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Taxonomy and Distribution of the Marine Calanoid Copepod Family Euchaetidae

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ABSTRACT

The marine calanoid copepod family Euchaetidae and its two genera, *Euchaeta* and *Paraeuchaeta*, are redefined. Fourteen species of *Euchaeta* and 61 species of *Paraeuchaeta*, including 13 new species, are described and their geographic ranges defined from specimens found in midwater trawl and plankton net samples collected throughout the Atlantic, Pacific, and Indian oceans. The species of *Euchaeta* are classified into three species groups - *marina, concinna*, and *acuta* groups - and an independent species, E *spinosa*; those of *Paraeuchaeta* were classified into six species groups *malayensis, pavlovskii, norvegica, glacialis, hebes*, and *antarctica* groups - and three independent species - *P. biloba, P. bisinuata*, and *P. grandiremis.* Each of the nine species groups is defined with detailed descriptions of its representative species and each of the four independent species that could not be grouped is also described in detail. Phylogenetic relationships among the species groups and independent species are discussed. Keys are presented for identification of the species groups in each genus and the species in each species group containing three or more species. The geographic distribution of the species groups and common species is discussed.

Key words: Taxonomy, phylogeny, geographic distribution, worldwide, Copepoda, Calanoida, Euchaetidae *Euchaeta, Paraeuchaeta*, species groups, new species, keys.

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INTRODUCTION

Giesbrecht (1892) erected the subfamily Euchaetina, which was subsequently raised to the rank of a family by Sars (1902). The family Euchaetidae comprised a single genus, *Euchaeta* Philippi 1843, until Scott (1909) proposed a division of the family into two genera, *Euchaeta* Philippi 1843 and *Paraeuchaeta* Scott 1909. He placed species of the *Euchaeta marina* type in *Euchaeta* and those of the *Euchaeta norvegica* type in *Paraeuchaeta.* The distinction between the two genera was based on the structure of the endopodal setae of the female maxilla and the exopods of the male 5th pair of legs. In the species assigned to *Euchaeta*, Scott found that 2 of the 6 endopodal setae of the female maxilla are armed with long spinules in addition to rows of very short spinules and the exopods in both the right and left 5th legs of the male taper into long spines. In the genus *Paraeuchaeta*, on the other hand, he found that none of the endopodal setae of the female maxilla has long spinules and none of the exopods of the male 5th pair of legs terminates in a long spine. Sars (1925) found another character by which the females of the two genera could be distinguished, viz., the appendicular caudal setae, which were found to be straight and much larger than the marginal caudal setae in Euchaeta but geniculated and much thinner than the marginal caudal setae in *Paraeuchaeta.*

With (1915) was the first author to disagree with Scott's proposal. He pointed out the problem of assigning *Euchaeta hebes* to either *Euchaeta* or *Paraeuchaeta*, because 1 of the 6 endopodal setae of its female maxilla is armed with long spinules as in *Euchaeta*, while its male 5th pair of legs is of the *Euchaeta norvegica* type. After examining a large number of euchaetid species, Vervoort (1957) also disagreed, mainly for the same reason as With (1915), to Scott's division of the Euchaetidae. The species Vervoort cited as intermediate and thus problematical include *Euchaeta pubera, E. spinosa, E. hebes*, and *E. russelli.* Vervoort also mentioned that the appendicular caudal setae vary in size and form without a definable correlation with the proposed division of the family into *Euchaeta* and *Paraeuchaeta.* For the sake of convenience, however, he arranged the species into the following 5 groups based on the presence or absence of spinulose setae on the female maxillary endopods and the structure of the male 5th pair of legs: 1) *Euchaeta marina* group, 2) *E. flava* group, 3) *E. hebes* group, 4) *E. pubera* group, and 5) *E. norvegica* group. The last was further subdivided into 2 subgroups according to the length of the digitiform process on the 2nd exopodal segment of the male left 5th leg.

Of Vervoort's 5 species groups of *Euchaeta*, only the marina group has subsequently been found to be a natural group (Bradford 1974), which now comprises 4 species: *E. marina* (Prestandrea 1833), *E. rimana* Bradford 1974, *E. marinella* Bradford 1974, and *E. indica* Wolfenden 1905. More recently Fontaine (1988) proposed that the 5 southernmost species of *Euchaeta* (*E. antarctica* Giesbrecht 1902, *E. austrina* Giesbrecht 1902, *E. similis* Wolfenden 1908, *Paraeuchaeta erebi* Farran 1929, and *E. tycodesma* Park 1978) form another natural species group, the *antarctica* species group.

In studies of the geographic distribution of bathypelagic calanoids based on plankton net and midwater trawl samples collected mostly from depths exceeding 1000 m throughout the Atlantic, Pacific, and Indian oceans, which are presently available at Scripps Institution of Oceanography, the Smithsonian Oceanographic Sorting Center, Woods Hole Oceanographic Institution, and the University of Tokyo Ocean Research Institute, I have found 75 species, including 13 new species, attributable to the family Euchaetidae. The identification of species was extremely difficult because descriptions in the literature are in most cases either inadequate or too general and thus applicable to more than one species. Furthermore, the proper diagnoses of new species and inadequately known species in many cases entailed redefining some of the previously known closely related species. When all of the species found in the studies were closely examined and compared with one another for their diagnoses, they were found to be classifiable into 9 species groups and 4 independent species that could not be grouped. Of the 9 species groups, 2 correspond to the *marina* and *hebes* groups of Vervoort (1957) and one to the *antarctica* group of Fontaine (1988). When these species groups and independent species were analyzed using the structure of the female genital somite, appendicular caudal setae, maxillule, maxilla, and maxilliped and the male 5th pair of legs, the distinction between

the 2 genera *Euchaeta* and *Paraeuchaeta* became clear. In this paper I attempt to rediagnose the family, redefine its 2 genera, characterize all species groups recognized in the family, describe in detail with figures each of the species found and provide information on their geographic distribution.

MATERIALS AND METHODS

The material on which this study is based consists of Isaacs-Kidd midwater trawl (IKMT) and plankton net samples selected from the collections available at Scripps Institution of Oceanography, Woods Hole Oceanographic Institution, the Smithsonian Oceanographic Sorting Center, and the University of Tokyo Ocean Research Institute. In selecting samples, efforts were made to cover as many different geographical areas as possible and select the deepest samples available for each area. A total of 167 samples (116 IKMT and 51 plankton net samples) covering the three great oceans were selected for the study. Their sources and the areas they represent are as follows:

1. Thirty-nine IKMT samples from Scripps Institution of Oceanography collected obliquely from the surface down to depths ranging from 2000 to 6000 mwo (meter wire out). Of these, 31 were taken in the Pacific, including the Malay Archipelago and the East and South China seas, between 38°N and 47°S; 3 in the western Indian Ocean between 17°S and 25°S; and 5 in the South Atlantic between 19°S and 32°S.
2. Thirty IKMT samples from Woods Hole Oceanographic Institution collected obliquely down to depths ranging from 800 to 3000 mwo in the Atlantic between 67°N and 36°S.
3. Twenty-four IKMT and 2 plankton net samples from the Smithsonian Oceanographic Sorting Center collected obliquely down to depths ranging from 800 to 3750 mwo, including 16 IKMT and 1 plankton net sample taken in the Pacific between 52°N and 76°S, 7 IKMT and 1 plankton net sample taken in the North Atlantic between 39°N and 78°N, and 1 IKMT sample taken in the Indian Ocean at 35°S. 60°E.
4. Twenty-three IKMT and 49 plankton net samples from the University of Tokyo Ocean Research Institute collected obliquely down to depths ranging from 2000 to 8000 mwo, comprising 12 IKMT and 36 plankton net samples taken in the western Pacific, including the Malay Archipelago, East and South China seas, between 110°E and 165°E and between 47°N and 25°S and 11 IKMT and 13 plankton net samples taken in the eastern Indian Ocean, including the Bay of Bengal, between 87°E and 111°E and between 17°N and 20°S.

The number of samples examined and the extent of geographic coverage for each ocean are as follows: 42 IKMT and 1 plankton net sample from between 78°N and 39°S in the Atlantic, 59 IKMT and 37 plankton net samples from between 52°N and 76°S in the Pacific, and 15 IKMT and 13 plankton net samples from between 17°N and 35°S in the Indian Ocean including the Bay of Bengal. Although a large number of deep samples taken in the Antarctic are available at the Smithsonian Oceanographic Sorting Center, only one of them was examined in this study for specimens of some Antarctic species, as the euchaetid fauna of the Antarctic has already been extensively studied by Park (1978) and Fontaine (1988).

Also examined in this study were sorted specimens of the Euchaetidae from Nancy J. Copley of Woods Hole Oceanographic Institution and Horst Weikert of the University of Hamburg, Germany. Copley's specimens were sorted from 4 MOCNESS (Multiple Opening/Closing Net and Environmental System) samples taken in the Guaymas Basin of the Gulf of California and Weikert's were those found in a total of 41 MOCNESS and plankton net samples taken from 17°-20°W, 47°-49°N in the northeastern Atlantic.

Citation of material usually includes, in order, the number of specimens, collecting gear, sampling depth, source, expedition or research vessel, cruise number, station number, latitude and longitude, area, and date of collection.

The following abbreviations are used in listing specimens examined: SIO, Scripps Institution of Oceanography; SOSC, Smithsonian Oceanographic Sorting Center; ORI, University of Tokyo Ocean Research Institute; UHG, University of Hamburg, Germany; WHOI, Woods Hole Oceanographic Institution; MV, Marine Vertebrate cruise; KH, R/V *Hakuhomaru*; KT, R/V *Tanseimaru*; IKMT, Isaacs-Kidd midwater trawl; MOCNESS, Multiple Opening/Closing Net and

Environmental System (Wiebe et al. 1976, 1985); ORI-100, Ocean Research Institute net with mesh opening of 1.00 mm; mwo, meter wire out.

With the exception of a few extremely large samples, such as some IKMT samples taken in the highly productive coastal waters, the whole sample was examined for adult specimens of the Euchaetidae. For identification, specimens were individually examined and measured usually in 50:50 glycerine-distilled water. The measurements usually include the body length as measured from the tip of the forehead to the distal end of the caudal ramus and the prosome length from the tip of the forehead to the distal end of the prosome as measured from the lateral side. When the distal ends of the prosome are produced asymmetrically, the measurement was taken from the side with the longer projection. For detailed morphological observation, the specimens were stained with methyl blue in lactic acid and the stained specimens were dissected in a drop of clear lactic acid. All line drawings were made from stained specimens with the aid of a camera lucida. Most of the morphological features described as important for species identification are illustrated and specific structures referred to in the description are labeled in the figures.

The following abbreviations are used in the descriptions: BL, body length; PL, prosome length; A1, antennule; A2, antenna; Md, mandible; Mx1, maxillule; Mx2, maxilla; Mxp, maxilliped; P1-P5, 1st to 5th legs.

The references cited in the synonymies are only those papers that provide descriptions or illustrations by which the identity of the species can be established. Previously published records used for defining the geographic range of the species are also only those records that can be verified by species descriptions or illustrations they accompany.

Type materials of the new species described here have been deposited in the U.S. National Museum of Natural History (USNM), Washington, DC, except for a few paratypes that were returned to H. Weikert of UHG. Other specimens examined in the study are in the planktonic invertebrates collection of Scripps Institution of Oceanography.

FAMILY EUCHAETIDAE GIESBRECHT 1892

Subfamily Euchaetina Giesbrecht 1892, p. 55.
Family Euchaetidae Sars 1902, p. 36.

Diagnosis. The taxa included in the family Euchaetidae have 4 synapomorphies distinguishing them from those of the family Aetideidae, the presumed sister family, and the other morphologically similar calanoid taxa. 1) Supralabrum anterior to labrum, a highly prominent structure with rows of long stiff hairs forming a "rake." 2) Appendicular caudal setae highly developed, straight, smoothly curved, or geniculated, and usually longer than marginal caudal setae. 3) Antennule with an extremely long seta on each of segments 3, 7, 9, 14, 18, 21, and 24. (Segments 8 and 9 are fused.) 4) Second exopodal segment of male left P5 extending distally into a serrated lamella and with a digitiform process.

Remarks. Appendicular caudal setae are present in the Aetideidae and the other related calanoid families but they remain poorly developed and are never longer than the principal marginal caudal setae. The segmentation and setal arrangement of the antennule are basically the same between the Aetideidae and Euchaetidae, with a relatively long seta on each of the segments 3, 7, 9, 14, 18, 21, and 24. These long setae are, however, extremely well developed in the Euchaetidae and they are apparently balanced by the highly developed appendicular caudal setae. According to Yen and Nicoll (1990), the long antennular setae are aligned along 3 planes and function mainly as mechanoreceptors.

The remaining diagnostic characters, the supralabrum of the female and the serrated lamella and digitiform process of the male left P5, are not found in any other calanoid families. However, the supralabrum is probably homologous to the anterior lobe of the labrum as described by Park (1966) for *Epilabidocera.* Structures probably homologous to the serrated lamella and digitiform process are found in certain genera of the Aetideidae. In the male of *Undeuchaeta, Euchirella*, and *Pseudochirella*, for example, the 2nd exopodal segment of the left P5 is produced distally into a single or bifurcated process which seems to be homologous to the serrated lamella but which is not serrated and remains poorly developed. The same segment in the male of *Pseudochirella* also has a rounded, ornamented distal tubercle on the posterior surface, which though inconspicuous is probably homologous to the digitiform process.

Additional description of female. With the exception of the diagnostic characters described above, the Euchaetidae is basically similar in morphology to the Aetideidae, with most of the characters described below also found in the Aetideidae. In describing variable characters the character states similar to those of the Aetideidae are regarded as plesiomorphic.

First pedigerous somite separated from cephalosome by a faint line representing the partially fused joint. Fourth and 5th pedigerous somites completely fused. Forehead (Fig. 1-a) in lateral view produced anteriorly into a frontal eminence of varying height, bearing suprafrontal sensilla. A low frontal eminence is regarded as plesiomorphic. Rostrum single, spiniform. Urosome 4-segmented (Fig. 1-b). First marginal seta (counted from lateral) of caudal ramus small (Fig. 1-g), pointing mediad. Second to 5th well developed.

Antennule (Fig. 1-j) with 8th and 9th segments fused; with an aesthete on each of 5th, 9th, 12th, 14th, 19th and 25th segments. Coxa of A2 (Figs. 1-k, 19-j) with a single inner marginal seta, basis with 2 inner marginal setae, one of which is often reduced. First endopodal segment usually with a small and a large inner marginal seta. Second endopodal segment with 8 setae on inner lobe and 6 on outer lobe. Exopod 7-segmented; 1st segment without setae; 2nd usually with a small inner marginal seta; 3rd to 6th segments each with a large inner marginal seta; 7th with an inner marginal (which may be absent in certain species) and 3 terminal setae. Mandibular blade (Fig. 1-l) with 5 groups of teeth and a basal spine. Primitively, basis with a strong, curved seta and a very small additional seta (Fig. 84-g); the latter is missing in most of the species. Endopod 2-segmented, with 1 inner marginal seta on 1st segment and 9 terminal and an appendicular seta on 2nd. The inner

marginal seta of the 1st segment is often reduced and the appendicular seta of the 2nd segment is absent in most of the species. Exopod 5-segmented; 1st to 4th segments each with an inner marginal seta, 5th with 2 terminal setae.

First inner lobe of Mx1 (Figs. 1-m, 20-a) in primitive condition with 13 spiniform setae: 1 small anterior, 9 marginal, and 3 posterior setae. Marginal setae fall into 2 groups: Proximal group of 2 setae and distal group of 7. Proximal marginal setae thinner but more spinulose than distal ones. Seven strong, clawlike distal setae arranged in 2 rows: Anterior row of 3 setae armed with relatively long spinules and posterior row of 4 setae furnished with relatively short spinules. One or both proximal marginal setae and 1 or 2 posterior setae often reduced. Second inner lobe basically with 2 setae, one or both of which often reduced. Third inner lobe with a single seta. Number of setae on basis varying from 6 to 3. Endopod 2-segmented. First segment appears to be a compound segment formed by fusion of the first 2 original endopodal segments, with setae varying in number from 7 to 1. Second segment, with 3 large setae, appears to be the original 3rd endopodal segment. Exopod with 11 setae. Outer lobe with from 9 to 5 setae.

Maxilla (Fig. 2-a) with 5 lobes and endopod. Each lobe with a relatively short posterior seta and 2 long terminal setae. Terminal setae of proximal 3 or 4 lobes armed with long spinules in addition to dense rows of short spinules. Endopod with 6 long setae, of which 1 or 2 proximal setae may be armed with long spinules in addition to short spinules.

Coxa of Mxp (Fig. 2-b) with a posterior seta close to proximal end (which may be absent in certain species) and 3 groups of spiniform setae along medial margin, with 2, 3, and 3 setae respectively in order from proximal. Basis with a middle group of 3 marginal setae and a distal group of 2 marginal setae. First seta (counted from proximal) of middle group usually curved, 2nd usually thickened at proximal end, 3rd normal and largest. Medial edge of basis armed either with short spinules only or with both short and long spinules. Endopod 5-segmented, usually with 4, 3, 2, 3, and 4 setae in order from proximal.

Basis of P1 (Fig. 2-c) with a curved inner marginal seta at posteromedial corner of anterior surface. First 2 exopodal segments usually remain unseparated, forming a compound segment. First segment with an outer spine, which is very small or missing; 2nd with an outer spine and an inner seta. Third exopodal segment with an outer spine, a terminal spine, and 3 inner setae. Endopod 1-segmented, with 5 setae.

In P2 (Fig. 2-d), coxa with an inner marginal seta. First and 2nd exopodal segments each with an outer spine and an inner seta. Third exopodal segment with 3 outer spines, a terminal spine, and 4 inner setae. Endopod 1-segmented, with 6 setae.

Third leg (Fig. 2-e) similar to 2nd except that endopod is 3-segmented. First and 2nd endopodal segments each with an inner seta. Third endopodal segment with 5 setae. Fourth leg (Fig. 2-f) similar to 3rd except that coxa without a row of inner marginal hairs.

Additional description of male. Similar in habitus to female except that prosome in lateral view usually with a pointed process varying in form from a sharp spiniform to a low angular ridge on posterodorsal margin (Fig. 3-b), urosome 5-segmented, and appendicular caudal setae (Fig. 3-c) geniculated or smoothly curved, and much less well-developed than in female.

In A1 (Fig. 21-g), segments 8-10 completely fused; segments 12 and 13 partially fused. A long anterior seta found on each of segments 3, 9, 14, 18, 21, and 24. Aesthetes found on all segments except segments 9, 20, 23, and 24.

In A2 (Figs. 3-e, 21-h), marginal seta of coxa greatly reduced in size, usually to a small thornlike process. Basis with 2 marginal setae, one of which is usually very small or missing. First endopodal segment with a small marginal seta. Inner lobe of 2nd endopodal segment with 5 large setae in addition to 1 to 3 very small setae medially; all 6 setae on outer lobe normally developed. Marginal setae normally developed on 3rd to 6th exopodal segments but absent on 2nd and 7th.

Mandibular blade (Fig. 3-f) reduced to a small lamella devoid of functional teeth. Basis without a seta. Endopod and exopod with same number of setae as in female, but seta on 1st endopodal segment and innermost seta on 2nd greatly reduced in size.

In Mx1 (Fig. 3-g), outer lobe and exopod with 5 and 10 well-developed setae respectively. First and 2nd inner lobes usually devoid of setae; 3rd inner lobe with a small seta. Basis and endopod with poorly developed setae, similar in number to female. Maxilla reduced to a small lobe usually devoid of setae.

Coxal setae of Mxp (Fig. 3-h) reduced in both number and size; marginal spinules of basis absent. Although poorly developed, setae on basis and endopod similar in number to those of female.

First to 4th swimming legs (Figs. 3-i, j) similar to those of female but their exopodal outer spines poorly developed and first 2 exopodal segments of P1 fully separated. In right P5 (Fig. 3-k), endopod 1-segmented, club-shaped. Exopod 2-segmented. Distal segment terminating with either a spiniform process or a blunt end. In left P5, endopod reduced to a minute process. Exopod 3-segmented. First segment relatively long. Second segment (Figs. 3-l, m) with serrated lamella and digitiform process. Third segment hollow, with a hairy tubercle proximally, 2 adjoining tufts of stiff hairs distally, and a terminal spine, which is either greatly developed as a long tapering process or vestigial. The hollow 3rd segment and the serrated lamella of the 2nd segment act as pincers to catch and carry spermatophores (Vervoort 1957).

Remarks. Although the general body shape and the details of the cephalosomal appendages and 4 pairs of swimming legs show relatively minor variations, the female genital segment and the serrated lamella of the male left P5 are highly variable from species to species and thereby serve as main diagnostic characters for species identification. Also important are the female appendicular caudal setae and the distal exopodal segments of the male 5th pair of legs, by which the 2 genera of the family can be readily diagnosed. In the cephalosomal appendages, minor but consistent differences among species are found in the structure of the maxillar endopodal setae, the number of setae on various lobes of the maxillule, and the occurrence of spinules on the maxilliped basis. Of the swimming legs, only the 1st and 2nd legs vary in the morphology of some outer exopodal spines and marginal lobes bearing the outer spines. The species also vary to some extent in the form of the rostrum, frontal eminence, and supralabrum.

LIST OF SPECIES OF THE FAMILY EUCHAETIDAE
(* denotes species not dealt with in this paper)

Cyclops marinus Prestandrea 1833 = *Euchaeta marina* (Prestandrea)
Euchaeta concinna Dana 1849
Euchaeta norvegica Boeck 1872 = *Paraeuchaeta norvegica* (Boeck)
Euchaeta barbata Brady 1883 = *Paraeuchaeta barbata* (Brady)
Euchaeta glacialis Hansen 1887 = *Paraeuchaeta glacialis* (Hansen)
**Euchaeta hebes* Giesbrecht 1888 = *Paraeuchaeta hebes* (Giesbrecht)
Euchaeta grandiremis Giesbrecht 1888 = *Paraeuchaeta grandiremis* (Giesbrecht)
Euchaeta media Giesbrecht 1888
Euchaeta longicornis Giesbrecht 1888
* *Euchaeta flava* Giesbrecht 1888, male unknown = *Paraeuchaeta flava* (Giesbrecht)
Euchaeta acuta Giesbrecht 1892
Euchaeta spinosa Giesbrecht 1892
Euchaeta tonsa Giesbrecht 1895 = *Paraeuchaeta tonsa* (Giesbrecht)
Euchaeta antarctica Giesbrecht 1902 = *Paraeuchaeta antarctica* (Giesbrecht)

Euchaeta austrina Giesbrecht 1902 = *Paraeuchaeta austrina* (Giesbrecht)
* *Euchaeta affinis* Cleve 1904, male unknown = *Paraeuchaeta affinis* (Cleve)
Euchaeta indica Wolfenden 1905
Euchaeta tumidula Sars 1905 = *Paraeuchaeta tumidula* (Sars)
Euchaeta gracilis Sars 1905 = *Paraeuchaeta gracilis* (Sars)
Euchaeta incisa Sars 1905 = *Paraeuchaeta incisa* (Sars)
Euchaeta porrecta Sars 1905
Synonym of *E. barbata* Brady 1883 (see Sars 1907, p. 3)
Euchaeta californica Esterly 1906 = *Paraeuchaeta californica* (Esterly)
Euchaeta propinqua Esterly 1906 = *Paraeuchaeta propinqua* (Esterly)
Euchaeta tenuis Esterly 1906
Euchaeta spinifera Esterly 1906
Synonym of *E. tonsa* Giesbrecht 1895
Euchaeta dubia Esterly 1906
Synonym of *E. californica* Esterly 1906 (see Park 1977, p. 136)
Euchaeta bisinuata Sars 1907 = *Paraeuchaeta bisinuata* (Sars)
Euchaeta pubera Sars 1907
Euchaeta similis Wolfenden 1908 = *Paraeuchaeta similis* (Wolfenden)
Euchaeta sarsi Farran 1908 = *Paraeuchaeta sarsi* (Farran)
Euchaeta scoatti Farran 1908 = *Paraeuchaeta scotti* (Farran)
Euchaeta quadrata Farran 1908
Synonym of *E. gracilis* Sars 1905 (see Farran 1926, p. 255)
Euchaeta rubicunda Farran 1908 = *Paraeuchaeta rubicunda* (Farran)
Euchaeta wolfendeni Scott 1909
Synonym of *E. indica* Wolfenden 1905 (see Bradford 1974, p. 159)
**Paraeuchaeta sibogae* Scott 1909, male unknown
Paraeuchaeta tuberculata Scott 1909
Paraeuchaeta gracilicauda Scott 1909
Paraeuchaeta weberi Scott 1909
Paraeuchaeta dentata Scott 1909, solely based on male.
Synonym of *E. sarsi* Farran 1908
**Euchaeta robusta* Wolfenden 1911, male unknown = *Paraeuchaeta robusta* (Wolfenden)
Euchaeta exigua Wolfenden 1911 = *Paraeuchaeta exigua* (Wolfenden)
Euchaeta diegensis Esterly 1911
Synonym of *E. media* Giesbrecht 1888
Euchaeta acuta var. *pacifica* Esterly 1911, solely based on male.
Synonym of *E. media* Giesbrecht 1888
Euchaeta solida Esterly 1911
Synonym of *E. tenuis* Esterly 1906 (see Sewell 1929, p. 149)

**Euchaeta ovata* Sato 1913, based on both female and male.

The female appears to be similar to *Paraeuchaeta russelli* (Farran 1936) but the male is of the *Euchaeta marina* type. Apparently, they are not conspecific.

Euchaeta elongata Esterly 1913 = *Paraeuchaeta elongata* (Esterly)

**Euchaeta bradyi* With 1915, male unknown = *Paraeuchaeta bradyi* (With)

Euchaeta farrani With 1915

Synonym of *E. barbata* Brady 1883

Euchaeta hansenii With 1915 = *Paraeuchaeta hansenii* (With)

Euchaeta japonica Marukawa 1921

Synonym of *E. elongata* Esterly 1913 (see Tanaka 1958, p. 355)

Paraeuchaeta investigatoris Sewell 1929

Paraeuchaeta malayensis Sewell 1929

Paraeuchaeta erebi Farran 1929

Paraeuchaeta rasa Farran 1929

Paraeuchaeta biloba Farran 1929

Euchaeta consimilis Farran 1936

Synonym of *E. concinna* Dana 1849 (see Grice 1962, p. 201)

Euchaeta russelli Farran 1936 = *Paraeuchaeta russelli* (Farran)

Euchaeta plana Mori 1937

Euchaeta daitomarui Mori 1937

Synonym of *E. russelli* Farran 1936 (see Tanaka 1958, p. 334)

Euchaeta murrayi Sewell 1947

Synonym of *E. plana* Mori 1937 (see Tanaka and Omori 1968, p. 221)

Paraeuchaeta withi Sewell 1947

Synonym of *E. hansenii* With 1915 (see Park 1978, p. 246)

**Paraeuchaeta polaris* Brodsky 1950, male unknown

Paraeuchaeta birostrata Brodsky 1950

Paraeuchaeta rubra Brodsky 1950

Paraeuchaeta brevirostris Brodsky 1950

Paraeuchaeta pseudotumidula Brodsky 1950

Synonym of *E. tumidula* Sars 1905 (see Heptner 1971, p. 108)

**Paraeuchaeta modesta* Brodsky 1950, male unknown

**Paraeuchaeta orientalis* Brodsky 1950, male unknown

Paraeuchaeta abyssalis Brodsky 1950

Paraeuchaeta pavlovskii Brodsky 1955

Euchaeta paraconcinna Fleminger 1957

Paraeuchaeta simplex Tanaka 1958

Paraeuchaeta confusa Tanaka 1958

Paraeuchaeta calva Tanaka 1958

Paraeuchaeta aequatorialis Tanaka 1958

Paraeuchaeta crassa Tanaka 1958
Synonym of *Paraeuchaeta rubra* Brodsky 1950 (see Tanaka and Omori 1968, p. 249)
Paraeuchaeta comosa Tanaka 1958
Euchaeta gladiöfera Gaudy 1963
Synonym of *E. paraconcinna* Fleminger 1957
Euchaeta pseudotonsa Fontaine 1967 = *Paraeuchaeta pseudotonsa* (Fontaine)
Euchaeta scaphula Fontaine 1967
Synonym of *Paraeuchaeta tuberculata* Scott 1909
**Euchaeta wrighti* Park 1968, male unknown
Euchaeta regalis Grice and Hulsemann 1968 = *Paraeuchaeta regalis* (Grice and Hulsemann)
Euchaeta vorax Grice and Hulsemann 1968 = *Paraeuchaeta vorax* (Grice and Hulsemann)
Paraeuchaeta eminens Tanaka and Omori 1968
Paraeuchaeta laudabilis Tanaka and Omori 1968
Synonym of *P. brevirostris* Brodsky 1950 (See Heptner 1986, p. 15)
Paraeuchaeta polita Tanaka and Omori 1968
Synonym of *P. calva* Tanaka 1958 (see Park 1975, p. 10)
Paraeuchaeta prudens Tanaka and Omori 1968
Paraeuchaeta simulantis Tanaka and Omori 1968
Synonym of *P. calva* Tanaka 1958 (see Park 1975, p. 10)
Paraeuchaeta striata Tanaka and Omori 1968
Synonym of *E. vorax* Grice and Hulsemann 1968 (see Park 1975, p. 21)
Paraeuchaeta kurilensis Heptner 1971
**Paraeuchaeta abrikosovi* Heptner 1971, male unknown
**Paraeuchaeta guttata* Heptner 1971, male unknown
**Paraeuchaeta longisetosa* Heptner 1971, male unknown
**Paraeuchaeta oculata* Heptner 1971, male unknown
**Paraeuchaeta plicata* Heptner 1971, male unknown
**Paraeuchaeta prima* Heptner 1971, male unknown
**Paraeuchaeta subtilirostris* Heptner 1971, male unknown
**Euchaeta paracuta* Tanaka 1973
Euchaeta rimana Bradford 1974
Euchaeta marinella Bradford 1974
Euchaeta alaminae Park 1975 = *Paraeuchaeta alaminae* (Park)
Euchaeta magniloba Park 1978
Euchaeta tycodesma Park 1978 = *Paraeuchaeta tycodesma* (Park)
Euchaeta vervoorti Park 1978 = *Paraeuchaeta vervoorti* (Park)
Euchaeta dactylifera Park 1978 = *Paraeuchaeta dactylifera* (Park)
Euchaeta abbreviata Park 1978 = *Paraeuchaeta abbreviata* (Park)
Euchaeta parvula Park 1978 = *Paraeuchaeta parvula* (Park)

Euchaeta biconvexa Park 1978
Synonym of *E tumidula* Sars 1905
Euchaeta eltaninae Park 1978 = *Paraeuchaeta eltaninae* (Park)
Euchaeta longissima Park 1978
Synonym of *Paraeuchaeta kurilensis* Heptner 1971
**Paraeuchaeta rotundirostris* Heptner 1987, male unknown.
Differs from the other species of the family in having a rounded rostrum.
**Paraeuchaeta bulbirostris* Heptner 1987, based on an immature specimen,
whose rostrum is also rounded.
**Paraeuchaeta implicata* Heptner 1987, male unknown
**Paraeuchaeta hastata* Heptner 1987, male unknown
**Paraeuchaeta abyssaloides* Heptner 1987, based solely on male
**Paraeuchaeta perplexa* Heptner 1987, based solely on male
**Paraeuchaeta tridentata* Heptner 1987, based solely on male
Paraeuchaeta copleyae, n. sp.
Paraeuchaeta paraprudens, n. sp.
Paraeuchaeta triloba, n. sp.
Paraeuchaeta megaloba, n. sp.
Paraeuchaeta mexicana, n. sp.
Paraeuchaeta papilliger, n. sp.
Paraeuchaeta euryrhina, n. sp.
Paraeuchaeta plaxiphora, n. sp.
Paraeuchaeta altibulla, n. sp.
Paraeuchaeta parabbreviata, n. sp.
Paraeuchaeta anfracta, n. sp.
Paraeuchaeta scopaeorhina, n. sp.
Paraeuchaeta sesquipedalis, n. sp.

GENUS *EUCHAETA* PHILIPPI 1843

Euchaeta Philippi 1843, p. 54.

Type species. Euchaeta marina (Prestandrea 1833)

Diagnosis. Appendicular caudal setae (Fig. 1-g) greatly developed, straight, and much thicker and longer than distal marginal setae of caudal ramus. Distal exopodal segment in both right and left 5th legs of male (Fig. 3-k) tapering into a long spine.

Additional description of female. Frontal eminence of forehead (Fig. 1-a) in lateral view varying from tall conical process to low ridge. First marginal seta of caudal ramus small (Fig. 1-g), pointing mediad; 2nd to 5th about as long as urosome.

Basis of A2 (Fig. 1-k) with a single inner marginal seta; 2nd exopodal segment without an inner marginal seta; 7th usually with an inner marginal seta. Basis of Md (Fig. 1-l) with a strong, curved seta; endopod with a marginal seta on 1st segment and 9 terminal setae on 2nd.

First inner lobe of Mx1 (Fig. 1-m) with 10 to 12 spiniform setae: a small anterior, 8 or 9 marginal and 1 or 2 posterior setae; 2nd inner lobe reduced to a low ridge without setae; 3rd inner lobe with a long seta; basis with 3 setae; 1st endopodal segment with 1 or 4 large setae; 2nd with 3 large setae; exopod with 11 setae; outer lobe with 5 to 9 setae. One or 2 endopodal setae of Mx2 (Fig. 2-a) armed with long spinules in addition to short spinules.

Coxa of Mxp (Fig. 2-b) with a posterior seta close to proximal end, which may be absent in certain species. Medial edge of Mxp basis armed either with short spinules only or with both short and long spinules. First exopodal segment of P1 (Fig. 2-c) usually without an outer spine.

Additional description of male. Appendicular caudal setae (Fig. 3-c) geniculated, thinner than but nearly as long as 2nd or 3rd marginal caudal seta. Fourth marginal caudal seta longest, usually about 1.3 times length of 3rd.

Basis of A2 (Fig. 3-e) usually with a well-developed marginal seta. First endopodal segment with a small marginal seta. In Md (Fig. 3-f), marginal seta of 1st endopodal segment and innermost marginal seta of 2nd greatly reduced in size; otherwise setation of both endopod and exopod as in female.

Basis of Mx1 (Fig. 3-g) with 1 to 3 small setae. Endopodal setae greatly reduced in size though same in number as in female. Coxal setae of Mxp (Fig. 3-h) greatly reduced in both number and size; only a proximal posterior seta and a distal group of 2 or 3 small marginal setae are usually found.

In right P5 (Fig. 3-k), spiniform 2nd exopodal segment longer than 1st. In exopod of left P5, a poorly sclerotized lobe may be found next to digitiform process of 2nd segment, next to tufts of stiff hairs, and on hairy tubercle of 3rd segment.

Remarks. In all *Euchaeta* species I have examined, the A1, A2, and Mb are similar. The most important characters for species identification are the female genital somite and male 5th pair of legs. The female Mx1, Mx2, and Mxp show relatively minor but consistent differences which, together with the male 5th pair of legs, are most useful for classifying the species.

The genus *Euchaeta* is classified into 3 species groups - the marina, concinna, and acuta groups - and an independent species, *E. spinosa*, which is distinctly different from the others.

KEY TO SPECIES GROUPS AND INDEPENDENT SPECIES OF *EUCHAETA*

1a. Basis of female Mxp with long spinules in addition to short spinules along proximal half of medial margin (Fig.2-b). Exopod of male left P5 with poorly sclerotized lobes.

Serrated lamella of male left P5 exopod reaching or extending beyond tuft of stiff hairs (Fig.3-l) 2

1b. Basis of female Mxp with short spinules only along proximal half of medial margin (Fig.12-i). Exopod of male left P5 without poorly sclerotized lobes (Fig.12-p). Serrated lamella of male left P5 exopod far short of reaching tuft of stiff hairs 3

2a. Two endopodal setae of female Mx2 armed with both long and short spinules (Fig.2-a). Third exopodal segment of male left P5 with a poorly sclerotized lobe next to tuft of stiff hairs (Fig.3-m) ..... *marina* species group

2b. One endopodal seta of female Mx2 armed with both long and short spinules (Fig.7-h). Third exopodal segment of male left P5 without a poorly sclerotized lobe next to tuft of stiff hairs (Fig.8-g) ..... *concinna* species group

3a. First endopodal segment of female Mx1 with 1 seta. Both exopods of male 5th pair of legs similar in length (Fig.12-n) ..... *acuta* species group

3b. First endopodal segment of female Mx1 with 4 setae (Fig. 18-g). Left exopod of male 5th pair of legs much shorter than right exopod (Fig.18-l) ..... *E. spinosa*

MARINA SPECIES GROUP

Diagnosis. Two endopodal setae of Mx2 (Fig. 2-a) armed with long spinules in addition to short spinules. Basis of Mxp (Fig. 2-b) with long spinules in addition to short spinules along proximal half of medial margin. Exopod of male left P5 (Fig. 3-m) with 3 poorly sclerotized lobes: 1) next to digitiform process of 2nd segment, 2) on hairy tubercle, and 3) next to tufts of stiff hairs on 3rd segment. In exopod of male left P5, digitiform process spiniform and serrated lamella long, extending beyond tufts of stiff hairs.

Composition. Euchaeta marina (Prestandrea 1833), *E. rimana* Bradford 1974, *E. marinella* Bradford 1974, and *E. indica* Wolfenden 1905.

Remarks. The *marina* species group was first recognized by Vervoort (1957) and has subsequently been reexamined by Bradford (1974).

Key to species of *marina* species group (based on females)

1a. Laterally, genital somite about twice as long as deep ..... *E. indica*

1b. Laterally, genital somite less than 1.5 times as long as deep 2

2a. In P2 exopod, 2nd outer spine of 3rd segment shorter than outer spine of 2nd segment (Fig.5-k) ..... *E. marinella*

2b. In P2 exopod, 2nd outer spine of 3rd segment longer than outer spine of 2nd segment (Fig.2-d) 3

3a. Ventrally, genital field with wide gap between genital flanges (Fig.1-f) ..... *E. marina*

3b. Ventrally, genital field with narrow gap between genital flanges (Fig.4-f) ..... *E. rimana*

Euchaeta marina (Prestandrea 1833)
Figures 1-3

Cyclops marinus Prestandrea 1833, P. 12.

Euchaeta marina; Giesbrecht 1892, p. 262, pl. 1, Figs. 10, 11; pl. 15, Figs. 31, 33; pl. 16, Figs. 1, 2, 8, 15-17, 22, 23, 25, 28-30, 41, 46; pl. 37, Figs. 30, 37, 38, 49.

- Bradford 1974, p. 159, figs, 1a, 2, 3a-b, 4a-d, 5a, 6a-b.

- Park 1978, p. 205, Figs. 65-66.

Description of female. Prosome length, 2.50-2.68 mm; body length, 3.40-3.64 mm. Laterally, forehead (Fig. 1-a) produced anteriorly into a large conical frontal eminence. Rostrum large pointing in an anteroventral direction, only slightly curved backward. Distal margin of prosome rounded (Fig. 1-b). Dorsally, posterolateral corners of prosome symmetrical and somewhat angular (Fig. 1-d). Genital somite in dorsal view strongly asymmetrical, with a large lobular outgrowth on right side and a small notch on left side. Laterally, right genital flange large, weakly bilobed (Fig. 1-e); left genital flange smaller than right, clearly divided into a broad anterior and a narrow posterior lobe (Fig. 1-c). Ventrally, posterior lobe of left genital flange extending mediad for only a short distance, leaving a relatively wide gap between it and medial edge of opposite genital flange (Fig. 1-f). Within this gap and posterior to genital opening are seen conspicuous cuticular ridges. Four distal marginal setae of caudal ramus (Figs. 1-g-i) about as long as urosome. Appendicular caudal setae about 1.3 times length of body.

Antennule (Fig. 1-j) extending beyond distal end of prosome by its last 3 segments. In A2 (Fig. 1-k), outer margin of 2nd exopodal segment strongly bulging. Inner marginal seta of last exopodal segment well developed. In Md (Fig. 1-l), endopod reaching about middle of exopod. First inner lobe of Mx1 (Fig. 1-m) with 1+9+1 (1 anterior + 9 marginal + 1 posterior) setae, 1st endopodal segment with 1 seta, outer lobe with 5 setae. Two endopodal setae of Mx2 (Fig. 2-a) armed with long spinules in addition to very short spinules. Basis of Mxp (Fig. 2-b) armed with long spinules in addition to rows of very small spinules along proximal half of medial margin.

Proximal, compound exopodal segment of P1, formed of first 2 unseparated segments, (Fig. 2-c) with nearly straight outer margin and well-developed outer spine reaching about 2/3 way to base of following outer spine. In P2 exopod (Fig. 2-d), 2nd outer spine short of reaching base of following outer spine. Fourth outer spine largest, a little short of reaching base of following outer spine. Marginal lobe bearing 4th outer spine separated from segment by a deep and wide incision. Marginal lobes carrying 2nd and 3rd outer spines separated from respective segments by a relatively deep cleft. In P3 and P4 (Figs. 2-e, f), all outer spines of 3rd exopodal segment equally small.

Description of male. Prosome length, 2.26-2.36 mm; body length, 2.88-3.20 mm. Laterally, dorsal margin of forehead (Fig. 3-a) only slightly arched; frontal eminence highly produced. Rostrum elongated, slightly curved backward pointing nearly downward. Dorsally, posterolateral corners of prosome about symmetrical. Laterally, distal margin of prosome (Fig. 3-b) produced into lappet; posterodorsal margin with a conspicuous toothlike process. Geniculated appendicular setae of caudal rami (Fig. 3-c) about as long as 5th marginal seta. Fourth marginal seta extending beyond distal end of appendicular seta by about 1/3 its length.

Antennule extending beyond distal end of prosome by its last 2 segments. In A2 (Fig. 3-e), inner marginal seta of basis well developed, reaching close to base of following seta on 1st endopodal segment. In Mx1 (Fig. 3-g), 3rd inner lobe and basis each with a very small seta, 1st and 2nd endopodal segments with 1 and 3 medium-sized setae, respectively. Coxa of Mxp (Fig. 3-h) with a posterior seta close to proximal end and 2 relatively small setae at distal end. Setation of basis and endopod as in female except for 4th endopodal segment, which has only a large inner marginal and a small anterior seta.

Outer spine of 2nd exopodal segment of P1 (Fig. 3-i) pointing in a posterolateral direction, about 2/3 length of segment. Second (Fig. 3-j) to 4th legs similar to those of female but all exopodal

outer spines of equally small size. In exopod of left P5 (Figs. 3-k-m), digitiform process spiniform, 2nd segment with a poorly sclerotized lobe on medial distal margin next to digitiform process. Hairy tubercle of 3rd segment also with a poorly sclerotized lobe. Third poorly sclerotized lobe, which is relatively large and fingerlike, is located just distal to tufts of stiff hairs. Serrated lamella elongated, overreaching tufts of stiff hairs of 3rd segment; its lateral margin bordered with relatively large teeth and its medial margin with a row of very fine teeth. These 2 rows of teeth of different size not coming in contact distally, leaving a relatively wide unserrated gap (Fig. 3-n).

Remarks. This species is diagnosed in the female by the presence of 1+9+1 setae on the 1st inner lobe, 1 seta on the 1st endopodal segment, and 5 setae on the outer lobe of Mxl; 2 spinulose setae on the Mx2 endopod; and long spinules on the proximal half of the medial margin of the Mxp basis; and in the male by the spiniform digitiform process and long serrated lamella of the 2nd exopodal segment and a long poorly sclerotized lobe next to the tufts of stiff hairs on the 3rd exopodal segment of the left P5.

The female of this species is distinguished from other species belonging to the same species group by the ventral aspect of the genital somite, in which the gap between the inner margins of the 2 opposing genital flanges is relatively wide, and by the shape of the genital flanges in lateral view. The male is identified by differences in the structure of the distal end of the serrated lamella in the left P5.

Distribution. Only the Atlantic and Mediterranean records of *E. marina* are now attributable to this species, as Bradford (1974) referred records from the Pacific and Indian oceans to a new species. *E. rimana.* Therefore, the geographic range of *E. marina* is now known to be confined to the Mediterranean and Atlantic including the Gulf of Mexico and Caribbean Sea and extends from 52°N southward to 37°S (Vervoort 1963, Park 1978). In the present study the species was found widely in the Atlantic between 39°N and 33°S.

Euchaeta rimana Bradford 1974
Figure 4

Euchaeta rimana Bradford 1974, p. 165, figs, 1b, 3c-d, 4e-h, 5b, 6c-d.

Description of female. Prosome length, 2.50-2.70 mm; body length, 3.40-3.80 mm. The female of this species can be distinguished from that of *E. marina* only by the structure of the genital somite as they are practically identical in all other morphological features including the forehead (Fig. 4-a). Main diagnostic features of the genital somite are as follows: In both dorsal and ventral view, the left side of the genital somite (Figs. 4-d, f) is smoothly curved. Laterally, the left genital flange (Figs. 4-b, c) is divided into 2 similar lobes and extends distally farther than the right genital flange and its posterior margin is nearly perpendicular to the ventral wall of the somite. The right genital flange (Fig. 4-e) in lateral view is relatively narrow and produced ventrally into a large rounded lobe, which has a small semicircular ridge on the top. In ventral view (Fig. 4-f) there is almost no gap medially between both genital flanges.

Description of male. Prosome length, 2.32-2.72 mm; body length, 3.24-3.96 mm. Similar in habitus (Fig. 4-g) to *E. marina.* The structure of the serrated lamella of the left P5 is the only morphological feature of the appendages found to be different between this species and *E. marina*; that is, the distal margin of the serrated lamella has a unserrated gap in *E. marina* but no such a gap in *E. rimana* (Figs. 4-h, i).

Distribution. As is mentioned above, Bradford (1974) considered all Pacific and Indian ocean records of *E. marina*, which extend over the whole of the tropical, subtropical, and temperate regions from 37°N to 30°S (Vervoort 1963), to be attributable to this species. In the present study the species was found throughout the Pacific and Indian oceans between 35°N and 25°S.

Euchaeta marinella Bradford 1974
Figure 5

Euchaeta marinella Bradford 1974, p. 168, figs, 1c, 3e-f, 4i-l, 5c, 6e-f.

Description of female. Prosome length, 1.95-2.10 mm; body length, 2.86-3.00 m. Laterally, rostrum relatively large, pointing at an angle of about 20° with respect to anterior dorsal wall of forehead (Fig. 5-a). In both dorsal and ventral view (Figs. 5-g, h), left side of genital somite smoothly curved as in *E. rimana.* Ventrally, right side of genital somite (Figs. 5-h, i) with a tubercular outgrowth at middle, which in lateral view (Figs. 5-e, f) appears as a rounded ridge posterior to genital flange. Left genital flange smaller than right and deeply divided into 2 lobes as in *E. marina*; the posterior lobe is almost hidden behind the anterior lobe when viewed laterally (Fig. 5-c) but is clearly visible when the somite is tilted clockwise (Fig. 5-d). Right genital flange in lateral view (Fig. 5-e) single-lobed and nearly rounded. Ventrally (Fig. 5-h), 2 opposing genital flanges extending mediad to meet each other without leaving a gap in between as in *E. rimana.*

Cephalosomal appendages as in *E. marina* except that all terminal setae of the 4 proximal lobes of Mx2 are furnished with long spinules in addition to rows of fine spinules as in *E. indica* described below. Swimming legs (Figs. 5-j, k) similar to those of *E. marina* but 2nd outer spine of 3rd exopodal segment of P2 barely reaching midway to base of 3rd outer spine and marginal lobe bearing 2nd outer spine is separated from segment by a relatively shallow incision.

Remarks. The male was not found in this study. According to Bradford (1974), it can be identified by the serrated lamella, whose distal margin is rounded and bordered by a row of small teeth flanked by larger teeth.

Distribution. Bradford's (1974) original description of the species was based on specimens collected in the Pacific between 21°N and 23°S and between 122°E and 80°W. In the present study the species was found in the central South Pacific at 25°S, 155°W.

Euchaeta indica Wolfenden 1905
Figure 6

Euchaeta indica Wolfenden 1905, p. 1008, pl. C, Figs. 7, 8, 10, 11, 17, 18.

-Bradford 1974, p. 159, 167.

Euchaeta wolfendeni Scott 1909, p. 68, pl. 17, Figs. 1-12.

-Tanaka and Omori 1968, p. 224.

Description of female. Prosome length, 1.60-1.88 mm; body length, 2.40-2.68 mm. Frontal eminence of forehead well developed (Fig. 6-a). Rostrum elongated, slightly curved backward. Distal end of prosome on each side broadly rounded in both dorsal and lateral view. Genital somite long, about twice as long as deep or as long as combined lengths of following 3 urosomal somites (Fig. 6-b). Dorsally as well as ventrally, right side of genital somite with a triangular process followed immediately by a rounded outgrowth in distal half and a lobular outgrowth at distal end (Figs. 6-d, f). Left side with a rounded outgrowth close to proximal end. Both genital flanges similar in shape and each in lateral view semicircular with bilobed top (Figs. 6-c, e).

Cephalosomal appendages as in *E. marina* except that all terminal setae of 4 proximal lobes of Mx2 (Fig. 6-g) armed with long spinules in addition to rows of fine spinules as in *E. marinella.* Swimming legs also similar to those of *E. marina* except that outer spine of proximal, compound segment of P1 exopod (Fig. 6-h) short of reaching halfway to base of following outer spine. In P2 exopod (Fig. 6-i), 2nd outer spine of 3rd segment distinctly shorter than outer spine of 2nd segment.

Description of male. Prosome length, 1.72-1.84 mm; body length, 2.32-2.56 mm. Similar in habitus (Fig. 6-j) to *E. marina.* Cephalosomal appendages and 4 pairs of swimming legs (Figs. 6-k, l) practically identical to those of *E. marina* except that outer spines of 3rd exopodal segment of P2 are more evenly spaced than in *E. marina.* Fifth pair of legs (Figs. 6-m, n) also similar to that of *E. marina* but can easily be distinguished from it, as in the other members of the species group, by

structure of serrated lamella, which is bilobed distally, with double rows of teeth bordering the lobes.

Distribution. This species, originally described from the Maldive and Laccadive archipelagoes, was demonstrated by Bradford (1974) to be a senior synonym of *E. wolfendeni*, a well-known epipelagic species recorded widely in the tropical and subtropical waters of the western Pacific and Indian oceans (Sewell 1947, Tanaka 1973). In a study on the calanoids from equatorial waters of the Pacific, Grice (1962) found the species only west of 138°W. In the present study it was found throughout the tropical waters of the Pacific from the American coast, to the Malay Archipelago, and to the eastern Indian Ocean. In the western Pacific, it was found as far north as 30°N off southern Japan.

CONCINNA SPECIES GROUP

Diagnosis. First inner lobe of Mx1 with 1 or 2 proximal marginal setae (Fig. 7-g). Only 1 endopodal seta of Mx2 armed with long spinules in addition to rows of small spinules (Fig. 7-h). Third exopodal segment of male left P5 without a poorly sclerotized lobe next to tufts of stiff hairs (Fig. 8-g). In all other features, this species group as in the *marina* species group.

Composition. Euchaeta concinna Dana 1849, *E. paraconcinna* Fleminger 1957, *E. longicornis* Giesbrecht 1888, and *E. plana* Mori 1937.

Key to species of *concinna* species group
(based on females)

1a. Dorsally, genital somite nearly symmetrical (Fig.11-d) ..... *E. plana*

1b. Dorsally, genital somite asymmetrical with conspicuous outgrowth on right side 2

2a. Dorsally, genital somite with winglike outgrowth on right side (Fig.10-d) ..... *E. longicornis*

2b. Dorsally, genital somite with toothlike outgrowth on right side (Figs.7-d, 9-d) 3

3a. Dorsally, genital somite with left side smoothly bulging (Fig.9-d) ..... *E. paraconcinna*

3b. Dorsally, genital somite with conspicuous notch on left side (Fig.7-d) ..... *E. concinna*

Euchaeta concinna Dana 1849
Figures 7 and 8

Euchaeta concinna Dana 1849, p. 21.

- Giesbrecht 1892, p. 246, pl. 15, fig. 32; pl. 16, Figs. 19, 40; pl. 37, Figs. 51, 53.
- Scott 1909, p. 65, pl. 19, Figs. 21-27.
- Farran 1936, p. 30, fig. 6.
- Mori 1937, p. 45, pl. 20, Figs. 1-5.
- Grice 1962, p. 201, pl. 14, Figs. 1-13.
- Tanaka and Omori 1968, p. 220.
- Tanaka 1973, p. 132. fig. 2.

Euchaeta consimilis Farran 1936, p. 90, fig. 6.

Description of female. Prosome length, 2.06-2.22 mm; body length, 2.10-2.52 mm.

Laterally, dorsal margin of forehead only slightly arched (Fig. 7-a). Frontal eminence large and conical. Rostrum small, strongly curved backward. Dorsally, posterolateral corners of prosome angular, asymmetrical, left side being much longer (Fig. 7-d). Laterally, left distal margin of prosome produced into lappet pointing in a dorsodistal direction (Figs. 7-b, c).

Dorsally as well as ventrally (Figs. 7-d, f), genital somite strongly asymmetrical, with a large toothlike outgrowth midway along right side and a conspicuous notch on left side about 2/5 length of somite from proximal end. The large toothlike outgrowth of the right side produced ventrally to form right genital flange. Posterior edge of genital field is defined by a structure appearing in lateral view (Fig. 7-e) like a conical process and in ventral view (Fig. 7-f) like a ridge on the right side. Left genital flange in lateral view (Fig. 7-c) appearing like a large arc followed by a small rounded ridge and in ventral view (Fig. 7-f) like an ear-shaped structure. Central ridge of genital operculum visible in lateral view (Fig. 7-e), developed as a toothlike process pointing backward. Appendicular and marginal setae of caudal ramus as in *E. marina* female.

Antennule extending beyond distal end of prosome by its last 3 segments. In morphological details, A1, A2, Md, and Mxp show no significant differences from those of *E. marina* female. Maxillule and Mx2 similar to those of *E. marina* female except that 1st inner lobe of Mx1 (Fig. 7-g) with 1+8+1 setae, instead of 1+9+1, and only 1 endopodal seta of Mx2 (Fig. 7-h) armed with long spinules in addition to very small spinules.

Swimming legs 1 (Fig. 7-i), 3, and 4 also similar to those of *E. marina* female. In P2 exopod (Fig. 7-j), however, outer spine of 2nd segment large, overreaching following outer spine. Marginal lobe bearing outer spine of 2nd segment also large, separated from segment by a deep incision. All other outer spines of similarly small size.

Description of male. Prosome length, 1.68 mm; body length, 2.30 mm. Laterally, dorsal margin of forehead only slightly arched (Fig. 8-a). Frontal eminence conical, highly pronounced. Margin of forehead anterior to frontal eminence straight, continuing as anterior margin of rostrum. Rostrum relatively short, pointing straight downward. Posterolateral corners of prosome in dorsal view more or less angular and symmetrical, in lateral view (Fig. 8-b) produced into a rounded lappet. A large toothlike process on posterodorsal margin of prosome. Appendicular and marginal setae of caudal ramus as in *E. marina* male.

Antennule extending beyond distal end of prosome by its last 2 or 3 segments. In morphological details, all cephalosomal appendages and 4 pairs of swimming legs (Figs. 8-c, d) similar to those of *E. marina* male.

Second exopodal segment of left P5 (Figs. 8-e-h) with a poorly sclerotized lobe on medial distal margin right next to digitiform process. Hairy tubercle of 3rd exopodal segment also with a poorly sclerotized lobe. Digitiform process spiniform, reaching about 3/5 way to tufts of stiff hairs. Serrated lamella elongate, hollow, with uniformly small teeth on medial and lateral margins and long teeth on distal margin (Figs. 8-i-k), and extending slightly beyond tufts of stiff hairs on 3rd exopodal segment.

Remarks. The female of this species is diagnosed by a genital somite that is strongly asymmetrical and in that only 1 endopodal seta of the maxilla is armed with long spinules. The male is distinguished from that of *E. marina* by the absence of a poorly sclerotized lobe next to the tufts of stiff hairs on the 3rd exopodal segment of the left P5. The digitiform process and serrated lamella are basically similar to those of the *E. marina* male but the distal end of the serrated lamella is very characteristic.

The cephalosomal appendages and swimming legs are practically identical in all 4 species of the group except that Mx1 has 1+8+1 setae on the 1st inner lobe in *E. concinna, E. paraconcinna*, and *E. longicornis*, but 1+9+1 setae in *E. plana*. However, the species are easily distinguished by characteristics of the genital somite in the female and those of the serrated lamella of the left P5 in the male.

Distribution. This species was first described from the tropical Pacific and has since been

found, often in large numbers, in the Malay Archipelago (Scott 1909), the Indian Ocean, the Bay of Bengal, the Arabian Sea (Wolfenden 1905; Sewell 1929, 1947; Tanaka 1973), the Great Barrier Reef (Farran 1936), off the Pacific coast of central Japan (Tanaka 1958), and the western equatorial Pacific (Grice 1962). In the present study it was found in the Malay Archipelago.

Euchaeta paraconcinna Fleminger 1957
Figure 9

Euchaeta paraconcinna Fleminger 1957, p. 358, pl. 2, Figs. 1-16.

- Vervoort 1963, p. 163.
- Park 1975, p. 6, fig. 3.

Euchaeta gladiofera Gaudy 1963, p. 9, pls. 1, 2

Description of female. Prosome length, 1.82-1.96 mm; body length, 2.38-2.56 mm. Similar in habitus to *E. concinna* but can be distinguished from it by the following features: Rostrum only slightly curved backward (Fig. 9-a). Distal end of prosome on each side broadly rounded in both dorsal and lateral view (Figs. 9-b-d). Dorsally as well ventrally, genital somite (Figs. 9-d, f) asymmetrical with smoothly curved left side and a toothlike process in distal half of right side. Viewed from left side (Fig. 9-c), genital prominence with a rounded tubercle at its anterior base and its posterior side perpendicular to ventral wall of somite. Left genital flange is so low that genital operculum is fully exposed. Viewed from right side (Fig. 9-e), genital somite with a toothlike process at middle, which is visible in dorsal view (Fig. 9-d); right genital flange relatively large, followed by a tubercle on genital prominence and another on ventral wall of somite. Cephalosomal appendages and swimming legs (Figs. 9-g, h) almost identical to those of *E. concinna.*

Description of male. Prosome length, 1.74-1.88 mm; body length, 2.36-2.60 mm. Very similar in habitus to *E. concinna* except that rostrum a little larger and slightly curved backward (Fig. 9-i). Cephalosomal appendages and 4 pairs of swimming legs also very similar to those of *E. concinna.* In left P5 exopod (Figs. 9-j, k), serrated lamella with fine teeth along entire length of medial margin and distal half of lateral margin; its distal margin with relatively large teeth in lateral portion and fine teeth in medial portion, these 2 portions are separated from each other by a gap (Fig. 9-l). Digitiform process less than 1/3 length of serrated lamella.

Distribution. This species was originally described from specimens obtained in the Gulf of Mexico and Onslow Bay, North Carolina, and has subsequently been recorded from the Gulf of Guinea along the coast from Sierra Leone to Angola (Vervoort 1963) and the Caribbean Sea (Park 1975). *Euchaeta gladiofera* Gaudy 1963, described from off Dakar is here considered a junior synonym. In the present study, specimens from the Gulf of Mexico were examined for additional morphological details.

Euchaeta longicornis Giesbrecht 1888
Figure 10

Euchaeta longicornis Giesbrecht 1888, p. 337; 1892, p. 246, pl. 16, Figs. 35, 37; pl. 37, Figs. 45, 46.

- Grice 1962, p. 203, p. 14, Figs. 14-20.
- Tanaka and Omori 1968, p. 220.
- Tanaka 1973, p. 133, fig. 3.

Description of female. Prosome length, 1.84-2.24 mm; body length, 2.72-3.32 mm. Laterally, forehead (Fig. 10-a) with high frontal eminence and long, slender rostrum, slightly curved backward and pointing downward. In both lateral and dorsal view, distal end of prosome on each side broadly rounded (Figs. 10-b-d). Dorsally and ventrally, genital somite (Figs. 10-d, f) strongly asymmetrical with a broad swelling on proximal half of left side and a large winglike outgrowth on distal half of right side. Lateral side of this winglike outgrowth bearing a small digitiform process. Genital flanges also strongly asymmetrical, right flange much larger than left. Cephalosomal appendages and swimming legs (Figs. 10-g, h) closely resembling those of *E concinna.*

Description of male. Prosome length, 1.80-2.04 mm; body length, 2.52-2.88 mm. Similar in habitus (Figs. 10-i, j) and details of cephalosomal appendages and 4 pairs of swimming legs to *E. concinna* except that rostrum larger and slightly curved backward. Fifth pair of legs also similar to that of *E. concinna* but different from it in the following respects: First exopodal segment of right leg with 2 patches of small teeth (Fig. 10-k), instead of a long band of such teeth, on inner margin. Digitiform process of left leg exopod (Figs. 10-l-o) sharply pointed and far short of reaching middle of serrated lamella. Poorly sclerotized lobe next to digitiform process much better developed. Medially as well as laterally, serrated lamella strongly curved toward 3rd exopodal segment and with a conspicuous notch on distal margin (Fig. 10-p), by which serration is interrupted. Teeth of uniformly small size along entire length of margin.

Distribution. This species was first described from off the west coast of South America between 3°N and 6°N and has since been recorded from the equatorial Pacific between 120°W and 138°W (Grice 1962), the Malay Archipelago (Scott 1909), off New Zealand (Farran 1929), the Great Barrier Reef (Farran 1936), the East China Sea (Mori 1937), the Izu region of Japan (Tanaka 1958), and the Indian Ocean (Tanaka 1973). In the present study it was found, often in large numbers, off the west coast of America between 16°N and 12°S and off the Philippines and Japan between 4°N and 35°N.

Euchaeta plana Mori 1937
Figure 11

Euchaeta plana Mori 1937, p. 46, pl. 21, Figs. 1-8.

- Tanaka 1958, p. 329, fig. 62.
- Tanaka and Omori 1968, p. 221, Figs. 1, 2.

Euchaeta murrayi Sewell 1947, p. 117, text fig. 26.

Description of female. Prosome length, 2.12-2.32 mm; body length, 3.10-3.30 mm. Laterally, dorsal margin of forehead only slightly arched (Fig. 11-a). Frontal eminence highly pronounced, conical. Rostrum elongate, slightly curved backward pointing in an anteroventral direction. Dorsally as well as laterally (Figs. 11-b-d), distal end of each side of prosome broadly rounded, and both sides symmetrical.

Dorsally, genital somite asymmetrical (Fig. 11-d), with a rounded swelling just anterior to middle on left side and with a low angular ridge at middle of right side. Ventrally, genital field (Fig. 11-f) strongly asymmetrical with 2 genital flanges appearing very different from each other and right side of genital field deeply emarginate. When the somite is tilted counterclockwise (Fig. 10-g), however, 2 genital flanges look quite similar. Laterally, 2 genital flanges (Figs. 11-c, e) also appear similar with rounded margin. Genital prominence very characteristic with a long, gradually sloping anterior margin and a short posterior margin which is perpendicular to ventral wall of somite.

All cephalosomal appendages similar to those of *E. concinna* except that 1st inner lobe of Mx1 with 1+9+1 setae as in *E. marina.* Swimming legs (Figs. 11-h, i) also similar to those of *E. concinna.* Second outer spine of P2 exopod, however, short of reaching distal end of following outer spine.

Description of male. Prosome length, 2.12-2.28 mm; body length, 2.84-3.16 mm. Laterally, dorsal margin of forehead only slightly arched (Fig. 11-j). Frontal eminence conical, highly pronounced. Rostrum elongated, pointing downward and only slightly curved backward. Posterolateral corners of prosome in dorsal view more or less angular and symmetrical, in lateral view produced into a rounded lappet (Fig. 11-k). A large toothlike process on posterodorsal margin of prosome.

In morphological details, all cephalosomal appendages and 4 pairs of swimming legs similar to those of *E. concinna* male. Fifth pair of legs (Figs. 11-l-n) also similar to that of *E. concinna*

except that serrated lamella of left leg exopod in anterior view extending straight distad, with distal end tapering along its medial margin into a spiniform process. Serration along medial margin of lamella with teeth of relatively uniform size extending up to distal end (Fig. 11-m). Serration along lateral margin, however, not extending over distal spiniform process and its teeth increasing in size toward distal end.

Remarks. This species differs from the other species in the group in the setation of the 1st inner lobe of Mx1; namely, the lobe has 1+9+1 setae in this species as in *E. marina*, while it has 1+8+1 setae in the others. Otherwise this species shares the basic morphological features of the other members of the group.

Distribution. This species was originally described from the East China Sea and has since been recorded from the Izu region of Japan (Tanaka 1958) and the Arabian Sea (Tanaka 1973). *Euchaeta murrayi* Sewell 1947, described from the Arabian Sea and the Gulf of Oman, was considered by Tanaka and Omori (1968) to be a junior synonym of *E. plana.* In the present study *E. plana* was found in the Malay Archipelago and off southern and central Japan between 3°N and 35°N.

ACUTA SPECIES GROUP

Diagnosis. Maxillule with 1 anterior, 9 marginal, and 1 posterior seta on 1st inner lobe and a single seta on 1st endopodal segment. Only 1 endopodal seta of Mx2 armed with long spinules in addition to rows of fine spinules (Fig. 12-h). Basis of Mxp without long spinules along medial margin (Fig. 12-i). In male left P5, basis greatly enlarged (Fig. 12-n); exopod without poorly sclerotized lobes; serrated lamella of exopod far short of reaching tufts of stiff hairs (Fig. 12-p).

Composition. Euchaeta acuta Giesbrecht 1892, *E. paracuta* Tanaka 1973, *E. media* Giesbrecht 1888, *E. magniloba* Park 1978, *E. tenuis* Esterly 1906, and *E. pubera* Sars 1907. *Euchaeta wrighti* Park 1968, whose male still remains unknown, probably belongs either to this species group or the *concinna* species group.

Remarks. As in the other species groups of *Euchaeta*, the genital somite of the female in this group shows highly pronounced interspecies variation making species identification relatively easy. The serrated lamella of the male left P5 is also highly variable from species to species. In the other species groups, this structure, though useful for species identification, exhibits relatively minor differences.

Euchaeta pubera is distinct from the other species of the group by the presence in both the female and the male of fine hairs that densely cover the entire body surface, by the absence in both the female and the male of the posterior seta close to the proximal end of the Mxp coxa, and by the form of the female genital somite which is more symmetrical than in the others.

Key to species of *acuta* species group
(based on females)

1a. Dorsally, genital somite nearly symmetrical 2
1b. Dorsally, genital somite asymmetrical 4

2a. Laterally, rostrum triangular with wide base (Fig.17-a); right genital flange tapering into curved spiniform process (Fig.17-e) ..... *E. pubera*
2b. Laterally, rostrum slender (Figs.14-a, 15-a); genital flange not spiniform 3

3a. Right genital flange much larger than left (Fig.15-c) ..... *E. tenuis*
3b. Genital flanges similar in size (Figs.14-c, e) ..... *E. magniloba*

4a. Dorsally, genital somite with steplike notch on right side (Fig.13-d). ..... *E. media*

4b. Dorsally, genital somite without notch on right side (Fig.12-d)..... *E. acuta*

Euchaeta acuta Giesbrecht 1892
Figure 12

Euchaeta acuta Giesbrecht 1892, p. 246, pl. 16, Figs. 6, 10, 14, 18, 21, 27, 39; pl. 37, Figs. 47, 48, 52.

- Scott 1909, p. 65, pl. 20, Figs. 1-9.
- With 1915, p. 187, pl. 6, fig. 12; text fig. 56.
- Sars 1925, p. 108, pl. 30, Figs. 12-15.
- Park 1978, p. 208, Figs. 69-70.

Description of female. Prosome length, 2.44-2.84 mm; body length, 3.60-4.28 mm. Body relatively slender. Laterally, dorsal margin of forehead (Fig. 12-a) only slightly arched. Frontal eminence pronounced but not acutely projecting forward. Rostrum large, pointing straight in an anteroventral direction. Posterolateral corners of prosome symmetrical, broadly rounded dorsally as well as laterally (Figs. 12-b-d).

Dorsally, genital somite asymmetrical with conspicuous conical protuberance proximally on left side and more convex margin on right side (Fig. 12-d). Ventrally, genital field asymmetrical with dissimilar genital flanges (Fig. 12-f). Genital prominence arising from anterior half of somite and, in lateral view, pointing in an anteroventral direction, with genital field facing in the same direction. Laterally, right genital flange produced at middle into a pointed process followed by a rounded outgrowth (Fig. 12-e). Left genital flange produced along its posterior margin into a large triangular lobe (Fig. 12-c). Appendicular and marginal setae of caudal ramus as in *E. marina* female.

Antennule extending beyond distal end of prosome by its last 2 segments. In anatomical features, A1, A2, Md, and Mx1 as in *E. marina* female except that 5 setae on Mx1 outer lobe are similar in length and an additional, very small seta is present distally on the same lobe (Fig. 12-g). Maxilla (Fig. 12-h) with 1 of endopodal setae armed with long spinules as in *E. concinna.* Maxilliped different from *E. marina* and *E. concinna* in the absence of long spinules along proximal half of medial margin of basis (Fig. 12-i).

Proximal, compound segment of P1 exopod with sigmoid outer margin and its outer spine reaching base of following outer spine (Fig. 12-j). In P2 exopod, 2nd outer spine reaching middle of following outer spine (Fig. 12-k). Fourth outer spine reaching close to base of following outer spine. First, 3rd, and 5th outer spines of equally small size. Marginal lobe bearing 4th outer spine separated from segment by relatively deep incision.

Description of male. Prosome length, 2.44-2.88 mm; body length, 3.36-4.08 mm. Body slender. Laterally, forehead (Fig. 12-l) similar to that of female, but its frontal eminence much less pronounced and rostrum pointing more downward. Last somite of prosome in dorsal view produced distally on each side into blunt and symmetrical lappet, in lateral view broadly rounded with inconspicuous toothlike process on dorsal side (Fig. 12-m). Appendicular and marginal setae of caudal ramus as in *E. marina* male.

Antennule extending beyond distal end of prosome by its last 2 segments. In morphological details, all cephalosomal appendages and first 4 pairs of swimming legs similar to those of *E. marina* male.

Anteriorly, 1st exopodal segment of right P5 (Fig. 12-n) with conspicuous toothlike process about 2/3 length of segment from proximal end. Basis of left P5 large and swollen, with pointed process midway along inner margin. Serrated lamella of 2nd exopodal segment in form of cordate leaf with uniformly serrated margin (Fig. 12-o). Digitiform process appearing linguiform with bluntly pointed distal end when viewed anteriorly; in medial view, however, it appears vermiform with rather irregular margin (Fig. 12-p).

Remarks. In the morphological features of the female appendages, this species differs from *E. marina* and *E. concinna* by the absence of long spinules on the proximal half of the medial margin of the Mxp basis; from *E. marina* by the presence of long spinules on only 1 of the endopodal setae of Mx2; and from *E. concinna* by the presence of 1+9+1 setae on the 1st inner lobe of Mx1. The male of this species differs from the *E. marina* and *E. concinna* males by the absence of poorly sclerotized lobes on the mediodistal margin of the 2nd exopodal segment, on the hairy tubercle, and next to the tufts of stiff hairs on the 3rd exopodal segment of the left P5.

Distribution. This species is known to be distributed in the tropical, subtropical, and temperate zones of the whole world's oceans (Park 1978). In the present study, specimens from the northeastern Atlantic, the eastern tropical Pacific, and the western Indian Ocean have been examined for purposes of comparison and no significant morphological variations were found.

Euchaeta paracuta Tanaka 1973

Euchaeta paracuta Tanaka 1973, p. 136, Figs. 5, 6.

This species was originally described from 2 females and 1 male collected from south of 30°S in the southeastern Indian Ocean and was said to be very closely allied with *E. acuta.* However, no specimens referable to this species were found in the present study.

Euchaeta media Giesbrecht 1888

Figure 13

Euchaeta media Giesbrecht 1888, p. 337; 1892, p. 246, pl. 16, Figs. 13, 36; pl. 37, Figs. 39, 40.

-Park 1975, p. 5, fig. 2; 1978, p. 207, Figs. 67, 68.

Euchaeta diegensis Esterly 1911, p. 323, pl 28, fig. 37; pl. 29, Figs. 49, 55; pl. 31, fig. 92.

Euchaeta acuta var. *pacifica* Esterly 1911, p. 324, pl. 32, fig. 115.

Description of female. Prosome length, 2.48-3.00 mm; body length, 3.64-4.58 mm. Close in habitus (Figs. 13-a, b) to *E. acuta* but can be readily distinguished from it and any other species in the group by the genital somite (Figs. 13-c-f) which in dorsal view has a large rounded swelling proximally on the left side and a steplike notch distally on the right side. In morphological features of the cephalosomal appendages and swimming legs, this species differs from *E. acuta* only by the presence of 7 setae, instead of 5, on the outer lobe of Mx1 (Fig. 13-g).

Description of male. Prosome length, 2.48-2.68 mm; body length, 3.56-3.88 mm. Similar in habitus (Fig. 13-h) and details of cephalosomal appendages and swimming legs to *E. acuta* but can be distinguished from it by serrated lamella of left P5 (Figs. 13-i, j), which is bilobed.

Remarks. The female Esterly (1911) described as a new species, *E. diegensis*, from off San Diego, California, was found, upon reexamination of the original specimen, to be in full agreement with the specimens of *E. media* found in the same area during the present study. The characteristics Esterly regarded as diagnostic of his new species were all found to be well within the normal range of variation in the species. The male Esterly (1911) described as *Euchaeta acuta* var. *pacifica* seems to be the male of *E. media* according to the serrated lamella of the left P5 he described and figured twice (Esterly 1905, p. 157, fig. 23, as *E. acuta* and Esterly 1911, p. 324, fig. 115, as *E. acuta* var. *pacifica*). His original specimen is no longer available.

Distribution. This species is known to occur widely throughout the tropical, subtropical, and temperate zones of the world's oceans (Park 1978). Specimens from a number of different locations in all three great oceans have been examined in this study for purposes of comparison and no significant geographical variations were found in their morphology.

Euchaeta magniloba Park 1978
Figure 14

Euchaeta magniloba Park 1978, p. 215, fig. 73.

Description of female. Prosome length, 2.20-2.44 mm; body length, 3.24-3.64 mm. Similar in habitus (Figs. 14-a, b) to *E. acuta*, but rostrum in lateral view longer and curved backward, left genital flange (Fig. 14-c) less pointed, right genital flange (Fig. 14-e) more elongated, genital somite in both dorsal and ventral view (Fig. 14-d) more or less symmetrical. All cephalosomal appendages similar to those of *E. acuta* except for the following features: Last exopodal segment of A2 (Fig. 14-f) without an inner marginal seta; outer lobe of Mx1 (Fig. 14-g) with 6 setae, the most distal of which is much shorter than the others.

Male unknown.

Distribution. This species was first described from a female collected at 33°S, 84°W in the southeastern Pacific. In the present study it is represented by 3 females taken, respectively, at 3°N, 81°W in the eastern tropical Pacific, at 10°N, 150°W and at 15°N, 160°W in the central Pacific.

Euchaeta tenuis Esterly 1906
Figures 15 and 16

Euchaeta tenuis Esterly 1906, p. 61, pl. 9, fig. 12; pl. 10, Figs. 29, 31.

- Scott 1909, p. 68, pl. 19, Figs. 1-8.
- Sewell 1929, p. 149, fig. 58; 1947, p. 117.
- Grice 1962, p. 201, pl. 13, Figs. 15-20.
- Tanaka 1973, p. 138, fig. 8.

Euchaeta solida Esterly 1911, p. 324, pl. 26, fig. 2; pl. 28, fig. 34; pl. 30, fig. 78.

Description of female (from the eastern Pacific). Prosome length, 3.7-4.2 mm; body length, 5.3-6.1 mm. Laterally, forehead with large frontal eminence (Fig. 15-a). Rostrum large, pointing nearly downward; its anterior margin beginning some distance from suprafrontal sensilla. Urosome elongated (Fig. 15-b). Distal margin of prosome on each side broadly rounded in both dorsal and lateral view. Laterally, dorsal wall of genital somite (Figs. 15-c, d) broadly convex with rather uneven outline. Genital prominence somewhat cylindrical with its posterior margin nearly perpendicular to ventral wall of somite. Genital flanges strongly asymmetrical, right one much larger than left. Genital field posterior to genital opening forming a large outgrowth, of which the right side is fully covered by right genital flange while the left side is only partially covered by left flange. Dorsally, genital somite about symmetrical. Ventrally, genital field asymmetrical with dissimilar genital flanges (Fig, 15-e).

Cephalosomal appendages as in *E. acuta* except that outer lobe of Mx1 (Fig. 15-f) with 8 setae. Swimming legs (Figs. 15-g, h) resembling closely those of *E. acuta* but in P2 exopod, outer spine of 2nd segment reaching distal end of following outer spine and longer than 2nd outer spine of 3rd segment by 1/3 its length.

Description of male (from off the west coast of South America). Prosome length, 3.40-3.70 mm; body length, 4.68-5.10 mm. Similar in habitus to *E. acuta* but forehead (Fig. 16-a) in lateral view with low frontal eminence; its anterior margin nearly perpendicular to long axis of body. Distance between suprafrontal sensilla and ventral wall of forehead at base of rostrum much greater than in *E. acuta.*

Cephalosomal appendages and 4 pairs of swimming legs (Figs. 16-b, c) similar to those of *E. acuta.* Fifth pair of legs also similar to that of *E. acuta* but serrated lamella of 2nd exopodal segment of left P5 (Figs. 16-d-f) sigmoid and distally enlarged into a large rounded plate armed around its circumference with triangular teeth of relatively uniform size. Digitiform process sigmoidally elongated and pointed distally along its medial margin.

Remarks. This species was first described from off San Diego, California. All specimens

from the eastern Pacific that were examined in the present study agree with the original species descriptions and figures by Esterly (1906, 1911). However, the species displays geographical variation in the form of the female genital somite toward the western Pacific and Indian oceans, that is, in lateral view the direction of the genital prominence is gradually turned backward and the length of the genital somite relative to its depth (including the genital prominence) decreases in specimens from more westward locations (Figs. 15-i, j). Other morphological features show no detectable variation.

Distribution. This species has been recorded from off the San Diego region of California (Esterly 1906), the equatorial Pacific (Grice 1962), the Malay Archipelago (Scott 1909), the Bay of Bengal and Arabian Sea (Sewell 1929, 1947; Tanaka 1973). In the present study it was found along the west coast of America between 29°N and 24°S, in equatorial waters of the whole Pacific between 0° and 11°S, the western Pacific including the Malay Archipelago, the East and South China seas, and waters off Japan between 35°N and 14°S, and the Indian Ocean between 5°N and 21°S.

Euchaeta pubera Sars 1907
Figure 17

Euchaeta pubera Sars 1907, p. 13; 1925, p. 109, pl. 30, Figs. 16-18.

- Tanaka 1958, p. 330, fig. 63; 1973, p. 137, fig. 7.
- Vervoort 1963, p. 166.
- Park 1975, p. 7, fig. 4.

Description of female. Prosome length, 3.0-3.2 mm; body length, 3.9-4.2 mm. Entire body surface covered with fine hairs. Laterally, forehead (Fig. 17-a) with well-defined frontal eminence. Rostrum thick with wide base, pointing parallel to anterior dorsal margin of forehead. Urosome robust (Fig. 17-b). Distal end of prosome broadly rounded. Genital somite (Figs. 17-c-e) including prominence as long as deep, and nearly symmetrical in dorsal view. Genital flanges single-lobed, asymmetrical with right one tapering into a clawlike process; genital somite otherwise symmetrical in both dorsal and ventral view. Setation of caudal ramus (Fig. 17-f) as in *E. marina* but appendicular caudal setae slightly diverging from each other.

Cephalosomal appendages including Mx1 resembling closely those of *E. acuta* except that long spinules on 1 endopodal seta of Mx2 better developed (Fig. 17-g), and coxa of Mxp without proximal posterior seta (Fig. 17-h). Swimming legs also similar to those of *E. acuta* except that outer margin of proximal, compound segment of P1 (Fig. 17-i) more strongly sigmoid and 2nd outer spine of 3rd exopodal segment of P2 (Fig. 17-j) reaching only halfway to base of following outer spine.

Description of male. Prosome length, 2.24-2.60 mm; body length, 2.86-3.48 mm. Similar in habitus to *E. acuta* but entire body surface covered with fine hairs as in the female and rostrum (Fig. 17-k) in lateral view thicker with wider base, pointing nearly parallel to anterior dorsal margin of forehead. Cephalosomal appendages and 4 pairs of swimming legs all similar to those of *E. acuta* except that coxa of Mxp lacking a proximal posterior seta as in the female. Serrated lamella of left P5 exopod (Figs. 17-l-n) elongated, nearly triangular, but far short of reaching tufts of stiff hairs, with small teeth along most of medial margin and only middle portion of lateral margin. Digitiform process sigmoidally curved, tapering into sharp spiniform process far short of reaching distal end of serrated lamella.

Remarks. The male found in the present study is in full agreement with the descriptions and figures I have previously given (Park 1975). It is distinct from the males of the other known species of the genus by the thick rostrum pointing more anteriorly and by the serrated lamella and digitiform process of the left P5, both of which terminate in a sharp point.

Distribution. This species has been found widely and usually in small numbers in the

tropical, subtropical, and temperate regions of the world's oceans. In the Atlantic it occurs from 37°N southward to the Gulf of Guinea (Vervoort 1963), including the Gulf of Mexico and Caribbean Sea (Park 1975). In the Pacific and Indian oceans, it has been recorded from the central North Pacific (Park 1968), off New Zealand down to 34°S (Farran 1929), off central Japan (Tanaka 1958), and the southern Indian Ocean south of 20°S (Tanaka 1973). In the present study it was found off Delaware in the western North Atlantic, at 25°S, 155°W in the central South Pacific, and at 25°S, 165°E in the western South Pacific.

Euchaeta wrighti Park 1968

Euchaeta wrighti Park 1968, p. 552, pl. 7, Figs. 23-26; pl. 8, Figs. 1-3.

This species was originally described from a single female specimen 2.73 mm long collected from 30°N, 155°W in the central North Pacific. It can be readily recognized by its genital somite, the prominence of which is located close to the proximal end of the somite, unlike any other known species in the genus. According to the appendicular caudal setae, Mx1, Mx2, P1, and P2 that have been described and illustrated, *E. wrighti* seems to belong to either the *concinna* or *acuta* species group, but its definitive taxonomic settlement must wait until further morphological information of the species including the male becomes available. The unique original specimen is no longer available.

EUCHAETA SPINOSA GIESBRECHT 1892

Figure 18

Euchaeta spinosa Giesbrecht 1892, p. 246, pl. 16, Figs. 12, 26, 34, 47; pl. 37, Figs. 31, 34, 35, 50.

- Sars 1925, p. 104, pl. 30, Figs. 1-6.
- Tanaka 1958, p. 332, fig. 64.
- Grice 1962, p. 203, pl. 14, Figs. 21-23.
- Park 1975, p. 8, fig. 5; 1978, p. 213, Figs. 71-72.

Diagnosis. Maxillule with 1 anterior, 9 marginal, and 2 posterior setae on 1st inner lobe and 4 setae on 1st endopodal segment (Fig. 18-g). One endopodal seta of Mx2 armed with long spinules in addition to rows of fine spinules. Basis of Mxp without long spinules on medial margin. In male left P5 (Figs. 18-l-n), basis greatly enlarged; exopod without poorly sclerotized lobes; serrated lamella short of reaching tufts of stiff hairs; 3rd exopodal segment terminated with a short spine

Additional description of female. Prosome length, 4.60-5.20 mm; body length, 6.20-7.00 mm. Body slender. Laterally, dorsal margin of forehead (Fig. 18-a) nearly straight. Frontal eminence pronounced but not conspicuously projecting forward. Rostrum very elongate, only slightly curved backward, pointing in an anteroventral direction. Urosome somewhat robust (Fig. 18-b). Posterolateral corners of prosome symmetrical, broadly rounded in both dorsal and lateral view.

Dorsally, genital somite (Fig. 18-d) nearly symmetrical with marked swelling at middle. Ventrally, genital somite (Fig. 18-f) strongly asymmetrical with genital field projecting far beyond left side of somite. Laterally, both genital flanges (Figs. 18-c, e) appearing similar in shape, but left one a little larger than and slightly posterior in position to right.

Appendicular and marginal setae of caudal ramus as in *E. marina.* Antennule extending beyond distal end of caudal ramus by its last 2 segments. In morphological features, A1, A2, and Md similar to those of *E. marina* female. Outer lobe of Mx1 (Fig. 18-g) with 9 setae, of which 2 proximal setae are smaller than 6 long distal setae and a seta between the proximal and distal groups of setae is very small. First endopodal segment of Mx1 often appearing 2-segmented, 3 proximal setae belonging to 1st segment and the 4th seta to 2nd. One endopodal seta of Mx2 armed

with long spinules in addition to rows of very short spinules and basis of Mxp with a row of only small spinules along proximal part of medial margin as in *E. acuta* female.

Proximal, compound segment of P1 exopod (Fig. 18-h) with sigmoid outer margin and its outer spine pointing straight backward reaching nearly halfway to base of following outer spine. In P2 exopod (Fig. 18-i), 4th outer spine extraordinarily long extending beyond base of following outer spine. Marginal lobe bearing 4th outer spine separated from segment by a deep incision. Second outer spine extending beyond distal end of following outer spine by 1/4 its length.

Additional description of male. Prosome length, 4.40-4.90 mm; body length, 5.80-6.60 mm. Body slender. Laterally, forehead (Fig. 18-j) with slightly arched dorsal margin. Frontal eminence low. Rostrum very elongate, pointing downward, with distal end curved slightly backward. Dorsally, posterolateral corners of prosome symmetrically angular. Laterally, prosome prolonged posteriorly into lappet of somewhat triangular form, with its distal margin rounded and its dorsal margin bearing low toothlike process (Fig. 18-k). Appendicular and marginal setae of caudal ramus as in *E. marina* male.

Antennule reaching distal end of 4th urosomal somite when pressed against body. In morphological features, all cephalosomal appendages and 4 pairs of swimming legs similar to those of *E. marina* male.

First exopodal segment of right P5 (Fig. 18-l) in anterior view with small toothlike process a little posterior to middle of segment. Basis of left P5 markedly enlarged, with pointed process a little anterior to middle of inner margin. Serrated lamella of 2nd exopodal segment (Fig. 18-m) spoon-shaped; teeth bordering its margin increase in size toward distal end. Medially, digitiform process (Fig. 18-n) linguiform, its distal 3rd tapering into blunt end, far short of reaching distal end of serrated lamella. Third exopodal segment hollow medially, tapering distally into a relatively short spiniform process, and about as long as 2nd exopodal segment including serrated lamella.

Remarks. This species is clearly distinct from all the other species of the genus in the setation of the female Mx1, which has 1+9+2 setae on the 1st inner lobe, 4 setae on the 1st endopodal segment, and a very small seta between the 2 size-groups of long setae of the outer lobe. The male of this species differs from the others in having a relatively short terminal spine on the 3rd exopodal segment of the left P5. In other respects, however, this species is closely allied with the *acuta* species group.

Distribution. This species is known to be distributed widely in the tropical, subtropical, and temperate regions of the world's oceans. In the Atlantic its range is known to extend from 52°N down to 37°S, in the Pacific from 55°N down to 33°S, and in the Indian Ocean from the Arabian Sea to the seas east of South Africa (Vervoort 1963, Park 1978). In the present study the species occurred at numerous locations between 27°N and 36°S in the Atlantic and between 35°N and 35°S in the Pacific and Indian oceans.

GENUS *PARAEUCHAETA* SCOTT 1909

Paraeuchaeta Scott 1909. p. 69.

Type species. Paraeuchaeta norvegica (Boeck 1872)

Diagnosis. Appendicular caudal setae (Figs. 19-g, h) of female either geniculated or smoothly curved and distinctly thinner but usually longer than principal marginal setae of caudal ramus. Third exopodal segment of male left P5 (Fig. 22-g) about as long as but much thinner than 2nd, with a very small, vestigial terminal spine.

Additional description of female. Similar in habitus to *Euchaeta.* However, frontal eminence of forehead (Fig. 19-b) in lateral view usually much less produced anteriorly. Rostrum variable in size from a small conical to large spiniform process (for possible exceptions see Remarks below). Second, 3rd, and 5th marginal setae of caudal ramus (Fig. 19-g) similar in length, usually a little shorter than urosome. Fourth marginal seta more than twice length of either 3rd or 5th.

Also similar in anatomical features of appendages to *Euchaeta* except for the following respects: Basis of A2 (Fig. 19-j) with 1 or 2 inner marginal setae; 1st endopodal segment usually with a small and a large inner marginal seta; 2nd exopodal segment usually with a small inner marginal seta.

Basis of Md (Fig. 19-k) with a strong, curved seta and, in certain species, a very small additional seta. First endopodal segment usually with an inner marginal seta. Second endopodal segment in certain species with an appendicular seta in addition to 9 terminal setae. First inner lobe of Mx1 (Fig. 20-a) with 9 to 13 spiniform setae: 1 small anterior, 7 to 9 marginal, and 1 to 3 posterior setae. Second inner lobe with 0 to 2 setae. Basis with 3 to 6 setae. First endopodal segment with 2 to 7 setae. Outer lobe with 5 to 9 setae.

All endopodal setae of Mx2 (Fig. 20-b) usually furnished with dense rows of very short spinules, but in some species 1 seta is armed with long spinules in addition to very short spinules. In Mxp (Fig. 20-c), medial edge of basis armed with rows of short spinules only. First exopodal segment of P1 (Fig. 20-d) usually with a small outer spine.

Additional description of male. Similar in habitus (Fig. 21-a) to *Euchaeta* but line of fusion between cephalosome and 1st pedigerous somite usually visible; frontal eminence of forehead (Fig. 21-b) less pronounced; posterolateral corners of prosome in dorsal view usually asymmetrical, left side being a little longer; toothlike process on posterodorsal margin of prosome (Fig. 21-c) variable in size; appendicular caudal setae (Figs. 21-e, f) geniculated or smoothly curved, much smaller than distal marginal setae. Fourth marginal seta longest, about 1.5 times length of 3rd.

In morphological details, all cephalosomal appendages and 4 pairs of swimming legs similar to those of *Euchaeta* with following exceptions: Basis of A2 (Fig. 21-h) with a small and a large inner marginal seta. First endopodal segment of Md (Fig. 21-i) usually without a seta; all 9 terminal setae of 2nd endopodal segment normally developed. Basis and 1st endopodal segment of Mx1 (Fig. 21-j) each with 2 or more small setae.

Coxa of Mxp (Fig. 21-l) with a posterior seta close to proximal end, a proximal inner marginal seta, and middle and distal groups of 3 inner marginal setae each. One of the 3 marginal setae in the middle and distal groups reduced to a hairlike structure. Endopodal setae same in number as in female but poorly developed. In P1 (Fig. 22-a), 1st exopodal segment usually with a very small outer spine. Outer spine of 2nd segment usually pointing in a posteromedial direction.

Second exopodal segment of right P5 (Fig. 22-e) club-shaped, usually with a blunt distal end, and about 2/3 length of 1st. In left P5, 3rd exopodal segment (Fig. 22-g) about as long as but much narrower than 2nd, hollow, with a large hairy tubercle at proximal end, distally tapering into a blunt end tipped with a minute spine, subterminally with 2 adjoining tufts of stiff hairs on inner edge and a small spine on outer edge.

Remarks. The females of *Paraeuchaeta* are readily diagnosed by the appendicular caudal setae, which are either geniculated or smoothly curved and distinctly thinner than the distal

marginal setae of the caudal ramus. The male is characterized by the 3rd exopodal segment of the left P5, which tapers distally into a blunt end bearing a minute terminal spine, but never distally tapers into a long, strong spine.

In *Euchaeta*, on the other hand, the appendicular caudal setae of the female are greatly developed, straight, and much thicker and longer than the distal marginal setae of the caudal ramus. They appear to serve as an important balancing organ. In the male of *Euchaeta*, the distal exopodal segment in both the left and right 5th legs has a long terminal spine.

Heptner (1987) has recently described 2 new species of *Paraeuchaeta* (*P. rotundirostris* Heptner 1987 and *P. bulbirostris* Heptner 1987) from deep depths of the Kuril-Kamchatka Trench, in which the rostrum is said to be represented by a rounded, lobular structure instead of a spiniform process. Their taxonomic relationship with the other species of the genus, however, remains unsettled until more information becomes available on their morphology.

The species of *Paraeuchaeta* were found to be classifiable into 6 species groups - *malayensis, pavlovskii, norvegica, glacialis, hebes*, and *antarctica* species groups - and 3 independent species - *P. biloba, P. bisinuata*, and *P. grandiremis* that could not be grouped.

KEY TO SPECIES GROUPS AND INDEPENDENT SPECIES OF *PARAEUCHAETA* (based on females)

1a. Appendicular caudal setae geniculated 2
1b. Appendicular caudal setae smoothly curved 5

2a. Genital flange linguiform, lying along length of genital field and produced distally into a distinct posterior lob (Fig.19-d) 3
2b. Genital flange in form of a triangle or conical process and neither elongated along genital field nor produced distally into a lobe (Fig.69-c) 4

3a. First inner lobe of Mx1 with 1+9+3 setae (Fig.20-a). Supralabrum pointing obliquely forward (Fig.19-b) ..... *malayensis* species group
3b. First inner lobe of Mx1 with 1+9+2 setae (Fig.63-f). Supralabrum pointing ventrad (Fig.63-a) ..... *pavlovskii* species group

4a In Mx1, 1st inner lobe with 1+9+3 setae, 2nd inner lobe with a setae, and basis with 4 or 5 setae (Fig.69-f) ..... *norvegica* species group
4b. In Mx1, 1st inner lobe with 1+9+1 setae, 2nd inner lobe without a seta, and basis with 3 setae (Fig.77-f) ..... *P. biloba*

5a. In Mx1, 1st inner lobe with 1+7+1 setae, 2nd inner lobe without setae, and 1st endopodal segment with 2 setae ..... *P. grandiremis*
5b. In Mx1, 1st inner lobe with 1+9+2 or 1+9+3 setae, 2nd inner lobe with 1 or 2 setae, and 1st endopodal segment with 3 or more setae 6

6a. In Mx1, 2nd inner lobe with 2 setae ..... *antarctica* species group
6b. In Mx1, 2nd inner lobe with 1 seta 7

7a. In Mx1, 1st inner lobe with 1+9+2 setae and basis with 3 setae ..... *P. bisinuata*
7b. In Mx1, 1st inner lobe with 1+9+3 setae and basis with 4 or 5 setae 8

8a. In Mx2, one of endopodal setae armed with long spinules ..... *hebes* species group

8b. In Mx2, none of endopodal setae armed with long spinules ..... *glacialis* species group

MALAYENSIS SPECIES GROUP

Diagnosis. Appendicular caudal setae geniculated (Fig. 19-h). Supralabrum (Fig. 19-b) pointing obliquely forward. Genital flange (Fig. 19-d) elongated along length of genital somite in the form of a tongue, usually divided into anterior and posterior lobes. Right and left flanges more or less symmetrical. First inner lobe of Mx1 (Fig. 20-a) with 1 anterior, 9 marginal, and 3 posterior setae. Second and 3rd inner lobes each with a seta. Basis with 5 setae, of which the outermost seta smallest or missing in certain species. First endopodal segment with 4 to 7 setae. None of endopodal setae of Mx2 (Fig. 20-b) armed with long spinules in addition to rows of small spinules. Digitiform process of male left P5 exopod (Fig. 22-h) relatively long.

Composition. The following species are referred to this species group:

P. malayensis Sewell 1929
P. parvula (Park 1978)
P. copleyae, new species
P. prudens Tanaka and Omori 1968
P. rubra Brodsky 1950
P. megaloba, new species
P. aequatorialis Tanaka 1958
P. papilliger, new species
P. calva Tanaka 1958
P. euryrhina, new species
P. propinqua (Esterly 1906)
P. abyssalis Brodsky 1950
P. californica (Esterly 1906)
P. confusa Tanaka 1958
P. hansenii (With 1915)
P. investigatoris Sewell 1929
P. gracilicauda Scott 1909
P. kurilensis Heptner 1971
P. parabbreviata, new species
P. anfracta, new species
P. barbata (Brady 1883)
P. eltaninae (Park 1978)
P. scotti (Farran 1908)
P. paraprudens, new species
P. triloba, new species
P. mexicana, new species
P. rasa Farran 1929
P. sarsi (Farran 1908)
P. regalis (Grice and Hulsemann 1968)
P. plaxiphora, new species
P. brevirostris Brodsky 1950
P. altibulla, new species
P. birostrata Brodsky 1950
P. comosa Tanaka 1958
P. eminens Tanaka and Omori 1968
P. rubicunda (Farran 1908)
P. vorax (Grice and Hulsemann 1968)
P. abbreviata (Park 1978)
P. alaminae (Park 1975)

According to the descriptions and illustrations available in the literature, the following species also seem to be referable to this species group:

P. sibogae Scott 1909
P. bradyi (With 1915)
P. modesta Brodsky 1950
P. longisetosa Heptner 1971
P. prima Heptner 1971
P. guttata Heptner 1971
P. subtilirostris Heptner 1971
P. hastata Heptner 1971.
P. robusta (Wolfenden 1911)
P. polaris Brodsky 1950
P. orientalis Brodsky 1950
P. oculata Heptner 1971
P. abrikosovi Heptner 1971
P. plicata Heptner 1971
P. implicata Heptner 1971

Remarks. This is the largest species group of the genus *Paraeuchaeta* and most of the new species described in the present study belong to this group. The females are distinguishable mainly by body size and the characteristics of the genital somite. Also useful in species identification are the shape and size of the rostrum, the number of setae on the outer lobe of Mx1, the length of outer spines of the P1 and P2 exopods, and the shape of the marginal lobe bearing the 2nd outer spine in the 3rd exopodal segment of P2.

The males are diagnosed mainly by body size and the characteristics of the serrated lamella and digitiform process of the 2nd exopodal segment of the left P5. Morphological features useful in matching the male with the female of the same species are similarities in body size, shape of the rostrum, and the characteristics of the marginal lobes and outer spines of the P2 exopod. The definitive criterion for recognizing the 2 different sexes of the same species, of course, will be whether or not they share the same distributional range.

Key to species of *malayensis* species group
(based on females)

1a. Outer spine of 2nd exopodal segment (or the 2nd of the first 2 exopodal segments forming a proximal, compound segment) of P1 normally developed.....2

1b. Outer spine of 2nd exopodal segment of P1 short of reaching middle of following segment (Fig.58-h).....36

2a. Outer lobe of Mx1 with 7 large distal setae extending laterad and 2 medium-sized, densely plumose proximal setae extending proximad along lateral side of appendage (Fig.20-a).....3

2b. Outer lobe of Mx1 with different number and/or type of setae.....9

3a. Genital segment with 2 conspicuous conical processes on left side at anterior base of genital prominence (Fig.36-c).....*P. papilliger*, n. sp.

3b. Genital segment without such processes.....4

4a. Laterally, rostrum triangular with wide base (Fig.42-a).....5

4b. Laterally rostrum spiniform (Fig.47-a).....6

5a. Laterally, posterior ventral wall of genital somite about parallel to long axis of somite (Fig.42-c).....*P. plaxiphora*, n. sp.

5b. Laterally, posterior ventral wall of genital somite strongly oblique to long axis of somite (Fig.43-c).....*P. propinqua*

6a. Laterally, posterior ventral wall of genital somite very short (Figs.19-d, 51-c).....7

6b. Laterally, posterior ventral wall of genital somite very long (Fig.47-c).....8

7a. Laterally, posterior margin of genital prominence longer than posterior ventral wall of genital somite (Fig.19-d).....*P. malayensis*

7b. Laterally, posterior margin of genital prominence shorter han posterior ventral wall of genital somite (Fig.51-c).....*P. hansenii*

8a. Laterally, rostrum large with straight anterior margin (Fig.47-a).....*P. californica*

8b. Laterally, rostrum small with hollow anterior margin (Fig.48-a).....*P. birostrata*

9a. Outer lobe of Mx1 with 5 long setae in addition to some very small setae proximally.....10

9b. Outer lobe of Mx1 with 6 or 7 long setae in addition to 1 or 2 small proximal setae pointing laterad and/or some minute setae proximally.....19

10a. Laterally, genital prominence high with emarginate genital flanges (Fig.37-c) 11

10b. Laterally, genital prominence low with more or less convex genital flanges (Fig.23-b) 13

11a. Laterally, genital somite with long posterior ventral wall; genital flange strongly emarginate (Fig.39-c) 12

11b. Laterally, genital somite with relatively short posterior ventral wall; genital flange slightly emarginate (Fig.37-c) ..... *P. sarsi*

12a. Laterally, posterior lobe of genital flange directed posteroventrad (Fig.39-c) ..... *P. calva*

12b. Laterally, posterior lobe of genital flange directed ventrad (Fig.40-c) ..... *P. regalis*

13a. Laterally, rostrum very small (Fig.24-a) ..... *P. parvula*

13b. Laterally, rostrum well developed (Fig.23-a) 14

14a. Laterally, posterior margin of genital prominence smoothly merging into posterior ventral wall of somite (Fig.55-c) 15

14b. Laterally, posterior margin of genital prominence distinct from posterior ventral wall of somite (Fig.23-b) 17

15a. Genital somite with conspicuously ridged outgrowth on left side posterior to genital prominence (Fig.56-c) ..... *P. vorax*

15b. Genital somite without such outgrowth (Fig.55-c) 16

16a. Laterally, rostrum very elongated, pointing somewhat ventrad (Fig.55-a) ..... *P. gracilicauda*

16b. Laterally, rostrum thick, pointing obliquely forward (Fig.57-a) ..... *P. kurilensis*

17a. Genital somite with conspicuous conical process on left side ..... *P. barbata*

17b. Genital somite without such process 18

18a. Laterally, genital prominence with 2 conspicuous semi-circular ridges (Fig.35-c) ..... *P. rasa*

18b. Laterally, genital prominence with a low ridge close to anterior margin (Fig.34-c) ..... *P. aequatorialis*

19a. Genital somite with a conical process on left side close to anterior base of genital prominence (Figs.45-c, 46-c) 20

19b. Genital somite without such conical process 21

20a. Conical process of genital somite large; posterior lobe of genital flange inconspicuous (Fig.45-c) ..... *P. abyssalis*

20b. Conical process of genital somite small; posterior lobe of genital flange projecting posteroventrad into conical process (Fig.46-c) ..... *P. altibulla*, n. sp.

21a. Dorsally and ventrally, genital somite asymmetrical (Fig.30-d) ..... *P. rubra*

21b. Dorsally and ventrally, genital somite symmetrical 22

22a. Laterally, genital flange with extremely large posterior lobe (Figs.52-c, 53-c) 23

22b. Laterally, genital flange with normal posterior lobe 24

23a. Laterally, genital somite with conspicuous dorsal hump (Fig.53-c) ..... *P. investigatoris*

23b. Laterally, genital somite with smooth dorsal margin (Fig.52-c) ..... *P. eminens*

24a. Laterally, genital somite with conspicuous dorsal hump (Fig.54-d) ..... *P. rubicunda*

24b. Laterally, genital somite with more or less smooth dorsal margin 25

25a. Laterally, genital prominence with conspicuously bulging posterior margin (Figs.49-c, 50-c) 26

25b. Laterally, genital prominence with nearly straight or only slightly bulging posterior margin 27

26a. Laterally, genital prominence with smoothly convex posterior margin (Fig.50-c) ..... *P. comosa*

26b. Laterally, genital prominence with irregular posterior margin (Fig.49-c) ..... *P. confusa*

27a. Outer lobe of Mx1 with 6 long setae plus 1 or 2 very small setae 28

27b. Outer lobe of Mx1 with 7 long setae plus 1 or 2 very small setae 29

28a. In 3rd exopodal segment of P2, 2nd marginal lobe separated from segment by very deep cleft and has long outer spine (Fig.32-f) ..... *P. megaloba*, n. sp.

28b. In 3rd exopodal segment of P2, 2nd marginal lobe separated from segment by shallow cleft and has relatively small outer spine (Fig.27-f) ..... *P. scotti*

29a. Laterally, genital prominence with posterior margin equal to or shorter than half length of posterior ventral wall of somite (Figs.33-c, 41-c) 30

29b. Laterally, genital prominence with posterior margin nearly equal to or longer than posterior ventral wall of somite (Fig.31-c) 31

30a. Laterally, posterior edge of genital field very small relative to posterior lobe of genita flange (Fig.41-c) ..... *P. eurythina*, n. sp.

30b. Laterally, posterior edge of genital field similar in shape and size to posterior lobe of genital flange (Fig.33-c) ..... *P. mexicana*, n. sp.

31a. Laterally, posterior margin of genital prominence and posterior ventral wall of somite forming an angle of less than 120° 32

31b. Laterally, posterior margin of genital prominence and posterior ventral wall of somite forming an angle of more than 140° 33

32a. Laterally, genital flange trilobed (Fig.31-c) ..... *P. triloba*, n. sp.

32b. Laterally, genital flange bilobed (Fig.44-c) ..... *P. brevirostris*

33a. Laterally, genital prominence with posterior margin distinctly longer than posterior ventral wall of somite (Fig.25-c) ..... *P. eltaninae*

33b. Laterally, genital prominence with posterior margin about as long as posterior ventral wall of somite 34

34a. In P1 exopod, 2nd outer spine far short of reaching base of 3rd outer spine (Fig.28-h) ..... *P. prudens*

34b. In P1 exopod, 2nd outer spine reaching base of 3rd outer spine 35

35a. Laterally, posterior margin of genital prominence slightly bulging and poorly defined from posterior ventral wall of somite (Fig.26-c) ..... *P. copleyae*, n. sp.

35b. Laterally, posterior margin of genital prominence straight and more or less distinct from posterior ventral wall of somite (Fig.29-c) ..... *P. parapridens*, n. sp.

36a. Laterally, dorsal margin of genital somite broadly arched (Fig.58-c) 37

36b. Laterally, dorsal margin of genital somite sigmoidally curved (Fig.62-c) ..... *P. anfracta*, n. sp.

37a. Laterally, genital flange appearing trilobed (Fig.61-c) ..... *P. alaminae*

37b. Laterally, genital flange bilobed 38

38a. Laterally, genital somite about 1.4 times as long as deep (Fig.58-c) ..... *P. abbreviata*

38b. Laterally, genital somite about 1.6 times as long as deep (Fig.60-c) ..... *P. parabbreviata*, n. sp.

Paraeuchaeta malayensis Sewell 1929
Figures 19-22

Paraeuchaeta malayensis Sewell 1929, p. 160, text-fig. 62.

- Sewell 1947, p. 121, text-fig. 27.
- Vervoort 1957, p. 84.
- Tanaka 1958, p. 341, fig. 68.
- Tanaka and Omori 1968, p. 241. Figs. 3M, 4M, 13.

Paraeuchaeta barbata; Scott 1909, p. 70, pl. 18, Figs. 1-8.

Description of female. Prosome length, 4.00-5.10 mm; body length, 6.40-7.30 mm. Body (Fig. 19-a) relatively slender. Laterally, dorsal side of forehead (Fig. 19-b) smoothly curved, ending anteriorly in low frontal eminence. Rostrum large, pointing downward. Urosome relatively slender (Fig. 19-c). Distal margin of prosome rounded and provided with a dense bunch of long hairs. Laterally, genital prominence high (Fig. 19-d), with both genital flange and posterior edge of genital field produced distally into conspicuous lobes. Ventral margin of genital flange straight or only slightly convex and somewhat oblique to long axis of body. Posterior margin of genital prominence sloping about 45° with respect to long axis of body. Posterior ventral wall of somite behind genital prominence characteristically short. Left side of genital somite with a low ridge close to posterior margin of genital prominence, which can be seen more clearly when viewed ventrally. Dorsally, genital somite symmetrical (Fig. 19-e), widest about 3/5 length of somite from proximal end. Ventrally, genital field symmetrical, ovoid across somite (Fig. 19-f).

Appendicular caudal seta (Figs. 19-g, h) a little more than 1.5 times length of 4th marginal

caudal seta, which is about 2.5 times length of 5th marginal caudal seta. When applied closely to body, A1 extending beyond distal end of prosome by last 4 segments. Marginal seta of 2nd exopodal segment of A2 relatively well developed (Fig. 19-j). First endopodal segment of Md (Fig. 19-k) produced outward into a lobe.

Outermost seta of basis of Mx1 relatively well developed (Fig. 20-a). First endopodal segment with 7 setae. Outer lobe with 9 setae, of which 2 proximal ones are relatively short. In Mx2 (Fig. 20-b) and Mxp (Fig. 20-c), features unique to this particular species have not been found.

In P1 exopod (Fig. 20-d), line representing fused joint between 1st and 2nd segments only vaguely visible. Outer spine of 1st segment relatively small; that of 2nd segment reaching base of following outer spine, which is a little longer than 3rd segment.

Second leg (Fig. 20-e) very characteristic in having an extraordinarily deep incision in 3rd exopodal segment, by which marginal lobe bearing 2nd outer spine is separated from segment. This deep incision reaching the level of the preceding incision separating the 1st marginal lobe of the segment. Second outer spine of 3rd segment longest of all outer spines in P2 exopod, extending slightly beyond base of following outer spine. Outer spine of 2nd segment about 70% length of 2nd outer spine of 3rd segment. In P3 and P4 (Figs. 20-f, g), all outer spines of exopod similarly small. In P3 endopod, first 2 segments partially fused.

Description of male. Prosome length, 4.30-4.40 mm; body length, 6.20-6.50 mm. Short line representing joint between cephalosome and 1st pedigerous somite visible on lateral side (Fig. 21-a); toothlike process on posterodorsal margin of prosome vestigial (Figs. 21-c, d); frontal eminence of forehead inconspicuous (Fig. 21-b). Rostrum long, more or less curved backward to point downward. Second, 3rd, and 5th marginal setae of caudal ramus (Figs. 21-e, f) all similar in length and slightly shorter than urosome. Fourth marginal seta about 1.4 times length of urosome. Geniculated appendicular caudal seta much thinner and shorter than any of distal marginal setae.

Antennule extending beyond distal end of prosome by last 4 segments and reaching middle of 3rd urosomal somite. In A2 (Fig. 21-h), long marginal seta of basis extending beyond base of marginal seta on 1st endopodal segment. In Mx1 exopod (Fig. 21-j). distalmost seta very small, while remaining 10 setae are all well developed.

In P1 (Fig. 22-a), outer spine of 2nd exopodal segment pointing in a posteromedial direction. In 3rd exopodal segment of P2 (Fig. 22-b), marginal lobe bearing 2nd outer spine separated from segment by a deep incision, which is however short of reaching the level of the preceding incision.

In right P5 (Fig. 22-e), 1st exopodal segment with a small toothlike process on outer margin about 2/5 length of segment from proximal end. Second exopodal segment of left P5 (Figs. 22-f-h) with a toothlike process on inner margin close to proximal end. Serrated lamella very characteristic with a large tooth at middle of inner serrated margin and a bilobed distal end, inner distal lobe much larger. Digitiform process tapering into a large spiniform structure. Third exopodal segment extending beyond distal end of serrated lamella by its distal half.

Remarks. The female of this species can be recognized by the long rostrum pointing straight downward, the high genital prominence which extends close to the distal end of the genital somite, and the marginal lobe bearing the 2nd outer spine in the 3rd exopodal segment of P2, which is separated from the segment by a very deep incision. The male is distinguished by its very characteristic serrated lamella and digitiform process of the 2nd exopodal segment of the left P5.

Distribution. This is an equatorial Indo-Pacific species. It has been recorded from the Malay Archipelago (Scott 1909, as *P. barbata)*, the Bay of Bengal (Sewell 1929), the Arabian Sea (Sewell 1947), the western Indian Ocean between 17°S and 41°S (Grice and Hulsemann 1967), and the Izu region of Japan (Tanaka 1958). In the present study the species was found in the Bay of Bengal, the Malay Archipelago, the South and East China seas, along the Pacific coast of Japan up to 35°18'N, and throughout the equatorial Pacific from the Malay Archipelago to the west coast of South America, where the species occurred between 2°N and 12°S off Ecuador and Peru.

Paraeuchaeta barbata (Brady 1883)
Figure 23

Euchaeta barbata Brady 1883, p. 66, pl. 22, Figs. 6-12.

- Sars 1902, p. 41, pl. 28.
- Farran 1908, p. 40, pl. 3, Figs. 13, 14.
- With 1915, p. 174, text fig. 49, pl. 6, fig. 8.
- Vervoort 1957, p. 83; 1963, p. 166.
- Park 1975, p. 9, fig. 7; 1978, p. 259, Figs. 105H, 107.

Paraeuchaeta barbata; Sars 1925, p. 112, pl. 31, Figs. 1-7

- Sewell 1929, p. 155, text fig. 59.
- Wilson 1932, p. 67, fig. 44.
- Brodsky 1950, p. 209, fig. 122.
- Tanaka 1958, p. 338, fig. 67.
- Tanaka and Omori 1968, p. 225, Figs. 3B, 4B, 5.

Euchaeta porrecta Sars 1905, p. 16.
Euchaeta farrani With 1915, p. 172, text fig. 48, pl. 6, fig. 6.

- Vervoort 1957, p. 83.
- Park 1978, p. 263, Figs. 105A-105G, 106, 107.

Paraeuchaeta farrani; Farran 1929, p. 240.
Paraeuchaeta sarsi; Scott 1909, p. 75, pl. 21, Figs. 9-15.

Description of female. Prosome length, 5.6-8.8 mm; body length, 7.5-11.8 mm. Similar in habitus to *P. malayensis* but rostrum (Fig. 23-a) pointing more forward, genital prominence (Fig. 23-b) at a more anterior position, its posterior margin meeting ventral wall of somite at a wider angle, and tubercle on left side of genital somite much higher. Outer lobe of Mx1 (Fig. 23-c) with 5 long setae and a minute seta proximally. In P1 exopod (Fig. 23-d), outer spine of 2nd segment far short of reaching base of following outer spine. In P2 exopod (Figs. 23-e-m), although varying considerably in length in proportion to body size, outer spine of 2nd segment usually longer than 2nd outer spine of 3rd segment. Marginal lobe bearing 2nd outer spine of 3rd segment separated from segment by a moderately deep incision, which is far short of reaching level of preceding incision.

Description of male. Prosome length, 4.8-6.1 mm; body length, 6.7-9.1 mm. Similar in habitus to *P. malayensis* but rostrum thicker and shorter (Fig. 23-n). Cephalosomal appendages and 4 pairs of swimming legs also similar in anatomical details to *P. malayensis* except that outer spine of 1st exopodal segment of P1 (Fig. 23-o) is very small or often missing and incision separating 2nd marginal lobe of 3rd exopodal segment of P2 relatively shallow (Fig. 23-p). Anteriorly, serrated lamella (Fig. 23-q) more or less rectangular with a shallow indentation, marked by a large tooth, along medial margin close to distal end; mediodistal corner terminating with a large tooth; relatively large teeth bordering entire length of medial and distal margins as well as distal half of lateral margin. Large toothlike process present next to serrated lamella on distal margin of lateral side of 2nd exopodal segment. Digitiform process elongated, pointed distally along its lateral margin.

Remarks. Paraeuchaeta barbata was originally described from a female specimen 8.4 mm long obtained from the southwestern Atlantic and has since been recorded widely in the world's oceans (Park 1978). With (1915) considered the Norwegian Sea population a separate species (*E. farrani* With 1915). Subsequently the Antarctic population was regarded as conspecific with the Norwegian population (Farran 1929, Vervoort 1957) and *P. farrani* therefore became an example of bipolar distribution. *Paraeuchaeta farrani* was originally distinguished from *P. barbata* mainly by the body size and the relative lengths of the outer spines of the female P2 exopod. Park (1978), however, found considerable variation in the relative lengths of the spines and considered the 2 species to be forms of a single species. Mauchline (1992) has reached a similar conclusion

regarding the status of the 2 species in his quantitative analyses of the relative lengths of the spines based on specimens from many different areas of the world's oceans.

The female specimens examined in this study vary widely in body size, between 7.5 and 11.8 mm, and the variation is latitudinal with the largest individuals occurring in the Norwegian Sea, northern Pacific, and Antarctic and the smallest in equatorial waters. The relative length of the 2nd outer spine of the 3rd exopodal segment of the female P2 is negatively related to the body size. When largest individuals from the higher latitudes are compared with the smallest individuals from the equatorial regions, they are clearly distinguishable by body size and the relative lengths of the outer spines of the female P2 exopod. However, when individuals from neighboring localities are compared, the body size and the relative length of the outer spines (Figs. 23-e-m) vary rather gradually from one end to the other of its geographical range, apparently as a function of the water temperature of the habitat. No other morphological differences among individuals from different geographical locations were found in the present study. *Paraeuchaeta farrani* is therefore considered here a synonym of *P. barbata.* However, it has not been possible to rule out the possibilities of *P. barbata* being a species complex consisting of 2 or more cryptic species.

The species was found to be quite abundant in the northern Atlantic, the Antarctic, and the northern Pacific, where individuals are uniformly large, while it was quite rare in the rest of its range. This seems to point to the possibilities that the populations in the northern Atlantic, northern Pacific, and Antarctic each constitute an independently evolving cohort, which may prove to be a separate species.

Distribution. A cosmopolitan species found throughout the world's oceans and common in the northern Atlantic and Pacific and the Antarctic.

Paraeuchaeta parvula (Park 1978)
Figure 24

Euchaeta parvula Park 1978, p. 256, Figs. 102-104.

Description of female. Prosome length, 5.6-6.2 mm; body length, 7.5-8.5 mm. Similar in habitus to *P. barbata* but rostrum very small (Fig. 24-a), pointing more or less downward. Genital somite more slender (Fig. 24-b). Laterally, genital flange with strongly bulging ventral margin (Fig. 24-c). Posterior margin of genital prominence nearly straight or slightly bulging and sloping about 35° with respect to long body axis. No tubercular outgrowth on genital somite.

Cephalosomal appendages including Mx1 (Fig. 24-d) and swimming legs also similar to those *of P. barbata* except that in P1 exopod (Fig. 24-e), outer spine of 2nd segment reaching base of following outer spine, which is nearly 1/2 length of terminal spine of 3rd segment, and in P2 exopod (Fig. 24-f), incision separating 2nd marginal lobe of 3rd segment relatively shallow.

Description of male. Prosome length, 4.6-4.9 mm; body length, 6.4-6.8 mm. Similar in habitus to *P. barbata* but rostrum relatively small (Fig. 24-g). Serrated lamella of 2nd exopodal segment of left P5 (Fig. 24-h) consisting of hollow rectangular main body and large clawlike extension along lateral margin; teeth bordering medial margin of rectangular main body and lateral margin of clawlike extension. Toothlike tubercle present next to serrated lamella on distal margin of lateral side of segment. Digitiform process more or less vermiform, with distal end curved slightly inward.

Remarks. The most important characters by which the female of this species can be readily recognized are the small rostrum and the long outer spine of the 3rd exopodal segment of P1.

Distribution. This is a circumpolar species of the Southern Ocean occurring widely in deep water of both the Antarctic and Subantarctic and found as far north as 26°30'S in the southwestern Atlantic and 34°S in the southeastern Pacific (Park 1978). In the present study *P. parvula* was present in most of the samples from the Southern Ocean; the northernmost sample yielding the species was from 31°11'S in the southeastern Atlantic and 35°S in the western Indian Ocean.

Paraeuchaeta eltaninae (Park 1978)

Figure 25

Euchaeta eltaninae Park 1978, p. 280, Figs. 118-120.

Description of female. Prosome length, 5.3-5.4 mm, body length, 7.3-7.8 mm. Similar in habitus to *P. parvula* but readily distinguishable from it by rostrum, which in lateral view is almost triangular with a wide base (Fig. 25-a). Urosome elongate (Fig. 25-b). Laterally, genital somite (Fig. 25-c) with strongly bulging dorsal margin. Ventral margin of genital flange nearly straight or only slightly emarginate and sloping posteroventrad. Posterior edge of genital field produced into a low angular ridge with a wide base. Posterior margin of genital prominence slightly bulging and sloping about 30° with respect to long body axis.

Cephalosomal appendages similar to those of *P. barbata* and *P. parvula* except that outer lobe of Mx1 (Fig. 25-d) with 7 long setae, of which the proximalmost is shorter than the others, and a minute seta proximally. Swimming legs similar to those of *P. parvula* but in P1 exopod (Fig. 25-e), outer spine of 2nd segment extending a little beyond base of outer spine of 3rd segment, which is shorter than 1/2 length of terminal spine; in P2 exopod (Fig. 25-f), incision separating 2nd marginal lobe of 3rd segment shallow.

Description of male. Prosome length, 4.5-4.9 mm; body length, 6.6-7.1 mm. Similar in habitus to *P. parvula* but rostrum (Fig. 25-g) more or less triangular with a wide base. Cephalosomal appendages and swimming legs also similar to those of *P. parvula.* Serrated lamella of 2nd exopodal segment of left P5 (Fig. 25-h) in anterior view consisting of a rectangular base tapering along lateral margin into a large clawlike process with a smoothly arched medial margin; relatively large teeth bordering entire length of margin; tooth at distal end of medial serrated margin of rectangular portion relatively large. Digitiform process nearly straight with a low angular corner at distal end of lateral margin.

Remarks. The female of this species can be readily recognized by the triangular rostrum and the vaulted dorsal wall of the genital somite.

Distribution. This is an antarctic deep water species found widely south of the Antarctic Convergence. In the present study it was found as far north as 47°S in the Tasman Sea.

Paraeuchaeta copleyae, new species

Figure 26

Type material. Collected by WHOI with MOCNESS in the Guaymas Basin hydrothermal vent field in the Gulf of California. Holotype female (PL=3.32 mm; BL=4.72 mm) (USNM 264825) from 1930-1895 m, 27°00'N, 111°25'W, July 27-28, 1985. Allotype male (PL=3.16 mm; BL=4.44 mm) (USNM 264826) and 3 paratype females (USNM 264827) from 1940-1800 m, 26°59'N, 111°25'W, July 29-30, 1985. Two paratype females (USNM 264828) from 1894-1750 m, 27°00'N, 111°20'W, July 30, 1985. Three paratype females (USNM 264829) and 4 paratype males (USNM 264830) from 1600-1450 m, 26°59'N, 111°25'W, July 29-30, 1985.

Description of female. Prosome length, 3.20-3.60 mm; body length, 4.60-5.17 mm. Similar in habitus to *P. eltaninae* female but distinguishable from it and other related species by the following characteristics: Laterally, rostrum with narrower base (Fig. 26-a); its anterior side originating a short distance from suprafrontal sensilla. Genital somite elongate (Fig. 26-b). Dorsal wall of genital somite (Fig. 26-c) smoothly arched without noticeable hump. Ventral margin of genital flange slightly emarginate or nearly straight, sloping in a posteroventral direction. Posterior edge of genital field produced into a large lobe, ventral side of which roughly parallel to long axis of body. Anterior margin of genital prominence nearly straight; posterior margin slightly bulging, gradually sloping and, together with posterior ventral wall of somite, forming a smooth curve. In both dorsal and ventral view (Fig. 26-d), genital somite symmetrical.

Cephalosomal appendages including setation of Mx1 (Fig. 26-e) as in *P. eltaninae* female. In

P1 exopod (Fig. 26-f), outer margins of first 2 segments not strongly sigmoid; outer spine of 2nd segment reaching base of outer spine of 3rd segment, which is a little more than 1/3 length of terminal spine. In P2 exopod (Fig. 26g), 3rd and 5th outer spines relatively long, about 1/2 length of 2nd.

Description of male. Prosome length, 3.04-3.24 mm; body length, 4.28-4.72 mm. Similar in habitus to *P. eltaninae* male but rostrum (Fig. 26-h) more elongated with hollow posterior margin. In P1 exopod (Fig. 26-i), outer spine of 2nd segment pointing straight backward, overreaching 1/2 way to base of following outer spine. Fifth outer spine of P2 exopod (Fig. 26-j) a little shorter than 4th and distinctly longer than other outer spines. Fifth pair of legs (Fig. 26-k) typical of the genus. Anteriorly, serrated lamella of left P5 exopod (Figs. 26-l-n) similar to that of *P. barbata* male, consisting of wide rectangular base and relatively narrow distal part and mediodistal corner of each part is marked by a large tooth; distal part is relatively longer than in *P. barbata.* Toothlike process next to serrated lamella on laterodistal margin of segment well developed. Digitiform process of left P5 exopod distally enlarged and rounded.

Etymology. The new species is named after Nancy J. Copley of Woods Hole Oceanographic Institution, who supplied the specimens.

Remarks. The female of this species can be distinguished from that of *P. eltaninae*, with which it is most closely allied, by the shape of the dorsal wall of the genital somite, which in lateral view is only slightly arched, and by the relatively well-developed outer spines of the 3rd exopodal segment of P2. The male is diagnosed, as in the other species of the genus, mainly by the serrated lamella and digitiform process of the left P5 exopod. The serrated lamella resembles closely that of *P. barbata* but the digitiform process is distally enlarged and rounded instead of tapering in a spiniform process as in the latter.

Distribution. The Guaymas Basin of the Gulf of California.

Paraeuchaeta scotti (Farran 1908)
Figure 27

Euchaeta scotti Farran 1908, p. 42, pl. 3, Figs. 11, 12.

- With 1915, p. 179, text fig. 51, pl. 6, fig. 10.
- Park 1975, p. 19, fig. 18; 1978, p. 278, fig. 117.

Description of female. Prosome length, 4.0-4.7 mm; body length, 5.7-6.6 mm. Similar in habitus to *P. eltaninae* female but distinguishable from it by the following characteristics: Rostrum in lateral view more elongated with narrower base (Fig. 27-a). Urosome somewhat robust (Fig. 27-b). Dorsal margin of genital somite (Fig. 27-c) with a conspicuous hump anterior to middle. Posterior edge of genital field produced distally into a relatively large lobe. Posterior margin of genital prominence nearly straight, sloping about 35° with respect to long body axis and about as long as posterior ventral wall of genital somite.

Cephalosomal appendages and swimming legs also similar to those of *P. eltaninae* female with following minor exceptions: In Mx1 outer lobe (Fig. 27-d), 2nd seta from proximal end small. Outer spine of 2nd exopodal segment of P1 (Fig. 27-e) scarcely reaching base of following outer spine. In P2 exopod (Fig. 27-f), outer spines of 3rd segment better developed.

Description of male. Prosome length, 3.8-4.2 mm; body length, 5.4-6.0 mm. Similar in habitus to *P. eltaninae* male but rostrum in lateral view more elongated with narrower base (Fig. 27-g). In P1 exopod (Fig. 27-h), outer spine of 1st segment usually missing. Outer spines of P2 exopod (Fig. 27-i) poorly developed as in *P. eltaninae.* Fifth pair of legs similar to that of *P. eltaninae* male but distal extension of serrated lamella (Figs. 27-j, k) elongated without tapering into a spiniform process and its tip pointing inward. Digitiform process (Fig. 27-l) tapering distally with its tip turned outward.

Remarks. The female of this species is very characteristic in having a conspicuous dorsal hump on the genital somite. The male is distinguishable from those of the other species by the

elongate, smoothly curved distal extension of the serrated lamella and the distally pointed digitiform process of the left P5 exopod.

Distribution. This species was originally described from the Atlantic slope off Ireland. Of the subsequent records, according to the accompanying species descriptions, only those of With (1915) from south of Iceland, Park (1975) from the Gulf of Mexico and Caribbean Sea, and Park (1978) from the southwestern Atlantic, southeastern Pacific, and south of Australia are attributable with certainty to this species. Wolfenden's (1911) record from the tropical Atlantic was ascribed by Tanaka (1958) to *P. aequatorialis.* As was pointed out by Park (1978), the records by Sars (1925) from the North Atlantic and those by Tanaka (1958) and Tanaka and Omori (1968) from off the Pacific coast of central Japan, according to the accompanying species descriptions and illustrations, seem not referable to *P. scotti.* In the present study the species was found sparsely but widely in the following regions of the three great oceans: The eastern and western North Atlantic, the eastern South Atlantic, the South Pacific between 24°S and 39°S, the Malay Archipelago at 4°S, the Coral Sea, the Tasman Sea north of 49°S, and the Mozambique Channel. Together with the previous records by Farran (1908), With (1915), Park (1975, 1978), the present study establishes the geographical range of the species as extending in the Atlantic from 62°N to 34°S and in the Pacific and Indian oceans between 4°S and 49°S. The species is absent in the North Pacific.

Paraeuchaeta prudens Tanaka and Omori 1968
Figure 28

Paraeuchaeta prudens Tanaka and Omori 1968, p. 247, Figs. 3P, 4P, 16.

Description of female. Prosome length, 5.2-5.6 mm; body length, 7.3-7.9 mm. Similar in habitus to *P. eltaninae* female but in lateral view rostrum more slender (Fig. 28-a); urosome (Fig. 28-b) and genital somite (Figs. 28-c-f) more elongate; dorsal margin of genital somite in lateral view not conspicuously bulging and with a weak indentation at middle; posterior edge of genital field extending for a shorter distance beyond posterior end of genital flange; sloping posterior margin of genital prominence as long as posterior ventral wall of somite; a low ridge present on left side of genital somite posterior to genital prominence and close to ventral wall of somite. Dorsally, genital swelling centered a little anterior to middle of somite, followed by a marked constriction.

Cephalosomal appendages similar to those of *P. eltaninae* but in Mx1 (Fig. 28-g), 1st endopodal segment with 6 setae and outer lobe with 7 setae, the proximalmost of which smaller than the others, often being reduced to a very small seta. In P1 exopod (Fig. 28-h), outer spine of 2nd segment reaching a little over 2/3 way to base of following outer spine. In P2 exopod (Fig. 28-i), 2nd outer spine reaching base of 3rd and a little longer than 4th; 3rd outer spine about 1.5 times length of 5th.

Male unknown

Remarks. This species can be recognized by the shape of the genital somite, which is relatively long. Also its genital prominence is close to proximal end of the somite and has relatively large genital flanges.

Distribution. This species was first described from a female specimen 7.78 mm long captured from off the Pacific coast of central Japan. In the present study the species occurred at 6 widely separated localities: Off central Japan (the type locality), in the Tasman Sea (at 2 localities), off San Diego, the eastern tropical Pacific off Central America, and the South Atlantic.

Paraeuchaeta paraprudens, new species
Figure 29

Type material. Holotype female (Pl=3.7 mm; BL=5.1 mm) found in IKMT sample from 5500-0 mwo, SIO MV 66-II, station 5, 38°13'N, 124°07'W, off California, May 24, 1966 (USNM 264831). One paratype female found in IKMT sample from 5500-0 mwo, SIO MV 67-II, station 1,

35°22'N, 122°27'W, off California, June 9, 1967 (USNM 264832). Two paratype females found in IKMT sample from 3000-0 mwo, SIO Aries I, station E, 9°52'N, 113°50'W, in the eastern tropical Pacific, November 19, 1970 (USNM 264833). Four paratype females found in IKMT sample from 3000-0 mwo, ORI KT 85-8, station A1, in Sagami Bay, Japan, July 2, 1985 (USNM 264834). One paratype female found in ORI-100 net sample from 4400-0 m, ORI KH 67-3, station 5-1, 33°04'N, 141°55'E off Japan, September 16-17, 1967 (USNM 264835). One paratype female found in ORI-100 net sample from 2220-0 m, ORI KT 67-4, station 229, 34°44'N,140°04'E off Japan, April 26, 1967 (USNM 264836).

Description of female. Prosome length, 3.3-3.8 mm; body length, 4.6-5.3 mm. Similar in habitus to *P. prudens* female but in lateral view, rostrum less elongated (Fig. 29-a); anterior margin of forehead anterior to frontal eminence more or less curved inward; urosome more robust (Fig. 29-b); dorsal margin of genital somite (Figs. 29-c, d) only slightly arched and in some specimens with an inconspicuous hump posterior to middle of somite; ventral margin of genital flange slightly emarginate, oblique in a posteroventral direction; posterior edge of genital field extending to a greater extent beyond posterior edge of genital flange; posterior margin of genital prominence straight and as long as posterior ventral wall of somite. Genital somite without a low ridge on left side. Second urosomal somite in lateral view (Fig. 29-b) with a low dorsal hump about 1/3 its length from proximal end.

Cephalosomal appendages similar to those of *P. prudens* female except for Mx1, in which 1st endopodal segment with 7 setae and outer lobe (Fig. 29-e) with 7 long setae followed proximally by 2 small setae. Swimming legs also similar to those of *P. prudens* but in P1 exopod (Fig. 29-f), outer spine of 2nd segment extending beyond base of following outer spine; in P2 exopod (Fig. 29-g), 3rd outer spine only slightly longer than 5th.

Male unknown.

Etymology. The specific name, formed with the Greek prefix *para* - meaning near, alludes to the apparent relationship of this new species with *P. prudens.*

Distribution. The species was found in 2 samples from off California, 1 sample from the eastern tropical Pacific, and 3 samples from the northwestern Pacific off central Japan.

Paraeuchaeta rubra Brodsky 1950
Figure 30

Paraeuchaeta rubra Brodsky 1950, p. 214, fig. 128.

- Tanaka and Omori 1968, p. 249, Figs. 3Q, 4Q, 17B.
- Heptner 1971, p. 85, fig. 5.

Paraeuchaeta crassa Tanaka 1958, p. 357, fig. 76.

Description of female. Prosome length, 4.8-5.4 mm; body length, 6.8-7.6 mm. Similar in habitus to *P. prudens* female but distinguishable from it by the following features: Laterally, rostrum relatively small (Fig. 30-a); distance between suprafrontal sensilla and beginning of rostrum relatively wide; supralabrum pointing more forward. Urosome robust (Fig. 30-b). Laterally, genital flange (Fig. 30-c) with strongly convex ventral margin and very large posterior lobe pointing posteroventrad. Posterior edge of genital field not produced into a distinct lobe. Posterior margin of genital prominence slightly bulging and so weakly inclined that it is nearly even with posterior ventral wall of somite, with a shallow indentation marking where the 2 parts meet. Laterally, dorsal margin of genital somite slightly bulging at middle. Dorsally as well as ventrally, genital somite (Figs. 30-d, e) strongly asymmetrical with a conspicuous outgrowth next to genital field on left side. Laterally, 2nd urosomal somite with a hump on dorsal margin about 1/3 length from proximal end.

Cephalosomal appendages similar to those of *P. prudens* but 1st endopodal segment of Mx1 with 7 setae and proximalmost seta of outer lobe (Fig. 30-f) invariably small. In P1 exopod (Fig. 30-g), outer spine of 2nd segment a little short of reaching base of following outer spine. In P2 exopod

(Fig. 30-h), 2nd outer spine extending beyond base of 3rd and only slightly longer than 4th; 3rd outer spine almost twice length of 5th; marginal lobes bearing 3rd and 4th outer spines each separated from segment by a relatively deep incision.

Description of male. Prosome length, 4.3-4.8 mm; body length, 6.0-6.8 mm. Similar to *P. scotti* male in habitus and details of cephalosomal appendages and 4 pairs of swimming legs (Figs. 30-j, k) except that rostrum larger, pointing more forward, and its posterior margin smoothly hollow (Fig. 30-i). Fifth pair of legs and particularly its serrated lamella in lateral view (Fig. 30-o) similar to those of *P. scotti* male but in anterior view, distal extension of serrated lamella (Figs. 30-l, m) relatively wider and its marginal teeth smaller. Digitiform process vermiform and as long as serrated lamella; its distal end appears truncate when viewed anteriorly or laterally (Figs. 30-l, o) but rounded when viewed anteromedially (Fig. 30-n).

Remarks. The female of this species can be recognized by the exceptionally large genital flanges and a large tubercular outgrowth on the left side of the genital somite.

Distribution. The species was originally described by Brodsky (1950) from the northwestern Pacific, the Sea of Okhotsk, and the Bering Sea and subsequently found to range as far south as the Izu region of Japan (Tanaka and Omori 1968). In the present study it was found to be one of the most common deep water euchaetid species along the continents of the North Pacific. On the western side it occurred as far south as 25°N in the East China Sea and on the eastern side down to 12°S along the coast of South America. The species was also found at one location (31°N, 155°W) in the central North Pacific.

Paraeuchaeta triloba, new species
Figure 31

Type material. Holotype female (PL=5.4 mm; BL=7.7 mm) found in IKMT sample from 5500-0 mwo, SIO MV 66-II, station 5, 38°13'N, 124°07'W off California, May 24, 1966 (USNM 264837). Three paratype females found in MOCNESS sample from 1600-1450 m, 26°59'N, 111°25'W in the Guaymas Basin of the Gulf of California, July 29-30, 1985 (USNM 264838).

Description of female. Prosome length, 5.08-5.40 mm; body length, 7.00-7.70 mm. Similar in habitus including urosome (Fig. 31-b) to *P. scotti* but in lateral view, forehead anterior to suprafrontal sensilla more concave (Fig. 31-a); dorsal wall of genital somite (Fig. 31-c) nearly straight; genital flange appears trilobed; posterior edge of genital field produced into a relatively small knob; posterior margin of genital prominence distinctly shorter than posterior ventral wall of somite and they meet in a rather smooth curve. Genital somite in both dorsal and ventral view (Fig. 31-e) widest at middle with marked genital swelling. Viewed laterally, left side of genital somite with a low ridge close to anterior base of genital prominence, which can be seen more clearly when the somite is tilted (Fig. 31-d). Second urosomal somite (Fig. 31-b) with a low dorsal hump close to proximal end.

Cephalosomal appendages and swimming legs similar to those of *P. scotti* except that outer lobe of Mx1 (Fig. 31-f) with 7 long distal plus 2 small proximal setae; in P1 exopod (Fig. 31-g), outer margin of 1st segment highly convex; marginal lobe bearing outer spine in 2nd segment much better developed; in 3rd exopodal segment of P2 (Fig. 31-h), 1st outer spine as long as but thicker than 3rd.

Male unknown.

Etymology. The specific name, *triloba*, alludes to the 3 lobes of the genital flange as seen in lateral view.

Distribution. The species was found at 2 locations: Off California and in the Gulf of California.

Paraeuchaeta megaloba, new species
Figure 32

Type material. Holotype female (PL=5.08 mm; BL=7.16 mm) (USNM 264839) and 18 paratype females (USNM 264841) from IKMT sample, 5500-0 mwo, SIO MV 72-II, station 36, 13°47'S, 77°49'W off Peru, May 12, 1972. Allotype male (PL=4.08 mm; BL=5.83 mm) found in MOCNESS sample from 2250-1850 m, UHG *Meteor* 6/7, Moc 14, 47°23'N, 19°15'W in the northeastern Atlantic, April 11, 1988 (USNM 264840).

Description of female. Prosome length, 4.41-5.10 mm; body length, 6.08-7.30 mm. Similar in habitus to *P. scotti* but in lateral view, rostrum relatively small (Fig. 32-a), pointing nearly parallel to anterior dorsal margin of forehead; genital somite relatively long (Fig. 32-b); its dorsal hump (Fig. 32-c) less conspicuous than in *P. scotti*; ventral margin of genital flange more or less convex; posterior edge of genital field produced into a large lobe; posterior margin of genital prominence meeting posterior ventral wall of somite in a smooth curve; dorsal hump of 2nd urosomal somite more pronounced than in *P. scotti.*

Cephalosomal appendages similar to those of *P. scotti* except that outer lobe of Mx1 (Fig. 32-d) with 6 long setae and a minute seta proximally. In P1 exopod (Fig. 32-e), outer spine of 1st segment relatively well developed; outer spine of 2nd segment extending beyond base of following outer spine by 1/4 its length. In P2 exopod (Fig. 32-f), outer spine of 2nd segment extending a little beyond base of following outer spine; 2nd outer spine of 3rd segment extending beyond base of 3rd by 1/6 its length; 1st outer spine of 3rd segment thick and about 1.5 times length of 3rd; posterior incision of marginal lobe bearing 2nd outer spine of 3rd segment reaching level of preceding incision.

Description of male. Prosome length, 4.08 mm; body length, 5.83 mm. Similar in habitus including distal end of prosome (Fig. 32-h) to *P. scotti* male but rostrum relatively short with a wide base (Fig. 32-g). Cephalosomal appendages and swimming legs (Figs. 32-i, j) also similar to those of *P. scotti* male except that marginal lobe bearing 2nd outer spine of 3rd exopodal segment in P2 separated from segment by a deeper and wider incision. Serrated lamella of left P5 (Figs. 32-k-m) basically similar to that of *P. scotti* male but its distal extension short, spiniform, strongly curved mediad, and its marginal teeth relatively smaller. Toothlike process next to serrated lamella on laterodistal margin of 2nd exopodal segment in the form of a rounded knob. Distal end of digitiform process more or less truncate when viewed laterally but rounded in anterior view.

Etymology. The specific name, *megaloba*, refers to the large lobular projection of the genital field as seen in lateral view.

Distribution. The species occurred widely in the Pacific: At 9 localities along the west coast of North and South America including the Gulf of California between 38°N and 35°S; 2 localities in the central South Pacific at 39°S and 45°S, respectively; 2 localities in the Tasman Sea, 1 locality in the Banda Sea in the Malay Archipelago, 1 locality off southern Japan. The species was also found in 9 MOCNESS samples of UHG obtained in the northeastern Atlantic between 17°W and 20°W and between 46°N and 49°N.

Paraeuchaeta mexicana, new species
Figure 33

Euchaeta aequatorialis; Park 1975, p. 8, fig. 6.

Type material. Holotype female (PL=3.12 mm; BL=4.20 mm) found in 1-m plankton net sample from 2834-0 mwo, Texas A&M University *Alaminos* cruise 72-A-10, station 6, 23°45'N, 91°30'W in the Gulf of Mexico, June 1, 1972 (USNM 264842).

Description of female. Prosome length, 3.04-3.24 mm; body length, 4.16-4.24 mm. Similar in habitus to *P. megaloba*, n. sp., and *P. aequatorialis* but distinguishable from them by the following characteristics: Laterally, rostrum nearly triangular with wide base (Fig. 33-a), straight

anterior margin, and slightly curved posterior margin. Supralabrum relatively large. Genital somite relatively short (Fig. 33-b), its dorsal wall (Fig. 33-c) with a low hump at middle, and without a low ridge as found in *P. aequatorialis* female as described below. Ventral margin of genital flange somewhat concave and roughly parallel to long axis of somite. Posterior edge of genital field produced into a relatively large lobe. Anterior margin of genital prominence bulging; posterior margin about 2/3 length of posterior ventral wall of somite and they meet in a sharp curve. Dorsally, genital somite (Fig. 33-d) symmetrical.

Cephalosomal appendages similar to those of *P. megaloba*, n. sp., except that outer lobe of Mx1 (Fig. 33-e) with 7 long setae plus a minute seta proximally. In P1 exopod (Fig. 33-f), outer spine of 1st segment tiny; that of 2nd segment extending beyond base of following outer spine by about 1/4 its length. In P2 exopod (Fig. 33-g), 1st and 3rd outer spines similar in size and a little shorter than 5th; 2nd and 4th outer spines similar in size and about 2.5 times length of 3rd; incision separating marginal lobe bearing 4th outer spine moderately deep.

Etymology. The specific name *mexicana* refers to the type locality, the Gulf of Mexico.

Remarks. Three female specimens on which this new species is based have been previously reported on (Park 1975) as *P. aequatorialis*, Tanaka 1958. When reexamined, they were found to be obviously different from *P. aequatorialis* Tanaka in the following features: The rostrum is much thicker; the dorsal hump of the genital somite is less pronounced; the genital flange is emarginate; the outer lobe of Mx1 has 7 long setae instead of 5; in the P1 exopod, the 2nd and 3rd outer spines are relatively long; in the P2 exopod, the 2nd and 4th outer spines are of equal length.

The material Vervoort (1963) described as *E. aequatorialis* from the Gulf of Guinea seems to belong to this new species according to the number of setae on the outer lobe of Mx1 and the morphological features of the swimming legs. However, Vervoort did not describe the details of the genital somite used here to characterize the species. The male Vervoort referred to *E. aequatorialis* also seems to belong to this new species. It differs from the original description of *P. aequatorialis* in the form of the serrated lamella of the left P5 exopod, which in Vervoort's specimen is relatively broad at the distal end rather than tapering in a point as described by Tanaka (1958). The male of *P. aequatorialis* found in the present study, as described below, is in full agreement with Tanaka's description.

Distribution. The Gulf of Mexico.

Paraeuchaeta aequatorialis Tanaka 1958
Figure 34

Paraeuchaeta aequatorialis Tanaka 1958, p. 348, fig. 72.

- Tanaka and Omori 1968, p. 225, Figs. 3A, 4A.

Euchaeta aequatorialis; Park 1978, p. 276, fig. 116.

Description of female. Prosome length, 3.40-3.90 mm; body length, 4.80-5.40 mm. Similar in habitus including urosome (Fig. 34-b) to *P. scotti, P. mexicana*, n. sp., and *P. rasa* but distinguishable from them by the following characteristics: Laterally, rostrum elongate (Fig. 34-a); forehead anterior to suprafrontal sensilla almost straight; dorsal wall of genital somite (Fig. 34-c) with a distinct hump at middle; ventral margin of genital flange only slightly convex or nearly straight, oblique in a posteroventral direction; posterior edge of genital field produced into a relatively wide lobe; anterior margin of genital prominence convex; posterior margin straight, about 2/3 length of posterior ventral wall of somite; a low, rounded ridge close to anterior margin of genital prominence on each side of genital somite.

Cephalosomal appendages similar to those of *P. scotti* except that outer lobe of Mx1 (Fig. 34-d) with 5 long setae and a minute seta proximally. Swimming legs (Figs. 34-e, f) also similar to those of *P. scotti* except that in P1 exopod, outer spine of 2nd segment reaching base of following outer spine.

Description of male. Prosome length, 3.2-3.6 mm; body length, 4.6-4.9 mm. Forehead (Fig. 34-g) in lateral view with smoothly curved dorsal margin. Rostrum moderately developed, pointing straight downward, with nearly straight anterior margin. Cephalosomal appendages similar to those of *P. malayensis.* In P1 exopod (Fig. 34-h), 1st segment without outer spine; outer spine of 2nd segment pointing in a posterolateral direction, about as long as that of 3rd segment. In P2 exopod (Fig. 34-i), 1st and 3rd outer spines equally small; 2nd and 5th outer spines equal in length and about 2/3 length of 4th. In 2nd exopodal segment of left P5 (Figs. 34-j, k), medial margin without an isolated toothlike process close to proximal end; serrated lamella dagger-shaped, entire length of its medial margin and distal 1/5 of its lateral margin serrated. Except for 1 relatively large tooth just posterior to middle of medial serrated margin, all marginal teeth of similar size. Laterodistal margin of segment with a rounded tubercular process next to serrated lamella. Digitiform process vermiform with rounded distal end.

Distribution. The species was originally described from both females and males from the Izu region of Japan (Tanaka 1958, Tanaka and Omori 1968). Park (1978) found the species in the southeastern Pacific. In the present study it was found in the South Atlantic, between 15°S and 35°S, and in the Pacific, where it occurred along the west coast of South America between 3°N and 35°S, in equatorial waters, the central North Pacific at 31°N, the Malay Archipelago, the South and East China seas, and off the Pacific coast of Japan up to 35°N. The species was also found in the eastern Indian Ocean between 5°S and 14°S and in the Bay of Bengal. However, it has not been found in the North Atlantic.

Paraeuchaeta rasa Farran 1929
Figure 35

Paraeuchaeta rasa Farran 1929, p. 240, fig. 10.

Euchaeta rasa; Vervoort 1957, p. 78, Figs. 57-59.

- Park 1978, p. 272, Figs. 113-115.

Description of female. Prosome length, 4.3-4.6 mm; body length, 5.8-6.4 mm. Similar in habitus to *P. scotti* and *P. aequatorialis* but readily distinguishable from them by the following features: Laterally, forehead anterior to suprafrontal sensilla almost straight (Fig. 35-a). Urosome relatively slender (Fig. 35-b). Dorsal wall of genital somite (Fig. 35-c) with a large hump posterior to middle. Posterior lobe of genital flange and posterior edge of genital field about on same level. Posterior margin of genital prominence about 1/3 length of posterior ventral wall of somite and almost perpendicular to it. Posterior ventral wall of somite strongly bulging. A low, rounded ridge close to anterior margin of genital prominence and a similar ridge close to posterior margin on each side of genital somite (Fig. 35-d).

Cephalosomal appendages similar to those of *P. aequatorialis* with a minor exception that 1st endopodal segment of Mx1 (Fig. 35-e) carrying 6 or 7 setae. Swimming legs (Figs. 35-f, g) also similar to those of *P. aequatorialis.*

Description of male. Prosome length, 4.0-4.4 mm; body length, 5.0-5.8 mm. Very similar to *P. aequatorialis* in habitus including forehead (Fig. 35-h) as well as appendages with exception of following details: In P1 exopod (Fig. 35-i), outer spine of 2nd segment pointing backward and about 2/3 length of that of 3rd segment. In P2 exopod (Fig. 35-j), 5th outer spine distinctly larger than 2nd and only slightly smaller than 4th. Serrated lamella (Figs. 35-k, l) of left P5 exopod terminated with 2 large teeth.

Distribution. This is one of the most common euchaetid species in deep water of both the Antarctic and the Subantarctic. In the southwestern Atlantic it has been reported as far north as 34°S (Park 1978). In the present study the species occurred south of 47°S in the Pacific and Indian oceans but in the southeastern Atlantic, it was found as far north as 31°S.

Paraeuchaeta papilliger, new species
Figure 36

Type material. Holotype female (PL=4.0 mm; BL=5.6 mm) (USNM 264843), allotype male (PL=3.5 mm; BL=4.8 mm) (USNM 264844), and 3 paratype females (USNM 264845) found in IKMT sample from 3000-0 m, SIO Francis Drake III, station 4, 2°57'N, 80°49'W in the eastern tropical Pacific. May 8, 1975. Sixteen paratype females (USNM 264846) found in IKMT sample from 2000-0 m. SIO MV 73-I, station 53, 13°24'N, 92°04'W in the eastern tropical Pacific, April 14, 1973.

Description of female. Prosome length, 3.8-4.2 mm; body length, 5.4-5.8 mm. Similar in habitus to *P. paraprudens*, n. sp., but readily distinguishable from it and other related species by the following features: Laterally, rostrum triangular with straight anterior and somewhat convex posterior margins (Fig. 36-a). Urosome robust (Fig. 36-b). Dorsal wall of genital somite (Figs. 36-c, e) with broad swelling just anterior to middle. Ventral margin of genital flange nearly straight, sloping in a posteroventral direction. Posterior edge of genital field produced into a relatively small lobe. A minor indentation marking where posterior margin of genital prominence meets posterior ventral wall of somite, but together they form a broad arc. Two tubercular outgrowths on left side of genital somite (Figs. 36-c, f) close to ventral wall anterior to genital prominence. The posterior one of the outgrowths has several ridges. Dorsally, genital somite (Fig. 36-d) with wavy lateral margins anterior to genital swelling. Second urosomal somite in lateral view with a low dorsal hump close to proximal end (Fig. 36-b).

Cephalosomal appendages including setation of Mx1 (Fig. 36-g) as in *P. malayensis* but seta on 2nd exopodal segment of A2 very small. In P1 exopod (Fig. 36-h), outer spine of 1st segment very small; that of 2nd segment a little short of reaching base of following outer spine. In P2 exopod (Fig. 36-i), 2nd outer spine reaching about base of 3rd and a little shorter than 4th; 1st, 3rd, and 5th outer spines equally small; incision separating marginal lobe bearing 4th outer spine moderately deep.

Description of male. Prosome length, 3.5-3.7 mm; body length, 4.8-5.2 mm. Laterally, rostrum triangular as in female but its anterior margin straight up to suprafrontal sensilla (Fig. 36-j). Cephalosomal appendages similar to those of *P. malayensis.* In P1 exopod, 1st segment with a minute outer spine which is often missing (Fig. 36-k); outer spine of 2nd segment relatively small, pointing backward. In P2 exopod (Fig. 36-l), 1st and 3rd outer spines equally small; 2nd and 5th outer spines of similar size and about 2/3 length of 4th. Fifth pair of legs similar to that of *P. aequatorialis* male but 2nd exopodal segment of left P5 (Figs. 36-m, n) with a large toothlike process on medial margin close to proximal end; medial margin of serrated lamella (Fig. 36-o) bordered with relatively large teeth interspersed with small teeth and distal half of lateral margin with small teeth; toothlike process next to serrated lamella on laterodistal margin of segment inconspicuous; digitiform process relatively robust with distal end variable from somewhat truncated to rounded.

Etymology. The specific name is formed from the Latin *papilla*, nipple or bud, and *gero*, to carry, alluding to the tubercular outgrowths on the female genital somite

Distribution. The species is represented by 47 females and 3 males found in 7 IKMT samples collected along the Pacific coast of America between 31°N and 12°S.

Paraeuchaeta sarsi (Farran 1908)
Figures 37 and 38

Euchaeta sarsi Farran 1908, p. 41, pl. 3, Figs. 15, 16.

- With 1915, p. 177, text fig. 50, pl. 6, fig. 7a (female only).
- Vervoort 1957, p. 84; 1963, p. 167.
- Park 1975, p. 19, fig. 17; 1978, p. 250, Figs. 97, 98.

Paraeuchaeta sarsi; Sars 1925, p. 114, pl. 31, Figs. 8-14.

- Sewell 1947, p. 127, text Figs. 29A, B.
- Tanaka 1958, p. 351, fig. 73.

Paraeuchaeta dentata Scott 1909, p. 76, pl. 21, Figs. 16-23.

- Tanaka and Omori 1968. p. 250, Figs. 3S, 4S, 18.

Description of female. Prosome length, 5.5-8.2 mm; body length, 7.8-11.3 mm. Body size highly variable between the smallest individuals at the lower latitudes and the largest at the higher latitudes. Being inversely related to body size, rostrum (Figs. 37-a, 38-a, b, e, h) also highly variable in size from a small spiniform process in the largest individuals from subantarctic waters to a large, elongate one in the small individuals from the lower latitudes. Urosome (Figs. 37-b, 38-d, g, j) robust in large individuals from higher latitudes but becomes more slender with decrease in body size toward lower latitudes. Laterally, dorsal wall of genital somite (Figs. 37-c, 38-c, f, i) nearly straight or with an inconspicuous hump just posterior to middle. Genital prominence in lateral view high and directed downward; it is narrower in small individuals. Ventral margin of genital flange emarginate; posterior lobe of the flange is well defined. Posterior edge of genital field only slightly produced to form a low and wide ridge. Posterior margin of genital prominence sloping onto posterior ventral wall of somite.

Cephalosomal appendages similar to those of *P. malayensis* except that outer lobe of Mx1 (Fig. 37-d) with 5 long setae in addition to 1 small and 2 or 3 minute setae proximally. In P1 exopod (Fig. 37-e), outer spine of 1st segment very small; that of 2nd segment a little short of reaching base of following outer spine. In P2 exopod (Fig. 37-f), 2nd outer spine reaching distal end of following outer spine and about 1.5 times length of 4th; 1st, 3rd, and 5th outer spines of similarly small size. Incision separating marginal lobe bearing 4th outer spine relatively shallow.

Description of male. Prosome length, 4.8-6.7 mm; body length, 6.8-9.4 mm. Rostrum (Fig. 37-g) highly variable in size as in female, tending to be smaller with increase in body size. Laterally, posterodorsal margin of prosome with small toothlike process (Fig. 37-h). Dorsally, posterolateral corners of prosome asymmetrical with left side being longer.

Cephalosomal appendages as in *P. malayensis.* In P1 exopod (Fig. 37-i), outer spine of 1st segment very small; that of 2nd segment usually pointing posteromediad and shorter than following outer spine. In P2 exopod (Fig. 37-j), 4th outer spine about 1.5 times length of 5th. Second exopodal segment of left P5 (Fig. 37-k) with a large toothlike process on medial margin close to proximal end. Serrated lamella (Fig. 37-l) of this segment very characteristic, consisting of more or less rectangular base and dagger-shaped extension straight along lateral margin. Small teeth bordering entire length of medial margin and distal 1/3 of lateral margin. Teeth decrease in size toward distal end. Toothlike process next to serrated lamella on laterodistal margin of segment vestigial. Digitiform process vermiform with enlarged, rounded distal end.

Remarks. This species exhibits a considerable degree of geographic variation in body size and in the shape of the rostrum (Figs. 37-a, 38-a, b, e, h) and female genital somite (Figs. 37-c, 38-c, f, i) both latitudinally and longitudinally. As described above, individuals from higher latitudes are larger, more robust, and have a smaller rostrum, while those from lower latitudes are smaller with a slender body and larger rostrum and in the females, with a more elongate genital somite and genital prominence. In the lower latitudes, individuals also show similar variations from the Atlantic westward to the Indian Ocean. Females from the tropical Indian Ocean are, therefore, quite distinct from those of the northern Atlantic, the type locality, or those of the Subantarctic, particularly in the shape of the genital somite. However, because the variations appear to be clinal, they are considered intraspecific, although it is still possible that *P. sarsi* is a species complex consisting of several cryptic species.

Distribution. This species was originally described from the Atlantic slope off Ireland and has since been recorded widely in the world's oceans. In the Atlantic it has been recorded throughout the area between 61°N (With 1915) and 57°S (Park 1978); in the Pacific, however, it

has been recorded only from off central Japan (Tanaka 1958), between 33°S and 59°S in the southeastern Pacific (Grice and Hulsemann 1968, Park 1978), and the Tasman Sea (Park 1978). The species has also been recorded from south of Australia between 46°S and 57°S (Park 1978), the western Indian Ocean between 2°N and 38°S (Grice and Hulsemann 1967), and the Arabian Sea (Sewell 1947).

In the present study the species was found widely in the Atlantic between 65°N and 36°S, in the South Pacific between 35°S and 49°S, the Malay Archipelago, the East China Sea, off southern Japan, and the tropical eastern Indian Ocean. It has not been found in the central and eastern Pacific north of 33°S and in the Antarctic south of 59°S.

Paraeuchaeta calva Tanaka 1958
Figure 39

Paraeuchaeta calva Tanaka 1958, p. 347, fig. 71.

Euchaeta calva; Park 1975, p. 10, fig. 9.

Paraeuchaeta comosa Tanaka 1958, p. 363, Figs. 79h-j (male only).

Euchaeta dubia; Vervoort 1963, p. 176, Figs. 21-23.

Paraeuchaeta californica; Tanaka and Omori 1968, p. 231, Figs. 3E, 4E, 7A-C.

Paraeuchaeta polita Tanaka and Omori 1968, p. 247, Figs. 3O, 4O, 15A-D.

Paraeuchaeta simulantis Tanaka and Omori 1968, p. 253, Figs. 3W, 4W, 19A-F.

Description of female. Prosome length, 5.3-6.1 mm; body length, 7.4-8.4 mm. Very similar in habitus to *P. sarsi* but distinguishable from it by the following characteristics: Laterally, rostrum (Fig. 39-a) more elongated and pointing more forward. Urosome also more elongated (Fig. 39-b). Ventral margin of genital flange (Fig. 39-c) strongly emarginate and posterior lobe of flange produced into a large toothlike process pointing in a posteroventral direction. Posterior edge of genital field scarcely produced beyond margin of genital prominence. Therefore, genital prominence is defined posteriorly by a nearly straight margin extending from genital flange to ventral wall of somite. Posterior section of genital somite as measured from distal end of genital flange relatively long, about 1.4-1.8 times length of genital flange, whereas it is about 1.0-1.2 times length of flange in *P. sarsi* female.

Cephalosomal appendages similar to those of *P. sarsi* except that outer lobe of Mx1 (Fig. 39-d) with 5 long setae and 3 minute setae proximally. Swimming legs (Figs. 39-e, f) practically identical to those of *P. sarsi.*

Description of male. Prosome length, 4.9-5.4 mm; body length, 6.8-7.9 mm. Similar in habitus, including toothlike process on posterodorsal margin of prosome (Fig. 39-h), to *P. sarsi* but rostrum (Fig. 39-g) is much more elongated. Cephalosomal appendages similar to those of *P. malayensis.* Swimming legs similar to those of *P. sarsi.* Second exopodal segment of left P5 (Fig. 39-i) with a large toothlike process on medial margin close to proximal end. Serrated lamella (Fig. 39-j) of this segment consisting of elongate, truncate main body with a small spiniform distal process along lateral margin. Relatively small teeth along entire length of medial margin and, in certain individuals, along a short distance of distal margin of main body; small teeth also present along about distal 1/3 of lateral margin including distal spiniform process. Medial margin of distal spiniform process, however, is not serrated. Toothlike process next to serrated lamella on laterodistal margin of segment in the form of a small bump. Digitiform process vermiform with rounded distal end.

Distribution. This species was originally described from the Izu region of Japan and has since been recorded from the Gulf of Guinea (Vervoort 1963 as *E. dubia*) and the Gulf of Mexico and Caribbean Sea (Park 1975). In the present study it was found in the northwestern Atlantic at 39°N, the central South Atlantic at 19°S, the central and western Pacific between 35°N and 25°S, the Malay Archipelago, the South and East China seas, and the Indian Ocean between 15°S and

25°S. The species seems to be limited to the tropical and temperate zones of the world's oceans but it has not yet been found in the eastern Pacific or the northeastern Atlantic.

Paraeuchaeta regalis (Grice and Hulsemann 1968)
Figure 40

Euchaeta regalis Grice and Hulsemann 1968, p. 329, Figs. 34-40 (female only).

- Park 1978, p. 253, Figs. 99-101.

Description of female. Prosome length, 6.4-6.9 mm; body length, 8.8-9.6 mm. Very similar in habitus including forehead (Fig. 40-a) and urosome (Fig. 40-b) to *P. calva* and can be distinguished from it only by carefully comparing the following features of genital somite (Figs. 40-c, d) in lateral view: Anterior and posterior lobes of genital flange separated by deep notch. Posterior lobe produced into a large conical process pointing usually straight downward. Posterior section of genital somite as measured from distal end of genital flange about 1.8-1.9 times length of flange, as opposed to 1.4-1.8 times length of flange as found in *P. calva.* Also different in body length (8.8-9.6 mm in *P. regalis*, 7.4-8.4 mm in *P. calva*) and geographical distribution (*P. regalis* is found in subantarctic waters and *P. calva* is found widely north to the Subantarctic).

Cephalosomal appendages including Mx1, outer lobe (Fig. 40-e) of which has 5 long and 3 minute setae, and swimming legs practically identical to those of *P. calva.*

Description of male. Prosome length, 5.8-6.0 mm; body length, 8.0-8.8 mm. Similar in habitus to *P. calva* but rostrum (Fig. 40-f) smaller, its anterior margin straight up to suprafrontal sensilla, and left distal end of prosome (Fig. 40-g) more produced distally. Cephalosomal appendages and swimming legs similar to those of *P. calva.* Fifth pair of legs also similar to that of *P. calva* except for serrated lamella (Fig. 40-h), of which mediodistal corner of rectangular main body produced mediad into a spiniform process and distal spiniform process more elongated in a laterodistal direction.

Distribution. This species was originally described from the southeastern Pacific between 33°S and 34°S and has subsequently been recorded widely in the Southern Ocean between 33°S and 67°S (Park 1978). In the present study it was found in the southeastern Atlantic between 31°S and 36°S and the Pacific between 39°S and 50°S.

Paraeuchaeta euryrhina, new species
Figure 41

Type material. Holotype female (PL=5.2 mm; BL=7.2 mm) (USNM 264847) and 6 paratype females (USNM 264848) found in IKMT sample from 2964-0 mwo, SIO Indopac VIII, station 6, 5°24'S, 133°39'E in the Banda Sea, the Malay Archipelago, September 19, 1976.

Description of female. Prosome length, 5.1-5.4 mm; body length, 7.1-7.3 mm. Similar in habitus to *P. sarsi* but distinguishable from it by the following features: Laterally, rostrum (Fig. 41-a) triangular with wide base, its anterior margin up to suprafrontal sensilla only slightly curved inward and its posterior margin similarly curved, and pointing almost downward. Urosome relatively short (Fig. 41-b). Genital somite (Fig. 41-c) including prominence with a depth-length ratio of 100:146. Dorsal wall with a low hump at middle. Measured along posterior margin, genital flange as high as rest of genital prominence. Ventral margin of genital flange slightly emarginate and almost parallel to long axis of body. Posterior edge of genital field produced into a small, narrow ridge. Posterior margin of genital prominence sloping about 45° with respect to long body axis, about 1/3 length of posterior ventral wall of somite. Dorsally, genital somite (Fig. 41-d) widest just anterior to middle.

Cephalosomal appendages as in *P. malayensis* and *P. sarsi* except that outer lobe of Mx1 (Fig. 41-e) with 7 long setae and 1 minute seta proximally. First leg (Fig. 41-f) similar to that of *P.*

sarsi. In P2 exopod (Fig. 41-g), marginal lobe bearing 2nd outer spine of 3rd segment relatively large and separated from segment by a deep incision.

Male unknown.

Etymology. The specific name is a combination of Greek *eurys*, broad, and *rhinos*, beak, alluding to the shape of the female rostrum as seen in lateral view.

Distribution. The species is represented by 7 females from a single station in the Banda Sea in the Malay Archipelago.

Paraeuchaeta plaxiphora, new species
Figure 42

Type material. Holotype female (PL=6.0 mm; BL=8.4 mm) (USNM 264849) and 1 paratype female (USNM 264850) found in IKMT sample from 5500-0 mwo, SIO MV 67-II, station 1, 35°22'N, 122°26'W, off California, June 9,1967.

Description of female. Prosome length, 6.0 mm; body length, 8.4 mm. Very similar in habitus to *P. euryrhina*, n. sp., but different from it in the following details: Laterally, anterior margin of rostrum (Fig. 42-a) straight up to suprafrontal sensilla, posterior margin slightly bulging close to proximal end. Urosome more elongated (Fig. 42-b). Genital somite (Figs. 42-c, d) relatively short with relatively high prominence, with a depth-length ratio of 100:118. Dorsal hump of genital somite located just posterior to middle. A small ridge on anterior margin of genital prominence. Genital flange relatively large, its ventral margin nearly straight or slightly emarginate and its posterior lobe large. Measured along posterior margin, genital flange as high as rest of prominence. Posterior edge of genital field produced into a relatively small conical process. Posterior margin of genital prominence sloping about 60° with respect to long body axis and smoothly curving to posterior ventral wall of somite, which is about 3 times length of sloping posterior margin of prominence.

Cephalosomal appendages similar to those of *P. euryrhina*, n. sp., but outer lobe of Mx1 (Fig. 42-e) with 9 setae as in *P. malayensis.* Swimming legs (Figs. 42-f, g) also similar to those of *P. euryrhina* except that outer spine of 1st exopodal segment of P1 better developed.

Male unknown.

Etymology. The specific name is a combination of the Greek *plax*, plate, and the suffix - *phor*, carry, alluding to the extraordinarily wide genital flanges of the female genital somite as seen in lateral view.

Distribution. Known only from 2 females found in a deep sample taken from off California.

Paraeuchaeta propinqua (Esterly 1906)
Figure 43

Euchaeta propinqua Esterly 1906, p. 61, pl. 9, fig. 9; pl. 10, Figs. 30, 33.

Description of female. Prosome length, 6.4 mm; body length, 9.0 mm. Very similar in habitus including rostrum (Fig. 43-a) to *P. plaxiphora*, n. sp., but different from it in shape of urosome including genital somite. Urosome relatively short (Fig. 43-b). Laterally, genital somite (Fig. 43-c) with a depth-length ratio of 100:124, its dorsal wall nearly straight without a noticeable hump. Genital flange high, with ventral margin only slightly emarginate. Measured along posterior margin, genital flange almost as high as rest of genital prominence. Posterior edge of genital field produced into a small conical process. Posterior margin of prominence sloping about 50° with respect to long body axis and about as long as posterior ventral wall of somite; they together forming a rather sharp curve.

Cephalosomal appendages including Mx1 (Fig. 43-d) as in *P. plaxiphora*, n. sp. Swimming legs also similar to those of *P. plaxiphora* with the following exceptions: In P1 exopod (Fig. 43-e),

outer spine of 1 st segment reaching 2/3 way to base of following outer spine, which is reaching close to base of outer spine of 3rd segment. Outer spine of 2nd exopodal segment in P2 (Fig. 43-f) reaching base of following outer spine.

Male unknown.

Remarks. This species was originally described from a single female 9 mm long from off San Diego, California. In the present study a female specimen of this species was found in a sample collected from 1000-0 m at 35°S, 74°W off Chile. The specimen was compared with Esterly's original specimen to verify the identity.

Paraeuchaeta brevirostris Brodsky 1950
Figure 44

Paraeuchaeta brevirostris Brodsky 1950, p. 215, fig. 129.

- Heptner 1971, p. 92. fig. 9.

Paraeuchaeta laudabilis Tanaka and Omori 1968, p. 239, Figs. 3L, 4L, 12.

Description of female. Prosome length, 5.2-5.7 mm; body length, 7.1-7.7 mm. Similar in habitus including forehead (Fig. 44-a) and urosome (Fig. 44-b) to *P. propinqua* but distinguishable from it by the following characteristics: Laterally, genital somite (Figs. 44-c, d) with a depth-length ratio of 100:120. Genital flange relatively low; its ventral margin emarginate and sloping in a posteroventral direction. Posterior edge of genital field produced into a conspicuous lobe some distance from genital flange. Posterior margin of genital prominence sloping about 60° with respect to long body axis and curving to posterior ventral wall of somite, which is about as long as sloping posterior margin of prominence. Small low ridges found close to anterior base of prominence on each side of genital somite.

Cephalosomal appendages similar to those of *P. malayensis* and *P. propinqua* except that 2 proximal setae of outer lobe of Mx1 (Fig. 44-e) very small. Swimming legs similar to those of *P. propinqua* with the following exceptions: In P1 exopod (Fig. 44-f), 1st segment with highly bulging outer margin and very small outer spine; 2nd segment with outer spine slightly overreaching base of following outer spine. In P2 exopod (Fig. 44-g), 2nd and 4th outer spines of similar length; incision separating marginal lobe bearing 4th outer spine deep, reaching close to level of preceding incision.

Description of male. Prosome length, 4.4-4.6 mm; body length, 6.3-6.5 mm. Similar in habitus to *P. malayensis* but rostrum (Fig. 44-h) relatively short with wide base, straight anterior margin, and pointing downward. Cephalosomal appendages and 4 pairs of swimming legs (Figs. 44-i, j) also similar to those of *P. malayensis* except that in P1 exopod, outer spine of 2nd segment curved outward and pointing in a posterolateral direction. Second exopodal segment of left P5 (Figs. 44-k, l) with a large toothlike process on medial margin close to proximal end. Serrated lamella (Fig. 44-m) of this segment scoop-shaped, with teeth bordering entire length of margin except for proximal portion of lateral margin. Teeth on medial margin decrease in size toward distal end and those on distal and lateral margins relatively small. Toothlike process next to serrated lamella on laterodistal margin of segment well developed. Digitiform process elongate and distally tapering along lateral margin into a short spiniform process pointing outward as in *P. scotti.*

Remarks. This species was originally described from a female (7.1 mm long) and a male (6.0 mm long) collected from a depth of 4000-1000 m in the northwestern Pacific. It is however the description of Heptner (1971) that has provided diagnoses of the species for the first time. *Paraeuchaeta laudabilis* Tanaka and Omori 1968, based on a single female 7.35 mm long obtained from the Izu region of Japan, was considered by Heptner (1971) a synonym of *P. brevirostris.* Tanaka and Omori's specimen was reexamined in the present study to verify its identity with *P. brevirostris.*

The species is represented in this study by 10 females and 3 males collected from off

northern Japan and the Kuril Islands in the northwestern Pacific between 33 °N and 46°N and 1 female obtained from off Vancouver Island in the northeast Pacific.

Paraeuchaeta abyssalis Brodsky 1950
Figure 45

Paraeuchaeta abyssalis Brodsky 1950, p. 219, fig. 133.

- Heptner 1971, p. 90, fig. 8.

Description of female. Prosome length, 6.1-6.6 mm; body length, 8.8-9.3 mm. Laterally, anterodorsal margin of forehead (Fig. 45-a) nearly straight. Rostrum elongate, pointing in a more forward direction than anterodorsal margin of forehead; its anterior margin beginning a short distance from suprafrontal sensilla and slightly concave; its posterior margin nearly straight. Urosome robust (Fig. 45-b). Genital somite (Figs. 45-c, d) with a depth-length ratio of 100:137; its dorsal wall bulging at about 1/3 its length from proximal end. Anterior and posterior margins of genital prominence smoothly and almost symmetrically curving to ventral wall of somite. Posterior margin about as long as posterior ventral wall of somite, together forming a smooth symmetrical arch. Genital flange emarginate, lying obliquely; its posterior lobe rounded. Posterior edge of genital field extending beyond genital flange in parallel to long body axis, without protruding beyond margin of genital prominence. A tall conical outgrowth on left side and a low ridge on right side of genital somite close to anteroventral wall.

Cephalosomal appendages similar to those of *P. malayensis* except that 1st endopodal segment of Mx1 (Fig. 45-e) with 6 setae and outer lobe with 6 long setae and a small seta proximally. In P1 exopod (Fig. 45-f), outer margin of 1st segment bulging out and outer spine very small; outer spine of 2nd segment extending straight backward behind 3rd segment and reaching base of terminal spine of 3rd segment. In P2 exopod (Fig. 45-g), 2nd outer spine extending beyond base of following outer spine; 3rd outer spine about twice length of 1st or 5th; 4th outer spine longer than 2nd by 1/5 its length; marginal lobe bearing 4th spine separated from segment by a deep incision reaching level of preceding incision.

Male unknown.

Remarks. This species was first described from the northwestern Pacific. In the present study it was found at 3 widely separated localities: 2 females from off the Pacific coast of central Japan, 1 female from the Tasman Sea, and 2 females from off Central America in the tropical eastern Pacific.

Paraeuchaeta altibulla, new species
Figure 46

Type material. Holotype female (PL=6.4 mm; BL=8.9 mm) (USNM 264851) found in ORI-100 net sample from 4400-0 m, ORI KH 67-3, station 5-1, 33°04'N, 141°55'E off the Pacific coast of central Japan, September 16-17, 1967. One paratype female (USNM 264852) found in MOCNESS sample from 4006-3880 m, UHG *Meteor* 70, Moc 4, 47°20'N, 19°44'W, in the northeastern Atlantic, May 21, 1985. The following type materials are in the collection of H. Weikert, UHG: 1 paratype female found in MOCNESS sample from 3665 m, UHG *Meteor* 6/7, Moc 12, 47°18'N, 19°25'W, in the northeastern Atlantic, April 7, 1988; 1 paratype female found in MOCNESS sample from 4260-4000 m, UHG *Meteor* 6/7, Moc 24, 47°15'N, 19°28'W, in the northeastern Atlantic, May 10, 1988.

Description of female. Prosome length, 5.75-6.40 mm; body length, 8.00-8.90 mm. Similar in habitus to *P. abyssalis* and *P. calva* but can be distinguished from them by combination of following characteristics: Laterally, rostrum (Fig. 46-a) beginning some distance from suprafrontal sensilla, pointing nearly parallel to anterodorsal margin of forehead. Urosome elongate (Fig. 46-b).

Dorsal wall of genital somite (Figs. 46-c, d) smoothly and broadly curved. Genital flange relatively low, with small but distinct posterior lobe pointing posteroventrad. Posterior edge of genital field produced into low ridge some distance from genital flange. Posterior margin of genital prominence slightly bulging and nearly perpendicular to, and merging in a curve into, posterior ventral wall of somite, which is nearly twice length of posterior margin of prominence excluding posterior edge of genital field. A low tubercular outgrowth close to ventral wall anterior to genital prominence on left side of genital somite. Ventrally (Fig. 46-e), genital somite widest anterior to middle; posterior lobe of genital flange pointing mediad.

Cephalosomal appendages similar to those of *P. abyssalis* except that 1st endopodal segment of Mx1 with 7 setae as in *P. malayensis.* Outer lobe of Mx1 (Fig. 46-f) with 6 long setae followed by a small proximal seta as in *P. abyssalis.* Swimming legs similar to those of *P. abyssalis* except that outer spine of 1st exopodal segment of P1 (Fig. 46-g) better developed and in P2 exopod (Fig. 46-h), 4th outer spine only slightly longer than 2nd and incision separating its marginal lobe short of reaching level of preceding incision.

Male unknown.

Etymology. The specific name *altibulla*, from Latin *altus* meaning high and *bulla* denoting a knob, alludes to the shape of the prominent posterior lobe of the female genital flange.

Distribution. The species is represented by 4 females: 1 from the northwestern Pacific off central Japan and 3 taken in 3 separate tows in the northeastern Atlantic southwest of Ireland.

Paraeuchaeta californica (Esterly 1906)
Figure 47

Euchaeta californica Esterly 1906, p. 60, pl. 9, fig. 11; pl. 10, Figs. 26, 34.

- Park 1977, p. 136, fig. 1.

Euchaeta dubia Esterly, 1906, p. 63, pl. 9, fig. 7; pl. 11, fig. 36; pl. 13, fig. 66; pl. 14, Figs. 84, 85.

Description of female. Prosome length, 5.5-5.9 mm; body length, 7.6-8.2 mm. Similar in habitus to *P. calva* but distinguishable from it by the following features: Laterally, rostrum (Fig. 47-a) relatively large, pointing almost parallel to anterior dorsal margin of forehead; its anterior margin straight, beginning a short distance from suprafrontal sensilla. Urosome relatively short (Fig. 47-b). Distal part of genital somite (Fig. 47-c) as measured from posterior end of genital flange about 1.9 times length of genital flange. Dorsal wall of somite with a low hump at middle. Ventral margin of genital flange emarginate, sloping in a posterodorsal direction at an angle of about 15° with respect to posterior ventral wall of somite. Anterior lobe of genital flange large, pointing anteroventrad; posterior lobe smaller, pointing posteroventrad. Posterior edge of genital field not produced. Posterior margin of genital prominence extending nearly straight up to genital flange, at an angle of about 55° with respect to posterior ventral wall of somite, which is about twice as long as posterior margin of genital prominence. Anterior margin of prominence somewhat bulging. Second urosomal somite (Fig. 47-b) in lateral view with a conspicuous dorsal hump just anterior to middle.

Cephalosomal appendages including Mx1 (Fig. 47-d) similar to those of *P. malayensis.* Swimming legs also similar to those of *P. malayensis* with the following exceptions: In P1 exopod (Fig. 47-e), outer margin of 1st segment strongly bulging; outer marginal lobe of 2nd segment well developed and its spine short of reaching base of following outer spine. In P2 exopod (Fig. 47-f), incision separating marginal lobe bearing 2nd outer spine of 3rd segment short of reaching level of preceding incision.

Description of male. Prosome length, 4.8-5.3 mm; body length, 6.8-7.6 mm. Similar in habitus including forehead (Fig. 47-g) and urosome to *P. calva* except that toothlike process on posterodorsal margin of prosome vestigial. Cephalosomal appendages and 4 pairs of swimming legs similar to those of *P. malayensis.* Fifth pair of legs similar to that of *P. calva* except for

serrated lamella of left leg exopod (Fig. 47-h), main body of which in anterior view bilobed along medial margin, large and rounded proximal lobe and triangular distal lobe. Distal extension of serrated lamella clawlike, with few teeth on laterodistal margin. Digitiform process relatively thick, with broadly rounded distal end.

Distribution. The female and male of this species were originally described as separate species (as *Euchaeta californica* and *E. dubia*, respectively) from off San Diego. Park (1977) redescribed the species from specimens collected at the type locality and reviewed the literature records. With the possible exception of the record by Davis (1949) from off northern California and Oregon, all the records of *P. californica.* (including *E. dubia*) from outside the type locality were found to be not referable to this species.

In the present study the species was found to range along the Pacific coast of America between 38°N and 23°S; in the equatorial Pacific between 16°N and 3°S, its range was found to extend from the American coast westward up to 160°W.

Paraeuchaeta birostrata Brodsky 1950
Figure 48

Paraeuchaeta birostrata Brodsky 1950, p. 213, fig. 127.

- Tanaka 1958, p. 359, fig. 77.
- Tanaka and Omori 1968, p. 228, Figs. 3C, 4D, 6.
- Heptner 1971, p. 79, fig. 2.

Description of female. Prosome length, 5.1-6.3 mm; body length, 7.0-8.4 mm. Similar in habitus including forehead (Fig. 48-a) and urosome (Fig. 48-b) to *P. californica* but distinguishable from it by the following features: Laterally, rostrum relatively small; its anterior margin beginning some distance from suprafrontal sensilla and strongly hollow; its posterior margin more or less straight. Genital somite (Figs. 48-c, d) with a dorsal hump just posterior to middle. Ventral margin of genital flange nearly straight or only slightly emarginate and nearly parallel to posterior ventral wall of somite or its anterior end only slightly tilted downward. Posterior edge of genital field not protruding. Posterior margin of genital prominence, extending up to genital flange, about as long as posterior ventral wall of somite and sloping about 50° with respect to posterior ventral wall of somite. Anterior margin of prominence somewhat bulging. A low ridge close to anterior base of prominence on left side of somite. Second urosomal somite (Fig. 48-b) with a dorsal hump about 1/3 length of somite from proximal end.

Cephalosomal appendages including Mx1 (Fig. 48-e) similar to those of P. *californica.* Swimming legs also similar to those of *P. californica* except that in P1 exopod (Fig. 48-f), outer margin of 2nd segment not strongly curved and outer spine reaching close to base of following outer spine. In P2 exopod (Fig. 48-g), incision separating 2nd marginal lobe of 3rd segment far short of reaching level of preceding incision; outer spine on this marginal lobe far short of reaching base of following outer spine and a little longer than outer spine of 2nd segment.

Description of male. Prosome length, 4.7-5.1 mm; body length, 6.6-7.4 mm. Similar in habitus including rostrum (Fig. 48-h) to *P. californica.* Cephalosomal appendages as in *P. malayensis.* Four pairs of swimming legs (Figs. 48-i, j) similar to those of *P. californica* except that in P2 exopod, incision separating 2nd marginal lobe of 3rd segment relatively shallow. Serrated lamella of left P5 (Fig. 48-k) in anterolateral view scoop-shaped, broadly rounded distally, with teeth along entire length of margin except for short proximal section of lateral margin; size of teeth increasing toward distal end. Laterally (Fig. 48-l), however, distal margin of lamella more or less flat: its mediodistal corner occupied by a relatively large tooth. Digitiform process (Fig. 48-m) with rounded, greatly enlarged distal end.

Distribution. This species has been found in the northwestern Pacific, the Bering Sea, and the Sea of Okhotsk (Brodsky 1950, Heptner 1971) and off the Pacific coast of central Japan

(Tanaka 1958, Tanaka and Omori 1968). In the present study it was one of the most common euchaetid species along the coast of the northern Pacific including the American side between 29°N and 35°N, south of the Aleutian Islands from 155°W westward, and the Pacific side of the Kuril Islands and Japan between 47°N and 34°N.

Paraeuchaeta confusa Tanaka 1958
Figure 49

Paraeuchaeta confusa Tanaka 1958, p. 344, fig. 70.

- Tanaka and Omori 1968, p. 232, Figs. 3F, 4F, 8.
- Park 1975, p. 13, fig. 11.

Description of female. Prosome length, 4.9-5.3 mm; body length, 6.8-7.3 mm. Laterally, rostrum (Fig. 49-a) large, spiniform, its anterior margin beginning some distance from suprafrontal sensilla and straight, forming an angle of about 20° with anterodorsal margin of forehead. Urosome elongate (Fig. 49-b). Dorsal wall of genital somite (Fig. 49-c) smoothly curved. Ventral margin of genital flange slightly bulging and strongly oblique in a posteroventral direction. Posterior edge of genital field produced into a conspicuous lobe, ventral margin of which relatively long, straight and nearly perpendicular to distal edge of genital flange. Posterior margin of genital prominence strongly convex, with an irregular outline, a little shorter than posterior ventral wall of somite, which is also bulged out; they meet at a sharp angle. Anterior margin of prominence nearly straight or slightly bulging out with a small inconspicuous ridge at middle.

Cephalosomal appendages including Mx1 (Fig. 49-d) similar to those of *P. malayensis* except that 2 small proximal setae of Mx1 outer lobe extending laterad, instead of pointing proximad, and in certain individuals, one or both of the small proximal setae (Figs. 49-e, f) are much reduced in size. In P1 exopod (Fig. 49-g), outer spine of 1st segment very small; that of 2nd segment short of reaching base of following outer spine. In P2 exopod (Fig. 49-h), 2nd outer spine reaching middle of following outer spine and a little longer than 4th outer spine; marginal lobe bearing 4th outer spine separated from segment by a relatively deep incision.

Description of male. Prosome length, 4.3-4.6 mm; body length, 6.5-6.9 mm. Similar to *P. malayensis* in habitus including forehead (Fig. 49-i) and distal end of prosome (Fig. 49-j), cephalosomal appendages, and 4 pairs of swimming legs (Figs. 49-k, l) with a minor exception that in P2 exopod, 2nd marginal lobe of 3rd segment separated from segment by a relatively shallow incision. Serrated lamella of left P5 exopod (Figs. 49-m, n) very characteristic in having 4 large, triangular, serrated teeth along medial margin and laterodistal corner projected into a small serrated tooth. Digitiform process also very characteristic in terminating with a wide, bilobed structure.

Remarks. Paraeuchaeta confusa reported by Heptner (1971) differs significantly in the lateral aspect of the female genital somite from the specimens described here, which are in full agreement with those originally described by Tanaka (1958).

Distribution. This species was known only from the Izu region of Japan, the type locality (Tanaka and Omori 1968), until Park (1975) recorded it in the Caribbean Sea. In the present study the species was found off the Pacific coast of Japan and in the East China Sea between 25°N and 35°N. The Caribbean specimens previously reported on are identical in all morphological features to those from the western Pacific, the type locality.

Paraeuchaeta comosa Tanaka 1958
Figure 50

Paraeuchaeta comosa Tanaka 1958, p. 363, Figs. 79a-g (female only).

Euchaeta comosa; Park 1975, p. 12, fig. 10; 1978, p. 268, Figs. 111, 112.

Paraeuchaeta hansenii; Tanaka 1958, p. 362, Figs. 78g-h (male only).

Paraeuchaeta dubia; Tanaka and Omori 1968, p. 234, Figs. 3G, 4G (female only).

Euchaeta regalis Grice and Hulsemann 1968, p. 331, Figs. 41-48 (male only).

Description of female. Prosome length, 5.9-7.4 mm; body length, 7.8-10.0 mm. Laterally, rostrum (Fig. 50-a) elongate, pointing obliquely forward at an angle of about 10° with respect to anterodorsal margin of forehead, and only slightly curved downward. Urosome robust (Fig. 50-b). Dorsal margin of genital somite (Fig. 50-c) smoothly curved. Genital flange with nearly straight or slightly bulging ventral margin and produced posteriorly into a large lobe. Posterior edge of genital field also produced distally into a relatively large lobe followed by posterior margin of genital prominence, which is bulging into characteristic curve and longer than posterior ventral wall of somite by about 1/4 its length. A low ridge is present close to anterodorsal margin on left side of genital somite.

Cephalosomal appendages similar to those of *P. malayensis* except that outer lobe of Mx1 (Fig. 50-d) with 6 long setae and 1 short seta proximally. In P1 exopod (Fig. 50-e), outer spine of 2nd segment short of reaching base of following outer spine. In P2 exopod (Fig. 50-f), outer spine of 2nd segment reaching middle of following outer spine. Second outer spine of 3rd segment longer than outer spine of 2nd segment by about 1/4 its length; marginal lobe bearing this 2nd outer spine separated from segment by an extraordinarily deep incision, which overreaches preceding incision.

Description of male. Prosome length, 5.3-6.3 mm; body length, 7.5-8.8 mm. Similar in habitus including forehead (Fig. 50-g) and distal end of prosome (Fig. 50-h) to *P. malayensis* but rostrum more elongated. Cephalosomal appendages and 4 pairs of swimming legs also similar to those of *P. malayensis* but in P2 exopod (Fig. 50-i), incision separating 2nd marginal lobe of 3rd segment reaching as high as preceding incision and 2nd outer spine relatively larger. Serrated lamella of left P5 exopod (Figs. 50-j-l) tapering in dagger shape; proximal half of its medial margin serrated with fine teeth, while varying length of distal portion of medial margin only or distal portions of both medial and lateral margins serrated with relatively large teeth; middle portion of medial margin and most of lateral margin not serrated. Digitiform process distally enlarged and rounded.

Distribution. Since its original discovery in the Izu region of Japan, *P. comosa* has been recorded from the southeastern Pacific (as the male of *Euchaeta regalis*) by Grice and Hulsemann (1968), the Gulf of Mexico and Caribbean Sea by Park (1975), the southwestern Atlantic at 34°S, the southeastern Pacific between 33°S and 57°S, and south of Australia at 46°S by Park (1978). In the present study it was found in all three great oceans: In the South Atlantic between 15°S and 36°S; in the southeastern Pacific between 35°S and 47°S, the central Pacific between 31°N and 45°S, and the western Pacific including the East and South China seas, Malay archipelago and Tasman Sea between 35°N and 50°S; in the Indian Ocean between 5°S and 35°S.

According to all the previous records together with the present findings, *P. comosa* is one of the most widely distributed euchaetid species. Its distribution is now established in the following areas: The Gulf of Mexico and Caribbean Sea, the South Atlantic between 15°S and 36°S; the eastern Pacific between 31°S and 57°S, the central Pacific between 31°N and 45°S, the western Pacific including the East and South China seas, Malay Archipelago, and Tasman Sea between 35°N and 50°S; and the Indian Ocean between 5°S and 46°S. The species is, however, conspicuously absent in the eastern Pacific from 31°S northward and in the entire North Atlantic except the Gulf of Mexico and Caribbean Sea.

Paraeuchaeta hansenii (With 1915)

Figure 51

Euchaeta hansenii With 1915, p. 181, text fig. 52.

- Park 1975, p. 17, fig. 14; 1978, p. 246, Figs. 95, 96.

Euchaeta sarsi; With 1915, p. 178, pl. 6, fig. 7b (male only).
Paraeuchaeta hansenii; Sars 1925, p. 115, pl. 31, Figs. 15-18.

- Tanaka 1958, p. 361, Figs. 78a-f (female only).
- Tanaka and Omori 1968, p. 237, Figs. 3J, 4J.

Paraeuchaeta withi Sewell 1947, p. 131, fig. 30.
- Tanaka and Omori 1968, p. 258, fig. 22.

Description of female. Prosome length, 6.0-7.0 mm; body length, 8.1-9.7 mm. Similar in habitus to *P. comosa* but readily distinguishable from it by the following characteristic features: Laterally, rostrum (Fig. 51-a) relatively short and thick, pointing obliquely forward in parallel to anterodorsal margin of forehead. Urosome robust (Fig. 51-b). Genital somite (Fig. 51-c) with a low dorsal hump just anterior to middle. Genital flange with emarginate ventral margin and produced distally into an extraordinarily large lobe. Posterior edge of genital field produced into a relatively small but high conical process followed by short and convex posterior margin of genital prominence, which is about 1/2 length of posterior ventral wall of somite. A low ridge is found close to anterodorsal margin on each side of genital somite.

Cephalosomal appendages including Mx1 (Fig. 51-d) as in *P. malayensis.* In P1 exopod (Fig. 51-e), outer spine of 1st segment relatively large; that of 2nd segment far short of reaching base of following outer spine. In P2 exopod (Fig. 51-f), outer spine of 2nd segment reaching about base of following outer spine and about as long as 2nd outer spine of 3rd segment; 2nd marginal lobe of 3rd segment separated from segment by a moderately deep incision.

Description of male. Prosome length, 5.7-6.5 mm; body length, 8.1-8.9 mm. Similar in habitus to *P. comosa* but rostrum (Fig. 51-g) much thicker with wide base and pointing more forward. Cephalosomal appendages and 4 pairs of swimming legs (Figs. 51-h, i) similar to those of *P. malayensis* except that in P2 exopod, incision separating 2nd marginal lobe of 3rd segment relatively shallow. Serrated lamella of left P5 exopod (Fig. 51-j) tapering in form of elongate scoop terminated with blunt, outwardly curved end when viewed anteriorly. Medial margin bordered with relatively large teeth except for a short distance in proximal half, which is serrated with very fine teeth. Distal 2/3 of lateral margin also serrated, with fine teeth along a short proximal portion and relatively large teeth along the rest. Teeth on distal end of lamella small or vestigial. Digitiform process in form of elbow, with thick proximal and narrow distal arms and terminated with somewhat enlarged, rounded end when viewed anteriorly.

Distribution. This species has been recorded in the Atlantic from the Norwegian Sea at 60°N (With 1915), near the Azores (Sars 1925), the Florida Current (Owre and Foyo 1967), the Gulf of Mexico and Caribbean Sea (Park 1975), and the southwestern Atlantic at 26°S (Park 1978); in the Pacific from off the Pacific coast of central Japan (Tanaka 1958, Tanaka and Omori 1968) and the southeastern Pacific between 30°S and 39°S (Grice and Hulsemann 1968, Park 1978); and in the Indian Ocean from the Arabian Sea (Sewell 1947), the western Indian Ocean between 5°N and the equator (Grice and Hulsemann 1967), and south of Australia at 46°S (Park 1978).

In the present study the species was found in the Atlantic between 47°N and 36°S; in the eastern and central Pacific between 38°N and 47°S; in the western Pacific including the East and South China seas, Malay Archipelago, and Tasman Sea between 35°N and 50°S; and in the Bay of Bengal and the Indian Ocean between 10°N and 25°S. These findings together with the previous records establish a very wide geographic range for this species which extends from 60°N down to 36°S in the Atlantic, from 35°N to 50°S in the Pacific, and from the Bay of Bengal and the Arabian Sea down to 46°S south of Australia. Within this range records are still missing along the Pacific coast of the Americas between 35°N and 30°S.

Paraeuchaeta eminens Tanaka and Omori 1968
Figure 52

Paraeuchaeta eminens Tanaka and Omori 1968, p. 235, Figs. 3I, 4I, 10.

Euchaeta eminens; Park 1978, p. 268, fig. 110.

Description of female. Prosome length, 4.3-4.6 mm; body length, 5.8-6.6 mm. Laterally, rostrum (Fig. 52-a) roughly triangular with wide base, pointing nearly downward; its anterior margin continuing almost straight up to suprafrontal sensilla. Urosome relatively slender (Fig. 52-b). Dorsal wall of genital somite (Fig. 52-c) smooth and only slightly curved. Genital flange with somewhat emarginate ventral margin, about parallel to long axis of body, and produced distally into an extraordinarily large lobe. Posterior edge of genital field produced distally into a relatively small ridge followed by very short posterior margin of genital prominence about 1/6 length of posterior ventral wall of somite.

Cephalosomal appendages similar to those of *P. malayensis* except that outer lobe of Mx1 (Fig. 52-d) with 7 long setae and a minute seta proximally. Swimming legs also similar to those of *P. malayensis* with following exceptions: In P1 exopod (Fig. 52-e), outer spine of 2nd segment a little short of reaching base of following outer spine. In P2 exopod (Fig. 52-f), 2nd outer spine of 3rd segment far short of reaching base of following outer spine and about as long as outer spine of 2nd segment.

Description of male. Prosome length, 3.9 mm; body length, 5.6 mm. Laterally, rostrum (Fig. 52-g) robust with wide base, pointing straight downward; its anterior margin beginning from suprafrontal sensilla nearly straight. Cephalosomal appendages and 4 pairs of swimming legs (Figs. 52-h, i) similar to those of *P. malayensis*. Serrated lamella of left P5 exopod (Figs. 52-j-l) spoon-shaped with expanded and hollow distal end. Except for proximal section of lateral margin, lamella is bordered with teeth, which increase in size toward distal end. Digitiform process greatly enlarged distally in form of baseball bat.

Remarks. This species was originally described from 2 female specimens. The male is described here for the first time.

Distribution. Besides the type locality off the Pacific coast of central Japan, the species has also been recorded from the Tasman Sea at 40°S (Park 1978). In the present study it was found in the East and South China seas, the Malay Archipelago, and the Coral Sea, all of which lie between the 2 previous records in the western Pacific.

Paraeuchaeta investigatoris Sewell 1929
Figure 53

Paraeuchaeta investigatoris Sewell 1929, p. 158, text fig. 60: 1947, p. 125, fig. 28.
- Tanaka and Omori 1968, p. 237, Figs. 3K, 4K, 11.

Paraeuchaeta californica; Scott 1909, p. 71, pl. 15, Figs. 1-8.

Description of female. Prosome length, 4.2-4.8 mm; body length, 5.8-6.6 mm. Laterally, rostrum (Fig. 53-a) thick, pointing obliquely forward in parallel to anterodorsal margin of forehead; its anterior margin beginning some distance from suprafrontal sensilla and nearly straight. Urosome robust (Fig. 53-b). Genital somite (Figs. 53-c, d) with a highly conspicuous dorsal hump about 1/3 its length from proximal end. Genital flange with extraordinarily large posterior lobe, which on left side extending in a posterodorsal direction and which on right side in posteroventral direction. Posterior edge of genital field not produced and merged indistinguishably into posterior margin of genital prominence, which is bulging with more or less irregular outline and a little longer than posterior ventral wall of somite.

Cephalosomal appendages similar to those of *P. malayensis* except that outer lobe of Mx1 (Fig. 53-e) with 6 long setae in addition to 2 minute setae proximally. In P1 exopod (Fig. 53-f), outer margin of 1st segment strongly bulging and outer spine very small. Outer spine of 2nd segment far

short of reaching base of following outer spine. In P2 exopod (Fig. 53-g), outer spine of 2nd segment extending beyond distal end of following outer spine and a little longer than 2nd outer spine of 3rd segment. Incision separating 2nd marginal lobe of 3rd segment moderately deep.

Description of male. Prosome length, 3.9-4.4 mm; body length, 5.4-6.5 mm. Similar to *P. malayensis* in habitus including rostrum (Fig. 53-h) and in details of cephalosomal appendages. In P1 exopod (Fig. 53-i), 1st segment without outer spine. Outer spine of 2nd segment relatively small, pointing straight backward. In P2 exopod (Fig. 53-j), incision separating 2nd marginal lobe of 3rd segment moderately deep. Anterolaterally, serrated lamella of left P5 exopod (Fig. 53-k) tapering sigmoidally into bifurcate distal end; medial margin bordered with relatively large teeth and lateral margin not serrated. Digitiform process (Fig. 53-l) vermiform with broadly rounded distal end, extending beyond distal end of serrated lamella.

Distribution. This species was originally described from 3 male specimens collected in the Bay of Bengal and has since been recorded from the Arabian Sea and Gulf of Aden (Sewell 1947) and the Izu region of Japan (Tanaka and Omori 1968). The female was first described by Scott (1909) as *Paraeuchaeta californica* from the Malay Archipelago (Sewell 1947). In the present study the species occurred in the South China Sea, Malay Archipelago, and Bay of Bengal.

Paraeuchaeta rubicunda (Farran 1908)
Figure 54

Euchaeta rubicunda Farran 1908, p. 44, pl. 3, Figs. 8-10.

Description of female. Prosome length, 6.35 mm; body length, 8.66 mm. Laterally, rostrum (Fig. 54-a) nearly triangular, pointing obliquely forward; its anterior margin extending up to suprafrontal sensilla and roughly straight. Urosome robust (Fig. 54-b). Genital somite (Figs. 54-c, d) with a conspicuous dorsal hump close to proximal end. Ventral margin of genital flange convex, facing anteroventrad. Left genital flange with large, well-defined posterior lobe pointing posteroventrad, followed by equally well-defined lobe formed by projecting posterior edge of genital field. Posterior margin of genital prominence smoothly bulging and as long as posterior ventral wall of somite. Right genital flange (Fig. 54-f) larger than left and its posterior lobe pointing posteroventrad. When viewed from right side, posterior edge of genital field appearing as a low, wide ridge, similar in shape to posterior lobe of genital flange of same side. Each side of anterior end of genital operculum produced into a tubercular process, which in lateral view projecting beyond genital flange. Dorsally, genital somite (Fig. 54-e) with several ridges on left side close to proximal end. Ventrally, genital field (Fig. 54-g) slightly asymmetrical with dissimilar posterior lobes of genital flanges.

Cephalosomal appendages similar to those of *P. malayensis* except that 1st endopodal segment of Mx1 (Fig. 54-h) with 6 setae and outer lobe with 7 long setae plus 2 minute setae proximally. In P1 exopod (Fig. 54-i), outer margin of 1st segment strongly bulging and outer spine very small. Outer spine of 2nd segment reaching close to base of following outer spine. In P2 exopod (Fig. 54-j), outer spine of 2nd segment extending slightly beyond base of following outer spine and a little shorter than 2nd outer spine of 3rd segment. Incision separating 2nd marginal lobe of 3rd segment moderately deep.

Male unknown.

Remarks. This species was originally described from a single female 8.8 mm long collected from deep water of the northeastern Atlantic off Ireland (55°01'N, 10°45'W). In the present study it is represented by a single female taken from 1850-1650 m at 47°23'N, 19°10'W close to the type locality. The specimen was found to be in good agreement in morphology with the original description except that 7 long setae, instead of 5 as described by Farran, were found on the outer lobe of the left Mx1 and only 4 on the same lobe of the right Mx1.

Paraeuchaeta gracilicauda Scott 1909
Figure 55

Paraeuchaeta gracilicauda Scott 1909, p. 72, pl. 18, Figs. 9-16.

Euchaeta gracilicauda; Park 1975, p. 13, fig. 12.

Description of female. Prosome length, 4.3-5.3 mm; body length, 6.2-7.9 mm. Laterally, rostrum (Fig. 55-a) of long spiniform, pointing obliquely forward in parallel to anterodorsal margin of forehead. Urosome slender (Fig. 55-b). Genital somite (Fig. 55-c) including prominence with a depth-length ratio of about 100:151, with smoothly and broadly curved dorsal margin. Genital flange with nearly straight ventral margin and produced distally into a large conical posterior lobe. Posterior edge of genital field extending far beyond genital flange but not projecting into a lobe similar to posterior lobe of genital flange as in *P. vorax* described below. Posterior margin of genital prominence smoothly and indistinguishably curving into ventral wall of somite. A low ridge is found on left side of genital somite posterior to genital prominence and close to ventral wall of somite; it is easily seen when the somite is tilted.

Cephalosomal appendages as in *P. malayensis* except that outer lobe of Mx1 (Fig. 55-d) with 5 long setae. In P1 exopod (Fig. 55-e), outer margin of 1st segment strongly bulging and outer spine very small. Outer spine of 2nd segment a little short of reaching base of outer spine of 3rd segment, which is about 1/3 length of terminal spine. In P2 exopod (Fig. 55-f), outer spine of 2nd segment extending beyond middle of following outer spine and longer than 2nd outer spine of 3rd segment by about 1/4 its length. Second marginal lobe of 3rd segment separated from segment by moderately deep incision.

Description of male. Prosome length, 4.3-4.5 mm; body length, 6.2-6.5 mm. Similar in habitus including forehead (Fig. 55-g), distal end of prosome (Fig. 55-h), and details of cephalosomal appendages and 4 pairs of swimming legs to *P. malayensis* with following exceptions: Rostrum nearly straight, pointing more forward; its anterior margin beginning some distance from suprafrontal sensilla and more or less straight. In P1 exopod (Fig. 55-i), 1st segment without outer spine; outer spine of 2nd segment relatively short and curved slightly inward. In P2 exopod (Fig. 55-j), incision separating 2nd marginal lobe of 3rd segment relatively shallow. Serrated lamella of left P5 exopod (Figs. 55-k, l) tapering in the form of a triangular, hollow scoop with rounded end, with uniform marginal teeth along entire length of medial margin and distal 1/2 of lateral margin. Digitiform process vermiform, extending beyond distal end of serrated lamella by about 1/5 its length, and its distal end sharply bent outward.

Distribution. This species has been recorded from the Malay Archipelago, the type locality, and the Gulf of Mexico and Caribbean Sea (Park 1975). In the present study it occurred widely in the tropical and temperate zones of the entire Pacific including waters along the Pacific coast of America between 31°N and 13°N, the central Pacific between 31°N and 10°S, and the western Pacific including the South China Sea, Malay Archipelago, Coral Sea, and Tasman Sea between 34°N and 50°S. This is one of the Pacific species occurring in the Gulf of Mexico and Caribbean Sea of the Atlantic, but not in the rest of the Atlantic.

Paraeuchaeta vorax (Grice and Hulsemann 1968)
Figure 56

Euchaeta vorax Grice and Hulsemann 1968, p. 331, Figs. 49-52.

-Park 1975, p. 21, fig. 19.

Paraeuchaeta striata Tanaka and Omori 1968, p. 257, Figs. 3X, 4X, 21.

Description of female. Prosome length, 4.9-5.3 mm; body length, 6.9-7.3 mm. Similar in habitus to *P. gracilicauda* but distinguishable from it by the following features: Laterally, rostrum (Fig. 56-a) thick and relatively short, pointing obliquely forward almost in parallel to anterodorsal margin of forehead; its anterior margin beginning a short distance from suprafrontal sensilla and

straight. Urosome less slender (Fig. 56-b). Laterally, genital somite (Fig. 56-c) including prominence with a depth-length ratio of about 100:137. Dorsal wall smoothly curved with peak about 1/3 its length from proximal end. Genital flange with nearly straight ventral margin and produced distally into a large lobe pointing posteroventrad. Posterior edge of genital field also produced into a large lobe. Posterior margin of genital prominence distinctly set apart from posterior edge of genital field and continuing on to ventral wall of somite in a smooth curve. A conspicuous ridge is present close to posterior ventral wall on left side of genital somite (Fig. 56-d).

Cephalosomal appendages and swimming legs similar to those of *P. gracilicauda* with following exceptions: Outer lobe of Mx1 (Fig. 56-e) with 1 or 2 minute setae in addition to 5 long setae. Outer spine of 2nd exopodal segment of P1 (Fig. 56-f)) far short of reaching base of following outer spine. In P2 exopod (Fig. 56-g), outer spine of 2nd segment slightly longer than 2nd outer spine of 3rd segment; 1st outer spine of 3rd segment nearly twice as long as 3rd.

Description of male. Prosome length, 4.66 mm; body length, 6.66 mm. Similar in habitus as well as details of cephalosomal appendages and 4 pairs of swimming legs to *P. gracilicauda* except that rostrum (Fig. 56-h) much thicker, left distal end of prosome less produced (Fig. 56-i) and outer spine of 2nd exopodal segment of P1 (Fig. 56-j) sharply turned inward. Fifth pair of legs also similar to that of *P. gracilicauda* but readily distinguished from it by the following details: Second exopodal segment of left leg (Figs. 56-k, l) without a large separate tooth on medial margin close to proximal end. Viewed laterally, serrated lamella tapering into an elongate triangle with uniformly fine marginal teeth. Digitiform process tapering distally into curved, pointed process.

Distribution. This species has so far been found in the southeastern Pacific at 34°S (Grice and Hulsemann 1968), off the Pacific coast of central Japan (Tanaka and Omori 1968 as *P. striata*), and the Gulf of Mexico and Caribbean Sea (Park 1975). In the present study it was found at 5 widely separated localities as follows: The central South Pacific at 25°S, the northwestern Pacific at 20°N, off the Pacific coast of central Japan, the eastern Indian Ocean at 5°S, and the western Indian Ocean at 35°S. This is another example of Indo-Pacific species occurring in the Gulf of Mexico and Caribbean Sea but not in the rest of the Atlantic.

Paraeuchaeta kurilensis Heptner 1971
Figure 57

Paraeuchaeta kurilensis Heptner 1971, p. 83, fig. 4.

Euchaeta longissima Park 1978, p. 283, Figs. 121, 122.

Description of female. Prosome length, 4.16-5.80 mm; body length, 5.83-7.90 mm. Similar in habitus including rostrum (Fig. 57-a) and urosome (Fig. 57-b) to *P. vorax* but can be distinguished from it by the absence of a conspicuous ridge on the left side of the genital somite. In form of genital somite, this species resembling closely *P. gracilicauda* but distinctly different from it in form of rostrum, which is relatively short and thick in this species but very elongated in *P. gracilicauda.* Ventral margin of genital flange (Fig. 57-c) more convex than in either *P. vorax* or *P. gracilicauda.*

Cephalosomal appendages as in *P. gracilicauda* and *P. vorax* with minor exceptions that 1st endopodal segment of Mx1 with 6 setae and outer lobe (Fig. 57-d, e) with 2 small setae proximally, which are somewhat variable in size, in addition to 5 long setae. In P1 exopod (Fig. 57-f), outer spine of 2nd segment reaching base of outer spine of 3rd segment, which is only a little shorter than 1/2 length of terminal spine. In P2 exopod (Fig. 57-g), outer spine of 2nd segment extending to or beyond distal end of following outer spine and about as long as 2nd outer spine of 3rd segment; incision separating 2nd marginal lobe of 3rd segment relatively deep.

Description of male. Prosome length, 4.08-4.80 mm; body length, 5.91-6.90 mm. Similar in habitus and details of appendages to *P. gracilicauda* and *P. vorax* but distinguishable from them by the following differences: Rostrum (Fig. 57-h) relatively short as in *P. vorax* but much narrower.

Serrated lamella of left P5 exopod (Figs. 57-i, j) similar to that of *P. gracilicauda* but its distal end much broader. Digitiform process with rounded distal end as in *P. gracilicauda* but it is straight and short of reaching distal end of serrated lamella.

Remarks. The original description of this species was based on females 8.00-8.35 mm long collected from depths of 4000-1900 m in the Kuril Trench. The specimens found in the present study, which are identical with those I have previously described as *E. longissima* from the Antarctic, are smaller than, and slightly different in some morphological details from Heptner's original specimens, one of which was reexamined in the present study. The main differences include the shape of the genital flange, which in Heptner's specimens has a ventral margin tilted more forward than in my specimens, and the 1st outer spine of the P1 exopod, which reaches halfway to the base of the following spine in Heptner's specimens, while it is very small in my specimens.

Distribution. This species has been recorded from the Kuril Trench of the northwestern Pacific (Heptner 1971) and the Antarctic (Park 1978, as *E. longissima*). In the present study it was found, in addition to 1 locality (76°S, 160°W) in the Pacific sector of the Antarctic, at 10 widely separated new localities as follows: the northeastern Atlantic between 47°N and 49°N, the eastern South Atlantic at 32°S, the central South Atlantic at 30°S, 2 localities at 13°N and 15°N, respectively, in the eastern tropical Pacific off Central America, the central North Pacific at 31 °N, 2 localities at 33°N and 35°N, respectively, off the Pacific coast of Japan, the Tasman Sea at 47°S, and the western Indian Ocean at 35°S. These findings together with the previous records establish the geographic range of the species as extending from the Antarctic into all 3 great oceans and as far north as 49°N in both the Atlantic the Pacific and 35°S in the Indian Ocean.

Paraeuchaeta abbreviata (Park 1978)
Figures 58 and 59

Euchaeta abbreviata Park 1978, P. 240, Figs. 92, 93.

Description of female. Prosome length, 5.40-5.80 mm, body length, 7.50-8.10 mm. Body robust. Laterally, dorsal outline of forehead (Fig. 58-a) only slightly arched, ending anteriorly in a low frontal eminence. Laterally, rostrum large with broad base, pointing forward nearly in parallel to anterior dorsal margin of forehead. Distal margin of prosome rounded. Urosome robust (Fig. 58-b). Genital prominence high, occupying center of genital somite (Figs. 58-c-e); its posterior margin following genital field sloping about 45° with respect to long axis of somite. Ventral margin of genital flange in lateral view straight or somewhat emarginate and produced distally into a posterior lobe. Genital field also produced distally into a similar lobe. Dorsally, genital somite symmetrical, widest at middle. Ventrally, genital field (Fig. 58-f) also symmetrical, ovoid across somite. Posterior lobe of each genital flange pointing inward. Right side of genital somite in some specimens (Fig. 58-e) had a small conical process close to anterior base of genital prominence.

Antennule, A2, Md, Mx2. and Mxp similar in morphological details to those of *P. malayensis.* First inner lobe of Mx1 with 1+9+3 setae as in *P. malayensis.* However, basis with only 4 setae without a small outermost seta; 1st endopodal segment with 5 setae; outer lobe with 6 long setae in addition to 2 minute setae proximally (Fig. 58-g).

In P1 exopod (Fig. 58-h), line representing fused joint between 1st and 2nd segments vaguely visible. First segment with strongly bulging outer edge and very small outer spine. Outer spine of 2nd segment small, extending less than 1/3 way to distal end of 3rd segment. Outer spine of 3rd segment longer than segment itself.

Of outer spines of P2 exopod (Fig. 58-i), that of 2nd segment longest, extending beyond distal end of following outer spine. Second outer spine of 3rd segment a little shorter than outer spine of 2nd segment and short of reaching base of following outer spine. First outer spine of 3rd segment distinctly longer than 3rd.

Description of male. Prosome length, 4.85-4.96 mm; body length, 6.87-7.10 mm. Laterally, dorsal margin of forehead (Fig. 59-a) broadly arched, with a low frontal eminence. Rostrum thick, pointing downward. Prosome in lateral view with rounded distal end (Fig. 59-b), without a toothlike process on posterodorsal margin.

Cephalosomal appendages similar in morphological details to those of *P. malayensis.* In P1 exopod (Fig. 59-c), outer edge of 1st segment only slightly bulging. First outer spine minute. Second outer spine extending about 1/3 way to base of following outer spine. Outer spine of 3rd segment about equal in length to segment itself. In P2 exopod (Fig. 59-d), outer spines 2, 3, and 5 similar in length, about 1/2 length of outer spine 4.

In left P5 (Figs. 59-e-g), 2nd exopodal segment with a toothlike process on medial margin close to proximal end. Serrated lamella in anterior view characteristically curved in sigmoid form, distally tapering in a large spiniform process, with uniformly small teeth along entire length of medial margin and a few sparsely arranged teeth along distal part of lateral margin. Size of lateral marginal teeth were somewhat variable among individuals. Digitiform process nearly as long as serrated lamella, more or less curved laterad when viewed anteriorly and tapering distally into a spiniform process. Third exopodal segment extending beyond distal end of serrated lamella by its distal half.

Remarks. In morphological details of the appendages, this species differs in the female from all of the species described above of this species group in the following respects: Mx1 with only 4 setae on basis and 5 setae on 1st endopodal segment; outer spine of 2nd exopodal segment of P1 very short.

Distribution. The species was first described from the Antarctic. In the present study it is represented by 37 females and 4 males from 4 samples: 1 in the Antarctic at 76°S, 160°W; 1 in the Tasman Sea at 47°S, and 2 in the eastern tropical Pacific off Central America at 13°N and 15°N, respectively.

Paraeuchaeta parabbreviata, new species
Figure 60

Type material. Holotype female (PL=5.1 mm; BL=7.3 mm) (USNM 264853) from IKMT sample, 3750-0 mwo, SOSC *Eltanin* cruise 26, station 1839, 47°08'S, 161°58'E, in the Tasman Sea, December 12, 1966. One paratype female (USNM 264854) from MOCNESS sample, 3500-3000 m, UHG *Meteor* 6/7, Moc 21, 48°45'N, 16°38'W, in the northeastern Atlantic, May 4, 1988. Two paratype females (USNM 264855) from MOCNESS sample, 3250-3000 m, UHG *Meteor* 6/7, Moc 24, net 8, 47°15'N, 19°28'W, May 10, 1988. The following type materials are in the collection of H. Weikert, UHG: Two paratype females from MOCNESS sample, 3500-3000 m, UHG *Meteor* 6/7, Mocl3, 47°22'N, 19°18'W, April 11, 1988; one paratype female from MOCNESS sample, 3500-3250 m, UHG *Meteor* 6/7, Moc 24, net 7, 47°15'N, 19°28'W, May 10, 1988.

Description of female. Prosome length, 4.33-5.10 mm; body length, 6.25-7.30 mm. Similar in habitus including rostrum (Fig. 60-a) to *P. abbreviata* but different from it in the following features: Urosome including genital somite more slender (Fig. 60-b). Dorsal wall of genital somite (Fig. 60-c) more convex 1/4 its length from proximal end. Posterior lobe of genital flange conspicuously produced in form of small conical process pointing posteroventrad. Posterior edge of genital field produced into a low and wide ridge some distance from genital flange. Posterior margin of genital prominence together with posterior ventral wall of somite forming a strongly curved arch.

Cephalosomal appendages similar to those of *P. abbreviata* except that basis of Mx1 (Fig. 60-d) with 5 setae as in *P. malayensis* and 1st endopodal segment in some specimens with 4 setae, instead of 5 (Fig. 60-e), with small innermost seta missing. Swimming legs (Figs. 60-f, g) also similar to *P. abbreviata* with exception of following details: in P2 exopod, 2nd outer spine of 3rd segment longer than 1st by about 1/3 its length and about 2/3 length of outer spine of 2nd segment.

Male unknown.

Etymology. The specific name, formed with the Greek prefix *para* - near, refers to the apparent relationship of this new species with *P. abbreviata.*

Distribution. The species is represented in the present study by 7 females: 1 from the Tasman Sea and 6 found in 4 separate samples taken in the northeastern Atlantic.

Paraeuchaeta alaminae (Park 1975)
Figure 61

Euchaeta alaminae Park 1975, p. 23, fig. 20.

Description of female. Prosome length, 4.50-5.30 mm; body length, 6.35-7.60 mm. Laterally, dorsal wall of forehead (Fig. 61-a) broadly arched. Rostrum robust with broad base, pointing obliquely forward in parallel to anterior dorsal margin of forehead. Urosome elongate (Fig. 61-b). Dorsal wall of genital somite (Fig. 61-c) rather strongly arched. A low ridge is found close to anterior dorsal wall on each side of genital somite. Genital prominence high, occupying about middle of somite; its anterior margin somewhat convex; its posterior margin similarly convex, with posterior edge of genital field produced into a conical lobe about 1/3 distance from genital flange to ventral wall of somite. Genital flange in lateral view appearing three-lobed but in ventral view, consisting of low anterior lobe and large, medially extending posterior lobe.

Cephalosomal appendages similar to those of *P. malayensis* except that outer lobe of Mx1 (Fig. 61-d) with 5 long setae plus a minute seta proximally. In P1 exopod (Fig. 61-e), outer margin of 1st segment strongly bulging and outer spine very small; outer spine of 2nd segment very small as in *P. abbreviata*, reaching less than 1/3 way to base of following outer spine and pointing in a posteromedial direction. In P2 exopod (Fig. 61-f), outer spine of 2nd segment reaching middle of following outer spine and longer than 2nd outer spine of 3rd segment by about 1/3 its length; incision separating 2nd marginal lobe of 3rd segment moderately deep.

Male unknown.

Distribution. This species was originally described from a single female from 2900-0 m in the western Caribbean Sea. In the present study it is represented by a single specimen obtained from 2000-0 m off the Pacific coast of Central America at 15°35'N, 98°10'W, which constitutes the second rinding of the species and the first record outside the type locality.

Paraeuchaeta anfracta, new species
Figure 62

Type material. Holotype female (PL=7.8 mm; BL=10.3 mm) (USNM 264856) and 1 paratype female (USNM 264857) from IKMT sample, 2000-0 m, SIO MV 73-1, station 53, 13°24'N, 92°04'W, in the eastern tropical Pacific, April 14, 1973. One paratype female (USNM 264858) from IKMT sample, 2100-0 mwo, SOSC *Eltanin* cruise 38, station 10, 40°06'S, 152°00'E, in the Tasman Sea, May 7, 1969. One paratype female (USNM 264859) from ORI-100 plankton net sample, 8000-0 mwo, ORI KH 67-3, station 5-1, 33°04'N, 141°55'E, off the Pacific coast of central Japan, September 16-17, 1967.

Description of female. Prosome length, 7.7-8.0 mm; body length, 10.3-10.5 mm. Laterally, dorsal wall of forehead (Fig. 62-a) smoothly arched, ending in a rather low frontal eminence. Rostrum relatively small, pointing straight downward; its anterior margin beginning some distance from suprafrontal sensilla and straight. Supralabrum with distal end pointing downward. Urosome robust (Fig. 62-b). Genital somite (Figs. 62-c, d) with strongly sigmoid dorsal wall. Genital prominence high; its anterior margin slightly bulging and sloping about 55° with respect to ventral wall of somite; its posterior margin perpendicular to ventral wall of somite. Genital flange with well-defined posterior lobe in form of conical process pointing posteroventrad. Posterior edge of genital field produced into a small process pointing in same direction as posterior lobe of genital

flange but not projecting beyond posterior margin of prominence. Posterior region of ventral wall of genital somite including posterior part of prominence densely pitted.

Cephalosomal appendages similar to those of *P. malayensis* except that basis of Mx1 (Fig. 62-e) with 4 setae, without small outermost seta; 1st endopodal segment with 4 setae, and outer lobe with 7 long setae and a small seta proximally. In P1 exopod (Fig. 62-f), outer margin of 1st segment strongly bulging and outer spine vestigial; outer spine of 2nd segment borne on a conspicuous marginal lobe, pointing posteromediad and far short of reaching midway to base of following outer spine. In P2 exopod (Fig. 62-g), outer spine of 2nd segment reaching close to distal end of following outer spine and about twice length of 2nd outer spine of 3rd segment, which is only a little longer than 1st outer spine. Incision separating 2nd marginal lobe of 3rd segment moderately deep.

Male unknown.

Etymology. The specific name *anfracta*, Latin meaning crooked, alludes to the sigmoidally curved dorsal wall of the female genital somite as seen in lateral view.

Remarks. This species is readily distinguished by its genital somite, which is highly characteristic in having a sigmoidally curved dorsal wall, high prominence, small but well-defined posterior lobe of the genital flange, and conical posterior edge of the genital field. In morphological details of appendages, however, this species is closely allied with *P. abbreviata* in having only 4 setae on the basis and less than 6 setae on the 1st endopodal segment of Mx1 and a very short outer spine on the 2nd exopodal segment of P1.

Distribution. The species is represented in the present study by 4 females: 2 from the eastern tropical Pacific and 1 each from the northwestern Pacific off central Japan and the Tasman Sea.

PAVLOVSKII SPECIES GROUP

Diagnosis. Appendicular caudal setae geniculated. Supralabrum (Fig. 63-a) pointing straight downward. Genital flange (Fig. 63-c) elongate along length of genital field in the form of a tongue, with well-developed posterior lobe. In Mx1 (Fig. 63-f), 1st inner lobe with 1 anterior, 9 marginal, and 2 posterior setae; 1st endopodal segment with 2 to 6 setae. None of maxillary setae (Fig. 63-g) heavily armed with long spinules. All setae on Mxp basis (Fig. 63-h) normally shaped. Outer spine of 2nd exopodal segment of P1 (Fig. 63-i) very small.

Composition. Paraeuchaeta pavlovskii Brodsky 1955; *P. scopaeorhina*, n. sp.; *P. sesquipedalis*, n. sp.; *P. dactylifera* (Park 1978); and *P. vervoorti* (Park 1978).

Remarks. Paraeuchaeta vervoorti is distinct from the other species in that the 1st endopodal segment of Mx1 has 5 or 6 setae, while the same segment has just 2 setae in the others. *Paraeuchaeta pavlovskii* and *P. dactylifera* are different from *P. scopaeorhina* and *P. sesquipedalis* in having no seta on the 2nd inner lobe of Mx1.

Key to species of *pavlovskii* species group (based on females)

1a. In Mx1 endopod, 1st segment with 5 or 6 setae (Fig.68-e) ..... *P. vervoorti*
1b. In Mx1 endopod, 1st segment with 2 setae (Fig.63-f) 2

2a. Basis of Mx1 with 3 setae (Fig.67-e); genital flange with long, fingerlike posterior lobe (Fig.67-c) ..... *P. dactylifera*
2b. Basis of Mx1 with 5 setae (Fig.63-f); genital flange with relatively short posterior lobe (Figs.63-c, 66-c) 3

3a. In Mx1, 2nd inner lobe with a seta (Fig.65-d) 4

3b. In Mx1, 2nd inner lobe without a seta (Fig.63-f) ..... *P. pavlovskii*

4a. Laterally, rostrum and genital prominence small (Figs.65-a, 65-c) ..... *P. scopaeorhina*, n. sp.

4b. Laterally, rostrum and genital prominence large (Figs.66-a, 66-c) ..... *P. sesquipedalis*, n. sp.

Paraeuchaeta pavlovskii Brodsky 1955
Figures 63 and 64

Paraeuchaeta pavlovskii Brodsky 1955, p. 186, figs 1-14.

- Tanaka and Omori 1967, p. 246.
- Tanaka and Omori 1968, p. 243, Figs. 3N, 4N, 14.

Description of female. Prosome length, 7.7-8.0 mm; body length, 11.0-11.2 mm. Body robust. Laterally, dorsal margin of forehead (Fig. 63-a) smoothly curved, bearing an inconspicuous frontal eminence, and ending in a rather small rostrum pointing straight downward. Supralabrum pointing downward, furnished with a crown of stiff, long hairs also pointing downward. Laterally, posterior end of prosome (Fig. 63-b) somewhat angular with a dense patch of long hairs on ventral side. Urosome robust.

Genital somite (Figs. 63-c, d) in lateral view with a relatively high genital prominence, whose posterior margin merges into ventral wall of somite in a smooth curve. Anterior margin of prominence only slightly bulging. Genital flange rather low, produced distally into a toothlike posterior lobe. Dorsal margin of somite with an inconspicuous hump at middle. Dorsally, genital somite symmetrical, widest at middle. Ventrally, posterior lobe of genital flange pointing inward as in *P. abbreviata.*

Antennule reaching close to distal end of prosome when pressed against body. In A2 (Fig. 63-e), basis and 1st endopodal segment each with 2 inner marginal setae. Seta on 2nd exopodal segment relatively long. Mandible as in *P. malayensis.*

In Mx1 (Fig. 63-f), 1st inner lobe with 1+9+2 setae, 2nd inner lobe without a seta, and 3rd inner lobe with a seta; basis with 5 setae, outermost of which smallest; 1st endopodal segment with 2 setae; exopod with 11 setae, proximalmost of which smallest; outer lobe with 7 subequal setae plus 2 minute setae proximally.

In Mx2 (Fig. 63-g), only first 2 lobes each with a patch of small spinules at base of its posterior seta. Spinules on terminal setae of first 3 lobes very short and found only on distal half of seta. Terminal setae of 4th and 5th lobes and endopodal setae fringed with very fine spinules. In Mxp (Fig. 63-h), marginal setae of coxa poorly armed with spinules. First of 3 middle marginal setae of basis not strongly curved and 2nd not thickened at proximal end as in *P. malayensis.*

First 2 exopodal segments of P1 (Fig. 63-i) partially separated. First segment with a highly bulging outer edge and a very small outer spine. Outer spine of 2nd segment very small. Anteriorly, distal border of 2nd exopodal segment of P2 (Fig. 63-j) without a row of find spinules as found in *P. malayensis.* None of external marginal lobes of exopod are separated from segment by an unusually deep incision. Of outer spines of exopod, that of 2nd segment longest, reaching base of following outer spine. Second outer spine of 3rd segment only slightly longer than either 1st or 3rd.

Description of male. Prosome length, 6.6 mm; body length, 9.1 mm. Laterally, dorsal margin of forehead (Fig. 64-a) smoothly arched, ending anteriorly in a relatively small rostrum pointing downward. Frontal eminence inconspicuous. Dorsally, posterolateral corners of prosome more or less symmetrical. Laterally, distal margin of prosome rounded; toothlike process on posterodorsal margin vestigial.

Antennule reaching close to distal end of prosome when pressed against body. In morphological details, all cephalosomal appendages as in *P. malayensis.* First 2 exopodal segments

of P1 (Fig. 64-b) separate. Outer spine of 1st segment minute; that of 2nd segment small, pointing in a posteromedial direction. In P2 exopod (Fig. 64-c), outer spines 2, 3, and 5 similar in length, only slightly longer than outer spine 4.

Second exopodal segment of left P5 (Figs. 64-d-f) without a toothlike process on medial margin close to proximal end as found in *P. malayensis*. Anteriorly, serrated lamella (Fig. 64-g) elongated like a spatula, teeth of similar size bordering entire length of medial margin and distal half of lateral margin. When tilted slightly mediad or laterad, lamella can be seen to be hollow. Digitiform process a little shorter than serrated lamella, strongly curved laterad and tapering into a blunt end when viewed anteriorly. Distal spine of 3rd exopodal segment small and fine.

Remarks. This species was first described from female specimens 10.4-10.8 mm long obtained from deep water of the Bering Sea and Kuril-Kamchatka Trench. The male is described here for the first time. The female can be diagnosed by the following features: The supralabrum points downward; the maxillule has 1+9+2 setae on its 1st inner lobe; the middle marginal setae of the Mxp basis are all normally shaped; and the 2nd exopodal segment of P1 has a very small outer spine. The male can be identified, as in the other species of the genus, mainly by the shape of the serrated lamella and digitiform process of the 2nd exopodal segment of the left P5.

Distribution. This species has so far been found in deep water of the Bering Sea and Kuril-Kamchatka Trench (Brodsky 1955) and off the Pacific coast of central Japan (Tanaka and Omori 1967, 1968). In the present study it is represented by 2 females and 1 male found in a IKMT sample from 3000-0 mwo in Sagami Bay, Japan.

Paraeuchaeta scopaeorhina, new species
Figure 65

Type material. Holotype female (PL=7.7 mm; BL=10.8 mm) (USNM 264860) from IKMT sample, 5500-0 mwo, SIO MV 67-11, station 1, 35°22'N, 122°27'W, off California, June 9, 1967. Two paratype females (USNM 264861) from IKMT sample, 5600-0 mwo, SIO MV 69-VI, station 7, 31°12'N, U9°18'W, off California, December 17-18, 1969. Two paratype females (USNM 264862) from IKMT sample, 5000-0 mwo, SIO MV 71-1, station 20, 29°17'N, 116°57'W, off Baja California, May 24, 1971. One paratype female (USNM 264863) from IKMT sample, 3000-0 m, SIO Francis Drake III, station 4, 2°57'N, 80°49'W, off Ecuador, May 8, 1975. One paratype female (USNM 264864) from IKMT sample, 5500-0 mwo, SIO MV 65-1V, station 3, 11°59'S, 79°01'W, off Peru, December 21, 1965. Two paratype females (USNM 264865) from IKMT sample, 5500-0 mwo, SIO Southtow IV, MV 72-II, station 36, 13°47'S, 77°49'W, off Peru, May 12, 1972.

Description of female. Prosome length, 7.5-8.0 mm; body length, 10.8-11.8 mm. Similar in habitus including forehead (Fig. 65-a) and urosome (Fig. 65-b) to *P. pavlovskii* but distinguishable from it by the following differences: Laterally, rostrum (Fig. 65-a) very small, pointing straight downward. Anterior margin of forehead highly convex. Anterior side of supralabrum nearly perpendicular to body, with hairs extending in same direction. Genital somite (Fig. 65-c) with dorsal hump just anterior to middle of somite. Genital prominence small, occupying much less than 1/2 length of somite. Genital flange with somewhat convex ventral margin. Posterior margin of prominence together with posterior ventral wall of somite forming a rather shallow arch.

Cephalosomal appendages similar to those of *P. pavlovskii* except that 2nd inner lobe of Mx1 (Fig. 65-d) with a seta; outer lobe with 8 long setae. Outer spine of 2nd exopodal segment of P1 (Fig. 65-e) very small, pointing in a posterolateral direction. In P2 exopod (Fig. 65-f), outer spine of 2nd segment far short of reaching base of following outer spine; 1st and 3rd outer spines of 3rd segment similar in size and only a little smaller than 2nd.

Male unknown.

Etymology. The specific name *scopaeorhina*, from Greek *skopaios* meaning dwarf and *rhinos* meaning nose, alludes to the very small rostrum.

Distribution. This new species is represented in the study by 9 females found in 6 deep tows taken along the Pacific coasts of the Americas between 35°N and 14°S.

Paraeuchaeta sesquipedalis, new species
Figure 66

Type material. Holotype female (PL=7.0 mm; BL=9.8 mm) (USNM 264866), allotype male (PL=6.2 mm; BL=8.5 mm) (USNM 264867), and 4 paratype females (USNM 264868) from IKMT sample, 5500-0 mwo, SIO MV 66-11, station 5, 38°13'N, 124°07'W, off California, May 24, 1966. One paratype female (USNM 264869) from IKMT sample, 5600-0 mwo, SIO MV 69-VI, station 7, 31°12'N, 119°18'W, off California, December 17-18, 1969. One paratype female (USNM 264870) from IKMT, 5000-0 mwo, SIO MV 71-1, station 20, 29°17'N, 116°57'W, off Baja California, May 24, 1971. One paratype female (USNM 264871) from IKMT sample, 4000-0 mwo, SIO Lusiad VII, station 19, 31°09'S, 00°45'E, in the southeastern Atlantic, June 9, 1963.

Description of female. Prosome length, 6.1-7.0 mm; body length, 8.9-9.8 mm. Similar in habitus to *P. pavlovskii* but distinguishable from it by the following features: Laterally, rostrum (Fig. 66-a) relatively large and its anterior margin sigmoidally curved. Supralabrum massive, with distal end sharply bent downward. Urosome slender (Fig. 66-b). Dorsal margin of genital somite (Figs. 66-c, d) nearly straight with slight hump at middle. Genital prominence large, occupying middle half of somite; its anterior margin markedly swollen. Genital flange projecting distally into a long, toothlike process. Posterior edge of genital field produced into a small but well-defined conical process. Posterior margin of genital prominence together with posterior ventral wall of somite forming smooth and shallow concavity.

Cephalosomal appendages similar to those of *P. pavlovskii* except that 2nd inner lobe of Mx1 (Fig. 66-e) with a seta and outer lobe with a small proximal seta in addition to 7 long setae. In P1 exopod (Fig. 66-f), 1st segment with strongly convex outer margin and a very small outer spine; outer spine of 2nd segment small, pointing posteromediad. In P2 exopod (Fig. 66-g), outer spine of 2nd segment short of reaching base of following outer spine and longer than 2nd outer spine of 3rd segment by 1/3 its length. Incision separating 2nd marginal lobe of 3rd segment relatively shallow.

Description of male. Prosome length, 6.2 mm; body length, 8.5 mm. Similar in habitus to *P. pavlovskii* but rostrum (Fig. 66-h) terminated with a small spiniform process. Cephalosomal appendages and 4 pairs of swimming legs (Figs. 66-i, j) similar to those of *P. pavlovskii* except that outer spine of 2nd exopodal segment of P2 similar in size to 2nd outer spine of 3rd segment. Fifth pair of legs (Figs. 66-k-n) also similar to that of *P. pavlovskii* except for following differences: Serrated lamella (Fig. 66-o) somewhat tapering and medial margin ending in a large tooth. Teeth of relatively uniform size bordering entire length of medial margin and distal 2/3 of lateral margin. Toothlike process next to serrated lamella on laterodistal margin of segment relatively inconspicuous. Digitiform process with massive base and tapering distally into slender, more or less spiniform process.

Etymology. The specific name *sesquipedalis*, from the Latin meaning 1 1/2' long, refers to the long posterior lobe of the female genital flange.

Remarks. The female of this new species can be diagnosed by a relatively massive rostrum and toothlike posterior lobe of the genital flange and the male by the serrated lamella, which tapers in the form of a dagger terminating in a rather small pointed process, and a slender spiniform digitiform process.

Distribution. This new species is represented in the study by 8 females and 1 male taken in 4 deep tows: 3 off the west coast of North America between 29°N and 38°N and 1 in the southeastern Atlantic at 31°S, 1°E.

Paraeuchaeta dactylifera (Park 1978)
Figure 67

Euchaeta dactylifera Park 1978, p. 240, fig. 91.

Description of female. Prosome length, 5.9-6.6 mm; body length, 8.9-10.0 mm. Similar in habitus to *P. pavlovskii* but distinguishable from it by the following features: Rostrum (Fig. 67-a) very small, pointing downward. Supralabrum massive and relatively low. Urosome elongate (Fig. 67-b). Laterally, genital somite (Fig. 67-c) with large dorsal hump about 1/4 its length from proximal end. Genital flange extending distally into long fingerlike process. Posterior edge of genital field produced distally into low, rounded ridge. Posterior margin of genital prominence relatively low and smoothly curving to merge indistinguishably into ventral wall of somite.

Cephalosomal appendages similar to those of *P. pavlovskii* except for following details: In A2 (Fig. 67-d), 1 of 2 basal setae very small; setae on 1st endopodal segment much reduced in size; inner lobe of 2nd endopodal segment with only 1 small seta in addition to 6 long setae; seta of 2nd exopodal segment very small; inner marginal seta of 7th exopodal segment vestigial. In Mx1 (Fig. 67-e), 2nd inner lobe without a seta; basis with 3 setae of equal length; outer lobe with 5 long setae. In Mx2 (Fig. 67-f), lobes without patches of spinules and none of setae armed with long spinules. Coxal setae of Mxp (Fig. 67-g) poorly armed with spinules; basal setae normal as in *P. pavlovskii.* Swimming legs (Figs. 67-h, i) also similar to those of *P. pavlovskii* except that outer spines of P2 exopod relatively short.

Male unknown.

Distribution. The original description of this species was based on females collected at 4 stations in the South Pacific between 49°S and 66°S and 1 station at 35°S in the southwestern Atlantic. In the present study the species is represented by 16 females found in 7 samples: 6 taken in the South Pacific from off South America to the Tasman Sea between 35°S and 50°S and 1 at 35°S in the southeastern Atlantic. Based on these findings together with the original discovery, the range of the species is restricted to the southern Atlantic and Pacific between 35°S and 66°S.

Paraeuchaeta vervoorti (Park 1978)
Figure 68

Euchaeta vervoorti Park 1978, P. 238, fig. 90.

Description of female. Prosome length, 6.2-8.2 mm; body length, 8.3-10.8 mm. Similar in habitus to -P. *pavlovskii* but readily distinguishable from it by the following features: Laterally, suprafrontal sensilla relatively close to ventral side of forehead (Fig. 68-a). Anterior side of supralabrum nearly perpendicular to body. Urosome relatively short (Fig. 68-b). Laterally, genital somite (Fig. 68-c) about as deep as long, with smoothly curved dorsal wall. Genital flange with small but well-defined posterior lobe pointing in a posteroventral direction. Posterior edge of genital field produced distally into a low, rounded ridge. Posterior margin of genital prominence together with posterior ventral wall of somite forming more or less symmetrical arch.

Cephalosomal appendages similar to those of *P. pavlovskii* except for following details: Setae on coxa and 2nd exopodal segment of A2 (Fig. 68-d) much better developed. Second inner lobe of Mx1 (Fig. 68-e) with a seta; basis with 6 setae; 1st endopodal segment with 6 setae, the innermost of which may be absent; outer lobe with 6 setae, the proximalmost of which relatively small and somewhat variable in size.

Swimming legs also similar to those of *P. pavlovskii* except for following features: Outer spine of 2nd exopodal segment of P1 (Fig. 68-f) pointing posteromediad and extending about 1/3 way to base of following outer spine. In P2 exopod (Fig. 68-g), outer spine of 2nd segment far short of reaching base of following outer spine and about as long as 2nd outer spine of 3rd segment. First outer spine of 3rd segment distinctly shorter than 3rd.

Male unknown.

Distribution. This species was originally described from females found in a deep tow taken in the southeastern Pacific at 34°S, 81°W. In the present study it was found at 6 widely separated localities as follows: Off Chile at 35°S (the type locality), off California at 38°N, off the Pacific coast of central Japan at 35°N, the Tasman Sea at 40°S, and 2 locations in the southeastern Atlantic at 31°S and 35°S, respectively.

NORVEGICA SPECIES GROUP

Diagnosis. Appendicular caudal setae geniculated. Supralabrum pointing obliquely forward (Fig. 69-a). Genital flange (Fig. 69-c) single-lobed, inconspicuous or projecting ventrad into a conical process but not elongated in the form of a tongue along length of genital somite. Cephalosomal appendages similar to those of the *malayensis* species group. Serrated lamella (Fig. 69-o) of male left P5 exopod terminating in a large spiniform process, with large marginal teeth.

Composition. Paraeuchaeta norvegica (Boeck 1872), *P. tonsa* (Giesbrecht 1895), *P. pseudotonsa* (Fontaine 1967), *P. tuberculata* Scott 1909, *P. weberi* Scott 1909, *P. exigua* (Wolfenden 1911), *P. gracilis* (Sars 1905), and *P. incisa* (Sars 1905).

Remarks. The species of this group can be divided into 2 subgroups: 1) Species whose females have a large tubercular outgrowth posterior to the genital opening and a genital field facing ventrad - *P. norvegica, P. exigua, P. gracilis*, and *P. incisa* - and 2) species whose females do not have a large tubercular outgrowth posterior to the genital opening and have a genital field facing posteriad - *P. tonsa, P. pseudotonsa, P. tuberculata*, and *P. weberi.* Morphological features useful for species identification are the shape of the frontal eminence of the forehead, the female genital somite, and the tubercular swellings of the 1 st exopodal segment and the serrated lamella of the 2nd exopodal segment of the male left P5, all of which exhibit a considerable degree of interspecies variations.

Key to species of *norvegica* species group
(based on females)

1a. Laterally, genital field facing ventrad, with large tubercular outgrowth behind genital orifice (Fig.69-c) 2
1b. Laterally, genital field facing posteriad, without large tubercular outgrowth behind genital orifice Fig.70-c) 5

2a. Genital somite with transverse ridge on ventral side anterior to genital prominence (Fig.69- c) ..... *P. norvegica*
2b. Genital somite without such a ridge 3

3a. Laterally, genital flange conical and tall (Fig.76-c) ..... *P. incisa*
3b. Laterally, genital flange low and inconspicuous 4

4a. Laterally, genital prominence extremely tall (Fig.75-c) ..... *P. gracilis*
4b. Laterally, genital prominence relatively low (Fig.74-c) ..... *P. exigua*

5a. Genital somite with large tubercular outgrowths on dorsal side (Fig.73-c) ..... *P. weberi*
5b. Genital segment without such outgrowths 6

6a. Laterally, posterior edge of genital field conically produced (Fig.72-c).....*P. tuberculata*

6b. Laterally, posterior edge of genital field not visible (Fig.70-c).....7

7a. Dorsally, genital somite with smoothly bulging lateral sides (Fig.71-d).....*P. pseudotonsa*

7b. Dorsally, genital somite with angular lateral sides (Fig.70-d).....*P. tonsa*

Paraeuchaeta norvegica (Boeck 1872)
Figure 69

Euchaeta norvegica Boeck 1872, p. 40.

-Sars 1902, p. 38, pls. 24-26.

Paraeuchaeta norvegica: Sars 1925, p. 111.

Description of female. Prosome length, 5.5-6.0 mm; body length, 7.7-8.5 mm. Body slender. Laterally, dorsal margin of forehead (Fig. 69-a) broadly arched, ending anteriorly in a rather pronounced frontal eminence. Rostrum thick, straight, pointing obliquely forward. Supralabrum big, pointing forward. Laterally, distal end of prosome (Fig. 69-b) terminated with a toothlike process. Urosome elongate.

Genital somite (Figs. 69-c, d) in lateral view with large conical genital prominence close to distal end of somite. Anterior margin of prominence highly arched. Posterior margin with a lobular swelling. Genital flange rather small, single-lobed, produced into a conical process. Ventral side of genital somite anterior to genital prominence with a transverse ridge. Dorsally, genital somite symmetrical, widest at middle of its posterior half. Ventrally, genital field (Fig. 69-e) slightly asymmetrical, with right side of field being more produced.

Antennule extending beyond distal end of prosome by its last 2 segments. In morphological details, Al, A2, Md, Mx2, and Mxp as in *P. malayensis.* Maxillule with 1+9+3 setae on 1st inner lobe, 1 seta each on 2nd and 3rd inner lobes, 5 setae on basis, the outermost of which is very small (Fig. 69-f). First endopodal segment with 7 setae. Outer lobe with 9 setae, of which 2 proximal ones are shorter than the others.

First 2 exopodal segments of P1 (Fig. 69-g) remain unseparated. Outer spine of 1st exopodal segment relatively long; that of 2nd segment reaching close to base of following outer spine. In P2 exopod (Fig. 69-h), outer spine of 2nd segment reaching close to distal end of following outer spine. Second outer spine of 3rd segment a little more than 1/2 length of outer spine of 2nd segment. Outer spine of 1st segment and 1st and 3rd outer spines of 3rd segment similarly small.

Description of male. Prosome length, 4.3-4.6 mm; body length, 6.0-6.8 mm. Body slender. Laterally, dorsal margin of forehead (Fig. 69-i) smoothly curved, with distinct frontal eminence and long rostrum pointing straight downward. Dorsally, posterolateral corners of prosome asymmetrical, with left side being longer. Laterally, left side of prosome (Fig. 69-j) produced distally into a large lappet covering anterior 1/2 of 1st urosomal somite; right side (Fig. 69-k) only slightly produced distally, covering anterior 1/3 of 1st urosomal somite; and each side with a toothlike process on dorsodistal margin.

Cephalosomal appendages similar in morphological details to those of *P. malayensis.* In P1 exopod (Fig. 69-l), 1st segment fully separated from 2nd. Outer spine of 1st segment small; that of 2nd segment pointing straight distad, a little short of reaching halfway to base of following outer spine. In P2 exopod (Fig. 69-m), outer spine of 1st segment and 1st outer spine of 3rd segment similar in size, and they are only slightly smaller than outer spine of 2nd segment, which is in turn a little smaller than 3rd outer spine of 3rd segment. Second outer spine of 3rd segment only a little larger than 3rd outer spine, reaching about 1/3 way to base of the latter.

First exopodal segment of right P5 with a toothlike process 1/3 its length from proximal end. Second segment slightly curved and about as long as the 1st. Endopod of left P5 with distal part sharply bent inward. First segment of left exopod (Fig. 69-n) longer than combined lengths of 2 following segments, with 2 large tubercular swellings along posterior margin. Serrated lamella of 2nd segment (Figs. 69-o, p) hollow, tapering into a large spiniform process in the form of a claw. Its medial border continuing as inner margin of segment, with about 10 large marginal teeth of relatively uniform size in addition to a separate tooth close to proximal end of segment. Lateral edge of hollow region of lamella with 1 to 3 teeth. Laterally, a toothlike process right next to serrated lamella on distal edge of segment. Digitiform process about as long as serrated lamella, with an enlarged distal end.

Remarks. In morphological details of the cephalosomal appendages, this species is similar to *P. malayensis.* Its female is however distinct from that of the latter in the structure of the genital flange, which is single-lobed in the form of a tooth and not elongated along the length of the somite. The male is characteristic in having a long rostrum, a toothlike process on the dorsodistal margin of the prosome, and a clawlike serrated lamella bordered with a relatively small number of large teeth.

Distribution. This species is the most common euchaetid throughout the northern Atlantic, ranging along the European coast down to Ireland (Farran 1908) and on the American side down to the continental slope off Delaware (Ferrari 1978). In the present study it was found in large numbers from the Norwegian Sea down to 47°N on the European side and from the Denmark Strait down to 39°N on the American side, an area coinciding to the previously known range of the species.

Paraeuchaeta tonsa (Giesbrecht 1895)
Figure 70

Euchaeta tonsa Giesbrecht 1895, p. 251, pl. 4, Figs. 9, 10.

- Esterly 1906, p. 64, pl. 9, fig. 10; pl. 10, fig. 32.
- Fontaine 1967, p. 195, Figs. 1A, 2A, 3A, D, 4A-C, 5A-C, 6A, D, 7A, 8A, D, 12.
- Park 1978, p. 231, Figs. 84, 87.

Euchaeta spinifera Esterly 1906, p. 62, pl. 9, fig. 8; pl. 11, fig. 35; pl. 14. Figs. 82, 83.

Description of female. Prosome length, 4.0-4.7 mm; body length, 5.6-6.7 mm. Laterally, forehead (Fig. 70-a) with conspicuous frontal eminence. Rostrum relatively small, pointing obliquely forward in parallel to anterior dorsal margin of forehead. Its anterior margin beginning some distance from suprafrontal sensilla and smoothly hollow. Laterally as well as dorsally, distal end of each side of prosome (Fig. 70-b) sharp-cornered and far from reaching genital prominence. Urosome slender. Laterally, genital somite (Fig. 70-c) with an inconspicuous dorsal hump anterior to middle. Genital prominence extending almost down to distal end of somite; its anterior margin nearly flat and sloping about 45° with respect to long body axis and distally curved to form smoothly bulging ventral margin of prominence. Genital flange low, single-lobed with rounded outline. Posterior margin of genital prominence smoothly arched, meeting ventral wall of somite at a right angle. Posterior edge of genital field not visible laterally. Dorsally (Fig. 70-d), genital swelling of more or less angular outline peaking about 3/4 length of somite from its proximal end.

Cephalosomal appendages similar to those of *P. norvegica* except that basis and 1st endopodal segment of A2 (Fig. 70-e) each with a single seta and basis of Mx1 (Fig. 62-f) with 4 setae, small outermost seta being absent. In P1 exopod (Fig. 70-g), 1st segment with convex outer margin and relatively well developed outer spine. Outer spine of 2nd segment reaching close to base of following outer spine. In P2 exopod (Fig. 70-h), outer spine of 2nd segment reaching middle of following outer spine; 2nd outer spine of 3rd segment reaching base of following outer spine and longer than outer spine of 2nd segment by 1/5 its length. Second marginal lobe of 3rd segment separated from segment by deep incision.

Description of male. Prosome length, 3.8-4.3 mm; body length, 5.3-5.9 mm. Laterally, frontal eminence of forehead (Fig. 70-i) pronounced. Rostrum relatively small, pointing straight downward; its anterior margin beginning far from suprafrontal sensilla and nearly perpendicular to long body axis. Dorsally, posterolateral corners of prosome asymmetrical, left side being considerably longer than right. Laterally, posterodorsal margin of prosome with a toothlike process as in *P. norvegica.*

Cephalosomal appendages as in *P. malayensis.* In P1 exopod (Fig. 70-j), outer spine of 1st segment very small; that of 2nd segment pointing straight backward, reaching about 1/3 way to base of following outer spine. In P2 exopod (Fig. 70-k), outer spine of 1st segment and 1st outer spine of 3rd segment similar in size; outer spine of 2nd segment similar in size to 3rd outer spine of 3rd segment and nearly twice length of outer spine of 1st segment; 2nd outer spine of 3rd segment about twice as long as 3rd, reaching about 2/5 way to base of the latter.

First exopodal segment of left P5 (Fig. 70-l) with a low hump midway along posterior margin. Serrated lamella (Figs. 70-m, n) scoop-shaped, tapering into large spinifomn process, with large teeth along medial margin only. Toothlike process next to serrated lamella on laterodistal margin of segment elongate with blunt distal end. Digitiform process relatively massive, with rounded distal end, and reaching far short of distal end of serrated lamella.

Distribution. This species was originally described from off California (35°N, 125°W) and has since been recorded widely throughout the world's oceans. However, Fontaine (1967) found that only those records from the northeastern Pacific are referable to this species and the rest to *P. pseudotonsa* and *P. scaphula*, n. sp. Subsequently, *P. tonsa* was found in the southeastern Pacific between 33°S and 34°S (Grice and Hulsemann 1968, Park 1978).

In the present study it was found along the west coast of North America between 38°N and 29°N, in the central Pacific between 31°N and 40°S, in the western Pacific including the Malay Archipelago between 10°N and 14°S, and in the eastern tropical Indian Ocean between 5°S and 10°S. These findings together with the previous records establish the geographic range of the species as extending along the west coast of America from 50°N (Fontaine 1967) to 34°S and from the American coast westward across the Pacific, with the latitudinal range narrowing until it is limited to the tropics in the eastern Indian Ocean.

Paraeuchaeta pseudotonsa (Fontaine 1967)

Figure 71

Euchaetapseudotonsa Fontaine 1967, p. 204, Figs. 1B, 2B, 3B, E, 7B, 8B, E, 9A, C, 10, 12. - Park 1975, p. 19, fig. 16; 1978, p. 231, Figs. 85-87.

Description of female. Prosome length, 4.3-5.3 mm; body length, 5.8-7.3 mm. Very similar in habitus including forehead (Fig. 71-a) and urosome (Fig. 71-b) to *P. tonsa* but distinguishable from it in the following respects: Laterally, distal end of prosome reaching anterior end of genital prominence. Dorsal margin of genital somite (Fig. 71-c) straight. Genital prominence nearly triangular with blunt distal end; its anterior margin somewhat convex; its posterior margin only slightly bulging. Dorsally, genital somite (Fig. 71-d) with smoothly curved swelling, widest about 2/3 its length from proximal end. Cephalosomal appendages and swimming legs as in *P. tonsa.*

Description of male. Prosome length, 3.9-4.8 mm; body length, 5.7-6.8 mm. Similar in habitus, including forehead (Fig. 71-e) and distal end of prosome, cephalosomal appendages and swimming legs to *P. tonsa* with a relatively minor exception that in P2 exopod (Fig. 71-f), 2nd outer spine of 3rd segment relatively short, reaching less than 1/3 way to base of following outer spine. In exopod of left P5 (Fig. 71-g), posterior margin of 1st segment with flattop hump; serrated lamella (Fig. 71-j) in certain individuals had 1 to 3 teeth on lateral margin; toothlike process next to serrated lamella relatively short and usually pointed (Fig. 71-h). Digitiform process (Fig. 71 -i) of left 5th leg exopod as in *P. tonsa.*

Remarks. The best diagnostic feature in the female for distinguishing this species from *P. tonsa* is the genital somite which in dorsal view has smooth lateral swellings in *P. pseudotonsa* but more or less angular lateral swellings in *P. tonsa.* The male of this species is not easily distinguishable from that of *P. tonsa.* The most reliable diagnostic feature in the male is the size and shape of the toothlike process next to the serrated lamella on the outer distal margin of the 2nd exopodal segment of the left P5, which is relatively short and spiniform in this species, while it is fingerlike and relatively long in *P. tonsa.*

Distribution. Fontaine (1967) referred all previous records of *P. tonsa* from the Atlantic, which extend from Iceland to the temperate zone of the South Atlantic, to this species. Subsequently, the species has been found in the Gulf of Mexico and Caribbean Sea (Park 1975), the southwestern Atlantic off Uruguay (at 35°S) (Park 1978), the southeastern Pacific between 33°S and 34°S (Grice and Hulsemann 1968), throughout the southern Pacific between 33°S and 60°S, the Tasman Sea at 40°S, and south of Australia at 46°S (Park 1978).

In the present study the species was found throughout the Atlantic between 63°N (east of Iceland) and 36°S, in the eastern and central South Pacific between 35°S and 47°S, the western Pacific including the Tasman sea between 25°S and 50°S, the eastern Indian Ocean at 17°S, and the western Indian Ocean at 25°S. According to these findings together with the previous records, the species is distributed throughout the Atlantic and widely in the southern parts of the Pacific and Indian oceans, where its range extends northward up to 33°S in the eastern Pacific, 25°S in the western Pacific, and 17°S in the eastern Indian Ocean. Its geographic range in the Pacific and Indian oceans is therefore contiguous along its northern border, without significant overlapping with that of *P. tonsa*, the species most closely related to it.

Paraeuchaeta tuberculata Scott 1909
Figure 72

Paraeuchaeta tuberculata Scott 1909, p. 76, pl. 21, Figs. 1-8 (male). *Paraeuchaeta tonsa;* Scott 1909, p. 72, pl. 14, Figs. 8-15 (female).

- Tanaka 1958, p. 365, fig. 80.

Euchaeta scaphula Fontaine 1967, p. 209, Figs. 1C, 2C, 3C, F, 6C, 7C, 8C, F, 9B, D, 11, 12.

- Tanaka and Omori 1968, p. 252, Figs. 3T, 4T.

Description of female. Prosome length, 4.2-5.0 mm; body length, 5.8-7.0 mm. Similar in habitus including forehead (Fig. 72-a) and urosome (Fig. 72-b) to *P. tonsa* and *P. pseudotonsa* but readily distinguishable from them by lateral aspect of genital somite (Fig. 72-c), viz, genital prominence pointing almost straight downward, with proximal portion of its anterior margin nearly perpendicular to ventral wall of somite, and its posterior margin more slanted than its anterior margin. Posterior edge of genital field produced distally into a small but well-defined conical process.

Cephalosomal appendages as in *P. tonsa* except that basis of Mx1 (Fig. 72-d) with a very small outer seta in addition to 4 large setae. Swimming legs also similar to those of *P. tonsa* but outer spine of 1st exopodal segment of P1 (Fig. 72-e) very small and 2nd outer spine of 3rd exopodal segment of P2 (Fig. 72-f) extending beyond base of following outer spine.

Description of male. Prosome length, 3.9-4.3 mm; body length, 5.5-5.9 mm. Similar in habitus, including details of forehead (Fig. 72-g), cephalosomal appendages and 4 pairs of swimming legs to *P. tonsa* and *P. pseudotonsa* but can be distinguished from them by the following respects of left P5 (Fig. 72-h): First exopodal segment with 2 conspicuous conical processes along posterior margin; serrated lamella of 2nd exopodal segment (Figs. 72-i-l) usually with several teeth along lateral margin.

Remarks. This species was originally described from males obtained in the Malay

Archipelago and subsequently recorded from the northeastern Indian Ocean by Sewell (1929). Fontaine (1967) redescribed the Indo-western Pacific population previously referred to *P. tonsa* (Giesbrecht 1895) as a new species under the name of *Euchaeta scaphula* and listed *P. tuberculata* Scott 1909, as a synonym of *E. scaphula.* However, *P. tuberculata* is a valid species. Because *E. scaphula* as described by Fontaine was found in the present study to be identical to *P. tuberculata* Scott, they are synonymized here and the latter has priority.

Distribution. Since its original discovery in the Malay Archipelago, *P. tuberculata* has been recorded from the Bay of Bengal (Sewell 1929), the equatorial Indian Ocean and the Arabian Sea (Sewell 1947), the Izu region of Japan (Tanaka 1958, as *P. tonsa*), and around the Philippine Islands and Monterey Bay, California (Fontaine 1967, as *P. scaphula*).

In the present study it occurred commonly in the western Pacific including the Malay Archipelago, the South and East China seas, and along the Pacific coast of Japan between 11°S and 35°N, and the equatorial Indian Ocean between 10°S and 14°S. It was also found in the central North Pacific at 31°N and off California at 35°N. According to these findings together with the previous records, its center of distribution appears to be the western Pacific, from which it extends westward in the Indian Ocean and northward along the eastern coasts of southeastern Asia and Japan up to about 35°N and it also extends eastward in the northern temperate zone of the Pacific to reach the west coast of North America. Its distribution overlaps in the Indo-western Pacific with that of *P. tonsa*, but in the rest of the Pacific, the 2 species are contiguous without overlapping significantly, with *P. tuberculata* occurring north to *P. tonsa.*

Paraeuchaeta tonsa, P. tuberculata, and *P. pseudotonsa*, the 3 very closely related species, all may have evolved in the Indo-western Pacific, from which *P. tuberculata* expanded its range northward and then eastward; *P. tonsa* was carried eastward, expanding its range both northward and southward as it approached the west coast of America; *P. pseudotonsa* moved southward, first occupying the subantarctic seas and then moving into the Atlantic, where in the absence of competitors, it has expanded its range to inhabit the entire ocean.

Paraeuchaeta weberi Scott 1909
Figure 73

Paraeuchaeta weberi Scott 1909, p. 74, pl. 15, Figs. 9-16.

-Sewell 1929, p. 169, text fig. 63; 1947, p. 123, text fig. 28A.

Euchaeta weberi; Grice and Hulsemann 1968, p. 332, Figs. 53-59.

-Park 1978, p. 224, Figs. 80, 81.

Description of female. Prosome length, 4.8-5.5 mm; body length, 6.7-8.0 mm. Laterally, rostrum (Fig. 73-a) inclined about 20° with respect to anterior dorsal margin of forehead; its anterior margin beginning some distance from suprafrontal sensilla and straight. Laterally as well as dorsally, prosome (Fig. 73-b) on each side produced distally into triangular form. Urosome slender. Genital somite very characteristic, strongly asymmetrical when viewed either dorsally or ventrally, with 2 large tubercles across its dorsal wall a little posterior to its middle and with large, asymmetrical lateral protrusions close to its distal end. Laterally (Figs. 73-c, d), genital prominence large, with genital field facing backward; its anterior margin bulging forward into large protuberance and its posterior margin perpendicular to ventral wall of somite. Genital flange small, triangular. Posterior edge of genital field not produced distally.

Cephalosomal appendages as in *P. norvegica.* Swimming legs similar to those of *P. tonsa* except that outer spine of 2nd exopodal segment of P1 (Fig. 73-e) and 2nd outer spine of 3rd exopodal segment of P2 (Fig. 73-f) relatively short.

Description of male. Prosome length, 4.3-4.8 mm; body length, 6.0-6.8 mm. Similar in habitus to *P. tonsa* but readily distinguishable from it by rostrum (Fig. 73-g), which is slender, curved backward, and its anterior margin extending straight close to suprafrontal sensilla.

Cephalosomal appendages and swimming legs also similar to those of *P. tonsa* with following exceptions: First exopodal segment of left P5 (Fig. 73-h) with a conical process midway along posterior margin. Serrated lamella (Figs. 73-i-k) enlarged distally, with a relatively small terminal spiniform process, and its hollow relatively deep. Toothlike process next to serrated lamella on laterodistal margin of segment (Fig. 73-i) relatively short.

Remarks. With large tubercular outgrowths on the dorsal and lateral sides, the female genital somite of this species is very distinct but its genital prominence including the genital flange is basically the same as that of *P. tonsa, P. pseudotonsa*, or *P. tuberculata.* The male is also very close in morphology to the males of these species and differences by which it can be identified are found only in the rostrum and the left P5 exopod.

Distribution. This species is known to occur in the Malay Archipelago (Scott 1909), the central equatorial region of the Indian Ocean at 76°E and 65°E (Sewell 1929, Grice and Hulsemann 1967), the Arabian Sea and the Gulf of Aden (Sewell 1947), the southeastern Pacific between 31°S and 39°S and between 73°W and 92°W (Grice and Hulsemann 1968, Park 1978).

In the present study it was found off Chile in the southeastern Pacific at 35°S and 47°S, in the Indo-western Pacific region including the equatorial western Pacific, the Malay Archipelago, the equatorial eastern Indian Ocean, and the Bay of Bengal between 10°N and 14°S and between 87°E and 158°E, and in the Mozambique Channel at 25°S. These findings together with the previous records show 2 disjunct areas of distribution: One in the equatorial area of the western Pacific and Indian Ocean extending from 158°E westward to Africa and another in the southeastern Pacific between 31°S and 47°S and between the Chilean coast and 92°W. No morphological differences were found in this study between individuals from these 2 isolated areas.

Paraeuchaeta exigua (Wolfenden 1911)
Figure 74

Euchaeta exigua Wolfenden 1911, p. 300, text fig. 52.

-Park 1978, p. 235, Figs. 88, 89.

Description of female. Prosome length, 4.8-5.5 mm; body length, 6.4-7.3 mm. Similar in habitus including toothlike process at distal end of prosome (Fig. 74-b) to *P. norvegica* but readily distinguishable from it by the following features: Laterally, frontal eminence of forehead (Fig. 74-a) less pronounced. Rostrum elongate, its anterior margin extending in a smooth inward curve up to suprafrontal sensilla. Urosome (Fig. 74-b) robust. Genital somite (Fig. 74-c) with slightly bulged dorsal margin and high genital prominence pointing posteroventrad, of which anterior and posterior margins nearly parallel to each other. Genital flange single-lobed in form of low triangle. Genital operculum protruding beyond genital flange. Large tubercular outgrowth immediately posterior to genital orifice, together with genital flange, giving genital prominence appearance of bilobed structure.

Cephalosomal appendages as in *P. norvegica* except that basis of Mx1 (Fig. 74-d) with 4 setae, small outermost seta being absent as in *P. tonsa.* Swimming legs also similar to *P. norvegica* except for following respects: Outer spine of 1st exopodal segment of P1 (Fig. 74-e) very small. Second outer spine of 3rd exopodal segment of P2 (Fig. 74-f) reaching close to base of following outer spine, and about as long as outer spine of 2nd exopodal segment. Incision separating 2nd marginal lobe of 3rd exopodal segment relatively deep, reaching about 3/5 way from distal to proximal end of segment, while in *P. norvegica*, it reaches about halfway from distal to proximal end of segment.

Description of male. Prosome length, 3.8-4.3 mm; body length, 5.3-6.0 mm. Similar in habitus to *P. norvegica* but anterior margin of rostrum (Fig. 74-g) extending straight up to suprafrontal sensilla. Cephalosomal appendages and swimming legs also similar to those of *P. norvegica* except that outer spines of 3rd exopodal segment of P2 (Fig. 74-h) relatively short. Left

P5 exopod different from that of *P. norvegica* in having a conspicuous conical process midway along posterior margin of 1st segment (Fig. 74-i). Serrated lamella (Figs. 74-j, k) tapering into long spiniform process. Medial serrated margin sigmoidally curved when viewed medially (Fig. 74-i). Lateral margin also serrated along its middle portion, usually with 5 or 6 teeth. Toothlike process next to serrated lamella on laterodistal margin of segment elongate, fingerlike (Fig. 74-j). Digitiform process vermiform, far short of reaching distal end of serrated lamella.

Remarks. The female of this species can be readily diagnosed by its characteristic genital somite. The male, however, is so close morphologically to those of the other species of the group that its identification requires careful examination of certain characters. The most useful are the flat anterior margin of the rostrum, a single conical process on the posterior margin of the 1st exopodal segment of the left P5, the elongate, spiniform distal process of the serrated lamella of the left P5.

Distribution. This species was first described from the southeastern Atlantic at 35°S (Wolfenden 1911). Subsequently, Vervoort (1957) found the species in the Tasman Sea at 44°S, Grice and Hulsemann (1967) in the southwestern Indian Ocean at 35°S, and Park (1978) in the southeastern Atlantic at 35°S, the Tasman Sea at 40°S, and south of Australia at 46°S.

In the present study the species was found in the eastern and western regions of the South Atlantic between 30°S and 36°S, south of New Caledonia and the Tasman Sea between 25°S and 50°S, and the western Indian Ocean between 25°S and 35°S. According to these and previous findings, this species seems to be restricted in distribution to 4 isolated areas: The eastern and western parts of the South atlantic between 30°S and 36°S, the area off the eastern and southern coasts of Australia between 25°S and 50°S and between 132°E and 165°E, and the western Indian Ocean between 25°S and 35°S. The species is conspicuously absent from the southeastern Pacific.

Paraeuchaeta gracilis (Sars 1905)
Figure 75

Euchaeta gracilis Sars 1905, p. 16.

- With 1915, p. 185, text fig. 55.
- Vervoort 1963, p. 168, fig. 17.
- Park 1975, p. 16, fig. 13.

Paraeuchaeta gracilis; Sars 1925, p. 120, pl. 33, Figs. 1-8.
Euchaeta quadrata Farran 1908, p. 43, pl. 3, Figs. 20, 21.
-Wolfenden 1911, p. 297, text fig. 49, pl. 35, fig. 1.

Description of female. Prosome length, 4.5-4.8 mm; body length, 6.4-6.9 mm. Laterally, rostrum (Fig. 75-a) pointing obliquely forward at angle of about 10° with respect to anterodorsal margin of forehead. Dorsally as well as laterally, distal end of prosome (Fig. 75-b) on each side broadly rounded. Urosome slender. Laterally, genital somite (Figs. 75-c, d) with slightly arched dorsal wall and tall, nearly cylindrical genital prominence. Genital flange inconspicuous in form of low triangle and receded from genital field. Immediately posterior to genital orifice, genital prominence produced into a massive, rounded protuberance, which is similar to but not as high as corresponding structure found in *P. norvegica, P. exigua* and *P. incisa.* Ventrally, genital field (Fig. 75-e) slightly asymmetrical.

Cephalosomal appendages, including Mx1 (Fig. 75-f), and swimming legs (Figs. 75-g, h) as in *P. exigua* with minor exception that in P2 exopod, 2nd outer spine of 3rd segment relatively long, reaching or extending slightly beyond base of following outer spine.

Description of male. Prosome length, 3.8-4.2 mm; body length, 5.2-5.8 mm. Very close in habitus to *P. exigua* except for following respects: Laterally, anterior margin of rostrum (Fig. 75-i) smoothly curved inward. Cephalosomal appendages and 4 pairs of swimming legs (Figs. 75-j, k) as in *P. exigua.* In 1st exopodal segment of left P5 (Fig. 75-l), conical process on posterior margin triangular. Serrated lamella (Figs. 75-m, n) of left P5 tapering into a very large spine, curved strongly inward and only its medial edge bordered with teeth.

Distribution. This species has been recorded widely in the Atlantic from the Labrador Sea at 62°N down to the Gulf of Guinea (Vervoort 1963). It has also been recorded in the Gulf of Mexico and Caribbean Sea (Grice 1969, Park 1975), the western Indian Ocean at 29°S and 32°S (Grice and Hulsemann 1967). In the present study it was commonly found in the whole eastern side of both the North and South Atlantic between 47°N and 32°S.

Paraeuchaeta incisa (Sars 1905)
Figure 76

Euchaeta incisa Sars 1905, p. 17.
-Park 1975, p. 17, fig. 15.

Paraeuchaeta incisa; Sars 1925, p. 117, pl. 32, Figs. 7-11.

Description of female. Prosome length, 4.0-4.3 mm; body length, 5.5-5.8 mm. Laterally, forehead (Fig. 76-a) with well-defined frontal eminence. Rostrum large, with wide base, pointing obliquely forward nearly in parallel to anterior dorsal margin of forehead. Distal end of prosome (Fig. 76-b) angular but not sharply pointed. Urosome robust. Genital somite (Figs. 76-c, d) with inconspicuous dorsal hump just posterior to middle. Genital prominence low, rectangular. Genital flange large, single-lobed, pointing straight downward. Large tubercular outgrowth posterior to genital orifice, together with genital flange, forming a characteristic bilobed structure.

Cephalosomal appendages similar to those of *P. norvegica* except that seta on 2nd exopodal segment of A2 (Fig. 76-e) much better developed; outermost seta on basis of Mx1 (Fig. 76-f) also well developed. In P1 exopod (Fig. 76-g), outer spine of 1st segment very small; that of 2nd segment short of reaching base of following outer spine. In P2 exopod (Fig. 76-h), outer spine of 2nd segment extending beyond distal end of following outer spine and about as long as 2nd outer spine of 3rd segment; incision separating 2nd marginal lobe of 3rd segment relatively deep.

Description of male. Prosome length, 3.8 mm; body length, 5.3 mm. Similar in habitus to *P. norvegica* but rostrum (Fig. 76-i) less elongated and its anterior margin extending up to suprafrontal sensilla without an indentation delimiting frontal eminence; toothlike process on posterodorsal margin of prosome small (Fig. 76-j). Cephalosomal appendages as in *P. norvegica.* In P1 exopod (Fig. 76-k), outer spine of 2nd segment curved, pointing backward. In P2 exopod (Fig. 76-l), 2nd outer spine of 3rd segment reaching about 1/3 way to base of following outer spine. Incision separating 2nd marginal lobe of 3rd segment moderately deep. In exopod of left P5 (Fig. 76-m), posterior margin of 1st segment broadly bulging, without conical process. Serrated lamella (Figs. 76-n-p) relatively short, sigmoidally curved when viewed from an anteromedial direction, terminated with a toothlike process, which is relatively small, and slightly hollow at distal end. Medial serrated edge of lamella also sigmoid, with teeth of relatively uniform size except for last 3 or 4, which gradually increase in size toward end. Toothlike process next to serrated lamella on laterodistal margin of segment in form of low triangle (Fig. 76-o). Digitiform process vermiform, with rounded distal end.

Remarks. This species exhibits a close similarity to *P. norvegica, P. gracilis*, and *P. exigua* in the female genital somite, which is characteristic in having a large tubercular outgrowth posterior to genital orifice, but differs from them in that the outermost seta on the basis of the femal e Mx1 is normally developed and the serrated lamella of the male left P5 is relatively short and its distal spiniform process is relatively small.

Distribution. This species has been recorded in the temperate North Atlantic between 30°N and 32°N and between 18°W and 43°W (Sars 1905, 1925) and at 32°N, 65°W (Grice 1963), and in the Gulf of Mexico and Caribbean Sea (Grice 1969, Park 1975). In the present study it was found in the eastern North Atlantic at 34°N, 16°W and in the western North Atlantic along 39°N between 64°W and 73°W. The species seems to be restricted in distribution to the temperate North Atlantic, the Gulf of Mexico, and the Caribbean Sea.

PARAEUCHAETA BILOBA FARRAN 1929
Figure 77

Paraeuchaeta biloba Farran 1929, p. 242, fig. 11.

Euchaeta biloba; Vervoort 1957, p. 79, Figs. 60-68.

- Park 1978, p. 217, Figs. 74-76.

Diagnosis. Appendicular caudal setae geniculated. Supralabrum pointing obliquely forward (Fig. 77-a). Genital somite (Fig. 77-c) with single-lobed, inconspicuous genital flanges and a tubercular outgrowth behind genital orifice. Maxillule (Fig. 77-f) with 1 anterior, 9 marginal, and 1 posterior seta on 1st inner lobe, and 3 setae on the basis. Distal exopodal segment of male right P5 (Fig. 77-m) tapering into a long spine as in the genus *Euchaeta.* Serrated lamella of male left P5 tapering into a large spiniform process (Fig. 77-n).

Additional description of female. Prosome length, 3.4-4.0 mm; body length, 5.3-6.4 mm. Body very slender, with elongate urosome (Fig. 77-b). Laterally, outline of forehead (Fig. 77-a) broadly arched, with distinct frontal eminence and large rostrum pointing at an angle of about 20° with respect to anterior dorsal margin of forehead. Distal margin of prosome rounded. Genital prominence with wide base occupying most of somite (Figs. 77-c, d), gradually narrowing distally into a bilobed structure formed by single-lobed genital flange followed by tubercular outgrowth posterior to genital orifice. Genital flanges asymmetrical, left side being larger. Dorsally, genital somite symmetrical, widest at middle, with its anterior 1/4 forming a narrow neck. Ventrally, genital field (Fig. 77-e) asymmetrical and slightly turned counterclockwise.

Antennule reaching about distal end of prosome when pressed against body. In morphological details, Al, A2, Md, Mx2, and Mxp similar to those of *P. malayensis.* Maxillule (Fig. 77-f), however, different significantly from that of *P. malayensis*, viz., 1st inner lobe with 1+9+1 setae, 2nd inner lobe without a seta, basis with 3 setae, 1st endopodal segment with 5 setae, and outer lobe with 6 setae.

In P1 exopod (Fig. 77-g), first 2 segments remain unseparated, forming a compound segment with outer margin of sigmoid form. First segment without outer spine. Second segment with outer spine reaching close to base of outer spine of 3rd segment. In P2 exopod (Fig. 77-h), outer spines relatively small; 2nd and 4th similar in size and a little larger than the remaining 3 of similarly small size.

Additional description of male. Prosome length, 3.4-3.8 mm; body length, 5.1-5.4 mm. Body slender. Laterally, dorsal margin of forehead (Fig. 77-i) broadly arched, with distinct frontal eminence and long rostrum, which in general is rather strongly curved backward. Laterally, distal end of prosome (Fig. 77-j) somewhat triangular with blunt apex; posterodorsal margin with a toothlike process. Dorsally, posterolateral corners of prosome symmetrically angular. Appendicular caudal seta geniculated, about 2/5 length of 5th marginal seta.

Antennule extending beyond distal end of prosome by its last 2 segments. All cephalosomal appendages similar to those of *P. malayensis* except that Mx2 with setae, which are poorly developed and fewer than in female; coxa of Mxp devoid of setae. In P1 (Fig. 77-k), 1st exopodal segment fully separated from 2nd, without an outer spine; outer spine of 2nd segment reaching about 3/5 way to base of following outer spine. Other swimming legs (Fig. 77-l) similar to those of female except that outer spines of exopods relatively small.

First exopodal segment of right P5 (Fig. 77-m) with a small toothlike process halfway along outer margin. Second segment only slightly longer than 1st, tapering into a sharp spiniform process. Endopod of left P5 with distal part sharply bent. First exopodal segment about 1.4 times length of following 2 segments combined. Serrated lamella (Fig. 77-n) tapering in a large spiniform process. Its proximal part hollow; lateral margin with a large tooth preceded by 3 to 4 small teeth; medial margin also with a large tooth which is, however, preceded by a row of about 18 small teeth and followed by 2 small teeth. Digitiform process cylindrical, reaching halfway to distal end of

serrated lamella. Third exopodal segment with small terminal spine far short of reaching distal end of serrated lamella. Joint between segment and terminal spine is indicated by a faint line. Small outer spine over the tufts of stiff hairs was not found.

Remarks. Paraeuchaeta biloba and the *norvegica* species group share an essentially similar basic structure of the female genital flange, which is conical or triangular, not elongated along the length of the somite, and in most species, inconspicuous. They are further characterized by the serrated lamella of the male left P5, which is bordered with a relatively small number of large teeth and terminated with a large spiniform process, which in *P. biloba* is very large in the form of a claw. *Paraeuchaeta biloba*, however, is distinct not only from the *norvegica* species group but also from all the other species of the genus in having a spiniform distal segment of the male right P5 exopod.

Distribution. This is one of the most common euchaetid species in both the Antarctic and Subantarctic and was found as far north as 35°S in both the southwestern Atlantic (Park 1978) and the western Indian Ocean (Grice and Hulsemann 1967). In the present study it was found as far north as 32°S in the southeastern Atlantic and 35°S in both the southeastern Pacific and the western Indian Ocean.

GLACIALIS SPECIES GROUP

Diagnosis. Appendicular caudal setae (Fig. 78-f) smoothly curved. Supralabrum pointing forward (Fig. 78-a). Genital somite in both dorsal and ventral view symmetrical (Fig. 78-e). Genital flange well developed and, in lateral view, single or bilobed (Fig. 78-c). Serrated lamella (Fig. 78-o) of male left P5 exopod sigmoidally curved. Cephalosomal appendages and swimming legs similar in morphological details to those of the *malayensis* species group.

Composition. Paraeuchaeta glacialis (Hansen 1887) and *P. tumidula* (Sars 1905).

***Paraeuchaeta glacialis* (Hansen 1887)**
Figure 78

Euchaeta glacialis Hansen 1887, p. 256, pl. 23, Figs. 5-5k; pl. 24, Figs. 1 -1d.

- Sars 1902, p. 40, pl. 27.
- Wolfenden 1904, p. 133, Figs. 1-2.
- Breemen 1908, p. 54, fig. 60.
- With 1915, p. 169, pl. 6, Figs. 5a-d; text-fig. 47.

Euchaeta norvegica; Sars 1900, p. 58, pl. 14.

Description of female. Prosome length, 7.4-7.8 mm; body length, 9.8-11.0 mm. Body robust with strongly built urosome (Fig. 78-b). Laterally, dorsal margin of forehead (Fig. 78-a) broadly arched, with distinct frontal eminence and thick rostrum pointing obliquely forward. Supralabrum large, pointing forward. Distal end of prosome more or less triangular. Genital prominence (Figs. 78-c, d) large and tall; its anterior margin smoothly curved; its posterior margin straight, perpendicular to ventral wall of somite. Genital flange well developed, deeply bilobed, each lobe more or less toothlike pointing downward; posterior lobe slightly larger. Dorsally as well as ventrally, genital somite (Fig. 78-e) highly bulging at middle, more or less symmetrical.

Appendicular caudal seta (Fig. 78-f) smoothly curved at proximal end, distinctly thinner than any of 4 principal marginal caudal setae and slightly longer than 5th marginal caudal seta. Fourth marginal caudal seta about 2.5 times length of 5th.

Antennule extending beyond distal end of prosome by its last 2 segments. In morphological details, Al, A2, Md, Mx2, and Mxp similar to those of *P. malayensis*. Maxillule also similar to that of *P. malayensis* except that its outer lobe (Fig. 78-g) with 8 setae, of which the proximalmost is smaller than the others.

First exopodal segment of P1 (Fig. 78-h) not separated from 2nd; its outer margin broadly bulging and its outer spine relatively long. Outer spine of 2nd segment short of reaching base of following outer spine. In P2 exopod (Fig. 78-i), 2nd outer spine about 1.3 times length of 4th; 4th reaching about 3/4 way to base of 5th. In 3rd segment, cleft between 2nd marginal lobe and segment moderately deep but far short of reaching level of preceding cleft.

Description of male. Prosome length, 5.6 mm; body length, 7.8 mm. Body slender. Laterally, dorsal margin of forehead (Fig. 78-j) smoothly curved, with a low frontal eminence and large rostrum pointing obliquely forward. Distal margin of prosome (Fig. 78-k) rounded. Posterodorsal margin with a low, somewhat angular hump, which is not produced into a toothlike process. Dorsally, posterolateral corners of prosome symmetrical. Appendicular caudal seta geniculated, thinner and shorter than adjoining marginal caudal setae.

Antennule extending beyond distal end of prosome by its last 2 segments. In morphological features, all cephalosomal appendages similar to those of *P. malayensis.*

First exopodal segment of P1 (Fig. 78-l) without an outer spine, fully separated from 2nd. Outer spine of 2nd segment relatively well developed, pointing in a posterolateral direction. In P2 exopod (Fig. 78-m), 4th outer spine longer than 2nd by about 1/3 its length.

Fifth pair of legs similar to that of *P. malayensis* except that 2nd exopodal segment of left leg (Figs. 78-n, o) without a toothlike process on medial margin close to proximal end, Serrated lamella in anterior view curved sigmoidally, with truncated distal end, and with rounded teeth of relatively uniform size along entire margin except for a short proximal section of lateral margin. Digitiform process straight, relatively thick, rounded distally, and short of reaching distal end of serrated lamella.

Remarks. This species is basically the same in morphological details of the appendages as *P. malayensis* but the appendicular caudal seta in the female is smoothly curved instead of being geniculated. The male is different from the *P. malayensis* male in that the posterolateral corners of the prosome in dorsal view are symmetrical and the serrated lamella of the male left P5 is sigmoid.

Distribution. This species is known to be very common in the Polar basin, the Norwegian Sea and Denmark Strait but was rarely found south of Iceland (With 1915). In the present study it was found in large numbers in the Norwegian Sea and Denmark Strait. It was also found in 2 deep tows in the North Atlantic: One from 2800-0 mwo at 47°N, 43°W and another from 3000-0 mwo at 46°N, 46°W.

Paraeuchaeta tumidula (Sars 1905)
Figure 79

Euchaeta tumidula Sars 1905, p. 15.

Paraeuchaeta tumidula; Sars 1925, p. 119, pl. 32, Figs. 15-20.

- Heptner1971,p. 108, fig. 17.

Paraeuchaeta pseudotumidula Brodsky 1950, p. 217, fig. 131.

Euchaeta biconvexa Park 1978, p. 264, Figs. 108, 109.

Description of female. Prosome length, 2.84-3.40 mm; body length, 4.04-4.80 mm. Laterally, forehead (Fig. 79-a) with a low frontal eminence. Rostrum thick, with wide base, pointing obliquely forward in parallel to anterior dorsal margin of forehead. Its anterior margin continuing in a smooth inward curve up to suprafrontal sensilla. Dorsally as well as laterally, distal end of prosome (Fig. 79-b) on each side broadly rounded. Urosome relatively slender. Laterally, genital somite (Fig. 79-c) with smoothly arched dorsal wall. Genital prominence including genital flange roughly triangular, occupying middle of somite. Genital flange nearly triangular, with long, convex anterior side and short, steep posterior side. Posterior edge of genital field produced distally into distinct tubercular outgrowth. Posterior margin of genital prominence convex and about as long as posterior ventral wall of somite. A low ridge visible on each side of genital somite close to

proximal end of its dorsal wall. Ventrally, genital somite symmetrical. Medial margin of genital flange emarginate and thereby flange is divided into anterior and posterior lobes. Dorsally and ventrally, appendicular caudal setae (Fig. 79-d) extending laterad far beyond lateral side of caudal ramus before curving backward.

Cephalosomal appendages as in *P. glacialis* except that outer lobe of Mx1 (Fig. 79-e) with 6 long setae plus a minute seta proximally. In P1 exopod (Fig. 79-f), outer spine of 1st segment small; that of 2nd segment extending beyond base of following outer spine by about 1/4 its length. Outer spines of P2 exopod (Fig. 79-g) well developed; that of 2nd segment a little longer than segment itself and reaching close to distal end of following outer spine. Second outer spine of 3rd segment only a little longer than 1st, reaching base of following outer spine, and about 3/4 length of outer spine of 2nd segment. Third outer spine of 3rd segment about 1/2 length of 2nd.

Description of male. Prosome length, 2.76 mm; body length, 3.88 mm. Laterally, rostrum (Fig. 79-h) nearly triangular with sharply pointed distal end; its anterior margin straight up to suprafrontal sensilla. Posterolateral comers of prosome symmetrical when viewed dorsally and rounded either dorsally or laterally (Fig. 79-i). Posterodorsal margin of prosome without toothlike process as found in *P. norvegica.*

Cephalosomal appendages similar to those of *P. malayensis* and *P. glacialis.* In P1 exopod (Fig. 79-j), outer spine of 2nd segment pointing straight backward, short of reaching middle of 3rd segment. In P2 exopod (Fig. 79-k), 2nd outer spine of 3rd segment reaching about 2/5 way to base of following outer spine; all other outer spines poorly developed.

Serrated lamella of left P5 exopod (Fig. 79-m) tapering distally into elongate, sigmoid process. Teeth bordering entire length of medial margin, diminishing in size from proximal to distal. Uniformly small teeth bordering distal half of lateral margin. Toothlike process next to serrated lamella on laterodistal margin of segment vestigial. Digitiform process (Fig. 79-l) about as long as serrated lamella, with rounded distal end.

Remarks. This species is practically identical in the anatomical features of the appendages to *P. glacialis.* However, they can be readily distinguished from each other by the shape of the genital prominence in the female and that of the serrated lamella in the male. *Euchaeta biconvexa* Park 1978, originally described from the southeastern Pacific, was found upon comparison of specimens to be synonymous with *P. tumidula.*

Distribution. This species was originally described from the temperate North Atlantic between 31°N and 40°N and between 24°W and 29°W (Sars 1905, 1925), and has subsequently been found in the northwestern Pacific (Brodsky 1950 as *P. pseudotumidula*, Heptner 1971), in the southeastern Pacific between 34°S and 39°S, and south of New Zealand at 60°S (Park 1978 as *Euchaeta biconvexa).*

In the present study it was found in the northeastern Atlantic at 47°N (close to the type locality), the eastern tropical Pacific close to Central America, off northern California, and off the Pacific coast of northern Japan at 33°N and 35°N. These findings together with the previous records seem to indicate that the species has a worldwide distribution, but records are still missing from the South Atlantic and Indian oceans.

HEBES SPECIES GROUP

Diagnosis. Appendicular caudal setae smoothly curved (Fig. 80-f) Supralabrum pointing obliquely forward (Fig. 80-a). Female genital flanges asymmetrical and highly variable among species. In Mx1 (Fig. 80-g), basis with 4 setae and 1st endopodal segment with 3 setae. One endopodal seta of Mx2 (Fig. 80-h) armed with long spinules. Otherwise, cephalosomal appendages as in the *malayensis* species group. Serrated lamella of 2nd exopodal segment of male left P5 (Fig. 81-e) about 1/3 length of segment; serration of its medial margin continuing over nearly whole length of medial margin of segment.

Composition. Paraeuchaeta hebes (Giesbrecht 1888), *P. elongata* (Esterly 1913), *P. russelli* (Farran 1936), and *P. simplex* Tanaka 1958. Of these *P. hebes* was not found in this study. *Euchaeta flava* Giesbrecht 1888, not found in this study, may also belong to this species group.

Remarks. The *hebes* species group was first recognized by Vervoort (1957) and the following 2 species were originally included in the group: *P. hebes* (Giesbrecht 1888) and *P. russelli* (Farran 1936).

Key to species of *hebes* species group
(based on females)

1a. Right genital flange large with extremely large posterior lobe (Fig.80-e) ..... *P. elongata*
1b. Right genital flange small, not well defined 2

2a. Laterally, lateral plate of genital operculum produced into large, rounded tubercular outgrowth (Fig.83-d) ..... *P. simplex*
2b. Laterally, lateral plate of genital operculum projecting only slightly beyond genital flange (Fig.82-d) ..... *P. russelli*

Paraeuchaeta elongata (Esterly 1913)
Figures 80 and 81

Euchaeta elongata Esterly 1913, p. 182, pl. 10, Figs. 5, 16, 27; pl. 11, fig. 37; pl. 12, fig. 49.
Paraeuchaeta elongata: Tanaka 1958, p. 355, fig. 75.
- Tanaka and Omori 1968, p. 234, Figs. 3H, 4H, 9.
Euchaeta japonica Marukawa 1921, p. 11, pl. 1, fig. 14; pl. 2, Figs. 5-10; pl. 3, figs 1-7.

- Campbell 1929, p. 313, pl. 1, fig. 1.
- Mori 1937, p. 47, pl. 22, Figs. 3-11.
- Davis 1949, p. 34, pl. 5, Figs. 56-65.
- *Paraeuchaeta japonica:* Brodsky 1950, p. 209, fig. 123.

Description of female, prosome length, 4.2-5.3 mm; body length, 6.0-7.6 mm. Body robust with rather short urosome (Fig. 80-b). Laterally, dorsal margin of forehead (Fig. 80-a) broadly curved, with distinct frontal eminence and large rostrum pointing obliquely forward. Supralabrum pointing in an anteroventral direction. Distal end of prosome produced into a lobular process. Dorsally, posterolateral corners of prosome symmetrical. Genital somite in dorsal view symmetrical and widest at middle; its lateral margins broadly arched.

Laterally, left genital flange (Fig. 80-c) low and elongate. Posterior edge of genital field not produced distally into a lobe. Right genital flange (Fig. 80-d) large, produced distally into a large, rounded lobe extending beyond posterior edge of genital field. Ventral wall of somite posterior to genital prominence conspicuously bulging. Ventrally, genital prominence (Fig. 80-e) asymmetrical, right genital flange being much larger than left, and the entire prominence is turned counterclockwise.

Appendicular caudal seta (Fig. 80-f) smoothly curved, distinctly thinner than but about 2 times as long as 4th marginal caudal seta, which is more than 2 times length of adjoining marginal caudal setae.

Antennule extending beyond distal end of prosome by its last 2 segments. In morphological details, Al, A2, Md, and Mxp as in *P. malayensis.* Maxillule (Fig. 80-g) with 1+9+3 setae on 1st inner lobe and 1 seta each on 2nd and 3rd inner lobes. Basis of Mx1 with 4 setae, without small outermost seta as found in *P. malayensis.* First endopodal segment with 3 setae. Outer lobe with 9 setae, of which 2 proximal ones are short. In Mx2, 1 endopodal seta (Fig. 80-h) armed with long spinules in addition to dense rows of very short spinules.

In P1 exopod (Fig. 80-i), 1st segment not separated from 2nd, without an outer spine. Outer spine of 2nd segment scarcely reaching base of following outer spine. In P2 exopod (Fig. 80-j), outer spine of 2nd segment reaching close to distal end of following outer spine and longer than 2nd outer spine of 3rd segment, which is reaching about 2/3 way to base of following outer spine. In 3rd segment, incision separating 2nd marginal lobe from segment moderately deep.

Description of male. Prosome length, 4.1-4.6 mm; body length, 5.9-6.4 mm. Body relatively slender. Laterally, dorsal margin of forehead (Fig. 81-a) smoothly curved, with distinct frontal eminence and long rostrum pointing straight downward. Distal end of prosome more or less triangular. Dorsally, posterolateral corners of prosome symmetrical. Appendicular caudal seta (Fig. 81-b) geniculated, thinner than last 4 marginal caudal setae and about as long as 3rd or 5th marginal caudal seta. Fourth marginal caudal seta about twice as long as adjoining marginal caudal setae and about 1.2 times length of urosome.

Antennule extending beyond distal end of prosome by its last 2 segments. Morphological features of all cephalosomal appendages as in *P. malayensis*. First exopodal segment of P1 (Fig. 81-c) fully separated from 2nd, without an outer spine. Outer spine of 2nd exopodal segment curved, pointing distad. In P2 exopod (Fig. 81-d), 2nd outer spine of 3rd segment about twice as long as outer spine of 2nd segment, which is about as long as 3rd outer spine of 3rd segment.

Two exopodal segments of right P5 equal in length. Endopod of left P5 vestigial and 2-segmented. Second exopodal segment of left P5 (Figs. 81-e, f) without a separate toothlike process on medial margin close to proximal end. Serrated lamella about 1/3 length of segment, far short of reaching distal end of digitiform process, divided distally into 2 lobes, the inner lobe elongated and longer than the outer lobe, which is more or less triangular. Entire margin of serrated lamella bordered with small teeth of similar size. Medial margin of serrated lamella continuing as inner margin of segment with serration extending close to proximal end of segment. Medially, digitiform process more or less sigmoid, its distal end folded or only partially inflated. Third exopodal segment scarcely extending beyond its tufts of stiff hairs; its distal spine vestigial.

Remarks. The female of this species is characterized by the strongly asymmetrical genital somite. In morphological features of the appendages, this species differs from *P. glacialis* by the presence of 4 and 3 setae, respectively, on the basis and 1st endopodal segment of Mx1 and by the presence of long spinules on one of the endopodal setae of Mx2.

The male is characterized by the symmetrical posterolateral corners of the prosome when viewed dorsally, short serrated lamella and digitiform process on the 2nd exopodal segment of the left P5, and the shape of the 3rd exopodal segment of the left P5, which ends abruptly at its tufts of stiff hairs.

Distribution. This species was originally described from off the San Diego region and has since been recorded from off Oregon, Vancouver Island, and the Gulf of Alaska (Campbell 1929, Davis 1949 as *Euchaeta japonica)*, the Bering Sea, the northwestern Pacific, the Sea of Okhotsk (Brodsky 1950 as *Paraeuchaeta japonica)*, the Sea of Japan (Marukawa 1921 as *Euchaeta japonica)*, and Sagami Bay of central Japan (Tanaka 1958).

In the present study it was found along the coast of the whole of the northern Pacific ranging from 33°N off California northward to the Aleutian Islands, westward to the Kuril Islands, and then southward along the Pacific coast of northern Japan down to 35°N. It was also found in the Sea of Japan.

Paraeuchaeta russelli (Farran 1936)
Figure 82

Euchaeta russelli Farran 1936, p. 91, fig. 7.

Paraeuchaeta russelli; Tanaka 1958, p. 334, fig. 65.

- Tanaka and Omori 1968, p. 250, Figs. 3R, 4R, 17A.

Euchaeta daitomarui Mori 1937, p. 48, pi, 23, fig. 4-8.

Description of female. Prosome length, 2.84-3.00 mm; body length, 3.88-4.16 mm. Similar in habitus, including forehead (Fig. 82-a) and urosome (Fig. 82-b), to *P. elongata* but readily distinguishable from it by the following features: Laterally, distal end of prosome broadly rounded, not terminated with a conical process as in *P. elongata.* Genital prominence (Figs. 82-c, d) relatively low, with its anterior and posterior margins sloping similarly toward its center and its posterior margin extending to distal end of somite. Genital flanges not clearly delimited from prominence, each bilobed, and asymmetrical, with right being longer. Left lateral plate of genital operculum produced into a rounded ridge projecting slightly beyond genital flanges. Ventrally, genital field (Fig. 82-e) asymmetrical, mainly because of dissimilarity of genital flanges. Appendicular caudal setae (Fig. 82-f) extending posterolaterad and smoothly curved.

Cephalosomal appendages as in *P. elongata* except that 2nd inner lobe of Mx1 (Fig. 82-g) without a seta and outer lobe with 5 long setae in addition to a small proximal seta. In P1 exopod (Fig. 82-h), 1st segment with a very small outer spine; outer spine of 2nd segment far short of reaching base of following outer spine. In P2 exopod (Fig. 82-i), outer spine of 2nd segment longer than segment itself, reaching distal end of following outer spine, and about as long as 2nd outer spine of 3rd segment, which is reaching base of following outer spine. Incision separating 2nd marginal lobe of 3rd segment deep, reaching close to level of preceding incision.

Description of male. Prosome length, 2.50-2.60 mm; body length, 3.50-3.70 mm. Similar in habitus to *P. elongata* but rostrum (Fig. 82-j) in lateral view slightly curved backward. Cephalosomal appendages and 4 pairs of swimming legs (Figs. 82-k, 1) also similar to those of *P. elongata* except that incision separating 2nd marginal lobe of 3rd exopodal segment of P2 reaching close to level of preceding incision.

In left P5 (Figs. 82-m, n), 2nd exopodal segment extending distally along its medial margin into a triangular serrated lamella, which is about 1/3 length of the segment, with a row of relatively large teeth of uniform size extending along medial margin from distal end of lamella close to proximal end of segment. The whole structure therefore is appearing like a comb. Toothlike process next to serrated lamella on laterodistal margin of segment vestigial. Digitiform process appearing double-layered, sigmoidally curved, with obtuse distal end, and extending same distance as serrated lamella.

Distribution. This species was originally described from both females and males collected in waters outside the Great Barrier Reef and has since been recorded from off the northeastern coast of Japan (Mori 1937 as *Euchaeta daitomarui)* and from the Izu region of Japan (Tanaka 1958, Tanaka and Omori 1968). In the present study it was found in 2 samples taken in Sagami Bay, Japan.

Paraeuchaeta simplex Tanaka 1958
Figure 83

Paraeuchaeta simplex Tanaka 1958, p. 336, fig. 66.

- Tanaka and Omori 1968, p. 253, Figs. 3V, 4V.

Description of female. Prosome length, 2.44 mm; body length, 3.36 mm. Similar in habitus including forehead (Fig. 83-a) and urosome (Fig. 83-b) to *P. russelli* but can be distinguished from it by the following features: Laterally, rostrum relatively short and more strongly curved backward. Genital somite (Figs. 83-c, d) relatively long, with a depth-length ratio of 100:155. Dorsal wall somewhat curved inward. Genital prominence roughly triangular, with steep anterior margin and gradually sloping posterior margin, which is extending to distal end of somite. Genital flanges very low, emarginate at middle, and not clearly set off from prominence. Both lateral plates of genital operculum produced into a large, rounded tubercular outgrowth; left one larger. Median plate of genital operculum with a well-developed central process. Ventrally, genital field (Fig. 83-e) nearly

symmetrical. Appendicular caudal setae (Fig. 83-f) smoothly curved proximally and hen extending straight backward.

Cephalosomal appendages including Mx1 as in *P. russelli*. Swimming legs similar to those of *P. russelli* except that outer margin of first 2 unseparated segments of P1 exopod (Fig. 83-g) more strongly curved; in P2 exopod (Fig. 83-h), 2nd outer spine of 3rd segment far short of reaching base of following outer spine and distinctly shorter than outer spine of 2nd segment. Incision separating 2nd marginal lobe of 3rd segment far short of reaching level of preceding incision.

Remarks. The male was not found in the study. According to Tanaka (1958), the male is very close in morphological details to that of *P. russelli*.

Distribution. This species was first described from both females and males collected in the Izu region of Japan. Tanaka (1958) considered Mori's (1937) records of *Euchaeta flava* from the Japanese waters to be referable to *P. simplex*. In the present study it was found in Sagami Bay, the type locality.

ANTARCTICA SPECIES GROUP

Diagnosis. Appendicular caudal setae smoothly curved (Fig. 84-e). Supralabrum pointing forward (Fig. 84-a). Anterior lobe of genital flange toothlike (Fig. 84-c) and genital operculum with a conspicuous tubercular central outgrowth; otherwise female genital somite highly variable in shape among species. In A2 (Fig. 84-f), basis with a single seta and 2nd exopodal segment with a very small seta. Mandible (Fig. 84-g) with a small seta in addition to a large, curved seta on basis, no seta on 1st endopodal segment, and an appendicular seta in addition to 9 terminal setae on 2nd endopodal segment. Second inner lobe of Mx1 (Fig. 84-h) with 2 setae; basis with 3 setae. In P1 (Fig. 84-i), outer spine of 1st exopodal segment relatively long. In male fifth pair of legs (Fig. 85-d), right endopod with a large lobe on lateral margin; digitiform process of left exopod reduced to a short ear-shaped process; hairy tubercle of 3rd exopodal segment tapering into a spiniform process.

Composition. *Paraeuchaeta antarctica* (Giesbrecht 1902), *P. austrina* (Giesbrecht 1902), *P. similis* (Wolfenden 1908), *P. erebi* Farran 1929, and *P. tycodesma* (Park 1978).

Remarks. Although all of these species have been fully described recently by Fontaine (1988), who has first recognized them as forming a natural species group, *P. antarctica* is described here again for purposes of comparison.

Key to species of *antarctica* species group (based on females)

1a. An endopodal seta of Mx2 armed with long spinules in addition to dense rows of small spinules 2

1b. None of endopodal setae of Mx2 armed with long spinules 3

2a. Ventrally, genital field about symmetrical (Fontaine 1988, fig. 16C) ..... *P. austrina*

2b. Ventrally, genital field asymmetrical (Fontaine 1988, fig. 11C) ..... *P. erebi*

3a. Genital segment with transverse ridge on ventral side anterior to genital prominence (Fig.84-c) ..... *P. antarctica*

3b. Genital segment without such a ridge 4

4a. Ventrally, genital field more or less symmetrical (Park 1978, fig. 83B) ..... *P. tycodesma*

4b. Ventrally, genital field strongly asymmetrical (Park 1978, fig. 82E) ..... *P. similis*

Paraeuchaeta antarctica (Giesbrecht 1902)
Figures 84 and 85

Euchaeta antarctica Giesbrecht 1902, p. 21, pl. 3, figs 1-8.

- Wolfenden 1908, p. 18, pl. 4, Figs. 5-6.
- Bradford 1971, p. 21, Figs. 64-67.
- Park 1978, p. 220, Figs. 77-79.
- Fontaine 1988, p. 32, Figs. 3-8.

Paraeuchaeta antarctica: Bradford 1981, p. 398, Figs. 1, 3, 5.
- Bradford et al. 1983, p. 25. fig. 10.

Description of female. Prosome length, 6.2-7.3 mm; body length, 8.4-9.9 mm. Body slender with elongate urosome (Fig. 84-b). Laterally, dorsal margin of forehead (Fig. 84-a) smoothly curved. Frontal eminence low but distinct. Rostrum thick, triangular, and pointing straight downward. Posterolateral corners of prosome rounded in dorsal view but more or less angular when viewed laterally.

Dorsally, genital somite symmetrical, with nearly straight margins. Laterally, genital prominence (Fig. 84-c) tall and very characteristic with a peculiar lappetlike outgrowth along anterior edge of genital field. Two genital flanges roughly symmetrical, each with a toothlike anterior lobe and a low, elongate posterior lobe (posterolateral flap of genital prominence of Ferrari and Dojiri 1987). Genital operculum with a central outgrowth (linguiform process of Ferrari and Dojiri 1987 or central structure of Fontaine 1988) appearing in lateral view like a toothlike process behind anterior lobe of genital flange. Ventral wall of genital somite with a pair of conspicuous folds (anteroventral genital process of Ferrari and Dojiri 1987) immediately anterior to genital prominence. Ventrally, genital somite (Fig. 84-d) nearly symmetrical.

Appendicular caudal seta (Fig. 84-e) smoothly curved in its proximal portion, much thinner than adjoining marginal caudal setae, and about 1.5 times length of 5th marginal caudal seta and about 3/4 length of 4th marginal caudal seta.

Antennule extending beyond distal end of prosome by its last 2 segments. Antennule, Mx2, and Mxp similar in morphological details to those *of P. malayensis.* Antenna (Fig. 84-f) differs from that of *P. malayensis* in having only 1 marginal seta on basis and that marginal seta of 2nd exopodal segment very small. Mandible (Fig. 84-g) with a small additional seta on basis, without a seta on 1st endopodal segment, and with an appendicular seta in addition to 9 distal setae on 2nd segment. Otherwise this appendage is like that of *P. malayensis.* Maxillule (Fig. 84-h) with 1+9+3 setae on 1st inner lobe, 2 setae on 2nd inner lobe, 1 seta on 3rd inner lobe; 3 setae on basis, 5 or 6 setae on 1st endopodal segment; 9 setae on outer lobe, 2 proximal ones of which are small.

First 2 exopodal segments of P1 (Fig. 84-i) not separated; outer spine of 1st segment reaching close to base of outer spine of 2nd segment, which is extending beyond base of outer spine of 3rd segment. In P2 exopod (Fig. 84-j), 2nd outer spine extending beyond base of 3rd. Fourth outer spine only slightly shorter than 2nd. In 3rd exopodal segment, incision separating 2nd marginal lobe from segment moderately developed.

Description of male. Prosome length, 4.9-5.3 mm; body length, 6.6-7.3 mm. Body slender. Forehead (Fig. 85-a) in lateral view similar to that of female but tip of rostrum slightly curved backward. Dorsally, posterolateral corners of prosome nearly symmetrical. Laterally, they are more or less triangular with rounded distal end. Appendicular caudal seta thinner and shorter than adjacent marginal caudal setae and smoothly curved proximally.

Antennule extending beyond distal end of prosome by its last 2 or 3 segments when applied closely to body. In morphological details, all cephalosomal appendages similar to those of *P. malayensis*.

In P1 exopod (Fig. 85-b), 1st segment fully separated from 2nd, without an outer spine. Outer spine of 2nd segment relatively small, pointing distad. In P2 exopod (Fig. 85-c), outer spine of 2nd segment extending slightly beyond base of following outer spine and similar in length to 2nd outer spine of 3rd segment. Incision delimiting 2nd marginal lobe of 3rd segment moderately deep.

Right P5 (Fig. 85-d) very characteristic in having a large rounded lobe on outer margin of endopod about 2/3 its length from proximal end. Left P5 is characteristic in having a short, ear-shaped digitiform process (Fig. 85-e). Serrated lamella (Fig. 85-f) about 1/2 length of 3rd exopodal segment, scoop-shaped, with uniformly small teeth along entire medial margin and minute teeth along distal portion of lateral margin. Hairy tubercle of 3rd exopodal segment tapering into a long spiniform process reaching distal end of serrated lamella.

Remarks. In morphological features of the appendages, the female of this species differs from *P. malayensis* and *P. glacialis* in the following respects: Basis of A2 with a single seta; in Md, the basis with a small additional seta, the 1st endopodal segment without a seta, and the 2nd endopodal segment with an appendicular seta; Mx1 with 2 setae on the 2nd inner lobe, 3 setae on the basis, and 5 or 6 setae on the 1st endopodal segment; and the outer spine of the 1st exopodal segment of P1 relatively well developed. The morphology of secondary sex characters of *P. antarctica*, including 2 different types of spermatophores, has veen fully described by Ferrari and Dojiri (1987).

The male can be diagnosed by the endopod of the right P5, which has a large lobe on its outer margin, the digitiform process of the 2nd exopodal segment of the left P5, which is short and ear-shaped, and by the characteristic shape of the serrated lamella.

In the form of the genital flange, which has a conical or toothlike anterior lobe, and the presence of a conspicuous ventral cuticular fold anterior to the genital prominence, this species appears to be related to *P. norvegica.* However, in the setation of A2, Md, and Mx1of the female and in the structure of the male 5th pair of legs, these species show significant differences from each other, in addition to the difference in the form of their appendicular caudal setae.

Five species are known in this species group and all of them are endemic to the Southern Ocean (Fontaine 1988). The females of all 5 species share basically the same features of the genital somite, viz., the conical or tooth-shaped anterior lobe of the genital flange and a conspicuous tubercular central outgrowth of the genital operculum. The cephalosomal appendages are practically the same in all 5 species with one exception that 1 of the endopodal setae of Mx2 is armed with long spinules in addition to short spinules in *P. austrina* and *P. erebi.* The males share the basic similarity in the form of the right P5 endopod, digitiform process, serrated lamella, and hairy tubercle of the left P5 exopod. Although the females can readily be identified by their genital somite, which is highly variable among species, the males are rather difficult to distinguish because their diagnostic characters involving the relative size and structure of the serrated lamella, hairy tubercle, and 3rd segment of the left P5 exopod show very subtle differences among species (Bradford 1981).

Distribution. Paraeuchaeta antarctica is known to occur throughout the Antarctic and often to penetrate as far north as 35°S in the southwestern Atlantic (Park 1978), the fjord region of the Chilean coast (Marin and Antezana 1985), and 45°S in the Indian Ocean (Vervoort 1957). In the present study it was found only in the samples taken in the Antarctic except one, which was taken in the Tasman Sea at 50°S.

Paraeuchaeta austrina (Giesbrecht 1902)

Euchaeta austrina Giesbrecht 1902, p. 22, pl. 3, Figs. 9-26.
- Fontaine 1988, p. 46, Figs. 6, 13, 16, 17.

The female of this species, which has recently been redescribed by Fontaine (1988), is similar in the shape of the genital somite to *P. antarctica* but differs from it in the form of Mx2, 1 of the endopodal setae of which is armed with long spinules in addition to short spinules as in *P. elongata.* The male, however, has not been rediscovered since its original description by Giesbrecht (1902).

The species has so far been recorded in the Bellingshausen Sea (Giesbrecht 1902), the Indian Ocean sector at 67°34'S, 35°51 'E (Seno et al. 1963), the Ross Sea and the Atlantic sector at 61°39'S, 39°10'W (Fontaine 1988). In the present study it was found northeast to the Ross Sea at 75°50'S, 159°59'W.

Paraeuchaeta similis (Wolfenden 1908)

Euchaeta similis Wolfenden 1908, p. 19, pl. 4, Figs. 1-4; 1911, p. 296, fig. 48.

- Bradford 1971, p. 22, Figs. 68, 69.
- Park 1978, p. 227, fig. 82.
- Fontaine 1988, p. 38, Figs. 6, 9, 10.

Paraeuchaeta similis; Bradford 1981, p. 400, Figs. 1, 3, 4, 7.

This species is known to be fairly common close to the Ross Ice Shelf and to occur throughout the Ross Sea (Fontaine 1988). Outside of the Ross Sea it has been found in the Indian Ocean sector close to Antarctica by Wolfenden (1911) and Vervoort (1957) and in the northern part of the Weddell Sea by Ferrari and Dojiri (1987) and Fontaine (1988). In the present study it was found northeast to the Ross Sea at 75°50'S, 159°59'W.

A full description of the female of this species has been given by Park (1978) and Fontaine (1988). The male was described for the first time by Bradford (1981). The female can be distinguished from those of the other species by the shape of the genital prominence, which is extraordinarily large, arises along the distal end of the somite, and is slightly turned anteriad. According to Bradford (1981), the male can be diagnosed by the following features: In P2 exopod, the outer spine of the 2nd segment is smaller than the 2nd outer spine of the 3rd segment. The serrated lamella extends beyond the hairy tubercle by about 1/4 its length and is 3/5 the length of the 3rd segment.

Paraeuchaeta erebi Farran 1929

Paraeuchaeta erebi Farran 1929, p. 239, fig. 9.
- Bradford 1981, p. 400, Figs. 1-4, 6.

Euchaeta erebi; Fontaine 1988, p. 41, Figs. 11-13.

This species is very similar to *P. similis* but can be distinguished from it in the female by the genital prominence, which is more anteriorly located with its posterior side at some distance from the distal end of the somite. The cephalosomal appendages similar to those of *P. antarctica* but 1 of the endopodal setae of Mx2 is armed with long spinules as in *P. austrina.*

The species was first described from females collected through a hole in the ice of the McMurdo Sound. Bradford (1981) rediscovered the species in the type locality and described the male for the first time. Fontaine (1988) found the species in Ross Sea shelf waters and redescribed both the female and male. No specimens referable to this species were found in the present study.

According to Bradford (1981), the male is diagnosed by the following details: The outer spine of the 2nd exopodal segment of P2 is shorter than the 2nd outer spine of the 3rd exopodal

segment. The serrated lamella of the left P5 exopod extends beyond the hairy tubercle by about 1/4 its length and is 4/5 the length of the 3rd exopodal segment.

Paraeuchaeta tycodesma (Park 1978)

Euchaeta tycodesma Park 1978, p. 229, fig. 83.

-Fontaine 1988, p. 45, Figs. 13-15.

Paraeuchaeta tycodesma; Bradford 1981, 401, Figs. 3, 4, 8.

This species was first described from females collected in the Ross Sea. The male was described by Bradford (1981) from specimens collected from under the ice in the McMurdo Sound. The species was also found by Fontaine (1988) in the Ross Sea. The female of this species, which has been redescribed by Fontaine (1988), is very similar to those of P. *similis* and *P. erebi* but can be distinguished from them by the shape of the genital prominence, which is of a hammer shape and arises close to the distal end of the genital somite. The male is diagnosed, according to Bradford (1981), by the serrated lamella of the left P5 exopod, which is similar to that of *P. erebi* but relatively shorter, being 3/4 the length of the 3rd exopodal segment. The species was not found during the present study.

PARAEUCHAETA BISINUATA (SARS 1907)
Figures 86 and 87

Euchaeta bisinuata Sars 1907. p. 12.

- Farran 1908, p. 45, pl. 3, Figs. 17-19; pl. 4, fig. 4.
- With 1915, p. 183, fig. 54, pl. 6, fig. 11.
- Vervoort 1963, p. 175.
- Park 1978, p. 244, fig. 94.

Paraeuchaeta bisinuata; Scott 1909, p. 70, pl. 16, Figs. 10-17.

- Sars 1925, p. 123, pl. 33, Figs. 16-22.
- Tanaka 1958, p. 343, fig. 69.
- Tanaka and Omori 1968, p. 230, Figs. 3D, 4C.

Diagnosis. Appendicular caudal setae smoothly curved (Fig. 86-f). Supralabrum extending forward (Fig. 86-a). Anterior lobe of genital flange (Fig. 86-c) produced into a toothlike process. In A2 (Fig. 86-g), basis with a single seta and marginal seta of 2nd exopodal segment very small. First endopodal segment of Md (Fig. 86-h) without setae. Maxillule (Fig. 86-i) with 1 anterior, 9 marginal, and 2 posterior setae on 1st inner lobe and 3 setae on basis. First exopodal segment of P1 (Fig. 86-k) with well-developed outer spine. In male 5th pair of legs (Fig. 87-f), right endopod with a large lobe along lateral margin and digitiform process reduced to small conical process.

Additional description of female. Prosome length, 3.8-4.2 mm; body length, 5.3-5.7 mm. Body robust. Laterally, anterodorsal margin of forehead (Fig. 86-a) nearly straight. Frontal eminence relatively low. Rostrum large, pointing obliquely forward, nearly parallel to anterodorsal margin of forehead. Supralabrum pointing forward. Posterolateral corners of prosome symmetrical and broadly rounded dorsally as well as laterally (Fig. 86-b). Urosome relatively elongate.

Genital somite in dorsal view symmetrical, with conspicuous swelling at middle. Laterally, genital prominence (Figs. 86-c, d) broad but relatively low. Each genital flange divided into an anterior and a posterior lobe. Anterior lobe toothlike, with a blunt tip. Posterior lobe lower but wider than anterior one. Two genital flanges, however, are not symmetrical, the right anterior lobe being much larger and the right posterior lobe being wider than the corresponding lobes of the left side. Posterior edge of genital field appearing like a large lobe, together with 2 lobes of genital flange, giving genital prominence a trilobed structure. Ventrally, genital field (Fig. 86-e) appears symmetrical.

Appendicular caudal seta (Fig. 86-f) thinner but much longer than adjoining marginal caudal setae, more than twice length of 5th marginal caudal seta, and extending in a posterolateral direction and only slightly curved inward, forming a low and wide arch.

Antennule reaching about distal end of prosome. In morphological details, Al, Mx2, and Mxp similar to those of *P. malayensis.* In A2 (Fig. 86-g), coxa, basis, and 1st endopodal segment each with a single seta; marginal seta of 2nd exopodal segment very small. First endopodal segment of Md (Fig. 86-h) without a marginal seta. Maxillule (Fig. 86-i) with 1+9+2 setae on 1st inner lobe, 1 seta each on 2nd and 3rd inner lobes, and 3 setae on basis. First endopodal segment with 3 or 4 setae (Fig. 86-j). Outer lobe with 6 subequal setae.

First exopodal segment of P1 (Fig. 86-k) with a highly bulging outer margin and relatively well developed outer spine. Separation between 1st and 2nd exopodal segments is indicated by a faint line of joint. Outer spine of 2nd exopodal segment reaching base of following outer spine.

In P2 exopod (Fig. 86-l), 2nd outer spine reaching close to distal end of following outer spine. Fourth outer spine about 3/4 length of 2nd, a little short of reaching base of 5th. Incision posterior to 2nd marginal lobe of 3rd exopodal segment relatively deep, though not reaching level of preceding incision.

Additional description of male. Prosome length, 3.4-3.7 mm; body length, 4.7-5.2 mm. Body slender. Laterally, forehead (Fig. 87-a) with a smoothly curved dorsal margin. Frontal eminence low. Rostrum with a massive base tapering into a spiniform process, slightly curved backward and pointing downward. Posterolateral corners of prosome symmetrical in dorsal view; rounded in lateral view, with an angular ridge on posterodorsal margin (Fig. 87-b). Appendicular caudal setae (Fig. 87-c) much thinner and shorter than adjoining marginal caudal setae and smoothly curved.

Antennule extending beyond distal end of prosome by its last 3 segments and reaching distal end of 2nd urosomal somite. All cephalosomal appendages similar in morphological features to those of *P. malayensis.*

First exopodal segment of P1 (Fig. 87-d) fully separated from 2nd, without an outer spine. Outer spine of 2nd segment small, pointing outward. In P2 exopod (Fig. 87-e), 4th outer spine largest, reaching about 2/3 way to base of following outer spine. All the other outer spines poorly developed.

First exopodal segment of right P5 (Fig. 87-f) with a small toothlike process on outer margin about 2/5 length of segment from proximal end. Endopod with a large lobe midway along outer margin. Endopod of left P5 small and straight. Serrated lamella of 2nd exopodal segment (Figs. 87-g, h) relatively short, only slightly overreaching hairy tubercle of 3rd exopodal segment. Medially, its serrated edge sigmoid, with relatively large teeth. Digitiform process very short and rounded.

Remarks. This species is very close in morphology to the *antarctica* species group, sharing the following characteristics: Anterior lobe of genital flange toothlike; basis of A2 with a single seta; 1st endopodal segment of Md without a seta; basis of Mx1 with 3 setae; outer spine of 1st exopodal segment of P1 well developed; endopod of male right P5 with a large rounded lobe on outer margin; digitiform process of male left P5 very short. *Paraeuchaeta bisinuata* is however distinct from the *antarctica* species group in the following respects: In Md, the small additional seta on the basis and appendicular seta on the 2nd endopodal segment are absent; in Mx1, the 1st inner lobe has 2 posterior setae, instead of 3, and the 2nd inner lobe has a single seta instead of 2; the genital operculum is without a conspicuous central projection; the serrated lamella of the male left P5 is short and bordered with a small number of large teeth; and the hairy tubercle is rounded, without a distal spiniform process.

Distribution. Paraeuchaeta bisinuata has been found throughout the tropical, subtropical, and temperate zones of the world's oceans (Vervoort 1963; Park 1975, 1978) and in the North Atlantic it has been recorded as far north as 60°30'N in the Norwegian Sea (With 1915). In the present study it was found widely in the low and midlatitudes of all three great oceans. The northernmost locations where the species occurred were 53°N in the Atlantic, 35°N in the eastern

and western Pacific, 31°N in the central Pacific, and 17°N in the Bay of Bengal. The southernmost locations where the species was found were 32°S in the Atlantic, 40°S in the central Pacific, 49°S in the Tasman Sea, and 25°S in the western Indian Ocean.

PARAEUCHAETA GRANDIREMIS (GIESBRECHT 1888)
Figures 88 and 89

Euchaeta grandiremis Giesbrecht 1888, p. 337.

- Giesbrecht 1892, p. 246, pl. 16, Figs. 11, 42; pl. 37, Figs. 41-42.

Diagnosis. Appendicular caudal setae smoothly curved (Fig. 88-f). Supralabrum pointing obliquely forward (Fig. 88-a). Genital prominence extremely high, with strongly asymmetrical genital flanges (Fig. 88-d). Antennule extraordinarily long (Fig. 88-a). Basis and 1st endopodal segment of A2 each with a single seta (Fig. 88-g). First inner lobe of Mx1 (Fig. 88-h) with 1 anterior, 7 marginal, and 1 posterior seta; 1st endopodal segment with 2 setae. Mx2 (Fig. 88-i) with a high protuberance on posterior margin; none of its endopodal setae armed with long spinules. Serrated lamella and digitiform process of male left P5 (Fig. 89-f) elongated to similar length.

Additional description of female. Prosome length, 3.7-4.0 mm; body length, 5.2-5.8 mm. Body slender(Fig. 88-a). First pedigerous somite separated from cephalosome by a clear line of joint. Laterally, forehead (Fig. 88-b) with a smoothly curved dorsal margin. Frontal eminence relatively high. Rostrum small, pointing straight in an anteroventral direction. Supralabrum relatively short, pointing obliquely forward roughly in parallel to rostrum.

Dorsally, posterolateral corners of prosome rounded and symmetrical. Laterally, they are broadly rounded (Fig. 88-c). Urosome relatively short. Dorsally, genital somite symmetrical, highly bulging about 2/5 length of somite from proximal end. Laterally, genital prominence (Figs. 88-d, e) extraordinarily high, with a rounded, enlarged distal end, which is actually the right genital flange. Left genital flange small, produced posteriorly into a conical lobe. Appendicular caudal setae (Fig. 88-f) thinner but nearly 3 times length of adjoining marginal caudal setae, smoothly curved proximally and straight thereafter.

Antennule (Fig. 88-a) extraordinarily long, extending beyond distal end of caudal ramus by its last 5 segments or by about 1/3 its length. In segmentation and setal arrangement, however, Al similar to that of *P. malayensis.* In A2 (Fig. 88-g), coxa, basis, and 1st endopodal segment each with a single seta. Second exopodal segment without a seta. Inner margin of 1st endopodal segment with a conspicuous swelling at proximal end.

Mandible similar to that of *P. malayensis.* Maxillule (Fig. 88-h) with 1+7+1 setae on 1st inner lobe, no seta on 2nd, and 1 seta on 3rd; 5 setae on basis (of which the small innermost seta was absent in many specimens), 2 setae on 1st endopodal segment. Exopod with 10 long setae and 1 minute seta distally. Outer lobe with 9 setae, the distalmost of which small. Maxilla (Fig. 88-i) similar to that of *P. malayensis* but with a high swelling on posterior margin proximal to 1st lobe. Maxilliped also similar to that of *P. malayensis* except that 2nd and 4th endopodal segments (Fig. 88-j) each with 2 setae, instead of 3.

First exopodal segment of P1 (Fig. 88-k) not separated from 2nd, without an outer spine; its outer margin only slightly bulging. Outer spine of 2nd segment relatively small, reaching about 1/3 way to base of following outer spine. In P2 exopod (Fig. 88-l), last 4 outer spines of similar size, only a little longer than 1st. First 2 marginal lobes bearing outer spines in 3rd exopodal segment each separated from segment by moderately deep incision. Exopod of P3 (Fig. 88-m) similar to that of P2.

Additional description of male. Prosome length, 3.1-3.3 mm; body length, 4.4-4.7 mm. Body slender (Fig. 89-a). Fusion between cephalosome and 1st pedigerous somite complete. Forehead (Fig. 89-b) in lateral view similar to that of female, but rostrum larger and slightly curved

backward. Dorsally, posterolateral corners of prosome symmetrical; laterally, they are rounded, with a toothlike process on dorsal margin. Appendicular caudal seta (Fig. 89-c) originating from a cylindrical base, smoothly curved, about 1/2 length of 3rd or 5th marginal caudal seta. Fourth marginal caudal seta longer than 3rd or 5th by 2/5 its length.

Antennule (Fig. 89-a) extending beyond distal end of caudal ramus by its last 2 or 3 segments when pressed against body. In morphological details, all cephalosomal appendages similar to those of *P. malayensis*. First exopodal segment of P1 (Fig. 89-d) almost fully separated from 2nd, without an outer spine. Outer spine of 2nd segment relatively small, pointing distad. Second (Fig. 89-e) to 4th legs similar to those of female.

First exopodal segment of right P5 (Fig. 89-f) with a large tubercle on outer margin about 2/3 length of segment from proximal end. Endopod of left P5 small, spiniform. First exopodal segment with a triangular outgrowth midway along medial margin. Serrated lamella of 2nd exopodal segment (Fig. 89-i) elongated, tapering into a curved, spiniform process; only distal half of its medial margin serrated with relatively small teeth. Laterally, 2nd exopodal segment (Fig. 89-g) with a spiniform process on its distal margin next to serrated lamella. No separate toothlike process is found on medial margin of this segment close to its proximal end. Digitiform process (Fig. 89-h) also elongated, about as long as serrated lamella; its distal part enlarged. Hairy tubercle relatively large, about 2/5 length of its segment.

Remarks. This species was first described from a female 5.2 mm long collected in the eastern equatorial Pacific. The male is described here for the first time. The female is very characteristic in having a long Al and high genital prominence. In anatomical features of the appendages, this species differs from *P. malayensis* in the following respects: Basis and 1st endopodal segment of A2 each with a single seta and 2nd exopodal segment without a seta. First inner lobe of Mx1 with 1+7+1 setae; 2nd inner lobe with no seta; small outermost seta on Mx1 basis is missing; 1st endopodal segment of Mx1 with 2 setae. Maxilla with a large outgrowth on posterior margin. Endopodal segments 2 and 4 of Mxp each with 2 setae. First 2 exopodal segments of P1 fully fused; outer spine of 1st segment missing.

The male is diagnosed by its long Al, large tubercle on the 1st exopodal segment of the right P5, small spiniform endopod of the left P5, triangular outgrowth on the 1st exopodal segment of the left P5, and elongate serrated lamella and digitiform process of the 2nd exopodal segment.

Distribution. This species is known to occur in the eastern equatorial Pacific between 11°N and 3°S and between 99°W and 124°W (Giesbrecht 1892). In the present study it was found, often in large numbers, in the same eastern tropical Pacific, between 3°N and 13°N and between the west coast of America and 150°W, and along the west coast of South America between 13°N and 24°S.

PHYLOGENY

The family Euchaetidae is most closely related to the Aetideidae, from which it can be distinguished by 4 synapomorphies: 1) highly developed supralabrum; 2) extremely large appendicular caudal setae; 3) well developed setae of Al; and 4) serrated lamella and digitiform process of male left P5. Of these characters, the first 3 of which are conspicuous in the female, the supralabrum is a specialization of the mouthparts, the large appendicular caudal setae seem to be balancing structures, and the long antennular setae are believed to be mechanoreceptors (Yen and Nicoll 1990); all must have evolved in connection with predatory behavior. The structures of the P5 are specialized male secondary sex characters used in mating and, together with the female genital segment, serve as the most important diagnostic features.

Of the 2 genera in the family, *Paraeuchaeta* seems to be more primitive according to the following character states polarized with the Aetideidae as the outgroup: 1) the appendicular caudal setae are relatively small and smoothly curved or geniculated; 2) the terminal spine of the male left P5 exopod remains very small; 3) more setae on various segments or lobes of such cephalosomal appendages as A2, Md, and Mx1.

Species groups of *Euchaeta*. Based on the character states shown in Fig. 90, the species of the genus *Euchaeta* can be assigned to 3 species groups - the *marina, concinna*, and *acuta* groups - and an independent species, *E. spinosa* that could not be grouped. *Euchaeta spinosa* is believed to be the most primitive and distinguished from the other *Euchaeta* species by its 3 plesiomorphies: 1) relatively short terminal spine of male left P5 exopod; 2) 2 posterior setae of 1st inner lobe of Mx1; 3) 4 setae on 1st endopodal segment of Mx1. The *acuta* species group is considered more primitive than the branch giving rise to the *concinna* and *marina* species groups and can be distinguished from them by the following plesiomorphies: 1) male left P5 exopod with short serrated lamella; 2) with normal digitiform process; and 3) without poorly sclerotized lobes; 4) Mxp basis without long marginal spinules. The *marina* species group is believed to be the most specialized and distinct from all the other species groups by 2 synapomorphies: 1) a poorly sclerotized lobe next to the tufts of stiff hairs on 3rd segment of male left P5 exopod; and 2) 2 spinulose endopodal setae of Mx2.

Species groups of *Paraeuchaeta*. The species of the genus *Paraeuchaeta* may be placed, according to the character states shown in Fig. 91, into 6 species groups - the *malayensis, pavlovskii, norvegica, glacialis, hebes*, and *antarctica* groups - and 3 independent species - *P. biloba, P. bisinuata*, and *P. grandiremis* that could not be grouped. Based on the character states of the appendicular caudal setae, the species of *Paraeuchaeta* can be divided into 2 groups: Those with smoothly curved setae and those with geniculated setae. The smoothly curved setae are believed to be plesiomorphic because they are similar in shape to those found in Aetideidae and occur in the *antarctica* species group which is considered the most primitive according to the distribution of other plesiomorphies. The *antarctica* species group has 3 plesiomorphies - 1) small digitiform process of male left P5 exopod, 2) additional seta on Md basis, and 3) 2 setae on 2nd inner lobe of Mx1- which distinguish it as the most primitive.

Paraeuchaeta bisinuata is closely related to the *antarctica* species group, sharing the following character states: 1) plesiomorphic small digitiform process of male left P5 exopod and 2) apomorphic lobe of male right P5 endopod. *Paraeuchaeta bisinuata* is, however, clearly distinct from the members of the *antarctica* species group in the absence of other synapomorphies that characterize the latter, such as the prominent central structure of the female genital operculum, scooplike serrated lamella and tapering hairy tubercle of male left P5 exopod.

The *hebes* and *glacialis* species groups and *P. grandiremis* all share the smoothly curved appendicular caudal setae with the *antarctica* species group and *P. bisinuata* but are distinct from them and from one another by a set of autapomorphies. However, no morphological evidence allowing further analysis of relationships has been found.

Of the species characterized by their geniculated appendicular caudal setae, the *malayensis* and *pavlovskii* species groups are united by a synapomorphy - the linguiform genital flanges - and the *norvegica* species group and *P. biloba* by the synapomorphic shape of serrated lamella of the male left P5 exopod. The *malayensis* and *pavlovskii* species groups are distinguished from each other by different character states of the supralabrum and the *norvegica* species group and *P. biloba* by differences in the distal segment of the male right P5 exopod.

GEOGRAPHIC DISTRIBUTION

Euchaeta is a circumglobal genus occurring widely in the low and midlatitudes of all three great oceans. The *marina* and *acuta* species groups and *E. spinosa* each have a geographic range roughly coinciding with that of the genus. The *concinna* species group is also circumglobal but primarily at the low latitudes.

Only 2, *E. marina* and *E. paraconcinna*, of the 16 species of the genus *Euchaeta* are endemic to the Atlantic. The species that have so far been found only in the Pacific are the following: *E. marinella, E. longicornis, E. magniloba*, and *E. wrighti. Euchaeta paracuta* is the only species known exclusively from the Indian Ocean. The following 5 species are Indo-Pacific in distribution: *E. rimana, E. indica, E. concinna, E. plana*, and *E. tenuis.* The circumglobal species are *E. acuta, E. media, E. pubera*, and *E. spinosa.* The *Euchaeta* fauna of the Atlantic therefore comprises 6 species including 2 endemic and 4 circumglobal species; that of the Pacific, 13 species including 4 endemic, 5 Indo-Pacific, and 4 circumglobal species; and that of the Indian Ocean, 10 species including 1 endemic, 5 Indo-Pacific, and 4 circumglobal species.

The species of the genus *Euchaeta* are mostly epipelagic and some are numerically very important in zooplankton communities. The species most prominent in the Atlantic is *E. marina* and those in the Pacific and Indian oceans include *E. rimana, E. indica, E. concinna*, and *E. longicornis.* The circumglobal species are usually found in small numbers but occur quite regularly throughout the three great oceans. However, the following 3 species still remain inadequately known: *E. wrighti* and *E. paracuta*, not rediscovered since the original descriptions based on one or a few specimens, and *E. magniloba*, originally described from a single specimen and represented in the present study by only 3 specimens.

Paraeuchaeta is a cosmopolitan genus occurring throughout the world's oceans including the arctic and antarctic waters. Most of the species belonging to the genus *Paraeuchaeta* are bathypelagic. As the geographic distribution of *Paraeuchaeta* is being examined further for a separate publication, only a brief account is given below for each of the 6 species groups and 3 independent species recognized in the study.

The malayensis *species group.* This is the most diverse group and has the most extensive range of geographic distribution, extending from the Arctic Ocean down to the Antarctic and throughout all three great oceans. The members are highly variable in abundance and geographic range. Fifty-four (about 67%) of the 81 species described for the genus are referred to this group and 39 of the 54 species were found in this study. Furthermore, as most of the new species described for the genus in this study as well as in the recent literature (Heptner 1971, 1987; Park 1978) belong to this group, it is believed that there are still more species yet to be discovered. However, because many species of this group are extremely rare, the geographic distributions presented below are limited to those species commonly found in the study.

A number of prominent species of this group are endemic to various regions of the world's oceans. *Paraeuchaeta polaris* is confined to relatively deep water of the Arctic Ocean (Brodsky 1957). Endemic to coastal waters of the northern Pacific are *P. birostrata, P. brevirostris*, and *P. rubra.* The species endemic to the eastern Pacific and particularly common along the west coast of America are *P. californica* and *P. papilliger.* The Indo-West Pacific also harbors 2 common endemic species, *P. eminens* and *P. investigatoris*, of which the former is found only in coastal waters of the western Pacific. *Paraeuchaeta eltaninae, P. parvula*, and *P. rasa* are common endemics in the Antarctic, and *P. regalis* is a common Subantarctic species. *Paraeuchaeta malayensis* is an Indo-Pacific species occurring mainly in the eastern Indian and western Pacific oceans and extends east in tropical waters up to the west coast of America. *Paraeuchaeta confusa* is quite common in the western Pacific and *P. gracilicauda* and *P. vorax* are found widely in the Indo-Pacific. These 3 Indo-Pacific species also occur in the Caribbean Sea and Gulf of Mexico but not anywhere else in the Atlantic.

A number of species have a worldwide distribution. The species with the widest range of distribution is *P. barbata*, which is found commonly and widely in deep water throughout the world's oceans from the Arctic Ocean to the antarctic seas but shows a considerable degree of geographical variation. The populations in the northern Atlantic, northern Pacific, and Southern oceans are distinct in body size and some details of the 2nd swimming legs from the warm water, circumglobal population. These 4 populations may eventually prove to be valid species. *Paraeuchaeta kurilensis* is also found widely but sparsely in deep water of all three great oceans including the Antarctic. *Paraeuchaeta aequatorialis, P. calva, P. comosa, P. hansenii, P. megaloba, P. sarsi*, and *P. scotti* are circumglobal, occurring mainly in low and midlatitudes. However, *P. aequatorialis* and *P. comosa* are conspicuously absent in the North Atlantic other than the Caribbean Sea and Gulf of Mexico, where *P. comosa* is found (Park 1975); *P. calva* has not been found in the eastern Pacific. *Paraeuchaeta megaloba* is relatively rare but has been found throughout the Pacific and also in the northeastern Atlantic. *Paraeuchaeta sarsi* and *P. scotti* are found throughout the Atlantic, but in the Indo-Pacific they are confined to the southern parts. *Paraeuchaeta sarsi*, however, varies geographically mainly in the form of the rostrum and genital segment. The populations of the Atlantic, Subantarctic, and Indo-West Pacific are, therefore, more or less distinguishable from one another.

In summary, of the 25 common species discussed above, which represent less than 1/2 the total number of species referred to this group, only 9 are circumglobal in distribution and 12 species are endemic to various regions; that is, the northern Pacific and Antarctic each have 3 common endemics, the eastern Pacific and Indo-West Pacific each have 2 common endemics, and the Arctic Ocean and Subantarctic each have 1 common endemic. There is no common endemic species of this group in the Atlantic.

The pavlovskii *species group.* The members of this group are all rare except for *P. dactylifera* and all of its 5 species have been described since 1955, including 2 described in the present study. This group has so far been found in the whole of the Pacific including the Antarctic and the southern part of the Atlantic.

Of the 5 species referred to this group, *P. dactylifera* is endemic to the Subantarctic, where it is rather common. *Paraeuchaeta pavlovskii* and *P. scopaeorhina* are very similar in morphology and allopatric, the former inhabiting the northwestern Pacific and the latter along the west coast of America. *Paraeuchaeta sesquipedalis* has been found in 2 disjunct areas: One off the west coast of North America and in the southeastern Atlantic. *Paraeuchaeta vervoorti* has been found widely in the Pacific and in 2 deep samples taken in the southeastern Atlantic. None of the species has been found in the Indian Ocean. With the exception of *P. dactylifera*, all species of this group are so rare that their geographic ranges are not believed to have been fully disclosed by the findings so far obtained.

The norvegica *species group.* This group comprises 8 species, all of which are relatively common and often found in tows taken to depths less then 1000 m, suggesting an upper limit of vertical distribution in the mesopelagic zone. Of course it is not possible to determine the lower limit of vertical distribution with samples taken with open nets as employed in the present study. Three species are endemic in the Atlantic: *P. norvegica* in the subarctic waters, *P. incisa* in the North Atlantic, and *P. gracilis* in the tropical and temperate zones of the whole Atlantic. Three species - *P. tonsa, P. tuberculata*, and *P. weberi* - are endemic in the Indo-Pacific. *Paraeuchaeta exigua* is confined to the southern Atlantic and southern parts of the Indo-West Pacific. *Paraeuchaeta pseudotonsa* displays the widest range of distribution, occurring throughout the Atlantic and in the southern parts of the Indo-Pacific.

The glacialis *species group.* The group comprises a common arctic/subarctic species *(P. glacialis)* and a rare species *(P. tumidula)* found worldwide. *Paraeuchaeta glacialis* is very common in the Arctic Ocean and such subarctic seas of the northern Atlantic as the Greenland and

Norwegian seas (Dunbar and Harding 1968, Sars 1902). In the present study the species was found rather commonly in the southern parts of the Norwegian Sea, the East Greenland Current, and the Labrador Current down to 45°N. *Paraeuchaeta tumidula* has been found widely but rather sparsely throughout the Pacific, Atlantic, and Southern oceans.

The hebes *species group.* This group is neritic and distributed in 3 disjunct areas: 1) the Mediterranean Sea and adjacent coastal waters of southern Europe and northwestern Africa, 2) the coastal areas of the North Pacific from off California to Japan, including the Bering Sea, Sea of Okhotsk, and Sea of Japan, and 3) the Great Barrier Reef of Australia. Of the 4 species referred to this group, *P. hebes* is a Mediterranean species and also occurs in adjacent coastal waters of southern Europe and northwestern Africa (Vervoort 1963). *Paraeuchaeta elongata* is endemic to coastal waters of the northern Pacific from California to Japan, including the Bering Sea, Sea of Okhotsk, and Sea of Japan (Brodsky 1950). *Paraeuchaeta russelli* is a coastal species so far found in 2 disjunct areas: 1) the southern coasts of Japan and Korea (Tanaka 1958, Kang 1992) and 2) the Great Barrier Reef of Australia (Farran 1936). This is an example of amphitropical distribution. *Paraeuchaeta simplex* is another western Pacific species so far known from coastal waters of central and southern Japan (Tanaka 1958). All the 4 species of this group are relatively shallow-living and have often been found in large numbers in the upper 200 m (Farran 1936, Hure 1955, Tanaka 1958, Ohman 1990, Kang 1992).

The antarctica *species group.* This group is the most primitive of all the species groups and independent species of the genus and comprises 5 species, all of which are endemic to the Southern Ocean. *Paraeuchaeta antarctica* occurs commonly throughout the Antarctic and also in subantarctic waters of all the three oceans (Vervoort 1957, Park 1978). *Paraeuchaeta erebi* is restricted to shelf waters of the Ross Sea, where it is abundant. *Paraeuchaeta similis* and *P. tycodesma* are also abundant in Ross Sea shelf waters but their ranges extend to Circumpolar Deep Water of the Antarctic (Fontaine 1988). *Paraeuchaeta austrina* is an inhabitant of Circumpolar Deep Water and has so far been recorded in small numbers from the Ross Sea (Fontaine 1988), the Bellingshausen Sea (Giesbrecht 1902), the Weddell Sea (Fontaine 1988), and in the Indian Ocean sector (Seno et al. 1963).

Independent species. Of the 3 independent species, *P. biloba* is endemic to the Southern Ocean and *P. grandiremis* is endemic to the eastern tropical Pacific; both of them are very common in their respective range. *Paraeuchaeta bisinuata* is rather rare but circumglobal in the warm water belt.

In sumary, of the 6 species groups, only the *antarctica* group, which is the most primitive group of the genus and endemic to the Southern Ocean, has a highly restricted distribution. Two of the 3 independent species also have a narrow distribution, *P. biloba* and *P. grandiremis* being endemic to the Southern Ocean and the eastern tropical Pacific, respectively. All the others are more or less worldwide. In view of the geographical distribution of the species groups and independent species, 2 regions are evident: 1) the Southern Ocean with an endemic species group (the *antarctica* group) and an endemic independent species (*P. biloba*), 2) the eastern tropical Pacific with an endemic independent species *(P. grandiremis).*

GENERAL REMARKS

Mainly based on midwater trawl samples, the study has inevitably leaned toward the large deep-living species. However, many of the deep-sea species found in the study are represented by too few specimens to allow adequate studies of their taxonomy and distribution. A number of undescribed species that are represented in collections by 1 or 2 specimens are, therefore, not included in this paper. The new species found in this study and new species described in the recent literature are all from deep samples (Heptner 1971, 1987; Park 1978), which seems to indicate that there are many more species in deep water yet to be discovered. All of these new species belong exclusively to 2 sister species groups, the *malayensis* and *pavlovskii* groups. The other species groups of *Paraeuchaeta* and all groups of *Euchaeta* are therefore believed to be fairly well known for their faunistic composition.

The species in the *malayensis* species group are highly diverse in abundance and geographical ranges, while the species belonging to the *pavlovskii* species group are all very rare except for one species, *P. dactylifera*, which was found rather commonly and widely in the Antarctic and Subantarctic. In these 2 groups, morphological differences among the species are very small and mainly involve minor details of the female genital segment and the serrated lamella of the male left P5 exopod. All of the remaining species with geniculated appendicular caudal setae in the female - 8 species of the norvegica group and *P. biloba* - were found to be relatively common and can readily be distinguished from one another by their secondary sex characters except for *P. tonsa* and *P. pseudotonsa*, which are morphologically very close to each other.

In species with smoothly curved appendicular caudal setae in the female, the genital somites are highly variable from species to species, making their identification relatively easy. Furthermore, the genital flanges of the female are usually asymmetrical and often very different from each other, as opposed to the relatively uniform and symmetrical genital flanges found in species with geniculated appendicular caudal setae. Of the species with smoothly curved appendicular caudal setae, the *antarctica* species group and *P. bisinuata* together form a single monophyletic group, sharing the following character states: The anterior lobe of the genital flange is toothlike; the basis of A2 has a single seta; the 1st endopodal segment of Md has no seta; the basis of Mx1 has only 3 setae; the outer spine of the 1st exopodal segment of P1 relatively well developed; the endopod of the male right P5 has a large lobe; the digitiform process of the male left P5 is very short. The *hebes* and *glacialis* groups and *P. grandiremis*, the remaining species with smoothly curved appendicular caudal setae, are however quite distinct from one another and their relationships remain unresolved. With the exception of *P. austrina*, all of the species with smoothly curved appendicular caudal setae were found to be relatively common and some were extremely abundant in certain areas. The *Antarctica* species group is unique in that the members are not only closely related to each other in morphology but all confined in geographic distribution to the Antarctic (Fontaine 1988).

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FIGURES

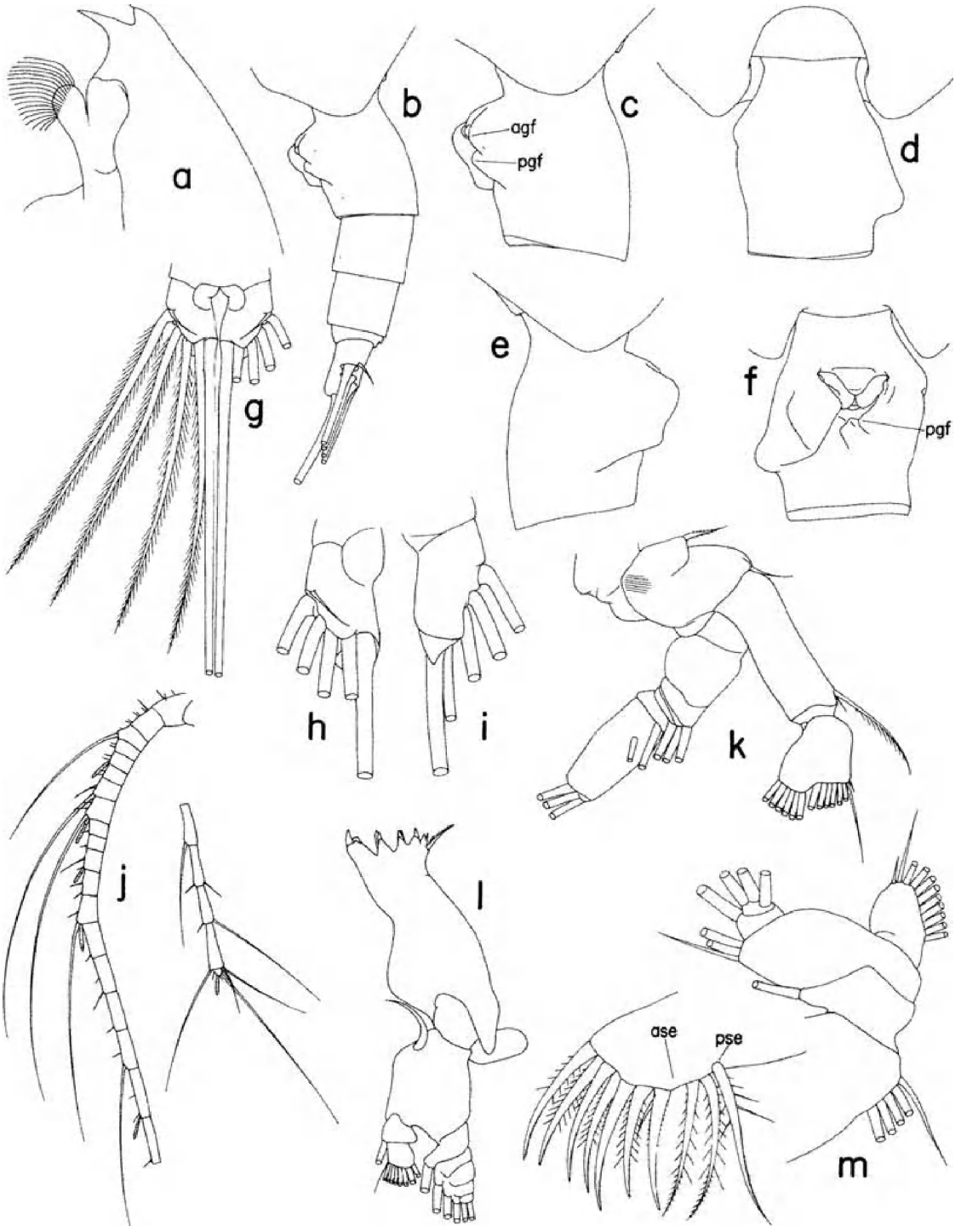

Figure 1. *Euchaeta marina* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, caudal rami, dorsal; h, left caudal ramus, dorsal; i, do, ventral; j, antennule, cut between segments 20 and 21; k, antenna; l, mandible; m, maxillule, first inner lobe separated, posterior. agf = anterior lobe of genital flange. ase = anterior seta. pgf = posterior lobe of genital flange. pse = posterior seta.

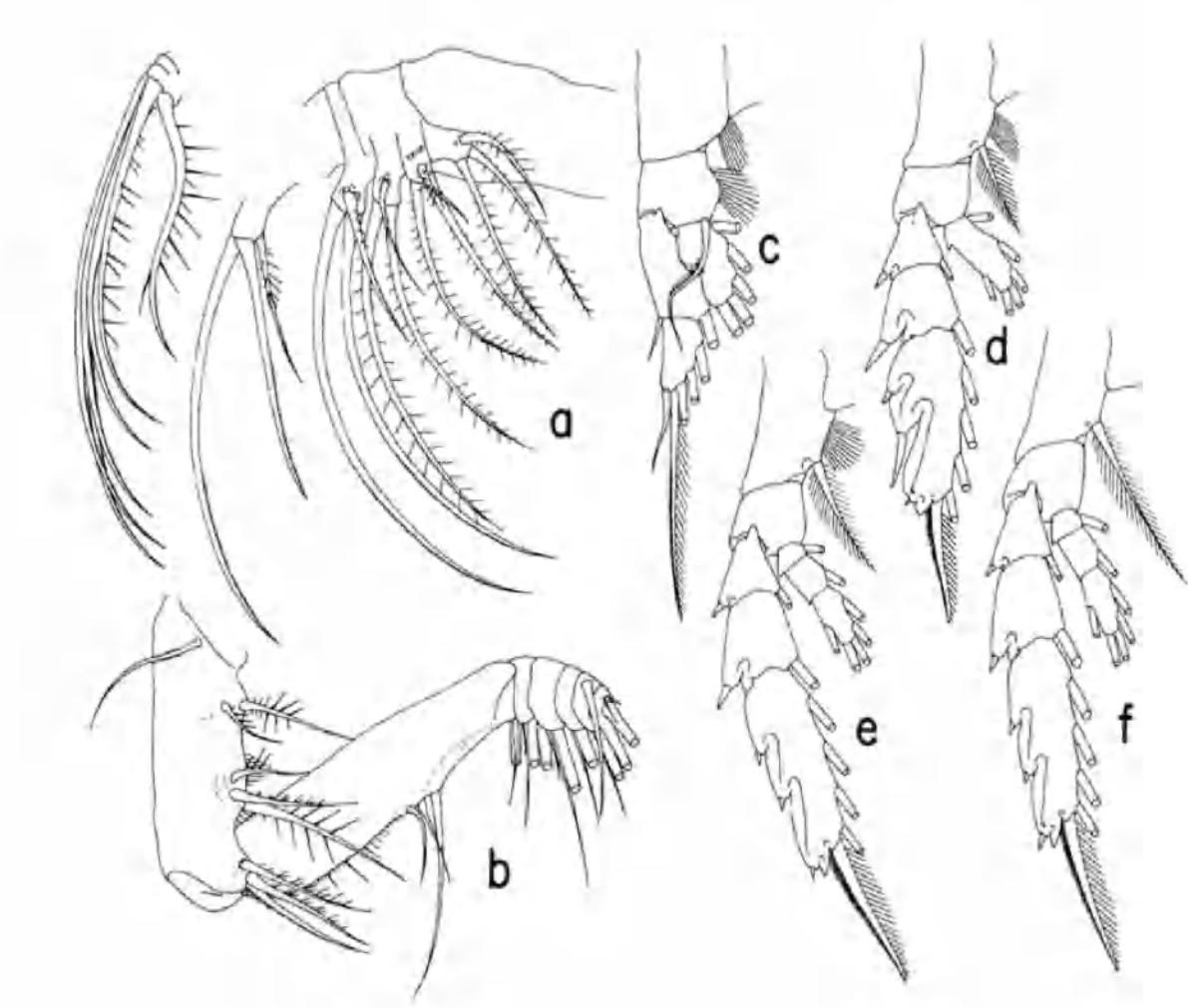

Figure 2. *Euchaeta marina* female: a, maxilla, 5th lobe and endopod separated, posterior; b, maxilliped, coxa posterior, the rest anterior; c. first leg, anterior; d, second leg, anterior; e, third leg, anterior; f, fourth leg, anterior.

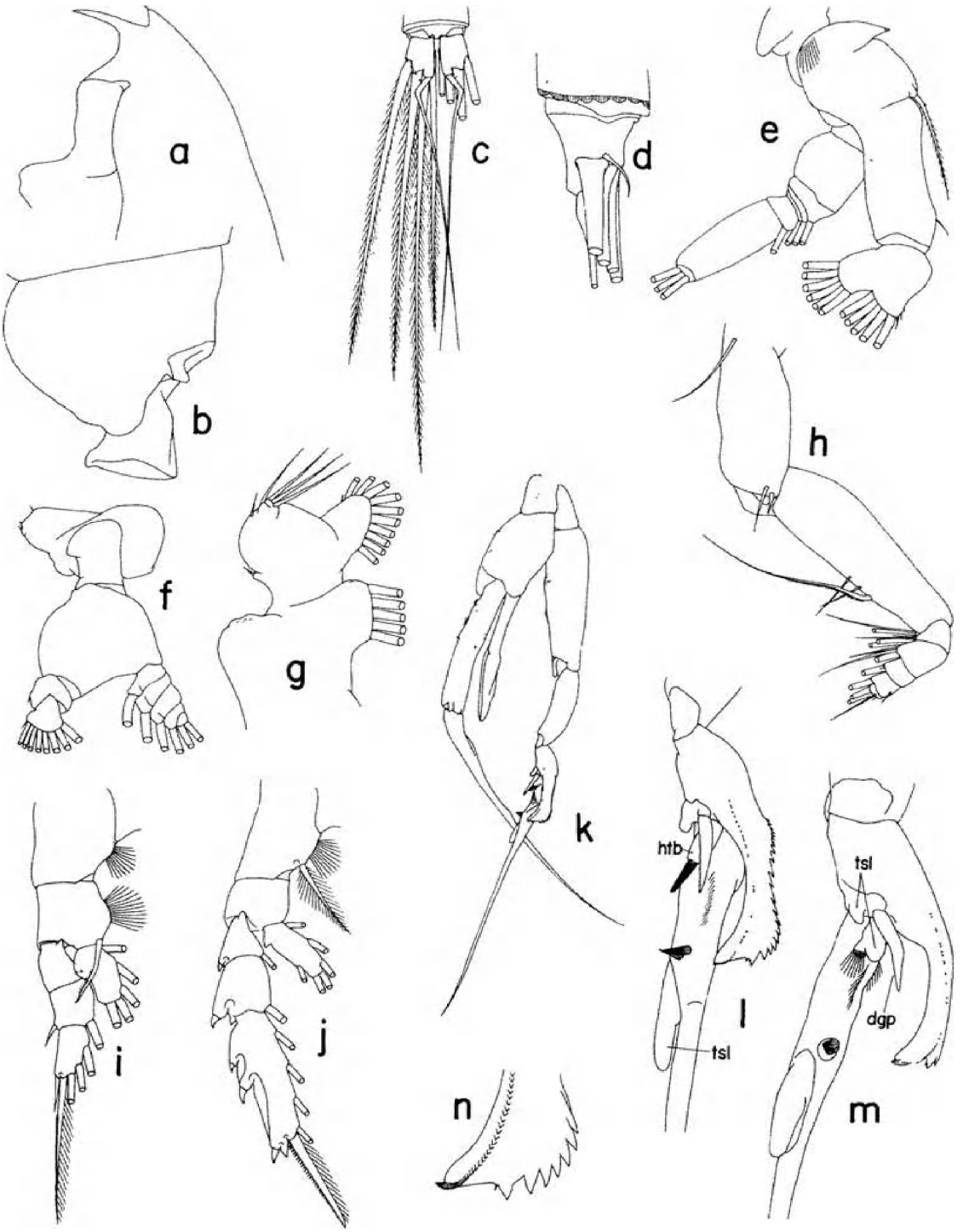

Figure 3. *Euchaeta marina* male: a, forehead, left; b, last pedigerous and genital somites, left; c, caudal rami, ventral; d, left caudal ramus, lateral; e, antenna; f, mandible; g, maxillule, posterior; h, maxilliped, coxa posterior, the rest anterior; i, first leg, anterior; j, second leg, anterior; k, 5th pair of legs, anterior; l, exopod of left 5th leg, anterior, tilted clockwise; m, do, medial, tilted counterclockwise; n, distal end of serrated lamella, anterior. dgp = digitiform process. htb = hairy tubercle. tsl = poorly sclerotized lobe.

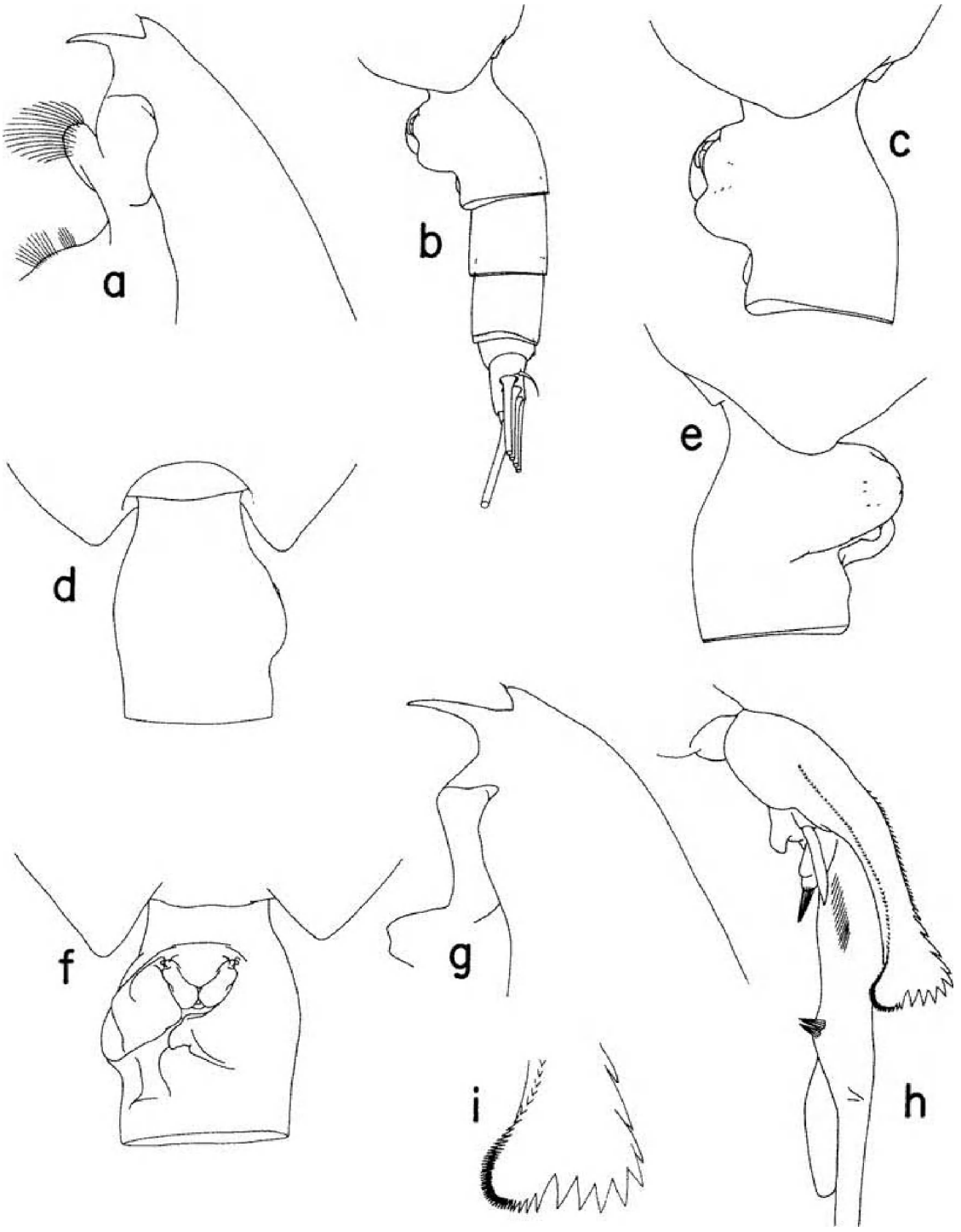

Figure 4. *Euchaeta rimana* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral. Male: g, forehead, left; h, exopod of left 5th leg, anterior, tilted clockwise; i, distal end of serrated lamella, anterior.

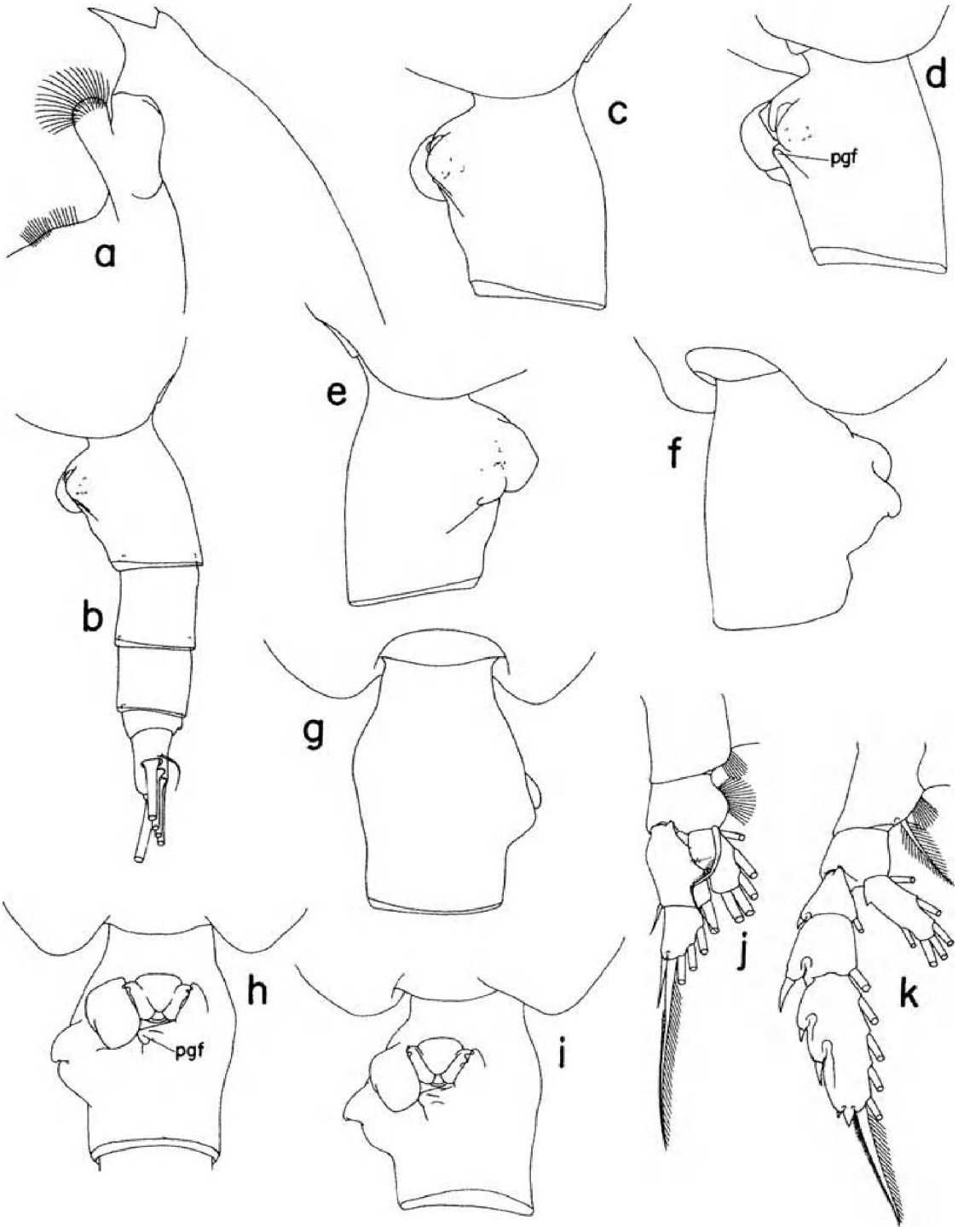

Figure 5. *Euchaeta marinella* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, tilted clockwise; e, genital somite, right; f, do, tilted clockwise; g, genital somite, dorsal; h, do, ventral; i, do, ventral, tilted counterclockwise; j, first leg, anterior; k, second leg, anterior. pgf = posterior lobe of genital flange.

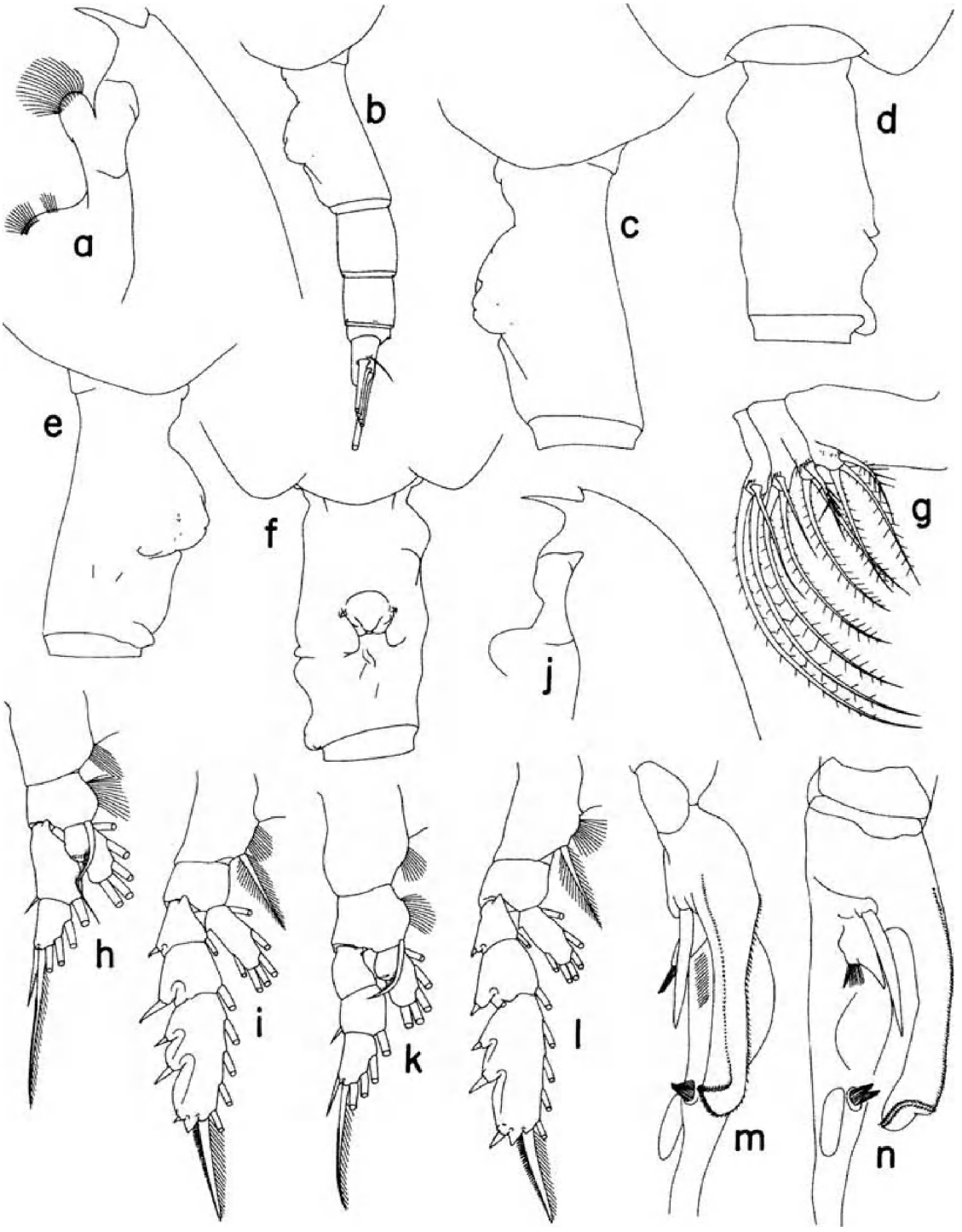

Figure 6. *Euchaeta indica* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, maxilla, fifth lobe and endopod omitted, posterior; h, first leg, anterior; i, second leg, anterior. Male: j, forehead, left; k, first leg, anterior; l, second leg, anterior; m, exopod of left 5th leg, anterior; n, do, medial.

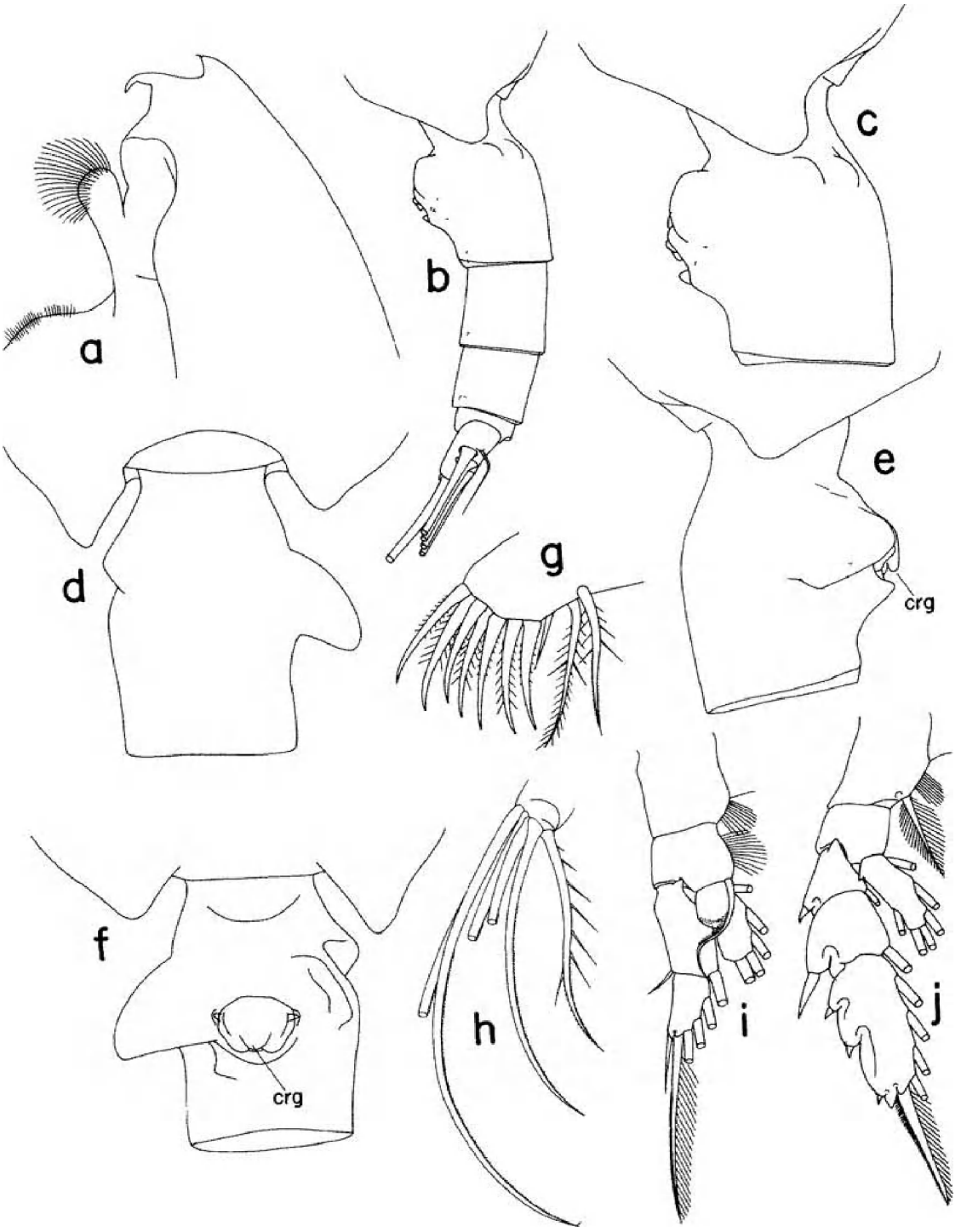

Figure 7. *Euchaeta concinna* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, first inner lobe of maxillule, posterior; h, endopod of maxilla; i, first leg, anterior; j, second leg, anterior. crg = central ridge of genital operculum.

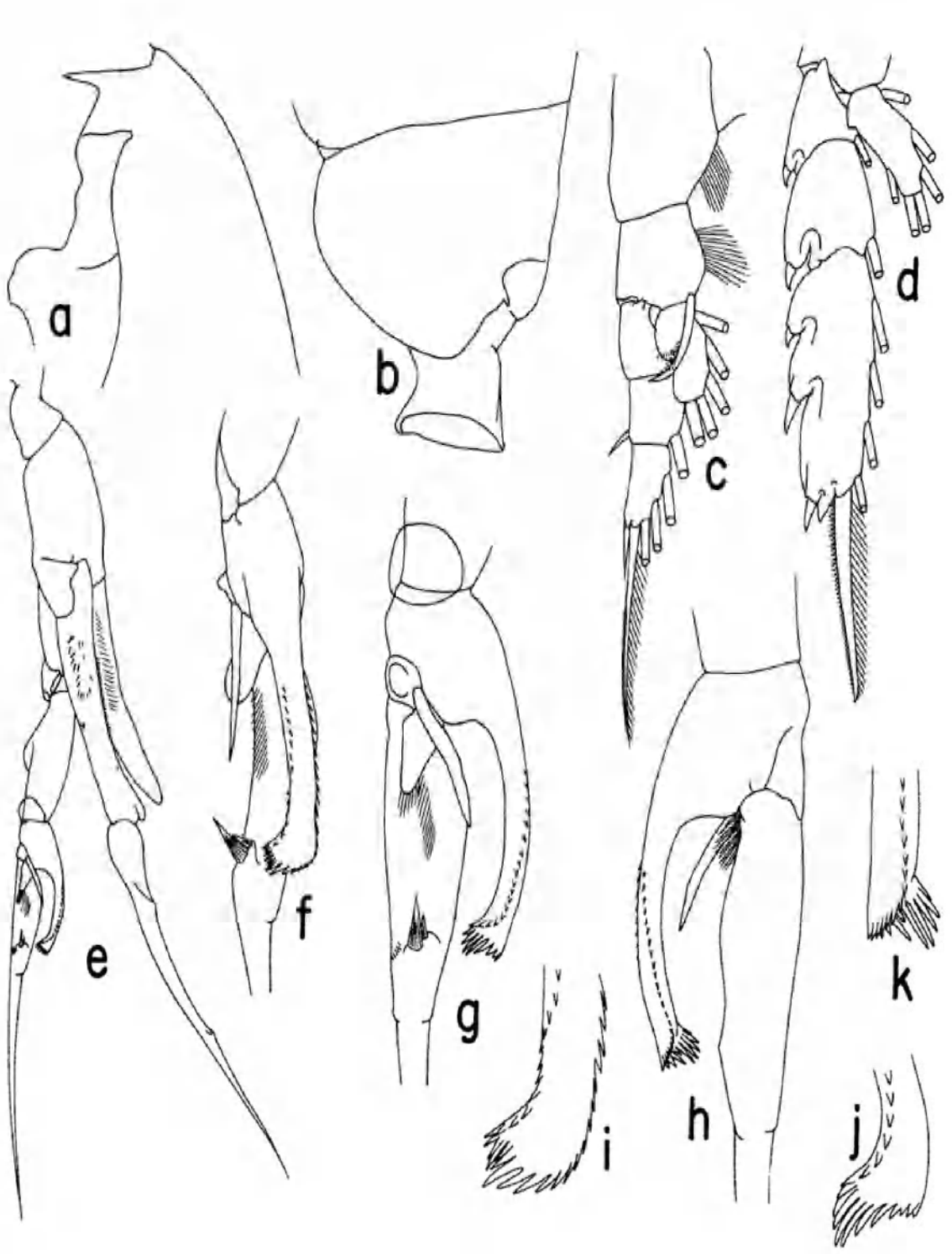

Figure 8. *Euchaeta concinna* male: a, forehead, left; b, last pedigerous and genital somites, left; c, first leg, anterior; d, second leg, anterior, protopod omitted; e, 5th pair of legs, viewed from right side; f, exopod of left 5th leg, anterior; g, do, medial, tilted counterclockwise; h, do, lateral; i, distal end of serrated lamella, anterior; j, do, anterior, tilted clockwise; k, do, lateral.

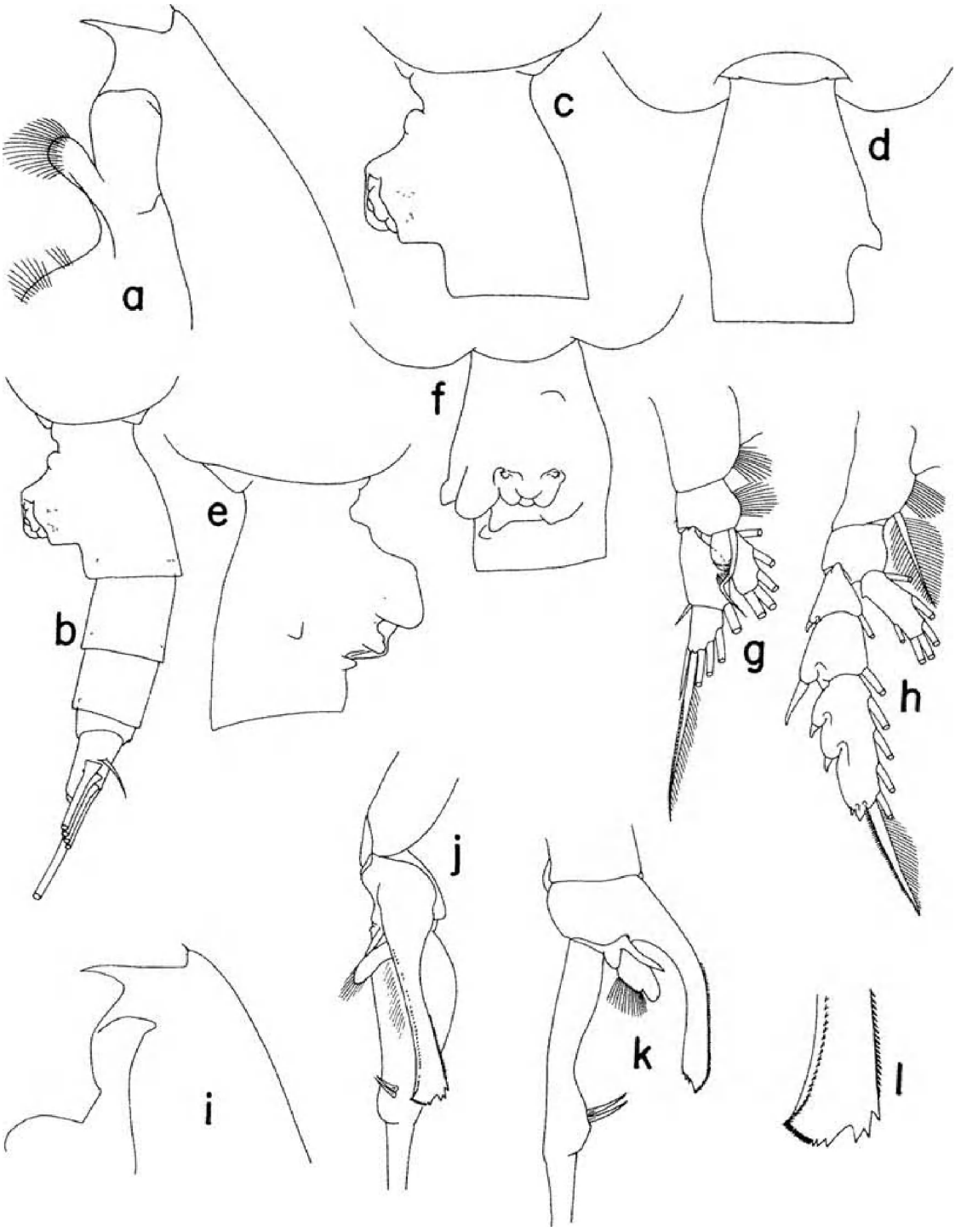

Figure 9. *Euchaeta paraconcinna* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, exopod of left 5th leg, anterior; k, do, medial; l, distal end of serrated lamella, anterior.

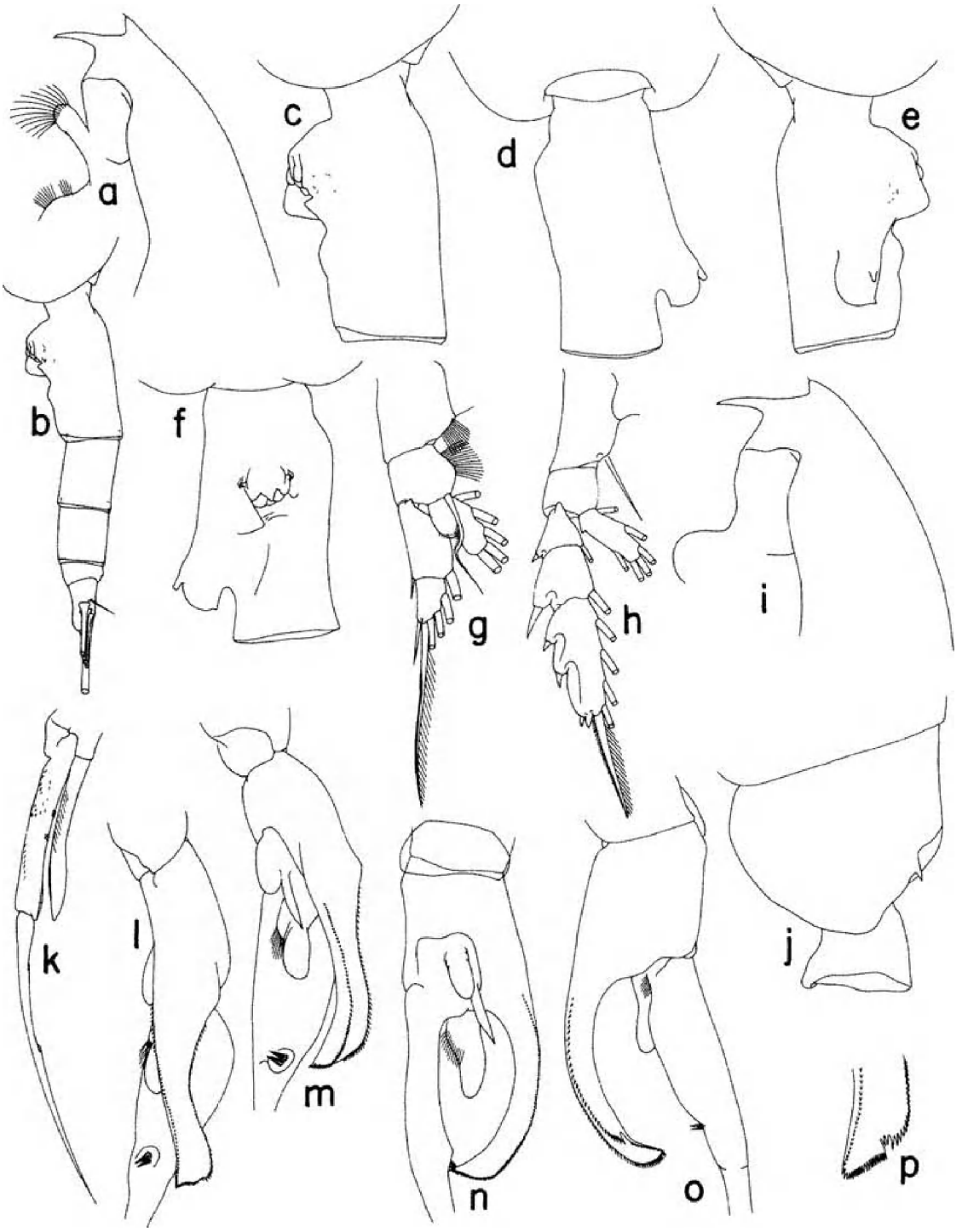

Figure 10. *Euchaeta longicornis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, last pedigerous and genital somites, left; k, right 5th leg, anterior, protopod omitted; l, exopod of left 5th leg, anterior; in, do, anterior, tilted clockwise; n, do, medial; o, do, lateral; p. distal end of serrated lamella, anterior.

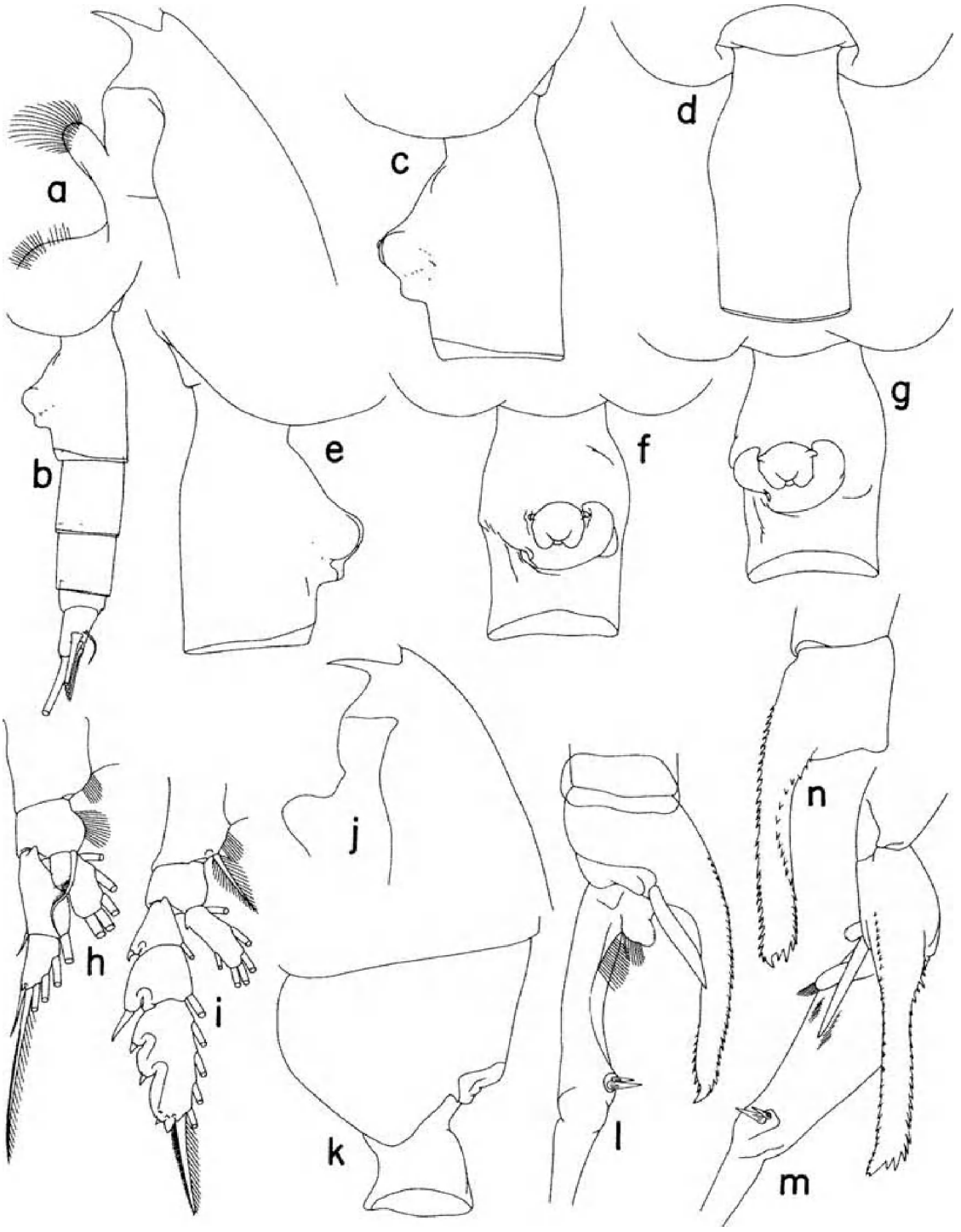

Figure 11. *Euchaeta plana* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do ventral; g, do, ventral, tilted counterclockwise; h, first leg, anterior; i, second leg, anterior. Male: j, forehead, left; k, last pedigerous and genital somites, left; l, exopod of left 5th leg, medial; m, do, anterior, tilted clockwise; n, serrated lamella, lateral.

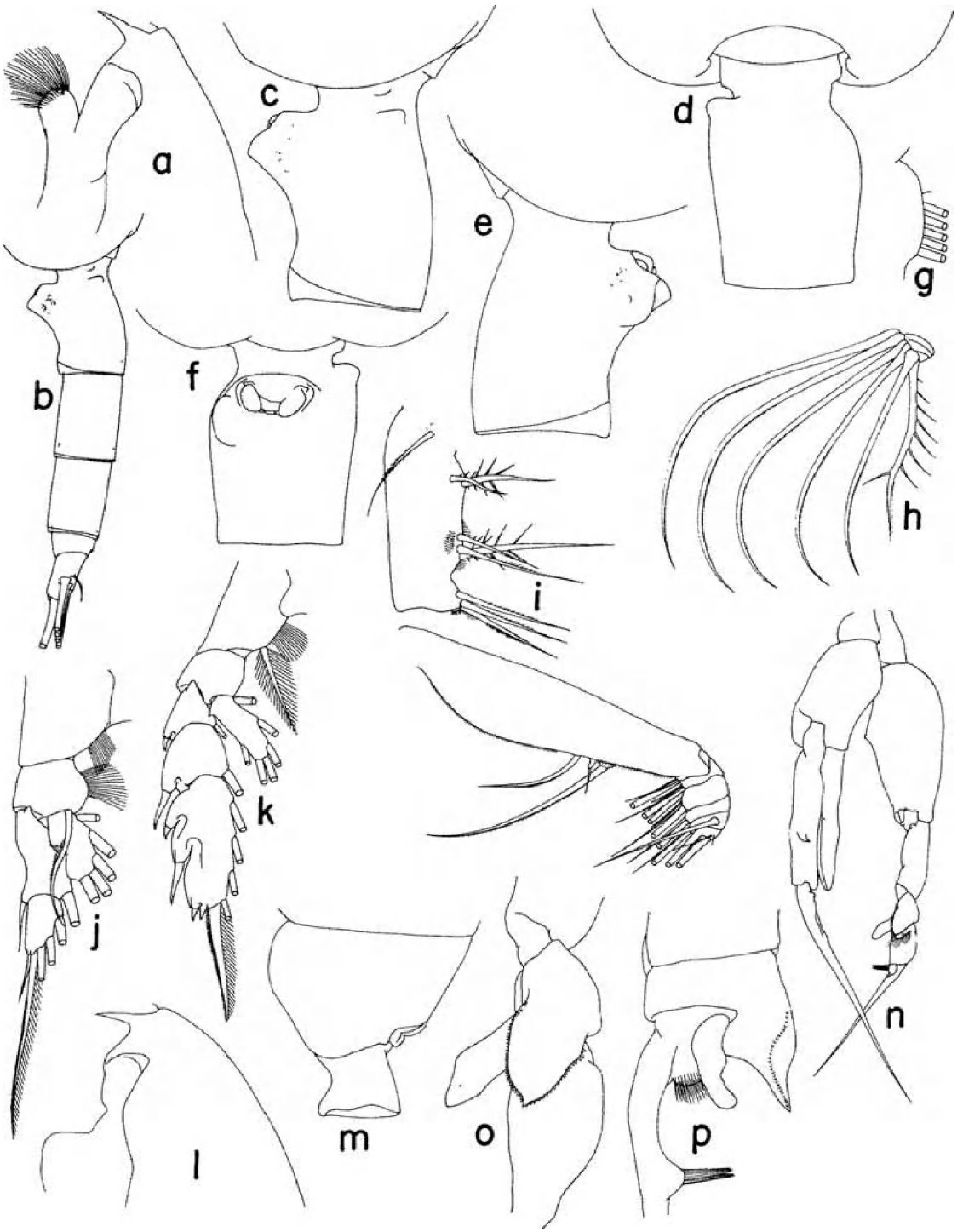

Figure 12. *Euchaeta acuta* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, outer lobe of maxillule; h, endopod of maxilla; i, maxilliped, coxa separated, coxa posterior, the rest anterior; j, first leg, anterior; k, second leg, anterior. Male: l, forehead, left; m, last pedigerous and genital somites, left; n, fifth pair of legs, anterior; o, exopod of left 5th leg, anterior; p, do, medial.

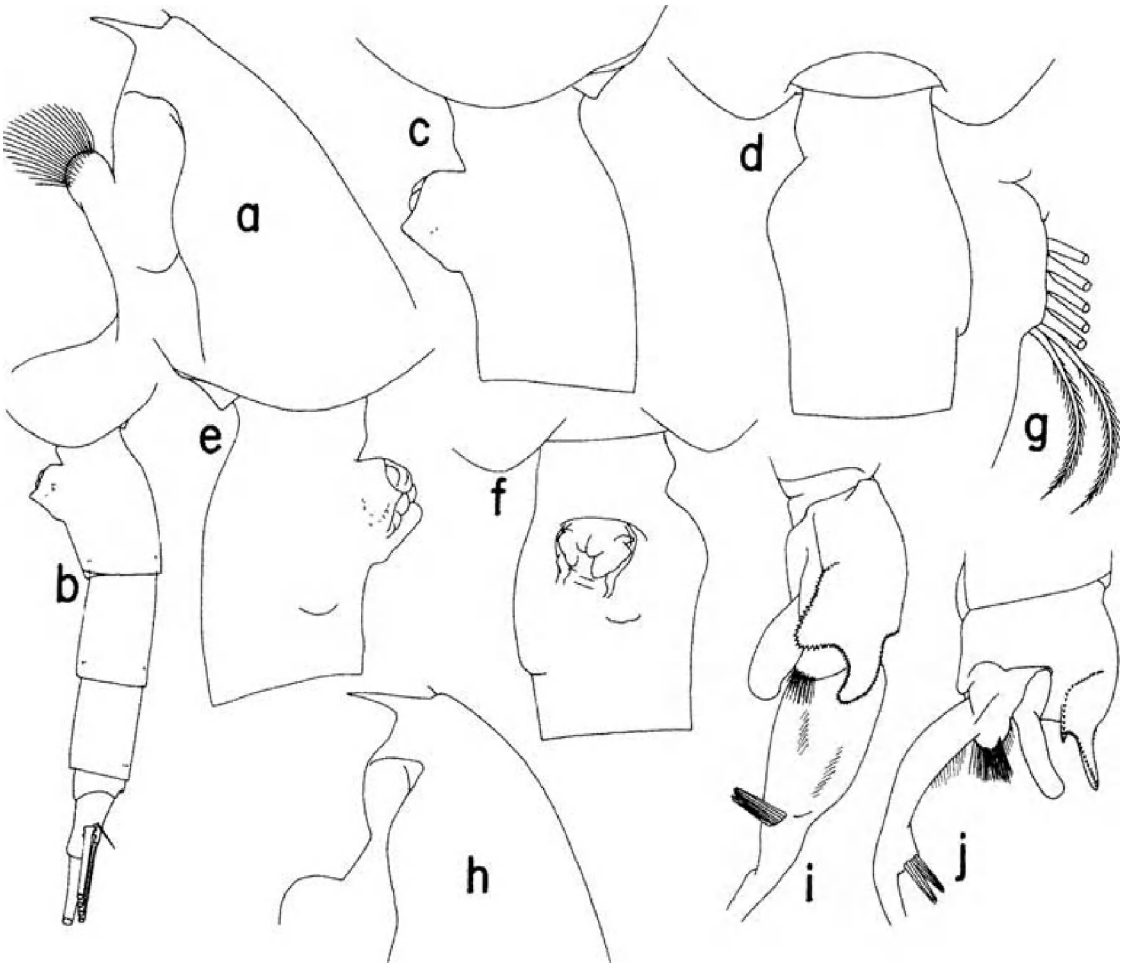

Figure 13. *Euchaeta media* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, outer lobe of maxillule. Male: h, forehead, left; i, exopod of left 5th leg, anterior; j, do, medial.

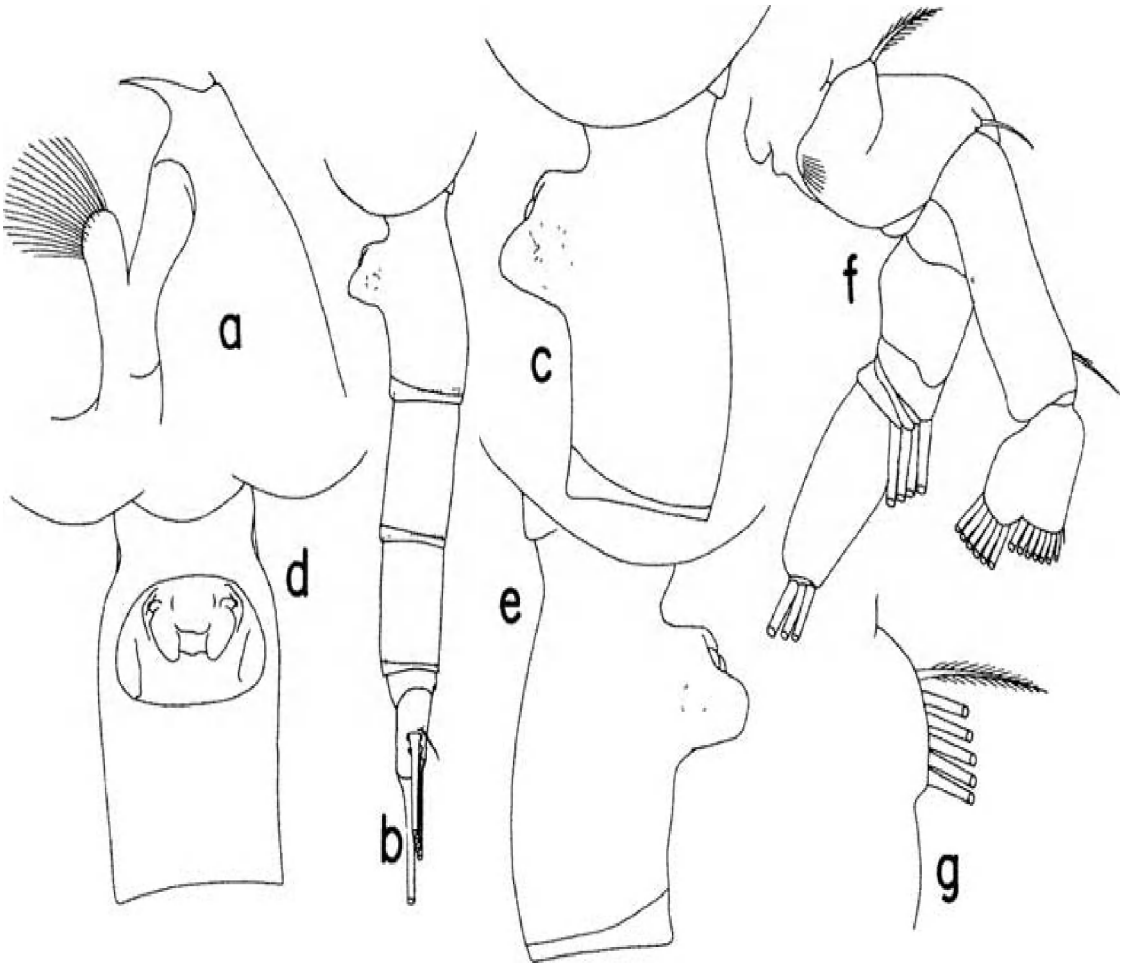

Figure 14. *Euchaeta magniloba* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, ventral; e, do, right; f, antenna; g, outer lobe of maxillule.

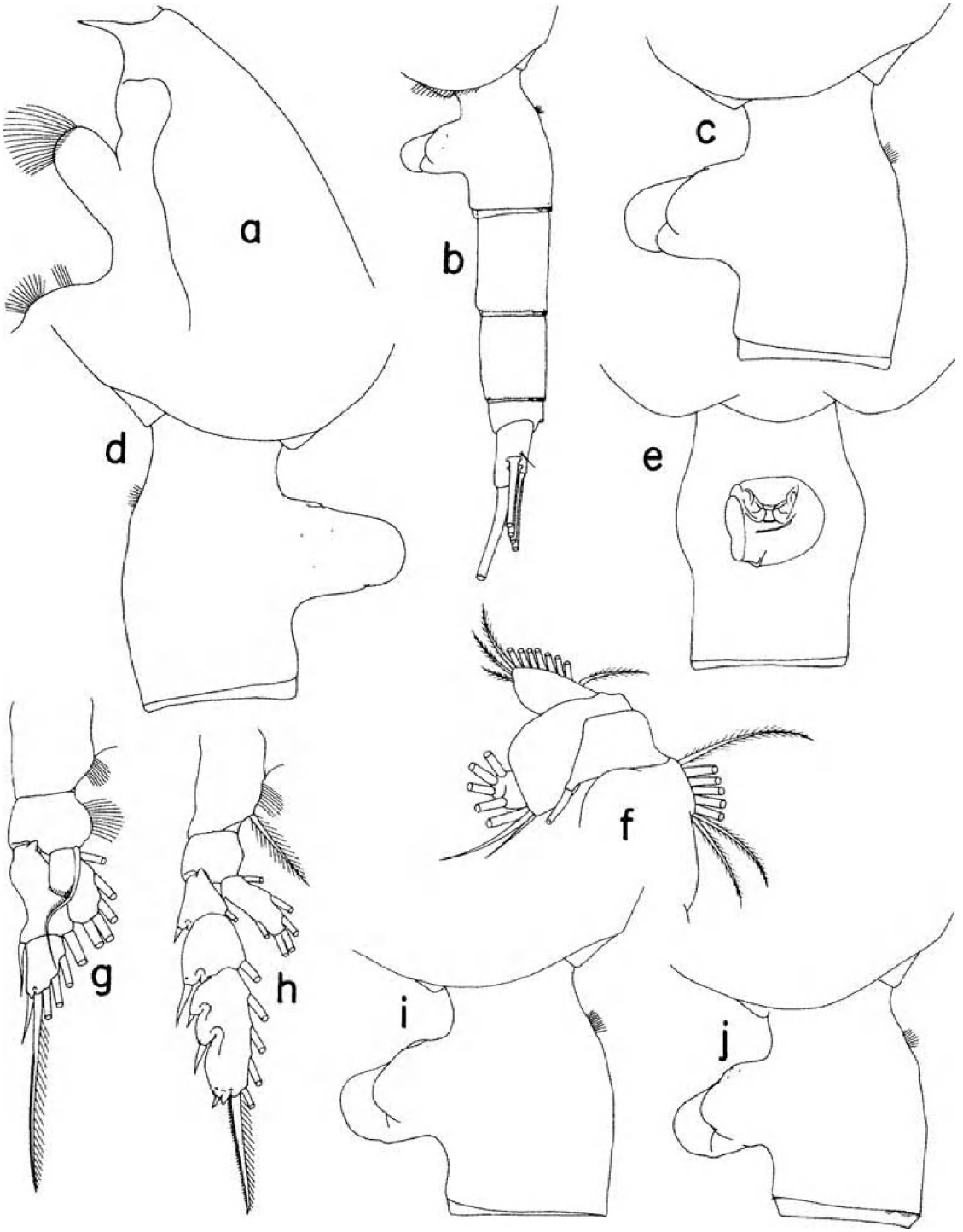

Figure 15. *Euchaeta tenuis* female (from the eastern Pacific): a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, maxillule, first inner lobe omitted; g, first leg, anterior; h, second leg, anterior. Female from the central equatorial Pacific: i, genital somite, left. Female from the East China Sea: j, genital somite, left.

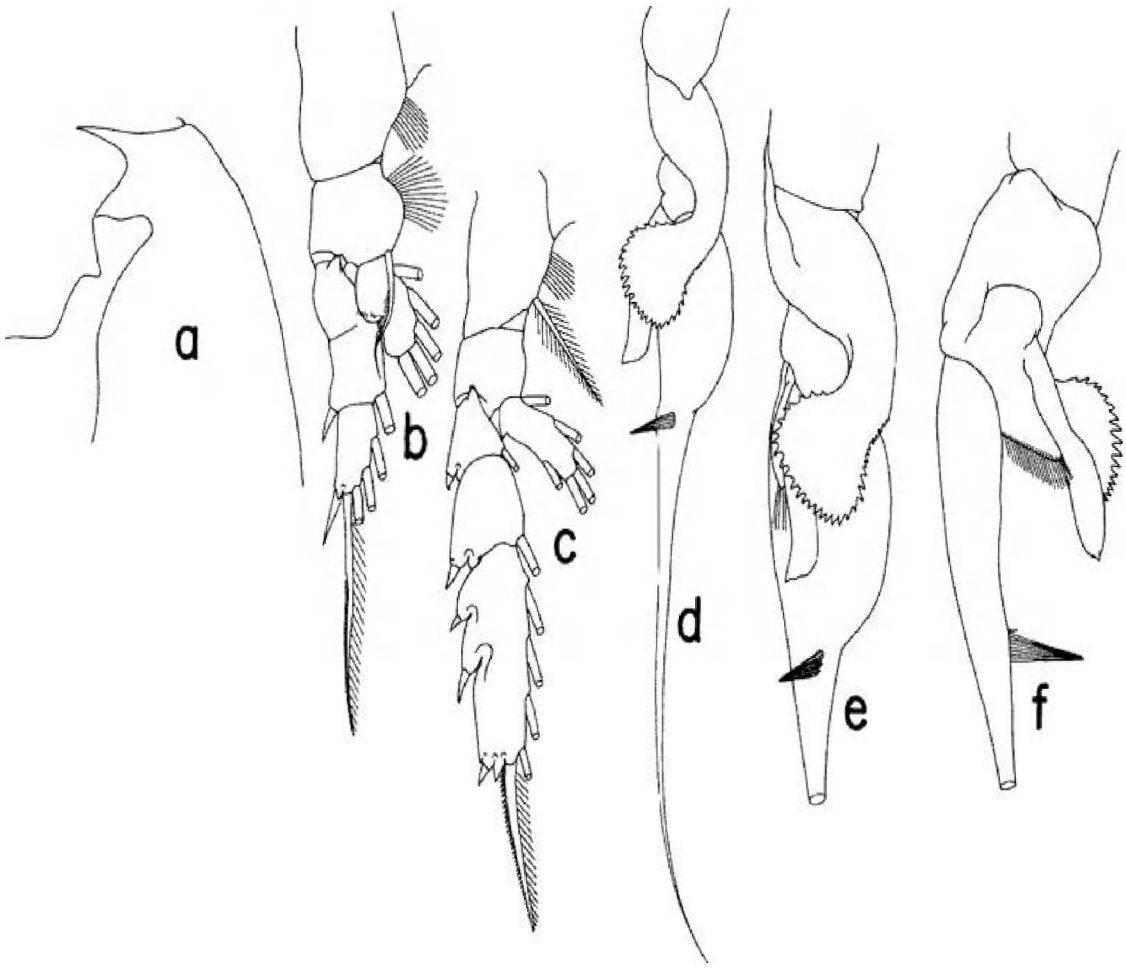

Figure 16. *Euchaeta tenuis* male: a, forehead, left; b, first leg, anterior; c, second leg, anterior; d, exopod of left 5th leg, anterior; e, do, anterior, tilted clockwise; f, do, medial, tilted clockwise.

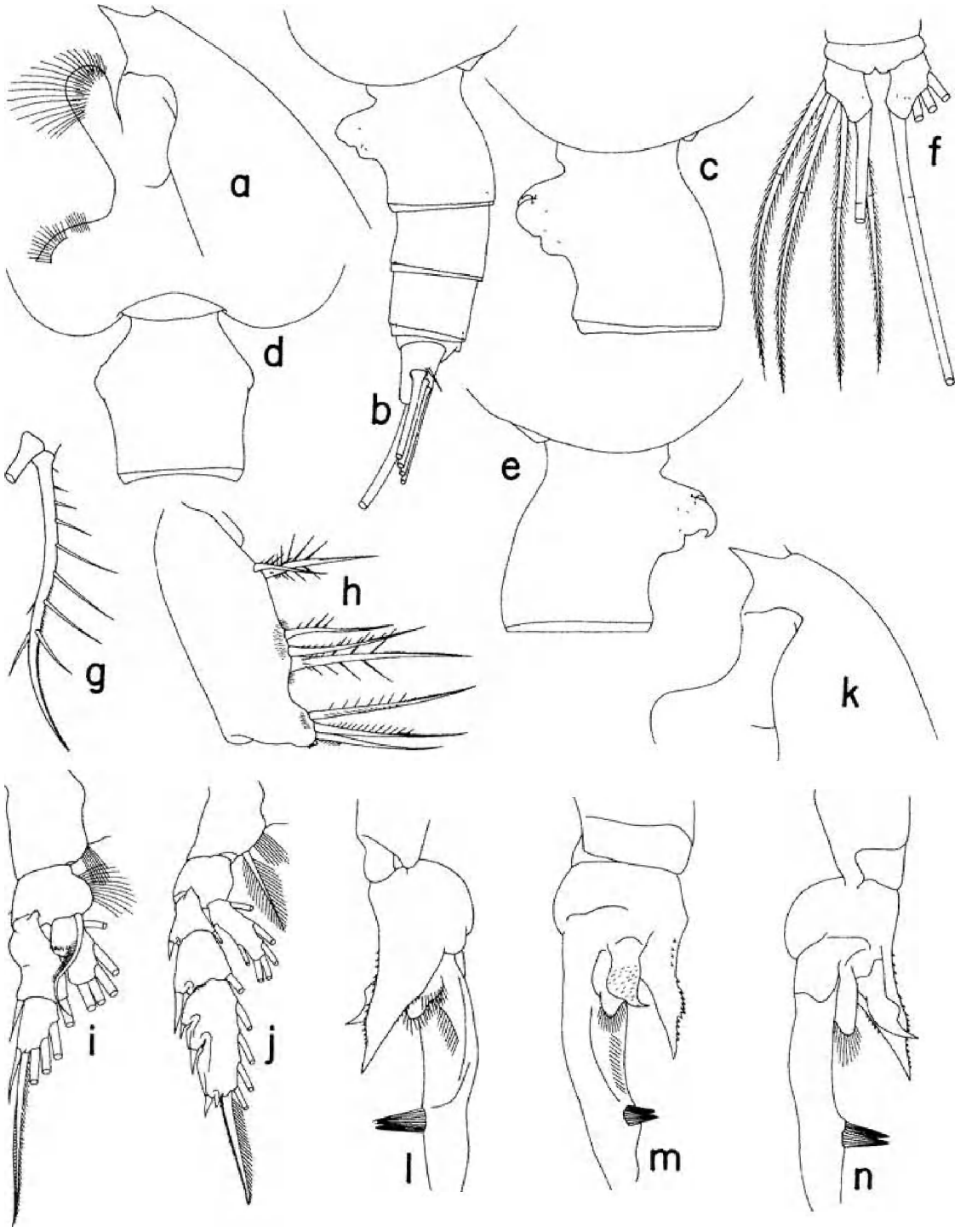

Figure 17. *Euchaeta pubera* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, caudal rami, ventral; g, spinulose seta of maxillary endopod; h, coxa of maxilliped, posterior; i, first leg, anterior; j, second leg, anterior. Male: k, forehead, left; l, exopod of left 5th leg, anterior, tilted counterclockwise; m, do, medial; n, do, medial, tilted clockwise.

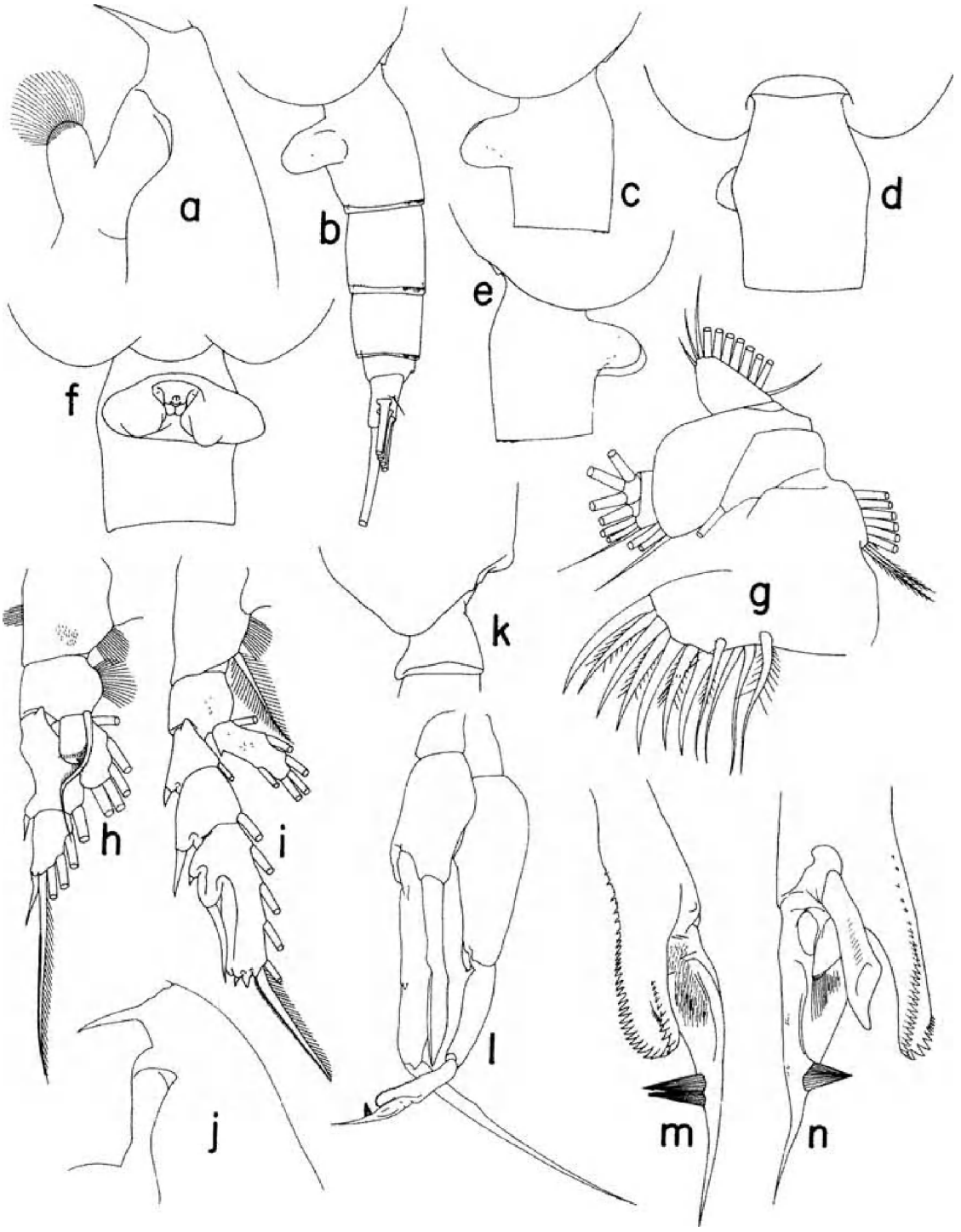

Figure 18. *Euchaeta spinosa* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, maxillule, first inner lobe separated, posterior; h, first leg, anterior; i, second leg, anterior. Male: j, forehead, left; k, last pedigerous and genital somites, left; l, fifth pair of legs, anterior; m, exopod of left 5th leg, anterior, tilted counterclockwise; n, do, medial.

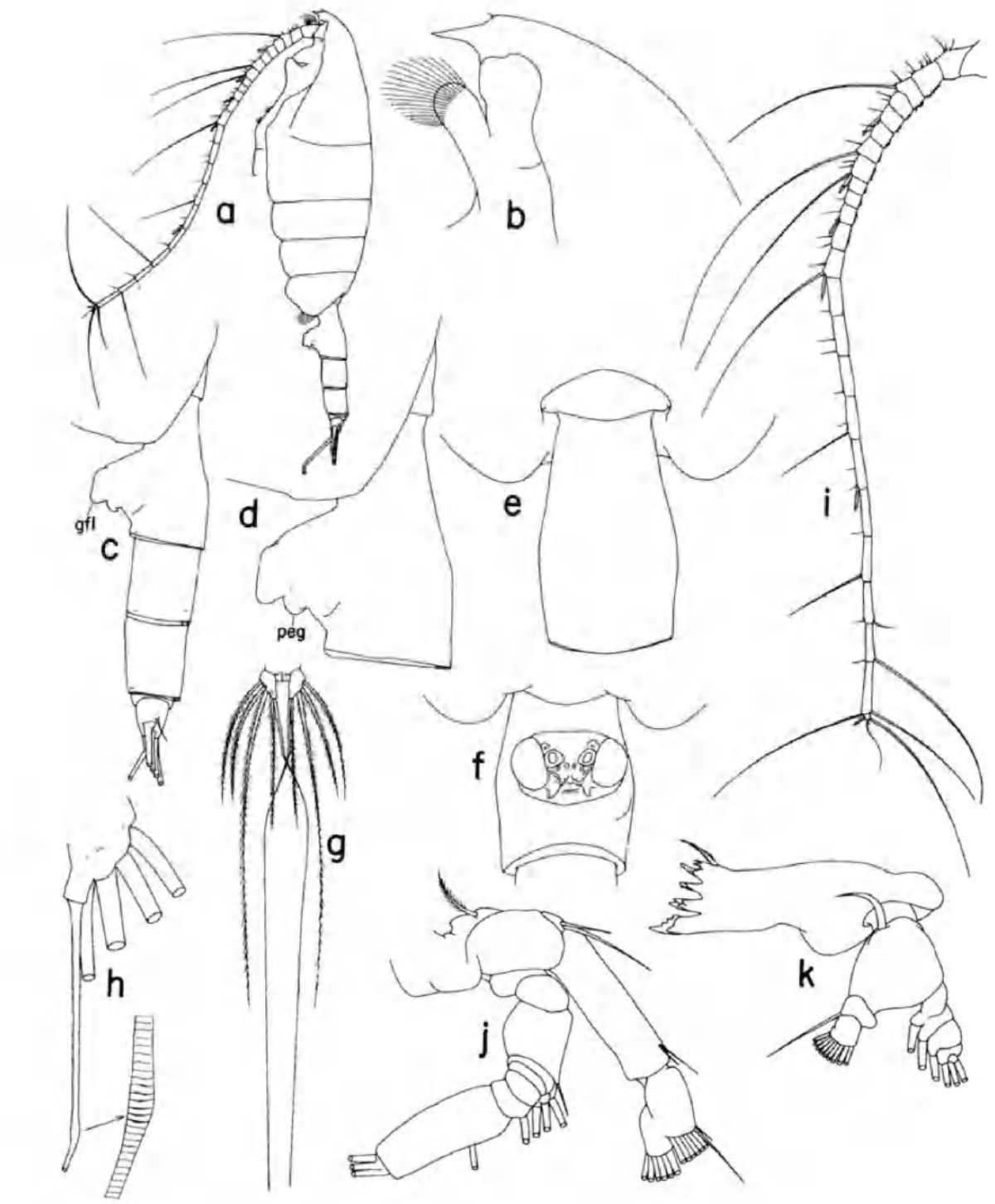

Figure 19. *Paraeuchaeta malayensis* female: a, habitus, left; b, forehead, left; c, urosome, left; d, genital somite, left; e, do, dorsal; f, do, ventral; g, caudal rami, ventral; h, left caudal ramus, ventral; i, antennule; j, antenna; k, mandible. gfl = genital flange. peg = posterior edge of genital field.

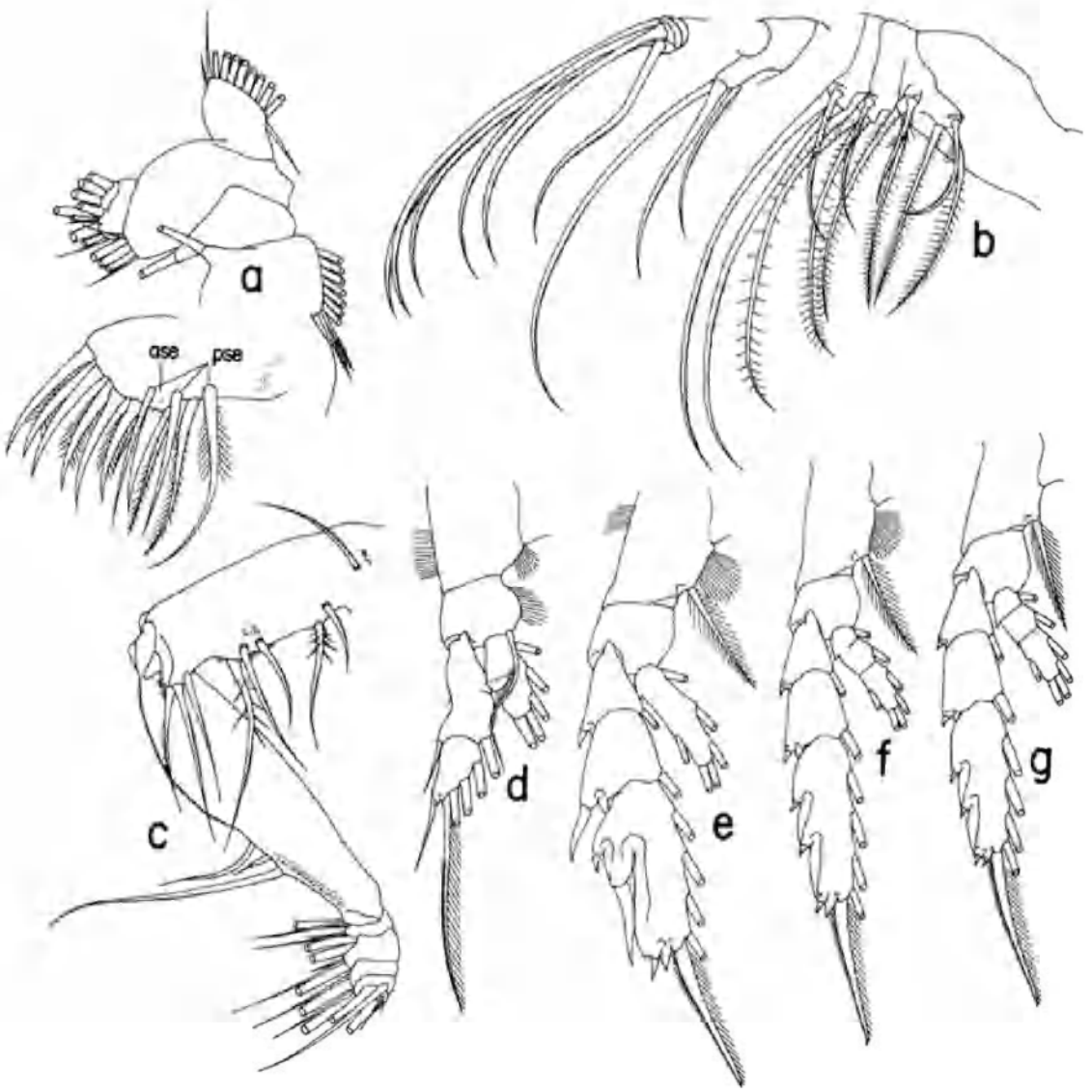

Figure 20. *Paraeuchaeta malayensis* female: a, maxillule, first inner lobe separated, posterior; b, maxilla, fifth lobe and endopod separated, posterior; c, maxilliped, coxa posterior, the rest anterior; d, first leg, anterior; e, second leg, anterior; f, third leg, anterior; g, fourth leg, anterior. ase = anterior seta. pse = posterior seta.

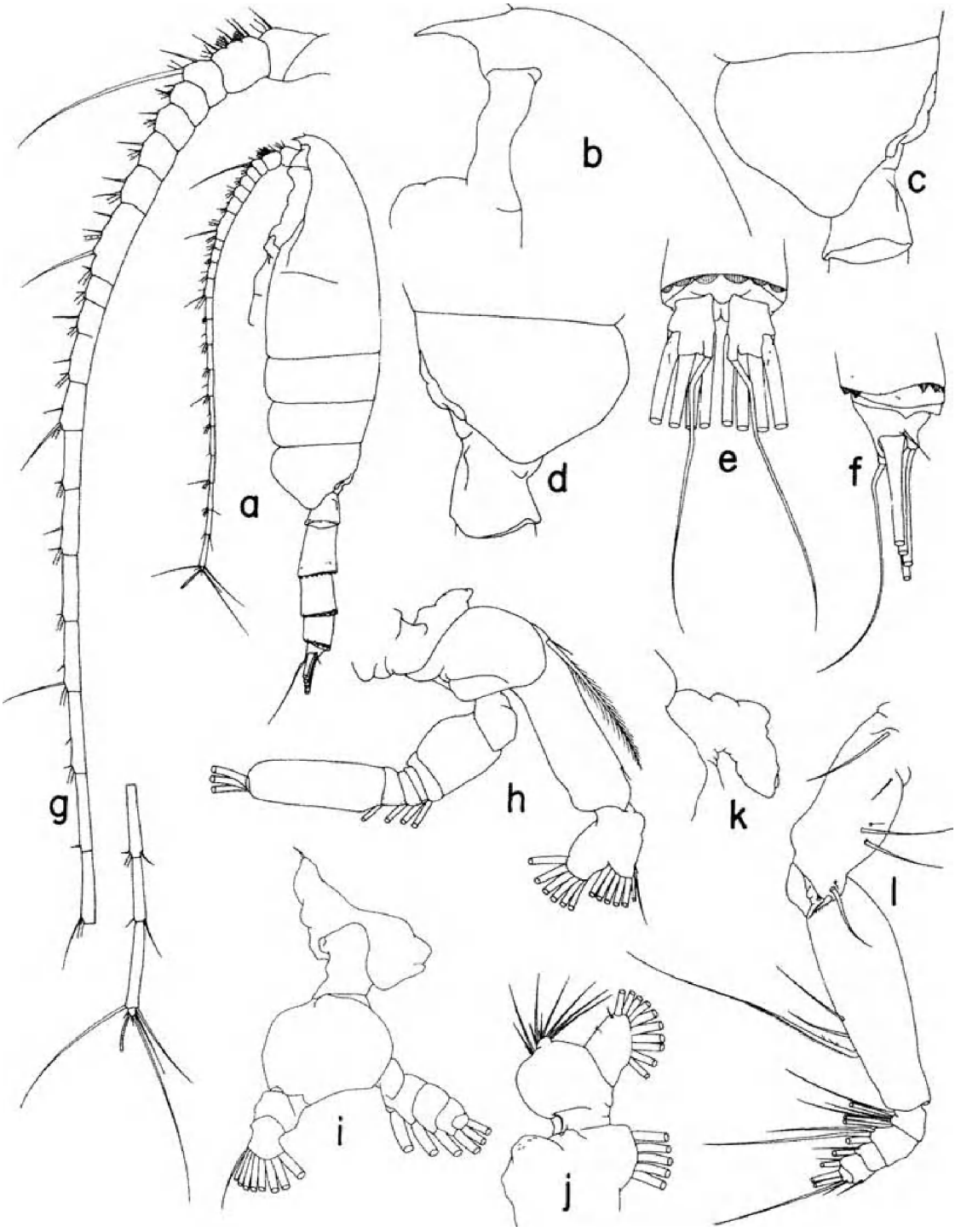

Figure 21. *Paraeuchaeta malayensis* male: a, habitus, left; b, forehead, left; c, last pedigerous and genital somites, left; d, do, right; e, caudal rami, ventral; f, left caudal ramus, left; g, antennule; h, antenna; i, mandible; j, maxillule, posterior; k, maxilla; l, maxilliped, coxa posterior, the rest anterior.

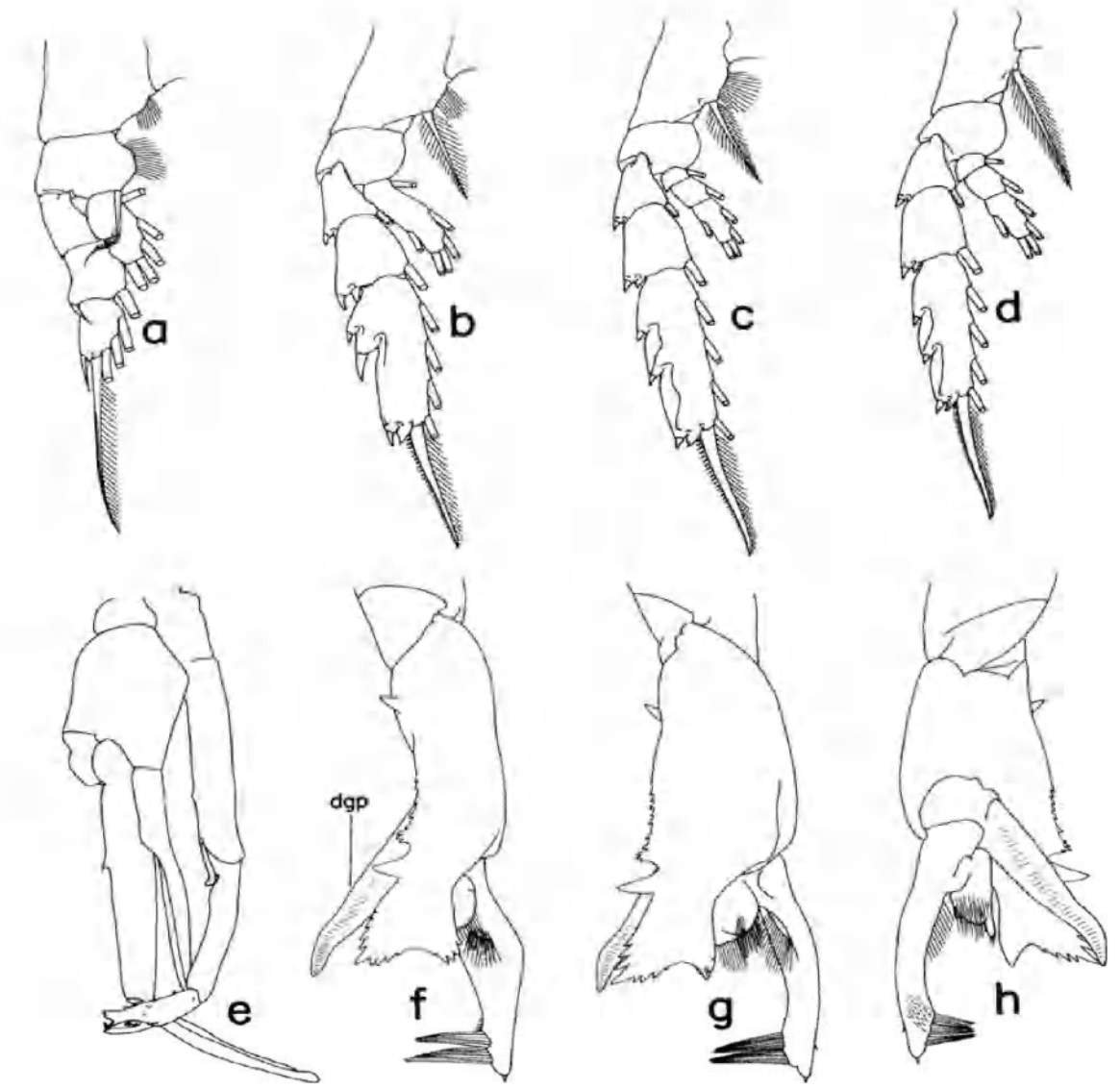

Figure 22. *Paraeuchaeta malayensis* male: a, first leg, anterior; b, second leg, anterior; c, third leg, anterior; d. fourth leg, anterior; e, fifth pair of legs, anterior; f, exopod of left 5th leg, anterior; g, do, anterior, tilted counterclockwise; h, do, medial, tilted clockwise. dgp = digitiform process.

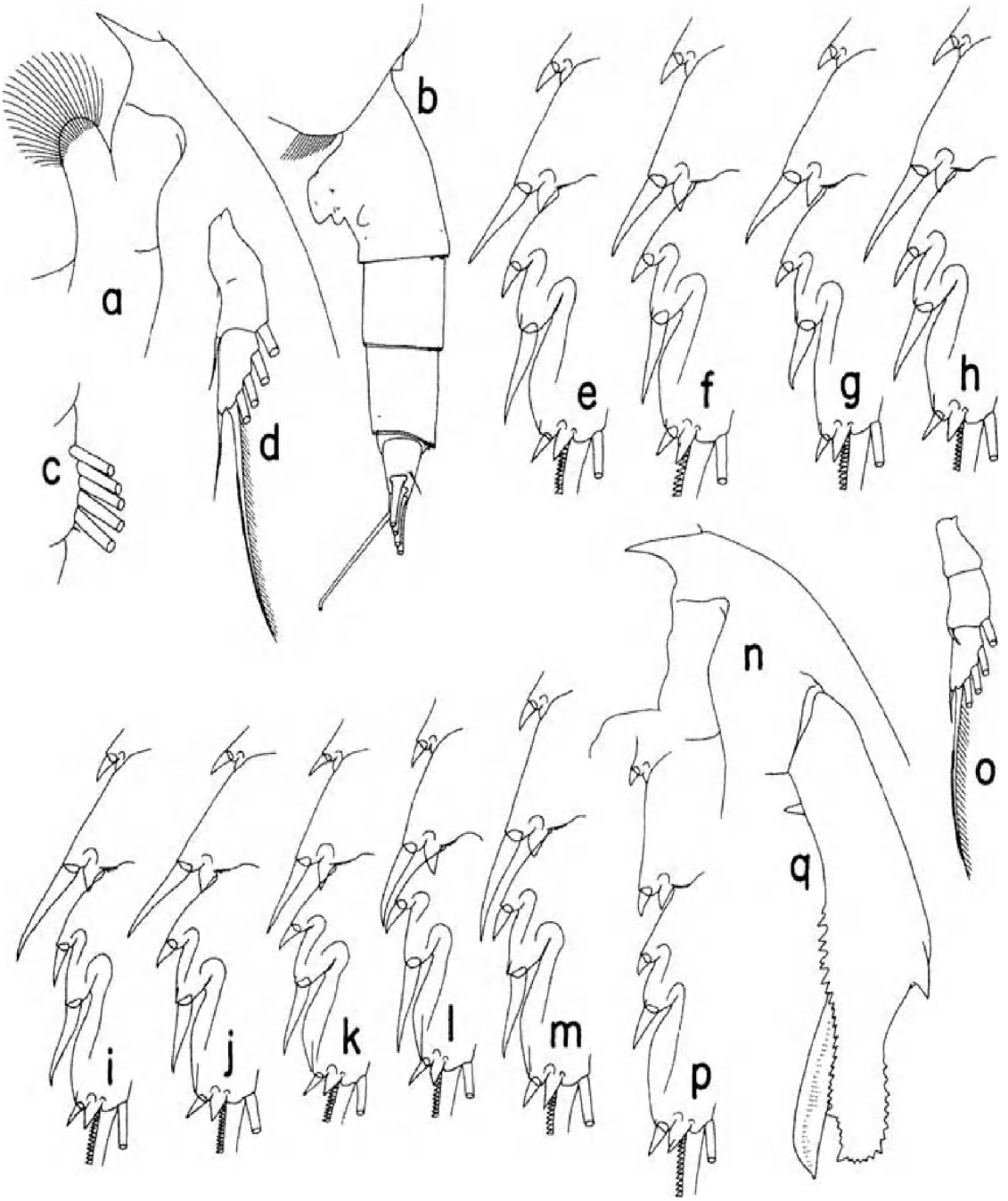

Figure 23. *Paraeuchaeta barbata* female (BL=8.25 mm, from 35°S, 7°E in the southeastern Atlantic): a, forehead, left; b, urosome, left; c, outer lobe of maxillule; d, exopod of first leg, anterior; e, exopod of second leg, anterior. Second leg exopods of other female specimens: f, BL=7.83 mm, from 26°N, 21°W in the northeastern Atlantic; g, BL=10.00 mm, from 63°N, 3°W in the Norwegian Sea; h, BL=10.83 mm, from 47°S, 76°W in the southeastern Pacific; i, BL=9.50 mm, from 3°N, 81°W in the eastern tropical Pacific; j, BL=10.50 mm, from 44°N, 150°E off northern Japan; k, BL=8.00 mm, from 13°N, 146°E in the western Pacific; l, BL=7.83 mm, from 17°S, 67°E in the Indian Ocean; m, BL=10.66 mm, from 50°S, 152°E in the Tasman Sea. Male: n, forehead, left; o, exopod of first leg, anterior; p, exopod of second leg, anterior; q, second exopodal segment of left 5th leg, anterior.

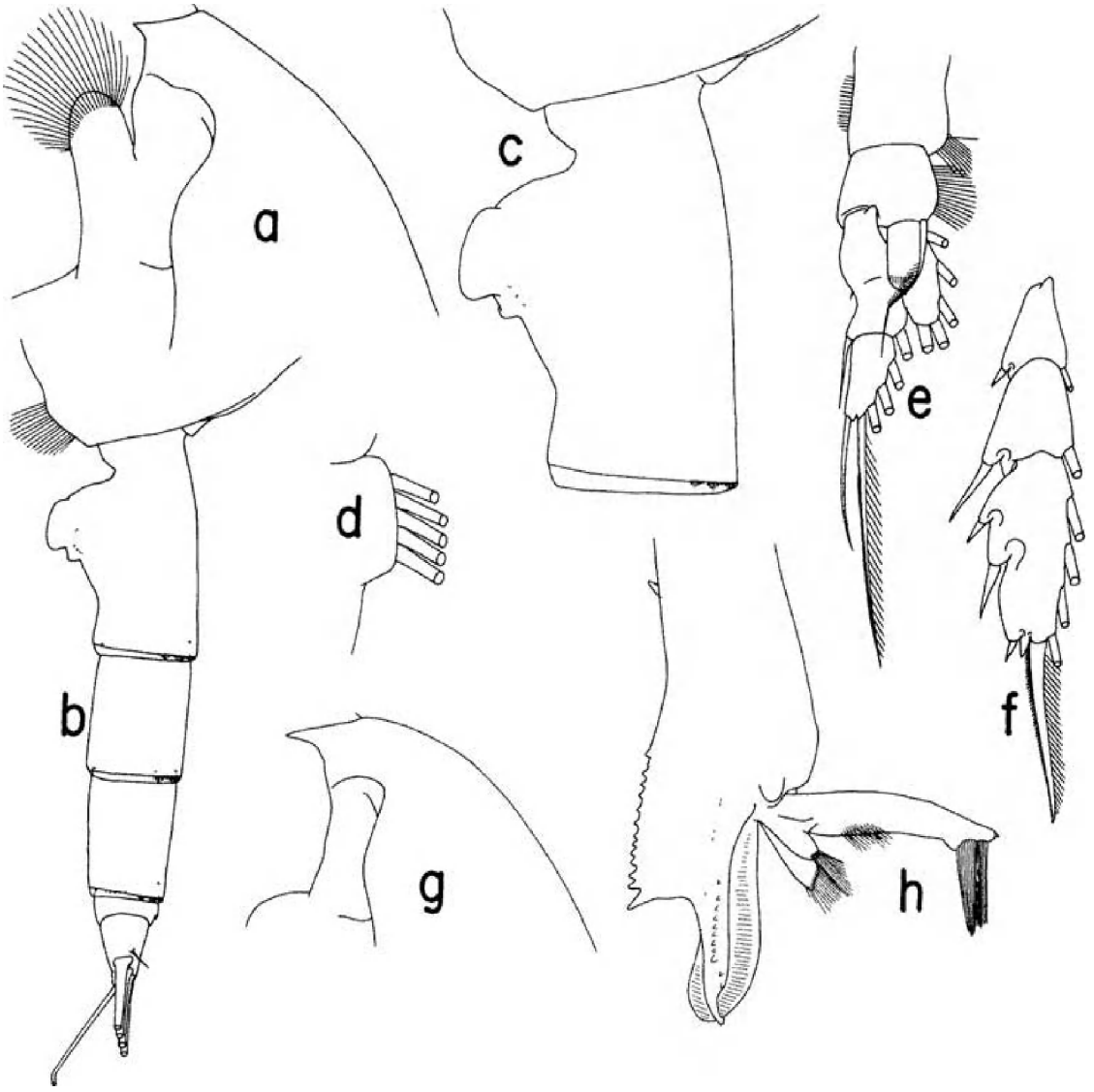

Figure 24. *Paraeuchaeta parvula* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, distal exopodal segments of left 5th leg, lateral.

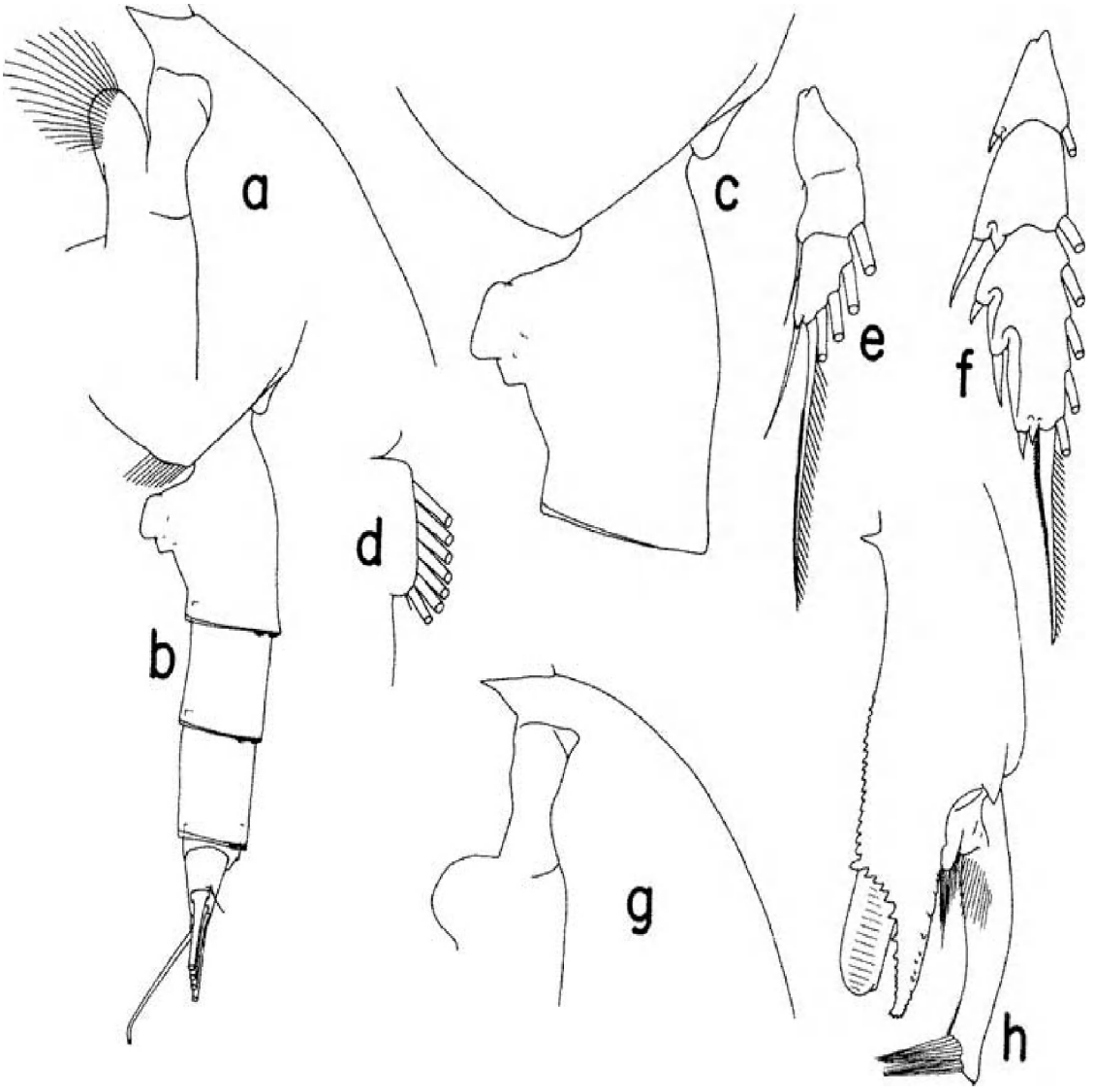

Figure 25. *Paraeuchaeta eltaninae* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h. distal exopodal segments of left 5th leg, lateral, tilted clockwise.

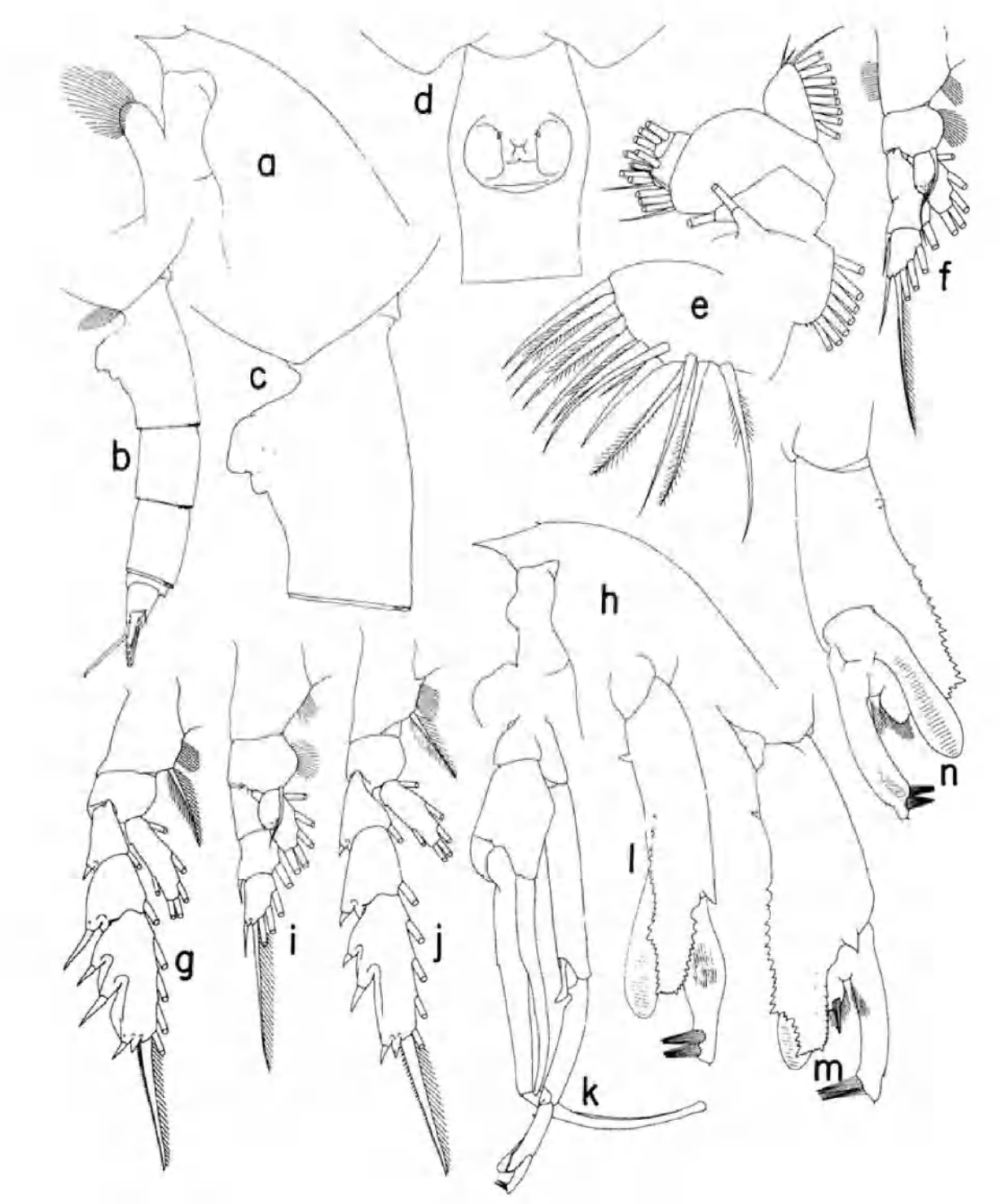

Figure 26. *Paraeuchaeta copleyae*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, ventral; e, maxillule, first inner lobe separated, posterior; f, first leg, anterior; g, second leg, anterior. Male: h, forehead, left; i, first leg, anterior; j, second leg, anterior; k, fifth pair of legs, anterior; l, distal exopodal segments of left 5th leg, anterior; m, do, lateral, tilted clockwise; n, do, medial.

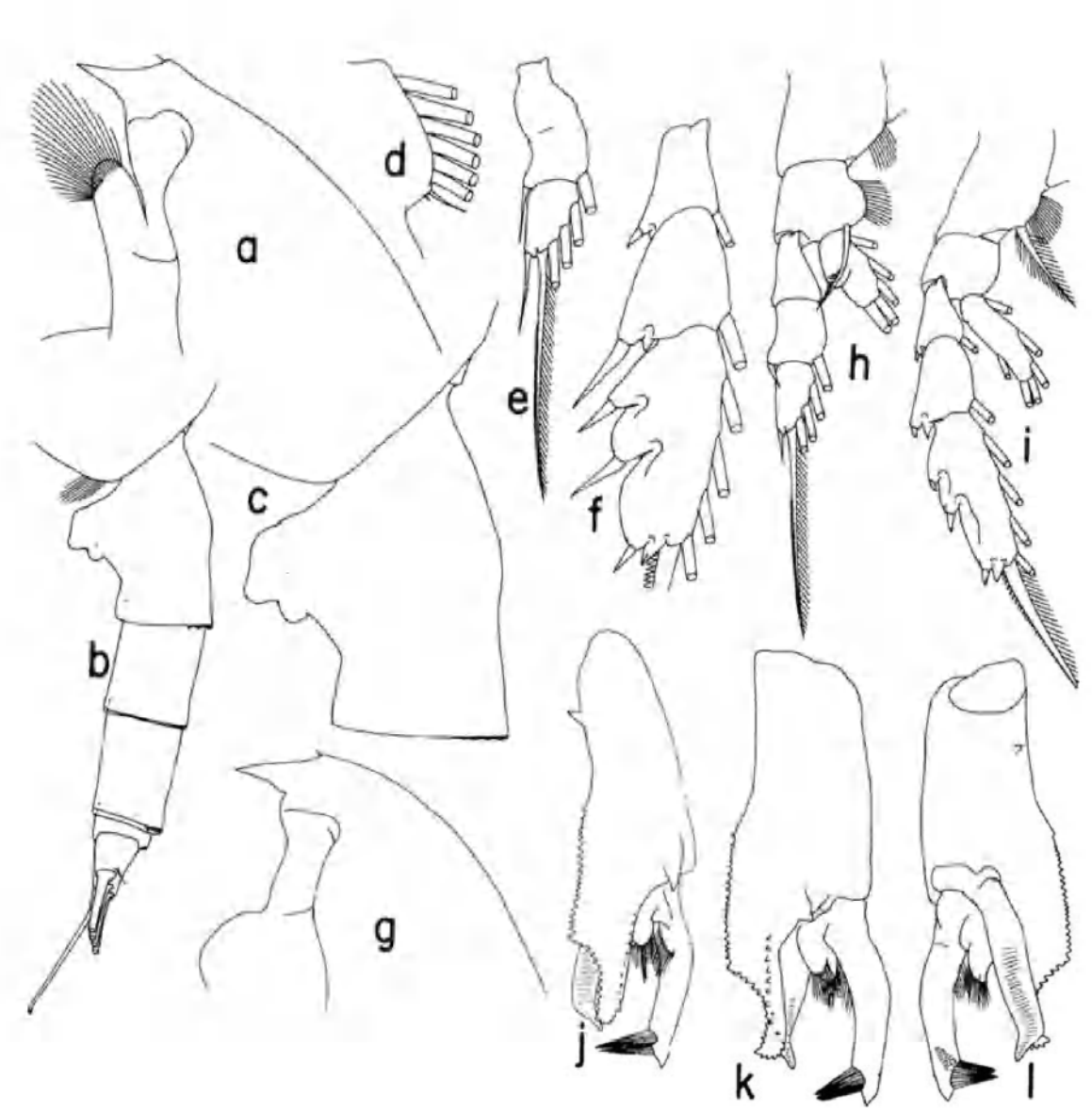

Figure 27. *Paraeuchaeta scotti* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, first leg, anterior; i, second leg, anterior; j, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; k, do, lateral; l, do. medial.

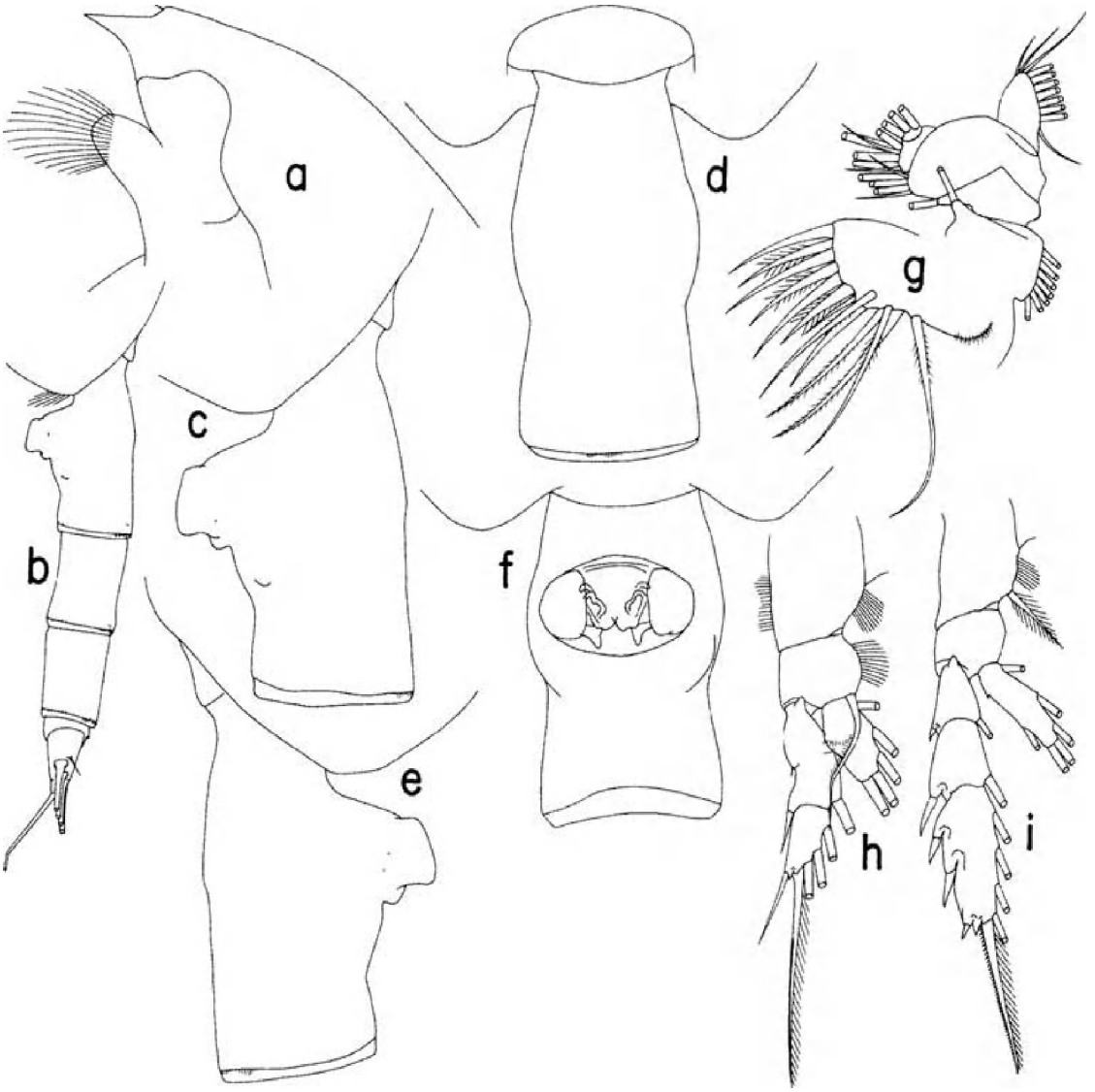

Figure 28. *Paraeuchaeta prudens* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, maxillule, first inner lobe separated, posterior; h, first leg, anterior; i, second leg, anterior.

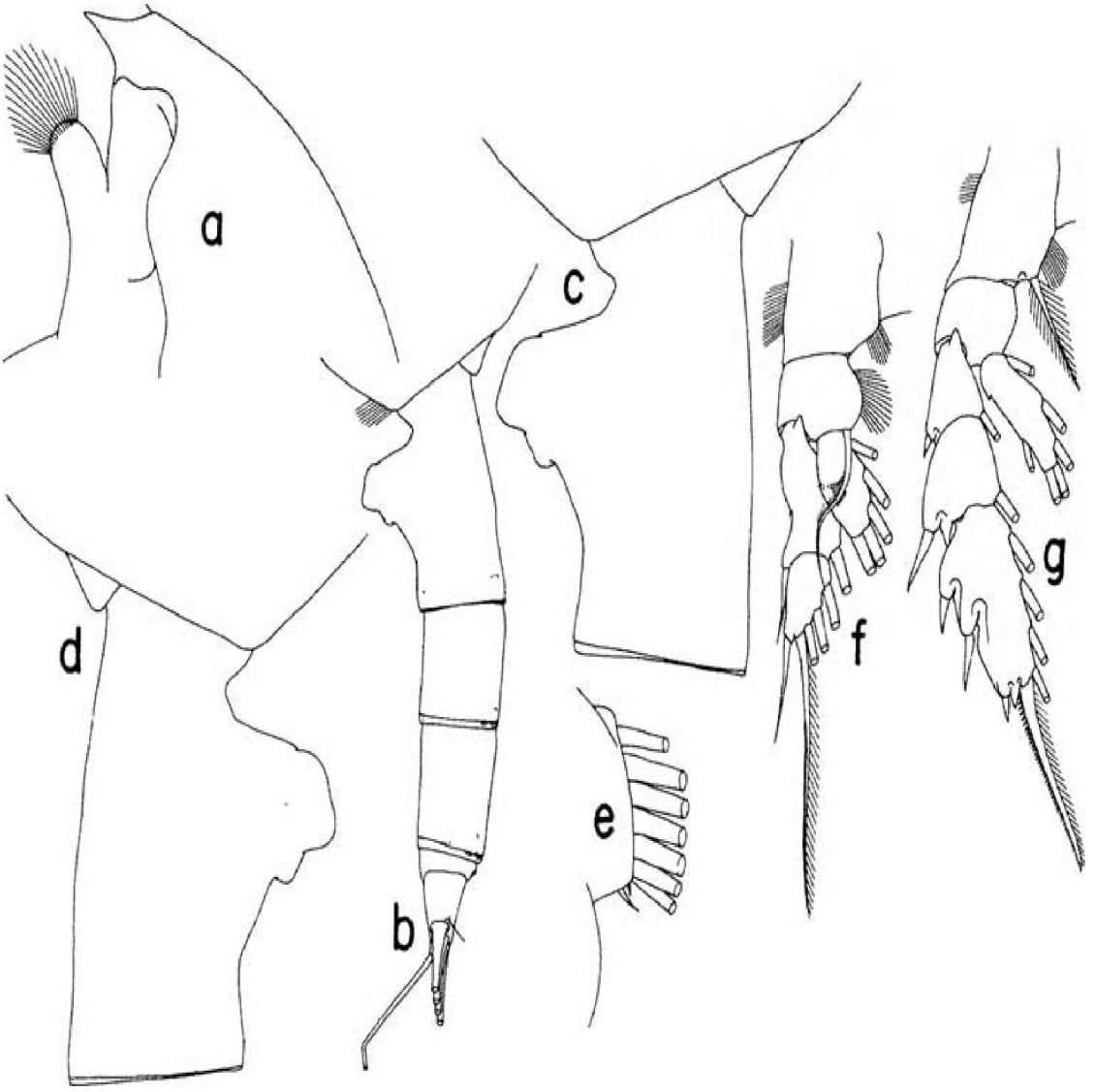

Figure 29. *Paraeuchaeta paraprudens*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, outer lobe of maxillule; f, first leg, anterior; g, second leg, anterior.

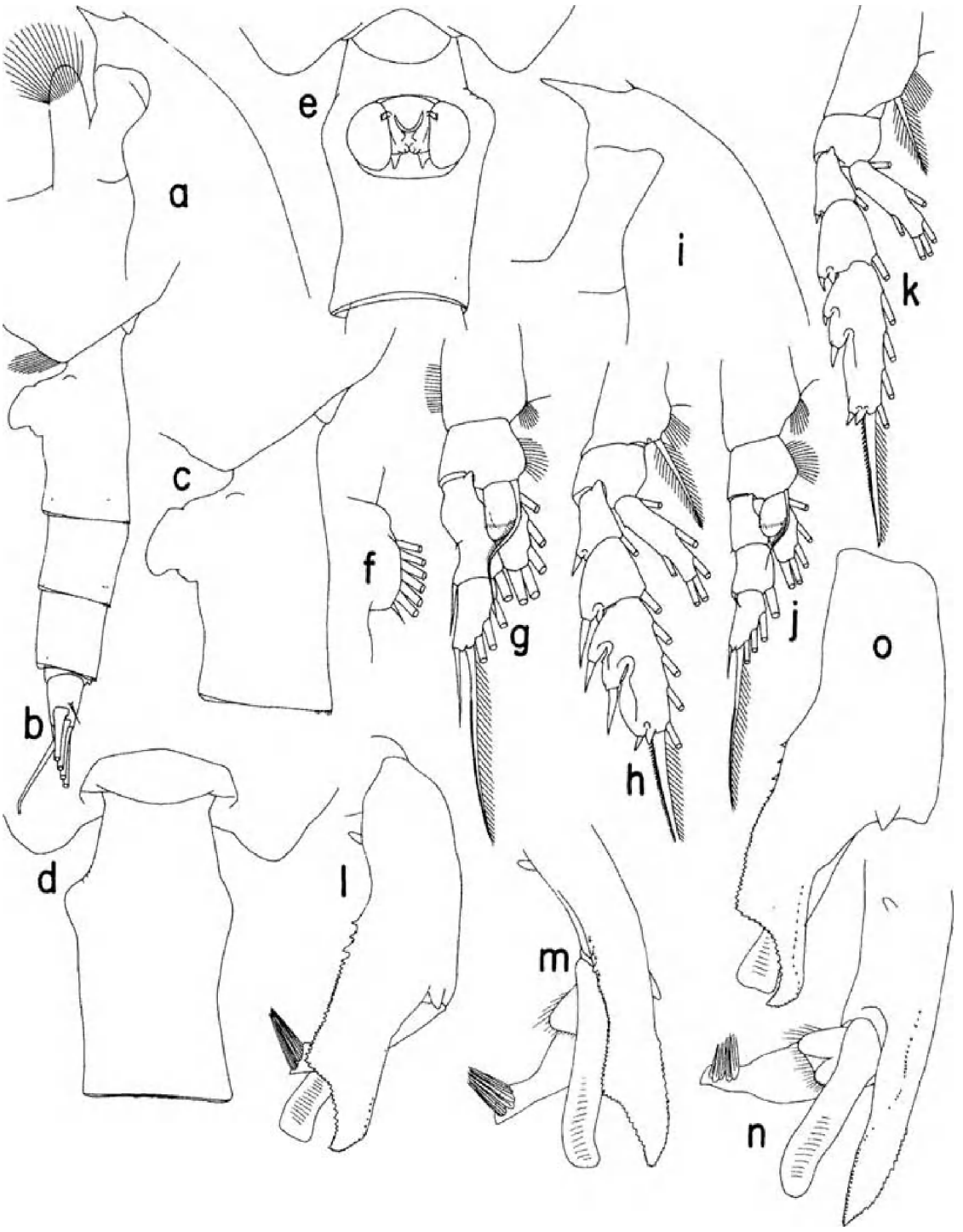

Figure 30. *Paraeuchaeta rubra* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, ventral; f, outer lobe of maxillule; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, first leg, anterior; k, second leg, anterior; l, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; m, do, anterior, tilted clockwise; n, do, medial, tilted counterclockwise; o, second exopodal segment of left 5th leg, lateral, tilted clockwise.

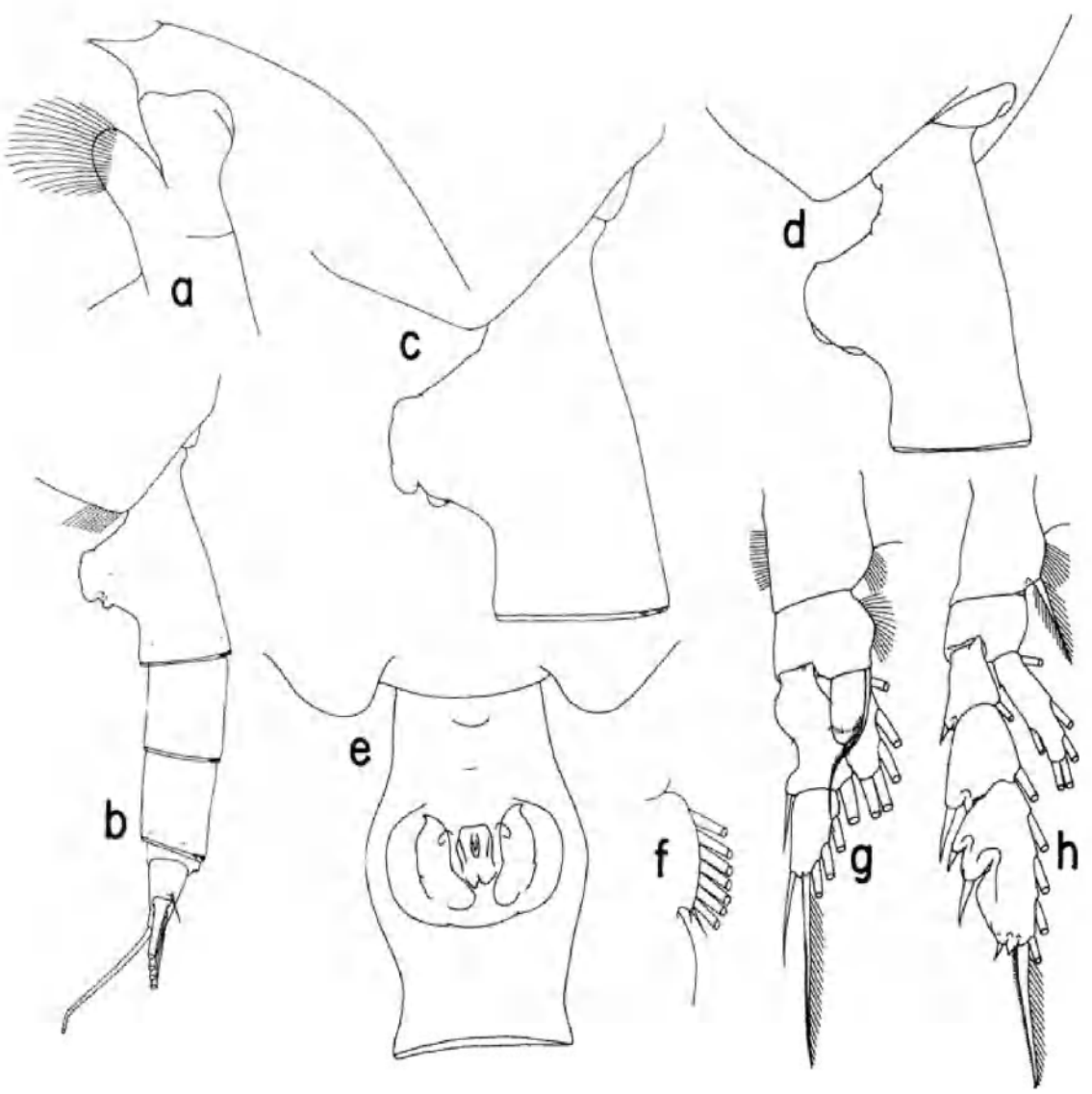

Figure 31. *Paraeuchaeta triloba*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, left, tilted counterclockwise; e, do, ventral; f, outer lobe of maxillule; g, first leg, anterior; h, second leg, anterior.

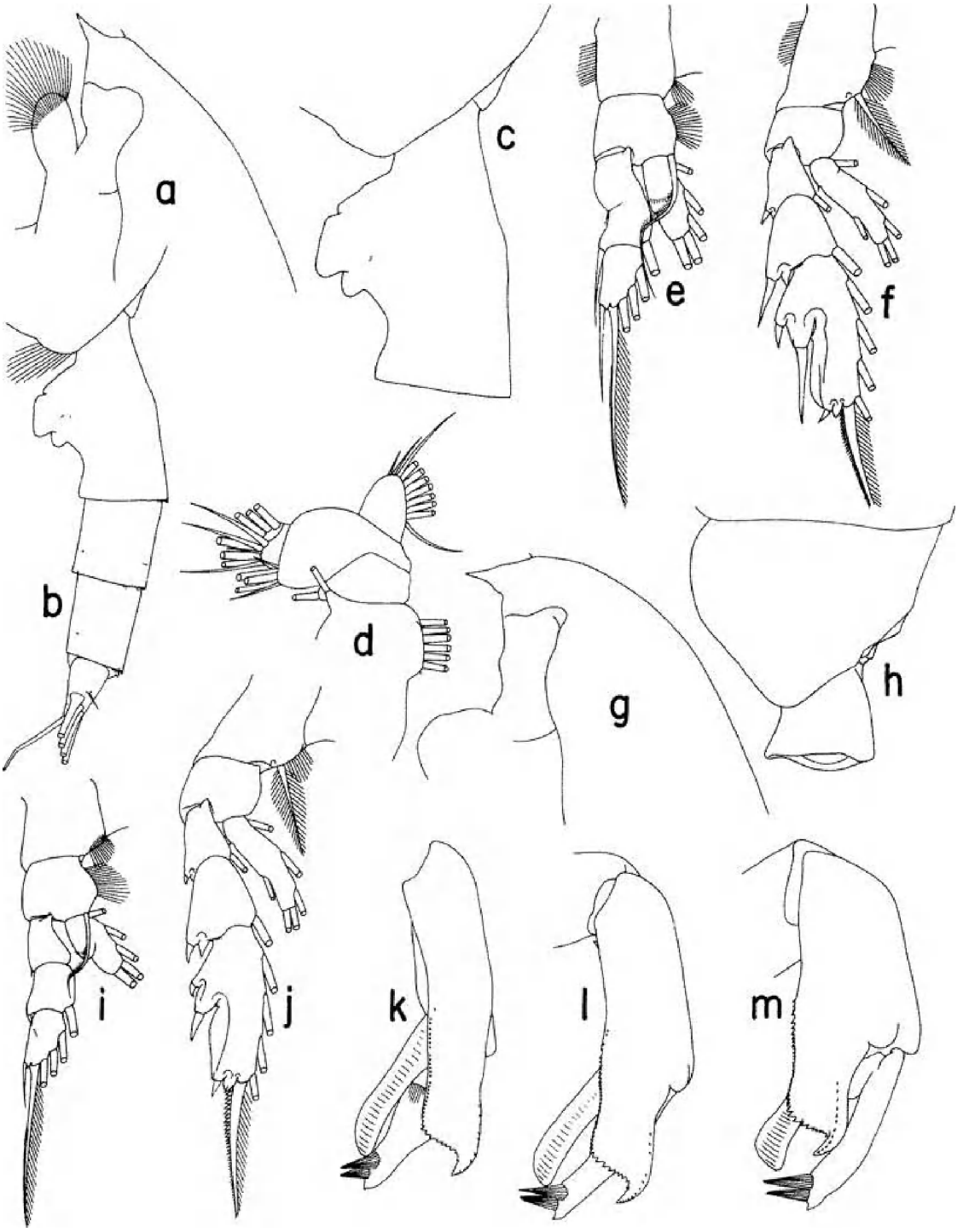

Figure 32. *Paraeuchaeta megaloba*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe omitted, posterior; e, first leg, anterior; f, second leg, anterior. Male: g, forehead, left; h, last pedigerous and genital somites, left; i, first leg, anterior; j, second leg, anterior; k, distal exopodal segments of left 5th leg, anterior, tilted clockwise; l, do, anterior, tilted counterclockwise; m, do, lateral, tilted clockwise.

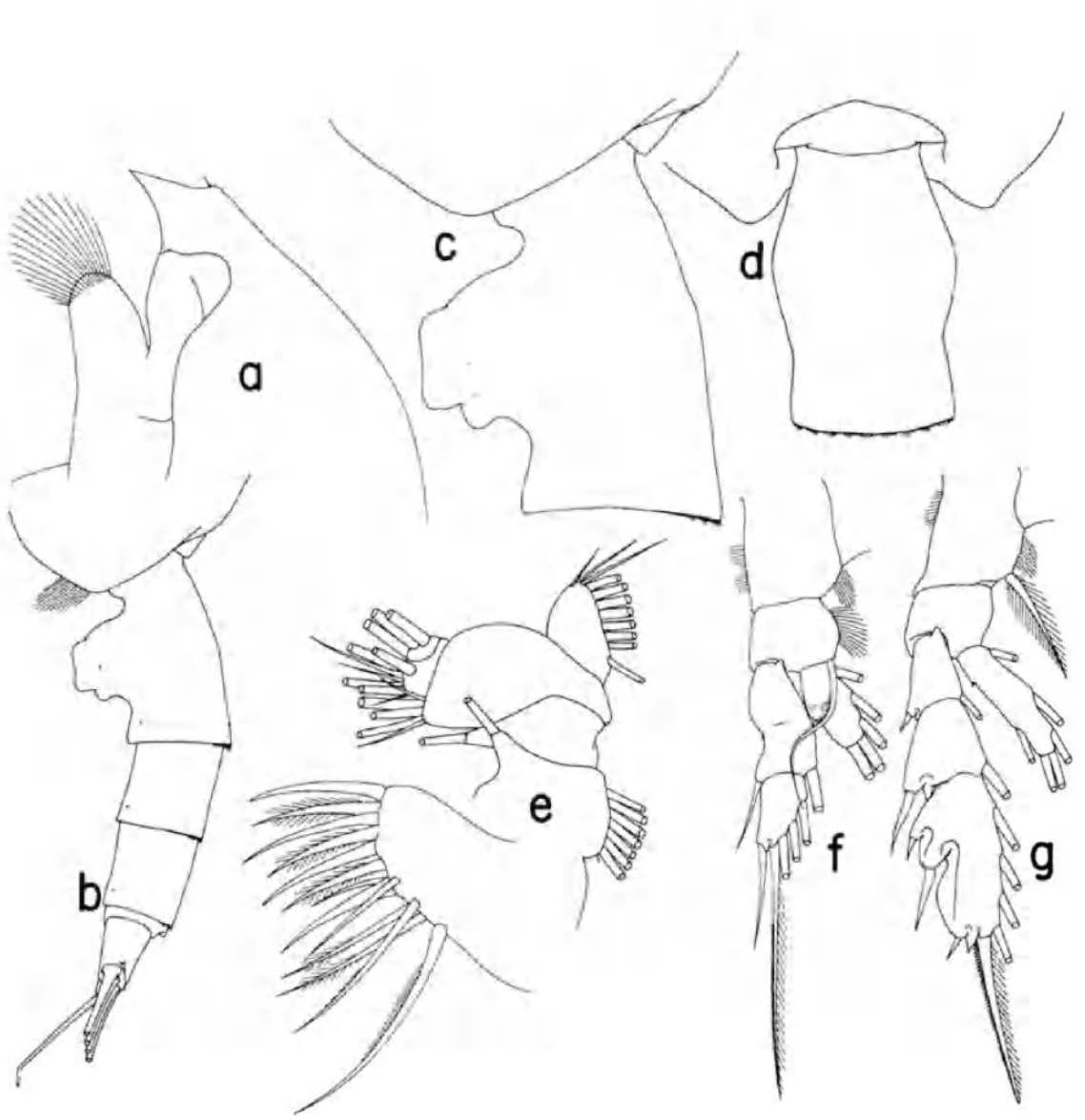

Figure 33. *Paraeuchaeta mexicana*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, maxillule, first inner lobe separated, posterior; f, first leg, anterior; g, second leg, anterior.

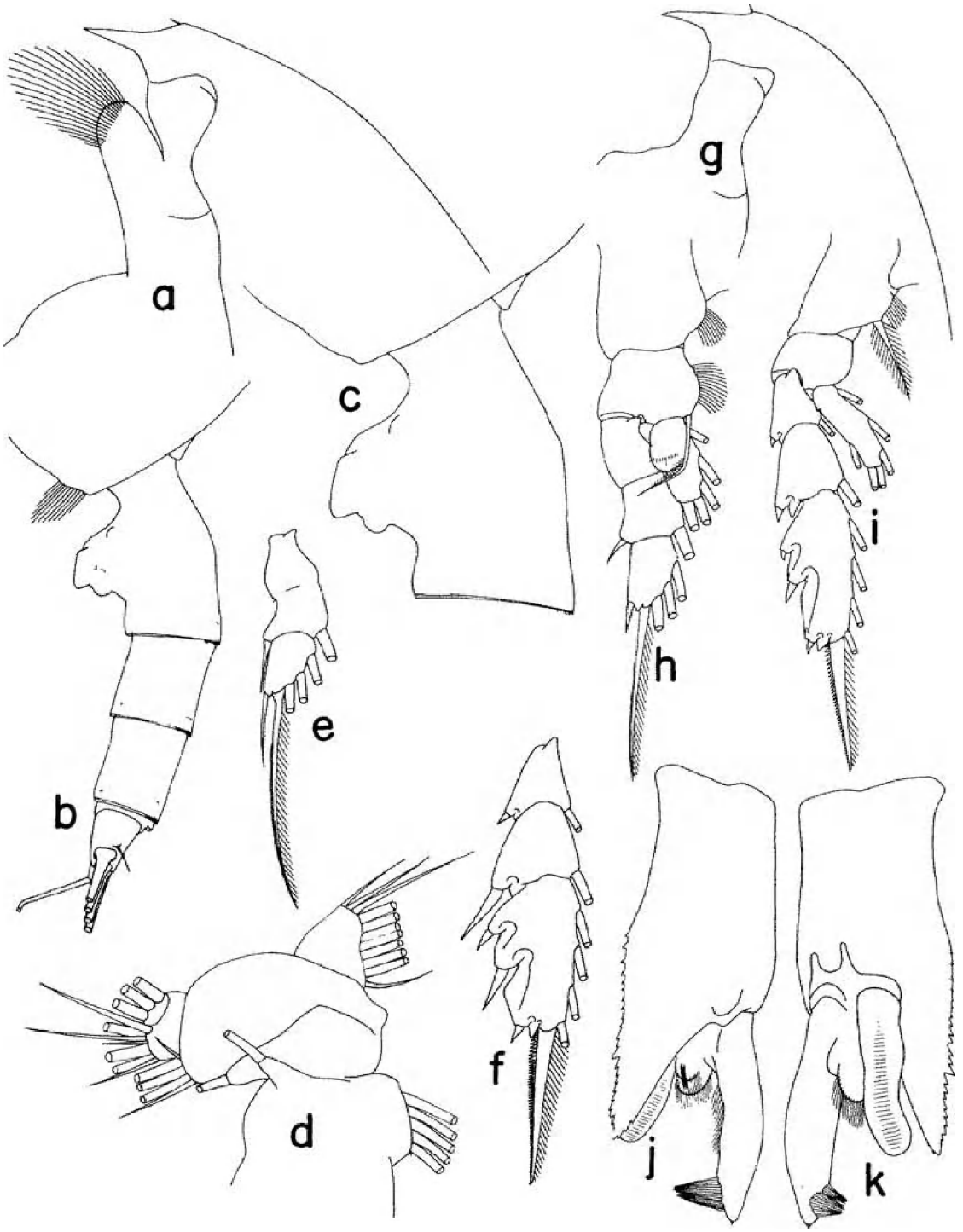

Figure 34. *Paraeuchaeta aequatorialis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe omitted, posterior; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, first leg, anterior; i, second leg, anterior; j, distal exopodal segments of left 5th leg, lateral, tilted clockwise; k, do, medial.

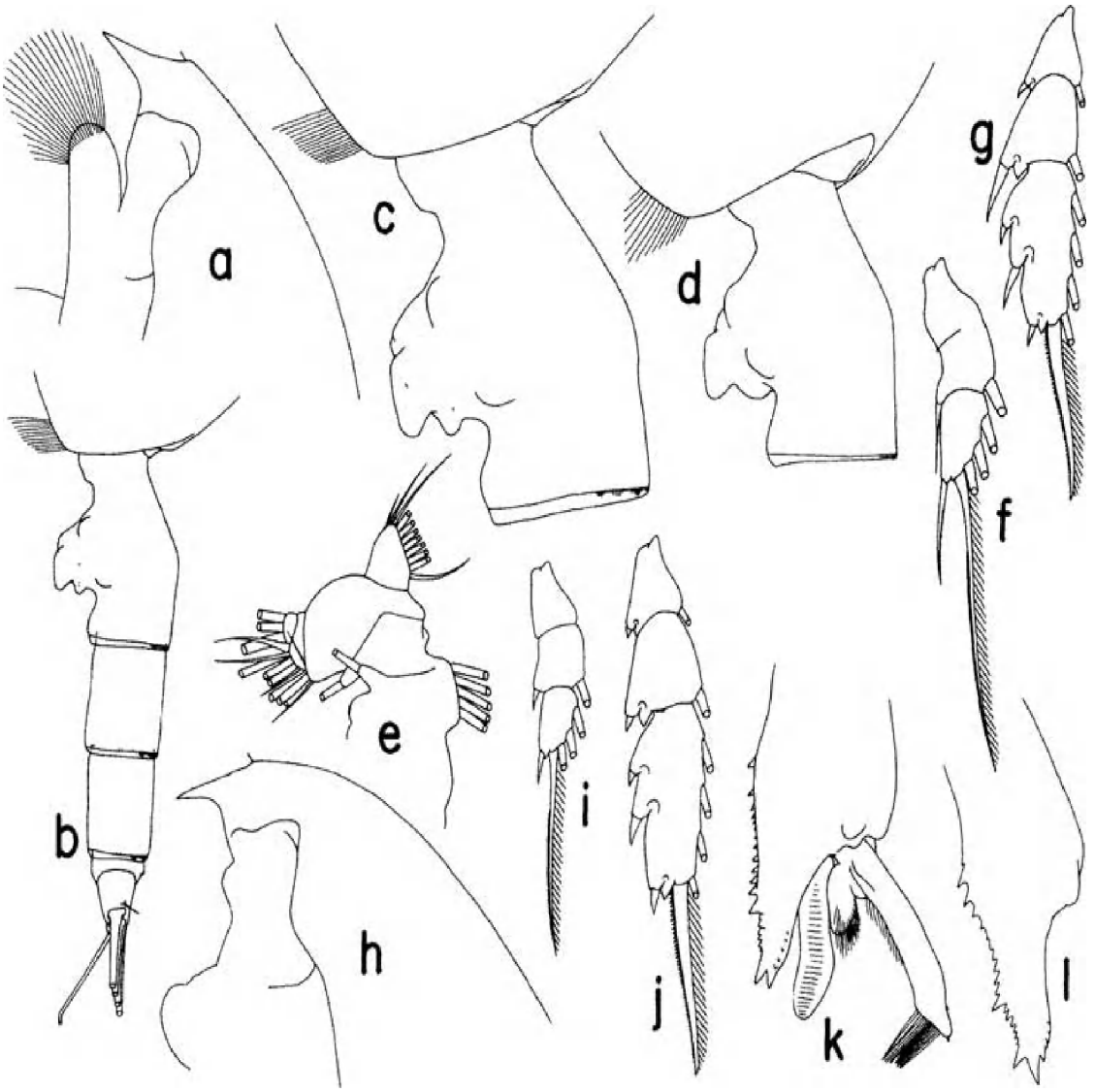

Figure 35. *Paraeuchaeta rasa* female: a forehead, left; b, urosome, left; c, genital somite, left; d, do, left, tilted counterclockwise; e, maxillule, first inner lobe omitted, posterior; f, exopod of first leg, anterior; g, exopod of second leg, anterior. Male: h, forehead, left; i, exopod of first leg, anterior; j, exopod of second leg, anterior; k, distal exopodal segments of left 5th leg, lateral, tilted clockwise; l, serrated lamella of left 5th leg exopod, anterior, tilted counterclockwise.

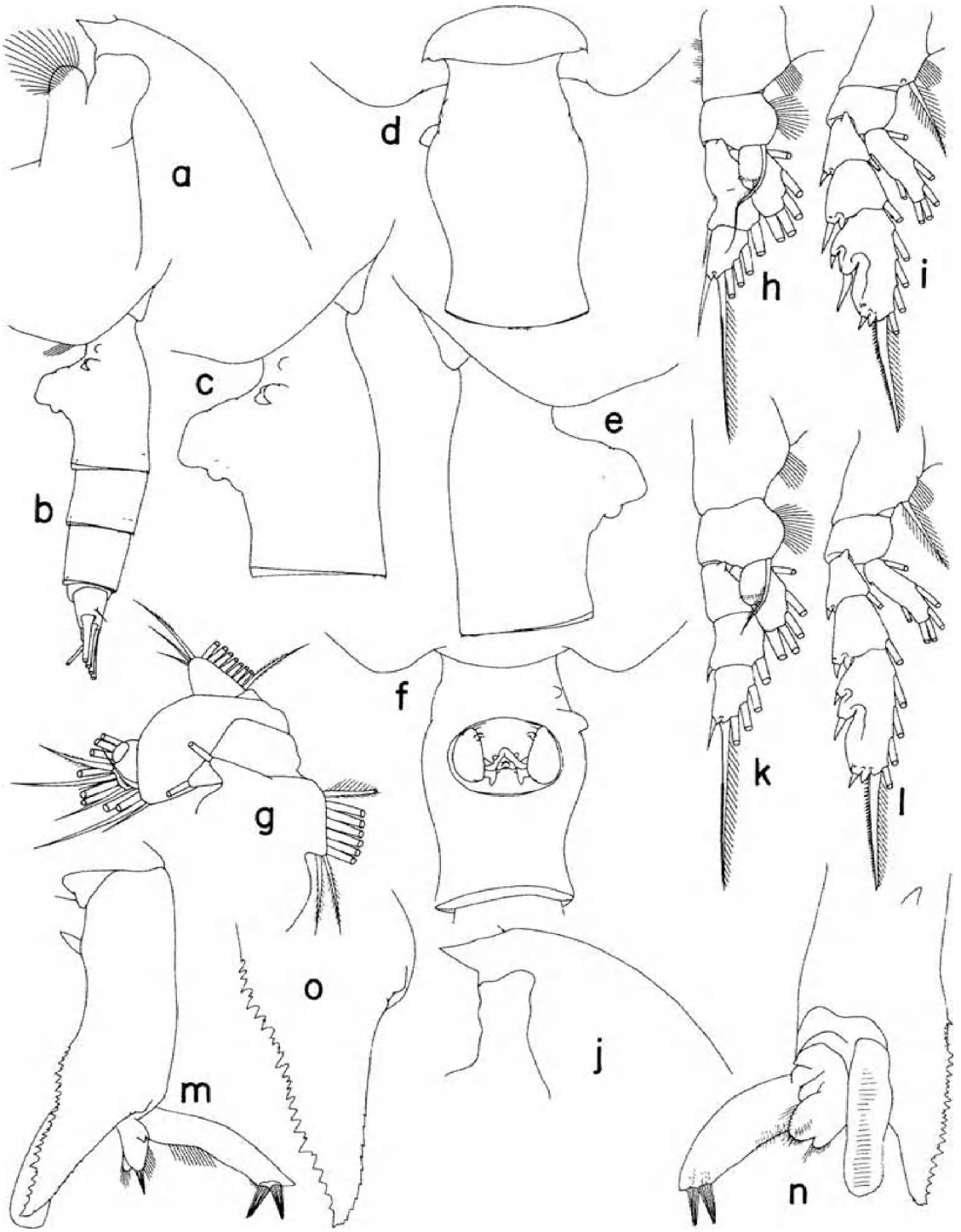

Figure 36. *Paraeuchaeta papilliger*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, do, right; f, do, ventral; g, maxillule, first inner lobe omitted, posterior; h, first leg, anterior; i, second leg, anterior. Male: j, forehead, left; k, first leg, anterior; l, second leg, anterior; m, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; n, do, medial; o, serrated lamella of left 5th leg exopod, anterior, tilted counterclockwise.

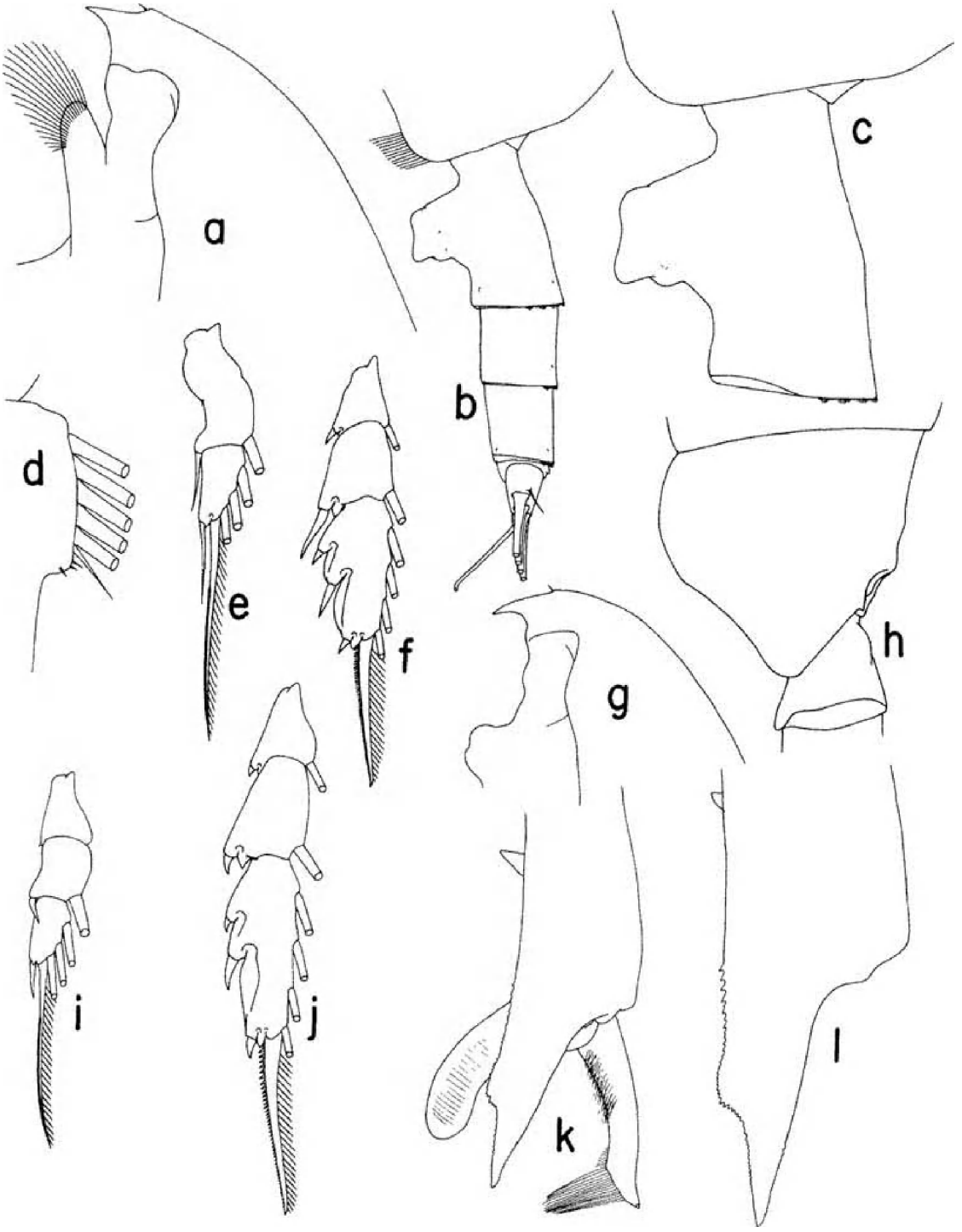

Figure 37. *Paraeuchaeta sarsi* female (BL=9.33 mm, from 65°N, 30°W, northern Atlantic): a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male (BL=9.04 mm, from 47°S, 76°W, southeastern Pacific): g, forehead, left; h, last pedigerous and genital somites, left; i, exopod of first leg, anterior; j, exopod of second leg, anterior; k, distal exopodal segments of left 5th leg, lateral, tilted clockwise; l, serrated lamella of left 5th leg exopod, lateral.

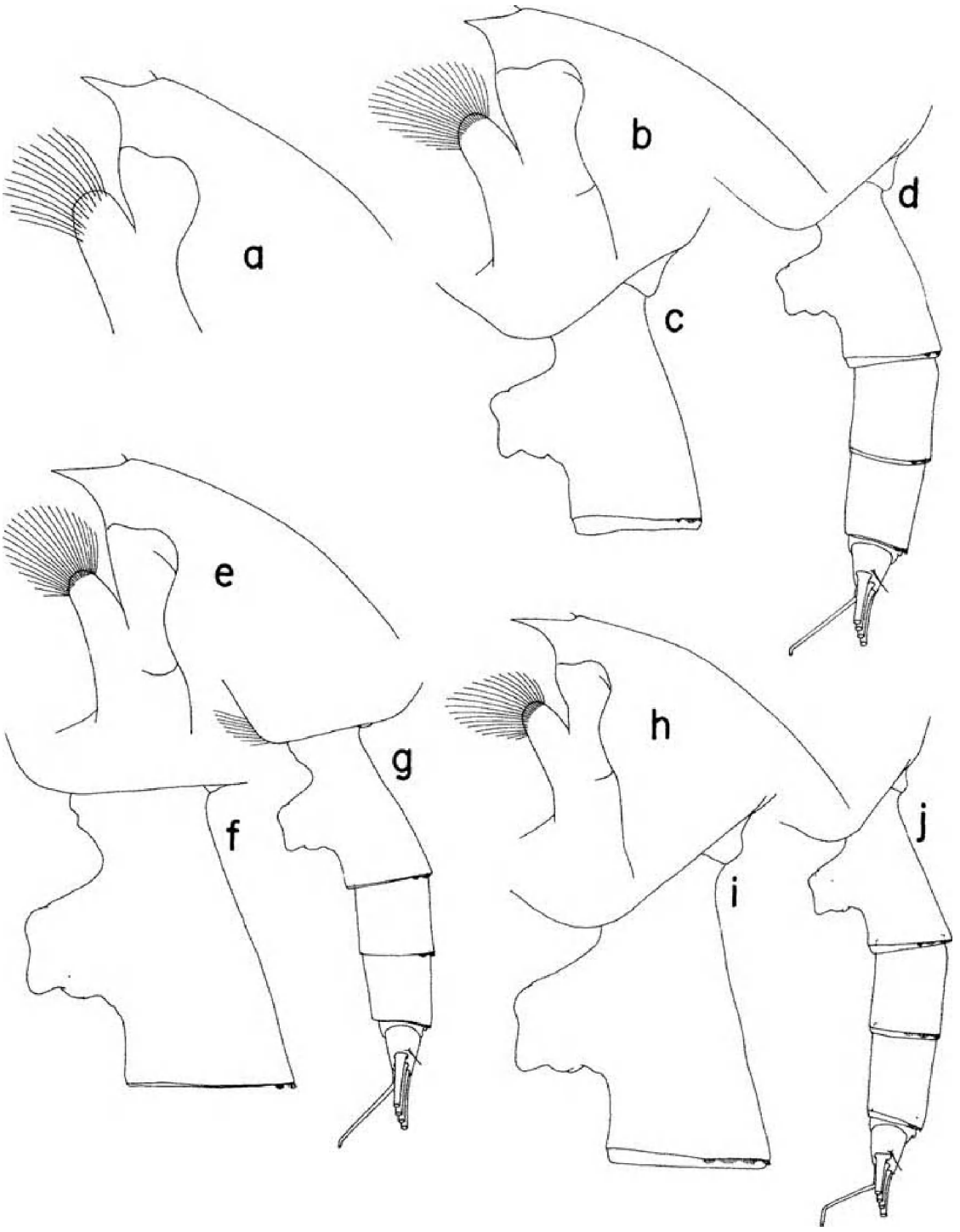

Figure 38. *Paraeuchaeta sarsi* female (Bl=8.58 mm, from Gulf of Mexico): a, forehead, left. Female (BL= 11.30 mm, from 47°S, 76°W, southeastern Pacific): b, forehead, left; c, genital somite, left; d, urosome, left. Female (BL=8.70 mm, from 26°N, 125°E, East China Sea): e, forehead, left; f, genital somite, left; g, urosome, left. Female (BL=7.80 mm, from 11°S, 111°E, eastern Indian Ocean): h, forehead, left; i, genital somite, left; j, urosome, left.

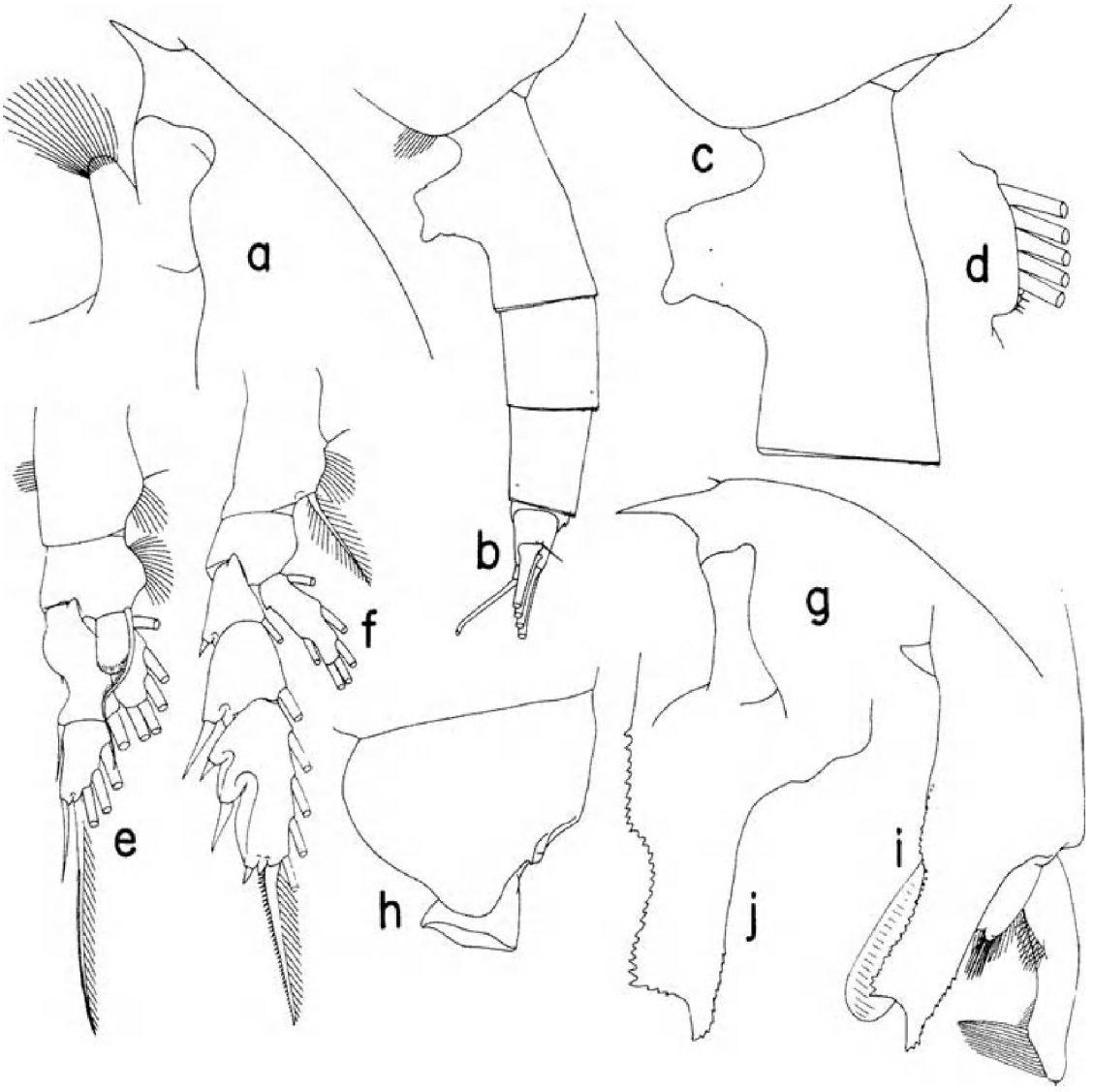

Figure 39. *Pameuchaeta calva* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, first leg, anterior; f, second leg, anterior. Male: g, forehead, left; h, last pedigerous and genital somites, left; i, distal exopodal segments of left 5th leg, lateral, tilted clockwise; j, serrated lamella of left 5th leg exopod, lateral.

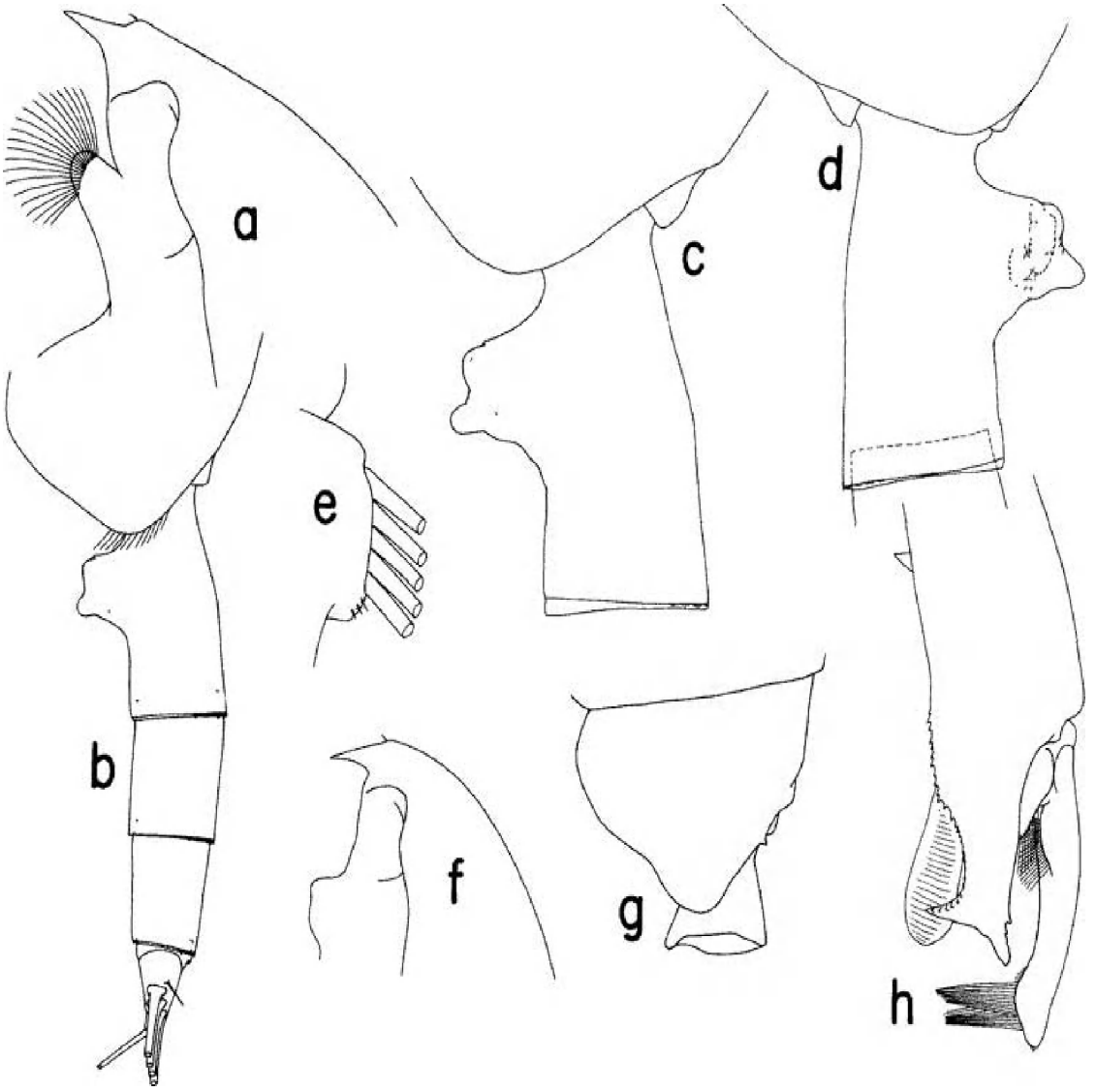

Figure 40. *Paraeuchaeta regalis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, outer lobe of maxillule. Male: f, forehead, left; g, last pedigerous and genital somites, left; h, distal exopodal segments of left 5th leg, lateral, tilted clockwise.

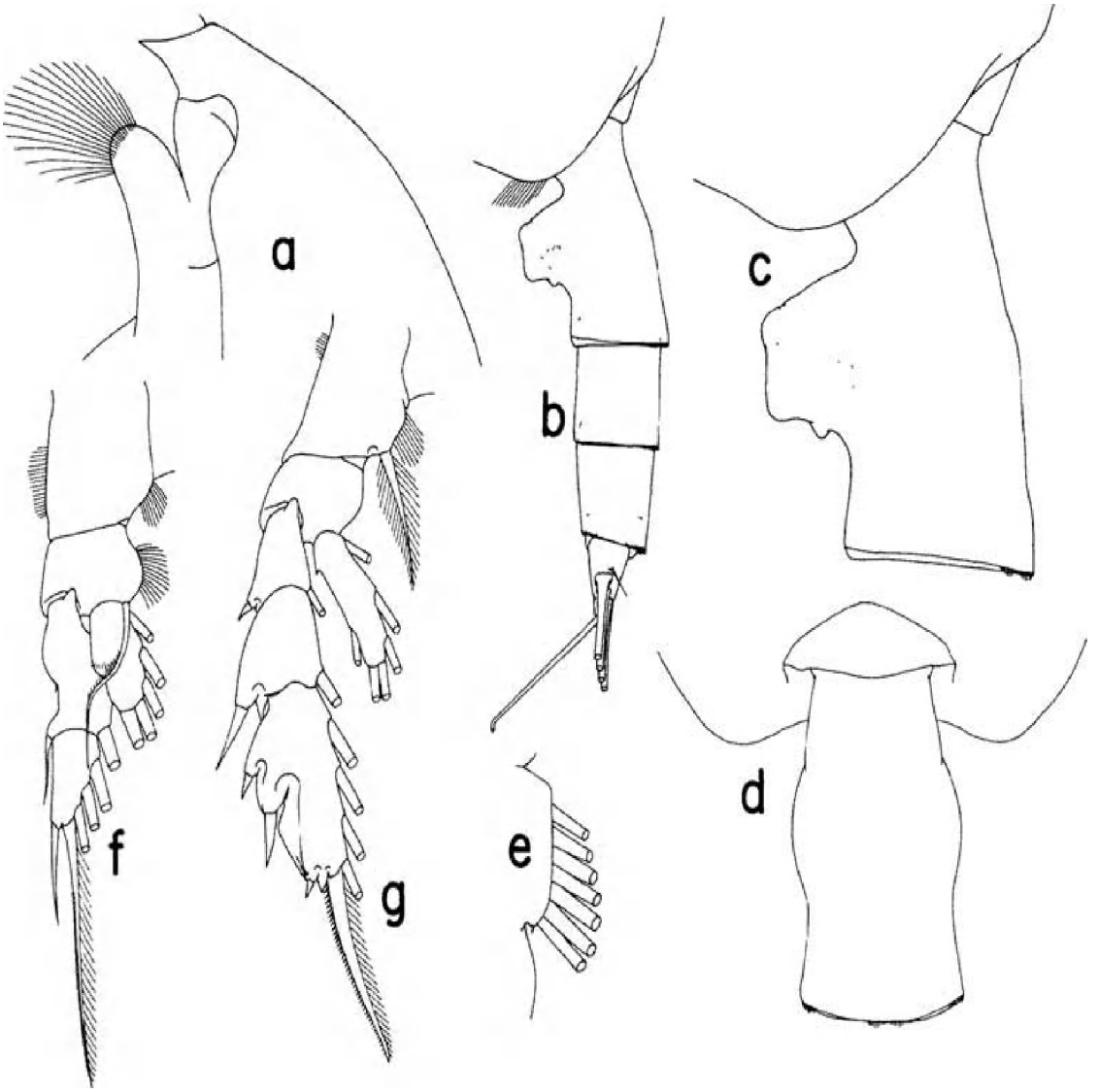

Figure 41. *Paraeuchaeta euryrhina*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do dorsal; e, outer lobe of maxillule; f, first leg, anterior; g, second leg, anterior.

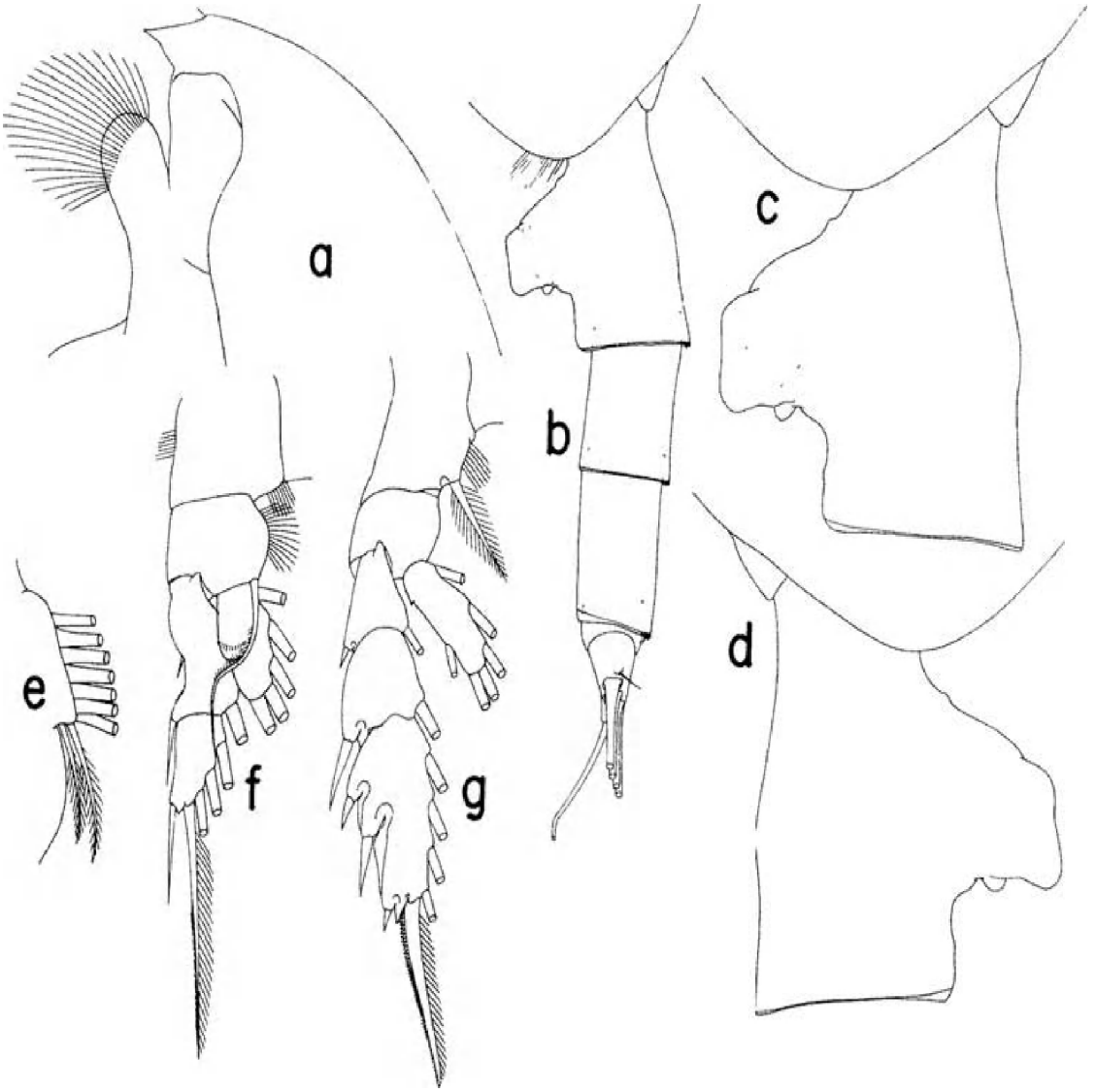

Figure 42. *Paraeuchaeta plaxiphora*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, outer lobe of maxillule; f, first leg, anterior; g, second leg, anterior.

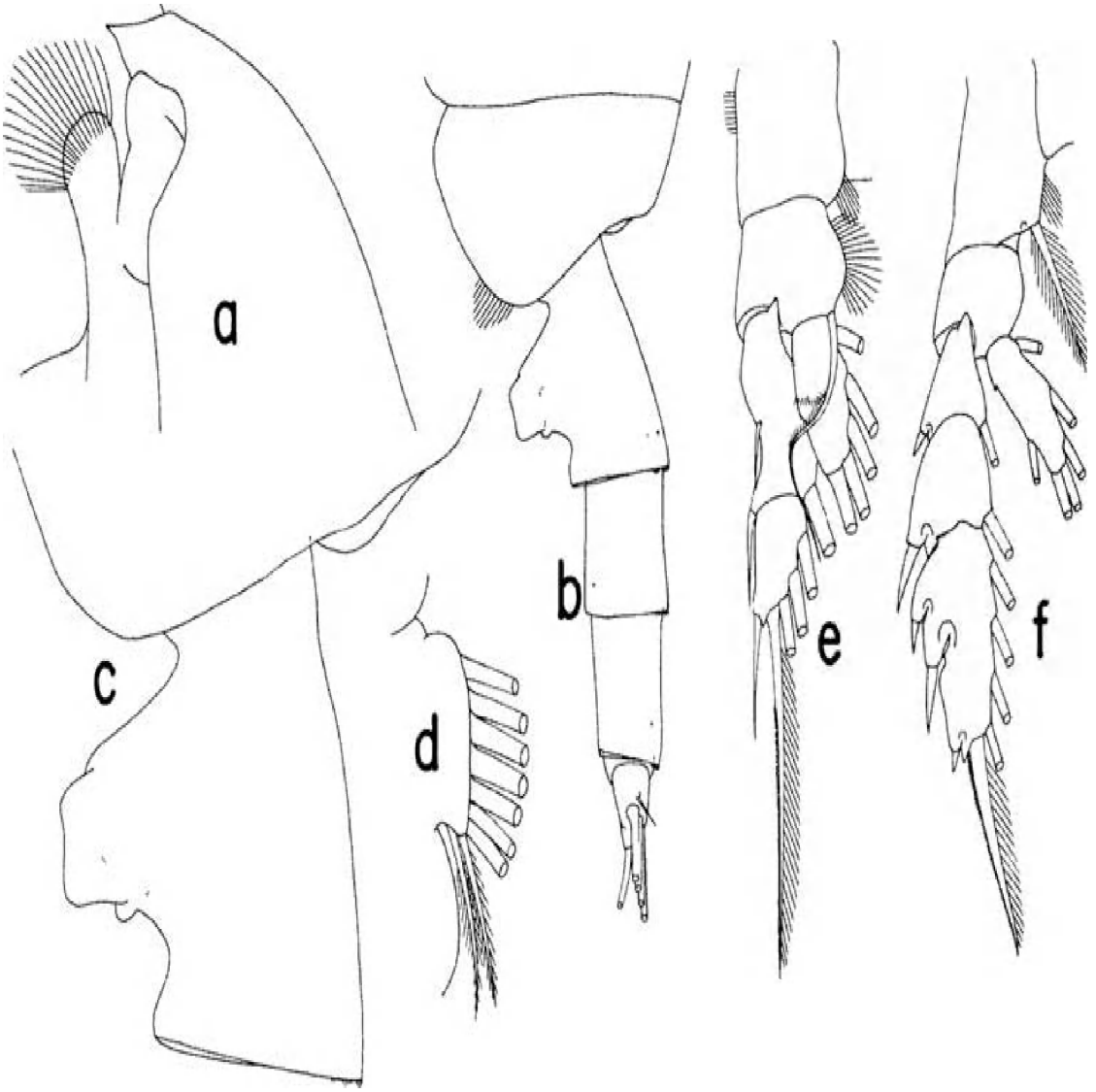

Figure 43. *Paraeuchaeta propinqua* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, first leg, anterior; f, second leg, anterior.

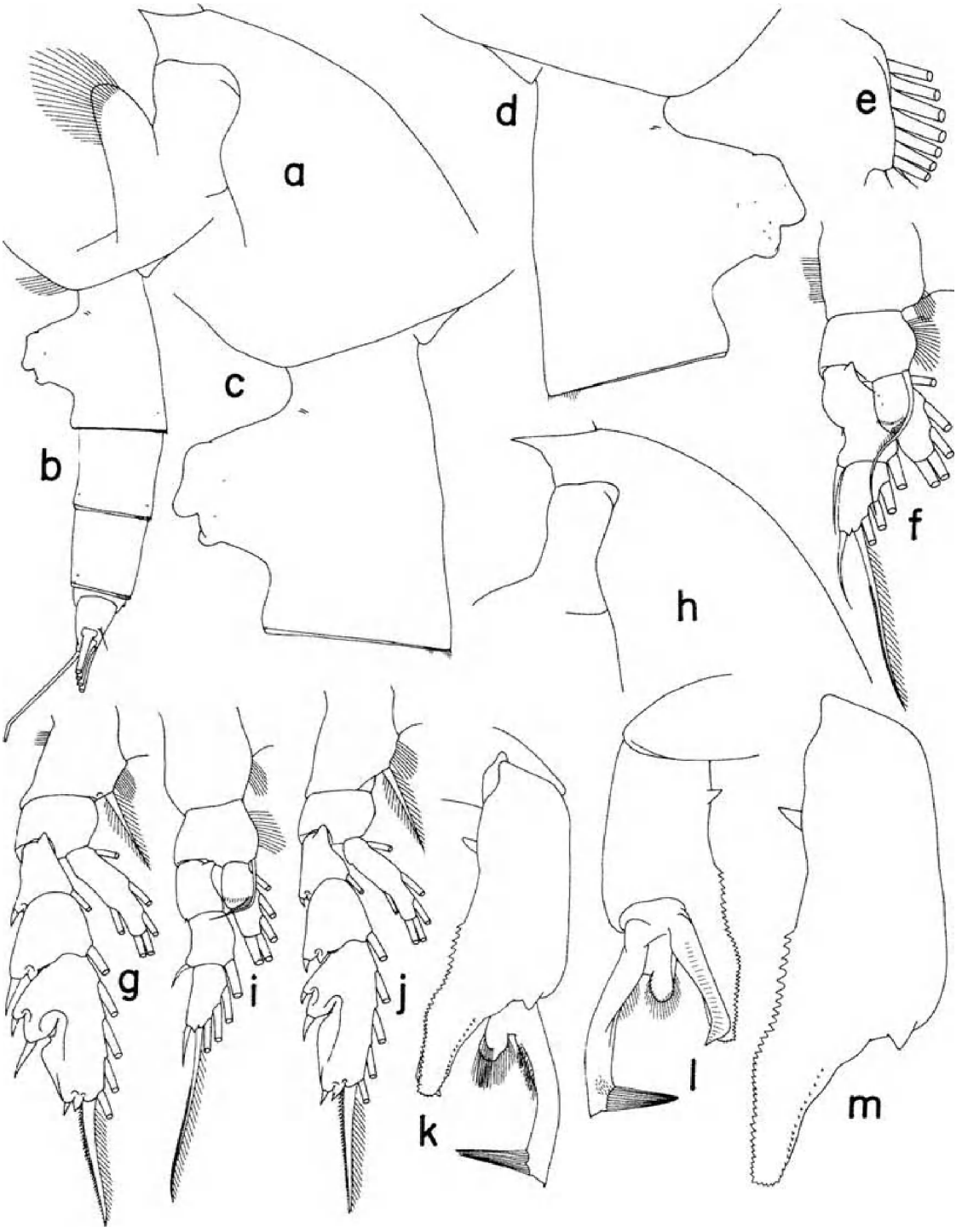

Figure 44. *Paraeuchaeta brevirostris* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, outer lobe of maxillule; f, first leg, anterior; g, second leg, anterior. Male: h, forehead, left; i, first leg, anterior; j, second leg, anterior; k, distal exopodal segments of left 5th leg, lateral, tilted clockwise; l, do, medial, tilted clockwise; m, serrated lamella of left 5th leg exopod, lateral, tilted clockwise.

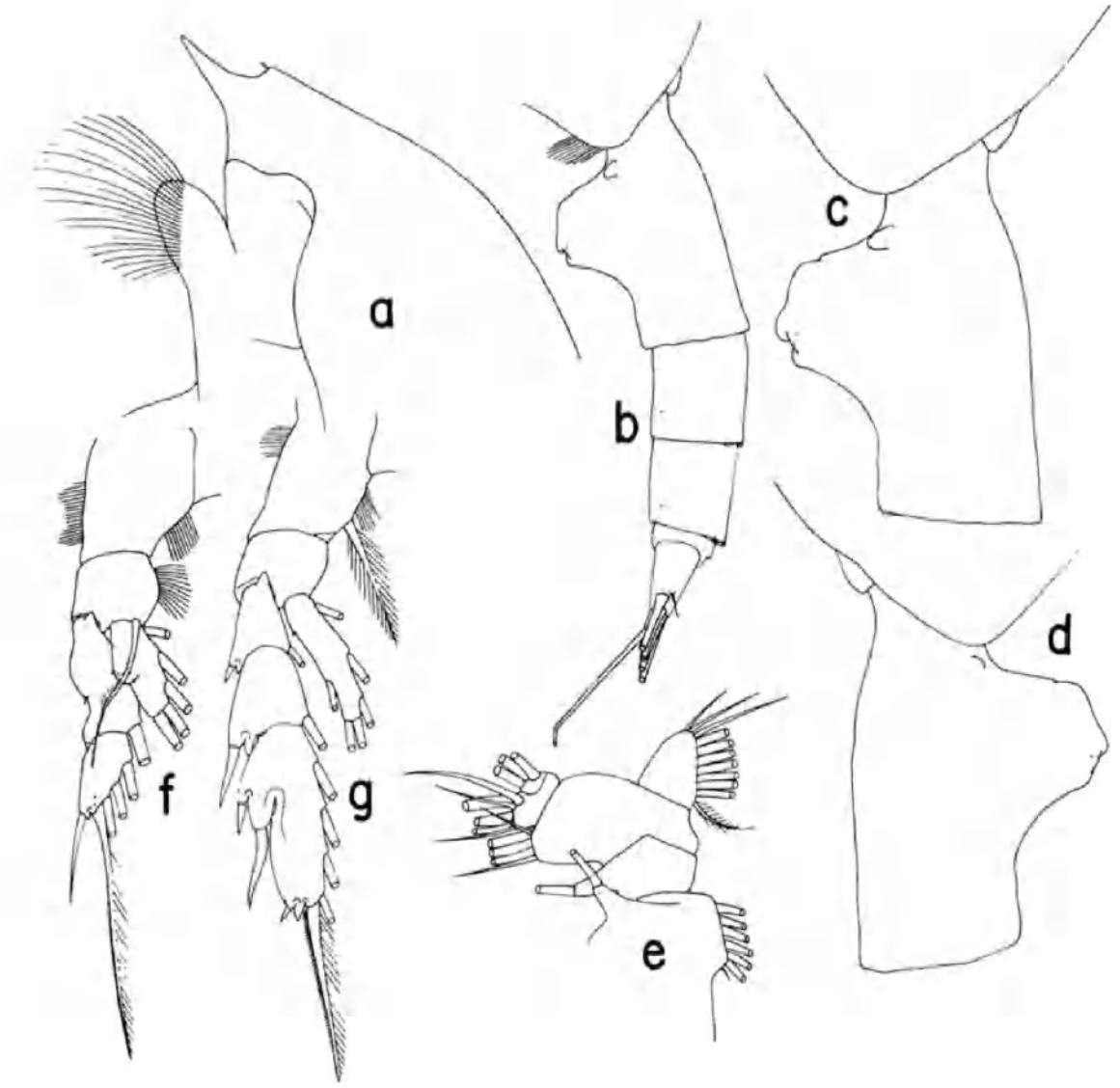

Figure 45. *Paraeuchaeta abyssalis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, maxillule, first inner lobe omitted, posterior; f, first leg, anterior; g, second leg, anterior.

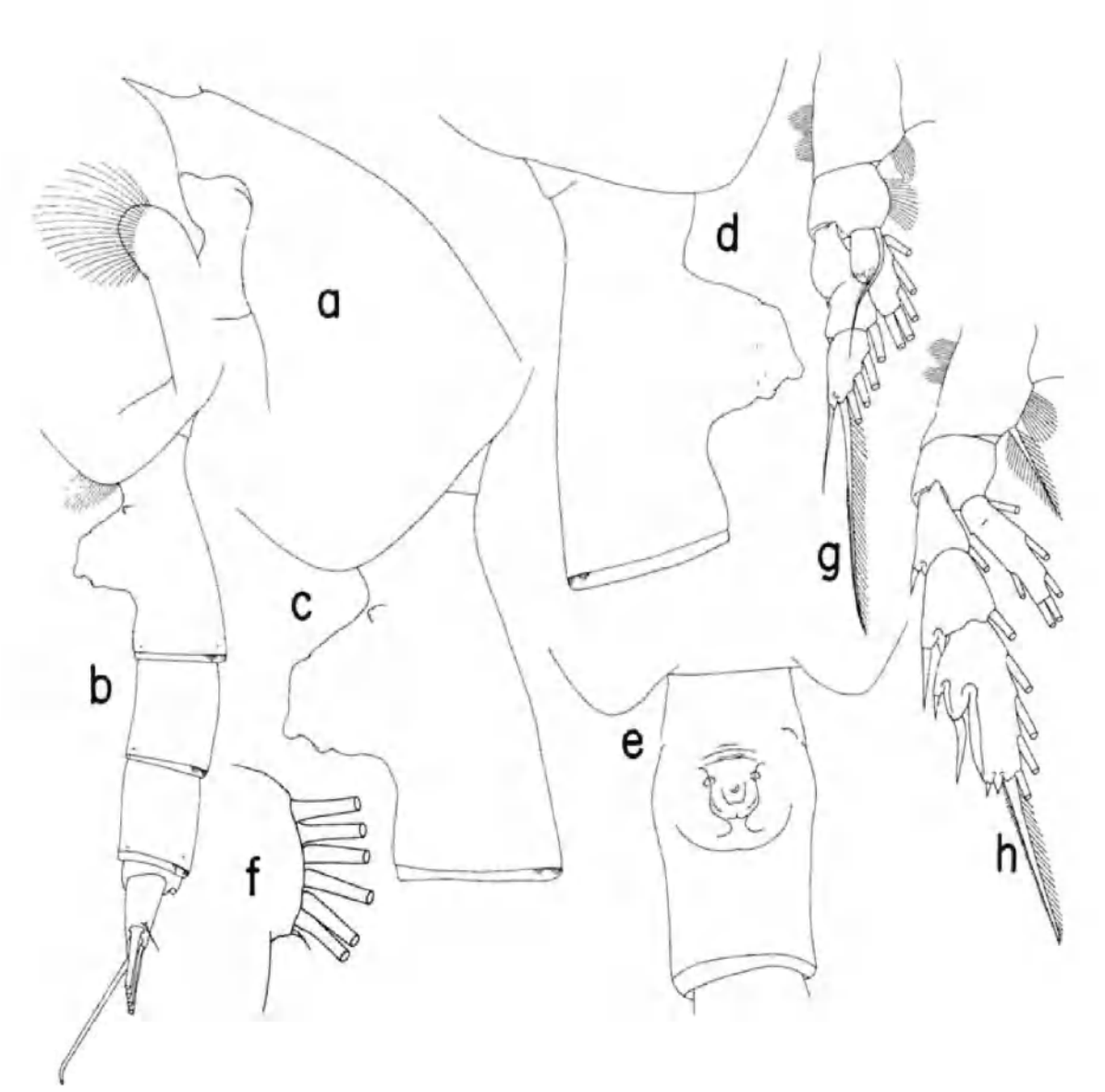

Figure 46. *Paraeuchaeta altibulla*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, outer lobe of maxillule; g, first leg, anterior; h, second leg, anterior.

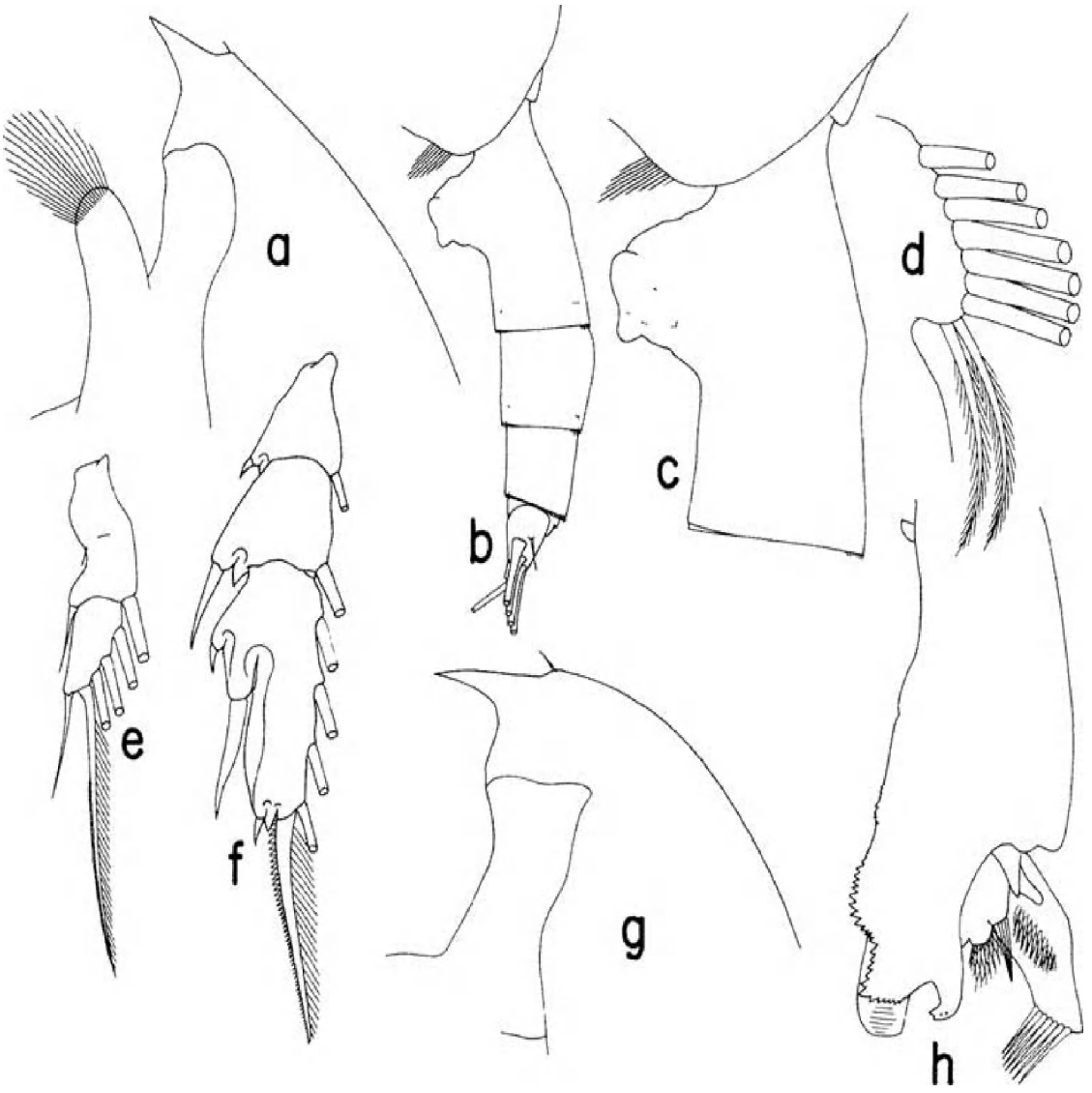

Figure 47. *Paraeuchaeta californica* female: a. forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, distal exopodal segments of left 5th leg, lateral, tilted clockwise.

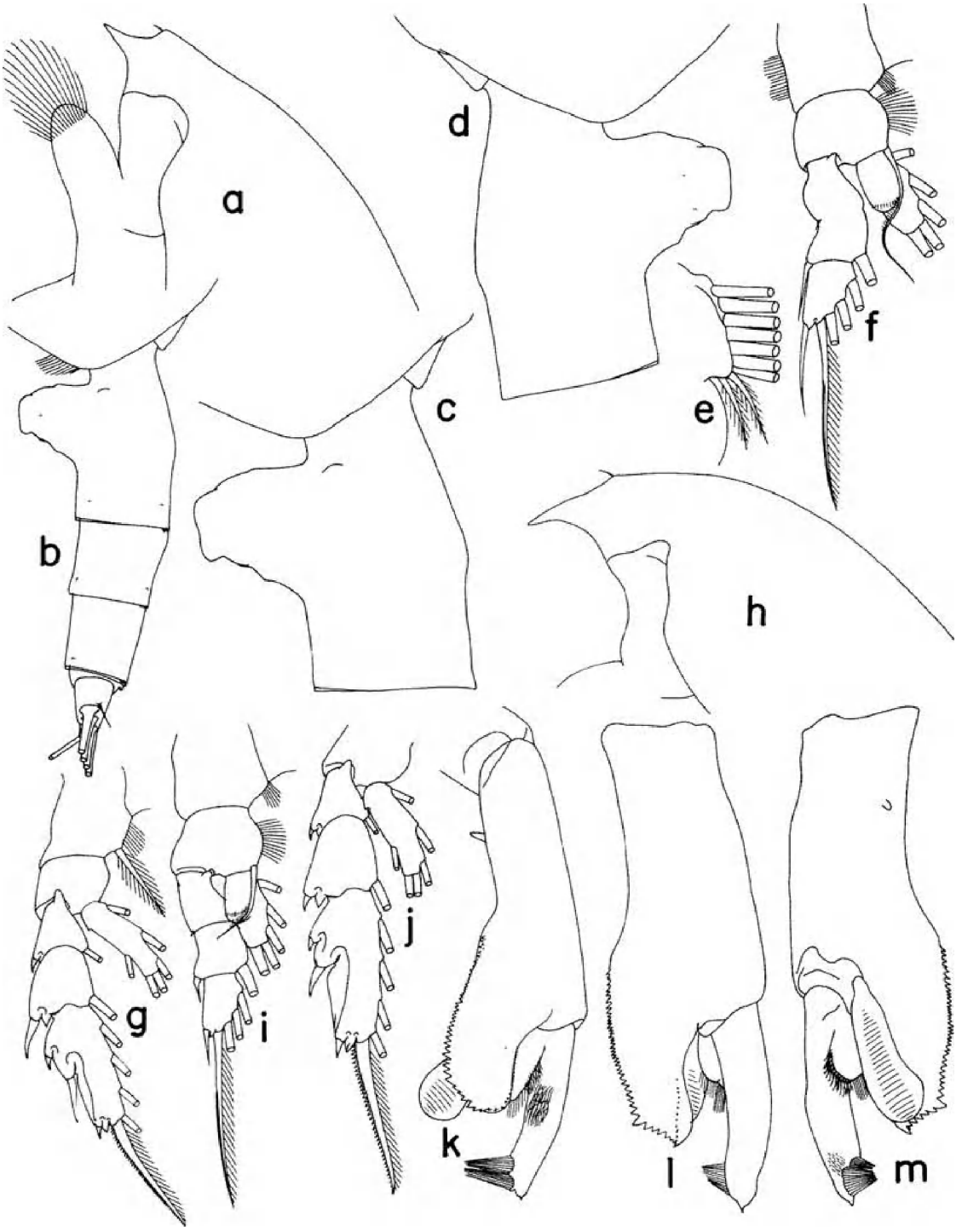

Figure 48. *Paraeuchaeta birostrata* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, outer lobe of maxillule; f, first leg, anterior; g, second leg, anterior. Male: h, forehead, left; i, first leg, anterior; j, second leg, anterior; k, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; l, do, lateral, tilted clockwise; m, do, medial, tilted clockwise.

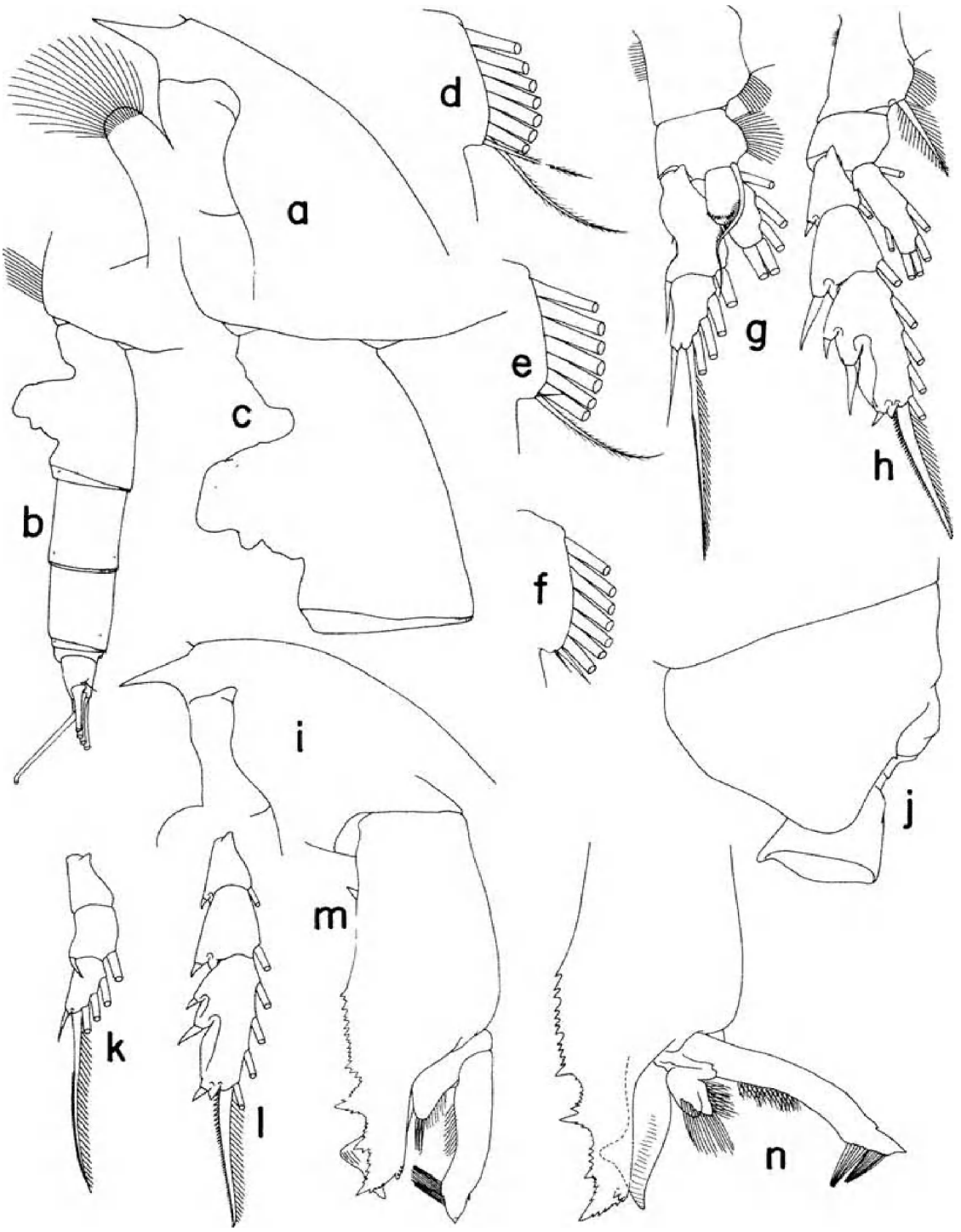

Figure 49. *Paraeuchaeta confusa* female: a, forehead, left; b, urosome, left; c, genital somite, left; d-f, outer lobe of maxillule, showing individual variations in size of proximal setae; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, last pedigerous and genital somites, left; k, exopod of first leg, anterior; l, exopod of second leg, anterior; m, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; n, do, lateral, tilted clockwise.

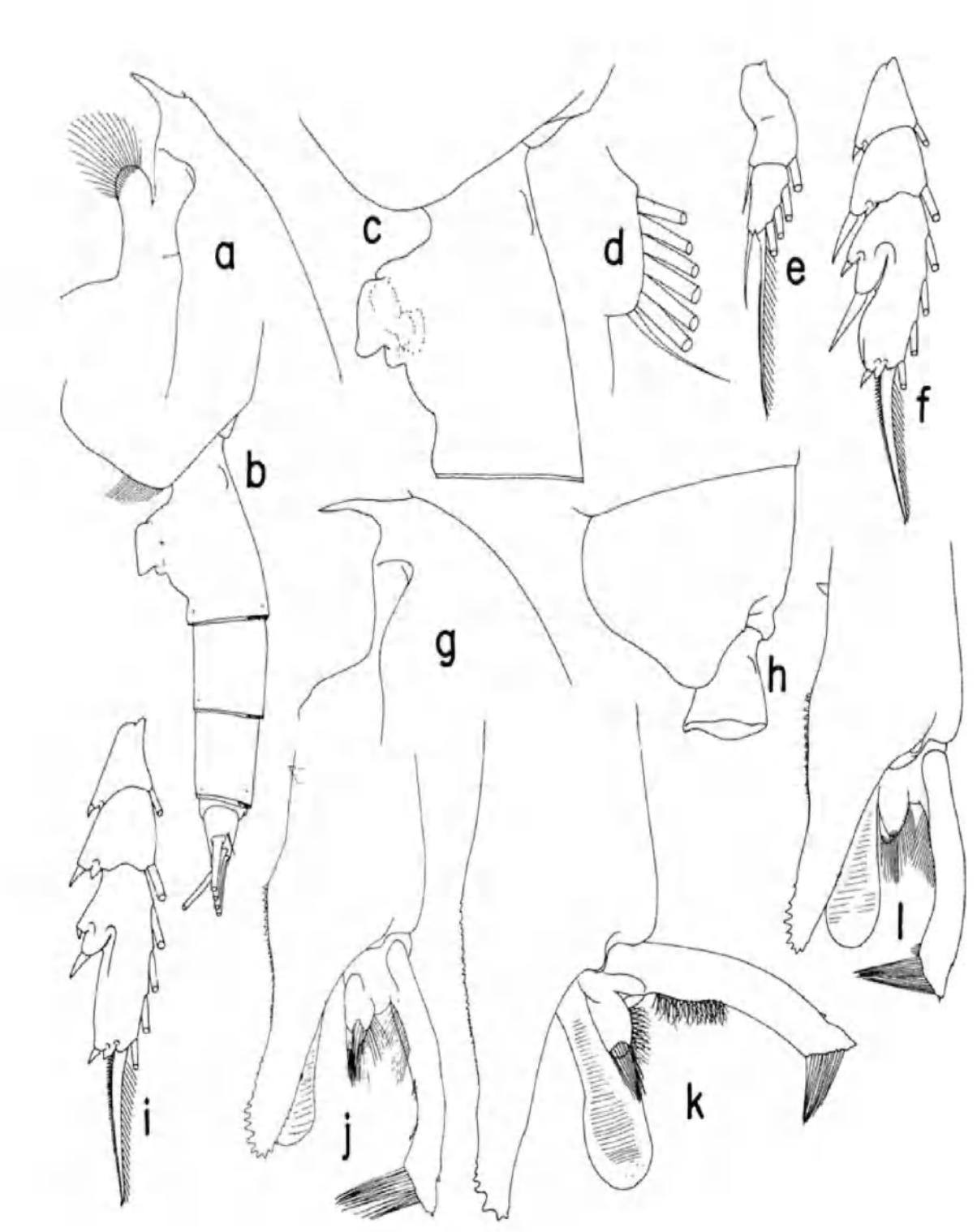

Figure 50. *Paraeuchaeta comosa* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, last pedigerous and genital somites, left; i, exopod of second leg, anterior; j, distal exopodal segments of left 5th leg, lateral, tilted clockwise; k, do, showing variation in teeth of serrated lamella; l, do, lateral, also showing variation in teeth of serrated lamella.

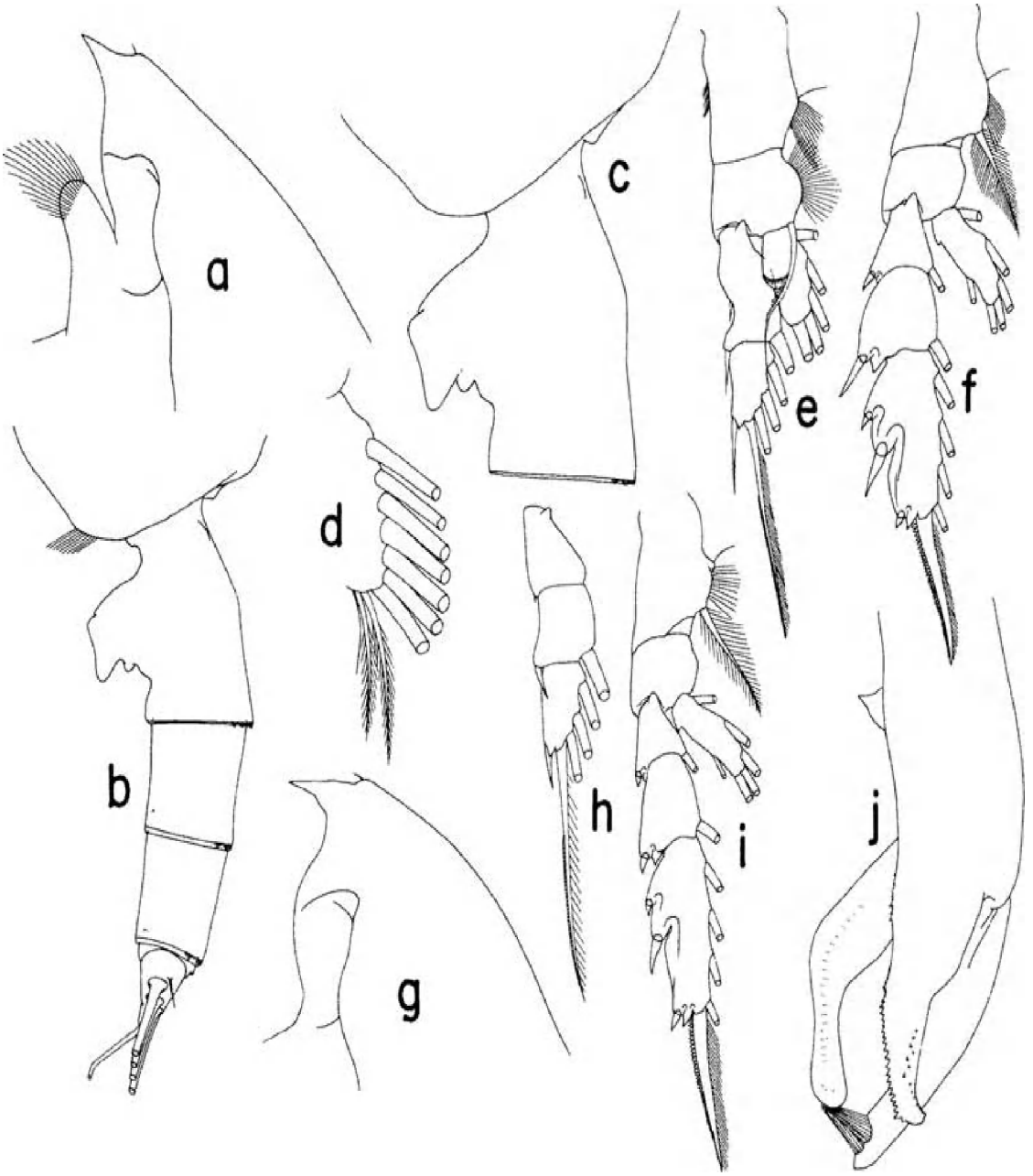

Figure 51. *Paraeuchaeta hansenii* female: a, forehead., left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, first leg, anterior; f, second leg, anterior. Male: g, forehead, left; h, exopod of first leg, anterior; i, second leg, anterior; j, distal exopodal segments of left 5th leg, anterior.

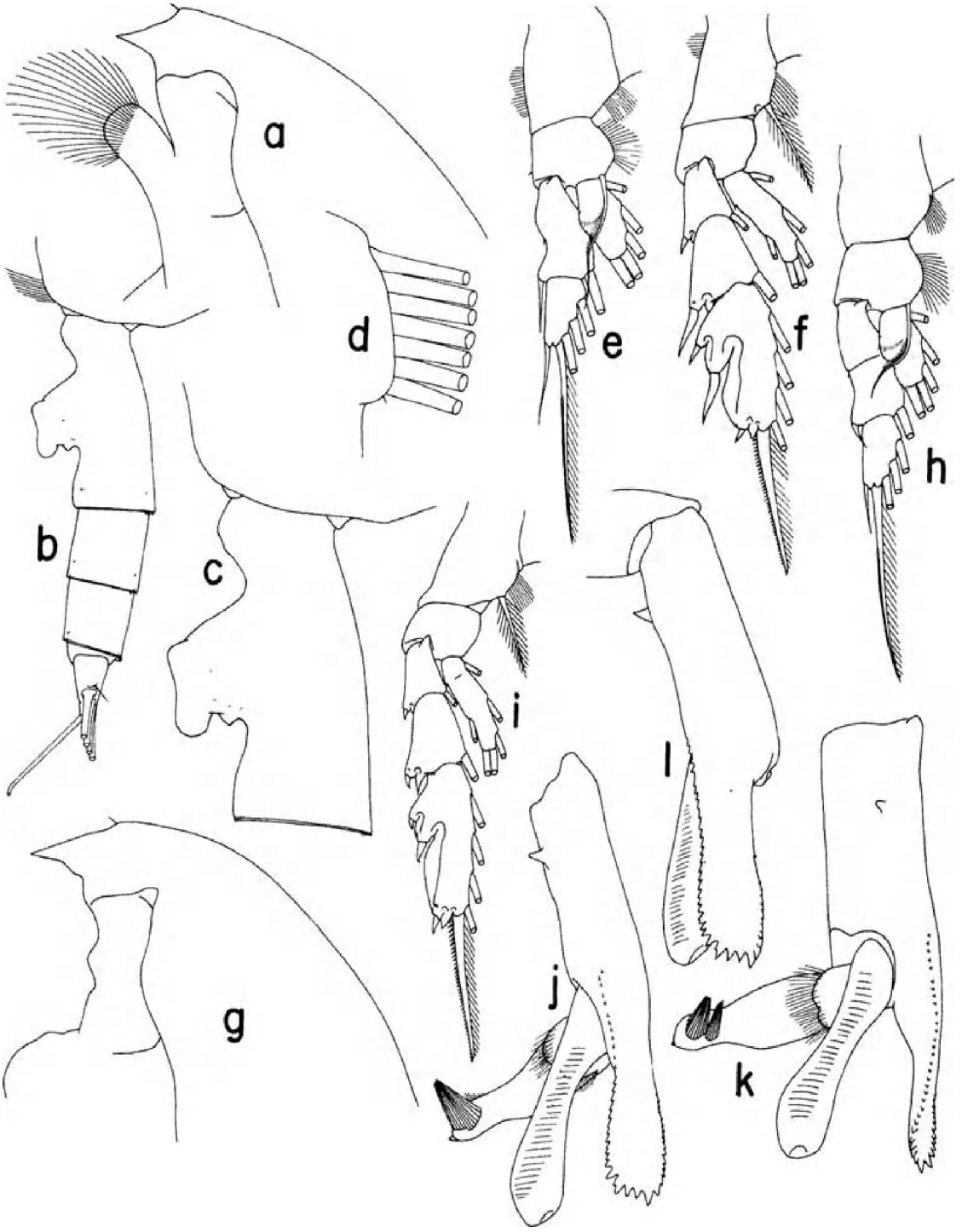

Figure 52. *Paraeuchaeta eminens* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, first leg, anterior; f, second leg, anterior. Male: g, forehead, left; h, first leg, anterior, i, second leg, anterior; j, distal exopodal segments of left 5th leg, anterior, tilted clockwise; k, do, medial, tilted counterclockwise; l, second exopodal segment of left 5th leg, anterior.

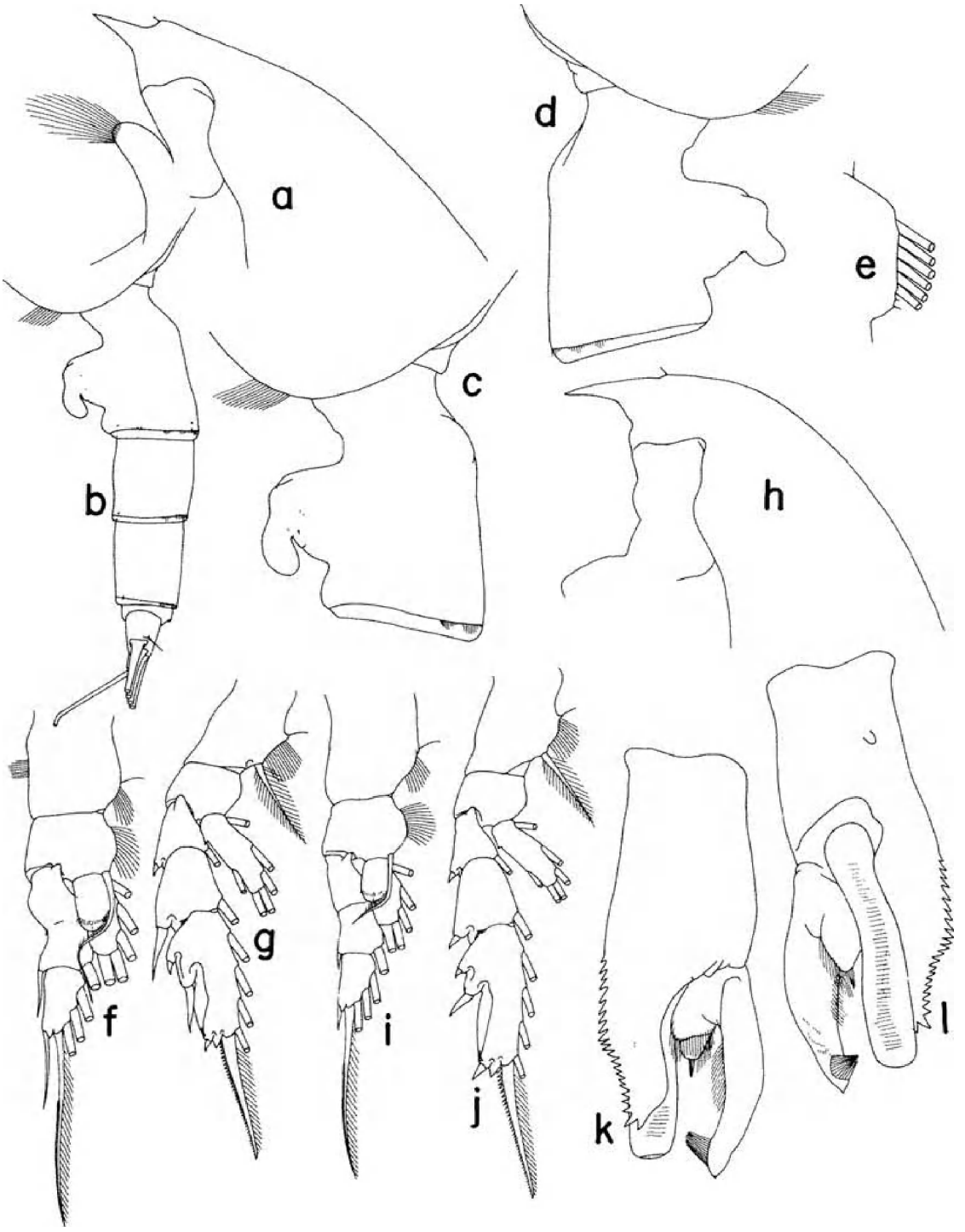

Figure 53. *Paraeuchaeta investigatoris* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, outer lobe of maxillule; f, first leg, anterior; g, second leg, anterior. Male: h, forehead, left; i, first leg, anterior; j, second leg, anterior, k, distal exopodal segments of left 5th leg, lateral, tilted clockwise; l, do, medial, tilted counterclockwise.

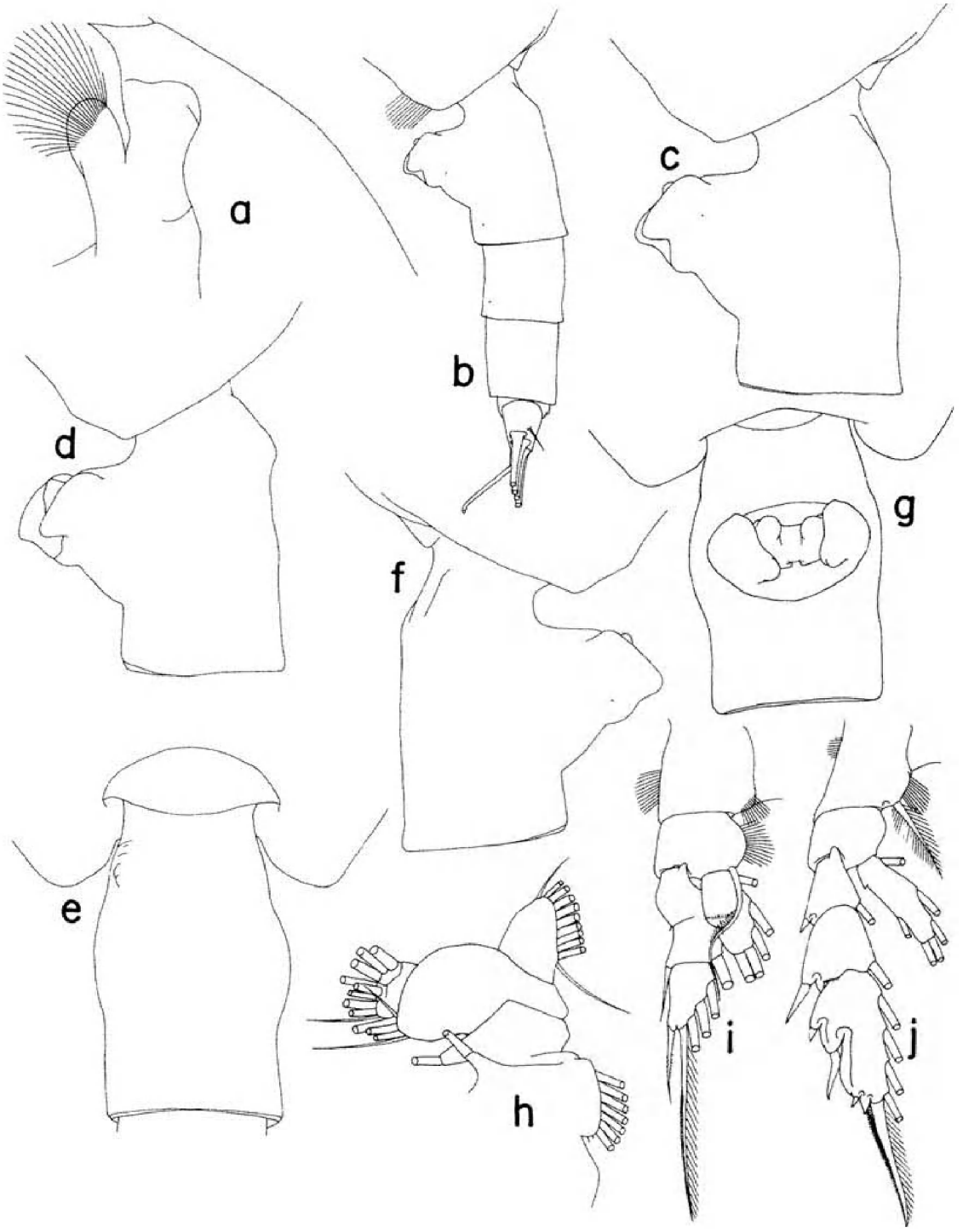

Figure 54. *Paraeuchaeta rubicunda* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, left, tilted clockwise; e, do, dorsal; f, do, right; g, do, ventral; h. maxillule, first inner lobe omitted, posterior; i, first leg, anterior; j, second leg, anterior.

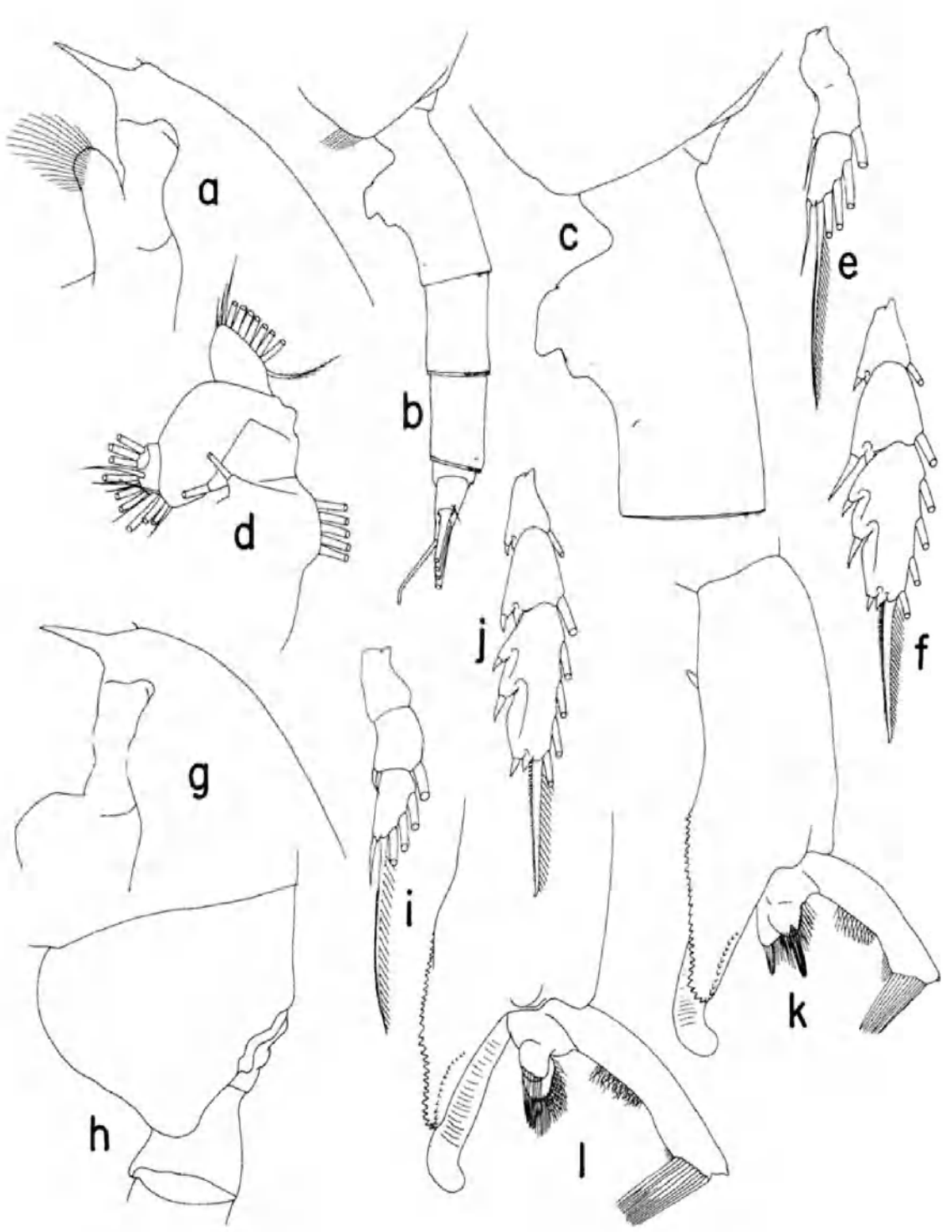

Figure 55. *Paraeuchaeta gracilicauda* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe omitted, posterior; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, last pedigerous and genital somites, left; i, exopod of first leg, anterior; j, exopod of second leg, anterior; k, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; l, do, lateral.

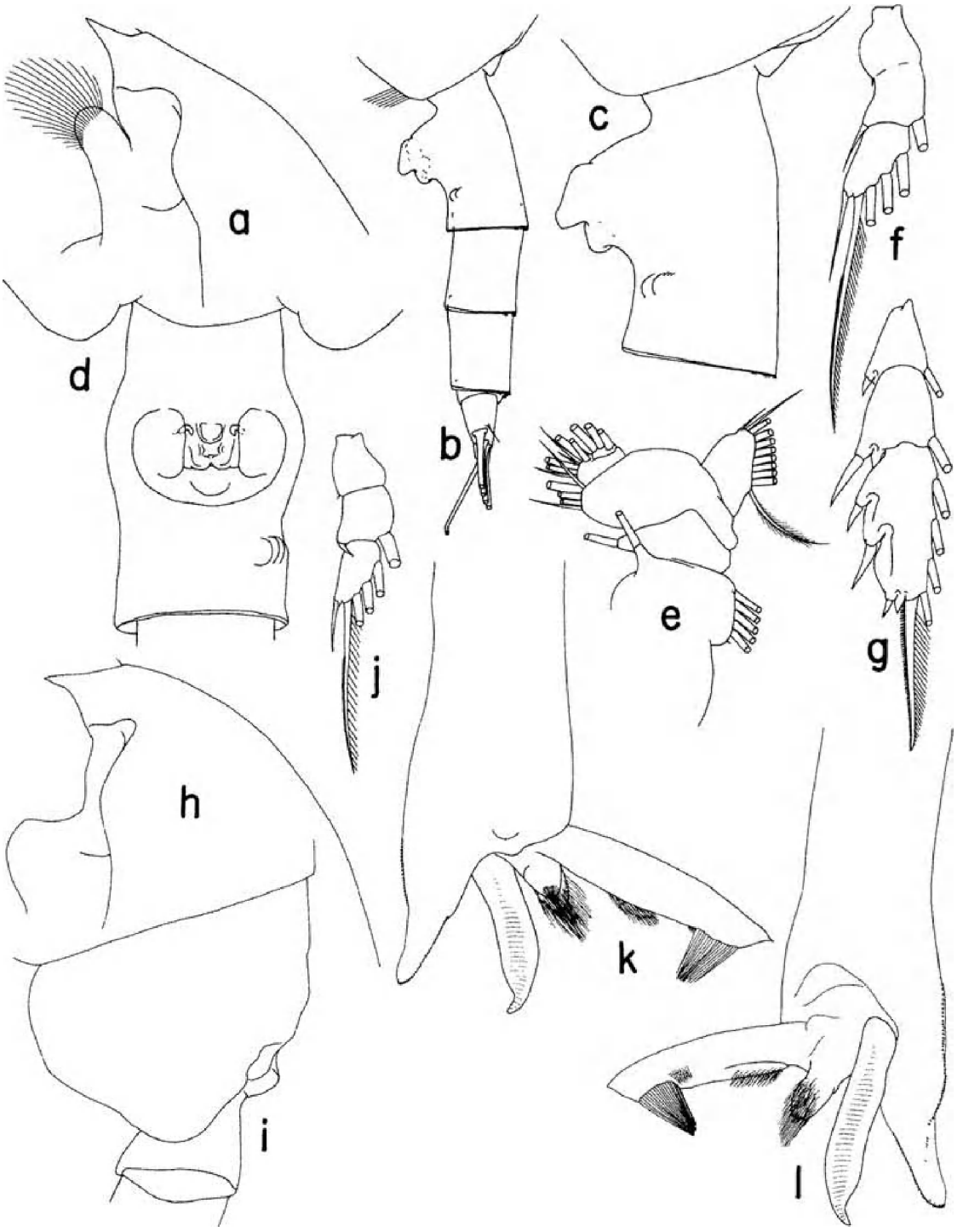

Figure 56. *Paraeuchaeta vorax* female: a, forehead, left; b, urosome. left; c, genital somite, left; d, do, ventral; e, maxillule, first inner lobe omitted, posterior; f, exopod of first leg, anterior; g, exopod of second leg, anterior. Male: h, forehead, left; i, last pedigerous and genital somites, left; j, exopod of first leg, anterior; k, distal exopodal segments of left 5th leg, lateral; l, do, medial.

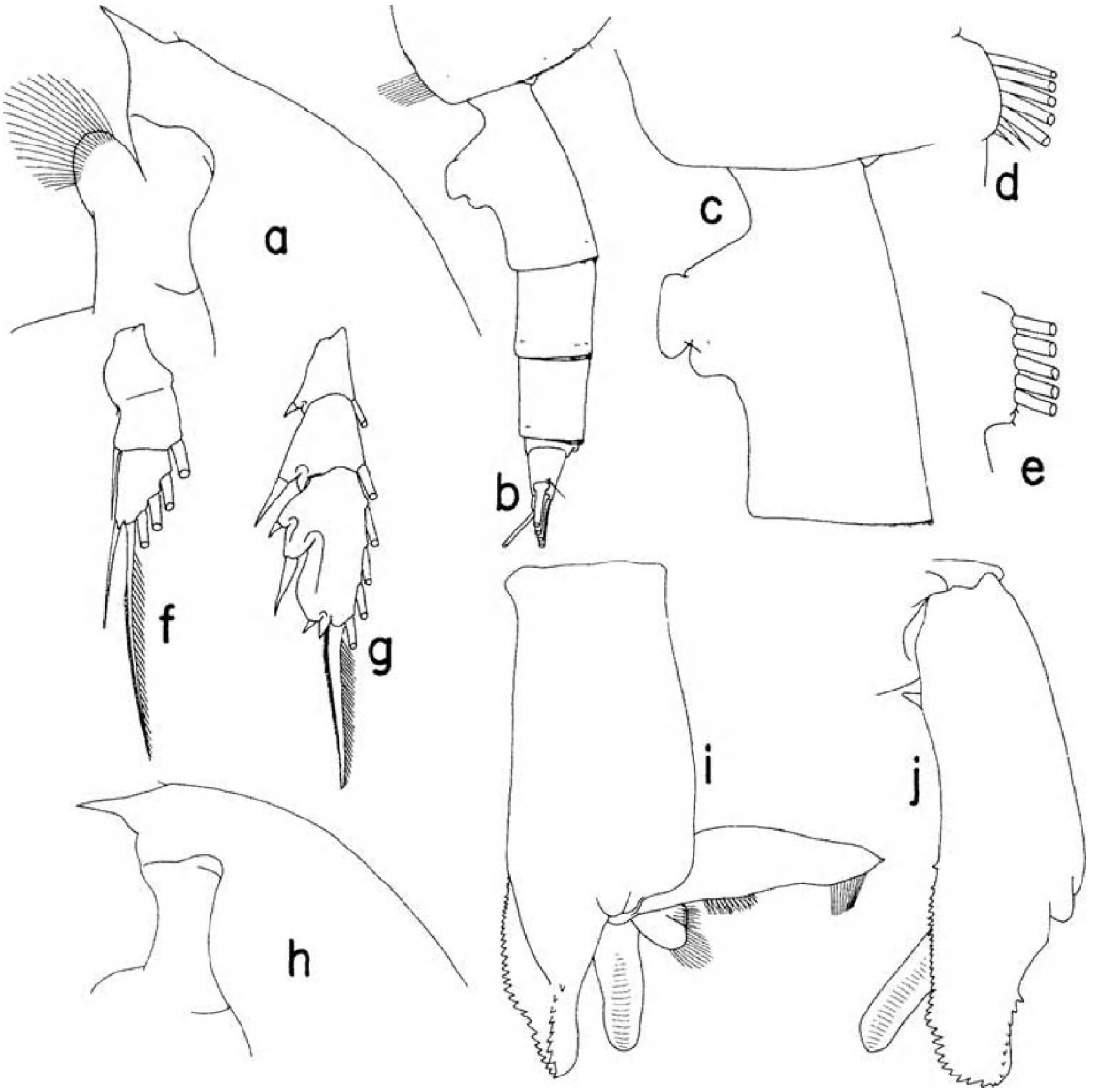

Figure 57. *Paraeuchaeta kurilensis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxilluie; e, do, showing variation in size of proximal setae; f, exopod of first leg, anterior; g, exopod of second leg, anterior. Male: h, forehead, left; i, distal exopodal segments of left 5th leg, lateral; j, second exopodal segment of left 5th leg, anterior.

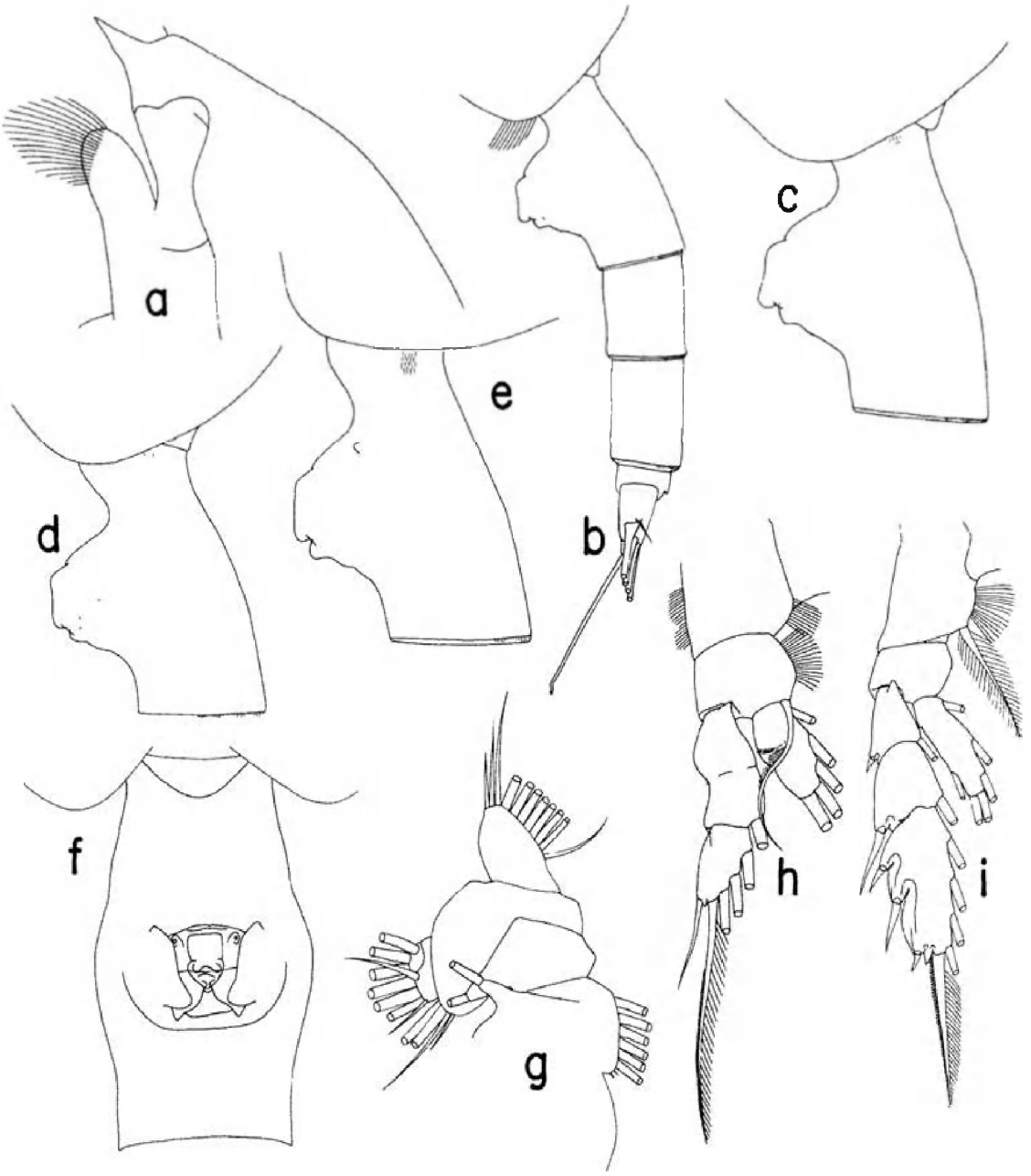

Figure 58. *Paraeuchaeta abbreviata* female: a, forehead, left; b, urosome. left; c, genital somite, left; d and e, genital somites showing variations in profile of genital flange and presence or absence of a small conical process; f, genital somite, ventral; g, maxillule, first inner lobe omitted, posterior; h, first leg, anterior; i, second leg, anterior.

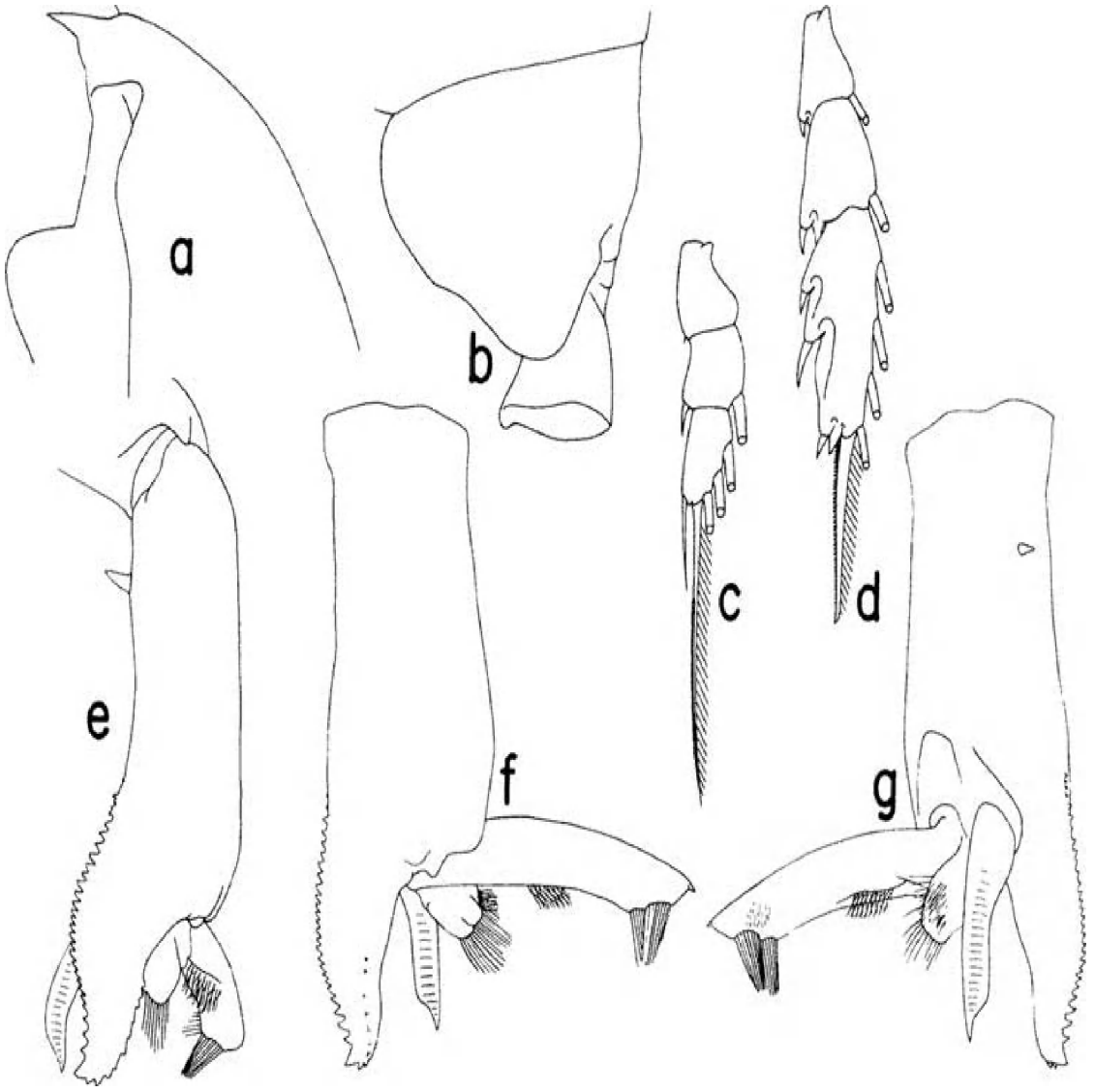

Figure 59. *Paraeuchaeta abbreviata* male: a, forehead, left; b, last pedigerous and genital somites, left; c, exopod of first leg, anterior; d, exopod of second leg, anterior; e, distal exopodal segments of left 5th leg, anterior; f, do, lateral; g, do, medial.

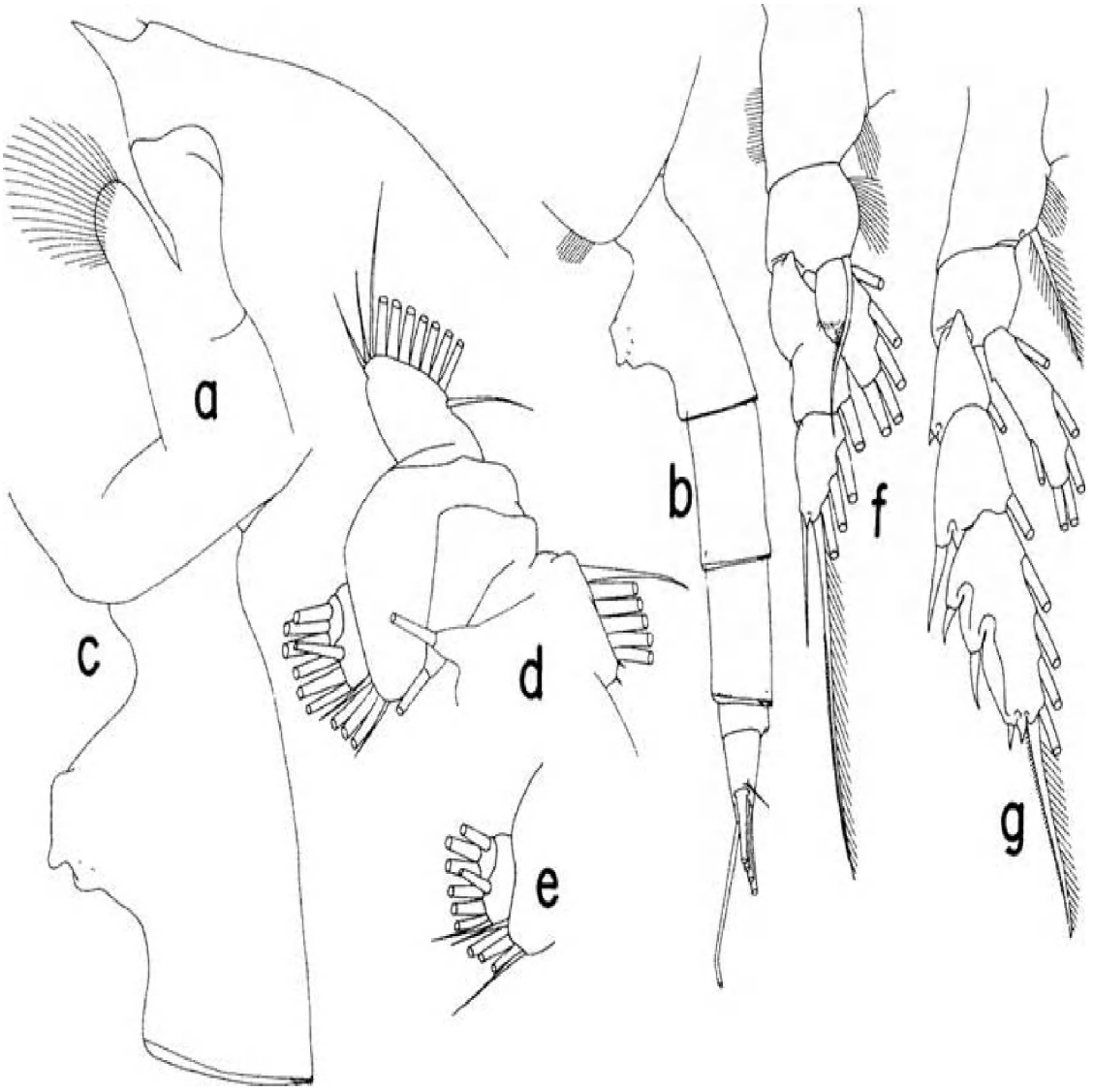

Figure 60. *Paraeuchaeta parabbreviata*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe omitted, posterior; e, basis and endopod of maxillule showing variation in setation; f, first leg, anterior; g, second leg, anterior.

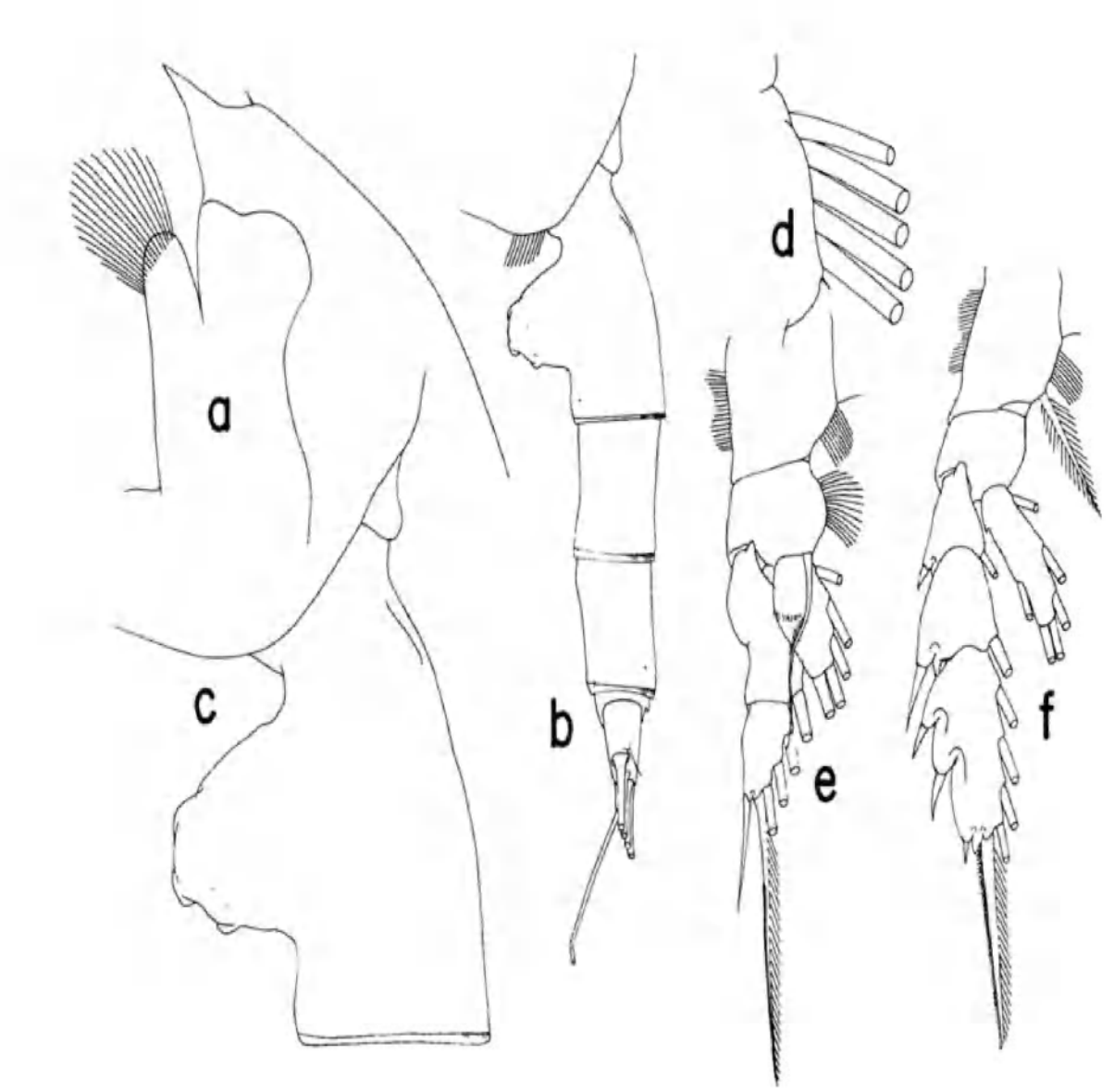

Figure 61. *Paraeuchaeta alaminae* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, outer lobe of maxillule; e, first leg, anterior; f, second leg, anterior.

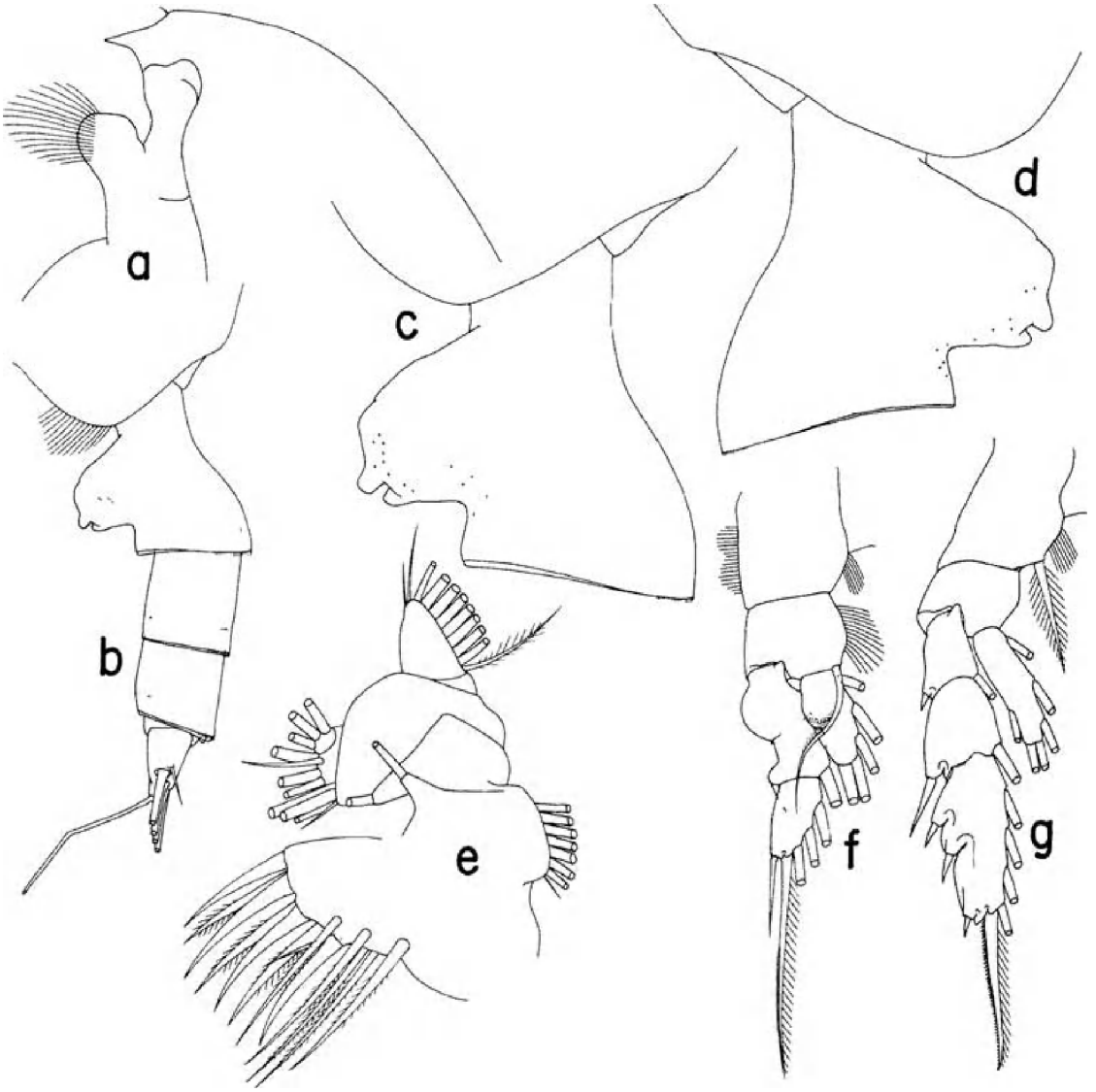

Figure 62. *Paraeuchaeta anfracta*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, maxillule, first inner lobe separated, posterior; f, first leg, anterior; g, second leg, anterior.

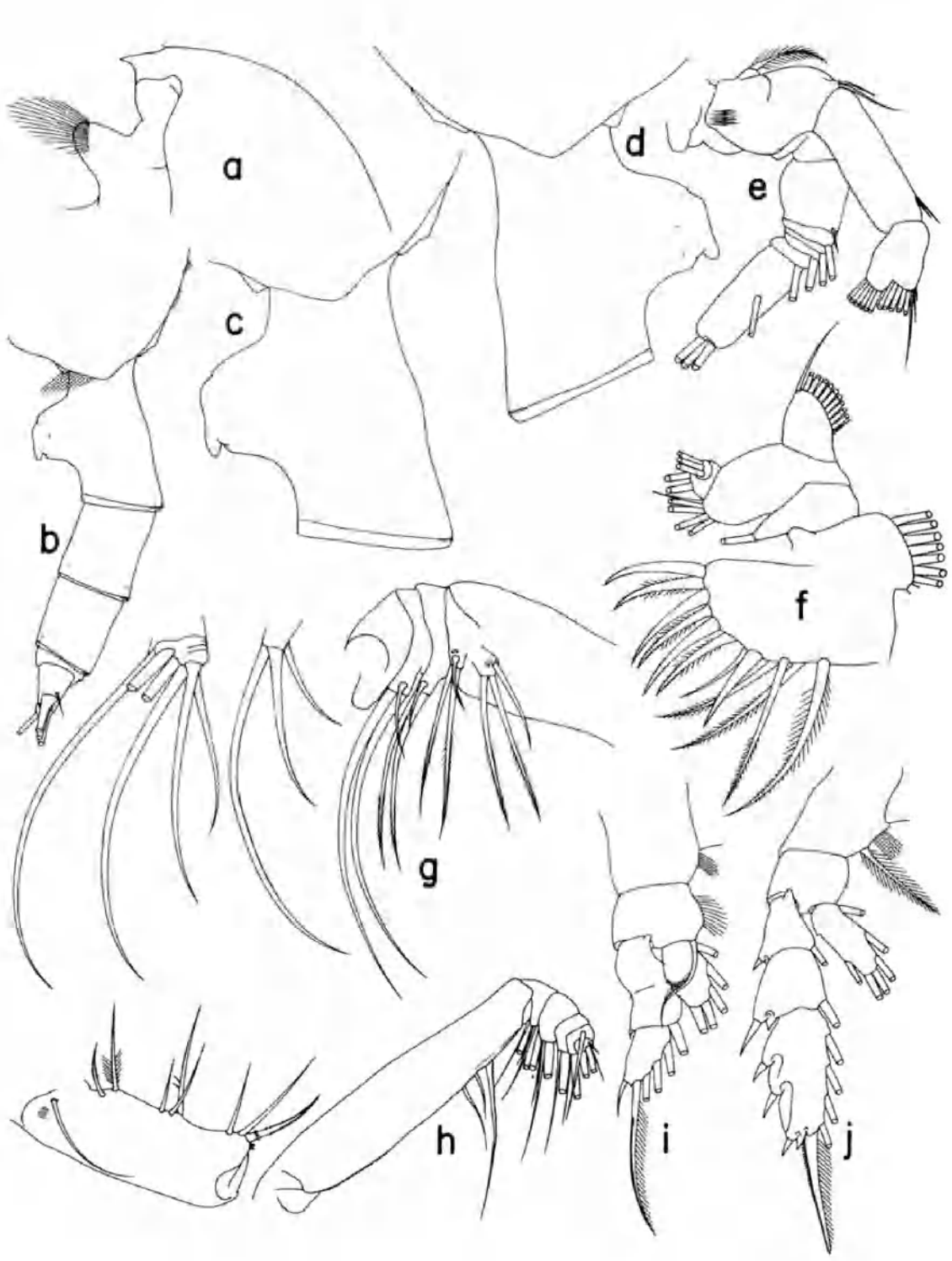

Figure 63. *Paraeuchaeta pavlovskii* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, antenna; f, maxillule, first inner lobe separated, posterior; g, maxilla, 5th lobe and endopod separated, posterior; h, maxilliped, coxa separated, coxa posterior, the rest anterior; i, first leg, anterior; j, second leg, anterior.

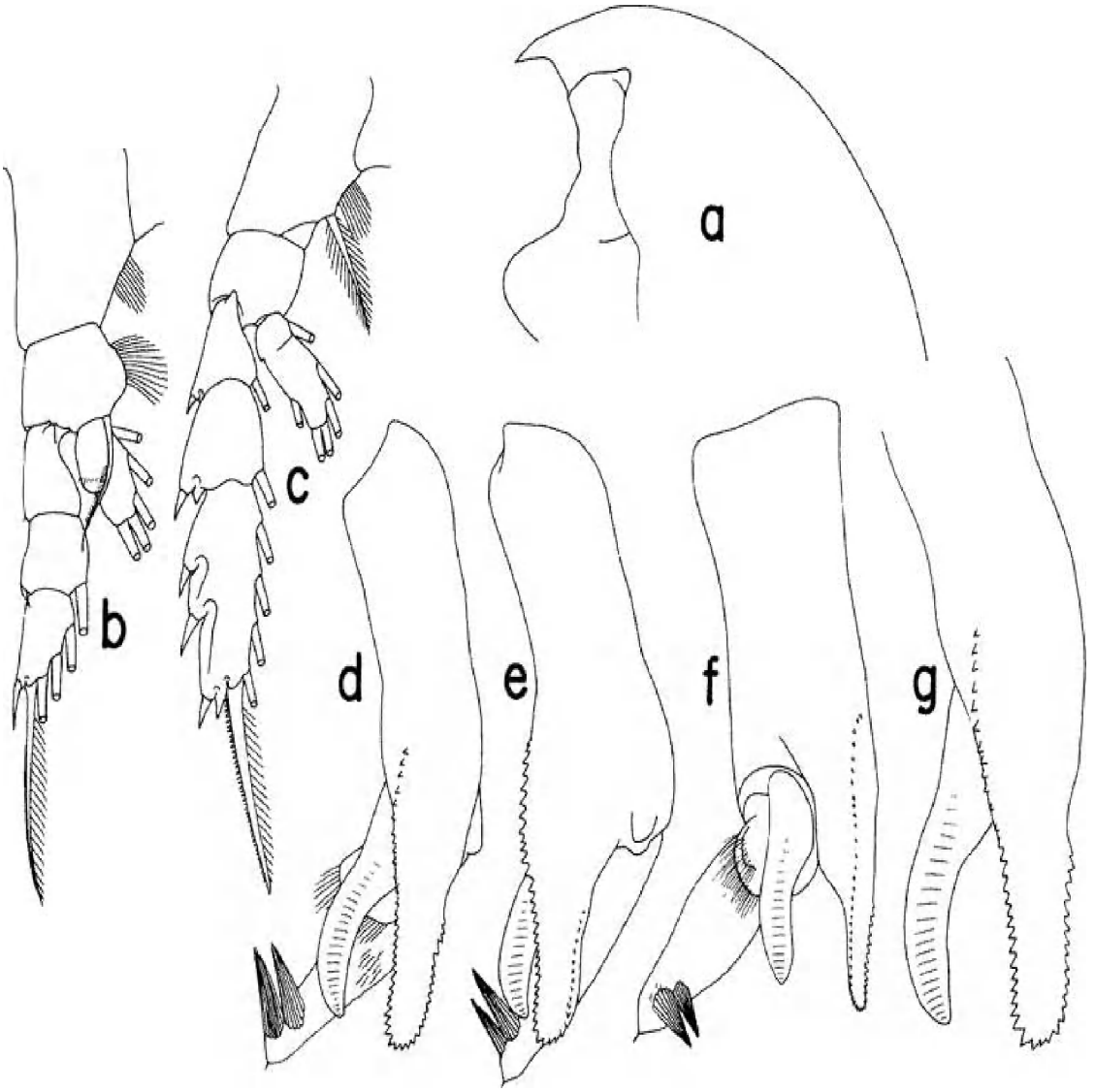

Figure 64. *Paraeuchaeta pavlovskii* male: a, forehead, left; b, first leg, anterior; c, second leg, anterior; d, distal exopodal segments of left 5th leg, anterior, tilted clockwise; e, do, lateral, tilted clockwise; f, do, medial, tilted counterclockwise; g, serrated lamella and digitiform process, anterior, tilted clockwise.

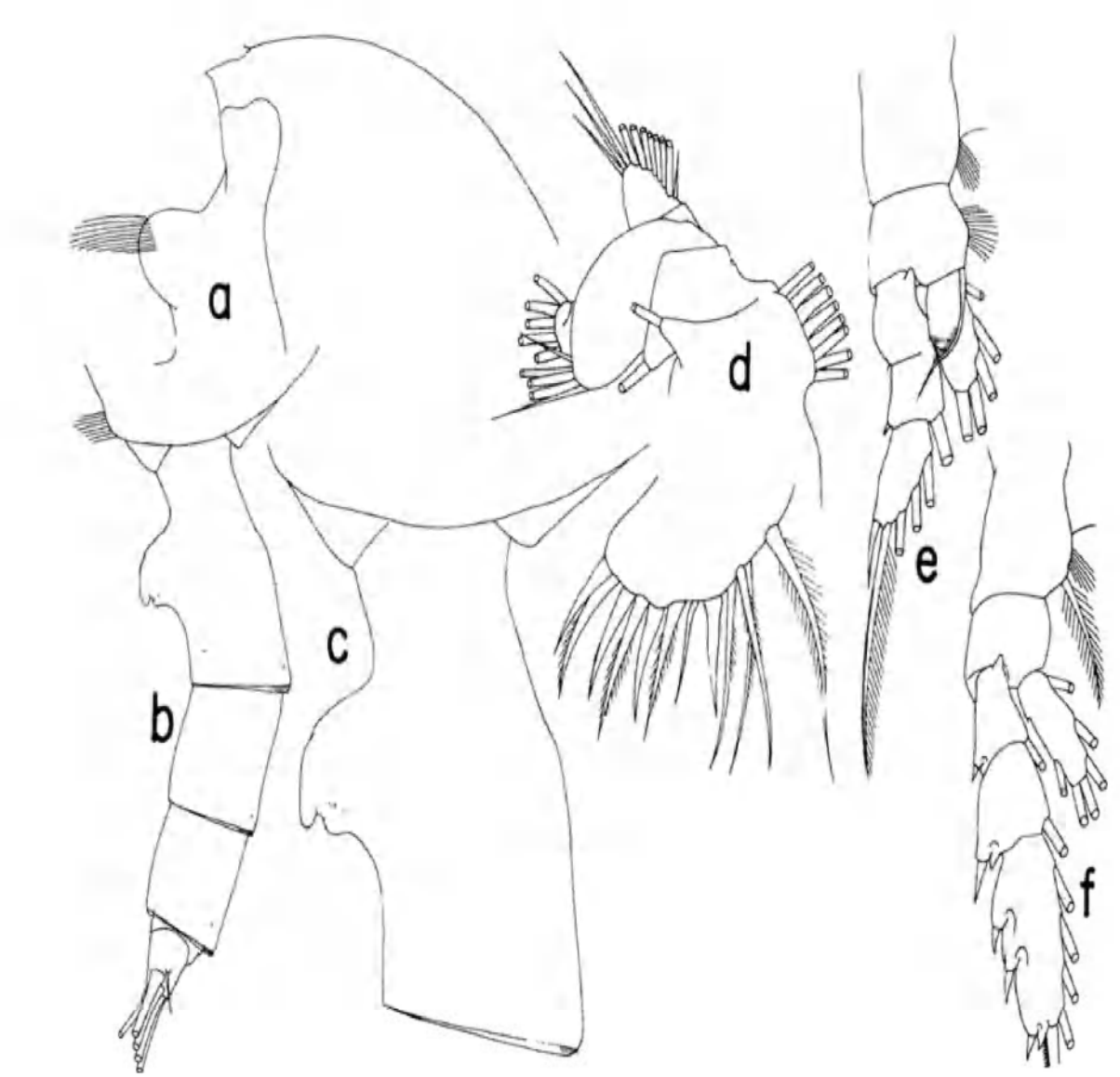

Figure 65. *Paraeuchaeta scopaeorhina*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe separated, posterior; e, first leg, anterior; f, second leg, anterior.

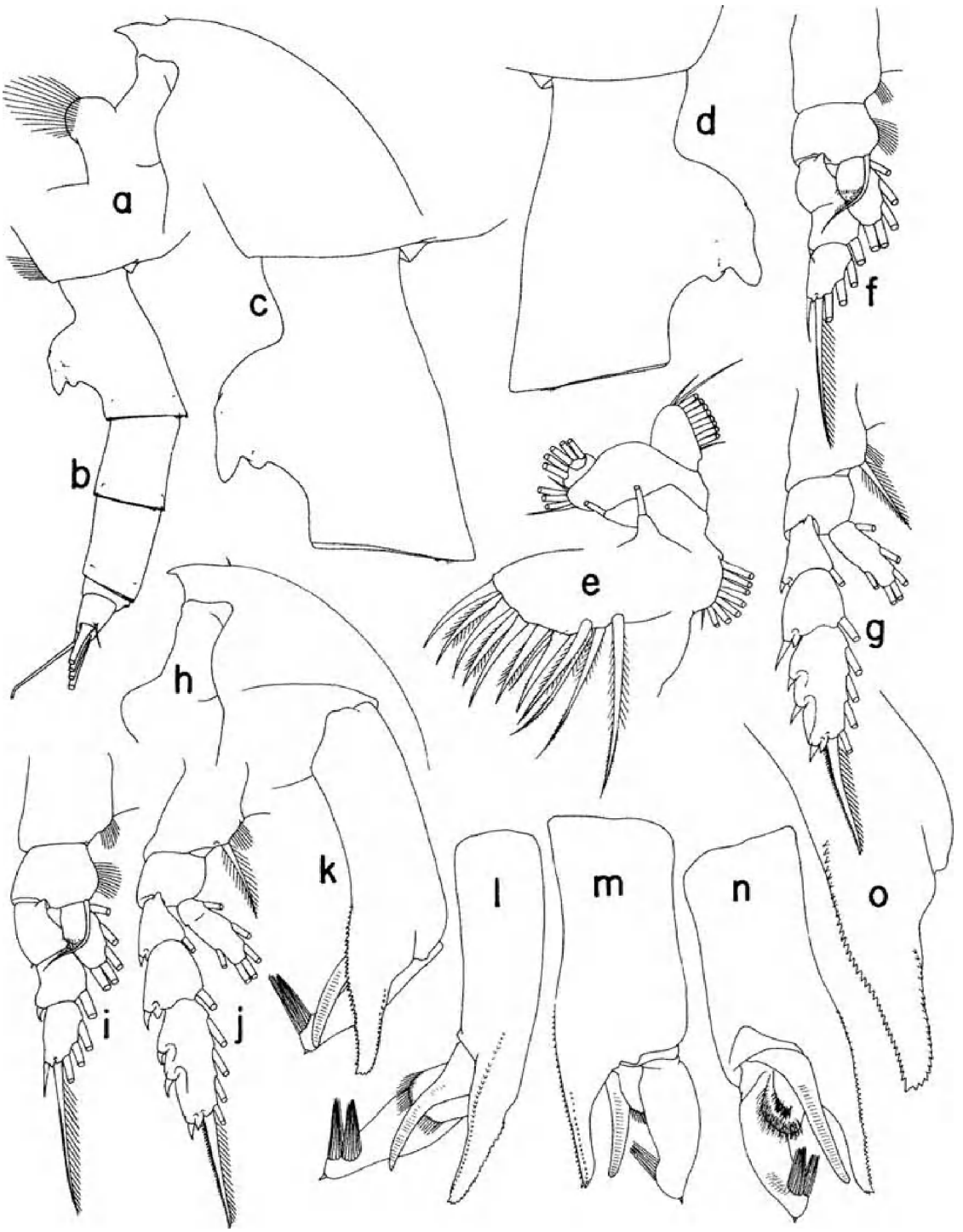

Figure 66. *Paraeuchaeta sesquipedalis*, new species, female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, maxillule, first inner lobe separated, posterior; f, first leg, anterior; g, second leg, anterior. Male: h, forehead, left; i, first leg, anterior; j, second leg, anterior; k, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; l, do, anterior, tilted clockwise; m, do, lateral; n, do, medial; o, serrated lamella of left 5th leg exopod, anterior, tilted counterclockwise.

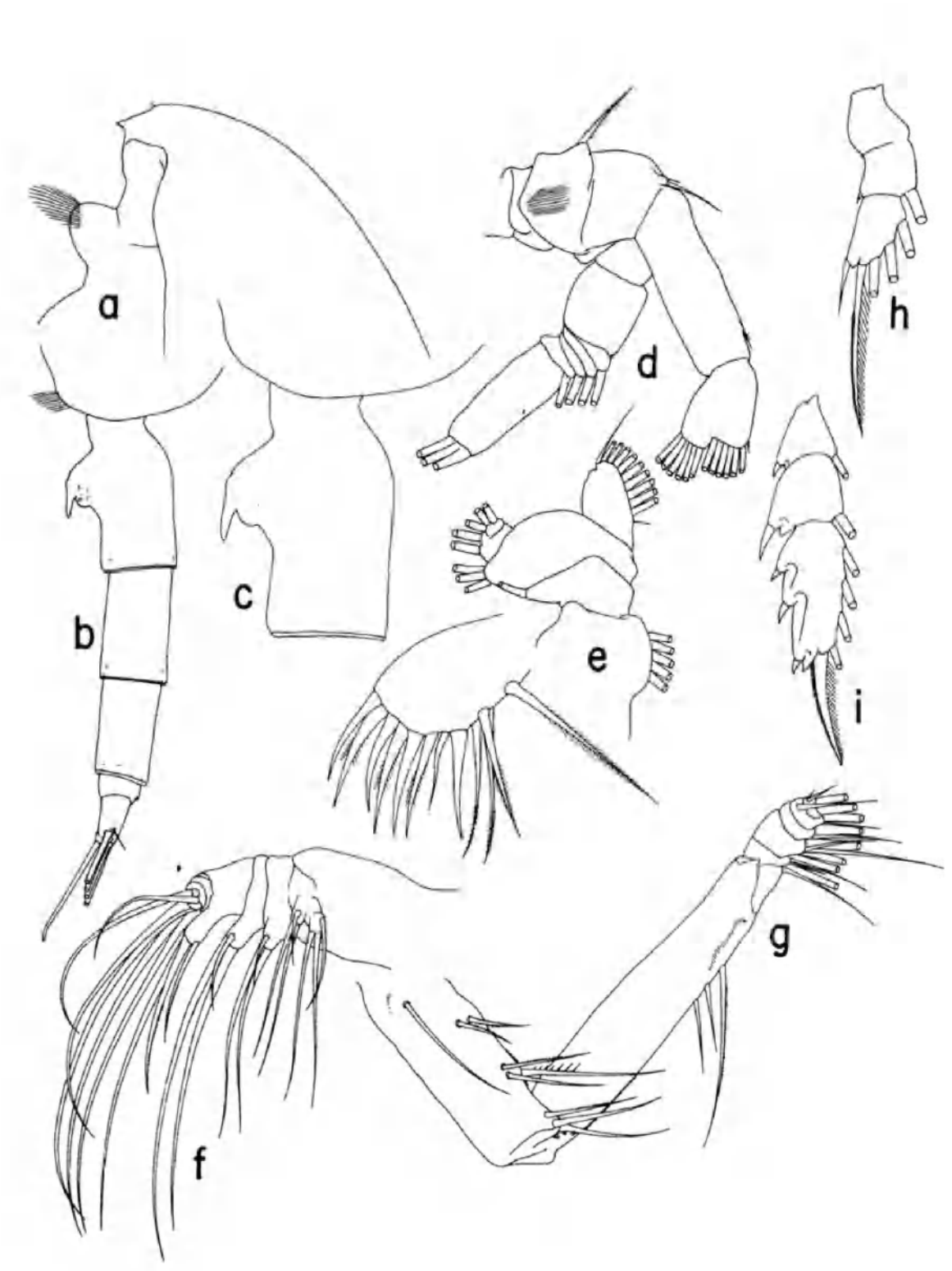

Figure 67. *Paraeuchaeta dactylifera* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, antenna; e, maxillule, first inner lobe separated, posterior; f, maxilla, posterior; g, maxilliped, coxa posterior, the rest anterior; h, exopod of first leg, anterior; i, exopod of second leg, anterior.

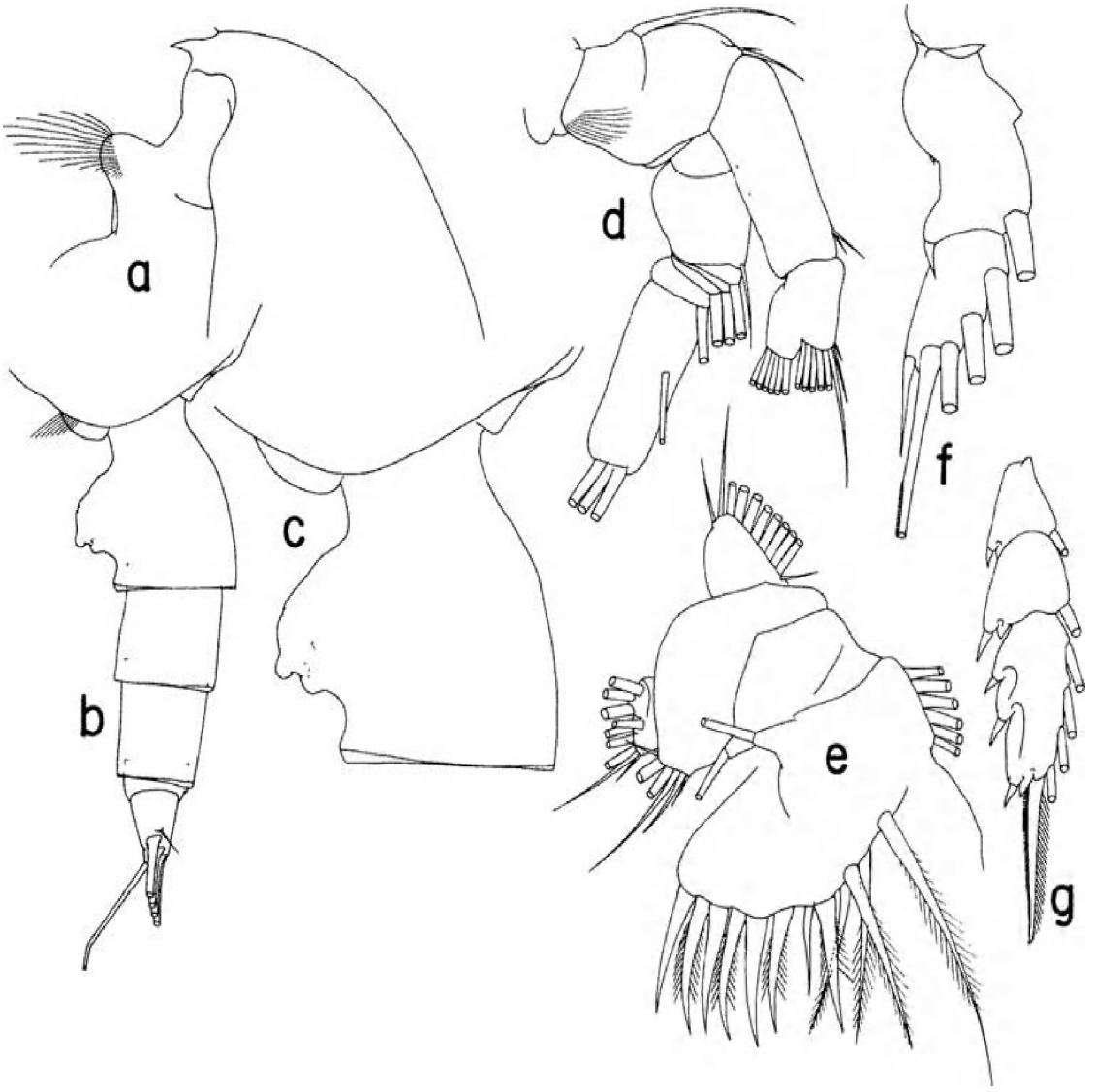

Figure 68. *Paraeuchaeta vervoorti* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, antenna; e, maxillule, first inner lobe separated, posterior; f, exopod of first leg, posterior; g, exopod of second leg, anterior.

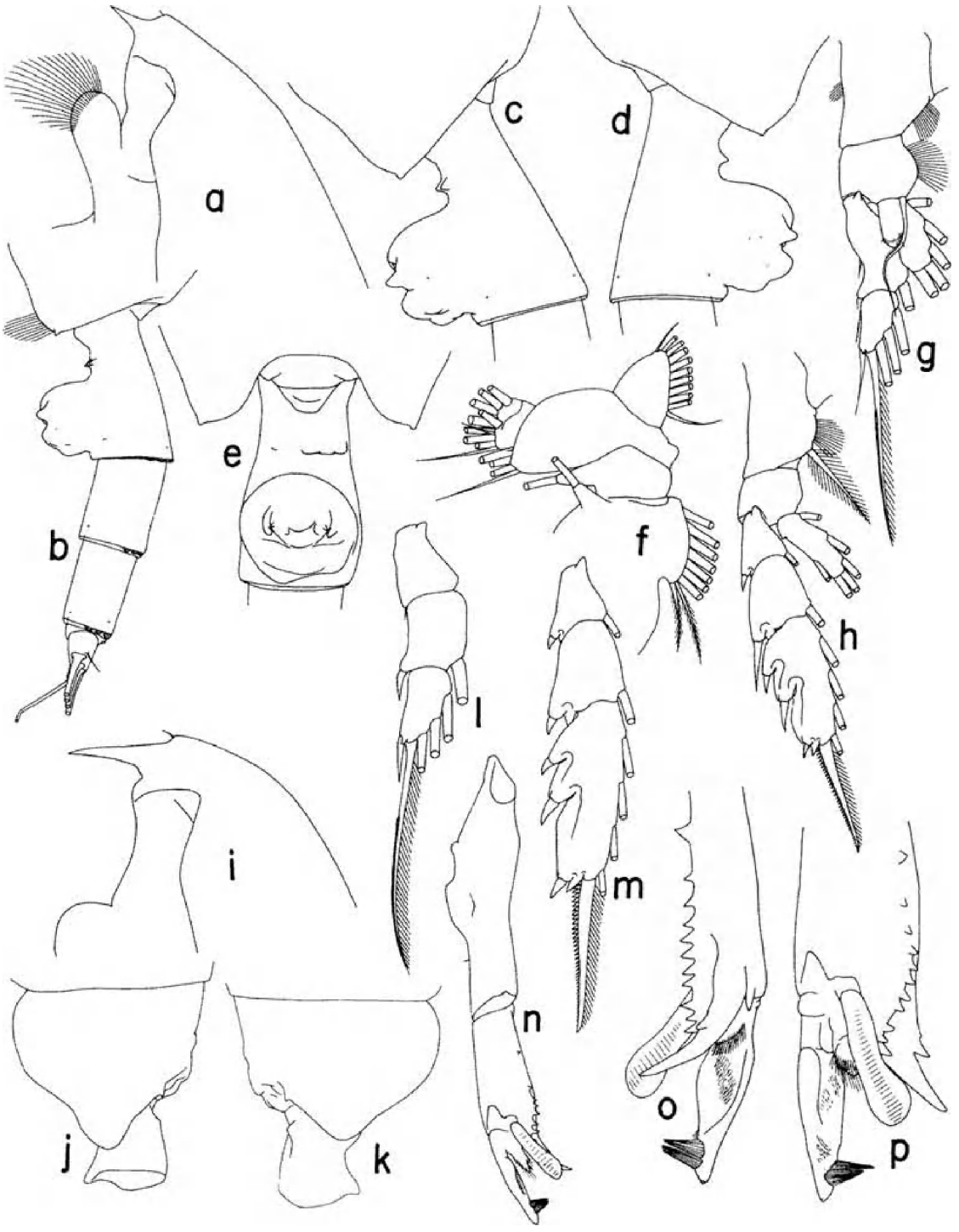

Figure 69. *Paraeuchaeta norvegica* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, maxillule, first inner lobe omitted, posterior; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, last pedigerous and genital somites, left; k, do, right; l, exopod of first leg, anterior; m, exopod of second leg, anterior; n, exopod of left 5th leg, medial; o, distal end of left 5th leg exopod, anterior; p, do, medial.

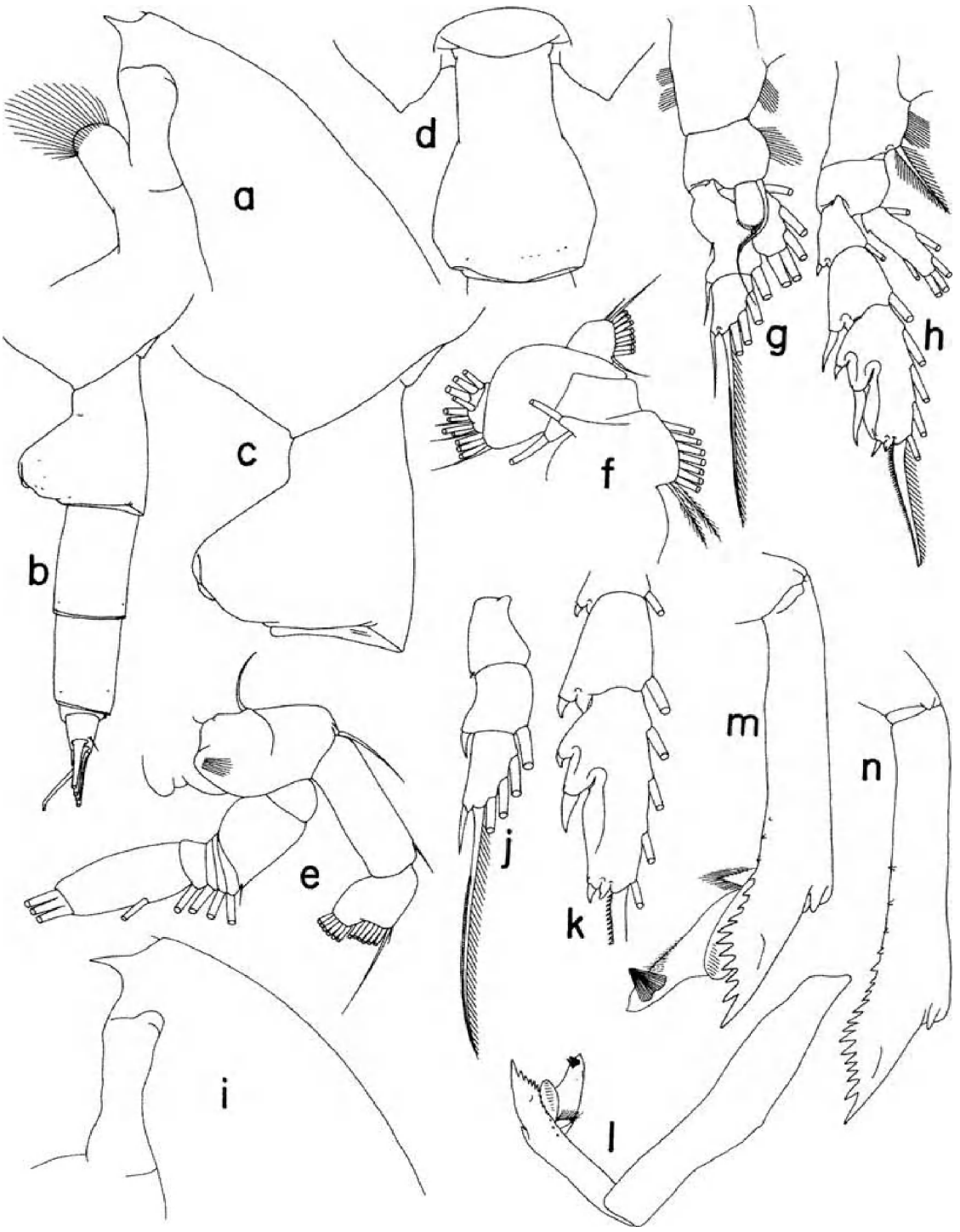

Figure 70. *Paraeuchaeta tonsa* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal; e, antenna; f, maxillule, first inner lobe omitted, posterior; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, exopod of first leg, anterior; k, exopod of second leg, anterior; l, exopod of left 5th leg, anterior; m, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; n, serrated lamella of left 5th leg exopod from different specimen, anterior, tilted counterclockwise.

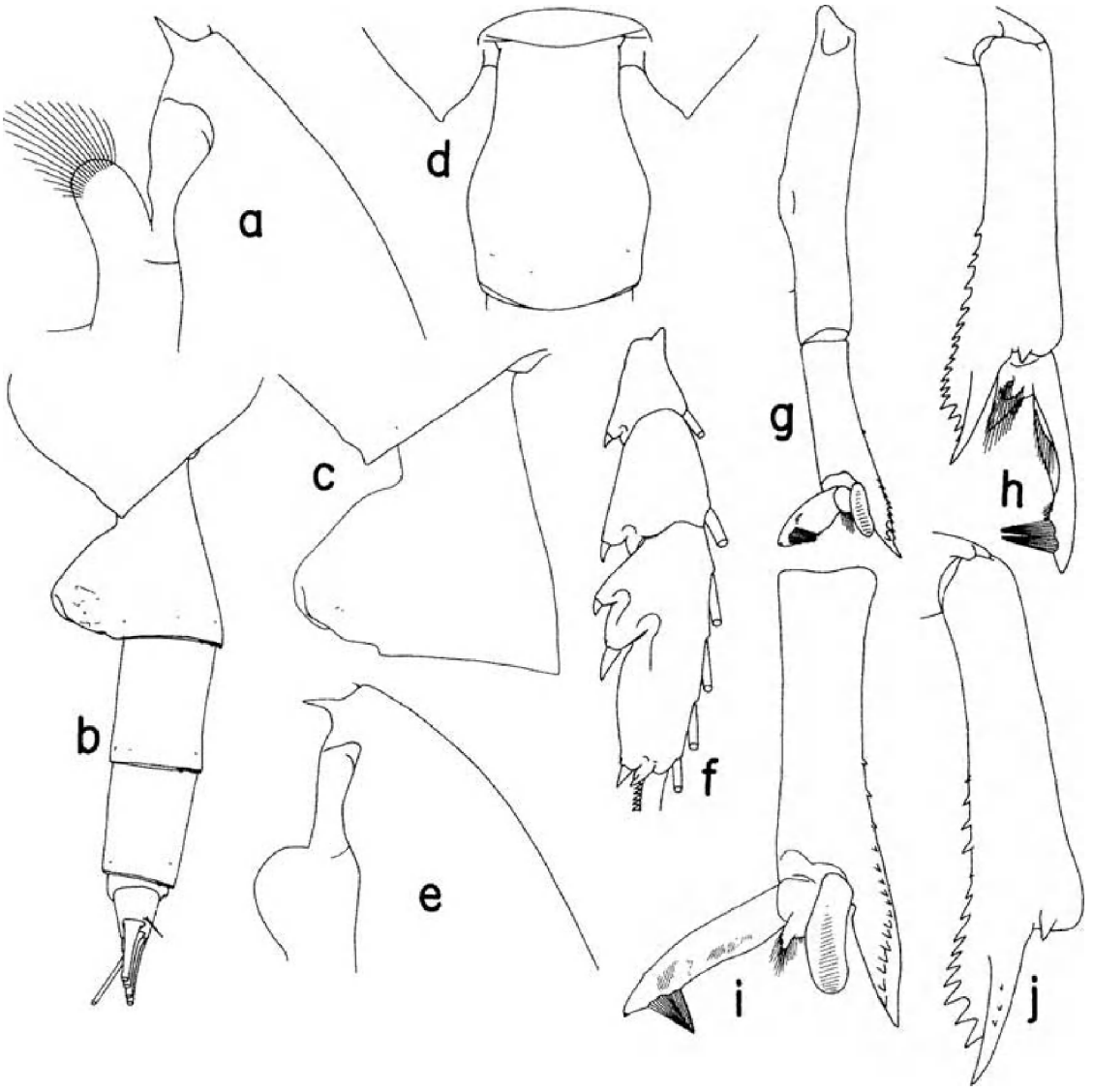

Figure 71. *Paraeuchaeta pseudotonsa* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, dorsal, Male: e, forehead, left; f, exopod of second leg, anterior; g, exopod of left 5th leg, medial; h, distal exopodal segments of left 5th leg, lateral, tilted clockwise; i, do, medial; j, serrated lamella of left 5th leg exopod from different specimen, lateral, tilted clockwise.

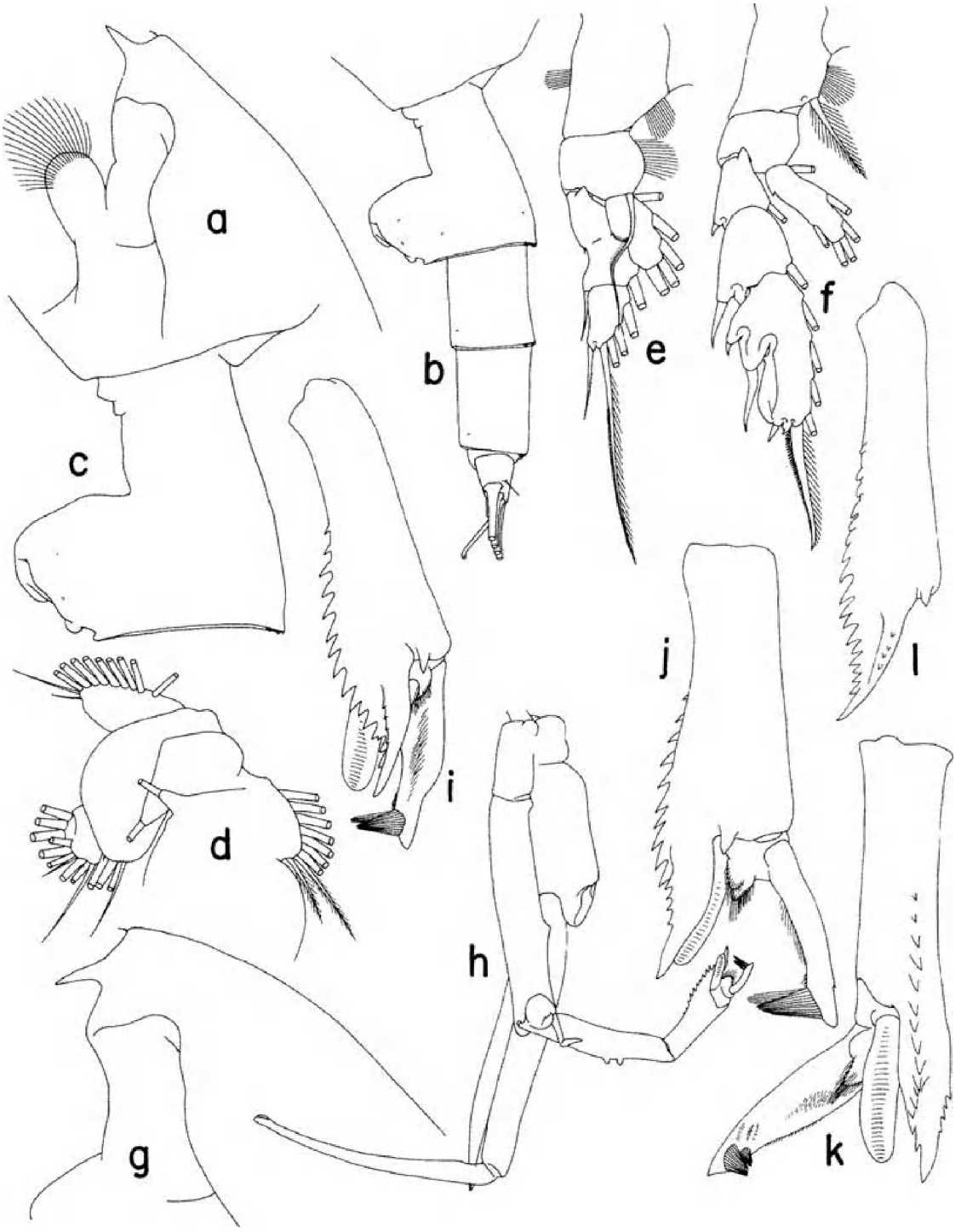

Figure 72. *Paraeuchaeta tuberculata* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe omitted, posterior; e, first leg, anterior; f, second leg, anterior. Male: g, forehead, left; h, fifth pair of legs, viewed from left; i, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; j, do, lateral; k, do, medial, tilted counterclockwise; l, serrated lamella of left 5th leg exopod, anterior, tilted counterclockwise.

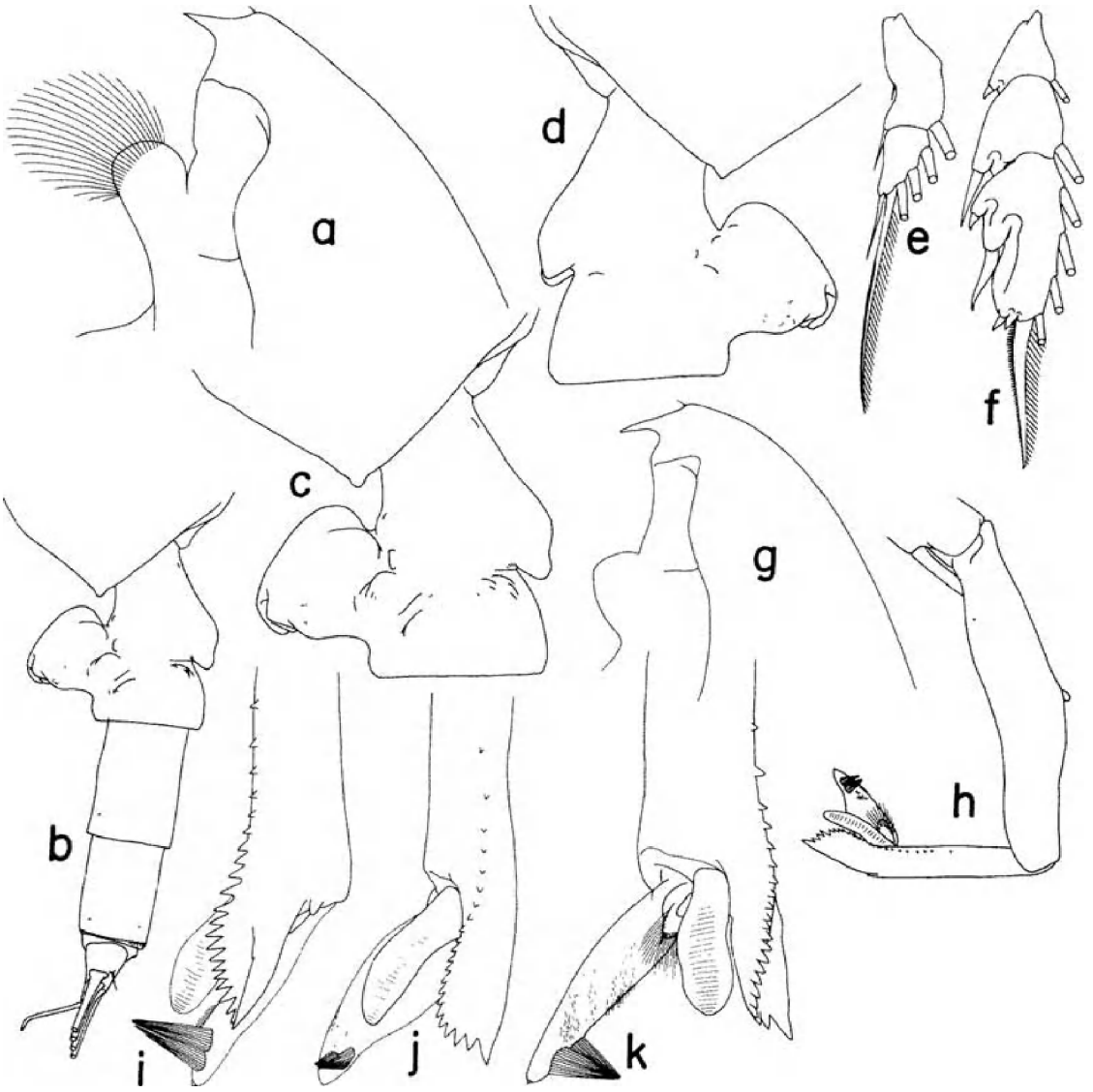

Figure 73. *Paraeuchaeta weberi* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, exopod of left 5th leg, anterior; i, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; j, do, anterior, tilted clockwise; k, do, medial.

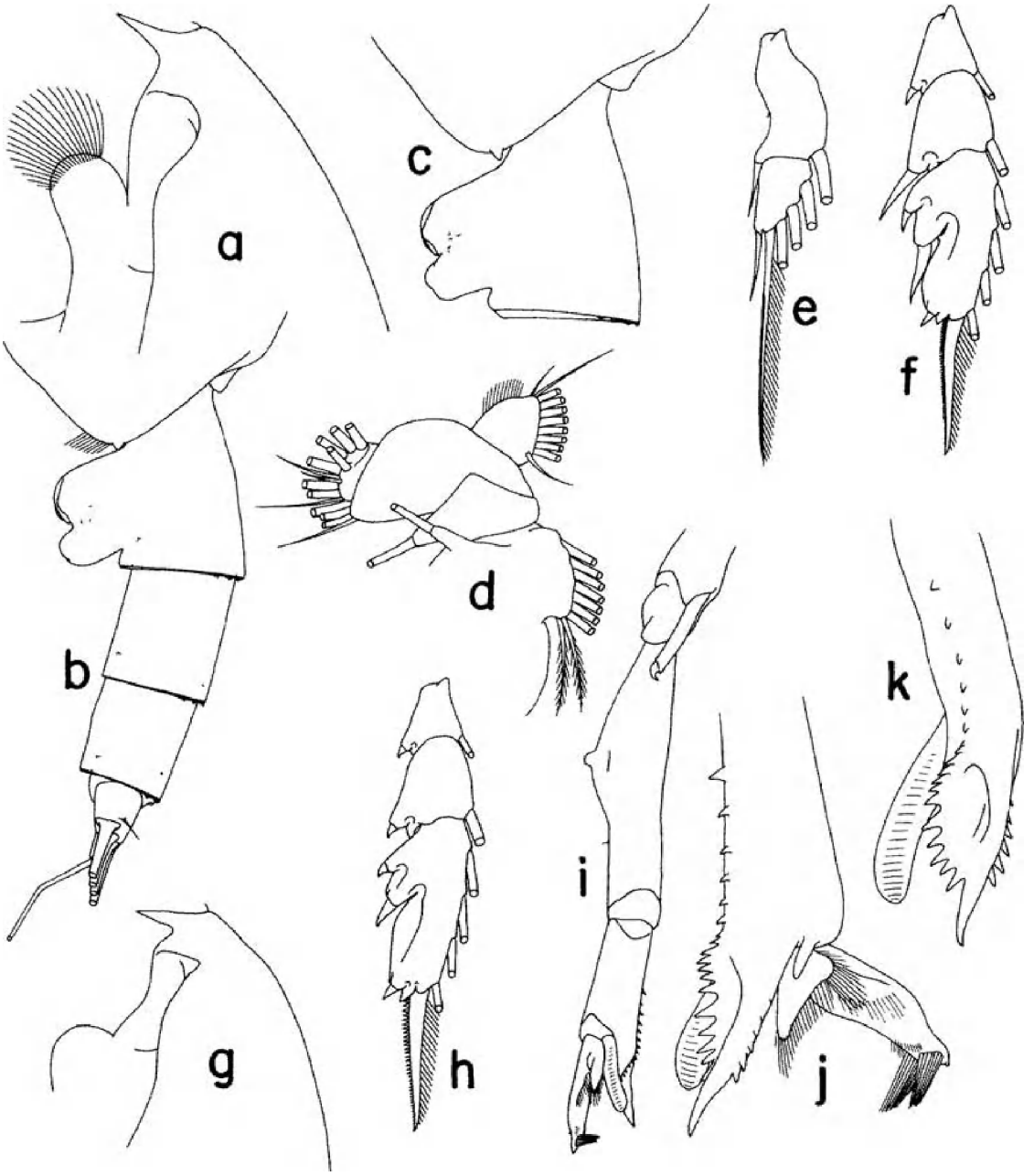

Figure 74. *Paraeuchaeta exigua* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, maxillule, first inner lobe omitted, posterior; e, exopod of first leg, anterior; f, exopod of second leg, anterior. Male: g, forehead, left; h, exopod of second leg, anterior; i, exopod of left 5th leg, medial; j, distal end of left 5th leg exopod, anterior, tilted counterclockwise; k, serrated lamella and digitiform process of left 5th leg exopod, anterior, tilted clockwise.

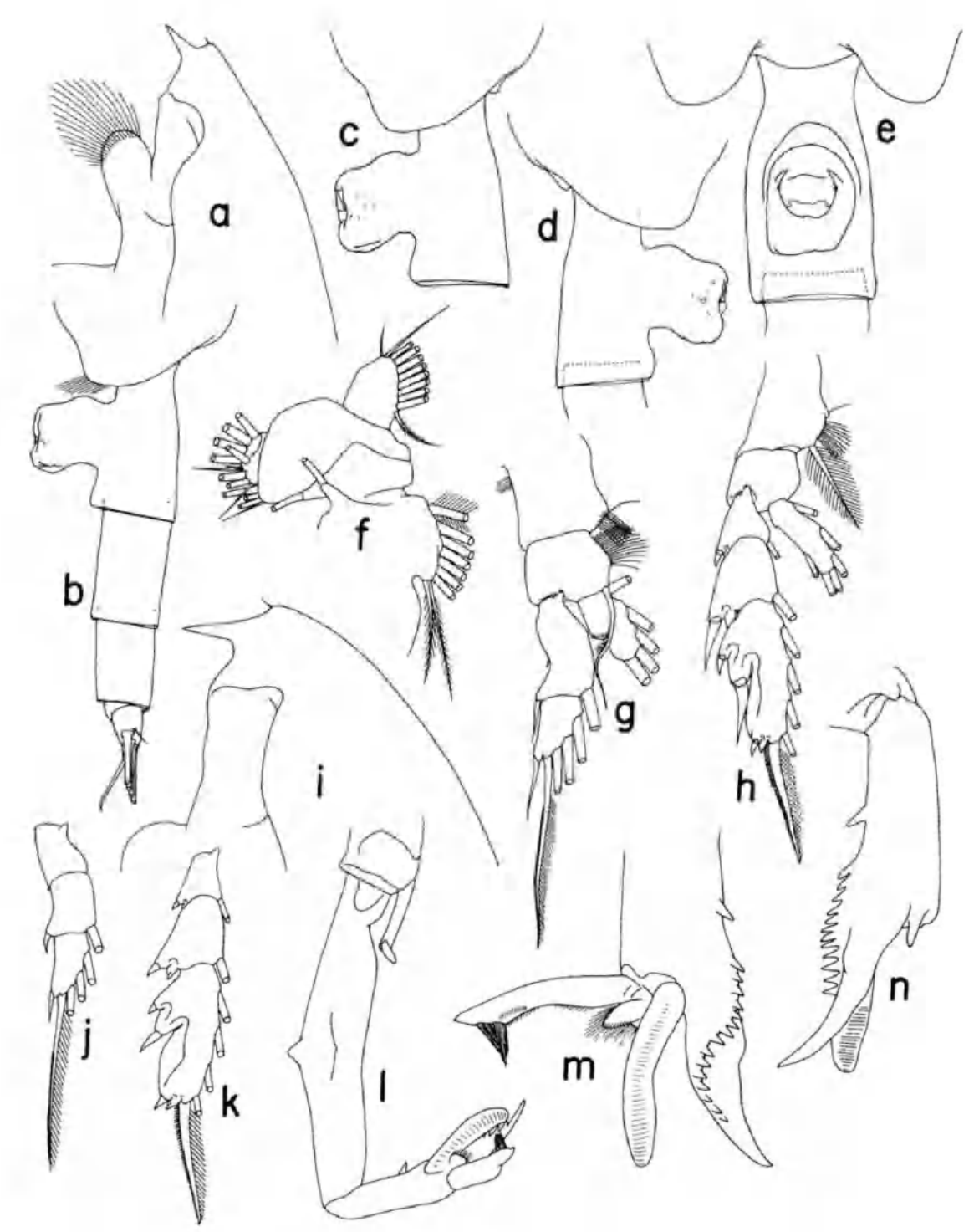

Figure 75. *Paraeuchaeta gracilis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, maxillule, first inner lobe omitted, posterior; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, exopod of first leg, anterior; k, exopod of second leg, anterior; l, exopod of left 5th leg, medial; m, distal end of left 5th leg exopod, medial, tilted counterclockwise; n, second exopodal segment of left 5th leg, anterior, tilted counterclockwise.

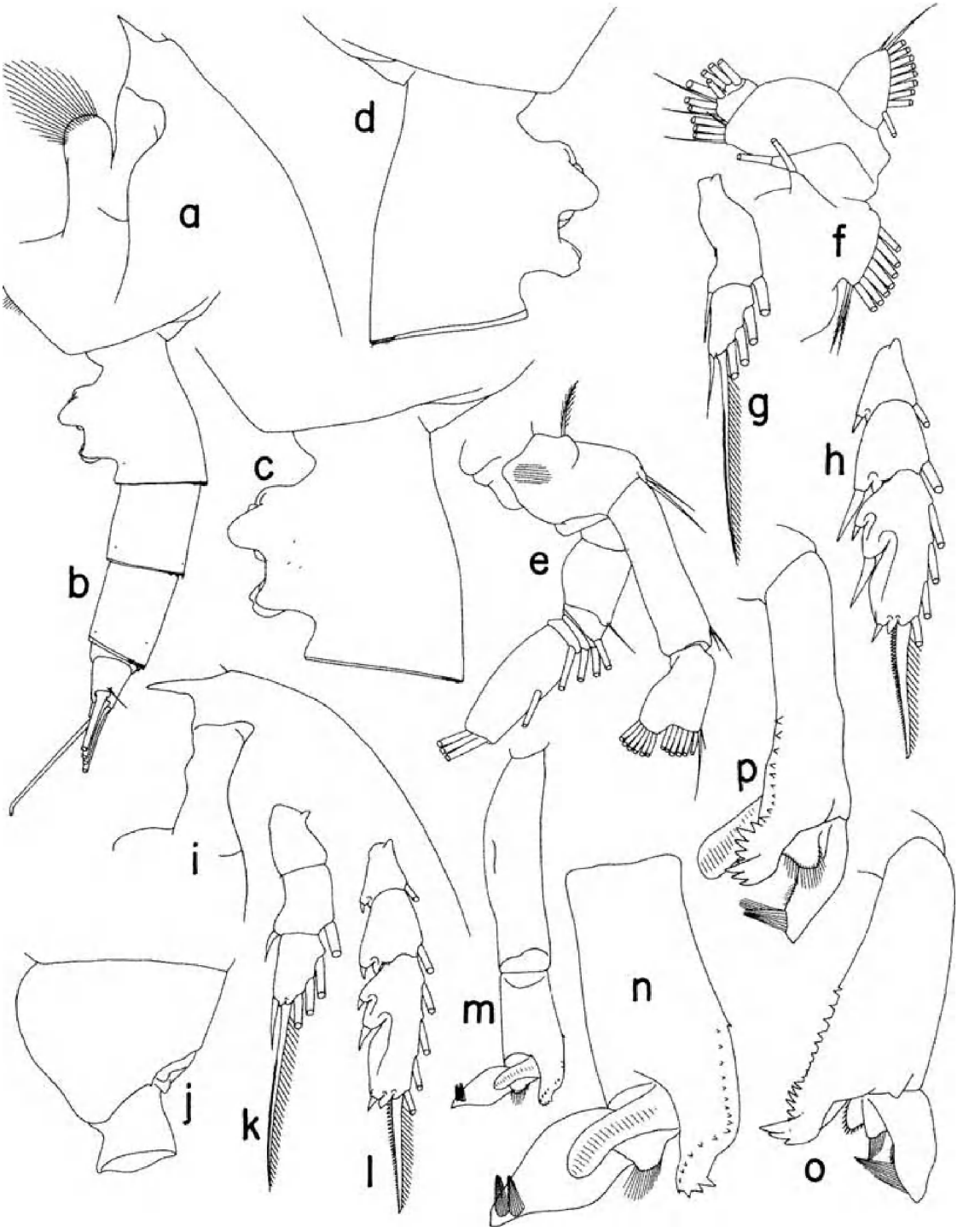

Figure 76. *Paraeuchaeta incisa* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, antenna; f, maxillule, first inner lobe omitted, posterior; g, exopod of first leg, anterior; h, exopod of second leg, anterior. Male: i, forehead, left; j, last pedigerous and genital somites, left; k, exopod of first leg, anterior; l, exopod of second leg, anterior; m, exopod of left 5th leg, medial; n, distal exopodal segments of left 5th leg, medial, tilted counterclockwise; o, do, lateral, tilted clockwise; p, do, anterior, tilted counterclockwise.

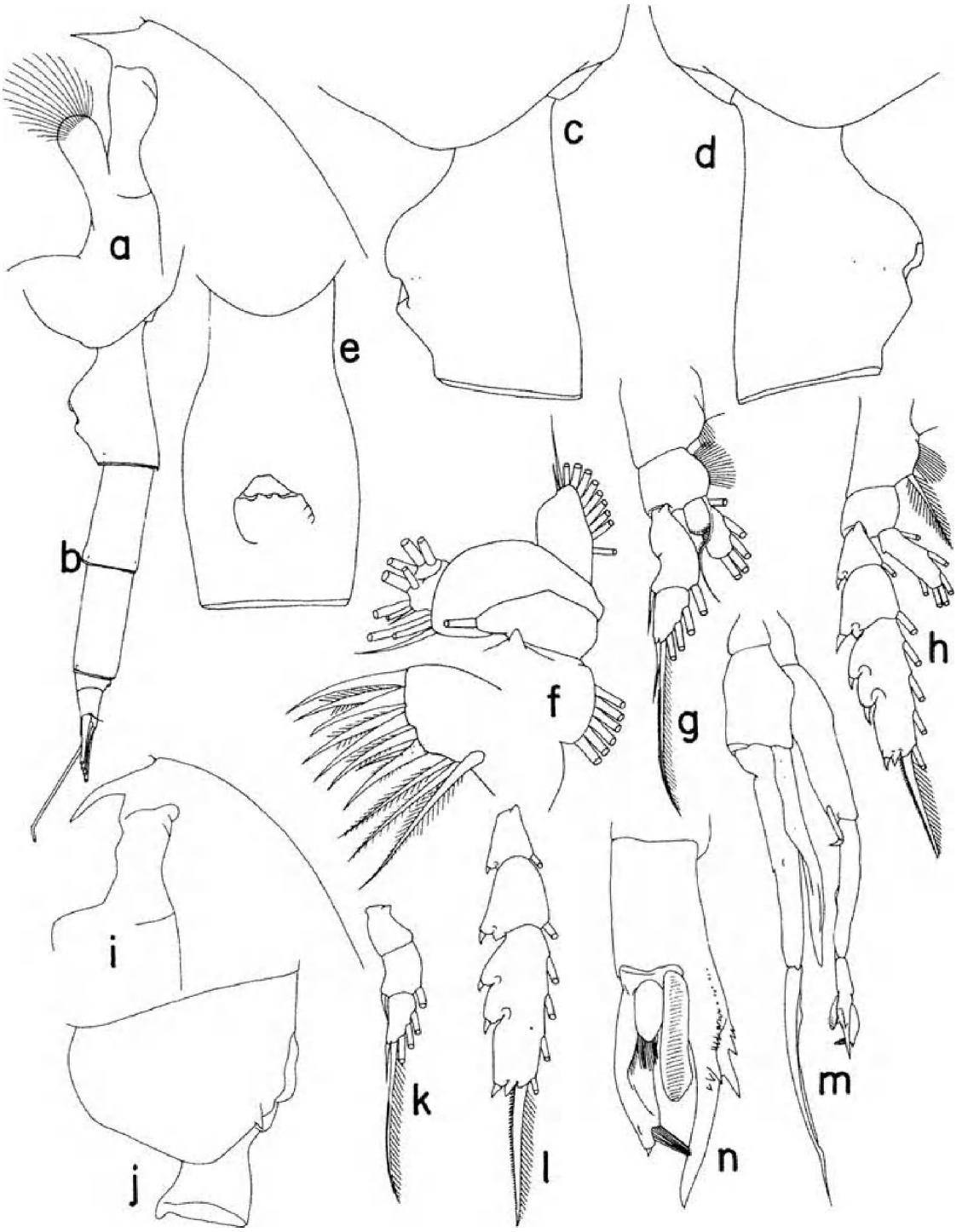

Figure 77. *Paraeuchaeta biloba* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, maxillule, first inner lobe separated, posterior; g, first leg, anterior; h, second leg, anterior. Male: i, forehead, left; j, last pedigerous and genital somites, left; k, exopod of first leg, anterior; l, exopod of second leg, anterior; m, fifth pair of legs, anterior; n, distal exopodal segments of left 5th leg, medial.

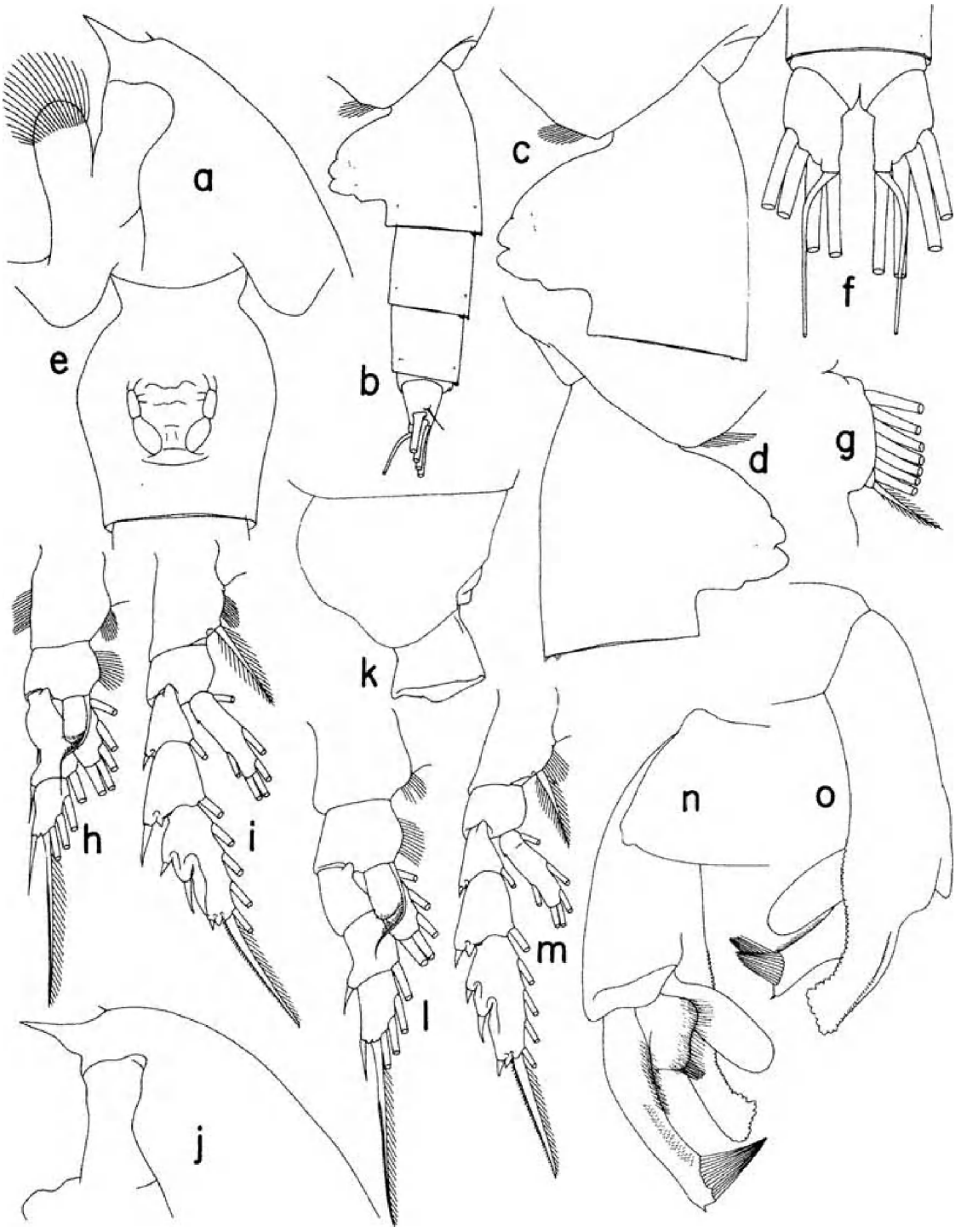

Figure 78. *Paraeuchaeta glacialis* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, caudal rami, ventral; g, outer lobe of maxillule; h, first leg, anterior; i, second leg, anterior. Male: j, forehead, left; k, last pedigerous and genital somites, left; l, first leg, anterior; m, second leg, anterior; n, distal exopodal segments of left 5th leg, medial, tilted clockwise; o, do, anterior.

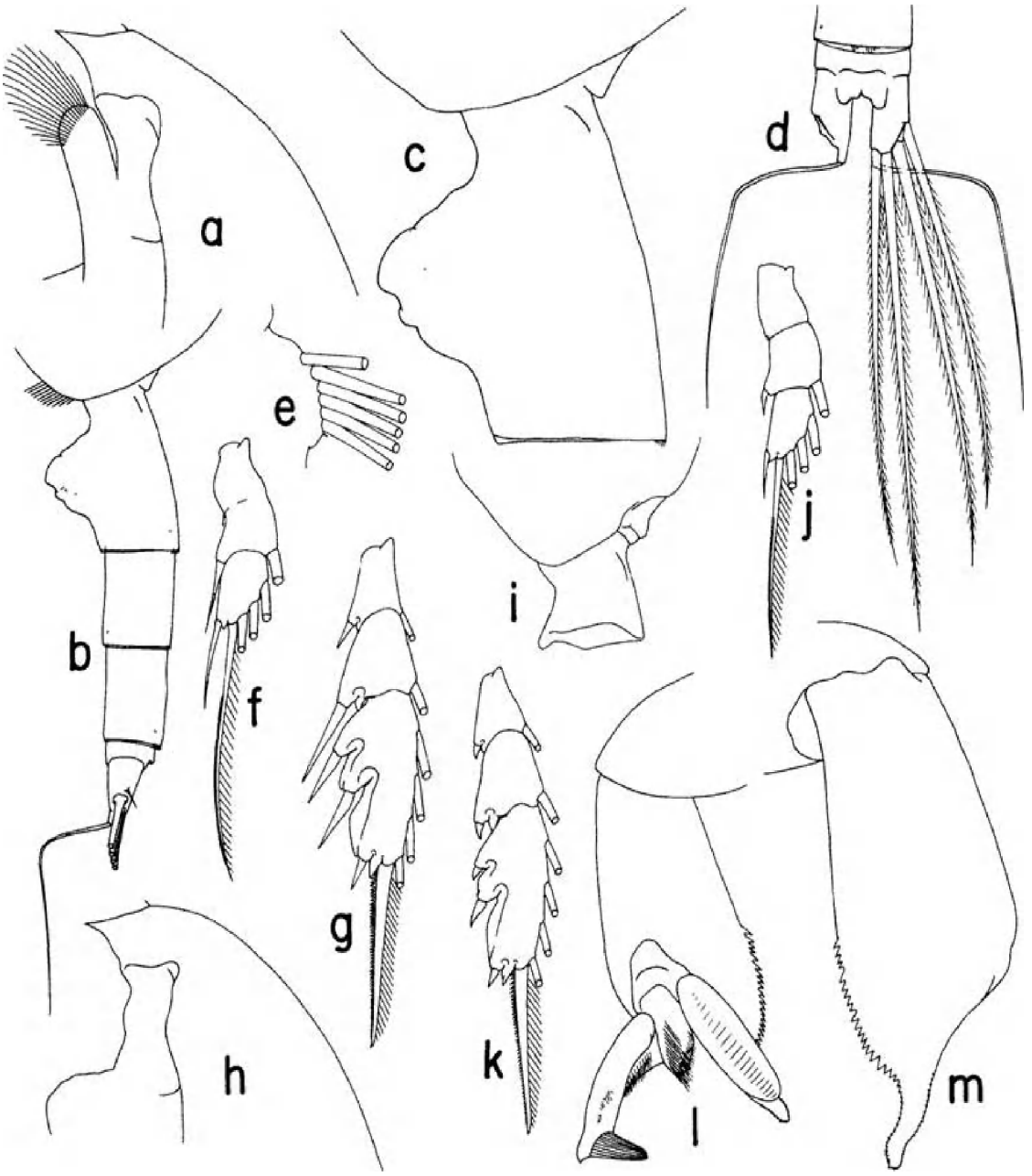

Figure 79. *Paraeuchaeta tumidula* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, distal end of urosome, dorsal; e, outer lobe of maxillule; f, exopod of first leg, anterior; g, exopod of second leg, anterior. Male: h, forehead, left; i, last pedigerous and genital somites, left; j, exopod of first leg, anterior; k, exopod of second leg, anterior; l, distal exopodal segments of left 5th leg, medial, tilted clockwise; m, serrated lamella of left 5th leg exopod, lateral, tilted clockwise.

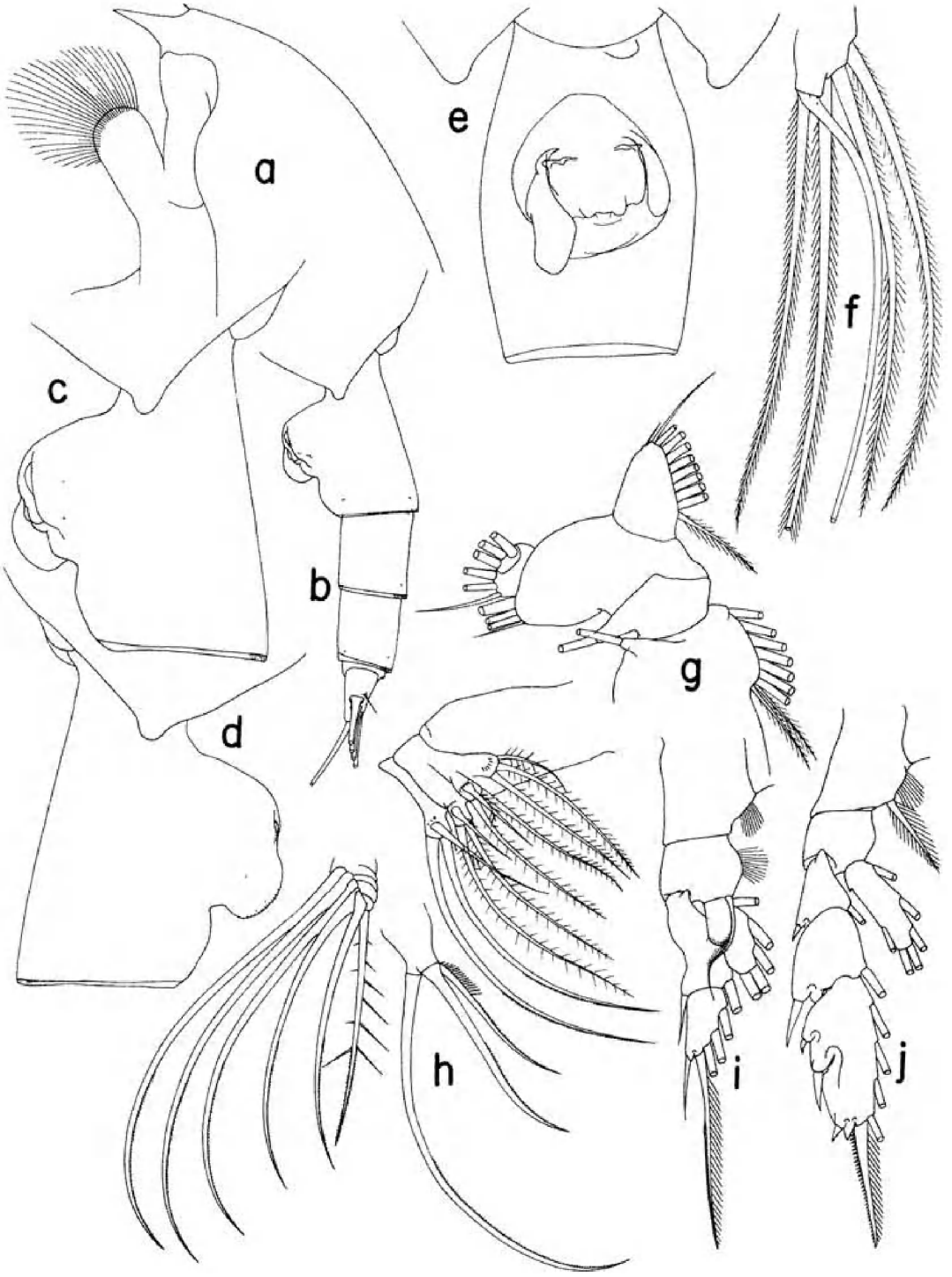

Figure 80. *Paraeuchaeta elongata* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, left caudal ramus, ventral; g, maxillule, first inner lobe omitted, posterior; h, maxilla, fifth lobe and endopod separated, posterior; i, first leg, anterior; j, second leg, anterior.

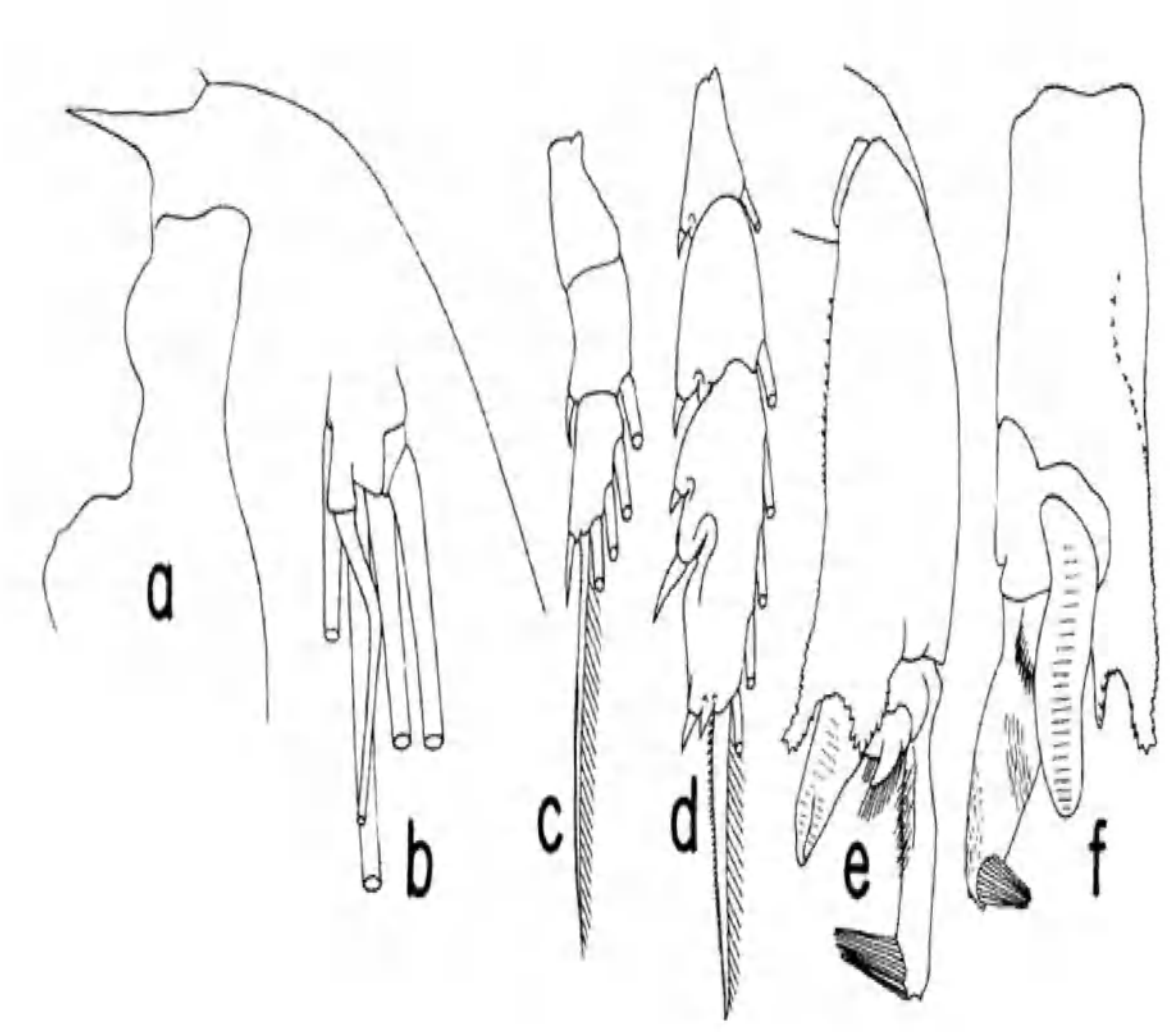

Figure 81. *Paraeuchaeta elongata* male: a, forehead, left; b, left caudal ramus, ventral; c, exopod of first leg, anterior; d, exopod of second leg, anterior; e, distal exopodal segments of left 5th leg, lateral, tilted clockwise; f, do, medial.

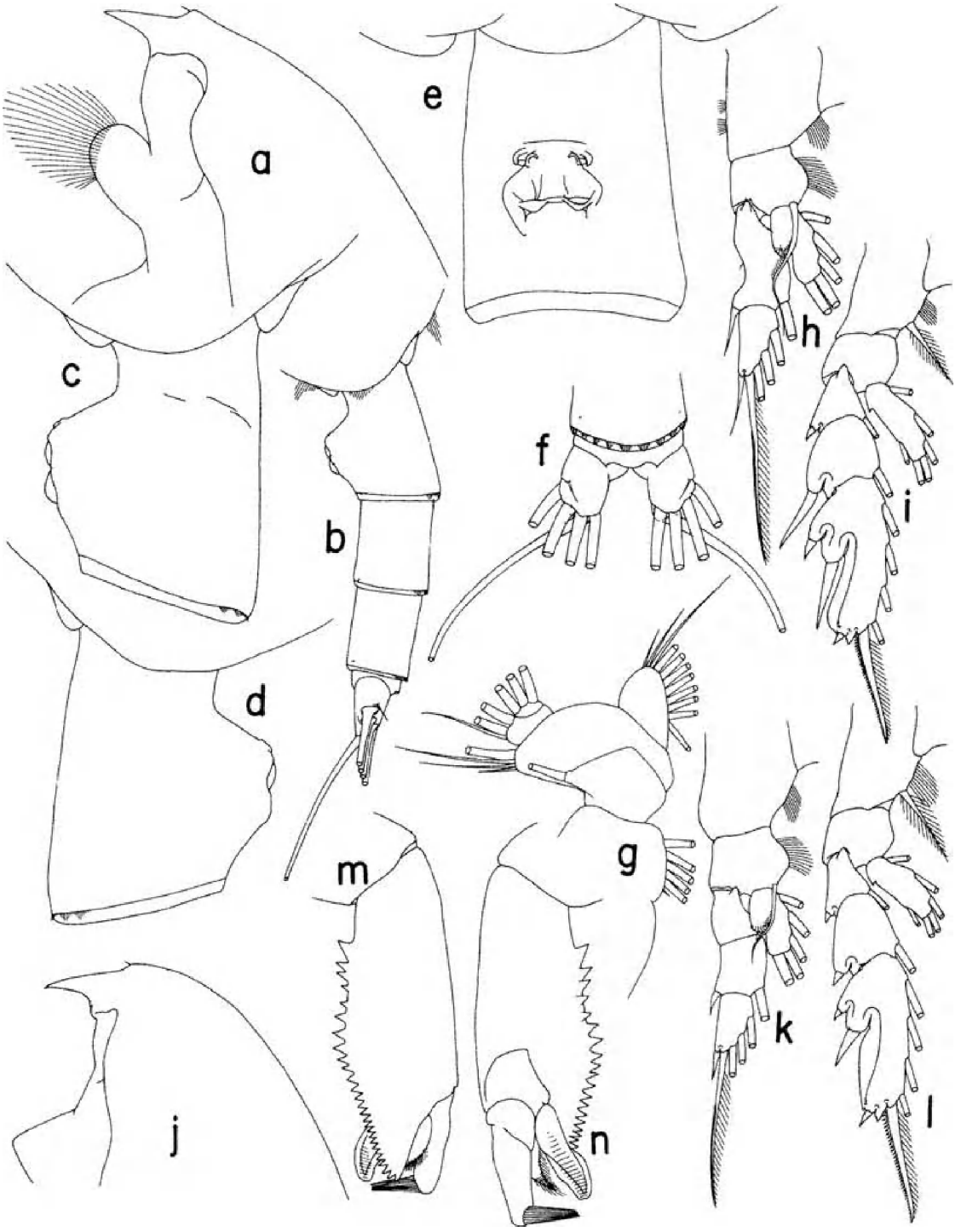

Figure 82. *Paraeuchaeta russelli* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, distal end of urosome, dorsal; g, maxillule, first inner lobe omitted, posterior; h, first leg, anterior; i, second leg, anterior. Male: j, forehead, left; k, first leg, anterior; l, second leg, anterior; m, distal exopodal segments of left 5th leg, anterior, tilted counterclockwise; n, do, medial, tilted clockwise.

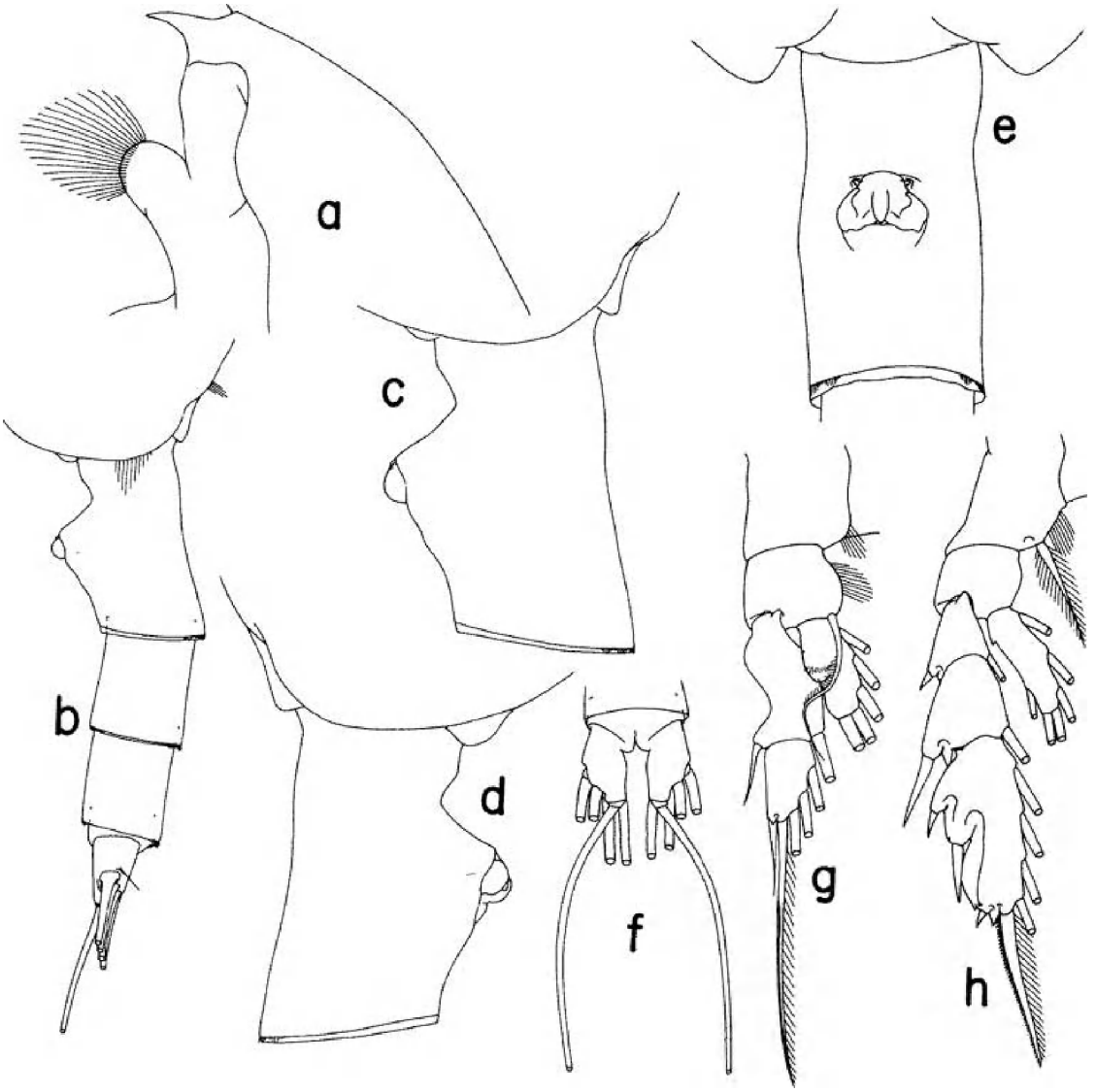

Figure 83. *Paraeuchaeta simplex* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, distal end of urosome, ventral; g, first leg, anterior; h, second leg, anterior.

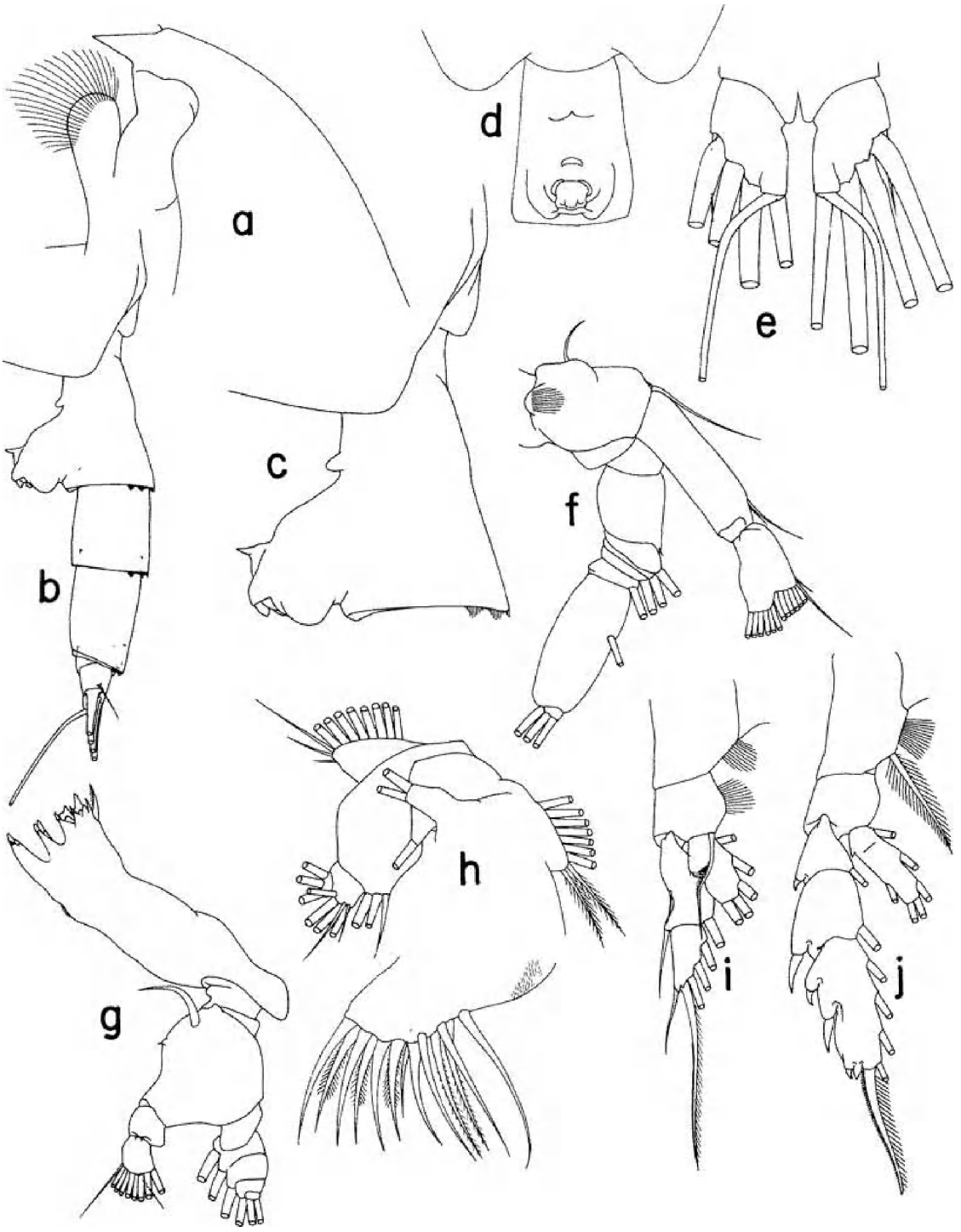

Figure 84. *Paraeuchaeta antarctica* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, ventral; e, caudal rami, ventral; f, antenna; g, mandible; h, maxillule, first inner lobe separated, posterior; i, first leg, anterior; j, second leg, anterior.

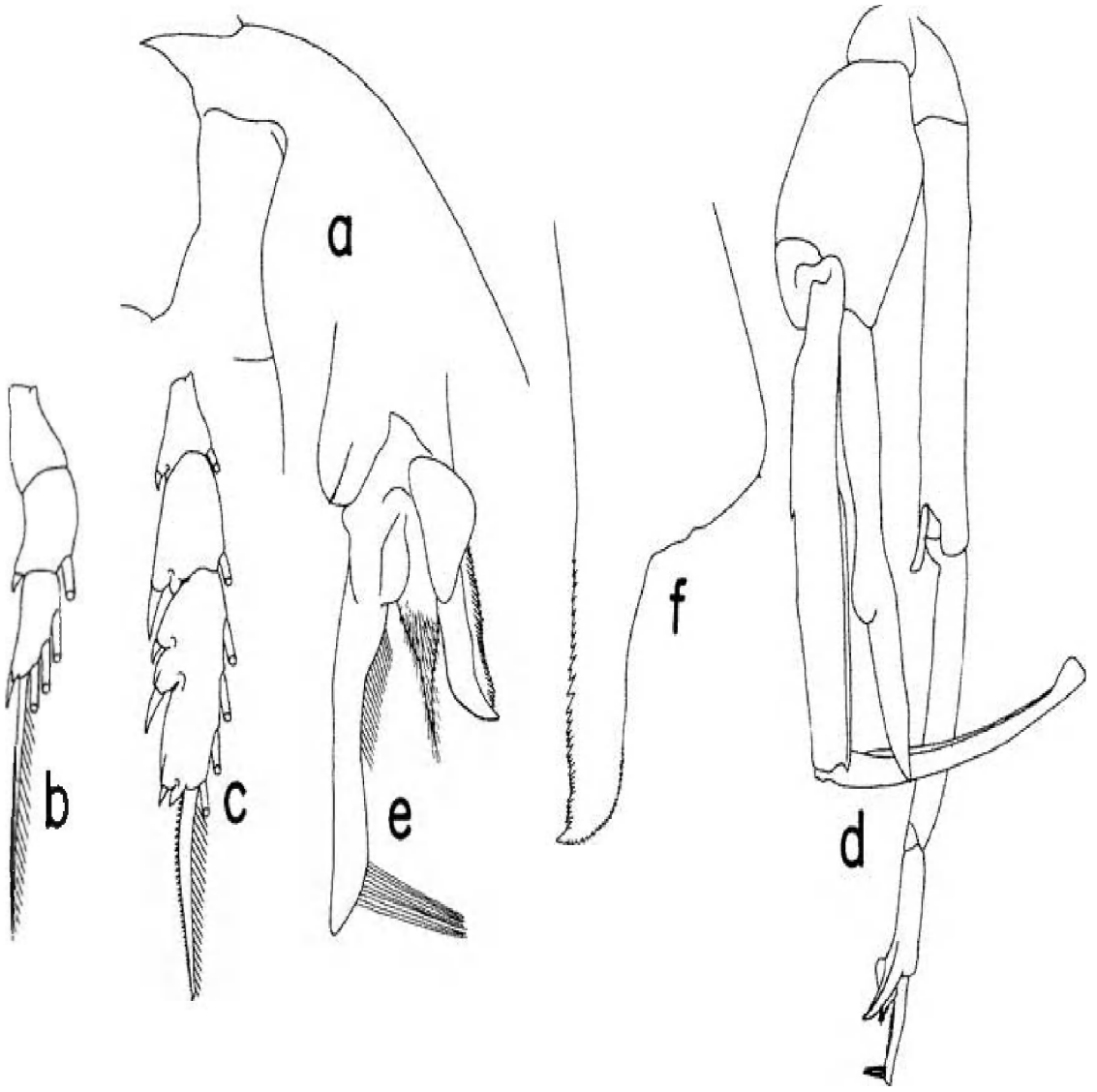

Figure 85. *Paraeuchaeta antarctica* male: a, forehead, left; b, exopod of first leg, anterior; c, exopod of second leg, anterior; d, fifth pair of legs, anterior; e, distal end of left 5th leg exopod, medial; f, serrated lamella, lateral.

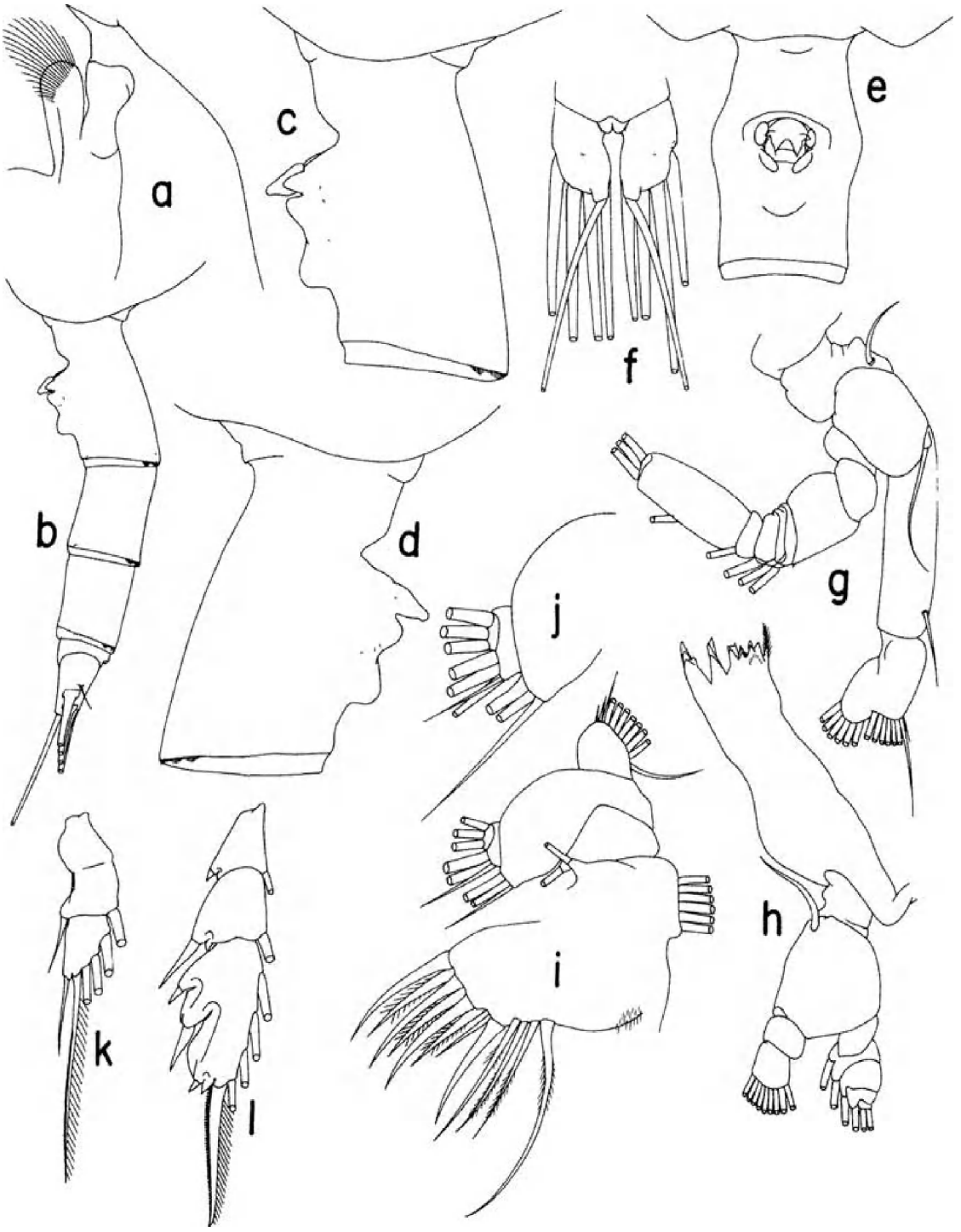

Figure 86. *Paraeuchaeta bisinuata* female: a, forehead, left; b, urosome, left; c, genital somite, left; d, do, right; e, do, ventral; f, caudal rami, ventral; g, antenna; h, mandible; i, maxillule, first inner lobe separated, posterior; j, basis and endopod of maxillule from different specimen showing variation in setation; k, exopod of first leg, anterior; l, exopod of second leg, anterior.

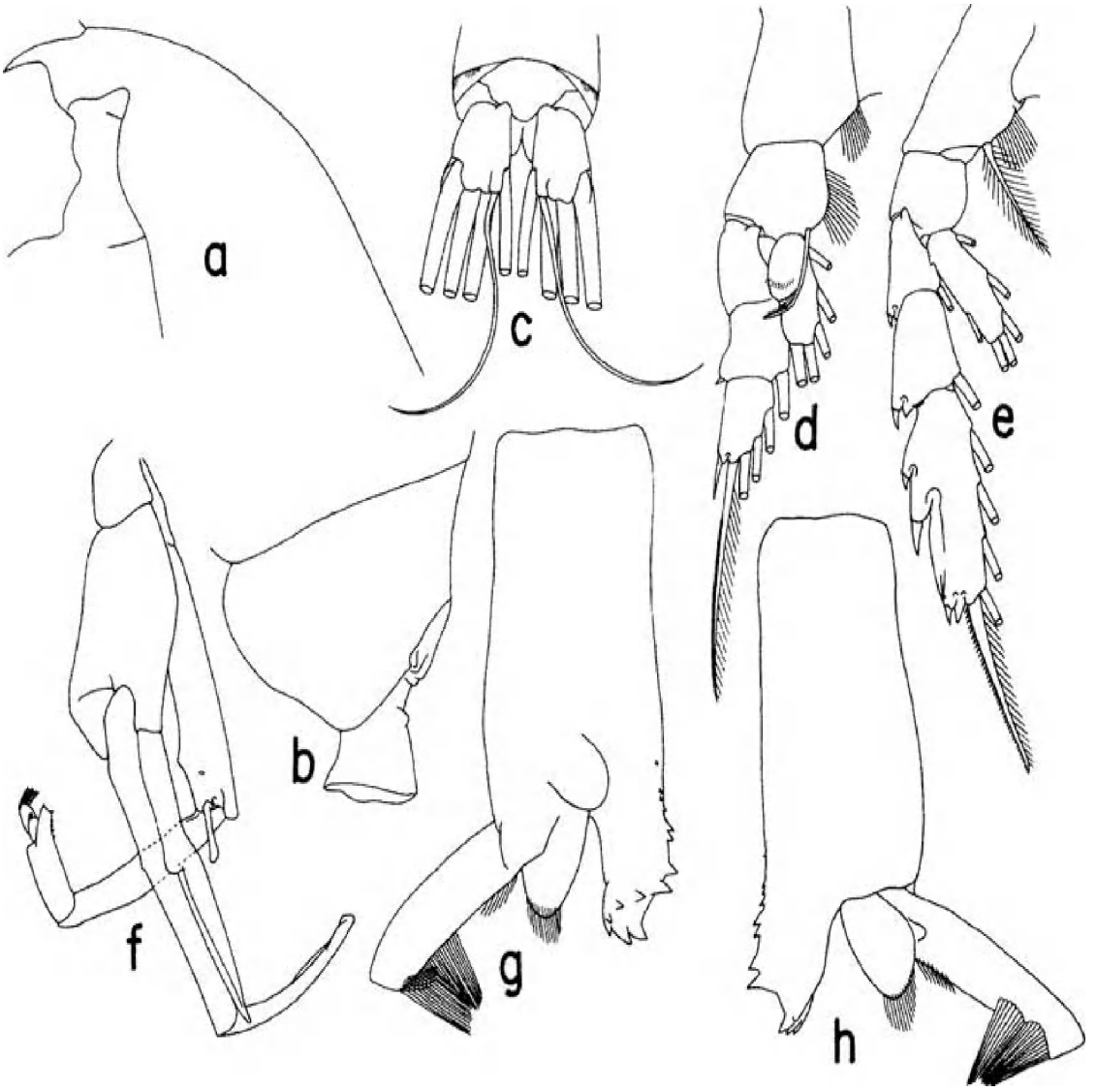

Figure 87. *Paraeuchaeta bisinuata* male: a, forehead, left; b, last pedigerous and genital somites, left; c, caudal rami, ventral; d, first leg, anterior; e, second leg, anterior; f, fifth pair of legs, viewed from right; g, distal exopodal segments of left 5th leg, medial; h, do, lateral.

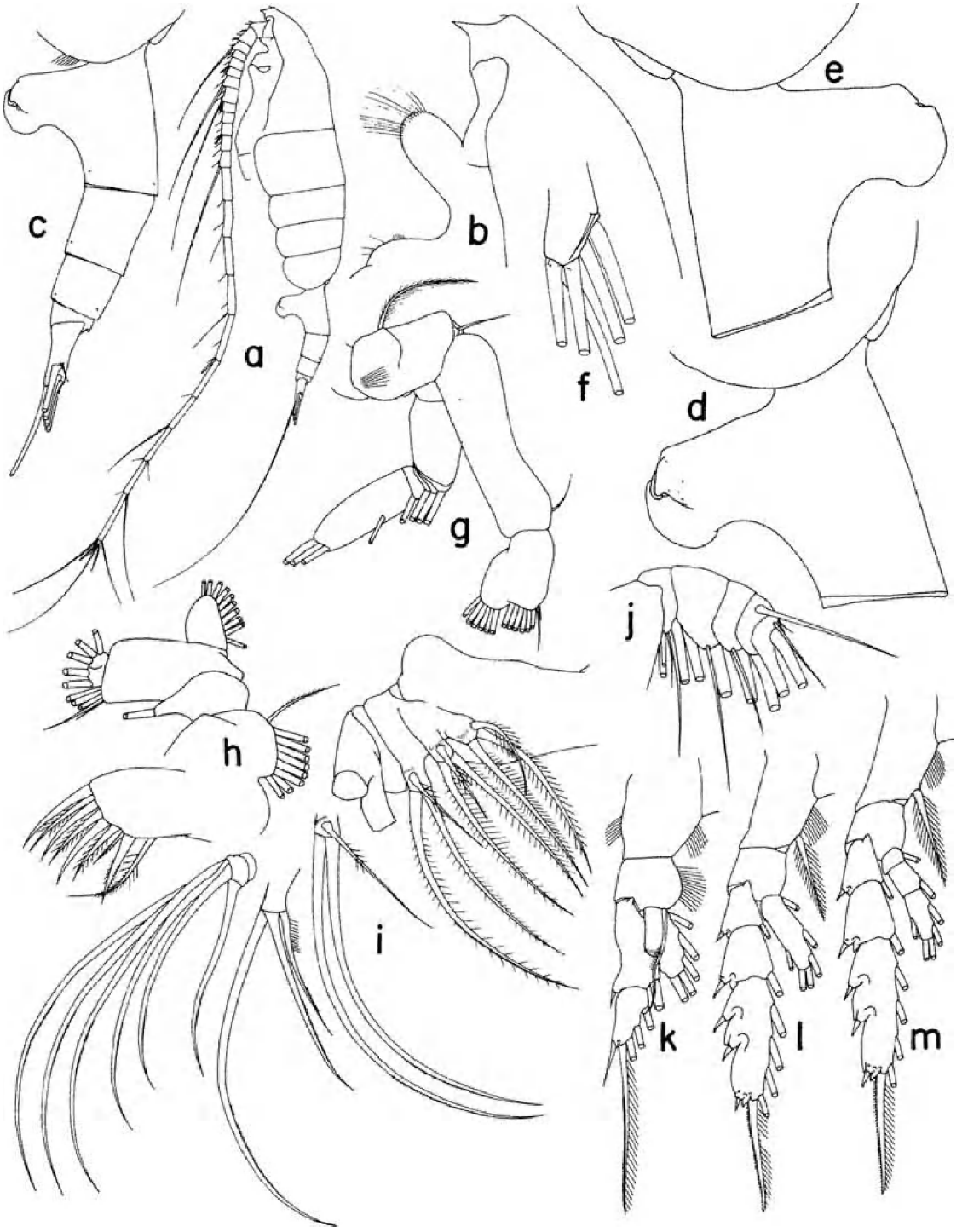

Figure 88. *Paraeuchaeta grandiremis* female: a, habitus, left; b, forehead, left; c, urosome, left; d, genital somite, left; e, do, right; f, right caudal ramus, dorsal; g, antenna; h, maxillule, first inner lobe separated, posterior; i, maxilla, 4th and 5th lobes and endopod separated, posterior; j, endopod of maxilliped, anterior; k, first leg, anterior; l, second leg, anterior; m, third leg, anterior.

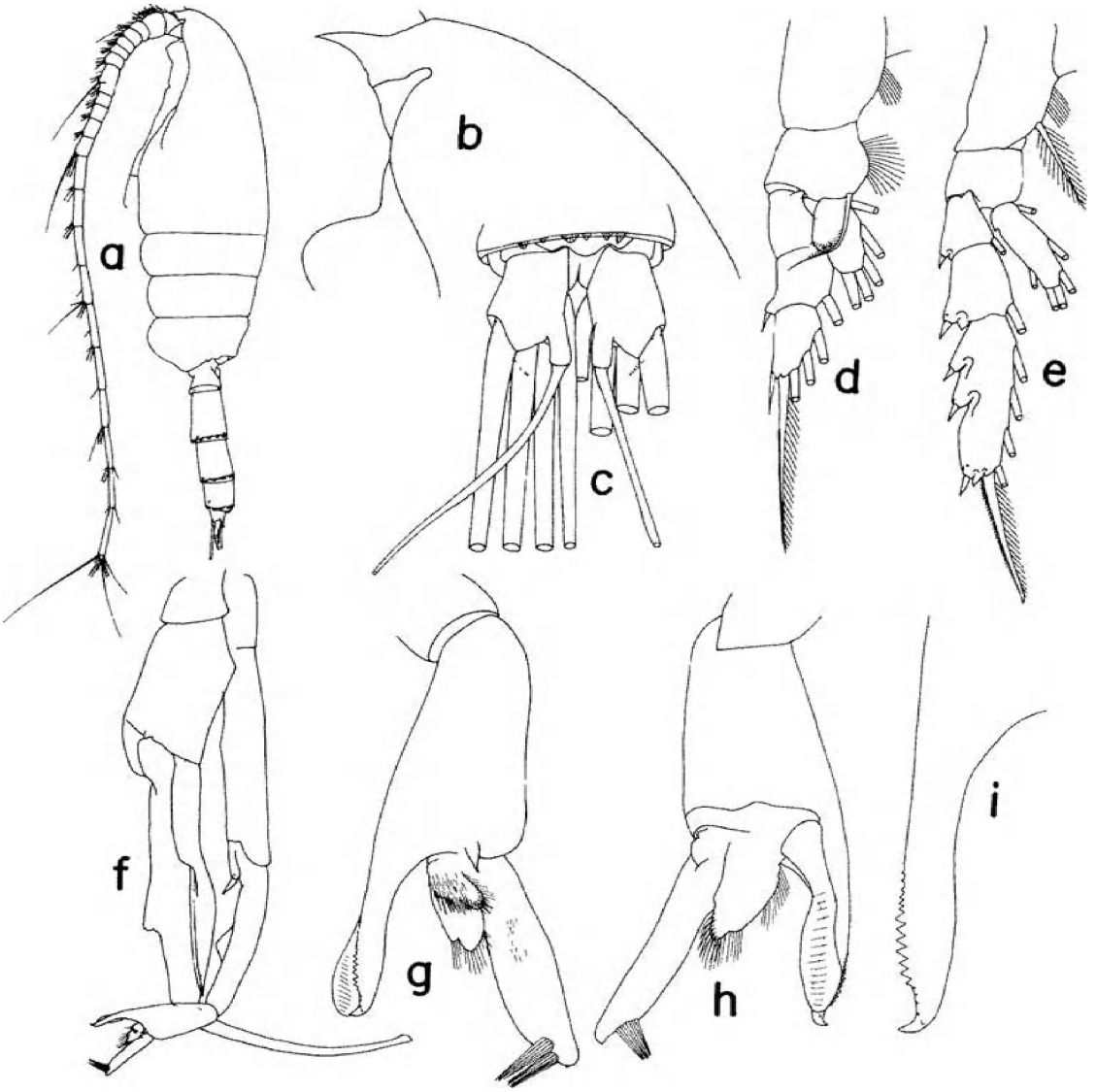

Figure 89. *Paraeuchaeta grandiremis* male: a, habitus, left; b, forehead, left; c, caudal rami, ventral; d, first leg, anterior; e, second leg, anterior; f, fifth pair of legs, anterior; g, distal exopodal segments of left 5th leg, lateral; h, do, medial; i, serrated lamella, lateral.

Figure 90
Distribution of character states in species groups and independent species of *Euchaeta*

Species group	sp	ac	co	ma
A. Appendicular caudal setae extremely long and straight (A')	A'	A'	A'	A'
B. Terminal spine of male left P5 exopod relatively short (B) or very long (B')	B	B'	B'	B'
C. First inner lobe of Mx1 with 2 (C) or 1 posterior seta (C')	C	C'	C'	C'
D. First endopodal segment of Mx1 with 4 (D) or 1 seta (D')	D	D'	D'	D'
E. Serrated lamella of male left P5 exopod relatively short (E) or very long (E')	E	E	E'	E'
F. Male left P5 exopod with (F') poorly sclerotized lobes next to digitiform process and on hairy tubercle	F	F	F'	F'
G. Digitiform process of male left P5 exopod normal (G) or spiniform (G')	G	G	G'	G'
H. Mxp basis with (H') long marginal spinules	H	H	H'	H'
I. Third segment of male left P5 exopod with poorly sclerotized lobe next to tuft of stiff hairs (I')	I	I	I	I'
J. Mx1 endopod with 1 (J) or 2 (J') spinulose setae	J	J	J	J'

sp=*Euchaeta spinosa*, ac=*acuta* group, co=*concinna* group, ma=*marina* group

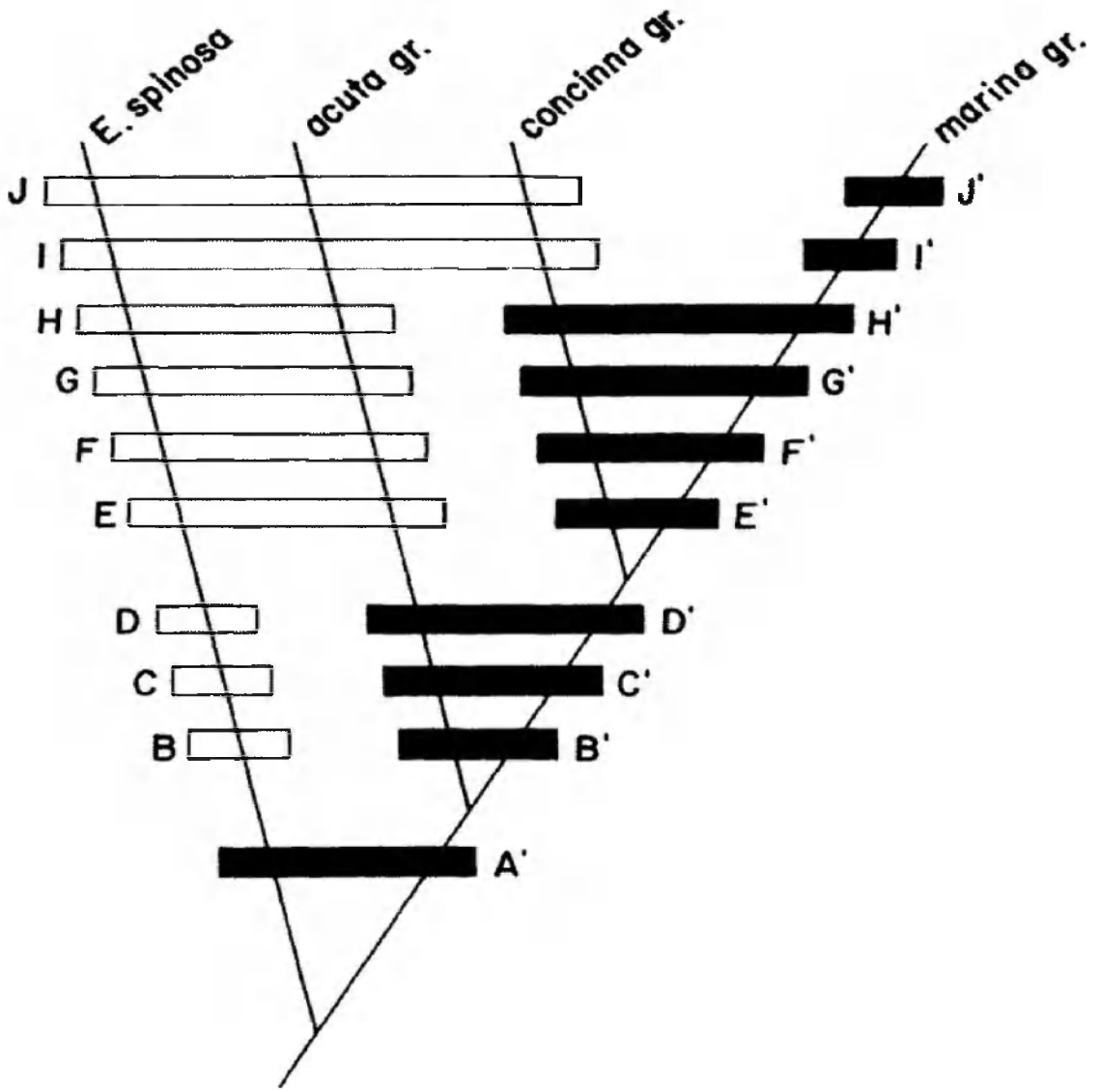

Figure 90. Phylogenetic relationships among the species groups and independent species of *Euchaeta.* Synapomorphies are black bars, plesiomorphies are open bars.

Figure 91
Distribution of character states in species groups and independent species of *Paraeuchaeta*

Species group	an	bs	he	gl	gr	ma	pa	no	bl
A. Appendicular caudal setae smoothly curved (A) or geniculated (A')	A	A	A	A	A	A'	A'	A'	A'
B. Male left P5 exopod with short (B) or long (B') digitiform process	B	B	B'	B'	B'	B'	B'	B'	B'
C. Male right P5 endopod with a lobe (C')	C'	C'	C	C	C	C	C	C	C
D. Md basis with an additional seta (D)	D	D'	D'	D'	D'	D'	D'	D'	D'
E. Second inner lobe of Mx1 with 2 (E), 1 or 0 (E') seta	E	E'	E'	E'	E'	E'	E'	E'	E'
F. Serrated lamella of male left P5 exopod short with its serration extending over most of the segment (F')	F	F	F'	F	F	F	F	F	F
G. Mx2 endopod with a spinulose seta (G')	G*	G	G'	G	G	G	G	G	G
H. A1 extremely long (H')	H	H	H	H	H'	H	H	H	H
I. Genital segment with long cylindrical prominence (I')	I	I	I	I	I'	I	I	I	I
J. Mx2 with a large lobe on posterior margin (J')	J	J	J	J	J'	J	J	J	J
K. Genital prominence with large, symmetrical, non-linguiform genital flanges (K')	K	K	K	K'	K	K	K	K	K
L. Serrated lamella of male left P5 exopod sigmoid (L')	L	L	L	L'	L	L	L	L	L
M. Genital flanges symmetrical, linguiform (M')	M	M	M	M	M	M'	M'	M	M
N. Supralabrum directed forward (N) or ventrad (N')	N	N	N	N	N	N	N'	N	N
O. Serrated lamella of male left P5 exopod tapering into spiniform process with large marginal teeth (O')	O	O	O	O	O	O	O	O'	O'
P. Second segment of male right P5 exopod spiniform (P')	P	P	P	P	P	P	P	P	P'

an=*antarctica* group, bs=*P. bisinuata*, he=*hebes* group, gl=*glacialis* group, gr=*P. grandiremis*, ma=*malayensis* group, pa=*pavlovskii* group, no=*norvegica* group, bl=*P. biloba*

G* =Two of the five species of this group have the character state of G'

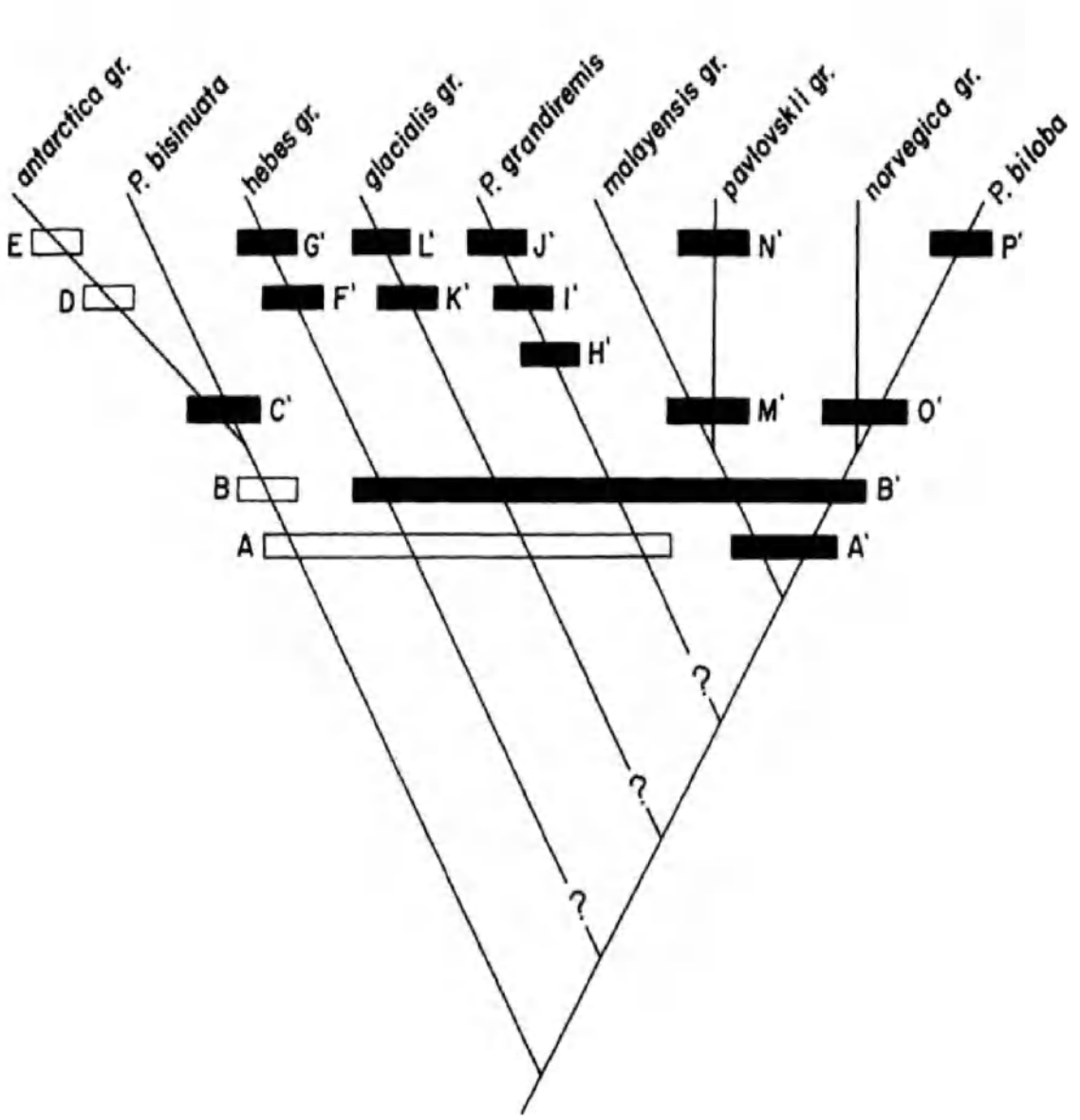

Figure 91. Phylogenetic relationships among the species groups and independent species of *Paraeuchaeta.* Synapomorphies are black bars, plesiomorphies are open bars.

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