

COPEPODS PARASITIC ON SOUTH INDIAN FISHES—  
FAMILY CALIGIDAE

By N. KRISHNA PILLAI

*Marine Biological Laboratory, Trivandrum-7*

TWENTY-Three species belonging to various genera of Caligidae were described earlier (Pillai, 1961). The present paper describes 17 species, 15 belonging to *Caligus* Muller and 1 to *Lepeophtheirus* Nordmann. 9 species of *Caligus* and 1 species of *Lepeophtheirus* are new. The collection is of particular interest as it includes some of the species insufficiently described by Bassett-Smith; these are briefly described with appropriate illustrations.

Genus *Caligus* Muller

*Caligus phipsoni* Bassett-Smith

(Fig. 1)

*Caligus phipsoni* Bassett-Smith, 1898a, p. 6, pl. 3, figs. 3-4.

**Material.** 7 females and 2 males were collected by the author from the inner surface of the opercle and the roof of the buccal cavity of *Polynemus plebeius* (Broussonet) at Trivandrum.

**Remarks.** The very short description given by Bassett-Smith applies to the present specimens but he has paid no attention to details. The frontal plates and lunules are as described by Bassett-Smith but the postero-median lobe of the carapace projects very well beyond the lateral lobes. The genital segment has a short anterior neck-like part and the basal part of the abdomen shows a prominent constriction. The sternal fork has a very narrow base but the rami are comparatively stout, slightly diverging and apically flanged. The vestigial endopod of the first leg has two spines, the first segment of the exopod is rather broad, with a distal upper spine, the second and third claws of the distal segment carry accessory spines and the distal seta is stout and feathery, much stouter than the ventral setae. Bassett-Smith makes no mention of the second leg; the third exopod spine of this leg is minute and the second endopod segment bears three or four rows of strong teeth. The basal hook of the exopod of third leg is blunt, curved inwards and externally flanged. The fourth leg is three segmented, with five claws. Bassett-Smith says that the terminal segment carries five claws but his figure shows a four jointed appendage with three claws on the terminal segment. Bassett-Smith mentions only the first maxilla of the male but the second antenna and second maxilliped also show the usual dimorphism. The second segment of the second antenna is corrugated and the third is short and apically trifid. The basal segment of the

second maxilliped is produced on its inner surface into a conical process and two sharp teeth.

Length of female 3.9 mm, male 2.5 mm.

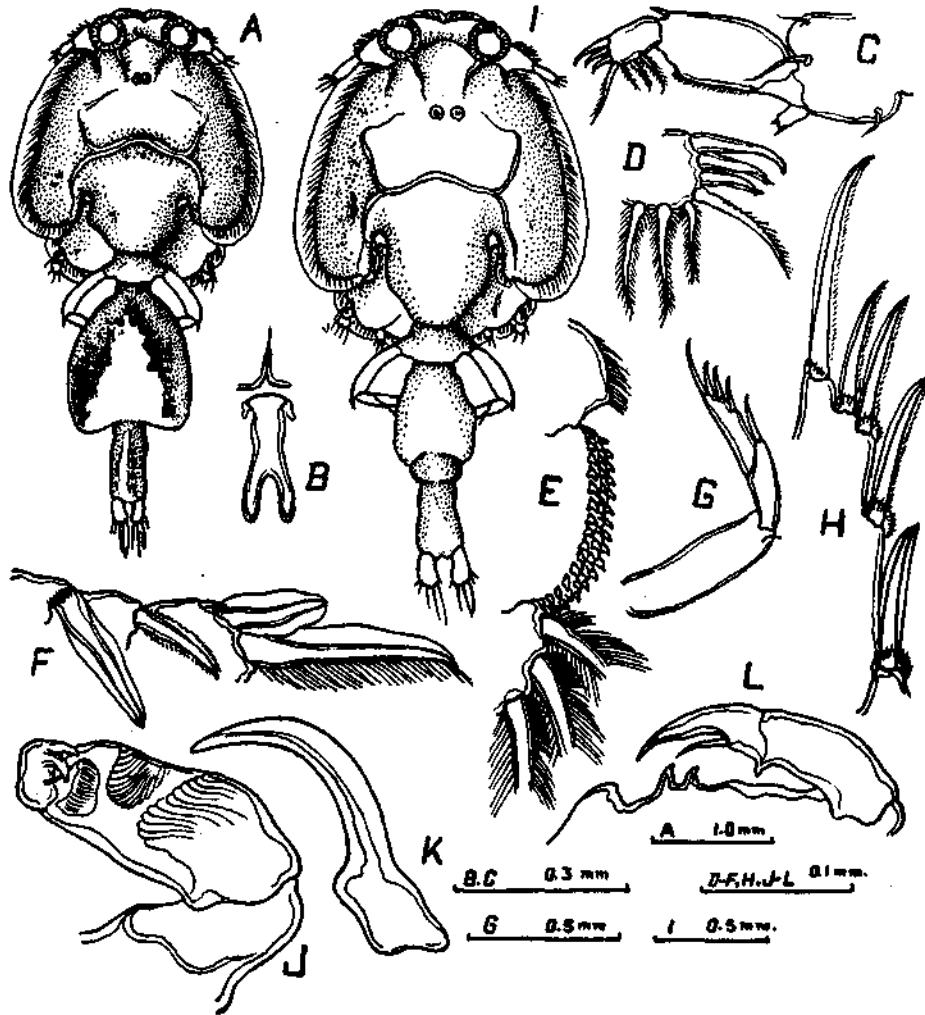
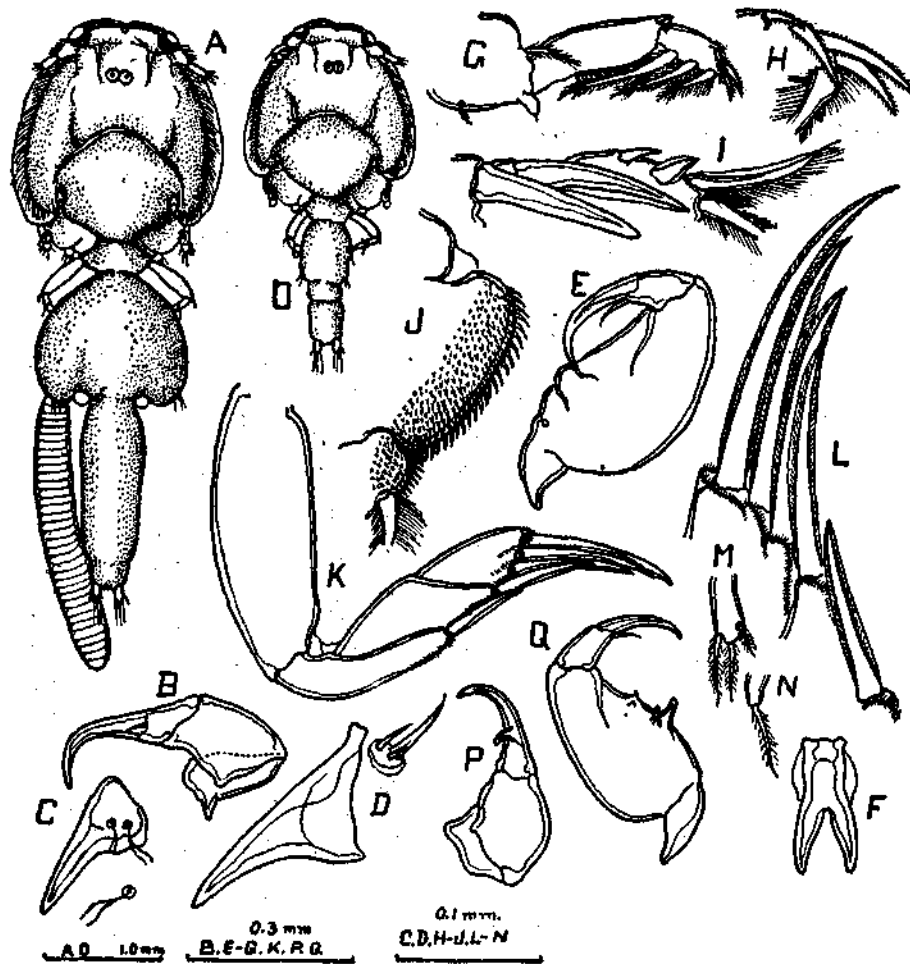


FIG. 1. *Caligus phipsoni* Bassett-Smith. A-H, female.

A, female, dorsal view. B, sternal fork. C, leg 1. D, same, tip enlarged. E, leg 2, endopod. F, same, exopod. G, leg 4. H, same, enlarged. I-L, male. I, male, dorsal view. J, antenna 2. K, maxilla 1. L, maxilliped 2, cutting edge.

*Caligus longicaudus* Bassett-Smith

(Fig. 2)

FIG. 2. *Caligus longicaudus* Bassett-Smith. A-N, female.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 2. F, sternal fork. G, leg 1. H, same, tip enlarged. I, leg 2, exopod. J, same, endopod. K, leg 4. L, same, tip enlarged. M, leg 5. N, leg 6. O-Q, male. O, male, dorsal view. P, antenna 2. Q, maxilliped 2.

*Caligus longicaudus* Bassett-Smith, 1898a, p. 7, pl. 4, figs. 1-3.

**Material.** 14 females and 8 males were collected by the author from the inner surface of the opercle of *Chirocentrus dorab* (Forsk.) at Trivandrum.

**Remarks.** This species parasitising one of the common food fishes appears to have not been recorded since Bassett-Smith described it and the male is

described for the first time. *C. longicaudus* can be distinguished by the following characters. The abdomen is as long as the carapace and two segmented, the distal segment is hardly one fifth the length of the proximal segment. The genital segment is semicircular and postero-laterally produced into rounded lobes. Bassett-Smith makes no mention of the palp of the second maxilla which carries, as usual in the genus, three spine-setae. The distal segment of the first leg has been described as having three claws, but there are actually four claws. The first two claws of the exopod of the second leg are very large and the third very small and the second and third endopod segments are prominently spiny. Bassett-Smith described the fourth leg as three segmented but this leg is clearly four segmented. What Bassett-Smith described as the fifth leg is the sixth, the fifth leg is composed of a single seta.

In the male the carapace is comparatively short, its postero-median lobe is more conical and the posterior sinuses are fully open. The genital segment is inverted U-shaped and the first segment of the abdomen is about half as long as the second. The appendages are generally like those of the female but the second antennae and second maxillipeds show the customary modifications. The distal segment of the former has a long spine and a curved accessory claw. Basal segment of the second maxilliped has three to four sharp processes on its inner border.

In the overall shape of the female, *C. longicaudus* resembles *C. quadratus* Shiino (1954b), but in the latter the carapace is more circular and the genital segment is longer than broad. In the males the shape of the genital segment and the comparative lengths of the abdominal segments are different. In *C. quadratus* the fourth leg is three segmented while it is four segmented in *C. longicaudus*.

Length of female 5.0 mm., male 2.9 mm.

#### *Caligus arii* Bassett-Smith

(Fig. 3)

*Caligus arii* Bassett-Smith, 1898b, p. 82, pl. 4, fig. 1; Barnard, 1948, p. 244; 1955, p. 248, figs. 10a-b.

**Material.** A single female was collected by the author from the inner surface of the opercle of *Pseudarius jatus* (Ham. Buch.) at Trivandrum.

**Remarks.** Though devoid of details, Bassett-Smith's description is applicable to the present specimen. *C. arii* is a very remarkable species with pronounced characters. The setae arming the basal segment of the first antenna are hirsute all over, quite unlike what is usually seen in *Caligus*. The third segment of the second antenna is very large and this appendage is obviously the main prehensile organ. The first maxilla is absent and the large second maxilla has a palp with three setae, one of which is very large. The apical claw of the first maxilliped is very long and the outer lobe prominent. Unlike as is usual in the genus, the second maxilliped is elongate cylindrical and very weak and the very short distal segment carries a long spine. The limbs of the sternal fork are as long as the base and very slightly diverge and their apices are spatulate. The first leg is very characteristic, the vestigial endopod is large and spiny and the basipod carries a very long conspicuously hirsute seta which is nearly as long as the basal segment of the exopod, the distal exopod segment carries three peculiarly modified claws, each claw is apically bifid

and has a prominent frilled wing on the ventral side. The basal segment of the exopod of the second leg is slender and long and the distal two segments short but deep, the claws on the segments are small but the second seta on the third segment is modified into a stout claw, the second and third endopod segments have their outer part covered with several rows of small spinules. The third limb deviates

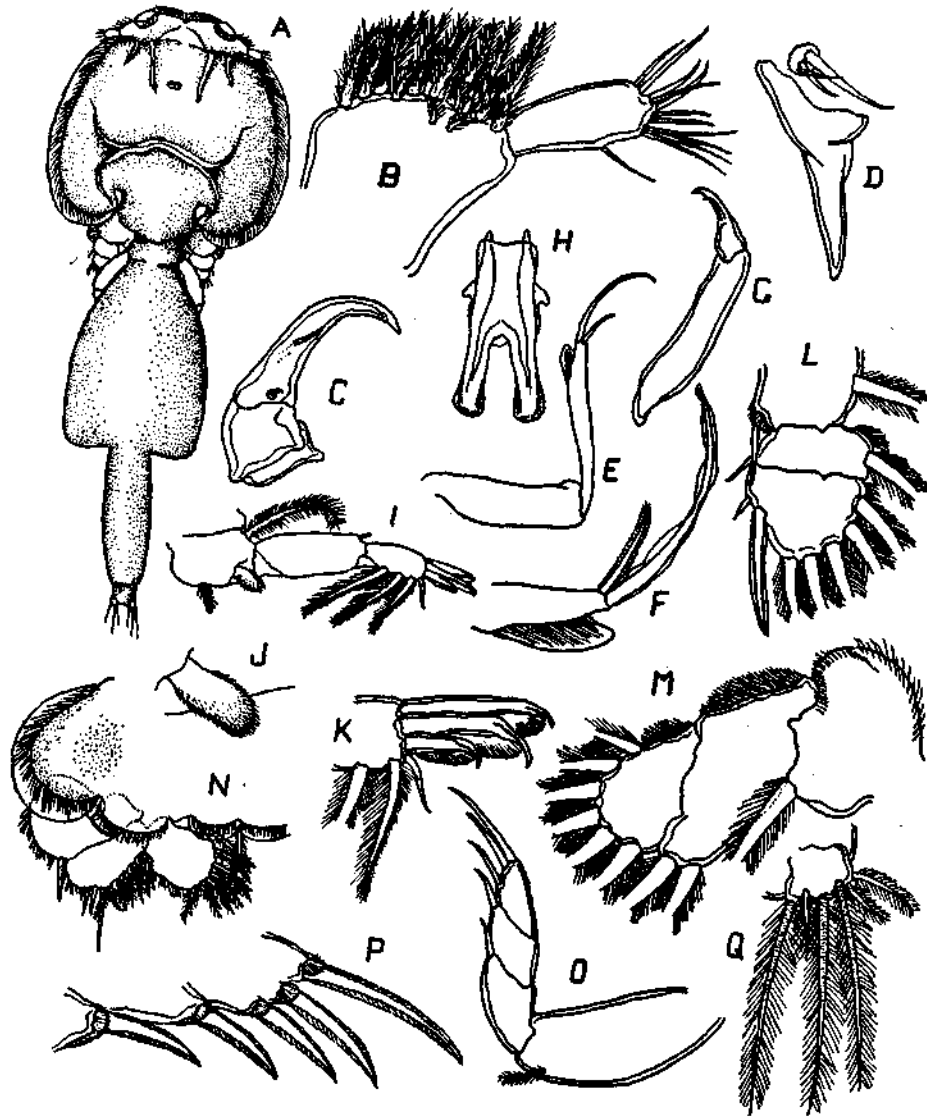


FIG. 3. *Caligus arii* Bassett-Smith.

A, female, dorsal view. B, antenna 1. C, antenna 2. D, maxilla 2. E, maxilliped 1. F, same, tip enlarged. G, maxilliped 2. H, sternal fork. I, leg 1. J, same, endopod. K, same, tip enlarged. L, leg 2, exopod. M, same, endopod. N, leg 3. O, leg 4. P, same, tip enlarged; Q, anal lamina.

from the typical, its apron is reduced in size, but the rami are expanded. Fourth leg is of the normal type, four segmented, with five winged claws. The anal laminae, as described by Bassett-Smith, are small lobes sunk into the small distal segment of the abdomen and they carry three long and three short setae, the long ones are transversely wrinkled.

According to Barnard (1955), in the South African specimens, there is no trace of a division in the abdomen and the fourth leg is three jointed. In my specimen they are exactly as described by Bassett-Smith.

Length of female 6.0 mm.

*Caligus robustus* Bassett-Smith

(Fig. 4)

*Caligus robustus* Bassett-Smith, 1898c, p. 361, pl. 2, figs. 1-2; Wilson, 1913, p. 212, pl. 28.

**Material.** 11 females and 6 males were collected by the author from the inner surface of the opercle of *Caranx sanson* (Forsk.) and 4 females from *Caranx melanampygus* Cuvier at Trivandrum.

**Remarks.** As both sexes of this species have been described by Wilson, the following remarks are confined to variations observed in the present material. The first maxilla is associated with the usual three bunches of setae and the second maxilla has a false joint a little above its tip and its palp carries two spine-setae. The second maxilliped has a bifid process on its basal segment. The sternal fork is as illustrated by Wilson, but the rami are flattened and winged. The distal segment of the first leg has three stout claws and a short dorsal spine, the customary distal seta is modified into a spine and the vestigial endopod is flat. The first two exopod spines of the second leg are very stout and the endopod is prominently spiny. The fourth leg is comparatively robust. As observed by Wilson, this species shows much variation in size proportional to the size of the host. Those collected from *Caranx melanampygus* are larger. Wilson has observed that the appendages of the male are exactly like those of the female without even the customary modifications of the second antennae and second maxillipeds; but this is not so. The second segment of the second antenna has its inner surface roughened and distally raised into a pad, the distal segment is slender and hook-like, with a median accessory claw and a basal spine. The basal segment of the second maxilliped has a trifid process and the middle process is distally spooned and into this concavity fits the distal segment. One of the setae of the sixth leg is modified into a stout spine.

Length of female 5.4 mm, male 3.1 mm.

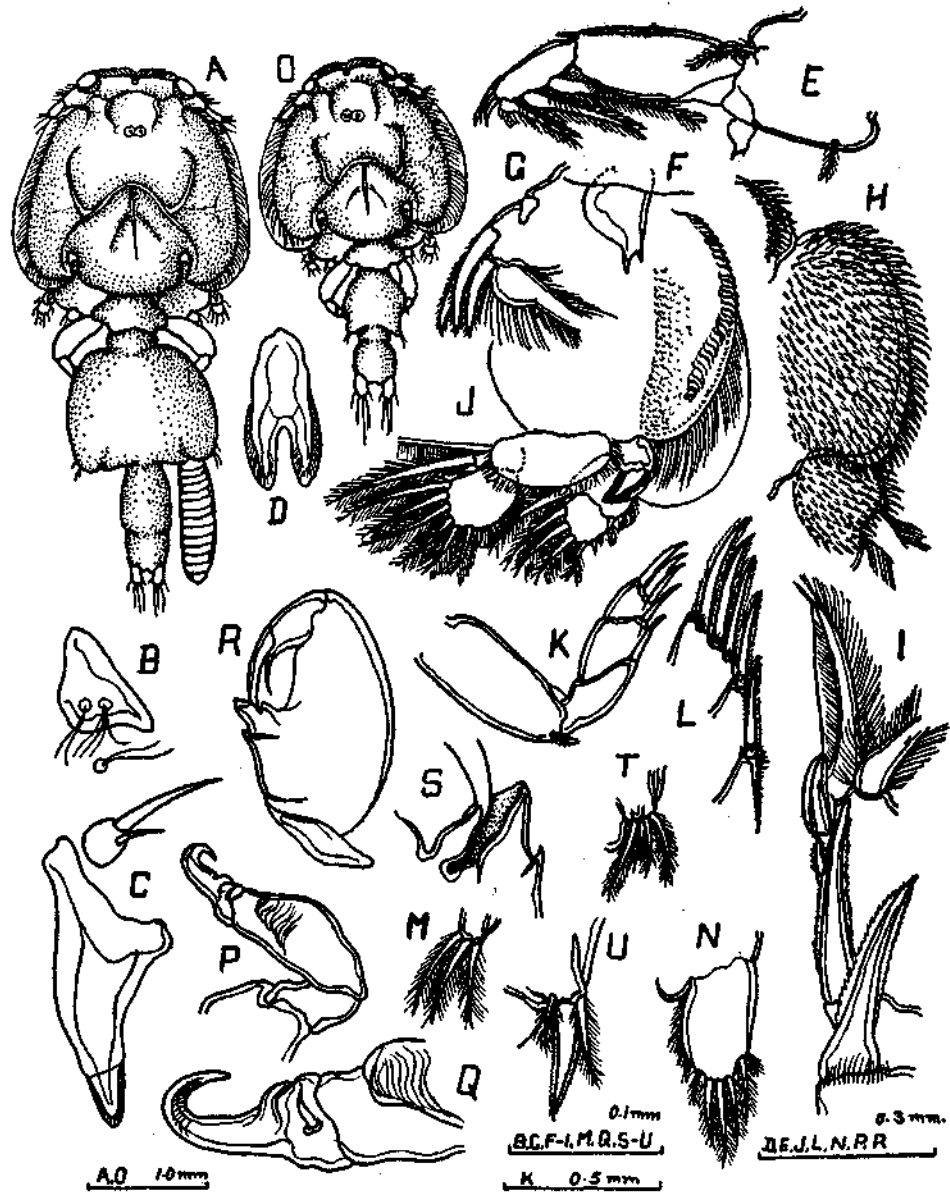
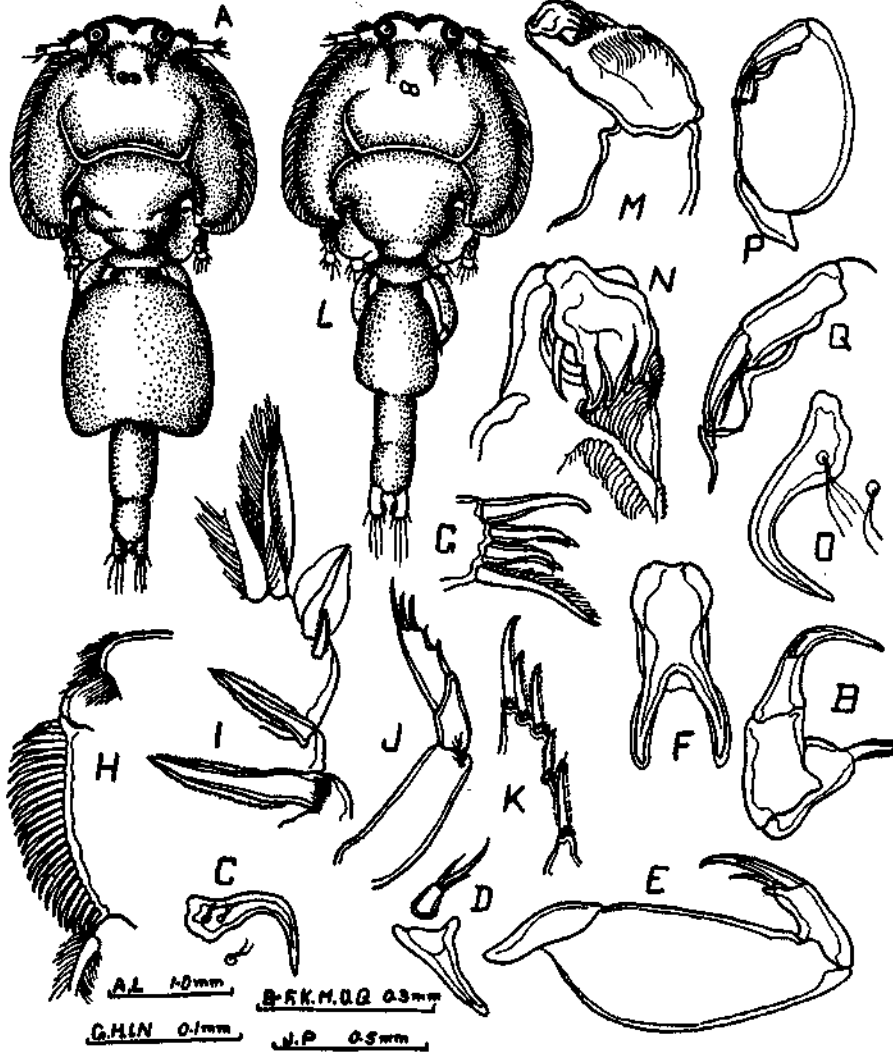


FIG. 4. *Caligus robustus* Bassett-Smith. A-N, female.

A, female, dorsal view. B, maxilla 1. C, maxilla 2. D, sternal fork. E, leg 1. F, same, endopod. G, same, tip of exopod. H, leg 2, endopod. I, same, exopod. J, leg 3. K, leg 4. L, same, tip enlarged. M, leg 5. N, anal lamina. O-U, male. O, male, dorsal view. P, antenna 2. Q, same, tip enlarged. R, maxilliped 2. S, same, inner side of segment 1. T, leg 5. U, leg 6.

*Caligus epinepheli* Yamaguti

(Fig. 5)

*Caligus epinepheli* Yamaguti, 1936, p. 4, pl. 3, figs. 27-39; Shiino, 1952, p. 80, figs. 1-2.*Caligus cossacki* Rangnekar and Murti, 1959, p. 78, figs.FIG. 5. *Caligus epinepheli* Yamaguti. A-K, female.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 2. F, sternal fork. G, leg 1, tip. H, leg 2, endopod. I, same, exopod. J, leg 4. K, same, tip enlarged. L-Q, male. L, male, dorsal view. M, antenna 2. N, same, tip enlarged. O, maxilla 1. P, maxilliped 2. Q, same, cutting edge.



**Material.** 4 females and 2 males were collected by the author from the inner surface of the opercle of *Chorinemus tala* Cuvier at Trivandrum.

**Remarks.** From *C. epinepheli*, as described by Yamaguti and Shiino, the present material differs as follows. The postero-median lobe of the carapace is produced more or less as shown by Shiino. Both Yamaguti and Shiino have shown the genital segment of the female as narrower in front but in the present specimens the genital segment has subparallel sides and its antero-lateral parts are shoulder-like and postero-lateral parts slightly produced. More important than these is the shape of the sternal fork which has much more slender and narrow rami. According to Shiino the apical segment of the second antenna of the male is spatulate with an acuminate but blunt tip. In my specimens this segment is short but broad, irregular in shape and apically trifid, its base carries a long spine. Shiino has described a single conical process on the basal segment of the second maxilliped of the male but in my specimens there are two. Nevertheless, the presence of a long apically blunt process on the basal segment of the second antenna, presence of rows of strong spines on the endopod of the second leg and the absence of setae on the lower border of the distal exopod segment of the first leg reveal the identity.

The specimens Rangnekar and Murti assigned to *C. cossacki* belong to *C. epinepheli* Yamaguti. They have correctly described the first and second legs of the female but apparently failed to observe that in *C. cossacki* these two appendages are different. If otherwise, there is every reason to think that Heegaard (1943), who gave a detailed description of *C. cossacki*, would have noticed them.

Length of female 4.5 mm, male 4.1 mm.

*Caligus spinosus* Yamaguti

(Fig. 6)

*Caligus spinosus* Yamaguti, 1939, p. 445, pl. 14, figs. 4-8 ;  
Shiino, 1960, p. 476, figs. 3-4.

**Material.** 6 females were collected from the roof of the buccal cavity of *Sphyraena obtusata* Cuvier by the author at Trivandrum.

**Remarks.** It is with some reservation that I refer the present specimens to Yamaguti's species. The genital segment in the present specimens is swollen and its posterior border is nearly subtruncate ; Yamaguti has shown it as postero-laterally rounded. According to Shiino, the shape of the genital segment is slightly variable. Yamaguti described the abdomen as short, cylindrical and one jointed and Shiino described it as less than half as long as the genital segment and indistinctly two segmented, the distal segment being much shorter than the proximal. In my specimens the abdomen is very short, but much more swollen, demarcated into two subequal segments and the distal segment is produced postero-laterally into small lobes reaching half way up the anal laminae. The vestigial endopod of the first leg is two segmented and the apron of the third leg shows a slightly different armature. Above the position of the endopod is a transverse patch of strong teeth, smaller than those in Shiino's specimens and above that of the endopod is a longitudinal row of teeth instead of two to three rows shown by Shiino. In spite of these variations I hesitate to consider these specimens as different from

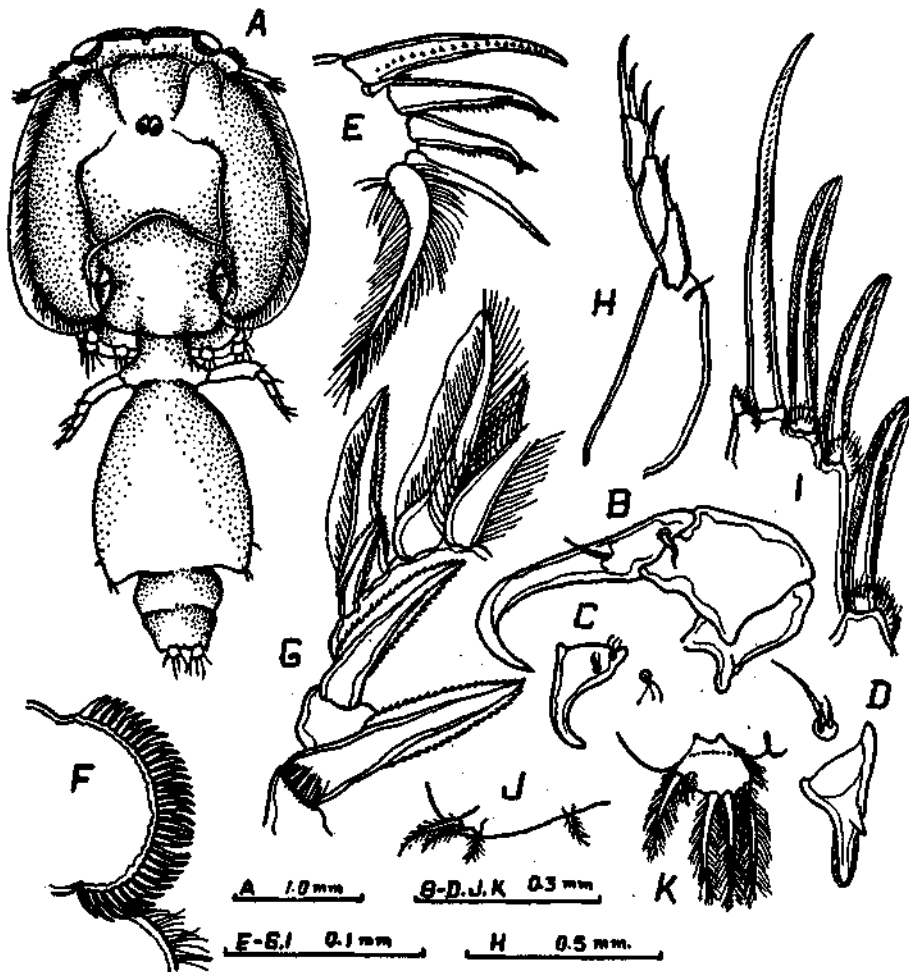


FIG. 6. *Caligus spinosus* Yamaguti.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, leg 1, tip. F, leg 2, endopod. G, same, exopod. H, leg 4. I, same, tip enlarged. J, legs 5 and 6. K, anal lamina.

*C. spinosus*. In the structure of the various appendages *C. spinosus* closely resembles *C. cordyla* sp. nov. and *C. brevicaudus* sp. nov., but can be distinguished by the shape of its sternal fork.

Length of female 5.1 mm.

*Caligus cunicephalus* Gnanamuthu

(Fig. 7)

*Caligus cunicephalus* Gnanamuthu, 1950, p. 113.

**Material.** 53 females and 4 males were collected by the author from the buccal cavity of *Trichiurus savala* Cuvier at Trivandrum.

**Remarks.** This species possesses prominent characters which make its identification easy. The genital segment of the female is large, as long as the carapace minus the frontal plates. The first maxilliped is short but stout, with strong

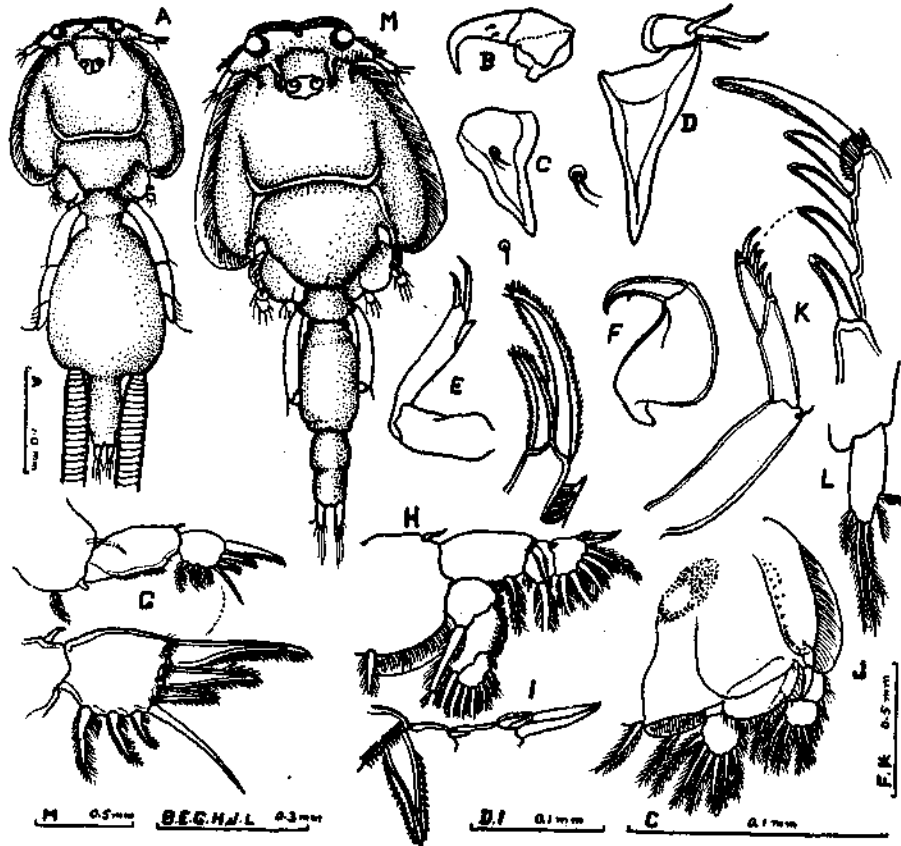


FIG. 7. *Caligus cunicephalus* Gnanamuthu. A-L, female.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 1. F, maxilliped 2. G, leg 1. H, leg 2. I, same, exopod. J, leg 3. K, leg 4. L, anal lamina. M, male, dorsal view.

distal claws, carrying prominently pectinate broad wings, the outer lobe is proportionately very large and almost reaches the tip of the distal segment. The second maxilliped has a very stout basal segment. The distal segment of the first leg is fairly large and carries on its distal border three stout claws steadily decreasing in length from the first to the third, the first claw has a broad conspicuously serrated ventral wing and the second and third a few teeth on the upper and several on the lower side, the spine seta at the lower distal angle is simple and as long as the first claw, the ventral border carries three comparatively short setae increasing in length basalwards, these setae carry spinules rather than hairs. The first claw of the exopod of the second leg is large and with serrate wings on both borders, second claw is minute and the third claw absent, first seta of third segment is small and second large, segments of the endopod are conspicuously spiny. Third leg is of

the usual pattern but the fourth leg is very characteristic. Its basal segment is slightly longer than the rest of the limb, the second segment is comparatively very long and the third very short so that the five claws arming this leg are virtually crowded at the tip of the appendage and in the dorsal view of the animal these legs project out conspicuously. The anal laminae are also diagnostic being long and subcylindrical, with three long distal setae.

Length of female 4.9 mm, male 2.6 mm.

*Caligus russellii* Kurian  
(Fig. 8)

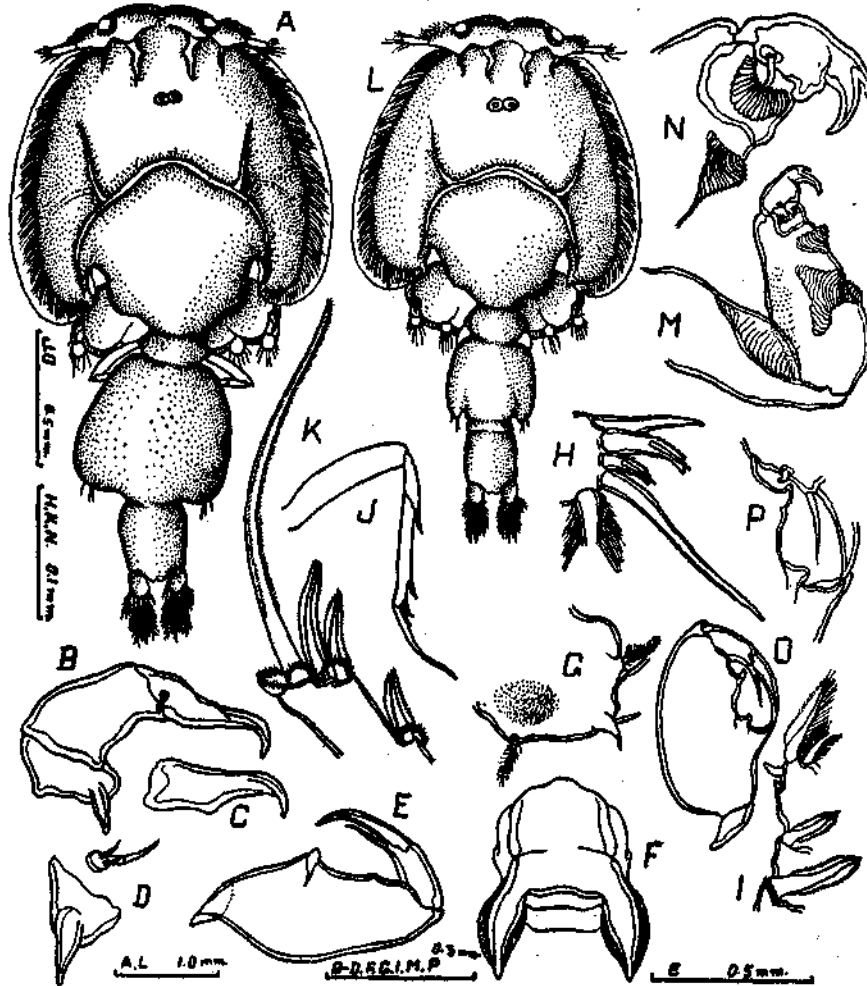


FIG. 8. *Caligus russellii* Kurian. A-K, female.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 2. F, sternal fork. G, leg 1, basipod. H, same, tip of exopod. I, leg 2, exopod. J, leg 4. K, same, tip enlarged. L-P, male. L, male, dorsal view. M, antenna 2. N, same, tip enlarged. O, maxilliped 2. P, same, cutting edge.

*Caligus russellii* Kurian, 1950, p. 2, pl. 2, figs. 2-15 ; 1955, p. 103.

**Material.** 2 females and 1 male were collected from the surface of the body of *Pterois russellii* Bennett and one female from the gills of *Pterois miles* (Bennett) by the author at Trivandrum.

**Remarks.** The present specimens are clearly referable to Kurian's species but certain differences were observed in my specimens. The membranous flange of the carapace is slightly broader than in Kurian's figure and the median posterior lobe of the carapace is convex and not concave as shown by Kurian. Associated with the first maxilla are three bunches of setules and the second maxilla has a pulp carrying three setae. In the description of the sternal fork Kurian makes no mention of the broad wings flanking the rami as well as of the stout base. The basipod of the first leg has a patch of denticles and the vestigial endopod carries a sharp spine, the second and third claws of the exopod of the second leg are large and winged, but the third is very minute, the first seta on the third segment is small and the second is winged on the dorsal side. The fourth leg has its apical claw very long, about four times as long as the penultimate claw. In the second maxilliped of the male Kurian has shown only two processes on the basal segment but there are actually three. The second antenna shows the usual modifications, its basal segment has a corrugated patch, second segment has three patches and the third segment has a swollen base and an accessory claw.

*C. russellii* resembles *C. punctatus* Shiino (1955) in the structure of the various appendages but the long fourth claw on the distal segment of the first leg, the very long apical claw of the fourth leg and the differently shaped sternal fork distinguish *C. russellii* from all the others.

Length of female 5.8 mm., male 4.4 mm.

*Caligus kuroshio* Shiino

(Fig. 9)

*Caligus bonito* Yamaguti, 1936, p. 8, pl. 5, figs. 69-71, pl. 6, figs. 72-85.

*Caligus kuroshio* Shiino, 1959a, p. 51, figs. 1-2.

**Material.** A large number of females and males were collected by the author from the gill arches of *Euthynnus affinis* (Cantor) at Trivandrum.

**Remarks.** Based on certain differences Shiino made the material Yamaguti assigned to *C. bonito* Wilson, a new species, *C. kuroshio*. The present specimens very closely resemble the latter in the structure of the various appendages, particularly the legs of the female and the first maxilla, second antenna and second maxilliped of the male. However, it differs in some other characters. In *C. kuroshio* the genital segment is broadest in the middle and narrows towards both directions, but in the present material it is almost triangular, broadest behind. Also the sternal fork has long apically narrowed slender rami while in *C. kuroshio* the rami are short, parallel sided and apically subtruncate. In the above two characters the present specimens also differ from *C. bonito* as described by Wilson (1905). He has described the genital segment as elliptical, and the abdomen appears immersed in the genital segment. Thus there is some difficulty in placing the present material under either of the two species. Probably the description of *C. bonito* by

Wilson is incomplete. Pending a detailed study of *C. bonito* the present material is identified as *C. kuroshio*.

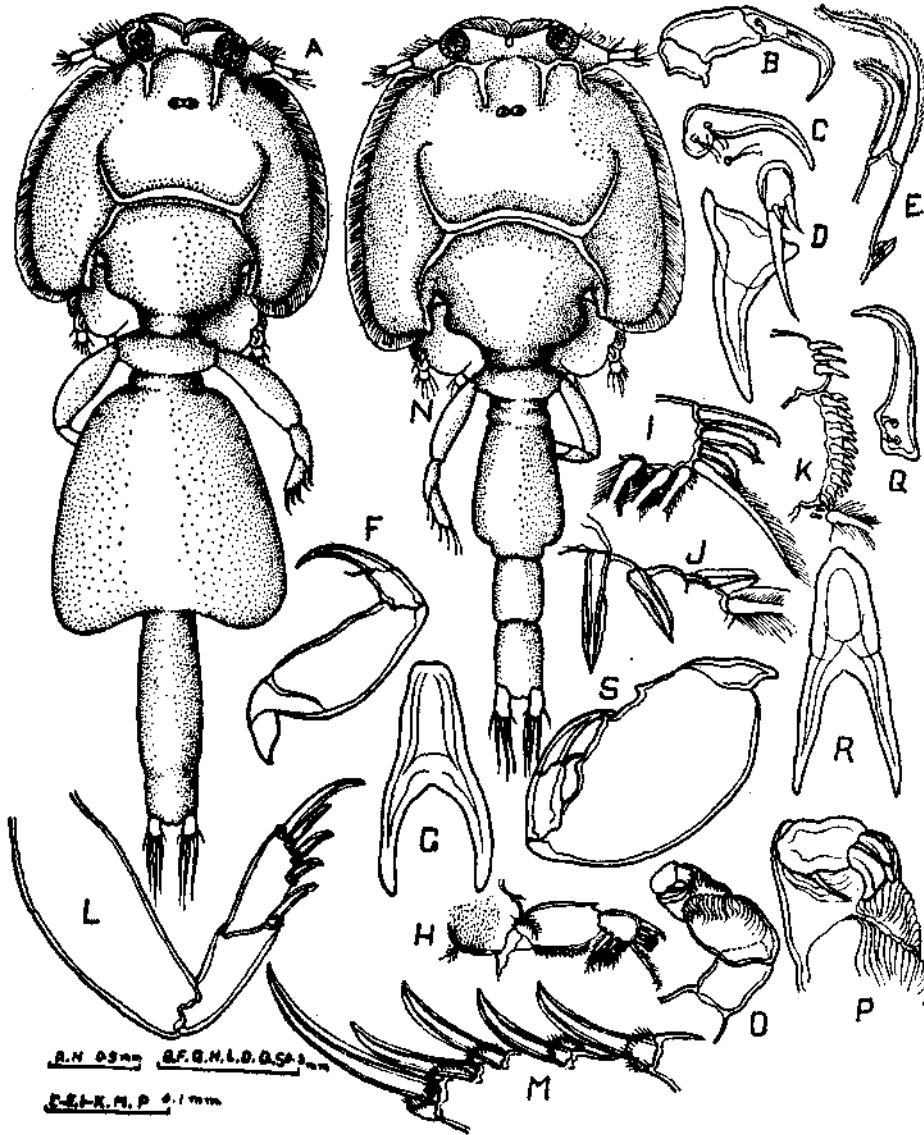


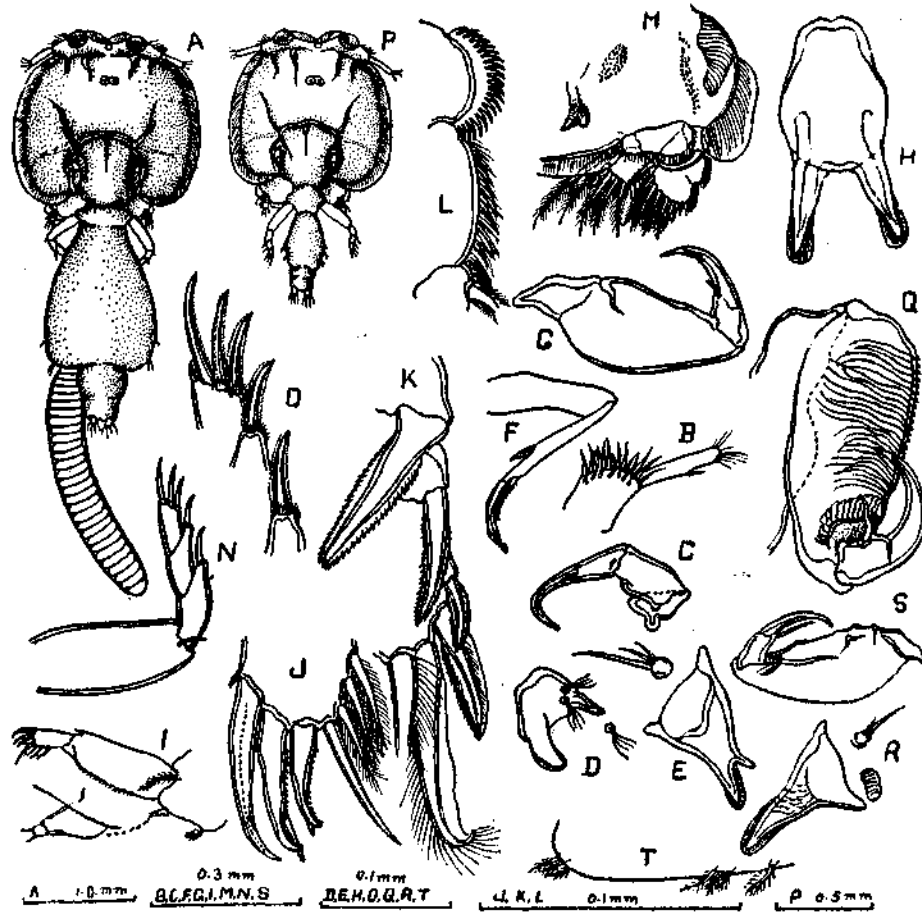
FIG. 9. *Caligus kuroshio* Shiino. A-M, female.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 1. F, maxilliped 2. G, sternal fork. H, leg 1. I, same, tip of exopod. J, leg 2, exopod. K, same, endopod. L, leg 4. M, same, tip enlarged. N-S, male. N, male, dorsal view. O, antenna 2. P, same, tip enlarged. Q, maxilla 1. R, sternal fork. S, maxilliped 2.

Length of female 4.2 mm., male 3.4 mm.; two of the males were larger than the rest and measured 4.7 mm.

*Caligus cordyla* sp. nov.

(Fig. 10)

FIG. 10. *Caligus cordyla* sp. nov. A-O, female.

A, female, dorsal view. B, antenna 1. C, antenna 2. D, maxilla 1. E, maxilla 2. F, maxilliped 1. G, maxilliped 2. H, sternal fork. I, leg 1. J, same, tip enlarged. K, leg 2, exopod. L, same, endopod. M, leg 3. N, leg 4. O, same, tip enlarged. P-T, male. P, male, dorsal view. Q, antenna 2. R, maxilla 2. S, maxilliped 2. T, legs 5 and 6.

**Material.** 23 females and 2 males were collected by the author from the inner surface of the opercle and from the gill arches of *Megalaspis cordyla* (Linn.) at Trivandrum. Holotype female, and allotype male, are deposited in the Indian Museum, Calcutta.

**Female.** Carapace nearly circular, frontal plates prominent and projecting, slightly slanting towards the antero-median part. Lunules shallow but projecting. Transverse dorsal rib placed far behind, cephalic area consequently much larger than thoracic. Posterior sinuses deep and closed behind, postero-median lobe only slightly broader than lateral lobes and hardly projecting beyond them.

Fourth thoracic segment much broader than long, fused with the genital segment, genital segment enlarged, broadening backwards, with a small anterior neck-like constriction. Abdomen short, two segmented. Anal laminae very small.

Distal segment of first antenna slender, longer than basal segment. Basal segment of second antenna with a rounded process, distal segment long and slender. First maxilla with a broad base carrying a stout accessory process, claw stout, curved and blunt, with a narrow flange. Second maxilla triangular, with a small accessory claw, main claw with a narrow flange, palp with one long and two short spines. Base of sternal fork stout and swollen, rami diverging, with flat rounded apex.

Basipod of first leg spiny, vestigial endopod two segmented, with two spinules, distal segment of exopod with three long toothed claws, a simple long spine-seta and three comparatively small setae, second and third claws with an accessory spine. Claws on the exopod of second leg large, with broad serrate wings, first seta of third segment fully winged and second seta winged on the dorsal side, first segment of endopod with a prominent crest of spines, second and third segments with stiff hairs. Apron of third leg with a patch of spines above the endopod and a long row above the exopod, inner rib of apron projecting as a bifid claw, outer part corrugated, basal claw of exopod strongly curved. Fourth leg four segmented, with short, strong, armed claws.

Total length 3.0 mm.

**Male.** Carapace like that of female, fourth segment larger, as long as broad and produced over the base of the legs, genital segment elliptical, abdomen two segmented, second segment slightly longer than first. Second segment of second antenna enlarged and prominently corrugated, third segment falcate, with a stout spine at its base. Second maxilla without the accessory spine. Basal segment of second maxilliped with three to four low projections.

Total length 2.0 mm.

**Remarks.** *C. cordyla* sp. nov. closely resembles *C. confusus* Pillai (1961), *C. spinosus* Yamaguti (1939) and *C. brevicaudus* sp. nov. This resemblance is clearly evident in the general shape of the body, long slender second segment of the first antenna, slender apically curved distal segment of the second antenna and in the presence of an accessory process on the second maxilla. The armature of the apron of the third leg is identical in all these species. The hosts of these species are also closely related. But *C. cordyla* differs from the others in the shape of the sternal fork; in *C. cordyla* the rami are apically flattened and spatulate, in *C. confusus* parallel and apically acute, with broad wings, in *C. spinosus* bracket-shaped and in *C. brevicaudus* almost like that of *C. spinosus*.

*Caligus brevicaudus* sp. nov.

(Fig. 11)

**Material.** 21 females and 17 males were collected by the author from the inner surface of the opercle of *Caranx* sp. at Trivandrum. Holotype female, and allotype male, are deposited in the Indian Museum, Calcutta.



Female. Carapace circular, with narrow membranous flange and low frontal plates. Postero-lateral lobes of carapace about half as broad as the median lobe, slightly curved inwards and overlapping the median lobe, latter produced far

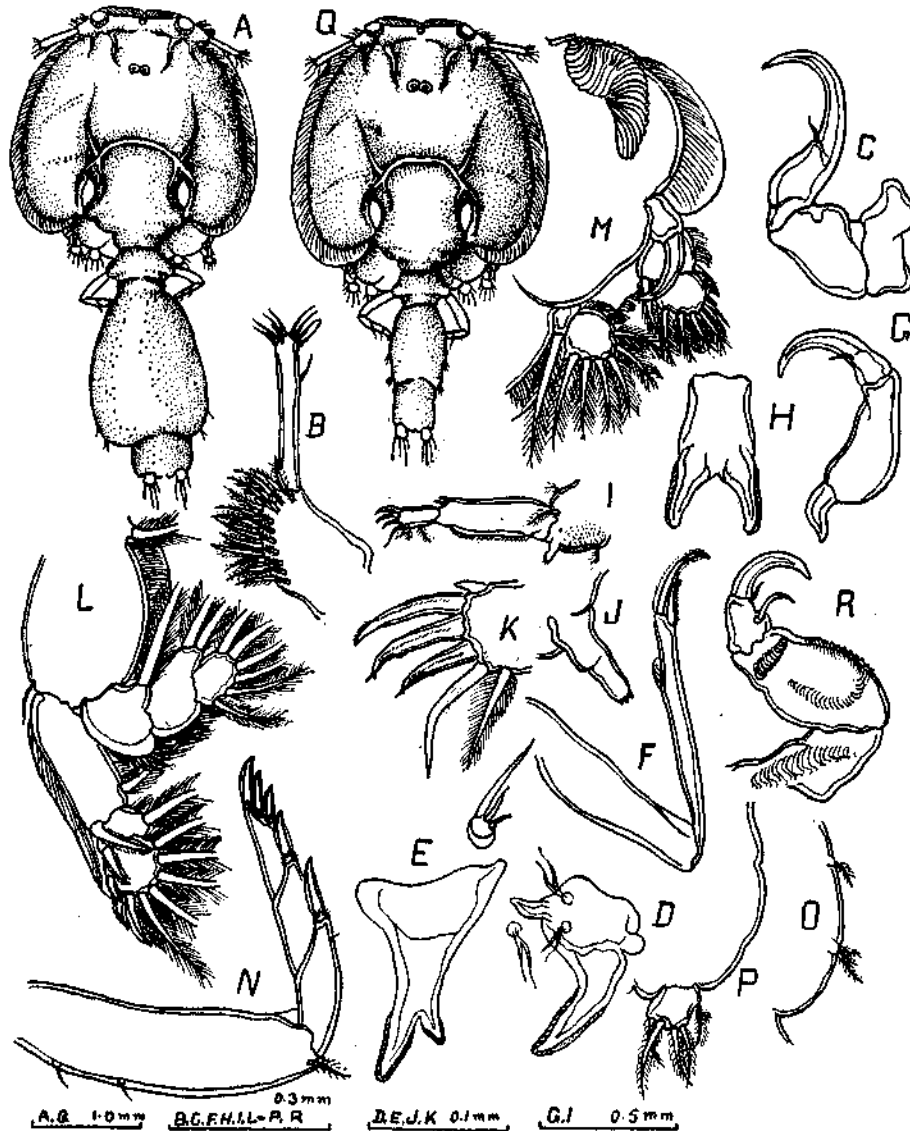


FIG. 11. *Caligus brevicaudus* sp. nov. A-P, female.

A, female, dorsal view. B, antenna 1. C, antenna 2. D, maxilla 1. E, maxilla 2. F, maxilliped 1. G, maxilliped 2. H, sternal fork. I, leg 1. J, same, endopod. K, same, tip of exopod. L, leg 2. M, leg 3. N, leg 4. O, legs 5 and 6. P, anal lamina. Q-R, male. Q, male, dorsal view. R, antenna 2.

beyond the lateral lobes, posterior sinuses deep and closed behind. Dorsal transverse rib placed far back, cephalic area very large. Fourth thoracic segment broader

than long, with prominent wing-like lobes overlapping the base of the legs. Genital segment large and pyriform. Abdomen one segmented, broader than long and distally subtruncate. Anal laminae small.

First antenna with long slender distal segment. Basal segment of second antenna with rounded lobe, third segment long and slender, with two spines. First maxilla with a small lower and a rounded upper processes, claw large and winged. Accessory claw of second maxilla stout, palp with one long and two short spines. Maxillipeds of the usual pattern, distal segment of second maxilliped as long as basal, slender and strongly curved. Sternal fork with roughly squarish base, rami blunt, apically slightly curved inwards and externally winged.

First leg very much similar to that of *C. cordyla*, except for the nearly cylindrical one segmented vestigial endopod carrying two to three tubercles instead of spinules. Second leg as in *C. cordyla*, with the spiny crest on the first endopod segment broader, the spines successively increasing in length, claws on exopod large. Third and fourth legs as in *C. cordyla*, but the basal segment of fourth leg stouter, longer than the rest of the limb. Fifth leg formed of one and sixth of three setae.

Total length 4.3 mm.

Male. Carapace exactly like that of female, with the postero-median lobe less produced. Fourth thoracic segment as long as broad, with prominent wing-like lateral lobes. Genital segment oblong, very slightly broader than abdomen, abdomen rectangular, one segmented, slightly longer than broad. Second antenna modified, with corrugated first and second segments, third segment stout, with a short seta and a long curved spine.

Total length 3.8 mm.

Remarks. *C. brevicaudus* shows the closest resemblance to *C. cordyla* sp. nov. but can be easily distinguished by its larger size, transversely rectangular short abdomen, bracket-shaped sternal fork and the arrangement of the spines arming the first segment of the endopod of the second leg.

*Caligus auxisi* sp. nov.

(Fig. 12)

Material. 3 females and 2 males were collected by the author from the inner surface of the opercle of *Auxis thazard* (Lacepede) at Trivandrum. Holotype female, and allotype male, are deposited in the Indian Museum, Calcutta.

Female. Carapace large and circular, with large projecting frontal plates and prominent circular lunules as deep as the frontal plates. Membranous flange of carapace broad. Dorsal transverse rib placed in the middle, cephalic area subequal to the thoracic. Posterior sinuses shallow and open, postero-median lobe about three times as broad as lateral and reaching beyond them. Fourth thoracic segment much broader than long, genital segment enlarged, nearly equal in length and breadth, abdomen one segmented, long and parallel sided. Anal laminae longer than broad, with three long and two short setae.

Basal segment of first antenna as long as distal, with comparatively stout setae. Basal segment of second antenna with a rounded process, distal segment with two spines. First maxilla long and claw-like, second maxilla triangular, its palp with

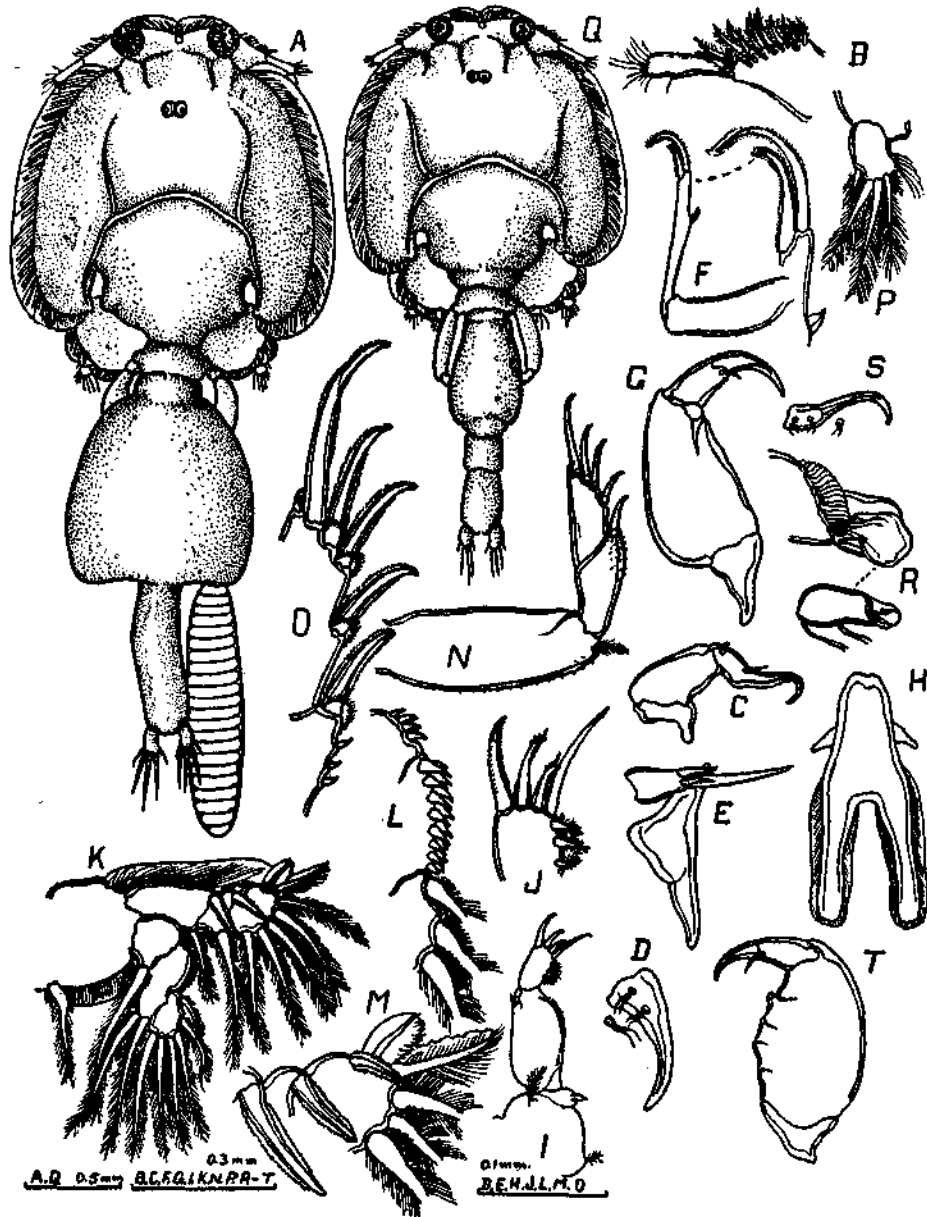


FIG. 12. *Caligus auxisi* sp. nov. A-P, female.

A, female, dorsal view. B, antenna 1. C, antenna 2. D, maxilla 1. E, maxilla 2. F, maxilliped 1. G, maxilliped 2. H, sternal fork. I, leg 1. J, same, tip of exopod. K, leg 2. L, same, endopod. M, same, exopod. N, leg 4. O, same, tip enlarged. P, anal lamina. Q-T, male. Q, male, dorsal view. R, antenna 2. S, maxilla 1. T, maxilliped 2.

one very large and two small setae. Outer lobe of first maxilliped placed far behind the tip, apical claws greatly unequal and with broad pectinate wings. Second maxilliped of the usual pattern. Sternal fork with narrow base, rami long and stout, apically subtruncate and with broad wings.

Basipod of first leg stout, with small endopod, lower border of first exopod segment with a row of sharp teeth, second segment with three claws, a long stout spine and three very small setae, second and third claws with accessory spine. Claws of exopod of second leg successively decreasing in size, with prominent serrate wings, first seta with broad upper wing and serrate lower wing, second seta winged only on the upper side, first segment of endopod with a single row of about four teeth, second segment with two rows of about sixteen teeth, all the setae with a long proximal outer row of teeth. Third leg of the usual pattern, with the basal hook of exopod winged on both sides. Fourth leg three segmented, basal segment longer than the rest of the limb, with spiny lower border, lower distal part of second segment with small sharp teeth, third segment with four strong claws steadily increasing in length towards the apex, all the claws prominently winged and each with a semicircular crest of spinules at its base.

Total length 3.8 mm.

**Male.** Carapace as in female, with the postero-median lobe slightly narrower but more projecting. Genital segment pyriform, abdomen two segmented, second segment longer than first. Second segment of second antenna with a rough raised distal pad, third segment short and claw-like, its base carrying a stout accessory claw and a spine, making it trifold. First maxilla a long sickle-shaped claw. Inner border of second maxilliped raised into four low projections.

Total length 2.7 mm.

**Remarks.** In the general shape of the body and in the structure of the appendages, *C. auxisi* closely resembles *C. bonito* Wilson (1905), *C. kuroshio* Shiino (1959a) and *C. indicus* Pillai (1961). This similarity is particularly evident in the structure of the legs, the first maxilla and the second antenna of the female. But in *C. auxisi* the shape of the abdomen and the sternal fork is different.

*Caligus minutus* sp. nov.

(Fig. 13)

**Material.** 2 females were collected by the author from the surface of the body of *Chiloscyllium indicum* (Gmelin) at Trivandrum. Holotype female, is deposited in the Indian Museum, Calcutta.

**Female.** Carapace slightly longer than broad, gradually broadening backwards. Frontal plates deep and projecting, with large circular lunules, as deep as the frontal plates. Cephalic area very slightly longer than thoracic. Posterior sinuses shallow and open, postero-median lobe convex, about three times as broad as lateral lobes and projecting very well beyond the latter. Fourth thoracic segment broader than long, genital segment with a very short anterior neck, posteriorly swollen, roughly equal in length and breadth. Abdomen one segmented and long, with a slight sinuosity at the anterior one-third, probably indicating the line of fusion of two segments.

First antenna of the usual type. Second antenna stout, basal segment produced into a large conical process, third segment stout, strongly curved, with a small spine. First maxilla like a strongly curved claw, second maxilla elongate

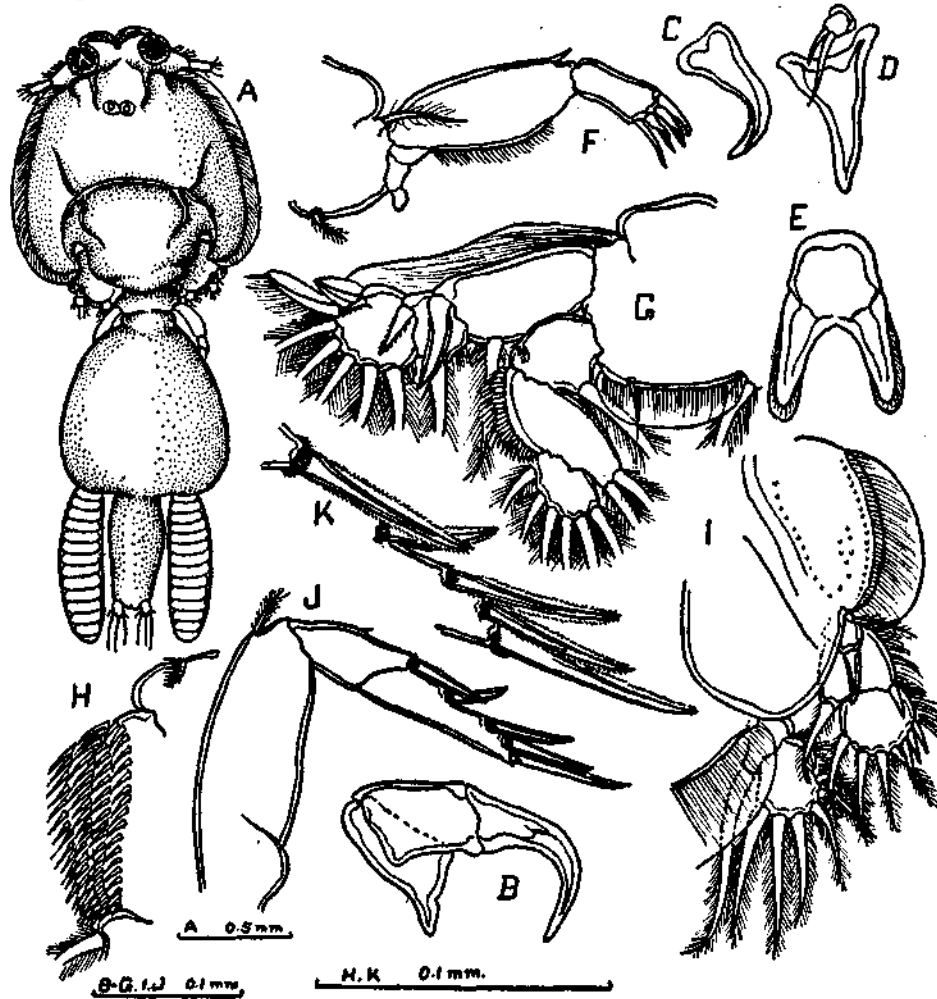


FIG. 13. *Caligus minutus* sp. nov.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, sternal fork. F, leg 1. G, leg 2. H, same, endopod. I, leg 3. J, leg 4. K, same, tip enlarged.

triangular, palp with two long spine setae. Maxilliped without any special features. Sternal fork with very short base, rami broad and diverging, with fairly broad wings, the whole forming an inverted cup.

Basipod of first leg stout, endopod two segmented, distal segment of exopod with three claws and one spine, second and third claws with an accessory spine, lower border without the usual setae. First claw of exopod of second leg very stout and winged, second and third toothed, first seta of third segment fully and second par-

tially winged, first segment of endopod with a transverse patch of spinules, second segment with several overlapping longitudinal rows of strong teeth. Apron of third leg externally spiny, rami placed near each other, comparatively large, basal claw of exopod nearly straight, with narrow external wing. Fourth leg three segmented, first segment stout, as long as the rest of the limb, all the five claws large and nearly straight, with fairly broad wings, with pectinate margin.

Total length 2.4 mm.

**Remarks.** A combination of characters clearly distinguishes *C. minutus* from all the others. In the structure of the first leg and the spinulation of the endopod of the second leg *C. minutus* shows some resemblance to *C. epinepheli* Yamaguti but the latter is a much larger species, and its sternal fork is totally different. This is one of the smallest species of *Caligus* I have examined.

*Caligus thynni* sp. nov.

(Fig. 14)

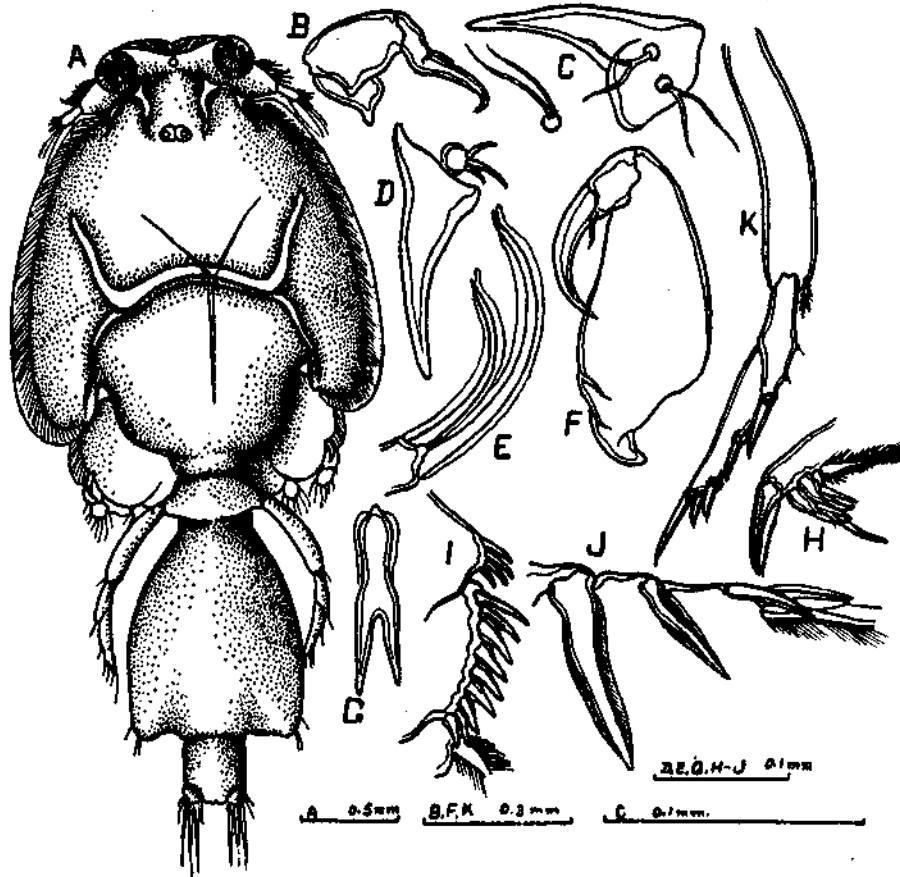


FIG. 14. *Caligus thynni* sp. nov.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 1. F, maxilliped 2. G, sternal fork. H, leg 1, tip of exopod. I, leg 2, endopod. J, same, exopod. K, leg 4.

**Material.** A single female was collected by the author from the gill arch of *Euthynnus affinis* (Cantor) along with several specimens of *C. kuroshio* Shiino at Trivandrum. Holotype female, is deposited in the Indian Museum, Calcutta.

**Female.** Carapace roughly triangular, visibly narrowing forwards, frontal plates very deep and prominently projecting, lunules large and circular. Cephalic area of carapace subequal to thoracic, posterior sinuses very shallow and fully open, postero-median lobe three times as broad as lateral lobes and considerably overreaching the latter. Fourth thoracic segment broader than long. Genital segment triangular, longer than broad, postero-laterally angular, posterior border nearly transverse. Abdomen very short, one segmented and nearly squarish, anal laminae sunk into the abdomen and not overreaching the postero-median part of the abdomen.

Basal segment of first antenna stout, with long prominent setae, distal segment with five very long hirsute setae. Basal segment of second antenna with a very small process, distal segment slender and curved. First maxilla elongate triangular, with three groups of long slender setae. Second maxilla more slender than first, palp composed of a short base carrying three spines. Apical claws of first maxilliped with broad wings. Basal segment of second maxilliped large, distal segment strongly curved. Sternal fork very small and narrow, base as long as the rami, latter slightly asymmetrical, probably an abnormality.

Distal segment of exopod of first leg with three claws, a strong spine and three stout setae, first claw very stout, with broad wings, second and third with large accessory claw making them almost symmetrically forked, setae on ventral border stout, with strong spines at the base. Claws on exopod of second leg large and winged, first twice the size of second, third slender, first segment of endopod with four sharp spines, second segment with a row of nine teeth. Apron of third leg externally spiny, rami small and wide apart, basal claw of exopod slightly curved and externally winged. Fourth leg slender and three segmented, first segment as long as the rest of the limb, but not broader, claws only slightly curved, apical claw nearly twice as long as the penultimate claw.

Total length 3.5 mm.

**Remarks.** In the shape of the genital segment *C. thynni* resembles *Cisonyx* Stp. & Lutk. and *C. triangularis* Shiino (1954a). But *C. isonyx* has a longer abdomen and entirely different sternal fork. From *C. triangularis*, *C. thynni* differs in the shape of the anal laminae and the armature of the endopod of the second leg. A remote resemblance to *C. cordiventris* Shiino (1952) is also evident. Since I have only a single female, probably slightly abnormal, the identification may be considered provisional.

*Caligus sphyraeni* sp. nov.

(Fig. 15)

**Material.** 12 females were collected from the inner surface of the opercle of *Sphyraena jello* Cuvier and 3 females from *S. acutipinnis* Day by the author at Trivandrum. Holotype female, is deposited in the Indian Museum, Calcutta.

**Female.** Carapace nearly equal in length and breadth, frontal plates deep and moderately projecting, lunules small and shallow, cephalic area of carapace

about one and a half times as long as thoracic. Posterior sinuses wide and fully open, median lobe less than twice as broad as lateral lobes and only slightly projecting beyond them. Fourth thoracic segment large, slightly broader than long, roughly triangular in shape. Genital segment large, as long as carapace, with

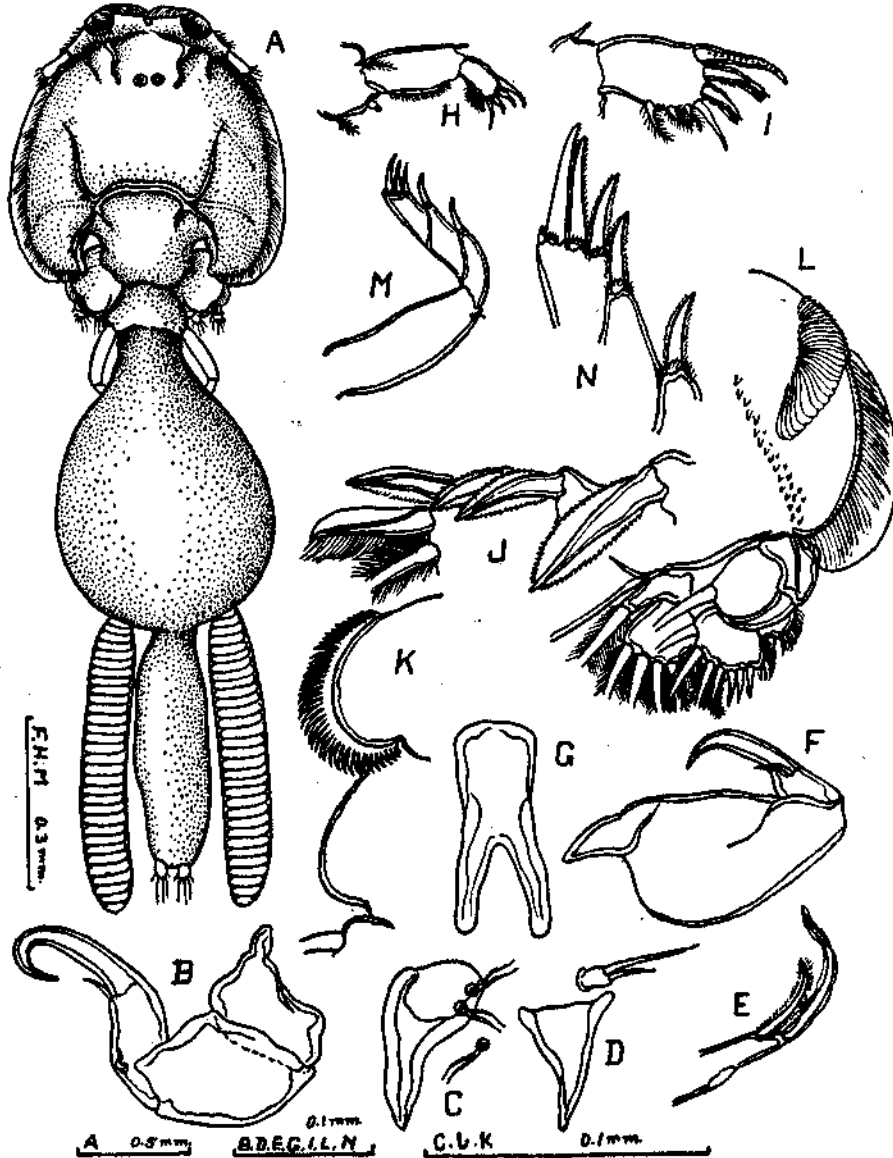


FIG. 15. *Caligus sphyraeni* sp. nov.

A, female, dorsal view. B, antenna 2. C, maxilla 1. D, maxilla 2. E, maxilliped 1. F, maxilliped 2. G, sternal fork. H, leg 1. I, same, tip enlarged. J, leg 2, exopod. K, same, endopod. L, leg 3. M, leg 4. N, same, tip enlarged.



anterior neck-like part and further on enlarging into a globular distal part. Abdomen as long as genital segment minus its neck, always slightly asymmetrical. Egg tubes slightly overreaching abdomen.

First antenna of the usual type. Basal segment of second antenna with a short process, third segment long and strongly curved at the apex. First maxilla triangular and blunt, palp of second maxilla with two spines, one of them very long. Inner distal claw of first maxilliped pectinate and outer winged. Basal segment of second maxilliped stout, distal slender. Sternal fork with a long rectangular base, rami shorter than base, very slightly diverging.

First leg short but stout, distal exopod segment with three claws, a simple spine and three setae, first claw long and barbed, second and third with accessory spine, setae on lower border very small. Claws on exopod of second leg large, with broad wings, first two setae of third segment winged, first segment of endopod with a prominent crest of spines. Apron of third leg externally corrugated, and with a longitudinal patch of large teeth, rami slightly overlapping, claw of exopod large and strongly curved. Fourth leg four segmented, first segment as long as the rest of the limb.

Total length 3.4 mm.

**Remarks.** This species shows resemblance to several others in one or more characters but differs from all in a combination of characters. The asymmetrical abdomen is a constant character which distinguishes it.

#### Genus *Lepeophtheirus* Nordmann

##### *Lepeophtheirus longipalpus* Bassett-Smith

*Lepeophtheirus longipalpus* Bassett-Smith, 1898b, p. 86, pl. 5, fig. 2.

*Indocaligus echinus* Pillai, 1961, p. 127, fig. 22.

**Material.** Two females were collected by the author from the inner surface of the opercle of *Pseudarius jatus* (Ham. Buch.) at Trivandrum.

**Remarks.** Unaware of the fact that Bassett-Smith had described it earlier I described this as a new species under a new genus *Indocaligus*. Bassett-Smith's description certainly suffices to identify this species but it hardly brings out its many peculiarities.

The setae on the basal segment of the first antenna are hirsute all over, exactly like those of *Caligus arii* and *Hermilius longicornis*. The first maxilla is absent and its position is indicated by the usual two groups of setules. The second maxilla is elongated and apically acute, quite unlike what is usually seen in *Lepeophtheirus*. All the legs show very peculiar modifications. The endopod of the first leg is very large and conspicuously spiny and the distal seta on the basipod is long, stout and much longer than usual, the distal exopod segment has three large claws, each with a prominent wing on the lower side, very much as in *C. arii*. The first spine on the exopod of the second leg is small, but the second and third are long and straight,

covered with bristles, quite different from what one finds in *Caligus* or *Lepeophtheirus*. The apron of the third leg is much reduced in size and the rami are enlarged; in this character also it resembles *C. arii* and *H. longicornis*. The fourth leg is most peculiar, the basal segment is longer than the rest of the limb, the distal segment is indistinctly three segmented and carries five claws, each claw having a median shaft and broad wings. The wings are strengthened by pinnately arranged ribs which project as small spines making the wing margin crenate. All the legs, including the setae on them, are covered with spinules.

I thought that the above peculiarities added together would be sufficient for the creation of a new genus. But a comparison of *L. longipalpus* with *C. arii* and *H. longicornis* has shown that the peculiarities are mostly adaptive. All the three species parasitise the same species of host, namely *Pseudarius jatus*. Consequently I withdraw the genus *Indocaligus* Pillai.

*Lepeophtheirus lagocephali* sp. nov.

(Fig. 16)

**Material.** 7 females and 3 males were collected by the author from the surface of the body of *Lagocephalus inermis* (Schlegel) at Vizhingom. Holotype female, and allotype male, are deposited in the Indian Museum, Calcutta.

**Female.** Carapace almost equal in length and breadth, with a slight narrowing towards the anterior end, posterior sinuses broad and shallow, fully open, postero-median lobe very broad, at least three times the width of the lateral lobes and projecting beyond them. Frontal plates of moderate size, with narrow flange, membranous flange of carapace fairly broad. Fourth thoracic segment diamond shaped, broader than long. Genital segment equal in length and breadth, roughly semicircular, with a slight postero-median projection overlapping the abdomen. Abdomen very short, indistinctly two segmented. Anal laminae with four large and two small setae.

Basal segment of first antenna stout, distal segment short. Third segment of second antenna strongly curved, with a fairly long seta. First maxilla with a stout base, claw only slightly curved. Second maxilla bifid, inner limb slender, palp with two setae. Distal segment of first maxilliped very long, with a broad outer lobe, distal claws greatly unequal, outer winged and inner pectinate. Second maxilliped normal. Sternal fork with a squarish base, rami apically narrowed and very slightly diverging.

Distal segment of first leg with three stout winged claws, a short simple spine and three stout setae. Second leg of the usual pattern, claws on exopod straight and winged, first seta fully winged and second only dorsally. Third leg with the rami fairly broad, claw at the base of exopod straight and directed inwards. Fourth leg slender and four segmented, second segment with a short spine, third with one and fourth with three claws, last claw about three times as long as the penultimate. Fifth leg formed of a single seta, sixth formed of a short process carrying one long and two short setae.

Total length 4.4 mm.

Male. Carapace comparatively broader than in female, nearly equal in length and breadth, postero-medial lobe overlapping the fourth segment. Genital segment rounded, overlapping the very short abdomen. Second antenna stout, first two segments conspicuously corrugated, third strongly curved, with a long basal spine and short distal cusp.

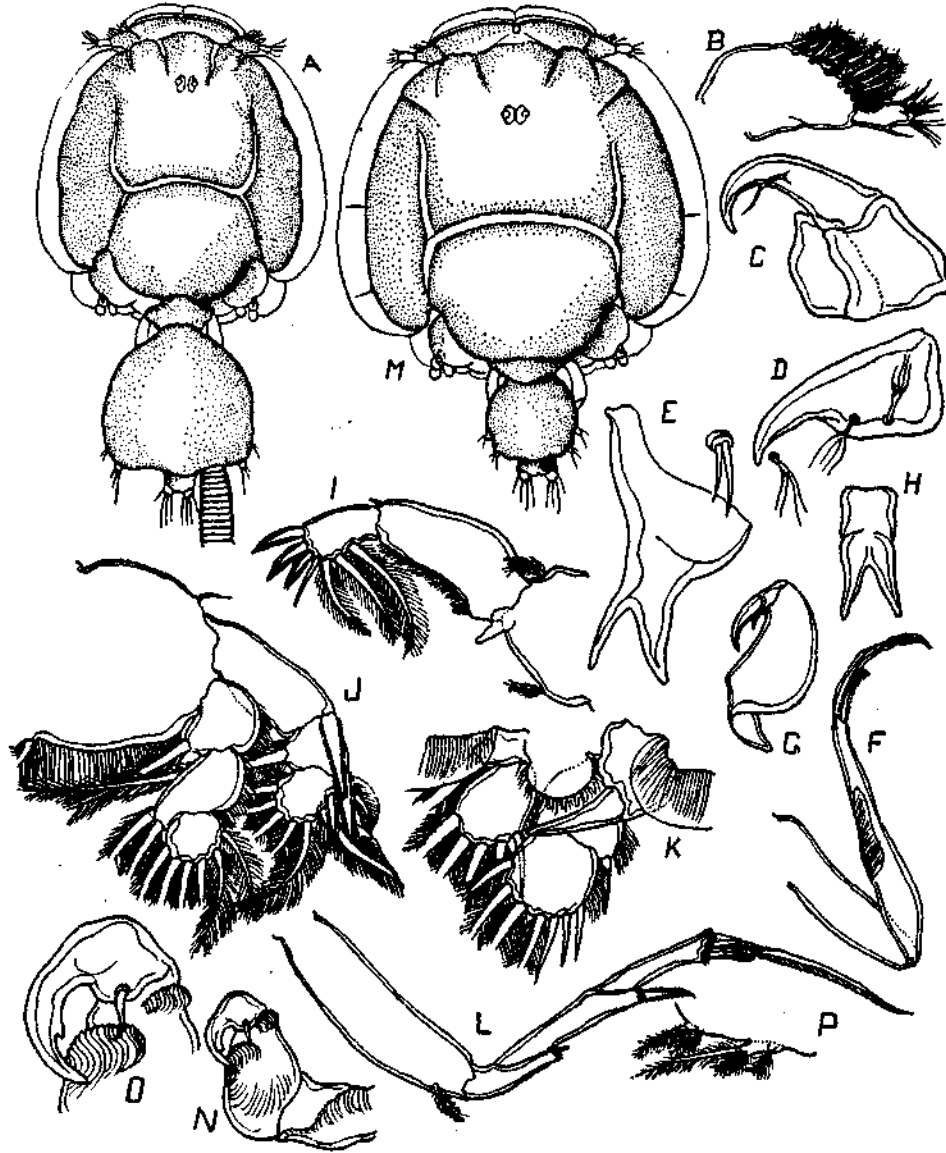


FIG. 16. *Lepeophtheirus lagocephali* sp. nov. A-L, female.

A, female, dorsal view. B, antenna 1. C, antenna 2. D, maxilla 1. E, maxilla 2. F, maxilliped 1. G, maxilliped 2. H, sternal fork. I, leg 1. J, leg 2. K, leg 3. L, leg 4. M-P, male. M, male, dorsal view. N, antenna 2. O, same, tip enlarged. P, leg 5 and 6.

Total length 3.5 mm.

**Remarks.** In the general shape of the body *L. lagocephali* shows a remote resemblance to *L. parviventris* Wilson (1905), *L. kareii* Yamaguti (1936) and *L. elegans* Gussev (1951). Except in the last species, the genital segment of all the others is different from that of *L. lagocephali*. Its resemblance to *L. elegans* is very close but can be distinguished by the difference in the structure of the second maxillae and the sternal fork. The apical spine of the fourth leg in *L. lagocephali* is comparatively very long, much longer than that of all the above mentioned species.

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