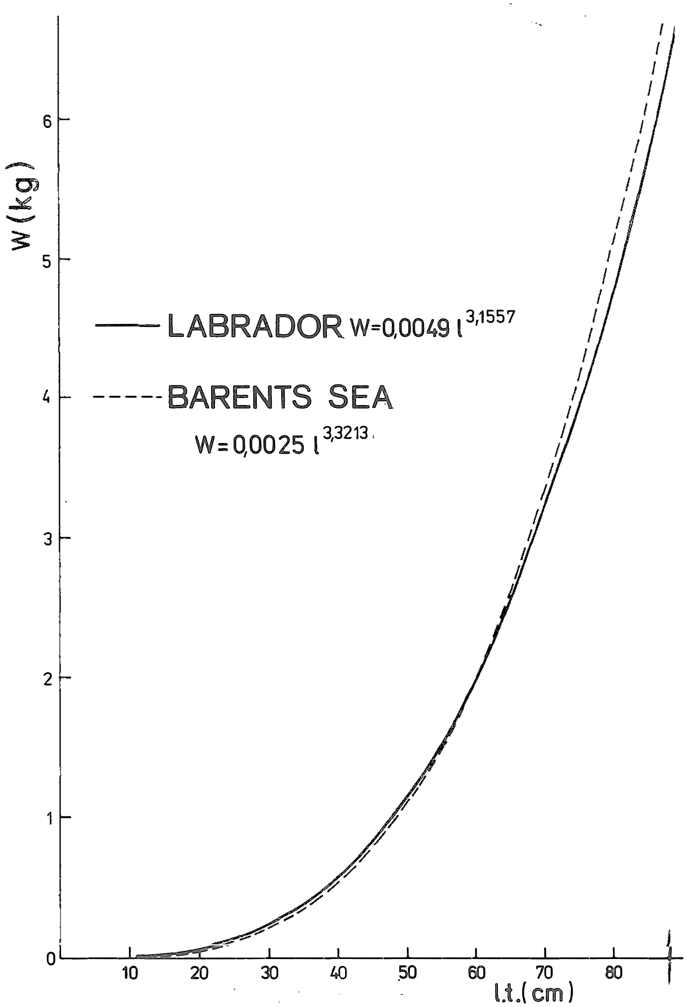

Fig. 3. Dependence between fish weight and length in the populations under study

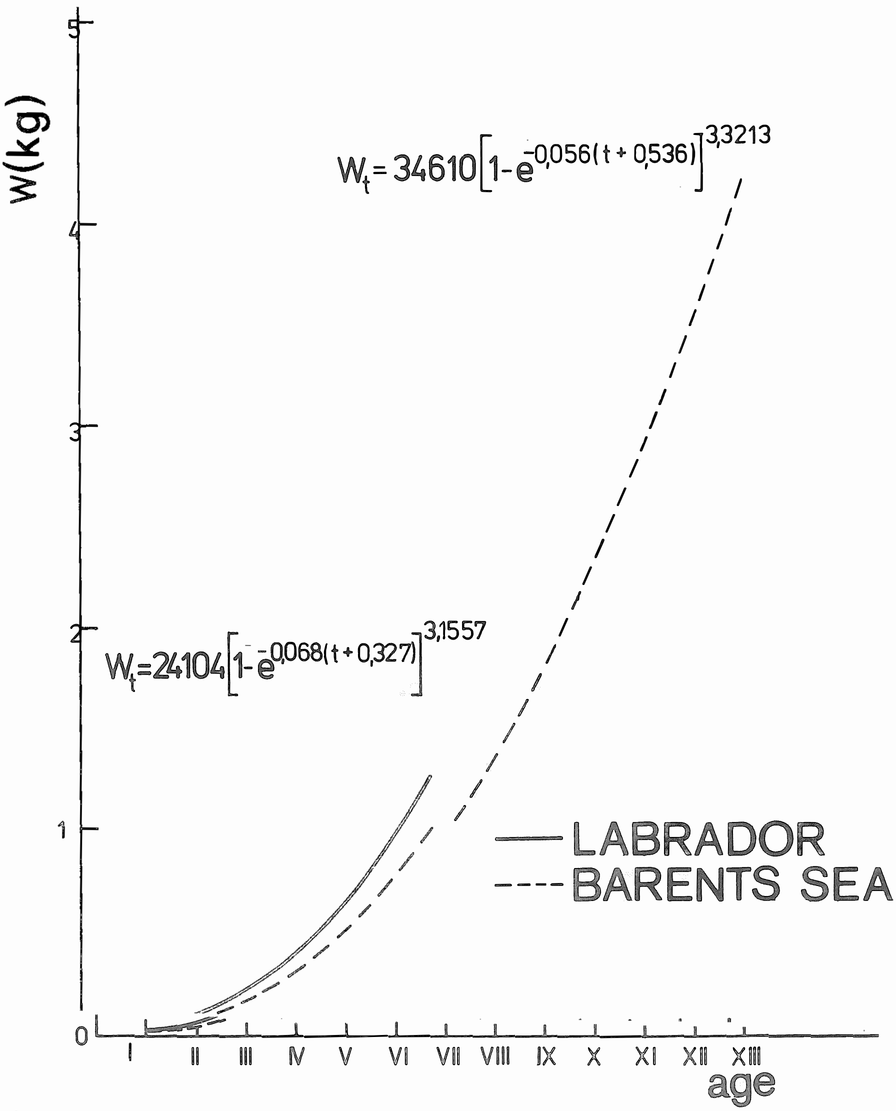

Fig. 4. Rate of growth in fish weight in the two regions, according to a modified v. Bertalanffy's equation

in the initial years of life, but lower asymptotic weight showed that growth of older fish might have been slower compared to the fish from the Barents Sea.

Comparison of parasitic fauna.

Analyses of the infestation with parasites of Greenland halibut caught in Labrador region and in the Barents Sea showed that the two regions differed considerably as

Table 2

Infestation of Greenland halibut by parasites of *Metazoa* group in two regions

Parasite species	Labrador region n – 155		Barents Sea n – 106	
	$\bar{x}$	s	$\bar{x}$	s
Monogenea				
Entobdella sp.	0.006	0.08	0	
Cestoda				
Grillotia erinaceus, pl.	0.006	0.08	0	
Nybelinia surmenicola, pl.	0		0.02	0.14
Scolex pleuronectis, pl.	6.57	9.70	20.60	84.11
Trematoda				
Fellodistomum furcigerum	0.65	5.60	2.93	10.03
Stenacron vetustum	3.14	4.90	0.16	0.86
Steganoderma formosum	0.35	1.23	0	
Hemiurus levinseni	0.17	2.00	0.35	1.85
Derogenes varicus	1.23	2.60	14.81	29.22
Genarchopsis mülleri	0.006	0.08	0	
Lecithaster gibbosus	0.55	0.98	0.04	0.19
Nematoda				
Anisakis simplex, larva	0.68	1.15	272.42	690.38
Phocanema decipiens, larva	0		2.34	3.60
Thynnascaris adunca, larva III st.	3.77	4.41	21.23	40.25
Thynnascaris adunca, larva IV st. et ad.	0		0.05	0.35
Acanthocephala				
Echinorhynchus gadi	0.55	3.99	0.04	0.30
Corynosoma strumosum, larva	0.006	0.08	4.55	7.43
Corynosoma semerme, larva	0		0.21	0.53
Crustacea				
Neobrachiella rostrata	0.27	0.57	0.81	1.81

n – number of fish
$\bar{x}$ – average intensiveness of population infestation (number of parasites per one fish in the population under study)
s – standard deviation

regards this fauna. The differences were most noticeable in case of the degree of infestation (Wierzbicka 1991a, 1992), and the number of particular parasite species found on the fish (Tab. 2). Also qualitative differences were noted, but these were less pronounced.

Four species of Protozoa were found in the North Atlantic. Two of them, *Ceratomyxa drepanopsettae* and *Paramyxoproteus reinhardti*, were present in similar amounts both in the Labrador region and the Barents Sea. Infestation of Greenland halibut with a protozoan *C. drepanopsettae* reached 100% in both regions. Also *P. reinhardti* dominated in both regions, but the fish from Labrador region were in 13% less infested than those from the Barents Sea. The other two species of Protozoa, *Myxidium incurvatum* and *Ortholinea divergens,* were much more numerous in the Labrador region. There were 41.2% more fish infested with the spores of *M. incurvatum* in this region compared to the Barents Sea. *O. divergens* may be regarded as frequent parasite in the Labrador region (infestation 41.9%), whereas it was quite rare in the Barents Sea. Also intensiveness of infestation with the two above species differed in the two regions.

Special attention should be given to parasites belonging to Metazoa. Totally 18 species of these parasites were found in the two regions. Some of them were sporadic: *Entobdella* sp., *Grillotia erinaceus, Nybelinia surmenicola,* and *Genarchopsis mülleri* (Tab. 2). However, most of them were fairly or very frequent in both regions. These parasites can be divided into two groups.

The first includes the species which were found in the fish from only one habitat. These were: *Phocanema decipiens,* and *Corynosoma semerme* found only in the Barents Sea, and *Steganoderma formosum* found only in the Labrador region (Tab. 2). Another species, *Corynosoma strumosus* was very frequent in halibut from the Barents Sea (81.1% infested), while it was almost absent in the Labrador region (Tab. 2).

The second group includes 10 Metazoa species. Infestation of Greenland halibut with these parasites differed, but generally they were more frequent in the Barents Sea, and the fish were more infested there (7 species). A tapeworm *Scolex pleuronectis* belonged to this group. Degree of infestation with this parasite was lower in the Barents Sea, but the intensiveness of infestation was almost 3 times higher than in the Labrador region (Tab. 2). In case of particular fish, intensiveness of infestation with this tapeworm was almost 8 times higher in the Barents Sea than in the region of Labrador.

As regards the trematodes, *Hemiurus levinseni, Fellodistomum furcigerum* and *Derogenes varicus* dominated in the Barents Sea. Extensiveness of the infestation with these parasite amounted to 7.55–74.5%, while in the Labrador region it was much lower (1.3–52.3%). These differences were even more noticeable when average intensiveness of population infestation was calculated (Tab. 2). Infestation of the fish with *F. furcigerum* was 4.5-fold higher in the Barents Sea than in the Labrador region, invasion of *H. levinseni* proved to be 2.1 times higher, and the infestation with *D. varicus* was 12-fold higher in the Barents Sea than in the Labrador region.

Also the nematodes *Anisakis simplex* and *Thynnascaris adunca* were more numerous in the Barents Sea. Per cent of fish infested with *Th. adunca* larvae was only slightly higher in this sea (by 7.1%), but average intensiveness of the infestation of fish population was 5 times higher than in the Labrador region (Tab. 2). Moreover, single adults of this species were found in the Barents Sea. In case of *A. simplex,* the differences in the fish infestation were very great. They were observed with respect to all parameters, and most of all in the average intensiveness of population infestation (Tab. 2). In addition to this, these differences were clearly noticeable also when fish age groups were compared. Average intensiveness of population infestation in the age groups 5+, 6+ and 7+ amounted to 13.08–108.10 parasites per one fish in the Barents Sea, while the respective numbers for the Labrador region were only 0.59–1.43.

Invasion of the crustacean *Neobrachiella rostrata* was also higher in the Barents Sea. Extensiveness of fish infestation with this parasite in the Labrador region was 11.7% lower compared to the situation in the Barents Sea. On the other hand, average intensiveness of population infestation was almost 3-fold lower in the Barents Sea than in the Labrador region (Tab. 2).

Greenland halibut in the Labrador region only in rare cases was more infested with parasites than in the Barents Sea. The nematode *Stenacron vetustum* was a common parasite in the Labrador region (infestation 78.1%), whereas it was rare in the Barents Sea. Also the nematode *Lecithaster gibbosus* was more frequent in the Labrador region (35.5% infestation) than in the Barents Sea, where it was very rare. The differences proved to be even more pronounced when average infestation of the fish populations was compared (Tab. 2). Infestation of Greenland halibut with the parasite *L. gibbosus* was almost 14 times higher in the Labrador region, and with *S. vetustum* 19.6 times higher than in the Barents Sea. The parasite *Echinorhynchus gadi* was relatively rare in the North Atlantic, while infestation with this parasite in the Labrador region was 14 times higher than in the Barents Sea (Tab. 2). The difference in the extensiveness of infestation was rather small in this case. It was only 5.8% higher in the Labrador region.

In order to check the significance of the differences in the fish infestation with parasites, statistical test were performed for 10 Metazoa species. They confirmed that the differences were significant also as regards numbers of these parasites in the two environments. Infestation with the following parasites was significantly higher in the Barents Sea: *Scolex pleuronectis, Fellodistomum furcigerum, Hemiurus levinseni, Derogenes varicus, Anisakis simplex, Thynnascaris adunca,* and *Neobrachiella rostrata.* On the other hand, infestation with *Stenacron vetustum, Lecithaster gibbosus,* and *Echinorhynchus gadi* was significantly higher in the Labrador region.

DISCUSSION

Hubbs and Wilimovsky (1964) performed a comparative analysis of the morphologic parameters of Greenland halibut from the Atlantic and the Pacific. They based their studies on a representative material consisting of 152 fish caught in the Pacific and 123 caught in the Atlantic. These authors questioned as earlier opinion of Vernidub and Panin (1937) that the differences between the populations from the two oceans were significant enough to be of importance for the systematic classification. However, the differences embraced four morphometric parameters only i.e.: head length, length of the upper jaw, length of the caudal part and its height. In addition to this, the materials collected by Vernidub and Panin were little representative, as they consised of 36 fish

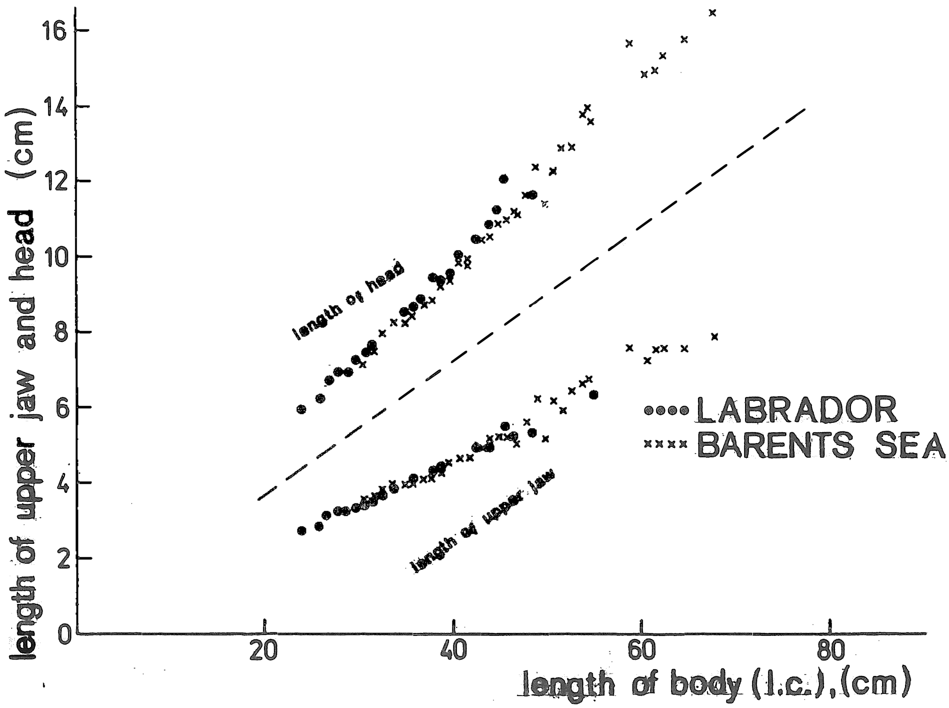

Fig. 5. Dependence between head length, upper jaw length, and body length (l.c.)

caught in the Bering Sea and 8 caught in the Atlantic. Notwithstanding this, the authors decided to classify the Pacific population as a subspecies *Reinhardtius hippoglossoides matsuurae,* and most of the other authors accepted this classification. Genetic differences between the fishes inhabiting the two oceans were confirmed by a more recent biochemical study by Fairbairn (1981) who applied the electrophoresis to establish the differences in the populations from North Pacific and North-West Atlantic. These differences pointed rather to the existance of two subspecies.

Comparative analysis of the biometric parameters of two Greenland halibut stocks from North Atlantic focused mostly on the features which had been used by Vernidub and Panin (1937) to distinguish the subspecies in the Pacific. Figs. 5 and 6 present the dependencies between head length, upper jaw length, and body length, and between length and height of the caudal part and body length of the fish originating from the Labrador region and the Barents Sea. The figures show that within the fish length found in the two regions, the observed values of these parameters (means for 1 cm intervals) formed overlapping sets, i.e. the two populations did not differ significantly with respect to these parameters.

Hubbs and Wilimovsky (1964) who performed similar analysis of the four parameters, did not find any significant differences between the Pacific and the Atlantic populations, but they also found that the regional differences in the Pacific were insignifi-

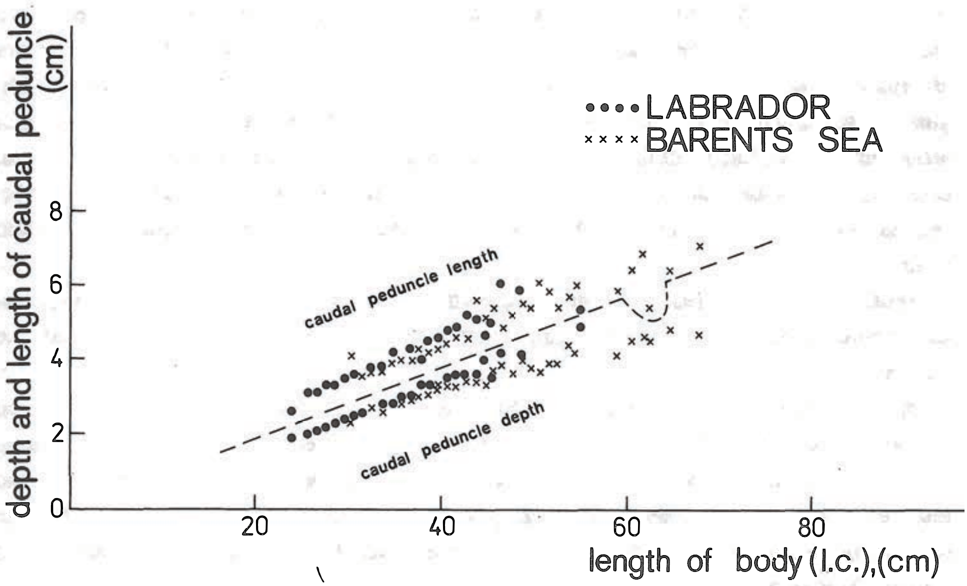

Fig. 6. Dependence between length and height of the caudal part and body length (l.c.)

cant as well. Contrarily to this, our studies showed that there were statistically significant differences between the two populations from North Atlantic. These differences were noticed with respect to several measurable parameters, with the exception of soft rays in the anal fin (Tab. 1). Taking into account the measurable parameters it can be noted that Greenland halibut from the Labrador region was characterized by longer and higher head, longer snout, longer and higher caudal part, and higher dorsal and anal fins. Halibut from the Barents Sea was characterized by longer body as well as longer pectoral and ventral fins.

When comparing the differences between measurable parameters it can be noted that from among 7 parameters under study, as many as 6 were on the average higher in the population from the Barents Sea. Only number of gill rakers on the first branchial arch proved to be higher in the fish population from the Labrador region. These results can be explained by Jordan's (1891) and Schmidt's (1930) rules. Jordan defined some regularities between vertebrae number and environmental conditions (mainly temperature and salinity). According to his rule, species living in cold waters are characterized by higher vertebrae number than those living in tropical waters. Schmidt carried out studies on the races of the same species. He found that the average number of vertebrae decreased southward along with increasing water temperature. Hence, higher average values of the meristic parameters in the more northern population from the Barents Sea.

Summing up the analysis of meristic parameters a question arises whether statistically significant differences noted between the two fish populations reflected their systematic difference, or whether they were due to ecologic factors only. The problem is quite complex. According to Szarski (1986) changes in particular morphologic parameters took place as the distance between the habitats increased, but they were not always related to each other, so that it became difficult to find a criterium to distinguish a subspecies. The two populations of Greenland halibut inhabited regions of different geographic latitude and, thus, conformed to Jordan's and Schmidt's rules. Consequently, differences of the meristic parameters can be explained by the differences of environmental conditions only, and cannot be used to distinguish taxonomic units.

Similar conclusion results from the growth curves related to length and weight of Greenland halibut in the two regions. The curves are of similar shape, and the differences reflect only different ecologic conditions in the two habitats.

Parasitic fauna of the fish under study, and the degree of fish infestation differed in the two regions of North Atlantic. From among 22 species of parasites (excluding 4 very rare species) only the protozoans *Ceratomyxa drepanopsettae* and *Paramyxoproteus reinhardti* were present with the same intensiveness in the two regions. The remaining 16 species showed significant quantitative differences, and to a less extent also qualitative ones.

The differences as to the degree of infestation with parasites of Greenland halibut from the Barents Sea and from the Labrador region were probably due to different conditions of the environment, which affected the parasitic fauna, in this also through the presence of intermediate or ultimate hosts. The parasitic fauna found in course of the studies embraced 4 species for which mammals were the ultimate hosts. These were larvae of the nematodes *Anisakis simplex* and *Phocanema decipiens,* and larvae of the acanthocephalans *Corynosoma strumosum* and *C. semerme.* Three species: *Ph. decipiens, C. strumosum,* and *C. semerme* were present almost exclusively in the Barents Sea. Extensiveness of halibut infestation with these parasites reached 15.2–81.1% while in the region of Labrador only one larvae of *C. strumosum* was found. Also fish infestation with *A. simplex* larvae was very high in the Barents Sea, whereas these parasites were far less frequent in the Labrador region (Tab. 2). It can be assumed that higher infestation with these parasites in the Barents Sea was to some an extent connected with the presence of marine mammals in this habitat.

It is not possible to explain in detail the differences observed in the infestation of Greenland halibut with parasites in the Barents Sea and the Labrador region because there were no data on food composition of this host, as well as on the fauna present in the fishing grounds where the fish were collected.

Many authors pointed to the relationships between environmental conditions and fish parasites in the sea. Gibson (1972) showed that *Platichthys flesus* from three coastal regions of Scotland (two estuaries and one open sea region) were characterized by different degree of infestation with particular parasites, most of all those which represented the so-called biologic indicators. Gibson explained these differences with different environmental conditions and the presence of intermediate hosts.

Also Glukova (1956) pointed to the differences in the parasitic fauna of *Platichthys flesus* and *Liopsetta glacialis* from the White Sea. She found that in the Kandalakski Lagoon marine parasites predominated, while in a less saline Dvina estuary there were also typical estuary and freshwater parasites. The same authoress found some Boreal forms in Onega estuary. She concluded that the fish under study formed local stocks inhabiting definite regions. According to Kulačkova (1977) infestation with *Monogenea* of herring from the White Sea estuaries was also differentiated and could be used as an indicator confirming the existance of local herring stocks. Similarly . Nikolaeva (1963a) compared parasitic fauna of fish from the Black Sea and suggested that there were three different stocks of *Engraulis encrasicholus* in this sea, which differed as regards the extensiveness and intensiveness of their infestation with the parasites, as well as four local stocks of *Trachurus mediterraneus ponticus,* which also differed with respect to parasite composition. Nikolaeva (1963b) also found differences in the parasitic fauna of *Spicara smaris* in the Black Sea near Crimea and Caucassus.

Mamaev and Baeva studied (1962–63) parasitic fauna of *Theragra chalcogramma* in different regions. These authors collected materials from the Okhotsk Sea and from the Pacific near Kamchatka. They observed higher level of infestation with 5 parasites in a fish sample from the Pacific, while 2 species were much more numerous in the Okhotsk Sea. Mamaev and Baeva suggested that two different fish stocks were present in Kamchatka coastal waters, one inhabiting the Okhotsk Sea and the other coastal Pacific waters. Interesting data were presented by Zubčenko (1981). He studied *Coryphaenoides rupestris (Macrouridae)* from some fishing ground of North Atlantic, along North American and European coast, and in its central part. This author noted considerable differences as to the degree of fish infestation although the same parasites were present in the regions under study. He also concluded that the parasite host formed local stocks.

Although the discussed papers delt fish different fish species and different waters or areas, their results are similar to those obtained with Greenland halibut and somehow confirm our results. Differences as to the parasitic fauna of halibut from the Barents Sea and the Labrador region were so great that it was also possible to conclude that we delt with two different stocks of this species, inhabiting distant and ecologically different regions of the North Atlantic.

CONCLUSIONS

1. Population of Greenland halibut from the Labrador region differed in many bimetric parameters from that from the Barents Sea. From among 22 measurable parameters, significant differences were found for 12 expressed as relative values in relation to body length, and 4 (from among 6) expressed in relation to head length. The

greatest differences were found for the pectoral fin, which was noticeably longer in fish from the Barents Sea. As regards average values of the meristic parameters, significant differences were found for as many as 6 out of the 7 parameters under study. Most pronounced differences in this group was observed for the vertebrae number.

2. Curves of growth in length and weight of Greenland halibut in the two regions were similar in shape. The fish from the Labrador region were characterized by more rapid growth, at least in the first few years of life.

3. Parasitic fauna of the fish differed significantly in the two regions. Out of 22 parasite species, when 4 very rare ones were excluded, only the protozoans *Ceratomyxa drepanopsettae* and *Paramyxoproteus reinhardti* were present with similar intensivess in the two regions. The other 16 species showed considerable quantitative differences, and to a lesser extent also qualitative ones.

4. The observed differences of the biometric parameters as well as of the growth rate (of length and weight), and of the parasitic fauna in Greenland halibut from the Labrador region and from the Barents Sea suggest that the fish under study belonged to two different stocks, but did not exceed the intraspecies variability.

REFERENCES

Fairbairn D.J., 1981: Biochemical genetic analysis of population differentiation in Greenland halibut (Reinhardtius hippoglossoides), from the Nortwest Atlantic, Gulf of St. Lawrence, and Bering Sea. – Can. J. Fish. Aquat. Sci., **38**: 669–677.

Gibson D.L., 1972: Flounder parasites as biological tags. – J. Fish Biol., **4**: 1–9.

Gluhova V.M., 1956: Parazitofauna kambalovyh ryb Belogo morja. – Trudy Karelo-Finskogo Fil. AN SSSR, ser. parazitol., **4**: 27–49. (in Russian).

Hubbs C.L., N.J. Wilimovsky, 1964: Distribution and Synonymy in the Pacific Ocean, and Variation, of the Greenland Halibut, Reinhardtius hippoglossoides (Walbaum). – J. Fish. Res. Bd. Canada, **25**, 5: 1129–1154.

Jordan D.S., 1891: Relations of temperature to vertebrae among fishes. – Proc. U.S. Nat. Mus., **14**: 107–120.

Krzykawski S., 1991: Morphometry and growth of Greenland halibut Reinhardtius hippoglossoides (Walbaum, 1792) off Labrador. – Acta Ichth. Pisc., **21**, 2: 87–106.

Krzykawski S., 1992: Biometric characters and growth of Greenland halibut Reinhardtius hippoglossoides (Walbaum, 1792) from the Barents Sea. – Acta Ichth. Pisc., **22**, 1: 97–111.

Kulačkova V.G., 1977: Monogenei (Gyrodactylidae) kak indikatory lokalnyh stad seldi (Clupea harengus pallasi n. maris-albi Berg) v Belom more. – Parazitol. sb., **27**: 27–34. (in Russian)

Mamaev Ju.L., O.M. Baeva, 1962–1963: Gelmintofauna mintaja vod Kamčatki i ispolzovanie etogo vida ryb dla pitanija. – Helminthologia, 4: 318–331. (in Russian)

Nikolaeva V.M., 1963a: Parazitofauna lokalnyh stad nekotoryh pelagičeskih ryb Černogo morja. – Trudy Sevastopolsk. biol. st. AN USSR, **16**: 387–438. (in Russian)

Nikolaeva V.M., 1963b: Materialy k parazitofaune smaridy Spicara smaris (L.) Černogo morja. – Trudy Sevastopolsk. biol. st. AN USSR, **16**: 439–442.

Schmidt J., 1930: Racial investigations X, Athe Atlantic cod (Gadus callarias L.) and local races of the some, C–R. – Trav. Lab. Carlsberg, **18**, 6: 1–72.

Sokal R.R., F.J. Rohlf, 1981: Biometry. The principles and practice of statistics in biological research. – W.H. Freemen and Company, San Francisco.

Szarski H., 1986: Mechanizmy ewolucji. – Warszawa, PWN. (in Polish)

Vernidub M.F., K.I. Panin, 1937: Nekotorye dannye o sistematičeskom položenii i biologii tihookeanskogo predstavitela paltusov iz roda Reinhardtius Gill. – Učen. zap. Leningr. Gos. Univer., 3, 15: 250–272. (in Russian)

Wierzbicka J., 1991a: Parasitic fauna of the Greenland halibut, Reinhardtius hippoglossoides (Walbaum, 1792) from Labrador area. – Acta Ichth. Piscat., 21, 1: 21–29.

Wierzbicka J., 1992: Parasitic fauna of the Greenland halibut, Reinhardtius hippoglossoides (Walbaum, 1792) from off Barents Sea. – Acta Ichth. Pisc., 22, 1 (in press).

Wierzbicka J., 1991b: An analysis of parasitic fauna of Greenland halibut, Reinhardtius hippoglossoides (Walbaum, 1792) in different age groups. – Acta Ichth. Pisc., 21, 1: 31–41.

Zubčenko A.V., 1981: Ispolzovanie parazitologičeskih dannyh dla izučenija lokalnyh gruppirovok tuporylogo makrurusa [Coryphaenoides rupestris Gunner]. Simpozium po parazitologii i patologii morskih organizmov. – Tezisy dokladov sovetskih učastnikov. Leningrad, 13–16 oktjabrja 1981 g.: 25–32. (in Russian)

Translated: Dr. M. Bnińska

Stanisław KRZYKAWSKI, Jadwiga WIERZBICKA

PRÓBA OKREŚLENIA PRZYNALEŻNOŚCI SYSTEMATYCZNEJ HALIBUTA NIEBIESKIEGO *REINHARDTIUS HIPPOGLOSSOIDES* (WALBAUM, 1792) Z REJONÓW LABRADORU I MORZA BARENTSA NA PODSTAWIE BADAŃ MORFOMETRYCZNYCH, BIOLOGICZNYCH I PARAZYTOLOGICZNYCH

STRESZCZENIE

Celem badań było porównanie wyników w zakresie zmienności cech przeliczalnych i wymierzalnych,tempa wzrostu długości i masy oraz fauny pasożytniczej halibuta niebieskiego z rejonów Labradoru i Morza Barentsa. Następnie podjęto próbę odpowiedzi, czy stwierdzone różnice pomiędzy porónywanymi populacjami, statystycznie istotne, świadczą o systematycznej ich odrębności, czy też mają jedynie podłoże ekologiczne.

Stwierdzono, że zaobserwowane różnice w zakresie przeprowadzonych badań między halibutami niebieskimi z rejonu Labradoru i Morza Barentsa świadczą o przynależności ich do dorębnych stad, ale nie wykraczają poza ramy zmienności wewnątrzgatunkowej.

Authors' address:

Received: 1991.06.07

Prof. dr hab. Stanisław Krzykawski,
doc. dr hab. Jadwiga Wierzbicka
Zakład Systematyki Ryb
Akademia Rolnicza
ul. K. Królewicza 4
71-550 Szczecin
Polska (Poland)