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Parasitology

PARASITIC FAUNA OF EUROPEAN BLUE WHITING, *MICROMESISTIUS POUTASSOU* (RISSO, 1810)

PARAZYTOFAUNA BŁĘKITKA EUROPEJSKIEGO *MICROMESISTIUS POUTASSOU* (RISCO, 1810)

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Parasitologic analyses were made on three samples of European blue whiting, *Micromesistius poutassou* (Risso, 1810). The first sample was made up by whole individuals caught off the Faeroes Is., the second contained viscera of the Norwegian Sea blue whiting, and the third – beheaded blue whiting examined on board during the cruise. Nine parasitic species (1 protozoan, 1 monogenean trematode, 5 cestodes, and 2 nematodes) were found. Invasion intensity and incidence as well as the parasites location in hosts were determined. Three species are considered pathogenetic for man.

INTRODUCTION

A growing interest in European blue whiting, *Micromesistius poutassou,* has been seen to evolve over the last decade; in contrast to 1970 when the species was fished by the Soviet Union and Spanish fleets only, 16 countries were engaged in fishing operations on the species in 1977, the total catch amounting to 246 924 t (FAO, 1978).

Since the species is intended for human consumption, it is imperative to gain knowledge on its parasitic fauna. However, papers on blue whiting parasites are scarce and their results tend to diverge.

The earliest data on the European blue whiting parasites, which we have found, are given by Poljanskij (1955) and Berland (1961); those authors, however, examined few

individuals. In 1971, Reimer et al. describing the parasitic fauna of the species put the special emphasis to the fish value as a commercial product viewed from the parasitologist's stand. They found 7 species to have occurred in their materials, including the *Anisakis simplex* larvae known to be pathogenetic for man but failed to found any parasites in the fish muscles. J. Grabda (1978) compared the infestation of the European and Southern (*M. australis* Norman) blue whiting species with the special reference to their utility for consumption and found 4 following parasitic species in European blue whiting: *Microspora, A. simplex, Thynnascaris adunca,* and *Diphyllobothrium sp.,* the first two being recorded in muscles. Parasites of the blue whiting off Spitsbergen are described by Szuks et al. (1978)* who found 2 species of protozoans, 4 trematodes, 3 cestodes, and 2 nematodes.

Additionally, some remarks on the blue whiting parasites can be spotted in other parasitologic papers. Golvan (1961) lists blue whiting as a host for *Pomphorhynchus tereticollis;* Euzet and Trilles (1961) found a monogenean *Diclidophora poutassou* in the Mediterranean blue whiting, and Andersen (1977) was the first to describe plerocercoids of *Diphyllobothrium sp.* cestode in the fish species discussed.

The present paper is a contribution to the knowledge of the European blue whiting parasitic fauna.

MATERIAL AND METHODS

Materials were collected during a cruise of MT "Rybak Morski" in 1979. The first sample was taken from the 1 April catch off the Faeroes (asproximate coordinates: 8°9′W, 62°N). The frozen fishes were delivered to the laboratory of the Faculty of Marine Fisheries and Food Technology, Szczecin, 30 whole specimens making up the sample examined.

The second sample taken on 3 June in the Norwegian Sea (approximate coordinates: 3°45′W, 65°28′N) consisted of 78 formalinfixed intestines with liver and gonads and was examined on land.

The third sample consisting of 100 fresh beheaded individuals was examined on board.

The Faeroes fish longitudo totalis and weight ranged within 26.0–35.0 cm (a mean of 32.5 cm) and 130–270 g (a mean of 175 g), respectively; the fish age was 4–6 years. The fishes were subject to a full parasitologic analysis, i.e., the skin, eyes, mouth and body cavities, intestine, liver, gonads, heart, and muscles were examined. The formalin-fixed viscera of the Norwegian Sea sample received an equally detailed treatment.

*This paper (Szuks H., Lorenz H., Steding D.: Zur Parasitierung des Blauen Wittling Micromesistius poutassou (Risso, 1810). Wiss. Z. Päd. Hochsch. "Liselotte-Hermann" Güstrow. Math.-naturwiss. Fak. 1978, 1: 144–151) is not available in Poland; the citation was found in Referativnyj Žurnal 1979, 1, K 16.

Table 1

Infestation of *Micromesistius poutassou* with parasites

Parasite species		Sample (no. of fish)			Total	Number of parasites
		whole fish (30)	viscera (78)	beheaded fish (100)		
Microspora	Incid.	0.00	–	15.00	11.53[a]	72[b]
	intens.	0	–	1–10	1–10	
	mean	0.00	–	0.72	0.55	
Diclidophora sp.	incid.	3.33	–	–	+	1
	intens.	1	–	–	+	
	mean	0.03	–	–	+	
Scolex pleuronectis	incid.	0.00	19.23	–	13.89[c]	28
	intens.	0	1–6	–	1–6	
	mean	0.00	0.26	–	0.26	
Diphyllobothrium sp.	incid.	6.67	1.28	–	2.78[c]	5
	intens.	1–2	2	–	1–2	
	mean	0.10	0.03	–	0.05	
Pyrami-cocephalus phocarum	incid.	70.0	34.62	–	44.44[c]	136
	intens.	1–10	1–10	–	1–10	
	mean	2.10	0.94	–	1.26	
Hepatoxylon trichiuri	incid.	3.33	0.00	–	0.93[c]	1
	intens.	1	0.00	–	1	
	mean	0.03	0.00	–	0.01	
Grillotia erinaceus	incid.	0.00	1.28	–	0.93[c]	1
	intens.	0	1	–	1	
	mean	0.00	0.01	–	0.01	
Anisakis simplex	incid.	100.00	100.00	100.00	100.00	7276
	intens.	1–239	1–367	1–131	1–367	
	mean	59.97	39.45	24.00	+	
Thynnascaris adunca	incid.	100.00	100.00	–	100.00[c]	1732
	intens.	2–46	2–46	–	2–46	
	mean	15.53	17.00	–	16.03	

Invasion incidence in per cent

Invasion intensity = no. of parasites per fish

Mean = a mean intensity of population infestation (a mean number of parasites per 1 individual of the whole population examined)

a = viscera disregarded, b = cysts, c = beheaded fish disregarded

RESULTS

Table 1 summarises data on the invasion incidence and intensity.

Protozoa

Microspora

Protozoan cysts were found in muscles of the sample examined on board. The cysts were rather small, elongated, measuring ca 3 X 0.5 mm, white-yellow in colour. They were found mainly in the ventral and tail muscles. No protozoans were found in the frozen fish examined in the laboratory.

PLATYHELMINTHES

Monogenea

Diclidophora sp.

A single specimen only was found on gill lamellae. The dimensions of the parasite were: length (with the attachment plate) 5 mm, width 0.6 mm. Owing to a poor condition of the specimen, it could not been identified to species.

Cestoda

Diphyllobothrium sp.

A total of 5 encysted parasites was found in stomach walls. The cysts were 2-mm diameter milky-white spheres. The plerocercoids measured 7–10 mm. Both the Faeroes and Norwegian Sea fishes proved infested.

Pyramicocephalus phocarum (Fabricius, 1780)

The most abundant cestode in the material examined, found both in the Faeroes and Norwegian Sea individuals. The cestodes, similarly to *Diphyllobothrium sp.*, were most frequently located in stomach walls (Fig. 1), 1 specimen only being found in the intestine wall of a Norwegian Sea individual. The size and colour of cysts were similar to those of the previous species. The *P. phocarum* larvae measured 10–25 mm.

Scolex pleuronectis Müller, 1788

The cestodes occurred mainly in the pyloric caeca (92.86%) and sometimes in the intestine (7.14%) of the Norwegian Sea fishes. The adhesive organs of all specimens were retracted making the specimens look like heart-shaped forms (Fig. 2). The length and width ranged within 1–5 mm and 0.75–3.5 mm, respectively. The parasites were white-creamy in colour, sometimes pink.

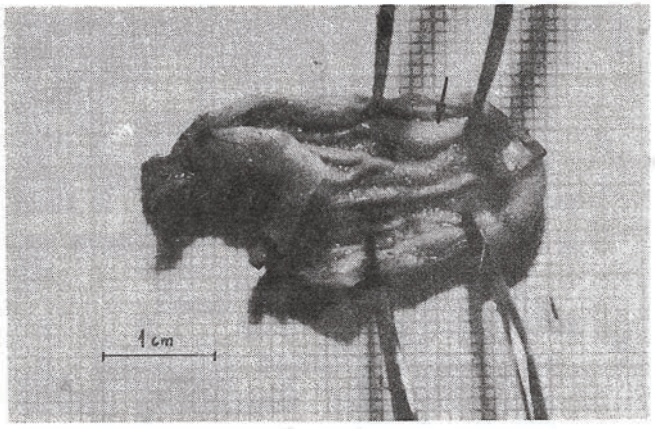

Fig. 1. *Pyramicocephalus phocarum* cyst in the stomach wall.

(Photo: A. Treder)

0,5 mm

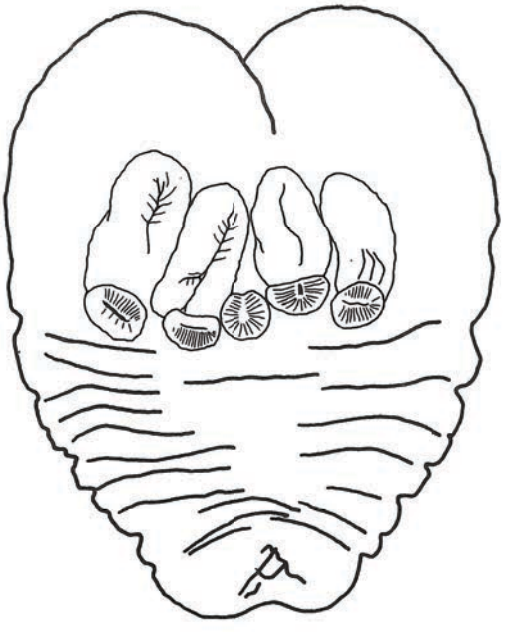

Fig. 2. Plerocercoid of *Scolex pleuronectis*

Table 2

Percentage distribution of *Micromesistius poutassou* parasites in fish organs
(data for the Faeroes sample of 30 whole fishes)

Parasite species	Stomach		Pyloric caeca		Intestine		Liver	Gonads	Muscles	Other organs	Total	Number of parasites
	A	B	A	B	A	B						
Microspora	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0[a]
Diclidophora sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100[b]	100	1
Scolex pleuronectis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0[c]
Diphyllobothrium sp.	100		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100	5
Pyramicocephalus phocarum	100		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100	63
Hepatoxylon trichiuri	0.00	0.00	0.00	0.00	100		0.00	0.00	0.00	0.00	100	1
Grillotia erinaceus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100	0[c]
Anisakis simplex	4.84	0.00	9.45	0.06	5.56	0.11	67.04	6.00	4.59	1.99	100	1799
Thynnascaris adunca	15.52	2.00	42.36	3.90	13.05	0.74	14.53	6.40	0.00	1.50	100	406

A = on the surface

B = inside

a = found in beheaded fish examined on board

b = on gill lamellae

c = found only in the Norwegian Sea sample

Hepatoxylon trichiuri (Holten, 1802)

A single specimen only was found on the external wall of the intestine of a fish caught off the Faeroes. The cream-coloured plerocercoid measured 8 mm.

Grillotia erinaceus (Beneden, 1858)

Similarly to the previous species, represented in the material examined by a single specimen only, found in the Norwegian Sea sample. The scolex length and width were 3.8 and 0.9 mm, respectively; the cysticercoid was found attached to the mesentery.

NEMATHELMINTHES

Nematoda

Anisakis simplex (Rudolphi, 1809)

The most abundant parasite of the blue whiting examined. The invasion incidence in each sample was 100%, the intensity exceeding 100 individuals per fish. The 15–25 mm stage 3 larvae found were translucent, turning white when formalin-fixed. The encysted larvae were found in different organs in the body cavity. Most nematodes were located on the liver under the epithelium, much less on the pyloric caeca and other organs (Table 2). The larvae were found also in muscles with a varying degree of infestation. The fishes examined on board were strongly infested (Table 1), while the muscles of the Faeroes individuals not so much so. The *A. simplex* larvae were found in muscles of 19 out of 30 individuals examined, the muscle invasion intensity varying from 1 to 12 specimes.

Thynnascaris adunca (Rudolphi, 1802)

The species belongs to the most common blue whiting parasites too. The invasion incidence and intensity were 100% and 2–46 specimens per fish, respectively. The *T. adunca* larvae, smaller than those of *A. simplex* (usually up to 10 mm long) were present on the same organs as did the latter. No *T. adunca* larvae were found in muscles. Almost all the larvae were at stage 3, four specimens only being at stage 4, the latter – found in the stomach – measuring up to 24 mm. Additionally, a single adult female was found in the stomach.

DISCUSION

The nine parasitic species found in the blue whiting examined differed in their invasion incidences and intensities.

The rarest species, respresented by a single individual each were: a monogenean trematode *Diclidophora sp.* and cestodes *Grillotia erinaceus* and *Hepatoxylon trichiuri*; their invasion incidences were thus very low (Table 1), and judging from our results they

can be regarded as parasites occurring sporadically. On the other hand, the literature data show *Diclidophora sp.* to be a common blue whiting parasite. Poljanskij (1955) recorded several individuals of this trematode in one fish; the studies reported by Euzet and Trilles (1961) also evidence a more frequent occurrence of the species than is the case in our data.

The larvae of *Hepatoxylon trichiuri* and *G. erinaceus* are widely distributed and very common in many teleost species (Dollfus, 1942); they have not been, however, recorded in blue whiting, so that they can be assumed to have occurred accidentally.

More frequent than the two mentioned species were the other two: *Microspora* protozoans and a cestode *Scolex pleuronectis*, their invasion incidence being 15 and 19.23%, respectively (for those samples containing them), while their invasion intensity did not exceed 10 individuals per fish (Table 1). The *S. pleuronectis* plerocercoids were found in the Norwegian Sea fishes, while they were absent in the Faeroes sample. These parasites were recorded by Reimer et al. (1971) in blue whiting caught off Ireland, while Poljanskij (1955) observed *S. pleuronectis* in this host from the Barents Sea. The species is cosmopolitan; most authors, however, consider it to be a collective name for various juvenile *Tetraphyllidea* (Dollfus, 1953; Poljanskij, 1955; Zukov, 1960; Dubinina, 1962). Our results as well as those of Reimer et al. (1971) indicate to a patchy occurrence of *S. pleuronectis* within its range of distribution.

The *Microspora* cysts in blue whiting were described by J. Grabda (1977, 1978). Her 1978 paper shows a relatively low infestation. In her paper of 1977 the author suggest the *Microspora* observed in the European blue whiting to belong to *Glugea punctifera.* The Microspora cysts were found in the sample examined on board, while they were absent from muscles of those individuals caught off the Faeroes. It is very likely that the occurrence of these parasites, similarly to *S. pleuronectis*, is not uniform and they may comprise several species.

Anisakis simplex is one of the commonest parasites in the samples examined, showing additionally a high invasion intensity (Table 1). The presence of this parasite in blue whiting was reported by Poljanskij (1955), Berland (1961), Reimer et al. (1971), and J. Grabda (1978). The invasion intensity observed by Poljanskij was very low, whereas the other papers report the presence of several hundred specimens per one fish.

Our data indicate the liver to be a site of the densest aggregations of *A. simplex* (Table 2). They are less dense on the pyloric caeca, stomach, and other organs affected. Virtually every organ was affected by the invasion. Reimer et al. (1971) did not observe *A. simplex* in the blue whiting muscles, which is inconsistent with the results obtained by J. Grabda (1978) and those in the present study. The typical feature of the larvae is their location on the surface of an organ; seldom do they penetrate inside the organ, which was found also by other authors.

Thynnascaris adunca is equally frequent in blue whiting (100% invasion incidence), the invasion intensity being, however, much lower than that of *A. simplex* (Table 1). Poljanskij (1955), Berland (1961), Reimer et al. (1971), and J. Grabda (1978) indicate the parasite to be rather common in the fish species in question. The *T. adunca* larvae

settle in a host in a different way than *A. simplex;* most larvae of the first are found on the pyloric caeca (Table 2).

Pyramicocephalus phocarum was a parasite relatively frequently recorded in the course of the present study. Dollfus (1953) stated that the distribution range of the species was identical with that of its definite hosts (*Phoca hispida, Erignathus barbatus*, and *Cystophora cristata*). It should be mentioned that this is also the range of blue whiting. The *P. phocarum* plerocercoids settle in the abdominal cavity between the pyloric caeca, on gonads, and even in muscles (J. Grabda, 1977). Our studies show encysted *P. phocarum* to occur mainly in the stomach wall (a mean of 99.26% of all the specimens found) and seldom in the intestinal wall. The literature available contains no record of *P. phocarum* in blue whiting. There are, however, reports on the presence of *Diphyllobothrium sp.*, a cestode morphologically similar to *P. phocarum*, in blue whiting (Andersen, 1977; J. Grabda, 1978), which was also the case in this study.

The *Diphyllobothrium* sp. plerocercoids were encysted, like *P. phocarum*, in the stomach wall and differed from the latter by their more rounded cross-section of the body, a clearly-separated neck and less corrugated margins of the bothria. The *Diphyllobothrium sp.* specimens were smaller (up to 10 mm) than *P. phocarum* reaching 25 mm.

The *Diphyllobothrium sp.* plerocercoids observed in our study differed in their appearance from those described by Andersen (1977) who remarked on a vague delimitation between the genera *Diphyllobothrium, Pyramicocephalus, Adenocephalus*, and *Diplogonoporus,* which makes the identification difficult. The *Diphyllobothrium sp.* plerocercoids identified in this study may belong to a species or a stage different from those described by Andersen (1977). Besides, a considerable variation in shapes of the *P. phocarum* scolexes observed in the present study seems to point out a marked intraspecific variability,

Table 3 summarises the European blue whiting parasites known to date. Certain discrepancies in the parasitic fauna composition as reported by various authors may be seen. It is only the nematodes *A. simplex* and *T. adunca* that were repeatedly found in all studies; *P. phocarum, H. trichiuri*, and *G. erinaceus* have not been found in blue whiting before.

The parasites found in the present study are of unequal importance for man *P. phocarum, Diphyllobothrium sp.,* and *A. simplex* are pathogenetic for humans. Yamaguti (1959) states that man is one of the definite hosts for *P. phocarum.* The *Diphyllobothrium sp.* plerocercoids, in spite of the incomplete knowledge on their developmental cycle, should be treated as dangerous since nammals are their definite hosts thus making it possible for man to become infested. The most dangerous parasite causing significant pathological changes in the human stomach and intestine (J. Grabda, 1977) is *A. simplex*. The larvae found were identified, based on J. Grabda (1976), as stage 3, invasive for mammals (including man). They occur also in blue whiting muscles, which is very significant as the preliminary treatment of the fish fails to remove the parasites.

Table 3

Parasites of *Micromesistius poutassou* found by various authors

	Poljanskij (1955)	Reimer (1971)	Grabda J. (1978)	Present study	Others
PROTOZOA					
Myxidium bergense	–	–	–	–	+ (Dollfus, 1953)
Microspora	–	–	+	+	
MONOGENOIDEA					
Diclidophora sp.	–	–	–	+	
D. poutassou	–	–	–	–	+ (Euzet i Trilles, 1961)
Octodactylus minor (= Diclidophora minor)	+	–	–	–	
TREMATODA					
Bucephalopsis gracilescens	–	+	–	–	
Podocotyle atomon	–	+	–	–	
P. reflexa	+	–	–	–	
CESTODA					
Diphyllobothrium sp.	–	–	+	+	+ (Andersen, 1977)
Pyramicocephalus phocarum	–	–	–	+	
Scolex pleuronectis	+	+	–	+	
Hepatoxylon trichiuri	–	–	–	+	
Grillotia erinaceus	–	–	–	+	
NEMATODA					
Anisakis simplex	+	+	+	+	+ (Berland, 1961)
Thynnascaris adunca	+	+	+	+	+ (Berland, 1961)
Cucullanus cirratus	–	–	–	–	+ (Dollfus, 1953)
Porrocaecum sp.	–	+	–	–	
ACANTHOCEPHALA					
Echinorhynchus sp.	–	+	–	–	
E. gadi	+	–	–	–	
Pomphorhynchus tereticollis	–	–	–	–	+ (Golvan, 1961)

It should be added that the other species found – while non-pathogenetic for man – may be of a considerable economic importance by impairing the fish as a raw material. The protozoans *Microspora* cysts are considered to be such parasites (J. Grabda, 1978).

In view of the fact that the parasites cannot be completely removed from fish, appropriate precautions should be observed before the fishes can be delivered for consumption. Deep-freezing down to –20°C (253°K) inside a fish over at least 3 days is the most recommended measure. Sufficient is heavy salting (brine density exceeding 1.19 g cm^{-3}, tissue salt content of over 14%) over 6 weeks, and also thermal treatment at above 60°C (333°K) (ZGR Instruction).

CONCLUSIONS

1. The European blue whiting parasitic fauna exhibits certain variations related to the area of fish capture.
2. In the present study, the class *Cestoda* is represented by as many as 5 species.
3. The dominant parasites are nematodes *Anisakis simplex* and *Thynnascaris adunca*, the invasion incidence of both being 100%; the *A. simplex* invasion intensity amounts to several hundred individuals per fish.
4. *Hepatoxylon trichiuri* and *Grillotia erinaceus* are considered accidental parasites of blue whiting.
5. The following parasites have not been recorded in blue whiting before: *Hepatoxylon trichiuri, Grillotia erinaceus*, and *Pyramicocephalus phocarum.*
6. The occurrence of 2 species pathogenetic for man (*Pyramicocephalus phocarum* and *Anisakis simplex*), a potentially pathogenetic one (*Diphyllobothrium sp.*), and one of economic importance (*Microspora*) was found.
7. The presence of *Anisakis simplex* in muscles calls for a thorough parasitologic inspection of the catch an appropriate treatment to be applied.

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PARAZYTOFAUNA BŁĘKITKA EUROPEJSKIEGO *MICROMESISTIUS POUTASSOU* (Risso, 1810)

Streszczenie

Bodźcem do napisania niniejszej pracy były wzrastające systematycznie w ostatnim dziesięcioleciu połowy błękitka europejskiego *Micromesistius poutassou* (Risso, 1810). Przeznaczenie go na konsumpcję dla ludzi wymaga pełnej znajomości parazytofauny tej ryby, tymczasem literatura z tego zakresu jest nieliczna.

Przebadano 3 różne próby błękitka. Pierwszą próbę pobrano 1.04.1979 w rejonie Wysp Owczych. Z próby tej przebadano w pracowni na lądzie 30 całych ryb. Drugą próbę pobrano 3.06.1979 na Morzu Norweskim. Z ryb tych pozyskano 78 przewodów pokarmowych wraz z wątrobami i gonadami i także przebadano na lądzie. Trzecią próbę stanowiły świeże tuszki błękitka w ilości 100 sztuk przebadane w trakcie trwania rejsu statku rybackiego.

Znaleziono 9 gatunków pasożytów: pierwotniaki *Microspora* przywrę monogenetyczną *Diclidophora sp.*, tasiemce: *Diphyllobothrium sp.*, *Pyramicocephalus phocarum*, *Scolex pleuronectis*, *Hepatoxylon trichiuri*, *Grillotia erinaceus* oraz nicienie: *Anisakis simplex* i *Thynnascaris aduncа*. Patogennymi dla człowieka są: *Anisakis simplex* i *Pyramicocephalus phocarum*. Szczególnie pierwszy z

nich jest niebezpieczny dla człowieka, gdyż wywołuje poważne zmiany patologiczne w żołądku i jelicie. Jego obecność w mięśniach ryb wymaga stosowania odpowiednich technologii uzdatniających surowiec rybny do spożycia. Za szkodliwy dla człowieka uznano także *Diphyllobothrium sp.* Jego cykl rozwojowy jest nieznany lecz wiele gatunków z tego rodzaju może pasożytować u człowieka i należy się liczyć z możliwością, iż ten gatunek także posiada taką właściwość. Pierwotniaki *Microspora* nie są szkodliwe dla człowieka lecz przy silnej inwazji powodują dyskwalifikację surowca rybnego.

Diclidophora sp., Hepatoxylon trichiuri i *Grillotia erinaceus* były reprezentowane tylko przez pojedyncze okazy. Dwa ostatnie uznano za pasożyty przypadkowe. Obok *Pyramicocephalus phocarum* są one po raz pierwszy notowane u błękitka.

Zwraca uwagę zarażenie wszystkich badanych ryb przez *Anisakis simplex* i *Thynnascaris adunca* przy jednoczesnej wysokiej intensywności zarażenia. Dane odnośnie wielkości charakteryzujących zapasożycenie błękitka zawierają tabele 1 i 2.

В. Куш, А. Тредер

ПАРАЗИТЫ ПУТАССУ MICROMESISTIUS POUTASSOU (RISSO, 1810)

Резюме

В последнем десятилетии уловы путассу Micromesistius poutassou постоянно возрастают. Использование этой рыбы в качестве продукта питания населения требует полного знания ее паразитов. Однако литература по этой теме немногочисленна. Исследовали путассу из 3 разных районов. Первую пробу взяли 1.04.1979 года в районе Шетландских островов. Из этой пробы подверглии исследованию в лаборатории на суше 30 рыб с внутренностями. Другая группа была выловлена 3.06.1979 года в Норвежском море. Из этих рыб получили 78 пищеварительных трактов вместке с печенью и гонадами. Анализ был совершен на суше. Третью группу составляли свежие тушки путассу в количестве 100 штук. Исследование проводили в море на рыболовном судне. Обнаружено 9 видов паразитов: простейшие Microspora, моногенетические трематоды Diclidophora sp., цестоды: Diphyllobothrium sp., Pyramicocephalus phocarum, Scolex pleuronectis, Hepatoxylon trichiuri, Grillotia erinaceus, а также наметоды: Anisakis simplex, Thynnascaris adunca. Патогенными для человека являются: A. simplex и P. phocarum. Особенно первый из них является опастным для человека, поскольку вызывает большие патологические изменения в желудке и кишечнике. Его присутствие в мышцах рыб требует при-

менения особых технологии, чтобы рыбное сырье сделать пригодным к употреблению. Вредным для человека считают также Diphyllobothrium sp., Его жизненный цикл пока неизвестен, но много видов из этого рода может паразитировать на человеке и надо иметь ввиду что этот вид тоже имеет такое свойсвто. Аростейшие Microspora безвреды для человека, однако при сильной инвазии ведет к дисквалификации рыбного сырья. Diclidosphora sp., Hepatoxylon trichiuri u Grillotia erinaceus были представлены единичными экземплярами. Два последных считают случайными. Вместе с P. phocarum их впервые отмечают у путассу. Обращает на себя внимание заражение всех исследованных рыб Anisakis simplex u Thynnascaris adunca с одновременной высокой интенсивностю заражения. Данные касающиеся величин характеризующих степень заражения путассу паразитами, представленны в таб. 1 и 2.

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