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FIVE NEW PARASITIC COPEPODS FROM
CALIFORNIA INSHORE FISH

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A collection of parasitic copepods sent to me by Mr. Edmund Hobson of the U. S. Bureau of Sport Fisheries and Wildlife, U. S. Department of Interior, contained a number of new species. One of these (*Caligus hobsoni* Cressey) has been reported elsewhere. This paper reports on five more, one of which constitutes a new genus of taeniacanthid. The entire collection plus additional new species will be reported on later.

All material has been deposited in the Smithsonian Institution, Division of Crustacea.

Mr. Hobson was assisted in the collecting by Mr. Lloyd D. Richards of the U. S. Bureau of Sport Fisheries and Wildlife.

Taeniastrotos new genus

Diagnosis: Bomolochiidae, Taeniacanthinae. First thoracic segment fused to head. Thoracic segments 2, 3, and 4 free. Postantennal process (maxillary hook) present. First antenna 7-segmented. Padlike process present between bases of first antenna on ventral rostral area. Second antenna, mandible, and first maxilla as in other members of the subfamily. Second maxilla with reduced terminal segment bearing 3 weak setae. Maxilliped well-developed and posterior to mouthparts. Rami of legs 1-4 3-segmented (segmentation of the rami of leg 1 incomplete). Terminal endopod segment of leg 4 without lateral spine. Leg 5 2-segmented, armed as in other members of the family. Leg 6 represented by 3 setae on the area of egg sac attachment.

The male is unknown.

Type species: *Taeniastrotos californiensis* new species.

Etymology: From Greek, masc. The generic name is a combination of *Taeniacanthus* and *Anchistrotos*, the two genera to which the new genus seems most closely related.

Remarks: The new genus can be separated from all other genera of the Taeniacanthinae by the reduced nature of the second maxilla and the lack of a lateral spine on the last endopod segment of leg 4. This is the first record of a taeniacanthin from the eastern Pacific and it is not surprising that it would be an undescribed form when one considers the high rate of endemism in that area.

Taeniastrotos californiensis new species

Figures 1-11

Material studied: Holotype ♀ (USNM 126240), and 7 paratype ♀ ♀ (USNM 126241) were collected from the body surface of *Paralebrax nebulifer* (Ciard) at La Jolla, California 2 October 1968.

Female: Body form as in figure 1. Total length 1.5 mm. Greatest width 0.65 mm (measured at widest part of cephalon). Cephalon comprises a little more than one-third total body length. First thoracic segment completely fused with head. Thoracic segments bearing legs 2, 3, and 4 free; each narrower than the one before. Genital segment small, only slightly longer than first abdominal segment and somewhat wider than long. Abdomen 4-segmented, 89 μ , 83 μ , 59 μ , and 83 μ in length respectively. Caudal rami (fig. 2) about three times as long as wide (94 μ \times 30 μ); armed with one lateral, four terminal, and one inner subterminal setae, longest seta 519 μ in length.

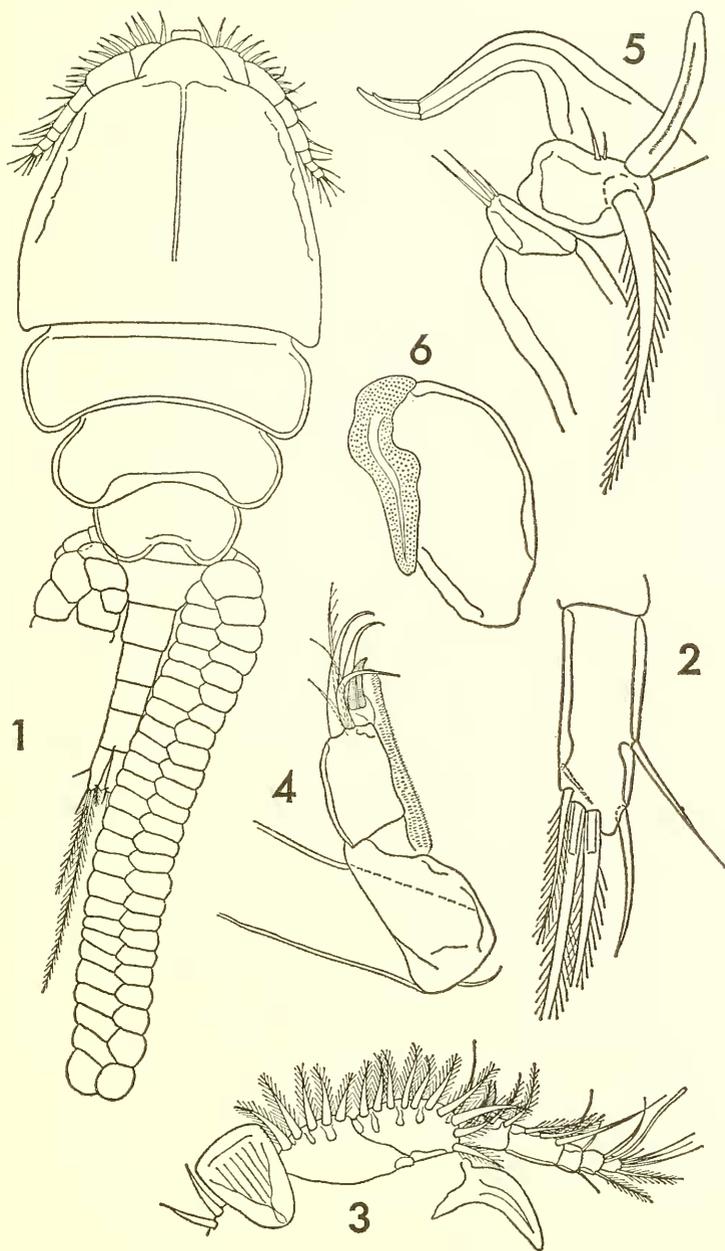
First antenna (fig. 3) 7-segmented; armed with setae as in the figure, an aesthete present on the penultimate segment. A padlike process, somewhat triangular, its broadest portion projecting slightly beyond the anterior margin of the body, present between the bases of the first antennae on the ventral rostral area (see fig. 3). A heavily sclerotized postantennal process present (see fig. 3). Second antenna (fig. 4) similar to that of other species in the subfamily; bearing one short thick spine, three longer spines, and three setae at tip (longest bearing a few plumosities).

Mandible (see fig. 5) a simple bladelike appendage bearing two unequal broad spines at tip. First maxilla (see fig. 5) consisting of a small lobe bearing a long plumose seta directed posteriorly, a bladelike blunt seta directed anteriorly, and two smaller setae. Second maxilla (see fig. 5) 2-segmented; terminal segment small, bearing three weak setae. Maxilliped (fig. 6) basal segment unarmed, terminal segment in form of a stout claw.

Legs 1-4 biramous. Leg 1 (fig. 7) exopod with plumose setae on the outer distal corners of each of the first two segments; terminal segment with two weak and five well-developed setae: endopod segmentation in-

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FIGS. 1-6. *Taeniastrotos californiensis* n. gen., n. sp. female: 1, dorsal; 2, caudal ramus, ventral; 3, first antenna; 4, second antenna; 5, mouthparts; 6, maxilliped.



complete but ramus bearing eight well-developed setae. Leg 2 (fig. 8) exopod spines on outer distal corners of first two segments plus first spine on last segment with conspicuously serrate edges; endopod second segment with spinelike process on outer distal corner, last segment distalmost spine finely plumose and sclerotized on basal half but distal half hyaline and naked. Basipod of leg 2 with two comblike rows of spines. Leg 3 (fig. 9) similar to leg 2 but with only one row of comblike spines on basipod, and additional serrate spine on last exopod segment, and terminal spine on last exopod segment normal. Leg 4 (fig. 10) exopod with serrate spines on all three segments, otherwise armed as in the figure; endopod last segment with a short terminal spine on outer distal corner and a long seta on inner distal corner, no lateral spine. Leg 5 (fig. 11) 2-segmented; basal segment with a long plumose seta and a row of spinules on outer distal corner; last segment with an outer lateral spine and an inner and outer spine terminally separated by a slightly longer seta, a small patch of spinules is present near the base of the inner spine. Leg 6 represented by two long setae on the midlateral margins of the genital segment at the area of egg sac attachment.

Egg sacs long (1.1 mm) and containing about 100 eggs arranged in two rows.

Male: Unknown.

Remarks: The species is named for the type locality (California). *Anchistrotos pleuronichthydis* Yamaguti 1939 has a first maxilla with the blunt anteriorly directed seta as in the new species described here. However, it differs from *californiensis* on other points and may represent a form intermediate between the new genus described here and *Anchistrotos*.

***Bomolochus longicaudus* new species**

Figures 12–22

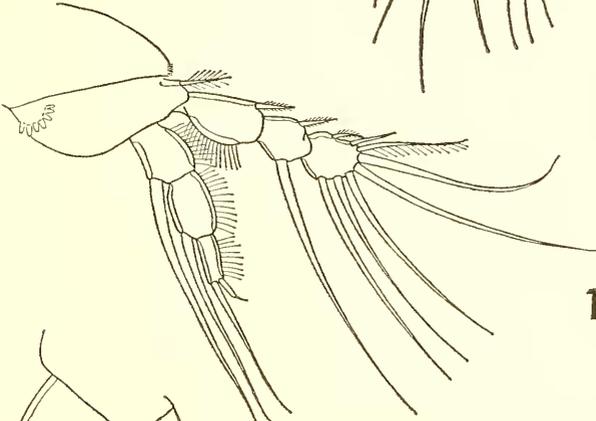
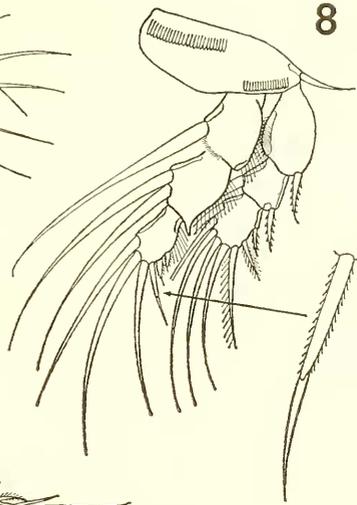
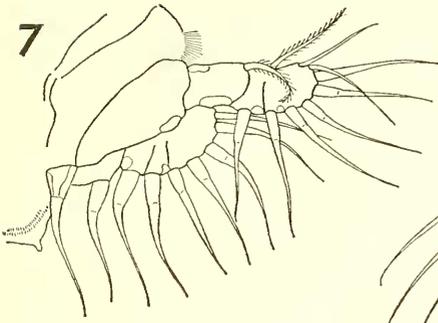
Material studied: Holotype ♀ (USNM 126242), a single ♀ paratype (USNM 126243) was collected from the gill cavity of *Paralebrax nebulifer* (Giard) 8 August 1968, and additional material from the same host (1 ♀ 6 August 1968, 3 ♀♀ 1 October 1968, and 1 ♀ 2 October 1968). An additional female was collected from the gill cavity of *Paralebrax clathratus* (Giard) 10 October 1968. All material was collected at La Jolla, California.

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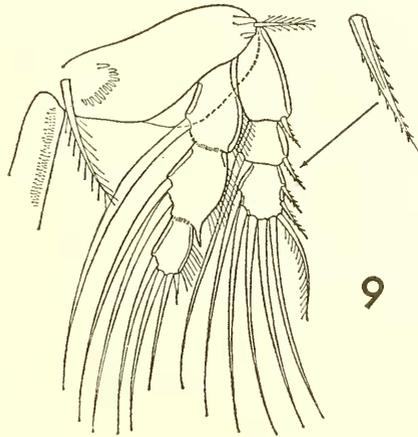
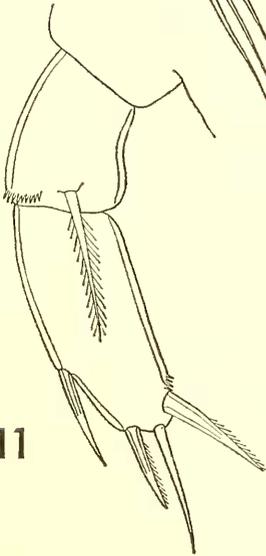
FIGS. 7–11. *Taeniastrotos californiensis* n. gen., n. sp., female (cont.): 7, first leg; 8, second leg; 9, third leg; 10, fourth leg; 11, fifth leg.

FIGS. 12–16. *Bomolochus longicaudus* n. sp., female: 12, dorsal; 13, caudal rami, ventral; 14, first antenna; 15, second antenna; 16, mouthparts.

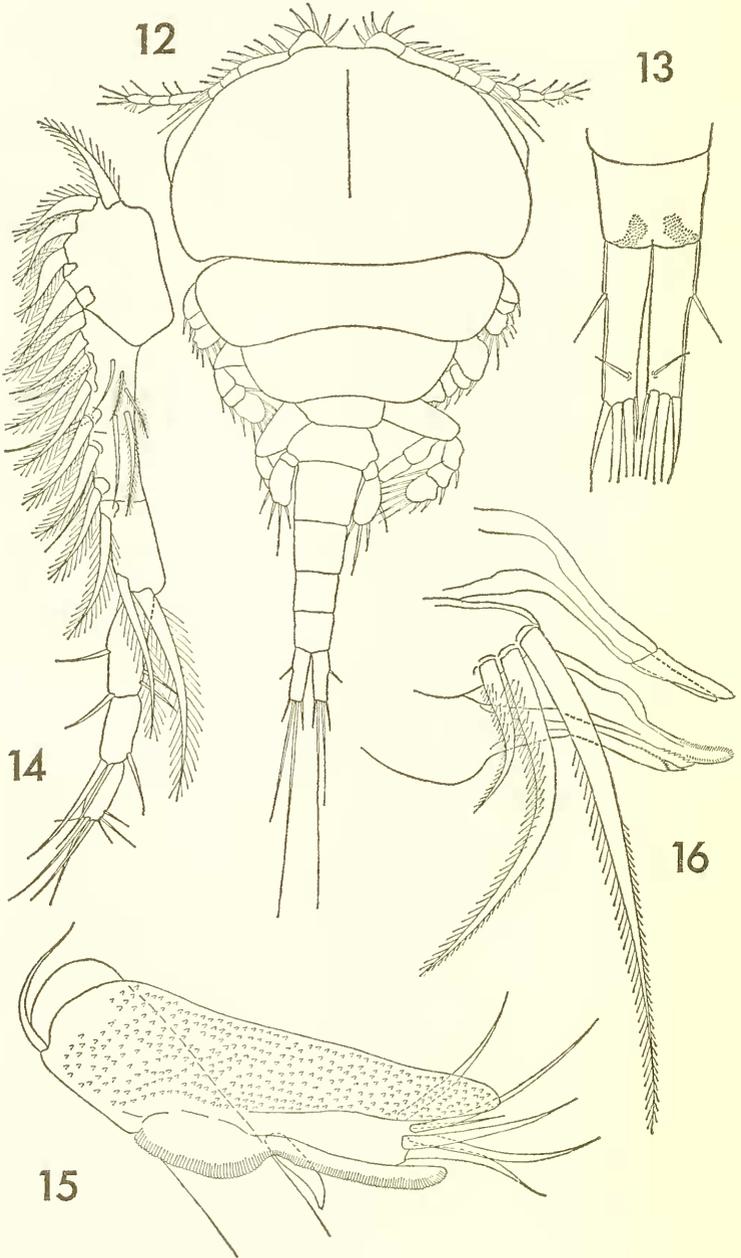
FIGS. 17–20. *Bomolochus longicaudus* n. sp., female (cont.): 17, maxilliped; 18, first leg; 19, second leg; 20, third leg.

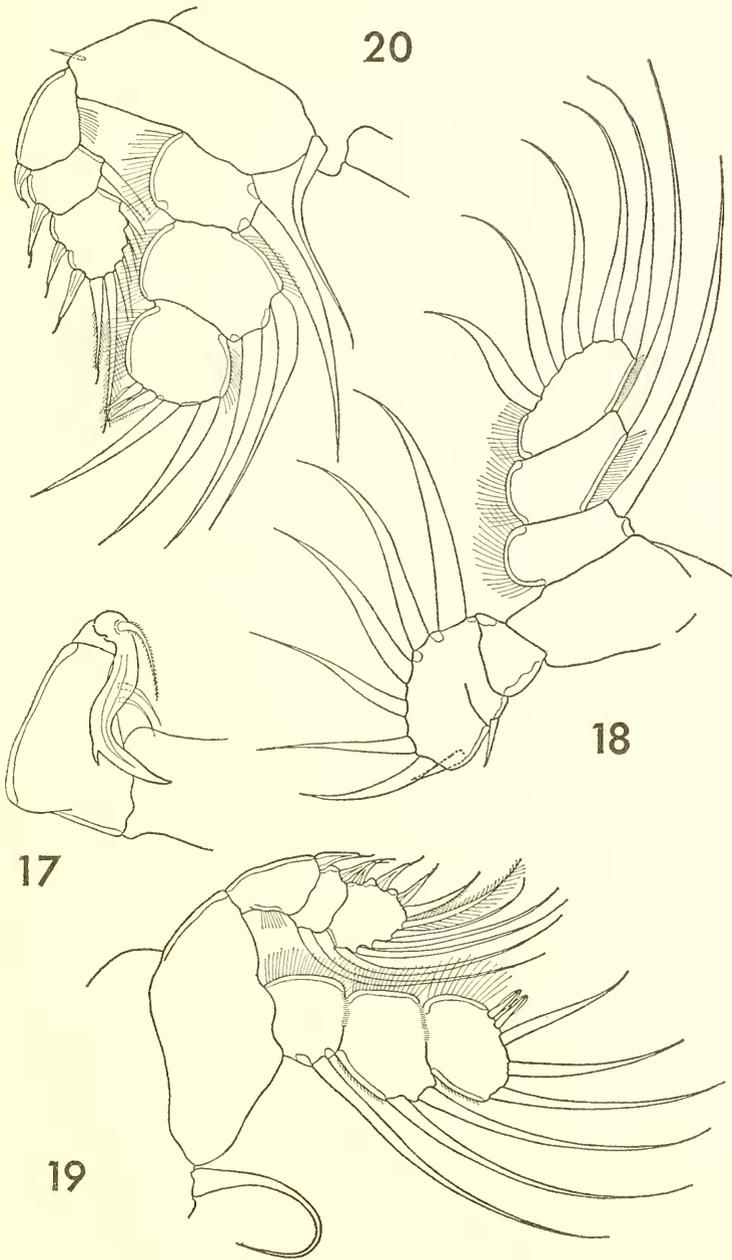


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Female: Body form as in figure 12. Total length 2.03 mm. Greatest width 1.01 mm (measured at widest part of cephalon). Cephalon comprises about one-third total body length. First thoracic segment fused with head. Thoracic segments bearing legs 2-4 free. Genital segment about as wide as long (approx. 200 μ). Abdomen 3-segmented; 147 μ , 136 μ , and 124 μ in length respectively, second and third segments each slightly narrower than preceding one, last segment with two patches of spinules ventrally. Caudal rami (fig. 13) about three times as long as wide (162 $\mu \times 50 \mu$); each ramus with four terminal, one subterminal, and one lateral setae, longest seta 600 μ long.

First antenna (fig. 14) with five distinct segments, second segment weakly subdivided making the actual number of segments difficult to ascertain; each segment armed with setae as in the figure. Second antenna (fig. 15) basically as in other members of the genus, spinules on surface not arranged in definite rows. Mouthparts as in other members of the genus except first maxilla (see fig. 16); first maxilla with very long inner seta, reaching nearly to the base of first legs. Maxilliped (fig. 17) terminal claw with accessory spine.

Legs 1-4 biramose. Leg 1 (fig. 18) exopod segmentation incomplete, two weak spines present on outer margin of ramus and six terminal to inner setae; endopod 3-segmented, first two segments with an inner seta on each and last segment with five terminal setae. Leg 2 (fig. 19) exopod outer five spines on ramus without fringes or hairs, terminal spine with fine hairs along inner margin; exopod last segment with two short outer spines each with a hyaline fringe, both rami with additional setae as in the figure. Leg 3 (fig. 20) similar to leg 2 except for a reduction in the number of spines and setae. Leg 4 (fig. 21) exopod similar to legs 2 and 3; endopod first two segments each with a short seta on inner distal corner, last segment with an inner and an outer short spine and a short terminal seta between. Leg 5 (fig. 22) 2-segmented; basal segment with a patch of spatulate spinules on distal third, last segment armed as in other members of the genus except for patches of spatulate spinules as shown in the figure. Leg 6 represented by three long setae at the point of egg sac attachment.

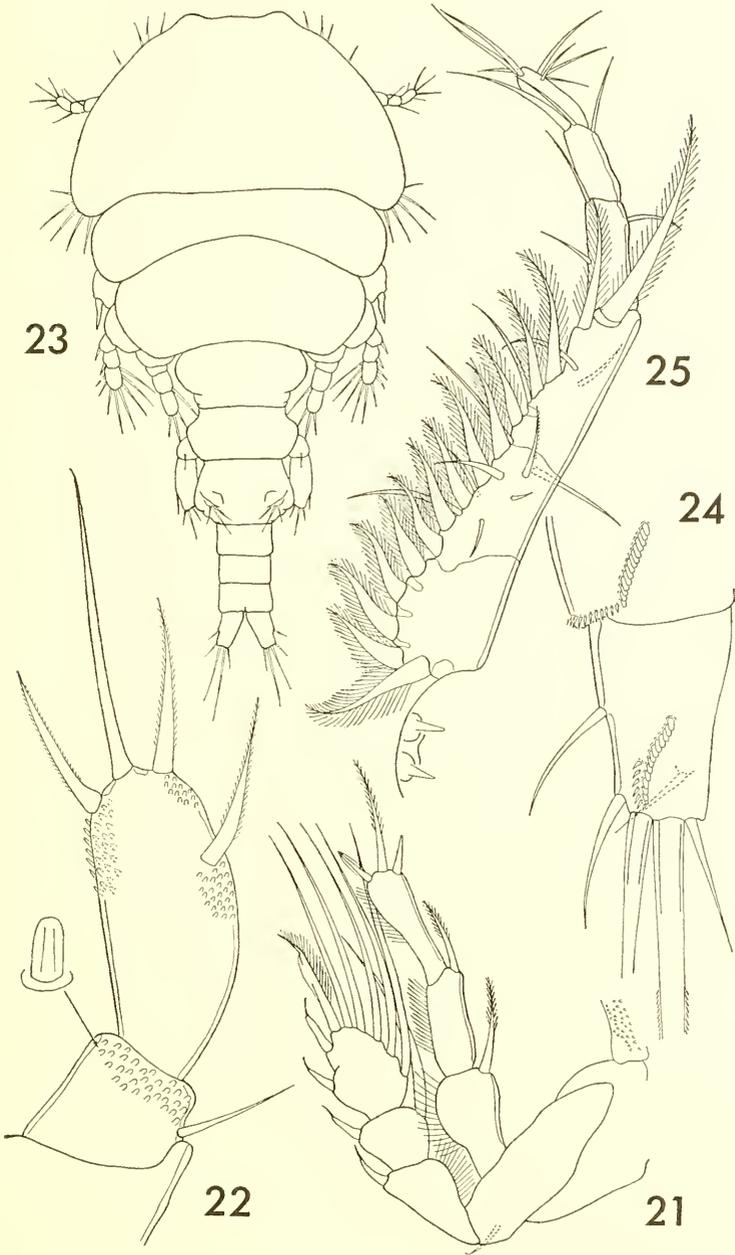
None of the material was ovigerous.

Male: Unknown.

Remarks: This species may be separated from all other species of the genus, except the following new species, by the nature of the first maxilla with its exceptionally long inner seta. *B. longicaudus* can be easily separated from the following new species on the basis of characters to be discussed following the description of this second species of *Bomolochus*.

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FIGS. 21-25. *Bomolochus longicaudus* n. sp., female (cont.): 21, fourth leg; 22, fifth leg. *Bomolochus prolixus* n. sp., female: 23, dorsal; 24, caudal ramus, ventral; 25, first antenna.



***Bomolochus prolixus* new species**

Figures 23–32

Material studied: Holotype ♀ (USNM 126244), 4 paratype ♀ ♀ (USNM 126245) were collected from the gill cavity of *Pleuronichthys coenosus* Giard, and additional material from the same host (1 ♀ 12 July 1968, 1 ♀ 6 August 1968, 2 ♀ ♀ 6 August 1968, 1 ♀ 16 October 1968, and 1 ♀ 15 January 1969). All material was collected at La Jolla, California.

Female: Body form as in figure 23. Total length 1.6 mm. Greatest width 0.58 mm (measured at widest part of cephalon). Cephalon comprises about one-fourth total body length. First thoracic segment fused with head. Thoracic segments bearing legs 2–4 free. Genital segment wider than long ($132 \mu \times 103 \mu$). Abdomen 3-segmented; 118μ , 94μ , and 118μ in length respectively, second and third segments each slightly narrower than preceding one. Caudal rami (fig. 24) longer than wide ($100 \mu \times 65 \mu$); bearing setae as in the previous species and two rows of spinules, spinules of the outer row of the usual pointed nature but the inner row spinules are spatulate (similar rows occur on the last abdominal segment).

First antenna (fig. 25) similar to *B. longicaudus*, second, third and fourth segments weakly articulated giving the appearance of a long second segment. Second antenna (fig. 26) also similar to preceding species but spinules on surface arranged in definite rows. Mouthparts as in *B. longicaudus*. Maxilliped (fig. 27) terminal hook with accessory process.

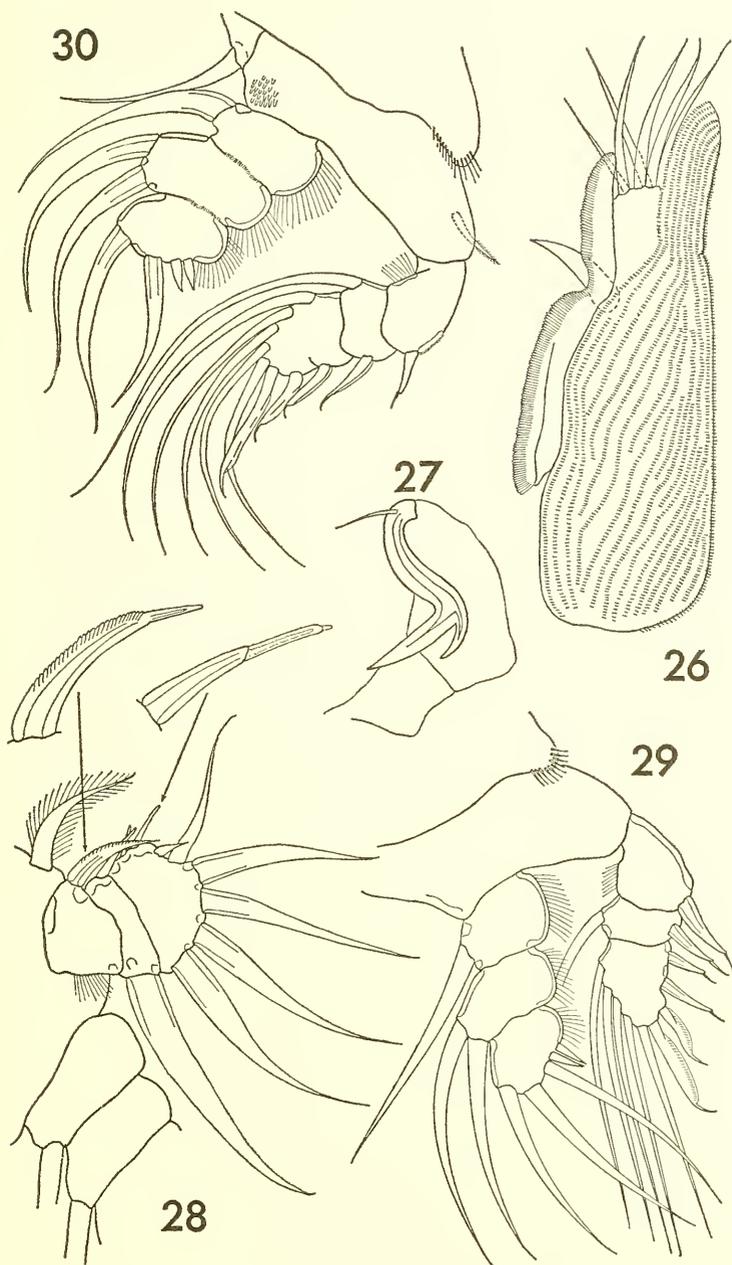
Legs 1–4 biramous. Leg 1 (fig. 28) exopod 3-segmented and clearly articulated; outer spine on first segment somewhat recurved with heavy fringe on outer edge and attenuated at tip, spine on second segment and first two spines on last segment with sclerotized basal half, a hyaline distal portion and a small discrete tip giving whole spine the appearance of being composed of three parts: endopod as in *B. longicaudus*. Leg 2 (fig. 29) as in *B. longicaudus* except terminalmost spines on exopod with an outer hyaline fringe. Leg 3 (fig. 30) as in *B. longicaudus* except for patch of spinules on basipod and other minor variations in armature as indicated by the figure. Leg 4 (fig. 31) armed as in *B. longicaudus* but endopod segments not elongated as in *longicaudus*. Leg 5 (fig. 32) 2-segmented; first segment with large patch of spinules on outer distal corner, second segment with usual lateral seta and three terminal spines or setae, inner and outer spines pinched at distal third, terminal and outer borders with spinules as in the figure. Leg 6 represented by three long setae at area of egg sac attachment.

None of the material was ovigerous.

Male: Unknown.

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FIGS. 26–30. *Bomolochus prolixus* n. sp., female (cont.): 26, second antenna; 27, maxilliped; 28, exopod of first leg; 29, second leg; 30, third leg.



Remarks: This species, like *B. longicaudus*, can be separated from all other species of the genus on the basis of the first maxilla. It can be separated from *longicaudus* by the nature of the caudal rami, the distinct rows of spinules on the second antenna, the nature of the fourth leg endopod, and the many other variations in the armature of the legs.

***Bomolochus spinulus* new species**

Figures 33–45

Material studied: Holotype ♀ (USNM 126246) and 43 paratype ♀ ♀ (126247) from the gill cavity of *Scorpaena guttata* Giard collected at La Jolla, California, 10 October 1968. Other material from the same host (2 ♀ ♀ 12 July 1968, 1 ♀ 14 October 1968, 39 ♀ ♀ 15 October 1968, 5 ♀ ♀ 16 October 1968, and 29 ♀ ♀ 16 October 1968) from *Oxylebius pictus* Gill (1 ♀ 9 December 1968) from *Sebastes mystinus* (Jordan and Gilbert) (3 ♀ ♀ 24 September 1968 and 1 ♀ 14 October 1968) and from *Sebastes serranoides* Eigenmann and Eigenmann (8 ♀ ♀ 12 September 1968 and 1 ♀ 12 September 1968). All other material collected at La Jolla, California.

Female: Body form as in figure 33. Total length 1.49 mm. Greatest width 0.87 mm (measured at widest part of cephalon). Cephalon slightly less than one-third body length. Thoracic segments bearing legs 2–4 free. Thoracic segment bearing leg 4 small and scarcely visible dorsally. Genital segment about as wide as long (200 μ). Abdomen 3-segmented, 224 μ , 200 μ , and 112 μ long respectively. Caudal rami about twice as long as wide (142 $\mu \times 60 \mu$); longest seta 768 μ long, patch of spinules on ventral distal surface (comparable patch on last abdominal segment also).

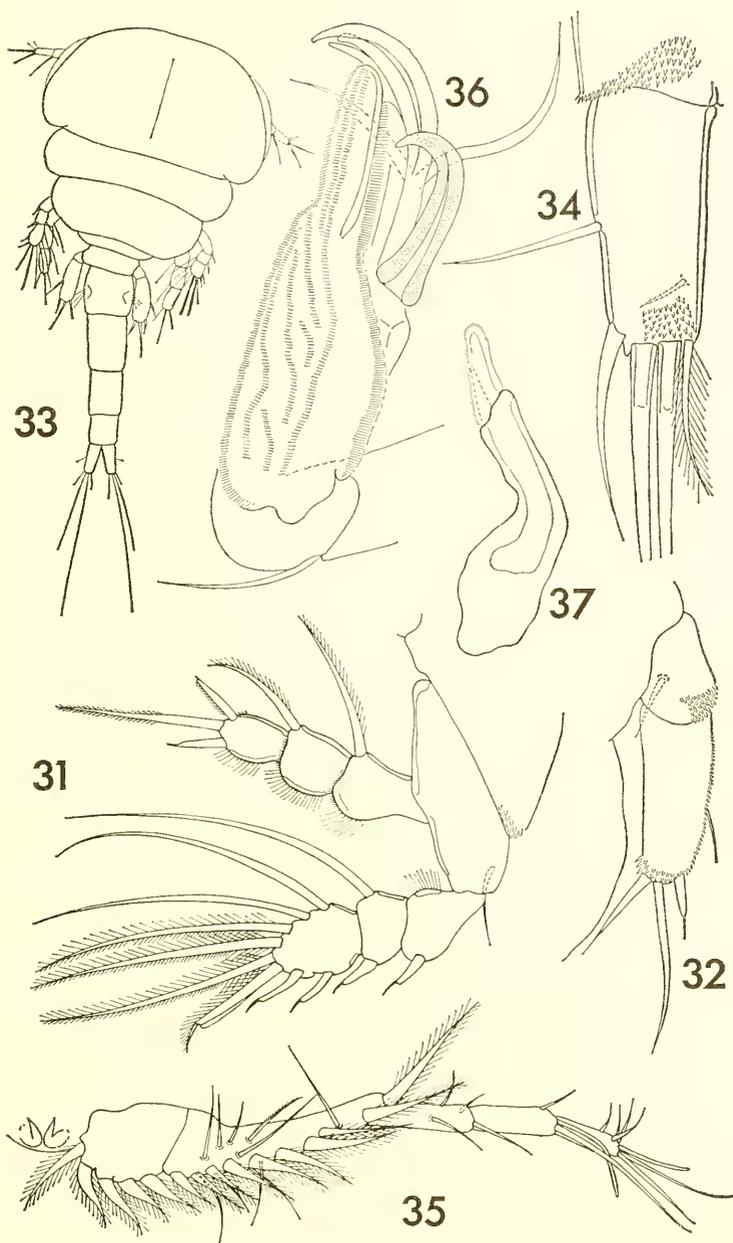
First antenna (fig. 35) armed as in the figure, an aesthete present on penultimate segment; segmentation weak giving the appearance of 5 segments. Second antenna (fig. 36) generally as in other members of the genus except claw at base of last segment well-developed and in the form of a hook. Mandible (fig. 37) bladeliike with two fringed processes at tip. Labrum with two lateral patches of spinules on posterior corners. First maxilla of usual form with two inner long setae and two outer short ones.

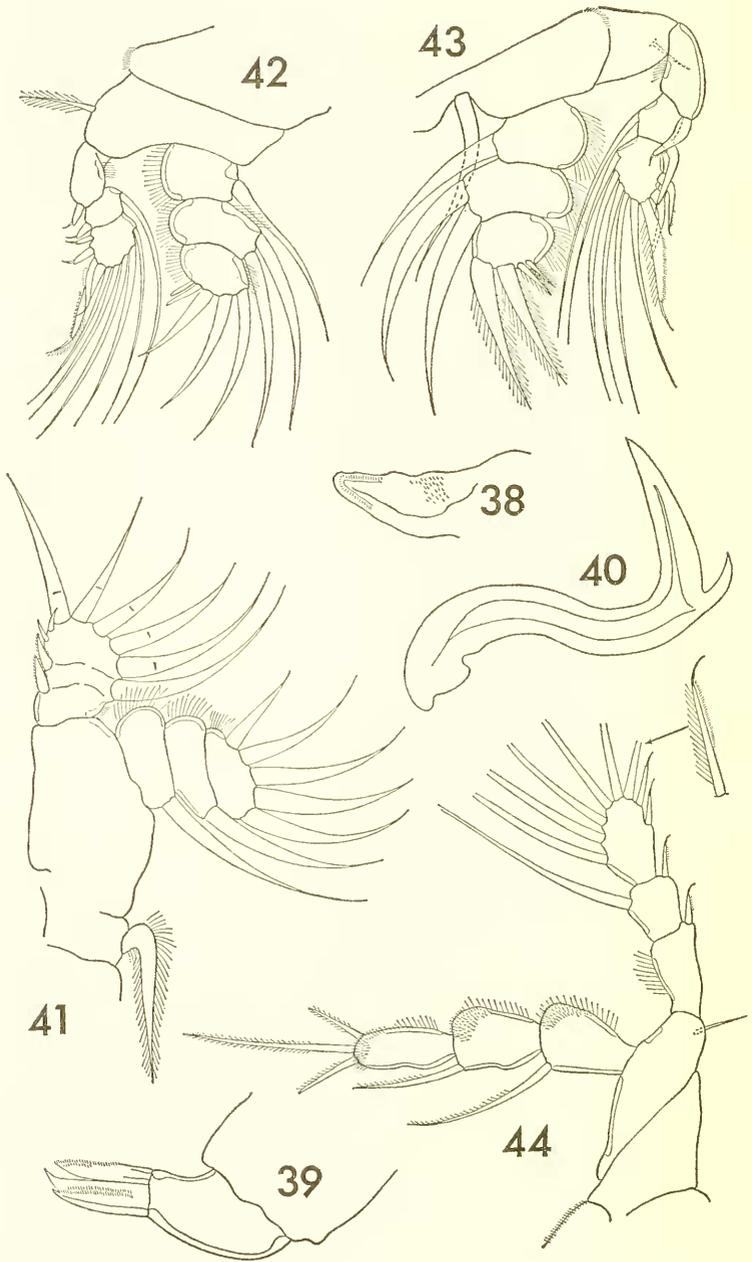
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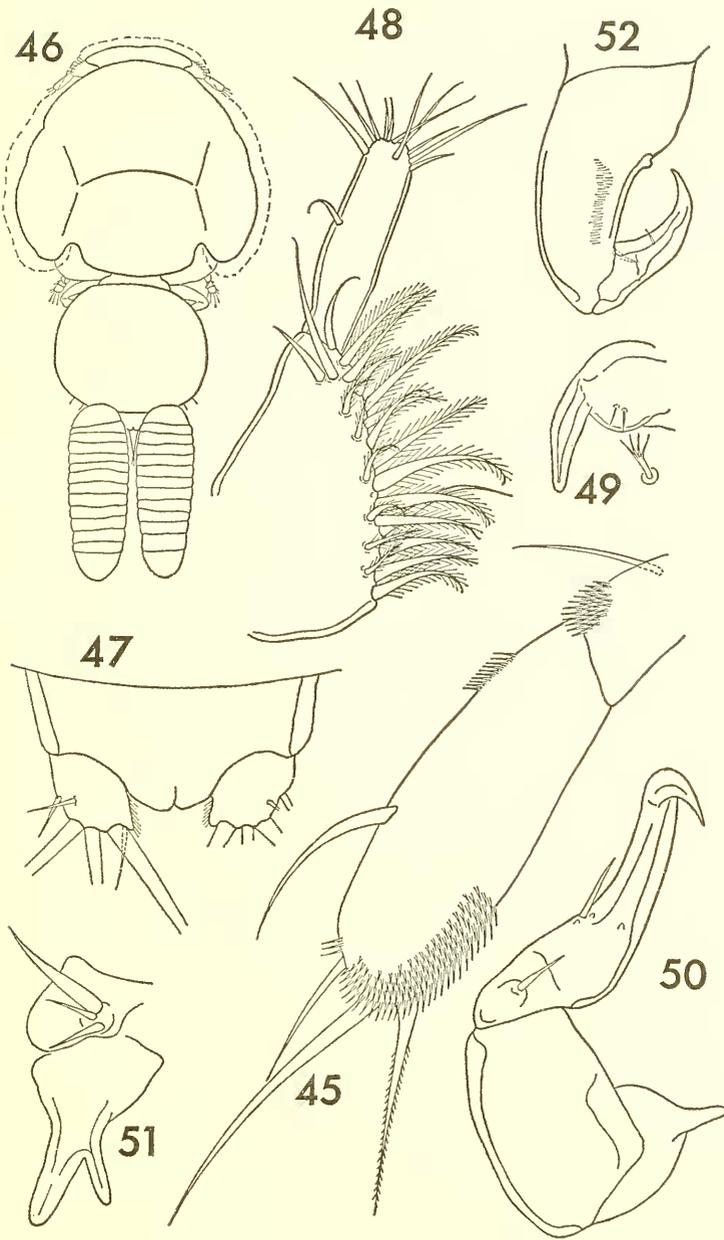
FIGS. 31–37. *Bomolochus prolixus* n. sp., female (cont.): 31, fourth leg; 32, fifth leg. *Bomolochus spinulus* n. sp., female: 33, dorsal; 34, caudal ramus; 35, first antenna; 36, second antenna; 37, mandible.

FIGS. 38–44. *Bomolochus spinulus* n. sp., female (cont.): 38, paragnath; 39, first maxilla; 40, maxilliped hook; 41, first leg; 42, second leg; 43, third leg; 44, fourth leg.

FIGS. 45–52. *Bomolochus spinulus* n. sp., female (cont.): 45, fifth leg. *Lepeophtheirus paulus* n. sp., female: 46, dorsal; 47, abdomen and caudal rami, ventral; 48, first antenna; 49, postantennal process; 50, second antenna; 51, postoral process; 52, maxilliped.







Paragnath in the form of a lobe with a patch of spinules and a striated tip (fig. 38). First maxilla (fig. 39) as in other members of the genus. Maxilliped hook (fig. 40) S-shaped and with an accessory process.

Legs 1-4 biramose. Leg 1 (fig. 41) both rami clearly 3-segmented, rami armed as in the figure. Leg 2 (fig. 42) exopod last segment two terminalmost spines with spinose fringe, penultimate spine somewhat overlapping ultimate spine: otherwise armed in the usual manner. Leg 3 (fig. 43) exopod spines on first two segments angular in shape and recurved inwardly, first two spines on last segment similar in nature but not as conspicuously recurved. Leg 4 (fig. 44) similar to other members of the genus except for prominent patches of spinules on outer distal corners of endopod segments. Leg 5 (fig. 45) 2-segmented and armed in usual manner, patches of spinules on both segments as in the figure. Leg 6 represented by three setae at the area of egg sac attachment.

Egg sac containing approximately 100 eggs and about 0.95 mm long.

Male: Unknown.

Remarks: This new species can be distinguished from all other species of *Bomolochus* except *B. attenuatus* Wilson 1913 by the nature and position of the outer spines on the exopod of leg 3. *Bomolochus spinulus* is closely related to *B. attenuatus*. The nature of the outer spines on leg 3 is the same in both species. Both species have patches of spinules on the endopod of leg 4 plus a patch of spinules on the ventral posterior surface of the caudal rami. They can be separated based on the following differences: the hooklike spine on the second antenna of *attenuatus* extends to the tip of the terminal setae whereas that of *spinulus* is only half the length, the last abdominal segment of *attenuatus* bears a row of spinules on the posterior ventral surface as opposed to a patch of spinules in the same area on *spinulus*. The holotype of *B. attenuatus* was examined for this comparison. *Bomolochus attenuatus* was described from *Scorpaena plumieri* from Jamaica.

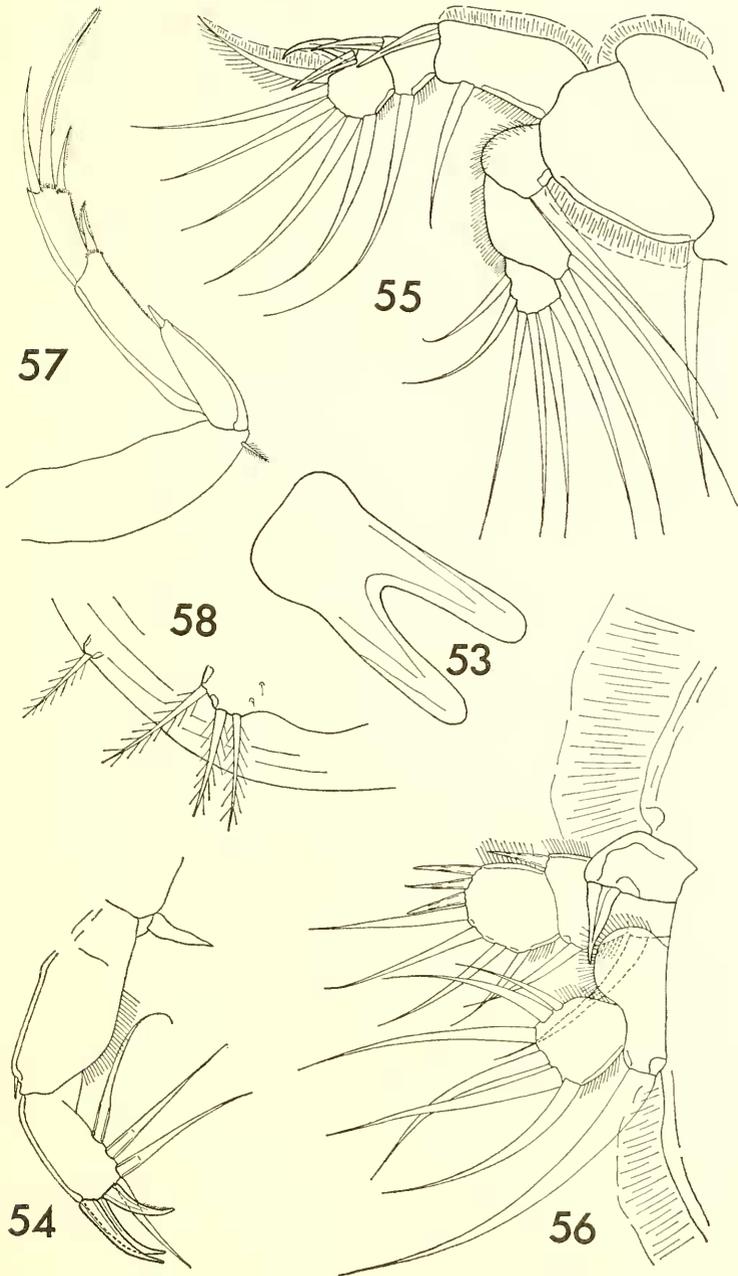
***Lepeophtheirus paulus* new species**

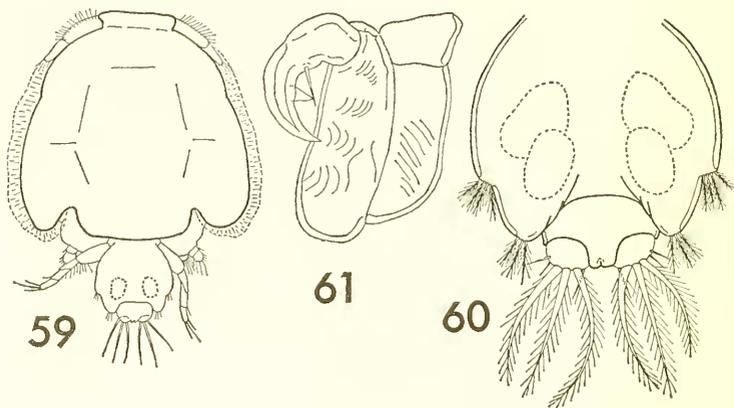
Figures 46-61

Material studied: Holotype ♀ (USNM 126248), allotype ♀ (USNM 126249), and 4 paratypes (USNM 126250, 3 ♀♀, 1 ♂) were collected from the roof of the mouth of *Sebastes sericeus* (Jordan and Gilbert) at La Jolla, California 22 July 1968. Additional material was collected from the same species of host and at the same locality (1 ♀, 4 ♀♀, 1 ♂, 1 ♀ 19 July 1968; 2 ♀♀, 1 ♂ 22 July 1968; 2 ♀♀, 3 ♀♀ 26 July 1968; 20 ♀♀ 30 September 1968; 6 ♀♀ 10 October 1968).

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FIGS. 53-58. *Lepeophtheirus paulus* n. sp., female (cont.): 53, sternal furca; 54, first leg; 55, second leg; 56, third leg; 57, fourth leg; 58, fifth leg.





FIGS. 59–61. *Lepeophtheirus paulus* n. sp., male: 59, dorsal; 60, genital segment, abdomen, and caudal rami; 61, second antenna.

Female: Body form as in figure 46. Total length 1.3 mm. Greatest width 1.3 mm (measured at widest part of cephalon). Five specimens measured for length and width all measured the same as above. Cephalon comprising about one-half total body length. Genital segment nearly round, slightly wider than long (1.2×1.0 mm). Abdomen (see fig. 47) short (159μ) and 1-segmented. Caudal rami (see fig. 47) short and about as wide as long, bearing one lateral, 2 subterminal, and three terminal plumose setae, longest seta 336μ long.

First antenna (fig. 48) 2-segmented and armed as in the figure. Post-antennal process (fig. 49) with single outer hooklike process, 2 sensory hairs on base and a sensory hair with terminus split into four hairs located near base. Second antenna (fig. 50) with well-developed hook bearing two setae. Mandible as in other members of genus bearing 12 teeth. First maxilla (fig. 51) a simple lobe bearing three setae. Second maxilla as in other members of the genus. Postoral process (see fig. 51) bifurcate, outer tine larger than inner. Maxilliped (fig. 52) hooklike, a rugose area present on surface of basal segment. Sternal furca (fig. 53) with rounded tines.

Legs 1–3 biramous. Leg 1 (fig. 54) exopod with three terminal spines and four terminal to inner setae, endopod a simple, weakly developed process near base of exopod. Leg 2 (fig. 55) rami 3-segmented; exopod segments with a total of four well-developed spines on outer margins and spines oriented along same axis as ramus, endopod with setae as in the figure. Leg 3 (fig. 56) exopod basal segment with a well-developed spine oriented so as to lie over the following segment, endopod 2-segmented and both rami armed with setae as in the figure. Leg 4 (fig. 57) last segment with three terminal setae, median seta longest. Leg 5 (fig. 58) located at

posterior corners of the genital segment and consisting of an anterior lobe bearing a single seta and a posterior lobe bearing three setae of about equal length. Leg 6 absent.

Egg sac short (1.45 mm) and bearing about 12–15 eggs each.

Male: Body form as in figure 59. Total length and width of three specimens 1.4×0.85 mm, 1.5×0.98 mm, and 1.4×0.82 mm. Cephalon comprising about three-fourths total body length. Genital segment wider than long ($442 \mu \times 384 \mu$). Abdomen (fig. 60) 1-segmented and short (106μ). Caudal rami armed as in the female. Appendages as in the female except second antenna (fig. 61) with rugose patches on basal segments and accessory tooth on claw. Leg 6 represented by three plumose setae near junction of genital segment and abdomen.

Remarks: This new species can be separated from all other species of *Lepeophtheirus* by the nature of the fourth leg. In *L. paulus* the middle seta is longer than either of the other two. Typically the outer seta is longest or at least as long as the middle. In other respects this species is most closely related to *L. elegans* Gussev 1951.

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