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Parasitic Copepods of Fishes of the USSR.

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Sub-Order CALIGOIDA G. O. SARS.

1901. Caligoida et Lernaeoida. Sars. Crustacea of Norway, IV, page 2.

1932. Caligoida et Lernaeopodoida, Wilson, Bulletin of U.S.N.M., No. 158, page 397.

The parasitic copepods belonging to this sub-order differ both in their structure, and in their body shape. Most often their body has a shield-like shape (Caligidae and others), is vermiformed (Lernaeidae and others), or is ovate-sacciform (Lernaeopodidae and others) etc. One should, however, consider the shield-like shape (the caligoid shape) as the initial one. When the body of sexually mature parasites has a different shape, the above-mentioned shape still manifests itself to some degree in the larval stages. A

characteristic peculiarity of this group of copepods is the presence of a conical oral tube of sucking type containing styletto-like or saw-like jaws. Differences in the jaw structure of Cyclopoida and Caligoida appear particularly distinctly in the process of individual development. Furthermore the Caligoida larvae usually attach themselves to their host by means of a frontal thread. A very important distinction of Caligoida is the presence of an original pupa, which is absent in Cyclopoida. Contrary to the latter the sexual segment of Caligoida in most cases is of large dimensions.

Representatives of Caligoida are all parasites without an exception. They parasitize mostly on fish. However, a considerable number of marine parasitic copepods have adapted themselves also to parasitize on animals from other systematic groups, such as worms, arthropods, molluscs, and cetaceans.

Determination table of families.

1 (2) Cephalothorax has a shield-like shape; males are of same size as females; trunk legs are well-developed ..... Caligidae.

2 (1) Cephalothorax of a different shape; males are smaller than females (the former are often dwarfs); trunk legs are strongly reduced or absent.

3 (4) Maxillipeds I (in females) are represented by long hand-like excrescences merging at the distal end and equipped with an unpaired attachment apparatus (bulla) . . . . . Lernaeopodidae.

4 (3) Maxillipeds of a different structure.

5 (8) Parasites attach themselves by the front end of their body plunged into tissues of the host and carrying horn-shaped excrescences or excrescences of other shapes; the head is connected to the body by means of a long "neck".

6 (7) Horn-shaped or other formations are located on the neck; the body is flattened in dorsal-ventral direction; males (dwarfs) are always attached to a female . . . . . Sphyriidae.

7 (6) Horn-shaped or other formations are located on the head; body is not flattened; males are not attached to females . . . . . Lernaeidae.

8 (5) Parasites are attached to the host by means of extremities of the head; the head has no special attachment-excrescences; the long "neck" is also absent . . . . . Dichelesthiidae.

The CALIGIDAE WILSON, 1905 Family.

Body is very flattened; cephalothorax is shield-formed. In the front end of the cephalothorax are frontal plates which in certain genera of caligids contain sucking-cup shaped cavities (lunula). The cephalothorax is composed, in addition to the head, of two or three frontal thoracic segments carrying swimmerets. These segments form one entity together with the head and are covered with mutual chitine /110 shield subdivided into sections by means of furrows. Segments of the free thorax remain uncovered by the chitine shield. The sexual segment is noticeably inflated; most probably it consist of the sexual segment proper and of the fifth ventral segment, since it has often rudimentary extremeties. Shape and relative dimensions of the sexual segment in different species of Caligidae are different, this is important in taxonomy. Abdomen is usually unisectional, although in some species it consists of two, three and even four segments. The abdomen ends in two short and wide caudal branches (plates) with several setae. Males are in most cases somewhat smaller than females and resemble the latter in structure. They parasitize simultaneously with females on the same hosts.

The antennules are small, and in most cases bi-sectional; their basal section is wide with strong feathered setae along the front edge; the terminal section is small with a tuft of

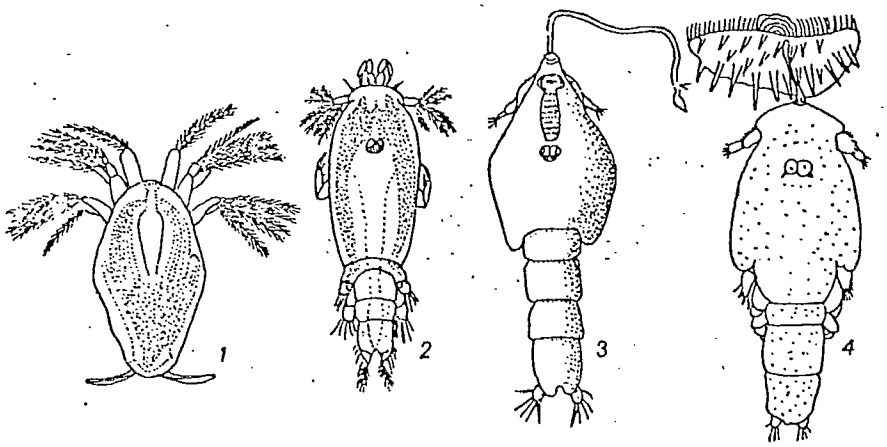

Fig. 56. Larval stages of the crustaceans of the Caligus genus:
1 - nauplius; 2 - copepodic larva;
3 - pupa; 4 - chalimus stage (3 - according to Heegaard, others - according to Wilson).

setae on the top. The antennae end in a claw and are thus transformed into an organ of attachment. Jaws are in an oral tube and represented by long and narrow chitine plates, which are covered by saw-like teeth on the interior edge of the distal part. Maxillules are arranged closer to the lateral edge of the shield and are represented by a small plate ending in a chitine claw. The maxillae consist of one section, and are formed as plates which often are bi-sected at the end. Furthermore, there is a papilla (exopodite) at the base with one to three setae. Occasionally the maxillae are represented by a spine. Maxillipeds I are slender and consist of two

or three sections. The basal section is very small and transitions into a somewhat widened central section. The distal section is narrow and long, and ends in two claw-like spines; often there is an additional spine (spur) at a certain distance from the top. Maxillipeds II represent a grasping organ with a strong claw at the top. Trunk legs are well-developed, the first and the fourth pairs being uniramose, while the second and the third ones - biramose. In certain species, one may observe rudimentary fifth, and sometimes even sixth pair of trunk legs on the genital segment.

The ovisacs are long and cylindrical with disc-shaped eggs placed one on top of the other in an orderly pile. Freely-swimming naupliuses emerge from the eggs. They are characterized by the presence of abdominal appendices (fig. / 111
56). After the second moulting, the naupliuses pass into the copepodic stage of development. The copepodic larvae are distinguished by their well-pronounced segmentation of the rear section of the body. The second copepodite larva, when attached to the body of a fish, is immediately changed into the pupal stage (Heegaard). This stage is characterized by the fact that it is located in the cuticular casing of preceding copepodite larvae; it is almost completely immobile and does not intake any food. At this time the larva transforms into the chalimus stage. Larvae of this stage, same as the pupa, are attached to the body of the host by means of

a frontal thread. After the fifth phase of its development the chalima transform into the adult state. At that time, their frontal thread falls off and adult crustaceans become able to move freely.

Five sub-families constitute a part of the composition of this family, they may be distinguished by means of the below-shown table.

Table for determination of sub-families.

1 (4) Three front thoracic segments merge with the head; fourth and sexual segments remain free.

2 (3) Fourth thoracic segment is smooth and, besides the fourth pair of legs, has no other appendages . . . . . Caliginae.

3 (2) Fourth thoracic segment carries a pair of dorsal plates, which usually overlap to the genital segment . . . . . Euryphorinae.

4 (1) A different number of frontal thoracic segments merge with the head.

5 (8) Only the first thoracic segment merges with the head, while the other thoracic segments remain free; one segment (sometimes even more) of the latter carries dorsal plates.

6 (7) Frontal plates are well isolated; the ovisacs are visible in their entire length . . . . Pandarinae.

7 (6) Frontal plates merge with the shield; the ovisacs are not visible . . . . . Cecropinae.

8 (5) Two front thoracic segments merge with the head; the remaining thoracic segments remain free . . Trebinae.

The Caliginae Sub-Family.

The cephalothoracic portion of the body has a shield-like shape; three front segments of thorax are contained in it in addition to the head. The fourth thoracic segment is smooth and has no appendages besides the fourth pair of legs. The sexual segment is large, wide and inflated. In the water basins of the Soviet Union representatives of five genera of parasitic copepods from this sub-family are known.

Table for determination of genera.

1 (6) Each of the frontal plates has a lacuna.

2 (3) Legs of the fourth pair are absent . . . . Caligopsis.

3 (2) Legs of the fourth pair are present.

4 (5) Legs of the fourth pair are well-developed and consist of several sections . . . . . Caligus.

5 (4) Legs of the fourth pair are rudimentary and represented by only one section . . . . . Pseudocaligus.

6 (1) Lacunae are absent.

7 (8) Legs of the fourth pair exist and are well developed . . . . . Lepeophtheirus.

8 (7) Legs of the fourth pair are absent . . Pseudolepeophtheirus.

The Caligus Müller, 1785. Genus.

Cephalothorax is wide, flattened and shield-like. In addition to the head-section three thoracic segments form a part of the cephalothorax; the fourth one remains free. The sexual segment is large, considerably inflated, particularly in sexually-mature females. Ovisacs are long, often longer /112 than the body itself. The number of abdominal segments ranges between one and four; however, the abdomen consists most often of one segment. Branches of the furca (caudal branches) are short and wide. The front edge of the shield is fringed with two frontal lobes (plates), each of which forms a lacuna on its front edge. The antennules are bi-sectioned; the basal section is wide and has a row of strong spineous setae on the front edge; the distal section is small, narrow and has a tuft of setae on the top. The distal section of the antennae ends

with a claw. One may see spine-like appendix (remnant of the exopodite) in their basal section - the sympodite. The maxillules, as a rule, have a claw-like shape, the basal and the hook-like portions are often separated from each other. The maxillae consist of two modified branches: hook-like branch (endopodite) and papilla-like branch (exopodite), the latter has setae. One may observe in the sexual segment a fifth, and sometimes a sixth, pair of very reduced extremities.

10 species are recorded of this very rich genus within the confines of the USSR. Furthermore, it is probable that a whole number of species described in adjoining countries will be found here.

Table for determination of species
(according to the females).

1 (10) Length of the cephalothoracic portion (of the shield) is considerably shorter than one half of the entire length of the body.

2 (5) Abdomen is considerably longer than the sexual segment.

3 (4) Shield narrows insignificantly towards the front end; its greatest width does not exceed its length; the lateral edges of the shield are almo$t straight . . . . . C. pelamydis.

4 (3) Shield narrows strongly towards the front end; its maximum width slightly exceeds its length; the lateral edges of the shield are arched . . . C. seriolae.

5 (2) Abdomen is approximately of the same length as the sexual segment or shorter than the same.

6 (7) Abdomen is of the same length as the sexual segment; the sexual segment has a deep incision in the rear edge . . . . . C. bonito.

7 (6) Abdomen is shorter than the sexual segment; the sexual segment has no incision in the rear edge.

8 (9) Length of the sexual segment exceeds considerably its width . . . . . C. spinosus.

9 (8) Length of the sexual segment is slightly below its width . . . . . C. tanago.

10 (1) Length of the cephalothoracic portion is almost equal or exceeds one half of the length of the entire body.

11 (16) Length of the cephalothoracic portion is approximately equal to one half of the entire length of the body.

12 (13) The rear edge of the sexual segment is almost straight; its width somewhat exceeds tis length . . . C. lacustris.

13 (12) The rear edge of the sexual segment is incised arch-like; its width does not exceed its length.

14 (15) Abdomen widens at the front end and narrows gradually towards the rear one; the base of thoracic furca is almost square . . . . . C. macarovi.

15 (14) Abdomen widens in the middle and narrows towards both ends; the base of thoracic furca is very narrow and shaped as a handle . . . . . C. belones.

16 (11) Cephalothoracic portion exceeds considerably one half of the length of the entire body.

17 (30) Abdomen consists of one section.

18 (19) Abdomen is longer than the sexual segment . . C. minimus.

19 (18) Abdomen is not longer than the sexual segment.

20 (21) Abdomen is of equal length as the sexual segment; the free thoracic segment is very short and is almost invisible from the dorsal side . . . . . C. centrodonti.

21 (20) Abdomen is shorter than the sexual segment; the free thoracic segment is of normal length and well visible from the dorsal side.

22 (23) Width of the sexual segment exceeds considerably its length . . . . . C. hyalinus.

23 (22) Width of the sexual segment does not exceed its length.

24 (27) Width of the sexual segment is approximately equal to its length.

25 (26) The sexual segment carries rudiments of the fifth and the sixth pairs of legs, the latter look like papillae with feathered setae on the top . . . C. orientalis.

26 (25) Sexual segment carries rudiments of legs only of the fifth pair, which are not seen from the dorsal side . . . . . C. curtus.

27 (24) The width of the sexual segment is considerably smaller than the length.

28 (29) The fifth pair has legs; sexual segment is almost square in shape; its length does not exceed its width . . . . . C. glacialis.

29 (28) No legs of the fifth pair . . . . . C. brevicaudatus

30 (17) Abdomen consists of two sections.

31 (32) The fourth thoracic segment has the same width as the genital one; frontal plates are wide, the lacunae are large . . . . . C. rapax. /113

32 (31) Fourth thoracic segment is narrower than the genital segment; plates are narrow, lacunae are small. . . . . C. gurnardi.

Caligus lacustris Steenstrup et Lütken.

1861. C. lacustris, Steenstrup et Lütken, Kongl. Danske Vidensk. Selsk. Skrifter / Journal of the Royal Danish Science Society /, 5th R.Volume, p. 15-16, Table 1, fig. 2.

1877. C. borealis, Olsson, Oefv. of Kongl. Vet.-Akad, Förh. / Publications of the Reports of the Royal Academy of Sciences/, No. 5, p. 77-79, fig. 2-4.

1906. S. dentatus, Gadd, Arkiv f. Zoologi, / Zoological Archives /, III, No. 15, p. 1 - 9, fig. 1 - 9.

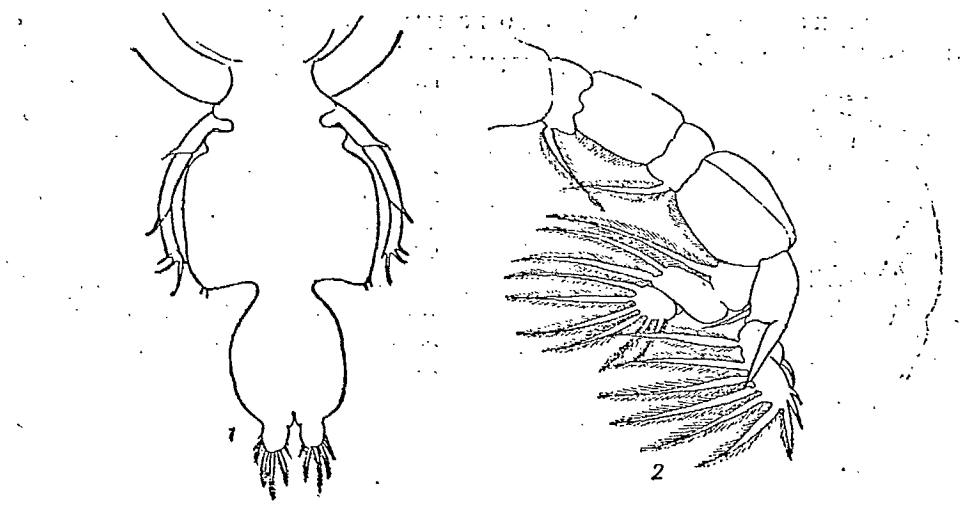

Fig. 57. Caligus lacustris (according to Markevich).

Female: 1 - fourth pair of legs, sexual segment and abdomen; 2- legs of the second pair.

Female (fig. 57). Cephalothoracic shield is ovate and slightly narrowing towards the front end. Its length equals approximately the genital segment and the abdomen taken together. Frontal plates and lacunae are fairly well developed. The genital segment is large with lateral edges running almost parallel; its rear edge has no incision. Abdomen is small, unisectional and has short caudal branches. Each of the branches has three long and three short feathered setae. Legs of the first pair end in four claw-like setae; from the rear edge of the distal section run three large feathered setae. Structure of legs of the second pair is shown in the drawing. Legs of the fourth pair are narrow, long with three spines and one seta on the top. The distal end of each of the two preceding sections is elongated at the exterior corner into a thin and pointed spine. Length of the body is 4-6.8 millimeters.

The Male resembles the female in external appearance. It differs, however, from the latter in a number of material traits. Thus the abdomen, for example, consists not of one, but of two segments. The antennae end in two (and not in one, as in a female) hooks. Maxillipeds II are more powerful than in a female, and at the interior edge of the basal section they have a well-developed tubercule covered with fine papilliform spines. The thoracic furca and the swimmerets resemble the same in a female. Body length is 4 - 7.6 millimeters.

Localization and host. Gills and skin of many freshwater and brakish-water fishes.

Occurrence. In USSR this species is recorded in the basins of the Aral, Caspian, Black and Baltic Seas. It is also extensively occurring in freshwater in Western Europe.

Described under the name of Caligus dentatus Gadd, 1906, the crustaceans from the Caspian Sea differ from the typical representatives of C. lacustris only in their larger size. We did not succeed in establishing any other morphological distinctions that indicate a special independance of C. dentatus. In connection with the above-said we came to the conclusion (1933), which was argued by Redeke (1939), that C. dentatus and C. lacustris are identical.

Caligus macarovi Gussev.

1951. Caligus macarovi, Gusev "Parasitological Compendium", Zoological Institute of the USSR Academy of Sciences, XIII, pp. 408-411.

Female (according to Gusev). The shield is relatively narrow with well-developed lacunae (fig. 58). Sexual segment is large, egg-shaped, slightly narrowing towards the rear end, where it forms an incision. It is approximately 1.6 times shorter than the shield. Abdomen is long, bi-sectional, it is also narrowing towards the rear end; its length

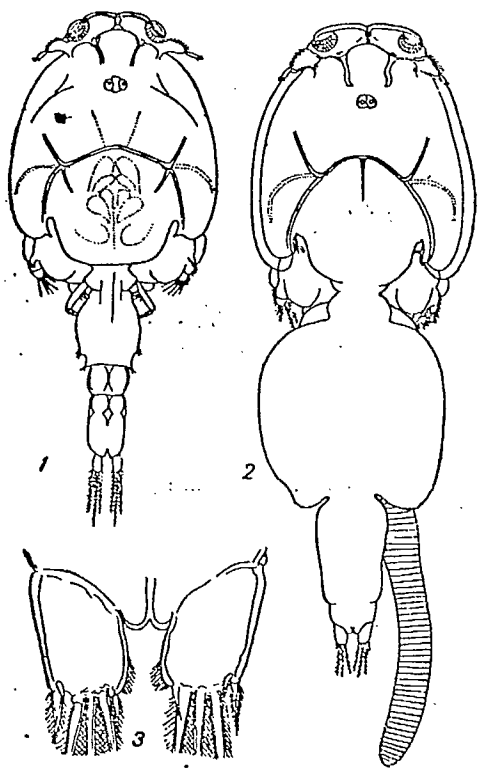

Fig. 58. Caligus macarovi (according to Gusev):
1- male; 2- female; 3- furca branches.

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comprises approximately 4/5 of the length of the sexual segment. The front segment of abdomen is 4 times as long as the rear one. The furca branches are well-developed; each of them has feathered setae: three long ones and three short ones.

The antennules have 11 setae on the top and one seta on the rear edge of the distal section. The basal section has 16 feathered shield-like spines at the front edge and 9 shorter

spines of the ventral side. The antennae have wide basal section and a rectangular, almost square second section; the distal section turned into a thick claw. The jaws look like thin rods with 12 teeth. The maxillules are curved claw-like with two papillae close to the base, each of the papillae ends in a seta. The maxillae are short with a widened base section, which narrows gradually and converts into the distal portion; the papilla has three setae - one large and two small. Thoracic furca has a rectangular, almost square base and somewhat curved branches. Maxillipeds I ends in two claws, the exterior one of these is half as long as the interior one. On the rear (interior) edge of the distal section is another, still smaller claw shaped as a spur. Maxillipeds II end in a short claw and a spine located at the base of the latter. The trunk legs are of ordinary type. The fifth and sixth pairs of legs are absent. Length of the body - 5.0-6.4 millimeters; length of shield - 2.3 - 2.7 millimeters, width - 1.7 - 2.3 millimeters; length /115
of the sexual segment - 1.3 - 1.7, width - 1.2-1.7 millimeters; length of abdomen - 1.1 - 1.3 millimeters, width - 0.5-0.8 millimeter; length of ovisacs - 2.7 - 3.6 millimeters.

Male is unknown.

Female C. macarovi resembles the female C. bonito. It differs, however, from the latter in details of antenna

structure, - namely, the proximal spine on the top section of the exopodite of the second pair of legs is straight and not curved (as in C. bonito), and the front edge of the middle section of endopodite of this pair of legs is fringed with fine cilia, and not with plates, as in C. bonito.

Localization and hosts. Body surface of Auxis maru, Spheroides rubripes, Cololabis sajra, Osmerus eperlanus dentex.

Occurrence. In Sea of Japan (Putyatin Island, Khanton Bay, Antonovo).

Caligus orientalis Gussev.

1951. Caligus orientalis, Gusev, Parasitological Compendium. Zoological Institute of the USSR Academy of Sciences, Vol. 13, pp. 411-414. Fig. 10,11.

Female (fig. 59). Shield is round with rather deep rear incisions. The sexual segment is relatively large with almost parallel lateral edges. In the rear corners of this segment are remnants of the fifth and sixth pairs of legs formed like slightly noticeable papillae with feathered spines. The sexual segment is 2 - 2.6 times shorter than the shield. Abdomen is small with obliquely cut rear-lateral corners; its width equals approximately its length. Branches of the furca are short and have six setae (3 long ones and 3 short ones).

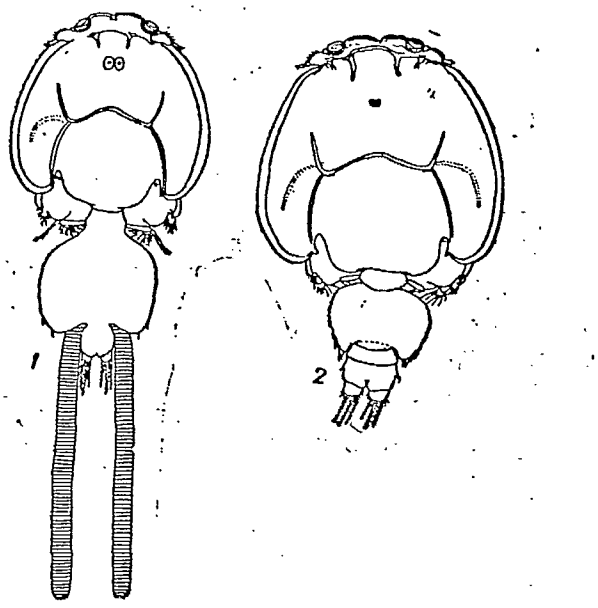

Fig. 59. Caligus orientalis (according to Gusev):
1 - female; 2 - male.

Antenulles have 12 setae on the free end of the antenna with spine-like growth on the basal section and with a small spine on the widened portion of the claw. Thoracic furca has wide, irregularly-shaped base and straight, but somewhat diverging branches. Maxillipeds I terminate in two unequal claws; there is a "spur" on the interior edge of the terminal section and closer to the apex. Maxillipeds II end in a rather long and thin claw and an additional spine located at the base of the latter. Swimmerets are of ordinary type. Legs of the fourth pair have three setae and a corner plate

on their top; the corner plate has five to six teeth along the edges. Length of the body is 3.6 - 4.3 millimeters; length of the shield - 2.2 - 2.6 millimeters, width - 2.0-2.3 millimeters; length of sexual segment is 0.8 - 1.1 millimeters, width - 0.5 - 1.1 millimeters; length of abdomen - 0.3 - 0.4 millimeter, width - o.3 - 0.4 millimeter; length of ovisacs - 1.3 - 3.3 millimeters.

Male. The shield is wide, rounded, with well-developed frontal lobes and with deep lacunae. The sexual segment is cross-ovate with lateral edges fringed in saw-like fashion. /116 On the rear corners of this segment are small rudiments of the fifth and sixth pairs of legs shaped as papillae with feathered setae. Abdomen consist of two inequal segments. A pair of spines is located on the middle of lateral edges of the larger rear segment. The length of abdomen is somewhat smaller than its width. Branches of the furca are short and end in six setae - three long ones and three short ones. The antennules are of ordinary type. The antennae have three sections; the basal section has 20 cross-furrows, the middle one - three zones of furrows. The distal section is bent to the ventral side and ends in four claw-like plates. At its sides one may see a pair of tactile setae. Maxillipeds I are of identical structure as the females. Maxillipeds II have powerful basal section, on the middle of the interior edge of which is an inflation. The terminal section ends with a long

claw and with a seta-like spine at the base of the latter. Legs in general are the same as in a female. Body length is 3.8 - 5.0 millimeters; shield length - 2.37-3.33 millimeters, and width - 2.21-3.07 millimeters.

Localization and hosts. Body surface of a "Pacific mullet" (Mugil so-iuy), prickly dab (Limanda aspera), halfbeak (Hyporhamphus sajori), Alaska greenling (Hexagrammos octogrammus), Tachanovsky's rockfish (Sebastodes taczanowskii), Brandt's dace (Leuciscus brandti).

Occurrence. The Sea of Japan (Putyatin Island, Khanton Bay).

Caligus seriolae Yamaguti.

1936. Caligus seriolae, Yamaguti, Paras. Cop. from fishes of Japan. Part 2, Caligoida, I, pp. 2-3, fig. 1 - 13.

Female (fig. 60). Shield is short and wide, narrowing towards the front end. Its maximum width even exceeds somewhat its length. Frontal lobes are well-developed and have large deep lacunae. The middle strip of the H-shaped vein is arched forwards; the rear branch deviates medially away from this vein. The sexual segment is rounded with the rear edge cut off; the length of the segment exceeds slightly its length. Abdomen is long and indistinctly bi-segmented; the terminal segment is much shorter than the preceding one and

slightly narrower. Branches of the furca are short; they have hair on the interior edge with three terminal and two subterminal setae.

Antennules are short; the basic section is covered with numerous feathered setae; about one dozen of simple setae are located on the top. Antennae end in a long, but slightly curving claw, with two small spines on the ventral side of their proximal part. Thoracic furca has rectangular base and two wide furcas fringed by branches. Maxillipeds I end in two relatively short pectinate claws. Maxillipeds II have a widened basal section and a claw-like curved distal section. Legs of the fourth pair are wide, shortened and consist of four segments. Each of the three distal sections has claw-like feathered setae: three setae on the distal section and one on each of two preceding sections. The rear-lateral corners of the sexual segment carry the fifth and the sixth pairs of the extremely reduced legs, actually represented merely by setae located upon the papilla. Length of the body is 4.6 millimeters; length of the shield is 1.6, maximum width - 1.8 millimeters; length of the sexual segment - 1.2, width of the same - 1.3 millimeters.

Male is unknown.

Localization and host. Gills of Seriola quinqueradiata.

Occurrence: Sea of Japan.

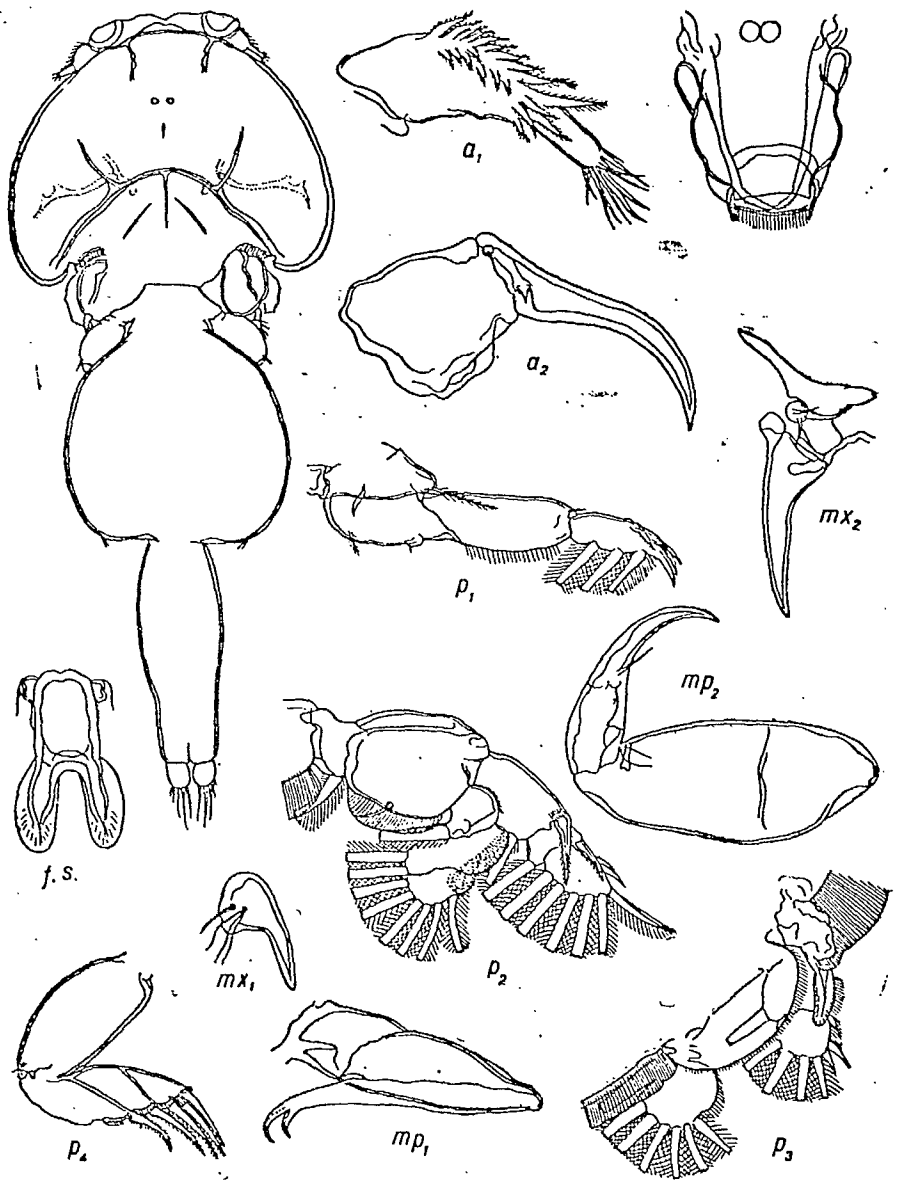

Fig. 60. Caligus seriolae (according to Yamaguti): female, its oral tube and extremities.

Caligus belones Kröyer.

1863. C. belones, Kröyer, Naturhist. Tidskrift, 3.R., Second volume, pp. 81-83, Plate VII, fig. 1, a - e.

Cephalothoracic shield is ovate (fig. 61); its length equals one half of the length of the entire body, or even exceeds it. Frontal plates are well-developed and have large, widely arranged lacunae. The free thoracic segment is short and considerably narrowed in its front portion adjoining the shield. Genital segment is elliptic and archedly incised at the rear end. Its length is one third of the length of the body. Abdomen is elongatedly elliptic and consists of only one segment. Caudal branches are short and wide covered by several feathered setae. Length of the legs of the fourth pair reaches one half of the length of the genital segment. /118 They consist of three sections with four spines. Body length of a female is 5 millimeters, of a male - 4-4.7 millimeters.

Localization and host. Parasitizes on the body surface of the garfish (Belone belone) and Coryphaena equisetis.

Occurrence: Coastal regions of Sweden, Norway, Denmark, Atlantic coast of North America.

Caligus brevicaudatus Scott.

1901. C. brevicaudatus, A.Scott, Transactions of Biol. Soc. of Liverpool, XV, p. 349, plate 11, figs. 7-10.

Cephalothoracic shield is rounded (fig. 61) and its length is approximately one half of the entire body. Frontal plates are slightly curved and carry well-developed lacunae. Genital segment is rectangular with parallel lateral edges and rounded corners. Its length is approximately one half of the cephalothoracic shield. Abdomen consist of one sector and is very short; its length is approximately 1/5 of the length of the genital segment. Caudal branches are also very small and carry several feathered setae each. Body length of a female is 5 millimeters.

Male is unknown.

Localization and host. Oral and gill cavities of Trigla hirundo and T. gurnardus.

Occurrence: Western half of the Sea of Barents, North Sea and Irish Sea.

Caligus hyalinus Czerniavsky.

1868. Caligus hyalinus, Chernyavsky, Transactions of the First Congress of Russian Naturalists and Physicians in St.Petersburg, Zoological Section.

Cephalothoracic shield is trapeze-shaped (fig. 61) and noticeably narrowed towards the front end. Frontal plates are well developed, wide, with deep lacunae that are arranged widely from each other and point in different directions.

Width of cephalothoracic shield (maximum width) is approximately equal to its length. Sexual segment is a quadrangle with regularly rounded corners. Its width exceeds considerably its length. Abdomen is small and consists of only one section. Caudal branches are short and wide with three long feathered and three naked short setae. Legs of the fourth pair consist of four sections. Legs of the fifth pair look like small plates with three short setae. Body length is 2.4 millimeters; body width is 1.8 millimeters.

Localization and host. Body surface predominantly of sea parrots (Crenilabrus ocellatus, C. griseus).

Occurrence: Black Sea.

Caligus glacialis Gadd.

1909. C. glacialis, Gadd, Öfv. Finska Vet-Soc. Förh., LII, Section A., No. 6, pp. 1-8, plate I.

Female (fig. 61). Cephalothoracic shield is oviform, narrowed towards the front end. Frontal plates are well-developed and have small widely arranged lacunae. The free thoracic segment is short and narrow. Genital segment is noticeably wider than the free thoracic segment. It has ovate shape with a rear edge cut off along a straight line. Length of genital segment is somewhat larger than one half of the length of the cephalothoracic shield. Abdomen is short and wide consisting of one section only. Caudal branches

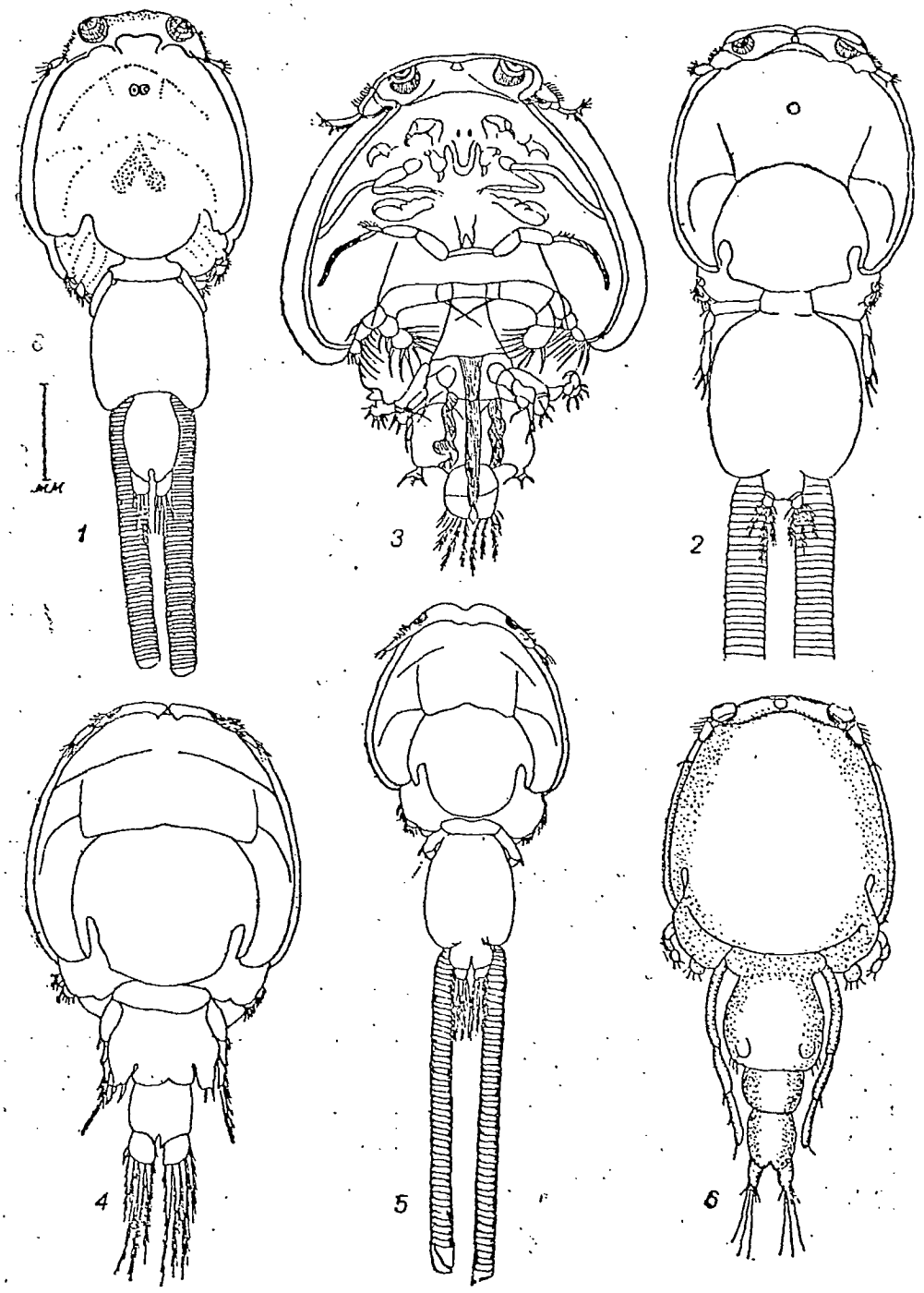

Fig. 61. Crustaceans of the Caligus genus:
1- C.belones (according to Wilson); 2- C.brevicaudus, female (according to Scott); 3- C.hyalinus (according to Chernyavsky); 4- C.glacialis, male; 5- C.glacialis, female (according to Gadd); 6- C.gurnardi, male.

are also short and wide, and have long feathered setae. Body length is 8.9 millimeters, width - 4.6 millimeters; length of ovisacs is 10.5 millimeters.

Male. Cephalothoracic shield is considerably wider than in a female and is somewhat narrowed towards the front end. Frontal plates are considerably narrower than in a female and have smaller lacunae. The free segment of the thorax is short, however, its width is equal to the width of the genital segment. Genital segment is trapeze-shaped and has a pair of rather well-developed extremities. Abdomen is monosectional and approches a square in its shape. Caudal branches look like short and wide plates with several feathered setae. Body length is 9.9 millimeters; width - 5.6 millimeters.

Host is unknown.

Occurrence: basin of the Arctic Ocean.

Caligus gurnardi Kröyer.

1863. Caligus gurnardi, Kröyer, Nat. Tidskrift, 3rd R, Second volume, p. 150, plate II, figs, 3a - g.

Female (fig. 61). Cephalothoracic shield is oviform and slightly narrowed towards the front end. The length is approximately 3/5 of the entire body. Frontal plates are

small and with small lacunae. The free thoracic segment is short and narrow. Sexual segment is wide, heart-shaped and narrowing towards the front end. Rear edge of this segment is cut off along a straight line. Abdomen is small, mono-sectional and ends in short caudal branches.

Antennules consist of two almost equally long sections. The distal section, however, is considerably narrower than the proximal one. Sternal furca is relatively large and its branches are somewhat diverging to the sides. Legs of the fourth pair are mono-ramose; each of them consists of three elongated sections. Body length is 6-7 millimeters.

Male. Cephalothoracic shield has the same shape as in the female. The genital segment, however, is considerably narrower in comparison with this segment in a female. Abdomen consists of two sections. Caudal branches are short and covered with some setae. The fourth pair of legs is distinguished by its length. Body length is 6 millimeters.

Localization and host. Oral and gill cavities of Triglia gurnardus, T. pini, T. hirundo.

Occurrence: Coasts of Norway, Sweden, England, as well as the basin of the Pacific Ocean.

Caligus curtus O.F. Müller.

1785. Caligus curtus, O.F. Müller, Entomostraca, seu Insecta etc. page 130, plate 21, fig. I.

1816. Caligus müllleri, Leach, Crust. suppl., Edinburgh Encyclopedia, page 405, plate 20.

1832. Caligus bicuspidatus, Nordmann, Mikrographische Beiträge, etc, page 28.

1838. Caligus americanus, Pickering et Dana, American journal of Science, XXXIV, page 65, plates III - V.

1850. Caligus diaphanus, Baird (nec Nordmann), Nat. Hist, British Entomostraca, page 269, plate XXXIII, fig. 1.

1851. Caligus elegans, Beneden, Ann. Sc. Nat. (3), XVI, p. 91.

1863. Caligus aeglefini, Kröyer, Naturhist. Tidskr., 3rd R., Second volume, page 89, plate VII, fig. 3a - f.

Female (fig. 62). Cephalothoracic shield is ovate and somewhat longer than the rest of the body. Frontal plates are wide and have large lacunae. The free thoracic segment is very small and short. Its width is approximately equal to one half of the width of the genital segment. Genital segment is elongated with parallel lateral edges, its length is approximately one half of the cephalothoracic shield. Abdomen is short and somewhat widened towards the rear end. Caudal branches are short and somewhat curved; each of them has several long setae. Legs of the fourth pair consist of three sections; they carry a seta and four curved spines. One spine is also located on the distal end of the second section, while the

other three - on the top. Body length of sexually mature females is 8-12 millimeters.

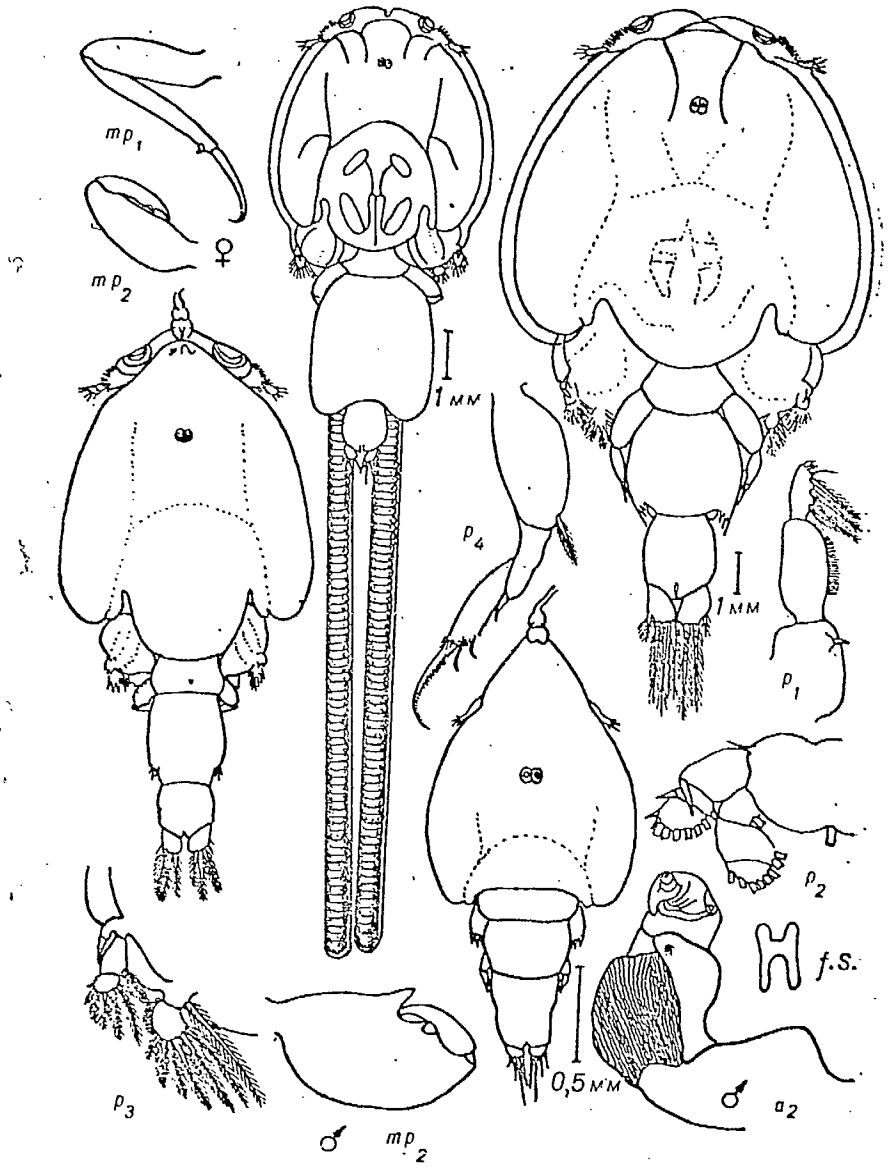

Fig. 62. Caligus curtus (according to Wilson). Female, male, chalima and extremities.

Male. Cephalothoracic shield is very wide and considerably widened towards the rear end. The free thoracic segment is short, although its width is equal to the width of the genital segment. Genital segment is short, wide, with rounded lateral edges. Abdomen consists of one section, which is rounded. Its length approximately equals the genital segment. Caudal branches are large, wide and carry on their top four feathered setae each. Body length is 13-20 millimeters.

Hosts. The described crustaceans occur particularly /122 frequently on fishes of the cod family (Gadus morrhua, G.merlanges, G.aeglefinus, G.pollachius, G.callarias, G. minutus, G.virens, Molva molva, Molva byrkelange). We found it more than once on Hippoglossus hippoglossus.

Occurrence. Barents, Baltic, North, Mediterranean Seas, Atlantic coasts of Europe and North America. This species is very common in the Barents Sea. Thus according to the data of Yu.I.Polyanovsky, 5% of coalfish is infested, 13.1% of haddock, and 17.9% of cod. Up to 12 individuals of crustaceans were observed on individual fishes.

Caligus spinosus Yamaguti.

1939. Caligus spinosus, Yamaguti, Vol. jubilare pro S. Yoshida, II. page 445, figs. 4-8.

Female (fig. 63). Cephalothoracic section is somewhat shorter than one half of the entire body. The free thoracic

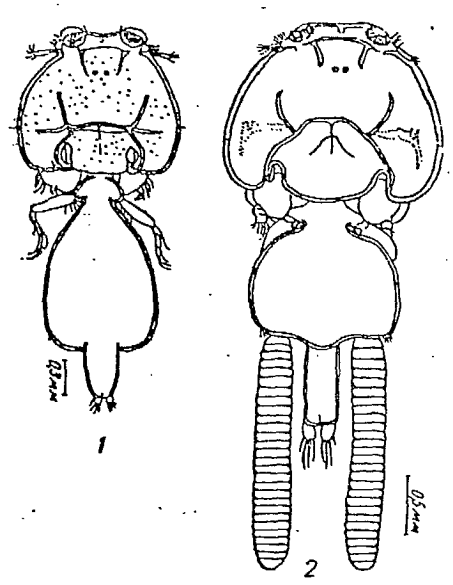

Fig. 63. General appearance of a female.
1- Caligus spinosus; 2- C.tanago (according to Yamaguti).

segment is narrow and compressed in its frontal portion looking like a neck. Sexual segment is oviform and narrows towards the front end; the rear edge is cut off a straight line. On the rear-lateral corners of this segment are extremely reduced legs of the fifth and sixth pair represented by setae. Abdomen is mono-sectional, conical-cylindrical, narrowing slightly towards the rear end; it is attached dorsally to the sexual segment. Branches of the furca are small; each of them has four feathered setae on the top and two on the exterior edge. There are setae on the interior edge of these branches. Maxillipeds I consist of two almost identically long sections. The distal section ends, as usually, in two claw-like dentate spines;

at a small distance to the top is a pointed plate (spur) the top of which reaches the base of the claw-like spines. Legs of the third pair have a strongly curved hook at the base of the exopodite. Legs of the fourth pair are four-sectional. Basal section has the same length as the remaining three sections taken together. The second and the third sections of these legs end in one spine, the terminal one has three such spines. Length of the body is 2.5 - 3.2 millimeters; shield is 1.2-1.3 X 1.4-1.5 millimeters; sexual segment - 0.5-1.2 X 0.4-1.0 millimeters; length of the abdomen is 0.4-0.6 millimeter.

Localization and host. Gills of the Seriola quinqueradiata.

Occurrence: This crustacean is described from the Turami region (Japan).

Caligus tanago Yamaguti.

1939. Caligus tanago, Yamaguti; Vol. jubilare pro S.Yoshida, II, p. 447, figs. 9 - 13.

Female (according to Yamaguti). Cephalothoracic shield (fig, 63) is round and has well developed rear-lateral lobes. Its width somewhat exceeds its length. The free thoracic segment is short and narrowing towards lateral sides. The sexual segment is wide with small protuberance at the rear

edge. Abdomen is cylindrical, vaguely bi-segmental; the front /123 segment approximately twice as long as the rear one. Branches of the furca are thick and have four setae at the top, two setae on the exterior edge, and hair on the distal portion of the interior edge.

Antennules have a small lump-like protuberance on the distal end of the basal section; the terminal section has 13 setae on the top and one seta near it. Antennae have a thick claw and no basal spine. Maxillules are claw-like and have two papillae ending in setae at the base portion. Jaws contain twelve teeth. Maxilles have a small spine on the interior side and a papilla carrying one large and two small setae. Distal section of maxillipeds I is somewhat longer than the basal section and has relatively short claws at the end. Legs of the third pair have a three-sectioned exopodite and a two-sectioned endopodite. Between the two branches of these legs is a large half-circular lobe with small hairs arranged along the edge. The hook at the base of the legs of this pair is bi-sectional; the spine is almost straight. Legs of the fourth pair are relatively thick, four-sectioned; the first section is as long as the three remaining ones. Second and third sections end in pectinate spines; third section has three such spines. Legs of the fifth pair are visible from the dorsal side; they are represented by papillae with three setae on the top, and furthermore with still

another one isolated seta located dorsally. Body length is 2.9-3.7 millimeters; shield - 1.2-1.6 X 1.4-1.8 millimeters; sexual segment is 0.8-1.0 X 0.8-1.2 millimeters; length of abdomen - 0.5-0.7 millimeter; length of ovisacs is 2.7 millimeters.

Localization and host. Gills of Ditrema temmincki and the section of body surface covered by operculum in Lateolabrax japonicus.

Occurrence. Recorded at Tarumi (Japan).

Caligus centrodonti Baird.

1850. Caligus centrodonti, Baird, Nat. Hist, Brit. Entomostraca, page 272, plate XXXII, figs. 6, 7.

1863. Caligus abbreviatus, Krŏyer, Naturhist. Tidskrift, 3 R., 2nd Volume, page 61, plate III, figs. 3a - h.

Female. Cephalothoracic shield is widely-ovate (fig. 64) somewhat narrowing towards the front end; its length is approximately equal to the width and constitutes 2/3 of the entire body's length. The free thoracic segment is very short. Sexual segment is wide and somewhat narrowing towards the rear end; its width is almost one and a half of the length. Abdomen is very small with very short furca branches; every branch has four or five short setae. Thoracic furca is rather massive and has slightly diverging branches. Legs of the fourth pair

are long. Basal section is of medium size and is equipped with a feathered seta close to the distal end. Two other sections are thin; the middle one is short and ends on the exterior side in a rather long spine. Terminal section has two thin spines on the top, one of which is particularly long and thus merely a trifle smaller than the distal section itself; furthermore, there is a small spine representing a simple pointed continuation of the section itself. Body length is approximately 4 millimeters. Ovisacs are shorter than the body.

Male generally resembles a female, primarily differing from the latter in greater dimensions of the shield. Sexual segment is slightly smaller than in a female and the incision on the rear edge of this segment is considerably deeper. Abdomen and furca branches are like-wise very short. The body length is approximately 5 millimeters.

Localization and hosts. Surface of the body and /124 fins of Sebastes marinus, Pagellus centrodontus.

Occurrence: North Sea, English Channel, St.George Strait, Irish Sea.

Osmanov (1940) indicates the presence of this species in the Black Sea, under the name of C.abbreviatus Kröyer. Similar to many other Black Sea animals the crustaceans here turned out to be smaller than the typical forms. Body length of a female attained 2.4 millimeters.

Caligus bonito Wilson.

1905. C.bonito, Wilson. Proc. U.S.N.M. XXVIII, page 589.

Female. Cephalothoracic shield is ovate (fig. 64), the length equalling the width. The free thoracic segment is narrow and short, compressed in its front portion. Sexual segment is large and has a deep incision at the rear edge; its length equals the length of the shield. Abdomen is long, widened in the middle and narrowing towards both ends. It consists of two sections, vaguely discernible; terminal section is 2.5-3 times shorter than the preceding one. Furca branches are of medium size and end in five feathered setae. Legs of the fourth pair are well-developed. Distal section ends in three long claw-like spines; a spine of smaller dimensions occurs on its rear edge. The second-last section carries the only large spine on the distal end. Rudimentaries of legs of the fifth pair are not visible from the dorsal side. Body length is 8.3 millimeters; shield length is 3 millimeters, length - 3 millimeters; length of sexual segment - 3 millimeters; abdomen length - 2.3 millimeters; length of ovisacs is 8 millimeters.

Male. Cephalothoracic shield is rounded with well-developed rear-lateral lobes. The free thoracic segment is short and narrowing towards the front end; its width exceeds the width of the sexual segment in the initial portion. The

sexual segment widenes somewhat towards the rear end. Abdomen is bi-sectional, equal in length to the sexual segment. Furca branches carry four feathered setae. Body length is 5.5 millimeters; shield length - 3 millimeters, width - 2.8 millimeters; length of sexual segment - 1 millimeter; length of abdomen - 1.2 millimeters.

Localization and host. Oral and gill cavities, more seldom the body surface of skipjack tuna - bonito (Katsuwonus pelamys).

Occurrence. Atlantic coast of North America (Woods Hall) and Africa. Reshetnikova (1954) records presence of this crustacean in the Black Sea, though she does not indicate the host.

Caligus minimus Otto.

1828. Caligus minimus, Otto, Nova Acta Kais.-leop.-carolin. deutsche Akad. d. Naturf., XIV, page 354, plate XXII, figs. 7, 8.

1840. Caligus minutus, M.Edwards, Hist. nat. d. Crustacés, volume III, page 450.

Female (fig. 64). Cephalothoracic shield is wide and circular. Its length equals one half of the body length. Frontal plates are well-developed, arched, and have large lacunae. The free thoracic segment is very small and shaped

as a neck uniting the cephalothoracic part with the genital segment. The genital segment is large, wide, and elliptic. Abdomen is small, narrow, and uni-sectional. Caudal branches are somewhat longer than one half of the abdomen's length.

Antennules are short, bi-sectional; terminal section is noticeably elongated and narrow. Thoracic furca is small and has short, somewhat diverging branches. The fourth pair of thoracic legs consists of three sections. The basal section is considerably widened, while the other two sections are narrow. At the top of each of these legs is one large and two small spines. Legs of the fifth pair look like small setaceous plates spreading from the rear-lateral corners of /125 the genital segment. Body length is 5 millimeters.

Male differs from a female by larger dimensions, but mainly by the shape of the genital segment. The latter is extremely narrow and has an elongated-barrel-like shape. Its widths exceeds only slightly the width of the abdomen and of the free thoracic segment. Body length is 7 millimeters.

Localization and hosts. Oral and gill cavities of the common bass (Morone labrax) and of scup (Pagellus centrodontus).

Occurrence: Coasts of England, Mediterranean Sea.

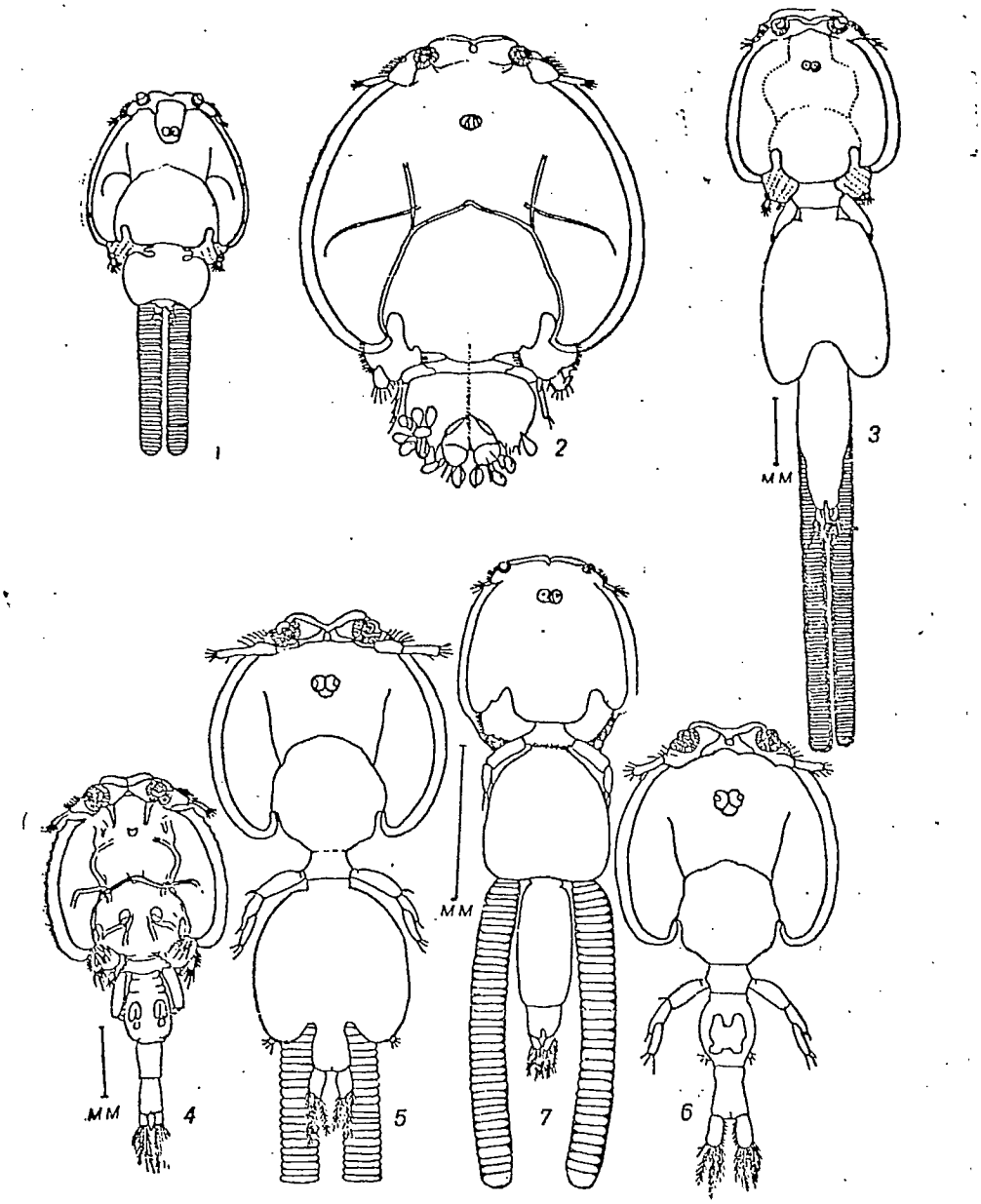

Fig. 64. Crustaceans of the Caligus genus.

1- C.centrodonti, female; 2- C.centrodonti, male; 3- C.bonito, female; 4- C.bonito, male; 5- C.minimus, female; 6- C.minimus, male; 7- C.pelamydis, female (2, 5, 6 - according to Scott, the remaining ones - according to Wilson).

Caligus pelamydis Krøyer.

1863. Caligus pelamydis, Krøyer, Nat. Tidsskr., 3 R., Second volume, page 50, plate IV, figs. 4a - g.

1896. C. scomberi, Bassett-Smith, Ann. Mag. Nat. Hist., XVIII, page 11, plate III, fig. 2.

Female (fig. 64). Cephalothoracic shield is rounded, short and wide. Its length equals its width. Frontal plates are rather well-developed and have widely arranged lacunae upon these plates. The free segment of thorax is short and narrow. Genital segment is large, heart-shaped and considerably narrowed towards the front end. The rear edge of this segment is cut off in a straight line; the rear-lateral corners are rounded. Abdomen is narrow and very elongated. Its length of the genital segment or even exceeds the latter. Caudal branches are short and have several small feathered setae. Legs of the fourth pair are relatively wide and short; they consist of four sections and carry 5 spines. Basal section equals the length of the three remaining segments taken together. Legs of the fifth pair distinguish themselves by their very small dimensions. Ovisacs are elongated and cylindrical. Their length is considerably shorter than the body. Body length is 3.5 - 5.5 millimeters.

Male generally resembles the male C.rapax. It differs from the female being smaller in size. Abdomen consists of two

sections and is somewhat shorter than the sexual segment. They occur rarely, considerably more rarely than the females. Body length is 2.9 millimeters.

Localization and hosts. It settles on the body surface and in the oral cavity of pelamid (Pelamys sarda) and of mackerel (Scomber scombrus).

Occurrence. The distribution area is very extensive. Already now we know of findings of this crustacean in various, mutually very distant regions, namely: Norway, Denmark, England, Mediterranean Sea, South Africa's coasts, Atlantic coast of North America. It is also recorded in the Black Sea (Reshetnikova, 1954).

Caligus rapax M.Edwards.

1832. Caligus elongatus, Nordmann, Mikrogr. Beiträge ... page 24.

1840. Caligus rapax, M.Edwards. Hist. nat. Crust., III, page 453, plate 38, fig. 9.

1840. Caligus elongatus ibidem, page 454.

1847. Caligus leptochilus, Frey and Leuckart, Beiträge zur Kenntniss wirbellosen Thiere, page 165.

Female (fig. 65). Cephalothoracic shield is wide, ovate, and somewhat narrowed towards the front end. Frontal

plates are wide, arched and have large lacunae. The free thoracic segment is very short and narrow. Genital segment is large and oviform. Abdomen is not segmented; its length varies noticeably in different specimens. Caudal branches are short, wide and carry one short and three long feathered setae.

Antennules are well-developed and bi-sectional. Distal section is narrow, although its length equals the length of the basal section. Antennae are small with a small appendix-hook on the rear edge of the basal section. Jaws look like plated rods with a curved terminal portion. On the exterior edge of this portion small teeth are arranged. Maxillules are small, short and slightly curved. Maxilles are straight and pointed towards the top.

Maxillipeds of the first pair are elongated and end in two slightly curved claws of inequal size. Maxillipeds of the second pair are better developed; their terminal claw is very large, it equals the basal section in length. A small somewhat curved claw is located upon the interior edge of the terminal claw. Thoracic furca is well-developed and has narrow, somewhat diverging branches. Legs of the fourth pair are uni-sectional; basal section is elongated and moderately /127 widened. It carries a small seta on the distal end's exterior side. Last two sections are narrow; the middle one of these has one spine-like seta on the distal end, while the terminal

section carries one such seta in the middle of the exterior edge and four spines on the top. Legs of the fifth pair are rudimentary. Each of them looks like a small plate with several short setae on the free edge. Body length is 5-7 millimeters; length of the cephalothoracic shield is 2.6-3.6 millimeters; length of the genital segment - 1.5-2.2 millimeters; length of abdomen - 1-1.5 millimeters; length of ovisacs - 2.6-3 millimeters.

Male. Cephalothoracic shield is rounded, wide and its width and length are equal. The free thoracic segment is considerably narrower and longer than in a female. Genital /128 segment is narrow, pear-shaped, regularly rounded at the rear end. Abdomen consists of two segments and is somewhat longer than the genital segment. Caudal branches are rather large, elongated and have long feathered setae. Antennae and maxillipeds of the second pair are thicker than in a female. Other extremities of the head as well as the trunk legs are similar to those of a female. Body length is 4.5 millimeters; length of the cephalothoracic shield is 2.3-2.4 millimeters; length of genital segment is 0.75 millimeter; length of abdomen - 1 millimeter.

Localization and hosts. The parasite settles upon the skin of many marine fish. Sometimes, however, it may occur (particularly at young age) on the gills of fish. It occurs often in free swimming condition in the surrounding

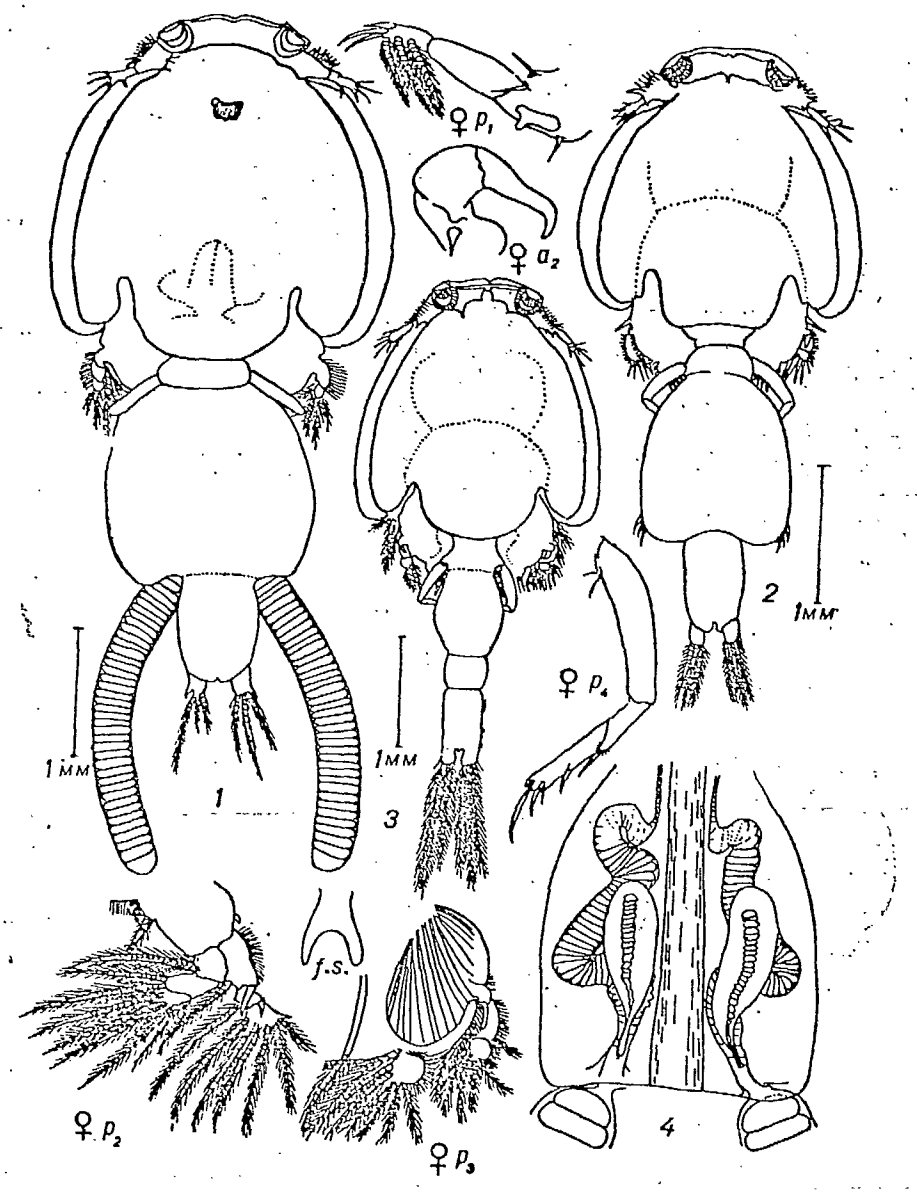

Fig. 65. Caligus rapax (according to Wilson):

1- sexually-mature female; 2- young female; 3- adult male; 4- sexual segment with cement glands; extremities

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medium. Hosts of C.rapax are mainly the fish of the cod family, although it is also known on many other fishes, such as :

Cyclopterus lumpus, Trichiurus lepturus, Gobius minutus, Pleuronectes flesus, Hippoglossus hippoglossus, Xiphia gladius, Acipenser sturio, Mugil capito, M.chelo, Salmo trutta, Raja spp, Singnathidae, Squalus acanthias, Urophycis tenuis and others.

Occurrence: Baltic, North, Mediterranean Seas, Atlantic coast of Europe and North America, Iceland, Greenland, Faeroe islands, and our Far-Eastern seas. According to available data, this is one of the most common Caligidae species in the Barents Sea.

Genus Caligopsis Markewitsch, 1940.

Cephalothoracic shield is broad-ovate, narrowing towards the front end. Frontal plates are well-developed and have deep lacunae. Abdomen is small and uni-sectional. Legs of the fourth pair are absent.

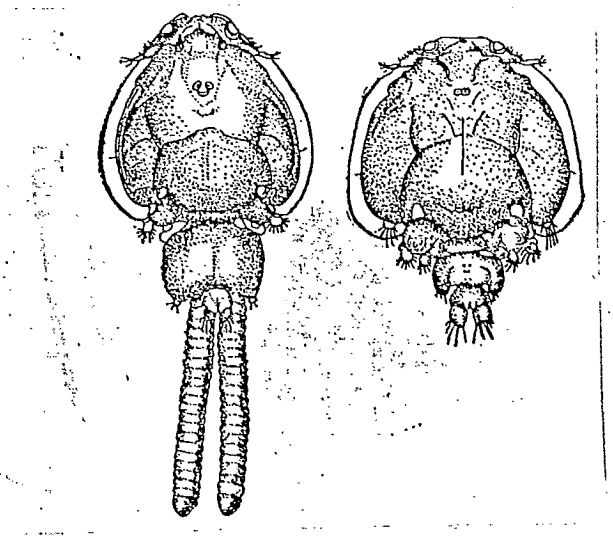

Fig. 66. Caligopsis ponticus (according to Markevich) Female and male.