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THE MONOGENETIC TREMATODES OF THE FAMILY

TETRAONCHIDAE BYCHOWSKY, 1937

by

O.N. Pugachev

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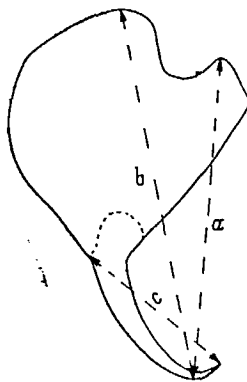
Information seulement

The species of the genus Tetraonchus obtained from different species /30* of coregonoid fishes are revised. The new species Tetraonchus grumosus is described; it differs from T. alaskensis Price, 1937, in the shape of the hamuli and the large dimensions of the chitinous parts of the opisthaptor and of the copulatory organ. T. cylindraceous Pronin, 1966 is reduced to a synonym of T. variabilis Mizelle et Webb, 1953. Three forms of the species T. borealis (Olsson, 1893) are distinguished.

Until now it has been thought that the coregonoid fishes in water bodies of the USSR are parasitized by two species of the genus Tetraonchus: T. alaskensis Price, 1937 and T. cylindraceous Pronin, 1966. The first has been noted on the following hosts: the arctic char (Salvelinus alpinus), the malma (S. malma) the Sakhalin char or "kundzha" (S. leucomaenis), the silver salmon (Oncorhynchus kisutch), the omul (Coregonus autumnalis), the peled (C. peled), the broad whitefish or "chir" (C. nasus), the pizhyan (C. lavaretus pidschan), the nelma (Stenodus leucichthys nelma), and arctic grayling (Thymallus arcticus) [Bauer, 1948a and 1948b; Petrushevskii et al., 1948; Strelkov, 1962;

*Numbers in the right-hand margin refer to the corresponding page in the Russian text.--Translator.

Figure 1: Diagram of hamuli measurements based on Gläser [1965]



KEY to abbreviations appearing in figures 2-7:

- VH = ventral hamulus
- DH = dorsal hamulus
- CB = connecting bar
- FB = fan-shaped bar
- MH = marginal hook
- CO = copulatory organ

Ekimova, 1971; Konovalov, 1971; Razmashkin and Kashkovskii, 1977; etc.].

The second species was described from the gills of the American round whitefish (Prosopium cylindraceum) from the Chara River.

While investigating the parasitofauna of fishes of water bodies in the northeastern USSR, we discovered representatives of the genus Tetraonchus in different species of salmonids and coregonoids. The worms from whitefish differed noticeably from the worms from arctic char in morphology and in the dimensions of some elements of the adhesive apparatus, permitting us to isolate them as a new species. While identifying the material, we ran up against the lack of a unified plan for measuring the elements of the opisthaptor. In particular, there is hardly any sense in measuring the shaft of the hamuli* since there is a tendency for them to "fuse" with the main part of the hook. It is therefore advisable to measure the hamuli according to the system of Gläser [1965], which has already been accepted for measuring the hooks of other lower monogenetic trematodes. Because of the structural features of the opisthaptor of the Tetraonchidae, it is necessary to alter the designation of some measurements in this system, since the concept of dorsoapical and ventroapical lengths will differ for the dorsal and ventral hamuli. We should therefore speak of the inner and outer length in relation to the hook itself, and not designate these measurements according to the position of the hamulus in the opisthaptor (Figure 1).

1. Tetraonchus alaskensis Price, 1937

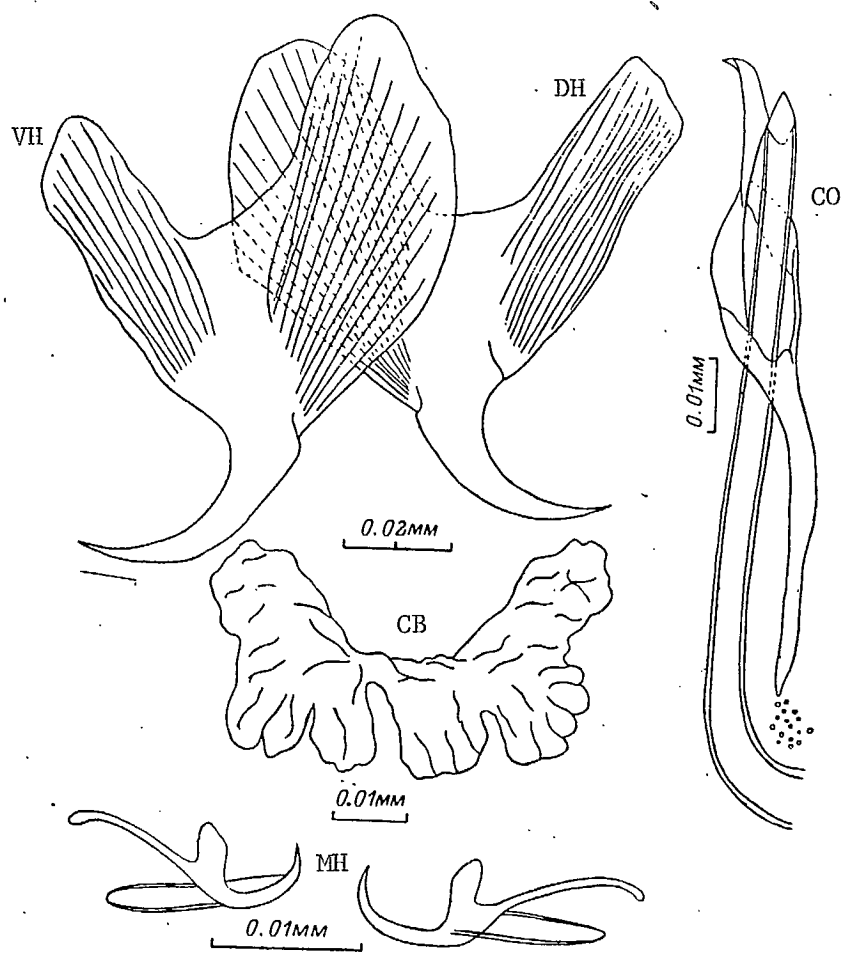
(Figure 2; Table 1)

Hosts: Salvelinus allus, S. malma, S. leucomaenis, Oncorhynchus kisutch.

Localization: gills.

*Russian sredinnyi kryuchok is literally "median hook".--Translator.

Figure 2: Tetraonchus alaskensis



(Note: all measurements in tables are expressed in μm ; bracketed figures show the range of variability.)

Table 1: *Tetraonchus alaskensis*

Feature	Price, 1937	Strelkov, 1962	Mizelle and Crane, 1975	Our data
VH (ventral hamulus)				
inner length	107	62-87	88 (84-97)	88.5 \pm 1.97 (83.9-90.3)
outer length				99.6 \pm 1.91 (87.7-107.0)
length of base	-	-	-	60.4 \pm 1.1 (55.0-65.8)
length of blade	-	-	-	42.9 \pm 0.68 (41.3-45.2)
DH (dorsal hamulus)				
inner length	110	77-104	96 (90-101)	88.3 \pm 0.82 (83.8-92.9)
outer length				97.3 \pm 0.8 (92.9-101.2)
length of base	-	-	-	57.1 \pm 0.54 (52.9-63.2)
length of blade	-	-	-	41.2 \pm 0.47 (38.7-43.9)
CB (connecting bar)				
length	30-35	23-39	42 (15-50)	25.3 \pm 1.35 (23.2-40.0)
width	20-25	12-14	-	8.9 \pm 0.73 (4.4-15.4)
MH (marginal hook)				
overall length	12	15-17	20 (19-20)	17.7 \pm 0.33 (15.4-21.0)
length of shaft	-	-	-	9.5 \pm 0.63 (7.7-11.0)
Length of tube of copulatory organ	80	94-109	106	91.8 \pm 3.22 (72.6-118.6)
Length of supporting structure of copulatory organ	60	72-90	104 (90-120)	75.2 \pm 2.47 (62.0-87.2)
Hosts	Mikizha Malma Coho	Mikizha Malma Coho Arctic grayling?	Malma	Kundzha Malma White char

Distribution: rivers of the Pacific Ocean basin.

The ventral and dorsal hamuli are similar in shape and size, with a clearly distinct blade, with different inner and outer roots on the basal part. The transition of the blade into the base is clearly delineated. Both roots have longitudinal striation, while their free ends have an uneven margin, to which are attached muscles that produce the movement of the hamuli. The connecting bar is irregular in shape and extremely variable. There are fan-shaped bars, but they differ from those of other species of the genus. They are larger, giving the appearance of a system of rods whose ends are sclerotized to some extent. Rods in glycerin-gelatin preparations differ from muscle fibers in their structure. The localization of these structures in the opisthaptor enables us to distinguish them from the fan-shaped lamellae.* There are 8 pairs of marginal hooks, as in all the representatives of this family, with a clearly pronounced heel and a long shaft, with sabre-like point. The copulatory apparatus consists of a wide and long tube, the distal end of which is usually bent at a right angle, and a supporting structure, which is shorter than the tube and envelopes it.

Morphometric data are found in Table 1 and a general description of this species is given below.

Length of body 2.8, width up to 0.7 mm. Length of marginal hooks 0.015-0.021 mm. Dorsal hamuli: inner length 0.084-0.095, outer length 0.092-0.101; length of base 0.053-0.063, of blades 0.040-0.046 mm. The dimensions of the connecting bar are 0.004-0.025 x 0.023-0.040, of the fan-shaped bars 0.018 x 0.025, the length of the tube of the copulatory organ 0.073-0.119, of the supporting part 0.060-0.120 mm.

The geographic range of T. alaskensis evidently corresponds to the geographic range of the Pacific group of salmonid fishes. It will only be

*Russian veeroobraznye plastinki may be rendered as fan-shaped lamellae, plates, or bars.--Translator.

possible to determine the geographic range of this species definitively after a study of the worms from the sea trout and Atlantic salmon of the Kola Peninsula and from the arctic char, since earlier works [Dogel' and Markov, 1937; Mitenev, 1973] contain incomplete descriptions of the worms' morphology.

2. Tetraonchus grumosus sp. n.

(Figure 3; Table 2)

(Syn: T. arcticus Bychowsky n. nud. Bauer, 1948 in part; T. alaskensis in Trofimenko, 1969; T. alaskensis in Ekimova, 1976; T. alaskensis in Rasmuschkin et Kaschkowsky, 1977).

Host: Coregonus nausu, C. peled, C. autumnalis.

Localization: gills.

Distribution: the Anadyr', Kolyma, Lena, Ob', Pechora rivers.

/33

Fifteen worms were examined from broad whitefish and a like number from omul. Length of body up to 3.5, width up to 1 mm. Length of marginal hooks 0.018-0.022 mm. Dorsal hamuli: inner length 0.084-0.084-0.141, outer length 0.064-0.123; length of base 0.056-0.100, of blade 0.030-0.46 mm. The dimensions of the connecting bar are 0.010-0.043 x 0.022-0.060, of the fan-shaped bars 0.023 x 0.030 mm. The length of the tube of the copulatory organ 0.074-0.112, of the supporting part 0.067-0.092 mm.

The ventral and dorsal hamuli differ in shape and dimensions. In the dorsal hamuli the inner length is greater than the outer, while the relationship in the ventral hamuli is the opposite. In some cases the roots of the hamuli are not visible. The transition of the blade into the base is distinct; the base often has excrescences or protuberances differing from the "elegant" striation of T. alaskensis. The connecting bar is not constant in shape. The fan-shaped bars are similar to the bars of T. alaskensis in structure.

Figure 3: *T. grumosus* sp. n.

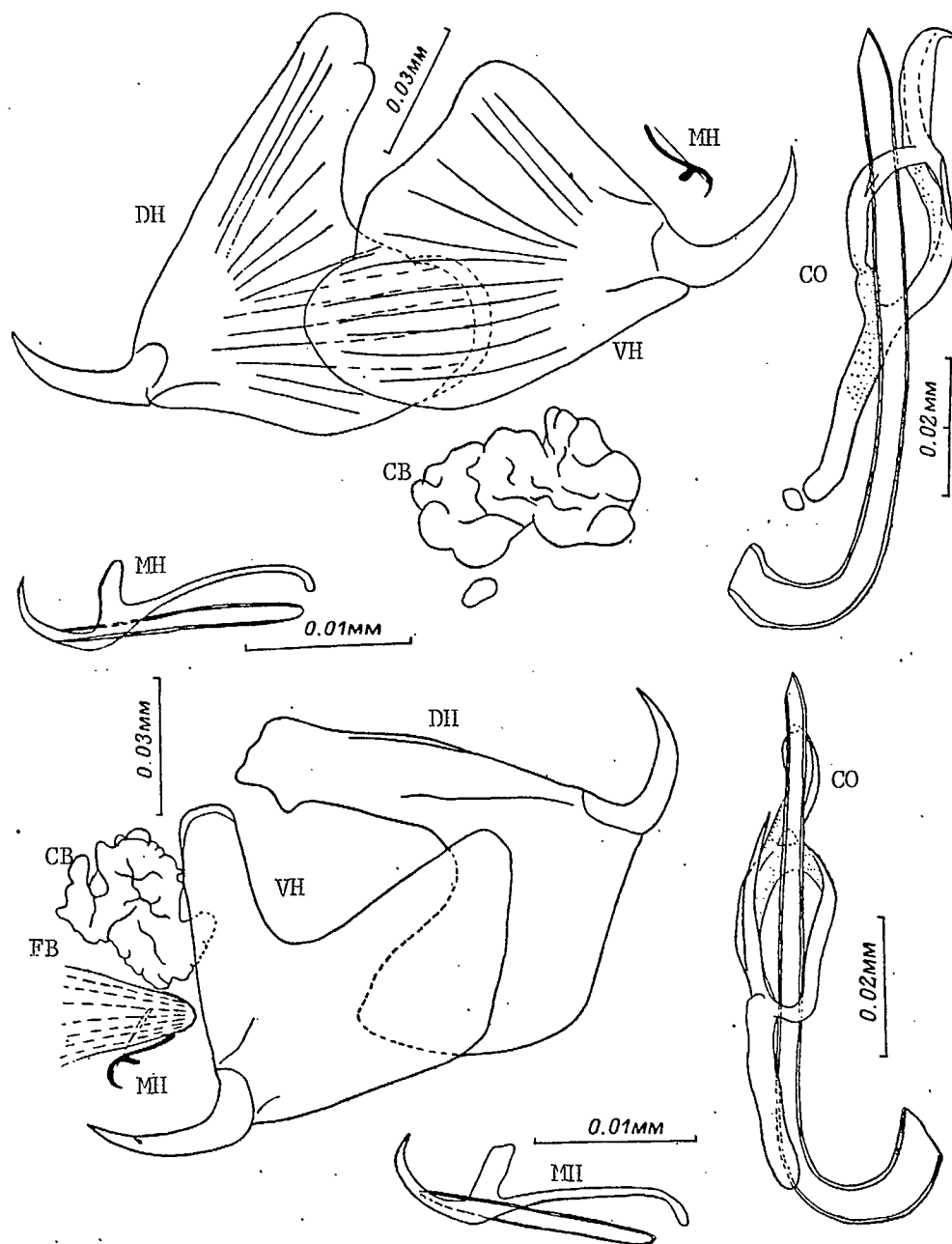


Table 2: Tetraonchus grumosus

Feature	Razmashkin & Kashkovskii, 1977		Our data	
	Peled	Chir	Chir	Omul
VH (ventral hamulus)				
inner length	95.2 (84.0-106.4)	117.6 (109.2-126.0)	117.67±1.18 (111.0-122.6)	124.7±1.85 (117.6-141.4)
outer length	82.6 (64.4-100.8)	114.8 (109.2-120.4)	111.83±1.23 (104.5-120.0)	116.01±1.23 (103.6-123.2)
length of base	78.4 (56.0-100.8)	67.6 (61.6-73.6)	73.54±2.36 (69.7-81.2)	75.69±1.63 (60.2-84.0)
length of blade	32.2 (30.8-33.6)	36.4 (30.8-42.0)	38.59±0.42 (34.8-41.3)	34.3±0.63 (32.2-42.0)
DH (dorsal hamulus)				
inner length	74.2 (64.4-84.0)	89.6 (84.0-95.2)	85.79±0.53 (78.7-90.3)	87.64±1.48 (74.2-96.6)
outer length	109.2 (98.0-120.4)	120.4 (100.8-140.0)	124.7±1.54 (113.5-131.6)	129.44±1.18 (120.2-137.2)
length of base	65.8 (53.2-78.4)	67.2 (56.0-78.4)	76.82±1.41 (65.8-82.0)	74.11±1.78 (64.4-89.6)
length of blade	32.2	36.4	42.27±0.68	36.87±0.45
CB (connecting bar)				
length	40.5 (28.0-53.0)	16.8 (14.0-19.6)	19.12±1.12 (11.6-21.9)	24.12±2.44 (9.9-42.0)
width	39.0 (22.0-56.0)	49.0 (42.0-56.0)	52.33±1.7 (46.6-60.6)	55.0±1.83 (37.8-60.2)
MH (marginal hook)				
overall length	18.7 (18.1-19.3)	20.4	19.57±0.15 (18.7-21.0)	20.97±0.17 (20.0-21.6)
length of shaft	11.5 (11.0-12.0)	12.0	11.94±0.15 (11.0-13.2)	13.17±0.11 (12.8-13.6)
Length of tube, copulatory organ	80.8 (73.6-98.0)	106.0 (100.8-112.0)	98.86±1.22 (90.2-105.8)	103.13±1.10 (96.6-110.6)
Length of supporting piece, copulatory organ	72.8 (67.2-78.4)	89.5 (78.4-90.7)	80.07±0.84 (74.8-84.7)	81.85±1.19 (75.6-92.4)

Note: the data of Razmashkin and Kashkovskii are from the Ob' River; our data are from the Anadyr' and Kolyma for the chir and from the Lena for the omul.

There are 8 pairs of marginal hooks. The tube of the copulatory organ is thinner and longer than that of T. alaskensis and its distal end bends at a right angle and frequently forms a small ring-like bend. The egg is oval in shape with a "knob" located on the apical end. The dimensions of the egg are 0.076 x 0.061 mm.

T. grumosus differs from T. alaskensis in the shape and dimensions of the hamuli, in their more developed base and its sculpture, in a larger connecting bar, in longer marginal hooks and in their more developed shaft. The holotype No. 10 780 and the paratypes are preserved in the collection of the Zoological Institute, USSR Academy of Sciences.

The smaller dimensions of worms from the peled [coregonus peled] draw attention to themselves (Table 2). This may result from a number of causes. First of all, the peled were dying at this time (infestation reached 2330 specimens of individual fish). An increase in population to such dimensions may also influence the dimensions of the adhesive organs. It should be noted that the dimensions of the hamuli decrease at the same time that the length of the marginal hooks vary insignificantly [Razmashkin and /35 Kashkovskii, 1977]. Secondly, monogenetic trematodes rarely cause epizootic in their customary hosts in nature. The pathogenic effect in the case of peled infestation leads us to think that the peled is not exactly the common host of this species and that the parasite-host system is insufficiently balanced and young. Thirdly, this may be the result of geographic variability. In order to be able to deal with these matters, it is necessary to study the dynamics of peled infestation for different age classes and at different seasons while also examining the morphology of the worms.

3. Tetraonchus variabilis Mizelle et Webb, 1953

(Figure 4)

(Syn.: Tetraonchus cylindraceus Pronin, 1966).Host: Prosopium cylindraceum.Localization: gills.Distribution: the Anadyr', Kolyma, and Chara rivers and water bodies in North America.

Hamuli with small thick blade and well-developed base. The connecting bar is small and rod-shaped; it may sometimes be absent. The short, thick, straight tube of the copulatory organ encompasses the supporting apparatus. The fan-shaped bars are indistinct.

This species was first described from the gills of Posopium cylindraceum and P. williamsoni [Mizelle and Webb, 1953] from water bodies of Canada and Alaska. These worms were first found in the USSR by Pronin [1966] and described as the new species T. cylindraceus. Having compared our data with the first descriptions, we came to the conclusion that T. cylindraceus Pronin, 1966 is a synonym of T. variabilis Mizelle et Webb, 1953. Our specimens had a somewhat smaller connecting bar than did Pronin's specimens, but this variability falls within the limits indicated in the original description given for the formation of the opisthaptor of T. variabilis.

We are presenting below a description of this species according to our materials and to the data of other authors.

Length of body up to 2.6, width up to 0.50 mm. Length of marginal hooks 0.013-0.016 mm. Dorsal hamuli: inner length 0.090-0.120, outer length 0.090-0.135 mm; length of base 0.052-0.066, of blade 0.028-0.040 mm. Ventral hamuli: inner length 0.060-0.100, outer length 0.100-0.145 length

Figure 4: T. variabilis

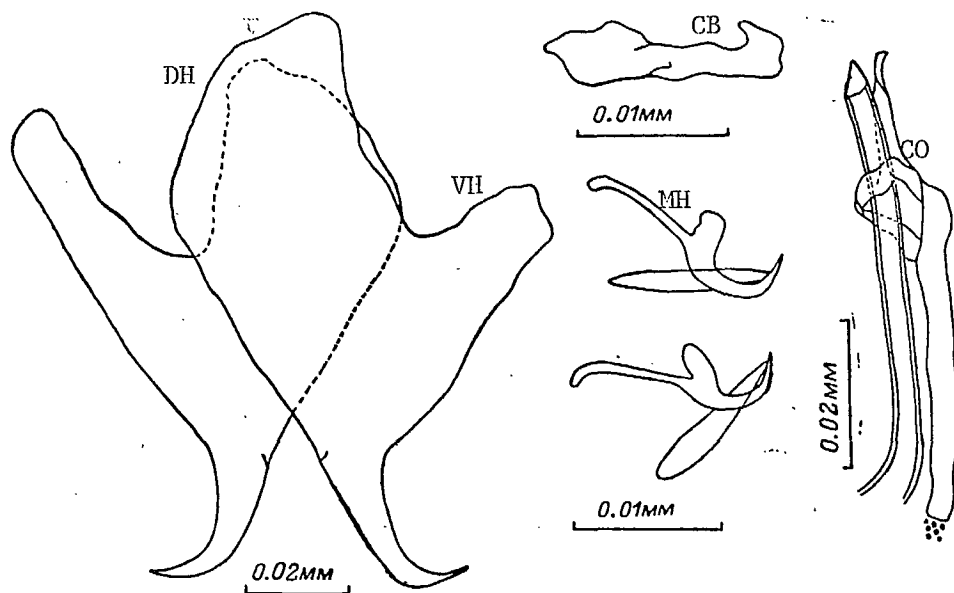
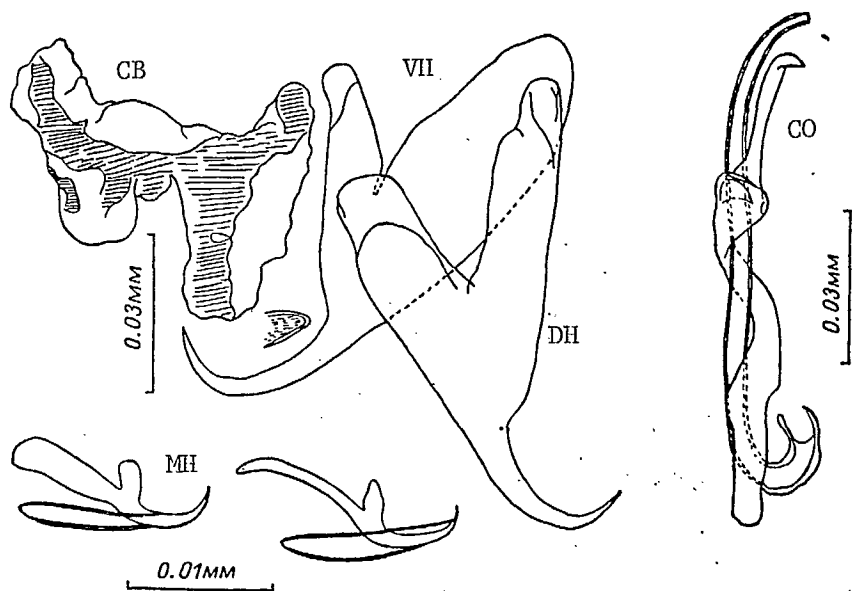


Figure 5: T. borealis forma typica



of base 0.050-0.086, of blade 0.029-0.040 mm. The dimensions of the connecting bar vary greatly, being 0.002-0.034 x 0.012-0.068 (sometimes it may be lacking); the fan-shaped bars are 0.015 x 0.018 mm (sometimes very indistinct). The length of the tube of the copulatory organ is 0.044-0.68, of the supporting part is 0.036-0.063 mm.

/36

While examining our material and the collection of the Zoological Institute, we found significant morphological variability in the worms commonly assigned to the species T. borealis (Olsson, 1893).

4. Tetraonchus borealis f. typica

(Figure 5)

Host: Thymallus thymallus.

Localization: gills.

Distribution: water bodies of the European USSR.

The length of the marginal hooks is 0.012-0.014 mm. Dorsal hamuli: inner length 0.080-0.110, outer length 0.071-0.090; length of base 0.051-0.080, of blade 0.025-0.030 mm. Ventral hamuli: inner length 0.068-0.090, outer length 0.090-0.110; length of base 0.050-0.075, of blade 0.030-0.035 mm. The size of the connecting bar is 0.009-0.018 x 0.047-0.080, of the fan-shaped bars 0.004-0.007 x 0.010-0.015 mm. The length of the tube of the copulatory organ is 0.106-0.126, of the supporting part 0.090-0.102 mm.

It differs from the other two forms in that the base of the hamuli together with the root is not more than 2.5 times greater than the length of the blade, while the overall length of the hamuli is not less than 0.065 mm.

5. Tetraonchus borealis f. rauschi

(Figure 6)

(Syn.: T. rauschi Mizelle et Webb, 1953).Host: Thymallus arcticus.Localization: gills.Distribution: the Kamchatka, Okhota, Anadyr; Kolyma rivers and water bodies of Alaska.

The length of the marginal hooks is 0.013-0.015 mm. Dorsal hamuli: inner length 0.097-0.130, outer length 0.080-0.111; length of base 0.060-0.082, of blade 0.025-0.030 mm. Ventral hamuli: inner length 0.078-0.095, /37 outer length 0.100-0.130; length of base 0.050-0.075, of blade 0.025-0.035 mm. The size of the extremely variable-shaped connecting bar is 0.011-0.026 x 0.072-0.125, that of the fan-shaped bars is 0.002-0.004 x 0.010-0.013 mm. The length of the tube of the copulatory organ is 0.102-0.150, of the supporting part is 0.088-0.135 mm.

It differs from the preceding form in that the base of the hamuli together with the root is not less than 2.5 times the length of the blade and "crests" and excrescences are often encountered on the roots of the hamuli.

6. Tetraonchus borealis f. minor

(Figure 7)

Host: Thymallus thymallus, T. arcticus.Localization: gillsDistribution: the Pinega (Arkhangel' Oblast) and Amur rivers.

Length of the marginal hooks 0.012-0.013 mm. Dorsal hamuli: inner length 0.065-0.067, outer length 0.060-0.063; length of base 0.040-0.051, /38 of blade 0.026-0.030 mm. Ventral hamuli: inner length 0.059-0.062, outer length 0.072-0.080; length of base 0.040-0.058, of blade 0.030-0.035 mm.

Figure 6: T. borealis forma rauschi

a---b = variability of the hamuli

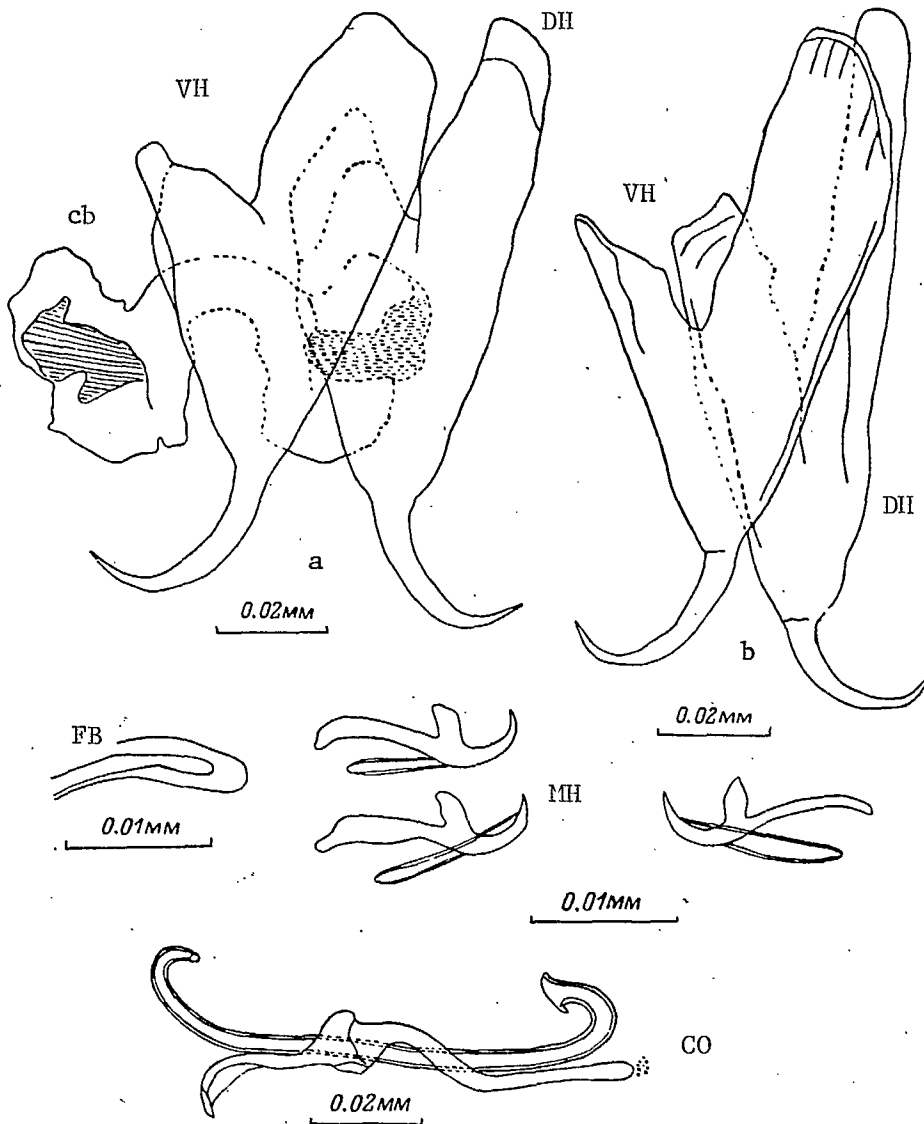
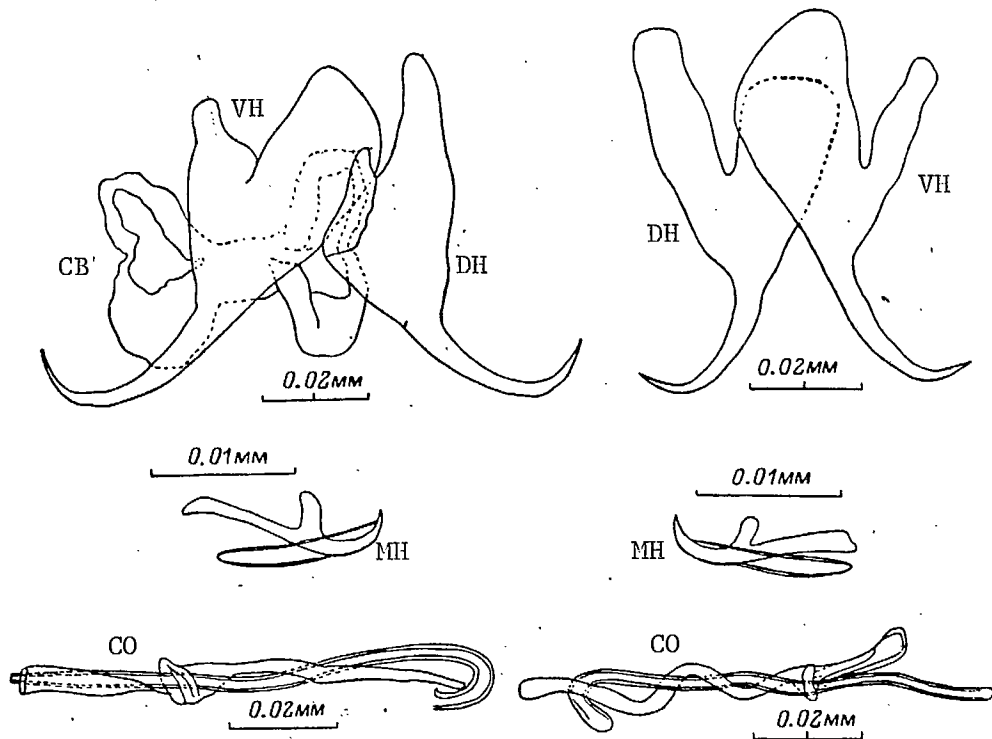


Figure 7: T. borealis forma minor

a = from the gills of Thymallus thymallus, Pinega River, Arkhangel' Oblast

b = from the gills of Th. arcticus, Amur River



The dimensions of the connecting bar are 0.009-0.011 x 0.040-0.050, of the fan-shaped bars 0.003-0.005 x 0.010 mm. The length of the tube of the copulatory organ is 0.102-0.139 mm; the length of the supporting part is 0.068-0.125 mm.

It differs from the two preceding forms in that the base of the hamuli together with the root is less than twice the length of the blade, while the inner length of the hamuli is not more than 0.070 mm.

Due to a lack of material or to unsatisfactory drawings and incomplete descriptions, it is impossible to assign all of the other finds of T. borealis within the confines of the Palearctic to any particular form. The geographic range of this species coincides with the geographic range of fishes of the genus Thymallus. It should be noted that species of the genus Thymallus are polytypic and form a number of subspecies. Since the systematics of the graylings has not been worked out sufficiently, it is quite likely some of them will be given species status. The latter evidently can be assigned to T. borealis and its forms.

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SUMMARY

A new species, *Tetraonchus grumosus*, from gills of *Coregonus nasus*, *C. autumnalis* and *C. peled* is described. The distribution area of this species includes the basins of the Pechora, Ob, Lena, Kolyma and Anadyr. *T. alaskensis* Price, 1937 is redescribed. Its distribution area seems to correspond to the distribution of the Pacific group of Salmonidae. *T. cylindraceus* Pronin, 1966 is reduced to a synonym of *T. variabilis* Mizelle et Webb, 1953. This species was found in the Lena, Kolyma and Anadyr. Three forms of *T. borealis* (Ollsson, 1893) are distinguished: *T. borealis* forma typica from gills of *Thymallus thymallus*, *T. borealis* f. *rauschi* from gills of *Thymallus arcticus* and *T. borealis* f. *minor* from gills of *Thymallus thymallus* and *T. arcticus*.