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Jadwiga GRABDA

Parasitology

STUDIES ON PARASITISATION AND CONSUMABILITY OF ALASKA POLLACK, *Theragra chalcogramma* (Pall.)

BADANIA NAD ZAPASOŻYCENIEM I PRZYDATNOŚCIĄ DO SPOŻYCIA MINTAJA *THERAGRA CHALCOGRAMMA* (Pall.)

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Alaska pollack spines imported from the USSR as the so-called "spinka" as well as whole fish were examined for parasites. The parasites found are described; the processing of spines and its efficiency in eliminating the parasites are discussed.

INTRODUCTION

Alaska pollack, *Theragra chalcogramma* (Pallas, 1811) is a species very common in the northern Pacific basin with numerous stock existing there. The species' northernmost limit of distribution reaches the sound separating the Čukotskij Peninsula and St. Lawrence Island. Off the Asiatic coast, it is commonly found in the Bering, Okhotsk, and Japanese Seas to Korea. Off the American coasts, *Th. chalcogramma* occur in waters surrounding Alaska and Aleutian Archipelago, extending southwards along the Canadian and US coasts down to the central California. On the US shelf *Th. chalcogramma* are scarce, occurring abundantly off the British Columbia.

The resources of the species are very ample und unexploited in full.

Following the ever-increasing demand for animal protein, the attention has been drawn to this species. In the sixties, detailed parasitologic studies on the species were carried out in the USSR, the results of which led to developing a special technique for the first-stage processing in order to render the fishes utilisable in human consumption. (Mamaev and Baeva, 1962–1963).

The fishes are beheaded and their abdominal parts together with parasites possibly dwelling there cut off. The so-called "spinka" or "balyk" thus obtained is exported. Poland has been an importer of these spines since 1975.

According to the Polish sanitary standards, no parasite likely to endanger the human health as well as that which – while not being harmful – causes an aversion in a consumer is permitted to occur in the consumable fish flesh. Thus the need arouse to determine a degree of parasite infestation and to assess the commercial value of Alaska pollack, the issues being dealt with in the present paper.

MATERIAL AND METHODS

The studies were carried out over the period from March 14, 1975 through March 18, 1976 on a frozen material imported from the USSR. The individuals examined were produced in different seasons of 1974 and 1975 as labelled on blocks. The official data did not allow the actual fishing ground to be determined.

Th. chalcogramma spines and whole individuals additionally found in the blocks were examined. The total number of 12 samples of spines, 50 individuals each (i.e., the total of 600 spines) were examined. The length and weight ranges were 22–44 cm and 50–300 g, respectively. The total number of 386 whole individuals of the respective length and weight ranges of 21–49 cm and 50–770 g were examined.

RESULTS

92.3% of fish examined were infested with 11 parasitic species of various taxa. They occurred in different organs, namely: *Haemobaphes diceraus* and *Clavella perfida* on gills; *Hemiurus levinseni, Tynnascaris adunca*, and *Echinorhynchus gadi* in the intestine; *Aporocotyle simplex* and *Haemobaphes diceraus* in the blood system, larvae of *Pyramicocephalus phocarum, Nybelinia surmenicola, Anisakis simplex, Phocanema dicipiens,* and *Tynnascaris adunca* in the abdominal cavity; *Microsporidia cysts, larvae of Pyramicocephalus phocarum, Nybelinia surmenicola, Anisakis simplex,* and *Phocanema decipiens* in muscles.

The degree of infestation with various parasites is presented in Fig. 1 and Table 1.

7.7% of the individuals examined were entirely parasitefree, this number being made up by fishes of the lowest length and weight classes, 24–26 cm and 50–110 g, respectively (Table 2).

13.1, 29.7, 28.4, 16.5, and 8.03% of the individuals examined were infested, respectively, by 1, 2, 3, 4, and 5 parasitic species, while 6 species were found in 5 individuals (1.3%).

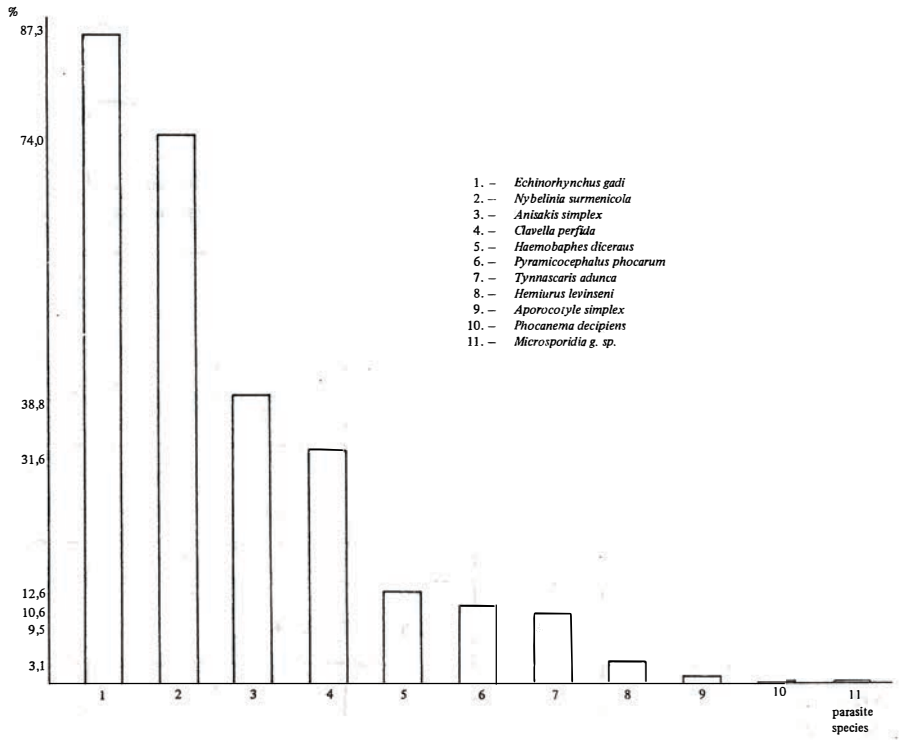


Fig. 1. Invasion incidence (%) of parasitic species found in Alaska pollack

SYSTEMATIC REVIEW OF PARASITES FOUND

Microsporidia gen. sp. (Figs. 2 and 3)

Protozoans encysted in muscles and various organs of fish belong here, the cysts being filled with enormous numbers of very small spores (4–5 μm length). The specific determination is very difficult to carry out under a low-power light microscope, therefore no specific names of the cysts found could be given here.

A few fine cysts of 2–4 μm length, spread in *Th. chalcogramma* muscles were found in only one whole fish and in 10 spines (10% of spines infested). No lesions were found in the infested muscle structure.

Very little is reported on Alaska pollack infestation with *Microsporidia*; only Achmerov (1951) describes an invasion of *Glugea punctifera* in the Okhotsk and Japanese Seas; presumably the same species is involved in the present studies.

Microsporidia constitute no danger to man, their stronger infestation decreasing the fish quality.

Table 1

Parasite invasion incidence and intensity of *Theragra chalcogramma*

Parasite species	Number of fish examined	Number of fish infested	Mean invasion incidence	Invasion intensity	Total number of parasites	Mean invasion intensity
1. *Microsporidia*	386	1	0.25	few cysty		
2. *Hemiurus levinseni*	386	13	3.1	1–12	46	3.5
3. *Aporocotyle simplex*	386	5	1.3	1–11	22	4.4
4. *Pyramicocephalus phocarum*, larva	386	41	10.6	1–4	51	1.5
5. *Nybelinia surmenicola*, larva	386	286	74	1–60	1998	6.9
6. *Anisakis simplex*, larva	386	150	38.8	1–9	343	2.3
7. *Thynnascaris adunca*, larva	386	37	9.5	1–10	90	2.4
8. *Phocanemu decipiens*, larva	386	1	0.25	1	1	1
9. *Echinorhynchus gadi*	386	337	87.3	1–118	4599	13.6
10. *Haemobaphes diceraus*	386	49	12.6	1–2	56	1.1
11. *Clavella perfida*	386	122	31.6	1–30	452	3.7

Table 2

Size-dependent *Theragra chalcogramma* infestion

No	Date of examination	Number of fish examined	Fish total length (cm)	Fish weigth in g.	Number of parasite-free fishes	Length of parasite-free fishes	Weigth of parasite-free fishes
1	14.III.75	50	33.5–49	100–770	0	–	–
2	8.IV.75	50	33 –46	150–580	0	–	–
3	27.V.75	50	24 –33	40–130	19	24–26	40–110
4	12.XI.75	42	32 –44	160–630	0	–	–
5	28.XI.75	50	24 –46	120–750	0	–	–
6	14.I.76	50	25 –39	70–350	2	26–29	70–100
7	17.III.76	50	22 –31	50–130	8	24–27	50–110
8	18.III.76	44	31 –40	210–440	0	–	–
	Total	386	22–49	40–770	29	24–29	40–110

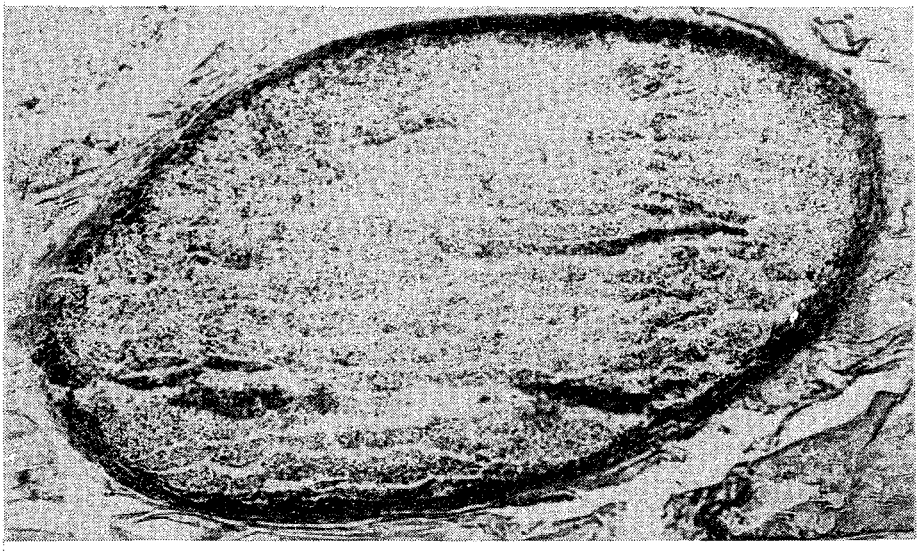


Fig. 2. Cross – section of a cyst of *Microsporidia gen. sp.*

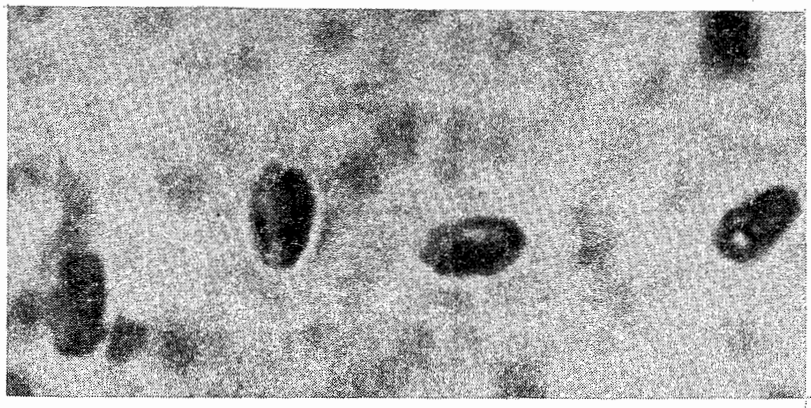


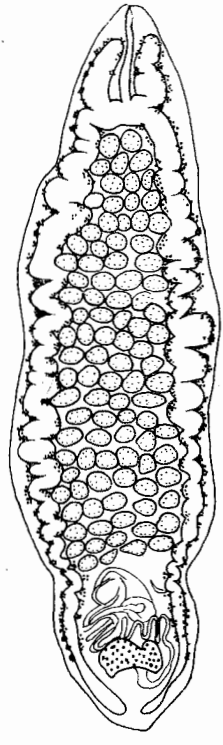
Fig. 3. Microsporidia spores of Alasca pollack

TREMATODA

Family: *SANGUINICOLIDAE (=Aporocotylidae)*

Aporocotyle simplex Odhner, 1900 (Fig. 4)

Medium-sized trematodes of 4–7×1–2 mm, lacking suckers. Typical of the species are numerous (more then 100) small nuclei filling the space between intestinal branches. Large oval ovary lies close to the end of the body. Characteristic is an H-shaped intestine.



A. simplex parasitises the blood system. The fishes studied yielded trematodes extravasated on the dissection, distributed loosely in gills, stomach lumen, on the intestine and between the viscera.

Four samples of whole Alaska pollack were infested in 2–4.7%. In the total of 5 fishes, i.e., in 1.3% on an average, these trematodes were found. The invasion intensity reached 11 parasites per one individual.

In the Far-Eastern Seas, the species was recorded by Zukov (1960) as well as by Mamaev and Baeva (1962–1963). The Soviet authors point to a strong infestation (up to 50%) of Alaska pollack with this trematode. The maximum number of 54 parasites was found in one fish individual. The trematode is harmless to man, a strong infestation of the fish blood system, however, bears an adverse effect on fish condition, the fact stated also by Mamaev and Baeva.

Fig. 4. *Aporocotyle simplex*

Family: *HEMIURIDAE*

Hemiurus levinseni Odhner, 1905 (Fig. 5)

Small trematodes of ca 2–4 mm length, occurring in stomachs and pyloric processes of a number of marine fishes.

During the present studies they were found in only 3 samples from March, April, and June 1975. The invasion incidence was 2–18% with a mean incidence of 3.1%; the intensity of invasion reached 12 parasites per one fish individual.

H. levinseni is common in Arctic seas. Many authors have noted its presence from off the Greenland coasts, from the Barents, White, Kara, Okhotsk, Bering, and Japanese Seas as well as off the Atlantic coast of the US and Canada.

The species is most common in gadid fishes, but its presence was also noted in various other fishes. According to Mamaev and Baeva (1962–1963) it is the commonest parasite of Alaska pollack. The authors showed a 77–100% invasion in *Th. chalcogramma,* the intensity reaching 247 individuals per one fish in the Okhotsk Sea and Pacific. Zukov's studies point to an equally heavy invasion in the Japanese Sea, the 100% infestation with 1–67 parasites per one fish being found.

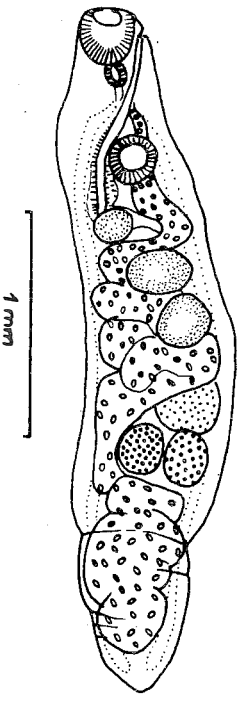


Fig. 5. *Hemiurus levinseni*

There is no data concerning any possible pathogenic effect of these parasites upon their hosts.

CESTODA

Order: *PSEUDOPHYLLIDEA*

Pyramicocephalus phocarum (Fabricius, 1780), plerocercoid (Fig. 6).

Large larvae reaching 5–6 cm length and 1–2 mm wide; a triangular, pyramid-like scolex clearly separated. The scolex up to 4 mm long, measuring 3 mm at its base. Two large attaching grooves with rippled margins are seen on the scolex.

The *P. phocarum* larvae were detected in 7 samples in the material studied. They were found mainly between pyloric processes, sometimes on the stomach, gonads, and intestine. One specimen was found in dorsal muscles just under the skin.

The invasion incidence ranged within 4–13.6%; on the average over the whole period studied plerocercoids were being found in 10.6% of the fishes examined. The maximum invasion intensity reached 4 parasites per one fish.

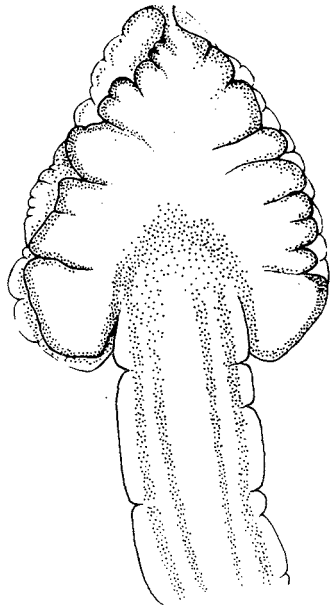


Fig. 6. *Pyramicocephalus phocarum*, plerocercoid scolex

P. phocarum was recorded by various authors off the Pacific coasts of America and Asia; its presence in fish was also noted in the Barents and White Seas.

Different fish species such as *Eleginus gracilis, Melletes papilio, Myoxocephalus verrucosus, Theragra chalcogramma, Cottidae,* are the parasite's intermediate hosts. Alaska pollack show a very heavy parasitisation at times. Mamaev and Baeva (1962–1963) found the incidence to range within 36–71% in the Kamtchatka waters, the invasion intensity reaching 119 plerocercoids per one fish. Whenever the liver was strongly attacked, the organ was observed to be destroyed (Šul'man and Šul'man – Al'bova, 1953).

Adult cestodes develop in seals (*Phoca barbata, Ph. hispida, Cystophora cristata, Eumetopias jubatus, Enhydra lutris*). Dogs can get infested and the cases of infestation in humans are known.

Order: *TETRARHYNCHIDEA*

Family: *TENTACULARIIDAE*

Nybelinia surmenicola Okada, 1929, larvae (Figs. 7, 8 and 9)

Blister-like larvae of this species with scolex drawn inwards, 4 completely developed bothridia and 4 probosces occur encysted in many marine fishes. Spherical white cysts of 1–4 mm diameter frequently contain 1–3 larvae up to 5 mm long in one common encasing. Sometimes the cysts are gathered in grapes often observed in the terminal part of abdominal cavity behind the anus.

Apart from the scolex, the larva has a short strobila with buds of gonads, the strobila being surrounded by a kind of blister, the so-called velum.

The *N. surmenicola* larvae appeared to be the parasites most commonly found in the fishes studied. They were revealed in all the samples; 38–96% (a mean of 74%) of fishes were infested, the invasion intensity reaching 60 larvae per one fish.

The larvae were present in various organs (stomach wall, intestine, pyloric processes, gonads); they were also encounterd lying loosely in the abdominal cavity. Most often they were found under the stomach mucosa (60.1%) where they formed palpable nodules, and in the abdominal cavity posterior part, usually attached to the terminal part of gonads. The larvae penetrated muscles as well. The greatest concentrations were found

near the anus, abdominal muscles showing a heavier infestation than dorsal ones (16.3 and 6.2%, respectively). The intensity of invasion in the dorsal muscles reached 14 larvae per one fish (Fig. 9).

In the whole fish studied, 1959 larvae were found altogether, of which number 90 larvae (4.6% of all of them) being found in the dorsal muscles.

In the spines examined, the larvae (disregarding those occurring on the cutting surfaces and in remains of abdominal muscles) were found in 4.8% of the properly cut spines, which is consistent with the previous result from unprocessed fish.

The *N. surmenicola* larvae occur in many fish species in the Pacific basin. Żukov (1960) found them in 16 species in the Soviet Far-Eastern waters; the most heavily infested were: *Cleisthenes herzensteini, Theragra chalcogramma, Pleurogrammus azonus, Myoxocephalus brandti*, and *Hippoglossus elassodon dubius*, the invasion intensity and incidence range amounting, respectively, in each species to: 100%: 11–104 parasites per one fish; 89.4%: 7–86; 75%: 1–59; 66.6%: 1–67; 53.3%: 1–65. The remaining species were invaded to a considerably lesser degree.

Various Soviet authors, like Strelkov (1960), Skrjabina (1963), Zukov (1960, 1963), Mamaev and Baeva (1962–1963) found the *N. surmenicola* larvae in *Th. chalcogramma*; the latter authors pointed to a very strong invasion in Alaska pollack of the Kamtchatka waters where the invasion incidence and intensity reached 93–100% and 205 larvae per one fish, respectively.

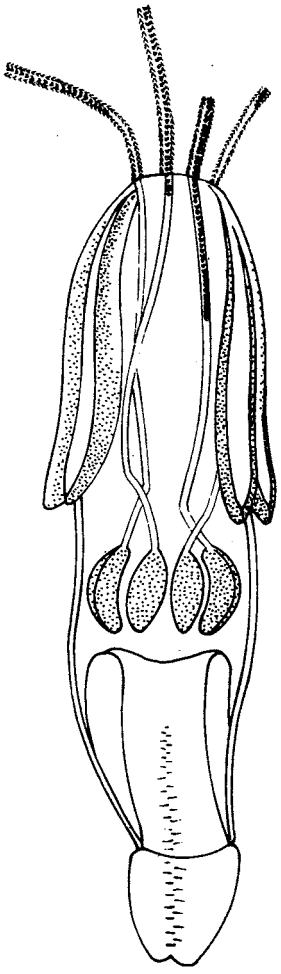


Fig. 7. *Nybelinia surmenicola*, larva

Sharks and skates are the definite hosts for *N. surmenicola*; the larvae do not invade man.

NEMATODA

Familly: *ANISAKIDAE*

Anisakis simplex (Rudolphi, 1908)

The third-stage larvae of this nematode, light-cream in their colour, their length ranging within 1.2–2.5 cm, occurred – coined in flat spirals covered with a thin transparent membrane of connective tissue – in every sample of whole fish. The invasion incidence ranged within 12–61.9% (a mean of 38.8%), while the invasion intensity was

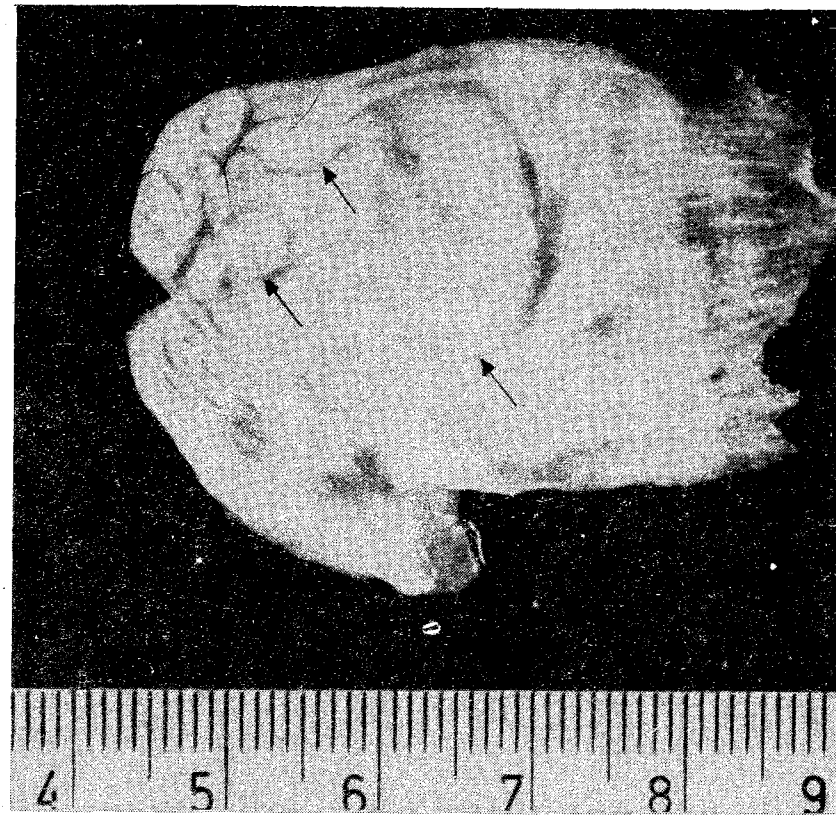


Fig. 8. *Nybelinia surmenicola* larvae beneath *Th. chalcogramma* stomach mucosa

1–9 larvae per one fish. The larvae occurred most frequently under the liver capsule as well as between pyloric processes, on the intestine, stomach, gonads, and in the abdominal muscles (Fig. 9).

The *Anisakis* larvae were frequently found in *Th. chalcogramma* by the Soviet workers. Żukov (1960) found the 100% infestation of the Japanese Sea *Th. chalcogramma* with the intensity range of 4–316 larvae per one fish, the larvae being concentrated mainly in the liver. A similarly heavy parasitisation of Alaska pollack was noted by Mamaev and Baeva (1962–1963) in the Okhotsk Sea and in the Pacific. The present author's own studies as well as those by the Soviet investigators indicate the invasion intensities to vary from one fishing ground to another.

The third-stage larvae are invasive to man. Therefore the fishes affected need to have a special treatment applied in order to prevent humans from an infection, which will be discussed to a greater length under the "Discussion" heading.

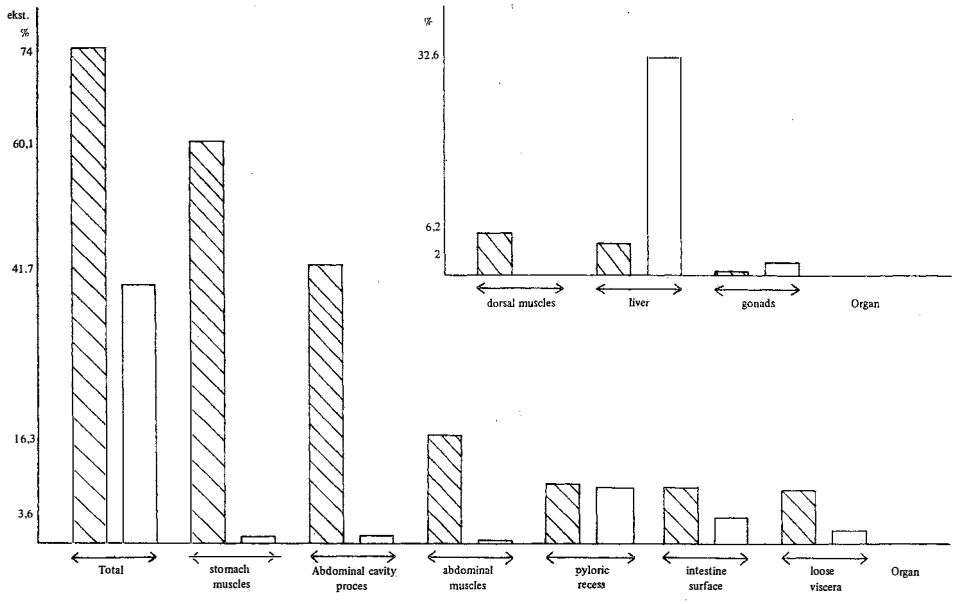


Fig. 9. Invasion incidence of *Nybelinia surmenicola* larvae (hatched blocks) and *Anisakis simplex* larvae (blank blocks) in various organs of *Th. chalcogramma*

Tynnascaris adunca (Rudolphi, 1802) (= *Contracaecum aduncum* (Rudolphi, 1802))

The third-stage larvae of *T. adunca* were found in every sample of whole Alaska pollack, the incidence ranging from 2 to 36% with a mean of 9.5%. The invasion intensity reached, at its maximum, 10 larvae per one fish (2.4 larvae on the average). Additionally, single adult specimens were found on three occasions in stomachs of fishes examined. The larvae dwelled mainly between pyloric processes (up to 10 individuals in one fish) as well as on the intestine, stomach, and in the liver. No parasite of this species was found in muscles, although these were reported to house the nematodes (Mamaev and Baeva, 1962–1963).

T. adunca is a nematode occuring commonly in many marine fish species as the third-stage larvae (in viscera), fourth-stage ones and adults being found in guts of predatory fishes. Particularly often the larvae are encountered in gadids. Many Soviet workers were noting their presence in fish from the Okhotsk and Japanese Seas as well as in the Pacific (Żukov, 1960; Skrjabina, 1963; Mamaev and Baeva, 1962–1963; Achmerov, 1951; Strelkov, 1956). Also the Bering Sea *Th. chalcogramma* revealed their presence (own data).

Phocanema decipiens (Krabbe, 1878) Myers, 1959) (= Porrocaecum decipiens = Terranova decipiens).

A singular brown-red 4 cm long larva was found in the dorsal muscles of a spine, another one in the liver of a whole *Th. chalcogramma*. The invasion incidence in spines and whole fish were 0.16 and 0.25%, respectively.

Larvae of this nematode settle usually in fish dorsal muscles, but specimens are found wandering in the abdominal cavity organs. In fish fillets they are well-visible due to their size and colour from brown to red; furthermore, muscles surrounding the larvar usually show congestion.

The nematodes were recorded from Alaska pollack by many Soviet authors who determined them as *Porrocaecum sp.* They presumably belong to *Ph. decipiens.*

The definite hosts for *Ph. decipiens* are seals; man can get infested by an accident. Recently, there have been reports on human infestations in Japan, USA, and Canada (Kagei et al., 1972; Suzuki et al., 1972; Little and Most, 1973; Kates et al., 1973; Juels et. al., 1975).

ACANTHOCEPHALA

Echinorhynchus gadi Zoega in Müller, 1776

Large orange acanthocephalans commonly found in marine and migratory fishes of the northern hemisphere, particularly often met with in gadid intestines.

E. gadi was the commonest parasite in *Th. chalcogramma* individuals studied. The invasion incidence in the samples checked was 66–98%; on the average 87.3% of fish were affected. The invasion intensity reached 118 acanthocephalans found in an intestine of one fish.

E. gadi were being found in the USSR Far-Eastern Seas by numerous authors (Strelkov, 1960; Żukov, 1960; Skrjabina, 1963; Mamaev and Baeva, 1962–1963).

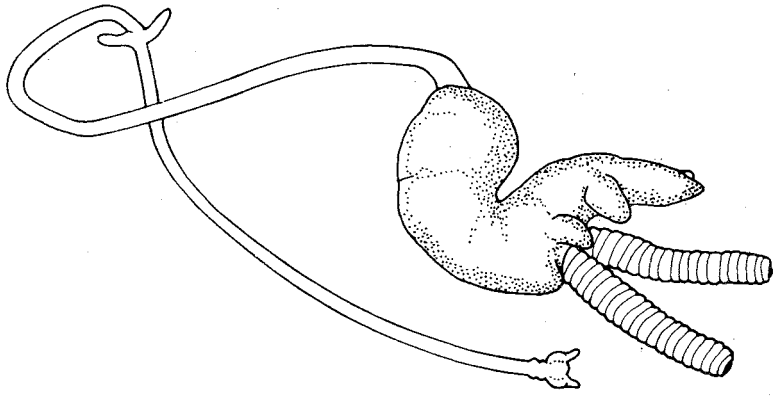


Fig. 10. *Haemobaphes diceraus*

PARASITIC COPEPODS (*COPEPODA PARASITICA*)

Family: *LERNAEOCERIDAE*

Haemobaphes diceraus Wilson, 1917 (Fig. 10)

Large parasitic copepods occurring on Alaska pollack gill arches; they dwell attached to an arch between two rows of gill lobes. The anterior part of a parasite's body in a form of a thin long neck is contained within an afferent blood vessel and truncus arteriosus, while the parasite's head reaches the bulbus arteriosus. On a single fish, one parasite individual is found most of the times, on occasions there being a pair attached to two different gill arches. The invasion intensity is limited by a diameter of the truncus arteriosus which is completely filled by two parasites deforming it. A thick S-shaped thorax and abdomen of the parasite stick out externally on the arch. The external part of the thorax and abdomen measures 15 mm, egg sacs are 8–15 mm long. The neck is of a variable length depending on the attachment site, the range being 29–43 mm.

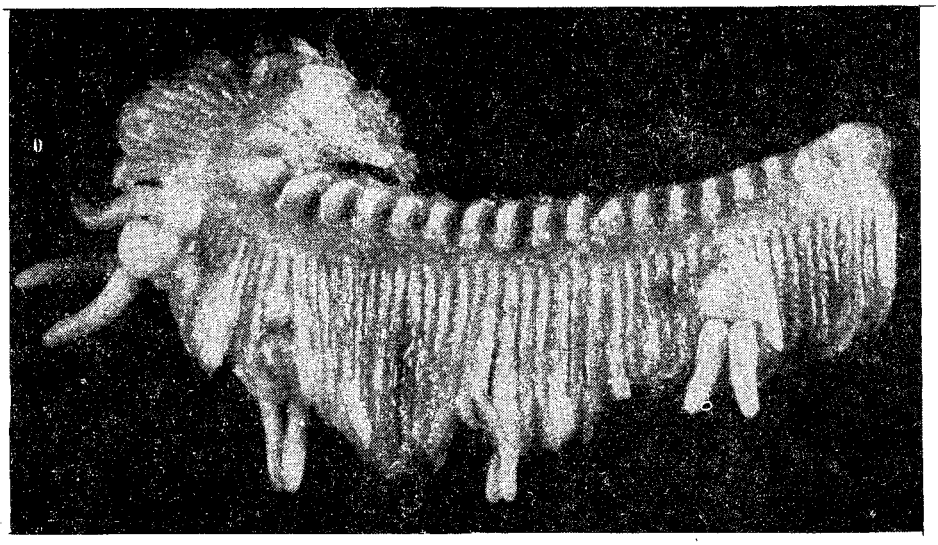


Fig. 11. *Clavella perfida* on Alaska pollack gills

In place of the parasite's attachment the gill lobes are shortened or completely atrophied. The parasite feeds on fish blood causing therefore large emboliae in blood vessels; furthermore, it damages vast areas of the internal membrane of vessels, which undoubtedly affects adversely the gill circulation system of a fish (J. Grabda, 1975).

H. diceraus is fairly often found on Alaska pollack. The species occurred in 6 samples examined, the invasion incidence ranging within 8.4–42%. A mean invasion incidence was 12.6%.

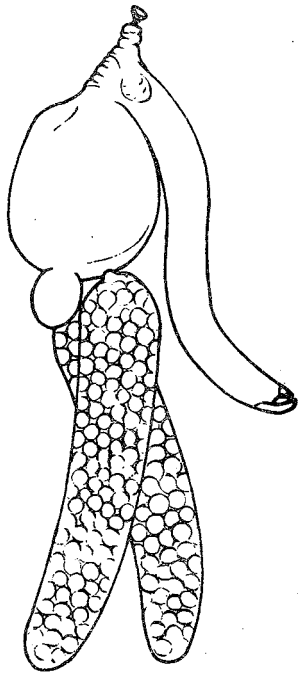


Fig. 12. *Clavella perfida:* a female

The species was described by Wilson (1917) from *Chaeturichthys scistius* off the Pacific coast of Asia (Japan, Hakkodate), then by Kabata (1967) from *Cymatogaster aggregata* off the British Columbia (Canada) coasts.

Family: *LERNAEOPODIDAE*

Clavella perfida Wilson, 1915 (Figs. 11, 12 and 13)

A specific parasite of *Th. chalcogramma*. Only a female is parasitic; it attaches itself to gill lobes by means of a funnel-like bulla. The female's length reaches 6 mm. Dwarfed males 0.5 mm long live attached to various places of the female body, several males being at times found on one female.

The parasite is fairly frequently found on Alaska pollack gills. In the studies presented, all the samples checked contained the parasite, the invasion incidence ranging within 18.1–42%. The invasion intensity range was 1–30 parasites per one fish individual.

The parasites caused an intensified excretion of mucus on gills as well as shortening of gill lobes in places ot attachment.

C. perfida was found and described by Wilson (1915) from the Pacific coast of North America. Gusev (1951) and Markiewicz (1956) reported its presence from the Asiatic coasts (Japanese Sea).

INFESTATION IN ALASKA POLLACK SPINES

The total number of 600 spines of the "spinka" type, i.e., 12 samples pf 50 individuals each were examined. The samples were collected from different batches in order to ensure as wide-range material as possible. Only two samples (100 spines) were parasite free, the remaining 10 samples contained 5 parasite species, namely:

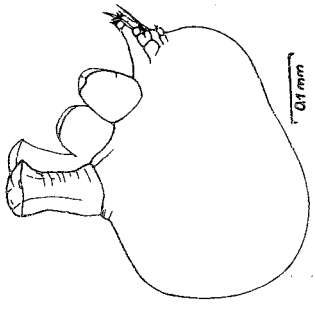


Fig. 13. *Clavella perfida:* a male

1. *Microsporidia gen. sp.*
2. *Nybelinia surmenicola*, larvae
3. *Pyramicocephalus phocarum*, larvae
4. *Phocanema decipiens*, larvae
5. *Echinorhynchus gadi*

Usually one parasite species occurred in spines. A mixed infestation with 2 species (*N. surmenicola* and *Microsporidia*) was recorded from 4 spines only. As little as 9% of spines were infested.

Microsporidia in the form of fine (2–4 mm long) oval white cysts occurred in 10 spines (1.6%). No pathologic lesions were observed in the spines infested.

N. surmenicola is the commonest parasite in spines. Larvae of this cestode were recorded from 8 samples out of 12 examined. The invasion incidence ranged from 2 to 16%, while the intensity reached 15 larvae per one spine. Spines were found in which the *N. surmenicola* larvae occurred on the cutting surfaces, remains of kidneys, and on partially left abdominal muscles in fishes improperly cut.

In dorsal muscles of 29 spines the cestode larvae occurred in numbers ranging from 1 to 15.

Pyramicophalus phocarum: only one larva was found in *Th. chalcogramma* dorsal muscles. Larvae of this cestode occur as a rule between the organs in the body cavity.

The *Phocanema decipiens* larva was found only in one spine of *Th. chalcogramma* (0.16% infestation). Compared to other gadids, *Th. chalcogramma* infestation with this nematode is relatively weak. A due caution should be exercised, however, as the instances are known of this parasite infesting man.

Echinorhynchus gadi was found, on the cutting surfaces, in two spines, one specimen on each. This seems to be an accidental contamination of spines with a parasite usually abundant in *Th. chalcogramma* intestine.

DISCUSSION

Eleven parasitic species were revealed to occur in whole individuals of *Th. chalcogramma*; this is not, however, a full list of Alaska pollack parasites known so far. Fine and delicate species of parasites are destroyed in frozen material, particularly so protozoans as well as monogenetic and digenetic trematodes. According to the Soviet specialists, a list of parasites dwelling in *Th. chalcogramma* encompasses more than 30 species of various taxa. Their invasion intensities differ from one fishing ground to another evidencing the occurrence of different stocks of Alaska pollack over the area under consideration (Achmerov, 1951; Mamaev and Baeva, 1962–1963).

The degree of infestation in *Th. chalcogramma* varies depending on fish size. Small fishes, 24–26 cm long weighing 50–100 g, i.e., those presenting no commercial value were completely parasite-free (Table 2). Larger fish, on the other hand, were not once invaded by 2 to 6 species of parasites occurring jointly. Indoubtedly the presence of a larger number of parasites is not indifferent to the fish affected. Studies made by various workers on effects of parasites on fish organisms showed the infested fish to contain a smaller number of erythrocytes, a lower amount of haemoglobin in blood, and a lower hematocrit as well as to exhibit a total protein deficiency in blood serum; there are also rearrangements within the globulin fraction. The total fish metabolism is affected and the fat content decreases in tissues of a fish infested. The changes are proportional to the number of parasites in the fish concerned (Mann, 1952–1953; Kabata, 1958; Eiszporn-Orecka, 1970; and others).

No parasite species should be disregarded as their action directed at a fish is summed

up; particularly hazardous are the blood system parasites such as *Aporocotyle simplex* and *Haemobaphes diceraus*. This latter species is – similarly to *Lernaeocera branchialis* in cod – especially dangerous to the fish (J. Grabda, 1975).

Eventually the fishes, when strongly infested, are anemic and emaciated, their flesh loosing thus its nutritional value.

Parasites dwelling in fish muscles are of the greatest significance from the fish processing technology point of view. According to the Polish sanitary standards, the presence of parasites in a fish eliminates it from consumption. The parasites concerned are: larvae of cestodes *Nybelinia surmenicola* and *Pyramicocephalus phocarum* as well as larvae of nematodes *Anisakis simplex* and *Phocanema decipiens*. The *Anisakis, Phocanema*, and *Pyramicocephalus* larvae are invasive to man and as such are subject to a strict control. On the other hand, man cannot get infested with the *Nybelinia* larvae, but they are relatively well-visible in a fish, therefore disqualify the flesh as an aversion-causing product.

Owing to the heavy infestation, Alaska pollack had not been caught by the Soviet fishermen for human consumption over many years. As late as in the sixties Mamaev and Baeva, on the basis of detailed parasitologic studies worked out a method for processing the species in a way rendering the ample resources ready to be consumed. The authors noted the parasites to occur mainly in the abdominal cavity organs as well as in the abdominal muscles as presented on a diagram (Fig. 14) where the density of dots corresponds to the density of parasites and a black spot indicates a place of their maximum concentration. Mamaev and Baeva discussed 3 parasitic species, i.e., those of the greatest practical importance: *N. surmenicola, A. simplex,* and *C. aduncum*. As seen on the figure, the parasites inhabit only the fish abdominal muscles, the dorsal ones being parasite-free. Consequently, when cutting the fish along the broken line indicated immediately below the backbone, from the head to the second dorsal fin, all the infested parts are rejected and only a consumable spine, so-called "spinka" or "balyk" remains.

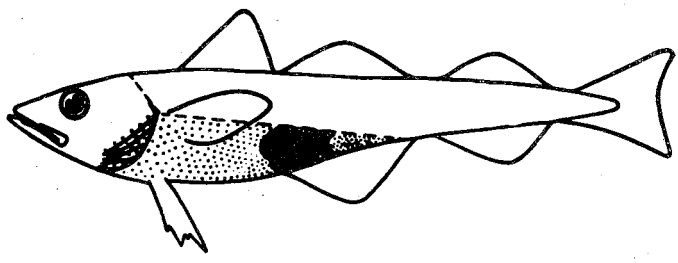


Fig. 14. Diagram of *Th. chalcogramma* muscles parasitisation (after Mamaev and Baeva, 1962–1963)

According to these authors, dorsal and tail muscles contain but a very few parasites if they occur there at all. Thus spines are produced of Alaska pollack both for the domestic market and for export.

The Soviet authors point out to the fact that in fish flesh gone bad parasites begin to disperse, penetrating also the dorsal muscles. Therefore they stress the utter need to use only fresh fish to the production of spines.

While proposing their method for processing *Th. chalcogramma*, Mamaev and Baeva take no account of the fact that heavily parasitised flesh of Alaska pollack in inferior in its quality. Moreover, the pathogenic effects of *Anisakis* and *Phocanema* larvae on man were not known at the time.

The method proposed, although eliminating most parasites, leaves a considerable number of them in dorsal parts. The present investigations revealed 5 parasite species there; the *Nybelinia surmenicola* larvae incidence reached 16%, the intensity of invasion being up to 15 larvae per one spine. *Phocanema* and *Pyramicocephalus* occurred as single individuals but as the parasites pathogenic to man they should be eliminated.

Thus the imported spines of *Th. chalcogramma* should be additionaly checked for parasites and the ones possibly occurring wiped out before the fishes can be marketed.

Alaska pollack spines are imported frozen to Poland. As the studies on the nematode low temperature resistance have shown, the fishes must be frozen ar least down to $-20^{\circ}C$ in each part of a block and kept at this temperature over 24 hours at the shortest (according to the Dutch regulations). Bier (1976) showed this period to be too short to kill anisakine nematodes. He found the *Contracaecum* larvae to survive 52 hours at $-20^{\circ}C$, therefore the freezing time should be appropriately prolonged to ensure death of all larvae.

CONCLUSIONS

The following conclusions can be drawn from the author's own studies confronted with the Soviet investigations:

1. Alaska pollack is heavily parasitised with numerous species of parasites of various taxa. A mixed infestation with several species is noted frequently.
2. The presence of a large number of parasites decreases the nutritional value of fish flesh. Blood system parasites such as *Haemobaphes diceraus* and *Aporocotyle simplex* are particularly detrimental to fish, being the direct factors decreasing the fish general metabolism.
3. Alaska pollack contain parasites invasive to man such as *Anisakis simplex*, *Phocanema decipiens*, and *Pyramicocephalus phocarum;* handling the fishes infested with them calls for a particular caution and protection measures to be taken.
4. Alaska pollack processed to obtain spines is by no means parasite-free. Out of the eleven species found in whole fishes, five were revealed in spines, those invasive to man in their number (*Ph. decipiens* and *Pyramicocephalus phocarum*).
5. In order to destroy the pathogenic parasites dwelling in *Th. chalcogramma* spines, the freezing temperature not higher than $-20^{\circ}C$ should be maintaied.
6. Alaska pollack spines should be examined in detail and the parasites possibly occurring in them eliminated before the fishes are marketed.

7. Due to a lower quality of Alaska pollack flesh resulting from a heavy infestation, and owing to the need of additional examinations, the species is of a little attractiveness to the fish market in Poland.

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Translated: mgr Teresa Radziejewska

BADANIA NAD ZAPASOŻYCENIEM I PRZYDATNOŚCIĄ DO SPOŻYCIA MINTAJA (*Theragra chalcogramma)*

Streszczenie

W latach 1975–1976 przeprowadzono badania nad stanem zarażenia pasożytami mintaja (*Theragra chalcogramma*) importowanego z ZSRR oraz ocenę skuteczności metody obróbki mintaja w formie grzbietów, opracowanej przez Mamaeva i Baevą (1963) celem likwidacji pasożytów.

Zbadano 386 ryb pełnych i 600 sztuk grzbietów mintaja. Mintaje były zarażone w 92,3%. Znaleziono w nich 11 gatunków pasożytów z różnych grup systematycznych. Stwierdzono tu 3 gatunki chorobotwórcze dla człowieka, a mianowicie: larwy III stadium *Anisakis simplex* i *Phocanema decipiens* oraz plerocerkoidy *Pyramicocephalus phocarum.*

Grzbiety były zarażone w 9%. Stwierdzono tu 5 gatunków pasożytów w tym również 2 gatunki chorobotwórcze dla człowieka jak larwy *Phocanema decipiens* i *Pyramicocephalus phocarum.* Pozostałe gatunki nieszkodliwe ale dyskwalifikujące grzbiety jako budzące odrazę u konsumenta.

Obróbka mintaja w formie grzbietów, jakkolwiek znacznie zmniejsza stopień zapasożycenia, to jednak nie usuwa całkowicie pasożytów i wymaga stosowania również innych zabiegów technologicznych, aby uzyskać produkt nie zagrażający człowiekowi i odpowiadający wymaganiom sanitarnym.

Я. Грабда

ИССЛЕДОВАНИЯ НАД ЗАРАЖЕНИЕМ ПАРАЗИТАМИ И ПИЩЕВОЙ ПРИГОДНОСТЬЮ МИНТАЯ (THERAGRA CHALCOGRAMMA)

Р е з ю м е

В 1975-1976 гг. были проведены исследования над степенью заражённости паразитами минтая (Theragra chalcogramma), импортированного из СССР, и произведена оценка эффективности метода разделки минтая на спинку, разработанного Мамаевым и Баевой (1963) для уничтожения паразитов.

Исследованиям подвергли 386 цельных рыб и 600 штук спинок минтая. Рыбы были заражены на 92,3%. В них обнаружено 11 видов паразитов из разных систематических групп. Среди них обнаружено 3 болезнетворных, опасных для человека вида, а именно: личники в III стадии Anisakis simplex, Phocanema decipiens а также плероцеркоиды Pyramicocephalus phocarum.

Спинки были заражены на 9%. В них обнаружено 5 видов паразитов, в том числе 2 болезнетворных, опасных для человека личинки Phocanema decipiens и Pyramicocephalus phocarum Остальные виды были безвредными, однако их присутствие придавало нетоварный вид продукту.

Разделка минтая на спинки, хотя и уменьшает значительным образом степень заражённости паразитами, не ликвидирует, однако, полностью паразитов и требует применения других технологических приёмов для получения товарной продукции, безвредной для человека и соответствующей санитарным требованиям.

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