REDESCRIPTION OF, AND COMMENTS ON, CALIGUS LACUSTRIS STEENSTRUP ET LÜTKEN, 1861 (COPEPODA, CALIGIDAE), A PARASITE OF FRESHWATER FISHES

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Abstract. Caligus lacustris is the only freshwater species of a marine genus containing some 200 species. Although it is widespread and abundant in extensive freshwater habitats of the Old World, it has never been adequately described and accurately illustrated. This paper provides detailed description and illustrations of C. lacustris, based on new material from the territory of the USSR.

Caligus lacustris Steenstrup et Lütken, 1861, is a unique member of the genus numbering more than 200 species. It is the only one that succeeded in colonizing freshwater habitats. Although it is obviously of marine origin, it has become widespread in brackish and fresh waters of Palearctic, where it occurs on skin and gills of numerous fish species. Because of the ubiquity of its occurrence, it attracted attention of many observers over many decades since its discovery. It has been mentioned in about 150 scientific publications.

It is all the more surprising that its morphology is only imperfectly known. Only 27 papers included its drawings, in only 13 were these drawings original. The original description (Steenstrup and Lütken 1861) contained rather stylized drawings of female and its appendages, all lacking in details now considered indispensable for taxonomic purposes. The female was subsequently illustrated by Olsson (1877), Gadd (1906), Alm (1916), Markevich (1937), Gusev (1962) and Agapova (1966), without significant additions to our knowledge. The first illustration of the male was published by Redieke (1939), and his low quality drawings have not been improved upon subsequently. The most detailed account and illustrations of developmental stages, i.e. the copepodid and all four chalimus, were published by Koziakowska (1957), but her drawings were not very helpful, either.

It is with the hope of advancing our knowledge of this very common and abundant species that the authors undertook to describe C. lacustris.

MATERIALS AND METHODS

The material the authors had at their disposal was scanty. It comprised at first only one mature female, several young ones, one preadult male (with the remnant of its frontal filament) and seven males at earlier stages of development. The specimens came from various fishes in Krasnoyarski Kray (the vicinity of the Azov Sea, USSR) and from Abramis brama from Kherson (Dnepr river). In addition, added to the collection were several specimens of adult females and males from Barbus brachycephalus from the Aral Sea.

Drawings of entire specimens and of dissected appendages were made in most instances with the aid of camera lucida. Standard methods were used in preparation of specimens. Morphological terminology follows that adopted by Kabata (1979). Measurements are given in mm. A part of the collection is deposited in the Zoological Institute, Academy of Sciences of the USSR, Leningrad.
DESCRIPTION

Female (Fig. 1A): Dorsal shield constituting half total length, longer than wide, wider posteriorly; frontal plates wide, lunules well developed; tips of lateral zones almost level with posterior margin of thoracic zone. Fourth leg-bearing segment wider posteriorly, without distinct border with genital complex. Latter somewhat longer than thoracic zone of shield, about equally long and wide, with convex lateral and tranversely truncated posterior margins; posterolateral corners angular or rounded, bearing vestigial fifth legs (shape and size of complex varying with age and maturity). Abdomen one-segmented, in adult females 3/4 length of genital complex, longer than wide, with parallel lateral margins; division between abdomen and genital complex indistinct. Caudal rami longer than wide. Dimensions of mature specimens: Total length (including caudal furca without setae) 5.1—7.8; dorsal shield length 2.8—3.7, width 2.5—3.4; genital complex length 1.5—2.4, width 1.4—2.4; abdomen length (with furca) 1.0—1.5, width 0.6—0.8; egg sac length 3.2—5.7, diameter 0.3—0.4.

First antenna with relatively narrow basal segment; terminal segment subcylindrical, slightly pedunculate; armature typical for Caligus (25 plumose and two naked setae on basal segment and 12 (one slit close to base) on terminal. Second antenna (Fig. 1B) with pointed posterior process; claw with two short spiniform setae on basal half. Postantennary process (Fig. 1C) slender, gently curving. Mandible typical for Caligus, with 11 or 12 teeth on dentiferous margin. First maxilla with slender dentiform process (Fig. 1D). Second maxilla (Fig. 1E) brachiform, with small flabellum (f, Fig. 1E); calamus and canna armed as in Caligus curtus (cf. Parker et al. 1968). Maxillipod (Fig. 1G) with slender corpus and unarmed myxal area; seta on subchela close to Suture between claw and shaft; barb short, claw with distinct indentation on inner margin near base. Sternal furca (Fig. 1F) with fairly long box and straight, divergent tines with rounded tips and narrow flanges on outer margins.

Table 1. Armature of thoracic legs of Caligus latus

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Armature of thoracic legs as shown in Table 1. Three of four spines on terminal segment of first exopod about equal in length, with serrated membrane along distal half of outer margins and rows of minute denticles parallel to it; fourth somewhat longer, unarmed (Fig. 1J). Spine of first exopod of second leg with smooth flanges along both margins (Pl. I, Fig. 1B), that of second with narrow, striated flanges on dorsal and ventral margins and two secondary spinules on lateral margin, third with one spine similar to that of second and another apparently armed only on medial margin. One semipinnate seta next to second spine. Endopod of second leg with ventral surface of second segment partly covered by densely packed, robust setules (Pl. I, Fig. 1A). Exopod spine of third leg (Pl. I, Fig. 1D) with flanges along both margins and one setule on margin of base. First terminal spine of fourth leg (Pl. I, Fig. 1E)
Fig. 1. *Caligus lacustris*, female. A — entire, dorsal; B — second antenna, ventral; C — postantennary process, ventral; D — dentiform process of first maxilla, lateral; E — second maxilla, ventral; F — sternal furea, ventral; G — maxilliped, ventral; H — first leg (pinnules omitted from pinnate setae), ventral; J — same, details of terminal armature of exopod; f — flabellum. Scale lines: A = 1 mm, E = 0.05 mm, all others 0.1 mm.
much longer than other two, carrying strip of finely serrated membrane along one margin. Fifth leg reduced to two small, unarmed setae (Pl. I, Fig. 1G). Caudal ramus (Pl. I, Fig. 1F) longer than wide, with armature usual for Caligus (three large pinnate setae, three much smaller setae and fringe of setules on median margin).

**Male** (Pl. II, Fig. 1A): Cephalothorax shield resembling that of female (in some specimens thoracic zone extending further caudal than tips of lateral zones). Fourth leg-bearing segment somewhat wider posteriorly. Genital complex with rounded lateral margins and slight posterolateral concavities, shorter than thoracic zone of shield. Border between genital complex and abdomen indistinct. Abdomen one-segmented, longer than wide, as long as genital complex. Measurements: Total length 5.5—6.5; cephalothorax length 3.2—3.5, width 2.1—2.8; genital complex length 0.7—1.0, width 0.7—1.2; abdomen length 1.1—1.4, width 0.6—0.8.

Appendages similar to those of female, with following exceptions: Second antenna (Pl. II, Fig. 1B) with small adhesion pad on moderately inflated middle segment; claw (Pl. II, Fig. 1C) bifid, with large but delicate seta at base. Dentiform process of first maxilla (Pl. II, Fig. 1D) with broad base and slender apex; latter with roughly obovate area apparently covered by thinner cuticle. Maxilliped (Pl. II, Fig. 1E) with broad corpus; myxal area (Pl. II, Fig. 1F) inflated, with several transverse ridges covered by fine striations, at lower end one (or more) dentiform outgrowths; claw of subchela without pronounced curvature on inner margin.

**DISCUSSION**

*Caligus lacustris* appears to be most closely related to four of its congeners: *C. curtus* Müller, 1785 (type species), *C. minimus* Otto, 1821, *C. mugilis* Brian, 1935, and *C. dicentrarchi* Cabral et Raibaut, 1987. These five species resemble one another in general habitus, although they show some differences in relatively minor details. Only *C. minimus* stands out in this group of five by having female genital complex that flares out in width posteriorly, rather than having parallel lateral margins. The relationship among these species is evident in characteristic features of morphology they share with one another (and with no other *Caligus* species). This applies most of all to the structure of their first and fourth legs. The armature of the distal margin of the exopod of the first leg's terminal segment consists in all of them of four setae gradually increasing in length from first to fourth, the fourth, however, being only slightly longer than other three. Setae 1—3 have no accessory branches, but carry some fine ornamentation. The fourth leg in all five species has a two-segmented exopod, the distal segment of which is devoid of armature on its lateral margin, carrying only the usual three terminal setae. The medialmost of these setae is at least twice as long as the other two, which are subeual in length. The similarity of leg armature does not extend to the endopod of the second leg, which in *C. lacustris* is differently armed from all the remaining members of the group. Whereas the other four species have a fringe of fine setules on the lateral margin of the second segment of that ramus, *C. lacustris* (Pl. I, Fig. 1A) carries a wide band of coarser setules in this position.

It is interesting to note that the distribution ranges of the four marine species closely related to *C. lacustris* overlap to a greater or lesser extent. *C. mugilis* and *C. dicentrarchi* appear to be limited to the western Mediterranean, the former having been found also in the Adriatic. The range of *C. minimus* extends beyond the confines of the landlocked Mediterranean to the North Sea and British waters. Only *C. curtus* has no authenticated Mediterranean records, but it also occurs in the North Sea and in British waters.
It is axiomatic that *C. lacustris* is derived from a marine ancestor. In view of its apparently close relationship to the four species discussed above, one could speculate that the area of its origin (Urheimat) is in, or close to, the western Mediterranean. The paths of its dispersal through the fresh waters of the Old World are difficult to postulate at our present stage of knowledge.

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**REFERENCES**


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Fig. 1. *Caligus lacustris*, female. A — second leg, entire (pinnules omitted from pinnate setae), ventral; B — same, details of exopod armature; C — rami and velum of third leg (armature of velum and pinnate setae partly omitted), ventral; D — exopod spine of third leg, ventral; E — fourth leg, ventral; F — caudal ramus, ventral; G — fifth leg, ventral. Scale lines: A = 0.2 mm, B, D = 0.05 mm, C, F = 0.1 mm, E = 0.25 mm, G = 0.02 mm.
Fig. 1. *Caligus lacustris*, male. A — entire, dorsal; B — second antenna, ventral; C — same, terminal lacinia, ventral; D — dentiform process of first maxilla, ventral; E — maxilliped, ventral; F — same, details of myxal area. Scale lines: A = 1 mm; B, E = 0.1 mm, all others 0.05 mm.