

## On a New Species of *Caligus* (Copepoda Parasitica) from the Coast of California

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AMONG THE MATERIAL of parasitic copepods which Dr. W. L. Klawe of the Inter-American Tropical Tuna Commission collected from fishes in the eastern Pacific and sent to the author for identification, there was an interesting specimen representing a new species of the genus *Caligus*. The specimen, consisting of a single female, was obtained off the coast of California. It has been preserved together with the host, *Engraulis mordax*, to whose body it was firmly clinging. The present note contains the description of this parasite.

The author wishes to express his thanks to Dr. Klawe for providing the present material, and takes a great pleasure in associating the name of the species with the naturalist.

### *Caligus klawei* sp. nov. Figs. 1-3

A female found on a specimen of *Engraulis mordax* 7.9 cm. long, taken off Coronado Hotel, San Diego, California, late in May, 1956. It was clinging to the side of the host above the pectoral fin. The anterior region of the body is lapped by a fleshy fold which is an abnormal outgrowth of host skin caused by the presence of the parasite.

Body flattened, length excluding rami 5.46 mm., carapace excluding marginal rim 2.39 mm.  $\times$  1.71 mm., fourth thoracic segment 0.21 mm.  $\times$  0.61 mm., length of exposed region of same 0.07 mm., genital segment 2.47 mm. long on midline, 2.89 mm. long in lateral region, 2.25 mm. wide, abdomen 0.56 mm.  $\times$  0.61 mm. Color whitish in formalin, without pigment.

Carapace elongate oval, about three quarters as wide as long, somewhat more strongly

convex above than in ordinary case, with lateral regions turning downward. Two sides very widely curved and fringed by relatively narrow rim. Frontal plates two thirds the width of carapace, only slightly arched on margin and provided with a lunule close to each lateral end. Median lobe half as wide as the carapace at its base, and about as long as it is wide. It is roughly trapezoid in shape, with well-rounded corners, and extends considerably beyond the lateral lobes. Sinuses between adjoining lobes are shallow and narrow, opening backward. The transverse dorsal rib is placed at about the center of the carapace, and arches forward to make, together with the incurved posterior halves of the longitudinal ribs, a continuous semicircle. Anterior halves of the latter extend diagonally outward, separating narrower lateral areas from the broader central area, in the center of which the eyes are located. Fourth thoracic segment is covered by carapace in front and by genital segment in the rear, showing merely a very short central region in dorsal aspect. Genital segment is a huge quadrangular segment which is produced backward on either side of abdomen into a pair of oval lobes. Anterior end is contracted into a short neck, but expanded just behind this abruptly to form gracefully round shoulders which continue back to slightly arched lateral margins. Segment as long as carapace on the midline, but one fifth longer on the lateral region; width across middle of segment is one and one third that of carapace. Abdomen is about a quarter of preceding segment in length, beyond whose lateral lobes it extends only a little. It is one-segmented, as long as wide, and has slightly undulated sides and V-shaped caudal margin.

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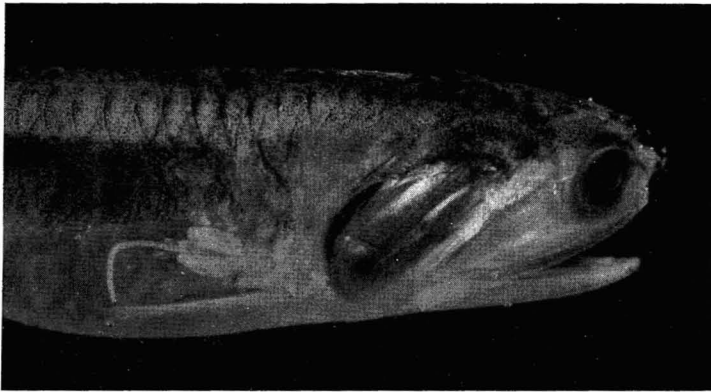


FIG. 1. *Engraulis mordax* infected by *Caligus klawei* sp. nov.  $\times 2.5$ .

First antennae two-jointed as usual. Apical joint ends in several delicate hairs and two thicker spines, and bears a solitary hair at about the center of its side. Basal joint triangular and fringed by three or four rows of stout pinnate spines on frontal margin. Lunules semicircular, truncate on front side. Second antennae three-jointed. Terminal joint sharp, strongly curved and carrying two tiny spinules, one at the base and the other a short distance distally. Basal joint armed with a pointed, spurlike posterior process. Mouth tube has broad apex, enclosing slender mandibles well dentate on their curved apical blade. First maxillae small in size, apex hook-like, base oblong and furnished on the surface with two delicate hairs, each arising from a papilla. A similar hair present on the sternum behind the maxilla. Second maxillae broad at base, slender toward tip and directed straight backward; exopodite made up of one longer and two shorter spines. First maxillipeds slender; terminal joint longer than basal joint, ending in two unequal claws with finely pectinate, narrow rims and carrying a narrowly triangular accessory lamina a short distance behind. Second maxillipeds cheliform, moderately stout. Their palm fusiform, about thrice as long as wide and with a very slight bulge at about the center of inner margin. Finger straight in its basal half, but terminating in a strongly curved, sharp claw which

acts against the bulge of the palm. Claw bears two short spines at its base. Sternal furca V-shaped, branches uniform in breadth, blunt at tip and without marginal rim.

First swimming legs provided with triangular rudiment of endopodite. Protopodite of second legs indistinctly divided into two joints. Two rami of third legs widely separated from each other by a crescentic dilatation of basal apron; exopodite two-jointed, whereas endopodite is practically one-jointed, owing to almost complete reduction of basal joint. Fourth legs uniramous, having protopodite longer than two-jointed exopodite. Arrangement of spines and setae present in each of four pairs of legs is shown in Table 1.

Of the apical spines on the first legs, the middle two are deeply forked into parallel, unequal branches; the external branch is shorter and has fine pectination on the sides. The outermost of them is bifid to a very slight extent, and the innermost is simple and more than once the length of the others. Plumose spines borne on the third joint of first legs, on the exopodite of second legs, and on the first endopodite joint of the latter are rimmed on one side for some distance from the base by hairs which are shorter but stiffer than those fringing the opposite side and other regions. The similar spine on the protopodite of second legs is dilated at the base into a semicircle, where it bears stiff hairs

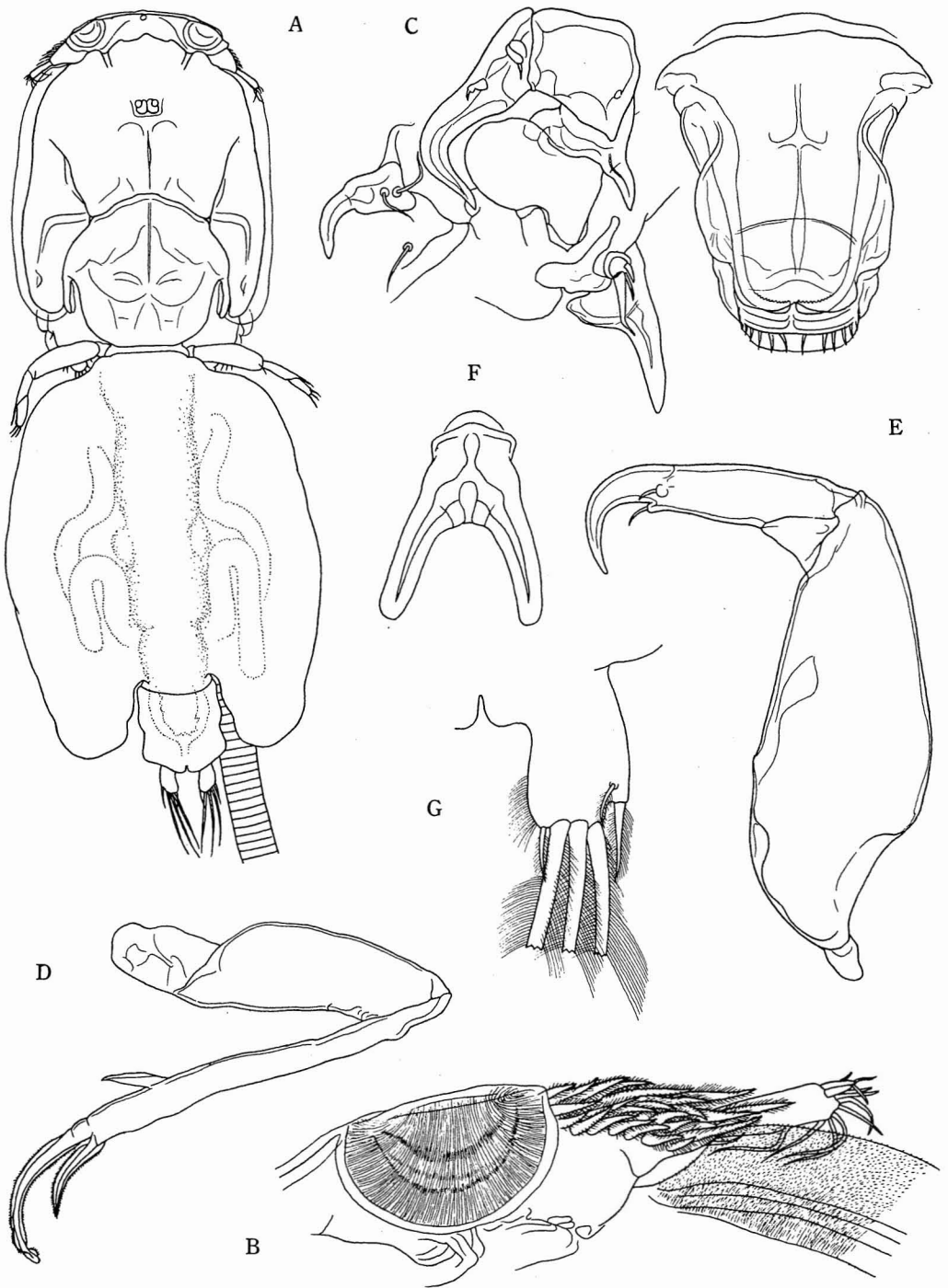


FIG. 2. *Caligus klawei* sp. nov. A, female, dorsal aspect; B, first antenna with lunule; C, second antenna, mouth tube and first and second maxillae in situ; D, first maxilliped; E, second maxilliped; F, sternal furca; G, uropod. A  $\times 19$ , B-G  $\times 100$ .

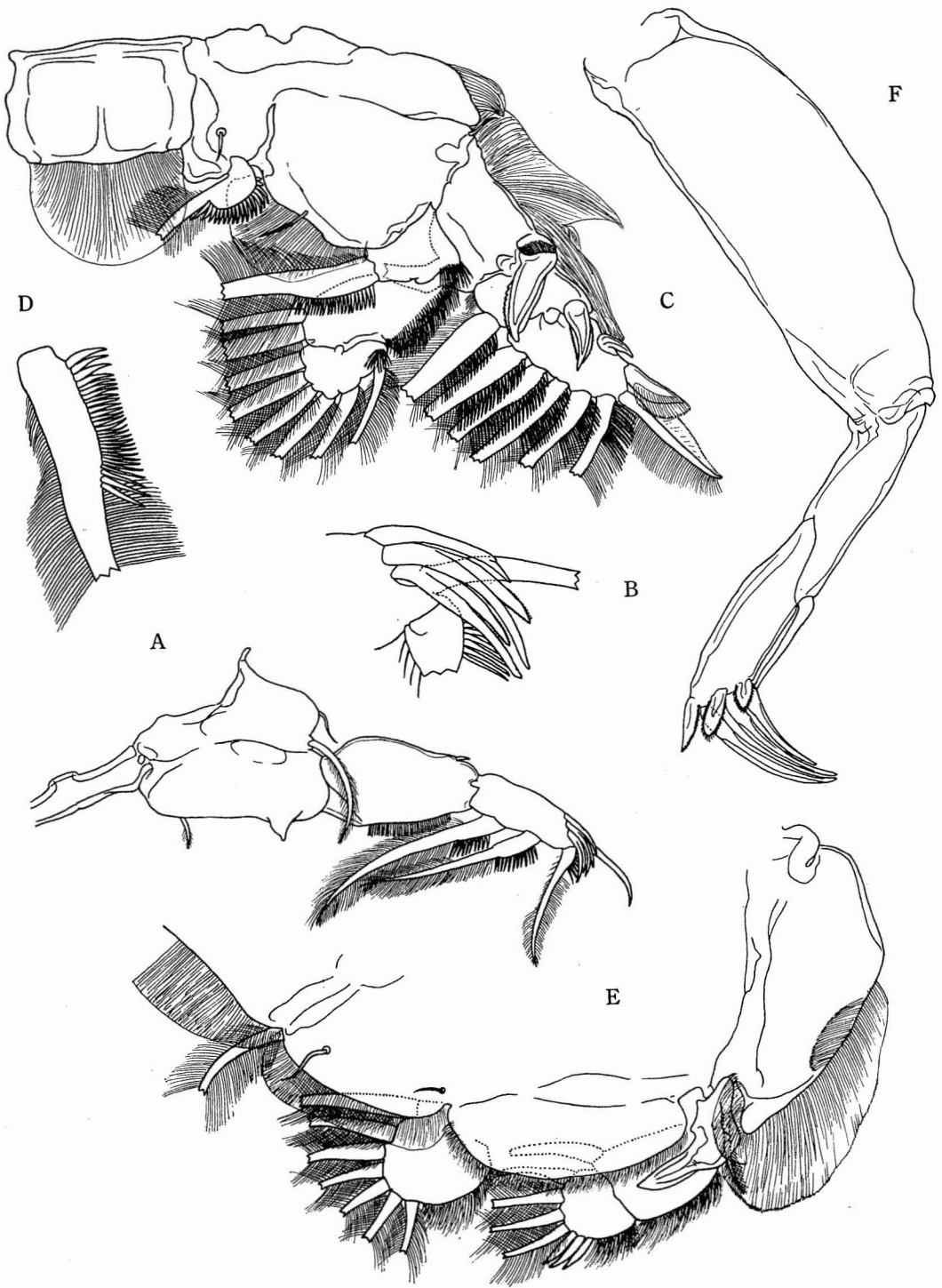


FIG. 3. *Caligus klawei* sp. nov. A, first swimming leg; B, apex of same; C, second leg; D, one of the spines on the exopodite of same; E, third leg; F, fourth leg. A, C, E, F  $\times 100$ ; B  $\times 340$ ; D  $\times 170$ .

TABLE 1  
ARMATURE PRESENT ON SWIMMING LEGS

| LEG | BORDER         | STERNAL PLATE | PROTOPODITE           |                | EXOPODITE       |              |              | ENDOPODITE |             |         |
|-----|----------------|---------------|-----------------------|----------------|-----------------|--------------|--------------|------------|-------------|---------|
|     |                |               | I                     | II             | I               | II           | III          | I          | II          | III     |
| I   | outer<br>inner |               | 1s, 1p<br>1p          |                | 1rh<br>c        | 3H, 1H<br>3P |              |            |             |         |
| II  | outer<br>inner | f             | 1s, 1P                | f, 1s<br>f, 1s | f, 1H<br>c, 1P  | 1H<br>c, 1P  | 2H, 1Q<br>5P | c<br>1P    | CC<br>c, 1P | c<br>6P |
| III | outer<br>inner | f             | f, 1p<br>1P, f, 2s, c |                | 1H', c<br>c, 1P | c, 3h<br>4P  |              | 1P         | c<br>6P     |         |
| IV  | outer<br>inner |               |                       |                | 1H              | 3H           |              |            |             |         |

Abbreviations: c, row of hairs; CC, area covered with spinules; f, membranous flange; H, stouter simple spine; h, feeble simple spine; H', hooklike spine; P, stouter plumose spine; ph, feeble plumose spine; Q, spine rimmed with hairs on one side, with membrane on the other; rh, tiny spine; s, solitary hair. Roman numerals represent the ordinals of legs or of joints and Arabic numerals denote the number of spines, or of other armature present on each of them.

the same as those on the spines just named. External spine on the first two exopodite joints of the same legs acuminate toward the tip and has pectinate rims along two opposite borders; that of the first joint accompanies a basal lamina with parallel striation on its surface. The basalmost of external spines on the third joint of the same exopodite is much reduced in size, without rim; the middle spine has a broad striated membrane on the inner side, and the terminal one bears an inner row of hairs besides the outer membrane. Basal hook on the exopodite of third legs ends in a straight apex which is narrowed to a point resembling an arrowhead. Terminal spines on the fourth legs are equal in length except the outermost, which is slightly shorter; all of them are doubly edged with a narrow rim and associated at the base with a fusiform lamina, circumscribed with pectination. Spine on the second joint is simple and devoid of basal lamina. Genital segment lacks any trace of fifth legs. Caudal rami are small in size and terminate in three plumose spines, which are attended outside with two similar, but much shorter, spines and inside with another short one. Inner margin of the rami is fringed by a short row of hairs. Egg strings are longer than

the body and packed with uniserial, flattened eggs.

#### REMARKS

The new species is characterized, above all, by the enormous size of its genital segment, which surpasses the carapace in length and width. In the genus *Caligus*, there are a number of species which present certain resemblances to the new species in the outline of this segment, in its size relative to that of the carapace, and in the possession of a small one-segmented abdomen. To facilitate distinction of *klawei* from such species some of the characters are summed up in Table 2.

As may be seen from this table, no species has a genital segment so strongly expanded as that of *klawei*. It is, however, close to *polycantbi*, *glandifer*, *fistulariae*, and *macarovi* in the outline of this segment. The first of these has the second maxillipeds stouter than in *klawei*, the second has the same limbs feeble, and the others are longer in the abdomen, which in them extends considerably beyond the foregoing segment.

The specimen will be preserved in the museum of the Prefectural University of Mie.

TABLE 2  
COMPARISON OF *Caligus klawei* WITH ALLIED SPECIES

|  | G.L/C.L | G.W/C.W | FOURTH LEG                    |                  |
|--|---------|---------|-------------------------------|------------------|
|  |         |         | Number of joints of exopodite | Number of spines |
| <i>alalongae</i> Kröyer (after Kirtisinghe) <sup>1</sup> . . . . . | 1.00    | 0.66    | 3                             | 0), 1, 1, 3      |
| <i>alatus</i> Heegaard . . . . .                                   | 0.70    | 0.77    | 2                             | 0), 1, 3         |
| <i>bicycletus</i> Heegaard . . . . .                               | 0.92    | 1.00    | 3                             | 0), 1, 1, 3      |
| <i>fstulariae</i> Yamaguti . . . . .                               | 0.86    | 0.82    | 2                             | 0), 1, 3         |
| <i>glandifer</i> Shiino . . . . .                                  | 0.81    | 0.68    | 2                             | 1), 1, (1) 3     |
| <i>macarovi</i> Gussev <sup>2</sup> . . . . .                      | 0.77    | 0.87    | 2                             | 1), 1, 3         |
| <i>minimus</i> Otto (after Brian) . . . . .                        | 1.00    | 0.73    | 2                             | 1), 1, 3         |
| <i>polycanthi</i> Gnanamuthu . . . . .                             | 0.66    | 0.77    | 2                             | 0), 1, 3         |
| <i>zei</i> Norman and Scott . . . . .                              | 0.71    | 0.76    | 2                             | 1), 1, (1) 3     |
| <i>klawei</i> sp. nov. . . . .                                     | 1.21    | 1.31    | 2                             | 0), 1, 3         |

C.L = length of carapace; C.W = width of same; G.L = length of genital segment; G.W = width of same. Proportion of genital segment and carapace is taken from the drawings given by the original authors unless otherwise indicated. Numerals shown in the rightmost column represent from the left to the right the number of spines on each of joints from basal to apical in due order. They denote, when put in parentheses, the spine borne on the outer border of joint, otherwise the terminal spines. Presence or absence of spine on the protopodite is indicated by 1) or 0).

<sup>1</sup>Kirtisinghe's *alalongae* does not seem conspecific with Kröyer's.

<sup>2</sup>*C. fulvipurpureus* Shiino is a synonym of *macarovi*.

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