Etymology: This species is named after A. Carter Broad who stimulated one of the author's (Mueller) interest in polychaetes by posing a question in polychaete systematics.

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A NEW SPECIES OF CYCLOPOID COPEPOD, PARASITIC ON SHINER SURFPERCH, *CYMATOGASTER AGGREGATA* GIBBONS, IN ANAHEIM BAY AND HUNTINGTON HARBOR, CALIFORNIA, WITH NOTES ON *BOMOLOCHUS CUNEATUS* FRASER AND *ERGASILUS LIZAE* KRØYER

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ABSTRACT: Three species of parasitic cyclopoid copepods are reported from the Shiner Surfperch, *Cymatogaster aggregata* Gibbons, collected from Anaheim Bay and Huntington Harbor, California. One of the copepods, *Holobomolochus embiotocae,* new species, of the family Bomolochidae inhabits the nasal cavity of the shiner perch. The other two copepods, *Bomolochus cuneatus* Fraser and *Ergasilus lizae* Krøyer, are reported as new host and locality records.

The three species of cyclopoid copepods reported herein are part of a collection made by the author while examining the ectoparasites of the surfperch, Embiotocidae, in Anaheim Bay and Huntington Harbor, California. Anaheim Bay is a salt water marsh with a year-round opening to the sea and is without a fresh water inlet, other than rainwater run off. Huntington Harbor is an adjoining small boat marina. Five hundred and nineteen shiner perch from monthly collections made between 24 March 1973 to 30 March 1974 were examined. The fish were obtained by otter trawl and gill net, then individually bagged and placed on ice for later laboratory examination with the aid of a dissecting microscope.

Holobomolochus embiotocae, new species

Material examined: 603 females (395 ovigerous) and 41 males were removed from the nasal cavities of the shiner perch, *Cymatogaster aggregata* Gibbons (the type host). The incidence of infestation was 67.6 percent. The holotype USNM 151182, allotype USNM 151183, and paratypes USNM 151184 are deposited in the U.S. National Museum, Washington, D.C.

Description: *Female*. Body (Fig. 1) mean length of 26 randomly selected ovigerous females 0.938 mm with a standard deviation of 0.125 mm. Cephalon comprising about one-fourth of the total body length.

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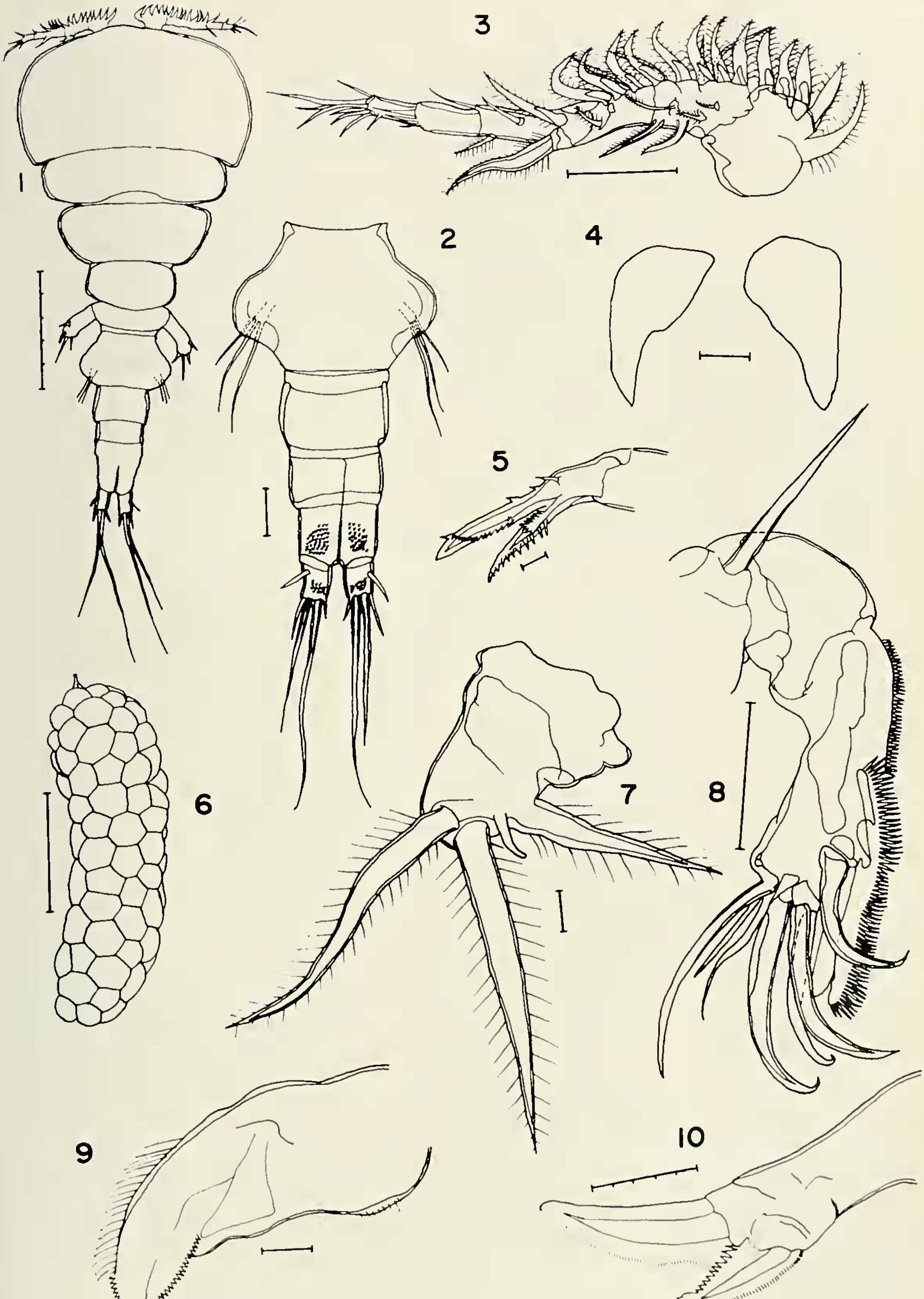
Figures 1–10. Holobomolochus embiotocae, new species, female. *1*, Body, with egg sacs removed; *2*, Genital segment and abdomen; *3*, First antenna; *4*, Rostral tines; *5*, Second maxilla. *6*, Egg sac removed; *7*, First maxilla; *8*, Second antenna; *9*, Paragnath; *10*, Mandible. Scales: Fig. 1, 0.5 mm; Figs. 6, 8, and 10, 0.05 mm; Figs. 2 and 3, 0.1 mm; Figs. 4, 5, 7, and 9, 0.01 mm.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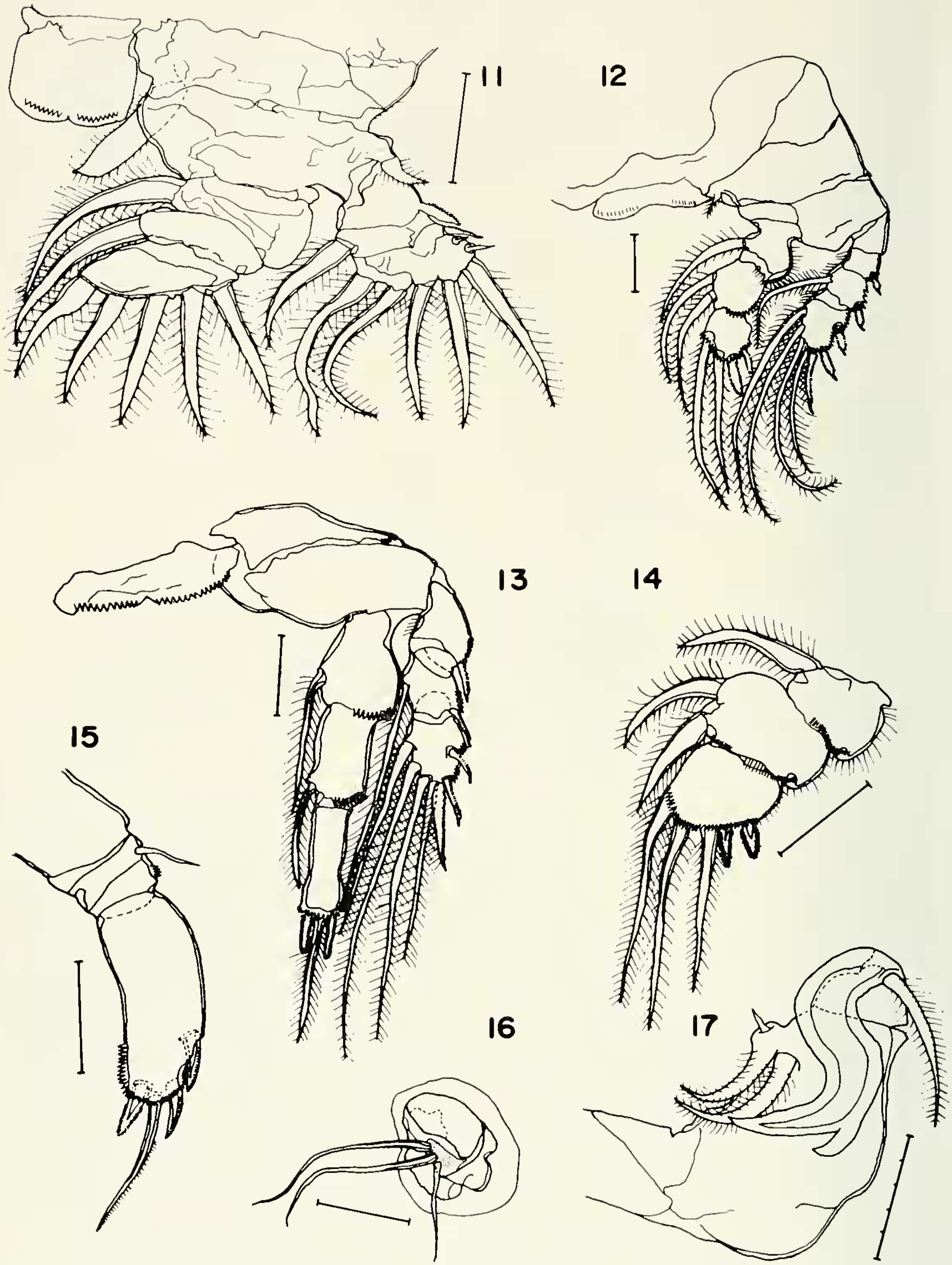
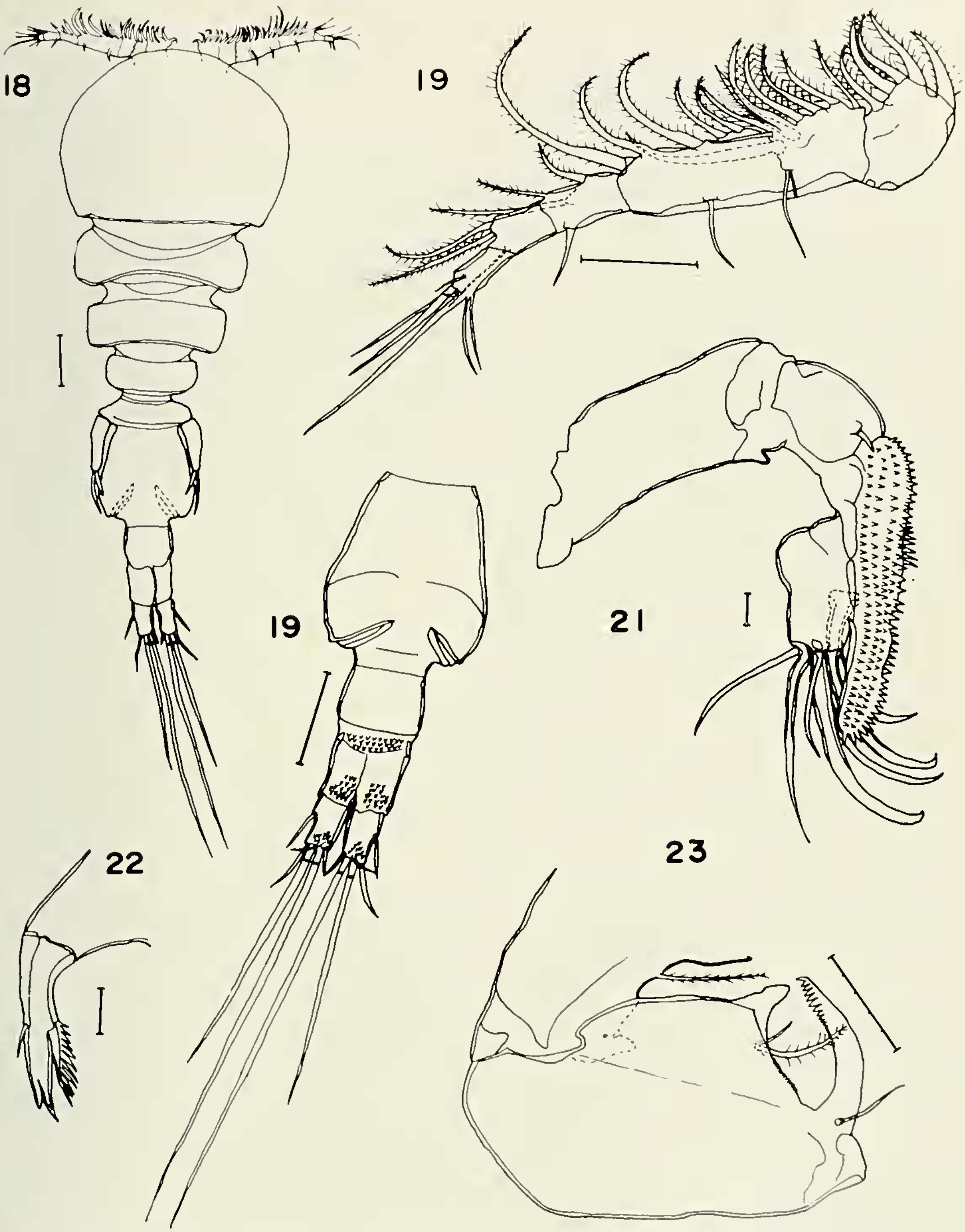
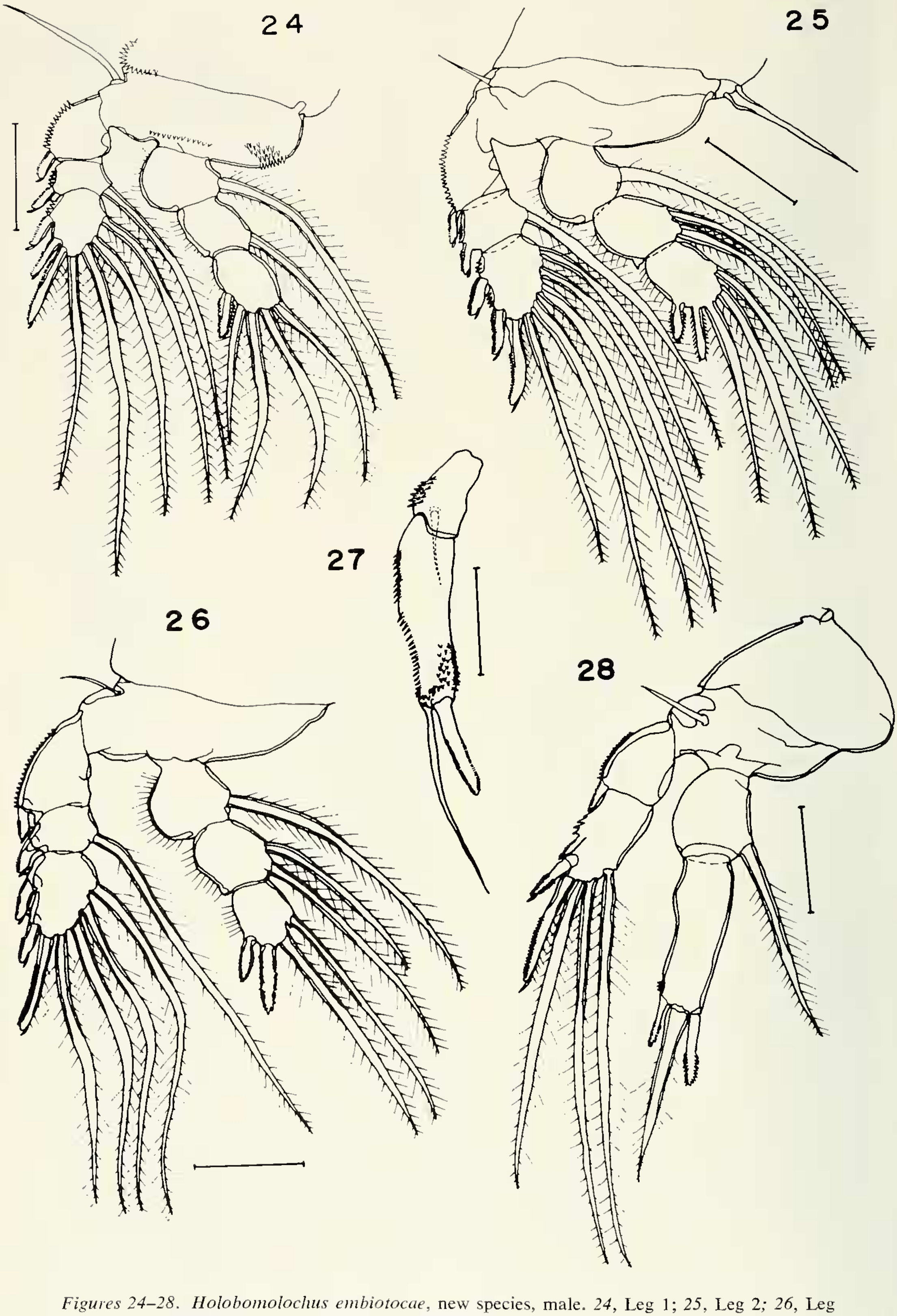


Figures 11–17. Holobomolochus embiotocae, new species, female. *11*, Leg 1; *12*, Leg 3; *13*, Leg 4; *14*, Leg 2, exopod; *15*, Leg 5, ventral; *16*, Leg 6; *17*, Maxilliped. Scales: Figs. 11–16, 0.1 mm; Fig. 17, 0.05.



Figures 18–23. Holobomolochus embiotocae, new species, male. *18*, Body; *19*, First antenna; *20*, Genital segment and abdomen; *21*, Second antenna; *22*, Second maxilla; *23*, Maxilliped. Scales: Figs. 18 and 20, 0.1 mm; Figs. 19 and 23, 0.05 mm; Figs. 21 and 22, 0.01 mm.



Figures 24–28. Holobomolochus embiotocae, new species, male. *24*, Leg 1; *25*, Leg 2; *26*, Leg 3; *27*, Leg 5, ventral; *28*, Leg 4. Scales: all figures, 0.05 mm.

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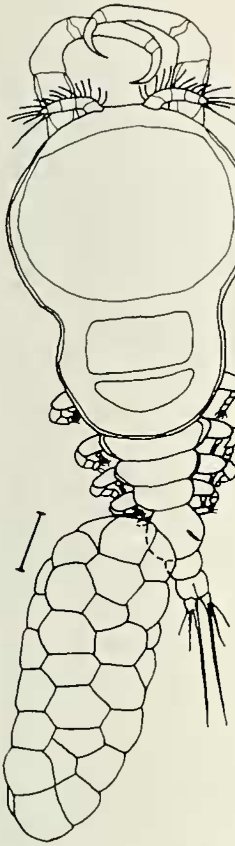

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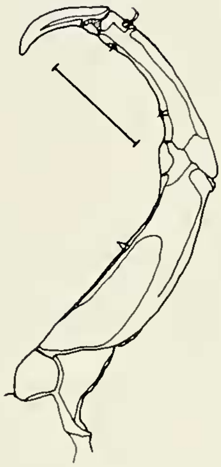

Figures 29–30. Ergasilus lizae, female. *29*, Body, one egg sac removed; *30*, Second antenna. Scale: both figures, 0.01 mm.

First thoracic segment fused with head, segments 2–4 free. Genital segment (Fig. 2) one-third wider than long. Abdomen three segmented, with third segment almost as long as first two combined. Caudal rami about four-fifths as long as wide; each ramus with four terminal, one subterminal, and one lateral setae; and a patch of spinnules arranged subterminally on the ventral surface. Egg sac (Fig. 6) about two-thirds of body length.

First antenna (Fig. 3) six-segmented with terminal three segments better defined. Armature being 5, 13, 8, 3, 2, 8, with reinforcing plates over the basal one-third of setae 2–14. Rostral tines (Fig. 4) as shown in illustration. Second antenna (Fig. 8) as in other members of the genus, having terminal segment armed with four setiform claws, three setae, and rows of spinules on ventral side.

Mandible (Fig. 10) a cylindrical masticatory process tipped with two teeth, terminal tooth being about twice the length of subterminal one. Paragnath (Fig. 9) with serrated tip and fringed with setules near apex and at proximal end. First maxilla (Fig. 7) with four setae; the two largest ones nearly equal in size, the third about one-half the longest and the fourth one-tenth the longest. Second maxilla (Fig. 5) two-segmented; distal segment having two pectinate processes, ventral one armed with a small seta near its base. Maxilliped (Fig. 17) lateral to other mouth parts; three-segmented, second segment bearing two plumose setae and a small seta near base, third segment with one long plumose seta about one-half the length of the claw, which carries an auxiliary claw.

Legs 1–4 (Figs. 11–14) biramous and three-segmented. Armature of legs (leg, endopod, and exopod, respectively): leg 1, 1–0/1–0/5, 0–I/1–I/7; leg 2, 1–0/2–0/3–II, 0–I/1–I/5–I III; leg 3, 1–0/2–0/2–II, 0–I/1–I/4–III; leg 4, 1–0/1–0/I–1–I, 0–I/1–I/4–III. Terminal segment of leg 1 exopodite (Fig. 11) having five plumose setae and two small naked setae. Leg 2 (Fig. 14) differing from leg 3 (Fig. 12) only in armature of terminal segments. Leg 5 (Fig. 15) two-segmented. Leg 6 (Fig. 16) represented by three long setae on dorsal side of genital opening.

Male. Body (Fig. 18) mean length of 22 randomly selected males 0.507 mm, with a standard deviation of 0.059 mm. First thoracic segment fused as in female. Genital segment (Fig. 20) nearly as wide as long. Abdomen two-segmented; first segment unarmed, second with two groups of spinnules. Caudal rami almost as wide as long and armed as in female.

First antenna (Fig. 19) six-segmented; armature (without reinforcing plates) being 5, 13, 7, 4, 3, and 7. Second antenna (Fig. 21) as in female except for the enlarged condition of the terminal segment.

Mouth parts as in female, except second maxilla (Fig. 22) which has two strong teeth; upper tooth with a small seta at base and lined with spinnules. Maxilliped (Fig. 23) three-segmented with single plumose seta on first segment. Second segment strongly developed, with two setae and a patch of teeth. Third segment with single seta and a row of teeth on inner terminal surface.

Legs 1–4 (Figs. 24–26 and 28) with armature (leg, endopod, and exopod, respectively): leg 1, 1–0/1–0/5–1, 0–1/1–I/4–III; leg 2, 1–0/2–0/3–II, 0–I/1–I/5–III; leg 3, 1–0/2–0/2–II, 0–I/1–I/4–III, leg 4, 1–0/1–1–I, 0–I/3–I–II. Outer margin of first segment on each exopod fringed with two rows of small teeth. Exopod of leg 4 (Fig. 28) with only two segments. Leg 5 (Fig. 27) (0.1 × 0.02 mm) two-segmented, first segment with single seta and second segment tipped with two elements. One naked and nearly twice as long, but half as wide as the other armed element.

REMARKS: According to Ho (1972), there are seven species of *Holobomolochus* reported from the Pacific coast of North America. *Holobomolochus embiotocae* appears to be most closely related to *H. venustus* Kabata, 1971. The general body forms are quite similar except that *H. venustus* has more ventral flexion and greater body length. The caudal rami differ in the location of the subterminal seta. The first antennae are similar except that setae 2–10 are reinforced in *H. venustus,* while setae 2–14 are reinforced in *H. embiotocae*. The fifteenth seta is much longer in relation to the other setae of *H. venustus* than in *H. embiotocae*. The paragnath of the new species does not possess a deep notch as in *H. venustus,* nor is the serration the same. The maxillipeds differ in the lengths and number of satae as well as the lack of an auxiliary denticle in *H. venustus*. The armature differs in legs 1, 3, and 4. There also appear to be minor differences in leg 5.

Of the previously known males of *Holobomolochus,* only the description of *H. prolixus* (Ho, 1972) can be used for comparison, since the other male descriptions are inadequate. This comparison shows a great deal of variation, including the reduction of the exopod on leg 4 of *H. embiotocae* to two segments.

Eleven additional female specimens were removed from the black perch, *Embiotoca jacksoni,* white perch, *Phanerodon furcatus,* and pile perch, *Damalichthys vacca.*

Bomolochus cuneatus Fraser, 1920

Record of specimens: Numerous lots of female specimens were collected from Anaheim Bay and Huntington Harbor, California during the study mentioned in the introduction.

Hosts: *Cymatogaster aggregata* Gibbons, 1854, *Damalichthys vacca* Girrard, 1885; *Embiotoca jacksoni* Agassiz, 1853; *Phanerodon furcatus* Girrard, 1854.

As Vervoort and Arai (1966) reported, the range of this copepod seems to coincide with that of the shiner perch. This report confirms Vervoort and Arai's speculation and extends that range to a new locality and to two new host species: *E. jacksoni* and *P. furcatus.*

Ergasilus lizae Krøyer, 1863

Record of specimens: Numerous lots of female specimens were collected in Anaheim Bay and Huntington Harbor, California.

Host: *Cymatogaster aggregata,* Gibbons

The identification of this species of *Ergasilus* is based on Roberts (1970). Specimens were cleared in lactic acid and dissected. Careful comparison of the body (Fig. 29) and especially the second antenna (Fig. 30) reveals that the species is *E. lizae*. Further comparison with Johnson and Rogers (1972) confirms the identification. The significance of this record is that *E. lizae* is a new parasite on the shiner perch and yet is closely related to *E. turgidus* Fraser, 1920, which has previously been reported on the shiner in British Columbia (Vervoort and Arai, 1966; Arai, 1967). This is also a new locality record for *E. lizae.*

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